User's Manual

SMARTDAC+™

Model GX10/GX20/GP10/GP20/GM10

Loop Control Function, Program Control Function (/PG Option) User's Manual

YOKOGAWA
Yokogawa Electric Corporation

IM 04L51B01-31EN
2nd Edition

Introduction

Thank you for purchasing the SMARTDAC+ GX10/GX20/GP10/GP20/GM10 (hereafter referred to as the GX, GP, or GM).
This manual describes the operating procedure for the loop control function and program control function (/PG option) of the GX, GP, and GM. **This manual uses GX20 screens to explain the procedures, but the procedures are similar on the GX10, GP10, and GP20.**
In this manual, the GX20, GP20, and GM10 standard type and large memory type are distinguished using the following notations.

- **Standard type: GX20-1/GP20-1, GM10-1**
- **Large memory type: GX20-2/GP20-2, GM10-2**

To ensure correct use, please read this manual thoroughly before beginning operation. Please use this manual in conjunction with the GX, GP, or GM User's Manual (GX/GP: IM 04L51B01-01EN, GM: IM 04L55B01-01EN).

Notes

- The contents of this manual are subject to change without prior notice as a result of continuing improvements to the instrument's performance and functions.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its contents. However, should you have any questions or find any errors, please contact your nearest YOKOGAWA dealer.
- Copying or reproducing all or any part of the contents of this manual without YOKOGAWA's permission is strictly prohibited.

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About the Usage of Open Source Software

This product uses open source software.
For details on using open source software, see *Regarding the Downloading and Installing for the Software, Manuals and Labels* (IM 04L61B01-11EN).

Revisions

1st Edition: June 2017
2nd Edition: March 2019

2nd Edition: March 2019 (YK)

Conventions Used in This Manual

Unit

K	Denotes 1024. Example: 768K (file size)
k	Denotes 1000.

Notes

Improper handling or use can lead to injury to the user or damage to the instrument. This symbol appears on the instrument to indicate that the user must refer to the user's manual for special instructions. The same symbol appears in the corresponding place in the user's manual to identify those instructions. In the manual, the symbol is used in conjunction with the word "WARNING" or "CAUTION."

WARNING Calls attention to actions or conditions that could cause serious or fatal injury to the user, and precautions that can be taken to prevent such occurrences.

CAUTION Calls attention to actions or conditions that could cause light injury to the user or cause damage to the instrument or user's data, and precautions that can be taken to prevent such occurrences.

Note Calls attention to information that is important for the proper operation of the instrument.

Reference Item

▶ Reference to related operation or explanation is indicated after this mark.
Example: ▶ section 4.1

Conventions Used in the Procedural Explanations

Bold characters Denotes key or character strings that appear on the screen.
Example: **Volt**

Aa#1 Indicates the character types that can be used.
A uppercase alphabet, a lowercase alphabet, # symbol, 1 numbers

Procedure Carry out the procedure according to the step numbers. All procedures are written with inexperienced users in mind; depending on the operation, not all steps need to be taken.

Explanation Explanation gives information such as limitations related the procedure.

Path Indicates the setup screen and explains the settings.

Description

Recorder Version and Functions Described in This Manual

The contents of this manual correspond to the GX/GP with release number 4 (see the STYLE S number) and style number 2 (see the STYLE H number) and the GM10 with release number 4 (see the STYLE S number) and style number 1 (see the STYLE H number).

Edition	Product	Description
1	GX/GP: Version 4.01 and later GM: Version 4.01 and later	—

In order to comply with the relevant standard.

To comply with CAN/CSA-IEC 61010-2-201, UL 61010-2-201(CSA NRTL/C), and EN 61010-2-201, make sure that the style numbers of the GX/GP main unit, GM90PS power supply module and GX60 I/O base unit are at least 2.

Notes on the User's Manual

- This user's manual should be readily accessible to the end users so it can be referred to easily. It should be kept in a safe place.
- This guide is intended for the following personnel;
  Personnel responsible for normal daily operation of the equipment.
- Read the information contained in this manual thoroughly before operating the product.
- The purpose of this user's manual is not to warrant that the product is well suited to any particular purpose, but rather to describe the functional details of the product.

QR code

The product may have a QR Code pasted for efficient plant maintenance work and asset information management. It enables confirming the specifications of purchased products and user's manuals.For more details, please refer to the following URL.
https://www.yokogawa.com/qr-code
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How to Use This Manual

How to Use

Read the GX/GP First Step Guide (IM04L51B01-02EN) or the GM First Step Guide (IM04L55B01-02EN) first to familiarize yourself with the basic operation, and then read this manual. For a description of the communication control command functions and software programs, read the respective manuals.
This manual consists of six chapters, and an appendix.

Chapter	Title and Description
1	**Functional Description** Provides an overview and describes the features, control functions, applications, and so on.
2	**Using the Control Function for the First Time** Describes basic configuration, monitoring, and operation when using the control function for the first time using a temperature control example.
3	**Configuring the Control Function** Describes how to configure the control function, input functions, output functions, alarm functions, and so on.
4	**Configuring the Program Control Function (/PG option)** Describes how to create program patterns and how to configure the program control function.
5	**Performing Operations (Main unit, Web application)** Describes loop control and program control operations.
6	**Using Network Functions (Ethernet interface)** Describes operations using Web application.
—	**Appendix** Describes function block diagrams and program control worksheets.

Contents

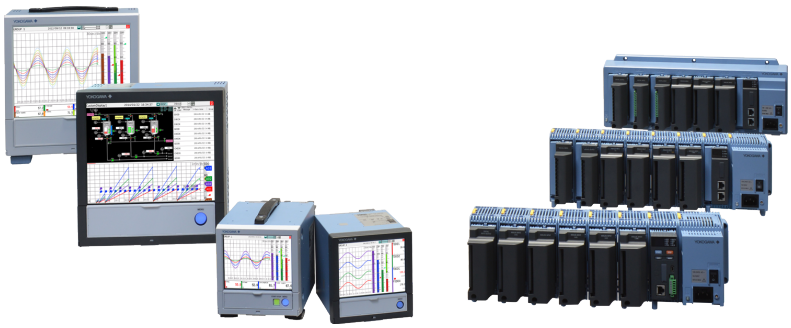
Appendix

1.1 Overview and Features

The GX90UT is a PID control module that connects to a GX/GP main unit, GX60 expandable I/O unit, GM main unit, or GM sub unit.
This chapter provides an overview of the main functions. For further details, see chapter 3 and subsequent chapters.

GX90UT PID Control Module

- A single GX90UT PID Control Module can perform PID control on up to two loops. It is equipped with two control inputs (PV inputs), two control outputs, eight digital inputs, and eight digital outputs. In addition to single loop control, cascade control and loop control with PV switching are possible. For the control output, you can select current output or voltage pulse for each loop.
- Loop control is possible by installing the PID Control Module in the GX/GP/GM. Control loops can be monitored and controlled from a control group screen, and adjustments can be made from a tuning screen.
- The /PG option of the GX/GP/GM main unit enables program control using program patterns stored in the GX/GP main unit.
- The GX90UT control data can be acquired and recorded in the GX/GP/GM main unit.



1.2 Instrument Configuration

The instrument configuration when PID Control Modules are used is indicated below.

Configuration with Only the GX/GP Main Unit

GX10/GP10 main unit only

Standard type
PID control module up to 3 units (up to 6 loops)

The maximum number is 2 when the GP10 supply voltage is 12 VDC.

GX20/GP20 main unit only

Standard type
PID control module up to 3 units (up to 6 loops)

Large memory type
PID control module up to 8 units (up to 16 loops)

Configuration with the GX/GP Main Unit and Expandable I/O

GX10/GP10 main unit
GX20/GP20 main unit

Expandable I/O
Up to six units

The number of units used in the system is

Standard type
PID control module up to 3 units (up to 6 loops)

Large memory type
PID control module up to 10 units (up to 20 loops)

Note

- If the system includes digital output modules (GX90YD) or digital input/output modules (GX90WD) in addition to PID control modules (GX90UT), the maximum total number of these three modules is 10. (large memory type)
- If the main unit's measurement mode is high speed, dual interval or if the advanced security function is enabled, PID control modules will not work.

GM Single Unit Configuration

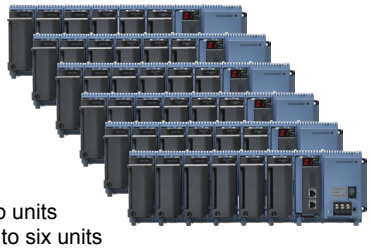
GM10

Standard type
PID control module up to 3 units
(up to 6 loops)

Large memory type
PID control module up to 5 units
(up to 10 loops)

GM Multi Unit Configuration

GM10



Sub units
Up to six units

The number of units used in the system is

Standard type
PID control module up to 3 units
(up to 6 loops)

Large memory type
PID control module up to 10 units
(up to 20 loops)

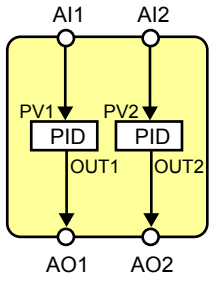
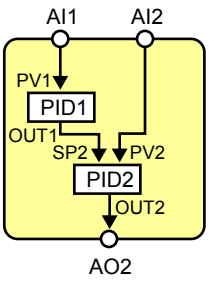
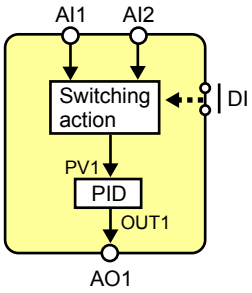
Note

- If the system includes digital output modules (GX90YD) or digital input/output modules (GX90WD) in addition to PID control modules (GX90UT), the maximum total number of these three modules is 10. (large memory type)
- If the main unit's measurement mode is dual interval or if the advanced security function is enabled, PID control modules will not work.

1.3 Control Functions

Control Mode

Control modes define the controls that a single PID Control Module can execute. The PID Control Module operates in the following manner by setting the control mode to execute.

Control mode schematic diagram	Description
GX90UT Single loop control  	"Single-loop control" provides the basic control function having one control computation unit. A single PID Control Module can perform two single-loop controls.
GX90UT Cascade control  	"Cascade control" has two control computation units and provides a control function that executes cascade control from a single PID Control Module. It is a type of control that provides the primary control output as the secondary control SP.
GX90UT Loop Control with PV Switching  	"Loop control with PV switching" uses two PV inputs, which are switched according to input contact signals or measurement ranges.

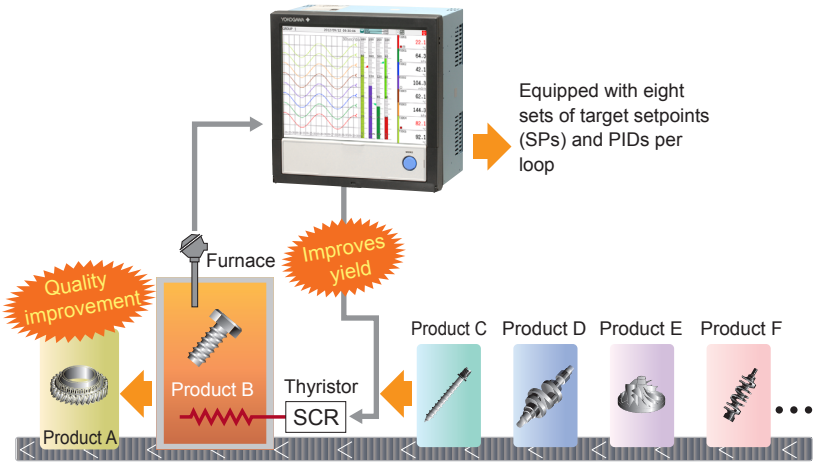
Explanation of Symbols

AI1: analog input 1, AI2: analog input 2
PV1: PV input 1 (loop 1 or primary side), PV2: PV input 2 (loop 2 or secondary side)
SP1: target setpoint 1 (loop 1 or primary side), SP2: target setpoint 2 (loop 2 or secondary side)
PID1: PID computation 1 (loop 1 or primary side), PID2: PID computation 2 (loop 2 or secondary side)
OUT1: control output1 (loop 1 or primary side), OUT2: control output 2 (loop 2 or secondary side)
AO1: analog output 1, AO2: analog output 2
DI: contact input

The three control modes can be applied to the following types of application. Examples of GX20 are described below.

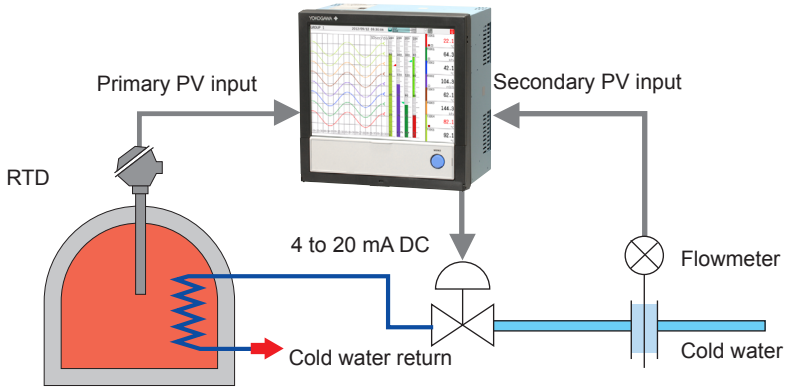
Industrial furnace temperature control (single-loop control)

Rich recipe management improves yield.



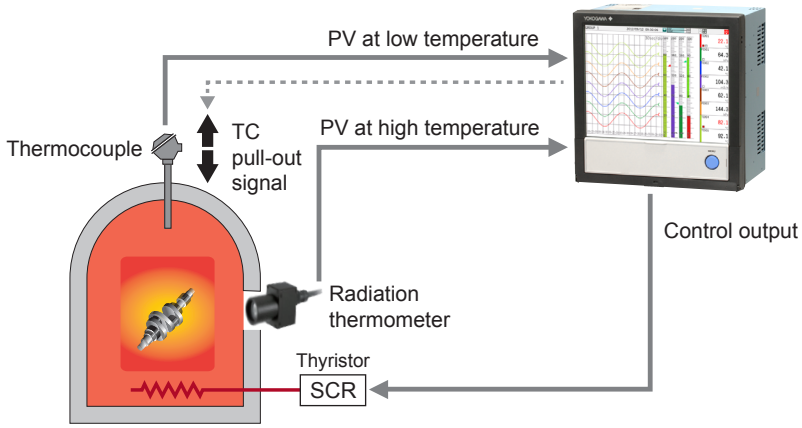
Cascade Control

Control targets with extremely long delay between changes in the control output and measurements on the control target or extremely long dead times can be controlled.



Loop Control with PV Switching

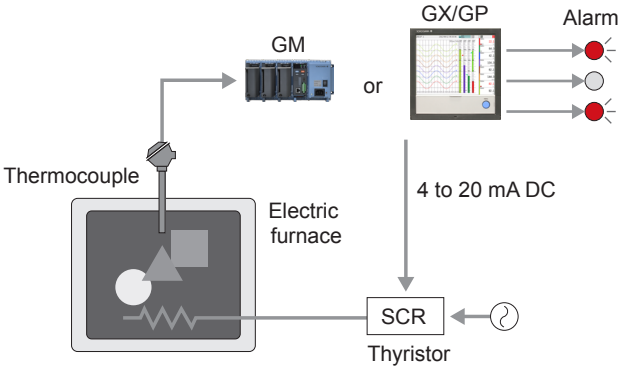
Control input is automatically switched depending on the temperature region.
During low temperature, PV input from a thermocouple is used to perform control, and during high temperature, PV input from a radiation thermometer is used to perform control.
When a switch occurs from low temperature to high temperature, a thermocouple pull-out signal is output.



Control Type

PID Control

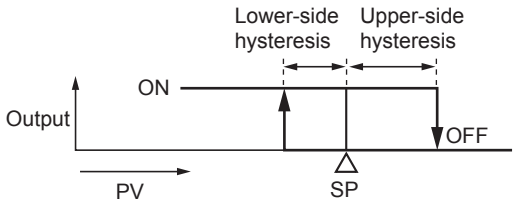
PID control is a general control using the PID control-related parameters. Continuous PID output (current output) or time proportional PID output (voltage pulse output) can be used.

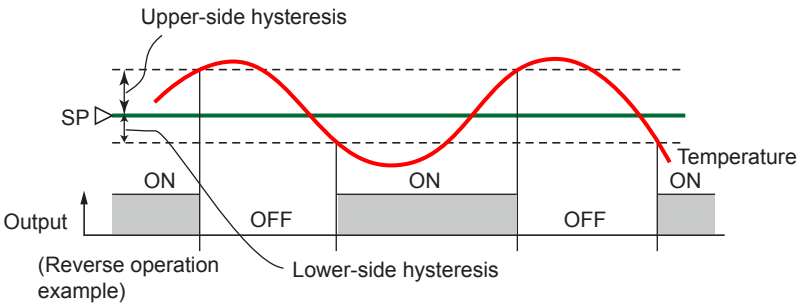


- Continuous PID control: Outputs the PID computation result using a current (analog signal) proportional to the PID computation value.
- Time proportional PID control: Outputs the PID computation result using an on/off signal pulse width proportional to the time. The pulse width is output a percentage of the cycle time (control output cycle) using a voltage pulse.

ON/OFF control

ON/OFF control compares the SP and PV and outputs an on or off signal according to the positive or negative deviation (PV – SP).
Hysteresis can be set in the vicinity of the on/off output operating point to prevent chattering.
The output type is voltage pulse output or current output.



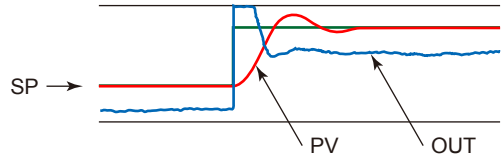


PID Control Mode

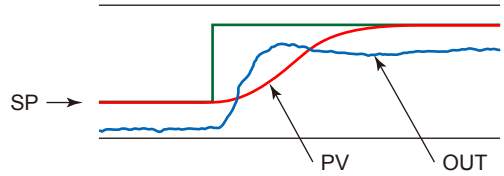
There are two PID control modes: standard PID control mode and fixed-point control mode.
In standard PID control mode, when the SP is changed, the output corresponding to the deviation is changed immediately. This mode focuses on reaching the setpoint quickly.
In fixed-point control mode, sensitive reaction in response to changes in the SP is suppressed. This mode focuses on stable output.
The GX90UT automatically selects the optimal control algorithm according to the operation mode status and performs control.

- PV derivative type PID: Because derivative actions work only on the PV, stable control output is possible. Even when the SP is changed significantly, the control output does not change drastically, and the deviation is gradually eliminated.

PV derivative type PID (output bump at SP change)

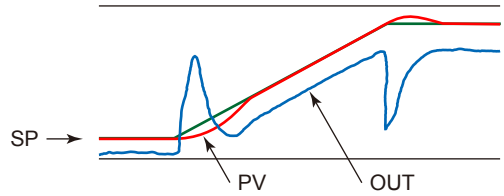


PV derivative type PID (output bumpless at SP change)



- Deviation derivative type PID: Because derivative actions work on the changes in the control deviation (difference between the PV and SP, quick response is exhibited to changes in the target setpoint. This method is useful when SP trackability is important.

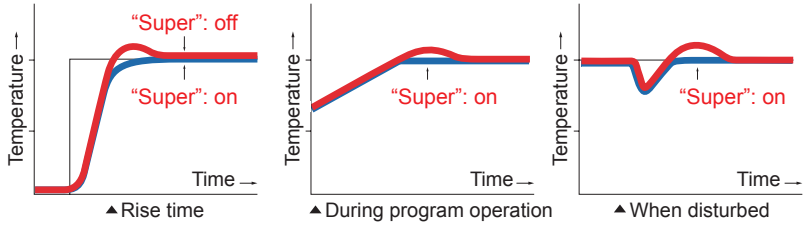
Deviation derivative type PID



Overshoot Suppressing Function (Super function)

“Super” function is an overshoot-suppressing function that uses fuzzy logic.
When used in combination with the auto-tuning function, the overshoot suppressing function proves effective in the following situations.

- When you want to suppress overshoot
- When you want to reduce rise time
- When there is a great amount of load fluctuation
- When the setpoint is changed frequently



Direct Operation and Reverse Operation

There are two PID control output operation directions: direct and reverse.
These define the increase and decrease directions in which the control output changes in response to positive and negative deviation between the SP and PV.

Over-Integration Suppressing Function (Anti-reset windup)

If the deviation between the SP and PV continues for a long time, integral action causes the control output to reach the control output high limit and saturate. Because the control output cannot disengage from the saturated state even when the PV exceeds the SP, overshooting can occur. The over-integration suppression function stops the integral action temporarily when the control output reaches the control output high limit.

SP Ramp-Rate Setting Function

The SP ramp-rate setting function forces the SP to change at a fixed rate in order to prevent abrupt changes in the SP or change the SP at a constant rate-of-change.

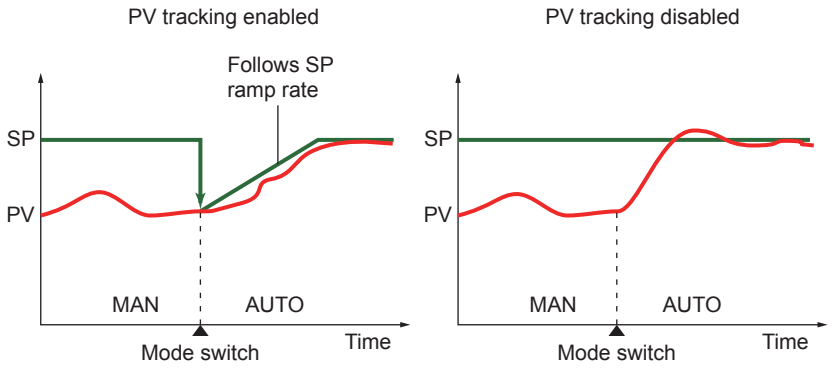
SP Limiter Function

The SP limiter function enables high and low limits to be placed on the SP.

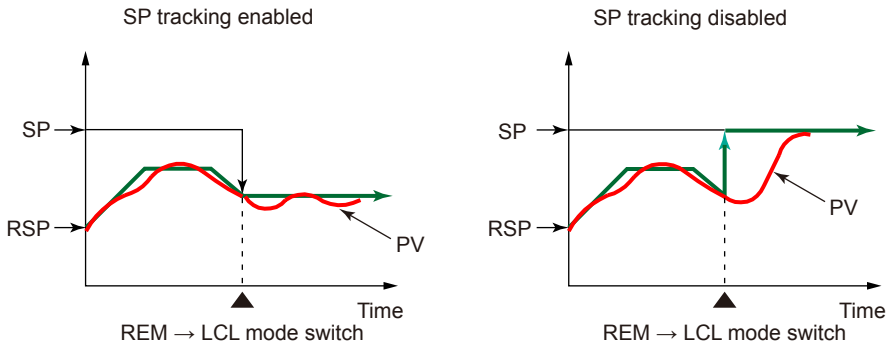
Tracking Function

The tracking function prevents the setpoint from changing drastically when the operation mode is changed. PV tracking and SP tracking are available.

PV tracking



SP tracking

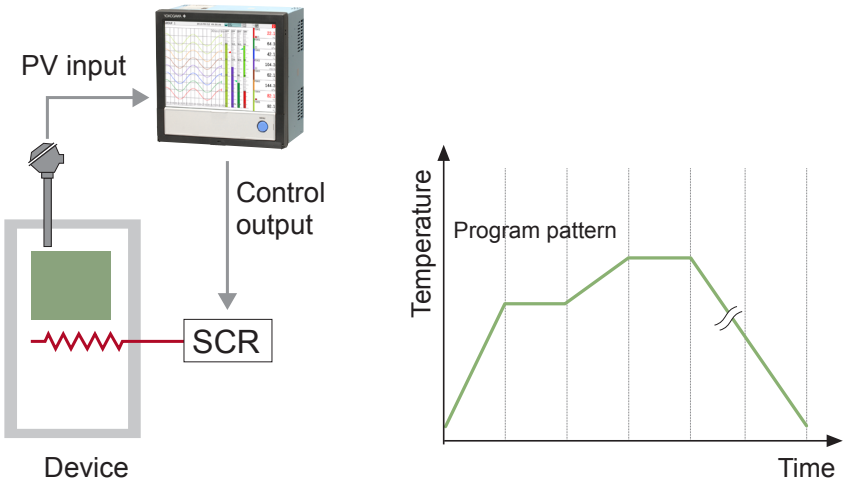


Explanation of Symbols

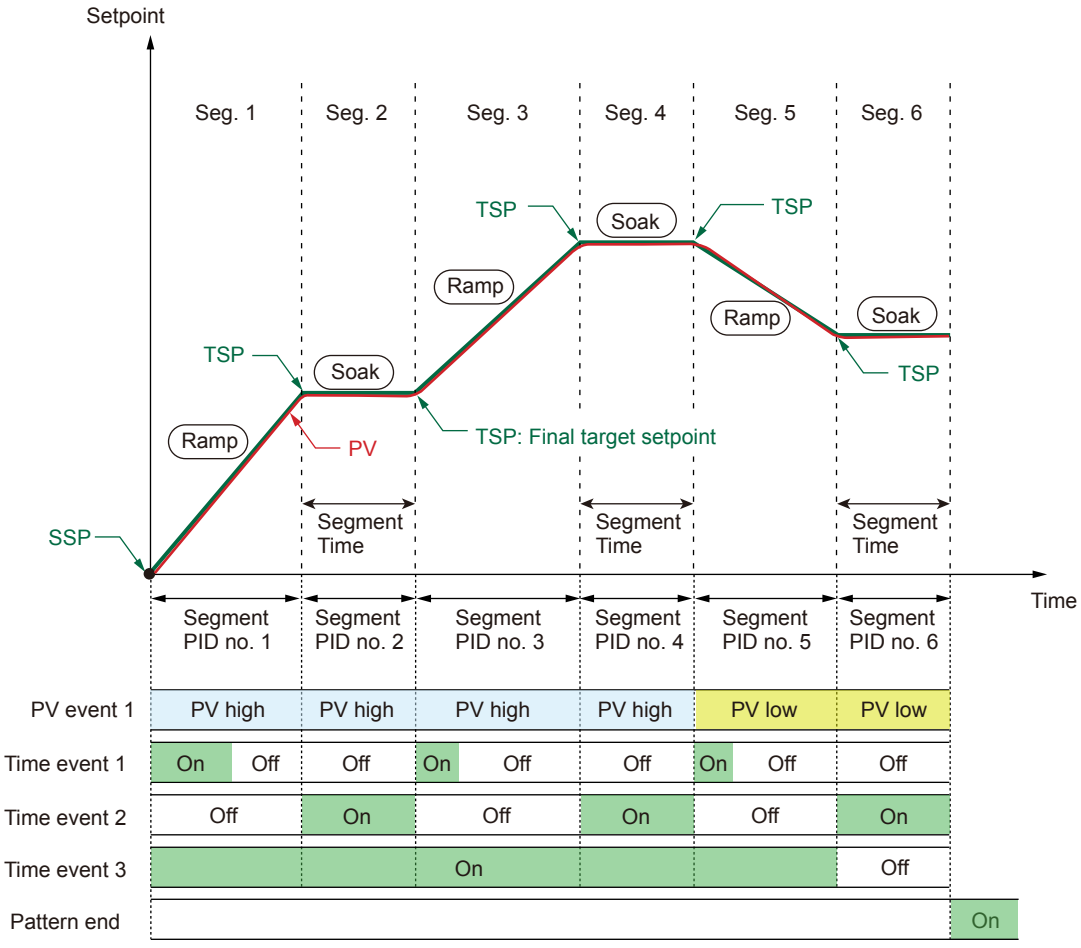
MAN: manual mode, AUTO: auto mode
REM: remote mode, LCL: local mode

1.4 Program Control Function (/PG option)

Program control is possible on the GX/GP/GM with the /PG option.



The program operation can be used to change the SP over time according to a preset program pattern.
A program pattern consists of several segments.
You can create a program pattern by setting the final target setpoint of each segment, segment time, PV events, time events, and so on.



Program Control Functions

Wait Function

The wait function pauses the progression of a program when the PV cannot follow the SP.

Repeat Function

The repeat function repeatedly runs a given segment (consecutive multiple segments also possible) in a program pattern.

Program Operation Pause (Hold Function)

The hold function forces the operation of a program pattern to pause when the program is running.

Program Segment Advance

The advance function forces a program pattern to transition to the next segment when the program is running.

Event Function

The event function can be used to output alarms according to the progression of program pattern operation or turn on or off the contact output after a given time elapses.

Time Event

The time event function turns on or off the contact output when a specified time elapses from the start of a segment operation.

PV Event

The PV function outputs alarms according to the progression of program pattern operation. Events operate only within the specified segments.

PID Selection

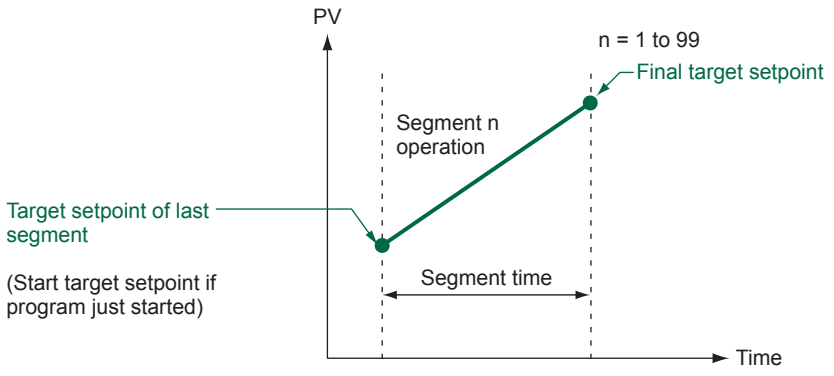
You can select zone PID selection, which selects the PID according to the PV or SP, or segment PID section, which selects the PID for each segment.

Local Mode

The local mode function stops program operation and performs fixed-point control.

Creating Program Patterns

To create a program pattern, you set a line graph of target setpoints in each segment using the final target setpoint (TSP) at the end of each segment and the segment time. You set a final target setpoint for each loop. The segment time applies to all loops.



Program Operation Start Action

Starting with the Start Target Setpoint

The program operation starts according to a pattern created with the target setpoint for starting the operation and the final target setpoint (TSP) of the first segment, regardless of the PV when the operation starts.

Ramp-Prioritized PV Start

Ramp-prioritized program runs according to the loop specified with the reference loop number.
This method determines the start point by comparing the PV at the start of the nth pattern to the program pattern.
Other unspecified loops start according to the pattern of the specified nth pattern.

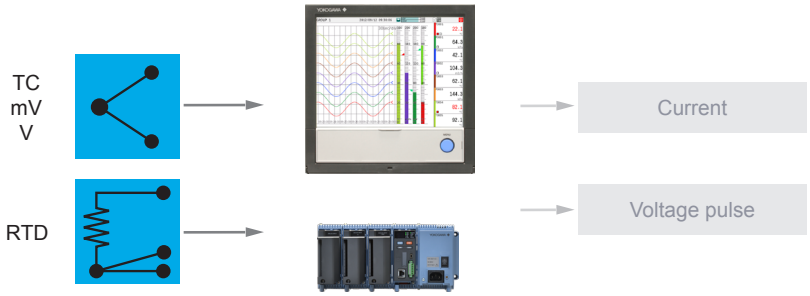
Time-Prioritized PV Start

The program operation starts according to a pattern created with the PV for starting the operation and the final target setpoint (TSP) of the first segment, regardless of the SP when the operation starts.

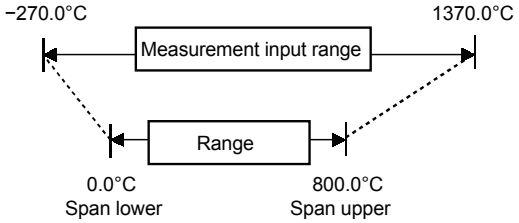
1.5 Input Function

PV Input

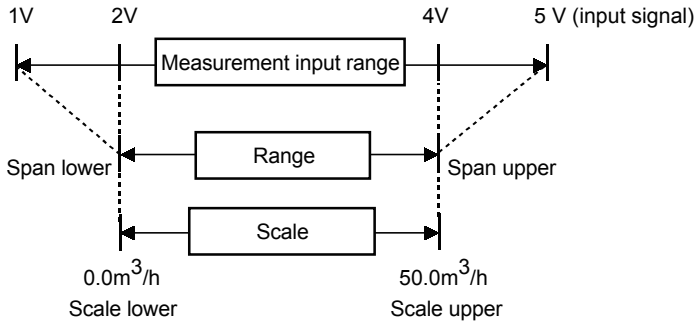
PV input is a universal input to arbitrarily set the type and range for the thermocouple (TC), resistance-temperature detector (RTD), DC voltage and DI.



Range Setting for Temperature Input



Range and Scale Settings for Voltage Input



Note

If you change the PV range or scale, the control setpoint may be changed.
It affects the SP, PV range high and low limits, input switching PV high and low limits, remote bias, SP ramp-rate, high and low limit hystereses, and deviation display band.

In addition to the range and scale settings, you can set the control PV input range that determines the actual range of control.
Normally, the range and scale values are set.
However, if the range and scale settings exceeds 30000, the control PV input range is set within 30000 based on the lower limit.
The control PV input range is used particularly during loop control with PV switching.

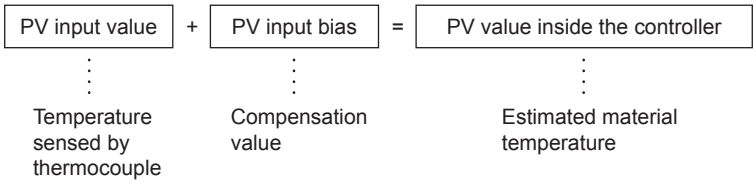
External PV (EXPV)

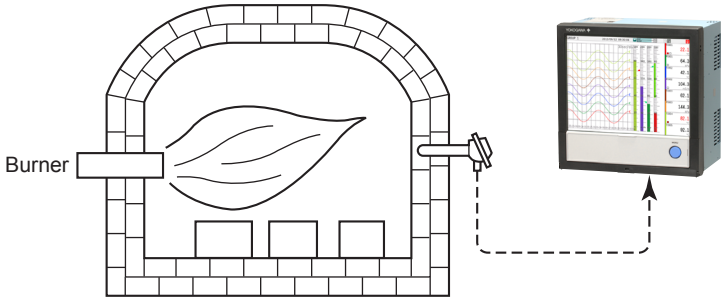
In place of the analog input of the PID control module itself, an external input channel (input, math, communication) is used for the PV input.
The setting range is set to the control PV input range setting range.

Calibration Correction Function

Bias Function

Bias is a function that adds a bias to the PV input and uses the result in the controller display and control. This function is used to finely adjust the values when the values are within the accepted accuracy range but deviate from those of other devices.





Filter Function

If the PV input reading fluctuates greatly and the lower digits are difficult to read, a digital filter can be inserted as a buffer. This filter provides a first-order lag calculation, which can remove more noise as the time constant becomes larger. But, making the time constant too large will distort the waveform.

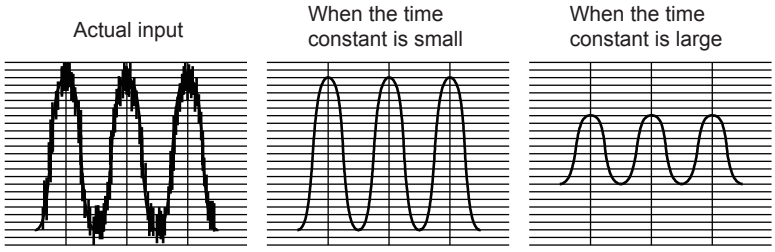
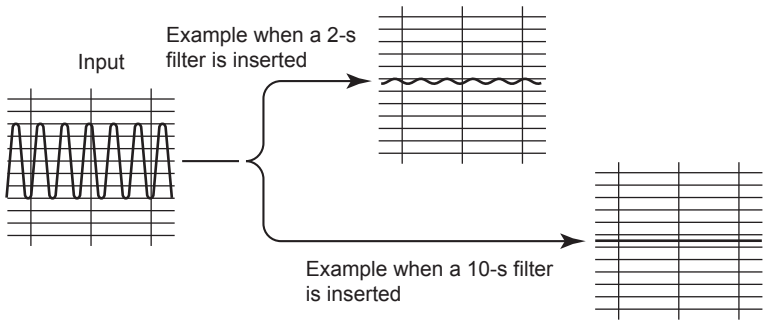


Illustration of the filter effect



Linearizer Approximation, Linearizer Bias, and Correction Factor*

Linearizer approximation is used when the input signal and the required measurement signal have a non-linear relationship, for example, when trying to obtain the volume from a sphere tank level.
Linearizer bias is used to correct an input signal affected by sensor deterioration.
The correction factor is used to set a correction value on the device side and a correction value on the sensor side and manage them.
* On models with the /AH option

Remote Input (RSP)

The analog input of the PID control module itself or an external input channel (input, math, communication) is used for the remote input (RSP).

Ratio Bias

Ratio bias computing performs ratio computation and bias addition for remote input.

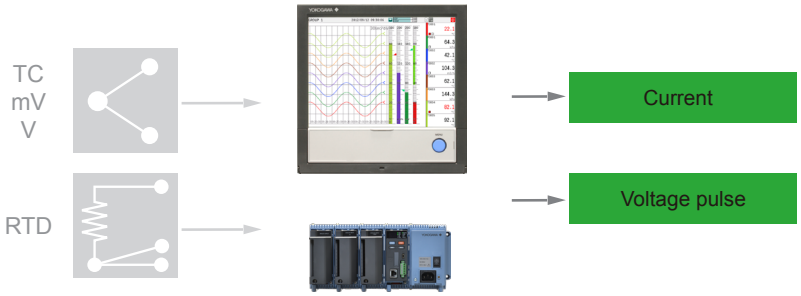
Digital Input

A single PID control module has eight contact inputs. It can be used to switch stop/run, auto/manual, and other operation modes as well as switch setpoint numbers, and switch program pattern numbers.

1.6 Output Function

Control Output

Control output (OUT) is an universal output. You can set the type of output to current pulse or voltage pulse.



Control Output Suppression

Control Output Limiter

Control output limiter can be used to set high and low limits on the control output operation range, regardless of the operation mode. Up to eight sets can be set in association with the PID parameters.

Output Velocity Limiter

Output velocity limiter prevents the control output signal from changing suddenly.

Preset Output

Preset output transmits a preset output value for the control output when the operation mode is changed from the operating state to the stopped state. The value can be set in the range of -5.0 to 105.0%.

Input Error Preset Output

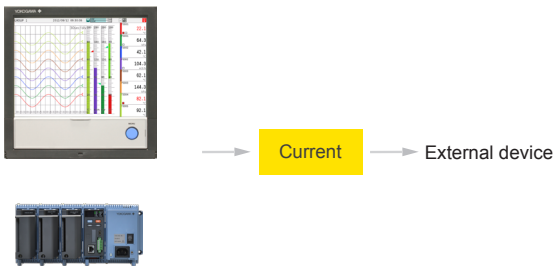
Input error preset output transmits a preset output value or 0% or 100% for the control output when an input burnout, A/D conversion error, or the like occurs.

Tight Shut Output

Tight shut output fully closes the control valve (output is zero for 4 to 20 mA current output) beyond its positioner dead band. However, in auto mode, the output low limit is set to -5.0%, and the output does not fall to 0.0 mA. In manual mode, tight shut output (approx. 0.0 mA) is achieved.

Retransmission Output (Analog Retransmission)

Retransmission output transmits PV, SP, control output (OUT), and the like externally using analog signals.



15 V DC Loop Power Supply

When the 15 V DC loop power supply is not used for control output or retransmission output, it can be used to supply 15 V DC to 2-wire type transmitters.

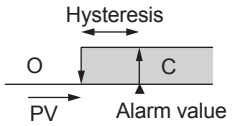
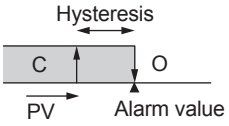
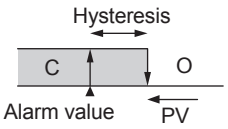
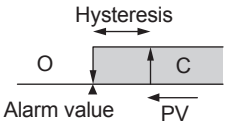
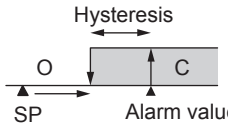
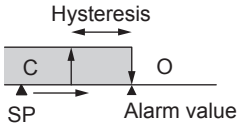
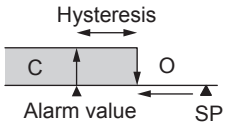
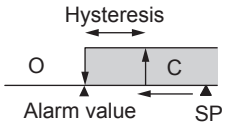
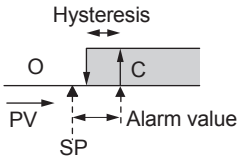
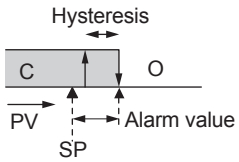
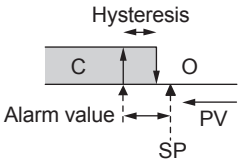
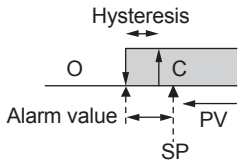
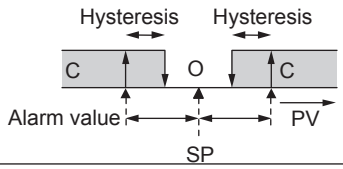
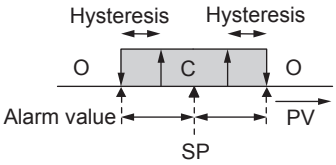
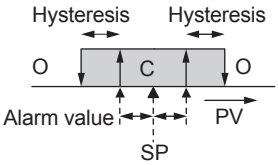
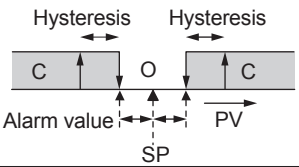
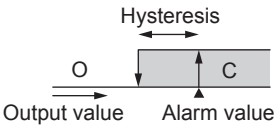
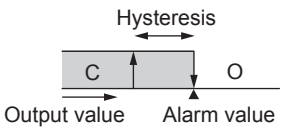
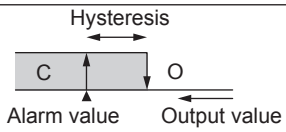
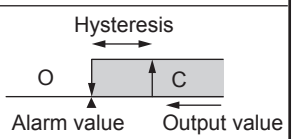
Digital Output

A single PID control module has eight contact outputs. They are used for alarm output and status output.

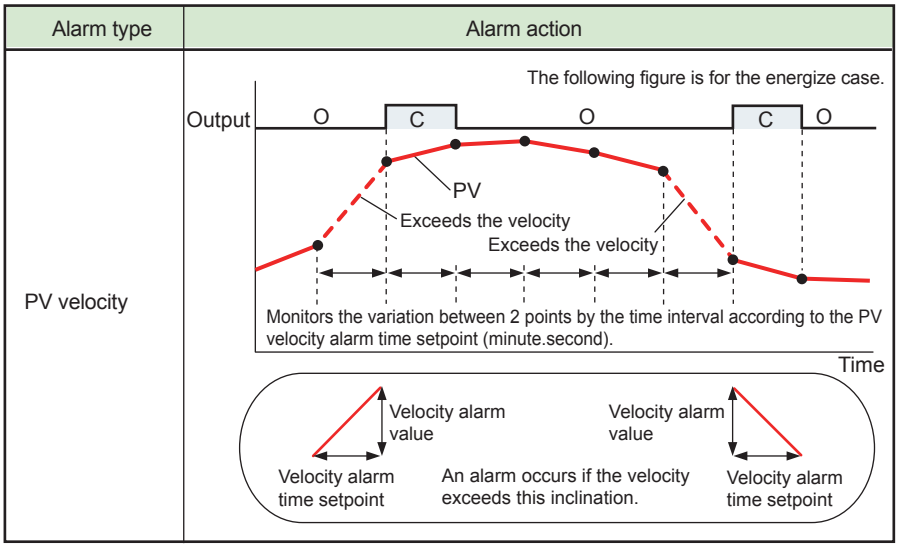
1.7 Alarm Function

Alarm Types

There are 11 control alarm types. The alarm operation varies depending on the contact action (energize or de-energize).

Alarm type	Alarm action (energize)	Alarm action (De-energize)
PV high		
PV low		
SP high limit		
SP low limit		
Deviation high limit		
Deviation low limit		
Deviation H/L limits		
Deviation within H/L limits		
Control output high limit		
Control output low limit		

* “O” and “C” indicate the relay contact open and close states.



* "O" and "C" indicate the relay contact open and close states.

Number of Alarm Setpoints

Number of alarm setpoints: 4 per loop

Alarm Hysteresis

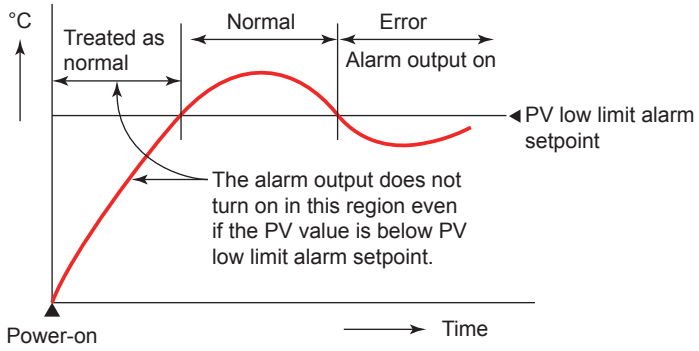
If the alarm output repeatedly turns on and off drastically, you can reduce the intensity by increasing the alarm hysteresis.

Standby Action

Standby action disables alarms until the first time the alarm condition ceases.
Standby action works in the following situations.

- At power-on
- When the SP is changed (in local mode)
- When the SP number is changed (in local mode) (The SP must change.)
- When the alarm type is changed

The following figure shows an example at power-on.



Alarm Mode

You can also select the alarm output operating conditions from the following three types.

- Alarm enabled at all times
- Alarm disabled when operation is stopped (STOP)
- Alarm disabled in manual mode (MAN) or when operation is stopped (STOP)

Alarm Delay Timer

Alarm-on delay timer starts a timer when an alarm condition occurs and turns on the alarm when the timer expires.
Alarm-off delay timer starts a timer when the alarm condition clears (returns to normal condition) and turns off the alarm when the timer expires.
If a value enters an area in which alarms do not occur when the timer is running, the timer is reset. Alarms will not occur.

Alarm ACK (Latch Function Release)

The alarm acknowledge (alarm ACK) operation releases all alarm indications and relay outputs.

Alarm Action during Program Control (/PG option)

Alarms can be set on PV, SP, and control output in addition to program settings when performing program control.

1.8 Action Function (Contact Input Switch Function)

The action function (contact input switch function) switches auto/manual, stop/run, and other operation modes using contact input, contact output, control alarm levels[1], or control alarm level states[2].
A single PID control module has eight digital inputs (DI1 to DI8), eight digital outputs (DO1 to DO8), four control alarm levels[1] (1 to 4), and four control alarm level states[2] (1 to 4).

*1: An alarm level indicates the alarm status regardless of the specified relay action. Relay action behaves in the same manner as nonhold.
*2: An alarm level indicates the alarm status including the specified relay action.

Note

This action function can switch the various functions within its own PID control module but cannot switch those of other PID control modules.

Switching Functions That Used as Actions

The action function have predetermined contact actions.

Event	Rising or falling edge	Trigger
AUTO/MAN switch	✓	
REMOTE/LOCAL switch	✓	
STOP/RUN switch	✓	
Switch to cascade		✓
Switch to AUTO		✓
Switch to MAN		✓
Switch to REMOTE		✓
Switch to LOCAL		✓
Auto-tuning START/STOP Switch	✓	
Alarm ACK		✓
Bit-0 to 3 of SP Number		✓
Bit-0 to 3 of PID Number		✓
PV switching	✓	

Action	Description
Rising edge (when the contact action is set to energize)	The action is executed when the event changes from off to on.
Falling edge (when the contact action is set to energize)	The action is executed when the event changes from on to off.
Trigger (detected on a ON signal lasting longer than the control period)	The action is executed when an event occurs.

1.9 Control Event Action Function

The control event action function is used to execute a specified action when certain events occur.
For example, you can use the control event action function to do the following:

Example 1. Start running when the remote control input (DI channel) turns on.
Example 2. Change the operation mode to manual when a control alarm occurs.

Functions that can be used as control event actions are shown below.

Note

The control event action function can use not only the DI/DO/internal switches of its own PID control module but also those of other modules. For example, time events and PV events of program patterns can be output to the DO of other modules.

Control Operation

Loop Control and Common Control

Function	Description
Run all control loops	Starts running all loops when the input changes from off to on.
Stop all control loops	Stops all loops when the input changes from off to on.
Control operation stop/start (specified loop)	Stops the control operation of specified loops when the input changes from off to on. Starts the control operation of specified loops when the input changes from on to off.
Auto/manual switch (specified loop)	Switches the control operation of specified loops to auto when the input changes from off to on. Switches the control operation of specified loops to manual when the input changes from on to off.
Remote/local switch (specified loop)	Switches the control operation of specified loops to remote when the input changes from off to on. Switches the control operation of specified loops to local when the input changes from on to off.
Auto switch (specified loop)	Switches the control operation of specified loops to auto when the input changes from off to on.
Manual switch (specified loop)	Switches the control operation of specified loops to manual when the input changes from off to on.
Cascade switch (specified loop)	Switches the control operation of specified loops to cascade when the input changes from off to on (during cascade control).
Remote switch (specified loop)	Switches the control operation of specified loops to remote when the input changes from off to on.
Local switch (specified loop)	Switches the control operation of specified loops to local when the input changes from off to on.
SP number switch (binary/BCD)	Switches the SP number according to the combination of input ON/OFF states (binary or BCD).

Program Control

Function	Description
Program RUN/RESET switch	Starts program operation when the input changes from off to on. Stops program operation when the input changes from on to off.
Hold operation	Pauses the operation of program patterns when the input changes from on to off.
Advance operation	Advances the operation of program patterns by one segment when the input changes from on to off.
Start of program operation	Starts program operation when the input changes from off to on.
Stop of program operation	Stops program operation when the input changes from off to on.
Hold operation (specified loop, specified program pattern)	Pauses the operation of the specified program pattern of the specified loop when the input changes from on to off.
Advance operation (specified loop, specified program pattern)	Advances the operation of the specified program pattern of the specified loop by one segment when the input changes from on to off.
Start of program operation (specified loop, specified program pattern)	Starts the operation of the specified program pattern of the specified loop when the input changes from on to off.
Stop of program operation (specified loop, specified program pattern)	Stops the operation of the specified program pattern of the specified loop when the input changes from on to off.
Program pattern number switch (binary/BCD selection)	Switches the program pattern number according to the combination of input ON/OFF states (binary or BCD).

Notification and Monitoring

Control status monitoring parameters and notifications (events) are output to DO or internal switches (as actions).

Function	Description
Control status (RUN/STOP)	Outputs the control status (RUN status: ON, STOP status: OFF).
Wait end signal (1s, 3s, 5s)	Outputs an ON state signal for 1, 3, or 5 seconds when the program operation wait state ends.
Pattern end signal (1s, 3s, 5s)	Outputs an ON state signal for 1, 3, or 5 seconds when the program operation ends.
PV event status	Outputs an ON state signal while a PV event is occurring during program operation.
Time event status	Outputs an ON state signal while a time event is occurring during program operation.
Wait flag	Outputs an ON state signal while the program operation is waiting.
Hold-on flag	Outputs an ON state signal while the program operation is being held.
Program operation mode monitoring (STOP/RUN)	Outputs the program operation status (RUN: ON, STOP: OFF)
Segment number monitoring (binary/BCD)	Outputs the running segment number in binary or BCD ON/OFF states.
Pattern number monitoring (binary/BCD)	Outputs the running pattern number in binary or BCD ON/OFF states.

* The behavior varies depending on the energize/de-energize state of the contact type.

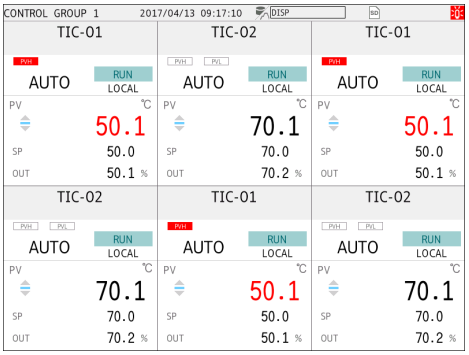
1.10 Operation Screen

An operation screen for control is available in addition to the measurement and recording screen.

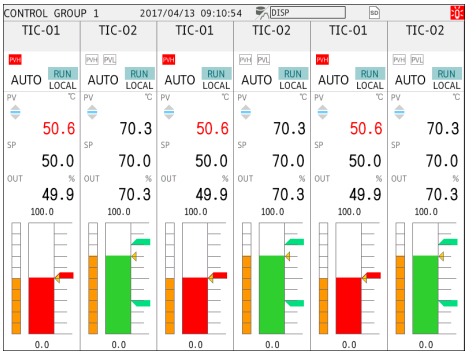
Control Group Screen

The control group screen is used to monitor multiple loops simultaneously. There are two display formats: controller style in which values are emphasized as on a digital indicating controller and faceplate style in which control values are displayed using bar graphs.

Controller style

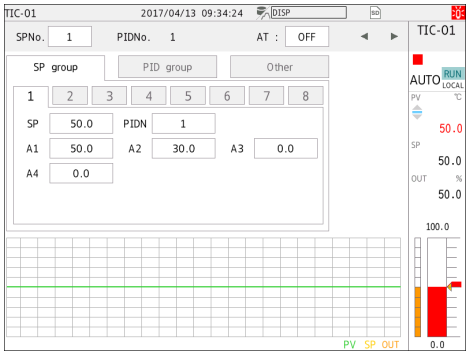


Faceplate style



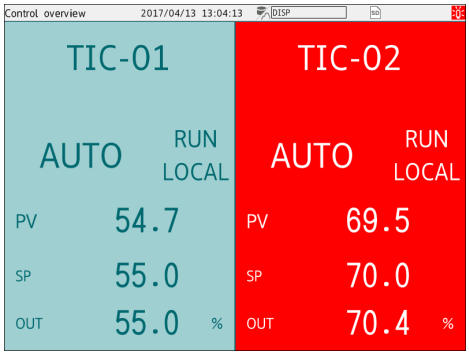
Tuning Screen

The tuning screen is used to adjust PID constants and other control parameters.



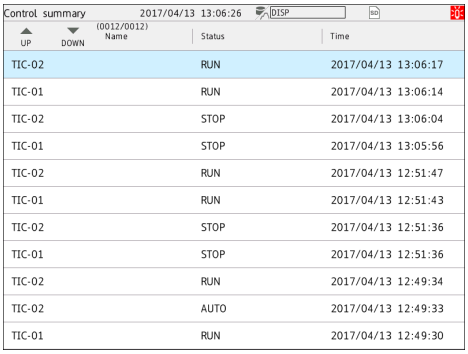
Control Overview Screen

The control overview screen is used to monitor all loops collectively.



Control Summary Screen

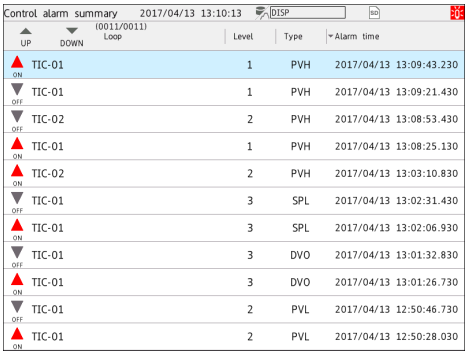
The control summary screen is used to display history of controls such as stop/run switching.



Name	Status	Time
TIC-02	RUN	2017/04/13 13:06:17
TIC-01	RUN	2017/04/13 13:06:14
TIC-02	STOP	2017/04/13 13:06:04
TIC-01	STOP	2017/04/13 13:05:56
TIC-02	RUN	2017/04/13 12:51:47
TIC-01	RUN	2017/04/13 12:51:43
TIC-02	STOP	2017/04/13 12:51:36
TIC-01	STOP	2017/04/13 12:51:36
TIC-02	RUN	2017/04/13 12:49:34
TIC-02	AUTO	2017/04/13 12:49:33
TIC-01	RUN	2017/04/13 12:49:30

Control Alarm Summary Screen

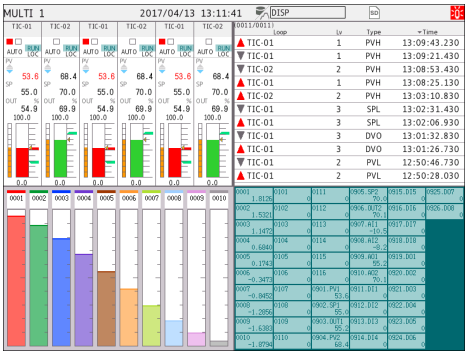
The control alarm summary screen is used to display history of control alarms.



Loop	Level	Type	Alarm time
TIC-01	1	PVH	2017/04/13 13:09:43.230
TIC-01	1	PVH	2017/04/13 13:09:21.430
TIC-02	2	PVH	2017/04/13 13:08:53.430
TIC-01	1	PVH	2017/04/13 13:08:25.130
TIC-02	2	PVH	2017/04/13 13:03:10.830
TIC-01	3	SPL	2017/04/13 13:02:31.430
TIC-01	3	SPL	2017/04/13 13:02:06.930
TIC-01	3	DVO	2017/04/13 13:01:32.830
TIC-01	3	DVO	2017/04/13 13:01:26.730
TIC-01	2	PVL	2017/04/13 12:50:46.730
TIC-01	2	PVL	2017/04/13 12:50:28.030

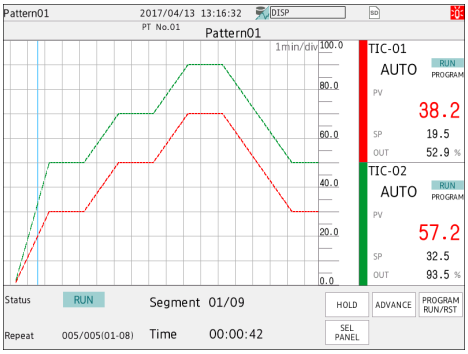
Multi Panel Screen (GX20/GP20 only)

The multi panel screen is used to collectively display screens with different display formats. It can be displayed along with measurement and recording screens.



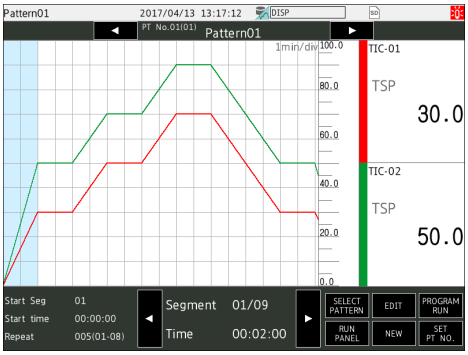
Program Operation Screen

The program operation screen is used to display the program pattern that is currently running.



Program Selection Screen

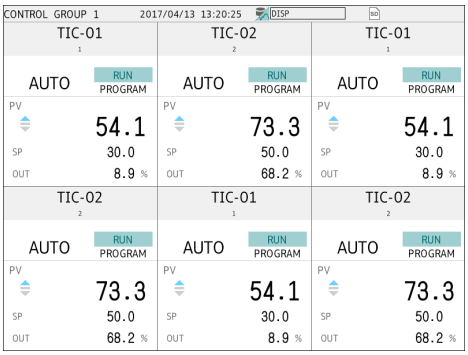
The program selection screen is used to select program patterns and view pattern settings.



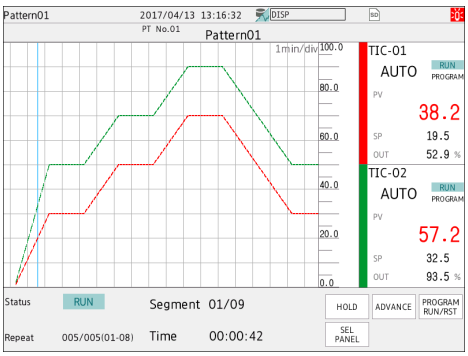
Background Color

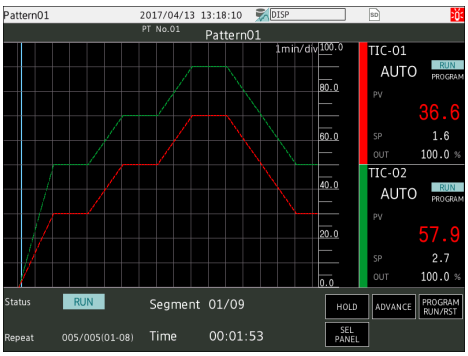
The background color of control screens can be set to white or black.

White background



Black background





Favorite and Standard Screens

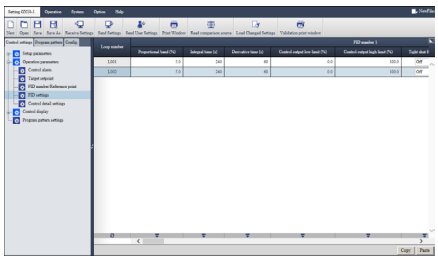
Control screens can be registered to favorite and standard screens.

1.11 PC Software

By combining the following PC software applications, you can use the control data in a wide range of applications.

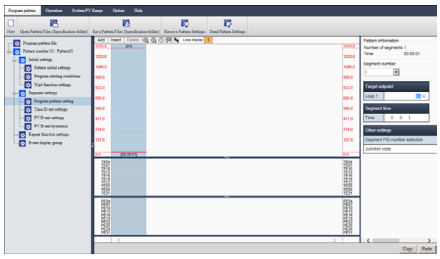
SMARTDAC+ Standard Hardware Configurator (R4.01.01 or later)

This application can be used to set the control functions and program patterns of GX/GP/GM main units.



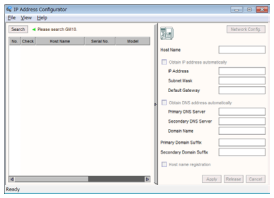
SMARTDAC+ Program Pattern Setting

This application is included in SMARTDAC+ Standard Hardware Configurator.
This application can be used to set the program patterns of GX/GP/GM main units. You can use this application when you want to manage and use the program pattern files by themselves.



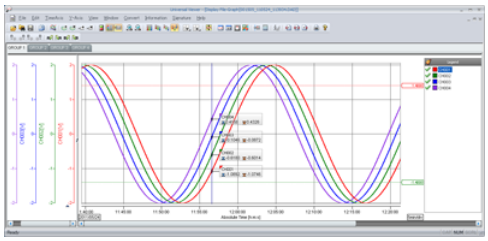
SMARTDAC+ Standard IP Address Configurator (R4.01.01 or later)

This application sets the GM IP address.



SMARTDAC+ Universal Viewer (R3.01.01 or later)

This application can display and print data generated by GX/GP/GM main units.



DXA170 DAQStudio Custom Display (R5.02.01 or later)

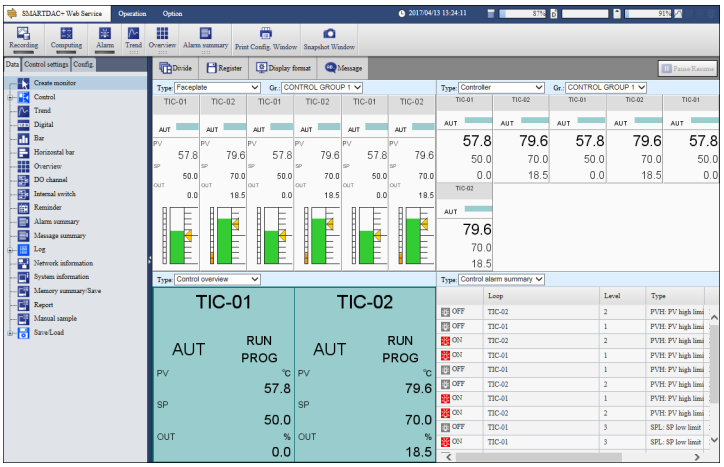
DAQStudio is a software application used to create original monitor screens for displaying data measured on GX10/GX20/GP10/GP20 paperless recorders.

GA10 Data Logging Software (R3.02.01 or later)

Data Logging Software GA10 is used to collect data from measuring instruments and controllers via communication and monitor and record the collected data. Recorded data can be displayed and printed from the Viewer software..

1.12 Web Application

The Web application can be used to control GX/GP/GM main units, configure main unit functions (except program patterns), and monitor data.



There is no need to install the Web application. The application screen appears when you specify the GX/GP/GM IP address on a Web browser.

Note

If a GX/GP/GM is accessed from multiple browsers simultaneously, the Web application performance may degrade.

For the details on the Web application screen, see the GX/GP or GM User's Manual.

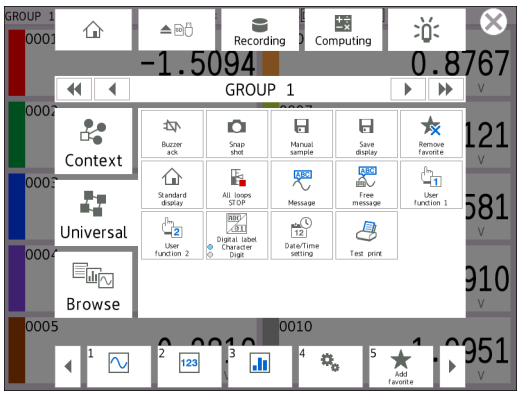
1.13 Control Data and I/O Data Acquisition/Recording Function

Control data refers to PV, SP, and control output (OUT). I/O data refers to analog input (AI), analog output (AO), digital input (DI), and digital output (DO).
By installing a PID control module in a GX/GP/GM and reconfiguring the system, you can acquire/record control data and I/O Data with PID channels (26 channels/module).
For configuring acquisition and recording, see the GX/GP or GM User's Manual.

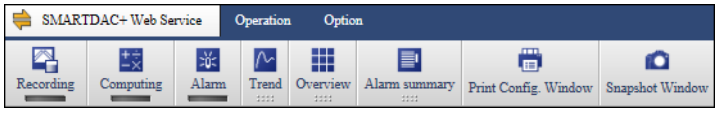
Note

The control period of PID control modules and the scan interval of the GX/GP/GM are asynchronous.

Control buttons on the GX/GP main unit

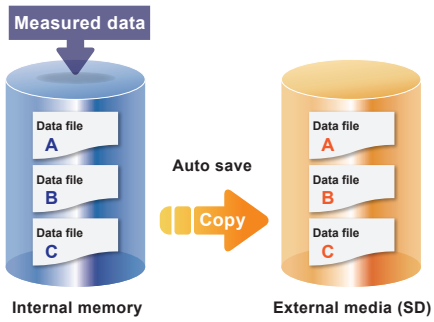


Control buttons on the Web application



Saving Data

Control data and I/O data made into channels are constantly saved in internal memory and can be transferred periodically to an external storage medium (SD card). Moreover, the FTP client function can be used to provide data redundancy using a file server. Data is saved without fail even in a sudden power interruption.



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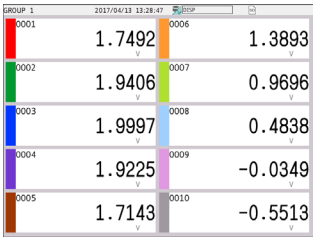
1.14 Screen Transitions

The following figure shows the transition between the operation screen for control and setting screen after the power is turned on.
Refer to this figure to configure and operate the system when using the PID control module.

Power-on

Digital screen

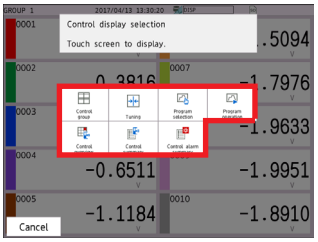


Press MENU.

Menu screen

Tap the Browse tab and then Control.

Control display selection



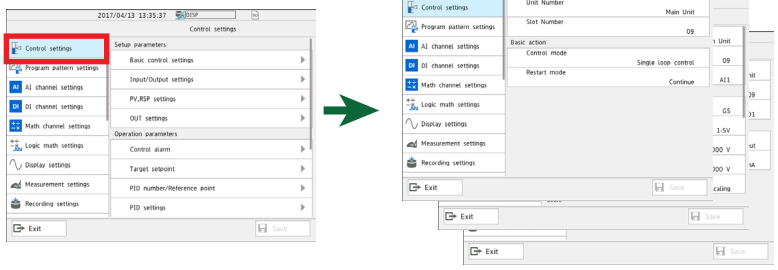
Tap the screen you want to show

Tap the Browse tab and then Setting.

Set the basic action of loop control.

Loop control Setting screen

Setting screen

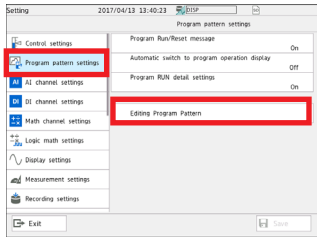


Perform program control

Create or edit a new program pattern. Set the program operation and the like.

Program control Setting screen

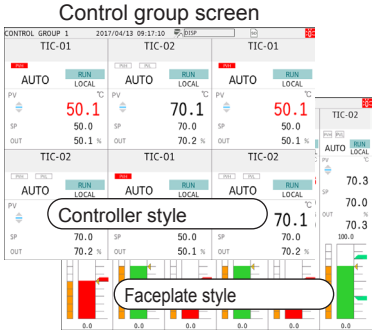
Setting screen



Tap Program pattern settings > Editing Program Pattern.

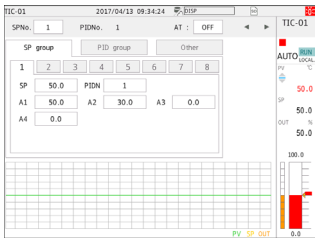
Operation screen

Control group screen

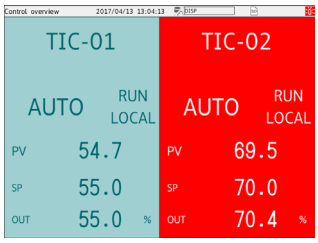


Tap the Context tab and then Display to switch.

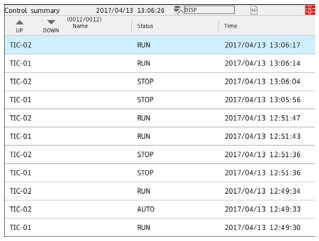
Tuning screen



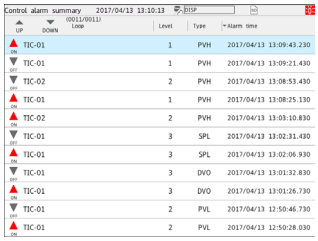
Control overview screen



Control summary

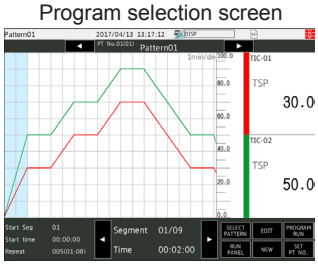


Control alarm summary

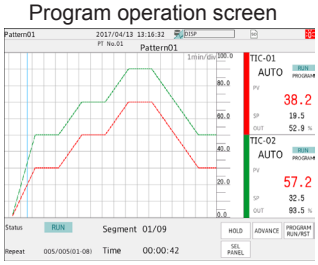


Program screen appears on models with the /PG option.

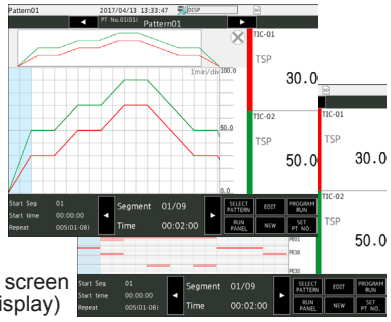
Program selection screen



Program operation screen



Program selection screen (whole pattern display)



Program selection screen (program event display)

Program selection screen

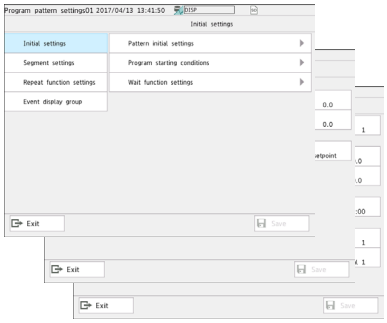
Tap NEW.

Tap EDIT.

Select a pattern number.

Edit the program pattern selected on the program selection screen.

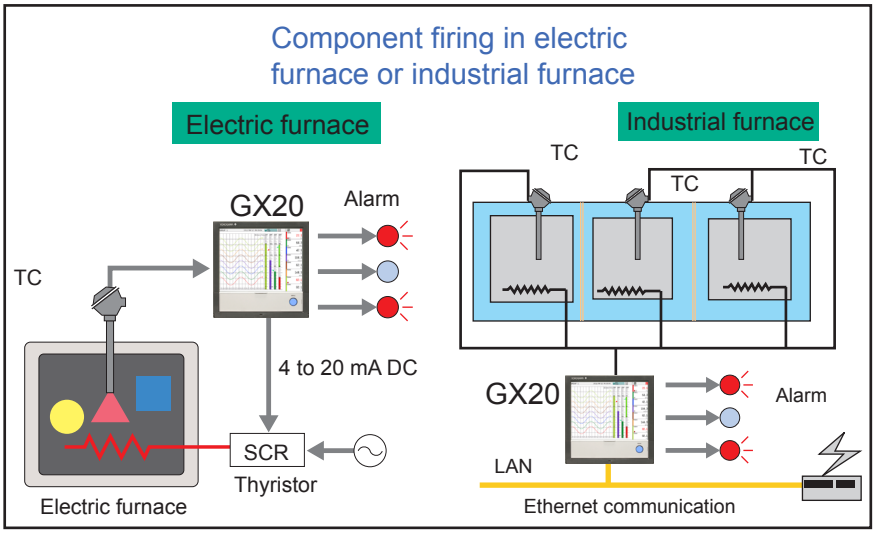
Program pattern setting screen



1.15 Application Examples

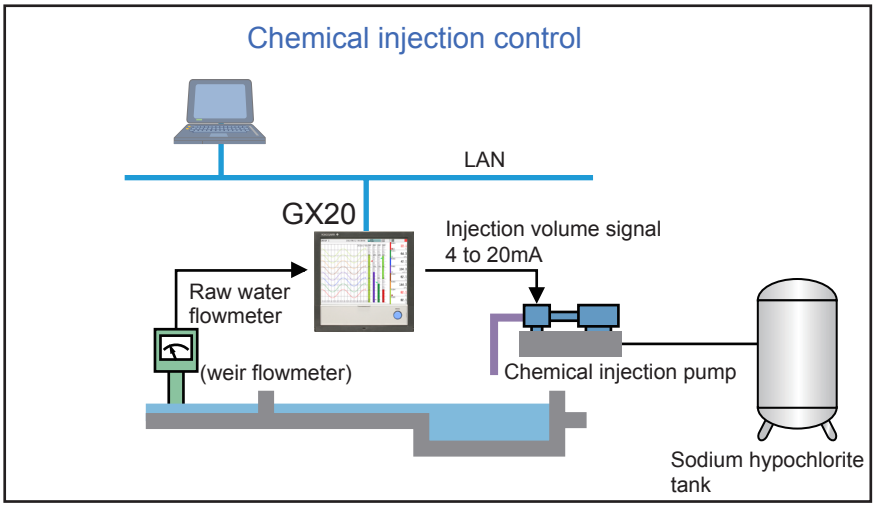
Component Firing in Electric Furnace or Industrial Furnace (GX10/GX20, loop control)

- Monitoring and turning control processes are easy.



Chemical Injection Control

- Complicated computation is possible.
- Injection ratio settings can be entered with actual values.

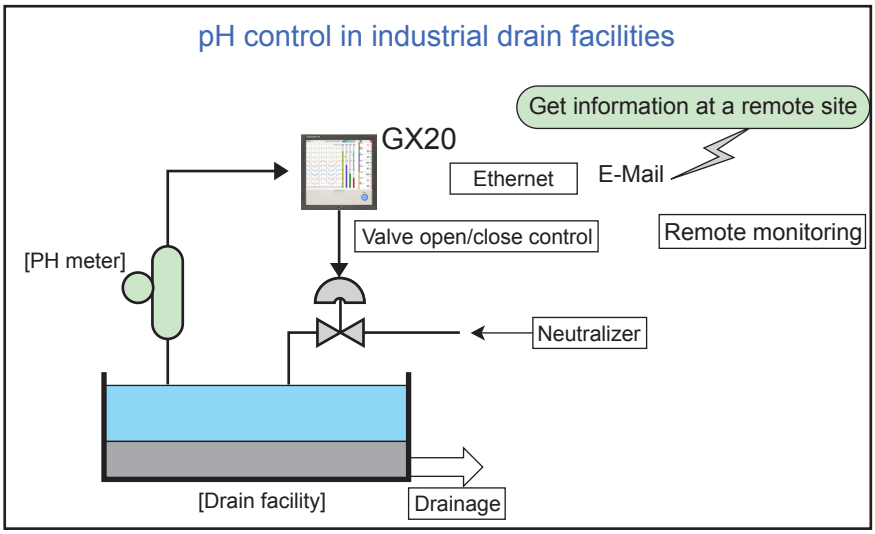


Injection volume of sodium hypochlorite is calculated based on the injection ratio, concentration, specific gravity in relation to the raw water flow rate. The injection volume setpoint is used to control or retransmit the setpoint to the pump.

$$\text{Injection flow rate (L/h)} = \text{Raw water flow rate (m3/h)} \times \text{Injection ratio (mL/m3)} \times \frac{1}{\text{Specific gravity}} \times \frac{1}{1000} \times \frac{100}{\text{Concentration (\%)}}$$

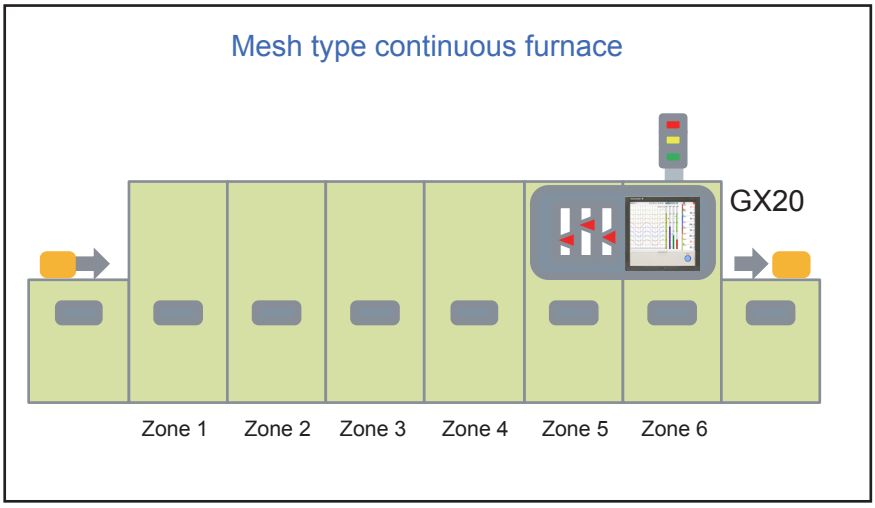
pH Control in Industrial Drain Facilities (GX10, loop control)

- This system is best suited to controlling wide areas such as drain facilities of factories.
- Additional loops can be supported flexibly.



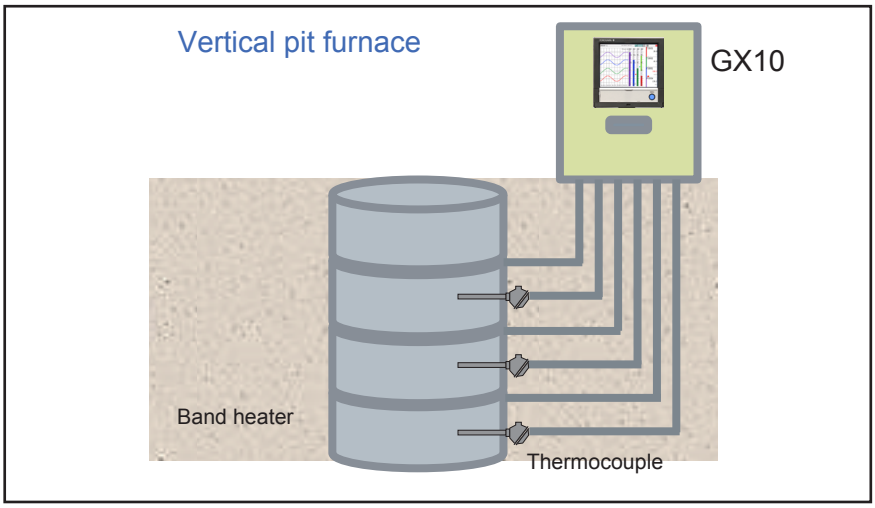
Mesh Belt Type Continuous Furnace Control (GX20, loop control)

- This system is best suited to the collective management of multiple loops.
- Module structure makes maintenance at the loop level easy.



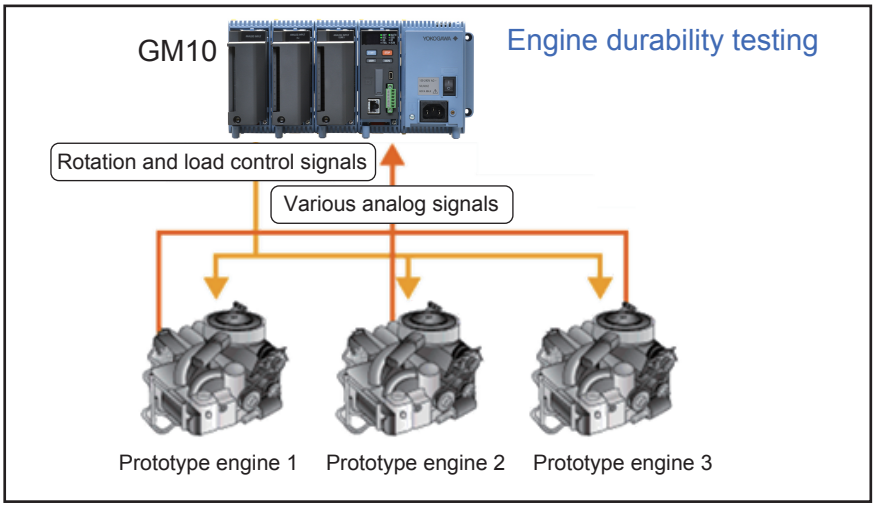
Vertical Pit Furnace Control (GX10)

- Synchronous program operation of multiple loops is possible.
- This system best suited to controlling batch furnaces and other devices.



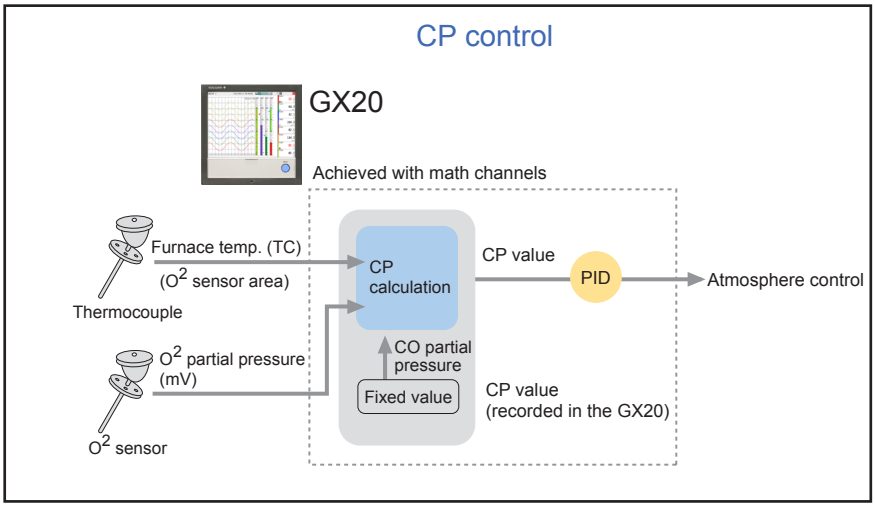
Engine Durability Test Bench (GM10, source and measure synchronization)

- Evaluation data can be measured while sourcing the test patterns.
- Source and measurement synchronization is easy.



Carburizing Furnace

- Carbon potential (CP) control is possible.
- Carbon potential (CP) monitoring and recording can be performed easily.
- O_2 sensors (zirconia sensors) or CO_2 analyzers (infrared analyzers) can be used.
- Multiple carbon potential (CP) computation is possible. (Simultaneous use of O_2 sensors and CO_2 analyzers is also possible. Best suited to management of accurate CP values.)



▶ For details of CP control and CLOG.AVE, “1.8 Configuring Math Channels (/MT option)” for GX/GP, “2.9 Configuring Math Channels (/MT option)” for GM.

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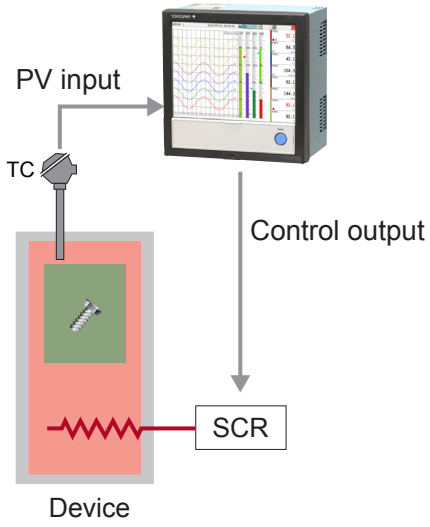
2.1 Overview

This chapter briefly explains the settings and operating procedure as a first step to help you understand the functions when using the PID control module for the first time.
Explanations are given using the GX20 as an example. If you are using the GM, you can perform similar configurations and operations as on the GX20 using the Web application.
Before configuring, you need to reconfigure the PID control module (identify the module).
For the instructions, see the GX/GP or GM First Step Guide.

Application Example

The GX20 is used to perform temperature control on a furnace loop.



Instrument Configuration

GX20 main unit (1 unit)
A GX90UT PID control module installed in slot 9

Settings and Items to Check

Setup item		Value
Control mode		Single loop control (set on each module)
Control type		PID control
Measurement input range (AI number: AI1)	Type	TC
	Range	K
	Span lower	0.0°C
	Span upper	100.0°C
Output type (AO number: AO1)	Type	Current
	Current output range	4 to 20 mA
Target setpoint		SP number 1: 50.0°C
Control alarm	Type	Level 1: PV high limit, Level 2: PV low limit
	Alarm value	Level 1: 50.0°C, Level 2: 30.0°C

Loop Numbers

Loop numbers are displayed during configuration. For information on what loop numbers (e.g., L091) mean, see section 3.2.

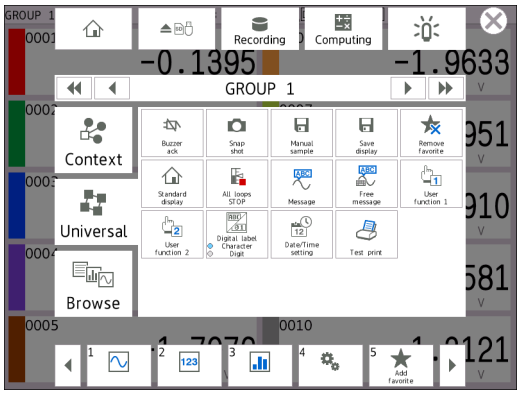
2.2 Initial Configuration

STEP 1: Setting the control basic operation of the PID control module

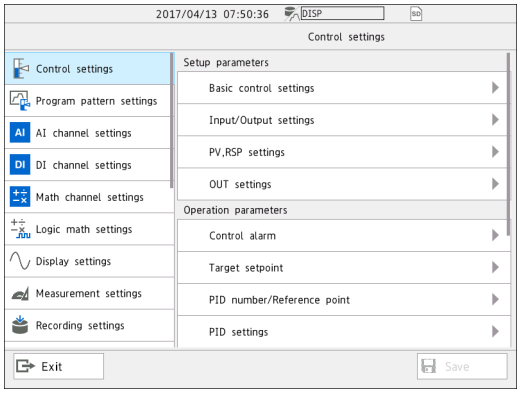
Check that the control mode is set to single loop control (default value).

Procedure

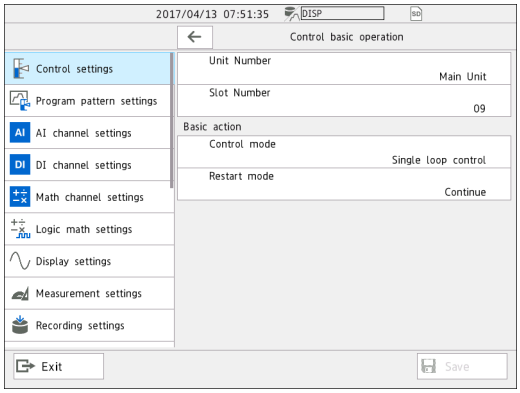
1 Press **MENU**.
The menu screen appears.



2 Tap the **Browse** tab and then **Setting**.
The Setting screen appears.



3 Tap **Control settings** > **Basic control settings** > **Control basic operation**.



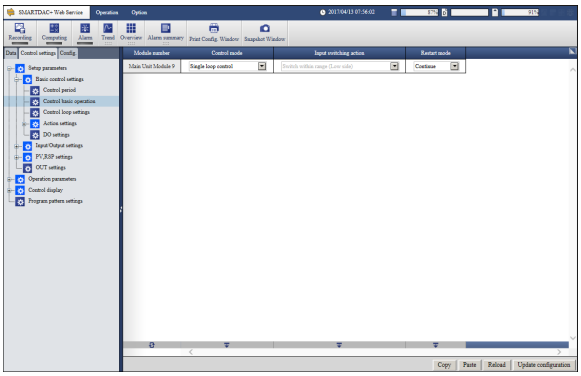
4 Check the unit number, slot number, and control mode.
Unit: Main Unit, Slot: 09, Control mode: Single loop control

Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control basic operation**

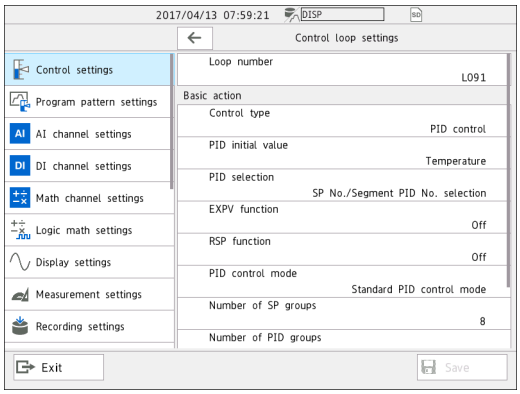


STEP 2: Setting the loop's basic action

Check that the control type is set to PID control (default value).

Procedure

1 Tap **Control settings** > **Basic control settings** > **Control loop settings**.



2 Check the control type.
Control type: PID control

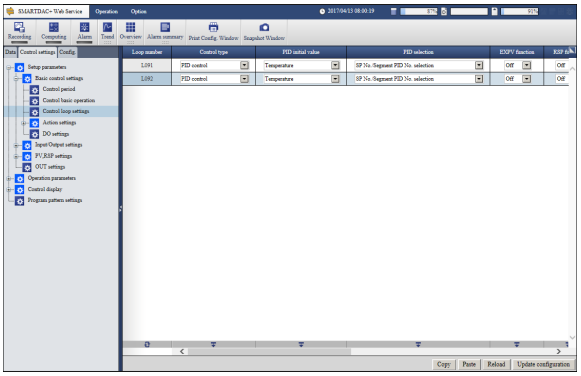
Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Set the control type of loop number L091.

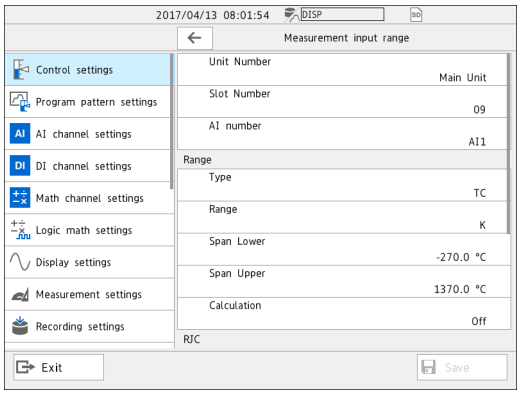


STEP 3: Setting the PV input type, range, and span

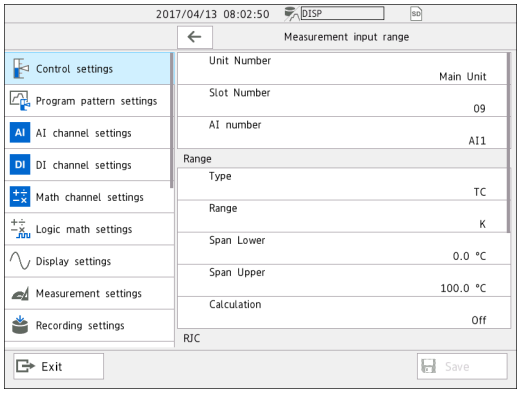
Set the PV input type, range, and span.

Procedure

1 Tap **Control settings** > **Input/Output settings** > **Measurement input range**.



2 Check the unit number, slot number, and AI number. Then, set **Type**, **Range**, **Span Lower**, and **Span Upper**.
(AI number: AI1) Type: TC, Range: K, Span Lower: 0.0°C, Span Upper: 100.0°C



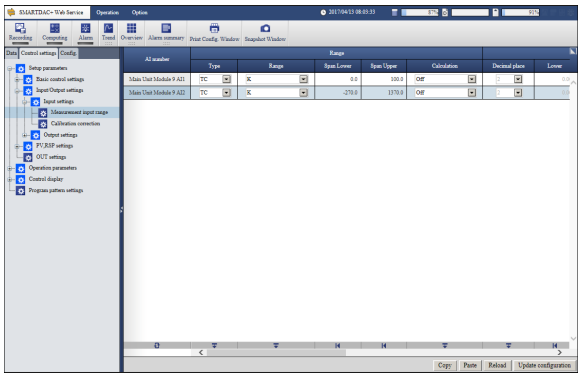
Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**

Set the PV input type, range, and span of loop number L091.

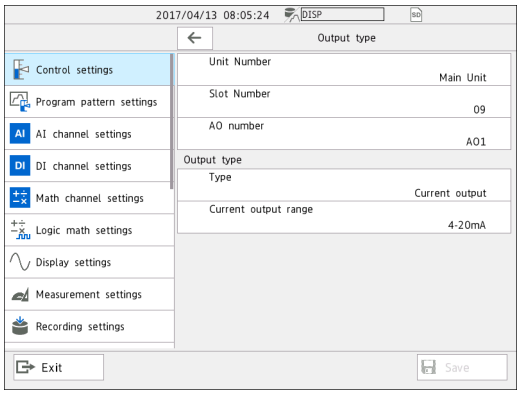


STEP 4: Setting the control output type

Check that the control output type is set to current (default value).

Procedure

1 Tap **Control settings** > **Input/Output settings** > **Output type**.



2 Check the unit number, slot number, AO number, type, and current output range.
Type: Current output, Current output range: 4-20mA

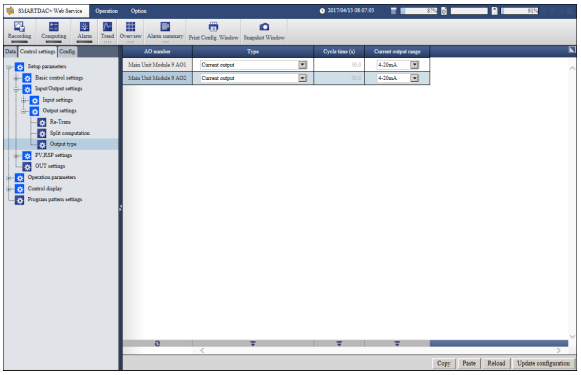
Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**

Set the control output type and current output range of loop number L091.

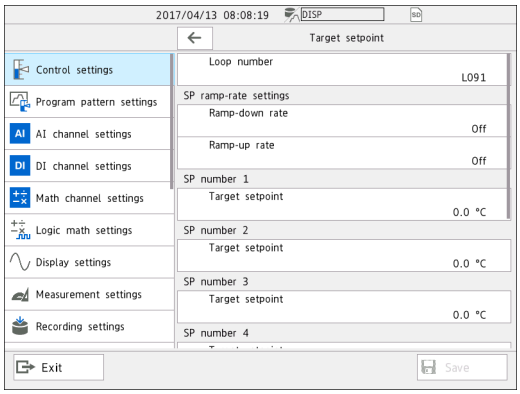


STEP 5: Setting the target setpoint

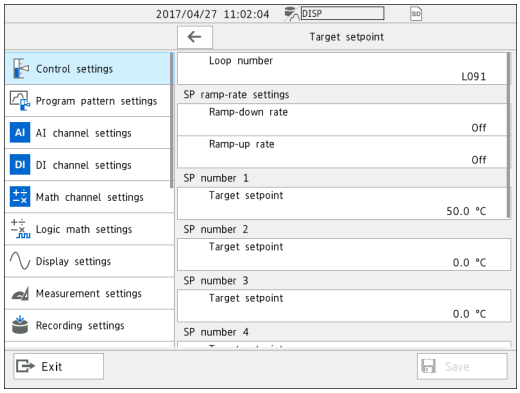
Set the target setpoint.

Procedure

1 Tap **Control settings** > **Target setpoint**.



2 Check the loop number, and set the target setpoint of SP number 1.
Main unit, slot number 9 (loop number: L091) SP number 1 target setpoint: 50.0°C



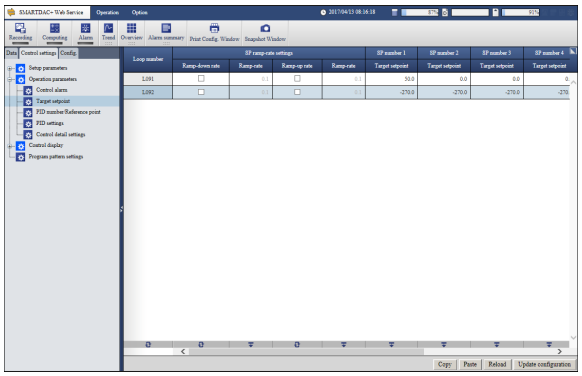
Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Operation parameters** > **Target setpoint**

Set the target setpoint of loop number L091.

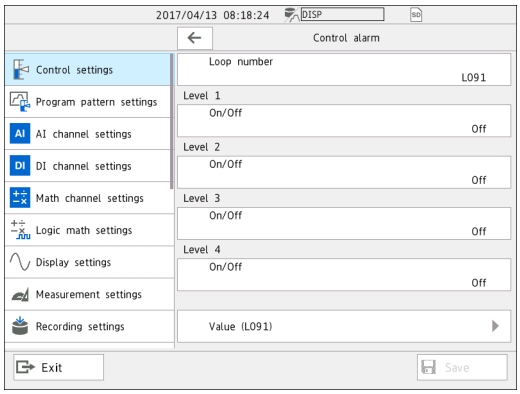


STEP 6: Setting the control alarm types and setpoints

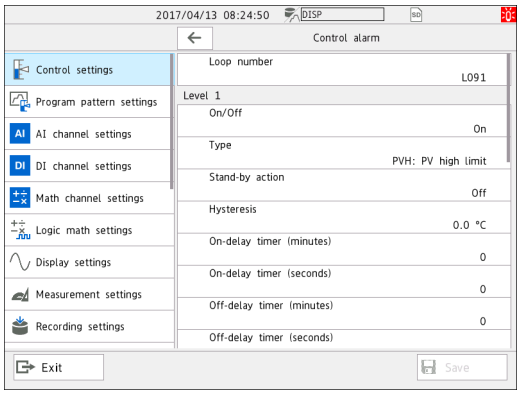
Set the control alarm types and setpoints.

Procedure

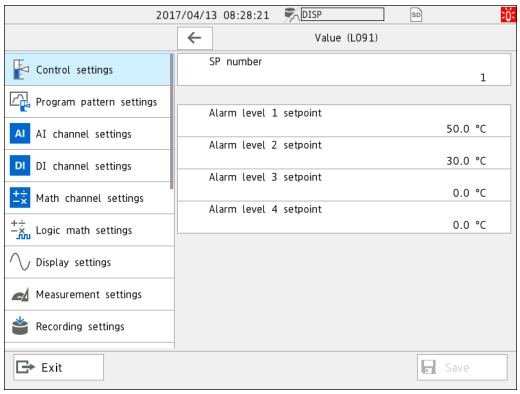
1 Tap **Control settings** > **Control alarm**.



2 Check the loop number, and set **On/Off** of Level 1 and Level 2 to On.
Loop 1, Level 1 type: PVH (PV high limit)
Loop 1, Level 2 type: PVL (PV low limit)



3 Tap **Value** (loop number), and set the alarm values.
Loop 1, Level 1 setpoint: 50.0°C
Loop 1, Level 2 setpoint: 30.0°C

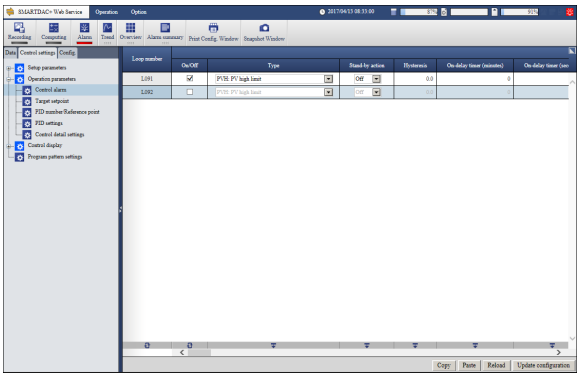


Operation complete

To configure using the Web application, use the screen at the following path.

Path

Web application: **Control settings** tab > **Operation parameters** > **Control alarm**



STEP 7: Saving the setting data

Tap Save in the lower right of the screen to save the changes made in STEP1 to STEP6.

Operation complete

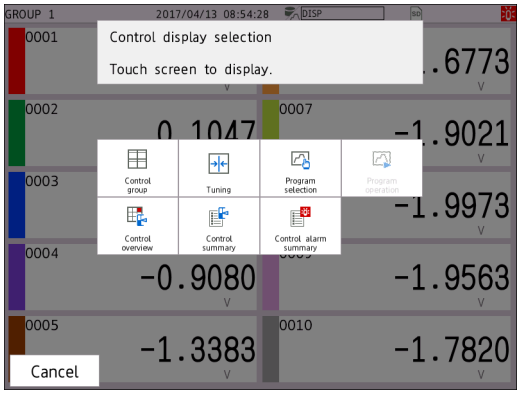
2.3 Monitoring and Controlling

2.3.1 Displaying the Monitoring Screen

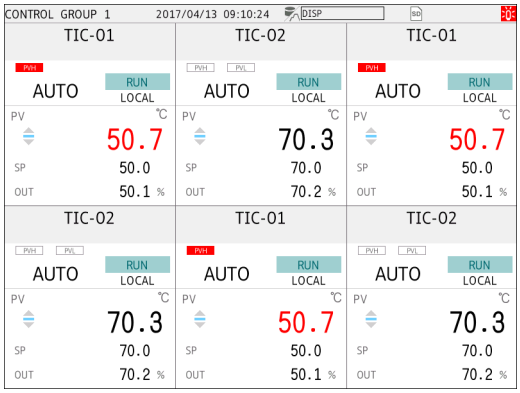
Procedure

1. Press **MENU**.
   The menu screen appears.

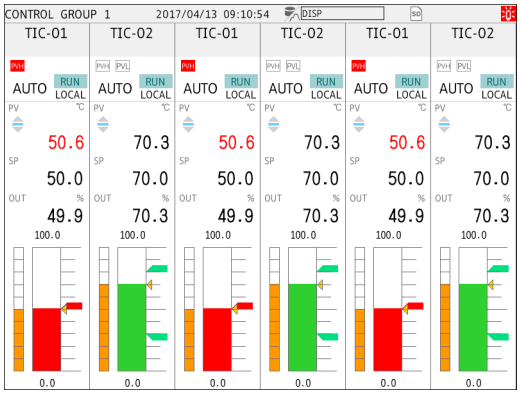
2. Tap the **Browse** tab and then **Control**.
   The control display selection screen appears.



3. Tap **Control group**.



(Controller style)



(Faceplate style)

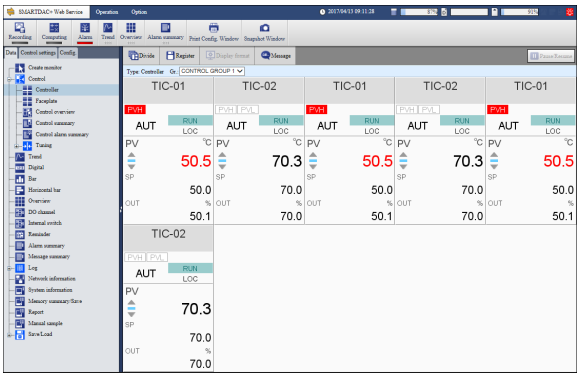
To switch between controller style and faceplate style, press MENU and then tap **Context** > **Display**.

Operation complete

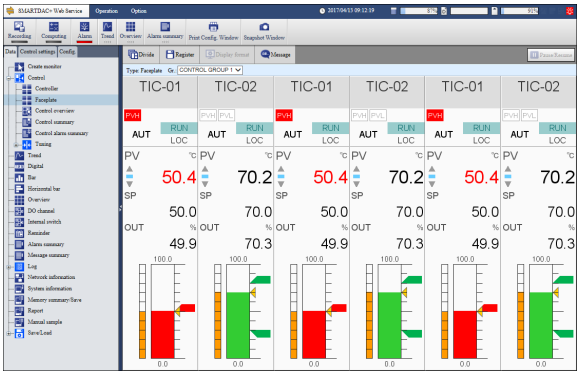
To monitor using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control > Controller** or **Faceplate**



(Controller style)



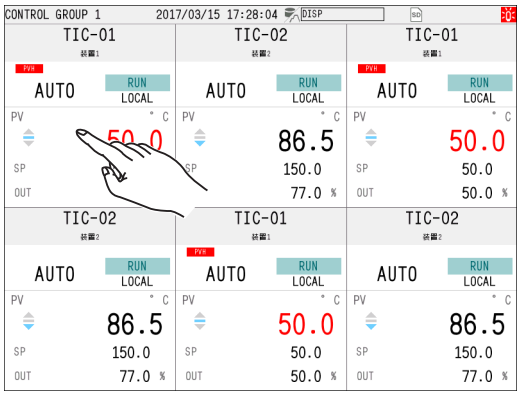
(Faceplate style)

The other available monitoring screens are control overview, control summary, control alarm summary.

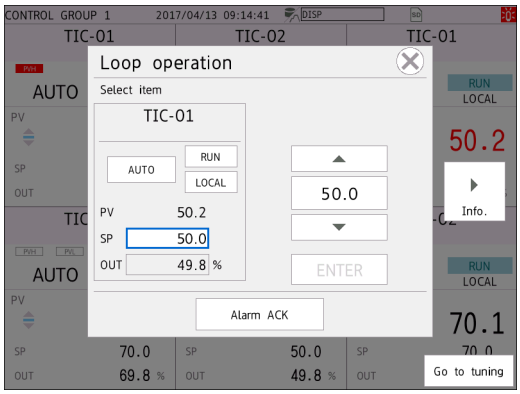
2.3.2 Changing Target Setpoints

Procedure

1 Display the control group screen.



2 Tap the loop you want to change the target setpoint of. Here, tap Loop 1.
The Loop operation screen appears.



3 Tap the SP value to display parameter edit buttons.
(The SP value can be tapped only in local mode.)

4 Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
(You can also enter the value directly from the keyboard by tapping the center value.)

Operation complete

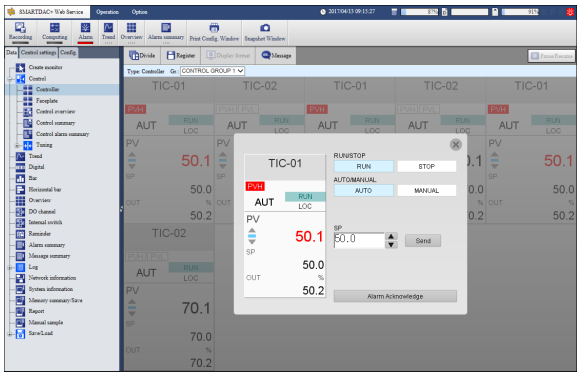
To change a target setpoint using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control > Faceplate** or **Controller**

Procedure

1. On the Faceplate or Controller screen, click the loop you want to change the target setpoint of. Here, click Loop 2.
   The Loop operation screen appears.



2. Click ▲ or ▼ to change the value, or enter the value directly from the keyboard, and click **Send**.

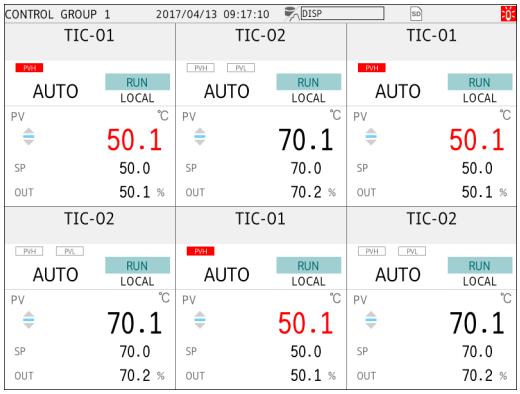
Operation complete

2.3.3 Determining the Optimal PID with Auto-Tuning

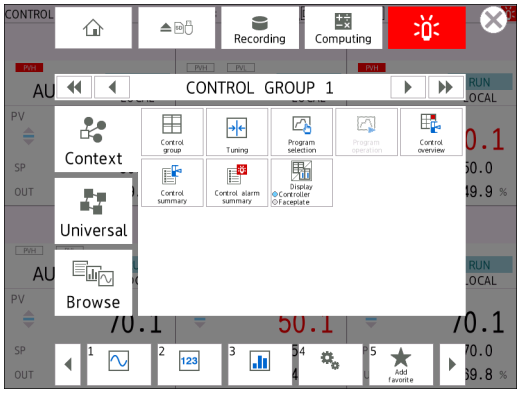
Set the target setpoint before executing auto-tuning.

Procedure

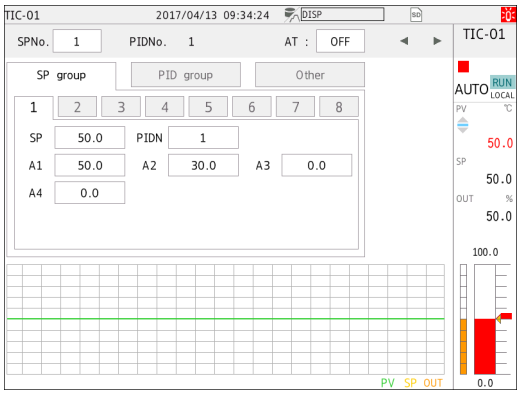
1 Display the control group screen.



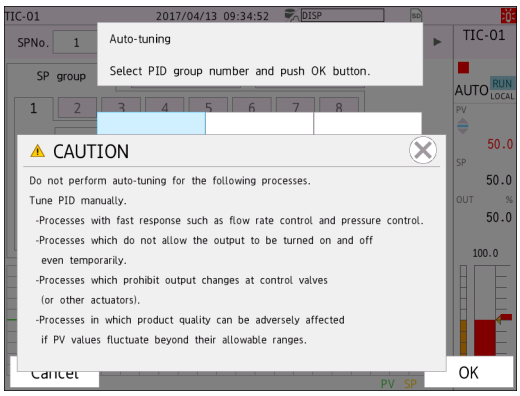
2 Press **MENU**.
The menu screen appears.



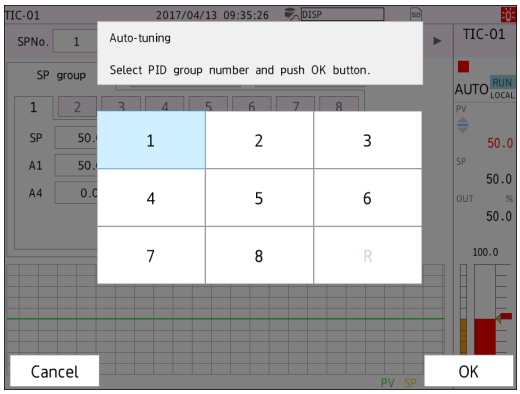
3 Tap the **Context** tab and then **Tuning**.
A tuning screen appears.



4 Tap **OFF** displayed to the right of AT.
A caution message for using auto-tuning appears. Read the message, and tap the **Close** icon.
AT cannot be executed in manual mode or when operation is stopped.



5 Select PID group number 1, and tap OK.



5 While auto-tuning is in progress, AT in the loop area blinks.

Operation complete

Note

- To execute auto-tuning, set the mode to AUTO and RUN.
- If the control mode is cascade control, execute auto-tuning on Loop 2 in AUTO and RUN modes and then Loop 1 in Cascade and RUN modes.
- If auto-tuning is executed on a loop running under program operation, the program operation is temporarily paused. The operation resumes when auto-tuning is complete.

Auto-tuning is canceled, when any of the following operations is performed.

- Select AT OFF.
- Set the loop on which AT is running to MAN.
- Set the loop on which AT is running to STOP or RESET.
- PV input burnout occurs.
- Power off

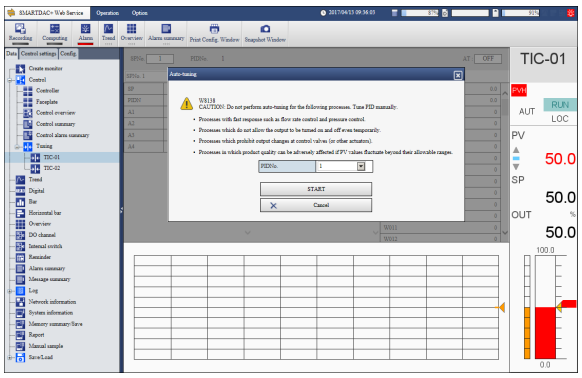
To tune using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control** > **Tuning** > loop range (e.g., L001-L002)

Procedure

1. On the tuning screen, click **AT:OFF**.
   A caution screen for auto-tuning appears.



2. Set the PID number (PIDNo.) to store the tuning results in.

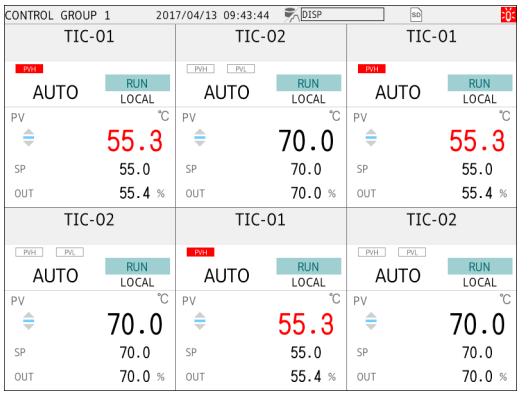
3. Click **Start** to execute auto-tuning.

Operation complete

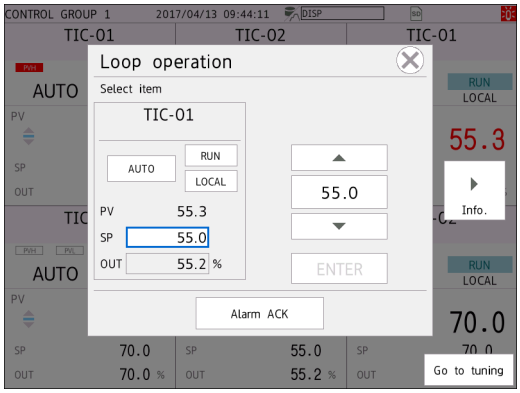
2.3.4 Stopping and Running Operations

Procedure

1. Display the control group screen.

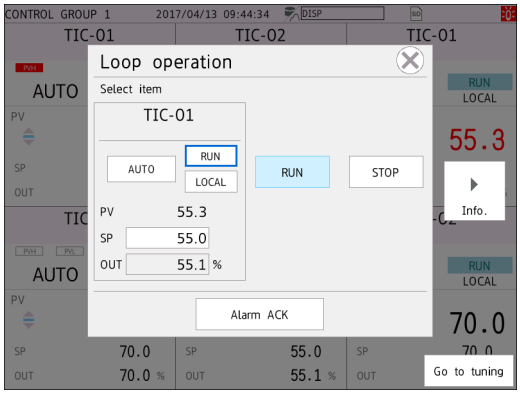


2. Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.



3. If the loop is running RUN is displayed. If the loop is stopped, STOP is displayed.

4. Tap **RUN** or **STOP** to display switch buttons on the right side of the screen. Tap a button to switch the operation mode.



Operation complete

▶ For details on loop operation, see section 5.1.2, “Loop Operation and Using the Loop Operation Dialog Box.”

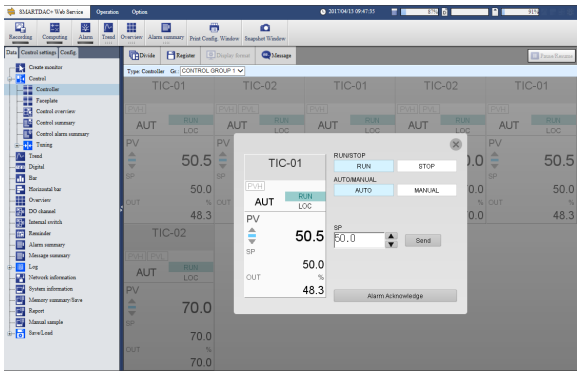
To switch the operation mode between run and stop using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control > Faceplate** or **Controller**

Procedure

1. On the Faceplate or Controller screen, click the loop you want to switch the operation mode between run and stop. Here, click Loop 2.
   The Loop operation screen appears.



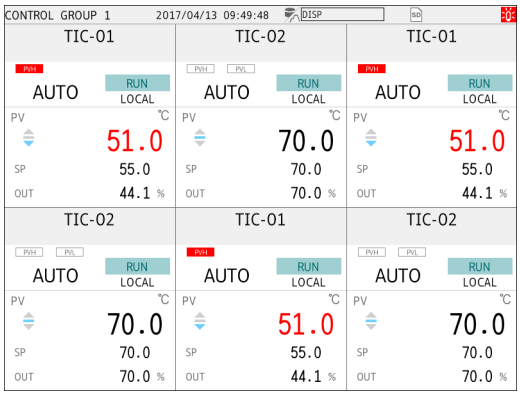
2. Click **RUN** or **STOP** to switch the operation mode.

Operation complete

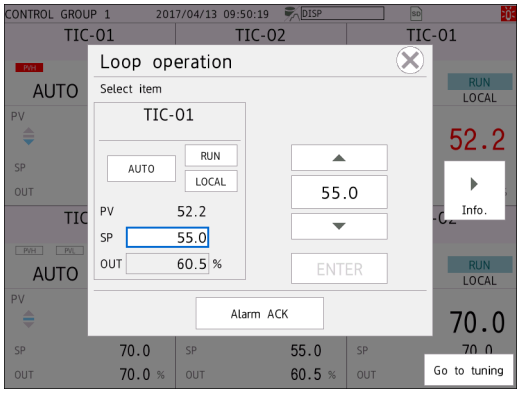
2.3.5 Switching between Auto and Manual Modes

Procedure

1. Display the control group screen.

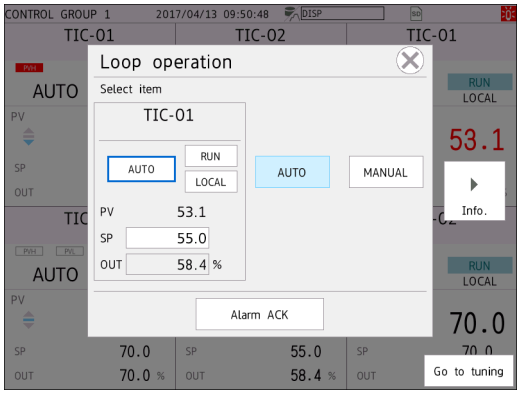


2. Tap the loop you want to switch the operation mode of.
   The Loop operation screen appears.



3. If the mode is auto, AUTO is displayed. If the mode is manual, MANUAL is displayed.

4. Tap **AUTO** or **MANUAL** to display switch buttons on the right side of the screen. Tap a button to switch the mode between auto and manual.



Operation complete

▶ For details on switching between auto and manual, see section 5.2.6, “Switching the Operation Mode.”

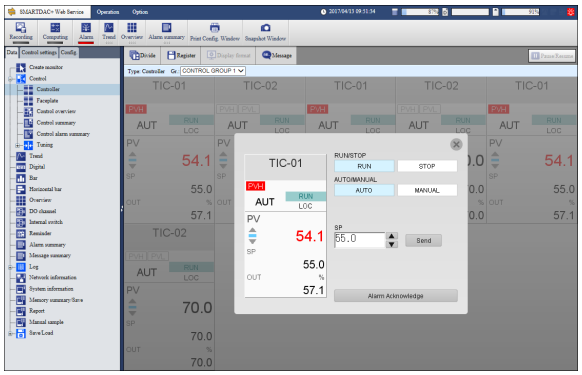
To switch the operation mode between auto and manual using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control > Faceplate** or **Controller**

Procedure

1. On the Faceplate or Controller screen, click the loop you want to switch the operation mode between auto and manual. Here, click Loop 2.
   The Loop operation screen appears.



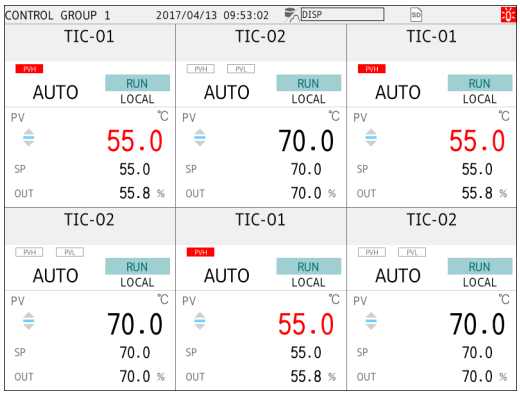
2. Click **AUTO** or **MANUAL** to switch the operation mode.

Operation complete

2.3.6 Controlling the Control Output in Manual Mode

Procedure

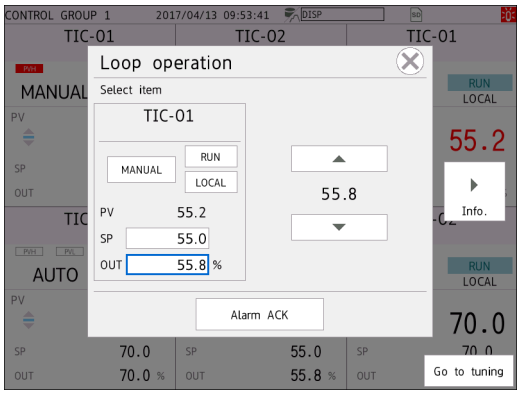
1 Display the control group screen.



2 Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.

3 Tap the output value to display buttons for changing the value on the right side of the screen.

4 Tap ▲ or ▼ to change the value (direct input method).
When you change the value, it is applied immediately to the process.



Operation complete

Description

There are two methods to change the control output value: the direct input method in which the value is changed continuously using the ▲ and ▼ buttons and the other method in which you confirm the changed value and bump the output using the ENTER button.

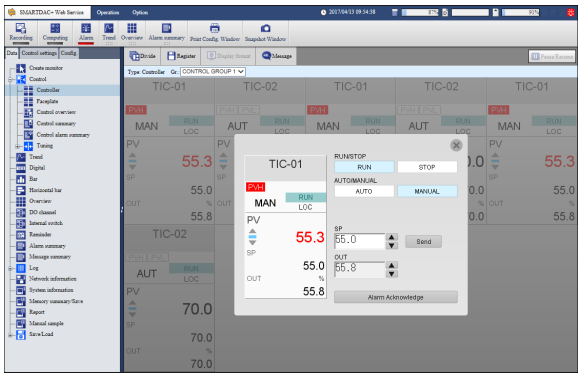
To change the control output value in manual mode using the Web application, use the screen at the following path.

Path

Web application: **Data** tab > **Control > Faceplate** or **Controller**

Procedure

1 On the Faceplate or Controller screen, click the loop you want to change the control output value of. Here, click Loop 1.
The Loop operation screen appears.

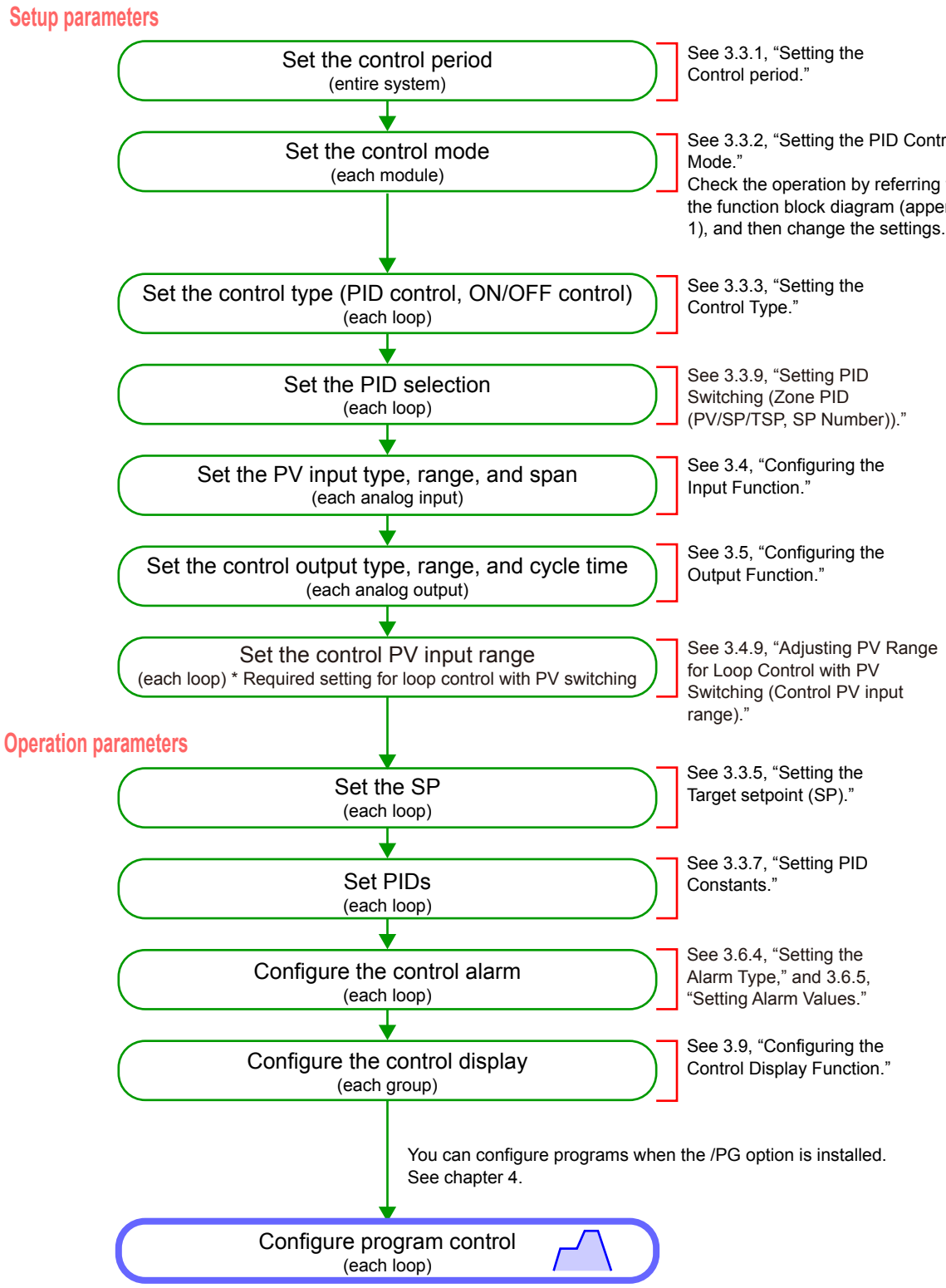


2 Click the output value and then the ▲ and ▼ buttons to change the value (direct input method).
When you change the value, it is applied immediately to the process.

Operation complete

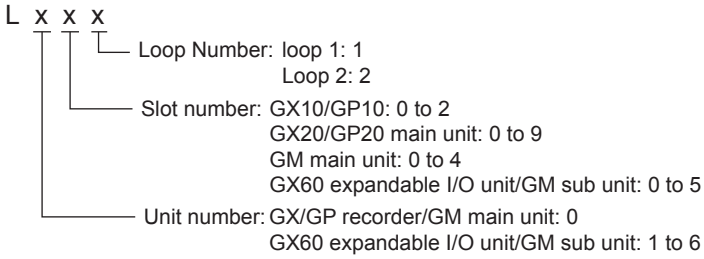
3.1 Loop Control Configuration Flowchart

Be sure to check the settings in the following flowchart before performing control. Set or change them according to you application. Changing the values afterwards may affect other settings. For other settings not listed here, set or change them as needed.



3.2 Loop Numbers and PID Channel Numbers

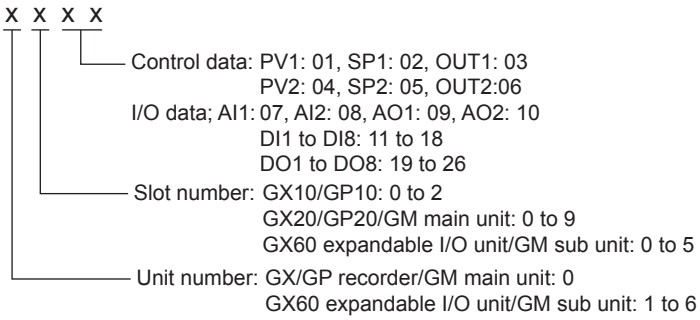
Loop Number



Example 1: GX20 main unit, slot 1, loop 2
Loop number: L012

Example 2: GM10 sub unit 1, slot 4, loop 2
Loop number: L142

Channel Number (PID Channel Number)



Example 1: GX20 main unit, slot 1, loop 1 PV
Channel number: 0101

Example 2: GM10 sub unit 1, slot 4, slot 4 DO1
Channel number: 1419

Areas Where Channel Numbers Can Be Used in Main Unit Functions

Item	PID PV, SP, OUT	AI AI1, AI2	DI DI1 to DI8	AO AO1, AO2	DO DO1 to DO8
Reference channel of AI, DI channel difference computation	√	√	√	√	√
AI, DI, math channel, communication channel alarm output destination	–	–	–	–	√ (condition: when the DO range type is set to alarm) See section 3.6.3.
AO module reference channel (INPUT)	√ (condition: PV, SP only)	√	√	–	–
Math channel formula	√	√	√	√	√
Logic math formula	√	√	√	√	√
Recording setting (event, display, manual sample) channel	√	√	√	√	√
Display group setting channel	√	√	√	√	√
Display channel (multi batch on)	√	√	√	√	√
Report channel report channel (I/O)	√	√	√	√	√
Event action > event type (remote)	-	-	–	-	-
Event action > event type (alarm I/O)	–	–	–	-	-
Event action > event type (relay)	-	-	-	-	√ (condition: when the DO range type is set to alarm or manual) See section 3.6.3.
Event action > action type (relay)	-	-	-	-	√ (condition: when the DO range type is set to manual) See section 3.6.3.
Control event action status output (DO/SW)	-	-	-	-	√ (condition: when the DO range type is set to manual) See section 3.6.3.
Control event action operation (DI/DO/SW)	-	-	√	-	√ (condition: when the DO range type is set to alarm or manual) See section 3.6.3.
E-mail alarm (channel set)	–	–	–	-	-
Modbus client I/O channel for writing	√	√	√	√	√
SLMP client I/O channel for writing	√	√	√	√	√
Modbus master I/O channel for writing	√	√	√	√	√

Note

Event action even type (remote or alarm I/O) or E-mail alarm cannot be set to a PID channel.

3.3 Configuring the Basic Control Function

Configure the basic function of the PID control module.

3.3.1 Setting the Control Period

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control period**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control period**

Description

Control period

Setup Item	Selectable Range or Options	Default Value
Control period	100 ms/200 ms	100 ms

Control period

Set the control period.

Note

- The control period is a common parameter for the GX/GP/GM system. The control period of all loops in the same system is the same.
- The sampling interval (scan interval) of the PID control module synchronizes to the control period.

3.3.2 Setting the Control Mode

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control basic operation**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control basic operation**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Basic control settings**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration

Unit Number, Slot Number

Select the target unit number and slot number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Control mode	Single loop control, cascade control, PV switching	Single loop control

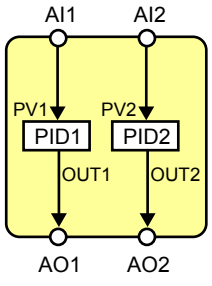
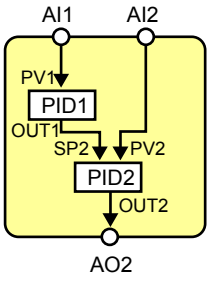
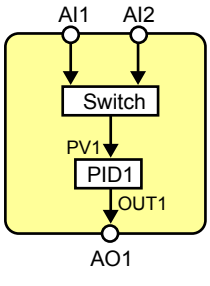
Control Mode

Set the control function according to the various controller applications.
Setting the control mode enables the control computation unit of the PID control module to be switched between single loop control, cascade control, and PV switching.

Note

Control mode is a setting for each module.
When the control mode is changed, control setup items except the control period are initialized.

Explanation

Single loop control (2 loops)	Cascade control	PV switching
A basic control function with two control computation units. Dual-loop control is possible. If you are using only the first loop, you do not need to wire or configure the second loop.	Has two control computation units and executes cascade control from a single PID control module.	Two PV inputs are switched based on the contact-input (DI) or PV-input threshold to perform single loop control.
		

▶ For details on the function block diagram, see appendix 1, “Function Block Diagrams.”

3.3.3 Setting the Control Type

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Control type	PID control, ON/OFF control	PID control

Control type

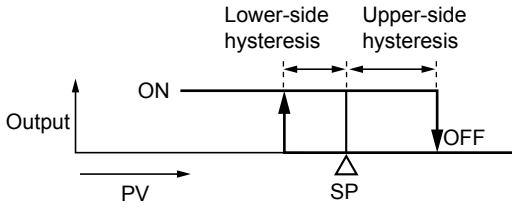
There are two control types: PID control and ON/OFF control.

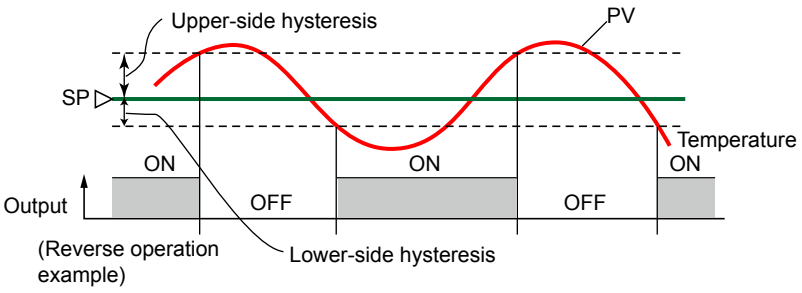
PID control

In PID control, PID computation is performed using the selected PID parameter value.

ON/OFF control

ON/OFF control compares the SP and PV and outputs an on or off signal according to the positive or negative deviation (SP – PV). Hysteresis can be set in the vicinity of the on/off output operating point.
If the SP and PV become close and the polarity of the deviation reverses frequently, the on/off output will cycle repeatedly.
The life of the output relay will therefore be dramatically shortened. In such a case, set a wider hysteresis so that the relay's frequent on/off output (chattering) does not occur.
Two points of hysteresis (deviation positive hysteresis and deviation negative hysteresis) can be set to the operating point.





Note

Control type is a setting for each loop.

3.3.4 Setting the PID Control Mode

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
PID control mode	Standard PID control mode, fixed-point control mode	Standard PID control mode

PID control mode

There are two PID control modes: standard PID control mode and fixed-point control mode.

You can select the PID control mode from the following depending on the action that is performed when the SP changes.
The PID control type, PV derivative type or deviation derivative type, and the control output bump or bumpless are automatically selected depending on the PID control mode, control mode (e.g., single loop), and operation mode (e.g., remote/local).

Note

PID control mode is a setting for each loop.

Explanation

Select a PID control computation formula shown in the following table according to the control mode or operation mode.

[Not during program operation]

Single Loop Control, Loop Control with PV Switching

	Operation mode	
	AUTO+Local	AUTO+Remote
Standard PID control mode	PV derivative type (output bump at SP change)	Deviation derivative type
Fixed-point control mode	PV derivative type (output bumpless at SP change)	PV derivative type (output bump at SP change)

Cascade Control (Primary Side Operation)

	Operation mode	
	Cascade+Local	Cascade+Remote
Standard PID control mode	PV derivative type (output bump at SP change)	Deviation derivative type
Fixed-point control mode	PV derivative type (output bump at SP change)	PV derivative type (output bump at SP change)

Cascade Control (Secondary Side Operation)

	Operation mode	
	AUTO	Cascade
Standard PID control mode	PV derivative type (output bump at SP change)	Deviation derivative type
Fixed-point control mode	PV derivative type (output bumpless at SP change)	PV derivative type (output bump at SP change)

[During program operation]

Single Loop Control, Loop Control with PV Switching

	Operation mode		
	Program+AUTO	Program (during hold)+AUTO	Local+AUTO
Standard PID control mode	Deviation derivative type	PV derivative type (output bump at SP change)	PV derivative type (output bump at SP change)
Fixed-point control mode	PV derivative type (output bump at SP change)	PV derivative type (output bumpless at soak, hold, and SP change)	PV derivative type (output bumpless at SP change)

Cascade Control (Primary Side Operation)

	Operation mode		
	Program+cascade	Program (during hold)+cascade	Local+cascade
Standard PID control mode	Deviation derivative type	PV derivative type (output bump at SP change)	PV derivative type (output bump at SP change)
Fixed-point control mode	PV derivative type (output bump at SP change)	PV derivative type (output bumpless at soak, hold, and SP change)	PV derivative type (output bump at SP change)

Cascade Control (Secondary Side Operation)

	Operation mode	
	Local+AUTO	Cascade+AUTO
Standard PID control mode	PV derivative type (output bump at SP change)	Deviation derivative type
Fixed-point control mode	PV derivative type (output bumpless at SP change)	PV derivative type (output bump at SP change)

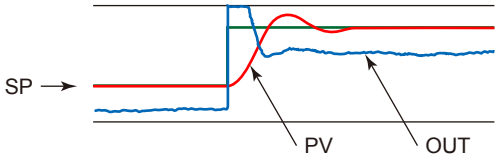
PV Derivative Type PID

This is a PID control method in which the derivative action works only on the PV.
It can also eliminate output bump due to SP changing operation in Local mode.
The following shows the PV derivative type PID control computation formula.

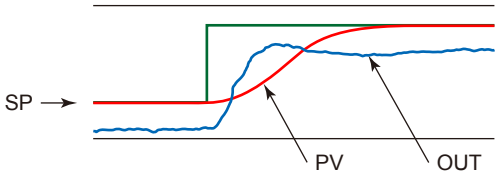
$$OUT = \frac{100}{P}\left(e + \frac{1}{Ti}\int e \cdot dt + Td\frac{d}{dt} \cdot PV\right)$$

where OUT: control output, e: deviation (PV-SP), P: proportional band, Ti: integral time, Td: derivative time,
and ΔPV: PVn-PVn-1 (n-1: value before one control period)

PV Derivative Type PID (output bump at SP change)



PV Derivative Type PID (output bumpless at SP change)

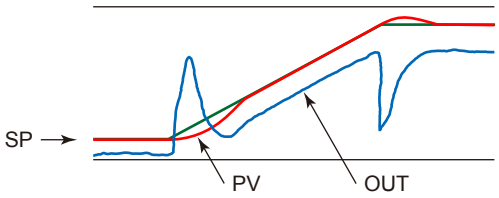


Deviation derivative type PID

The PID control method in which derivative action works for the deviation value = PV – SP.
The derivative action works for a SP change, so this method is useful for cases like cascade secondary-loop control where the SP-following capability is important.
The following shows the deviation derivative type PID control computation formula.

$$OUT = \frac{100}{P}\left(e + \frac{1}{Ti}\int e \cdot dt + Td\frac{d}{dt} \cdot e\right)$$

where OUT: control output, e: deviation (PV-SP), P: proportional band, Ti: integral time, Td: derivative time



3.3.5 Setting the Target setpoint (SP)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Target setpoint**
Web application: **Control settings** tab > **Operation parameters** > **Target setpoint**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Target setpoint**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

SP numbers 1 to 8

Setup Item	Selectable Range or Options	Default Value
Target setpoint	Minimum value of control PV input range to maximum value of control PV input range	Minimum value of control PV input range

PID initial value

Set up to eight target setpoints per loop.

Note

Target setpoint is a setting for each loop.

3.3.6 Setting a PID Initial Value (Reference Value) Suitable for Temperature or Pressure/Flow rate Control

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
PID initial value	Temperature, Pressure/Flow rate	Temperature

PID initial value

Select whether to set the initial values of the PID constant in PID parameter settings to values suitable for temperature control or those suitable for pressure or flow rate control.

The initial values of PID constants are as follows:
Initial values for temperature: P=5.0%, I=240 s, D=60 s
Initial values for pressure/flow rate: P=120.0%, I=20 s, D=0 s

Note

- PID initial value a setting for each loop.
- When you change the PID initial value, they are initialized to the above values.

3.3.7 Setting PID Constants

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

Select the number of the PID group you want to set.

Setup Item	Selectable Range or Options	Default Value
Proportional band	0.1 to 999.9%	5.0%
Integral time	0 (off),* 1 to 6000 s	240 s
Derivative time	0 (off),** 1 to 6000 s	60 s

* If the integral time is set to 0, the integral function is turned off, and you can use manual reset.
** If the derivative time is set to 0, the derivative function is turned off.

Proportional band, integral time, derivative time

▶ For details on proportional band, integral time, and derivative time, see the explanation in section 5.2.3, “Adjusting the PID Manually (Manual Tuning).”

Note

PID constant is a setting for each loop and PID group number.

3.3.8 Setting PID Constants (PID for Reference Deviation)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings(Reference PID)**
Web application: **Control settings** tab > **Operation parameters** > **PID settings(Reference PID)**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings(Reference PID)**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Setup Item	Selectable Range or Options	Default Value
Proportional band	0.1 to 999.9%	5.0%
Integral time	0 (off),* 1 to 6000 s	240 s
Derivative time	0 (off),** 1 to 6000 s	60 s

* If the integral time is set to 0, the integral function is turned off, and you can use manual reset.
** If the derivative time is set to 0, the derivative function is turned off.

Proportional band, integral time, derivative time

- For details on proportional band, integral time, and derivative time, see the explanation in section 5.2.3, “Adjusting the PID Manually (Manual Tuning).”
- For details on reference deviation, see the explanation in section 3.3.9, “Setting PID Switching (Zone PID (PV/SP/TSP, SP Number)).”

Note

PID constant for reference deviation is a setting for each loop.

3.3.9 Setting PID Switching (Zone PID (PV/SP/TSP, SP Number))

Setting the PID Selection

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
PID selection	SP No./Segment PID No. selection,* zone PID selection (PV), zone PID selection (target SP), external selection	SP No./Segment PID No. selection*

* This becomes “SP number selection” when recorder option /PG is not available and “SP No./Segment PID No. selection” when it is available. Segment PID number selection is used when recorder option /PG is available.

PID selection

Set the PID selection. Set the reference point, hysteresis, or reference deviation depending on the PID selection.

Note

PID selection is a setting for each loop.

Setting PID Switching Points

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID number/Reference point**
Web application: **Control settings** tab > **Operation parameters** > **PID number/Reference point**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID number/Reference point**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Reference point

Setup Item	Selectable Range or Options	Default Value
Points 1 to 7	Control PV input range low limit to high limit	Control PV input range high limit

Setup Item	Selectable Range or Options	Default Value
Zone PID switching hysteresis	0.0 to 100.0% of control PV input range span	0.0% of control PV input range span
Reference deviation On/Off	On/Off	Off
Refer	0.0 to 100.0% of control PV input range span	0.0% of control PV input range span

Note

Reference point, hysteresis, and reference deviation are settings for each loop.

Explanation

SP number selection

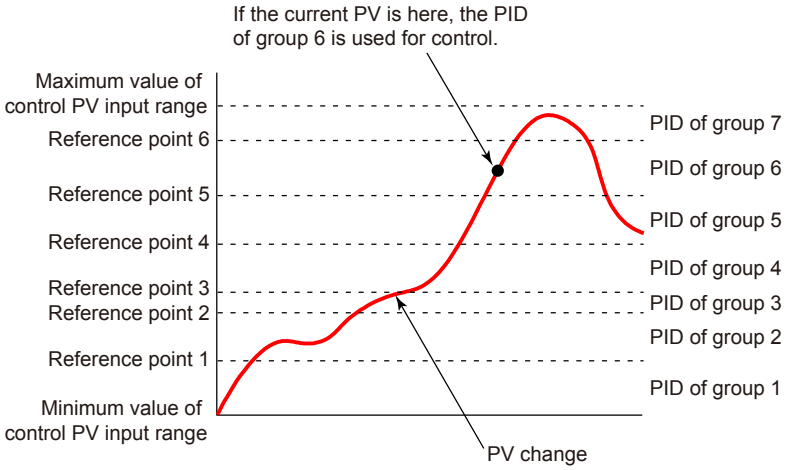
The SP group number selection selects a group of target setpoint (SP) and PID parameters by switching the SP number (SPNO).
The PID number selection (PIDN) can be set for each SP group.

SP number (SPNO)	SP	PID parameter group
1	SP of group 1	Specify using the PID number of group 1
2	SP of group 2	Specify using the PID number of group 2
3	SP of group 3	Specify using the PID number of group 3
4	SP of group 4	Specify using the PID number of group 4
5	SP of group 5	Specify using the PID number of group 5
6	SP of group 6	Specify using the PID number of group 6
7	SP of group 7	Specify using the PID number of group 7
8	SP of group 8	Specify using the PID number of group 8

Zone PID selection (PV)

The PID switching according to PV is a function that switches between the groups of PID parameters according to the PV. The maximum number of PID groups to be switched is 8. This function is useful for reactors in which the chemical reaction gain changes depending on the temperature.

The figure below shows an example of dividing the control PV input range from the maximum value to the minimum value into seven zones by reference points 1 to 6.



The control PV input range can be divided into the number of zones that is set in the reference point.
Set the reference points so that reference point 1 < reference point 2 < reference point 3 < reference point 4 < reference point 5 < reference point 6 < reference point 7.

Hysteresis at the time of zone switch can be set.

▶ For details on hysteresis, see “Setting Hysteresis at Time of PID Switch,” provided later.

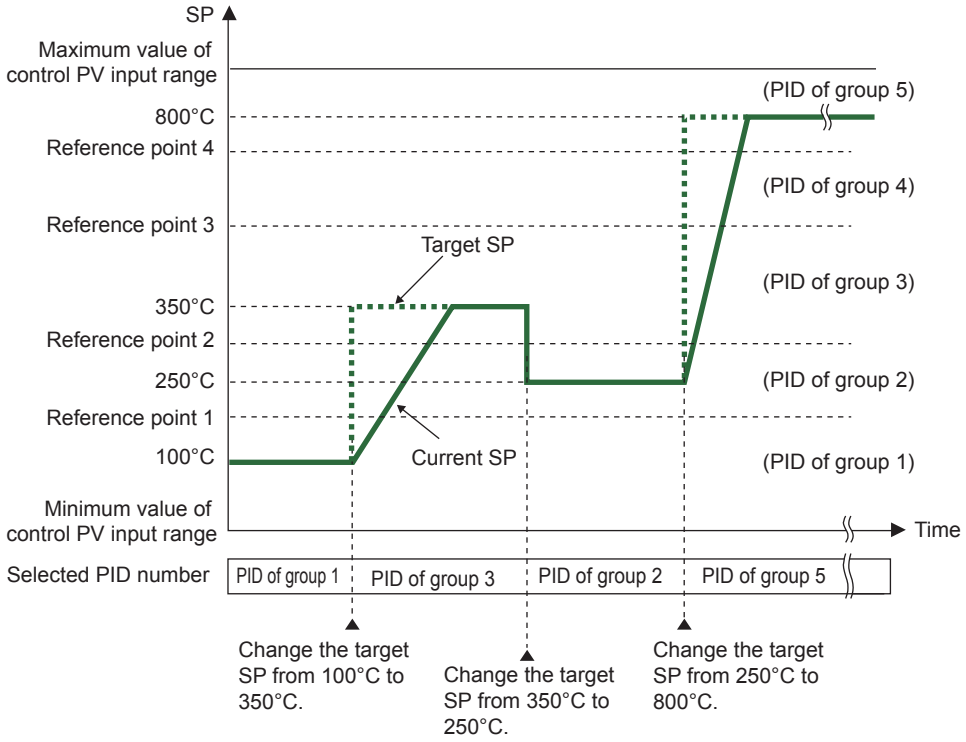
Reference deviation can be set at the same time.

▶ For details on reference deviation, see “Switching PID According to Deviation (Reference Deviation),” provided later.

Zone PID selection (target SP)

The zone PID selection by target SP switches between the groups of PID parameters according to the target SP.

The figure below shows the example of switching the group of PID parameters according to the target SP. It shows an example of dividing the control PV input range from the maximum value to the minimum value into five zones by reference points 1 to 4.



The control PV input range can be divided into the number of zones that is set in the reference point.
Set the reference points so that reference point 1 < reference point 2 < reference point 3 < reference point 4 < reference point 5 < reference point 6 < reference point 7.

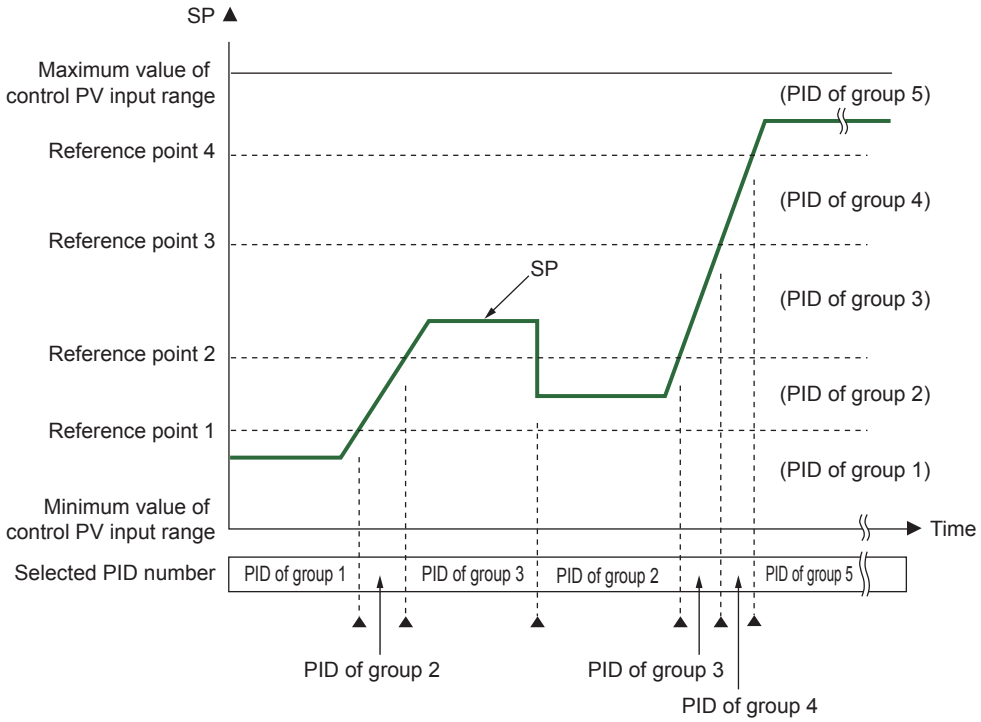
Reference deviation can be set at the same time.

▶ For details on reference deviation, see “Switching PID According to Deviation (Reference Deviation),” provided later.

Zone PID selection (SP)

The zone PID selection by SP switches between the groups of PID parameters according to the SP. The maximum number of PID groups to be switched is 8.

The figure below shows the example of switching the group of PID parameters according to the SP. It shows an example of dividing the PV input range from the maximum value to the minimum value into five zones by reference points 1 to 4.



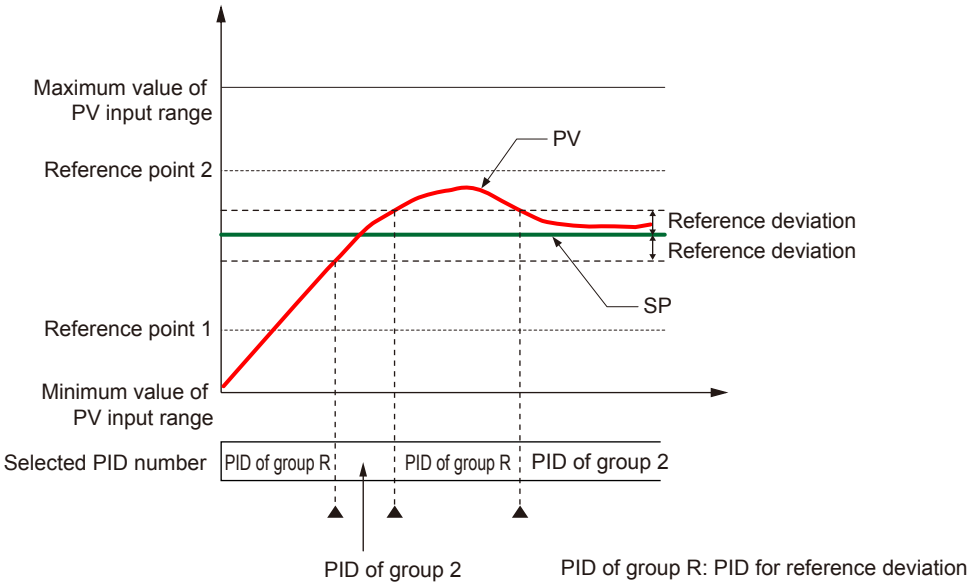
The control PV input range can be divided into the number of zones that is set in the reference point.
Set the reference points so that reference point 1 < reference point 2 < reference point 3 < reference point 4 < reference point 5 < reference point 6 < reference point 7.

Reference deviation can be set at the same time.

▶ For details on reference deviation, see “Switching PID According to Deviation (Reference Deviation),” provided later.

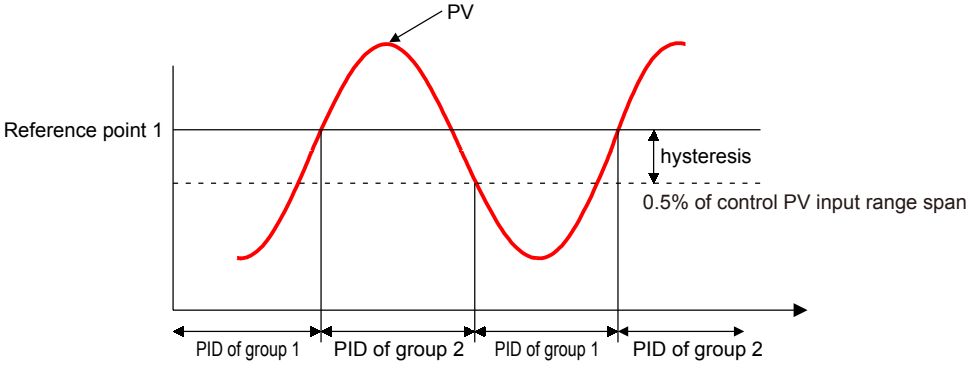
Switching PID According to Deviation (Reference Deviation)

The zone PID selection by deviation switches between the groups of PID parameters according to the amount of deviation.
This function is called “reference deviation.”
In the fixed point control, if the actual amount of deviation exceeds the setpoint of the reference deviation, the controller automatically changes to the PID parameter group (PID of group R) set for the zone. If the actual amount of deviation becomes smaller than the setpoint of reference deviation, the controller changes to the PID parameter group appropriate for the zone.
For example, if the deviation is large, PV can be reached more rapidly to SP by increasing the proportional gain (i.e., narrowing the proportional band). Switching PID according to deviation is effective when zone PID selection (PV), (target SP), or (SP) is in use. The zone PID selection by reference deviation has priority over other zone PID selections.



Setting Hysteresis at Time of PID Switch

When the zone PID selection is selected, hysteresis at time of each zone switch can be set.
The following shows the operation example of hysteresis at time of zone switch.



External selection

PID number can be switching by contact input.

▶ For details on switching by contact input, see section 3.7, “Configuring the Action Function (Contact Input Function).”

3.3.10 Suppressing Overshoot (Super Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Overshoot suppressing function

Setup Item	Selectable Range or Options	Default Value
Super function	Off, Normal mode	Off

Note

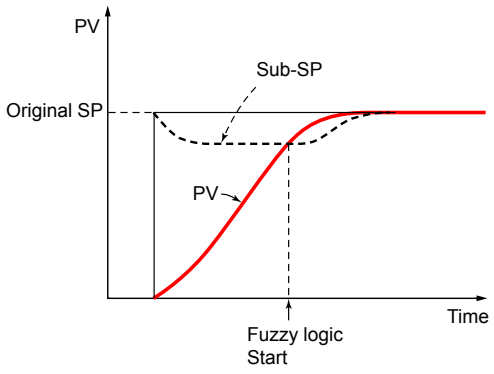
- Super function is a setting for each loop.
- Super function operates in PID control. It does not operate in ON/OFF control.

Super function

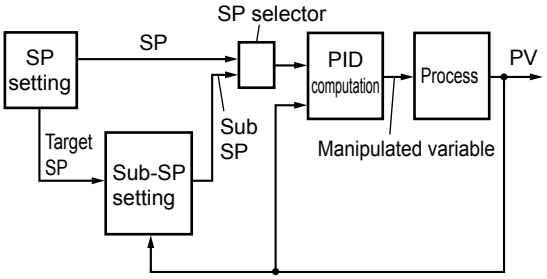
The Super function monitors the deviation for evidence that there is a danger of overshoot, and on sensing such danger automatically changes the setpoint temporarily to a somewhat lower value (sub-SP). Once the danger of overshoot appears diminished, the function returns the effective SP gradually to the true SP. “Fuzzy ratiocination” techniques are employed in the algorithms used to change the SP to the lower temporary value, and to return it gradually to the true SP.

Explanation

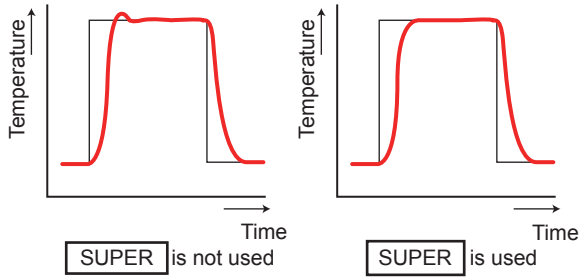
Operation Diagram



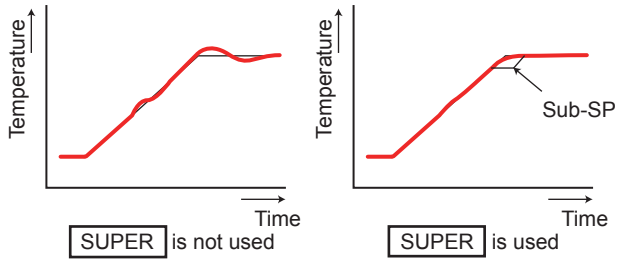
Control System Block Diagram



Example of Overshoot Suppression Control for Setpoint Changes



Example of Overshoot Suppression Control for Ramp-to-soak Transition



3.3.11 Suppressing Integral Action (Anti-reset windup)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

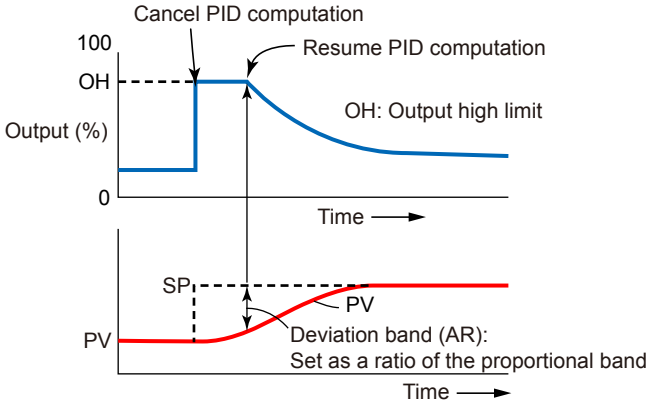
Anti-reset windup

Setup Item	Selectable Range or Options	Default Value
Type	AUTO, MAN	AUTO
Value*	50.0 to 200.0%	50.0%

* The deviation value is set when the type is set to MAN.

Type

Where there is a large deviation at the start of the control operation, for example, integral outputs are accumulated and the PV exceeds the SP, thereby causing the output to overshoot. To avoid this, the controller provides an anti-reset windup function for suppressing an extreme integral output by stopping PID computations. Same applies to the case of undershoot. This function is running all the time.



The parameter AR sets the point (by deviation band (%)) to restart the PID computation that is suspended by the controller's anti-reset windup function. PID computation restarts when the deviation band has decreased to the setpoint. When the anti-reset windup type is set to AUTO, the controller automatically determines the point at which to restart the PID computation.

$$\text{Deviation band (= anti-reset windup setpoint)} = \frac{|PV - SP|}{\text{Proportional band}} \times 100\ (\%)$$

Note

Anti-reset windup is a setting for each loop.

3.3.12 Adjusting Auto-tuning Operation

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Auto-tuning

Setup Item	Selectable Range or Options	Default Value
Type	Normal, Stability	Normal
Output low limit	-5.0 to 104.9% Output low limit < Output high limit	0.0%
Output high limit	-4.9 to 105.0% Output low limit < Output high limit	100.0%
SP bias	-100.0 to 100.0% of control PV input range span	0.0% of control PV input range span

Note

Auto-tuning type, limiter, and SP are settings for each loop.

Type

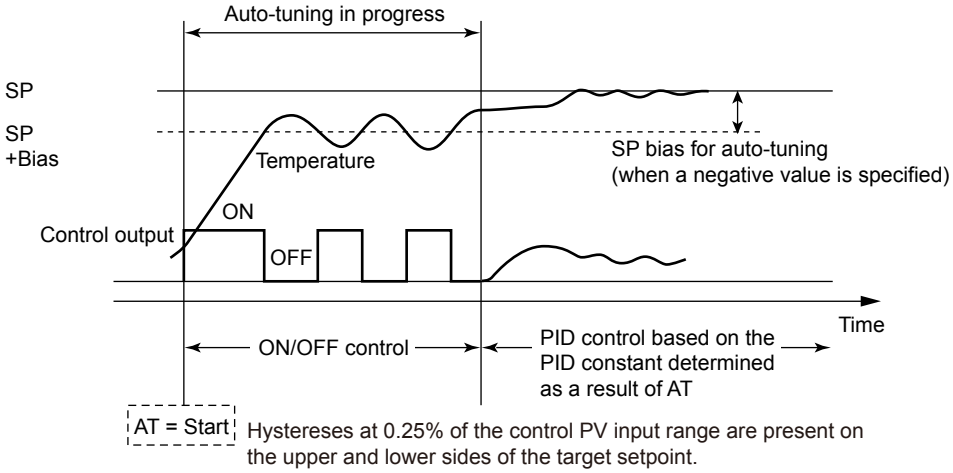
“Normal” of auto-tuning type requires a rapidly rising PID constant. This type is useful for processes that allow some overshooting.
On the other hand, “stable” of auto-tuning type requires a slowly rising PID constant.

Auto-tuning Output Limiter (Output low limit, high limit)

When executing auto-tuning, the control output high and low limits can be set.
When the control output low limit > output low limit, or output high limit < control output high limit, auto-tuning is limited by the control output low or high limit.

SP bias

SP bias allows changing the tuning point by adding a bias to the tuning point (SP) when auto-tuning is running.



Note

In time proportional output, the output is turned on and off irrespective of the upper/lower limit.

3.3.13 Setting the Number of SP Groups to Use (Limiting the Number of Use)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Number of SP groups	1 to 8	8

Number of SP groups

Up to eight SP groups can be used, but you can place a limit on this number.
A single SP group consists of a target setpoint (SP), control alarm (alarm level and alarm setpoint), and PID group number (group of PID parameters).
When you change the SP number, the SP, control alarm, and PID parameters change collectively.

Note

Number of SP groups is a setting for each loop.

3.3.14 Setting the Number of PID Groups to Use (Limiting the Number of Use)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Number of PID groups	1 to 8	8

Number of PID groups

You can place a limit on the PID parameter groups to use.
If zone PID selection is used, you cannot select a PID group number greater than the limit value.

Note

- If number of PID groups is set to a number smaller than the PID number currently in use, the number is changed to the specified number.
- Number of PID groups is a setting for each loop.

3.3.15 Setting SP Limiter

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

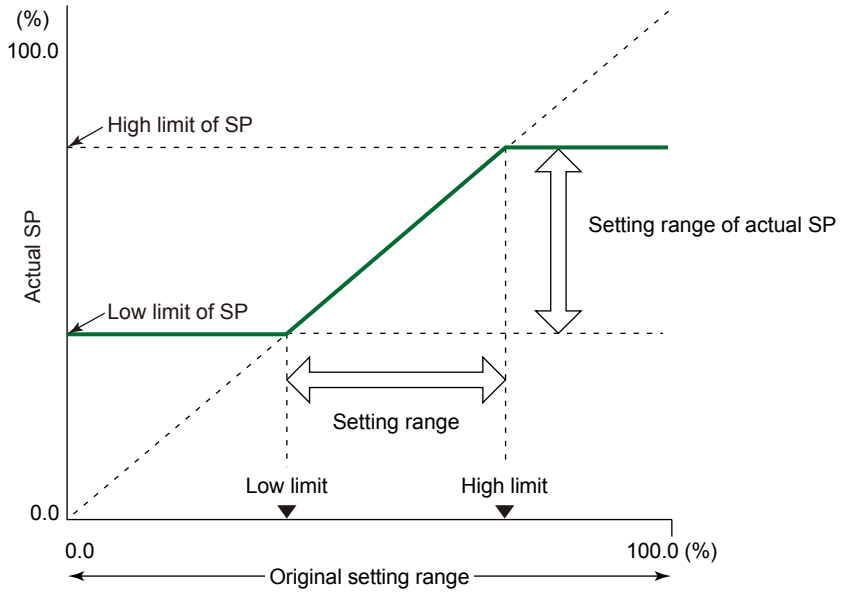
SP limit

Setup Item	Selectable Range or Options	Default Value
Low limit	Low limit to high limit of control PV input range	Low limit of control PV input range
High limit	Low limit to high limit of control PV input range	High of control PV input range

* SP low limit < SP high limit

Low limit, High limit

The SP high and low limits can be set to restrict the SP to the range between those limits. They work on the SP of all SP groups. Limits are placed whether in REM (remote) or LCL (local) mode.
In Cascade control, the SP high and low limits can be set for both Loop-1 and Loop-2.



Note

- When the SP limiter is changed, if the SP value goes outside the range, the value is changed to the limit value.
- SP limiter is a setting for each loop.
- This does not work when a program pattern is being created. It works during program operation.

3.3.16 Enabling the External Remote Input Function (RSP Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

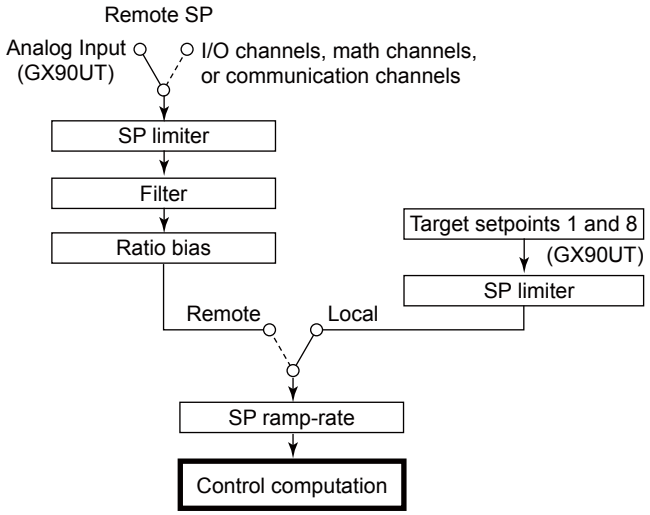
Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
RSP function	Off/On	Off

RSP function

Remote setpoint (RSP) is used to sequentially change (along a ramp, for example) the I/O channel, math channel, communication channel, or the analog input of a PID control module by using it as a setpoint. These setpoints are called remote setpoints.
To use remote setpoints, the operation mode needs to be changed from local to remote. The PID in remote mode uses the PID group that was in use before switching to remote mode.



If the RSP input is an I/O channel, math channel, or communication channel, the GX/GP/GM sends the most recent value of the specified channel to the PID control modules at the following transmission interval.

- At the control period if the number of PID control module in the entire system is 1 to 3 (100 ms or 200 ms)
- 200 ms if the number of PID control module in the entire system is 4 to 6
- 500 ms if the number of PID control module in the entire system is 7 or more

However, if the transmission interval is 500 ms and the control period or scan interval is 200 ms or if the transmission interval is 200 ms and the scan interval is 500 ms, the RSP of PID control modules is not updated at 500 ms. It is updated alternately at 600 ms and 400 ms.
If the RSP input is analog input (AI terminal), the RSP is updated at the control period.

Input values are limited by the SP limiter (SP low limit to SP high limit).
Remote setpoints become SPs, which are checked.

▶ For details on remote input, see section 3.3.14, “Selecting and Compensating Remote Input.”

Note

RSP function is a setting for each loop.

3.3.17 Selecting and Compensating Remote Input

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PV,RSP settings** > **RSP function**
Web application: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **RSP function**
Hardware configurator: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **RSP function**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

RSP

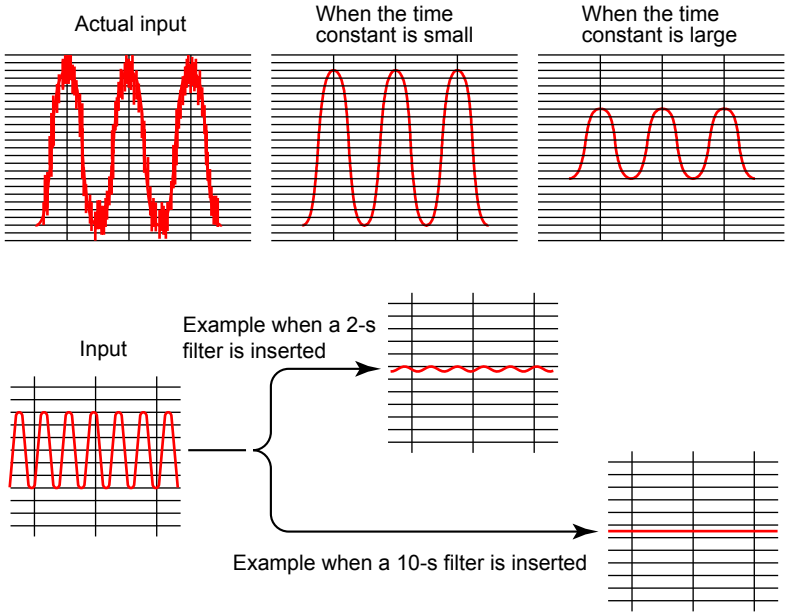
Setup Item	Selectable Range or Options	Default Value
Type	I/O channel, Math channel, Communication channel, AI terminal (analog input of a PID control module)	AI terminal
AI terminal number	1/2	1 or 2 (1 for Loop 1, 2 for Loop 2)

Remote input

Setup Item	Selectable Range or Options	Default Value
Input filter	Off/On	Off
Filter	1 to 120 s	1 s
Input ratio	Off/On	Off
Ratio	0.001 to 9.999	1.000
Input bias	Off/On	Off
Bias	-100.0 to 100.0% of control PV input range span	0.0% of control PV input range span

Filter

The remote setpoint filter performs a first-order lag calculation on the remote setpoint (received external analog input signal). The larger time constant, the more noise that can be removed or setpoint fluctuation that can be suppressed.



Note

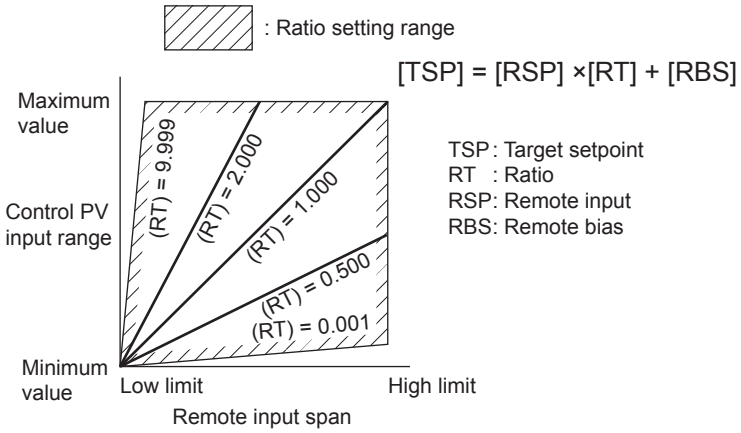
Remote input is a setting for each loop.

Ratio Bias

Ratio bias computing performs ratio computation and bias addition for remote setpoints.

SP = remote SP×ratio + bias

The remote input ratio bias function can be used in applications such as distributing loads to different zones or performing air-fuel ratio control.
The ratio is indicated relative to the reference, which is assumed to be 1 when the remote input after filtering and scaling matches exactly the PV input span.



3.3.18 Changing SP at a Fixed Rate (SP Ramp-Rate Setting Function)

SP ramp-rate time unit

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

SP ramp-rate time unit

Setup Item	Selectable Range or Options	Default Value
Unit	Hour, Minute, Second	Hour

Unit

Set the unit of time when the SP rises or falls.
Set Hour for per hour, Minute for per minute, and Second for per second.

Note

- SP ramp-rate time unit is a setting for each loop.
- SP ramp-rate setting function does not work during program operation.

SP ramp-rate settings

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Target setpoint**
Web application: **Control settings** tab > **Operation parameters** > **Target setpoint**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Target setpoint**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

SP ramp-rate settings

Setup Item	Selectable Range or Options	Default Value
Ramp-down rate	Off/On	Off
Ramp-rate	0.0 + 1 digit to 100.0% of the control PV input range span	0.0 + 1 digit of control PV input range span
Ramp-up rate	Off/On	Off
Ramp-rate	0.0 + 1 digit to 100.0% of the control PV input range span	0.0 + 1 digit of control PV input range span

SP ramp rate setting function

SP ramp-rate setting function forces SP to change at a fixed rate when SP is changed in order to prevent abrupt changes in SP.
Velocity (rate-of-change) can be set for both the SP ramp-up rate and SP ramp-down rate.
Set the ramp–rate time unit (TMU) per hour, minute, or second.

Note

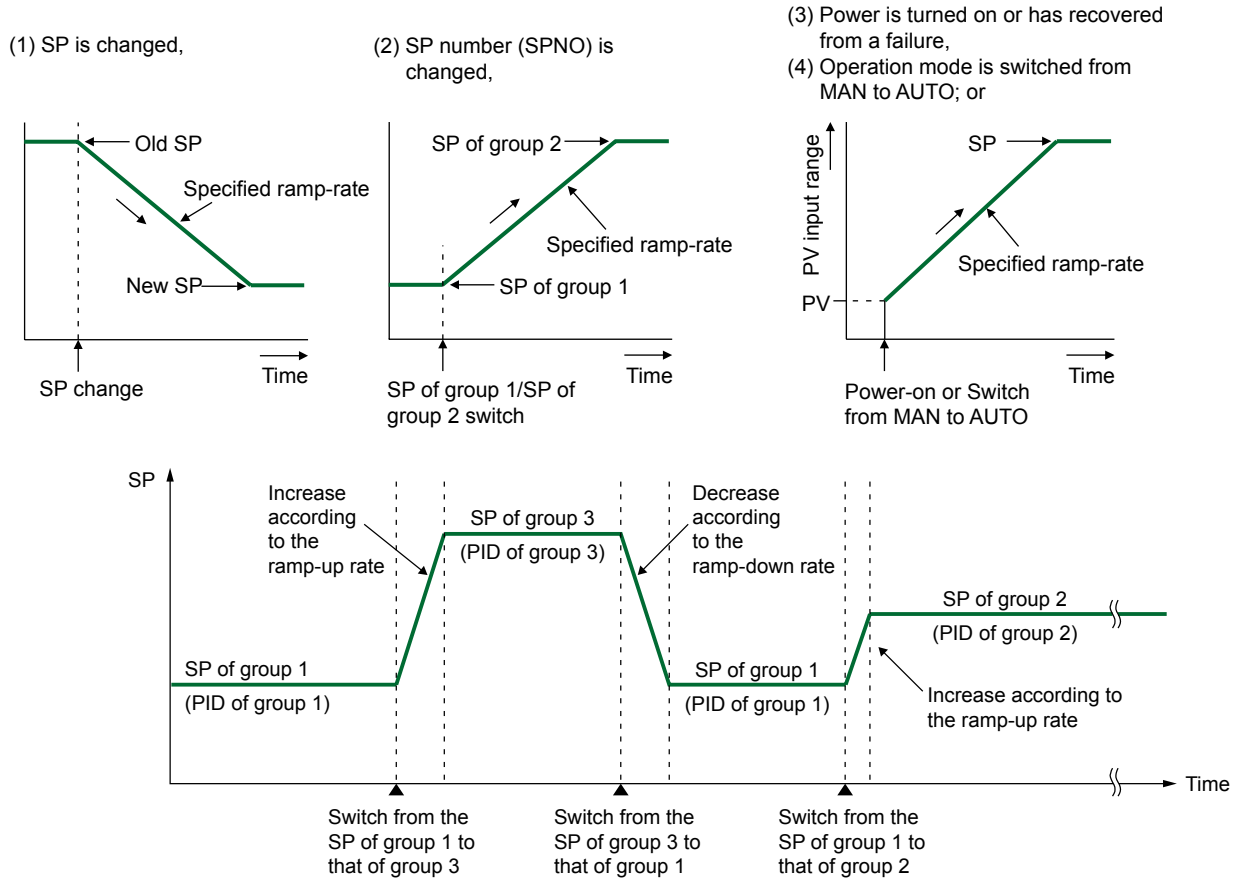
- SP ramp-rate time unit is a setting for each loop.
- SP ramp-rate setting function does not work during program operation.

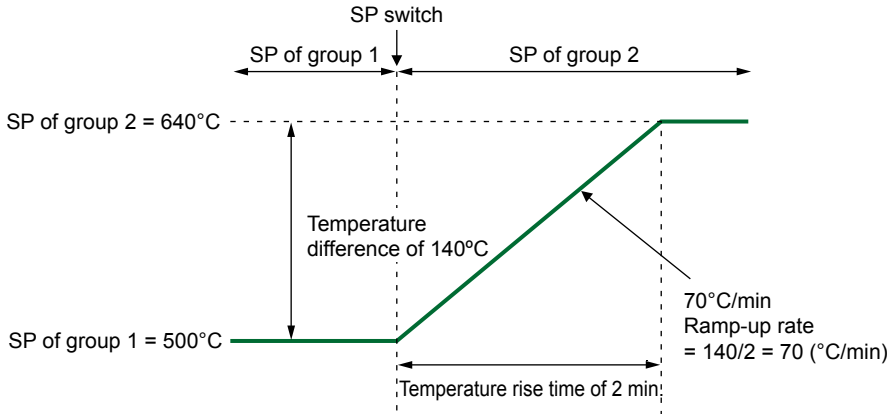
Explanation

The SP ramp-rate setting function works when:

(1) SP is changed.
(2) SP is changed by switching SP number (SPNO).
(3) Power is turned on or has recovered from a failure (PV tracking=ON); or
(4) Operation mode is switched from MAN to AUTO (PV tracking=ON).

SP ramp-rate setting action starts from PV when the PV tracking function is used.





$$\text{Ramp-up rate} = \frac{\text{Temperature difference (°C)}}{\text{Time (minutes)}} = \frac{140°C}{2 \text{ minutes}} = 70 \text{ (°C/minute)}$$

3.3.19 Forcing SP to Track PV (PV Tracking)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Tracking

Setup Item	Selectable Range or Options	Default Value
PV tracking	Off/On	Off

PV tracking

PV tracking function is used to prevent abrupt PV changes.

Note

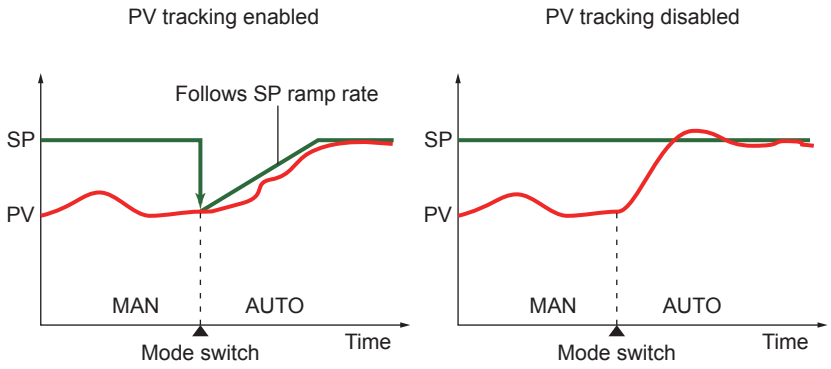
PV tracking is a setting for each loop.

Explanation

With PV tracking, SP is first aligned with PV and then changed automatically to its original SP at the SP ramp rate.

▶ For details on the SP ramp-rate setting function, see section 3.3.18, “Changing SP at a Fixed Rate (SP Ramp-Rate Setting Function).”

PV tracking function works when:
(1) Power is turned on or has recovered from a failure,
(2) SP number (SPNO) is changed,
(3) Operation mode is switched from STOP to RUN,
(4) Operation mode is switched from MAN to AUTO; or
(5) Operation mode is switched from MAN to CAS (in Cascade control).



3.3.20 Forcing SP to Track RSP (SP Tracking)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Tracking

Setup Item	Selectable Range or Options	Default Value
SP tracking	Off/On	On

SP tracking

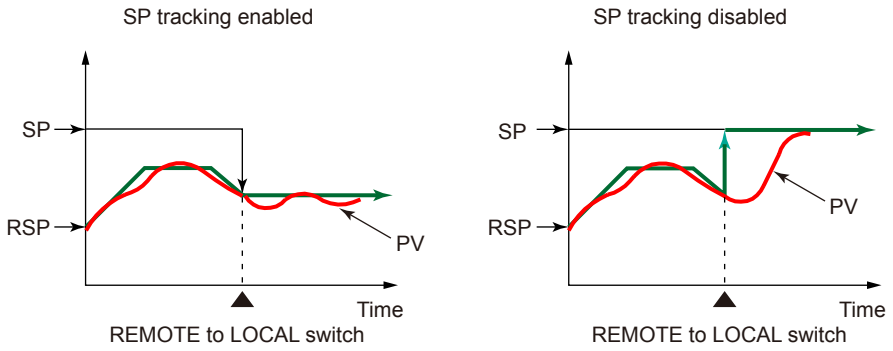
The SP tracking function forces the local SP to track the remote SP when the operation mode is switched from remote to local.
This is useful when you want to prevent abrupt changes in the PV.

Note

SP tracking is a setting for each loop.

Explanation

The following figure shows the behavior when SP tracking is on and when it is off.



3.3.21 Setting the PID Control Module Action at Power-On (Restart Mode)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Basic control settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control basic operation**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Basic control settings**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration

Unit Number, Slot Number

Select the target unit number and slot number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Restart mode	Continue, Manual, Auto, Reset	Continue

Restart mode

You can use the restart mode setting to specify the operation mode and control output that are used when the PID module powers on.

Alarm action	Does not continue. Alarm with stand-by function will enter stand-by status. Alarm latch will be initialized.	
Setting parameters	Set contents of each parameter are retained.	
Auto-tuning	Canceled.	
Control action	Varies depending on the restart mode.	
	Continue	Continue action set before power failure.
	Manual	Outputs the preset output value (PO) of the PID group used as control output and continues action in MAN mode.
	Auto	The control computation is executed in AUTO mode based on the preset output value (PO) of the PID group used as control output.
	Reset*	Starts from reset mode when a program pattern is used.

* All program patterns are reset if any of the PID control modules in use is set to Reset.

Note

- Restart mode is a setting for each module.
- Reset action works when the GX/GP main unit or GM main unit is powered on. It does not work when only an expansion slot or sub unit is powered on.

3.4 Configuring the Input Function

Set the measurement input range, span, RJC, burnout, bias, and filter of the PID control modules.
Set the necessary setup items in order from the top.

3.4.1 Setting the Input Type, Unit, Range, Scale, and Decimal Place

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Measurement input range**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AI number	AI1/AI2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AI number

Select the input terminal of the PID control module to receive as PV input.

Range

Setup Item	Selectable Range or Options	Default Value
Type	Volt, GS (general signal), TC (thermocouple), RTD (resistance-temperature detector), DI (contact, voltage level)	TC
Range	See “Range Details” on the next page.	See “Range Details.”
Span Lower	Numerical value (depends on the range)	—
Span Upper	Numerical value (depends on the range)	—
Calculation	Off, Linear scaling, Square root	Off when the range type is TC or RTD. Linear scaling for other cases.

Note

Type, range, span, and the like are settings for each analog input (AI).

Type

Set the input signal type.

Options	Description
Volt, GS, TC, RTD, DI	Input type. Represents DC voltage, GS (0.4-2V, 1-5V inputs), thermocouple, RTD, and ON/OFF input, respectively.

Range

Set the input type range.

Range Details

Type	Range	Selectable Range	Default Value	Notes
Volt (DC voltage)	20 mV	-20.000 mV to 20.000 mV	2 V	
	60 mV	-60.00 mV to 60.00 mV		
	200 mV	-200.00 mV to 200.00 mV		
	1 V	-1.0000 V to 1.0000 V		
	2 V	-2.0000 V to 2.0000 V		
	6 V	-6.000 V to 6.000 V		
	20 V	-20.000 V to 20.000 V		
	50 V	-50.00 V to 50.00 V		
DI	LVL (level)	On (1)/off (0) (voltage)	LVL	On: 2.5 V or more, Off: 2.3 V or less
	DI (contact)	On (1)/off (0) (contact)		
GS (general signal)	0.4-2 V	0.3200 V to 2.0800 V	1-5V	
	1-5V	0.800 V to 5.200 V		
TC (thermocouple)	R	0.0°C to 1760.0°C	K	Type R
	S	0.0°C to 1760.0°C		Type S
	B	0.0°C to 1820.0°C		Type B
	K	–270.0°C to 1370.0°C		Type K
	K-H	–200.0°C to 500.0°C		Type K
	E	–270.0°C to 800.0°C		Type E
	J	–200.0°C to 1100.0°C		Type J
	T	–270.0°C to 400.0°C		Type T
	N	–270.0°C to 1300.0°C		Type N
	W	0.0°C to 2315.0°C		Type W
	L	–200.0°C to 900.0°C		Type L
	U	–200.0°C to 400.0°C		Type U
	WRe3-25	0.0°C to 2320.0°C		Type WRe (WRe3-25)
	PLATINEL	0.0°C to 1395.0°C		
	PR20-40	0.0°C to 1900.0°C		
	KpvsAu7Fe	0.0K to 300.0K		Kp vs Au7Fe
	NiNiMo	0.0°C to 1310.0°C		
	WWRe26	0.0°C to 2320.0°C		W/WRe26
	N14	0.0°C to 1300.0°C		Type N (AWG14)
	XK	–200.0°C to 600.0°C		XK GOST
RTD (resistance temperature detector)	Pt100	–200.0°C to 850.0°C	Pt100	
	Pt100-H	-150.00°C to 150.00°C		
	JPt100	–200.0°C to 550.0°C		
	Jpt100-H	-150.00°C to 150.00°C		
	Cu10GE	–200.0°C to 300.0°C		Cu10 (GE)
	Cu10LN	–200.0°C to 300.0°C		Cu10 (L&N)
	Cu10WEED	–200.0°C to 300.0°C		Cu10 (WEED)
	Cu10BAILEY	–200.0°C to 300.0°C		Cu10 (BAILEY)
	Cu10a392	–200.0°C to 300.0°C		Cu10: α = 0.00392 at 20°C
	Cu10a393	–200.0°C to 300.0°C		Cu10: α = 0.00393 at 20°C
	Cu25	–200.0°C to 300.0°C		Cu25: α = 0.00425 at 0°C
	Cu53	–50.0°C to 150.0°C		Cu53: α = 0.00426035 at 0°C
	Cu100	–50.0°C to 150.0°C		Cu100: α = 0.00425 at 0°C
	J263B	0.0K to 300.0K		J263*B
	Ni100SAMA	–200.0°C to 250.0°C		Ni100 (SAMA)
	Ni100DIN	–60.0°C to 180.0°C		Ni100 (DIN)
	Ni120	–70.0°C to 200.0°C		
	Pt25	–200.0°C to 550.0°C		
	Pt50	–200.0°C to 550.0°C		
	Pt200WEED	–100.0°C to 250.0°C		Pt200 (WEED)
	Cu10G	–200.0°C to 200.0°C		Cu10 GOST
	Cu50G	–200.0°C to 200.0°C		Cu50 GOST
	Cu100G	–200.0°C to 200.0°C		Cu100 GOST
	Pt46G	–200.0°C to 550.0°C		Pt46 GOST
	Pt100G	–200.0°C to 600.0°C		Pt100 GOST

Span Lower, Span Upper

Set the input range. The selectable range varies depending on the range setting.
For the selectable ranges, see “Range Details.”

Note

You cannot set the same value to **Span Lower** and **Span Upper**.

Calculation

Linear scaling or square rooting can be executed.
This is fixed to off when the range type is TC or RTD.

Scale

Setup Item	Selectable Range or Options	Default Value
Decimal place	0/1/2/3/4/5	2
Scale Lower	–999999 to 999999	0.00
Scale Upper	–999999 to 999999	100.00
Unit	Character string (up to 6 characters, Aa#1)	—

Decimal place

Set the decimal place for linear scaling and square rooting.

Scale Lower, Scale Upper

Assign values to the results of unit conversion of linear scaling and square rooting.

Unit

Set the unit.

Low-cut

Setup Item	Selectable Range or Options	Default Value
On/Off[1]	Off/On	Off
Low-cut value[2]	0.0% to 5.0%	0.0
Low-cut output[2]	Output 0%, Output linear	Output 0%

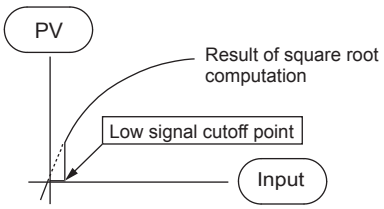
1 You can set this when the type is set to **Volt** and Calculation is set to **Square root** or when the type is set to **GS** and Calculation is set to **Square root**.
2 You can set this when On/Off is set to **On**.

On/Off

Select **On** to use the low-cut function.

Low-cut value (%)

Set the low-cut value in the range of 0.0% to 5.0% of the input span.



Low-cut output

Set the output value when the input is less than the low-cut value for when the low-cut function is in use.

Options	Description
Output 0%	Set the value for 0%.
Output linear	Outputs values that result by applying linear scaling to the input on the basis of the specified span and scale.

3.4.2 Setting Burnout Detection for Input

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Measurement input range**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AI number	AI1/AI2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AI number

Select the input terminal of the PID control module to receive as PV input.

Burnout set

Setup Item	Selectable Range or Options	Default Value
Mode	Off/Up/Down	Off

* You can set this when the range type is set to **GS**, **TC**, or **RTD**.

Note

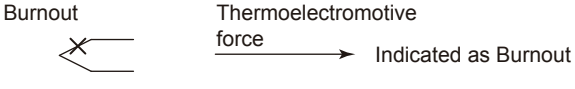
Burnout set is a setting for each analog input (AI).

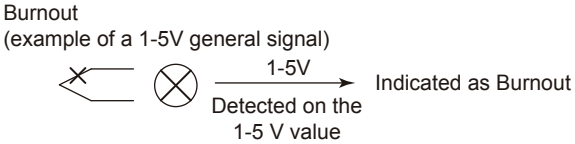
Mode

When the range type is set to **GS**, **TC**, or **RTD**, sensor burnouts are detected.

Options	Description
Off	Does not detect burnouts in the sensor.
Up	When the sensor burns out, the measured result is set to +over range. The measured value is displayed as “Burnout.” When the input type is set to **GS**, the GX/GP/GM assumes that the sensor has burned out when the measured value moves out of the range defined by the upper and lower limits of burnout specified on the specified span width. (Example: If the lower limit of burnout is set to -10% and the upper limit to 110%, when the measured value is less than –10 or greater than 110 when the scale is set to 0 to 100 in linear scaling)
Down	When the sensor burns out, the measured result is set to –over range. The measured value is displayed as “Burnout.” When the input type is set to **GS**, the GX/GP/GM assumes that the sensor has burned out when the measured value moves out of the range defined by the upper and lower limits of burnout specified on the specified span width. (Example: If the lower limit of burnout is set to -10% and the upper limit to 110%, when the measured value is less than –10 or greater than 110 when the scale is set to 0 to 100 in linear scaling)

Thermocouple Examples





3.4.3 Setting the Burnout Criteria

Set the upper and lower limits for determining burnout for when the range type is set to **GS** or **GS (4-20mA)**.

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Measurement settings** > Select unit **Main unit** or **Unit1 to 6** > **Module 0 to 9**
Web application: **Config.** tab > **Measurement settings** > **Module operation settings**
Hardware configurator: **Measurement settings** > **Module operation settings**

Description

Standard signal

Setup Item	Selectable Range or Options	Default Value
Lower limit of burnout set	-20.0 to 5.0%	-10.0
Upper limit of burnout set	105.0 to 120.0	110.0

Lower Limit of Burnout Set

Set the lower limit for determining burnout.
Set as a percentage of the specified span width.

Upper Limit of Burnout Set

Set the upper limit for determining burnout.
Set as a percentage of the specified span width.

3.4.4 Setting the Input Reference Junction Compensation (RJC)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Measurement input range**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AI number	AI1/AI2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AI number

Select the input terminal of the PID control module to receive as PV input.

RJC[1] (Reference junction compensation)

Setup Item	Selectable Range or Options	Default Value
Mode	Internal/External	Internal
Temperature[2]	–20.0 to 80.0°C, 253.1 to 353.2K (KpvsAu7Fe)	0.0°C, 273.2K (KpvsAu7Fe)

1 You can set this when the range type is set to **TC**.
2 You can set this when the mode is set to **External**.

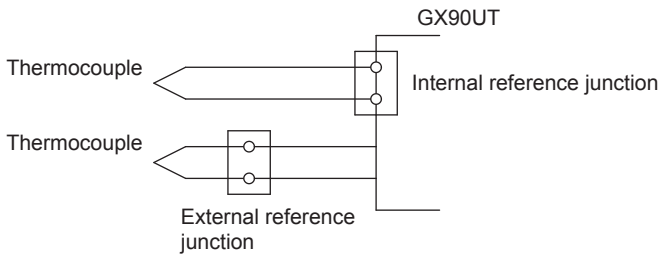
Note

Reference junction compensation is a setting for each analog input (AI).

Mode

Set the reference junction compensation method of the thermocouple.

Options	Description
Internal	Uses the reference junction compensation function of the GX90UT.
External	Uses an external reference junction compensation function.



Temperature

When the RJC is set to external, set the compensation temperature.

3.4.5 Performing Calibration Correction

Bias, Filter

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Measurement input range**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Measurement input range**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AI number	AI1/AI2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AI number

Select the input terminal of the PID control module to receive as PV input.

Bias*

Setup Item	Selectable Range or Options	Default Value
Value	-999999 to 999999	0

* You can set this when the input range type is not set to **DI**.

Input filter*

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Filter	1 to 120 s	1 s

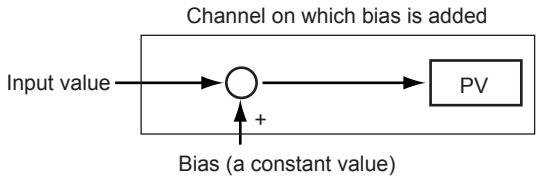
* You can set this when the input range type is not set to **DI**.

Note

Bias and input filter are settings for each analog input (AI).

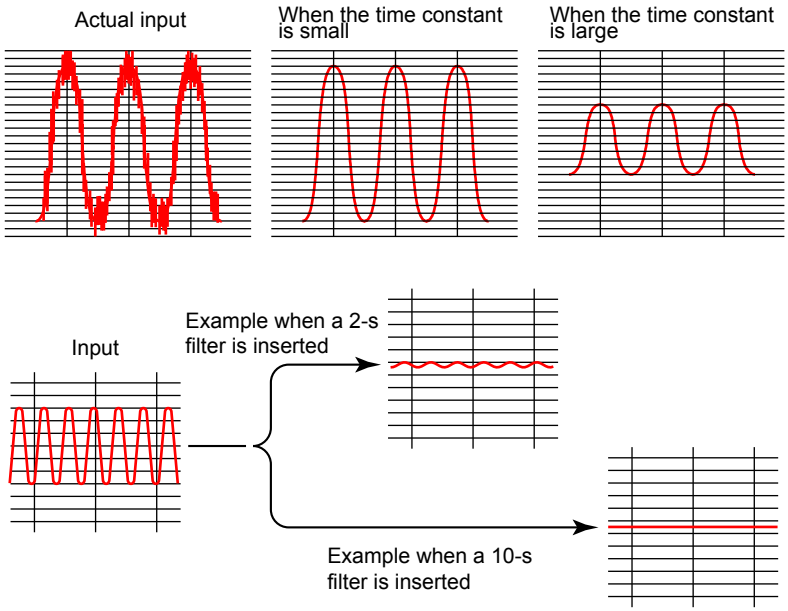
Value (Bias)

Set the bias to add to input values or linear scaling values (input calculation).



Input filter

If input noise or variations cause the low-order display digits to fluctuate so that the displayed value is difficult to read, a digital filter can be inserted to smooth operation. This filter provides a first-order lag calculation, which can remove more noise the larger the time constant becomes. However, an excessively large time constant will distort the waveform.



Linearizer Approximation, Linearizer Bias, and Correction factor

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Calibration correction**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Calibration correction**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Calibration correction**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AI number	AI1/AI2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AI number

Select the input terminal of the PID control module to receive as PV input.

Mode

Setup Item	Selectable Range or Options	Default Value
Mode	Off, Linearizer Bias, Linearizer Approximation, Correction factor*	Off
Number of set points**	2 to 12	2

* Correction factor is available when the aerospace heat treatment (recorder option /AH) is installed.
** Appears when the mode is not set to **Off**.

Mode

Set the correction mode when performing calibration correction.

Number of set points

Set the number of points that make up the segments (including the start and end points).

Note

Linearizer approximation, linearizer bias, and correction factor are settings for each analog input (AI).

2 to 12*

* The number of displayed points varies depending on the number of set points.

Linearizer Approximation

Setup Item	Selectable Range or Options	Default Value
Linearizer input	Measuring range or scale lower to scale upper (Set the inputs so that they increase monotonically: Input 1 < Input 2 < . . . < Input 12.)	Measuring range or 0.0 to 100.0% of the scale equally distributed by the number of set points
Linearizer output	Measuring range or scale lower to scale upper	Measuring range or 0.0 to 100.0% of the scale equally distributed by the number of set points
Execution of the input measurement	—	—

Linearizer bias

Setup Item	Selectable Range or Options	Default Value
Linearizer input	Measuring range or scale lower to scale upper (Set the inputs so that they increase monotonically: Input 1 < Input 2 < . . . < Input 12.)	Measuring range or 0.0 to 100.0% of the scale equally distributed by the number of set points
Linearizer output	Measuring range or -100.0 to 100.0% of the scale span	0
Execution of the input measurement	—	—

Linearizer input, Linearizer output

Enter the value of the set point. For linearizer input, set a value that is greater than the previous value.

Selectable Range of Linearizer Input and Output Values

- Channels using linear scaling
  –999999 to 999999 (the decimal place is the same as that for the scale value)
- Other channels
  Values inside parentheses are examples for the 2 V range.

Linearizer approximation

Selectable range of linearizer input: Measurable range (–2.0000 to 2.0000 V)
Selectable range of linearizer output: Display range (–2.2000 to 2.2000 V)

Linearizer bias

Selectable range of linearizer input: Measurable range (–2.0000 to 2.0000 V)
Selectable range of linearizer output: Measurement span width ± 100% (–4.0000 to 4.0000 V)*

Execution of the input measurement

The linearizer input value and uncorrected value are set to the current measured value.

2 to 12*

* The number of displayed points varies depending on the number of set points.

Correction Factor

Setup Item	Selectable Range or Options	Default Value
Uncorrected value	Measuring range or scale lower to scale upper (Set the inputs so that they increase monotonically: Input 1 < Input 2 < . . . < Input 12.)	Measuring range or 0.0 to 100.0% of the scale equally distributed by the number of set points
Instrument correction factor	Measuring range or -100.0 to 100.0% of the scale span	0
Sensor correction factor	Measuring range or -100.0 to 100.0% of the scale span (However, the sum of this factor with the instrument correction factor must not exceed this range.)	0
Execution of the input measurement	—	—

Uncorrected value

Enter the uncorrected value. Set a value that is greater than the previous value.

- Channels using linear scaling or open/close computation
  –999999 to 999999 (the decimal place is the same as that for the scale value)
- Other channels
  Values inside parentheses are examples for the 2 V range.

  Measurable range (–2.0000 to 2.0000 V)

Instrument correction factor

Set the instrument-dependent correction factor.

- Channels using linear scaling
  –999999 to 999999 (the decimal place is the same as that for the scale value)
  However, the sum of this factor with the sensor correction factor must not exceed this range.

  Example:
  If the instrument correction factor 12 is set to 999999, the selectable range for sensor correction factor 12 is –999999 to 0.
- Other channels
  Values inside parentheses are examples for the 2 V range.

  Measurement span width ± 100% (–4.0000 to 4.0000 V)*
  However, the sum of this factor with the sensor correction factor must not exceed this range.

Sensor correction factor

Set the sensor-dependent correction factor.

- Channels using linear scaling
  –999999 to 999999 (the decimal place is the same as that for the scale value)
  However, the sum of this factor with the instrument correction factor must not exceed this range.
- Other channels
  Values inside parentheses are examples for the 2 V range.

  Measurement span width ± 100% (–4.0000 to 4.0000 V)*
  However, the sum of this factor with the instrument correction factor must not exceed this range.

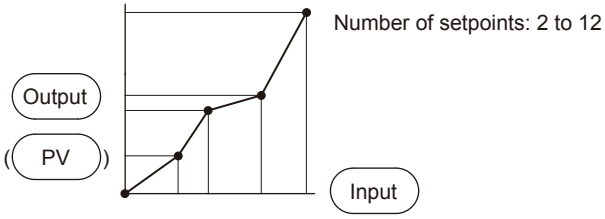
Execution of the input measurement

The linearizer input value and uncorrected value are set to the current measured value.

Explanation

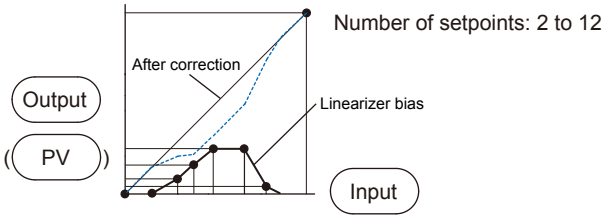
Linearizer Approximation

Corrects input values using characteristics specified with segments to derive output values.



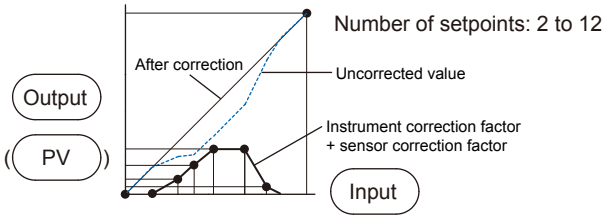
Linearizer bias

Corrects input values using bias values specified with segments to derive output values.



Correction Factor

Corrects input values using the instrument correction factor and sensor correction factor specified with segments to derive output values. Correction factor can be set when the /AH option is installed.



3.4.6 Enabling the External PV Input Function (EXPV Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

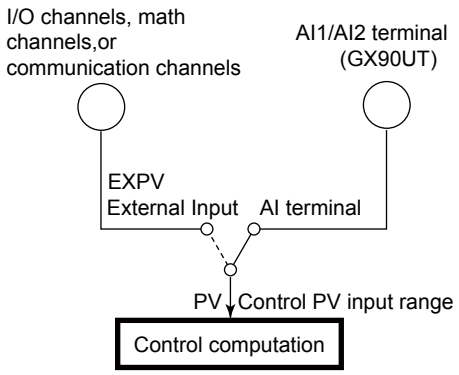
Setup Item	Selectable Range or Options	Default Value
EXPV function	Off/On	Off

EXPV function

Input used for control can be set externally. PV input processed as necessary using a math function or the like can be used as input.
The input data range is the range that can be expressed using 4-byte floating point numbers, but the PV input is limited by the control PV input range.
The function can also be used for testing when sensors, such as thermocouples, are not connected.
Channels that can be selected as external input are I/O channels, math channels, communication channels, and analog inputs of PID control modules.
The GX/GP/GM sends the most recent value of the specified channel to the PID control modules at the following transmission interval.

- At the control period if the number of PID control module in the entire system is 1 to 3 (100 ms or 200 ms)
- 200 ms if the number of PID control module in the entire system is 4 to 6
- 500 ms if the number of PID control module in the entire system is 7 or more

However, if the transmission interval is 500 ms and the control period or scan interval is 200 ms or if the transmission interval is 200 ms and the scan interval is 500 ms, the EXPV of PID control modules is not updated at 500 ms. It is updated alternately at 600 ms and 400 ms.
By factory default, the input terminals on PID modules are used.



Note

EXPV function is a setting for each loop.

3.4.7 Selecting and Compensating External PV Input (EXPV Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PV,RSP settings** > **EXPV function**
Web application: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **EXPV function**
Hardware configurator: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **EXPV function**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number
Select the target loop number.

EXPV

Setup Item	Selectable Range or Options	Default Value
Type	Off,* I/O channel, Math channel, Communication channel	I/O channel
Channel number	Channels that you can set	AI channels of this module (channel number **07 or **08)

* For loop control with PV switching, the Off (disable EXPV) option is available.

Type
Set the type of EXPV channel.

Channel number
Set the channel number to assign to the EXPV channel.

EXPV2

Setup Item	Selectable Range or Options	Default Value
Type	Off,* I/O channel, Math channel, Communication channel	I/O channel
Channel number	Channels that you can set	AI channels of this module (channel number **07 or **08)

* For loop control with PV switching, the Off (disable EXPV) option is available.

Type
Set the type of EXPV2 channel.

Channel number
Set the channel number to assign to the EXPV2 channel.

Input Error Detection

Input errors when external PV input is in use are determined as follows:
When an error occurs, the preset output value is transmitted.

- If I/O channels are in use, errors are determined based on the burnout setting of each input and A/D errors.
- If math channels are in use, errors are determined based on computation errors.
- If communication channels are in use, errors do not occur.

If analog inputs of PID control modules are in use, errors are determined based on their own burnout settings and A/D errors.

3.4.8 Setting the Measuring Range to Use for PID Control (Control PV input range)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PV,RSP settings** > **Control PV input range**
Web application: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Control PV input range

Setup Item	Selectable Range or Options	Default Value
Decimal place	0 to 4	1
Minimum value of range	Range from –30000 to 30000, excluding the decimal point)	Measuring range or scale lower
Maximum value of range	Range from –30000 to 30000, excluding the decimal point)	Measuring range or scale upper
Unit	Character string (up to 6 characters, A a # 1)	Measuring range or scale unit

Note

When using loop control with PV switching, set this range to use two input ranges with a single control range. See section 3.4.9, “Adjusting PV Range for Loop Control with PV Switching (Control PV input range).”

Decimal place

Set the decimal place for the minimum value of input range and maximum value of input range.

Minimum value of input range, Maximum value of input range

Set the control range.
The decimal place is determined by the **Decimal place** setting.

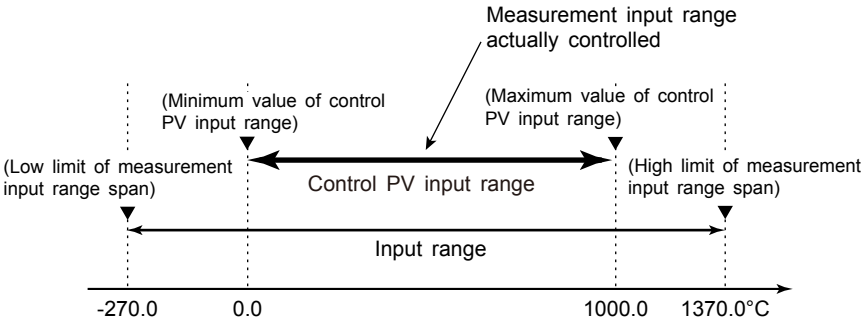
Note

- Set the minimum value of input range less than the maximum value of input range.
- Set so that |Maximum value of input range – Minimum value of input range| ≤ 30000.

Unit

Set the unit of the control target.

If the measurement span high and low limits of input signals are different, such as in loop control with PV switching or the calculated results of math functions, this function is used to change them to the range used in control computation.



3.4.9 Adjusting PV Range for Loop Control with PV Switching (Control PV input range)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PV,RSP settings** > **Control PV input range**
Web application: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Control PV input range

▶ For details on the control PV input range, see section 3.4.8, “Setting the Measuring Range to Use for PID Control (Control PV input range).”

Decimal place

Set the decimal place for the minimum value of input range and maximum value of input range.

Minimum value of input range, Maximum value of input range

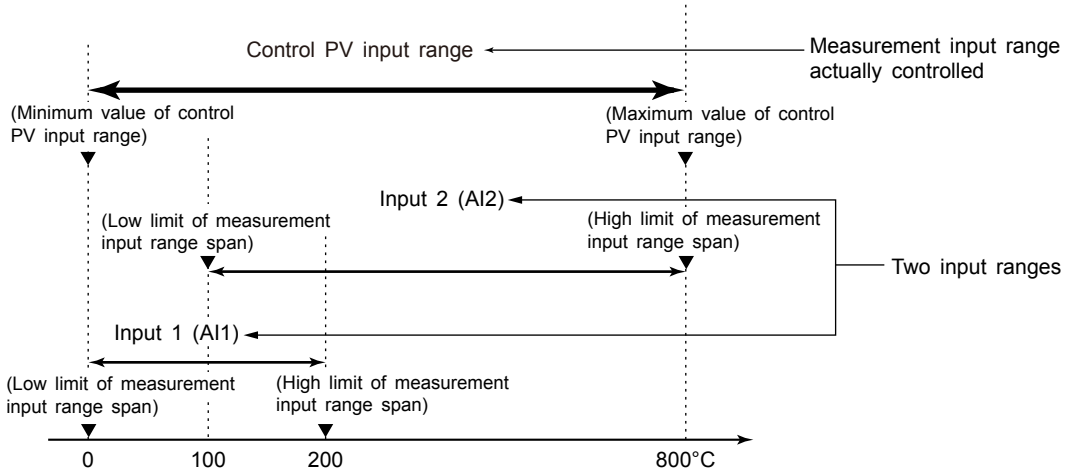
Set the control range.
The decimal place is determined by the **Decimal place** setting.

Unit

Set the unit of the control target.

Loop control with PV switching and Loop control with PV auto-selector need to determine the PV range for control if the measurement ranges of two input signals are different.

The figure below is an example of setting the AI1 terminal input to 0 to 200°C, the AI2 terminal input to 100 to 800°C, and the control PV input range to 0 to 800°C.



Note

For loop control with PV switching, these are settings for each module.

3.4.10 Setting PV Switching Methods of Loop Control with PV Switching

Setting the Input Switching Action

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Basic control settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control basic operation**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Basic control settings**

Description

Basic action

Setup Item	Selectable Range or Options	Default Value
Input switching action	Switch within range (Low side), Switch within range (High side), Switch at PV high limit, Switch using DI	Switch within range (Low side)

Input switching action

Set the switching action of two input signals.
The switching action of loop control with PV switching can be set when the control mode is set to PV switching.

Note

Input switching action is a setting for each module.

▶ For switching to loop control with PV switching, see section 3.3.2, “Setting the Control Mode.”

Input 1: AI1 terminal input
Input 2: AI2 terminal input

Setting Input Switching Points

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PV,RSP settings** > **Control PV input range**
Web application: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**
Hardware configurator: **Control settings** tab > **Setup parameters** > **PV,RSP settings** > **Control PV input range**

Description

Input switching PV range

Setup Item	Selectable Range or Options	Default Value
Input switching PV low limit	Control PV input range low limit to high limit	Control PV input range low limit
Input switching PV high limit	Control PV input range low limit to high limit	Control PV input range high limit

Input switching PV low limit and high limit

Set the input switching PV low limit or high limit or both.

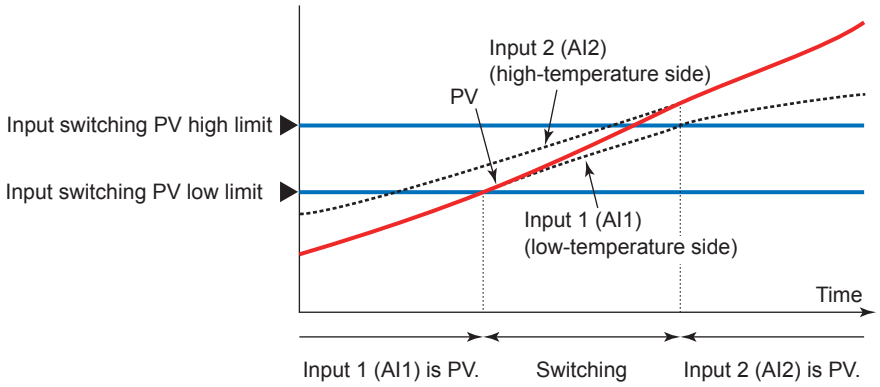
Note

Input switching point is a setting for each module.

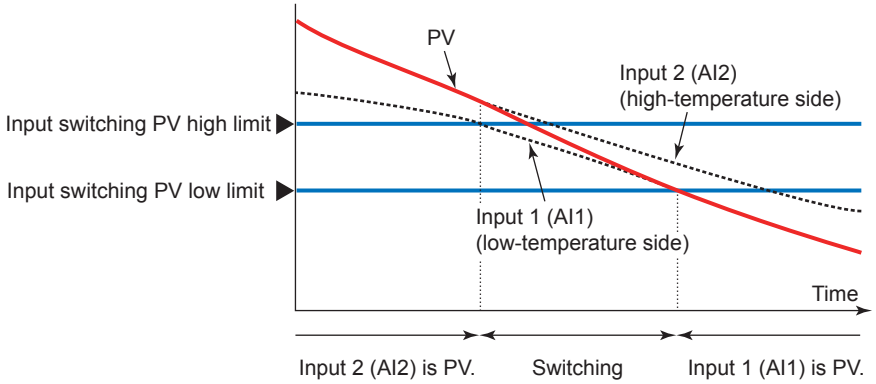
Switching within the Temperature Range (Low-temperature side)

This method automatically switches PV within the range of input switching PV high limit and low limit.
It should be selected in case where a sudden change in PV must be avoided.

PV rising process



PV falling process



When input 1 (AI1) ≤ input switching PV low limit, PV = Input 1 (AI1)

When input switching PV low limit < input 1 (AI1) < input switching PV high limit,

$$PV = \left(1 - \frac{\text{Input 1 (AI1)} - \text{input switching PV low limit}}{\text{Input switching PV high limit} - \text{input switching PV low limit}}\right) \times \text{Input 1 (AI1)}$$

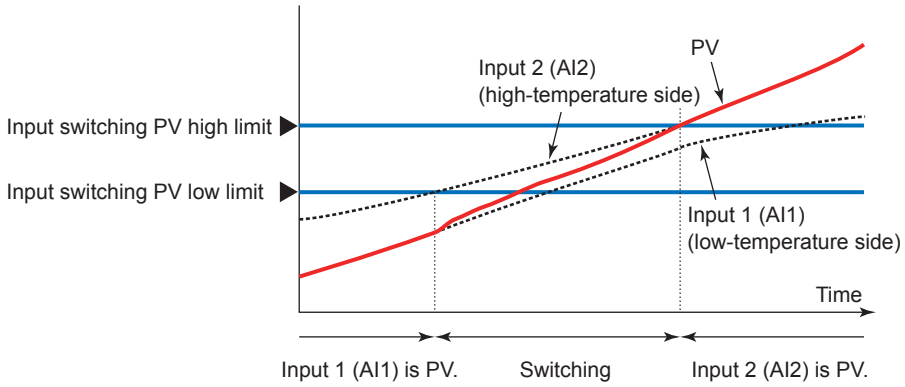
$$+ \left(\frac{\text{Input 1 (AI1)} - \text{input switching PV low limit}}{\text{Input switching PV high limit} - \text{input switching PV low limit}}\right) \times \text{Input 2 (AI2)}$$

When input switching PV high limit ≤ input 1 (AI1), PV = Input 2 (AI2)

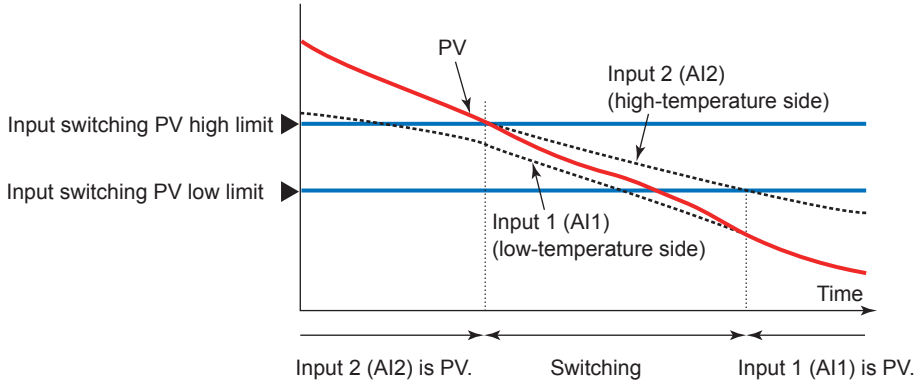
Switching within the Temperature Range (High-temperature side)

This method automatically switches PV within the range of input switching PV high limit and low limit.
It should be selected in case where a sudden change in PV must be avoided.

PV rising process



PV falling process



When input 2 (AI2) ≤ input switching PV low limit, PV = Input 1 (AI1)

When input switching PV low limit < input 2 (AI2) < input switching PV high limit,

$$PV = \left(1 - \frac{\text{Input 2 (AI2)} - \text{input switching PV low limit}}{\text{Input switching PV high limit} - \text{input switching PV low limit}}\right) \times \text{Input 1 (AI1)}$$

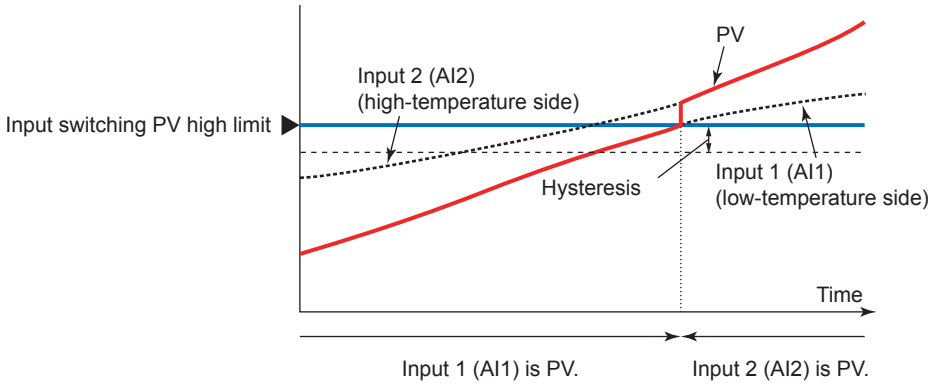
$$+ \left(\frac{\text{Input 2 (AI2)} - \text{input switching PV low limit}}{\text{Input switching PV high limit} - \text{input switching PV low limit}}\right) \times \text{Input 2 (AI2)}$$

When input switching PV high limit ≤ input 2 (AI2), PV = Input 2 (AI2)

Switching at the Input Switching PV High Limit

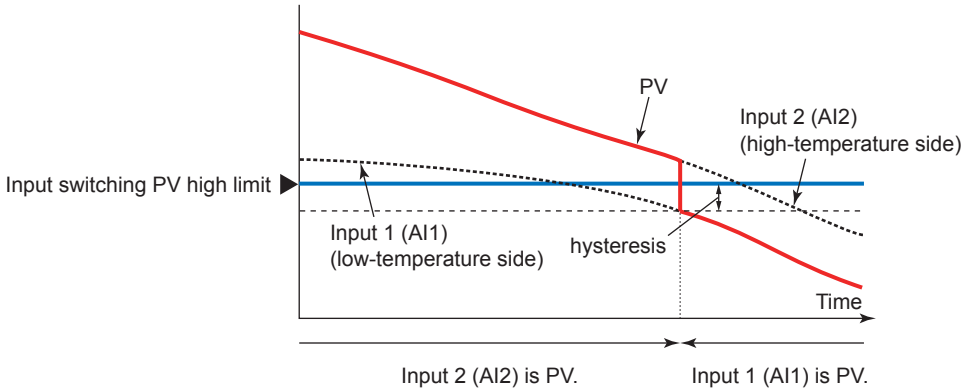
This method automatically switches two inputs at switching point (input switching PV high limit).
It should be selected in case where a sudden change in PV is allowed.
Control output will change smoothly (i.e., without any bumps) when PV switches.
Hysteresis (0.5% of PV range span) is provided around the switching point.

PV rising process



When input 1 (AI1) < input switching PV high limit, PV = Input 1 (AI1)
When input switching PV high limit ≤ input 1 (AI1), PV = Input 2 (AI2)

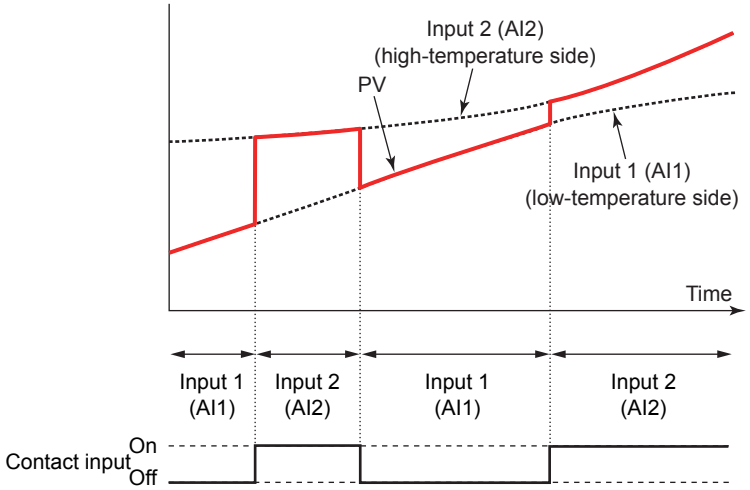
PV falling process



When input 1 (AI1) < input switching PV high limit – 0.5% of PV input range span, PV = input 1 (AI1)
When input switching PV high limit – 0.5% of PV input range span ≤ input 1 (AI1), PV = Input 2 (AI2)

Switching by Contact Input

This method switches two inputs by contact input ON/OFF.
When the contact input is OFF, PV = Input 1 (AI1) (low-temperature side).
When the contact input is ON, PV = Input 2 (AI2) (high-temperature side).



Control output will change smoothly (i.e., without any bumps) when PV switches.

3.5 Configuring the Output Function

Set the control output type. If you are not using the analog output as a control output, you can use it as a 15 V DC loop power supply.

3.5.1 Setting the Control Output Type (Current output, Voltage pulse output, 15 V DC loop power supply)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Output type**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output type**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the control output terminal.

Output type

Setup Item	Selectable Range or Options	Default Value
Type	Current output, Voltage pulse output, 15 V DC loop power supply	Current output

Type

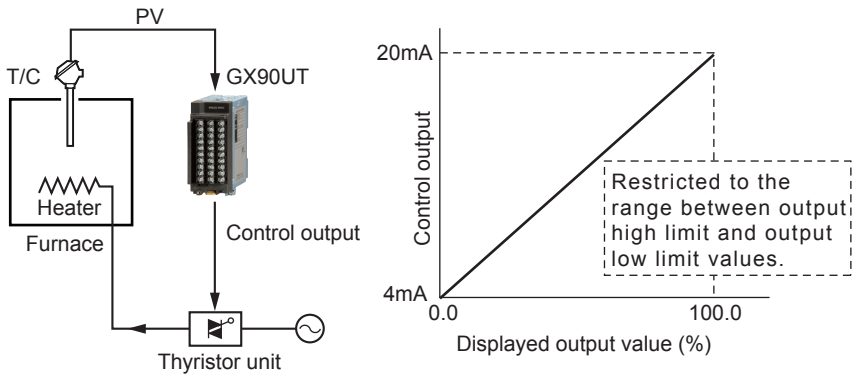
Control output is an universal output.

Note

Output type is a setting for each analog output (AO).

Current output

In current output, the control computation result is output as a current signal. (Example of 4 to 20 mA)

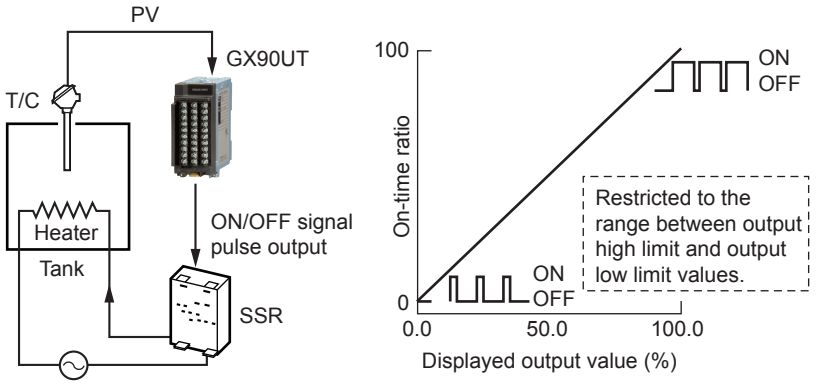


▶ For setting the current output range, see section 3.5.3, “Changing the Current Output Range.”

Voltage Pulse Output (Time proportional voltage pulse output)

In time proportional output, the control computation result is output in the form of an on/off signal pulse width proportional to the time. The pulse width is calculated as follows with the cycle time (control output cycle) at 100%.

Control output pulse width = Control output (%) × Cycle time



▶ For setting the cycle time, see section 3.5.2, “Setting the Cycle Time of Control Output (Voltage pulse output).”

15 V DC loop power supply

▶ For details on the 15 V DC loop power supply, see section 3.5.15, “Using the 15 V DC Power Supply.”

3.5.2 Setting the Cycle Time of Control Output (Voltage pulse output)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Output type**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the control output terminal.

Output type

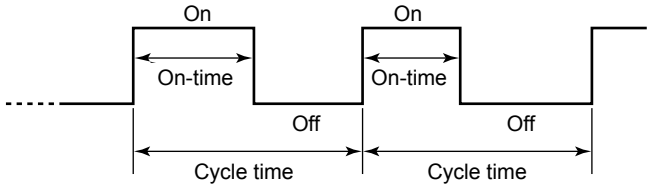
Setup Item	Selectable Range or Options	Default Value
Cycle time	0.5 to 1000.0 s	30 s

Note

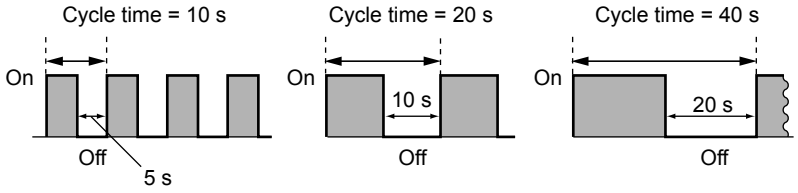
Set the cycle time when the control output type is set to **Voltage pulse output**. This is a setting for each analog output (AO).

Cycle time

Cycle time is the basic cycle period for the voltage pulse output to repeat on and off. Reducing the cycle time results in faster cycling and finer control.



Comparison of operations for the same control output (50%)



3.5.3 Changing the Current Output Range

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Output type**
Web application: **Config.** tab > **Control settings** > **Input/Output settings** > **Output settings** > **Output type**
Hardware configurator: **Control settings** > **Input/Output settings** > **Output type**.

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the control output terminal.

Output type

Setup Item	Selectable Range or Options	Default Value
Current output range	4-20mA/0-20mA/20-4mA/20-0mA	4-20mA

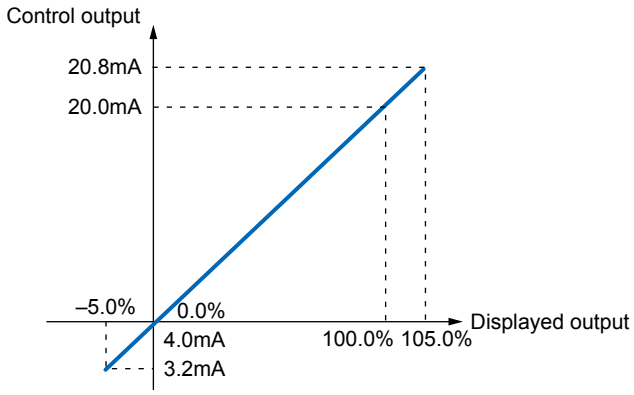
Current output range

The analog output type can be selected from 4-20, 0-20, 20-4, and 20-0 (mA).

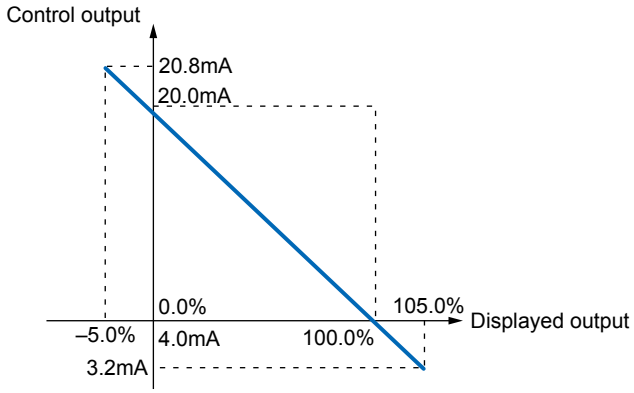
Note

Set the current output range when the control output type is set to **Current output**. This is a setting for each analog output (AO).

When set to 4-20mA



When set to 20-4mA



3.5.4 Setting Direct or Reverse Operation

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

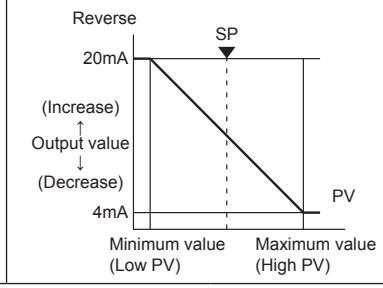
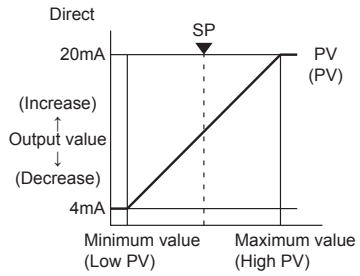
PID number

Select the PID loop number.

Setup Item	Selectable Range or Options	Default Value
Direct/Reverse action switch	Reverse, Direct	Reverse

Direct/Reverse action switch

Direct and reverse actions define the increase and decrease directions in which the output changes in response to positive and negative deviation (difference between the PV and SP).

	Reverse		Direct	
Condition	PV>SP	PV<SP	PV>SP	PV<SP
ON/OFF output	Off	On	On	Off
Current output	Current decrease	Current increase	Current increase	Current decrease
Time proportional output	On time decreases	Off time decreases	Off time decreases	On time decreases
Output change direction				

Note

Direct/reverse action is a setting for each loop and PID group number.

3.5.5 Setting Limiters to Control Output

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

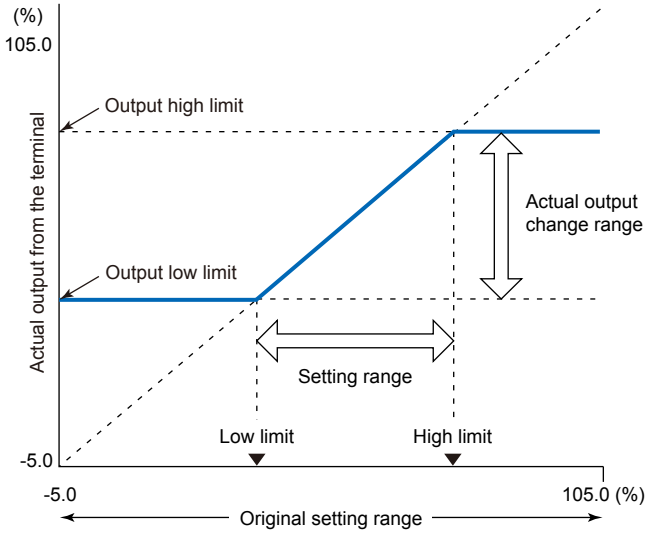
Select the PID loop number.

Setup Item	Selectable Range or Options	Default Value
Control output low limit	-5.0 to 104.9%	0.0%
Control output high limit	-4.9 to 105.0%	100.0%

Control output limiter (control output low limit, high limit)

Control output high and low limits can be set to restrict the control output to the operation range between those limits.
The output limiter is available for each PID group and works according to the selected PID group.
This, however, excludes preset output in STOP mode.
In manual mode, the output limiter can be enabled or disabled with the output limiter switch setting.

▶ For details on the output limiter switch, see section 3.5.6, “Disabling the Output Limiter Function in Manual Mode (Output limiter switch).”



Note

Control output limiter is a setting for each loop and PID group number.

3.5.6 Enabling the Output Limiter Function in Manual Mode (Output limiter switch)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **OUT settings**
Web application: **Control settings** tab > **Setup parameters** > **OUT settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **OUT settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Output limiter switch

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off

On/Off

The output limiter function can be disabled in manual mode by setting the output limiter switch to Off.
Note that the output bump is caused if the operation mode is changed from MAN to AUTO while the control output is out of the range between the control output high limit and control output low limit.
Control output bumps to control output high limit in MAN mode when it is larger than the limit. It bumps to control output low limit when it is smaller than the limit.
The switch can be set only on the loop 2 side during cascade control.
If you want to use the tight shut function, disable the output limiter switch and set the function to On.

Note

The output limiter switch is a setting for each loop.

3.5.7 Setting the Velocity Limiter to Control Output

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control detail settings**
Web application: **Control settings** tab > **Operation parameters** > **Control detail settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control detail settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Output velocity limiter

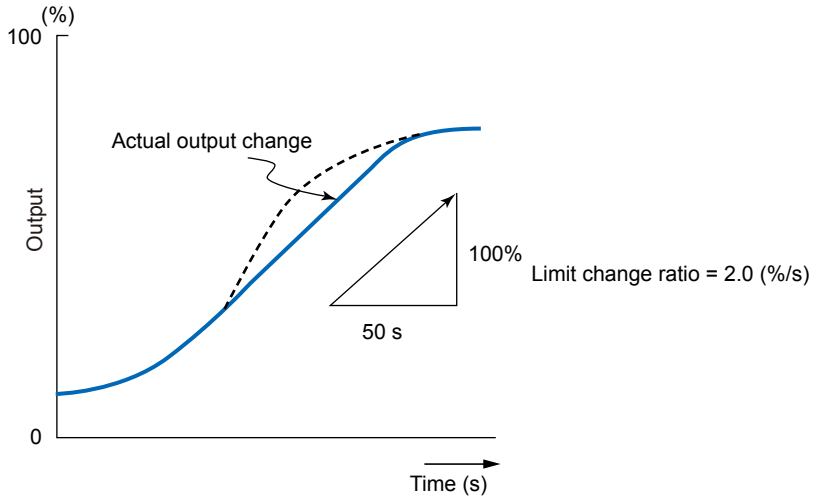
Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Value	0.1% to 100.0% / s	0.1%

On/Off

Output velocity limiter prevents the control output signal from changing suddenly in order to protect the control valves (or other actuators) and controlled process.

The output velocity limiter does not work in MAN or STOP mode or when input burnout or A/D error occurs.
Note that setting an output velocity limit may cancel the effects of derivative action.

The following shows the operation example of output velocity limiter.
In ON/OFF control, the setting is invalid even if the output velocity limiter is set.



Note

Output velocity limiter is a setting for each loop.

3.5.8 Reducing 4-20 mA Current Output to 0 mA (Tight Shut Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

Select the PID loop number.

Setup Item	Selectable Range or Options	Default Value
Tight shut function	Off/On	Off

Tight shut function

Enables the tight shut function. This is valid only for current output.
If you want to use the tight shut function, disable the output limiter switch.

Explanation

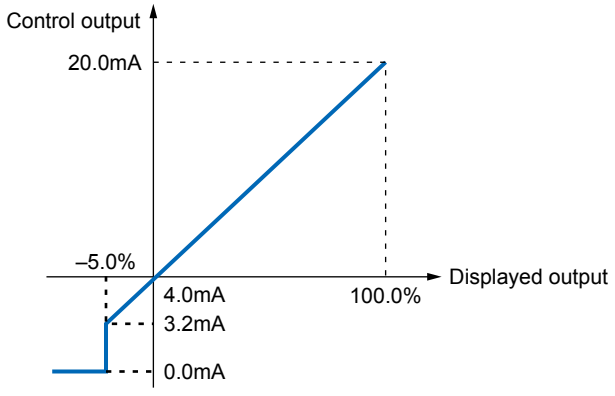
Tight shut function fully closes the control valve (or other actuators) (i.e., so that output is zero) beyond its positioner dead band.

In MAN mode

When the output is reduced with the down arrow key and “SD” is displayed as the output value, the output level reaches –5.0% or less. The control output delivers a tight shut signal (about 0.0 mA).

In AUTO mode

The output is limited by the output low limit.
It does not decrease to 0.0 mA.



Note

- Tight shut function is a setting for each loop and PID group number.
- Tight shut function can be used when the current output range is 4-20mA.
- Tight shut output cannot be disabled with PID group switching alone.

3.5.9 Setting the ON/OFF Control Hysteresis

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

Select the PID loop number.

This appears when the control type is ON/OFF control.

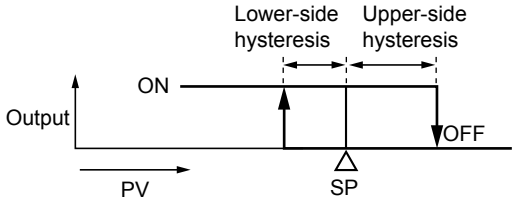
Setup Item	Selectable Range or Options	Default Value
Upper-side hysteresis	0.0 to 100.0% of control PV input range span	5.0% of control PV input range span
Lower-side hysteresis	0.0 to 100.0% of control PV input range span	5.0% of control PV input range span

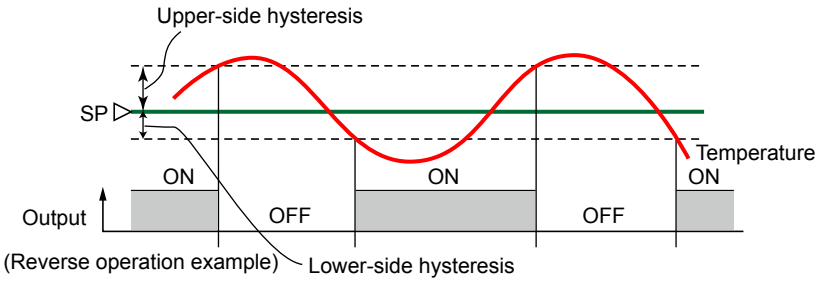
Note

Hysteresis is a setting for each loop and PID group number.

Upper-side hysteresis, Lower-side hysteresis

If the SP and PV become close and the polarity of the deviation reverses frequently, the on/off output will cycle repeatedly.
Hysteresis prevents the relay's frequent on/off output (chattering) from occurring.
Set two points of hysteresis (deviation positive hysteresis and deviation negative hysteresis) to the operating point.





3.5.10 Canceling the PV and SP Offset (Manual Reset)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

Select the PID loop number.

Setup Item	Selectable Range or Options	Default Value
manual reset	-5.0 to 105.0%	50.0%

Note

Manual reset is a setting for each loop and PID group number.

Manual reset

Manual reset can be used when the integral action is disabled (0 s).
When the integral action is disabled, there will be an offset of PV and SP. Manual reset cancels this offset.
The manual reset value equals the output value when PV = SP is true.

3.5.11 Setting the Retransmission Output Type (PV/SP/OUT, PV2/SP2/OUT2), Range, and Scale

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Re-Trans**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Re-Trans**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Re-Trans**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the retransmission output terminal.

Re-Trans

Setup Item	Selectable Range or Options	Default Value
On/Off	On (retransmission output enabled), Off(retransmission output disabled)	Off
Type	OUT1/PV1/SP1/OUT2/PV2/SP2	OUT1 or OUT2

Note

Retransmission output is a setting for each analog output (AO).

Type

Select the type of output to transmit from retransmission output.
With AO terminals of PID modules, PV input for control or SP for control can be selected in addition to control output (OUT) for outputting from the output terminal.

In Single Loop Control or Cascade Control

Type	Description
OUT1	Loop 1 control output (OUT)
PV1	Loop 1 PV
SP1	Loop 1 SP
OUT2	Loop 2 control output (OUT)
PV2	Loop 2 PV
SP2	Loop 2 SP

In Loop Control with PV Switching

Type	Description
OUT1	Loop 1 control output (OUT)
PV1	Loop 1 PV
SP1	Loop 1 SP

Minimum or Maximum value of input scale[1]

Setup Item	Selectable Range or Options	Default Value
Minimum value of input scale	-30000 to 30000 Set so that |maximum – minimum | ≤ 30000.	Minimum value of control PV input range
Maximum value of input scale	-30000 to 30000 Set so that |maximum – minimum | ≤ 30000.	Maximum value of control PV input range

1 These cannot be set when the type is OUT1 or OUT2.

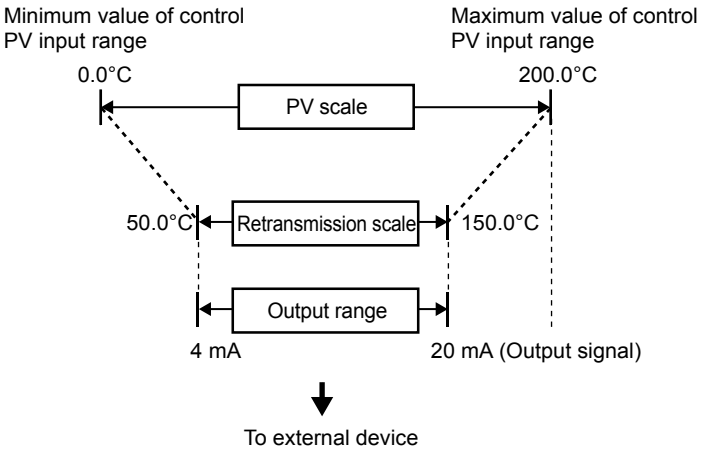
Scaling

The selected value is converted into a percentage of the retransmission scale span (the minimum to maximum of the retransmission scale span are mapped to 0.0 to 100.0%) and output according to the following output format. The output period is the same as the control output period.

- Time proportional voltage pulse output: Outputs an on/off voltage signal with a pulse width proportional to the time according to the selected value
- Current output: Continuously outputs a current (analog signal) proportional to the selected value

* If control output (OUT1/2) is selected, scaling cannot be set.
The output ranges from 0.0 to 100.0%.

Example in which the PV is scaled and output



3.5.12 Setting the Output Value for STOP Mode (Preset Output)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID settings**
Web application: **Control settings** tab > **Operation parameters** > **PID settings**
Hardware configurator: **Control settings** tab > **Operation parameters** > **PID settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration
PID number	1 to 8	1

Loop number

Select the target loop number.

PID number

Select the PID loop number.

Setup Item	Selectable Range or Options	Default Value
Preset output	-5.0 to 105.0%	0.0%

Preset output

Set the preset output value.

The preset output function is used to output a preset output value when a specified condition occurs.
When the operation mode is changed to STOP, a constant value (preset output value) is output, separate from the control output value up to that point.
The preset output value can be set in the range of –5.0 to 105.0% of the control output, regardless of the output high and low limits.

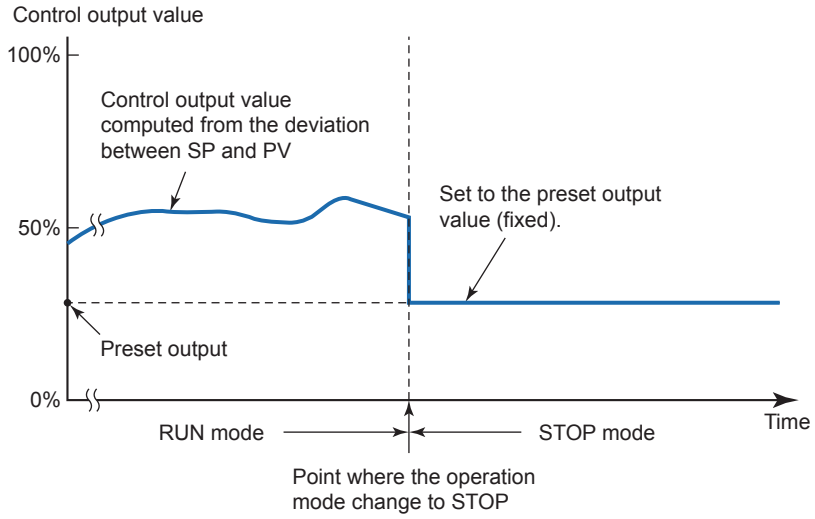
Note

Preset output is a setting for each loop and PID group number.

Explanation

When the operation mode is switched from RUN to STOP
The preset output function outputs a preset output when the operation mode is switched from RUN to STOP. The preset output value is not limited by the output limiter.

Operation mode switching	Output action
RUN→STOP	The control output value bumps to the preset output value.
STOP→RUN	The control output value works without bumps.



Preset output value is available for each PID parameter group and works according to the selected PID parameter group.

Preset Output Value for On/Off Output (Control)

During on/off output (ON/OFF control), 0.0% is output when the preset output value is 0.0% or less and 100.0% when the value is 0.1% or more.

3.5.13 Setting the Output Value for Input Errors

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **OUT settings**
Web application: **Control settings** tab > **Setup parameters** > **OUT settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **OUT settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Preset output

Setup Item	Selectable Range or Options	Default Value
Input error preset output	Preset output, 0% output, 100% output	Preset output

Input error preset output

The 0% output, 100% output, or input preset output can be selected and output as input error preset output in the following conditions.

- An input burnout occurs in AUTO or CAS mode and RUN mode.
- An ADC error occurs in AUTO or CAS mode and RUN mode.
- A computation error occurs when EXPV or RSP is in use in control computation in AUTO or CAS mode and RUN mode.

However, the manual output becomes the output when any of the errors above occurs in MAN mode and RUN mode.

▶ For details on preset output, see section 3.5.12, “Setting the Output Value for STOP Mode (Preset Output).”

Note

Input error preset output is a setting for each loop.

3.5.14 Configuring the Split Computation Output Function

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Split computation**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Split computation**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Split computation**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the input terminal of the PID control module to receive as PV input.

Split computation

Setup Item	Selectable Range or Options	Default Value
Mode	On/Off	Off
Output 0% segmental point	-100.0 to 200.0%	0.0%
Output 100% segmental point	-100.0 to 200.0%	100.0%

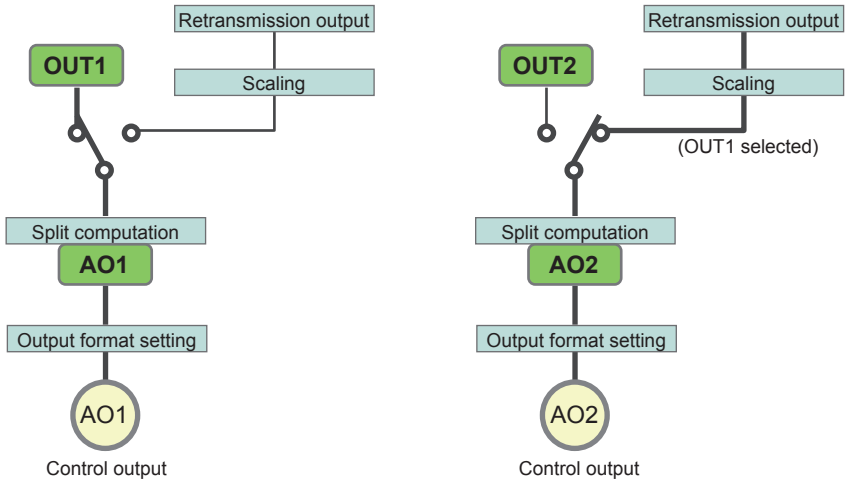
Mode

Enables the split computation.
Split computation output is useful for the case where multiple operating units for switching, for example, hot and cool water are linked for control. There are two characteristics of split computations: V-mode characteristics and Parallel-mode characteristics.

Note

Split computation is a setting for each analog output (AO).

Split computation is performed using two outputs: control output and retransmission output (OUT1).

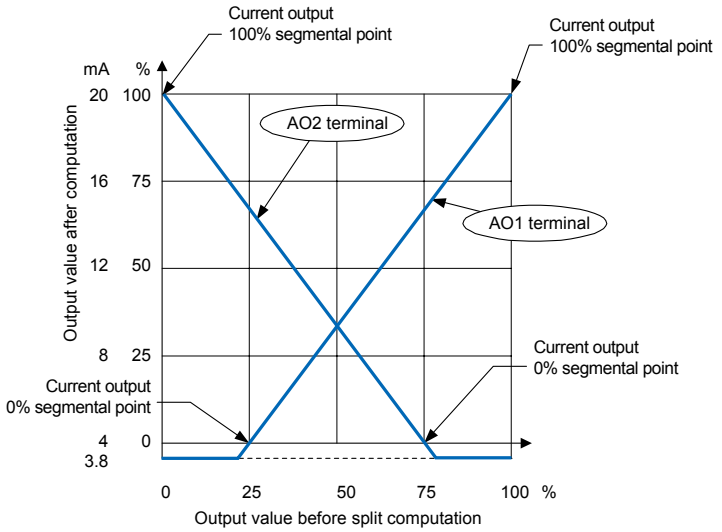


- **V-mode Characteristics**

The following explains an example of letting the AO1 and AO2 terminals present the V-mode characteristics of split computations.

Setup Example

	AO1 terminal	AO2 terminal
Retransmission output type	OUT1	OUT1
Current output 0% segmental point	25.0%	75.0%
Current output 100% segmental point	100.0%	0.0%
Current output range	4-20 mA	4-20 mA

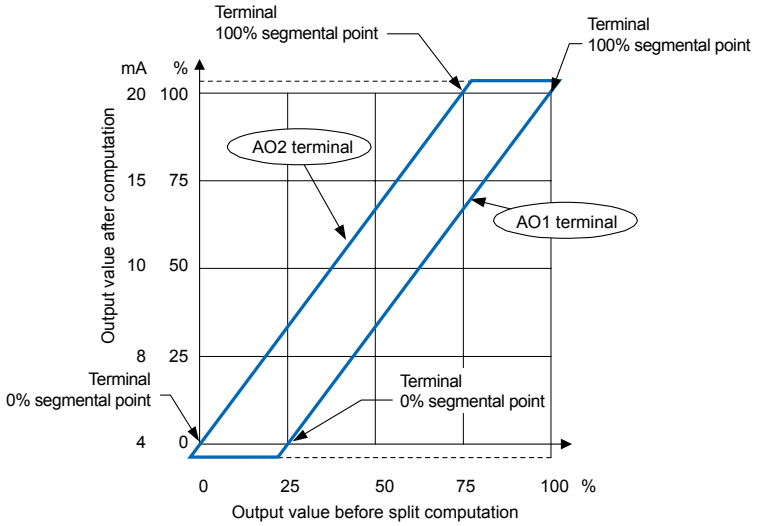


- **Parallel-mode Characteristics**

The following explains an example of letting the AO1 and AO2 terminals present the parallel-mode characteristics of split computations.

Setup Example

	AO1 terminal	AO2 terminal
Retransmission output type	OUT1	OUT1
Current output 0% segmental point	25.0%	0.0%
Current output 100% segmental point	100.0%	75.0%
Current output range	4-20 mA	4-20 mA



3.5.15 Using the 15 V DC Loop Power Supply

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Input/Output settings** > **Output type**
Web application: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Input/Output settings** > **Output settings** > **Output type**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
AO number	AO1/AO2	—

Unit Number, Slot Number

Select the target unit number and slot number.

AO number

Select the input terminal of the PID control module to receive as PV input.

Output type

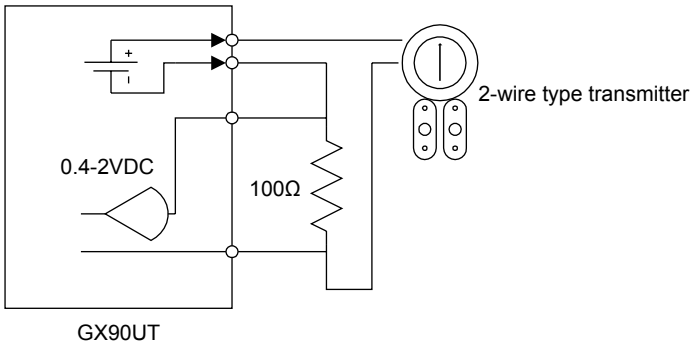
Setup Item	Selectable Range or Options	Default Value
Type	15 V DC loop power supply	—

Note

The 15 V DC loop power supply is a setting for each analog output (AO). It can be used when the analog output terminal is not being used for control output or retransmission output.

Explanation

The 15 V DC loop power supply is a function to supply DC power (14.5 to 18.0 V DC (21 mA DC)) to a 2-wire transmitter.
The loop power supply block is isolated from the controller's internal circuitry. In addition, the block is equipped with a current limiting circuit. Therefore, accidental short-circuits that may occur in the field do not adversely affect the rest of the controller's internal circuitry.
Note that the loop power supply function cannot be used for digital communication where the supply voltage is superposed on the signal line.
The following shows the examples of loop power supply connection to a 2-wire transmitter.



3.6 Configuring the Control Alarm Function

Process alarms, such as PV high limit and PV low limit, hysteresis, delay timer, and the like can be set.

3.6.1 Setting the Number of Alarms to Use

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Number of Alarms	1 to 4	4

Number of Alarms

You can set up to four alarms. For each alarm, you can set the alarm type, hysteresis, (on/off) delay timer, and alarm setpoint. Alarms you do not need can be hidden or set to off.

Note

Number of alarms is a setting for each loop.

3.6.2 Setting the Alarm Action depending on the Operation Mode

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Basic action

Setup Item	Selectable Range or Options	Default Value
Alarm mode	Always active, Not active in STOP mode, Not active in STOP or MAN mode	Always active

Alarm mode

Normally, alarm actions work regardless of the operation mode.
By setting the alarm mode, you can disable alarm actions in STOP mode or in STOP and MAN mode.

When Program Control Is Disabled

Options	Description
Always active	Alarms work (are enabled) at all times
Not active in STOP mode	Alarms do not work (are disabled) when the operation mode is STOP.
Not active in STOP or MAN mode	Alarms do not work (are disabled) when the operation mode is STOP or MAN.

When Program Control Is Enabled

Options	Description
Always active	Alarms work (are enabled) at all times
Not active in STOP mode	Alarms do not work (are disabled) when the operation mode is RESET.
Not active in STOP or MAN mode	Alarms do not work (are disabled) when the operation mode is RESET or MAN.

Note

Alarm mode is a setting for each loop.

3.6.3 Setting How to Use the DO Terminal (Contact output within module, Alarm, Manual)

Set how to use the DO of the PID control module.
In addition to control alarm output, the DO can be used for measurement alarm output or can be controlled from the screen (manual).

▶ For details on controlling the DO output from the screen, see “DO Channel Operation from the Monitor” in section 2.2, “Displaying Measured Data,” of the GX/GP User’s Manual (IM 04L51B01-01EN).

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **DO settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **DO settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **DO settings**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration
DO number	DO1 to DO8	—

Unit Number, Slot Number

Select the target unit number and slot number.

DO number

Select the DO of the PID control module.

Note

DO settings are available for each digital output (DO).

Range

Setup Item	Selectable Range or Options	Default Value
Type	Contact output within module, Alarm, Manual	Contact output within module

Type

Options	Description
Contact output within module	Used only for control inside the PID control module.
Alarm	Uses the DO of the PID control module as an alarm output for another module.
Manual	Used as an DO that can be controlled manually.

DO function selection

Set this item when the range type is set to Contact output within module.

Setup Item	Selectable Range or Options	Default Value
Type	Loop 1, Loop 2, Common	—
Output	Off When the type is Loop 1 or Loop 2 Alarm Level 1 to 4, Alarm 1 to 4 status, STOP/RUN, MAN/AUTO, MAN,*1 AUTO,*1, Cascade,*1 REMOTE/LOCAL, Auto-tuning status, EXPV/AI When the type is Common DI1 to DI8 status, AI1 burnout, AI1 AD error, AI2 burnout, AI2 AD error	Off

1 Can be set when the control mode is cascade control and even loops are in use.

Alarm Level and Alarm Status

Alarm level indicates the alarm state. Alarm status indicates the alarm output state including the relay action.

Type
Set each loop or for all loops.

Output
Set the output of each loop or for all loops.

Action

Setup Item	Selectable Range or Options	Default Value
Energize/De-energize	Energize/De-energize	Energize
Action[1]	And, Or, Reflash	Or
Hold[1, 2]	Hold, Nonhold	Nonhold
Relay action on ACK[1]	Normal, Reset	Normal
Relay deactivated interval[1, 3]	500ms/1s/2s	500ms

1 Appears when the type is not set to **Alarm**.
2 Does not appear when Action is set to **Reflash**.
3 Appears when Action is set to **Reflash**.

Energize/De-energize
Set whether to **Energize** or **De-energize** the DO output when an alarm occurs.

Action

Options	Description
And	Activated when all assigned alarms are occurring simultaneously
Or	Activated when any of the specified alarms is occurring
Reflash	When multiple alarms are assigned to one alarm output relay, the GM notifies the occurrence of subsequent alarms after the relay is activated by the first alarm.

Hold
Set the DO channel output operation.

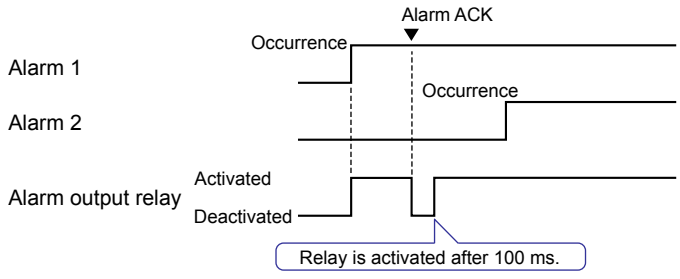
Options	Description
Hold	Holds the output relay at ON until an alarm acknowledge operation is performed.
Nonhold	Turns the output relay off when the alarm condition is released (returns to normal condition).

Relay action on ACK
Set what the output state of the DO channel would be after an alarm ACK operation.
If Individual alarm ACK is set to On, this is set to Reset.

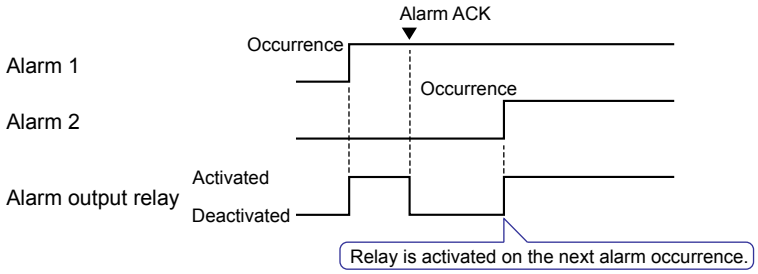
Options	Description
Normal	The relay is deactivated when an alarm ACK is executed. If the condition for activating the alarm output relay is met in the next 100 ms, the relay will be activated. This operation is valid only when the alarm output relay is set to **Hold**.
Reset	The relay is deactivated when an alarm ACK is executed. If the condition for activating the alarm output relay is met again, the relay will be activated.

Example:
An example of the relay action when alarm ACK is executed is shown below. In this example, the relay is set to Or and Hold.

Normal



Reset



Relay deactivated interval

Set the relay's not-active interval for reflash operation.

Explanation

AND/OR Operation

When multiple alarms are assigned to one alarm output relay, you can select which condition below will activate the output relay. You can also specify AND operation for internal switches.

- AND: Activated when all assigned alarms are occurring simultaneously
- OR: Activated when any of the specified alarms is occurring

Reflash

When multiple alarms are assigned to one alarm output relay, this function notifies the occurrence of subsequent alarms after the relay is activated by the first alarm. When subsequent alarms occur, the output relay is released temporarily. The duration for which the relays are deactivated can be set to 500 ms, 1 s, or 2 s.
Relays set to Reflash will operate using **Or** and **Nonhold** settings.

Energize or De-energize Operation

You can select whether the alarm output relay is energized or de-energized when an alarm occurs. If you select de-energize, the alarm output relays will be in the same state when the GX/GP is shut down as they are when an alarm occurs.

Nonhold/Hold

The alarm output relay can be set to operate in the following fashion when the alarm condition is no longer met.

- Turn OFF the relay output (nonhold).
- Hold the relay at ON until the alarm ACK is executed (hold).

Alarm acknowledge operation

All alarm ACK

The alarm acknowledge (alarm ACK) operation releases all alarm indications and relay outputs.

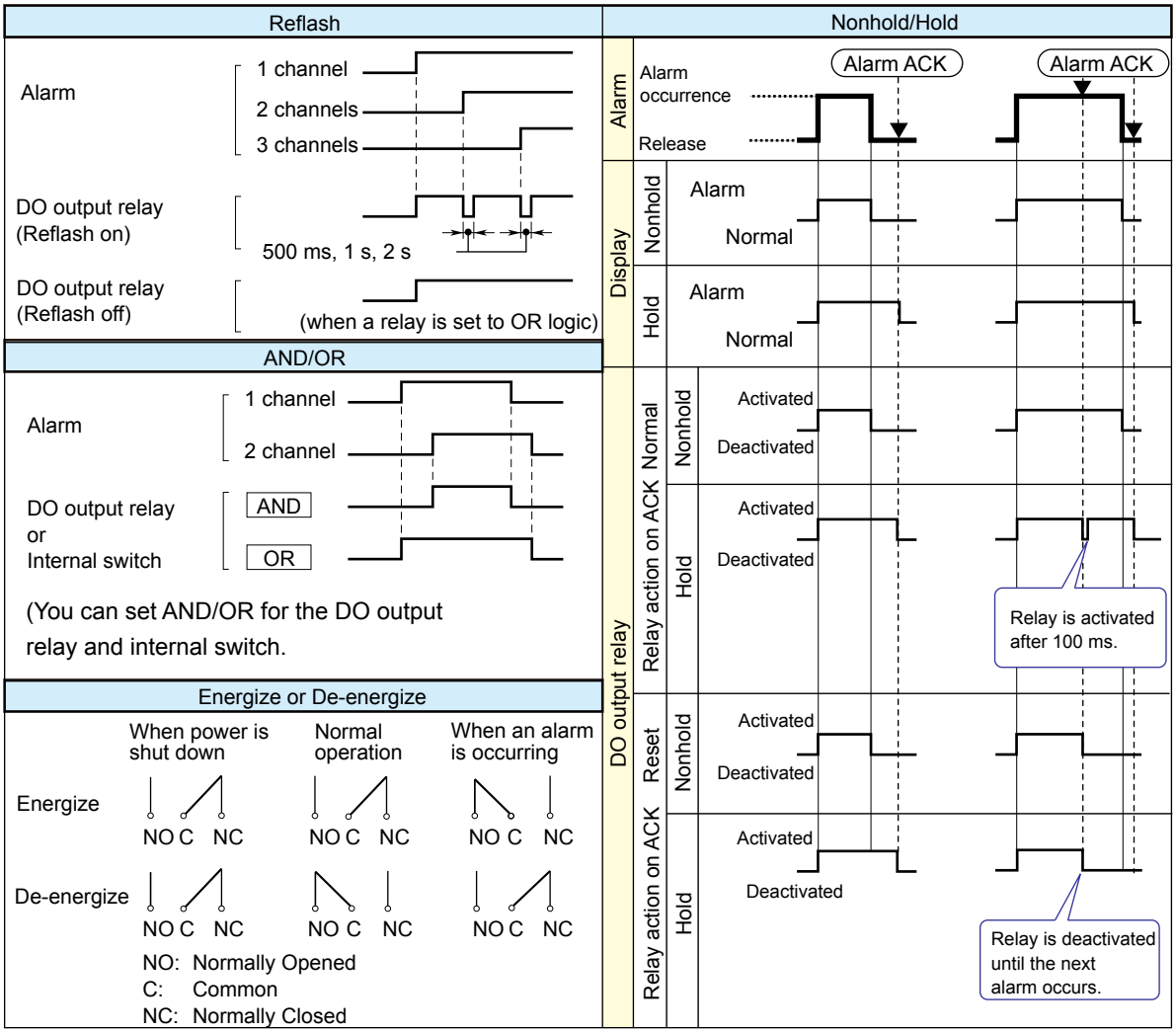
Individual alarm ACK

Individual alarm ACK operation releases specific alarms.

For the behavior of alarm indication and alarm output relay when you execute an alarm ACK operation, see the next page.

DO Output Relay Operation

The DO output relay operation is shown below. (This applies when the DO of the PID control module is set to **Alarm** or **Manual**.)



DO Output Relay Operation during an Error

When an error (FAIL) occurs in the system, the DO output relay is de-energized (as shown below). The DO output relay operation is shown below.

Item	Description
When a CPU error occurs in the GX/GP/GM main unit	The DO output relay of the GX/GP/GM main unit is de-energized. The DO output relays of all expandable I/O and sub units are de-energized.
When a CPU error occurs in an expansion module	The DO output relay of the GX/GP/GM main unit continues normal operation. The DO output relays of expandable I/O and sub units in which the error did not occur continue normal operation. The DO output relay of the expandable I/O and sub unit in which the error occurred is de-energized.
When a connection between expandable I/Os or sub units are disconnected	The DO output relay of the GX/GP/GM main unit continues normal operation. The DO output relays of the expandable I/O or sub unit that was disconnected and those of subsequent units are de-energized. Normal operation resumes when the connection recovers.

3.6.4 Setting the Alarm Type

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control alarm**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Type[1]	PVH: PV high limit, PVL: PV low limit, SPH: SP high limit, SPL: SP low limit, DVH: deviation high limit, DVL deviation low limit, DVO: Deviation H/L limits, DVI: Dev. within H/L limits, OTH: control output high limit, OTL: control output low limit, PVR: PV velocity	PVH: PV high limit
PV velocity alarm time setpoint (minutes)[2]	0 to 99	0
PV velocity alarm time setpoint (seconds)[2]	0 to 59	1

*1 Appears when Level (1 to 4) is set to **On**.
*2 Appears when the type is set to **PVR: PV velocity**. PV velocity alarm time ranges from 0 minutes 1 second to 99 minutes to 59 seconds.

On/Off

To use an alarm level (1 to 4), set this to **On**.

Type

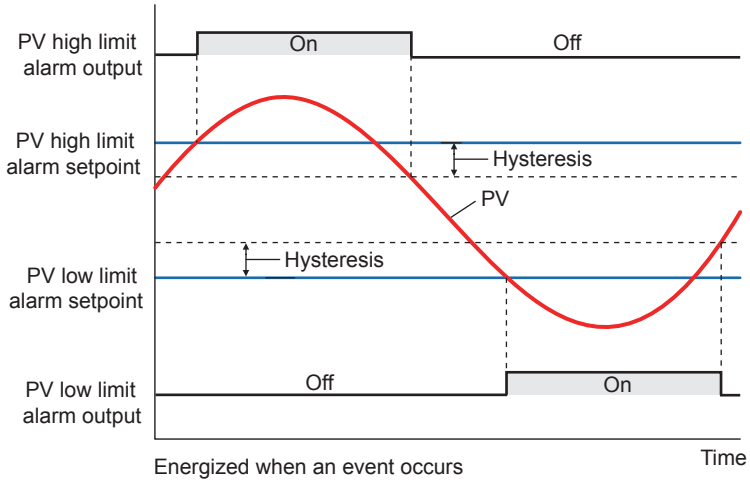
Set the alarm type.

Note

- Alarm type is a setting for each alarm level.
- The alarm type setting is not applied to PID channels.
  Example: Even if a PV high limit alarm is assigned to loop number L011, an alarm is not assigned to PID channel number 0101 (0101.PV1).

Explanation

PV high limit, PV low limit



Energized when an event occurs

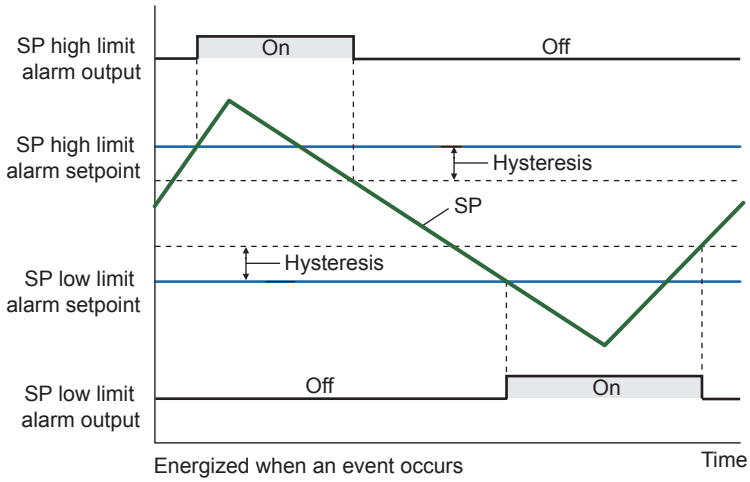
PV high limit

Condition	Alarm status	Energized output	De-energized output
PV ≥ alarm setpoint	On	On	Off
PV < alarm setpoint – hysteresis	Off	Off	On

PV low limit

Condition	Alarm status	Energized output	De-energized output
PV ≤ alarm setpoint	On	On	Off
PV > alarm setpoint + hysteresis	Off	Off	On

SP high limit, SP low limit



Energized when an event occurs

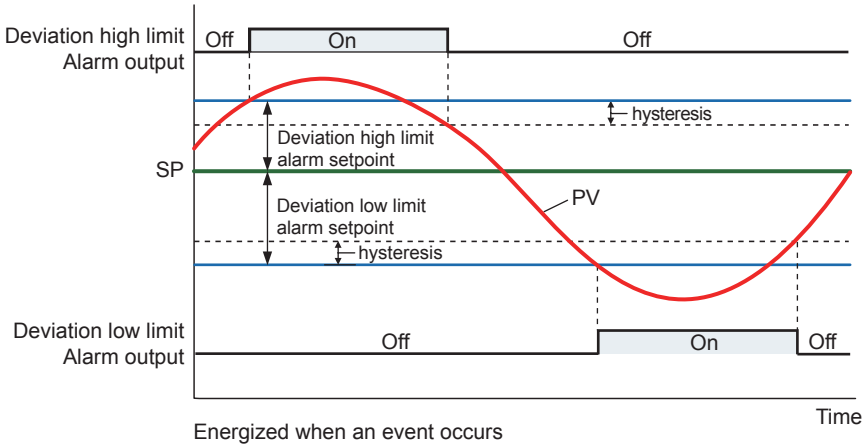
SP high limit

Condition	Alarm status	Energized output	De-energized output
SP ≥ alarm setpoint	On	On	Off
SP < alarm setpoint – hysteresis	Off	Off	On

SP low limit

Condition	Alarm status	Energized output	De-energized output
SP ≤ alarm setpoint	On	On	Off
SP > alarm setpoint + hysteresis	Off	Off	On

Deviation high limit, Deviation low limit



Energized when an event occurs

Deviation high limit

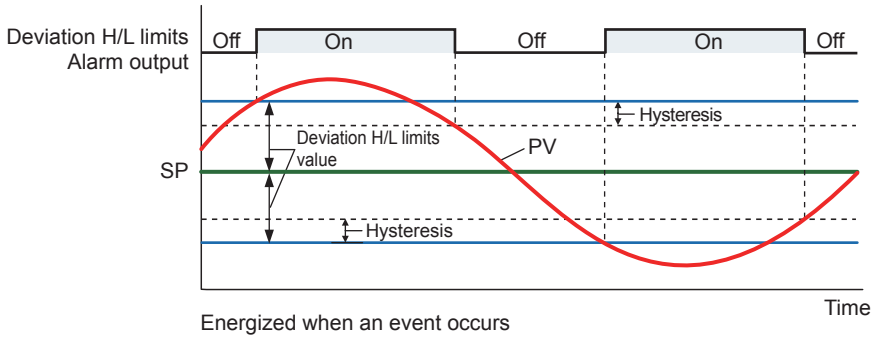
Condition	Alarm status	Energized output	De-energized output
PV ≥ SP + alarm setpoint	On	On	Off
PV < (SP + alarm setpoint) – hysteresis	Off	Off	On

Deviation low limit

Condition	Alarm status	Energized output	De-energized output
PV ≤ SP + alarm setpoint	On	On	Off
PV > (SP + alarm setpoint) + hysteresis	Off	Off	On

For deviation low limit, set the alarm setpoint with a negative value.

Deviation H/L limits



Energized when an event occurs

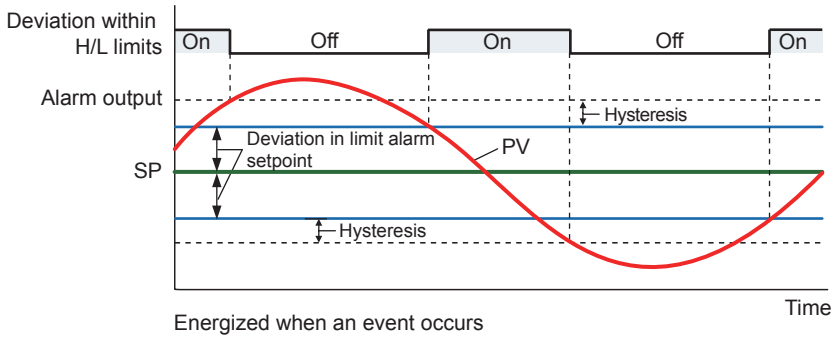
Deviation H/L limits

Condition	Alarm status	Energized output	De-energized output
PV ≥ SP + alarm setpoint	On	On	Off
PV < (SP + alarm setpoint) – hysteresis	Off	Off	On

Condition	Alarm status	Energized output	De-energized output
PV ≤ SP + alarm setpoint	On	On	Off
PV > (SP + alarm setpoint) + hysteresis	Off	Off	On

For deviation low limit, set the alarm setpoint with a negative value.

Deviation within H/L limits



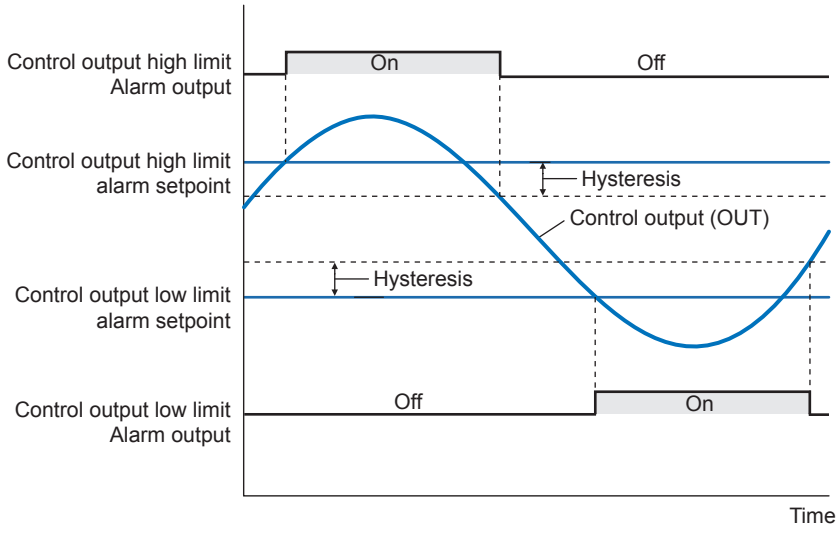
Energized when an event occurs

Deviation within H/L limits

Condition	Alarm status	Energized output	De-energized output
PV ≤ SP + alarm setpoint	On	On	Off
PV > (SP + alarm setpoint) + hysteresis	Off	Off	On

Condition	Alarm status	Energized output	De-energized output
PV ≥ SP – alarm setpoint	On	On	Off
PV < (SP – alarm setpoint) – hysteresis	Off	Off	On

Control output high limit, Control output low limit



Energized when an event occurs

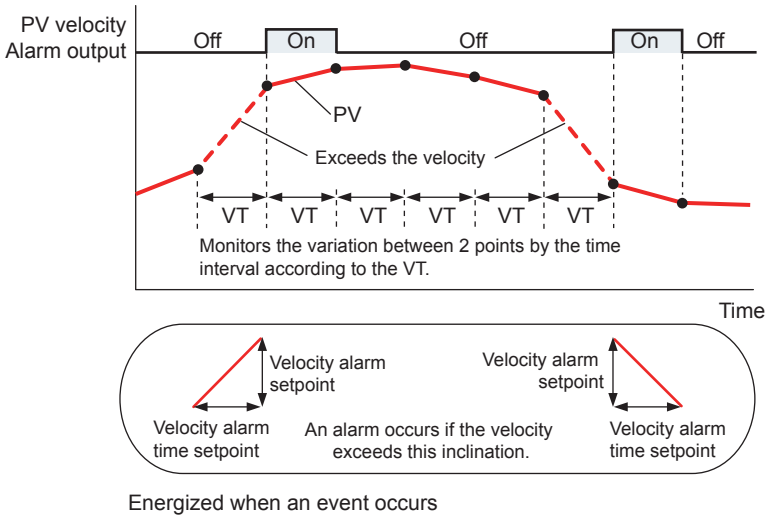
Control output high limit

Condition	Alarm status	Energized output	De-energized output
Control output value ≥ alarm setpoint	On	On	Off
Control output value < alarm setpoint – hysteresis	Off	Off	On

Control output low limit

Condition	Alarm status	Energized output	De-energized output
Control output value ≤ alarm setpoint	On	On	Off
Control output value > alarm setpoint + hysteresis	Off	Off	On

PV velocity



Energized when an event occurs

PV velocity

Condition	Alarm status	Energized output	De-energized output
PV change width > alarm setpoint	On	On	Off
PV change width < alarm setpoint	Off	Off	On

Note

Hysteresis, stand-by action, and on/off-delay timers are not available.

3.6.5 Setting Alarm Values

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Value**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
SP number	1 to 8 (depends on how Number of SP groups is set)	1

SP number

Select the SP number group.

Setup Item	Selectable Range or Options	Default Value
Alarm level 1 setpoint, Alarm level 2 setpoint, Alarm level 3 setpoint, Alarm level 4 setpoint	-30000 to 30000 (excluding the decimal point)	0

Alarm level 1 setpoint, Alarm level 2 setpoint, Alarm level 3 setpoint, Alarm level 4 setpoint

Set the alarm setpoints.

Alarm values can be set for each alarm level for the number of SP groups.
When you change the SP number, the alarm setpoint also changes.

▶ For instructions on how to use the loop screen, see section 5.1, “Using Loop Control.”

3.6.6 Setting Stand-by Actions

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control alarm**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Stand-by action	On, Off	Off

On/Off

To use an alarm level (1 to 4), set this to **On**.

Stand-by action

Stand-by action disables alarms until the first time the alarm condition ceases. When a value enters an area in which alarms do not occur, the stand-by action is reset.

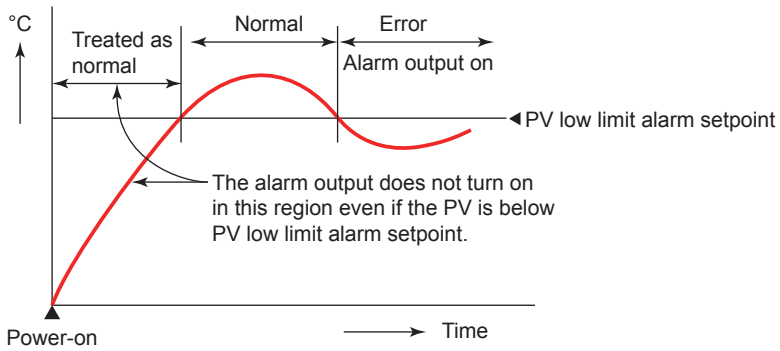
Note

Stand-by action is a setting for each alarm level.

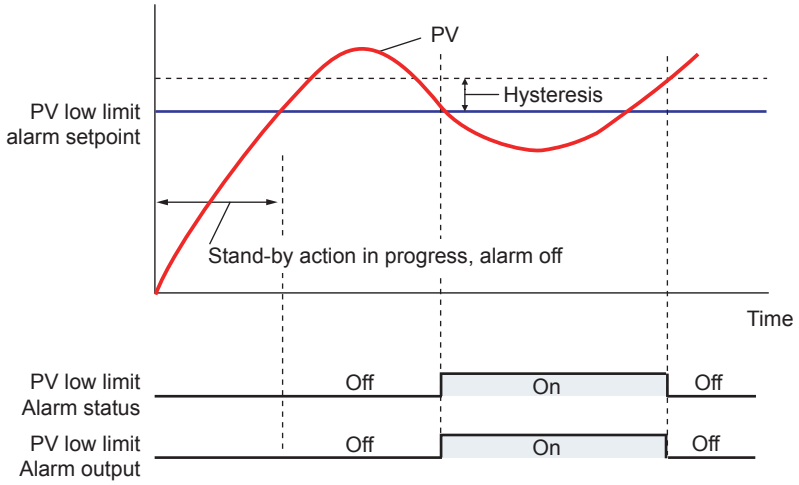
Stand-by action works in the following situations.

- At power-on
- When the SP is changed (in local mode)
- When the SP number is changed (in local mode) (The SP must change.)
- When the alarm type is changed

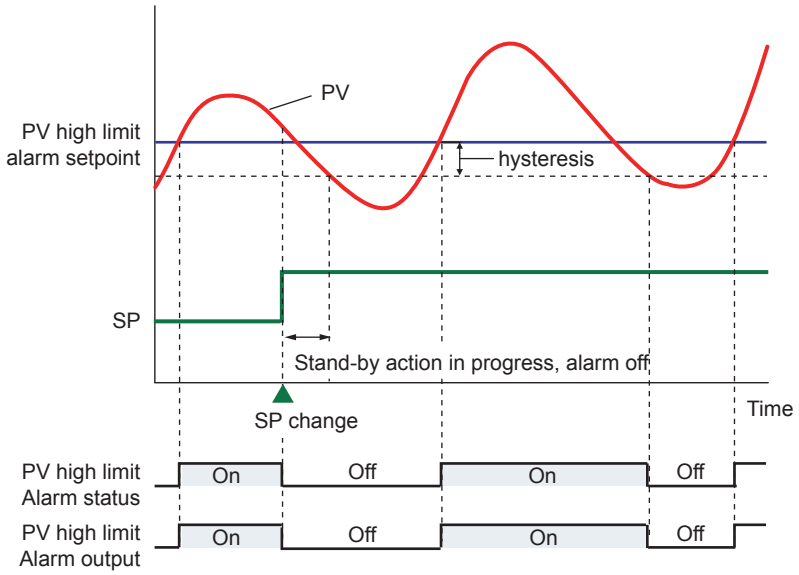
The following figure shows an example at power-on.



At power-on



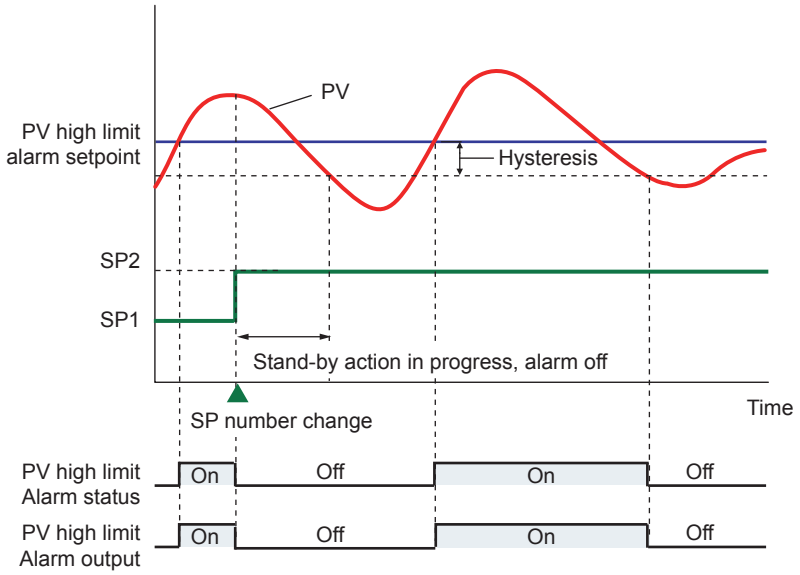
When the SP is changed (in local mode)



Note

In remote mode, stand-by action is not executed based on changes in the remote setpoint.

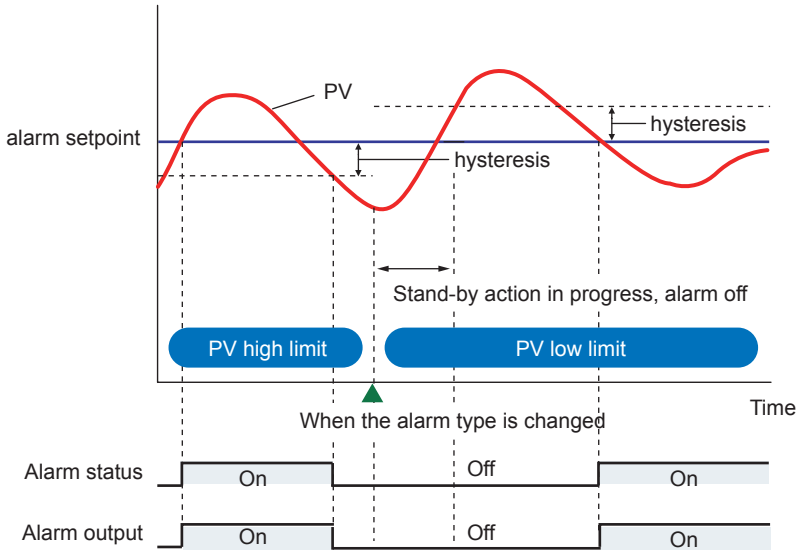
When the SP number is changed (in local mode)



Note

Stand-by action is not performed if the SP does not change.

When the alarm type is changed



3.6.7 Setting Hysteresis on Alarm Action

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control alarm**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Hysteresis[1]	0 to 30000	0

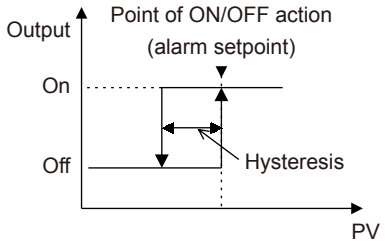
*1 The decimal place of the hysteresis is synchronized to the control PV input range.

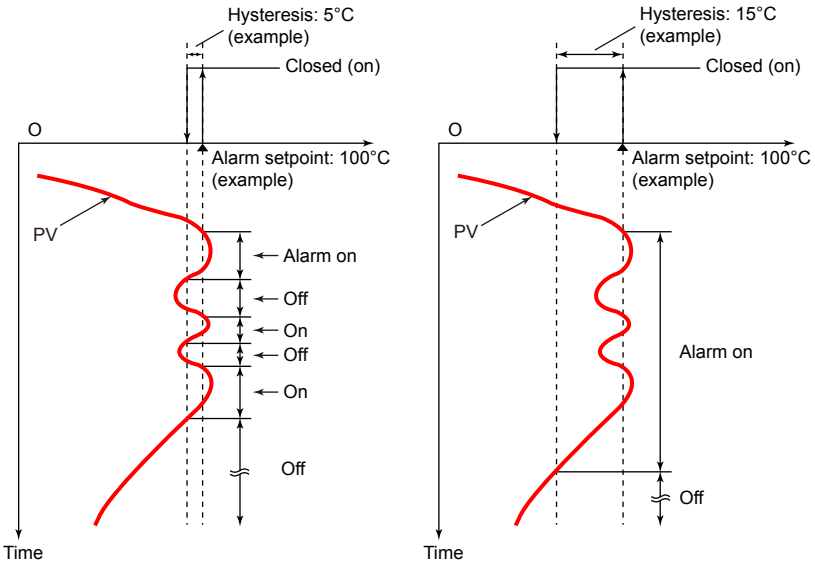
On/Off

To use an alarm level (1 to 4), set this to **On**.

Hysteresis

If the alarm output repeatedly turns on and off drastically, you can reduce the intensity by increasing the hysteresis.





Note

Hysteresis is a setting for each alarm level.

3.6.8 Delaying the Alarm Output (Delay timer)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control alarm**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
On-delay timer (minutes)[1]	0 to 99	0
On-delay timer (seconds)[1]	0 to 59	0
Off-delay timer (minutes)[1]	0 to 99	0
Off-delay timer (seconds)[1]	0 to 59	0

*1 Appears when Level (1 to 4) is set to **On**.

Note

Delay timer is a setting for each alarm level.

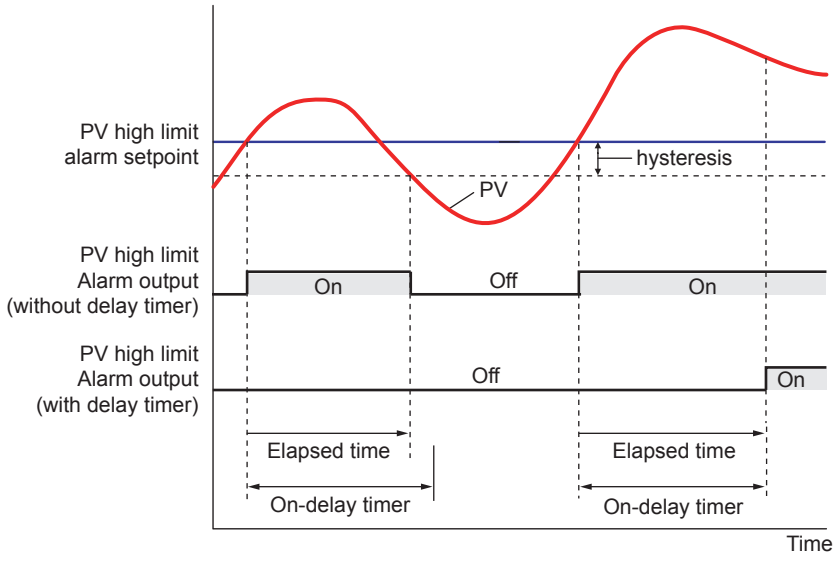
On/Off

To use an alarm level (1 to 4), set this to **On**.

On-delay timer

On-delay timer starts a timer when an alarm condition occurs and turns on the alarm when the timer expires.
If a value enters an area in which alarms do not occur when the timer is running, the timer is reset. While the timer is running, the alarm output and alarm status do not change.

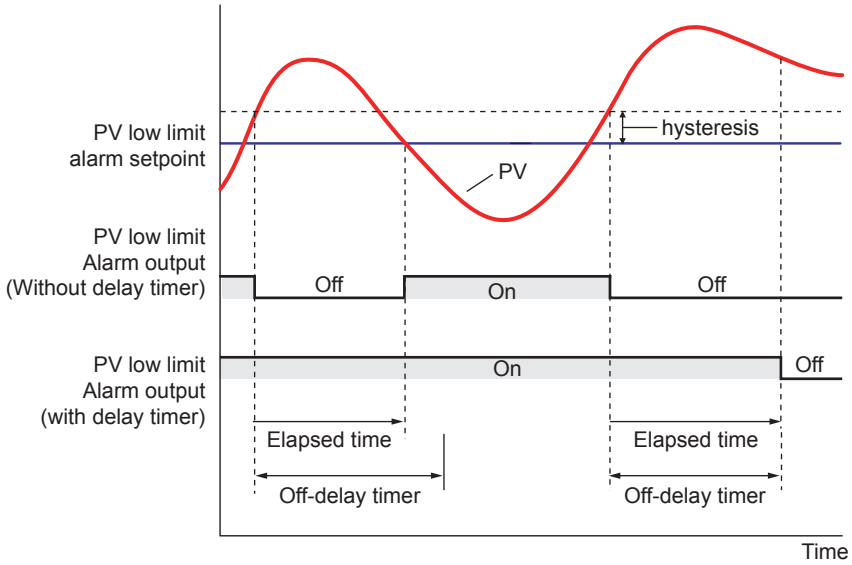
The following figure shows an example of an on-delay timer.



Energized when an event occurs

Off-delay timer

Off-delay timer starts a timer when the alarm condition clears (returns to normal condition) and turns off the alarm when the timer expires.
If a value enters an area in which alarms occur when the timer is running, the timer is reset.
While the timer is running, the alarm output and alarm status do not change.
The following figure shows an example of an off-delay timer.



Energized when an event occurs

3.6.9 Alarm ACK (Alarm Relay Hold Function and Hold Release Function)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control alarm**
Web application: **Control settings** tab > **Operation parameters** > **Control alarm**
Hardware configurator: **Control settings** tab > **Operation parameters** > **Control alarm**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Level 1, Level 2, Level 3, Level 4

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Relay action	Nonhold, Hold, Hold + Reset action on ACK, Nonhold + Reset action on ACK, Hold + Normal action on ACK	Nonhold

*1 Appears when Level (1 to 4) is set to **On**.

Note

Alarm ACK function is a setting for each alarm level.

On/Off

To use an alarm level (1 to 4), set this to **On**.

Relay action

The alarm ACK function holds an alarm output once an alarm condition (alarm output = on) occurs until an alarm ACK is received.

Explanation

The alarm ACK function has the following four types of actions.

- **Nonhold**

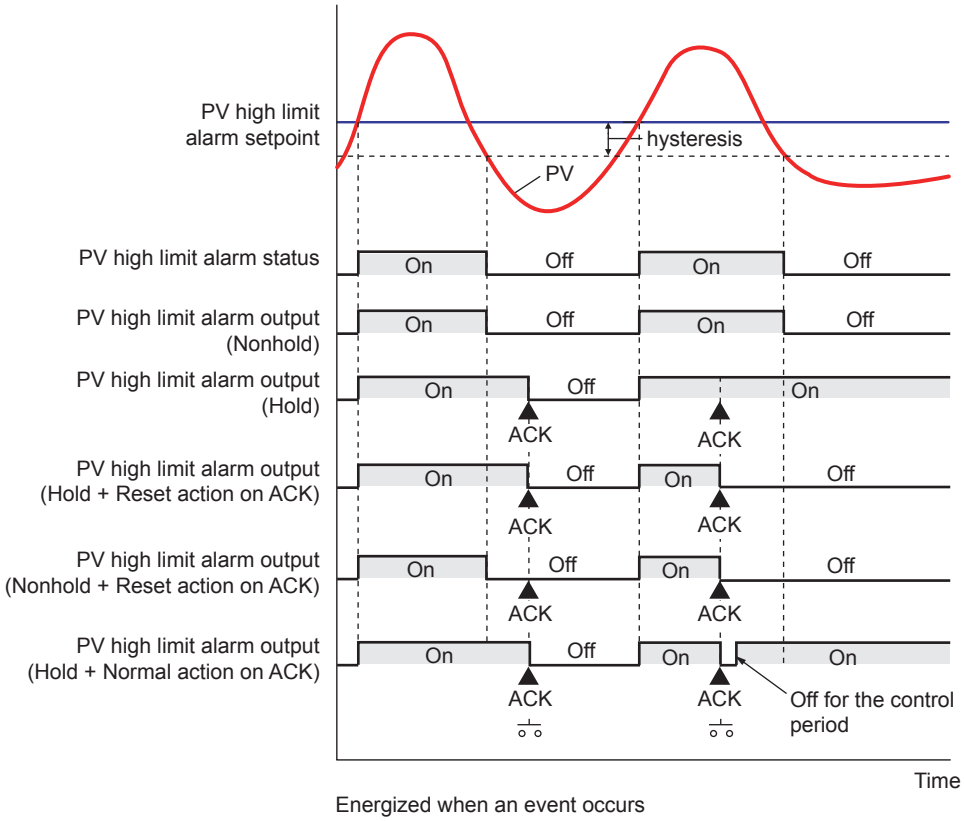
  The alarm ACK function is disabled.
- **Hold**

  Alarm output is released when an alarm ACK is received. (Alarm output = Off)
  However, alarm ACKs received when an alarm condition is true are ignored.
- **Hold + Reset action on ACK**

  Alarm output is released when an alarm ACK is received. (Alarm output = Off)
- **Nonhold + Reset action on ACK**

  Alarm output is released when an alarm ACK is received or when an alarm condition is no longer true. (Alarm output = Off)
- **Hold + Normal action on ACK**

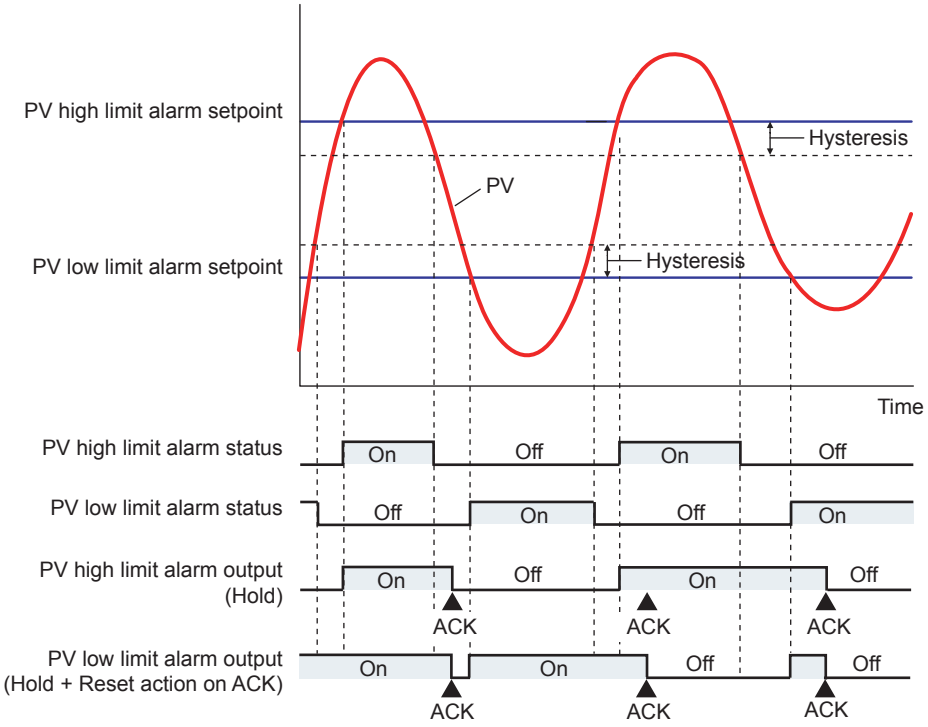
  Alarm output is released when an alarm ACK is received. (Alarm output = Off)
  However, if an alarm ACK is received when an alarm condition is true, alarm output is released for the control period. (Alarm output = Off)



Energized when an event occurs

Releasing Alarm ACK Hold

An alarm ACK hold can be released from the main unit or through contact input.
When released, all the alarm outputs in the relevant loop are released.
The following figure shows the alarm status and the alarm output state when PV high limit and PV low limit are in use.



Energized when an event occurs

3.7 Configuring the Action Function (Contact Input Function)

The action function is used to execute a specified action on the basis of events that occur. Auto/manual, stop/run, and other operation modes can be switched based on the occurrence of actions (contact inputs).

3.7.1 Setting Actions

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Action settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Action settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Action settings**

Description

Setup Item	Selectable Range or Options	Default Value
Unit number	Main unit, units 01 to 06	Depends on the module configuration
Slot number	00 to 09	Depends on the module configuration

Unit Number, Slot Number

Select the target unit number and slot number.

Action

Setup Item	Selectable Range or Options	Default Value
AUTO/MAN Switch (Loop1)	Off, DI1 to DI8,* DO1 to DO8,* Alarm 1 to 4,** Alarm 1 to 4 status**	Off
AUTO/MAN Switch (Loop2)		Off
STOP/RUN Switch (Loop1)		Off
STOP/RUN Switch (Loop2)		Off
REMOTE/LOCAL Switch (Loop1)		Off
REMOTE/LOCAL Switch (Loop2)		Off
Switch to cascade		Off
Switch to AUTO (Loop1)		Off
Switch to AUTO (Loop2)		Off
Switch to MAN (Loop1)		Off
Switch to MAN (Loop2)		Off
Switch to REMOTE (Loop1)		Off
Switch to REMOTE (Loop2)		Off
Switch to LOCAL (Loop1)		Off
Switch to LOCAL (Loop2)		Off
Auto-tuning START/STOP Switch (Loop1)		Off
Auto-tuning START/STOP Switch (Loop2)		Off
Alarm ACK (Loop1)		Off
Alarm ACK (Loop2)		Off
Bit-0 of SP Number (Loop1)		Off
Bit-1 of SP Number (Loop1)		Off
Bit-2 of SP Number (Loop1)		Off
Bit-3 of SP Number (Loop1)		Off
Bit-0 of SP Number (Loop2)		Off
Bit-1 of SP Number (Loop2)		Off
Bit-2 of SP Number (Loop2)		Off
Bit-3 of SP Number (Loop2)		Off
Bit-0 of PID Number (Loop1)		Off
Bit-1 of PID Number (Loop1)		Off
Bit-2 of PID Number (Loop1)		Off
Bit-3 of PID Number (Loop1)		Off
Bit-0 of PID Number (Loop2)		Off
Bit-1 of PID Number (Loop2)		Off
Bit-2 of PID Number (Loop2)		Off
Bit-3 of PID Number (Loop2)		Off
PV switching		Off

* Digital inputs (DI1 to DI8) and digital outputs (DO1 to DO8) are only for PID control modules.
** Alarm level indicates the alarm state. Alarm status indicates the alarm output state including the relay action.

AUTO/MAN switch

Contact input is used to switch AUTO and MAN. Switching takes place on the signal edge.

Contact status	Action
OFF→ON	Auto
ON→OFF	Manual

REMOTE/LOCAL switch

Contact input is used to switch REMOTE and LOCAL. Switching takes place on the signal edge.
This can be executed when on the Hardware configurator, **Control settings** tab > **Basic control settings** > **Control loop settings** > Basic action > RSP function is set to **ON**.

Contact status	Action
OFF→ON	Remote mode
ON→OFF	Local mode

STOP/RUN switch

Contact input is used to switch STOP and RUN. Switching takes place on the signal edge.
This cannot be executed on loops running under program operation.

Contact status	Action
OFF→ON	STOP
ON→OFF	START

Switch to Cascade

Contact input is used to switch to cascade mode during cascade control. Switching takes place on triggers.
This can be executed when on the Hardware configurator, **Control settings** tab > **Basic control settings** > **Basic control settings** > Basic action > Control mode is set to **Cascade control**.

Contact status	Action
OFF→ON	Switch to cascade
ON→OFF	The current operation is retained.

Switch to AUTO

Contact input is used to switch to AUTO. Switching takes place on triggers.

Contact status	Action
OFF→ON	Switch to AUTO
ON→OFF	The current operation is retained.

Switch to MAN

Contact input is used to switch to MAN. Switching takes place on triggers.

Contact status	Action
OFF→ON	Switch to MAN
ON→OFF	The current operation is retained.

Switch to REMOTE

Contact input is used to switch to REMOTE. Switching takes place on triggers.
This function works when the RSP function is set to **On**.

Contact status	Action
OFF→ON	Switch to REMOTE
ON→OFF	The current operation is retained.

Switch to LOCAL

Contact input is used to switch to LOCAL. Switching takes place on triggers.
This function works when the RSP function is set to **On**.

Contact status	Action
OFF→ON	Switch to LOCAL
ON→OFF	The current operation is retained.

Auto-tuning START/STOP Switch

Contact input is used to switch Auto-tuning START/STOP. Auto-tuning is executed on the currently specified PID group. Switching takes place on the signal edge.

Contact status	Action
OFF→ON	Auto-tuning start
ON→OFF	Auto-tuning stop

Alarm ACK

Contact input is used to switch alarm ACK. Switching takes place on triggers.

Contact status	Action
OFF→ON	Alarm ACK
ON→OFF	The current operation state is retained.

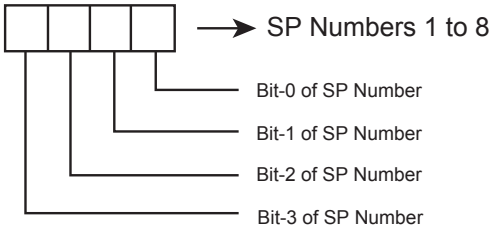
PV switching

Contact input is used to switch the input during loop control with PV switching. Switching takes place on the signal edge.
If EXPV input is in use, AI2 becomes EXPV2 and AI1 becomes EXPV1.
This can be executed when on the Hardware configurator, **Control settings** tab > **Basic control settings** > **Basic control settings** > Basic action > Control mode is set to **PV switching** and the Input switching action is set to **Switch using DI**.

Contact status	Action
OFF→ON	AI2 input
ON→OFF	AI1 input

Bit-0 to 3 of SP Number

Contact input is used to switch SP numbers. Switching takes place on triggers.
The on/off combination of contacts are used to switch the SP number.



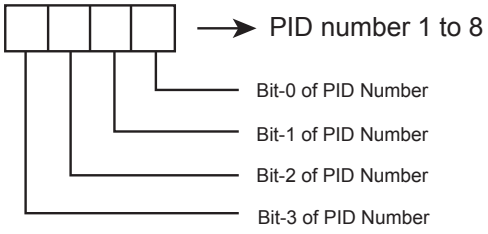
SP number	Contact status			
	Bit 3	Bit 2	Bit 1	Bit 0
The current status is retained.	Off	Off	Off	Off
1	Off	Off	Off	On
2	Off	Off	On	Off
3	Off	Off	On	On
4	Off	On	Off	Off
5	Off	On	Off	On
6	Off	On	On	Off
7	Off	On	On	On
8	On	Off	Off	Off

Note

- If a value greater than the specified number of SP groups, the current number is retained.
- If a number between 9 and 15 is set, the current number is retained.
- If bits of SP number are not assigned to the contact input, contact input is off.
- If the bits are all off, the previous SP number is retained.

Bit-0 to 3 of PID Number

This can be executed when on the Hardware configurator, **Control settings** tab > **Basic control settings** > **Control loop settings** > Basic action > PID selection is set to **External selection**.
Contact input is used to switch PID numbers. Switching takes place on triggers.
The on/off combination of contacts are used to switch the PID number.



PID number	Contact status			
	Bit 3	Bit 2	Bit 1	Bit 0
The current status is retained.	Off	Off	Off	Off
1	Off	Off	Off	On
2	Off	Off	On	Off
3	Off	Off	On	On
4	Off	On	Off	Off
5	Off	On	Off	On
6	Off	On	On	Off
7	Off	On	On	On
8	On	Off	Off	Off

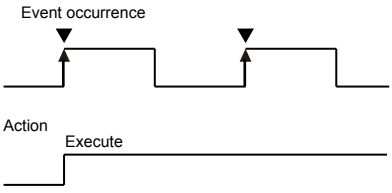
Note

- If a value greater than the specified number of PID groups, the current number is retained.
- If a number between 9 and 15 is set, the current number is retained.
- If bits of PID number are not assigned to the contact input, contact input is off.
- If the bits are all off, the previous PID number is retained.

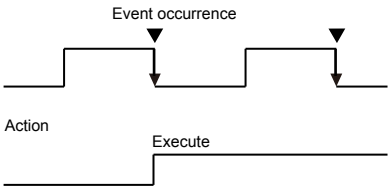
Operation mode

Operation mode	Description
Rising edge (when the contact action is set to energize)	The action is executed when the event changes from off to on.
Falling edge (when the contact action is set to energize)	The action is executed when the event changes from on to off.
Trigger (detected on a ON signal lasting longer than the control period)	The action is executed when an event occurs.

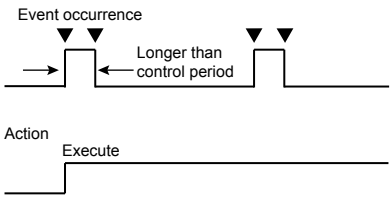
Rising edge
(when the contact action
is set to energize)



Falling edge
(when the contact action
is set to energize)



Trigger
(detected on a ON signal lasting
longer than the control period)



3.8 Configuring the Control Event Action Function

The DIs, DOs, and internal switches of the modules installed in the main unit or expansion I/O or sub unit can be assigned to events and actions of the event action function.

3.8.1 Setting the Control Event Action Number, Event, and Action

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control event action**
Web application: **Config.** tab > **Control event action**
Hardware configurator: **Config.** tab > **Control event action**

Description

Setup Item	Selectable Range or Options	Default Value
Control event action number	1 to 100	1

Control event action number

Select the control event action number to assign a control event action.

DI/DO/Internal switch registration

Setup Item	Selectable Range or Options	Default Value
Type	Off, DI, DO, Internal switch	Off
Number	0001 to 0100 (available channel number)	0001
Operation/Status output	Operation/Status output	Operation
Content (operation)	PROG/RESET Switch[1] Pattern no. 1 to 2 (1 bit: PT1-2)[1] Pattern no. 1 to 4 (2 bit: PT1-4)[1] Pattern no. 1 to 8 (3 bit: PT1-8)[1] Pattern no. 1 to 16 (4 bit: PT1-16)[1] Pattern no. 1 to 32 (5 bit: PT1-32)[1] Pattern no. 1 to 64 (6 bit: PT1-64)[1] Pattern no. 1 to 99 (7 bit: PT1-99)[1] Pattern no. 1 to 99 (BCD 8bit: PT1-99)[1] Pattern no. 1 to 9 (BCD 4 bit: PT1-9)[1] Switch to HOLD,[1] Advance of segment[1] Start of program operation,[1] Stop of program operation[1] HOLD operation of specified loop[1, 2] ADVANCE operation of specified loop[1, 2] Start program operation of specified loop[1, 2] Stop program operation of specified loop[1, 2] Run all control loops, Stop all control loops STOP/RUN Switch, AUTO/MAN switch REMOTE/LOCAL switch Switch to AUTO, Switch to MAN, Switch to Cascade Switch to Remote, Switch to Local SP no. 1 to 2 (1 bit: SP1-2) SP no. 1 to 4 (2 bit: SP1-4) SP no. 1 to 8 (3 bit: SP1-8) SP no. 1 to 8 (BCD 4 bit: SP1-8)	—
Detail 1 *2	Pattern number, Variable constant (W)	—
Number *2	1 to 99 when Detail 1 is Pattern number 1 to 100 when Detail 1 is Variable constant (W)	—
Detail 2 *2	Loop number, Variable constant (W)	—
Number *2	L001 to L652	—

1 This is available when the /PG option is installed.
2 This is set for operation of specified loops.

Setup Item	Selectable Range or Options	Default Value
Content (Status output)	Segment no. 1 (1 bit: Seg1)[1] Segment no. 1 to 3 (2 bit: Seg1-3)[1] Segment no. 1 to 7 (3 bit: Seg1-7)[1] Segment no. 1 to 15 (4 bit: Seg1-15)[1] Segment no. 1 to 31 (5 bit: Seg1-31)[1] Segment no. 1 to 63 (6 bit: Seg1-63)[1] Segment no. 1 to 99 (7 bit: Seg1-99)[1] Segment no. 1 to 99 (BCD 8bit: Seg1-99)[1] Segment no. 1 to 9 (BCD 4 bit: Seg1-9)[1] Pattern no. 1 (1 bit: Patrn1)[1] Pattern no. 1 to 3 (2 bit: Patrn1-3)[1] Pattern no. 1 to 7 (3 bit: Patrn1-7)[1] Pattern no. 1 to 15 (4 bit: Patrn1-15)[1] Pattern no. 1 to 31 (5 bit: Patrn1-31)[1] Pattern no. 1 to 63 (6 bit: Patrn1-63)[1] Pattern no. 1 to 99 (7 bit: Patrn1-99)[1] Pattern no. 1 to 99 (BCD 8bit: Patrn1-99)[1] Pattern no. 1 to 9 (BCD 4 bit: Patrn1-9)[1] PROG/RESET monitoring[1] Wait end signal (1s)[1] Wait end signal (3s)[1] Wait end signal (5s)[1] Pattern end signal (1s)[1] Pattern end signal (3s)[1] Pattern end signal (5s)[1] PV event status[1] Time event status[1] Wait flag[1] Hold-on flag[1] Control status[1]	—

1 This is available when the /PG option is installed.

Note

To set the status output, set the range type in DO settings of the DO module or PID control module to **Manual**.

Control operation

The control operation can be switched using DI, DO, or SW.

Control operation content	Contact status	Action
All loop control operation start	OFF→ON	All loop control operation start
	ON→OFF	The current operation state is retained.
All loop control operation stop	OFF→ON	All loop control operation stop
	ON→OFF	The current operation state is retained.
Control operation stop/run (specified loop)	OFF→ON	Control operation stop
	ON→OFF	Control operation run
Auto/manual switch (specified loop)	OFF→ON	Switch to AUTO
	ON→OFF	Switch to MAN
REMOTE/LOCAL switch (specified loop)	OFF→ON	Switch to MAN
	ON→OFF	Switch to Local
Switch to AUTO (specified loop)	OFF→ON	Switch to AUTO
	ON→OFF	The current operation state is retained.
Switch to MAN (specified loop)	OFF→ON	Switch to MAN
	ON→OFF	The current operation state is retained.
Cascade switch (specified loop)	OFF→ON	Switch to Cascade
	ON→OFF	The current operation state is retained.
Remote switch (specified loop)	OFF→ON	Switch to MAN
	ON→OFF	The current operation state is retained.
Local switch (specified loop)	OFF→ON	Switch to Local
	ON→OFF	The current operation state is retained.
Switch to HOLD	OFF→ON	Hold operation run
	ON→OFF	The current operation state is retained.
Advance of segment	OFF→ON	Segment advance
	ON→OFF	The current operation state is retained.
Start of program operation	OFF→ON	Start of program operation
	ON→OFF	The current operation state is retained.
Stop of program operation	OFF→ON	Stop of program operation
	ON→OFF	The current operation state is retained.
PROG/RESET Switch	OFF→ON	Operation run (PROG)
	ON→OFF	Operation stop (RESET)
HOLD operation of specified loop	OFF→ON	Hold operation run*
	ON→OFF	The current operation state is retained.
ADVANCE operation of specified loop	OFF→ON	Segment advance*
	ON→OFF	The current operation state is retained.
Start program operation of specified loop	OFF→ON	Program operation run*
	ON→OFF	The current operation state is retained.
Stop program operation of specified loop	OFF→ON	Program operation stop*
	ON→OFF	The current operation state is retained.
Pattern no. 1 to 2 (1 bit)	OFF→ON ON→OFF	See the table in “■ Binary Switching.”
Pattern no. 1 to 4 (2 bit)		
Pattern no. 1 to 8 (3 bit)		
Pattern no. 1 to 16 (4 bit)		
Pattern no. 1 to 32 (5 bit)		
Pattern no. 1 to 64 (6 bit)		
Pattern no. 1 to 99 (7 bit)		
Pattern no. 1 to 99 (BCD 8bit)	OFF→ON ON→OFF	See the table in “■ BCD Switching.” If the bits are all off, the previous pattern number is retained.
Pattern no. 1 to 9 (BCD 4 bit)		
SP no. 1 to 2 (1 bit)	OFF→ON ON→OFF	See the table in “■ Binary Switching.”
SP no. 1 to 4 (2 bit)		
SP no. 1 to 8 (3 bit)		
SP no. 1 to 8 (BCD 4 bit)	OFF→ON ON→OFF	See the table in “■ BCD Switching.” If the bits are all off, the previous SP number is retained.

* If the pattern file does not contain the specified pattern number or loop number, the function does not work.

The following operation is performed on the specified pattern number.

Operation
Switch to HOLD
Advance of segment
Start of program operation
Stop of program operation
PROG/RESET switch

Pattern number setting method
Control event action: Pattern number setting binary
Control event action: Pattern number setting BCD
Communication command (OCtrlPat)
SET PT No. button on the program selection screen

■ Binary Switching

Switching the pattern number based on the binary combination of DI, DO, and SW

Pattern number	DI, DO, and SW states						
	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	OFF	OFF	OFF	ON
3	OFF	OFF	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	OFF	ON	ON
5	OFF	OFF	OFF	OFF	ON	OFF	OFF
6	OFF	OFF	OFF	OFF	ON	OFF	ON
7	OFF	OFF	OFF	OFF	ON	ON	OFF
8	OFF	OFF	OFF	OFF	ON	ON	ON
9	OFF	OFF	OFF	ON	OFF	OFF	OFF
10	OFF	OFF	OFF	ON	OFF	OFF	ON
			•				
			•				
91	ON	OFF	ON	ON	OFF	ON	OFF
92	ON	OFF	ON	ON	OFF	ON	ON
93	ON	OFF	ON	ON	ON	OFF	OFF
94	ON	OFF	ON	ON	ON	OFF	ON
95	ON	OFF	ON	ON	ON	ON	OFF
96	ON	OFF	ON	ON	ON	ON	ON
97	ON	ON	OFF	OFF	OFF	OFF	OFF
98	ON	ON	OFF	OFF	OFF	OFF	ON
99	ON	ON	OFF	OFF	OFF	ON	OFF

Switching the target setpoint number based on the binary combination of DI, DO, and SW

Target setpoint number	DI, DO, and SW states						
	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF
2	OFF	OFF	OFF	OFF	OFF	OFF	ON
3	OFF	OFF	OFF	OFF	OFF	ON	OFF
4	OFF	OFF	OFF	OFF	OFF	ON	ON
5	OFF	OFF	OFF	OFF	ON	OFF	OFF
6	OFF	OFF	OFF	OFF	ON	OFF	ON
7	OFF	OFF	OFF	OFF	ON	ON	OFF
8	OFF	OFF	OFF	OFF	ON	ON	ON

■ BCD Switching

Switching the pattern number based on the BCD combination of DI, DO, and SW

Pattern number	DI, DO, and SW states							
	Higher digits (0-9)				Lower digits (0-9)			
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
				•				
				•				
91	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
92	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
93	ON	OFF	OFF	ON	OFF	OFF	ON	ON
94	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
95	ON	OFF	OFF	ON	OFF	ON	OFF	ON
96	ON	OFF	OFF	ON	OFF	ON	ON	OFF
97	ON	OFF	OFF	ON	OFF	ON	ON	ON
98	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
99	ON	OFF	OFF	ON	ON	OFF	OFF	ON

Note

If DI, DO, and SW area all set to off, the previous pattern number is retained.

Switching the target setpoint number based on the BCD combination of DI, DO, and SW

Target setpoint number	DI, DO, and SW states							
	Higher digits (0-9)				Lower digits (0-9)			
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF

Note

If DI, DO, and SW area all set to off, the previous target setpoint number is retained.

Example: Switching the target setpoint number of loop number L611 to SP5 using internal switches (SW30 to 33)

Setup Item	Value
Type	Internal switch
Number	0030
Operation/Status output	Operation
Description	SP no. 1 to 8 (BCD 4 bit)
Number	L611

Internal switch values

Internal switch	Value
SW30(Bit0)	**ON**
SW31(Bit1)	**OFF**
SW32(Bit2)	**ON**
SW33(Bit3)	**OFF**

Notification and Monitoring

Control status monitoring parameters and notifications (events) are output to DO or internal switches (as actions).
When outputting to DO or internal switches, the range type in DO settings must be set to Manual.

▶ For details on how to use the DO terminals, see section 3.6.3, “Setting How to Use the DO Terminal (Contact output within module, Alarm, Manual).”

Output information	Contact status	
	ON	OFF
Control status	RUN mode	STOP mode
Wait end signal (1s)	Wait end	Normal operation
Wait end signal (3s)	Wait end	Normal operation
Wait end signal (5s)	Wait end	Normal operation
Pattern end signal (1s)	Pattern end	Normal operation
Pattern end signal (3s)	Pattern end	Normal operation
Pattern end signal (5s)	Pattern end	Normal operation
PV event status	PV event occurrence	Normal operation
Time event status	Time event occurrence	Normal operation
Wait flag	Waiting	Normal operation
Hold-on flag	Holding	Normal operation
PROG/RESET monitoring	Operation run (PROG)	Operation stop (RESET)
Segment no. 1 (1 bit)	Running segment number See the table in “■ Pattern Number Output, Segment Number Output.”	
Segment no. 1 to 3 (2 bit)		
Segment no. 1 to 7 (3 bit)		
Segment no. 1 to 15 (4 bit)		
Segment no. 1 to 31 (5 bit)		
Segment no. 1 to 63 (6 bit)		
Segment no. 1 to 99 (7 bit)		
Segment no. 1 to 99 (BCD 8bit)		
Segment no. 1 to 9 (BCD 4 bit)		
Pattern no. 1 (1 bit)	Running pattern number See the table in “■ Pattern Number Output, Segment Number Output.”	
Pattern no. 1 to 3 (2 bit)		
Pattern no. 1 to 7 (3 bit)		
Pattern no. 1 to 15 (4 bit)		
Pattern no. 1 to 31 (5 bit)		
Pattern no. 1 to 63 (6 bit)		
Pattern no. 1 to 99 (7 bit)		
Pattern no. 1 to 99 (BCD 8bit)		
Pattern no. 1 to 9 (BCD 4 bit)		

Note

Output information “segment number binary,” “segment number BCD,” “pattern number binary,” and “pattern number BCD” can be used on consecutive channels in the same module. (DO channels of multiple modules cannot be used consecutively.)

■ Pattern Number Output, Segment Number Output

Switching the pattern number or segment number based on the binary combination of DO and SW

Pattern number, segment number	DO and SW states						
	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0	OFF	OFF	OFF	OFF	OFF	OFF	OFF
1	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	ON	OFF	ON	OFF
			•				
			•				
91	ON	OFF	ON	ON	OFF	ON	ON
92	ON	OFF	ON	ON	ON	OFF	OFF
93	ON	OFF	ON	ON	ON	OFF	ON
94	ON	OFF	ON	ON	ON	ON	OFF
95	ON	OFF	ON	ON	ON	ON	ON
96	ON	ON	OFF	OFF	OFF	OFF	OFF
97	ON	ON	OFF	OFF	OFF	OFF	ON
98	ON	ON	OFF	OFF	OFF	ON	OFF
99	ON	ON	OFF	OFF	OFF	ON	ON

Switching the pattern number or segment number based on the BCD combination of DO and SW

Pattern number	DO and SW states							
	Higher digits (0-9)				Lower digits (0-9)			
	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
1	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON
2	OFF	OFF	OFF	OFF	OFF	OFF	ON	OFF
3	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
4	OFF	OFF	OFF	OFF	OFF	ON	OFF	OFF
5	OFF	OFF	OFF	OFF	OFF	ON	OFF	ON
6	OFF	OFF	OFF	OFF	OFF	ON	ON	OFF
7	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
8	OFF	OFF	OFF	OFF	ON	OFF	OFF	OFF
9	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
10	OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF
				•				
				•				
91	ON	OFF	OFF	ON	OFF	OFF	OFF	ON
92	ON	OFF	OFF	ON	OFF	OFF	ON	OFF
93	ON	OFF	OFF	ON	OFF	OFF	ON	ON
94	ON	OFF	OFF	ON	OFF	ON	OFF	OFF
95	ON	OFF	OFF	ON	OFF	ON	OFF	ON
96	ON	OFF	OFF	ON	OFF	ON	ON	OFF
97	ON	OFF	OFF	ON	OFF	ON	ON	ON
98	ON	OFF	OFF	ON	ON	OFF	OFF	OFF
99	ON	OFF	OFF	ON	ON	OFF	OFF	ON

Conditions That Can Be Set for Control Event Actions

Type (event/action)			Operation/Status output (action/event)	Description
DO	SW	DI		
√ When the DO range type is set to alarm or manual		√	Action	PROG/RESET Switch*
				Pattern number setting binary*
				Pattern number setting BCD*
				Switch to HOLD*
				Advance of segment*
				Program operation run*
				Program operation stop*
				HOLD operation of specified loop*
				ADVANCE operation of specified loop*
				Start program operation of specified loop*
				Stop program operation of specified loop*
				Run all control loops
				Stop all control loops
				STOP/RUN switch
				AUTO/MAN switch
				REMOTE/LOCAL switch
				Switch to AUTO
				Switch to MAN
				Switch to Cascade
				Switch to MAN
				Switch to Local
				SP number setting binary
				SP number setting BCD
√ When the DO range type is set to manual		–	Status output (event)	Segment number binary*
				Segment number binary*
				Segment number BCD*
				Pattern number binary*
				Pattern number BCD*
				PROG/RESET monitoring*
				Wait end signal (1s)*
				Wait end signal (3s)*
				Wait end signal (5s)*
				Pattern end signal (1s)*
				Pattern end signal (3s)*
				Pattern end signal (5s)*
				PV event status*
				Time event status*
				Wait flag*
				Hold-on flag*
				Control status

* With the /PG option

3.9 Configuring the Control Display Function

Configure display settings.

3.9.1 Configuring Control Groups

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Control group settings**
Web application: **Control settings** tab > **Control settings** > **Control group settings**
Hardware configurator: **Control settings** tab > **Control settings** > **Control group settings**

Description

Setup Item	Selectable Range or Options	Default Value
Group number	GX10/GX20/GP10/GP20/GM10 standard type: 1 to 5 (the number of loops that can be registered on the GX10/GP10 standard type is six, and that on the GX20/GP20/GM10 standard type is eight) GX20/GP20/GM10 large memory type: 1 to 10 (the number of loops that can be registered on the GX20/GP20/GM10 is eight)	1

Group number

Select the target group group number.

Note

- Measurement channels cannot be registered to the control group screen.
- The display update interval is 500 ms (fixed).

Group settings

Setup Item	Selectable Range or Options	Default Value
Group On/Off	Off/On	Depends on the module configuration
Group name	Character string (up to 16 characters, Aa#1)	Group number 1 is “CONTROL GROUP 1.” Group number 2 is “CONTROL GROUP 2.” • • • Group number 10 is “CONTROL GROUP 10.”
Division	Split 2, Split 4, Split 6, Split 8	GX10/GP10: Split 6 GX20/GP20: Split 8

Group On/Off

Set this to **On** to use the target group number.

Group name

Set the group name.

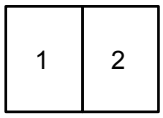
Division

Set the number of loops to display on the control group screen.

The screen layout is determined by the display division setting. The layout for each setting is shown below.

Controller style

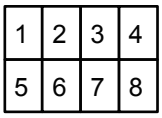
Display division: 2



Display division: 4

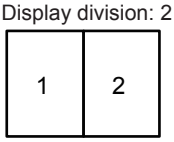
Display division: 6

Display division: 8

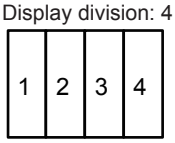


Faceplate style

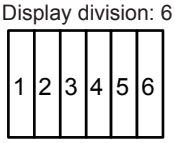
Display division: 2



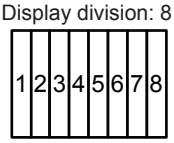
Display division: 4



Display division: 6



Display division: 8



1 to 8

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Loop number	L001 to L652	—

On/Off

Set this to **On** to use the target loop number.

Loop number

Select the loop number.

3.9.2 Setting the Displayed Contents of Loops

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Loop display settings**
Web application: **Control settings** tab > **Control display** > **Loop display settings**
Hardware configurator: **Control settings** tab > **Control display** > **Loop display settings**

Description

Setup Item	Selectable Range or Options	Default Value
Loop number	L001 to L652	Depends on the module configuration

Loop number

Select the target loop number.

Tag

Setup Item	Selectable Range or Options	Default Value
Characters	Character string (up to 32 characters, Aa#1)	—
No.	Character string (up to 16 characters, Aa#1)	—

Characters

Set the tag.
Not all characters may be displayed due to space constraints.

No.

Set the tag number.

Precedence in Displaying Characters and Numbers

If either the tag number or tag characters can be displayed in the loop tag display area, tag numbers are displayed with higher precedence than tag characters.

When tag numbers are not assigned, tag characters are displayed.
If neither the tag numbers or tag characters are assigned, loop numbers are displayed.

Color (recorder option /PG)

Setup Item	Selectable Range or Options	Default Value
Pattern color	24 colors (red, green, blue, blue violet, brown, orange, yellow-green, light blue, violet, gray, lime, cyan, dark blue, yellow, light gray, purple, black, pink, light brown, light green, dark gray, olive, dark cyan, and spring green) and a user-defined color (1 color)	—

Pattern color*

Set the loop color. This is used in the waveform display of program patterns.

* This is available only when the /PG option is installed.

Deviation display band

Setup Item	Selectable Range or Options	Default Value
Deviation display band	0.0 to 100.0% of control PV input range span	1.0% of control PV input range span

Deviation display band

Set the deviation display band. This is used in the deviation display on the control group screen.

3.9.3 Setting the PID Channel Display

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **PID channel settings**
Web application: **Control settings** tab > **Control display** > **PID channel settings** > **Channel range** (display example: 0001-0026)
Hardware configurator: **Control settings** tab > **Control display** > **PID channel settings** > **Channel range** (display example: 0001-0026)

Description

Setup Item	Selectable Range or Options	Default Value
Channel number	PID channel	—

Channel number

Select the target computation channels.

Note

You cannot assign alarms to PID channels. Control alarm settings are not applied to PID channels.

Tag

Setup Item	Selectable Range or Options	Default Value
Characters	Character string (up to 32 characters, Aa#1)	—
No.	Character string (up to 16 characters, Aa#1)	Channel number, dot, and ID symbol (Example) 0001.PV1, 0002.SP1 to 0026.DO8

Characters

Set the tag.
Not all characters may be displayed due to space constraints.

No.

Set the tag number.

Precedence in Displaying Characters and Numbers

Tag numbers are displayed with higher precedence than tag characters.
When tag numbers are not assigned, tag characters are displayed.
If neither the tag numbers or tag characters are assigned, channel numbers are displayed.

Color

Setup Item	Selectable Range or Options	Default Value
Color	24 colors (red, green, blue, blue violet, brown, orange, yellow-green, light blue, violet, gray, lime, cyan, dark blue, yellow, light gray, purple, black, pink, light brown, light green, dark gray, olive, dark cyan, and spring green) and a user-defined color (1 color)	—

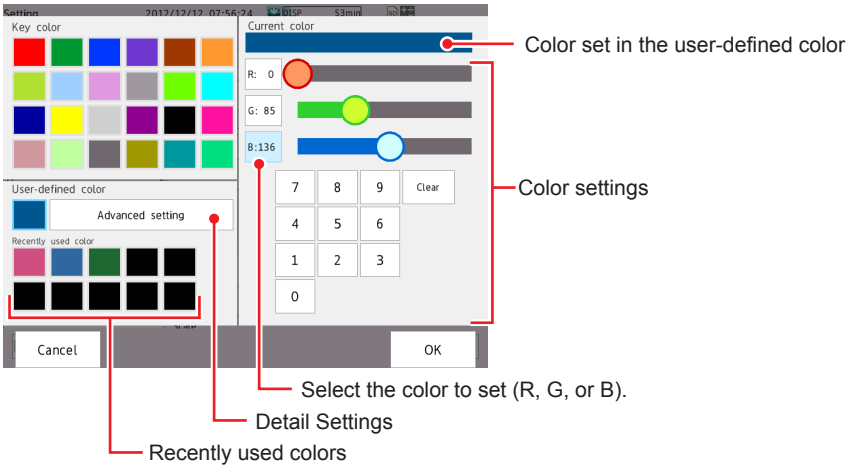
Color

Set channel display colors. The colors apply to the trend display and bar graph display.

Setting the User-Defined Color

1. Tap **Color**.
   The Setting screen appears.

2. Tap **Advanced setting**.
   Setup keys appear in the right area.



3. Select R, G, B one at a time, and set each value using the numeric keypad or the bars.

4. Tap **OK**.
   The user-defined color is set.

The color that you created is registered under **Recently used color** (up to 10 colors). You can select a color from here.

Operation complete

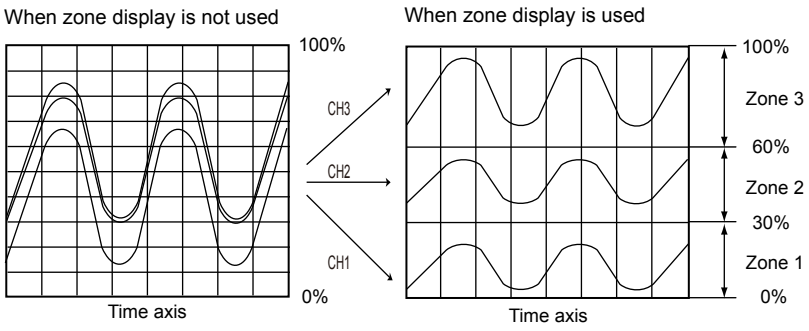
Zone

Setup Item	Selectable Range or Options	Default Value
Lower	0 to 95%	0
Upper	5 to 100%	100

Lower and Upper

Set these values when you want to divide the waveform displays of channels into separate zones so that waveforms do not overlap. Set the **Lower** and **Upper** positions as percentages of the maximum display width. Set **Lower** to a value less than **Upper**, and set the zone width (**Upper** – **Lower**) to be 5% or greater.

Example:
Set the channel 1 zone to 0 to 30%, the channel 2 zone to 30 to 60%, and the channel 3 zone to 60 to 100%.



Scale

Setup Item	Selectable Range or Options	Default Value
Position	GX20/GP20: Off/1/2/3/4/5/6/7/8/9/10 GX10/GP10: Off/1/2/3/4/5/6	1
Division	4/5/6/7/8/9/10/11/12/C10	10

Position

Set the scale display positions when you want to display multiple scales on the trend display. Set this to **Off** to not display scales.

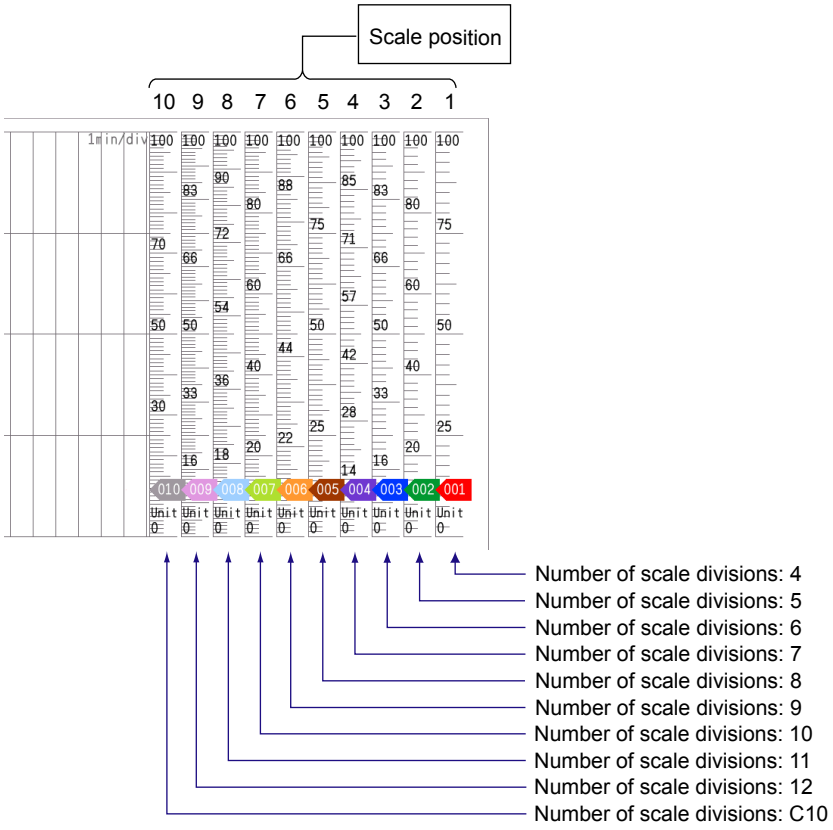
Division*

Set the number of divisions to make with the main scale marks.
C10: The scale is equally divided into 10 sections by main scale marks, and scale values are indicated at 0, 30, 50, 70, and 100% positions.

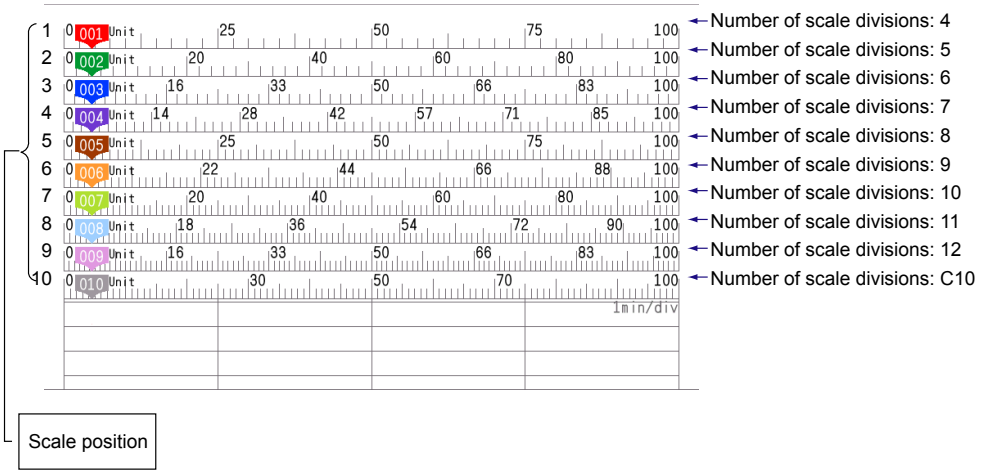
* You can set this for channels other than DI and DO.

The figure below shows an example of scales for different number of divisions where the span is between 0 and 100 and the unit is set to "Unit."

Horizontal Trend Display



Vertical Trend Display



Bar graph

Setup Item	Selectable Range or Options	Default Value
Base position	Lower, Center, Upper	Lower
Division	4/5/6/7/8/9/10/11/12	10

Base position

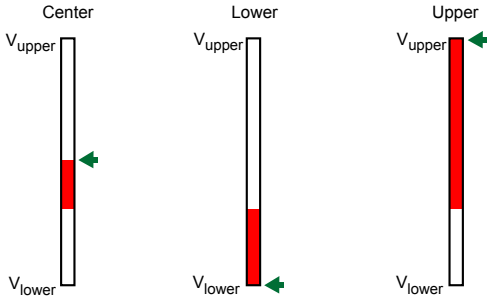
Set the bar graph base position. Depending on the setting, the bar graph is displayed as follows. This setting is applied when you are displaying the current value on the scale as a bar graph on the bar graph and trend displays.

When the Display Direction of the Bar Graph Is Vertical

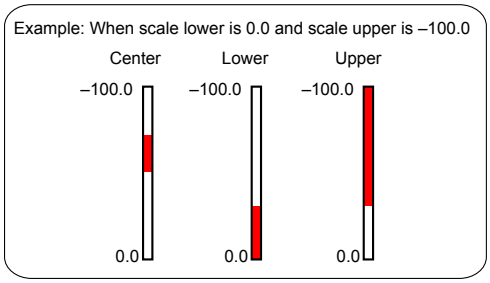
For PV and SP, the minimum and maximum values of the control PV input range become the top and bottom edges of the bar graph. For AI, the scale lower and scale upper become the top and bottom edges. For OUT and AO, 0% and 100% become top and bottom.

Starting point of the bar

Center: Center
Lower: Bottom edge
Upper: Top edge



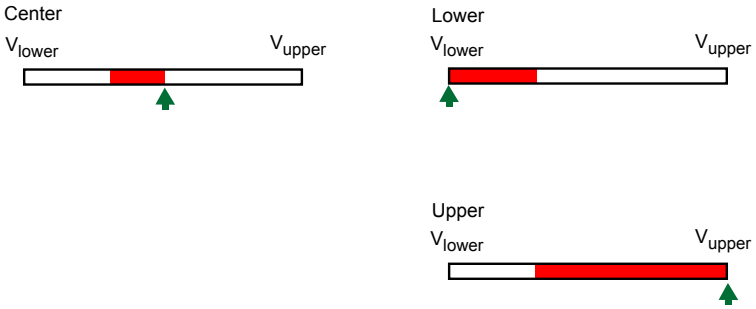
Vupper: Maximum value of control PV input range, scale upper, or 100%
Vlower: Minimum value of control PV input range, scale lower, or 0%
◀ : Starting point of the bar



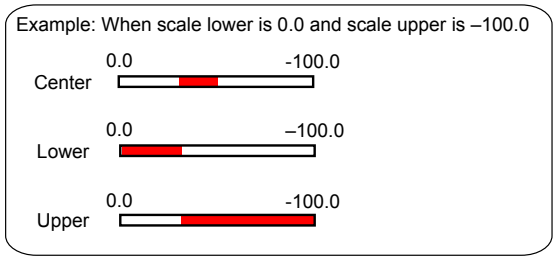
When the Display Direction of the Bar Graph Is Horizontal

For PV and SP, the minimum and maximum values of the control PV input range become the top and bottom edges of the bar graph. For AI, the scale lower and scale upper become the top and bottom edges. For OUT and AO, 0% and 100% become top and bottom.

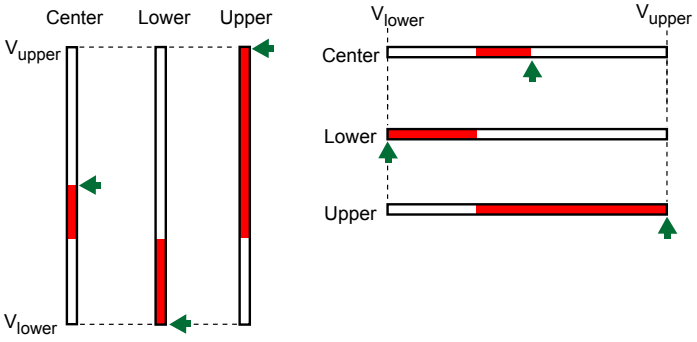
Starting point of the bar
- Center: Center
- Lower: Left edge
- Upper: Right edge



Vupper: Maximum value of control PV input range, scale upper, or 100%
Vlower: Minimum value of control PV input range, scale lower, or 0%
▲ : Starting point of the bar



When Displaying the Current Value on the Scale Using the Bar Graph



Division*

Set the number of divisions to make with the main scale marks.

* You can set this for channels other than DI and DO.

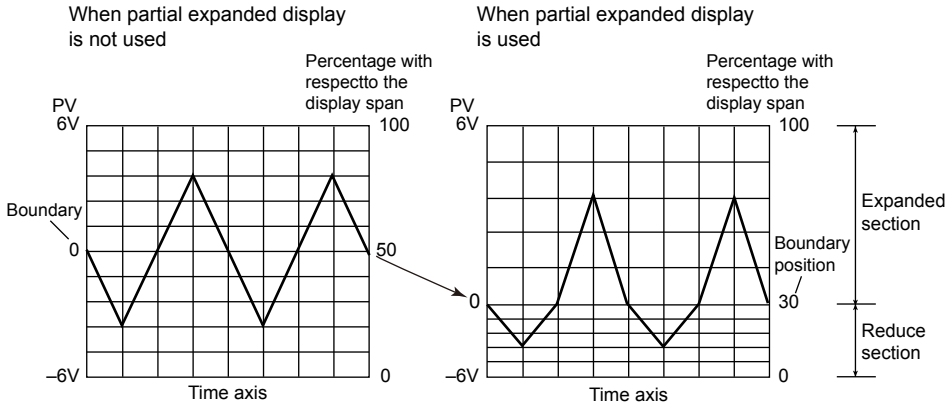
Partial*

Setup Item	Selectable Range or Options	Default Value
On/Off	Off/On	Off
Position	1 to 99(%)	50%
Boundary	Span lower limit + 1 digit to span upper limit – -1 digit	0.0000

* Appears when in the **Display settings** of the setting menu, the trend partial expansion **On/Off** is set to **On**.

On/Off

Set this to **On** to enable the partial expanded display function. You can set this on PV, SP, and AI channels.
Partial expanded display compresses a section of the waveform display range, so that the rest of the section is expanded.
In the example below, 0 V (boundary value) is moved to the 30% position of the display range (new boundary position). The 30% area below the boundary corresponds to "–6 V to 0 V" and 70% area above the boundary corresponds to "0 V to 6 V."



Note

Display span cannot be zoomed for channels whose partial expanded display is set to On.

Expand

Set at which position to display the value specified by **Boundary** within the display width. Specify a percentage.

Boundary

Set the value that is to be the boundary between the reduced section and the expanded section in the range of "minimum span value + 1 digit to maximum span value – 1 digit." For channels that are set to linear scaling, the selectable range is "minimum scale value + 1 digit to maximum scale value – 1 digit."

Example: Input range: –6 V to 6 V. Expand: 30. Boundary: 0
The –6 V to 0 V range is displayed in the 0% to 30% range, and the 0 V to 6 V range is displayed in the 30% to 100% range.

Displayed characters for values*

Setup Item	Selectable Range or Options	Default Value
0	Character string (up to 8 characters, Aa#1)	—
1	Character string (up to 8 characters, Aa#1)	—

* Appears for DI and DO channels.

0

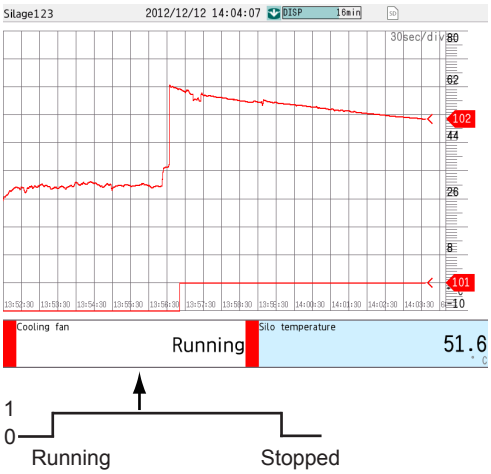
Set the character string to display when the measured value is 0.

1

Set the character string to display when the measured value is 1.

Examples of display characters of each value

Receive a device operation status through DI input and display measured values (0 and 1) as “Running” and “Stopped.”
You can select whether to display measured values (0 or 1) or characters.



Explanation

▶ For descriptions of displays, see section 1.2.3, “Setting the Display,” of the GX/GP User’s Manual.

3.9.4 Setting the Background Color

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Screen display settings**
Web application: **Control settings** tab > **Control display** > **Screen display settings**
Hardware configurator: **Control settings** tab > **Control display** > **Screen display settings**

Description

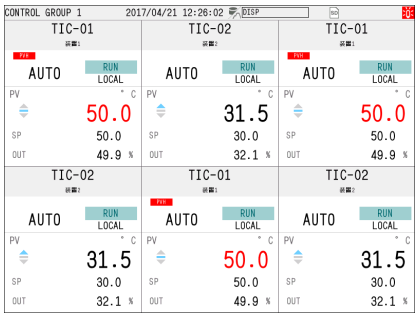
Setup Item	Selectable Range or Options	Default Value
Display background	Black, White	White

Display background

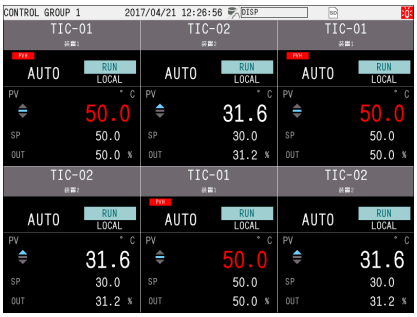
Set the background color of the screen. This applies to the control group screen, tuning screen, program selection screen, and program operation screen.

Example of the control group screen

White background



Black background



The screen background color setting applies only to the GX/GP.
If you want to change the control screen background color of the Web application, use Web options on the Web application menu bar.

3.9.5 Setting the Control Output Operation Type for Manual Mode

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Screen display settings**
Web application: **Control settings** tab > **Control display** > **Screen display settings**
Hardware configurator: **Control settings** tab > **Control display** > **Screen display settings**

Description

Setup Item	Selectable Range or Options	Default Value
Manual output operation type	Direct input method, Set/Enter input method	Direct input method

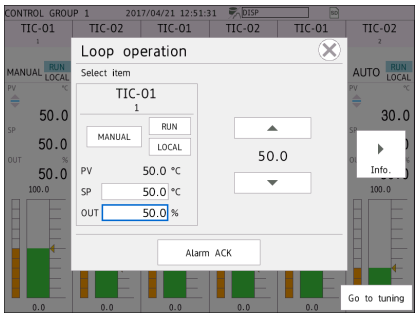
Manual output operation type

Set the control output operation method for manual mode.
In STOP mode, you cannot operate the control output.

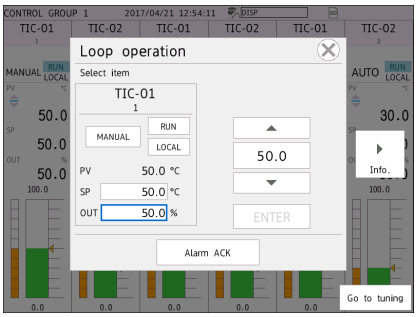
In direct input method, the control output value changes immediately after the value is changed. In Set/Enter input method, the control output value does not change until you tap the ENTER button after changing the value.

Setting	Description
Direct input method	The OUT value changes immediately when you tap the up and down arrow buttons.
Set/Enter input method	After you change the input value with the up and down arrow buttons, the OUT value changes when you tap ENTER. Or, change the OUT value directly from the keyboard.

Direct input method



Set/Enter input method



When entering the OUT value, tight shut output can be performed when:
- The tight shut function is on
- The operation mode is MANUAL and RUN
- The output limiter switch is off.
- The output type is current and 4 to 20 mA.

The display is “SD.”
If you enter a value less than -5.0%, tight shut output occurs immediately from -5.0.

3.10 Common Functions on the Main Unit

For instructions on how to use the common functions on the main unit, see the GX/GP or GM First Step Guide.

Saving and Loading Setting Parameters

Control settings are saved in the setting parameter file of the main unit.

Note

You cannot save a setting parameter file containing only the control settings.

Saving Program Patterns (/PG option)

Each program pattern is saved to a separate file.
There are three methods to save program patterns.

Options	Description
Save specified program pattern	Only the specified program pattern is saved to the external storage medium.
Save all program patterns	All program patterns in the main unit are saved to the external storage medium. Only those with registered pattern numbers are saved. (Those without registered pattern numbers are not saved.)
Saving setting parameters	All settings in the main unit are saved to the external storage medium. (Setting parameters, scale images, report templates, custom displays, certificates, program patterns, etc.)

Save specified program pattern

The specified program pattern is saved to a file name of your choice.

Save all program patterns

Program patterns are saved with fixed file names in the specified folder.

Loading Program Patterns (/PG option)

Program patterns in the external storage medium can be loaded into the main unit.
There are three methods to load program patterns.

Options	Description
Load specified program pattern	Only the specified program pattern in the external storage medium is loaded.
Load all program patterns	All program patterns in the external storage medium are loaded. * Program pattern files in the main unit are not initialized. Program patterns in the main unit are overwritten with those in the external storage medium. * When patterns are loaded by an event action, program pattern files in the main unit are initialized.
Loading setting parameters	All settings in the external storage medium are loaded. (Setting parameters, scale images, report templates, etc.)

Note

- A pattern file corresponding to the pattern number whose program is running cannot be loaded.
- After a program pattern is loaded, if a PID number specified in the program pattern setting does not exist in the main unit, the smallest PID group number is used.

Deleting Program Patterns (/PG option)

There are two methods to delete pattern files.

▶ For the procedure to delete program patterns, see section 1.25.6, “Loading and Deleting Program Patterns (/PG option),” in the GX/GP User’s Manual or section 2.28.6, “Saving, Loading, and Deleting Program Patterns (/PG option),” in the GM User’s Manual.

Options	Description
Delete specified program pattern	Specify the pattern number to delete the corresponding pattern.
Delete all program patterns	Delete all patterns.

Configuring the Security Functions

Control items that can be restricted are as follows:

Setup Item	Selectable Range or Options	Default Value
Remote/Local operation*	Free/Lock	Free
Control operation*	Free/Lock	Free
Tuning operation*	Free/Lock	Free
SP operation*	Free/Lock	Free
Program operation**	Free/Lock	Free

* Only when a PID control module is installed
** Only when a PID control module is installed and the /PG option is installed

Remote/Local operation

Restricts remote/Local operation.

Control operation

Restricts AUTO/MAN/Cascade control, RUN/STOP control, and control output value control.

Tuning operation

Restricts auto-tuning operation and turning operation from the operation screen.
Turning configuration is possible from the setting screen.

SP operation

Restricts SP operation from the operation screen.
SP configuration is possible from the setting screen.
Setting the SPs in the SP group of the tuning screen is possible.

Program operation

Restricts PROG/RESET operation, advance operation, and changing of the TSP, SP, or segment remaining time in hold mode.

Initializing Control Settings

You can initialize control settings using **Initialize all** or **Control settings**.

Note

- If key lock is applied to setting operation, control settings cannot be initialized.
- The following items that are not initialized in control settings are initialized using **Initialize all** or **Other**.
  - PID channel settings of control display
- When Initialize all is executed, program patterns are also initialized.

Reconfiguring the System (Module identification)

PID control modules must be identified when they are installed in the main unit, expandable I/O or sub unit.

Note

PID control modules are not identified when the measurement mode is High speed or Dual interval measurement.

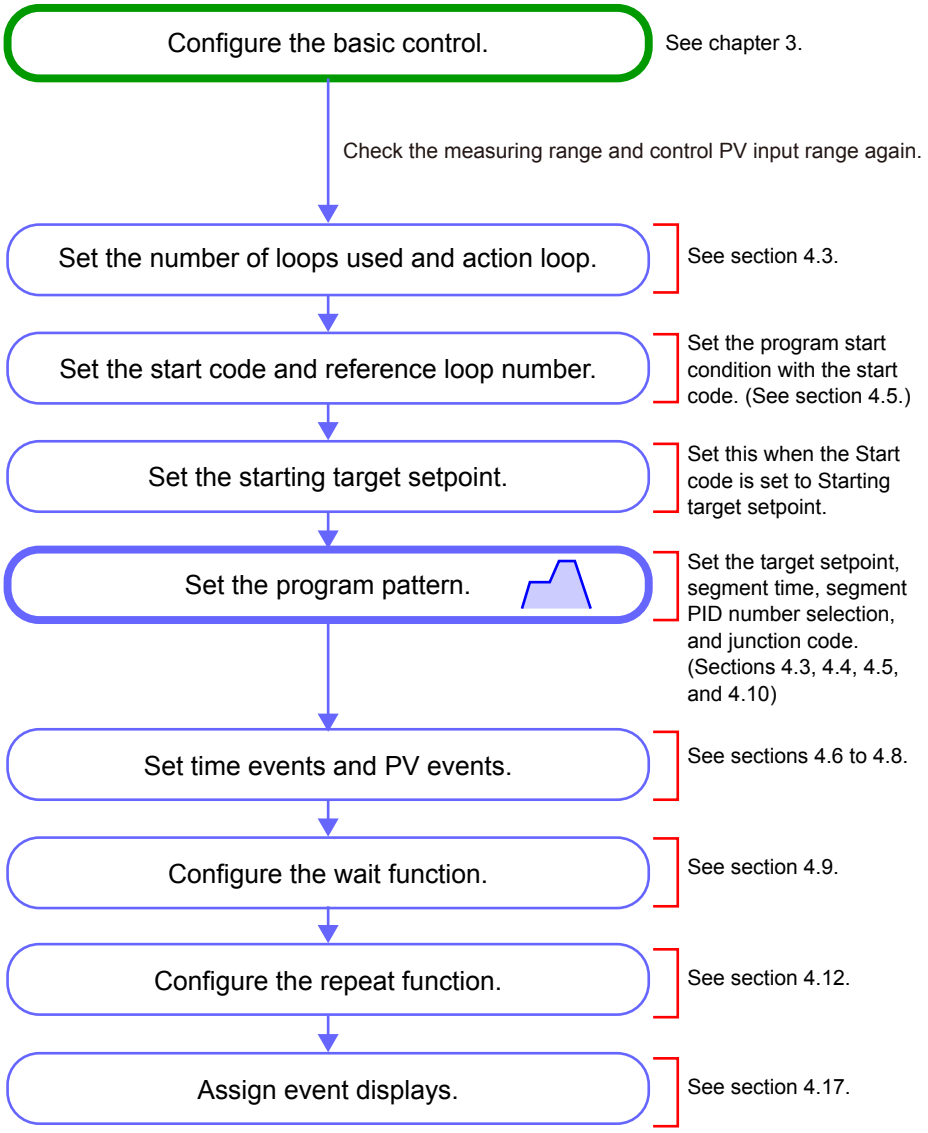
Troubleshooting

For a list of messages and troubleshooting measures, see the GX/GP or GM user's manual.
▶ See section 5.2, "Troubleshooting," in the user's manual.

Blank

4.1 Program Control Configuration Flowchart

Before configuring the program control, you need to configure the basic control.
In particular, changing the measuring range or control PV input range afterward will affect program patterns.
For other settings, set or change them as necessary.



4.2 Notes on Creating Program patterns

Notes on Specifications

Note

- Program patterns can only be created when PID modules are installed.
- The number of loops that can be configured for each program pattern varies depending on the model, so view the system specifications, limitations, and the like in the General Specifications (GS 04L53B01-31EN).
- The interval at which SPs are sent to PID control modules when a program pattern is running varies depending on the number of PID control module in the entire system and the control period.
  - Control period if the number of PID control module in the entire system is 1 to 3
  - 200 ms if the number of PID control module in the entire system is 4 to 6
  - 500 ms if the number of PID control module in the entire system is 7 or more

  If the transmission interval is 500 ms and the control period is 200 ms, the SP of PID control modules is not updated at 500 ms. It is updated alternately at 600 ms and 400 ms.

Notes on Configuration and Operation

Note

- Before creating program patterns, be sure to check the control PV input range and decimal place. Changing these after you create patterns will cause the values in the program patterns to be changed. (The patterns' range and scale ratios will be changed.)
- The time axis of each loop set in a program pattern will be the same.
- Each program pattern is assigned to a single loop. You cannot set the same loop number to a single program pattern.
- When you are creating a program, if you change the segment time to 00:00:00 in the middle and save it, the program pattern after this segment will be discarded.

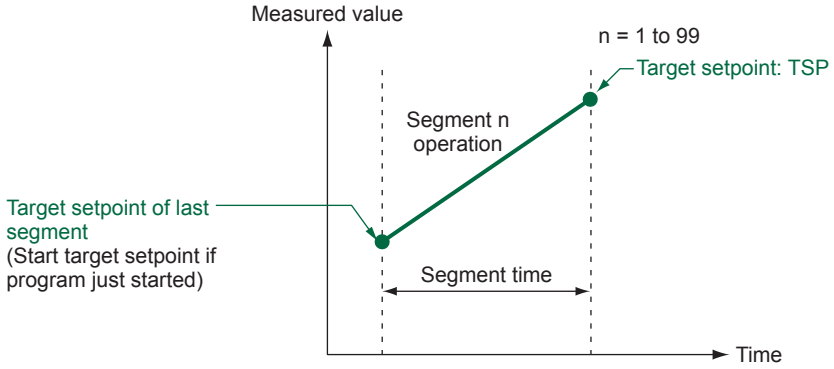
Notes on Program Patterns Saved in the Main Unit's Internal Memory

Note

- If you change the measurement mode, program patterns in the internal memory will be initialized.
- If you enable the multi-batch function or change the number of batches, program patterns in the internal memory will be initialized.
- If you enable the advanced security function, program patterns in the internal memory will be initialized.
- If you initialize all settings and internal data in initialization/calibration, program patterns in the internal memory will be cleared.

4.3 Creating Program Patterns

A program pattern defines a set of segment operations based on target setpoints (TSPs) and segment times. The target setpoint is the control target to be attained at segment end, whereas the segment time is the time duration from the start of that segment to the end.



Set the segment time in the range of 00:00:01 to 99:59:59 (hour:minute:second). The segment time applies to all loops and is set for each segment.
If the segment time is 00:00:00 signifies segment end. Segments after segment end do not run.

Note

For details on how to create program patterns, see section 4.18, “Program Pattern Examples,” provided later.

Initial Configuration

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Initial settings** > **Pattern initial settings**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Initial settings** > **Pattern initial settings**

Description

Setup Item	Selectable Range or Options	Default Value
Pattern name	Up to 20 characters	**Pattern01** for pattern number 1 **Pattern99** for pattern number 99
Number of loops used	1 to number of configured loops in the system	1

Pattern name

Set the program pattern name.

Number of loops used

Set the number of loops to use (run) in a single program pattern.

Action loop

Setup item	Selectable Range or Options	Default Value
LoopX	L001 to L652	Depends on the module configuration

LoopX

Set the loop number and action loop number (LXXX).

Creating a Program (Configuring Segments)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **Program pattern setting**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **Program pattern setting**

Description

Setup item	Selectable Range or Options	Default Value
Segment number	1 to 99	1

Segment number

Set the number of the segment you want to set the target setpoint, segment time, and the like for.
The segment number is automatically incremented by 1 when the segment time is set to a value other than 00:00:00.

Target setpoint

Setup item	Selectable Range or Options	Default Value
LoopX	Minimum to the maximum value of control PV input range	LoopX is the minimum value of the control PV input range for segment number 1 and the previous segment number for all other loops. (Soak state)

LoopX

The action loop specified in the initial settings is displayed. Sets the target setpoint of the specified segment.

Segment time

Setup item	Selectable Range or Options	Default Value
Time	00:00:01 to 99:59:59 (hour:minute:second)	—

Time

Sets the time of the specified segment. The segment time applies to all loops.
A segment with the time set to 00:00:00 is the end.

Setup item	Selectable Range or Options	Default Value
Segment PID number selection[1]	1 to 8	1
Junction code[2]	Switching for continuation, Hold-on switching, Local-mode switching, Wait during segment switching1/2/3/4/5, Wait within segment interval 1/2/3/4/5, Wait during segment switching1/2/3/4/5 + Local, Wait during switching 1/2/3/4/5 + Hold	—

1 Segment PID number selection is used when the PID selection is set to **SP number selection/ PID number selection**.
2 See “Setting the Operation in Segment Switching (Junction Code)” or “4.9 Setting Wait Functions in a Program (Junction Code).”

4.4 Setting the PID Selection

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Basic control settings** > **Control loop settings**
Web application: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**
Hardware configurator: **Control settings** tab > **Setup parameters** > **Basic control settings** > **Control loop settings**

Description

Basic action

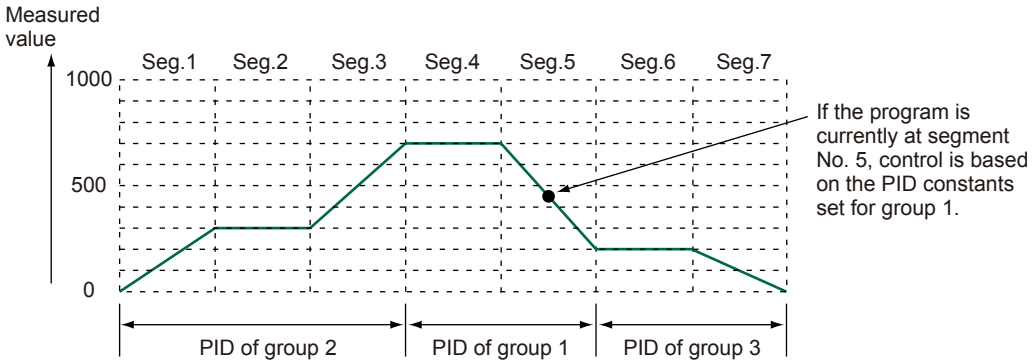
Setup item	Selectable Range or Options	Default Value
PID selection	SP No./Segment PID No. selection, Zone PID selection (PV), Zone PID selection (target SP), External selection	SP No./Segment PID No. selection*

PID selection

SP No./Segment PID No. selection*

In segment PID selection, PID settings are changed according to the program pattern setting for each segment during program pattern operation.
The PID number is set for each segment at the same time as when the program pattern is set.

The following example shows how PID settings change in segment PID selection.



Seg.: Segment

Zone PID selection (PV), Zone PID selection (target SP), External selection

▶ See section 3.3.9, “Setting PID Switching (Zone PID (PV/SP/TSP, SP Number)).”

4.5 Setting the Program Starting Conditions

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Initial settings** > **Program starting conditions**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Initial settings** > **Program starting conditions**

Description

Starting target setpoint

Setup item	Selectable Range or Options	Default Value
LoopX	Minimum to the maximum value of control PV input range	Minimum value of control PV input range

LoopX

Set the starting target setpoint of the current loop. Set this when the Start code is set to **Starting target setpoint**.

Setup item	Selectable Range or Options	Default Value
Start code	Starting target setpoint, Ramp-prioritized PV, Time-prioritized PV, Local setpoint	Starting target setpoint
Reference loop number	1 to the number of loops used	1

Note

Starting target setpoint is a setting for each loop.

Start code

Set the conditions for starting the program pattern operation.

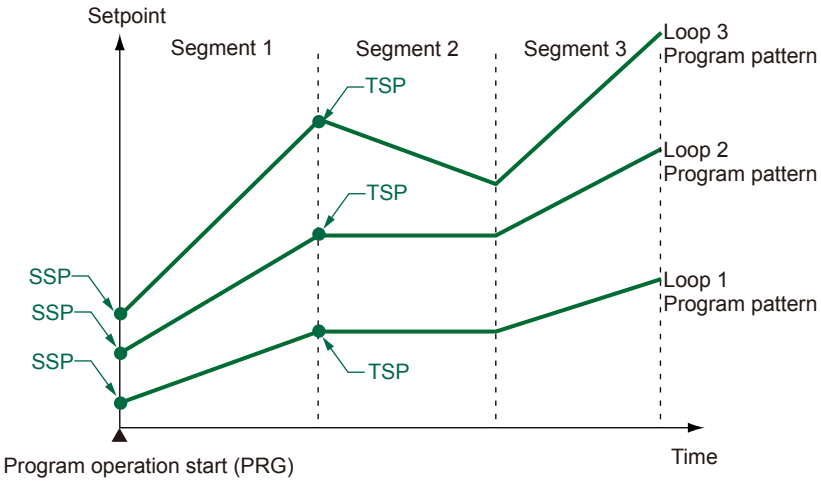
Reference loop number

When the start code is set to **Ramp-prioritized PV** or **Time-prioritized PV**, set the reference loop number if an operation reference loop is necessary.

Starting the Operation at the Starting Target Setpoint (SSP)

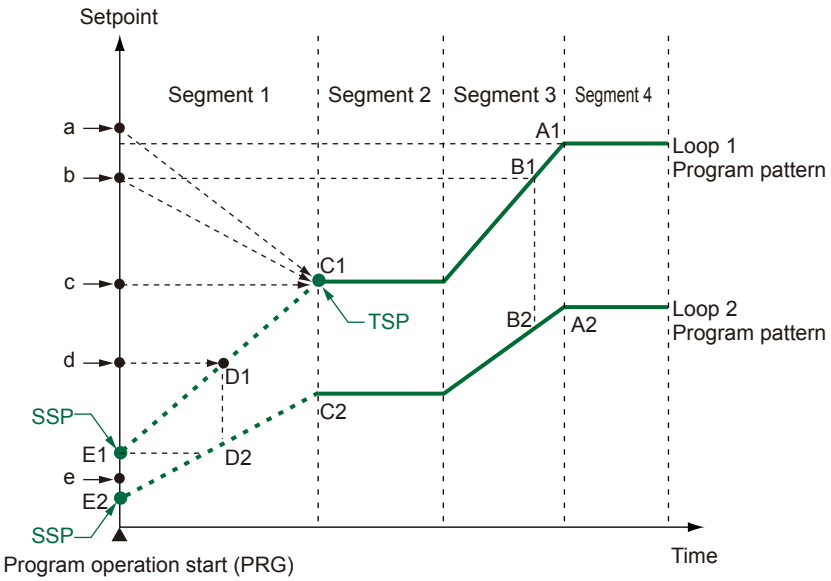
The start target setpoint (SSP) is the target setpoint at which programmed operation starts. When selected as the start condition, the setpoint can be changed from the starting target setpoint (SSP) to the target setpoint (TSP) using the (TSP - SSP)/TIME ramp. This change is made independent of PV.

The following figure shows an example of three loops created in a program pattern.

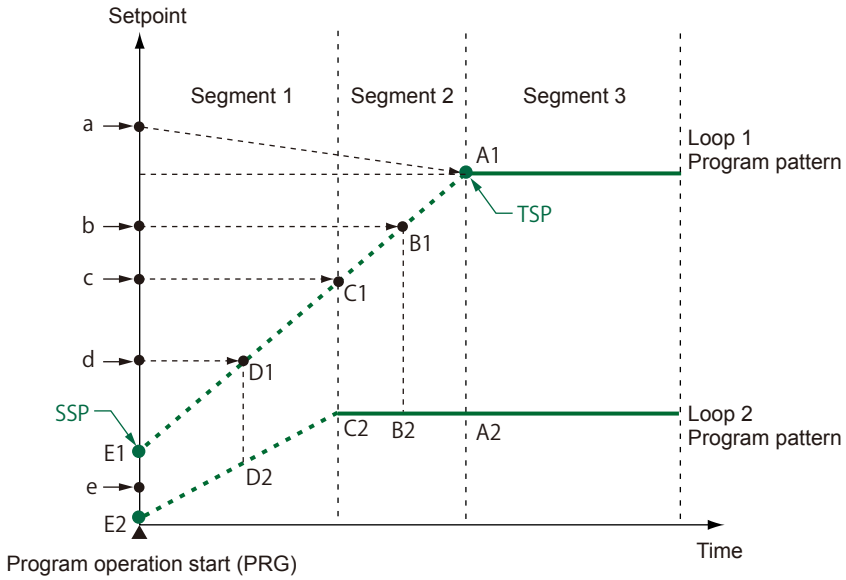


Ramp-prioritized PV Start

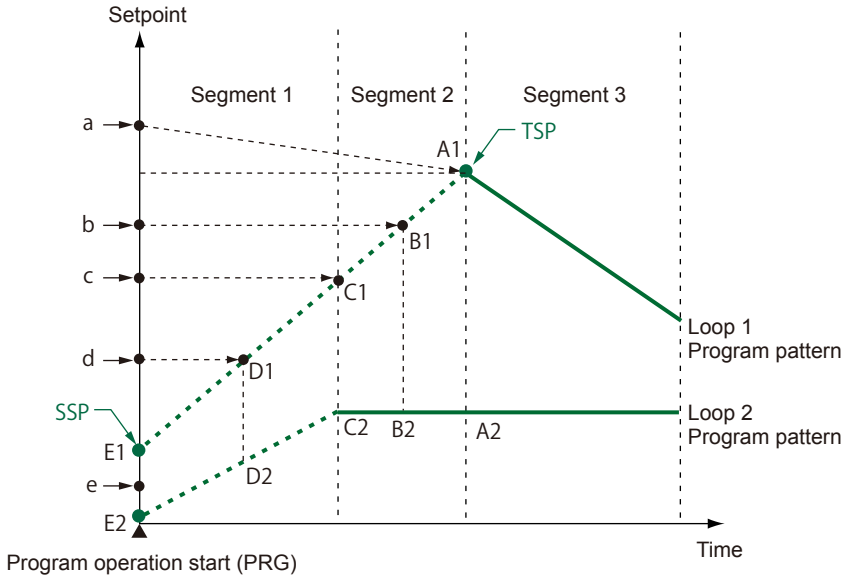
(The explanation below assumes that the reference loop is set to Loop-1.)
When segment 1 of loop-1 program pattern is ramp and segment 2 is soak
In ramp-prioritized PV start, the ramp-rate of Loop-1 is prioritized. Loop-1 is either point C1, D1, or E1.
Because the program pattern operation start point of Loop-2 is the same as that of Loop-1, if the program pattern operation start point of Loop-1 is C1, then that of Loop-2 is C2.



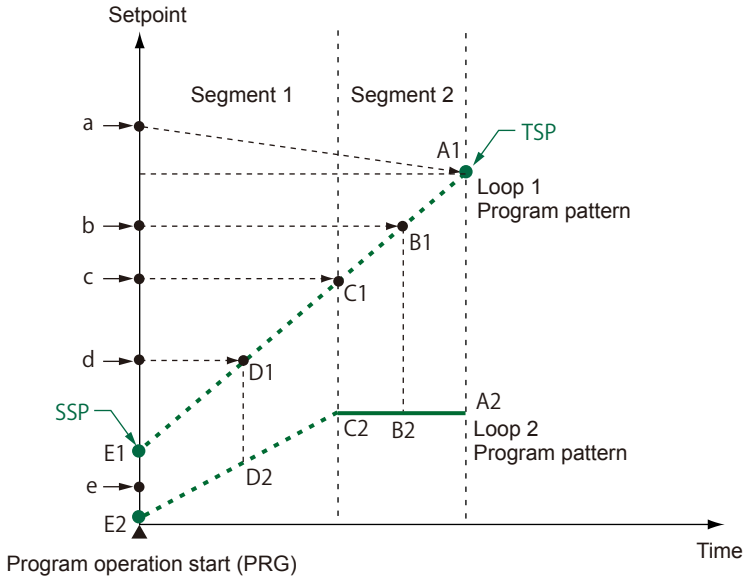
(The explanation below assumes that the reference loop is set to Loop-1.)
When segments 1 and 2 of loop-1 program pattern are ramp and segment 3 is soak
Program operation start point of Loop-1 is any of the points A1 to E1. Because the program pattern operation start point of Loop-2 is the same as that of Loop-1, if the program pattern operation start point of Loop-1 is A1, then that of Loop-2 is A2.



If the Program Pattern of Loop-1 Does Not Contain Soaking
(The explanation below assumes that the reference loop is set to Loop-1.)
Program operation start point of Loop-1 is any of the points A1 to E1. Depending on the PV, the program advances to segment 5. If the PV is point a, the program advances until point A1, where the ramp-rate is inverted.

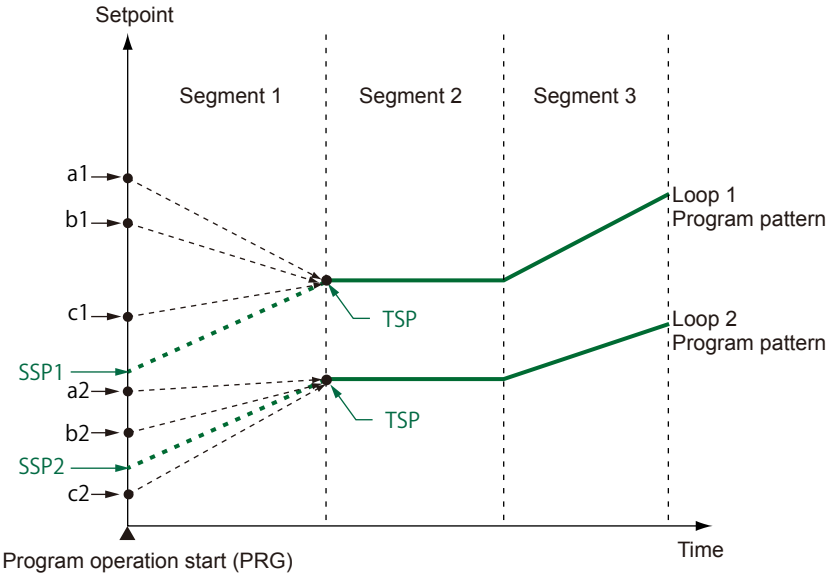


If the Program Pattern of Loop-1 Contains Only Ramp-up Segments
Program operation start point of Loop-1 is any of the points A1 to E1.
Depending on the PV, the program advances to segment 5. Because the program pattern operation start point of Loop-2 is the same as that of Loop-1, if the program pattern operation start point of Loop-1 is B1, then that of Loop-2 is B2. When the program operation starting point is set to A1, program operation is performed for one control period, and program operation ends according to the junction code (JC) for segment 2.



Time-prioritized PV Start

In time-prioritized PV start, program pattern operation starts by prioritizing the segment time from the PV at the program pattern operation start to the target setpoint (TSP) of segment 1. The segment ramp-rates are determined by the segment time (TIME).
The program pattern starts with loop-1 PV for loop-1 and loop-2 PV for loop-2.



4.6 Setting PV Events

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **PV Event settings**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **PV Event settings**

Description

Setup item	Selectable Range or Options	Default Value
Segment number	1 to 99	1

Segment number

Set the number of the segment you want to set an event for.

PV Event 1 to 32

Setup item	Selectable Range or Options	Default Value
Loop number	Off, Loop 1 to Loop 20 (range of loops in use)	Off
Type	PVH: PV high limit, PVL: PV low limit, SPH: SP high limit, SPL: SP low limit, DVH: deviation high limit, DVL deviation low limit, DVO: Deviation H/L limits, DVI: Dev. within H/L limits, OTH: control output high limit, OTL: control output low limit	PVH
Value	-30000 to 30000	0

Loop number

Set the loop number.

Type

Set the PV high limit, PV low limit, SP high limit, SP low limit, deviation high limit, deviation low limit, deviation high and low limits, deviation within high and low limits, control output high limit, and control output low limit.

▶ See “Setting the Alarm Type” in chapter 3.

Value

For PV or deviation alarms, set within the control PV input range or range span.
For control output alarms, set in the range of -5.0 to 105.0%.

Explanation

The PV event function outputs preset PV alarms, deviation alarms, and the like according to the program progression.
PV events are set for each segment.
PV events do not have a stand-by action or alarm ACK action.
The PV event action and hysteresis action are the same as the alarm action.
When the control mode is Cascade control or Loop control with PV switching, PV events of the secondary loop (loop on which a program pattern is not running) do not work.

4.7 Setting the PV Event Hysteresis

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **PV Event Hysteresis**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **PV Event Hysteresis**

Description

Hysteresis

Setup item	Selectable Range or Options	Default Value
PV Event 1 to 32	0.0 to 100.0%	0.5%

PV Event 1 to 32

Set the PV event hysteresis.

4.8 Setting Time Events

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **Time Event settings**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **Time Event settings**

Description

Setup item	Selectable Range or Options	Default Value
Segment number	1 to 99	1

Segment number

Set the number of the segment you want to set an event for.

Time Event 1 to 32

Setup item	Selectable Range or Options	Default Value
Start Condition	OFF start, ON start	OFF start
On time	00:00:00 to 99:59:59 (hour:minute:second) However, within the segment time	00:00:00
Off time	00:00:00 to 99:59:59 (hour:minute:second) However, within the segment time	00:00:00

Start Condition

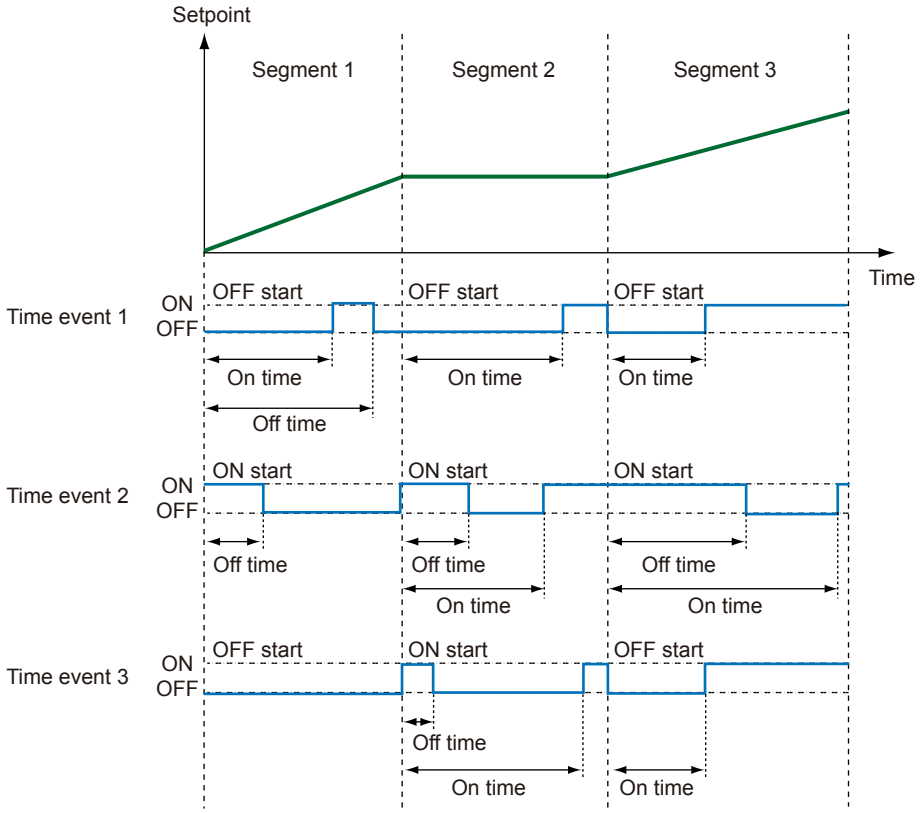
Set the event status at the segment start time.

On time, Off time

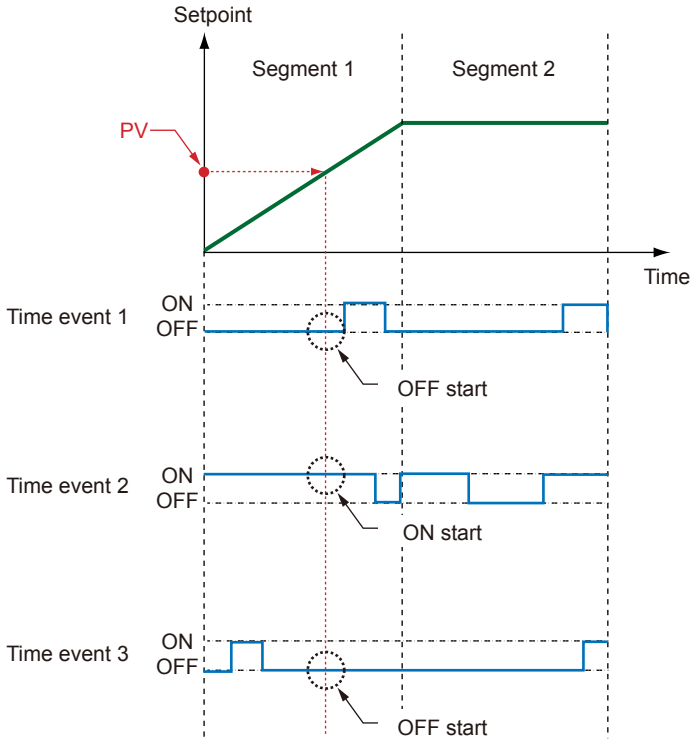
Set the time to turn on the time event and the time to turn off the event after the segment starts.

Explanation

The time event function starts a timer at the start of the segment and turns on the contact output when the specified time expires.
Set the On time and Off time of time events within the segment time.
Time events are set for each segment.
The time event turns off when the program operation ends.
If the time event's On time and Off time in the same segment are the same, the event status at the segment start time continues to the end of the segment.



Time event action when start code (STC) is set to ramp-prioritized PV start
When operation is started in the middle of a segment by the start code (STC), the event action starts in the event setting state at the time when operation should have started, on the assumption that the set event action has been performed by that time.



4.9 Setting Wait Functions in a Program (Junction Code)

Setting the Wait Operating Conditions

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Initial settings** > **Wait function settings**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Initial settings** > **Wait function settings**

Description

Loop 1 to 20

Setup item	Selectable Range or Options	Default Value
Wait function	On/Off	Off
Lower-side wait zone	0.0 to 10.0% of control PV input range span	0.5% of control PV input range span
Upper-side wait zone	0.0 to 10.0% of control PV input range span	0.5% of control PV input range span

Wait function

The wait function pauses the progression of a program when the PV cannot follow the SP. Set this to On to use the wait function.

Lower-side wait zone, Upper-side wait zone

Segment switch wait function forces the program to wait when the PV has not reached the target setpoint (TSP) before advancing to the next segment.
The program advances to the next segment when the PV reaches the wait zone.

Note

Wait zone a setting for each loop.

Wait time

Setup item	Selectable Range or Options	Default Value
Time	00:00:00 to 99:59:59 (hour:minute:second)	00:00:00

Time

Set the wait time.

Note

- Wait time is are settings for each wait zone number.
- The wait time is valid only when wait during segment switching is in use.

Setting a Wait Function in a Segment

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **Program pattern setting**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **Program pattern setting**

Description

Setup item	Selectable Range or Options	Default Value
Junction code	Switching for continuation, Hold-on switching, Local-mode switching, Wait during segment switching1/2/3/4/5, Wait within segment interval 1/2/3/4/5, Wait during segment switching1/2/3/4/5 + Local, Wait during switching 1/2/3/4/5 + Hold	Switching for continuation

Junction code

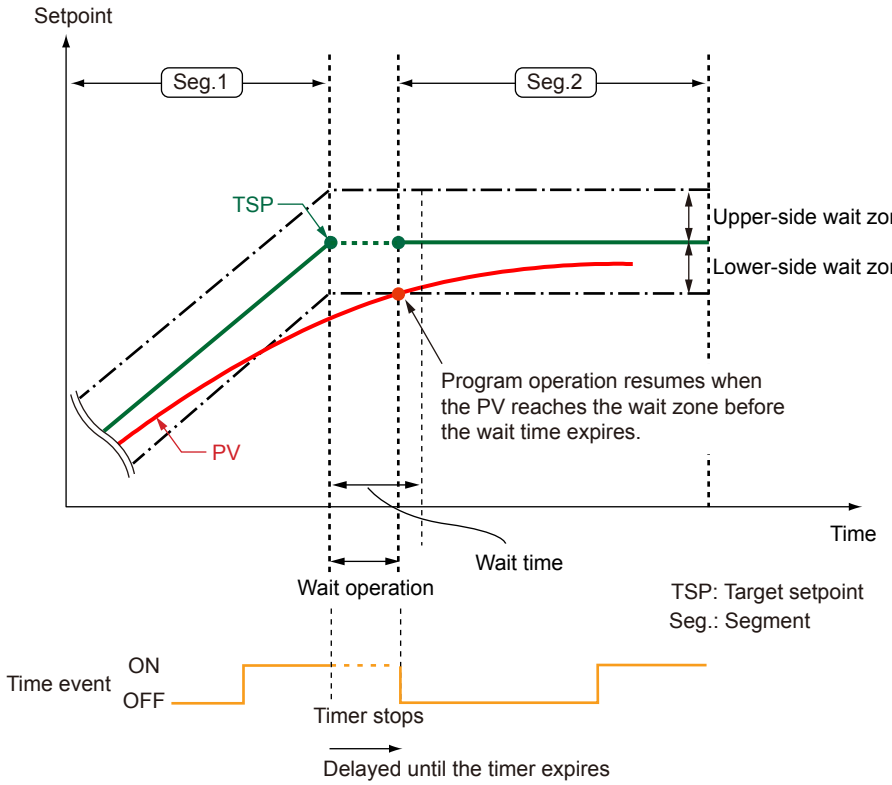
Set the wait function with the junction code for each segment. Up to 5 sets can be set.
Set the segment junction code to **Wait during segment switching1/2/3/4/5**, **Wait within segment interval 1/2/3/4/5**, **Wait during segment switching1/2/3/4/5 + Local**, or **Wait during switching 1/2/3/4/5 + Hold**.

Explanation

Wait during segment switching

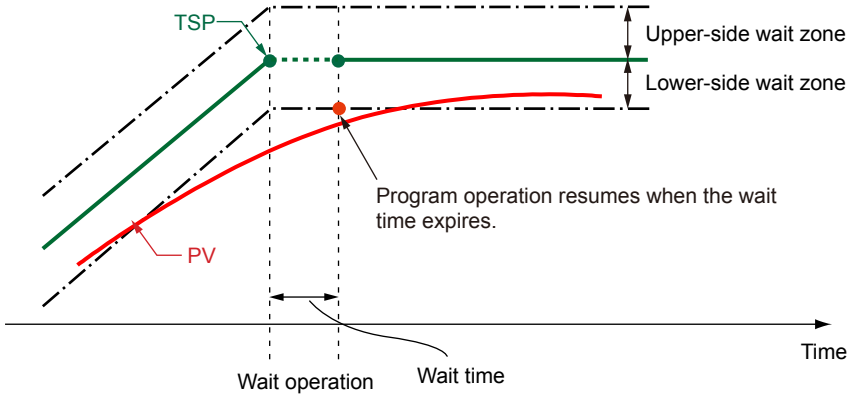
- **Operation when the measured input reaches the wait zone before the wait time expires**

After the wait function starts, if the PV reaches the wait zone before the wait time expires, the operation mode changes from waiting to running, and the program advances to the next segment.
Note that while waiting, the program pattern advance timer is stopped, so the time event value is held.



- **Operation when the measured input does not reach the wait zone before the wait time expires**

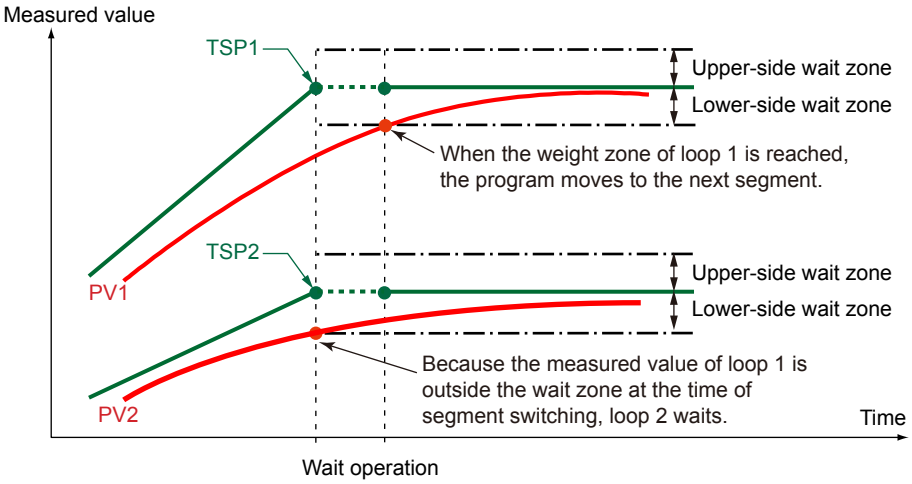
After the wait function starts, if the wait time expires before the PV reaches the wait zone, the operation mode changes from waiting to running, and the program advances to the next segment.
Note that while waiting, the program pattern advance timer is stopped, so the time event value is held.



If the wait time is set to 00:00:00 (hour:minute:second), the wait mode continues until the PV enters the wait zone.

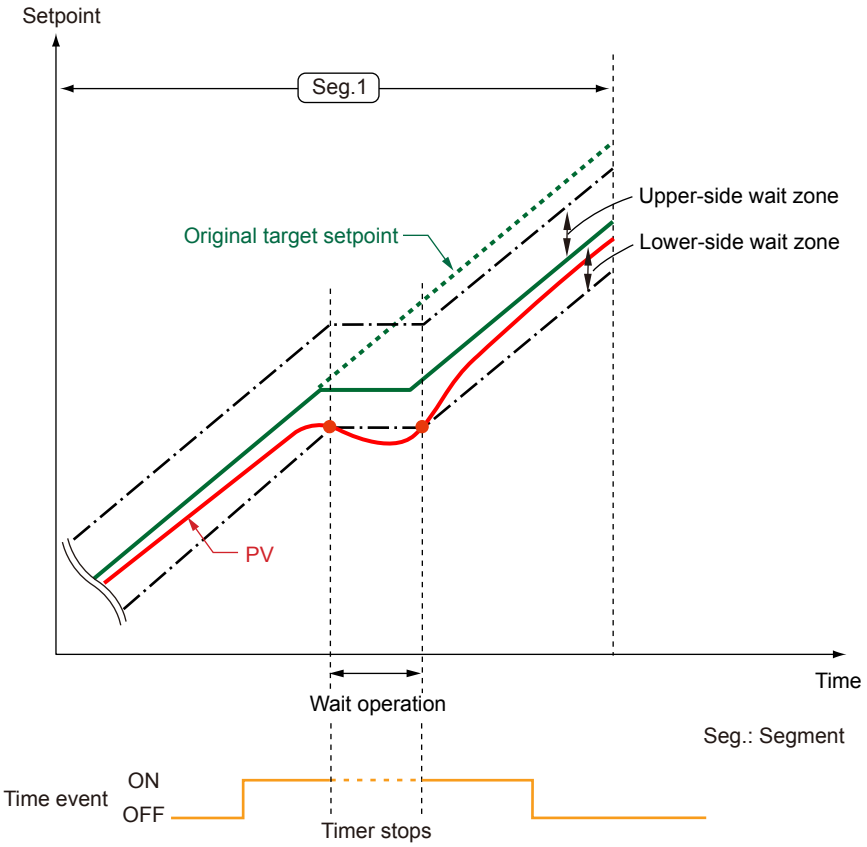
- **Operation when a program pattern is used for Loop-2**

Wait functions can be set to Loop-1 and Loop-2. If the wait function is set with a junction code in Loop-1 or Loop-2, both loops are held until the PV value of the loop reaches the wait zone.



Wait within segment interval

When the program operation is within a given segment interval, if the PV goes outside the wait zone specified for the current setpoint, the operation switches to wait mode and pauses the program operation.
When the PV returns within the wait zone, the operation mode changes from waiting to running, and the program operation resumes.
Wait time is invalid for wait within segment interval.



Wait end notification, Wait flag

Description

The wait end notification function outputs a signal to indicate that a wait within a program pattern segment has been released.
Wait end notifications can be output to a DO of a DO or DIO module, a DO of a PID control module, or an internal switch.
Wait end notification can be set to 1 s, 3 s, or 5 s with the control event action function.

▶ See section 3.8, “Configuring the Control Event Action Function” in chapter 3.

Note

To use the wait end notification, the DO module setting, internal switch setting, or the DO setting in PID control module settings must be set to **Manual**.

4.10 Setting the Operation in Segment Switching (Junction Code)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **Program pattern setting**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Segment settings** > **Program pattern setting**

Description

Setup item	Selectable Range or Options	Default Value
Junction code	Switching for continuation, Hold-on switching, Local-mode switching, Wait during segment switching1/2/3/4/5, Wait within segment interval 1/2/3/4/5, Wait during segment switching1/2/3/4/5 + Local, Wait during switching 1/2/3/4/5 + Hold	Switching for continuation

Junction code

You can set the conditions for advancing to the next segment for each segment.
Segment switching is set using junction codes. You can specify Switching for continuation, Hold-on switching, or Local-mode switching.
You can set a wait function for switching segments.

▶ For details on the wait function, see section 4.9, “Setting Wait Functions in a Program.”

Note

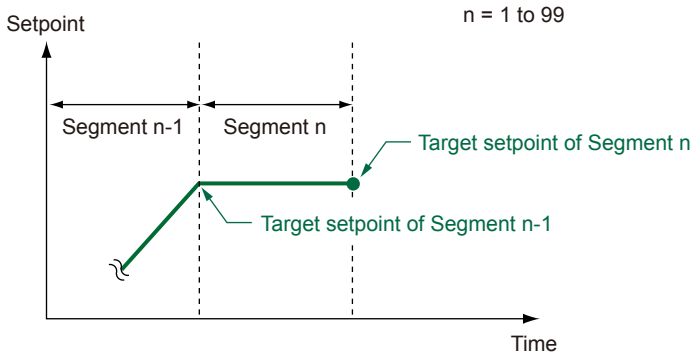
Junction code is are settings for each segment.

Explanation

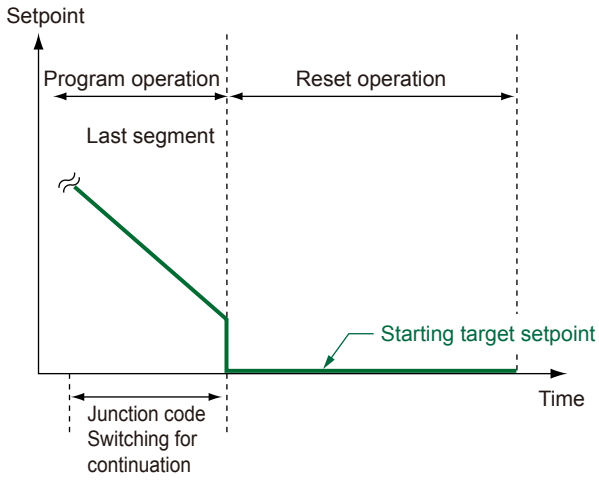
Switching for continuation

When a segment set to Switching for continuation ends, the program advances to the next segment and continues the operation. If the last segment is set to Switching for continuation, the program stops (resets) at the end of that segment. At the end of the last segment, the target setpoint is set to the starting target setpoint.

When switching in the middle of a program pattern



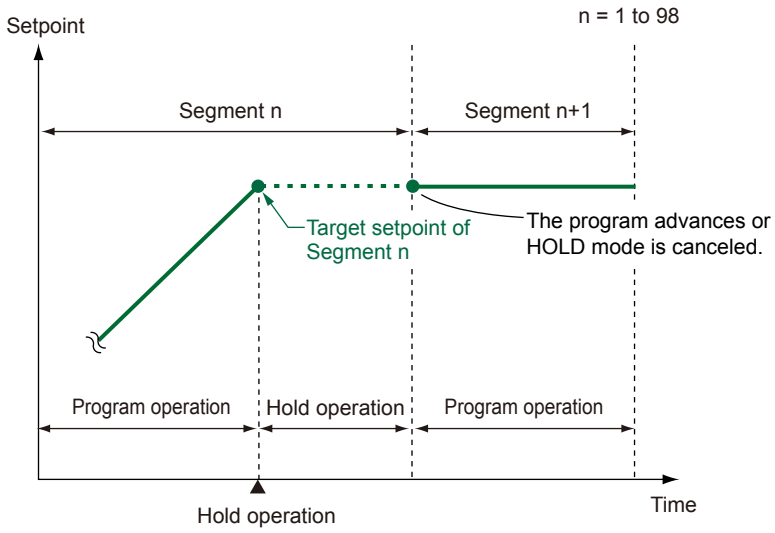
At the last segment



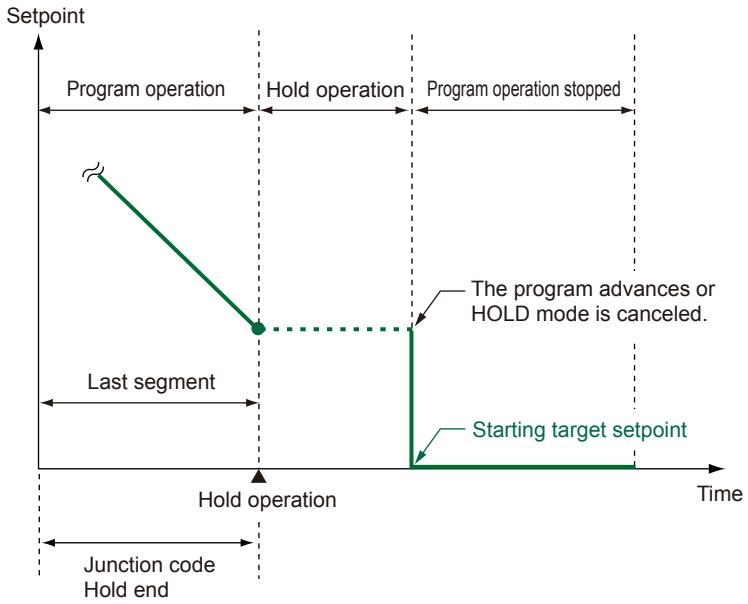
Hold-on switching

If a segment set to Hold-on switching ends, the program operation pauses (is placed on hold). While the program is on hold, a HOLD icon blinks in the operating status display area of the program operation screen. The program is kept on hold until the hold state is released either by a touch operation, external contact input, or communication function. If the hold state is released in the last segment, the program operation stops (resets). Executing the advance function while the program is on hold releases the hold state.

When switching in the middle of a program pattern



At the last segment

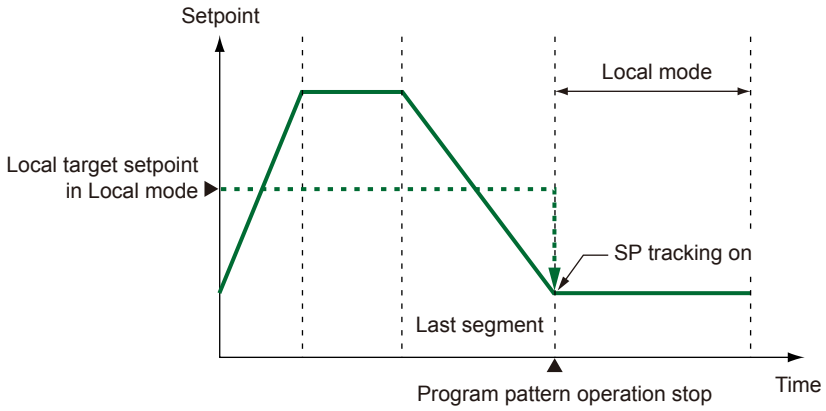


Local-mode switching

When the last segment of program operation ends, the operation mode changes to local mode. The action after the end of program operation is executed according to the SP tracking on/off state and junction code as follows. When zone PID selection is selected, the action is controlled according to zone selection, and when segment PID selection is selected, the action is controlled according to local PID number selection.
Switch to Local is valid only in the last segment. If it is used in the middle of a program pattern, the action will be the same as when the junction code is set to **Continue**.

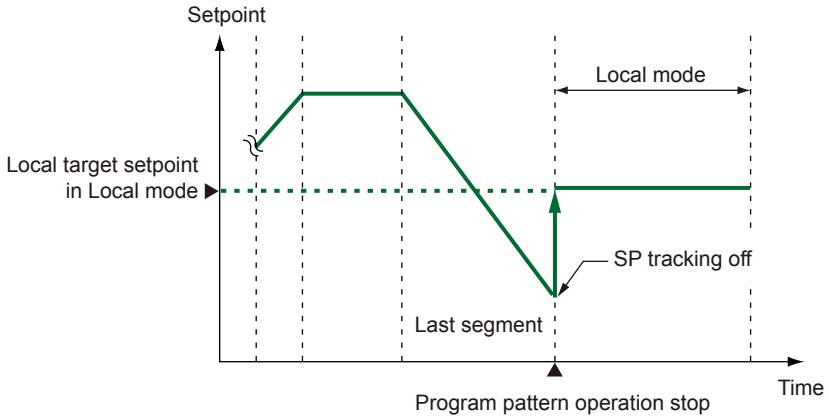
When setpoint tracking is ON

The target setpoint at the end of the program is set to the final target setpoint (TSP) of the program pattern. PV event and time event are set to off.



When setpoint tracking is OFF

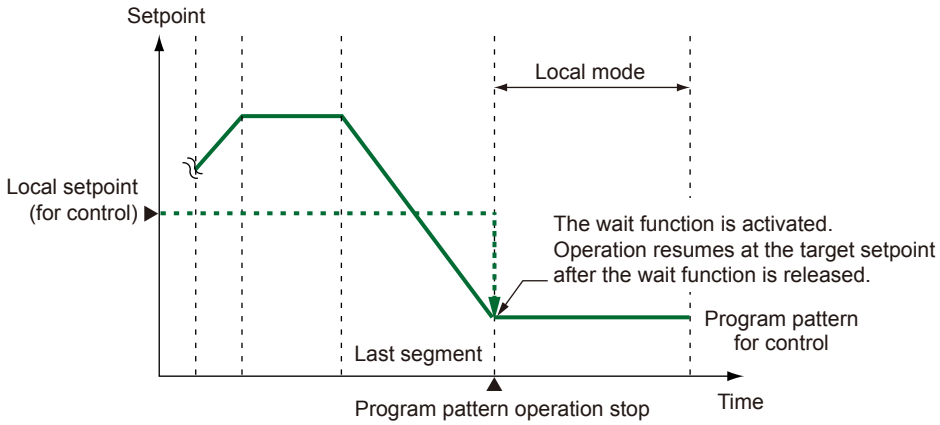
The target setpoint at the end of the program is set to the local target setpoint. PV event and time event are set to off.



Local-mode switching after wait during segment switching is released

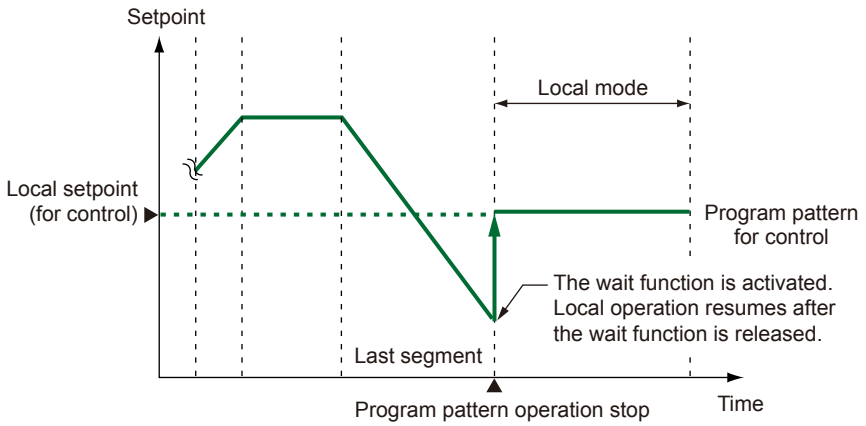
When setpoint tracking is ON

The wait function is activated at the last segment of program operation. When waiting is released, the program operates using the final target setpoint (TSP) of the program pattern.



When setpoint tracking is OFF

The wait function is activated at the last segment of program operation. When waiting is released, the operation mode changes to local mode.



4.11 Setting the Action at the Start of Program Operation

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Program pattern settings** > **Program RUN detail settings**
Web application: **Control settings** tab > **Program pattern settings**
Hardware configurator: **Control settings** tab > **Program pattern settings**

Description

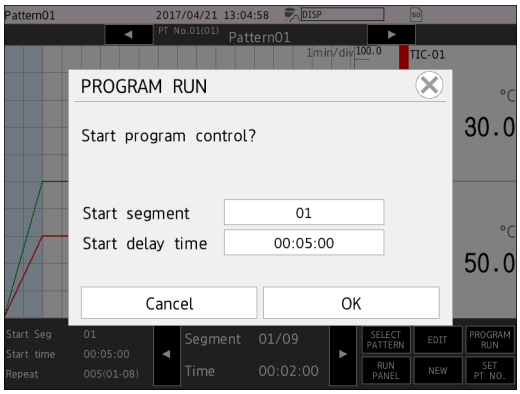
Setup item	Selectable Range or Options	Default Value
Program RUN detail settings	Off/On	Off

Program RUN detail settings

Set whether to set the segment to start the program operation on and the time until the program operation starts when starting the program operation.

Segment number and start delay time at the start of program operation

If Program RUN detail settings is set to **On**, you will be able to set the start segment number and start delay time as shown below.



Start segment

Description

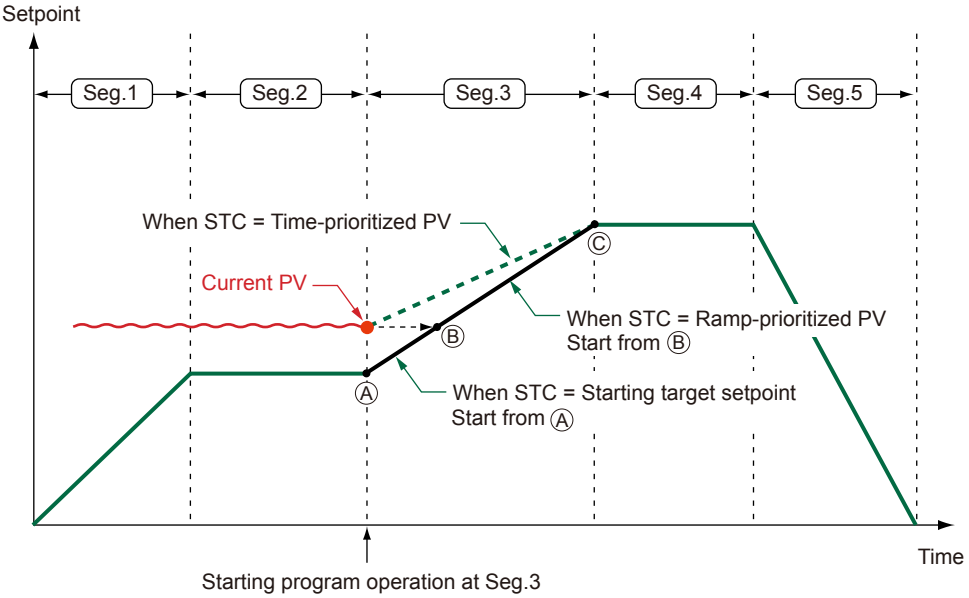
Setup item	Selectable Range or Options	Default Value
Start segment	1 to 99	1

Start segment

Set the segment number to start the program operation on.

Explanation

Program operation starts on the specified segment number.
When the operation mode changes to reset or local, the number automatically returns to 1.



Seg.: Segment

Start delay time

Description

Setup item	Selectable Range or Options	Default Value
Start delay time	00:00:00 to 99:59:59 (hour:minute:second)	00:00:00

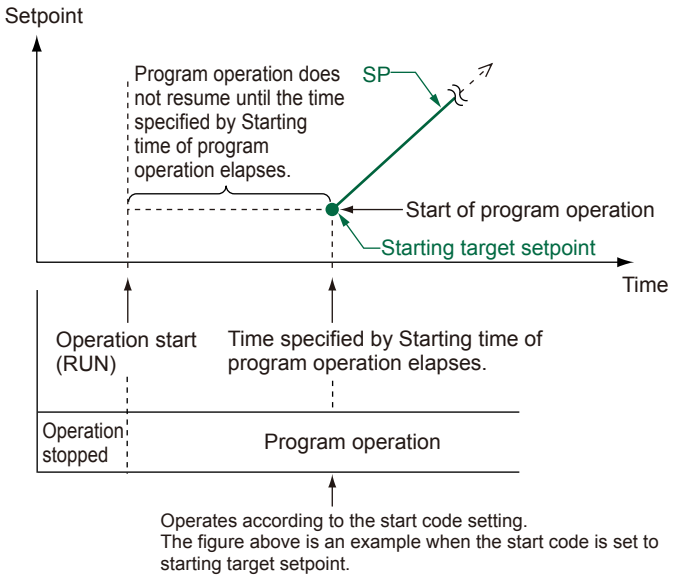
Start delay time

Set the time until the program pattern operation starts.
This setting applies to every loop and is effective only for a single program operation. It cannot be set while a program operation is running.

Explanation

You can delay the program operation by the specified start delay time. The time until the operation actually starts is counted down after starting the program operation. You can view the countdown time with the remaining segment time.

	State until program operation starts
Target setpoint	Action according to the starting target setpoint (SSP)
PV event	Off
Time event	Off



4.12 Setting the Segment Repetition

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Repeat function settings**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > Program pattern setting menu **Pattern number XX** > **Repeat function settings**

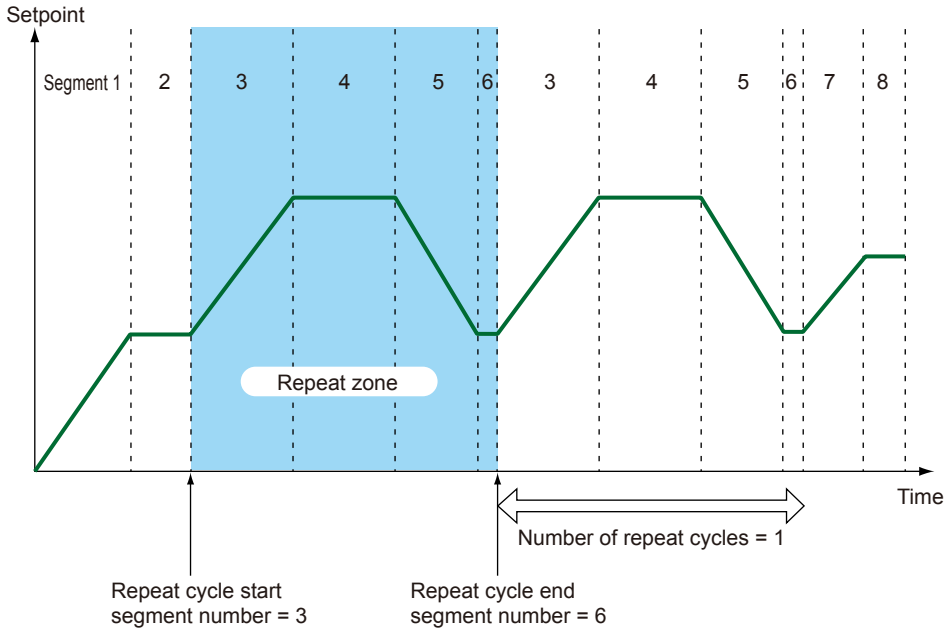
Description

Repeat function settings

Setup item	Selectable Range or Options	Default Value
Repeat function	On, Off, Repeat	Off
Number of repeat cycles	1 to 999	1
Repeat cycle start segment number	1 to the number of segments in use	1
Repeat cycle end segment number	1 to the number of segments in use	1

Repeat function

The repeat function repeats the same segment in a program pattern numerous times. To use the repeat function, set the repeat cycle start segment number, repeat cycle end segment number, and number of repeat cycles.
One set of repeat operation can be set for each program pattern.



Is the start code is set to **Time-prioritized PV start** or **Ramp-prioritized PV start**, the start code setting is also applied to the start of repeat operation.

4.13 Program Pattern End Signal

Description

A pattern end signal notifies the outside of the end of a program pattern when the execution of the program pattern ends.
Pattern end signals can be output to a DO module, the DO of a PID control module, or an internal switch. Pattern end signals can be set to 1 s, 3 s, or 5 s.
Even if program operation starts while the pattern end signal is on, the pattern end signal is not turned off.

▶ For details on the pattern end signal, see section 3.8, “Configuring the Control Event Action Function.”

Note

To use the program pattern end notification, the DO module setting, internal switch setting, or the DO setting in PID control module settings must be set to **Manual**.

4.14 Editing Program Patterns

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Segment settings** > **Insert/Delete segment**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > **Pattern number XX** > **Segment settings** > **Program pattern setting**

Description

Inserting a segment in a program pattern

Setup item	Selectable Range or Options	Default Value
Segment number	1 to the segment number of the created program (99 max.)	—
Insert/Delete segment	Off, Insert, Delete	Off
Execute	Execution	—

Segment number

Set the segment number.

Insert/Delete segment

Select **Insert**.

Execute

Tapping Execute inserts a segment before the segment selected with **Segment number** and increases the number of segments in use by 1.

Deleting a segment in a program pattern

Setup item	Selectable Range or Options	Default Value
Segment number	1 to the segment number of the created program (99 max.)	—
Insert/Delete segment	Off, Insert, Delete	Off
Execute	Execute	—

Segment number

Set the segment number.

Insert/Delete segment

Select **Delete**.

Execute

Tapping Execute inserts a segment before the segment selected with **Segment number** and decreases the number of segments in use by 1.

4.15 Printing Auto Messages When a Program Is Run or Reset

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Program pattern settings**
Web application: **Control settings** tab > **Program pattern settings**
Hardware configurator: **Control settings** tab > **Program pattern settings**

Description

Setup item	Selectable Range or Options	Default Value
Program Run/Reset message	Off/On	On

Off/On

To write messages automatically when the program operation starts or stops while recording, set this to **On**.

4.16 Automatically Displaying the Operation Screen at the Start of Program Operation (GX/GP only)

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Program pattern settings**
Web application: **Control settings** tab > **Program pattern settings**
Hardware configurator: **Control settings** tab > **Program pattern settings**

Description

Setup item	Selectable Range or Options	Default Value
Automatic switch to program operation display	Off/On	Off

Off/On

To switch to the program operation screen when a program execution command is received through the communication function, set this to **On**.

▶ For details on automatic switching the program operation screen, see section 5.4.6, “Automatically Displaying the Program Operation Screen.”

4.17 Assigning Event Displays to Groups

Path

GX/GP: **MENU** key > **Browse** tab > **Setting** > Setting menu **Control settings** > **Program pattern settings** > **Program pattern settings**
Or, **MENU** key > **Browse** tab > **Control** > **Program selection**
NEW* or **EDIT** button > Program pattern setting menu **Event display group**

* If you use the NEW button, a dialog box appears in which you select the program pattern, and then the Program pattern setting screen appears.

Hardware configurator: **Program pattern** tab > **Pattern number XX** > **Segment settings** > **Program pattern setting**

Description

Event display 1 to 10

Setup item	Selectable Range or Options	Default Value
Display	Off	On
Event type	Time event, PV event.	Time event
Event number	1 to 32	—

Display

Set the group display to **On**.

Event type

Select Time event or PV event.

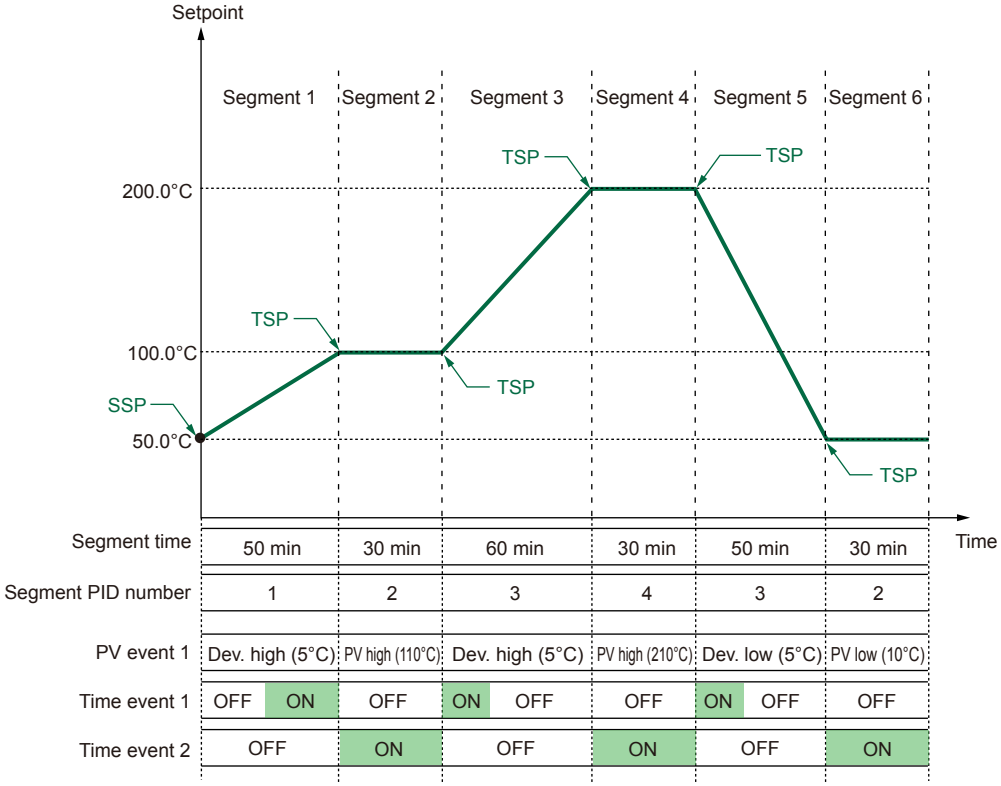
Event number

Select the event number.

Up to 10 events can be assigned to groups.
Event display groups are set for each program pattern.

4.18 Program Pattern Examples

This section explains how to set the program pattern shown in the following figure. The explanation is given only for Loop 1, but other loops can be set in the same way as well.



SSP: Starting target setpoint
TSP: Target setpoint

Set the target setpoint and segment time for segments 1 to 6 as follows:
(1)The operation start temperature is 50.0°C. The temperature is increased to 100.0°C over 50 minutes.
(2)When the temperature reaches 100.0°C, this temperature is maintained for 30 minutes.
(3)The temperature is increased to 200.0°C over 60 minutes.
(4)When the temperature reaches 200.0°C, this temperature is maintained for 30 minutes.
(5)The temperature is decreased to 50.0°C over 50 minutes.
(6)When the temperature reaches 50.0°C, this temperature is maintained for 30 minutes.

Segment PID number and junction code are set for each segment.
PV event and time event are set after setting the program pattern.

Before setting program pattern settings and program control settings, the following control settings must be configured. These are the control basic operation settings. For the setup procedure, see chapter 2.

Control settings

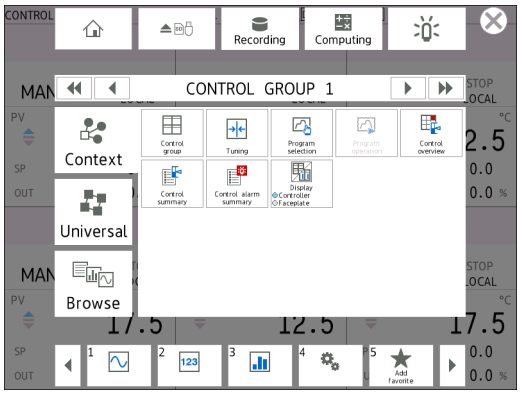
We assume that the PID control module is installed in slot number 09 of the main unit.

Setup item	Settings menu	Value
Control mode	Control settings > Basic control settings > Control basic operation	Single loop control
PID type	Control settings > Basic control settings > Control loop settings	PID Control
PID selection	Control settings > Basic control settings > Control loop settings	SP No./Segment PID No. selection
Number of PID groups	Control settings > Basic control settings > Control loop settings	8
AI number	Control settings > Input/Output settings > Measurement input range	AI1
Type	Control settings > Input/Output settings > Measurement input range	TC
Range	Control settings > Input/Output settings > Measurement input range	K
Span Lower	Control settings > Input/Output settings > Measurement input range	0.0°C
Span Upper	Control settings > Input/Output settings > Measurement input range	200.0°C

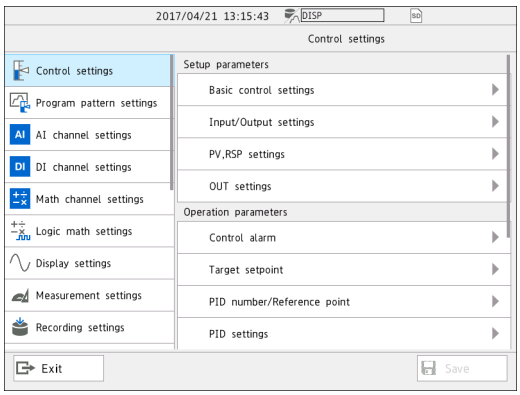
Use the default values for settings other than those above.

Procedure

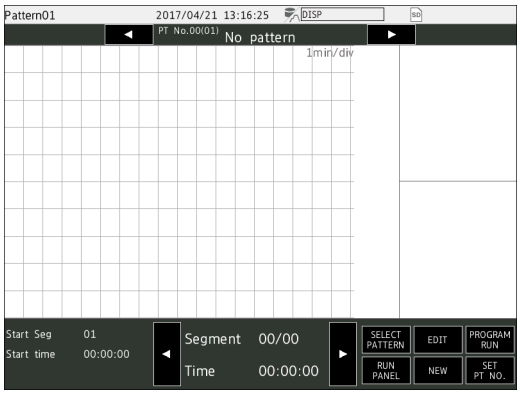
1 Press **MENU**.
The menu screen appears.



2 Tap the **Browse** tab and then **Setting**.
The Setting screen appears.

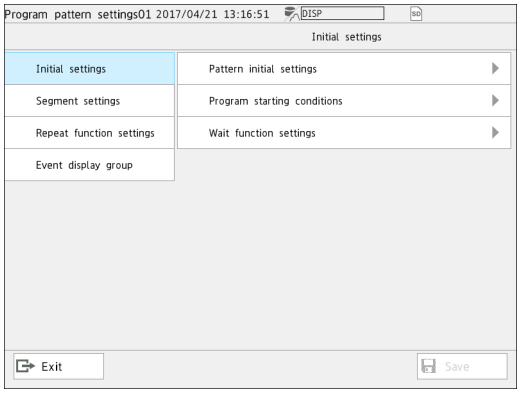


3 Tap **Program pattern settings** > **Editing Program Pattern**.
A program pattern selection screen appears.



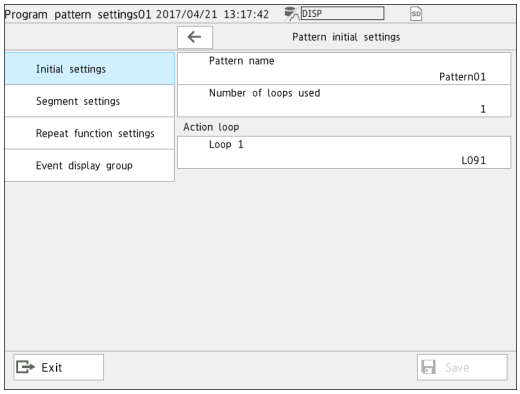
4 Tap **NEW**.

5 Select a pattern number, and tap **OK**.
A program pattern setting screen appears.



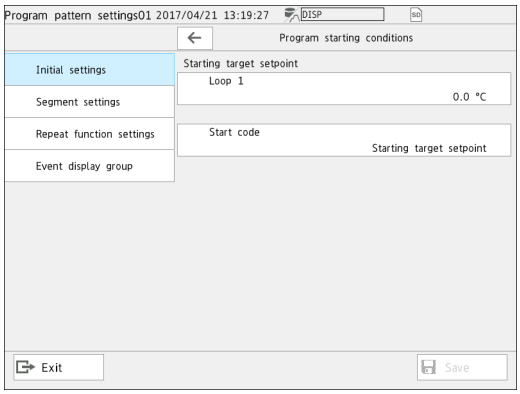
6 Tap Program setting menu **Initial settings** > **Pattern initial settings**.
Set the setup items according to the following table.

Setup item	Value
Pattern name	Sample program
Number of loops used	1
Action loop	L091 (main unit, slot 09, loop 1)



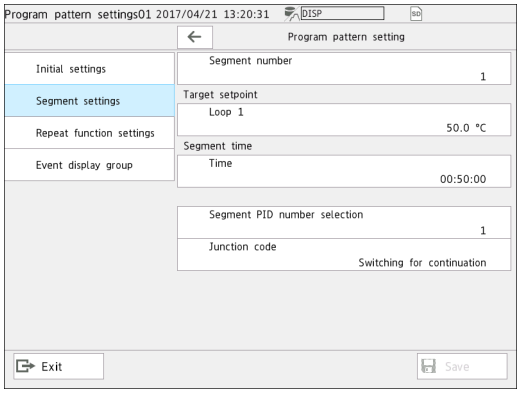
7 Tap Program setting menu **Initial settings** > **Program starting conditions**.
Set the setup items according to the following table.

Setup item	Settings menu	Value
Starting target setpoint	Initial settings > Program starting conditions	50.0°C
Start code	Initial settings > Program starting conditions	Starting target setpoint

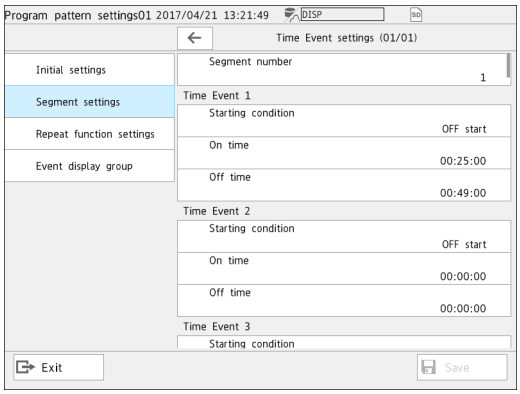


8 Tap Program setting menu **Segment settings** > **Program pattern setting**.
Set the setup items according to the following table.

Segment	Setup item	Value
1	Target setpoint	100.0°C
	Segment time	00:50:00
	Segment PID number selection	1
	Junction code	Switching for continuation
2	Target setpoint	100.0°C
	Segment time	00:30:00
	Segment PID number selection	2
	Junction code	Switching for continuation
3	Target setpoint	200.0°C
	Segment time	01:00:00
	Segment PID number selection	3
	Junction code	Switching for continuation
4	Target setpoint	200.0°C
	Segment time	00:30:00
	Segment PID number selection	4
	Junction code	Switching for continuation
5	Target setpoint	50.0°C
	Segment time	00:50:00
	Segment PID number selection	3
	Junction code	Switching for continuation
6	Target setpoint	50.0°C
	Segment time	00:30:00
	Segment PID number selection	2
	Junction code	Switching for continuation

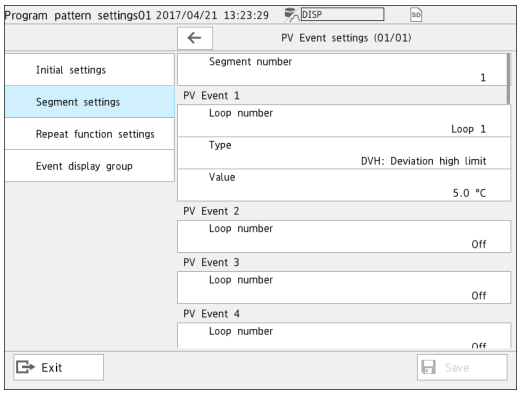


9 Tap Program setting menu **Segment settings** > **Time Event settings**.
Set the setup items according to the following table.



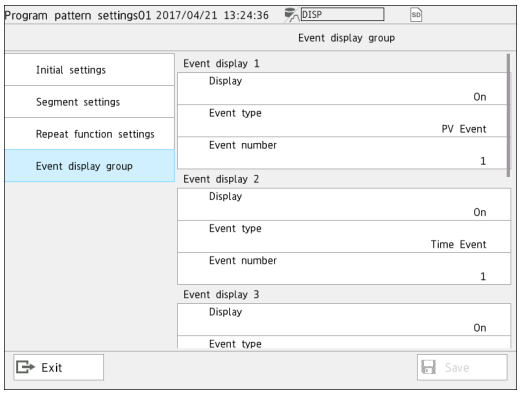
Segment	Time event	Setup item	Value
1	Time event 1	Start Condition	OFF start
		On time	00:25:00
		Off time	00:00:00
	Time event 2	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
2	Time event 1	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
	Time event 2	Start Condition	ON start
		On time	00:00:00
		Off time	00:00:00
3	Time event 1	Start Condition	ON start
		On time	00:00:00
		Off time	00:20:00
	Time event 2	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
4	Time event 1	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
	Time event 2	Start Condition	ON start
		On time	00:00:00
		Off time	00:00:00
5	Time event 1	Start Condition	ON start
		On time	00:00:00
		Off time	00:20:00
	Time event 2	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
6	Time event 1	Start Condition	OFF start
		On time	00:00:00
		Off time	00:00:00
	Time event 2	Start Condition	ON start
		On time	00:00:00
		Off time	00:00:00

10 Tap Program setting menu **Segment settings** > **PV Event settings**.
Set the setup items according to the following table.



Segment	PV event	Setup item	Value
1	PV event 1	Loop number	Loop 1
		Type	DVH: Deviation high limit
		Value	5.0°C
2	PV event 1	Loop number	Loop 1
		Type	PVH: PV high limit
		Value	110.0°C
3	PV event 1	Loop number	Loop 1
		Type	DVH: Deviation high limit
		Value	5.0°C
4	PV event 1	Loop number	Loop 1
		Type	PVH: PV high limit
		Value	210.0°C
5	PV event 1	Loop number	Loop 1
		Type	DVL: Deviation low limit
		Value	-5.0°C
6	PV event 1	Loop number	Loop 1
		Type	PVL: PV low
		Value	10.0°C

11 Tap Program setting menu **Event display group**.
Set the setup items according to the following table.



Event display	Setup item	Value
1	Display	On
	Event type	PV event
	Event number	1
2	Display	On
	Event type	Time event
	Event number	1
3	Display	On
	Event type	Time event
	Event number	2

Operation complete

5.1 Monitoring Loop Control

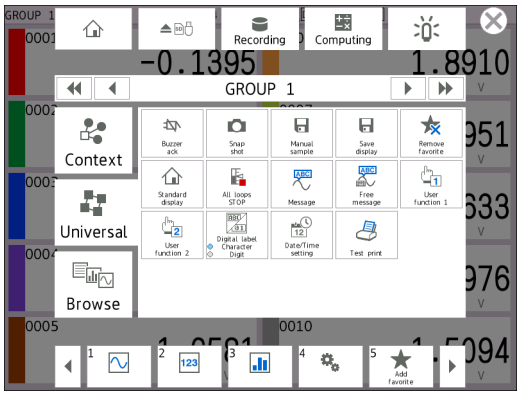
5.1.1 Monitoring and Controlling on the Control Group Screen

The control group screen can be displayed using one of two styles: controller style and faceplate style.

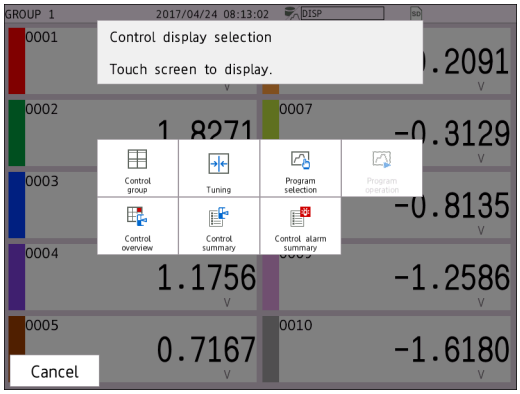
Displaying the Controller Style Screen

Procedure

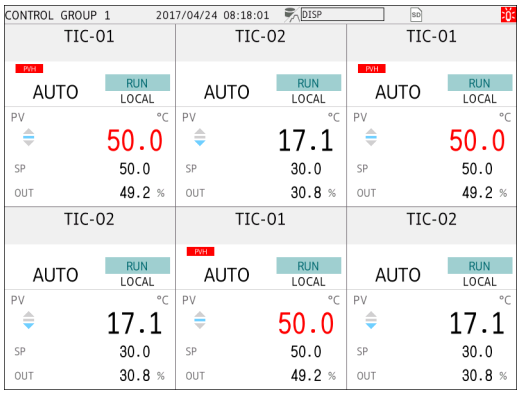
1 Press **MENU**.
The menu screen appears.



2 Tap the **Browse** tab and then **Control**.
The control display selection screen appears.



3 Tap **Control group**.
The control group screen (controller style (default condition)) is displayed.

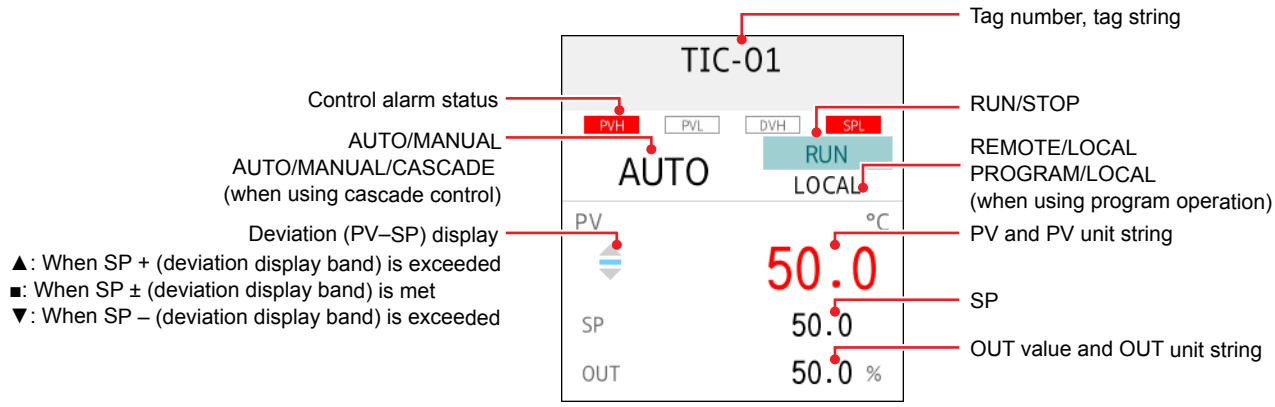


Operation complete

Explanation

The contents displayed on the controller style control group screen are shown below.

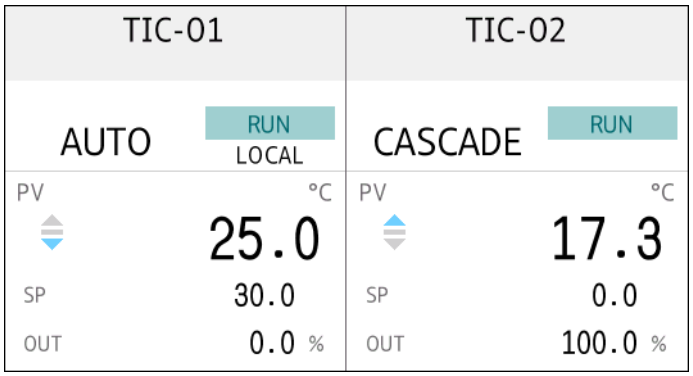
Controller style



Item	Displayed Content
Tag No.	Displays the assigned tag number. * If tag numbers are not assigned, loop numbers (L***) are displayed. * If the text does not fit, as much of the text that can be displayed is displayed with left justification.
Tag string	Displays the assigned tag string. * If the text does not fit, as much of the text that can be displayed is displayed with left justification.
AUTO/MANUAL/ CASCADE	Displays the current control operation mode. AUTO: automatic operation MANUAL: manual operation CASCADE (when using cascade control): cascade operation
REMOTE/LOCAL/ PROGRAM	Displays the current control operation mode. REMOTE: remote operation LOCAL: local operation PROGRAM (when using program operation): program operation
RUN/STOP	Displays the current operation status. * “AT” blinks when auto-tuning is in progress.
Control alarm status	Displays the control alarm status and control alarm string. * If the alarm display is set to **Hold**, alarms that have not been acknowledged blink.
PV	Displays the loop PV. If any of the control alarms occurs, the PV is displayed in red.
PV unit string	Displays the PV unit string.
Deviation (PV–SP) status	Displays the deviation status. The deviation display behavior follows the deviation display band setting.
SP	Displays the loop SP.
OUT value	Displays the loop OUT value. * “SD” is displayed if the tight shut is in effect.
OUT unit string	Displays the OUT unit string.

When the Control Mode Is Cascade

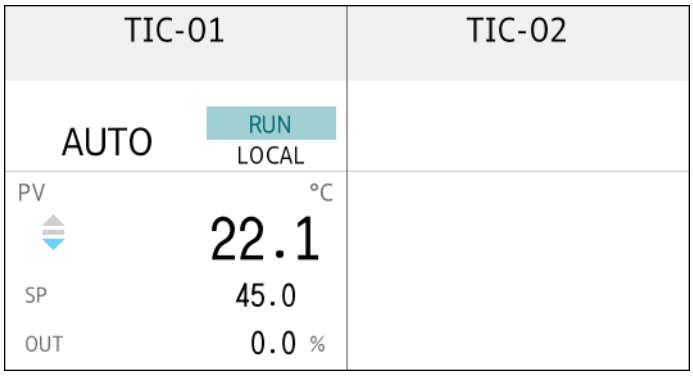
When the control mode is cascade, the contents displayed for the cascade primary side and secondary side are different.



Loop	Content
Cascade primary side	Fixed to AUTO. RUN/STOP: The operation is the same for the primary side and secondary side. This can be changed. LOCAL/REMOTE: Displayed according to the operation mode. This can be changed.
Cascade secondary side	AUTO/MANUAL/CASCADE Displayed according to the operation mode. This can be changed. RUN/STOP: The operation is the same for the primary side and secondary side. This can be changed.

When the Control Mode is Loop Control with PV Switching

When the control mode is loop control with PV switching, the Loop 2 side only displays the loop name area. Touch operation is not possible.

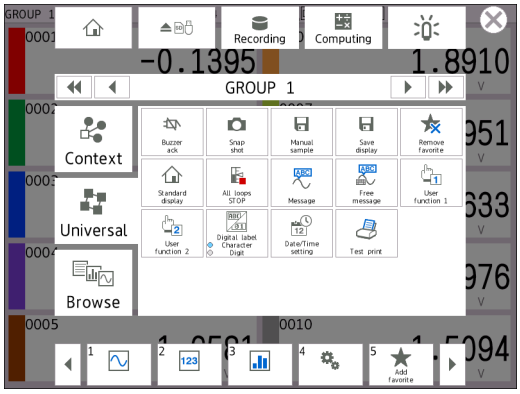


Displaying the Faceplate Style Screen

Change from the controller style to the faceplate style.

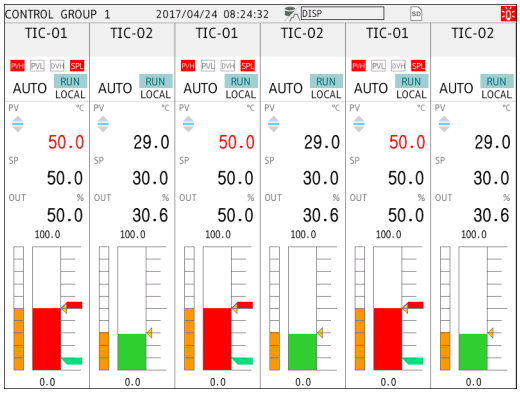
Procedure

1 Press **MENU**.
The menu screen appears.



2 Tap the **Context** tab and then **Display**. The style switches between controller and faceplate each time you tap.

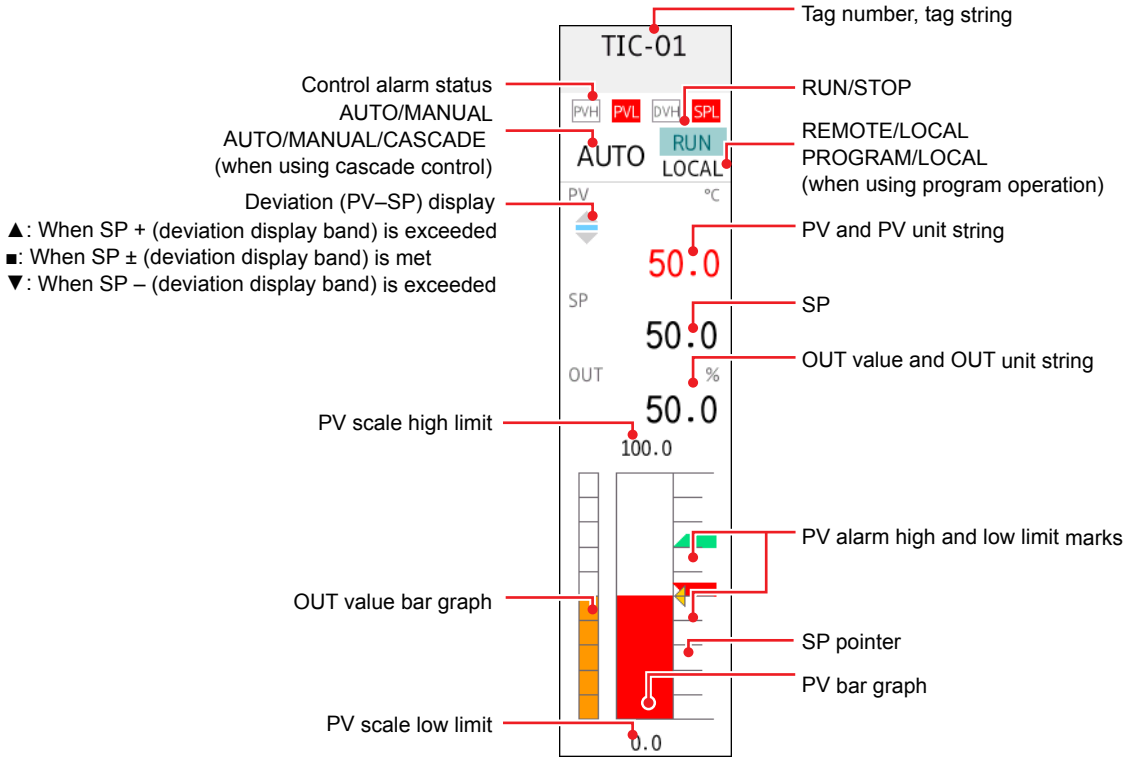
3 Tap the **Close** icon.



Operation complete

Explanation

The contents displayed on the faceplate style control group screen are shown below.



Item	Displayed Content
Tag No.	Same as the controller style
Tag string	
AUTO/MANUAL/CASCADE	
REMOTE/LOCAL/ PROGRAM	
RUN/STOP	
Control alarm status	
PV	
PV unit string	
Deviation (PV–SP) status	
SP	
OUT value	
OUT unit string	
PV scale high and low limits	Displays the PV scale high and low limits.
PV bar graph	Displays the PV bar graph. When the PV color is red, the PV bar graph is also displayed in red.
PV alarm high and low limit marks	Displays the PVH or PVL alarm high and low limit marks. * The marks are displayed in red when an alarm is occurring and green when the alarm is off.
OUT value bar graph	Displays the OUT value bar graph.
SP pointer	Displays the SP indicator.

5.1.2 Loop Operation and Using the loop operation dialog box

When the control group screen or program operation screen is displayed, you can control specific loops. You can also view tags, loop numbers, PID group numbers, and so on.

Procedure

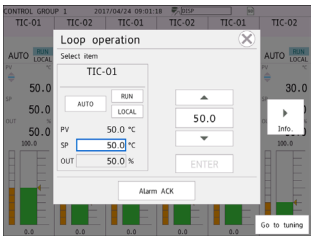
1. Tap a loop on the control group screen or tuning screen.
   A loop operation dialog box appears.

Operation complete

Loop Operation Dialog Box

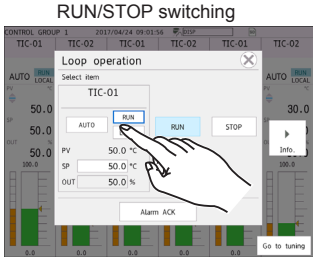
You can control specific loops in the loop operation dialog box.

You can select a parameter by tapping it. The selected parameter is shown with a blue frame.
When the loop operation dialog box appears, the SP is selected.
Parameter edit buttons corresponding to the selected parameter are shown on the right side.
You can change the loop parameter by tapping the edit buttons.

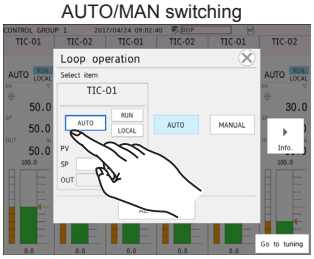


Tap an item you want to change.

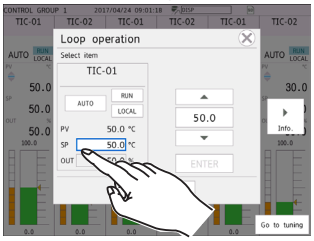
RUN/STOP switching



AUTO/MAN switching

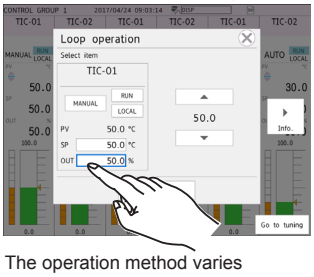


SP change



Change the value with ▲ and ▼.
Confirm with ENTER.

OUT value change



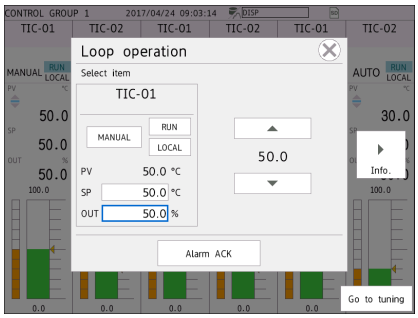
The operation method varies depending on the Control settings > Screen display settings > Manual output operation type.
Direct input method: When you change a value, the change is immediately applied to the control.
Set/Enter input method: When you change a value and press ENTER, the change is applied to the control.

Note

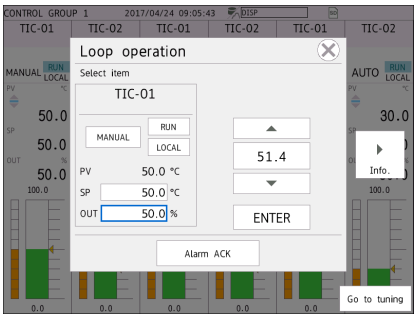
- The loop operation dialog box displays the information (control status, PV, SP, OUT) of the selected loop.
- Even when **Display settings** > **Screen display settings** > **Changing each value from monitoring** is set to **Off**, operation on the loop operation dialog box is possible. (Loop operation does not depend on the On/Off setting.)

OUT Value Input Method

Direct input method



Set/Enter input method



When entering the OUT value, tight shut output can be performed when:

- The tight shut function is on
- The operation mode is MANUAL and RUN
- The output limiter switch is off.
- The output type is current and 4 to 20 mA.

The display is “SD.”

If you enter a value less than -5.0%, tight shut output occurs.

▶ For details on changing the OUT value input method, see section 3.9.5, “Setting the Control Output Operation Type for Manual Mode.”

Note

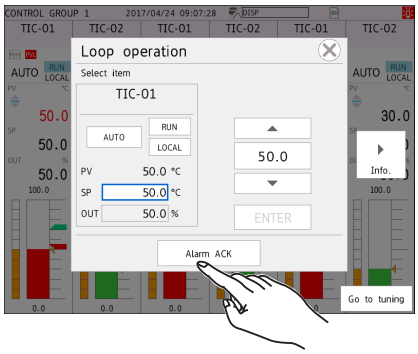
While tight shut is in effect, tight shut is not released even if the tight shut setting is changed to off or if the PID group number is changed.

The parameters that you can control in the loop operation dialog box are shown below.

Parameter	Change range
Control operation state	Switches between RUN and STOP
Control operation	Switches between REMOTE, LOCAL, and PROGRAM.
	Switches between AUTO, MANUAL, and CASCADE.
SP	Switch the local target setpoint.
OUT	Switch the manual output value.
Alarm ACK	ACK at the loop level
Unselect	Unselect. * Only on the program selection screen and operation screen.
Loop display on/off	Switches between on and off. * Only on the program selection screen and operation screen.

You cannot tap parameters that cannot be changed.

When you tap the alarm ACK button, all the control alarms assigned to the loop are acknowledged.



Tap **Go to tuning** to switch to the loop's tuning screen.
Tap **Info.** to show the loop information dialog box.

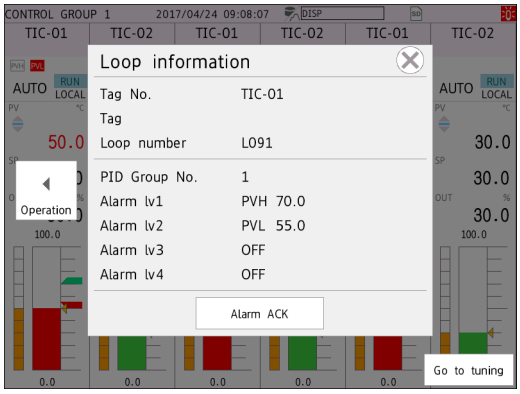
Note

- If Security function > Touch operation is set to **Ope lock** and the operation lock is enabled, the buttons are unavailable under the following conditions.
- If Security function > Touch operation is set to **Login** and a restricted user is logged in, the buttons are unavailable under the following conditions.
- If Security function > Touch operation is set to **Login** and the user is logged out, the loop operation dialog box cannot be displayed.

Buttons in the loop operation dialog box	Limitations applied to tapping
RUN/STOP	Control operation
AUTO/MANUAL/CASCADE	Control operation
LOCAL/REMOTE/PROGRAM	Remote/Local operation
SP	SP operation
OUT	Control operation
Alarm ACK	Alarm ACK
Go to tuning	

Channel Information Dialog Box

The loop information dialog box shows tag and alarm information of specific loops.



The loop information dialog box shows the following:

- Loop's tag number, tag, loop number
- Loop's PID group number
- Loop's control alarm information (alarm type, alarm value)

For details on control alarm types, see the control alarm summary screen.
For details on the alarm ACK button, see the loop operation dialog box.
Tap **Loop operation** to show the loop information dialog box.

5.1.3 Switching the Displayed Group

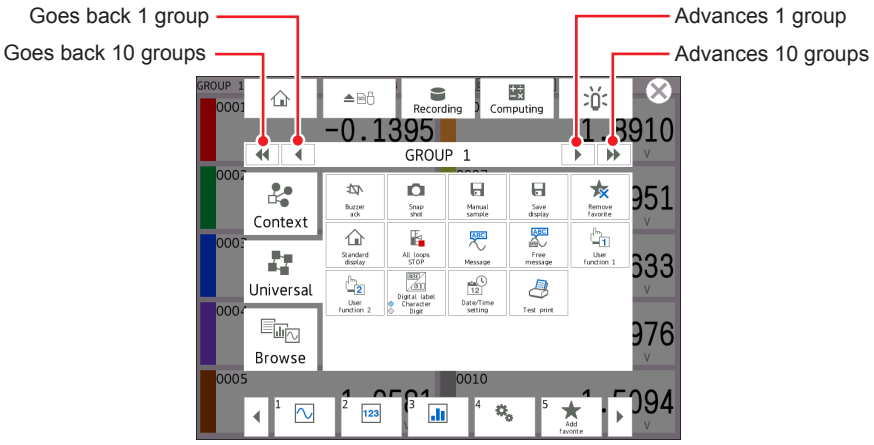
This is an operation that can be performed on the control group screen.

Procedure

Switching the Group with the Group Switch Icons

1. Press **MENU**.
   The menu screen appears.

2. Tap the **group switch icons** to switch the displayed group.
   The group that you selected appears.

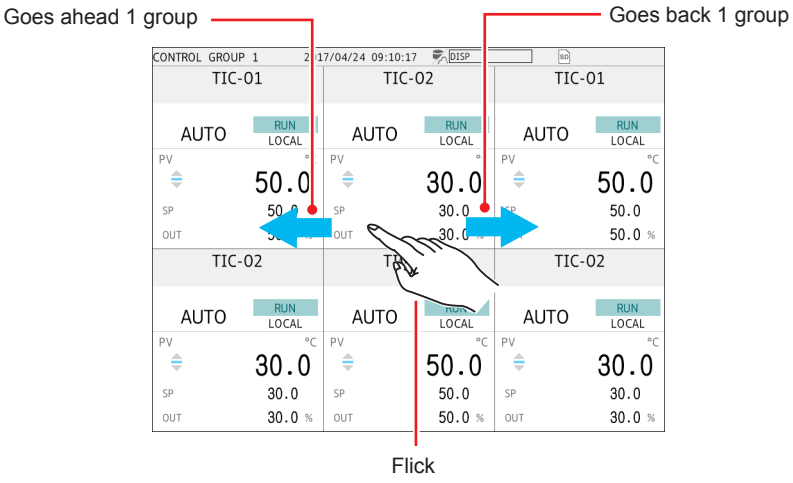


3. Tap the **Close** icon to close the menu screen.

Operation complete

Switching the Group by Flicking

Go ahead one group: Flick the screen to the left
Flick the screen up
Go back one group: Flick the screen to the right
Flick the screen down



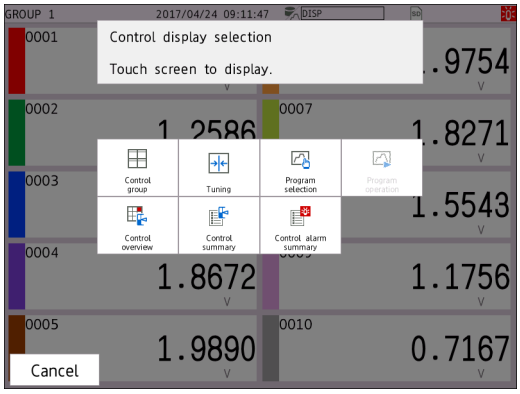
5.1.4 Showing the Status of All Loops on a Single Screen (Control Overview)

This section explains how to use the control overview screen.
The control overview screen shows on a single screen the alarm status of all loops.

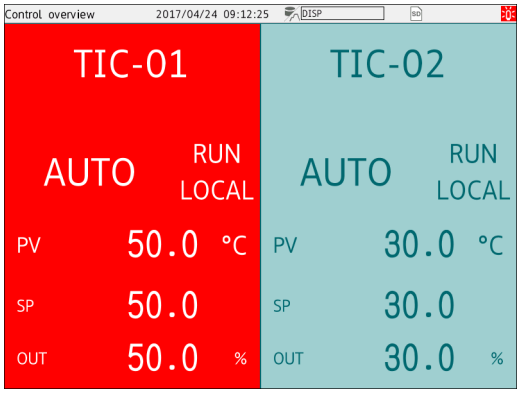
Procedure

1. Press **MENU**.
   The menu screen appears.

2. Tap the **Browse** tab and then **Control**.
   The control display selection screen appears.



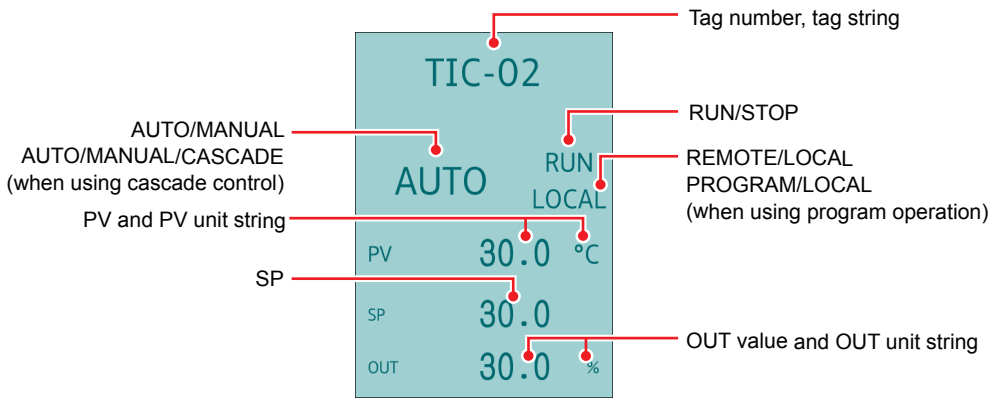
3. Tap **Control overview**.



Operation complete

Explanation

The contents displayed on the control overview screen are shown below.



Item	Displayed Content
Tag No.	Same as the controller style
Tag string	
AUTO/MANUAL/ CASCADE	
REMOTE/LOCAL/ PROGRAM	
RUN/STOP	
PV	
PV unit string	
SP	
OUT value	
OUT unit string	

Loops with any activated control alarms are displayed with a red background and white text.

The screen layout is determined by the total number of loops. The screen layout depending on the number of loops is shown below.

Total number of loops	Screen layout
1 or 2	Vertical 1 × horizontal 2
3 or 4	Vertical 2 × horizontal 2
5 or 8	Vertical 2 × horizontal 4
9 or 12	Vertical 3 × horizontal 4
13 or 16	Vertical 4 × horizontal 4
17 or 18	Vertical 3 × horizontal 6
19 or 20	Vertical 4 × horizontal 6

The display position of a loop is determined by its loop number. (Loops are displayed in ascending order by loop number.) Illustrations are provided below.

Number of loops: 2

1	2

Number of loops: 4

1	2
3	4

Number of loops: 8

1	2	3	4
5	6	7	8

Number of loops: 12

1	2	3	4
5	6	7	8
9	10	11	12

Number of loops: 16

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	16

Number of loops: 18

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18

Number of loops: 20

1	2	3	4	5	6
7	8	9	10	11	12
13	14	15	16	17	18
19	20				

Note

- * If the alarm display is set to **Hold**, loops with even a single alarm that has not been acknowledged blink.
- The colors depending on whether the alarm is on or off and whether the loop is blinking are the same as the overview screen for measurement.
- On the control overview screen, you can display the loop operation dialog box by tapping a loop.
  ▶ For details on the loop operation dialog box, see section 5.1.2, “Loop Operation and Using the Loop Operation Dialog Box.”
- When the control mode is loop control with PV switching, secondary loops are not shown on the control overview screen.

5.1.5 Displaying the Multi Panel (GX20/GP20 only)

You can divide the screen into several areas and assign the displays of your choosing to the areas.
There are nine display division patterns available. You can set up to 20 multi panels.

▶ For details on the multi panel screen, see “Multi Panel Screen (GX20/GP20 only)” in the GX/GP User’s Manual.

The following control screens can be assigned to the multi panel screen.

Screen type	Notes
Control group	Can be assigned only to areas larger than four equally divided areas.
Control summary	Can be assigned to all positions, but some contents are omitted depending on the display size. (Example: Column names are omitted depending on the screen size.)
Control alarm summary	Can be assigned to all positions, but some contents are omitted depending on the display size. (Example: Column names are omitted depending on the screen size.)
Control overview	Can be assigned only to areas larger than four equally divided areas.

Note

- If a control group screen or control overview screen is assigned to an area smaller than four equally divided areas, the area is filled with the background color (is hidden).
- If a control group screen is assigned, you can change the control group number by tapping the left and right arrow buttons of the multi panel edit screen.
- The tuning screen, program selection screen, and program operation screen cannot be shown in the multi panel screen.

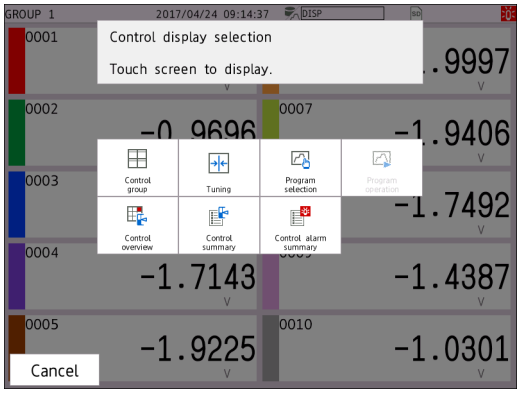
5.1.6 Listing the Control Log (Control summary)

This section explains how to use the control summary.
The control summary screen shows the control (RUN, STOP, etc.) log.

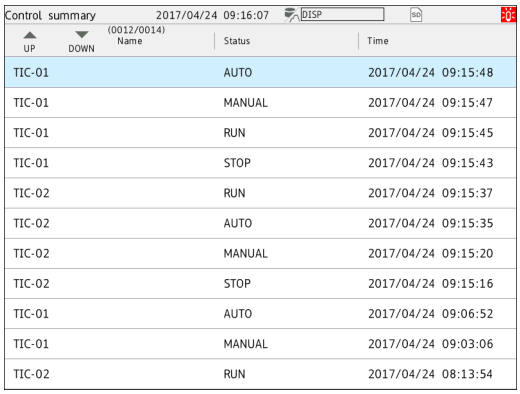
Procedure

1. Press **MENU**.
   The menu screen appears.

2. Tap the **Browse** tab and then **Control**.
   The control display selection screen appears.



2. Tap **Control summary**.
   The control summary appears.



Operation complete

Scrolling the Control Summary Display

You can scroll the display in the following manner.

- Drag or flick the data display area up or down.
- Scroll icons
  UP: Scrolls the status information up
  DOWN: Scrolls the status information down

Displaying the Historical Trend When Control Events Occur

1. Tap the status information that occurred.
   The selected status information appears.

2. Tap **Go to trend**.
   The historical trend screen at the point where the control event occurred is displayed.

Operation complete

Explanation

The control summary screen shows Name, Status, and Time columns.
The Name column shows names of loops under control and program pattern names.
The Status column shows control types. The following table shows the available control types.
The Time column shows timestamps of control events.

Status	Description	Content displayed in the Name column
LOCAL	Control operation changed to local.	Loop name (The order of display precedence is tag number, tag, and loop number.)
REMOTE	Control operation changed to remote.	
PROGRAM	Control operation changed to program.	
AUTO	Control operation changed to auto.	
MANUAL	Control operation changed to manual.	
CASCADE	Control operation changed to cascade.	
RUN	Run control operation	
STOP	Stop control operation	
AT** ON	Auto-tuning start **: PID number or “R”	
AT OFF	Auto-tuning stop	
PROG RUN	Program operation run	Program pattern name (The order of display precedence is pattern name and pattern number.) * Pattern name: Up to 20 characters
PROG RESET	Program operation stop	
HOLD ON	Program operation hold start	
HOLD OFF	Program operation hold release	
WAIT ON	Program operation wait start	
WAIT OFF	Program operation wait release	
ADVANCE	Program operation advance execution	
PVE** ON	PV event occurrence in program operation **: Event number	Program pattern name + loop name + event type
PVE** OFF	PV event release in program operation **: Event number	
TME** ON	Time event occurrence in program operation **: Event number	Program pattern name
TME** OFF	Time event release in program operation **: Event number	

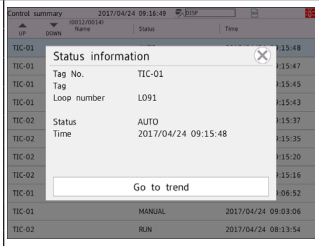
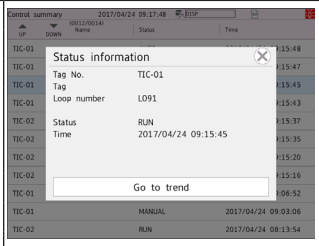
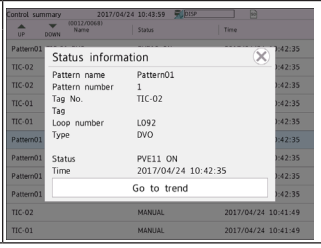
Note

- The display order of control summary is fixed to descending order by event occurrence.
- Up to 1000 control (RUN, STOP, etc.) log entries are displayed. If the maximum number is exceeded, the oldest event is cleared.
- The list of program event types is the same as that of the control alarm summary screen.

Status Information Dialog Box

A status information dialog box can be displayed by tapping the control summary.
The status information dialog box shows the details of the selected control event and allows jumping to corresponding time in the historical trend screen.

The content of the status information dialog box varies depending on the control type. The content for each type is shown below.

Control Type	Content of the Information Dialog Box	Illustration
LOCAL REMOTE PROGRAM AUTO MANUAL CASCADE RUN STOP AT** ON AT OFF STAND-BY ON STAND-BY OFF	Tag No. Tag Loop number Status Time	
PROG RUN RESET HOLD ON HOLD OFF WAIT ON WAIT OFF ADVANCE TME** ON TME** OFF	Pattern name Number Status Time	
PVE** ON PVE** OFF	Tag No. Tag Loop number Pattern name Number Type Status Time	

Note

- If the record type is **Display+Event**, two types of buttons, Go to trend(Disp) and Go to trend(Event), are displayed.
- You can jump to the data at the corresponding control event in the historical trend by tapping the Go to trend button in the Status information dialog box. If the data does not exist, E532 (No data available) appears, and jumping is not possible.
- If multi batch is enabled and multiple data values exist at the point where the summary occurred, a search is made from the last displayed batch group number, and the data found first is automatically displayed.

5.1.7 Listing the Log of Alarm Occurrences and Releases (Control alarm summary)

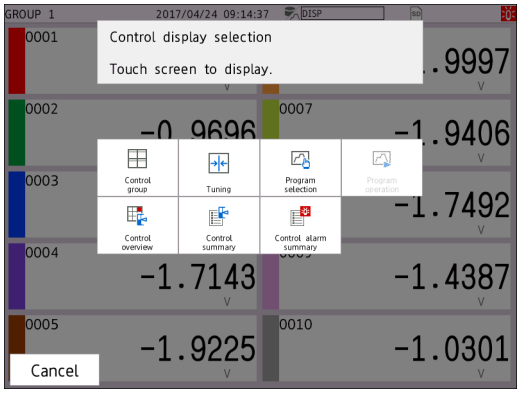
This section explains how to use the control alarm summary.
The control alarm summary screen shows the control alarm log.

Procedure

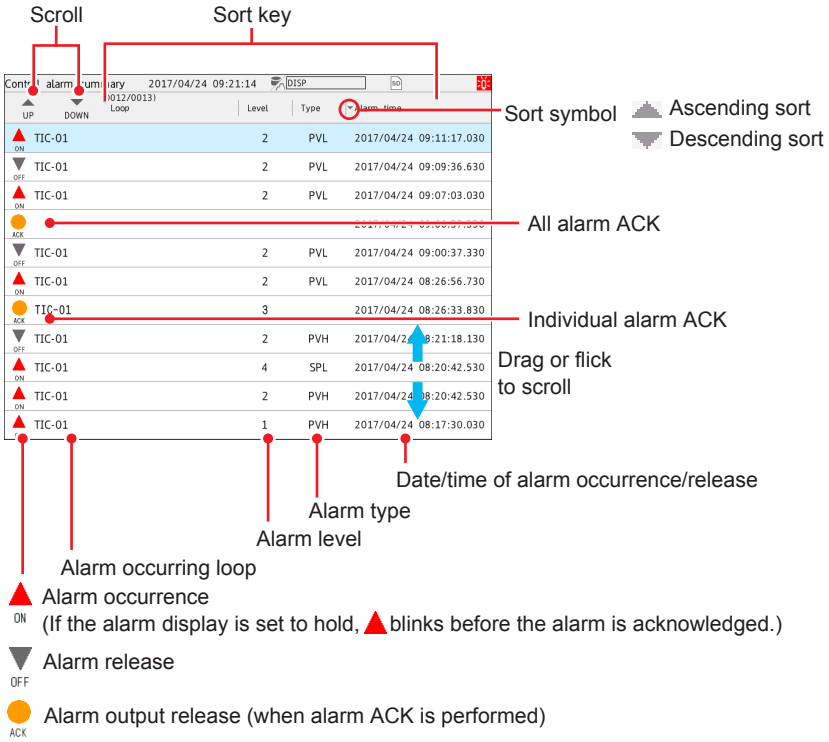
1 Press **MENU**.

The menu screen appears.

2 Tap the **Browse** tab and then **Control**.
The control display selection screen appears.



3 Tap **Control alarm summary**.
The control alarm summary appears.



Operation complete

Scrolling the Control Alarm Display

You can scroll the display in the following manner.

- Drag or flick the data display area up or down.
- Scroll icons
  UP: Scrolls the control alarm information up
  DOWN: Scrolls the control alarm information down

Sorting Items in Ascending or Descending Order

Tap a sort item to sort the list.
You can sort alarms in ascending or descending order by the following items. The sort symbol is displayed next to the sort item.

- Loop number: Sorts the control alarms by loop number even when tags are in use. Alarms within a single loop are displayed in order according to the occurrence and release times.
- Level: Sorts the alarms by the alarm level number.
- Type: Sorts in the order PVH, PVL, SPH, SPL, DVH, DVL, DVO, DVI, OTH, OTL, PVR.
- Alarm time: Time of occurrence or release

You can change the sort order (ascending or descending) by tapping the column being sorted.

Explanation

Note

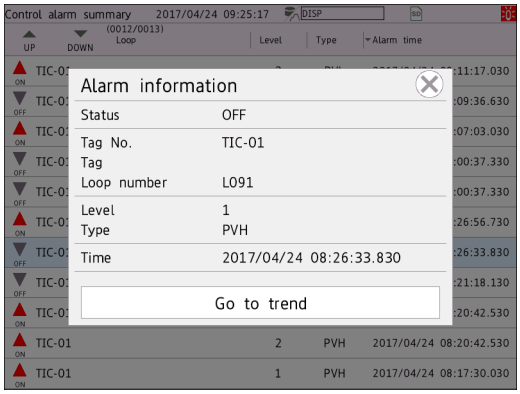
- The maximum number of entries that can be displayed in the control alarm summary is 500. If the maximum number is exceeded, the oldest event is cleared.
- A loop name and status icon are shown in the loop column. Icons are the same as those of the measurement alarm summary. The following table shows the statuses.
- The timestamps can be displayed with or without milliseconds. Change it from the Context menu.

Status	Loop	Level	Type
ON	Loop name (Tag number > tag > loop number)	Shown	
OFF			
Individual alarm ACK		Hidden	
All loop off	All loop off		
All alarm ACK	None		

Alarm type	Characters
PV high limit	PVH
PV low limit	PVL
SP high limit	SPH
SP low limit	SPL
Deviation high limit	DVH
Deviation low limit	DVL
Deviation H/L limits	DVO
Dev. within H/L limits	DVI
Control output high limit	OTH
Control output low limit	OTL
PV velocity	PVR

Control Alarm Information Dialog Box

A control alarm information dialog box can be displayed by tapping the control alarm summary.
The control alarm information dialog box shows the details of the selected alarm event and allows jumping to corresponding time in the historical trend screen.
Below is an illustration of the control alarm information dialog box.



Note

- If the record type is **Display+Event**, two types of buttons, Go to trend(Disp) and Go to trend(Event), are displayed.
- You can jump to the data at the corresponding alarm event in the historical trend by tapping the Go to trend button in the control alarm information dialog box. If the data does not exist, E532 (No data available) appears, and jumping is not possible.
- If multi batch is enabled and multiple data values exist at the point where the summary occurred, a search is made from the last displayed batch group number, and the data found first is automatically displayed.

5.1.8 Viewing and Adjusting PID and Other Control Parameters (Tuning)

This section explains how to use the tuning screen.
The tuning screen allows you to view and adjust the control parameters (e.g., PID constant) of specific loops.
Below is an illustration of the tuning screen.

Note

- If a setting parameter is changed, the value on the tuning screen is also changed immediately.
- While the tuning screen is displayed, the control target loop name is displayed in the screen name area of the status area.

Up to eight groups of setting parameters that fall into the SP group category can be set for each SP group number. SP group setting parameters are shown below.

Category	Setting parameter
SP group	Target setpoint SP
	Control alarm value A1
	Control alarm value A2
	Control alarm value A3
	Control alarm value A4
	PID group number PIDN

Up to eight groups of setting parameters that fall into the PID group category can be set for each PID group number. PID group setting parameters are shown below.
If you want to use a reference deviation PID, you can set it separately from the PID group number. (The reference deviation setting parameters are displayed on the R tab.)

Category	Setting parameter
PID group	Proportional band P
	Integral time I
	Derivative time D
	Output high limit OH
	Output low limit OL
	Manual reset MR
	Control direction DR
	Preset output PO
	Upper-side hysteresis HY.UP
	Lower-side hysteresis HY.DN
	Tight shut SD

Setting parameters that do not fall into the SP group or PID group categories are placed in the Other category. (One set for each loop or one set for the system)
The other setting parameters are shown below.

Category	Setting parameter
Other	AI1 bias BS1
	AI2 bias BS2
	SP computation remote bias value RBS
	AI1 first-order lag filter FL1
	AI2 first-order lag filter FL2
	SP computation (remote setpoint) filter value RFL
	SP computation (remote setpoint) input ratio value RT
	Target setpoint ramp-up rate value UPR
	Target setpoint ramp-down rate value DNR
	Logic math constants W001 to W100

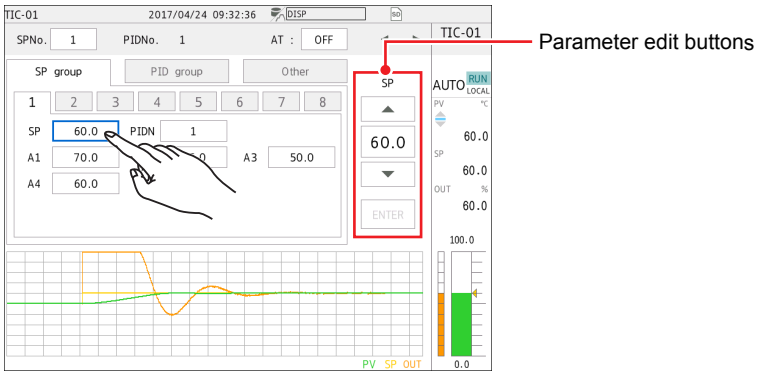
The contents displayed in the tuning screen vary depending on the setting screen. Setting parameters that are not displayed on setting screens are not displayed on the tuning screen either. (Example: PID constant when the control type is ON/OFF control)

Note

You cannot show or hide the setting parameters displayed on the tuning screen to your liking.

Changing Parameters

On the tuning screen, tapping the setting parameter you want to change displays parameter edit buttons. An illustration of parameter edit buttons is shown below.



▶ For details on changing parameters, see section 5.2.3, “Adjusting the PID Manually (Manual Tuning).”

Procedure

1. Tap the parameter value you want to change.

   Parameter edit buttons appear.

2. Tap the up and down arrow buttons to change the value. To set the value, tap ENTER. Tap the value to display a keyboard that you can use to enter the value. Press Enter on the keyboard to confirm the value.

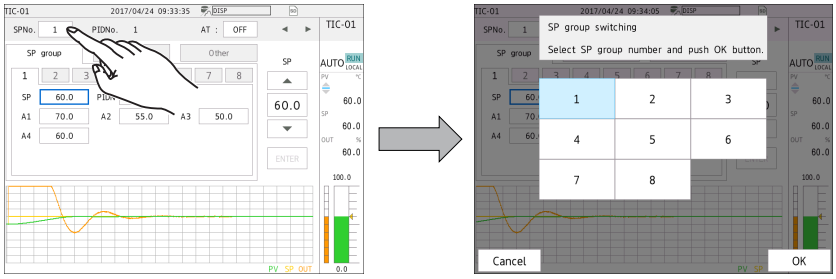
Operation complete

Note

- If the selected parameter is a logic math constant, the up and down arrow buttons are unavailable.
- If the selected parameter is not a value, the parameter keyboard cannot be displayed (e.g. tight shut function on/off).

Changing the SP Number

The tuning screen shows the SP group number and PID group number that are currently used for control.
Tapping the SP group number currently in use displays a SP group number switch dialog box. An illustration is shown below.



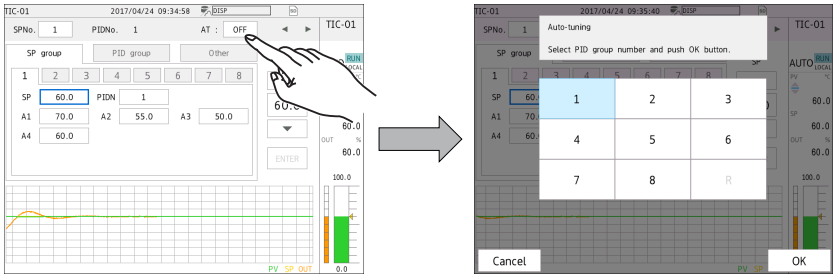
In case the PID selection is SP No. selection, in the SP group number switch dialog box, you can change the SP group number to use for control. PID group numbers are set in pairs with the SP group numbers.

▶ For details on changing the SP number, see section 5.2.4, “Setting or Changing the Target Setpoint Number (SP number).”

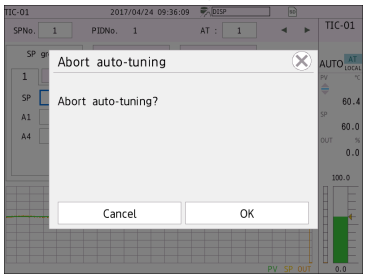
Performing and Canceling Auto-Tuning

The tuning screen shows the PID group number currently being auto-tuned (“OFF” when auto-tuning is stopped).
Tapping the PID group number being auto-tuned displays a dialog box corresponding to the current status. An illustration is shown below.

Auto-tuning start dialog box (when tapped when stopped)

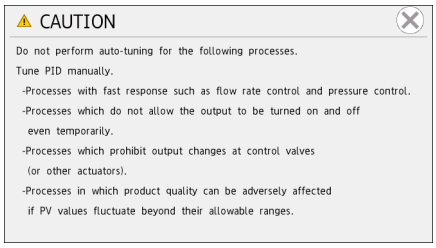


Abort auto-tuning dialog box (when tapped when running)



In the auto-tuning start dialog box, you can perform auto-tuning.
Numbers greater than the number of PID groups appear dimmed. If reference deviation is disabled, R is unavailable.
In the abort auto-tuning dialog box, you can cancel an auto-tuning in progress.

If auto-tuning is set to off, the following warning message appears when displaying the auto-tuning start dialog box.



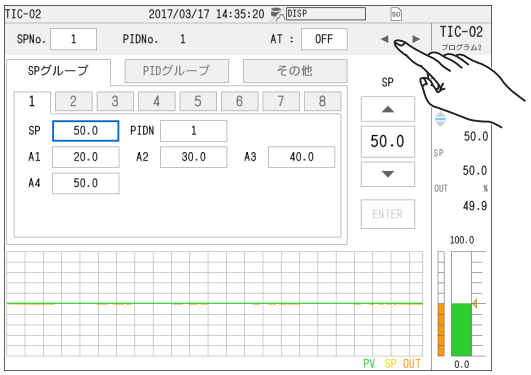
▶ For details on auto-tuning, see section 5.2.2, “Performing and Canceling Auto-Tuning.”

Note

The tuning screen shows the trend waveforms of PV, SP, and OUT from when the screen is displayed.
The trend waveforms are drawn every display update interval regardless of the recording status. If the tuning screen is switched to another screen, all the drawn waveforms will be cleared.

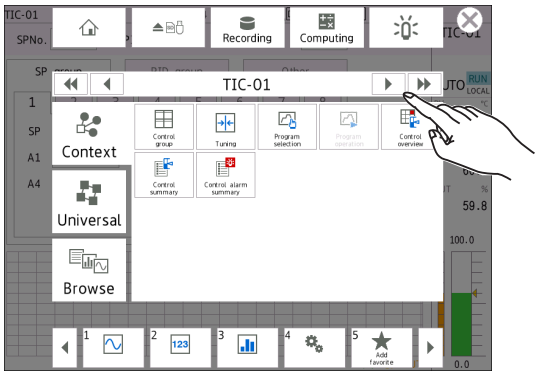
Switching the Tuning Target Loop

You can change the tuning target loop number by tapping the loop number switch buttons.



Button type	Content
Tuning number switch (back)	Displays the previous valid loop number. Folds back from the first loop to the last loop.
Tuning number switch (forward)	Displays the next valid loop number. Folds back from the last loop to the first loop.

You can also change the tuning target loop number by tapping the switch buttons on the menu.



Button type	Content
Tuning number switch (back by 10)	Displays the 10th previous valid loop number. Folds back from the first loop to the last loop.
Tuning number switch (back)	Displays the previous valid loop number. Folds back from the first loop to the last loop.
Tuning number switch (forward)	Displays the next valid loop number. Folds back from the last loop to the first loop.
Tuning number switch (forward by 10)	Displays the 10th next valid loop number. Folds back from the last loop to the first loop.

When switching through loop numbers, secondary loop numbers of loop control with PV switching are skipped.

Note

In the case of the GX10, if there are six or more tabs in the SP group (PID group), tab switch buttons will be displayed. You can change the selected tab one by one by tapping the switch buttons.

Note

- If Security function > Touch operation is set to **Ope lock** and Tuning operation is set to **Lock**, the tuning operation cannot be executed while the operation lock is enabled.
- If Security function > Touch operation is set to **Login** and Tuning operation is set to **Lock**, the tuning operation cannot be exceuted when the user is logged out or when a restricted user is logged in.

5.2 Using Loop Control

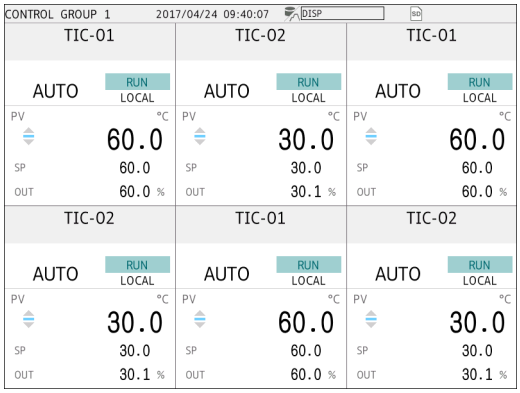
This section explains loop control operation from the control group screen.

5.2.1 Setting or Changing the Target setpoint (SP)

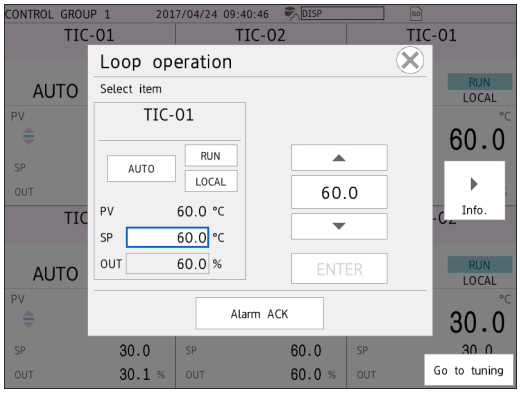
Set or change the target setpoint (SP).

Procedure

1 Display the control group screen.



2 Tap the loop you want to change the target setpoint of.
The Loop operation screen appears.



3 Tap the SP value to display parameter edit buttons.
(The SP value can be tapped only in local mode.)

4 Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
Tapping the center value displays a numeric input keyboard that you can use to change the value directly.

Operation complete

5.2.2 Performing and Canceling Auto-Tuning

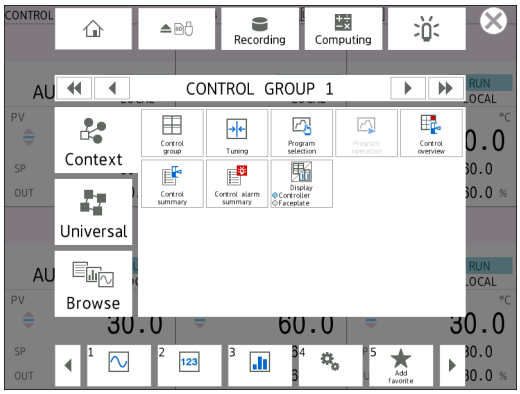
You can use the auto-tuning function to perform or cancel tuning.

Procedure

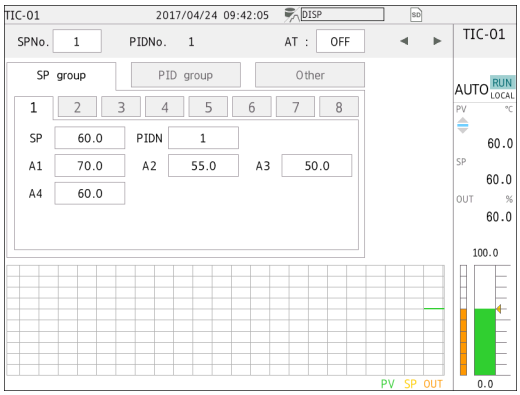
Performing Auto-Tuning

1. Display the control group screen.

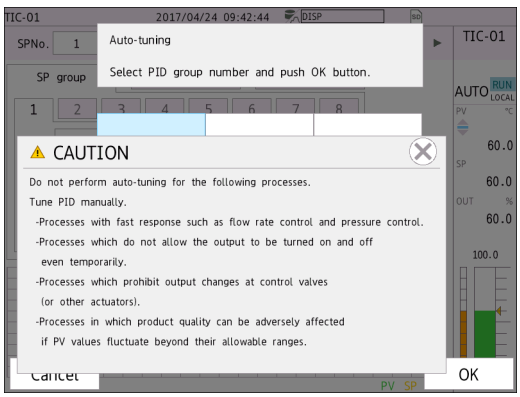
2. Press **MENU**.
   The menu screen appears.



3. Tap the **Context** tab and then **Tuning**.
   A tuning screen appears.



4. Tap **OFF** displayed to the right of AT.
   A caution message for using auto-tuning appears. Read the message, and tap the **Close** icon.



5 Select PID group number to auto-tune, and tap OK.

6 While auto-tuning is in progress, AT in the loop area blinks.

Operation complete

Note

- To execute auto-tuning, set the mode to AUTO and RUN.
- If the control mode is cascade control, execute auto-tuning on Loop 2 in AUTO and RUN modes and then Loop 1 in Cascade and RUN modes.

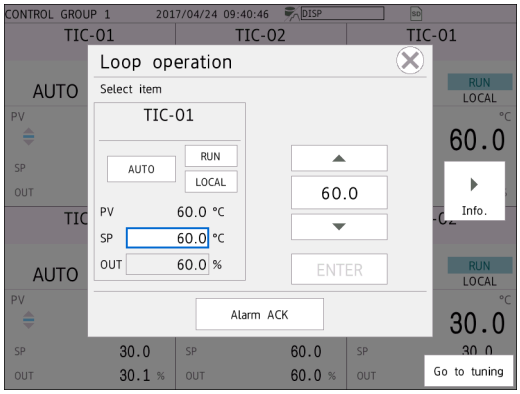
If auto-tuning is executed on a loop running under program operation, the program operation is temporarily held. The operation resumes when auto-tuning is complete.

Procedure

Canceling Auto-Tuning

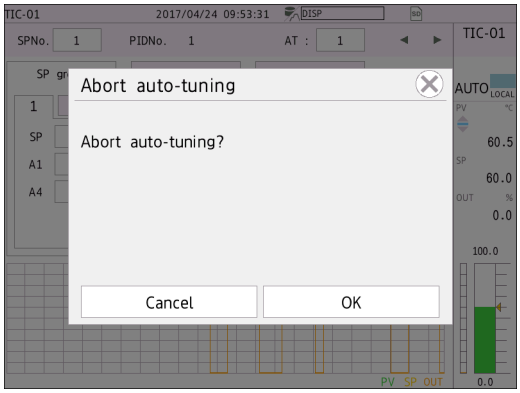
1. Display the control group screen.

2. Press **MENU**.
   The menu screen appears.



3. Tap the **Context** tab and then **Tuning**.
   A tuning screen appears.

4. Tap the PID group number displayed to the right of AT.
   An abort auto-tuning message appears. Tap OK to cancel auto-tuning.



5. When the auto-tuning is canceled, the AT blinking disappears.

Operation complete

Explanation

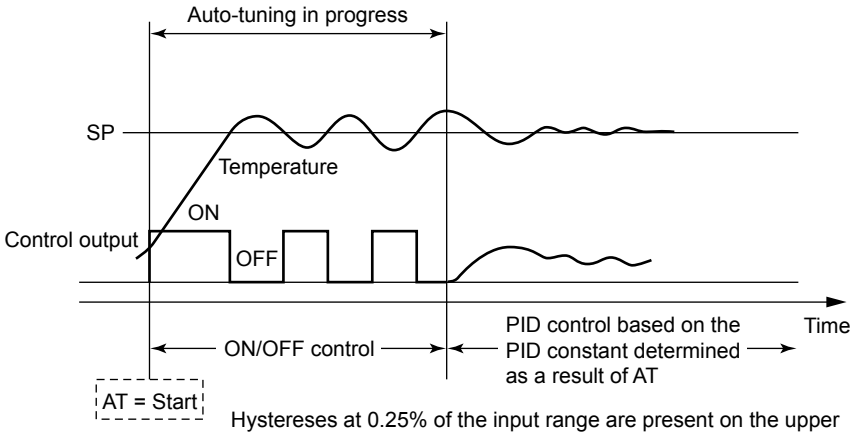
Auto-tuning is a function with which the controller automatically measures the process characteristics and sets PID constants, which are control-related parameters, to optimum values for the setpoint.
Auto-tuning temporarily executes ON/OFF control, calculates appropriate PID constants from response data obtained, and sets these constants.

Note

Avoid using auto-tuning for the following types of processes.
Use manual tuning instead.

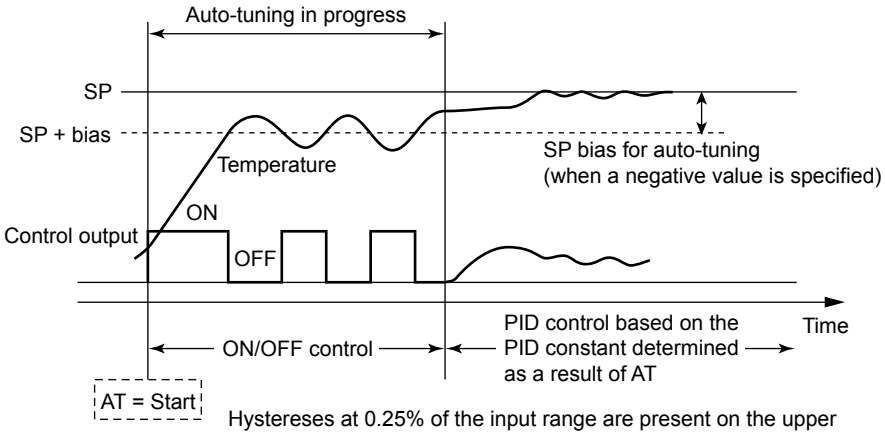
- Processes with fast response such as flow rate control and pressure control
- Processes which do not allow the output to be turned on and off even temporarily
- Processes which prohibit output changes at control valves (or other actuators).
- Processes in which product quality can be adversely affected if PV values fluctuate beyond their allowable ranges.

Auto-Tuning Operation



Hystereses at 0.25% of the input range are present on the upper and lower sides of the target setpoint.

Operation when SP bias in auto-tuning is set



Hystereses at 0.25% of the input range are present on the upper and lower sides of the target setpoint.

▶ For details on SP bias in auto-tuning, see section 3.3.9, “Adjusting Auto-tuning Operation.”

Tuning Point and Storage Location of Tuning Results

The tuning point when performing auto-tuning is the target setpoint that is currently used for control computation. PID constants after the tuning are stored in the PID group that is specified when performing auto-tuning.

Operation mode	AT target PID group	Tuning point	Storage location
Program/local	1 to 8, R	Setpoint that is currently used	P, I, and D of the PID group specified in AT.
Remote	1 to 8, R	Remote setpoint	P, I, and D of the PID group specified in AT.

When the AT target PID group is “R,” the AT result is stored in the PID group for reference deviation.
When performing auto-tuning in the AT target PID group is "R", set the PID selection to a value other than “SP No./Segment PID No. selection” or “External selection” and reference deviation to a value other than zero.

Auto-tuning Limitations

Auto-tuning cannot be performed when the control type is ON/OFF control.
In addition, auto-tuning cannot be performed in the following cases.

- Input error occurs. (Input burnout, ADC error, etc.)
- The operation mode is STOP.
- The operation mode is MAN.
- Operation mode is RESET (during program control).

Start and Stop of Auto-tuning

Start and stop of auto-tuning can be set by a touch operation, communication or contact input.
Auto-tuning is stopped in the following cases.

- Switch to MAN
  During cascade control, cascade mode (CAS) mode is changed to another mode.
  Auto mode is changed to another mode.
- Switch to STOP
- Switch to RESET (during program control)
- Power failure
- Auto-tuning is not finished even after the time-out detection time elapses.

Auto-tuning Execution Error

The time-out detection time is about 24 hours.
When an auto-tuning error occurs, the error code is shown in the operation screen.

▶ For details on output limiter in auto-tuning, see section 3.3.9, “Adjusting Auto-tuning Operation.”

5.2.3 Adjusting the PID Manually (Manual Tuning)

There are eight groups of PID parameters for each loop.
In cascade control, there are eight groups in each of the primary and secondary loops.

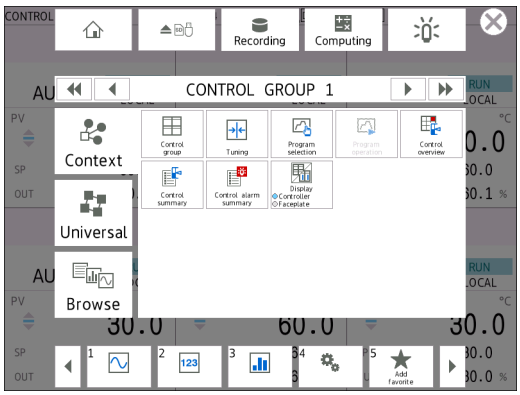
PID parameters can be selected using the following methods.
(1)SP No./Segment PID No. selection
(2)Zone PID selection (PV, target SP, SP)
(3)External selection (external contact input)

- ▶ For details on selection using contact input, see section 3.7, “Configuring the Action Function (Contact Input Function).”
- ▶ For selecting by zones, see section 3.3.6, “Setting PID Switching (Zone PID (PV/SP/TSP, SP Number)).”

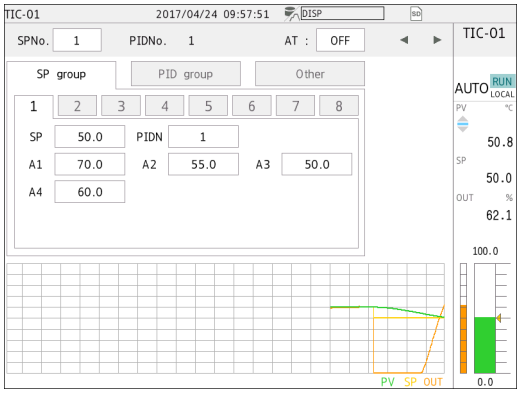
Procedure

1 Display the control group screen.

2 Press **MENU**.
The menu screen appears.



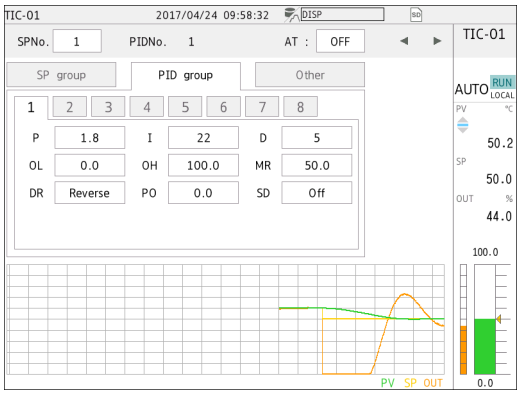
2 Tap the **Context** tab and then **Tuning**.
A tuning screen appears.



Note

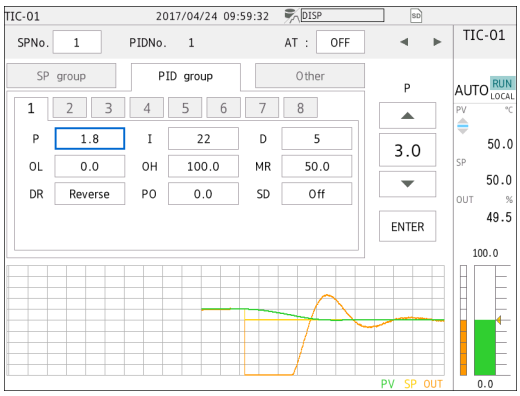
SP No. and **PID No.** in the top area of the tuning screen are the values currently in use for control. Check the SP No. and PID No. you want to manually tune and adjust them.

3 Tap **PID group**.



4 Tap P, I, or D you want to tune.
Parameter edit buttons appear.

5 Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
You can also enter the value directly from the keyboard by tapping the center value.

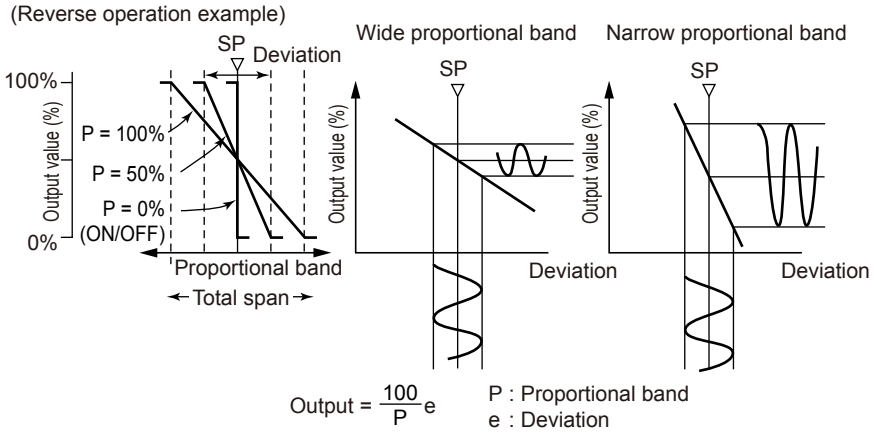


Operation complete

Explanation

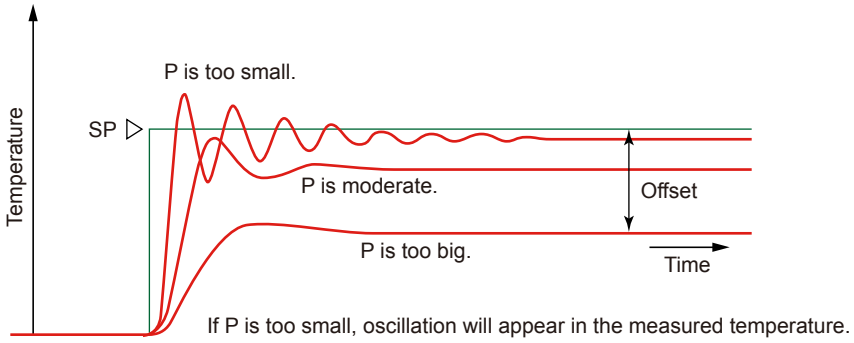
Description and Tuning of Proportional Band

The proportional band is defined as the amount of change in input (or deviation), as a percent of span, required to cause the control output to change from 0% to 100%. Because a narrower proportional band gives greater output change for any given deviation, it therefore also makes the control performance more susceptible to oscillation. At the same time, a narrower proportional band reduces the offset. Reducing the proportional band to its smallest limit (proportional band = 0%) results in ON/OFF control.



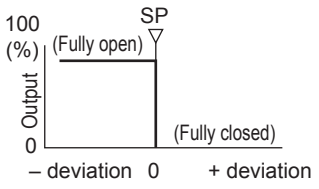
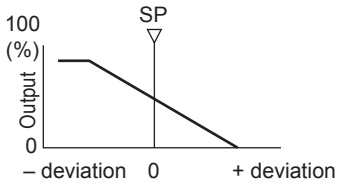
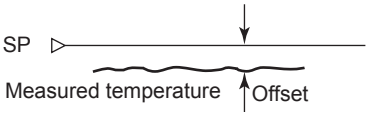
To fine-tune a proportional band obtained using auto-tuning, or to manually tune the proportional band:

- Work from larger to smaller numbers (wider to narrower).
- If cycling appears, that means that the proportional band is too narrow.
- Proportional band tuning cannot cancel an offset.



▶ For details on offset, see section 3.5.9, “Canceling the PV and SP Offset (Manual Reset).”

Proportional band is a control parameter for adjusting the effectiveness of proportional action.
Here the behavior of proportional action is explained by drawing a parallel with ON/OFF action.

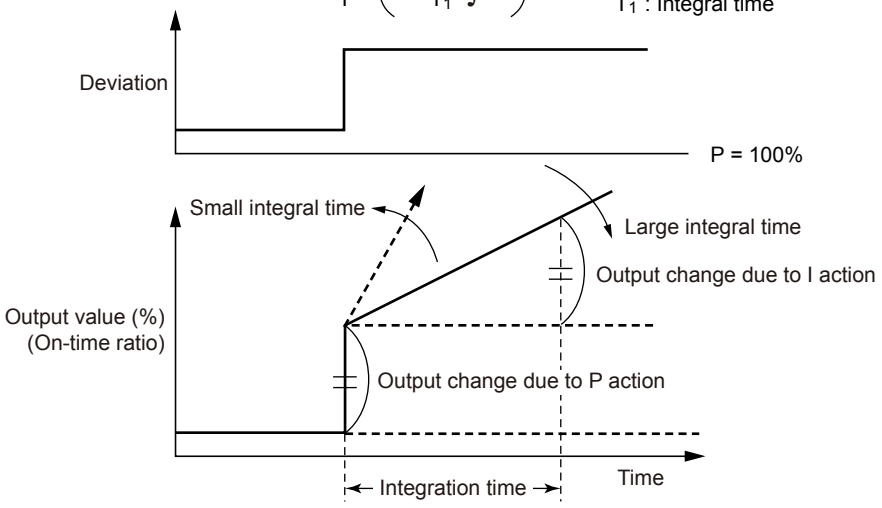
	ON/OFF action	Proportional action
Control output (Reverse operation example)	No middle state 	The magnitude of the output changes continuously in proportion to the amount of deviation. 
Control performance	More susceptible to oscillation 	The control performance is smooth. 
Offset (Constant deviation)	None	In principle, a constant offset exists between the target setpoint and measured temperature.

Description and Tuning of Integral Time

The integral action (I action) is a function that will automatically diminish the offset (steady-state deviation) that is inherently unavoidable with proportional action alone. The integral action continuously increases or decreases the output in proportion to the time integral of the deviation (the product of the deviation and the time that the deviation continues).
The integral action is normally used together with proportional action as proportional-plus-integral action (PI action).
The integral time is defined as the time required to develop, when a stepwise change in deviation is imposed, an output change due to integral action that is exactly equal to the change due to proportional action.
The longer the integral time set, the slower the change in output; the smaller the time, the faster the output changes.

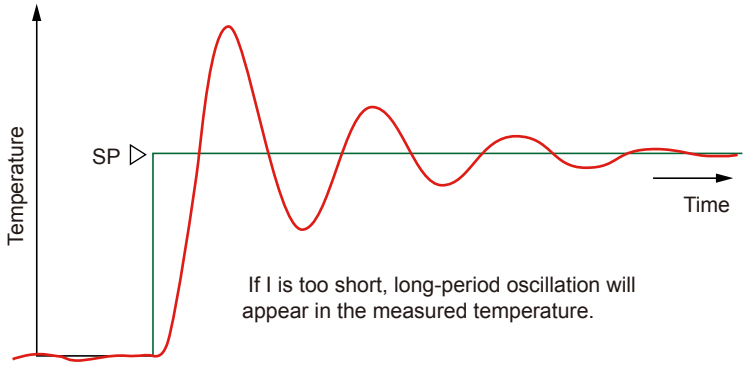
$$\text{Output} = \frac{100}{P}\left(e + \frac{1}{T_1}\int edt\right)$$

e : Deviation
T_1 : Integral time



To manually tune the integral time

- The main goal is to reduce the offset.
- Adjust from longer time to shorter time.
- If you see an oscillation at a longer period than that seen when the proportional band is too narrow, then you have made the integral time too short.



Use the manual reset to cancel an offset when the integral action is disabled.

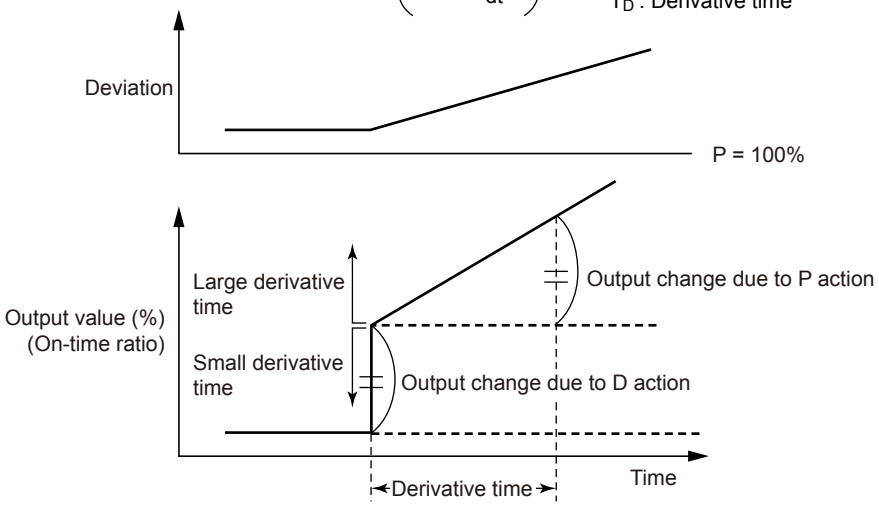
▶ For details on manual reset, see section 3.5.9, “Canceling the PV and SP Offset (Manual Reset).”

Description and Tuning of Derivative Time

If the control object has a large time constant or dead time, the corrective action will be too slow with proportional action or proportional-plus-integral action alone, causing overshoot. However, even just sensing whether the deviation is on an increasing or a decreasing trend and adding some early corrective action can improve the controllability. Thus the derivative action (D action) is action that changes the output in proportion to the deviation derivative value (rate-of-change).
The derivative time is defined as the time required with PD action to develop, when a constant-slope change in deviation is imposed, an output change due to derivative action that is exactly equal to the change due to proportional action.

$$\text{Output} = \frac{100}{P}\left(e + T_D \frac{d}{dt} e\right)$$

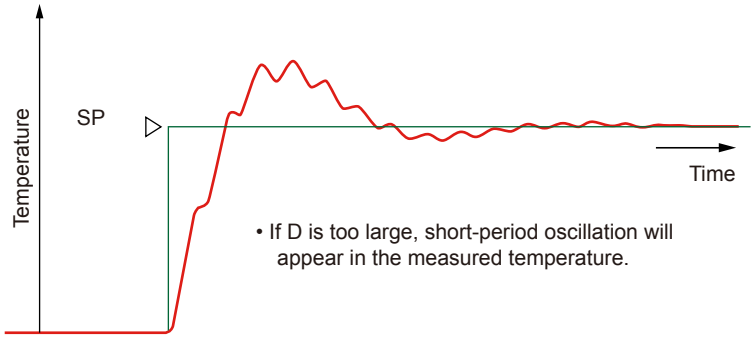
e : Deviation
T_D : Derivative time



To manually tune the derivative time

- Adjust from shorter time to longer time.
- If you see a short-period oscillation, the time is too long.

The longer the derivative time set, the stronger the corrective action, and the more likely the output will become oscillatory. Oscillations due to derivative action are characterized by a short period. Derivative time should always be set to off when controlling fast-responding inputs such as pressure and flow rate, or inputs characterized by rapid fluctuation, such as optical sensors.



Manual PID Tuning Procedure

(1)In principle, auto-tuning must be used.
(2)Tune PID parameters in the order of P, I, and D. Adjust a numeric slowly by observing the result, and keep notes of what the progress is.
(3)Gradually reduce P from a larger value. When the PV value begins to oscillate, stop tuning and increase the value somewhat.
(4)Also gradually reduce I from a larger value. When the PV value begins to oscillate (with long period), stop tuning and increase the value somewhat.
(5)Gradually increase D from a smaller value. When the PV value begins to oscillate (with short period), stop tuning and lower the value slightly.

Reference Values for Manual Tuning of Temperature, Pressure, and Flow Rate

Control target	PID parameter	Setting range (reference)
Pressure	P	100 to 300%
	I	5 to 30 s
	D	0 s
Flow rate	P	100 to 240%
	I	8 to 30 s
	D	0 s
Temperature (electric furnace)	P	1 to 20%
	I	180 to 600 s
	D	1/4 to 1/6 of I

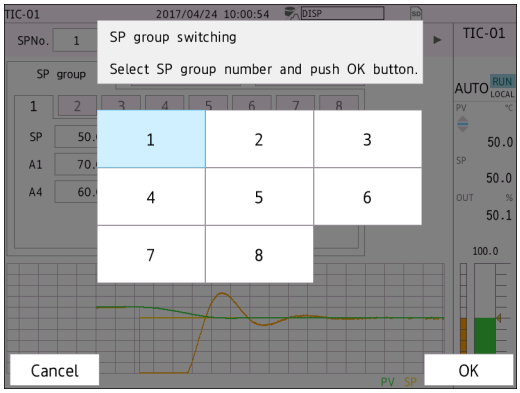
5.2.4 Setting or Changing the Target Setpoint Number (SP number)

Set or change the SP number currently in use for control.

Procedure

1. Display the control group screen.
2. Press **MENU**.
   The menu screen appears.
3. Tap the **Context** tab and then **Tuning**.
   A tuning screen appears.

4. Tap the SP group number displayed to the right of SP No.
   A SP group switching screen appears.



5. Select a number, and tap **OK**.

Operation complete

5.2.5 Setting or Changing the Alarm Setpoint

Set or change the alarm setpoint currently in use for control.

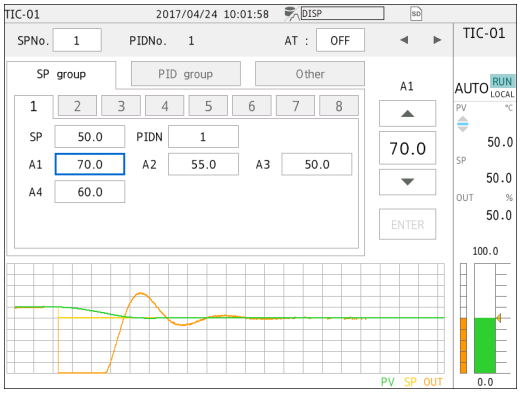
Procedure

1. Display the control group screen.

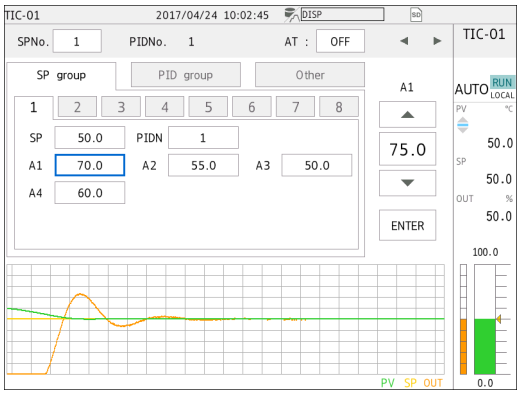
2. Press **MENU**.
   The menu screen appears.

3. Tap the **Context** tab and then **Tuning**.
   A tuning screen appears.

4. Tap the **SP group** tab and then an alarm setpoint (A1, A2, A3, or A4).
   Parameter edit buttons appear.



5. Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
   You can also enter the value directly from the keyboard by tapping the center value.



Operation complete

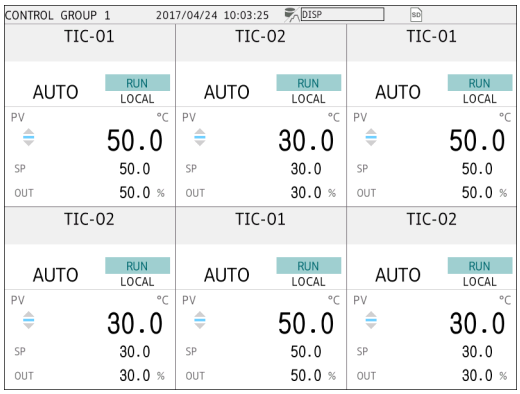
5.2.6 Switching Operation Modes

Switching between AUTO and MANUAL

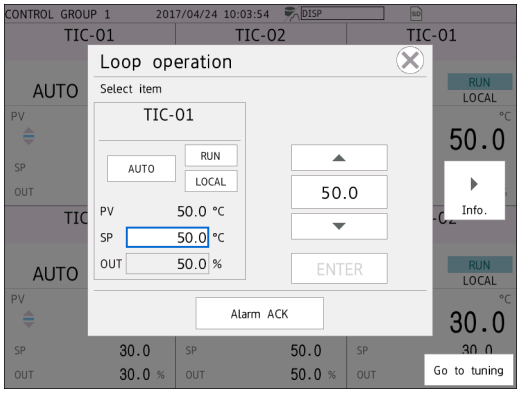
Switch between AUTO and MANUAL on the Loop operation screen of the Control group screen. Here AUTO is switched MANUAL. You can execute this on a screen that can display the loop operation dialog box.

Procedure

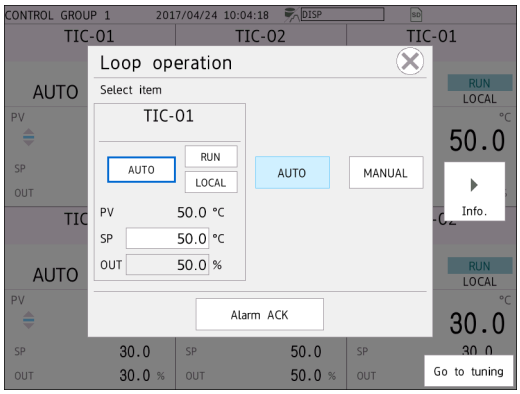
1 Display the control group screen.



2 Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.



3 Tap **AUTO**.
AUTO and **MANUAL** are displayed.



4 Selecting **MANUAL** will switch the mode to manual mode.

Operation complete

Control Output Behavior When the Operation Mode Is Changed

Operation mode switching	Control output behavior
AUTO→MANUAL	The control output value in auto mode is retained.
MANUAL→AUTO	The control output value works without bumps. This does not work when integral time (I) is set to OFF.

Control Output Control in Manual Mode

You can control the control output value through touch operation.

Switching between CASCADE, AUTO, and MANUAL (during cascade control)

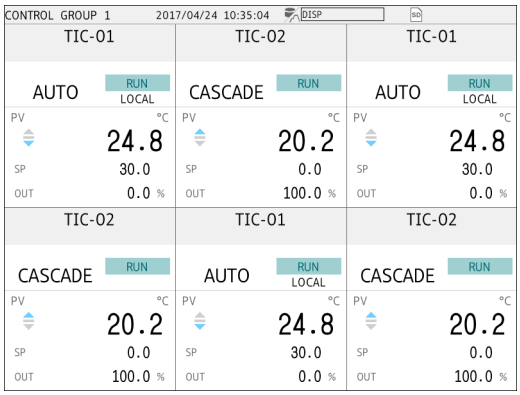
Switch between CASCADE, AUTO, and MANUAL using Loop operation on the Control group screen. Here cascade mode is switched to auto mode (secondary side). You can execute this on a screen that can display the loop operation dialog box.

Note

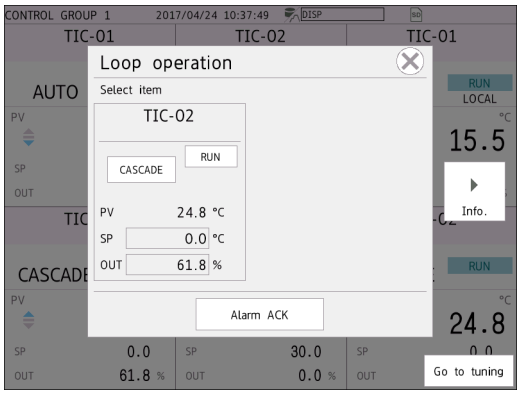
During cascade control, switching the operation mode between cascade, auto, and manual is performed on the secondary loop.

Procedure

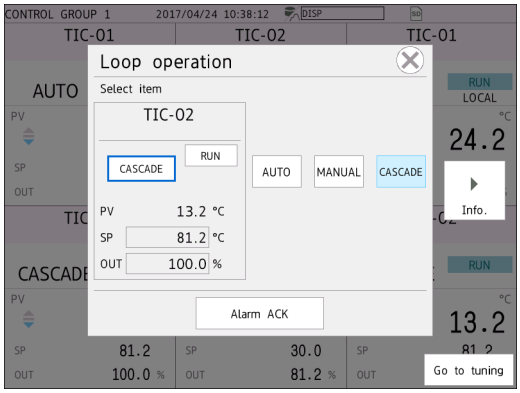
1 Display the control group screen.



2 Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.



3 Tap **CASCADE**.
AUTO, **MANUAL**, and **CASCADE** are displayed.



4 Selecting **AUTO** will switch the mode to auto mode (secondary side).

Operation complete

Control Output Behavior When the Operation Mode Is Changed

Operation mode switching	Control output behavior
CASCADE→AUTO	The control output value works without bumps.
CASCADE→MANUAL	The control output value in cascade mode is retained.
AUTO→CASCADE	The control output value works without bumps.
AUTO→MANUAL	The control output value in auto mode is retained.
MANUAL→AUTO	The control output value works without bumps.
MANUAL→CASCADE	The control output value works without bumps.

Secondary Target Setpoint When the Operation Mode Is Changed

Operation mode switching	Secondary target setpoint (SP)	Action
CASCADE→AUTO	Sets the target setpoint specified with SP number selection (SP No.)	Depends on the target setpoint tracking (SP tracking) on/off state
CASCADE→MANUAL		
AUTO→CASCADE	Sets the target setpoint to the primary side output	Operates from the target setpoint of auto mode
AUTO→MANUAL	Sets the target setpoint specified with SP number selection (SP No.)	Target setpoint of auto mode
MANUAL→AUTO		Target setpoint of manual mode
MANUAL→CASCADE	Sets the target setpoint to the primary side output	Operates from the target setpoint of auto mode

Control Output Control When the Operation Mode Is Changed from Cascade or Auto to Manual

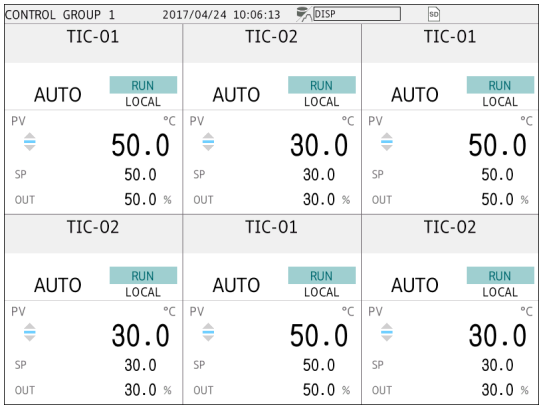
You can control the control output value through touch operation.

Switching between RUN and STOP

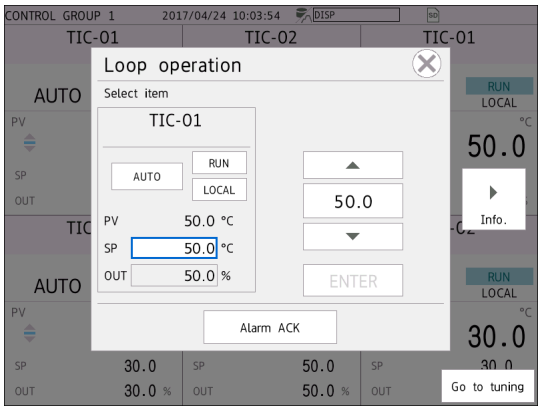
Switch between RUN and STOP on the Loop operation screen of the Control group screen. Here RUN is switched to STOP. You can execute this on a screen that can display the loop operation dialog box.

Procedure

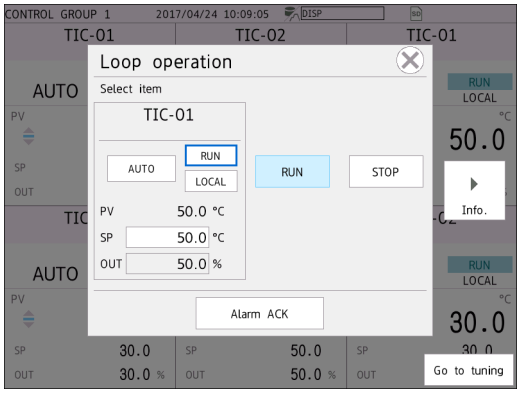
1 Display the control group screen.



2 Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.



3 Tap **RUN**.
RUN and **STOP** appear.



4 Selecting **STOP** will switch the mode to STOP.

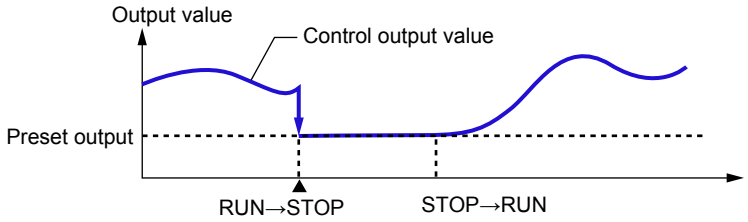
Operation complete

Control Output Behavior When the Operation Mode Is Changed

Operation mode switching	Control output behavior
RUN→STOP	Control output bumps to the preset output value.
STOP→RUN	The control output value works without bumps. This does not work when integral time (I) is set to OFF.

Cascade Control Operation

When the control mode is cascade, the primary side and secondary side operate simultaneously.



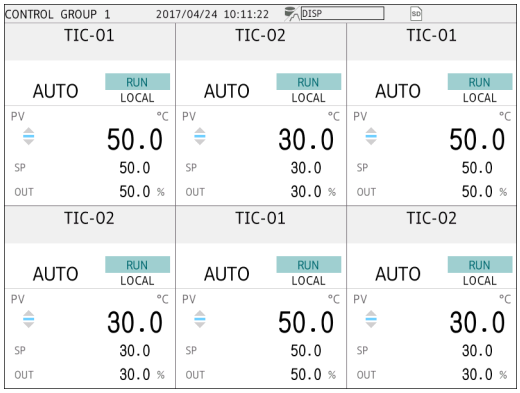
Control Output Control in STOP Mode

You cannot control the control output value in STOP mode. The preset output value of the selected PID No. group is output. To control the control output value, you need to switch to manual mode.

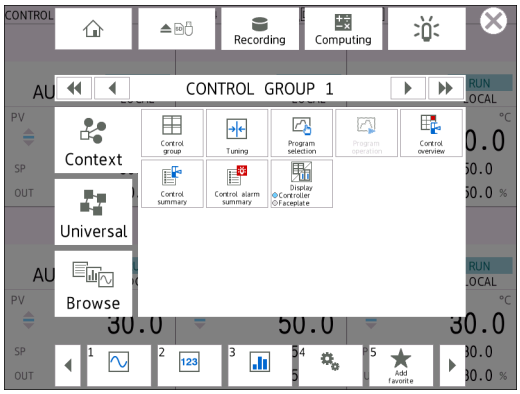
Stopping the Operation of All Loops

Procedure

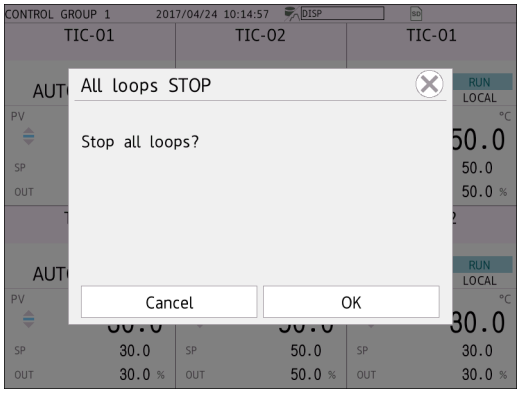
1 Display the control group screen.



2 Press **MENU**.
The menu screen appears.



3 On the Universal menu, tap **All loops STOP**.
The All loops STOP screen appears.



4 Tap **OK** to stop the control operation of all loops.

Operation complete

Note

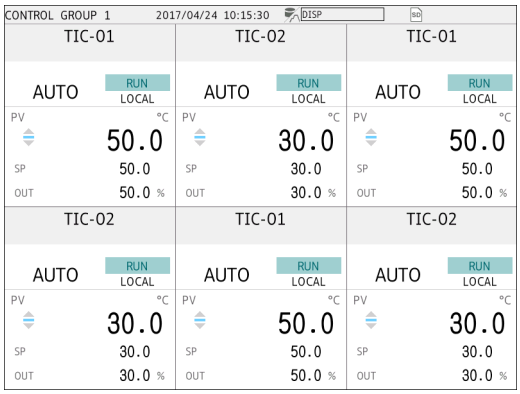
- If Security function > Touch operation is set to **Ope lock** and control operation under Limitations is set to **Lock**, the All loops STOP button cannot be used while the operation lock is enabled.
- If Security function > Touch operation is set to **Login** and control operation under User property is set to **Lock**, the All loops STOP button cannot be used when the user is logged out or when a restricted user is logged in.

Switching between REMOTE and LOCAL

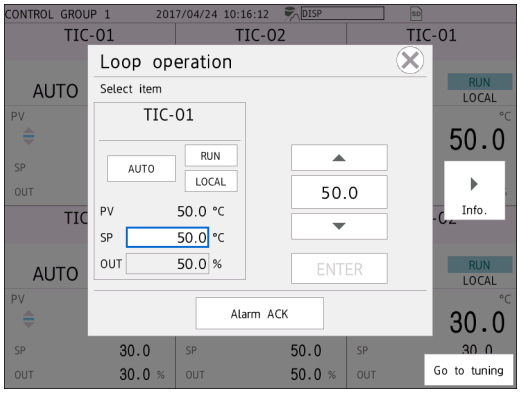
Switch between REMOTE and LOCAL on the Loop operation screen of the Control group screen. Here LOCAL is switched REMOTE. You can execute this on a screen that can display the loop operation dialog box.

Procedure

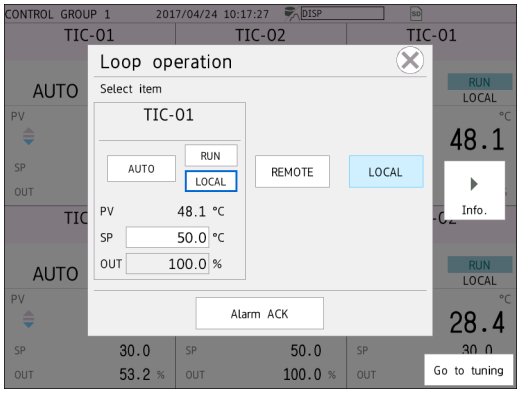
1 Display the control group screen.



2 Tap the loop you want to switch the operation mode of.
The Loop operation screen appears.



3 Tap **LOCAL**.
REMOTE and **LOCAL** appear.
If **Basic control settings** > **Control loop settings** > **RSP function** is set to Off, **REMOTE** is not displayed.
REMOTE is not displayed for loops under program control.



4 Selecting **REMOTE** will switch the mode to remote mode.

Operation complete

Target Setpoint Behavior When the Operation Mode Is Changed

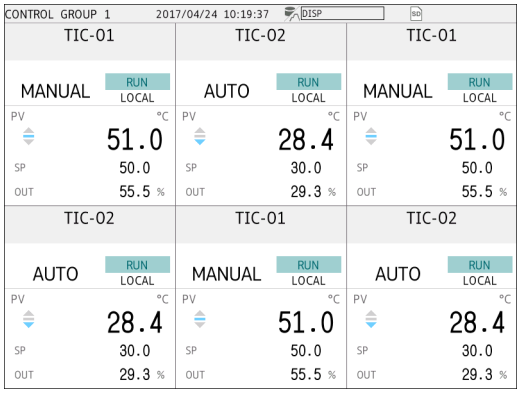
Operation mode switching	Target setpoint behavior
LOCAL→REMOTE	The target setpoint bumps from the local target setpoint to the remote setpoint. Remote setpoint takes on an I/O channel value or the like.
REMOTE→LOCAL	The target setpoint bumps from the remote setpoint to the local target setpoint. Or, the local target setpoint is forced to track the remote setpoint. The local target setpoint is set to the value specified with the target setpoint number (SP No.).

5.2.7 Controlling the Control Output in Manual Mode

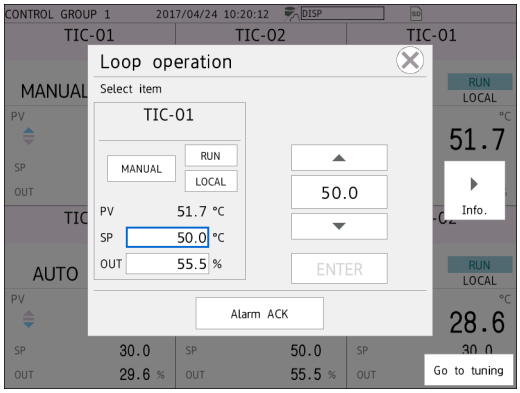
Control the control output value on the Loop operation screen of the Control group screen. To control the control output value, you need to switch to manual mode. See “Switching between AUTO and MANUAL” or “Switching between CASCADE, AUTO, and MANUAL” in section 5.2.6, “Switching Operation Modes.”
You can execute this on a screen that can display the loop operation dialog box.

Procedure

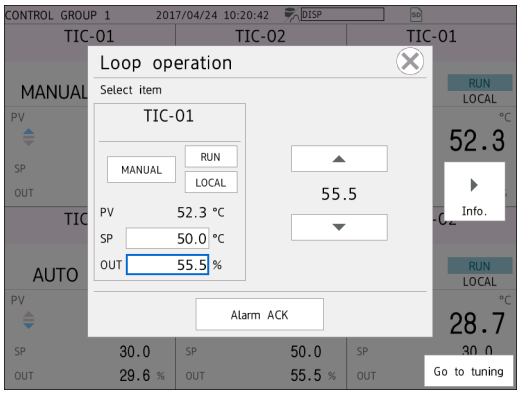
1 Display the control group screen. (Manual mode)



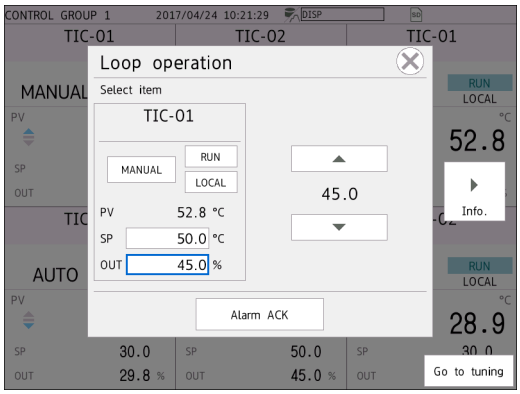
2 Tap the loop you want to control the control output of.
The Loop operation screen appears.



3 Tap **OUT**.
Parameter edit buttons appear.



4 Tap ▲ or ▼ to change the value.



5 Tap the **Close** icon.

Operation complete

Note

Control output is controlled directly, so when you change the value, the output changes immediately. You can change this to the entry method by setting the Manual output operation type.

▶ For details on setting the output control method, see section 3.9.5, “Setting the Control Output Operation Type for Manual Mode.”

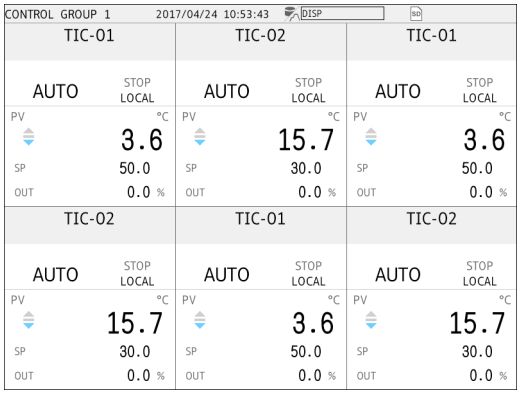
5.3 Performing Program Control (recorder option /PG)

This section explains program control operation from the control group screen.

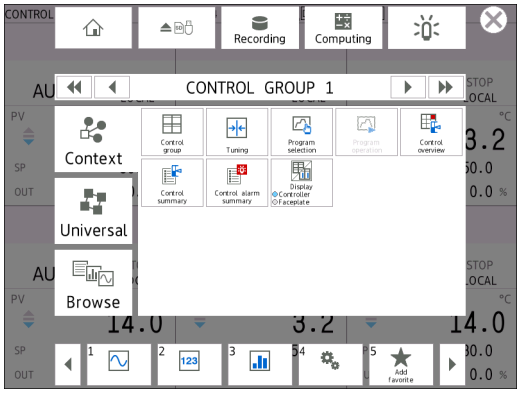
5.3.1 Selecting a Program Pattern

Procedure

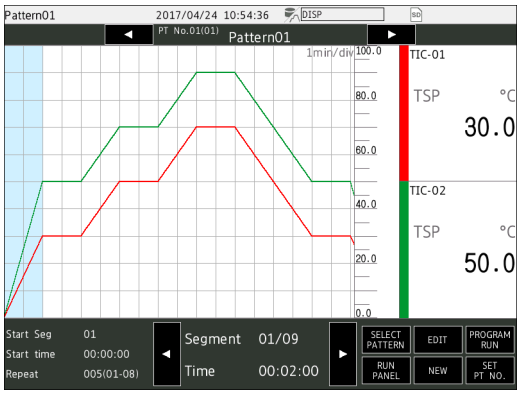
1 Display the control group screen.



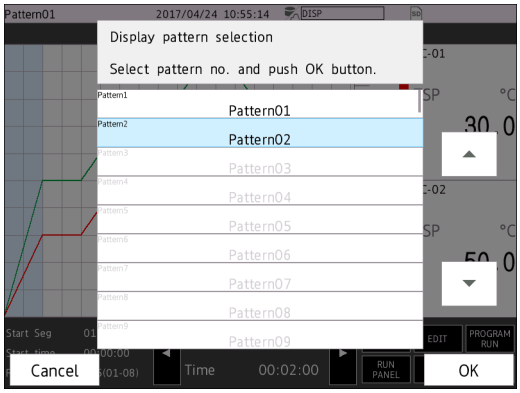
2 Press **MENU**.
The menu screen appears.



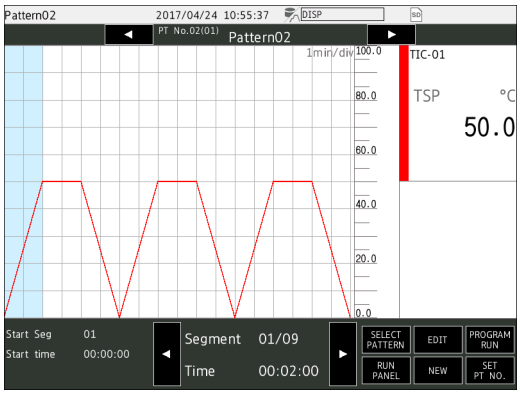
3 Tap the **Context** tab and then **Program selection**.
A program selection screen appears.



4 Tap **SELECT PATTERN**.
A Display pattern selection screen appears.



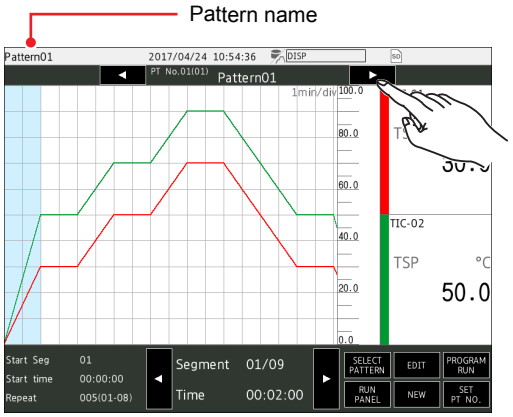
5 Select the program pattern to use, and tap **OK**.



Operation complete

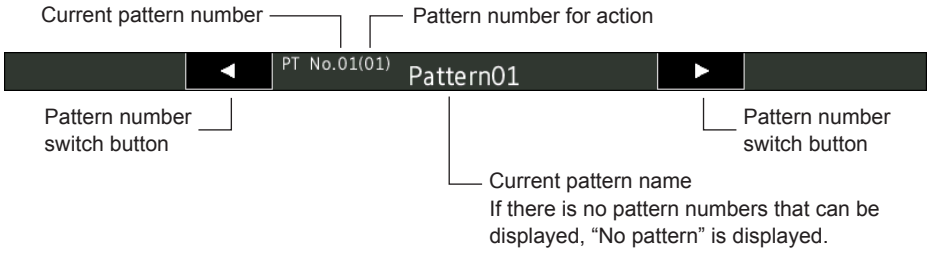
Explanation

On the Program selection screen, you can display the waveform of the pattern number you specify.
The pattern name is displayed in the status area.



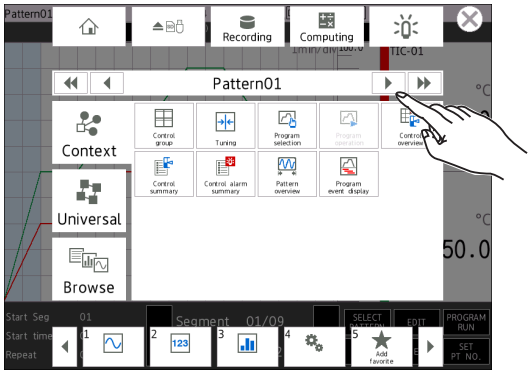
Switching the Pattern Number

You can change the current pattern number by tapping the pattern number switch buttons. When you tap a pattern number switch button, the next or previous valid pattern is displayed.
You can select the pattern number to be displayed directly from the Program selection screen.



Button type	Content
Pattern number switch (back)	Displays the previous valid pattern number. Folds back from the first pattern to the last pattern.
Pattern number switch (forward)	Displays the next valid pattern number. Folds back from the last loop to the first loop.

You can also change the current pattern number by tapping the switch buttons in the dashboard menu.



Button type	Content
Pattern number switch (back by 10)	Displays the 10th previous valid pattern number. Folds back from the first loop to the last loop.
Pattern number switch (back)	Displays the previous valid pattern number. Folds back from the first loop to the last loop.
Pattern number switch (forward)	Displays the next valid pattern number. Folds back from the last loop to the first loop.
Pattern number switch (forward by 10)	Displays the 10th next valid pattern number. Folds back from the last loop to the first loop.

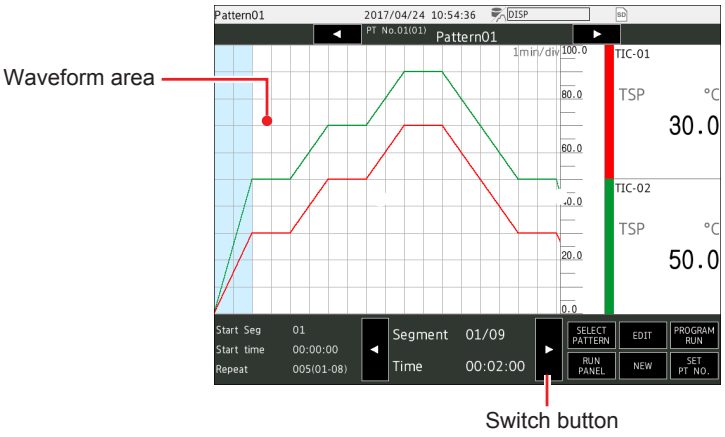
Waveform Area

The waveform area shows the current pattern waveform.

Note

The display order of pattern waveforms is the same as the order in which patterns were assigned.
(Example: If the order is L001 and L002, the L001 waveform is displayed first.)
If a loop is selected, the waveform of that loop is displayed in front.
For a segment set to repeat, a single iteration is drawn.

You can change the current segment number by tapping the waveform area or the segment number switch buttons. (The tapped segment is displayed in light blue.)



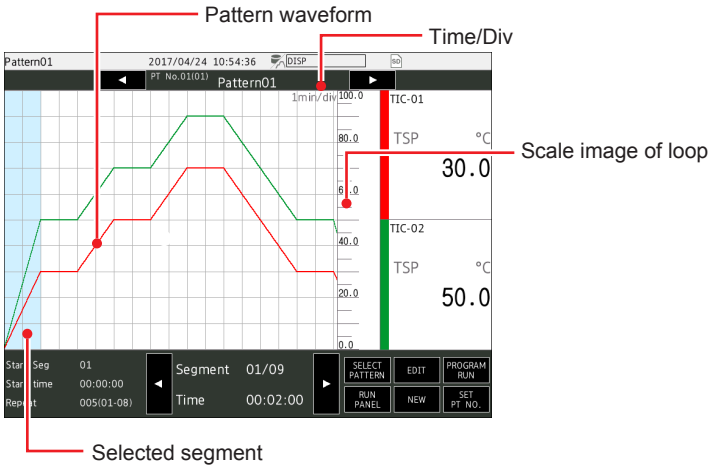
You can scroll the displayed pattern waveform by dragging or flicking the waveform area. You can compress the pattern waveform by pinching in or out on the waveform area. The compression range is from 1x to 1/8x.

Note

The number of grid divisions in the waveform area is the same as the number of grid divisions on the trend screen. (If set to auto, the number of divisions of the target loop is used. If a number is specified, the specified number of divisions is used.)
The grid interval on the time axis is the same as that on the trend screen.

The scale image is shown with the control input range of the target loop. The number of divisions is according to the number-of-division setting of the target loop's PV channel.
The loop used for the scale image is automatically set according to the following conditions.

Selected loop	Loop used for the scale image
Available	The selected loop
None	The first loop



Note

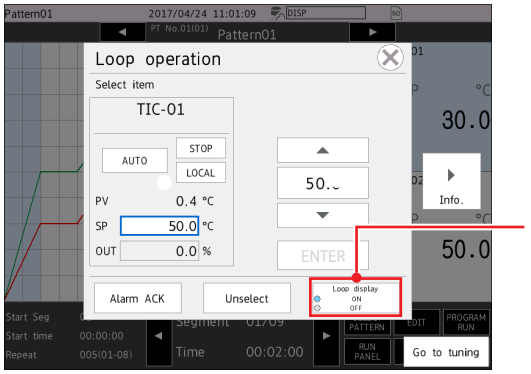
The waveform display resolution is determined by the trend interval (recording interval for event data). If the segment time is set short relative to the update interval (e.g. 30 min/div trend interval and 10 s segment time), pattern waveform will be difficult to view. Be careful when the segment is short.

Waveform thickness

From the setting menu of the setting screen, select **Display settings** > **Trend settings** > **Trend line** to set the waveform thickness.

Showing and hiding waveforms

You can change the setting in the loop operation dialog box.



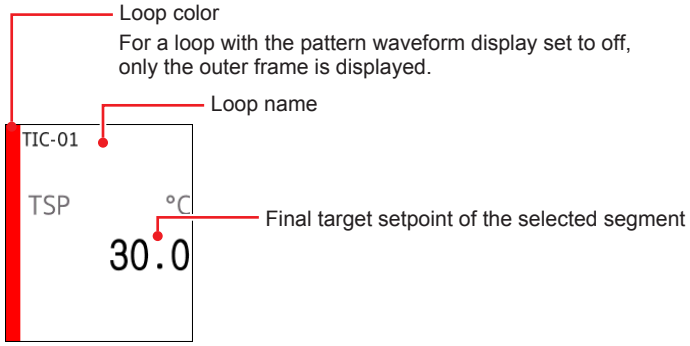
Background color setting

The background color of each area changes according to the background color setting of the control screen.

Background color setting of the control screen	Waveform area	Areas other than the waveform area
Black	Black	White
White	White	Black

Loop Area

The loop area shows all loops assigned to patterns.



Note

The loops are displayed in order by tag number, tag string, and loop number.

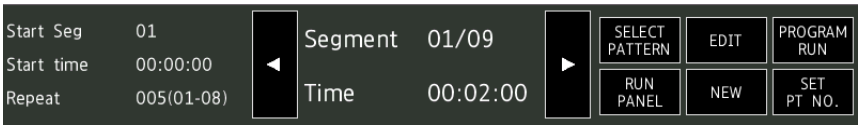
Tap a loop area to select the loop. Tapping a selected loop displays a loop operation dialog box.
If you want to unselect the loop, tap **Unselect** in the loop operation dialog box.

Pattern Status Display and Control Area

Information about the displayed pattern is shown at the bottom of the program selection screen.

The following table shows the pattern information that is shown.

Information	Content
Start segment	Start position of the program pattern
Repeat	When the repeat function is set to on: Repeat count (start segment – end segment) When the repeat function is set to off: Hidden When the repeat function is set to repeat: “REPEAT”
Start time	The delay until the program pattern starts.
Segment	Selected segment number/total number of segments in the pattern
Time	Current segment time



Buttons for executing various operations are shown. The following table shows the buttons.

Button type	Description
Segment number switch (left and right arrows)	Switches the current segment number. Hold down to switch consecutively.
EDIT	Edit the displayed program pattern.
SELECT PATTERN	Select the displayed program pattern.
PROGRAM RUN	Starts the operation of the displayed program pattern.
RUN PANEL	Shows the program operation screen of the running program.
NEW	Create a new program pattern.
SET PT NO.	Set the program pattern to start through communication (contact, communication command, internal switch). The pattern number selected through communication, contact, or the like is changed to the displayed pattern number.

Note

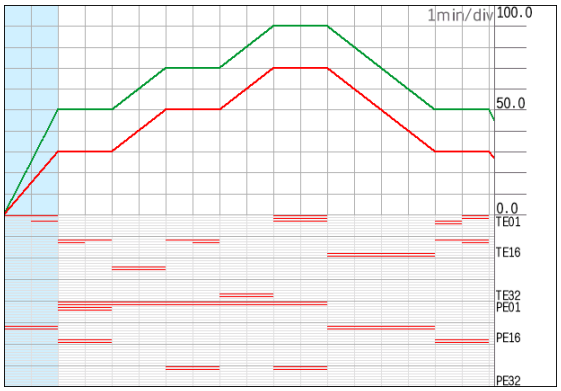
- If Security function > Touch operation is set to **Ope lock** and the operation lock is enabled, the buttons are unavailable under the following conditions.
- If Security function > Touch operation is set to **Login**, the buttons are unavailable under the following conditions when the user is logged out or when a restricted user is logged in.

Button on the program selection screen	Limitations applied to tapping	Tapping when logged out*
Pattern number switching	**None**	**Yes**
Segment number switch	**None**	**Yes**
SELECT PATTERN	**None**	**No**
EDIT	**Configuration**	**No**
PROGRAM RUN	**Program operation**	**No**
RUN PANEL	**None**	**Yes**
NEW	**Configuration**	**No**
SET PT NO.	**None**	**No**

* When Operation without Login is set to On. No for all buttons if it is set to Off.

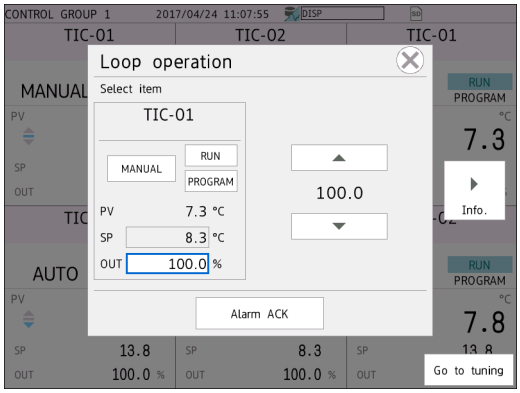
Event Display

On the selection screen, the time range of specified PV events and time events is displayed in red.



Loop Operation Dialog Box

You can control specific loops in the loop operation dialog box.



If the loop operation dialog box is opened from a program screen, the following buttons are also displayed.

Button type	Description
Unselect	Unselects the selected loop.
Loop display	Turns the pattern waveform display on and off.

Note

- The loop display on/off state is retained for each loop. When the power is turned off or when the system is reconfigured, the display is reset to on for all loops.
- If a loop with the control mode set to cascade or loop control with PV switching is displayed, the loop display of the secondary side is turned off.

5.3.2 Performing and Canceling Auto-Tuning

▶ For details on auto-tuning, see section 5.2.2, “Performing and Canceling Auto-Tuning,” for loop control.

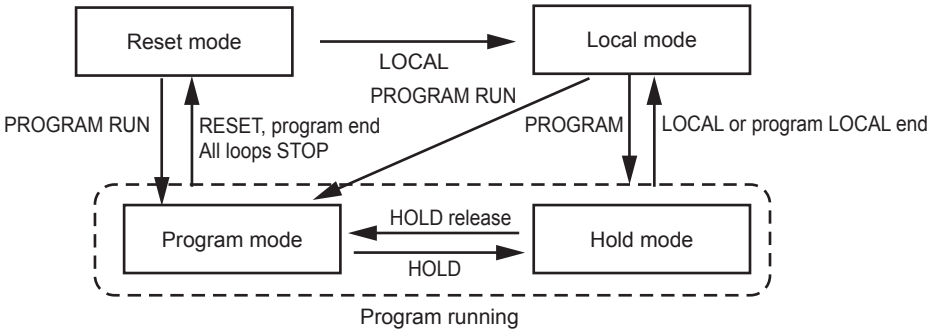
5.3.3 Adjusting the PID Manually (Manual Tuning)

▶ For details on manual tuning, see section 5.2.3, “Adjusting the PID Manually (Manual Tuning),” for loop control.

5.3.4 Switching Operation Modes

Operation Mode Transition Diagram

Operation mode	Description
Program operation	Control operation in progress according to a program pattern. In hold mode, the program operation is held (only the time is held).
Reset	Program operation of all loops is stopped (preset output).
Local	Constant-value operation in progress according to local setpoints.



Note

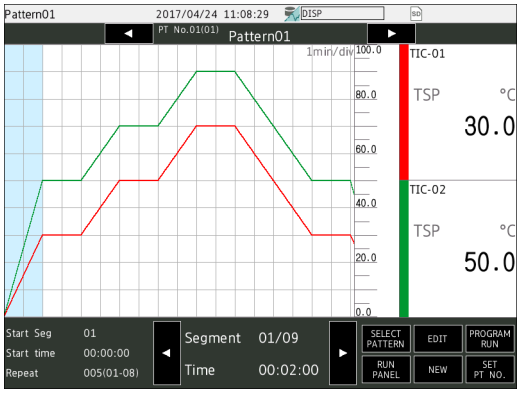
- RESET mode
  When program operation is stopped, PV events and time events are turned off.
  Preset output in RESET mode is as follows.
  If PID selection is **SP No./Segment PID No. selection**, the preset output of PID group number 1 is output. In other cases, the preset value of the PID group number selected with the zone setting is output.
- Local mode
  In local mode, local setpoints are used for control. The SP in local mode is the target setpoint of the PID control module.
- Loops set to LOCAL mode through loop operation while the program is running can be changed to program operation mode using the “PROGRAM” loop control.
  If all loops are in LOCAL mode, they cannot be changed to program operation using loop control. (“PROGRAM” control in the figure)
  If all loops are in LOCAL mode, they can be changed to program operation mode with the “PROGRAM RUN” operation shown in the figure.

Running and Resetting Program Operation (PROG, RESET)

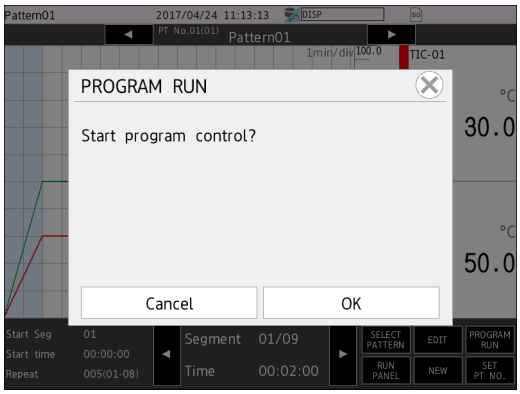
Procedure

Starting a Program Pattern Operation

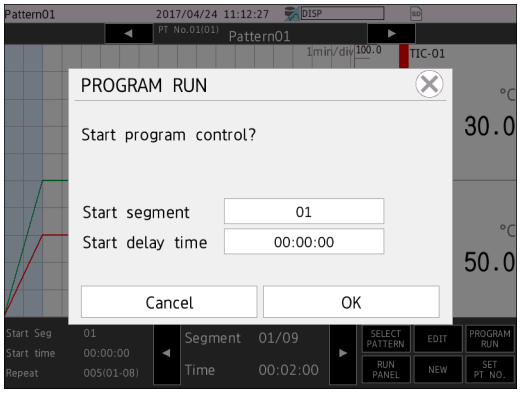
1 Display the **Program selection** screen.



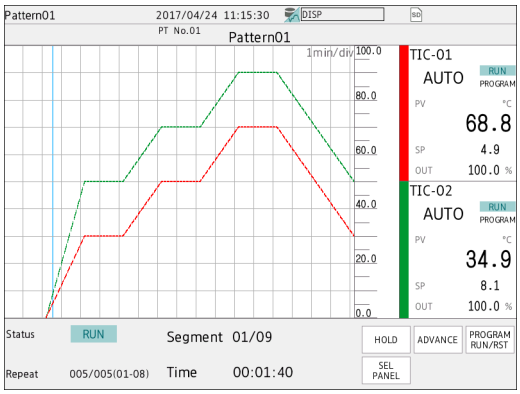
2 Tap **PROGRAM RUN**.
A message for running the program appears.



If Program RUN detail settings in Program pattern settings is set to **On**, the following screen appears.
You can set the start segment and start delay time.



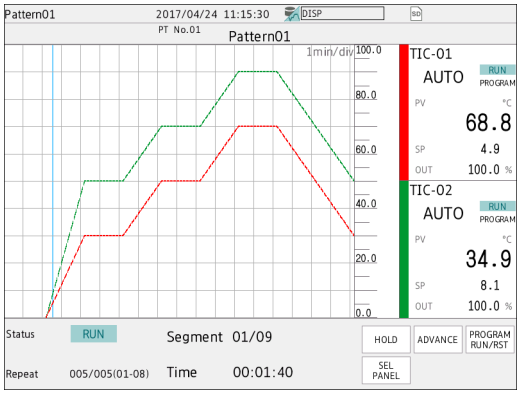
3 Tap **OK** to run the program.



Operation complete

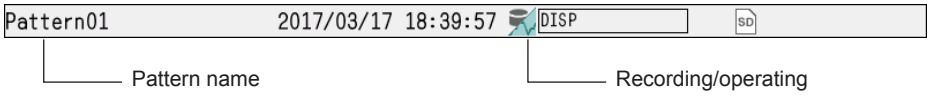
Explanation

On the Program operation screen, you can display the waveform of the program pattern that is running.
When program operation is stopped, you cannot switch to the program operation screen.



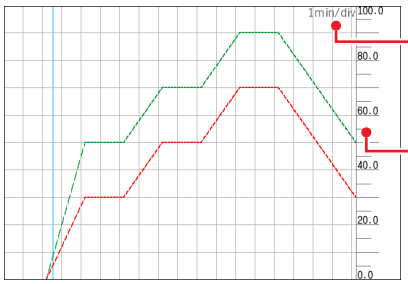
Status indication

The program operating status is displayed in the status area.
The status is displayed when the program pattern option is valid and a PID control module is detected.



Recording status	Program operation status	Icon
Stopped	Stopped	
Recording	Stopped	
Stopped	Running	
Recording	Running	

Waveform area



The area to the left of the pattern progress position cursor (past waveform area) shows PV and SP waveforms. The PV waveform is displayed only when recording.
The displayed content in the past waveform area varies depending on the recording status.

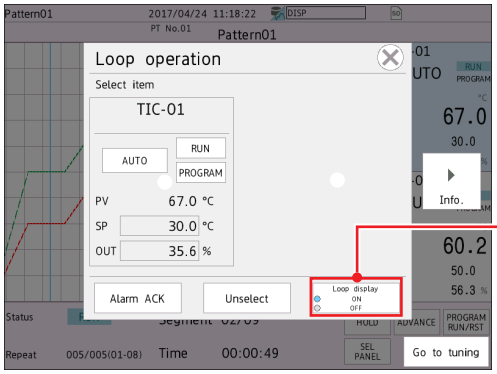
Recording status	Displayed content in the past waveform area
Recording	Displays the PV and SP waveforms existing in the recorded data (PV: solid line, SP: broken line). * To display waveforms during recording, select the PV and SP channels of the PID channel in recording channel settings.
Stopped	Displays with a broken line the pattern waveform scrolled from the future waveform area.

Waveform thickness

From the setting menu of the setting screen, select **Display settings** > **Trend settings** > **Trend line** to set the waveform thickness.

Showing and hiding waveforms

You can change the setting in the loop operation dialog box.



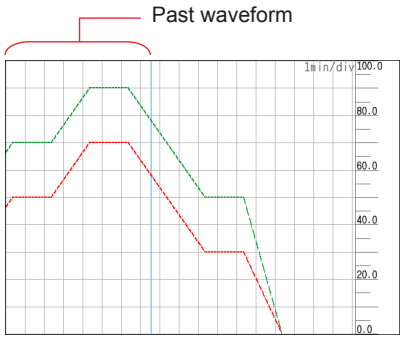
Note

- Grid time is displayed only in the past waveform area displaying the recorded data.
- If multi batch is enabled, the displayed content in the past waveform area is determined by the recording status of the batch group number displayed last.
- If recorded data is not displayed in the past waveform area, the pattern waveform is scrolled to the past waveform area according to the current progress status. Because the shape of the waveform may be different from the waveform that is actually measured, if you want to view the accurate waveform, display the recorded data.
- The waveform scroll interval is the same as the trend interval (recording interval for event data). If program operation stops, waveform scrolling also stops.
  If the program operation is held (HOLD or WAIT), the future waveform area stops scrolling, and only the past waveform area scrolls.

The past waveform area is cleared if any of the actions below is performed.
- If the recording mode switches between run and stop.
- If the time is changed while recording is stopped.
- If the background settings are changed while recording is stopped.
- If the trend interval (recording interval for event data) is changed while recording is stopped.

Even while recording, the past waveform area will be the same as when recording is stopped in the following cases.
- When there is no recording channels.
- When waiting for an event data trigger or when recording has finished after a trigger
- When trend interval switching is set to On

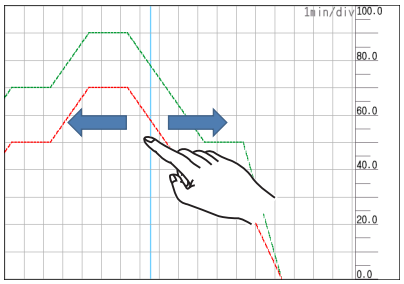
- When recording, the waveform in the past waveform area may be delayed depending on the module installation condition.
- You can compress the pattern waveform by pinching in or out on the waveform area. The maximum compression range is from 1x to 1/8x. (The range varies depending on the simultaneous number of loops under program operation.)



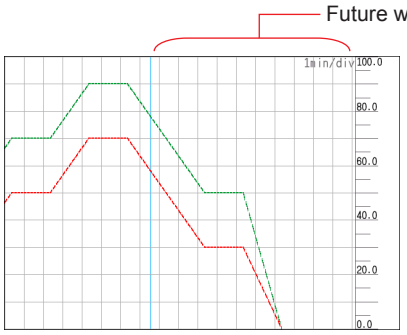
Note

The waveform display resolution is determined by the trend interval (recording interval for event data). If the segment time is set short relative to the update interval (e.g. 30 min/div trend interval and 10 s segment time), pattern waveform will be difficult to view. Be careful when the segment is short.

The current pattern progress position is displayed with a blue cursor.
You can scroll the displayed pattern waveform by dragging the waveform area.
The scrollable range is from where the cursor position is at the left edge to where the cursor position is at the right edge.



The area to the right of the pattern progress position cursor (future waveform area) shows pattern waveforms with broken lines.



The behavior of the future waveform area varies depending on the program operating status.

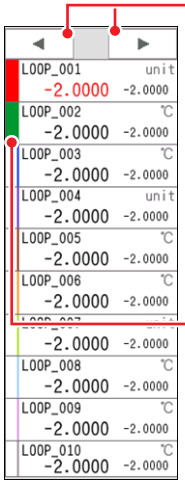
Operating status	Displayed content in the future waveform area
PROG RUN	The pattern waveform progresses each scroll interval.
ADVANCE	The pattern waveform shifts to the beginning of to the next segment.
HOLD, WAIT, or loop in the pattern is auto-tuning.	Pattern waveform stops, and only the background grid moves.
PROG RESET	Pattern waveform and background grid stops.

Note

Data displayed in the past waveform area during recording is drawn by comparing the record start timing and pattern start timing. Whichever comes first is drawn first.
Data displayed in the past waveform area when recording is stopped is only the waveform after switching to the program operation screen.
The display start position of past waveforms and event occurrence information are drawn based on the data recorded in the control summary. Note that if the number of control operations after starting the program operation exceeds the maximum summary number, waveforms will not be displayed correctly.

Loop Area

The loop area shows loops assigned to patterns.



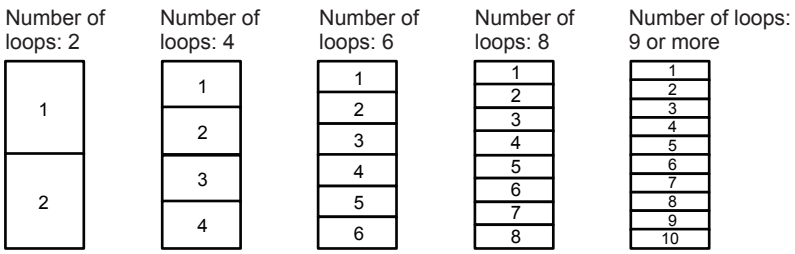
Show/hide button

Tapping a display switch button changes the displayed loop.
Tapping the right arrow displays loop 11 and later; tapping the left arrow displays loops 1 to 10.

Loop color

The loop color is displayed on the left side of each loop. For a loop with the pattern waveform display set to off, only the frame is displayed.

The maximum number of loops that can be displayed simultaneously in the loop area is 10. If there are more than 10 loops, you can switch the display using the display switch button. The layout in the loop area changes according to the number of loops assigned to the patterns.



Item	Displayed Content
Loop name	Displays the assigned tag number of tag string. If a tag is not assigned, the loop number (L***) is displayed.
RUN/STOP	Displays the current operation status. * “AT” is displayed when auto-tuning is in progress. RUN: Program running STOP: Program stopped
AUTO/MANUAL	Displays the current control operation mode. AUTO MANUAL
REMOTE/LOCAL/PROGRAM	Displays the current control operation mode. REMOTE LOCAL PROGRAM (when using program operation)
PV, PV unit string	Displays the loop’s PV and PV unit string. * The PV color is the same as that on the control group screen.
SP	Displays the loop SP.
OUT value, OUT unit string	Displays the loop’s OUT value and OUT unit string.

The displayed content in a loop is omitted depending on the available display area.

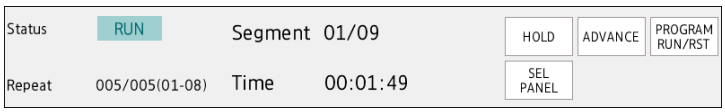
Tap a loop area to select the loop. Tapping a selected loop displays a loop operation dialog box.

If you want to unselect the loop, tap **Unselect** in the loop operation dialog box.

Pattern Status Display and Control Area

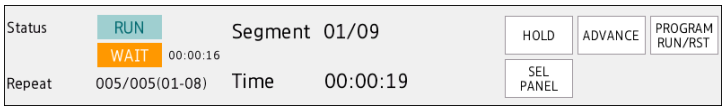
Information about the displayed pattern is shown at the bottom of the program selection screen.
The following table shows the pattern information that is shown.

Information	Description	Notes
Operating status	RUN/RESET, HOLD, WAIT, DELAY	In HOLD mode, the string blinks. In WAIT mode, the elapsed time is displayed on the right side.
Repeat	When repeat is set to off: Hidden When repeat is set to on: The remaining repeat count (start – end) When repeat is set to repeat: REPEAT (start – end)	Start to end segment numbers in parentheses. If you change the repeat setting while the program is running, the repeat count up to that point is retained.
Segment	Current segment number/total number of segments in the pattern	"00" in DELAY mode. "00" in RESET mode.
Time	Segment remaining time	Remaining time until operation start when in DELAY mode.



Buttons for executing various operations are shown. The following table shows the buttons.

Button type	Description
HOLD	Holds the pattern or releases the hold.
ADVANCE	Advances the pattern.
SEL PANEL	Displays the program selection screen.
PROGRAM RUN/RST	Starts or resets the program pattern.
TSP CHANGE	Changes the TSP while held.
SP CHANGE	Changes the SP while held.
Time remaining	Changes the segment remaining time while held.



Note

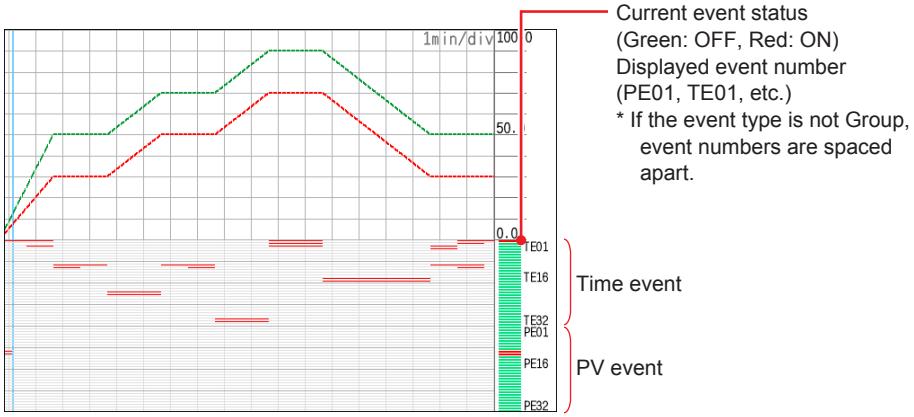
- If Security function > Touch operation is set to **Ope lock** and the operation lock is enabled, the buttons are unavailable under the following conditions.
- If Security function > Touch operation is set to **Login**, the buttons are unavailable under the following conditions when the user is logged out or when a restricted user is logged in.

Button on the program operation screen	Limitations applied to tapping	Tapping when logged out*
HOLD	Program operation	No
ADVANCE	Program operation	No
PROGRAM RUN/RST	Program operation	No
SEL PANEL	None	Yes
TSP CHANGE	Program operation	No
SP CHANGE	Program operation	No
Time remaining change	Program operation	No

* When Logout > Operation without Login is set to On. No for all buttons if it is set to Off.

Event Display

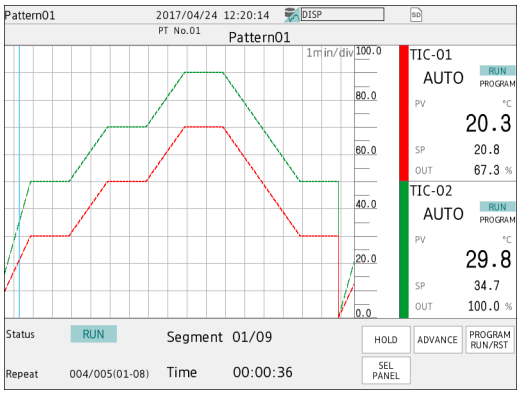
For instructions on how to display program events, see section 5.4.5, “Event Display.”
Time events are shown both in the past waveform area and future waveform area. In the past waveform area, the times when time events occurred are displayed in red. In the future waveform area, times when time events are assigned are displayed in red.
PV events are shown only in the past waveform area. In the past waveform area, the times when PV events occurred are displayed in red.



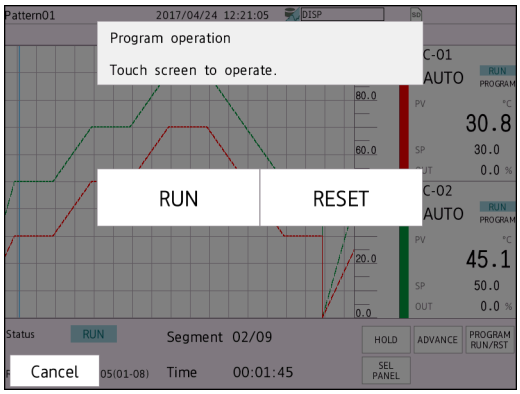
The event display when recording data is displayed shows the same information as that recorded in the control operation summary.

Resetting Program Operation

1 Display the **Program operation** screen.



2 Tap **PROGRAM RUN/RST**.
A message for operating the program appears.



3 Tap **RESET** to reset the program operation.

Operation complete

Switching between AUTO and MANUAL

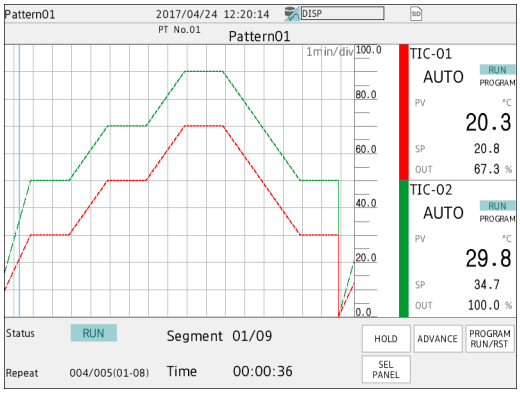
▶ For details on auto and manual, see “Switching between AUTO and MANUAL” in section 5.2.6, “Switching the Operation Mode.”

Holding and Releasing the Program Operation

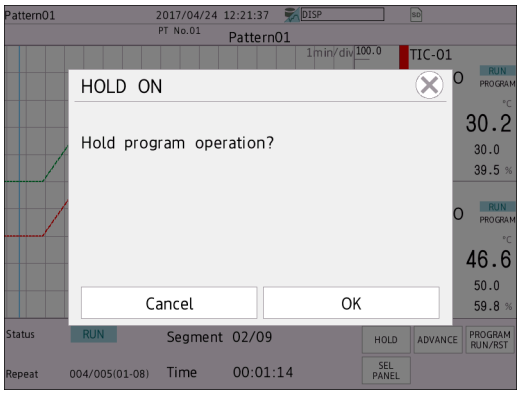
Procedure

Holding the Program Operation

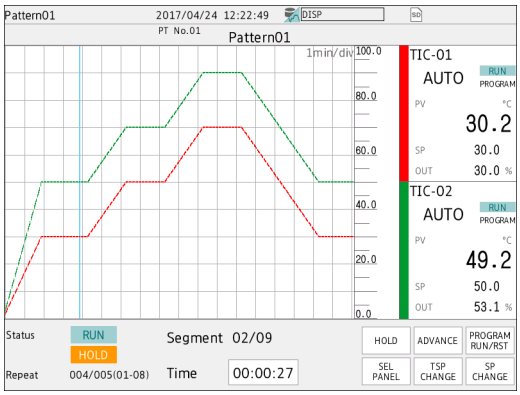
1 Display the **Program operation** screen.



2 Tap **HOLD**.
A message for holding the program operation appears.



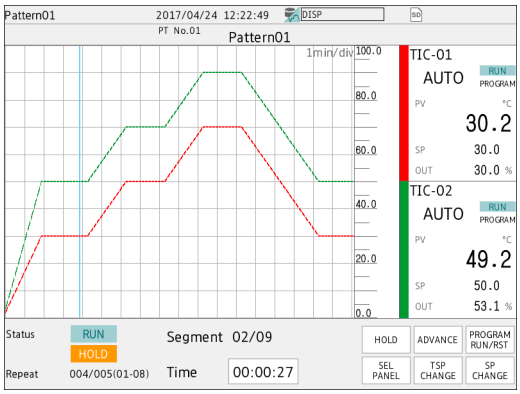
3 Tap **OK** to hold the program operation.



Operation complete

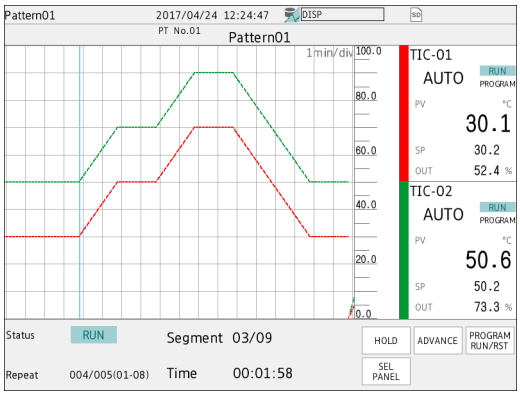
Releasing the Program Operation Hold

1 Display the **Program operation** screen.



2 Tap **HOLD**.
A message for releasing the program operation hold appears.

3 Tap **OK** to release the program operation hold.

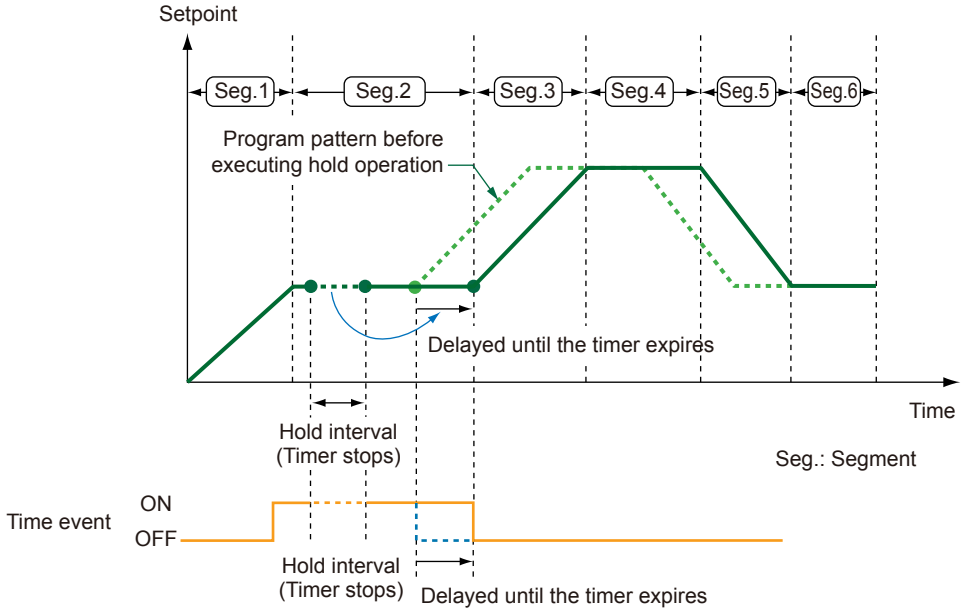


Operation complete

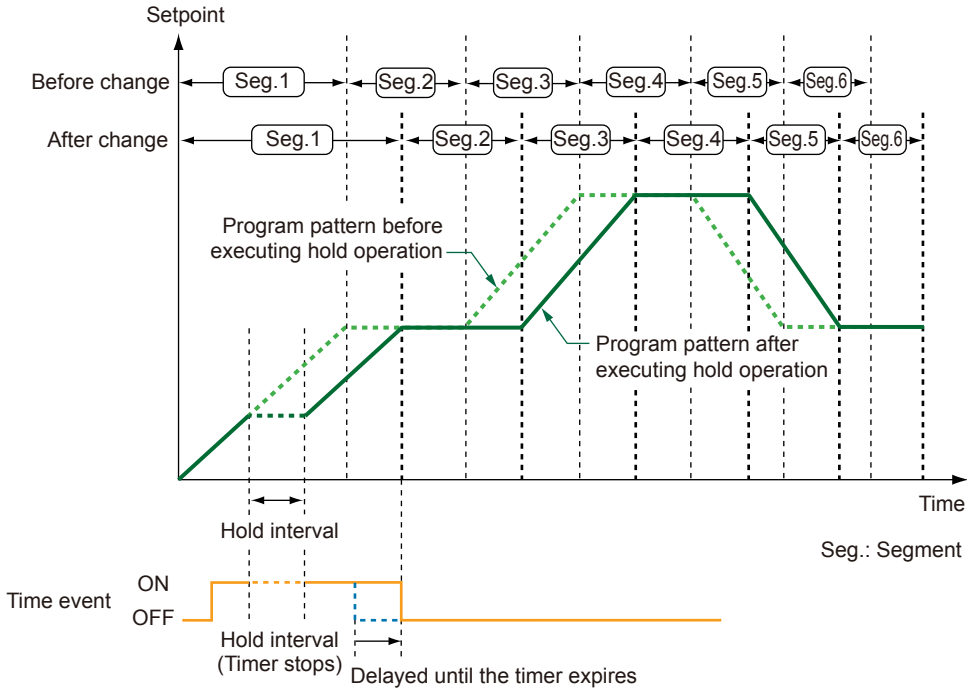
Explanation

The hold function temporarily stops the progression of the program pattern.
The hold mode stops the segment time and the time of the time event.
The segment time and time event is extended by the length of time the operation is held.
Releasing the hold state restarts the segment time and the time of the time event from the time when they were stopped.
Control in hold mode is performed using the setpoint at the time when the hold operation starts. The time event keeps the state and the PV event continues the action at the time when the hold operation starts.

Hold Operation in Soak Segment



Hold Operation in Ramp Segment

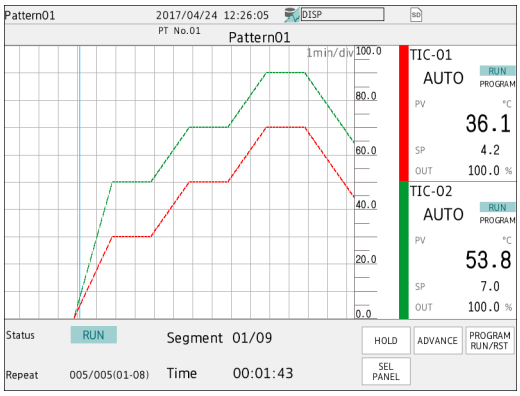


Hold operation is also released by advancing the segment or by running or resetting to the program operation.

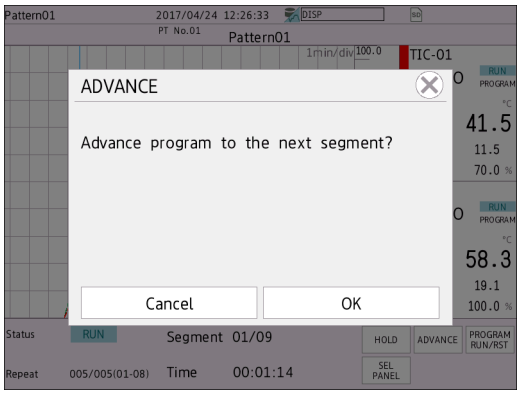
Advancing the Segment

Procedure

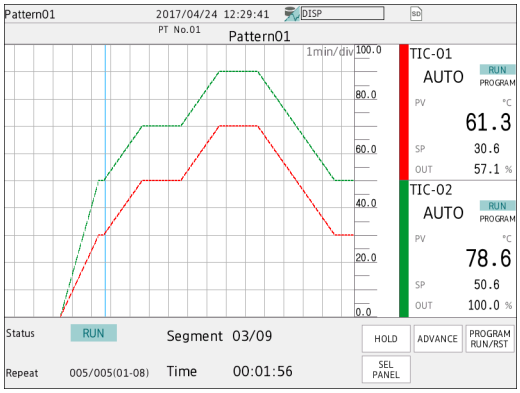
1 Display the **Program operation** screen.



2 Tap **ADVANCE**.
A message for advancing the segment appears.



3 Tap **OK** to advance the segment.



Operation complete

When the advance function is executed, the program moves to the next segment, regardless of the junction code setting.
The advance function operates in the following manner depending on the segment to be executed and operation status.

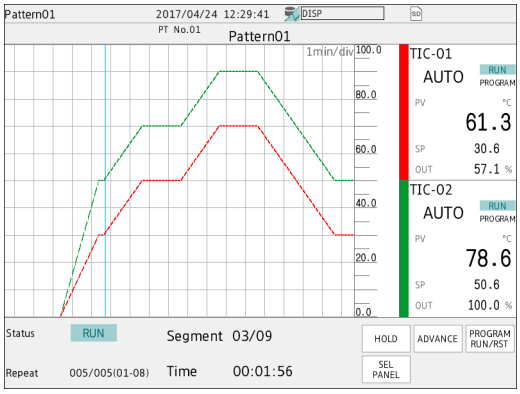
- If executed in the last segment
  The program switches to reset mode (when the junction code is set to Switching for continuation) or local mode.
- If executed in a repeat-end segment
  The program performs a repeat operation.
- If executed when the hold function is enabled
  The hold function is disabled, and the controller resumes the program pattern operation from the next segment.

When the advance function is executed, the segment time or event time of the current segment is shortened.

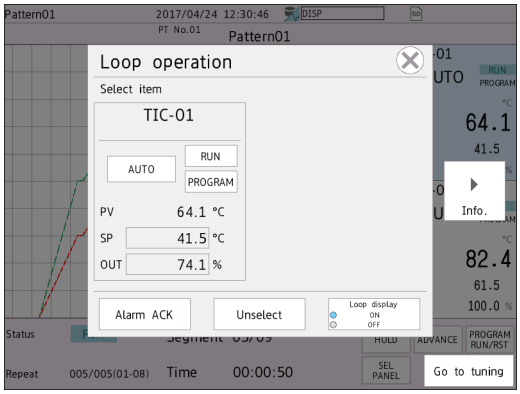
Switching to Local Mode

Procedure

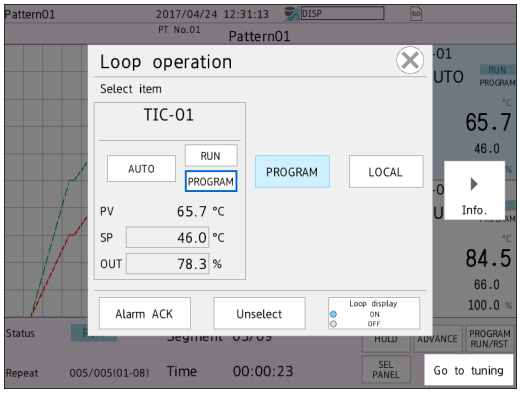
1 Display the **Program operation** screen.



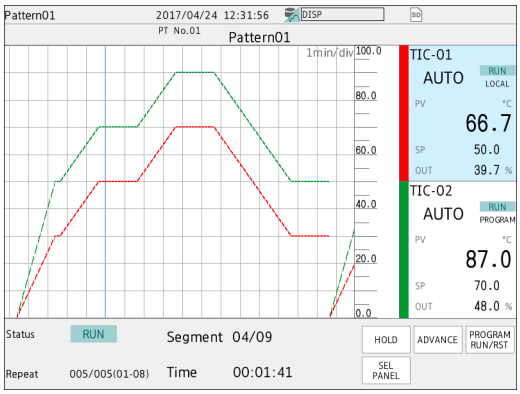
2 Tap the loop you want to set to local mode.
The Loop operation screen appears.



3 Tap **PROGRAM**.
PROGRAM and **LOCAL** appear.



4 Tap **LOCAL** to switch to local mode.



Operation complete

5.3.5 Controlling the Control Output in Manual Mode

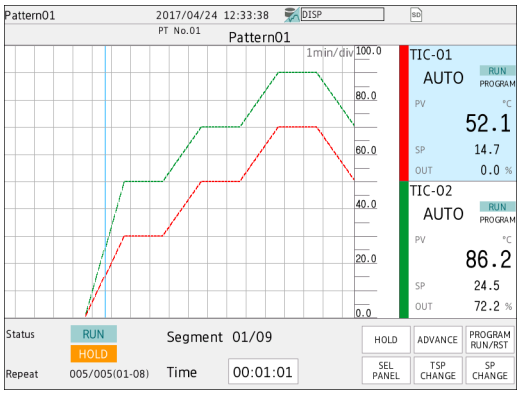
▶ For details on controlling the control output in manual mode, see section 5.2.7, “Setting the Control Output Operation Type for Manual Mode.”

5.3.6 Changing the Current Setpoint in Hold Mode

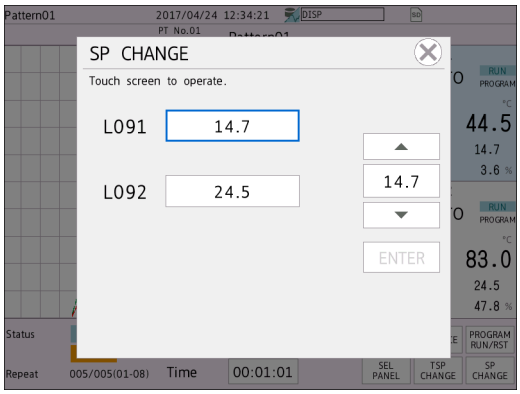
Switch to hold mode before performing this operation.

Procedure

1. Display the **Program operation** screen.

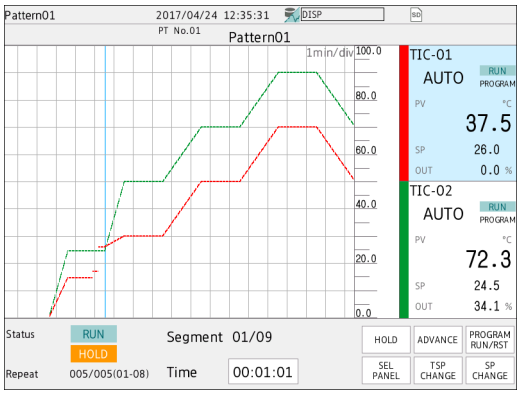


2. Tap **SP CHANGE**.
   The SP CHANGE screen appears.



3. Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
   You can also enter the value directly from the keyboard by tapping the center value.

4. Tap the **Close** icon.



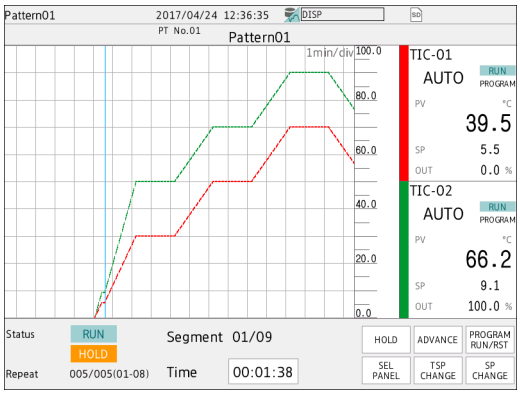
Operation complete

5.3.7 Changing the Target Setpoint in Hold Mode

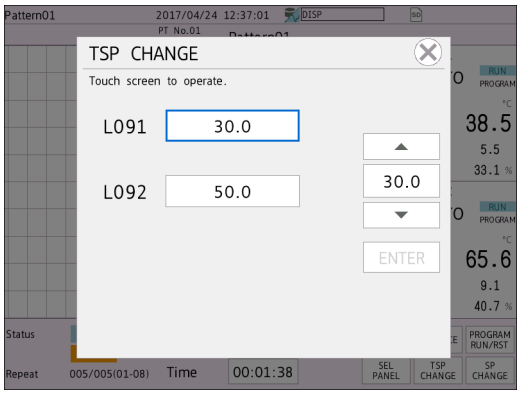
Switch to hold mode before performing this operation.

Procedure

1. Display the **Program operation** screen.

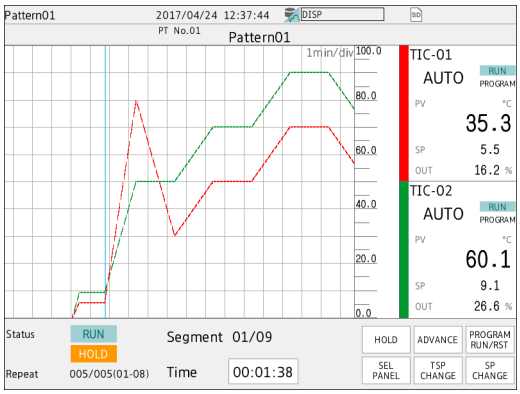


2. Tap **TSP CHANGE**.
   The TSP CHANGE screen appears.



3. Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
   You can also enter the value directly from the keyboard by tapping the center value.

4. Tap the **Close** icon.



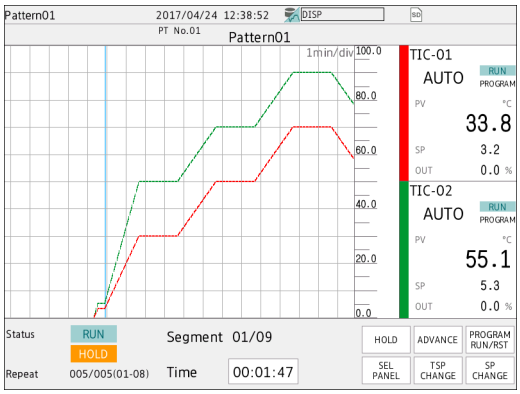
Operation complete

5.3.8 Changing the Remaining Segment Time in Hold Mode

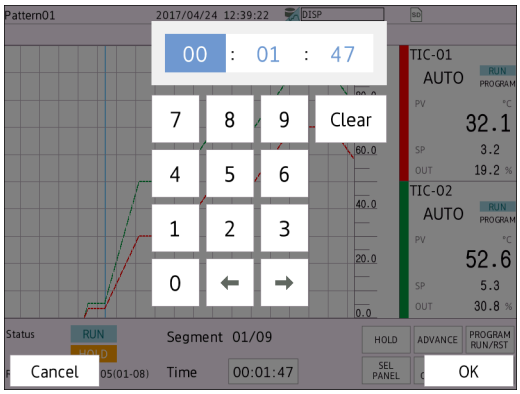
Switch to hold mode before performing this operation.

Procedure

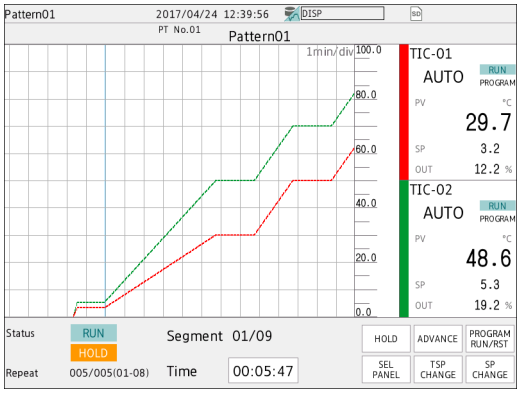
1. Display the **Program operation** screen.



2. Tap the segment time value.
A keyboard appears.



3. Change the remaining segment time, and tap **OK**.



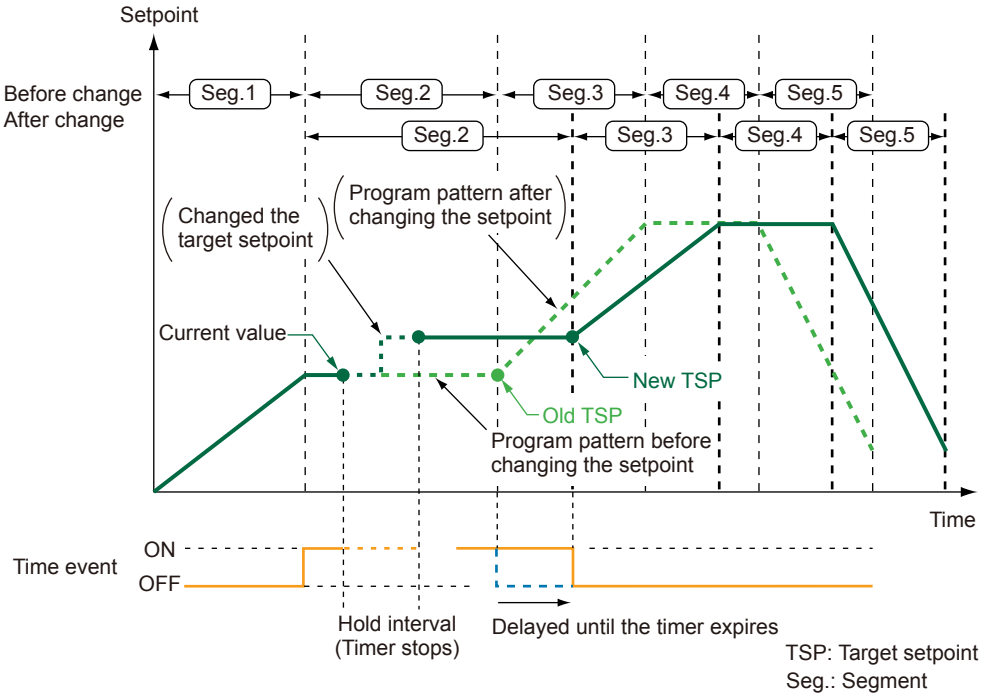
Operation complete

Explanation

The current setpoint (hold SP), final target setpoint (TSP), and remaining segment time can be changed in hold mode.
The value changed in hold mode is temporary. When the program resumes, it operates according to the original program pattern. To operate the program using the changed value, the original program pattern needs to be changed.

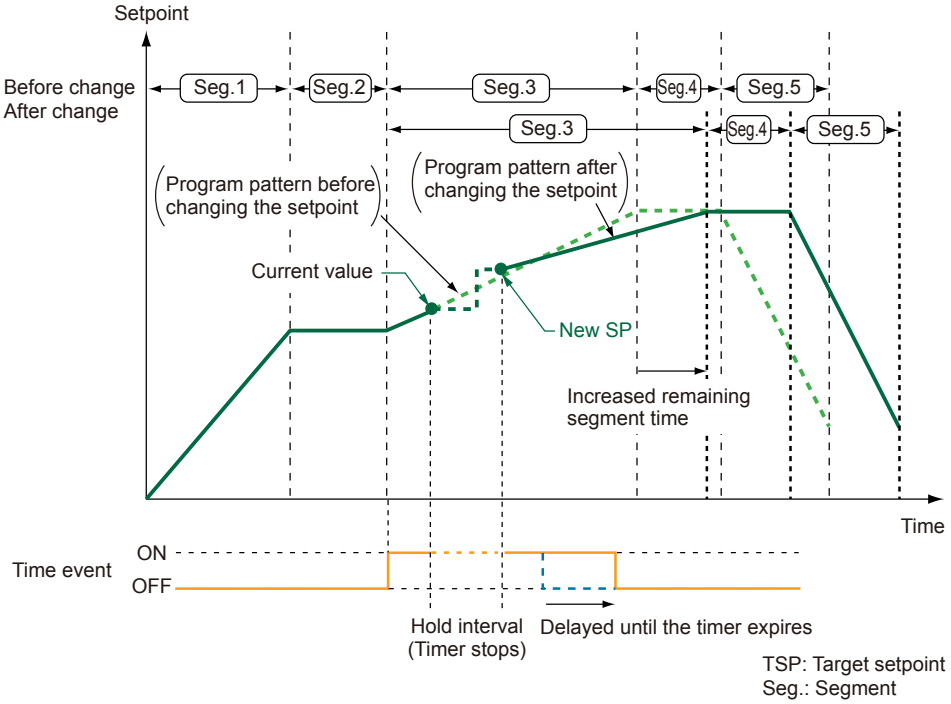
Behavior When the Hold SP Is Changed in a Soak Segment

If you change the hold SP in a soak segment, the final target setpoint (TSP) also changes. When the hold mode is released, the program pattern operation resumes from the changed setpoint.



Behavior When the Hold SP Is Changed in a Ramp Segment

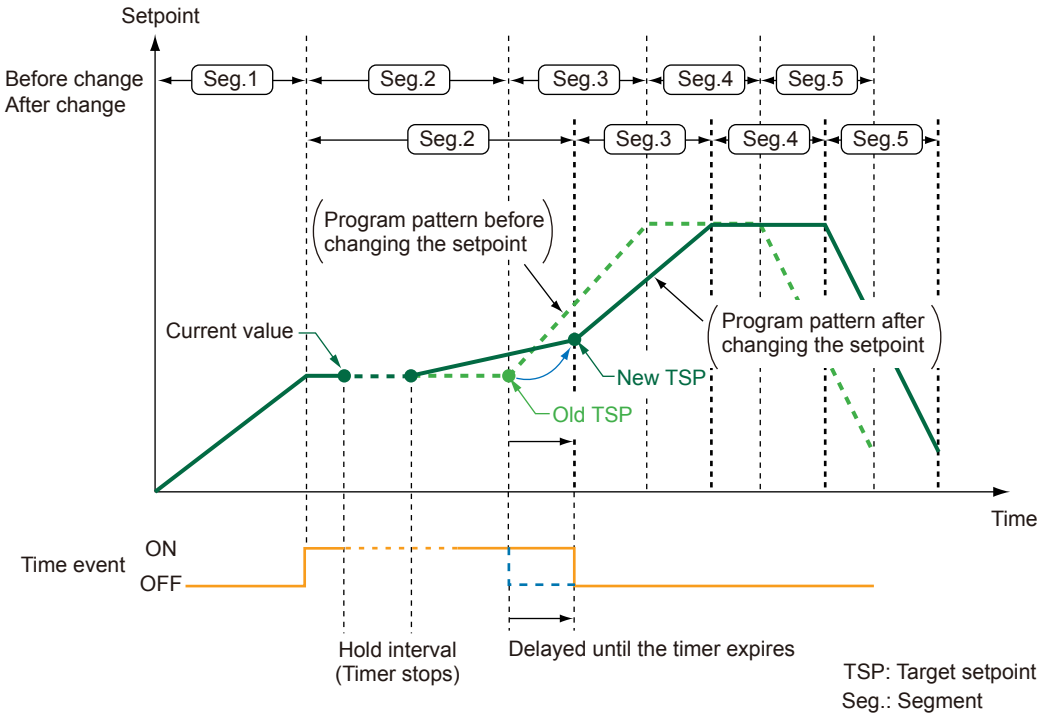
If you change the hold SP in a ramp segment and release the hold mode, the program pattern operation resumes from the changed setpoint and works towards the final target setpoint (TSP).



If you set the hold SP to the same value as the TSP and change the hold SP again, the TSP also changes. (This is the same behavior as when the hold SP is changed in a soak segment.)

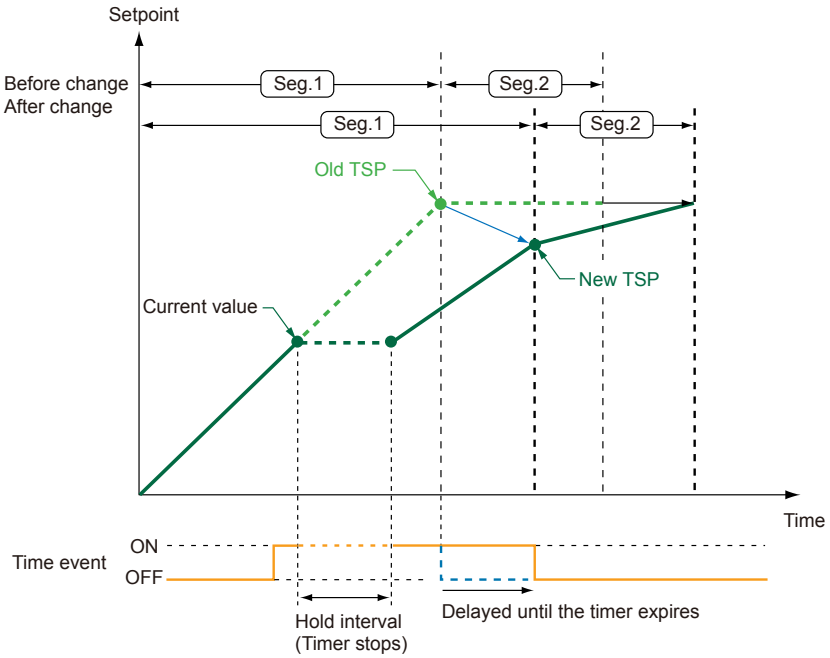
Behavior When the TSP Is Changed in a Soak Segment

You can change the final target setpoint (TSP) in a soak segment.
When the hold mode is released, the program pattern operation resumes and works towards the changed final target setpoint (TSP).



Behavior When the TSP Is Changed in a Ramp Segment

If you change the final target setpoint (TSP) in a ramp segment and release the hold mode, the program pattern operation resumes and works towards the final target setpoint (TSP).



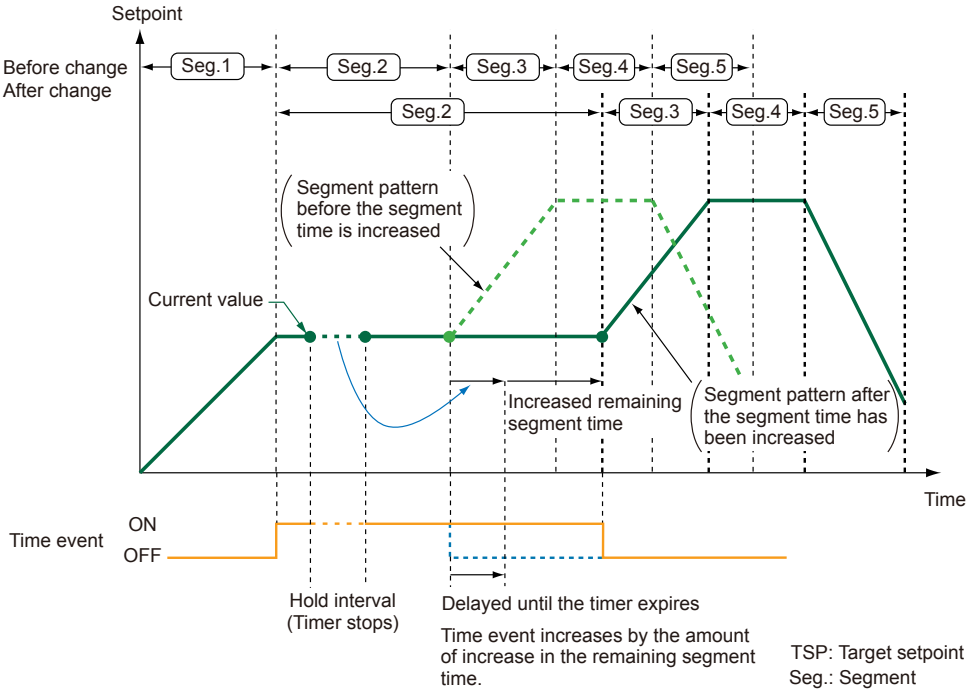
TSP: Target setpoint
Seg.: Segment

Behavior When the Segment Time of a Soak Segment Is Increased

You can change the remaining segment time from the time when the hold mode is released in hold mode.

If you change the remaining segment time in a soak segment and release the hold mode, the program pattern operation resumes from the changed value.

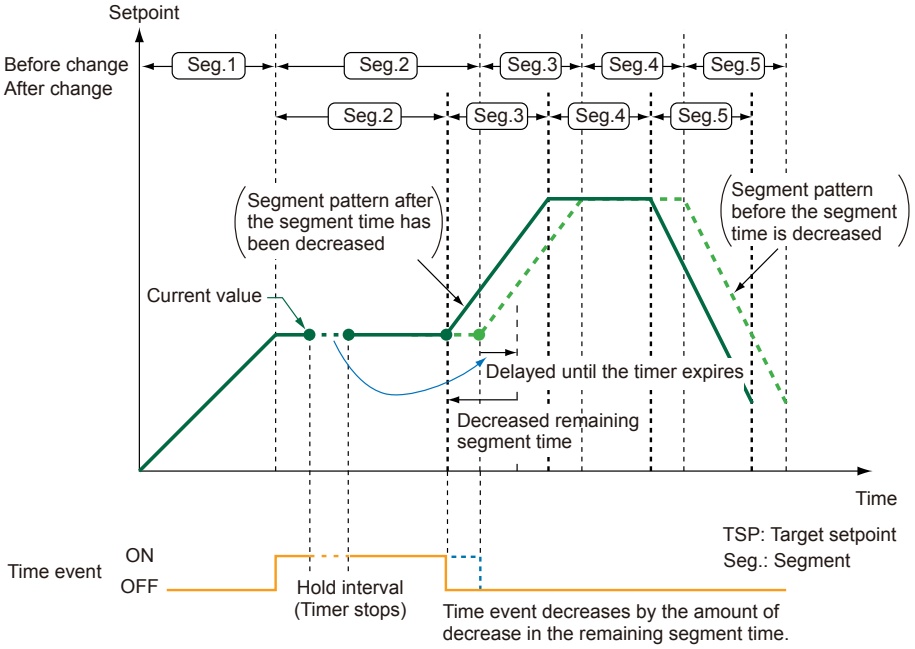
If you increase the segment time, the segment time and time event time are extended accordingly.



TSP: Target setpoint
Seg.: Segment

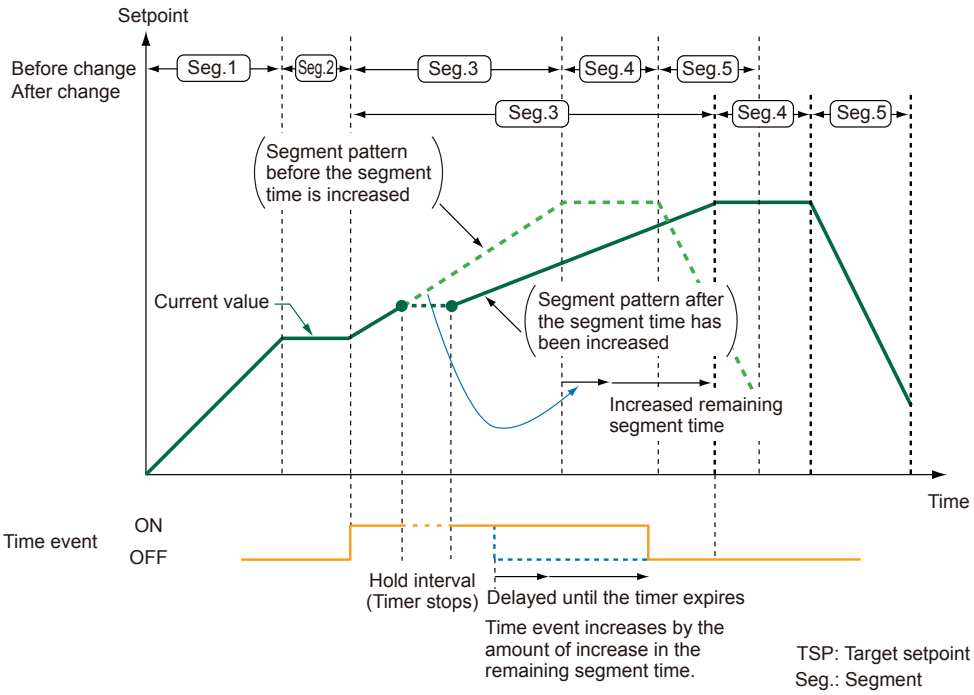
Behavior When the Segment Time of a Soak Segment Is Decreased

You can change the remaining segment time from the time when the hold mode is released in hold mode.
If you change the remaining segment time in a soak segment and release the hold mode, the program pattern operation resumes from the changed value.
If you decrease the segment time, the segment time and time event time are shortened accordingly.
If the on time or off time of the time event is longer than the changed remaining segment time, the program works according to the changed remaining segment time.



Behavior When the Segment Time of a Ramp Segment Is Increased

You can change the remaining segment time from the time when the hold mode is released in hold mode.
However, the ramp-rate for the changed program setpoint changes.
If you change the remaining segment time in a ramp segment and release the hold mode, the program pattern operation resumes from the changed value.
If you increase the segment time, the segment time and time event time are extended accordingly.



Behavior When the Segment Time of a Ramp Segment Is Decreased

You can change the remaining segment time from the time when the hold mode is released in hold mode.
However, the ramp-rate for the changed program setpoint changes.
If you change the remaining segment time in a ramp segment and release the hold mode, the program pattern operation resumes from the changed value.
If you decrease the segment time, the segment time and time event time are shortened accordingly.

5.3.9 Changing the Program Pattern during Program Operation

During program operation, you can change the program pattern on the program parameter edit screen.
Unlike the changes made on the program operation screen in hold mode, changes to setpoints made on the program parameter edit screen are saved. During program operation, parameters of the current segment cannot be changed.

▶ For details on changing the SP in hold mode, see section 5.3.6, “Changing the Current Setpoint in Hold Mode.”

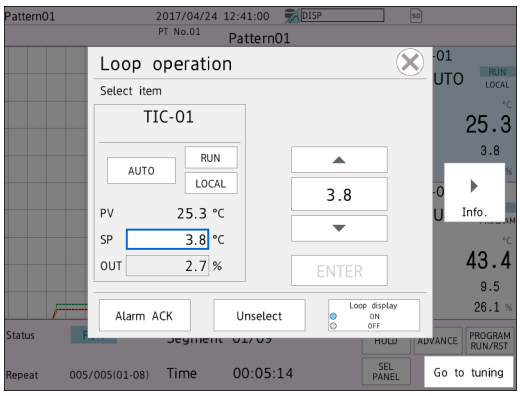
During program operation, program patterns cannot be changed from the Hardware Configurator.

5.3.10 Changing the Local Setpoint in Local Mode

Before changing the local setpoints, you need to change the operation mode to local.

Procedure

1 Display the Loop operation screen.



2 Tap the SP value to display parameter edit buttons.

4 Tap ▲ or ▼ to change the value. To confirm the value, tap ENTER.
You can also enter the value directly from the keyboard by tapping the center value.

Operation complete

5.4 Executing Various Functions

5.4.1 Releasing the Alarm Output (Alarm ACK)

This operation is valid when the following configuration is in use:

- In **System settings**, under **Alarm basic settings**, Indicator's **Hold/Nonhold** is set to **Hold**.
- Under **DO channel settings**, Action's **Hold** is set to **Hold** or **Relay Action on ACK** is set to **Reset**
- In **Control settings**, under **Control alarm**, the relay action is not set to **Nonhold**

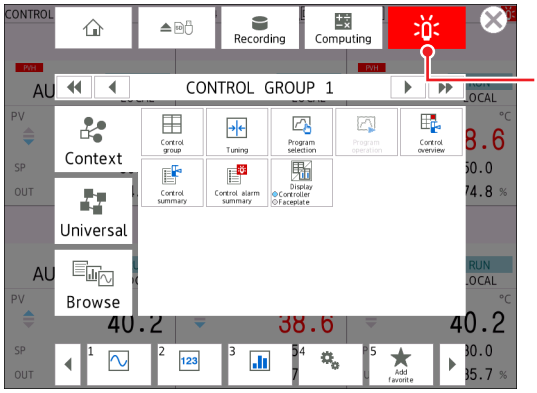
Procedure

All alarm ACK

When an alarm acknowledge operation is carried out, the indicators and outputs (relays) of all activated alarms are cleared.
You can carry out this procedure after an alarm occurs.

1 Press **MENU**.
The menu screen appears.

2 Tap the **Alarm** icon.
The alarm ACK confirmation screen appears.



3 Tap **OK**.
The alarm output is released.

Operation complete

5.4.2 Acknowledging Control Alarms

There are two types of alarm ACK operations: all loop and individual loop.

Alarm ACK Action

Item	Procedure	Action
All alarm ACK	Touch operation (from the alarm icon on the screen), communication command, event action	Alarm ACK is applied to all alarms (measurement channels, all loops). If the alarm display is set to hold, it is released (measurement channels, all loops).
Alarm ACK on each loop	Touch operation (from the alarm icon on the screen), communication command, action settings of the PID module	Alarm ACK is applied to the alarm of the specified loop. If the alarm display is set to hold, it is released (specified loop).

5.4.3 Using, Registering, and Deleting Favorite Screens

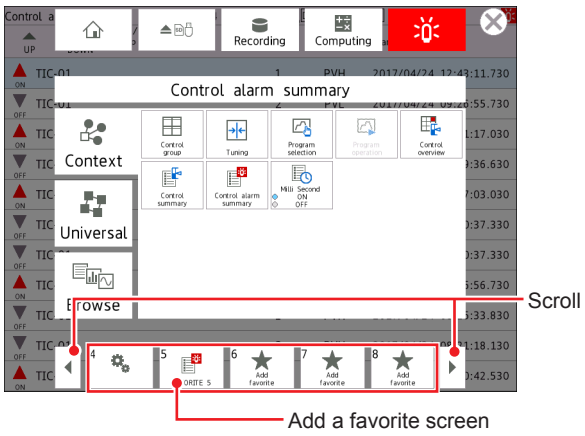
You can register displays that you use frequently as favorite screens and display them with easy operation.
You can register up to 20 displays.

Procedure

Registering a Favorite Screen

1. Show the display that you want to register as a favorite screen.

2. Press **MENU**.
   The menu screen appears.



Favorite screen list

3. Tap **Add favorite**.
   A confirmation screen appears.

4. Tap **Favorite name**, and enter the name.

5. Tap **OK**.
   The display is registered.

6. Tap the **Close** icon to close the menu screen.

Operation complete

Deleting a Favorite Screen

1. Press **MENU**.
   The menu screen appears.

2. Tap **Universal** tab > **Remove favorite**.
   A confirmation screen appears.

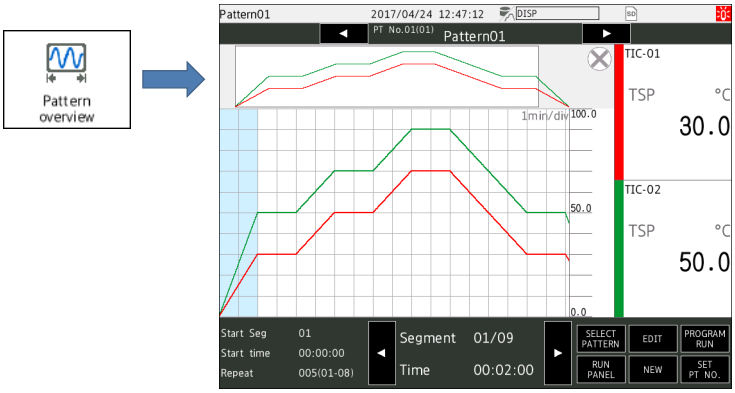
3. Select the screen to delete, and tap **OK**.
   The screen is deleted from favorites.

4. Tap the **Close** icon to close the menu screen.

Operation complete

5.4.4 Pattern Overview

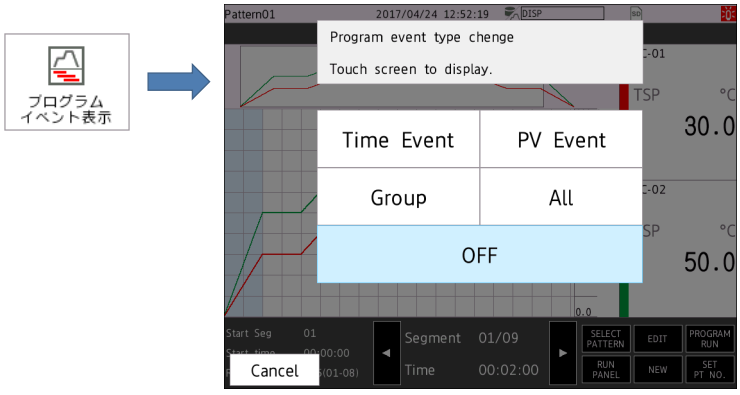
You can display a pattern overview by tapping Context > Pattern overview when the program selection screen is displayed.

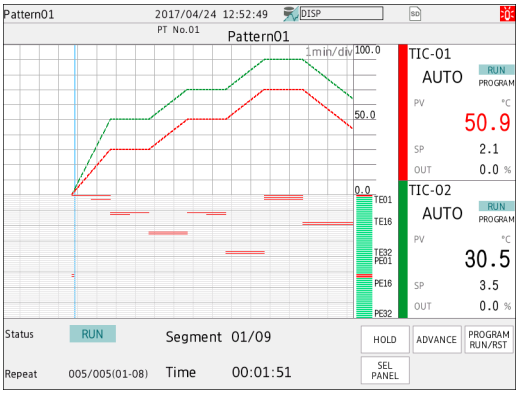


You can change the pattern position to display in the waveform area by tapping the overview area.
Tap the **Close** icon to close the overview.
If you show the event display while the overview is displayed, the overview closes.

5.4.5 Event Display

You can display an event type change screen by tapping Context > Program event display when the program selection screen or program operation screen is displayed.





On the event type change screen, you can switch the event display on the screen by tapping the event type you want to view. The following table shows the event types that can be displayed.

Event type	Description
Time event	Displays all time events.
PV event	Displays all PV events.
Group display	Displays events according to the content of the **Event display group** in pattern settings.
All	Displays all program events (from the top, time events and PV events).
OFF	Program events are not displayed.

The event display status applies to all pattern numbers.
If All is selected during the event display, the event display turns off (on the program selection screen).

5.4.6 Automatically Displaying the Program Operation Screen

The program operation screen can be displayed automatically when a program operation is started with a method other than a touch operation (communication, event action, contact, etc.) by setting Automatic switch to program operation display in **Program pattern settings** to On.
However, if a setting screen, save/load screen, initialize calibration screen, touch screen calibration screen, AD calibration screen, or due date setting screen (/AH) is displayed, the screen does not change.

Blank

6.1 Monitoring and Controlling Loop Control

This section explains the monitoring screen on the Web application and how to use it.
For details on network connection, PC system requirements, GX/GP/GM network configuration, starting and closing the Web application, and the Web application window, see the GX/GP or GM User's Manual.
This section describes screens related to control.

6.1.1 Control Monitor Screens

Procedure

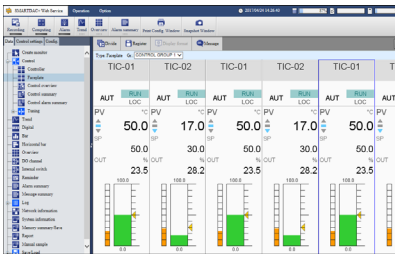
1. Click the **Data** tab and then **Control**.
2. Click the name of the screen you want to view.

Operation complete

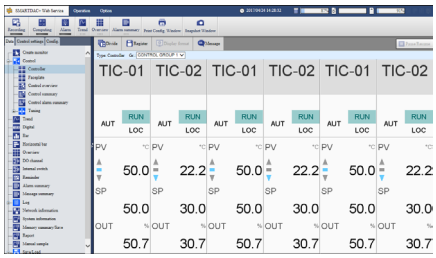
Description

The monitor screens are shown below.

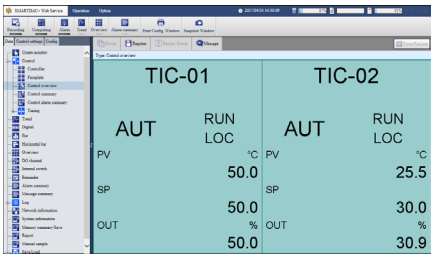
Faceplate



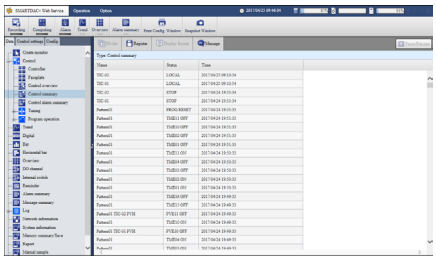
Controller



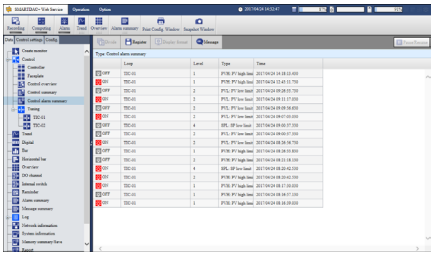
Control overview



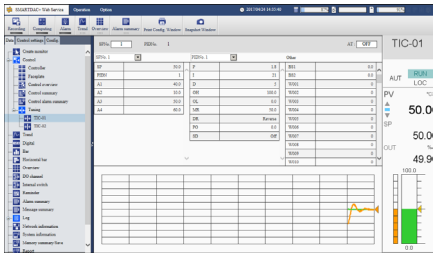
Control summary



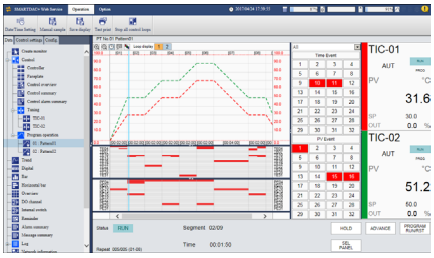
Control alarm summary



Tuning

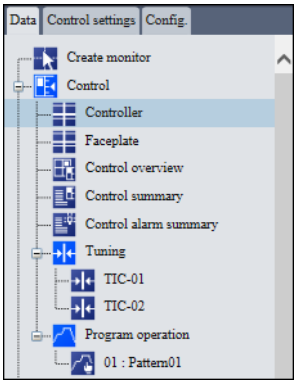


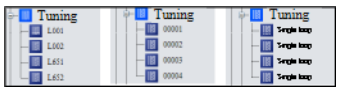
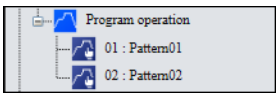
Program operation (recorder option /PG)



Content Selection Tree

Clicking a screen name in the tree displays the corresponding screen.



Item	Description
Tuning	Loop titles are displayed using the loop number, tag number, or tag string. The order of display precedence is tag number, tag string, and loop number. (When tag numbers are not assigned, tag strings are displayed.)  Loop number Tag No. Tag string
Program operation	Pattern titles are displayed using the pattern number:pattern name. The title of a pattern that is running is displayed as the pattern number:pattern name (RUN). 

Control Area

The control area is displayed in the faceplate, controller, control overview, control summary, and control alarm summary screens.

Divide button: Select the division format.
Register button: Assign a name to the division format and register it.
Display format button: Not available on the control screen.
Message button: Write a preset or free message in the trend.
Pause/Resume button: Not available on the control screen.

▶ For details on the functions and operations on the control area, for the GX/GP, see section 4.1.4, “Monitoring the GX/GP Data and Controlling the GX/GP from the Monitor Screen,” in the user’s manual. For the GM, see section 3.1.2, “Monitoring the GM Data and Controlling the GM from the Monitor Screen,” in the user’s manual.

6.1.2 Faceplate Screen and Controller Screen

Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Faceplate** or **Controller**.

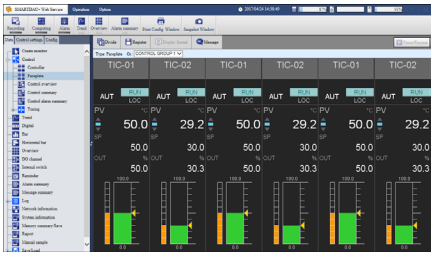
Operation complete

Explanation

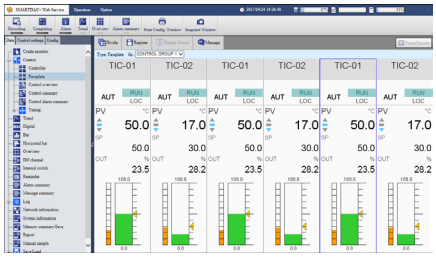
The faceplate and controller screens are monitor screens for control loops.

Faceplate screen: PV, SP, and OUT are displayed numerically and with bar graphs.
Controller screen: PV, SP, and OUT are displayed only numerically.

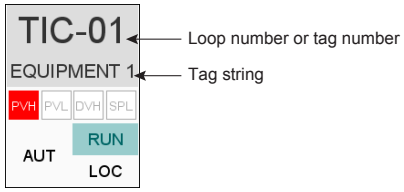
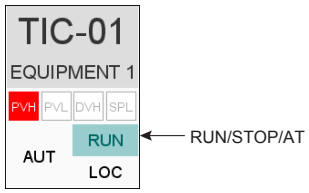
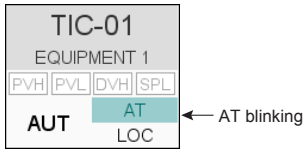
Black background

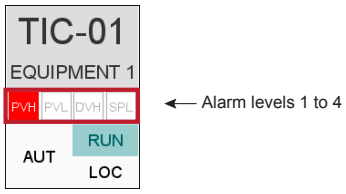


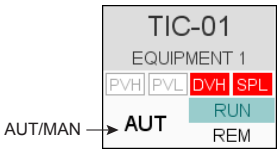
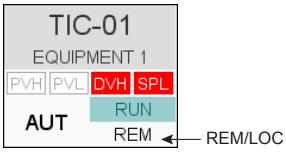
White background

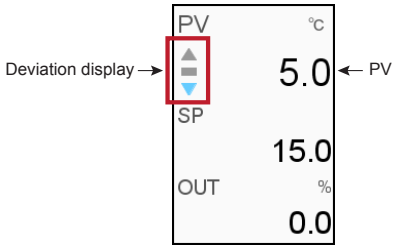
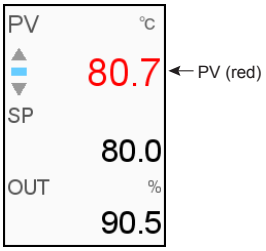
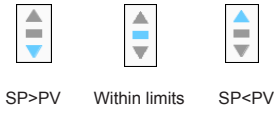
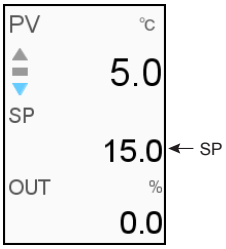
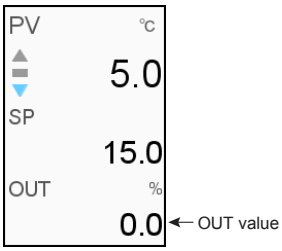


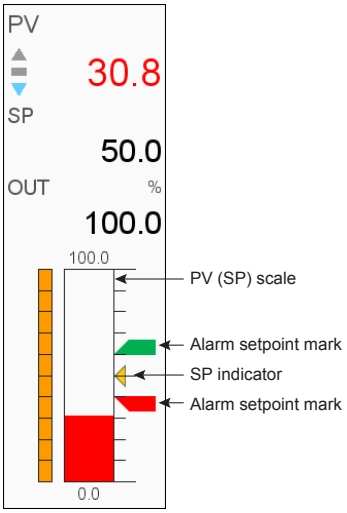
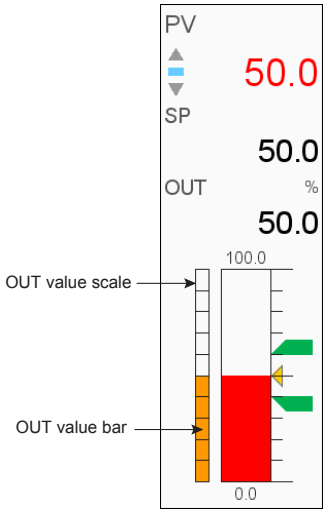
You can change the screen background by using **Control display settings** > **Display background** in the Web options dialog box.

Item	Description
Loop number, tag number, tag string	The loop number, tag number, and tag string are displayed at the top.  * If the text does not fit, the end of the text is abbreviated with an ellipsis (...).
RUN/STOP	The loop's control RUN/STOP status is indicated with text.  * "AT" blinks when auto-tuning is in progress as shown below. 

<table>
<tr><th>Item</th><th>Description</th></tr>
<tr><td>Alarm mark</td><td>Specified alarm status is indicated. Alarm levels 1 to 4 are displayed in order from the left. The alarm type is displayed with three characters.
 

The mark turns red when an alarm is occurring and gray when it is not. * If the alarm basic setting is Hold, the mark blinks if the alarm has not been acknowledged.
Alarm type characters
<table>
<tr><th>Alarm type</th><th>Characters</th></tr>
<tr><td>PV high limit</td><td>PVH</td></tr>
<tr><td>PV low limit</td><td>PVL</td></tr>
<tr><td>SP high limit</td><td>SPH</td></tr>
<tr><td>SP low limit</td><td>SPL</td></tr>
<tr><td>Deviation high limit</td><td>DVH</td></tr>
<tr><td>Deviation low limit</td><td>DVL</td></tr>
<tr><td>Deviation H/L limits</td><td>DVO</td></tr>
<tr><td>Dev. within H/L limits</td><td>DVI</td></tr>
<tr><td>Control output high limit</td><td>OTH</td></tr>
<tr><td>Control output low limit</td><td>OTL</td></tr>
<tr><td>PV velocity</td><td>PVR</td></tr>
</table></td></tr>
<tr><td>AUTO/MANUAL</td><td>The loop control mode is displayed. AUTO is displayed as AUT and MANUAL as MAN. Cascade mode during cascade control is displayed as CAS.
 
</td></tr>
<tr><td>REMOTE/LOCAL</td><td>The loop’s remote/local mode is displayed. REMOTE is displayed as REM and LOCAL is displayed as LOC.
 
</td></tr>
</table>

Item	Description
PV display	The PV is displayed numerically. If there is a unit, it is displayed.  The PV is displayed in red when an alarm is occurring. 
Deviation	The deviation between the PV and SP is displayed. The top, middle, or bottom indicator turns blue according to the deviation status. 
SP display	The SP is displayed numerically. The unit is not displayed. 
OUT display	The loop's control output value (OUT) is displayed as a percentage. 

Item	Description
PV bar (faceplate only)	The PV is displayed with a bar (fixed to 10 divisions). The color is normally green and turns red when an alarm occurs. PV alarm high and low limits are displayed with alarm setpoint marks. The mark turns red when the corresponding alarm occurs. When the control mode is loop control with PV switching, alarm point marks are not displayed. And, only the loop number and tag areas are displayed.  OUT value bar (faceplate only) The OUT value is displayed with a bar (fixed to 10 divisions). The scale is fixed to 0.0 to 100.0. The OUT value scale is displayed with an orange bar. 

Note

The PV, SP, and OUT decimal point type can be changed between period and comma using **Display settings** > **Decimal Point Type** in the Web options dialog box.

6.1.3 Control Overview Screen

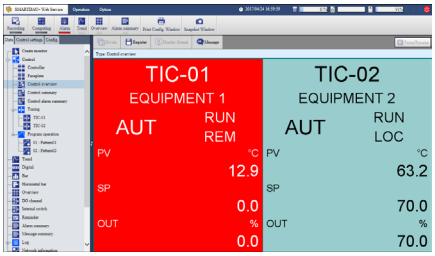
Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Control overview**.

Operation complete

Description

The control status of the entire system is displayed.



Example of 2 loops

Item	Description
Number of displayed loops	Up to 20
Display update rate	Approx. 1 s
Background and font color	The background turns red when an alarm is on and light blue when the alarm is off. If the alarm basic setting is **Hold**, the background blinks if there is even a single alarm that has not been acknowledged.

AUTO/MANUAL, RUN/STOP/AT, REMOTE/LOCAL, PV display, SP display, and OUT display are the same as those of the faceplate and controller screens. However, alarms for each level and deviation are not displayed.

6.1.4 Control Summary Screen

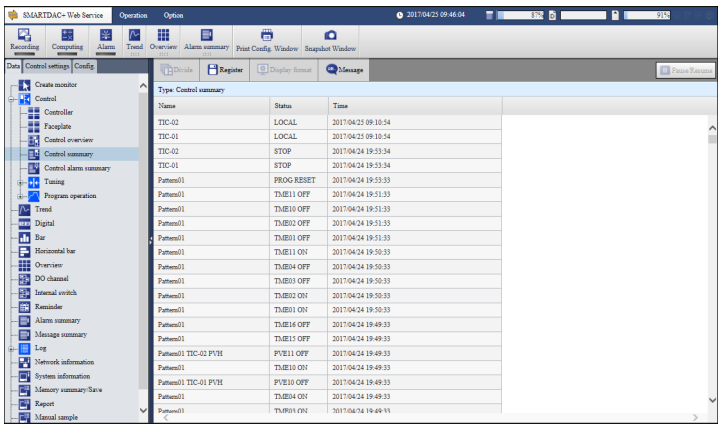
Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Control summary**.

Operation complete

Description

The following figure shows the displayed contents of the control summary. The maximum number of entries that can be displayed in the control summary is 1000.



Column	Function	Displayed content
Name	Loop control	Loop name[1]
	Program operation	Pattern name[2]
	PV event	Pattern name[2] Loop name[1] Type name[7]
	Time event	Pattern name[2]
Status	Loop control	LOCAL, REMOTE, PROGRAM AUTO, MANUAL, CASCADE RUN, STOP ATxx ON[3] AT OFF
	Program operation	PROG RUN, RESET HOLD ON, HOLD OFF WAIT ON, WAIT OFF ADVANCE
	PV event	PVExx ON[4] PVExx OFF[4]
	Time event	TMExx ON[5] TMExx OFF[5]
Time	Time of occurrence	Displays the time[6]

1: Loop name: The order of display precedence is tag number, tag string, and loop number.
2: Pattern name: The order of display precedence is pattern name and pattern number.
3: PID number, R
4: PV event number (1 to 32)
5: Time event number (1 to 32)
6: The time display format can be changed in Web options.
7: Same as the control alarm summary type

6.1.5 Control Alarm Summary Screen

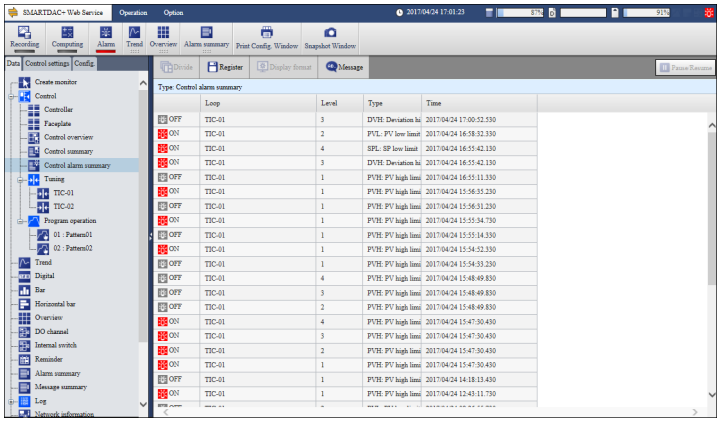
Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Control alarm summary**.

Operation complete

Description

The following figure shows the displayed contents of the control alarm summary. The maximum number of entries that can be displayed in the control alarm summary is 500.



Column	Function	Displayed content
Space	Alarm status	ON/OFF/ACK
Loop	Control loop	Loop name[1]
Level	Alarm level	L1 to L4
Type	Alarm type	PVH: PV high limit PVL: PV low SPH: SP high limit SPL: SP low limit DVH: Deviation high limit DVL: Deviation low limit DVO: Deviation H/L limits DVI: Dev. within H/L limits OTH: Control output high limit OTL: Control output low limit PVR: PV velocity
Time	Time of alarm occurrence	Displays the time[2]

1: Loop name: The order of display precedence is tag number, tag string, and loop number.
2: The time display format can be changed in Web options.

If the alarm basic setting is **Hold**, the alarm icon blinks if the alarm has not been acknowledged.

6.1.6 Tuning Screen

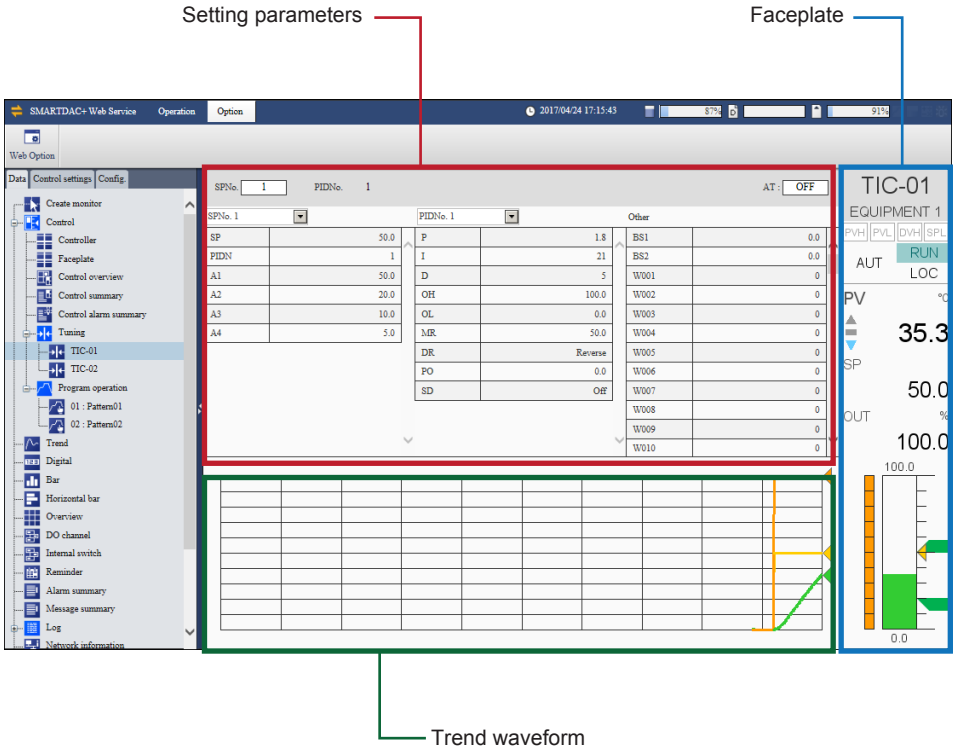
Procedure

1. Click the **Data** tab and then **Control**.
2. Click the **Tuning** tab and then the relevant loop.

Operation complete

Description

This section explains how to use the tuning screen.
The tuning screen allows you to view and adjust the control parameters (e.g., PID constant) of specific loops.
Below is an illustration of the tuning screen.

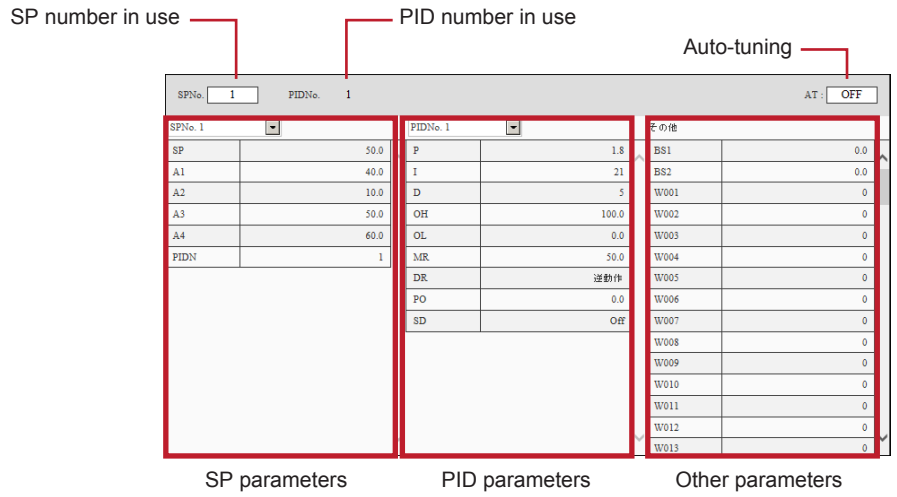


The tuning screen show a faceplate on the right side, setting parameters in the upper left, and trend waveform in the lower left.
The loop name is displayed using the loop number, tag string, or tag number depending on the setting.
The background color can be set to white or black using Options > Web options.

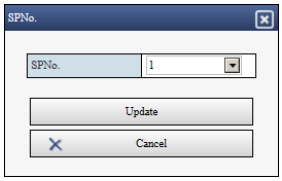
Setting parameters

Item	Description
Displayed content	Operation parameters of a loop
Number of displayed items	Depends on the settings.
Display update rate	Approx. 1 s

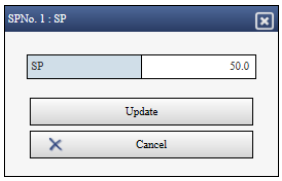
Setting parameters consists of SP parameters (up to 8 sets), PID parameters (up to 8 sets), and other parameters.



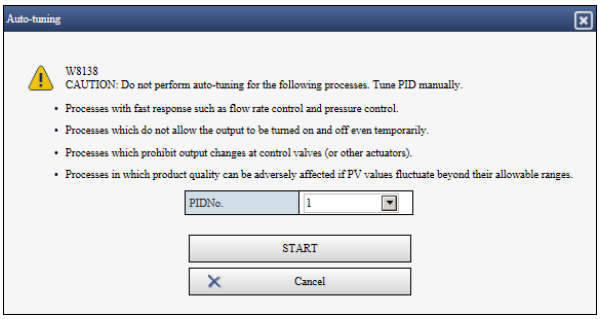
The SP number in use, PID number in use, and auto-tuning are displayed above the setting parameters. You can select the SP number and PID number with the list boxes. Parameters of the selected numbers are displayed. Double-clicking a parameter displays an edit dialog box.



Edit dialog box with a list box



Edit dialog box with a number box

Item	Description
Auto-tuning	Clicking the AT box displays an auto-tuning edit dialog box. Select which PID group to store the tuning results in. Click **START** to execute auto-tuning. For details on the tuning function, see chapter 3.  To abort an ongoing auto-tuning process, click the AT box. This will display a cancel confirmation message.
SP number in use	Double-clicking the SP number displays an edit dialog box.
PID number in use	The selected PID number is displayed.
Setting parameters	The following operation parameters are displayed. Some parameters may be shown or hidden depending on the settings. For details on the operation parameter functions, see section 5.1.8, “Adjusting the PID Manually (Manual Tuning).” <SP parameters> SP number (SP No.), target setpoint (SP), control alarm values (A1, A2, A3, A4), PID group number (PIDN) PID number (PID No.1) <PID parameters> Proportional band (P), integral time (I), derivative time (D) output high limit (OH), output low limit (OL), manual reset (MR), control direction (DR), preset output (PO), upper hysteresis (HY.UP), lower hysteresis (HY.DN), tight shut (SD) <Other parameters> AI1 bias (BS1), AI1 first-order lag filter (FL1), AI2 bias (BS2), AI2 first-order lag filter (FL2), ratio (RT) remote bias (RBS), remote filter (RFL), target setpoint ramp-up rate (UPR), target setpoint ramp-down rate (DNR), variable constants (W001 to W100)

Explanation

▶ For details on auto-tuning and manual tuning, see section 5.2.2, “Performing and Canceling Auto-Tuning,” and section 5.2.3, “Adjusting the PID Manually (Manual Tuning).”

Trend waveform

Item	Description
Displayed content	PV, SP, OUT of the relevant loop
Display update rate	Approx. 1 s
Time axis grid	10 divisions
Grid	Vertical axis: PV range for PV and SP. 0 to 100% for OUT. Fixed to 10 divisions. Horizontal axis: Fixed to 10 divisions.
Waveform	Draws the PV, SP, and OUT values from the right side of the area. Data points are at 1-s intervals, and the maximum number of points is 1200. 120 points are drawn in a grid.
Indicators	Current SP, PV, and OUT values are indicated with arrows to the right of the position where waveform drawing starts. If they overlap, OUT is shown in front of PV, and PV is shown in front of SP.

Faceplate

The displayed content and operation are the same as those of the control group faceplate.

Note

While the tuning screen is displayed, if it becomes impossible to tune the relevant loop, a message “Loop disabled” is displayed. If tuning becomes possible again, the initial tuning screen appears.

6.1.7 Switching Operation Modes

You can change the operation mode on the loop screen (edit dialog box) on the faceplate, controller, control overview, and turning screens.

Operations

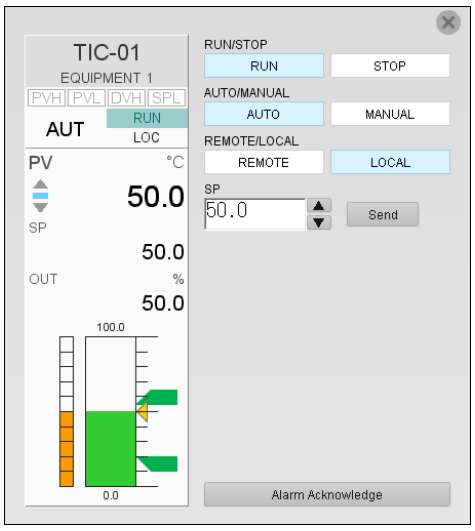
Switch operation	Behavior
AUTO/MANUAL	Switches between AUTO and MANUAL.
AUTO/MANUAL/ CASCADE	Displayed when the control mode is cascade. Switches between AUTO, MANUAL, and CASCADE.
RUN/STOP	Runs or stops the loop.
REMOTE/LOCAL	Switches between remote and local.
PROGRAM/LOCAL	Displayed during program operation. Switches between operation using local SPs and operation using program patterns.

Switching between Auto and Manual Modes

This is an example of the operation on the faceplate screen.

Procedure

1. On the faceplate screen, click the loop you want to change the mode of.
   An edit dialog box appears (in the case of the faceplate screen).



2. To select auto, click **AUTO**. To select manual, click **MANUAL**.
3. Click **Close** .

Operation complete

Description

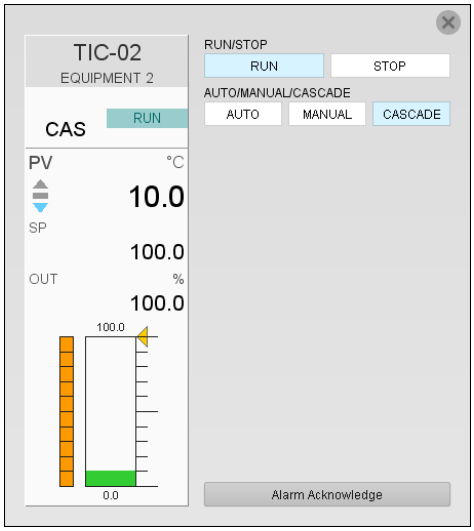
The displayed operation mode, such as RUN/STOP, AUTO/MANUAL, and REMOTE/LOCAL, is updated to the current state. The displayed SP and OUT values are not updated. SP and OUT values (when using the Set/Enter input method) are applied when you click **Send**.
The edit dialog box is not displayed for the secondary loop of loop control with PV switching.

Switching between Cascade, Auto, and Manual Modes

This is an example of the operation on the faceplate screen.

Procedure

1. On the faceplate screen, click the loop you want to change the mode of.
   An edit dialog box appears.



2. To select auto, click **AUTO**. To select manual, click **MANUAL**. To select cascade, click **CASCADE**.

3. Click **Close**.

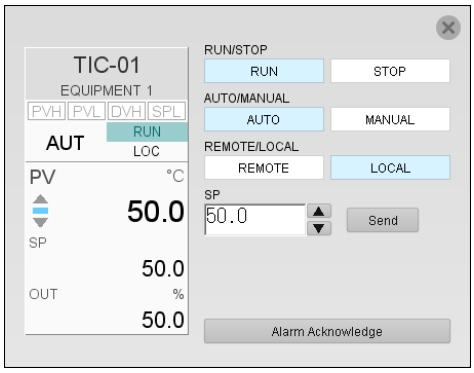
Operation complete

Switching between Run and Stop Modes

This is an example of the operation on the controller screen.

Procedure

1. Click the loop you want to change the mode of.
   An edit dialog box appears.



2. To select run, click **RUN**. To select stop, click **STOP**.

3. Click **Close**.

Operation complete

Resetting the Operation of All Loops

Procedure

1. On the **Operation** tab, click **Stop all control loops**.
   An All loops STOP dialog box appears.

2. Click **Stop all control loops**.

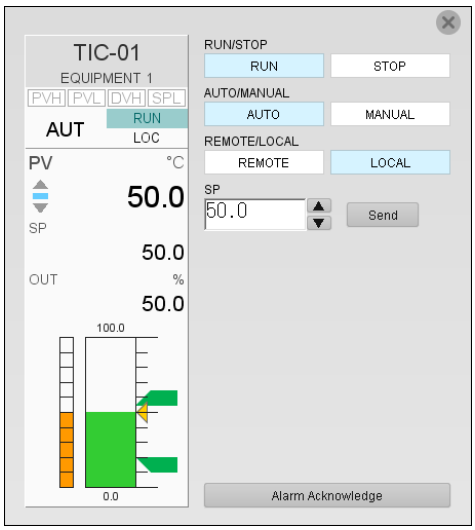
Operation complete

Switching between Remote and Local Modes

This is an example of the operation on the faceplate screen.

Procedure

1. On the faceplate screen, click the loop you want to change the mode of.
   An edit dialog box appears.



2. To select remote, click **REMOTE**. To select local, click **LOCAL**.
3. Click **Close** .

Operation complete

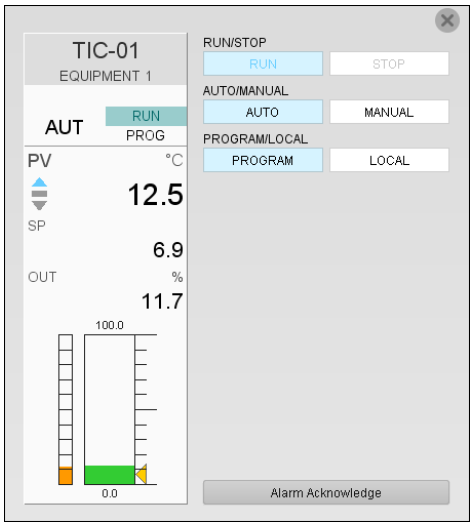
Description

You can switch between remote and local when the RSP function is set to On.

Switching from Program to Local Mode

Procedure

1. Click the loop you want to change the mode of.
   An edit dialog box appears.



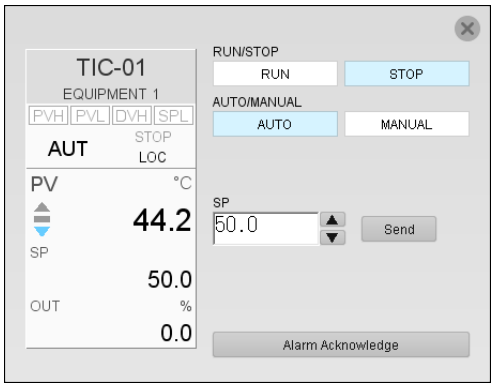
2. To select local mode, click **LOCAL**.
3. Click **Close** .

Operation complete

6.1.8 Changing Target Setpoints

Procedure

1. Click the loop you want to change the target setpoint of.
   An edit dialog box appears.



2. Enter the SP from the keyboard or change the value using the up and down arrow buttons. Then, click **Send**.
3. Click **Close** .

Operation complete

6.1.9 Controlling the Control Output in Manual Mode

You can change the control output value (OUT).
There are two output control methods: Set/Enter input and Direct input.
With the direct input method, you can change the value consecutively by holding down the up and down arrow buttons.

▶ For details on controlling the control output in manual mode, see section 5.2.7, “Setting the Control Output Operation Type for Manual Mode.”

6.2 Monitoring and Configuring Program Control

You can view the control status of each program pattern. During program operation, you can change the parameters.

Program selection screen refers to the pattern setting display screen of program patterns when program operation is stopped.
Program operation screen refers to the pattern operation display screen of program patterns when program operation is running.

▶ For setting program patterns, see section 4.1, “Program Control Configuration Flowchart.” You can set program patterns from the Hardware Configurator. You cannot set them from the Web application.

6.2.1 Displaying the Program Selection Screen and Program Operation Screen

Procedure

Displaying the Program Selection Screen

1. Click the **Data** tab and then **Control**.
2. Click **Program operation** and then the pattern number:pattern name.
   The program pattern appears in the pattern setting display area.

Operation complete

Displaying the Program Operation Screen

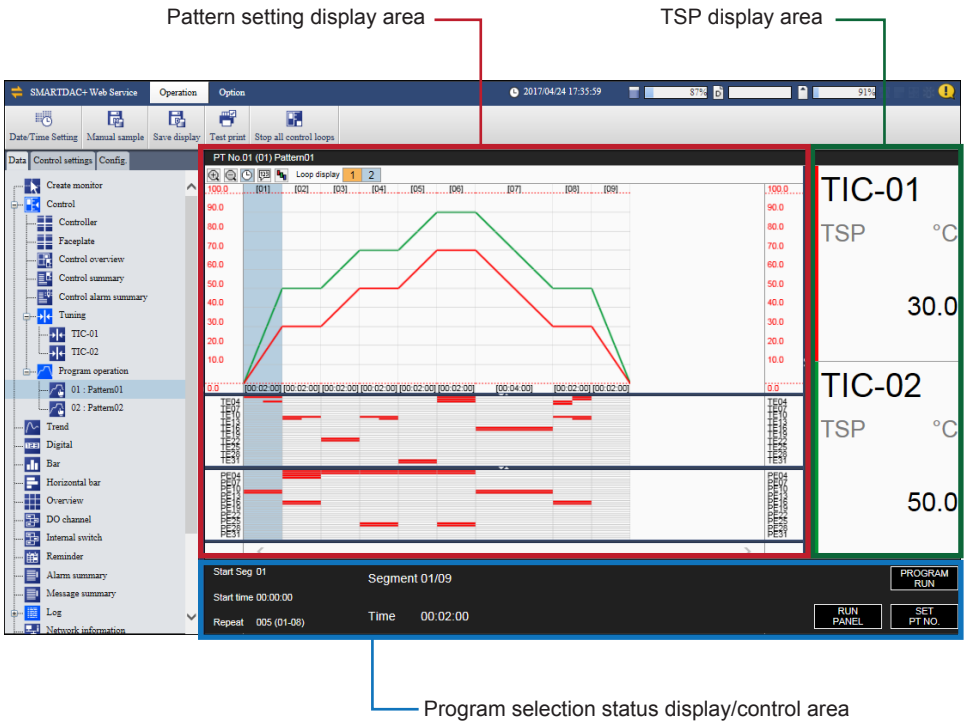
1. Click the **Data** tab and then **Control**.
2. Click **Program operation** and then the pattern number:pattern name (RUN).
   The program pattern appears in the pattern setting display area.

Operation complete

Description

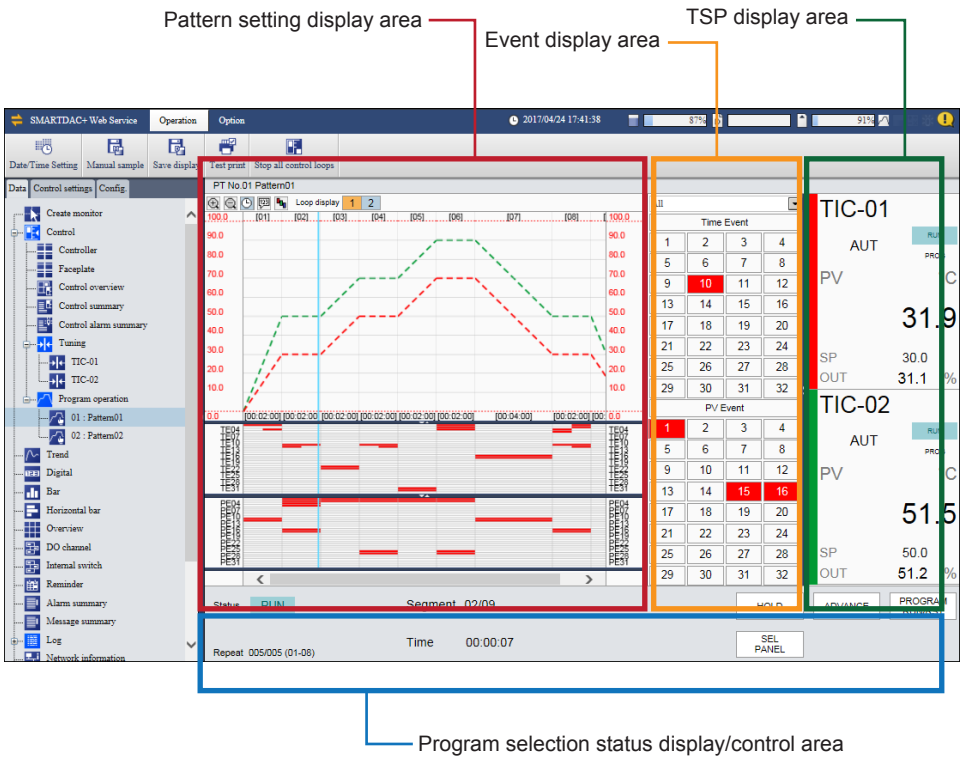
The program selection screen shows a pattern setting display area, TSP display area, and program selection status display/control area.

Program Selection Screen (in stop mode)



The program operation screen shows a pattern setting display area, event display area, TSP display area, and program operation status display/control area.

Program Operation Screen (in run mode)



Item	Description
Displayed content	1 program patterns
Number of displayed loops	Up to 20
Display update rate	Approx. 1 s (however, it may be longer depending on the communication traffic and PC load)

There are separators at the boundaries of each area. You can show or hide each area by clicking the appropriate boundary.
The background color can be set to white or black by changing the display settings in Web options.

Note

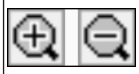
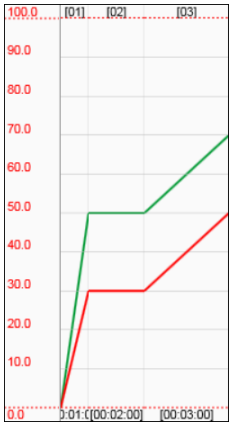
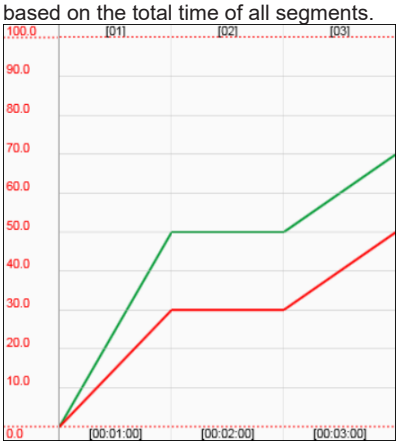
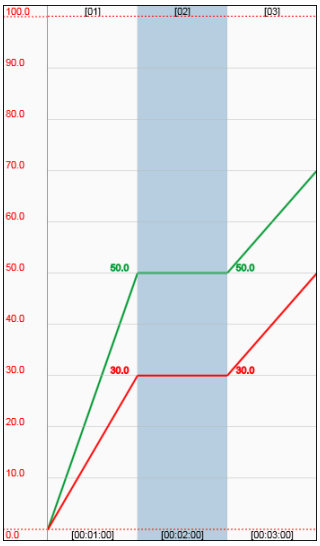
- In run mode, the TSPs of each loop are displayed as waveforms with broken lines.
- On the Web application, the PV (solid line) is not displayed in the past waveform area during recording. Only the TSP waveform (broken line) is displayed.

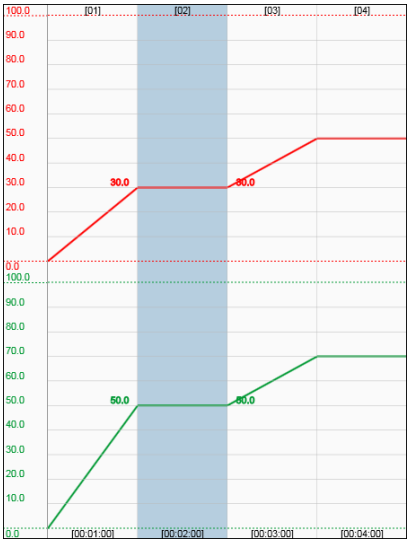
▶ For details on the waveform display on the GX/GP, see “Waveform Area” in section 5.3, “Performing Program Control (recorder option /PG).”

Description of the Parts of the Program Selection Screen and Program Operation Screen

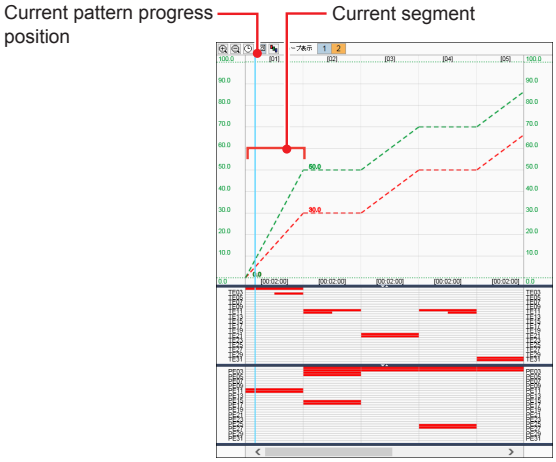
This section describes the icons and buttons on the program selection screen and program operation screen.

Pattern Setting Display Area

Item	Description
Zoom	Click the icon to expand or reduce the time scale. 
Segment equal interval, Display in linear time scale	Click the icon to switch the time scale to equal interval or real-time ratio.  **Equal interval mode**  **Real-time mode** The display width ratio is set to real-time ratio based on the total time of all segments.  Example of 2 loops
TSP display on the program pattern	Click the icon to display the TSP of the selected segment.  TSP display  Example of 2 loops

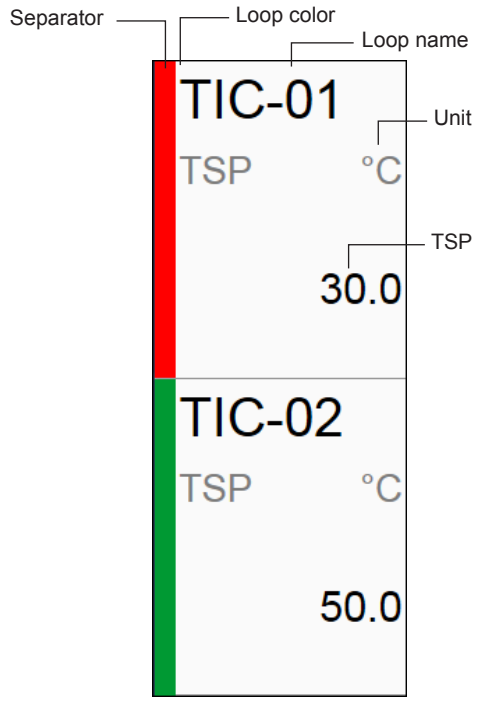
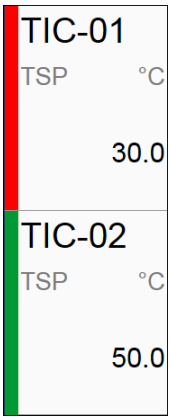
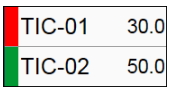
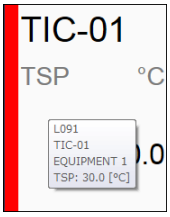
Item	Description
Loop TSP axis split display	Click the icon to split the display for each pattern.  Loop TSP axis split display  Example of 2 loops
Loop show/hide switch	Click the icon to show or hide patterns.  Example of 2 loops

Display during Pattern Operation

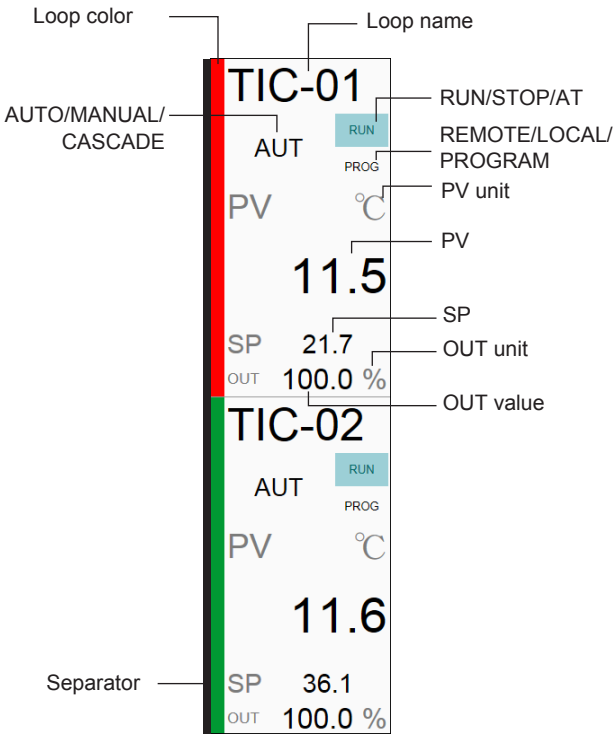
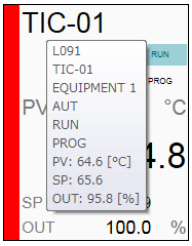


During program operation, PV events show the settings. You can view the event occurrence status in the event display area, explained later.

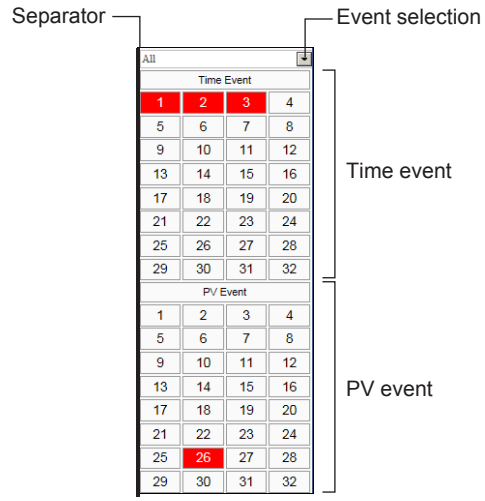
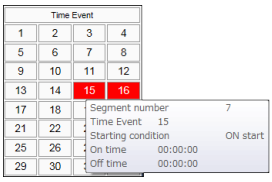
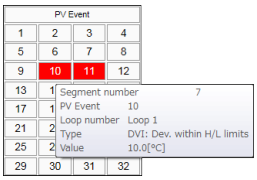
TSP Display Area (during program selection)

Item	Description
TSP display area	The TSP display area shows the controller screen.  Click the separator to switch between show and hide. The display style depending on the screen size is shown below. Normal display (displays all items)  Simple display (loop name and TSP (no unit)) 
Tooltip	Moving the cursor over each loop displays all items in a tooltip.  The tooltip shows the loop number, tag number, tag string, and TSP.

TSP Display Area (during program operation)

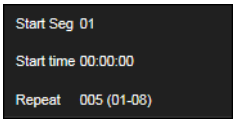
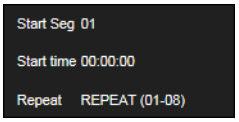
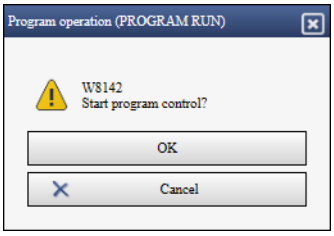
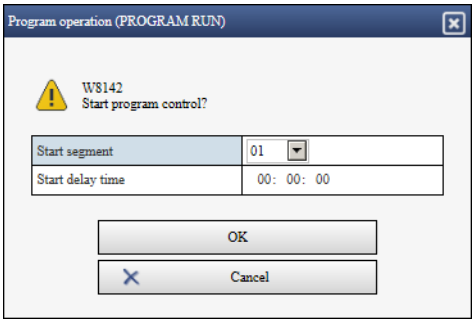
Item	Description
TSP display area	PV, SP, OUT, and loop status (e.g., RUN/STOP) are displayed. In addition, you can click the separator to switch between show and hide. 
Tooltip	Pointing to a loop shows a tooltip.  Loop number, tag number, tag string, AUT/MAN/CAS, RUN/STOP/AT, REM/LOC/PROG, PV, SP, and OUT are displayed.

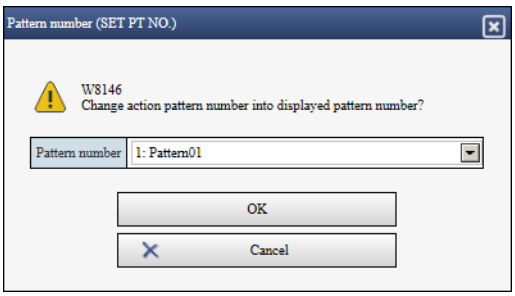
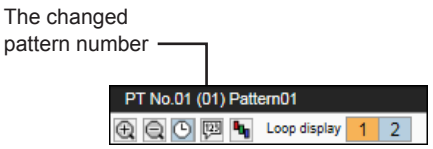
Event Display Area

Item	Description
Event display	The event display area shows the PV event and time event occurrence status. You can select PV event, Time event, Group,* or All from the event selection list box. In addition, you can click the separator to switch between show and hide. * Group can be displayed when any of the event display groups in program pattern settings is set to On.  When an event occurs, the event number turns red.
Time event tooltip	Pointing to an active event shows a tooltip.  The segment number, time event number, starting condition, on time, and off time are displayed.
PV event tooltip	Pointing to an active event shows a tooltip.  The segment number, PV event number, loop number, type, and setpoint are displayed.

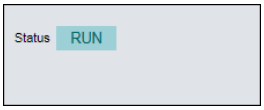
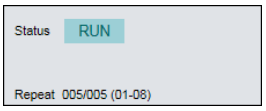
Item	Description
Group display	Group can be displayed when any of the event display groups in program pattern settings is set to On. 
All	All time events and PV events are displayed.

Status Display/Control Area (during program selection)

Item	Description
Repeat function	When the repeat function is set to On  Number of repeat cycles Example: Segments 1 to 8 are repeated five times. When the repeat function is set to Repeat  REPEAT Example: Segments 1 to 8 are repeated indefinitely.
PROGRAM RUN button	Clicking the PROGRAM RUN button starts the program operation.  When Program RUN detail settings in Control settings is set to Off  When Program RUN detail settings in Control settings is set to On  Start segment: You can select the start segment. Start delay time: You can enter the start delay time from the keyboard. Clicking OK starts the program operation according to the specified start segment and start delay time. ▶For details on the start delay time and start segment, see section 4.11, “Setting the Action at the Start of Program Operation.”

Item	Description
RUN PANEL button	This is displayed on the program selection screen. Clicking the RUN PANEL button displays the current program operation screen. 
SET PT NO. button	Clicking the SET PT NO. button switches the action pattern.  Pattern number: Select the pattern number you want to switch to. Clicking OK switches the action pattern number to the selected pattern number. Clicking Cancel closes the dialog box without changing anything.  ▶For details on action patterns, see section 5.3.1, “Selecting a Program Pattern.”

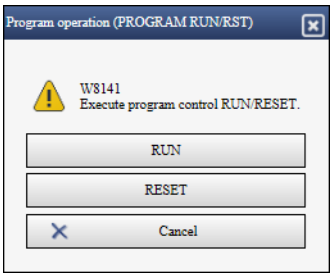
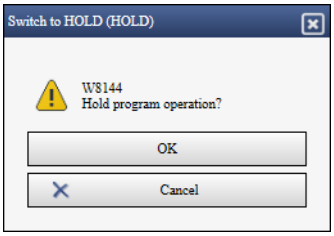
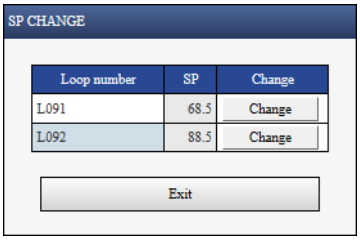
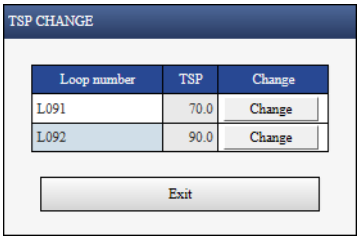
Status Display/Control Area (during program operation)

Item	Description
RUN/RESET	RUN: Program running RESET: Program operation is complete or RESET was executed during operation.
HOLD/WAIT/DELAY	HOLD: Hold mode WAIT: Wait mode DELAY: Delaying the start of operation
Repeat function	When the repeat function is set to Off:  When the repeat function is set to On:  Number of repeat cycles Example: Segments 1 to 8 are repeated five times. When the repeat function is set to Repeat  REPEAT Example: Segments 1 to 8 are repeated indefinitely.
Segment number	The total number of segments specified in pattern settings and the segment number currently being executed are displayed. It is set to “00/00” when the operation is complete or when the operation is reset.  Segment: Segment number currently being executed (2 digits)/total number of segments (2 digits)
Segment remaining time	The remaining time of the segment currently being executed is counted down.  Time: hh:mm:ss (hour:minute:second) Example: Time 00:01:58 The remaining segment time is 1 minute 58 seconds.

User Limitation on Program Operation

Note

Program operation can be disabled through User property (Lock).

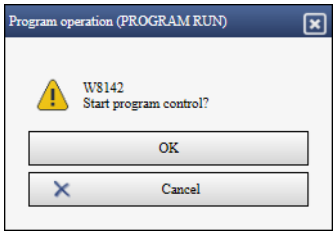
Item	Description
PROGRAM RUN/ RST button	Clicking the RUN button starts the operation of the currently displayed pattern in RESET mode from start segment 1 with start delay time 00:00:00. Clicking the RUN button starts during operation resets (stops) the currently displayed pattern in run mode. 
HOLD button	Clicking the HOLD button displays a HOLD dialog box. Click **OK** to hold the operation. When in hold mode, the time stops. When in hold mode, you can change the time, TSP, and SP. A HOLD release dialog box appears. Click **OK** to resume operation. 
ADVANCE button	Clicking the ADVANCE button forces the program to advance from the current segment to the next segment.
SEL PANEL button	Clicking the SEL PANEL button displays a pattern selection screen of the displayed running pattern number.
SP CHANGE button	Clicking the SP CHANGE button displays an SP CHANGE dialog box. (This operation is possible only in hold mode.) The SP in hold mode is displayed. You can change the SP of each loop. 
TSP CHANGE button	Clicking the TSP CHANGE button displays a TSP CHANGE dialog box. (This operation is possible only in hold mode.) The segment TSP in hold mode is displayed. You can change the TSP of each loop. 

6.2.2 Running and Resetting Program Pattern Operation (PROG, RESET)

Procedure

Starting a Program Pattern Operation

1. In the status display/control area, click **PROGRAM RUN**.
   A PROGRAM RUN dialog box appears.

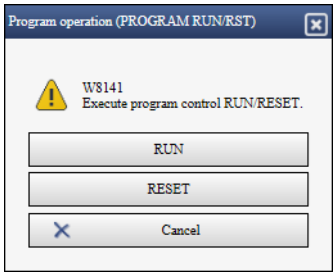


2. Click **OK** to start the program operation.

Operation complete

Ending a Program Pattern Operation

1. In the status display/control area, click **PROGRAM RUN/RST**.
   A PROGRAM RUN/RST dialog box appears.



2. Click **RESET** to reset the program operation.

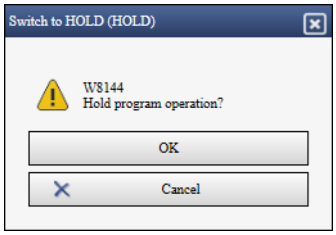
Operation complete

6.2.3 Holding and Releasing the Program Operation

Procedure

Holding the Operation

1. During program operation, in the status display/control area, click **HOLD**.
   A HOLD dialog box appears.



2. Click OK.
3. Operating status “HOLD” blinks in the status display/control area.

Operation complete

Releasing the Hold Mode

1. In hold mode, click **HOLD** in the status display/control area.
   A HOLD dialog box appears.

2. Click OK.
3. Operating status “HOLD” clears from the status display/control area.

Operation complete

Description

The following figure shows the status display/control area in hold mode.

The time becomes a button.
The countdown stops in hold mode.
A TSP CHANGE button is displayed.
An SP CHANGE button is displayed.

The following figure shows the status display/control area after releasing the hold mode.

The time becomes only a display.
After the hold mode is released, the countdown resumes from the changed segment remaining time.
The TSP CHANGE button is not displayed.
The SP CHANGE button is not displayed.

Hold mode is released also by clicking ADVANCE or PROGRAM RUN/RST.

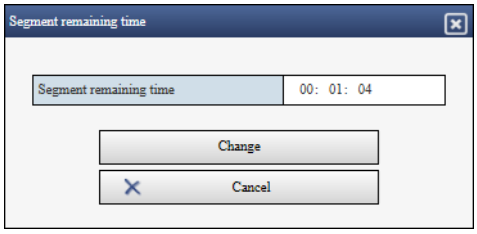
Explanation

▶ For details on holding and releasing the hold, see “Holding and Releasing the Program Operation” in section 5.3, “Performing Program Control (recorder option /PG).”

6.2.4 Changing the Segment Remaining Time in Hold Mode

Procedure

1. In hold mode, click the **Time** button in the status display/control area.
   A Segment remaining time dialog box appears.



2. Enter the segment remaining time from the keyboard.
3. Click **Change** to apply the change to the status display/control area. To apply it to the program operation, release the hold mode.

Operation complete

Description

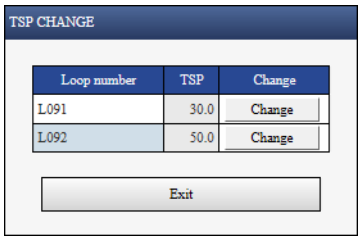
You can change the segment remaining time in hold mode.

You can change it in the range of 00:00:00 to 99:59:59 regardless of the segment settings.

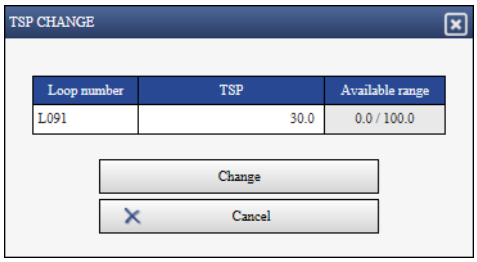
6.2.5 Changing the Target Setpoint in Hold Mode

Procedure

1 In hold mode, click the **TSP CHANGE** button in the status display/control area.
A TSP CHANGE dialog box appears.



2 Click **Change**.
A TSP CHANGE dialog box appears.



3 Enter the TSP from the keyboard, and click **Change**.

Operation complete

Description

You can change the final target setpoint (TSP) in hold mode.

TSP CHANGE Dialog Box

Loop number: The running loop number.
TSP: The current segment TSP of each loop.
Change button: Displays the TSP CHANGE dialog box of each loop.

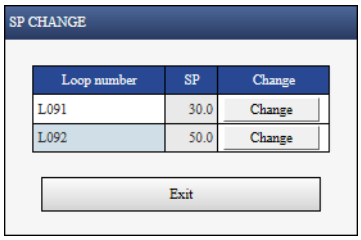
TSP CHANGE Dialog Box

Loop number: The loop number you are changing the TSP of.
TSP: Change the TSP. Click and enter a value.
Available range: The loop's control PV input range (high and low limits).

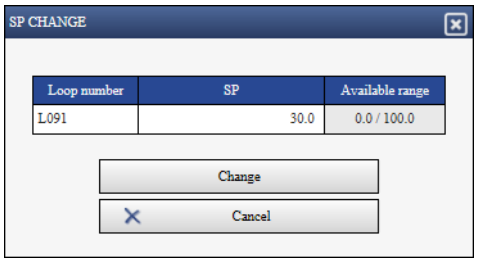
6.2.6 Changing the Current Setpoint in Hold Mode

Procedure

1. In hold mode, click the **SP CHANGE** button in the status display/control area.
   An SP CHANGE dialog box appears.



2. Click **Change**.
   An SP CHANGE dialog box appears.



3. Enter the SP from the keyboard, and click **Change**.

Operation complete

Description

You can change the current target setpoint (SP) in hold mode.

SP CHANGE Dialog Box

Loop number: The loop number you are changing the SP of.
SP: The SP at the current segment remaining time of each loop.
Change button: Displays the SP CHANGE dialog box of each loop.

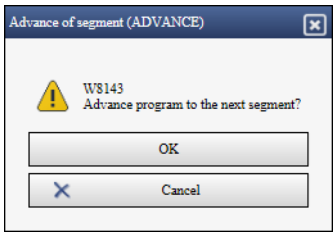
SP CHANGE Dialog Box

Loop number: The loop number you are changing the SP of.
SP: Change the SP.
Available range: The loop's control PV input range (high and low limits).

6.2.7 Advancing the Segment

Procedure

1. During program operation, click **ADVANCE** in the status display/control area.
   An Advance of segment (ADVANCE) dialog box appears.



2. Click **OK** to advance the segment.

Operation complete

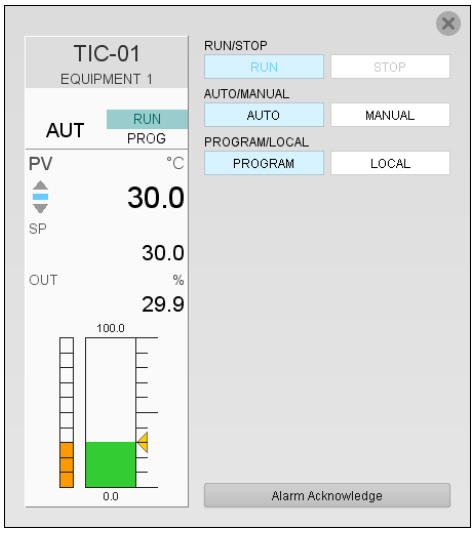
Description

▶ For details on advancing, see section 5.3, “Performing Program Control (recorder option / PG).”

6.2.8 Switching from Program to Local Mode

Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Faceplate**, **Controller**, or **Control overview**.
3. Click the loop you want to change to local mode.
   An edit dialog box appears.



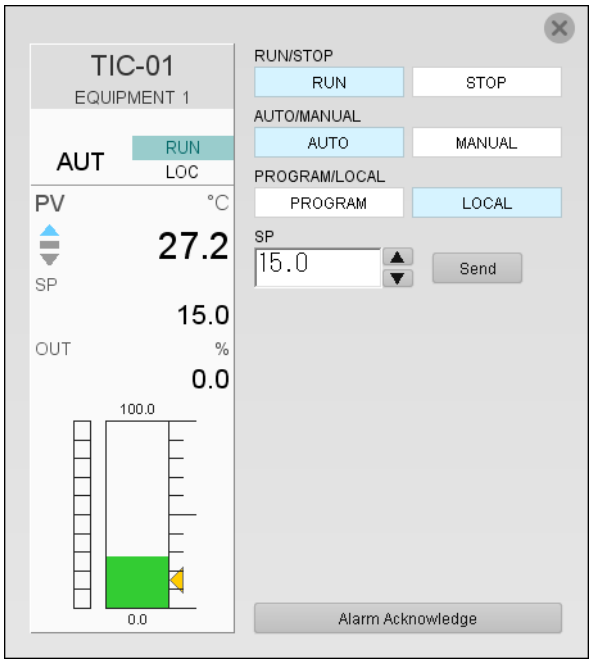
4. Click **LOCAL** to switch to local mode.

Operation complete

6.2.9 Changing the Local Setpoint in Local Mode

Procedure

1. Click the **Data** tab and then **Control**.
2. Click **Faceplate**, **Controller**, or **Control overview**.
3. Click the loop screen you want to change the local setpoint of.
   An edit dialog box appears.

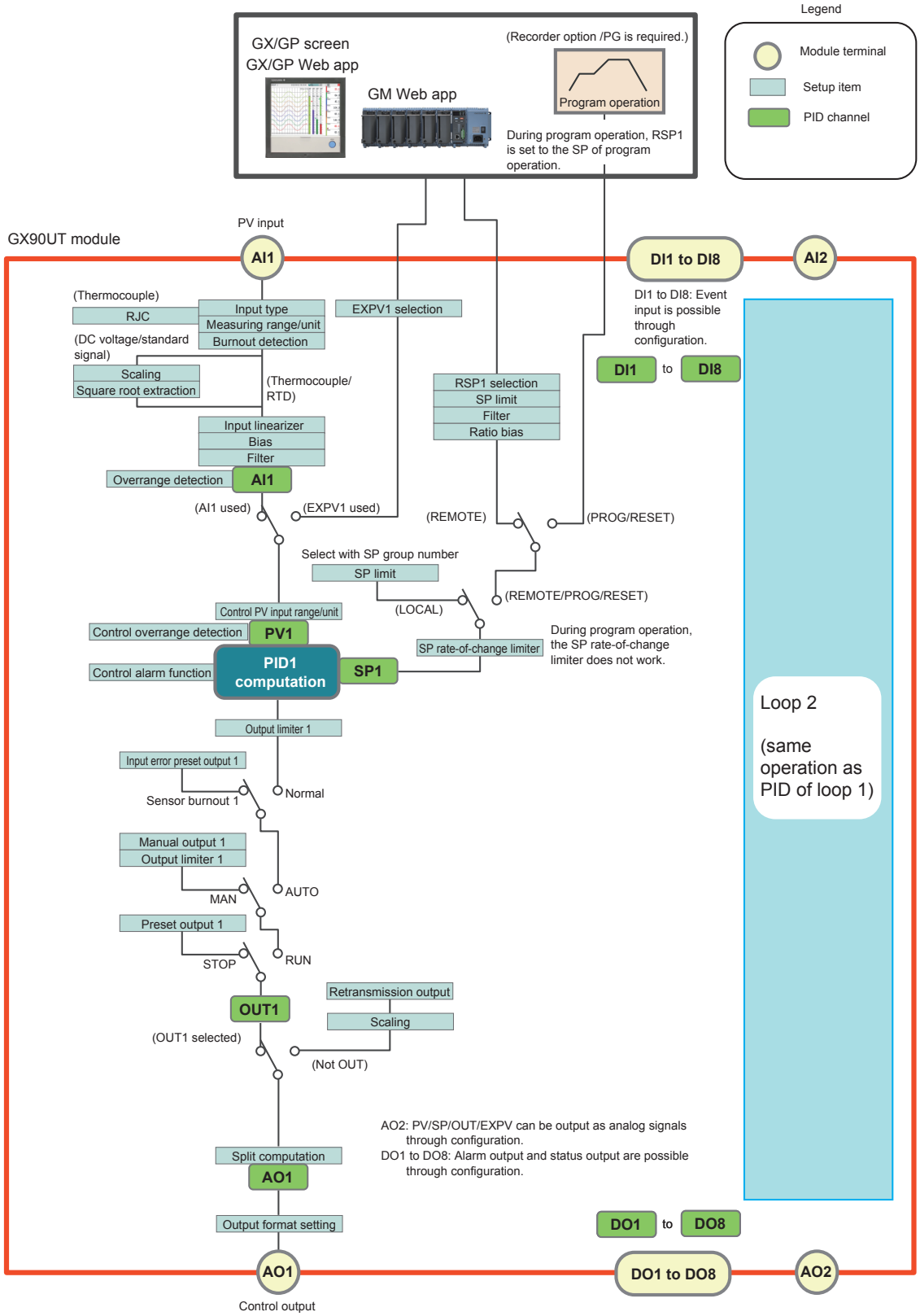


4. Enter the local SP from the keyboard or change the value using the up and down arrow buttons. Then, click **Send**.
5. Click **Close** .

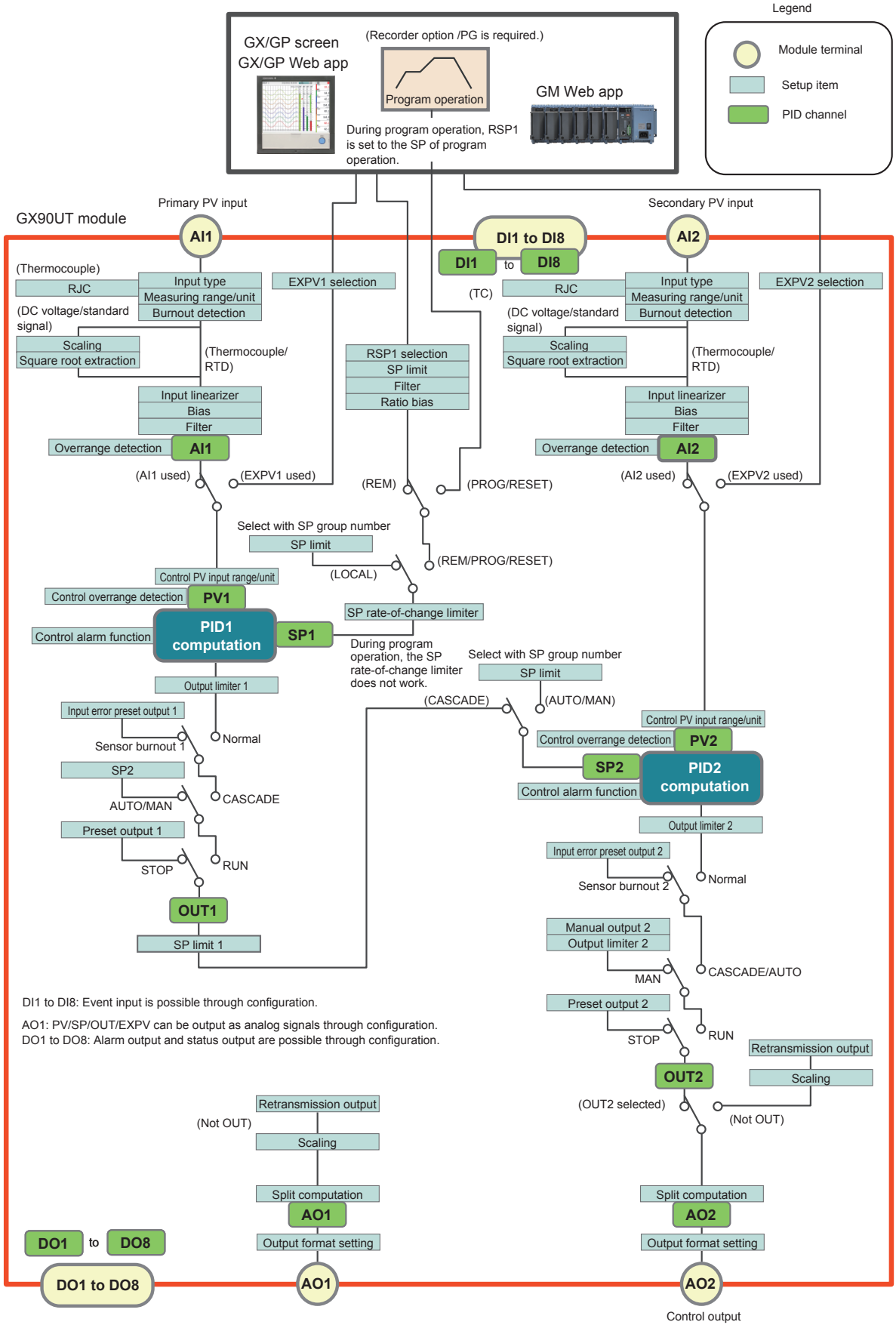
Operation complete

Appendix 1 Block Diagram

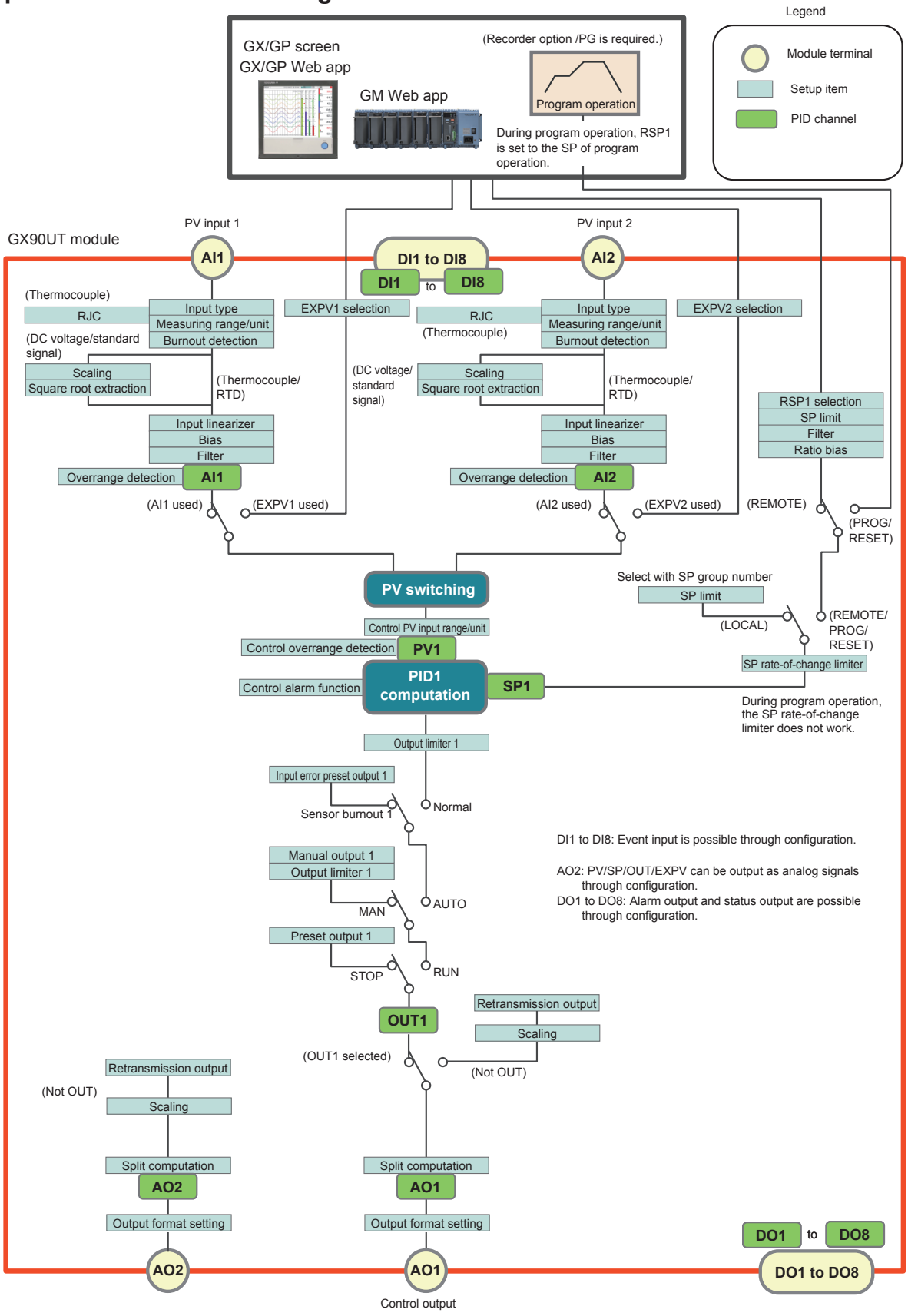
Single loop control



Cascade Control



Loop Control with PV Switching



Appendix 2 Program Pattern Setting Table

This is a worksheet for the main setup items. Please use it to create programs.

Pattern Initial Settings

Program Pattern Settings

Setup item	Setpoint			
Pattern name				
Number of loops used				
Action loop	Loop 1	L _ _ _	Loop 11	L _ _ _
	Loop 2	L _ _ _	Loop 12	L _ _ _
	Loop 3	L _ _ _	Loop 13	L _ _ _
	Loop 4	L _ _ _	Loop 14	L _ _ _
	Loop 5	L _ _ _	Loop 15	L _ _ _
	Loop 6	L _ _ _	Loop 16	L _ _ _
	Loop 7	L _ _ _	Loop 17	L _ _ _
	Loop 8	L _ _ _	Loop 18	L _ _ _
	Loop 9	L _ _ _	Loop 19	L _ _ _
	Loop 10	L _ _ _	Loop 20	L _ _ _

When Program RUN detail settings in Program pattern settings is On, you can set the following items at the start of program operation. Program pattern settings

Setup item	Setpoint
Start-of-program segment number	
Starting time of program operation (hour:minute:second)	: :

Program starting conditions

Program Pattern Settings

Setup item	Setpoint
Start code	
Reference loop number	

* Set the reference loop number when the start code is set to **Ramp-prioritized PV**.

Set the starting target setpoint when the start code in program starting conditions is set to Starting target setpoint.

Starting target setpoint

Setup item	Setpoint
Loop 1	
Loop 2	
Loop 3	
Loop 4	
Loop 5	
Loop 6	
Loop 7	
Loop 8	
Loop 9	
Loop 10	
Loop 11	
Loop 12	
Loop 12	
Loop 13	
Loop 14	
Loop 15	
Loop 16	
Loop 17	
Loop 18	
Loop 19	
Loop 20	

Wait function settings

Wait function (1 to 5) settings: Table for setting 20 loops

Program Pattern Settings

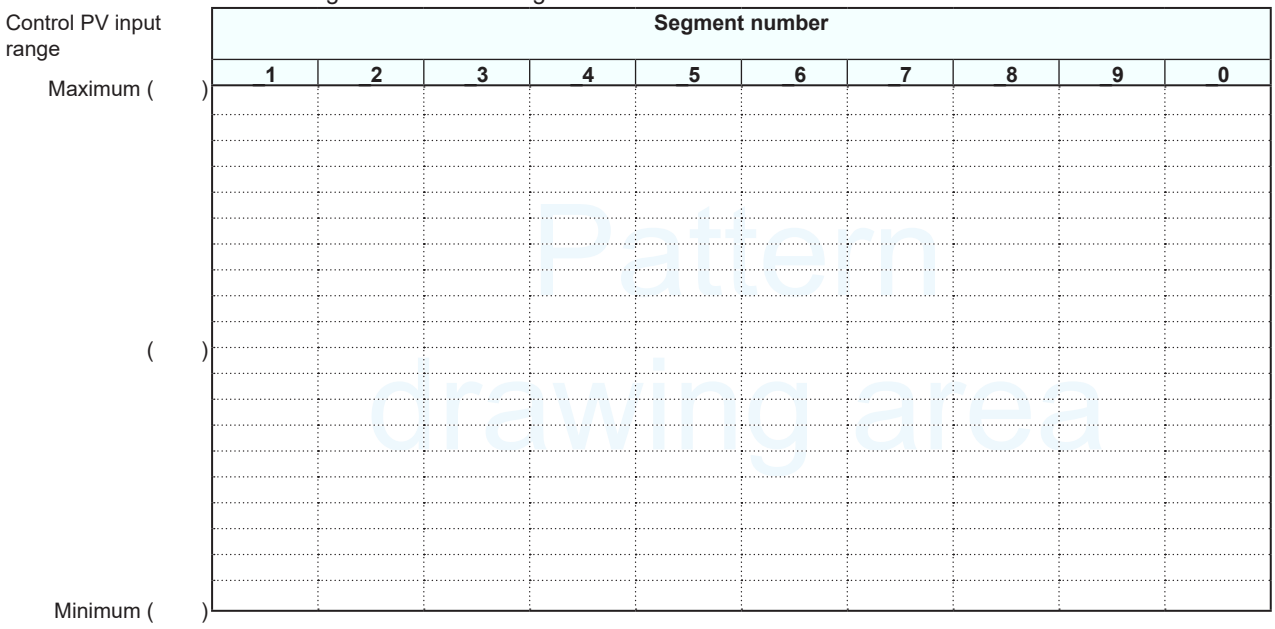
Loop number	Wait zone	Wait zone number				
		1	2	3	4	5
Loop 1	Lower-side					
	Upper-side					
Loop 2	Lower-side					
	Upper-side					
Loop 3	Lower-side					
	Upper-side					
Loop 4	Lower-side					
	Upper-side					
Loop 5	Lower-side					
	Upper-side					
Loop 6	Lower-side					
	Upper-side					
Loop 7	Lower-side					
	Upper-side					
Loop 8	Lower-side					
	Upper-side					
Loop 9	Lower-side					
	Upper-side					
Loop 10	Lower-side					
	Upper-side					
Loop 11	Lower-side					
	Upper-side					
Loop 12	Lower-side					
	Upper-side					
Loop 13	Lower-side					
	Upper-side					
Loop 14	Lower-side					
	Upper-side					
Loop 15	Lower-side					
	Upper-side					
Loop 16	Lower-side					
	Upper-side					
Loop 17	Lower-side					
	Upper-side					
Loop 18	Lower-side					
	Upper-side					
Loop 19	Lower-side					
	Upper-side					
Loop 20	Lower-side					
	Upper-side					

	Wait zone number				
	1	2	3	4	5
Wait time (hour:minute:second)	: :	: :	: :	: :	: :

Program Pattern Settings

Segment settings (segment _1 to _0): Table for setting 10 segments

Program Pattern Settings



Loop 1	TSP										
Loop 2	TSP										
Loop 3	TSP										
Loop 4	TSP										
Loop 5	TSP										
Loop 6	TSP										
Loop 7	TSP										
Loop 8	TSP										
Loop 9	TSP										
Loop 10	TSP										
Loop 11	TSP										
Loop 12	TSP										
Loop 13	TSP										
Loop 14	TSP										
Loop 15	TSP										
Loop 16	TSP										
Loop 17	TSP										
Loop 18	TSP										
Loop 19	TSP										
Loop 20	TSP										
Common	TIME	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	PID No.										
	JC										

TSP: Target setpoint
TIME: Segment time
PID No.: Segment PID number selection (when not zone PID selection or external selection)
JC: Junction code

PID number/Reference point

Reference point, hysteresis, and reference deviation: Table for setting 20 loops

Control settings

When the PID selection is Zone PID selection, set the reference point, hysteresis, or reference deviation.

Setup item	Loop (loop number)									
	1	2	3	4	5	6	7	8	9	10
	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)
Point 1										
Point 2										
Point 3										
Point 4										
Point 5										
Point 6										
Point 7										
Zone PID switching hysteresis										
Reference deviation										

Setup item	Loop (loop number)									
	11	12	13	14	15	16	17	18	19	20
	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)	(L _ _ _)
Point 1										
Point 2										
Point 3										
Point 4										
Point 5										
Point 6										
Point 7										
Zone PID switching hysteresis										
Reference deviation										

Time Event settings

Time event (1 to 16) settings (segment _1 to _0): Table for setting 10 segments

Program Pattern Settings

		Segment									
		_1	_2	_3	_4	_5	_6	_7	_8	_9	_0
Time event 1	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 2	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 3	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 4	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 5	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 6	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 7	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 8	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 9	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 10	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 11	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 12	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 13	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 14	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 15	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 16	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :

Time event (17 to 32) settings (segment _1 to _0): Table for setting 10 segments

Program Pattern Settings

		Segment									
		_1	_2	_3	_4	_5	_6	_7	_8	_9	_0
Time event 17	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 18	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 19	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 20	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 21	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 22	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 23	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 24	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 25	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 26	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 27	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 28	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 29	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 30	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 31	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
Time event 32	Start Condition										
	On time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :
	Off time	: :	: :	: :	: :	: :	: :	: :	: :	: :	: :

PV Event settings

PV event (1 to 16) settings (segment _1 to _0): Table for setting 10 segments

Program Pattern Settings

		Segment									
		_1	**_2**	**_3**	**_4**	**_5**	**_6**	**_7**	**_8**	**_9**	**_0**
PV event 1	Loop number										
	Type										
	Setpoint										
PV event 2	Loop number										
	Type										
	Setpoint										
PV event 3	Loop number										
	Type										
	Setpoint										
PV event 4	Loop number										
	Type										
	Setpoint										
PV event 5	Loop number										
	Type										
	Setpoint										
PV event 6	Loop number										
	Type										
	Setpoint										
PV event 7	Loop number										
	Type										
	Setpoint										
PV event 8	Loop number										
	Type										
	Setpoint										
PV event 9	Loop number										
	Type										
	Setpoint										
PV event 10	Loop number										
	Type										
	Setpoint										
PV event 11	Loop number										
	Type										
	Setpoint										
PV event 12	Loop number										
	Type										
	Setpoint										
PV event 13	Loop number										
	Type										
	Setpoint										
PV event 14	Loop number										
	Type										
	Setpoint										
PV event 15	Loop number										
	Type										
	Setpoint										
PV event 16	Loop number										
	Type										
	Setpoint										

PV event (17 to 32) settings (segment _1 to _0): Table for setting 10 segments

Program Pattern Settings

		Segment									
		_1	_2	_3	_4	_5	_6	_7	_8	_9	_0
PV event 17	Loop number										
	Type										
	Setpoint										
PV event 18	Loop number										
	Type										
	Setpoint										
PV event 19	Loop number										
	Type										
	Setpoint										
PV event 20	Loop number										
	Type										
	Setpoint										
PV event 21	Loop number										
	Type										
	Setpoint										
PV event 22	Loop number										
	Type										
	Setpoint										
PV event 23	Loop number										
	Type										
	Setpoint										
PV event 24	Loop number										
	Type										
	Setpoint										
PV event 25	Loop number										
	Type										
	Setpoint										
PV event 26	Loop number										
	Type										
	Setpoint										
PV event 27	Loop number										
	Type										
	Setpoint										
PV event 28	Loop number										
	Type										
	Setpoint										
PV event 29	Loop number										
	Type										
	Setpoint										
PV event 30	Loop number										
	Type										
	Setpoint										
PV event 31	Loop number										
	Type										
	Setpoint										
PV event 32	Loop number										
	Type										
	Setpoint										

Repeat function settings

Program Pattern Settings

Setup item	Setpoint
Repeat function	
Number of repeat cycles	
Repeat cycle start segment number	
Repeat cycle end segment number	

Appendix 3 Terminology

This section explains the terminology used in this manual.

Term	Explanation
15 V DC loop power supply	A function that supplies15 V DC power to a 2-wire transmitter.
Advance	The act of moving from the current segment to the next segment during program control.
Alarm level	The alarm status.
Alarm level status	The output status assigned to the alarm level.
Alarm mode	A mode in which alarm output action is set according to the operating status.
Anti-reset windup	Where there is a large deviation at the start of the control operation, for example, integral outputs are accumulated and the PV exceeds the SP, thereby causing the output to overshoot. To avoid this, the controller provides an anti-reset windup function for suppressing an extreme integral output by stopping PID computations. Same applies to the case of undershoot. This function is running all the time.
Auto-tuning	A function that automatically calculates the PID settings. It temporarily executes ON/OFF control, calculates appropriate PIDs from response data obtained, and sets them. This method is referred to as the limit cycle method.
Bias function	A function that adds a bias to the PV input and uses the result in the display and control. This function is used to finely adjust the values when the values are within the accepted accuracy range but deviate from those of other devices.
Burnout	A condition in which a break in the input signal is detected.
Carbon potential (CP)	A term indicating the carburizing potential of atmosphere for heating steel.
Cascade control	When cascade control is used in a feedback control system, the target setpoint of the secondary PID is varied according to the output signal of the primary PID measuring the control target. This is used when the dead time between changes in the control output to PV input is large. Cascade control has two control computation units and provides a control function that executes cascade control from a single PID Control Module.
Cascade mode	A mode in which cascade control is being used.
Continuous PID control	A function that outputs the PID computation result using a current (analog signal) proportional to the PID computation value.
Control mode	Control modes define the controls that a single PID Control Module can execute. Single loop control, cascade control, and loop control with PV switching are available.
Control output	The act of outputting the control computation result with a current or voltage pulse.
Control period	The cycle time from when a PV is received and control computation is performed to when output is delivered based on the results. This is a common setting for the system and can be set to 100 ms or 200 ms. The sampling interval (scan interval) of the analog input terminals is synchronized to the control period.
Control type	PID control or ON/OFF control.
Correction Factor	A function used to set a compensation value on the device side and a compensation value on the sensor side and manage them. Recorder option /AH is required.
Cycle time	Cycle time is the basic cycle period for the voltage pulse output to repeat on and off during time proportional PID control.
Delay timer	There are two delay timers: on-delay timer and off-delay timer. On-delay timer starts a timer when an alarm condition occurs and turns on the alarm when the timer expires. Off-delay timer starts a timer when the alarm condition clears (returns to normal condition) and turns off the alarm when the timer expires.
Derivative action	An action that changes the output in proportion to the deviation derivative value (rate-of-change). The derivative time is defined as the time required with PD action to develop, when a constant-slope change in deviation is imposed, an output change due to derivative action that is exactly equal to the change due to proportional action.
Deviation	Deviation = SP – PV

Deviation derivative type PID	Because derivative actions work on the changes in the control deviation (difference between the PV and SP, quick response is exhibited to changes in the target setpoint. This method is useful when SP trackability is important.
Direct action	When the SP is less the PV, the system operates to increase the OUT value (control output). The reverse of this action is reverse action.
External input	In place of the analog input of the PID control module itself, an external input channel (input, math, communication) is used for the PV input.
Filter function	A filter is applied if the PV input reading fluctuates greatly and the lower digits are difficult to read. The filter provides a first-order lag calculation.
Final target setpoint	During program control, this is the target setpoint of each segment.
Fixed-point control	A control in which the target setpoint (SP) is constant.
Fixed-point control mode	A mode that is used when you do not want to disturb the PV as a result of the control output (OUT) reacting too sensitively when the target setpoint (SP) is changed during continuous fixed-point control. In local mode, the output value (OUT) does not change drastically when the target setpoint (SP) is changed. The deviation is gradually removed using only the integral term (I) in response to the deviation that occurs. This is useful for fast-responding processes such as flow-rate control and pressure control.
Hold	The act of holding the progress of a pattern during program control.
Hysteresis	There are two types of hysteresis: control hysteresis and alarm hysteresis. Control hysteresis defines the value for turning the output on and off according to the SP during ON/OFF control. Alarm hysteresis defines the alarm's dead band. Increasing the band reduces chattering.
Input error preset output	A function that selects between 0% control output, 100% control output, or preset output when an input error occurs.
Integral action	The integral action (I action) is a function that will automatically diminish the offset (steady-state deviation) that is inherently unavoidable with proportional action alone.
Linearizer approximation	Linearizer approximation is used when the input signal and the required measurement signal have a non-linear relationship, for example, when trying to obtain the volume from a sphere tank level. Output values for 12 input values can be assigned.
Linearizer bias	Linearizer bias is used to correct an input signal affected by sensor deterioration. Compensation values are set to results obtained by adding a bias to each of the 12 input values.
Local mode	The local mode function stops program operation and performs fixed-point control.
Loop control	Loop control has a temperature indicator section and a target setpoint section. Control signals are generated based on the difference between the indication (temperature measurement) and setpoint and works to bring the temperature to the setpoint.
Loop control with PV switching	A function that switches between two PV inputs according to measurement ranges or the like and uses the result as the PV.
Loop number	A number, which starts with the letter L, assigned to a loop. It is defined by the unit number, slot number, and loop number. Example: GX20 main unit slot 1 loop 2 Loop number: L012
Measurement input range	A range of measurable input values.
ON/OFF control	ON/OFF control compares the SP and PV and outputs an on or off signal according to the positive or negative deviation (PV – SP).
Output limiter	A function that limits the control output to the operation range between high and low limits.
Output velocity limiter	Output velocity limiter prevents the control output signal from changing suddenly in order to protect the control valves (or other actuators) and controlled process.
Over-integration suppressing function	See "anti-reset windup."
Overshoot suppressing function "Super"	A function that controls the PV from overshooting or undershooting the target setpoint.
PID channel	PID channels are used to display control data and I/O data of PID control modules on trend or digital displays and save the data as recorded data. There are 26 PID channels for each module.
PID control	A control in which the PV is converged to the SP by combining proportional control, integral control, and derivative control.

PID control mode	There are two PID control modes: standard PID control mode and fixed-point control mode. See “standard PID control mode” and “fixed-point control mode.” The optimal control algorithm is automatically selected according to the operation mode status to control the system.
Preset output	A function that outputs a constant value (preset output value) , separate from the control output value up to that point, when the operation mode is changed to STOP or RESET.
Program control	A function that can be used to change the SP over time according to a preset program pattern.
Program operation	The program operation can be used to change the SP over time according to a preset program pattern. A program pattern consists of several segments.
Program pattern	A program pattern consists of several segments. You can create a program pattern by setting the final target setpoint of each segment, segment time, PV events, time events, and so on.
Proportional action	The proportional band (P) is defined as the amount of change in input (or deviation), as a percentage of span, required to cause the control output to change from 0% to 100%.
PV derivative type PID	Control method in which stable control output is possible because derivative actions work only on the PV. Even when the SP is changed significantly, the control output does not change drastically, and the deviation is gradually eliminated.
PV event	The PV event function outputs preset PV alarms, deviation alarms, and the like according to the program progression.
PV input	Input such as temperature, flow rate, and pressure from the control target.
PV tracking	PV tracking function is used to prevent abrupt PV changes. This function forces the SP to match the PV temporarily. Then, the SP is returned automatically to its original SP at the SP ramp rate.
Ramp-prioritized PV start	During program control, control starts by prioritizing the ramp-rate of the first segment.
Ratio bias	Ratio bias computing performs ratio computation and bias addition for remote input.
Reference deviation	A function for switching the PID group according to the deviation.
Reference Junction Compensation (RJC)	The temperature of a measurement target can be determined by measuring the temperature of the terminal section (reference contact) of the measuring instrument that a thermocouple is connected to and compensating the calculation based on the measurement results. This act is referred to as reference junction compensation (RJC).
Reference point	The point for switching the PID when zone PID is in use. Up to eight points can be set.
Remote input	An external input used as remote setpoints.
Remote mode	A mode in which external input is used for the target setpoint.
Repeat function	The repeat function repeatedly runs a given segment (consecutive multiple segments also possible) in a program pattern.
Reset mode	A state in which program operation is stopped.
Resistance-temperature detector (RTD)	An RTD is a temperature sensor that makes use of a property of metal that exhibits increasing electric resistance with increases in temperature.
Restart mode	A function for selecting how to control the system after a power recovery. Available options are continue the operation before the power failed, auto, manual, and reset.
Retransmission output	Retransmission output transmits PV, SP, control output (OUT), and the like using analog signals to recorders and the like.
Reverse action	When the SP is greater than the PV, the system operates to increase the OUT value (control output). The reverse of this action is direct action.
Segment	An element that comprise a program pattern. Up to 99 segments can be created in a pattern.
Single loop control	A basic control function with two control computation units.
Soak state	A state in which the SP in a program pattern is constant.
SP limiter function	A function that limits the SP setting range (high and low limits).
SP ramp-rate setting function	SP ramp-rate setting function forces SP to change at a fixed rate when SP is changed in order to prevent abrupt changes in SP.

Split computation output	Split computation output is useful for the case where multiple operating units (up to two) for switching, for example, hot and cool water are linked for control. There are two characteristics of split computations: V-mode characteristics and Parallel-mode characteristics.
Standard PID control mode	A mode in which PV derivative type PID is employed to quickly reach the new target setpoint when the target setpoint is changed. In PV derivative type PID, output P, which is proportional to the deviation caused by a target setpoint (SP) change, is immediately output in order to quickly reach the new target setpoint. This is useful for controlling temperature and other slow-responding parameters.
Standby action	Standby action disables alarms until the first time the alarm condition ceases. When a value enters an area in which alarms do not occur, the stand-by action is reset.
Starting target setpoint	During program control, control starts from the specified starting target setpoint regardless of the starting PV input.
Super function	The Super function monitors the deviation for evidence that there is a danger of overshoot, and on sensing such danger automatically changes the setpoint temporarily to a somewhat lower value (sub-SP). Once the danger of overshoot appears diminished, the function returns the effective SP gradually to the true SP. “Fuzzy ratiocination” techniques are employed in the algorithms used to change the SP to the lower temporary value, and to return it gradually to the true SP.
Target setpoint	The target setpoint of the control target. There are two types of target setpoints used in control computation: local target setpoint, which is set to the specified value, and remote target setpoint, which is varied continuously according to inputs received through the I/O channels or math channels.
Target setpoint (SP) tracking	The setpoint at the start of program control.
Target setpoint number	SP group refers to a collection of SPs, PID groups, and alarm values. There are multiple SP groups numbered from 1 to 8. Target setpoint number refers to this number.
Thermocouple	A thermocouple is a temperature sensor made of two different types of metals that forms a closed circuit causing a current to flow when a temperature difference is detected.
Tight shut function	Tight shut function fully closes the control valve (or other actuators) beyond its positioner dead band.
Time event	The time event function starts a timer at the start of the segment and turns on the contact output when the specified time expires.
Time proportional PID control	In time proportional PID control, the control output value of the PID computation result is converted into a ratio of the cycle on/off time. At 100% output, the output is always on. At 0% output, the output is always off. At 25% output, the output is on 25% of the cycle time and off 75% of the cycle time.
Time-prioritized PV start	During program control, control starts from the starting PV regardless of the starting SP.
Universal input	A function that allows the PV type to be set to thermocouple, RTD, or DC voltage/current through configuration.
Universal output	A function that allows current/voltage pulse control output to be selected through configuration.
Wait Function	The wait function pauses the progression of a program when the PV cannot follow the SP.
Wait function (segment switch wait)	During program control, this wait function forces the program to wait when the PV has not reached the target setpoint (TSP) before advancing to the next segment. If the PV reaches the wait zone before the wait time expires, the program advancing to the next segment at that point. If not, the program advancing to the next segment when the wait time expires.
Wait function (Wait within segment interval)	During program control, this wait function forces the program to wait when the PV tracking is slow and the deviation from the SP becomes large.
Zone PID	A function for switching between PID parameter groups according to the PV or SP. This function is useful for reactors in which the chemical reaction gain changes depending on the temperature.

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