

# Zelio Control

## REG48/96 Temperature Controller User Guide

09/2012

EIO0000001299.00

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When devices are used for applications with technical safety requirements, the relevant instructions must be followed.

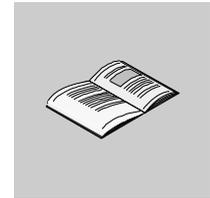
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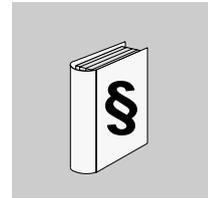
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## Safety Information



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### Important Information

#### NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.



The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

### **DANGER**

**DANGER** indicates an imminently hazardous situation which, if not avoided, **will result in death or serious injury.**

### **WARNING**

**WARNING** indicates a potentially hazardous situation which, if not avoided, **can result in death or serious injury.**

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 **CAUTION**

**CAUTION** indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

***NOTICE***

***NOTICE*** is used to address practices not related to physical injury.

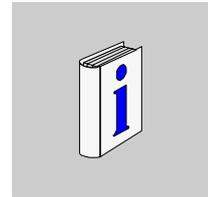
**PLEASE NOTE**

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

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## About the Book



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### At a Glance

#### Document Scope

This manual will acquaint you with the Temperature Controllers (REG48 and REG96) tell you how to install them, describe changes you may make in configuration, review the operation.

The Temperature Controllers are Single loop controller controlled devices performing the following enhanced functions:

- PID
- Auto-tuning
- Fuzzy logic
- Alarms
- Ramps

There are 3 versions of Temperature Controllers, with different sizes and characteristics.

The product references in accordance with the sizes are:

- REG24P•••••: 24x48 mm (0.94x1.89 in.) (Refer to Zelio Control, REG24 Temperature Controller User Guide (*see page 8*))
- REG48P•••••: 48x48 mm (1.89x1.89 in.)
- REG96P•••••: 48x96 mm (1.89x3.78 in.)

Solution approach used:

- Controllers
- Sensors
- Solid state and electromechanical relays

#### Validity Note

This document is valid for the Temperature Controllers REG48 and REG96

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## Related Documents

Title of Documentation	Reference Number
TSX CUSB485 USB to RS485 converter Quick Reference Guide	35013735
Zelio Control, REG24 Temperature Controller User Guide	EIO0000001300 (Eng), EIO0000001303 (Fre), EIO0000001306(Ger), EIO0000001332 (Ita), EIO0000001335 (Spa), EIO0000001338 (Chs)
Zelio Control, REG Communication and ZelioControl Soft Installation User Guide	EIO0000001301 (Eng), EIO0000001304 (Fre), EIO0000001307 (Ger), EIO0000001333 (Ita), EIO0000001336 (Spa), EIO0000001339 (Chs)

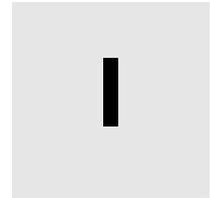
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## User Comments

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# REG48/REG96 Temperature Controller



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# Introduction



# 1

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## What Is in This Chapter?

This chapter contains the following topics:

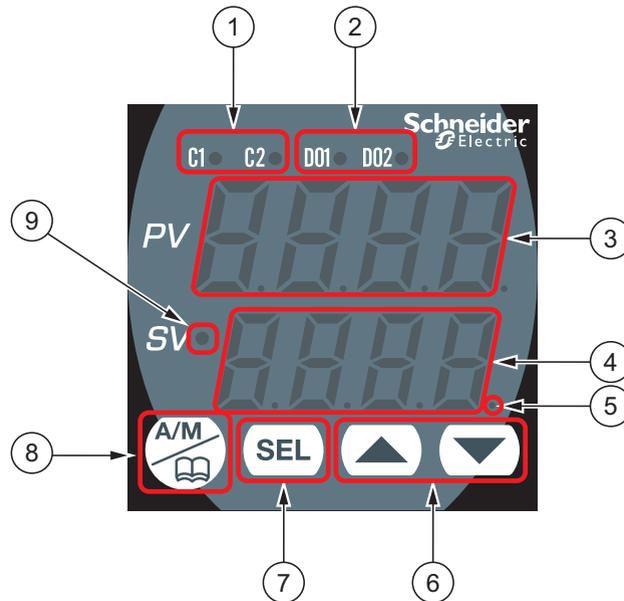
Topic	Page
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## Display and Controller References of REG48

### Overview

The REG48 is the medium Temperature Controller (48 x 48 mm (1.89 x 1.89 in.)). It can be used in Stand alone installation for simple machine or more complex system in association with PLC (Programmable Logic Controller), HMI (Human Machine Interface) through communication Modbus (RS485).

The front panel has the Process Value (PV) and Setpoint value (SV) displays, the status indicating lamp, and the setting keys.



Item	Name	Function
1	Control output (C1, C2) lamp	Lights on at 100% output and goes off at 0% output. For values between 0% and 100%, the output is indicated by the length of time the lamp flickers.
2	Digital Output (D01/2) lamp	Lights on when there is digital output (D0) from D01 or D02. The lamp blinks when delay action is on.
3	PV Display	<ul style="list-style-type: none"> <li>Displays the measuring Process Values</li> <li>Displays the name of the parameters when setting parameters.</li> </ul>

Item	Name	Function
4	SV Display	<ul style="list-style-type: none"> <li>• Displays the Setpoint Values</li> <li>• Displays the output value during manual mode.</li> <li>• Displays current parameters setting value when changing parameter settings.</li> <li>• Displays <math>50FF</math> during soft start.</li> </ul>
5	MAN/AT/SELF lamp	<ul style="list-style-type: none"> <li>• Stays lit during manual mode.</li> <li>• Blinks during auto-tuning and self-tuning.</li> </ul>
6	Down key / Up key	<ul style="list-style-type: none"> <li>• Pressing once will decrease/increase the SV by one.</li> <li>• Holding down the button will continue to decrease/increase the value.</li> <li>• Changes SV on the PV/SV display.</li> <li>• Move between items in channel screen display and parameter screen display.</li> </ul>
7	Select (SEL) key	<ul style="list-style-type: none"> <li>• Switches the PV display to/from the SV display</li> <li>• After switching to parameter mode, this key functions as the select key when changing parameters.</li> <li>• Holding down in channel display or parameter display returns you to the PV/SV display.</li> <li>• Pressing this key in PV/SV display shows the manual output value at the bottom of the screen.</li> </ul>
8	USER (A/M) key	<ul style="list-style-type: none"> <li>• Pressing in monitor mode display or setup mode display returns you to the PV/SV display.</li> <li>• Pressing on the PV/SV display allows you to set the function for <math>UEEY</math> under the system menu <math>545 [k]7</math>.</li> </ul>
9	Setpoint value (SV) lamp	<ul style="list-style-type: none"> <li>• Illuminates when displaying the SV value. Does not illuminate in manual mode.</li> <li>• Blinks while performing ramp/soak or lamp SV operations.</li> </ul>

## Controller References and Characteristics

The following table shows the controller references with the characteristics of each:

Part Number	Power supply	Input	Output 1	Output 2	Modbus	Alarm
REG48PUN1RHU	100...240 Vac	Universal	Relay	-	X	2
REG48PUNL1RHU			Relay	-	-	2
REG48PUN1LHU			SSR	-	X	2
REG48PUNL1LHU			SSR	-	-	2
REG48PUN1JHU			4-20mA	-	X	2
REG48PUN2RHU			Relay	Relay	X	2
REG48PUN2LRHU			SSR	Relay	X	2
REG48PUN2LJHU			SSR	4-20mA	X	2
REG48PUN1RLU	24 Vdc	Universal	Relay	-	X	2
REG48PUN1LLU			SSR	-	X	2
REG48PUN1JLU			4-20mA	-	X	2
REG48PUN2RLU			Relay	Relay	X	2
REG48PUN2LRLU			SSR	Relay	X	2
REG48PUN2LJLU			SSR	4-20mA	X	2
REG48PCOV	Terminal block cover					

## Modbus Communication Accessories

The following table shows the accessories for modbus communication:

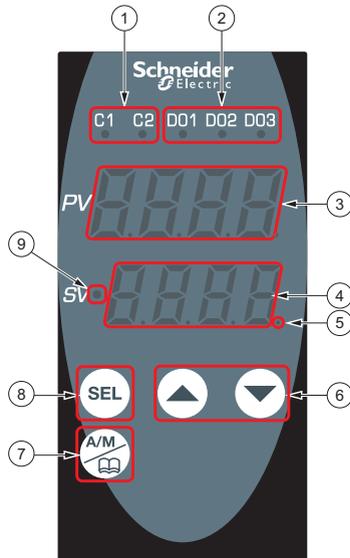
Part Number	Description
TSXCUSB485 or VW3A8118	USB to RS485 converter
TWDXCAFJ010	1 x RJ45 connector and 1 end with flying leads
PC software	ZelioControl Soft V1.6 ZelioControl Soft V2.1 (new version)
TWDXCAISO	Isolated RS485 T-junction box
TWDXCAT3RJ	T-junction box
LU9GC3	Modbus splitter box

## Display and Controller References of REG96

### Overview

The REG96 is the largest Temperature Controller (96x48 mm (3.78 x 1.89 in.)). It can be used in Stand alone installation for simple machine, or more complex in association with PLC (Programmable Logic Controller), HMI (Human Machine Interface) through communication Modbus (RS485).

The front panel has the Process Value (PV) and Setpoint value (SV) displays, the status indicating lamp, and the setting keys.



Item	Name	Function
1	Control output (C1, C2) lamp	Lights on at 100% output and goes off at 0% output. For values between 0% and 100%, the output is indicated by the length of time the lamp flickers.
2	Digital Output (DO1/2/3) lamp	Lights on when there is digital output (Do) from D01, DO2 or DO3. The lamp blinks when delay action is on.
3	PV Display	<ul style="list-style-type: none"> <li>Displays the measuring Process Values.</li> <li>Displays the name of the parameters when setting parameters.</li> </ul>

Item	Name	Function
4	SV Display	<ul style="list-style-type: none"> <li>● Displays the Setpoint Values.</li> <li>● Displays the output value during manual mode.</li> <li>● Displays current parameters setting value when changing parameter settings.</li> <li>● Displays <math>\zeta_{OFF}</math> during soft start.</li> </ul>
5	MAN/AT/SELF lamp	<ul style="list-style-type: none"> <li>● Stays lit during manual mode.</li> <li>● Blinks during auto-tuning and self-tuning.</li> </ul>
6	Down key / Up key	<ul style="list-style-type: none"> <li>● Pressing once will decrease/increase the Setpoint value by one.</li> <li>● Holding down the button will continue to decrease/increase the value.</li> <li>● Changes SV on the PV/SV display.</li> <li>● Move between items in channel screen display and parameter screen display.</li> </ul>
7	USER (A/M) key	<ul style="list-style-type: none"> <li>● Pressing in monitor mode display or setup mode display returns you to the PV/SV display.</li> <li>● Pressing on the PV/SV display allows you to set the function for <i>UTLY</i> under the system menu <math>\zeta_{CH7}</math>.</li> </ul>
8	Select (SEL) key	<ul style="list-style-type: none"> <li>● Switches the PV display to/from the SV display</li> <li>● After switching to parameter mode, this key functions as the select key when changing parameters.</li> <li>● Holding down in channel display or parameter display returns you to the PV/SV display.</li> <li>● Pressing this key in PV/SV display shows the manual output value at the bottom of the screen.</li> </ul>
9	Setpoint value (SV) lamp	<ul style="list-style-type: none"> <li>● Illuminates when displaying the SV value. Does not illuminate in manual mode.</li> <li>● Blinks while performing ramp/soak or lamp SV operations.</li> </ul>

## Controller References and Characteristics

The following table shows the controller references with the characteristics of each:

Part Number	Power supply	Input	Output 1	Output 2	Modbus	Alarm
REG96PUN1RHU	100...240 Vac	Universal	Relay	-	X	3
REG96PUNL1RHU			Relay	-	-	3
REG96PUN1LHU			SSR	-	X	3
REG96PUNL1LHU			SSR	-	-	3
REG96PUN1JHU			4-20mA	-	X	3
REG96PUN2RHU			Relay	Relay	X	3
REG96PUN2LRHU			SSR	Relay	X	3
REG96PUN2LJHU			SSR	4-20mA	X	3
REG96PUN1RLU			24 Vdc/Vac	Universal	Relay	-
REG96PUN1LLU	SSR	-			X	3
REG96PUN1JLU	4-20mA	-			X	3
REG96PUN2RLU	Relay	Relay			X	3
REG96PUN2LRLU	SSR	Relay			X	3
REG96PUN2LJLU	SSR	4-20mA			X	3
REG96PCOV	Terminal block cover					

## Modbus Communication Accessories

The following table shows the accessories for modbus communication:

Part Number	Description
TSXCUSB485 or VW3A8118	USB to RS485 converter
TWDXCAFJ010	1 x RJ45 connector and 1 end with flying leads
PC software	ZelioControl Soft V1.6 ZelioControl Soft V2.1 (New version)
TWDXCAISO	Isolated RS485 T-junction box
TWDXCAT3RJ	T-junction box
LU9GC3	Modbus splitter box

## Main Characteristics

### Overview

The following table presents the main characteristics of the REG48 and the REG96:

Characteristics	Values
Digits display	4 (10 mm (0.39 in.)), 2 lines (Process Value and Setpoint Value)
Buttons	4 (Up, down, Sel and Auto-Manual)
Front face	IP66 NEMA-4X
Functions	<ul style="list-style-type: none"> <li>● Loop break alarm</li> <li>● Soft start function</li> <li>● 2 alarms for REG48</li> <li>● 3 alarms for REG96</li> </ul>
Ramp	16
Power supply	<ul style="list-style-type: none"> <li>● 100 to 240 Vac</li> <li>● 24 Vac</li> <li>● 24 Vdc</li> </ul>
Input	<ul style="list-style-type: none"> <li>● Thermocouple</li> <li>● PT100</li> <li>● Voltage 1-5Vdc, 0-5Vdc, 0-10Vdc, 2-10Vdc, 0-100mVdc</li> <li>● Current 0-20mA, 4-20mA</li> </ul>
Sampling time	200 ms
Communication	RS485 Modbus (9600 up to 19200 bauds)
Output	<ul style="list-style-type: none"> <li>● 1 or 2 outputs</li> <li>● Electromechanical relay</li> <li>● Solid state relay</li> <li>● Analog output current</li> </ul>
Digital Output (alarm output)	<ul style="list-style-type: none"> <li>● 2 (D01, D02) for REG48</li> <li>● 3 (D01 to D03) alarms for REG96</li> </ul>
Certifications and Declarations	<ul style="list-style-type: none"> <li>● CE mark</li> <li>● UL Recognized</li> <li>● CSA</li> <li>● Gost</li> </ul>
Hazardous Substances	RoHs
EEPROM writing	100 000 maximum operations
Pc software	ZelioControl Soft V1.6 ZelioControl Soft V2.1 (new version)

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# Hardware of REG48/REG96

# 2

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## What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
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Dimensions and Installation of REG48	22
Dimensions and Installation of REG96	27
Wiring of REG48/REG96	32

## Electrical and Environmental Characteristics

### Electrical Characteristics of REG48/REG96

The following table presents the Electrical Characteristics:

Specifications	Values
Power Supply	<ul style="list-style-type: none"> <li>● 100 Vac (-15%) to 240 Vac (+10%).</li> <li>● 24 Vac/Vdc (+10%).</li> <li>● 50/60 Hz</li> </ul>
Power Consumption	12 VA or less
Control Output	Relay contact output: contact 110-220 Vac / 30Vdc, 3A (resistive load)
	SSR/SSC drive output (voltage pulse output) <ul style="list-style-type: none"> <li>● ON: 20 Vdc (18 to 24 Vdc)</li> <li>● OFF: 0.5 Vdc or less</li> <li>● Max Current 20mA DC or less (both OUT1 and OUT2)</li> <li>● Load resistance <math>\geq 850\Omega</math></li> </ul>
	Current Output <ul style="list-style-type: none"> <li>● 0 to 20mA DC / 4 to 20mA DC</li> <li>● Acceptable load resistance 600<math>\Omega</math> or less</li> <li>● Accuracy +/- 5%FS</li> </ul>
Digital Output	Relay contact output 110-220 Vac, 30Vdc/ac, load capacity 3A
Process Value input	Input accuracy <ul style="list-style-type: none"> <li>● Thermocouple input: greatest one among <math>\pm 0.3\%</math>FS, <math>\pm 1</math>digit, and <math>\pm 1^\circ\text{C}</math> or <math>2^\circ\text{C}</math></li> <li>● Resistance bulb input: greatest one among <math>\pm 0.3\%</math>FS, <math>\pm 1</math>digit, and <math>\pm 0.5^\circ\text{C}</math></li> <li>● mV input, voltage input, current input: <math>\pm 0.3\%</math>FS, <math>\pm 1</math>digit, Indication resolution: <math>\pm 0.3\%</math>FS or less</li> </ul>
Communication function (RS485 interface, 9600 and 19200)	<ul style="list-style-type: none"> <li>● Transmission method: Half-duplex bit serial asynchronous cycle.</li> <li>● Transmission rate: 9600 bps, 19200 bps.</li> <li>● Transmission protocol: In conformity to Modbus RTU.</li> <li>● Transmission distance: Max 500 m (Total length).</li> <li>● Connectable units: 31units.</li> </ul>

**NOTE:** Connect a 250 $\Omega$  resistor when using current input. Refer to the Wiring topic (*see page 33*) for more information.

**Environmental Characteristics of REG48/REG96**

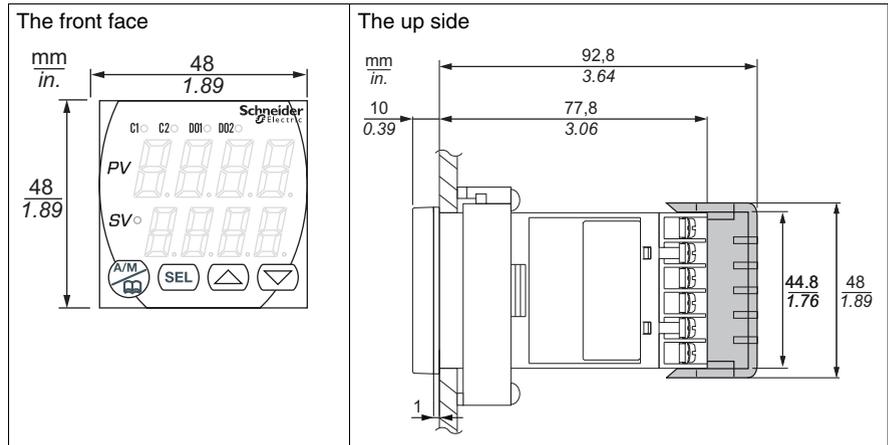
The following table presents the Environmental Characteristics:

<b>Characteristics</b>	<b>Values</b>
Operating ambient temperature	<ul style="list-style-type: none"> <li>● -10 °C...50 °C (14 °F...122 °F)</li> <li>● -10 °C...45 °C(14 °F...112 °F):formounting close together.</li> </ul>
Operating ambient humidity	≤90 % RH - no condensation
Storage temperature	-20 °C...60 °C (-4 °F...140 °F).
Installation category	II (conforming to IEC1010-1).
Pollution degree	2 (conforming to IEC1010-1).
Conforming to standard	EMC EN 61326-1 LVD EN 61010-1

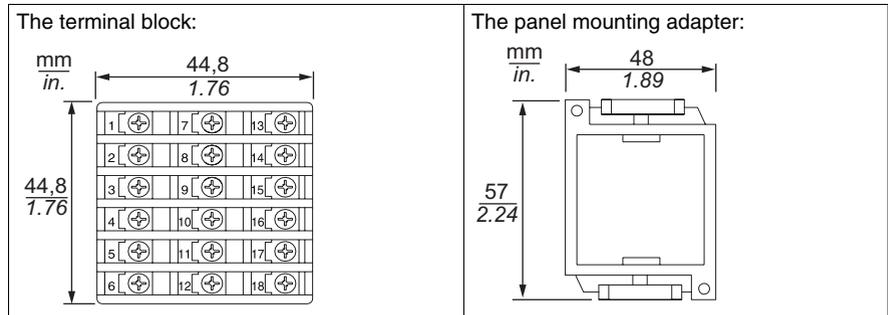
## Dimensions and Installation of REG48

### Dimensions of Controller

The following figure shows the external dimensions of:



The following figure shows the external dimensions of:



## Installation Precautions

### **WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

Do not install the controller where:

- Ambient temperature is outside the range of -10 °C...50 °C (14 °F...122 °F) while in operation.
- Ambient humidity is more than 90 % RH while in operation.
- Condensation can occur.
- Corrosive or combustible gases are present.
- There is vibration or shock higher than the specified value.
- Exposure to water oil, chemicals, steam or vapor.
- Exposure to dust, salty air, or air containing high concentrations of metal particles.
- Subject to electromagnetic interference from static electricity, magnetism, and external electromagnetic interference sources.
- Exposure to direct sunshine.
- Heat accumulation due to solar radiation.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## ⚠ WARNING

### UNINTENDED EQUIPMENT OPERATION

Do not allow the openings around the controller to be blocked, heat dissipation ability will be reduced.

Do not allow the ventilation openings on top of the terminal block to be blocked.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## NOTICE

### UNINTENDED EQUIPMENT OPERATION

To ensure protection against dust and water (IP66):

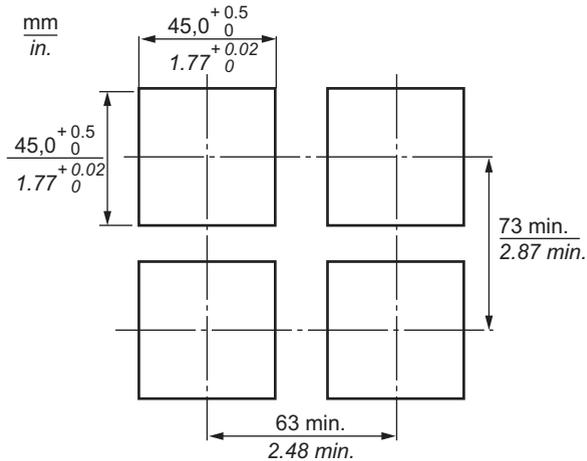
- Use the appropriate panel cut out.
- Use the appropriate gasket and panel mounting adapter provided.
- Assemble the product according to installation guide.

**Failure to follow these instructions can result in equipment damage.**

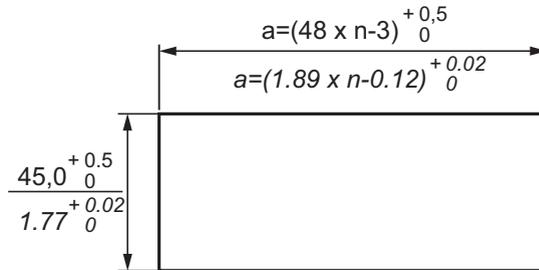
**NOTE:** The front side of this controller conforms to NEMA 4X.

### Panel Cut-out

Panel cut-out dimensions for separate mounting:



Panel cut-out dimensions for mounting close together:



Value of a:

Number of units: n	2	3	4	5	6
a (mm)	93	141	189	237	285
a (in.)	3.66	5.55	7.44	9.33	11.22

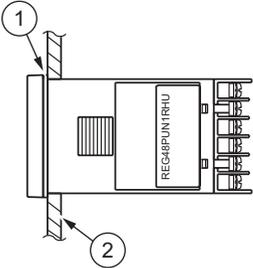
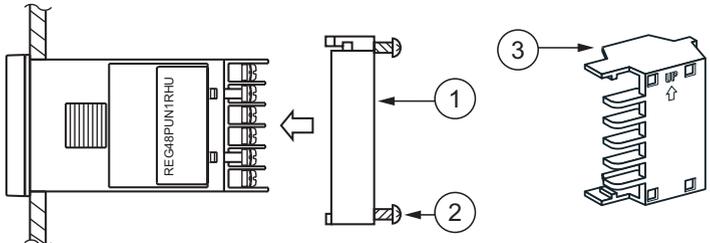
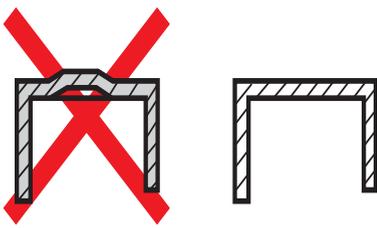
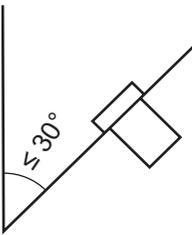
**NOTE:**

- The water resistance feature is unavailable if mounted close together.
- Maximum ambient temperature is 45 °C (113 °F) if mounted close together.

## Installation

Follow the steps given below when installing the Controller:

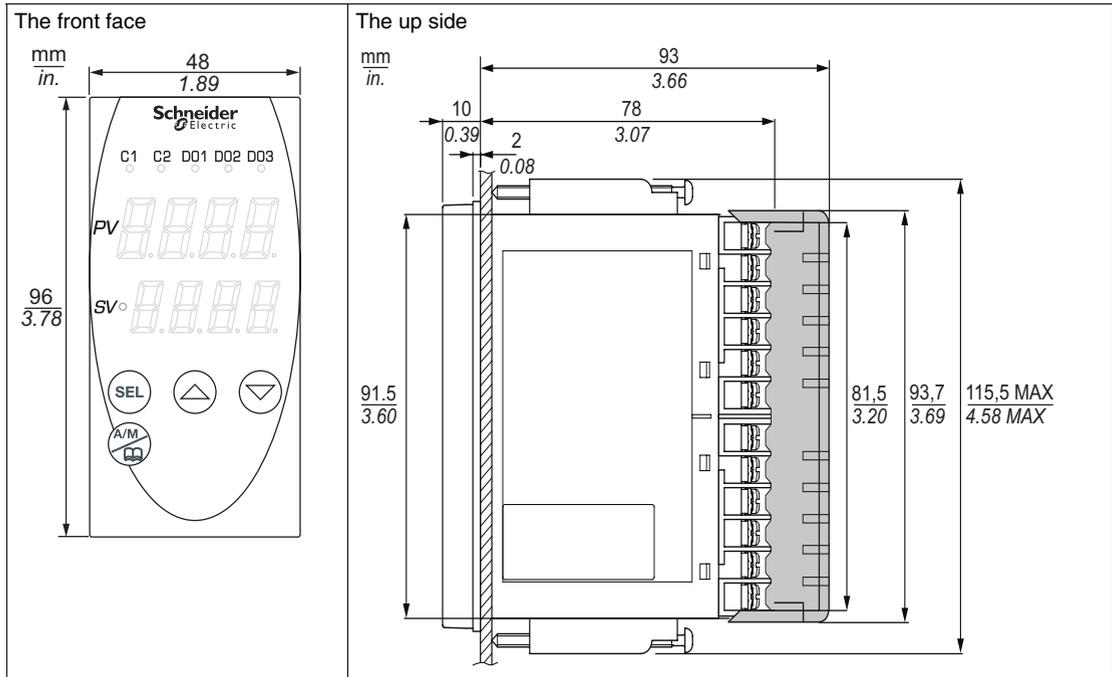
Step	Action
1	<p>Insert the IP66 protection gasket (include inside the packaging)(1) on the controller (3)</p> <p><b>NOTE:</b> (2): Label</p>

Step	Action
2	<p>Insert the controller (1) into the panel Cut-out (2) with the label in right position:</p> 
3	<p>Insert the panel mounting adapter (1) from rear of the controller and tighten the screws (2) to eliminate the gaps between the front of controller, gasket and panels. After wiring install the (3) terminal block cover (sold separately)</p> 
4	<p>If the IP66 protection gasket is deformed like the left diagram, the panel cut out is insufficient:</p> 
5	<p>If you are installing the controller in a slanted panel, make sure that the panel is not tilted more than 30 degrees:</p> 

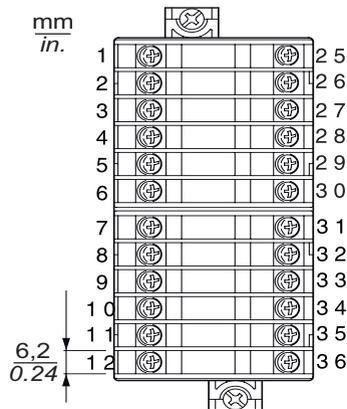
## Dimensions and Installation of REG96

### Dimensions of Controller

The following figure shows the external dimensions of:



The following figure shows the external dimensions of the terminal block:



## Installation Precautions

### **WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

Do not install the controller where:

- Ambient temperature is outside the range of -10 °C...50 °C (14 °F...122 °F) while in operation.
- Ambient humidity more than 90 % RH while in operation.
- Condensation can occur.
- Corrosive or combustible gases are present.
- There is vibration or shock higher than the specified value.
- Exposure to water oil, chemicals, steam or vapor.
- Exposure to dust, salty air, or air containing high concentrations of metal particles.
- Subject to electromagnetic interference from static electricity, magnetism, and external electromagnetic interference sources.
- Exposure to direct sunshine.
- Heat accumulation due to solar radiation.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

### **WARNING**

#### **UNINTENDED EQUIPMENT OPERATION**

Do not allow the openings around the controller to be blocked, or the unit's heat dissipation ability will be reduced.

Do not allow the ventilation openings on top of the terminal block to be blocked.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

## **NOTICE**

### **UNINTENDED EQUIPMENT OPERATION**

To ensure protection against dust and water (IP66):

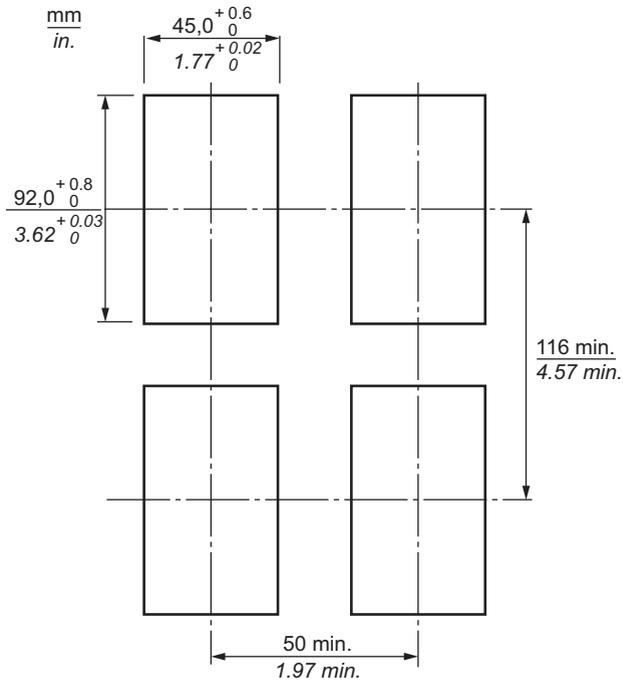
- Use the appropriate panel cut out.
- Use the appropriate gasket and panel mounting adapter provided.
- Assemble the product according to installation guide.

**Failure to follow these instructions can result in equipment damage.**

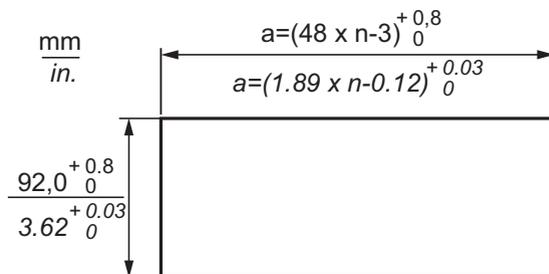
**NOTE:** The front side of this controller conforms to NEMA 4X.

### **Panel Cut-out**

Panel cut-out dimensions for separate mounting:



Panel cut-out dimensions for mounting close together:



Value of a:

Number of units: n	2	3	4	5	6
a (mm)	93	141	189	237	285
a (in.)	3.66	5.55	7.44	9.33	11.22

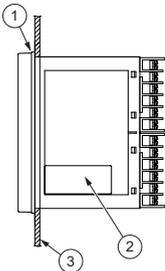
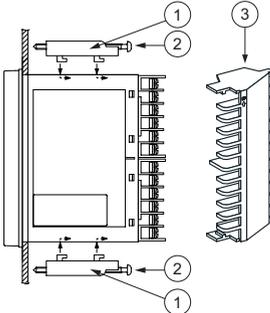
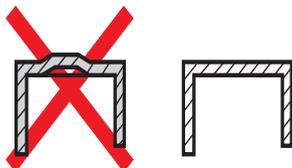
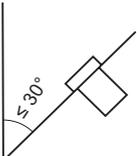
**NOTE:**

- The water resistance feature is unavailable if mounted close together.
- Maximum ambient temperature is 45 °C (113 °F) if mounted close together.

**Installation**

Follow the steps given below when installing the controller:

Step	Action
1	<p>Insert the IP66 protection gasket (include inside the packaging) (1) on the controller (2):</p>

Step	Action
2	<p>Insert the controller (1) into the panel cut-out (3) with the label (2) in right position:</p> 
3	<p>Insert the two installation fasteners (1) from top and bottom of the controller and tighten the screws (2) to eliminate the gap between the front of controller, gasket and panels. After wiring install the (3) terminal block cover (sold separately)</p> 
4	<p>If the IP66 protection gasket is deformed like the left diagram, the panel cut out is insufficient:</p> 
5	<p>If you are installing the Controller in a slanted panel, make sure that the panel is not tilted more than 30 degrees:</p> 

## Wiring of REG48/REG96

### Overview

 <b>DANGER</b>
<b>HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH</b>
<ul style="list-style-type: none"><li>● Remove all power from the Controller.</li><li>● Always use a properly rated voltage sensing device to confirm power is off.</li><li>● Use only the specified voltage when operating the Controller.</li></ul>
<b>Failure to follow these instructions will result in death or serious injury.</b>

### Wiring Installation Instructions

- For the thermocouple sensor type, use thermocouple compensation wires for wiring.
- For the RTD type, use a wiring material with a small lead wire resistance and no resistance differentials among three wires.
- Keep input lines away from power line and load line to avoid the influence from electromagnetic interference induced.
- For the input and output signal lines, be sure to use shielded wires and keep them properly segregated from each other.
- If an electromagnetic interference level is excessive in the power supply, the additional installation of an insulating transformer and the use of an electromagnetic interference filter are recommended.
- Use stranded power supply cable for the instrument.
- For the unit with an alarm against a burn-out in the heater, use the same power line for connection of the power supplies for the heater and the controller.
- A setup time is required for the contact output when the power is turned on. If the contact output is used as a signal for an external interlock circuit, use a delay relay at the same time.
- Use the auxiliary relay since the unit's operational life is shortened if full capacity load is connected to the output relay. Use the SSR/SSC drive output type if the output operations occur frequently.
- If an inductive load such as magnetic switches connected as a relay output load, use a protection module (Free wheel Diode or RC circuit or Varistor).
- Use a non-grounded sensor for resistance bulb or thermocouple of the SSR/SSC-driven output, output of 4 to 20 mA DC.

## ⚠ WARNING

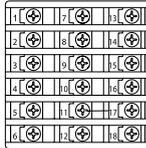
### UNINTENDED EQUIPMENT OPERATION

Follow the wiring rules explained above in the Wiring Installation Instructions section.

**Failure to follow these instructions can result in death, serious injury, or equipment damage.**

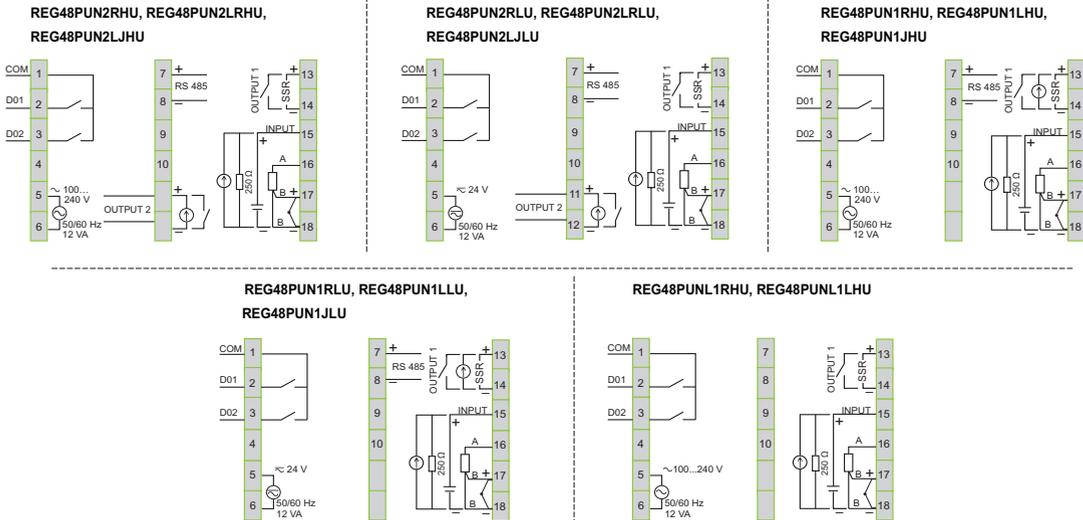
### Controller Terminal Block of the REG48

The following figure displays the terminal block situated on the rear face of the controller:



### Wiring of the REG48

The following figure displays the wiring of the REG48 Controllers:



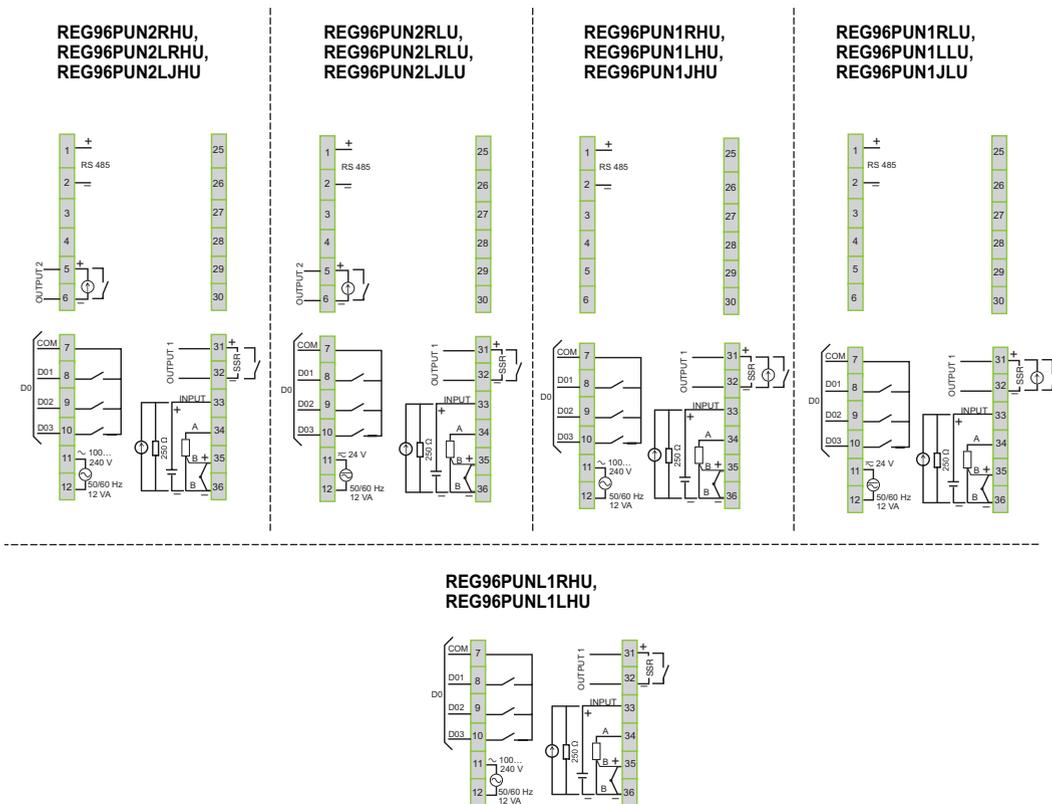
### Controller Terminal Block of the REG96

The following figure displays the terminal block situated on the rear face of the Controller:



### Wiring of the REG96

The following figure displays the wiring of the REG96 Controllers:

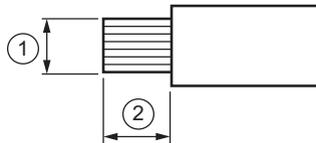


**Designation of Wiring Material****NOTE:**

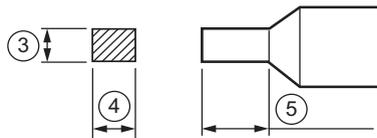
- Do not use wire other than the one stated below.
- Be sure to insert wire toward the recess of the terminal block.
- The recommended torque is 0.4 N•m (3.54 lb-in).

**Wire:**

- (1): Gauge: AWG28 (0.1 mm<sup>2</sup>) to AWG16 (1.25 mm<sup>2</sup>).
- (2): Strip-off length: 5...6 mm (0.20...0.24 in.).

**Rod terminal:**

- (3) (4): Dimension of exposed conductor section: 2 x 1.5 mm (0.08 x 0.06 in.) or smaller.
- (5): Length of exposed conductor section: 5...6 mm (0.2...0.24 in.).





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# Configuration of REG48/REG96

# 3

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## What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
How to Configure Using Front Panel	38
Basic Operations	39
Key Lock and Password	41
Setting the Temperature Controller	43
Parameters Flowchart	46
Parameters List	49



## Basic Operations

### Changing SV (set values)

Changing set values is done in Operational Mode:

Step	Action
1	 Press  to change the display to PV/SV display (shown when you turn on the power and the SV lamp is lit).
2	Change the SV value with the  and  key. <b>NOTE:</b> The value will be automatically saved.

### Changing MV (control output values)

Changing control output values is done in Manual Mode:

Step	Action
1	 Press  to switch to manual mode, the display will change to PV/MV display. (see Operation Parameters ( <i>see page 49</i> )).
2	Pressing the  key in manual mode toggles between PV/SV display and PV/MV display.
3	Change the MV value with the  and  keys. (Changes are reflected to the MV value as it is changed). MAN/AT/SELF lamp is light ON in the lowest digit place in the SV display when Manual mode.. An  appears in the highest decimal place during PV/MV display.

### Monitor Mode

The following table presents how to confirm the status of the controller by checking each value:

Step	Action
1	Press and hold the  key to enter monitor mode from operational mode or manual display mode. <b>NOTE:</b> The device will enter monitor mode with [MV1] selected.
2	Use the  and the  key to scroll through the information.

## Setup Mode

The following table presents how to set the parameters for the device:

Step	Action
1	When the Monitor Mode with [MV1] is selected, press and hold the <b>(SEL)</b> key to enter setup mode.
2	Press and hold the <b>(SEL)</b> key to enter the channel menu in setup mode.
3	Use the <b>(▲)</b> and the <b>(▼)</b> key to select the channel that includes the parameters you wish to change.
4	Press and hold the <b>(SEL)</b> key.
5	Use the <b>(▲)</b> and the <b>(▼)</b> key to check the parameters and their values.
6	When the value of the parameter you wish to change is being displayed. Press the <b>(SEL)</b> key to change this value. <b>Results:</b> the parameter value will blink.
7	Change the value with the <b>(▲)</b> and the <b>(▼)</b> key.
8	Press the <b>(SEL)</b> key to set the parameter to your desired value. <b>Results:</b> the value will then cease to blink.

## Key Lock and Password

### Setting Key Lock

When key lock is activated, parameters cannot be changed but can displayed.

Use the following steps to set key lock:

Step	Action
1	Display the operation menu <i>OPR [h11]</i>
2	Display key lock <i>LOCK</i> and press the (SEL) key
3	Set the value: <ul style="list-style-type: none"> <li>● 0: No lock (all parameters can be changed. Initial value)</li> <li>● 1: All lock (no parameters can be changed)</li> <li>● 2: All lock but SV locked (only the SV value can be changed)</li> </ul>
4	Press the (SEL) key to set the value

### Saving and entering a password

Use the following steps to save a password:

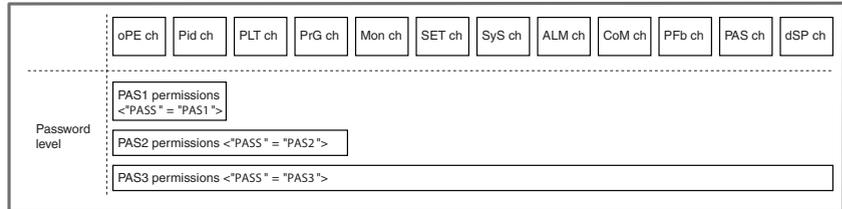
Step	Action
1	Display the password menu <i>PAS [h11]</i>
2	Display password 1 <i>PAS1</i> and press the (SEL) key
3	Set the password: You can enter the hexadecimal value 0000 through FFFF
4	Press the (SEL) key to set the value. <i>PAS2</i> and <i>PAS3</i> can be saved in the same way.

**NOTE:** The authority of the passwords grows from *PAS1* to *PAS2* to *PAS3*. The higher the authority, the greater number of channels for display and settings.

Use the following steps to entered a password:

Step	Action
1	In monitoring mode, display <i>PAS5</i> and press the (SEL) key
2	Enter and save password and press the (SEL) key. You will be able to operate the equipment depending on the authority of your password.

The diagram below represents each parameter channel and the authority of passwords from *PAS1* to *PAS2* to *PAS3*:



**NOTE:** When *FFFF* is entered as *PASS*, all of the channels *oPE ch* to *dSP ch* can be displayed and set. This “super password” function is useful when you forget the set passwords.

## Setting the Temperature Controller

### Input Setting

The input sensor type and the range for the input sensor can be set in the setup menu  $SEF [h] 6$ :

Step	Action
1	Choose an input type ( $P_{udf}$ ) Check the type of the thermocouple or resistance bulb which is used.
2	Set the PV scaling input range ( $P_{ub}/P_{uf}$ ) Set Pvb (see page 56) to the lower limit of the temperature range and Pvf (see page 56) to the upper limit. It is recommended to set the values at the standard range, even though they can be set at values beyond of it. There is no standard range for DC voltage or DC current input. (-1999...9999, lower limit<upper limit)
3	Set the decimal point location ( $P_{ud}$ ) Sets whether or not to display digits after the decimal point. Two digits can also be displayed after the decimal point when using 1...5Vdc, and 4...20mA dc.

**NOTE:** PV scaling and decimal point location can be used with the default factory settings.

### Input Range and Codes Table

The following table provides more informations on input types, input scaling, decimal point location and input codes:

Input type		Measurement range [°C]	Measurement range [°F]	Smallest input increment [°C]	Input code
Resistance bulb JIS (IEC)	Pt 100Ω	0...150	32...302	0.1	1888
		0...300	32...572	0.1	
		0...500	32...932	0.1	
		0...600	32...1112	1	
		-50...200	-58...212	0.1	
		-100...200	-148...392	0.1	
		-150...600	-238...1112	1	
		-200...850	-328...1562	1	

Input type		Measurement range [°C]	Measurement range [°F]	Smallest input increment [°C]	Input code
Thermo-couple	J	0...400	32...752	0.1	2 <sup>000</sup>
		0...1000	32...1832	1	
	K	0...400	32...752	0.1	3 <sup>000</sup>
		0...800	32...1472	0.1	
		0...1200	32...2192	1	
	R	0...1600	32...2912	1	4 <sup>000</sup>
	B	0...1800	32...3272	1	5 <sup>000</sup>
	S	0...1600	32...2912	1	6 <sup>000</sup>
	T	-200...200	-328...392	0.1	7 <sup>000</sup>
		-200...400	-328...752	0.1	
	E	0...800	32...1472	0.1	8 <sup>000</sup>
		-200...800	-328...1472	1	
N	0...1300	32...2372	1	12 <sup>000</sup>	
PL-2	0...1300	32...2372	1	13 <sup>000</sup>	
DC voltage	0...5 Vdc	-1999...9999 (Range where scaling is allowed)			15 <sup>000</sup>
	1...5 Vdc				16 <sup>000</sup>
	0...10 Vdc				17 <sup>000</sup>
	2...10 Vdc				18 <sup>000</sup>
	0...100 mVdc				19 <sup>000</sup>
DC current <sup>1</sup>	0...20 mA dc				15 <sup>000</sup>
	4...20 mA dc				16 <sup>000</sup>
<b>1</b> Connect a 250Ω resistor when using DC current input. Refer to the Wiring topic for more information.					

### Output Setting

The range of the control output can be set in the setup menu  $5E7$   $[h88]$  (only applies to analog current output) :

Step	Action
1	Set the range of the control output (OUT1/OUT2) ( $[1r]$ / $[2r]$ ) Choose between 0...20mA or 4...20mA DC.

### Controls Setting

- Reverse operation: As the process value (PV) rises, the control output (MV) becomes smaller. Used to heat the control object.
- Normal operation: As the process value (PV) rises, the control output (MV) becomes larger. Used to cool the control object.

The range of the control output can be set in the setup menu  $Pd$   $[h82]$  then  $rE\bar{u}$ :

Step	Action
1	Set the normal operation or reverse operation with $rE\bar{u}$ parameter.

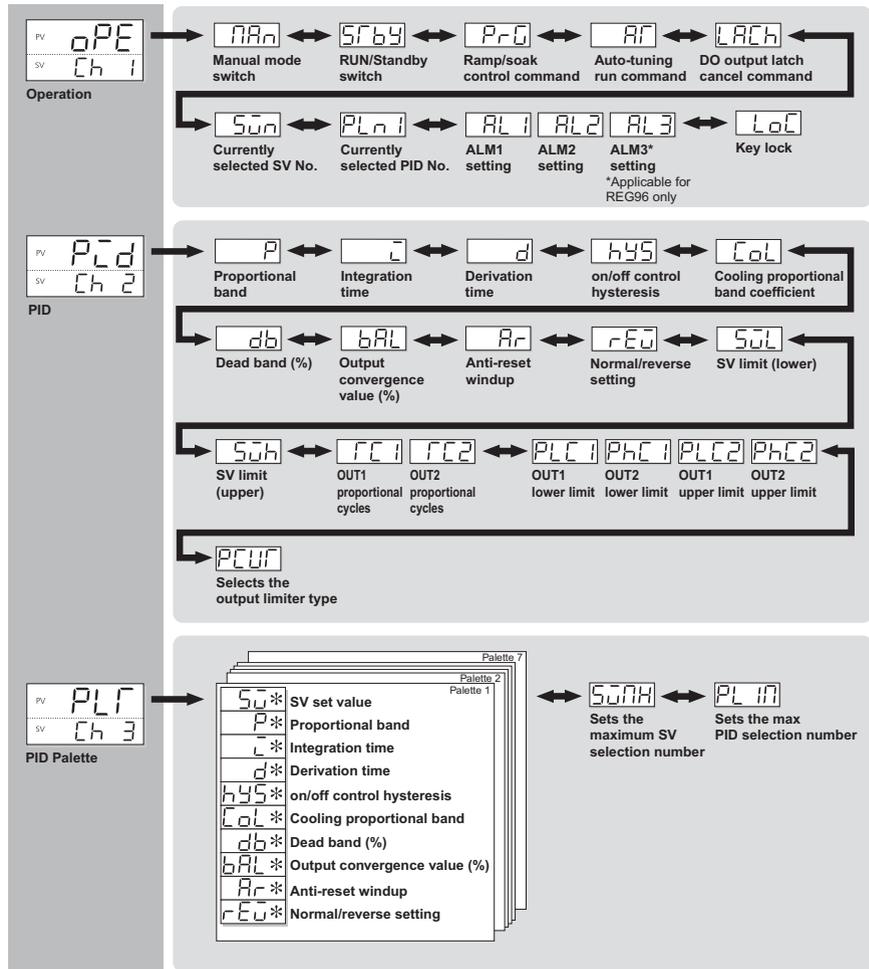
Choose any of the following combinations of heat and cool to suit your system :

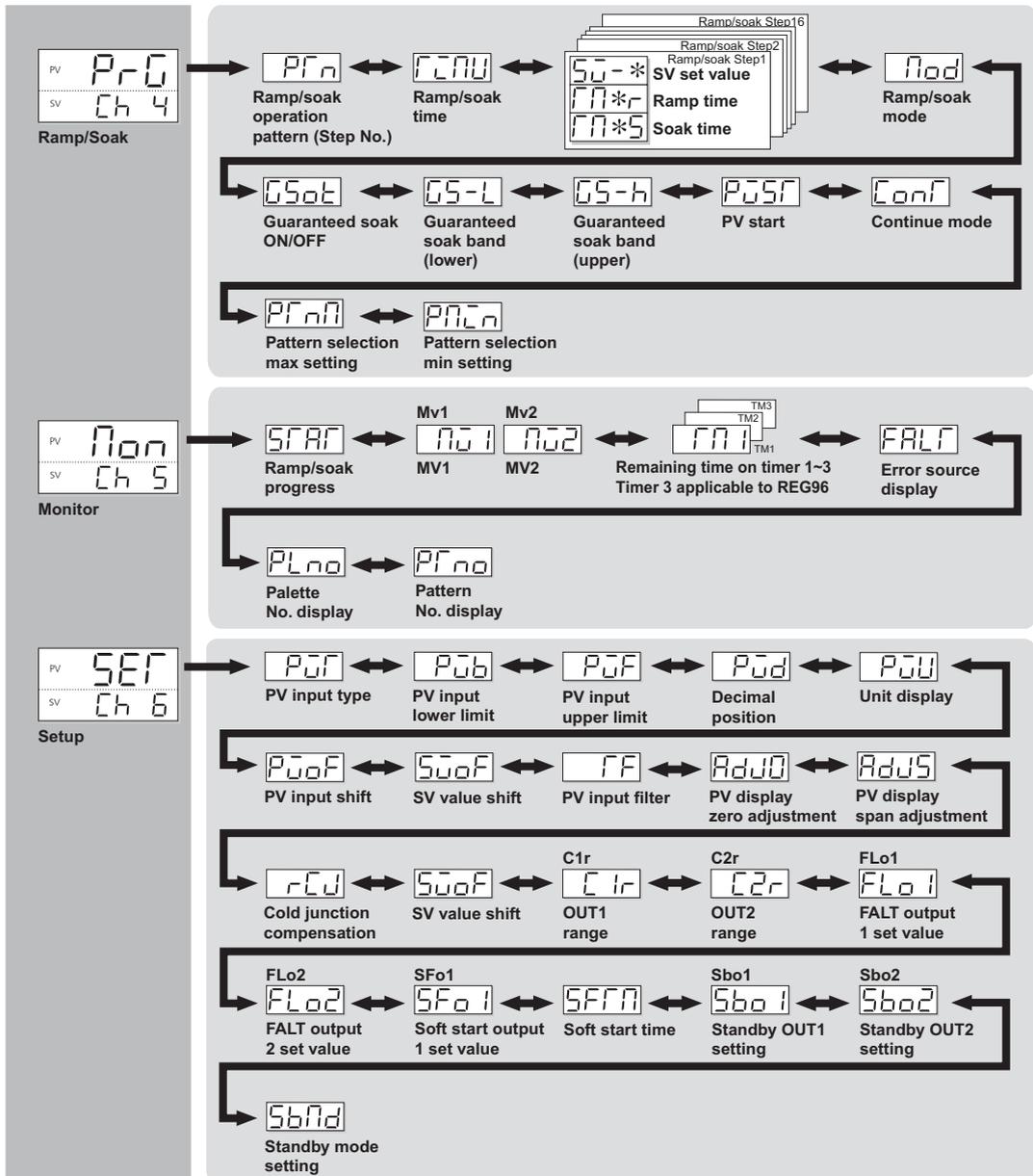
rEv	Control output 1	Control output 2
rv--	Reverse	-
no--	Normal	-
rvno	Reverse	Normal
norv	Normal	Reverse
rvrv	Reverse	Reverse
nono	Normal	Normal

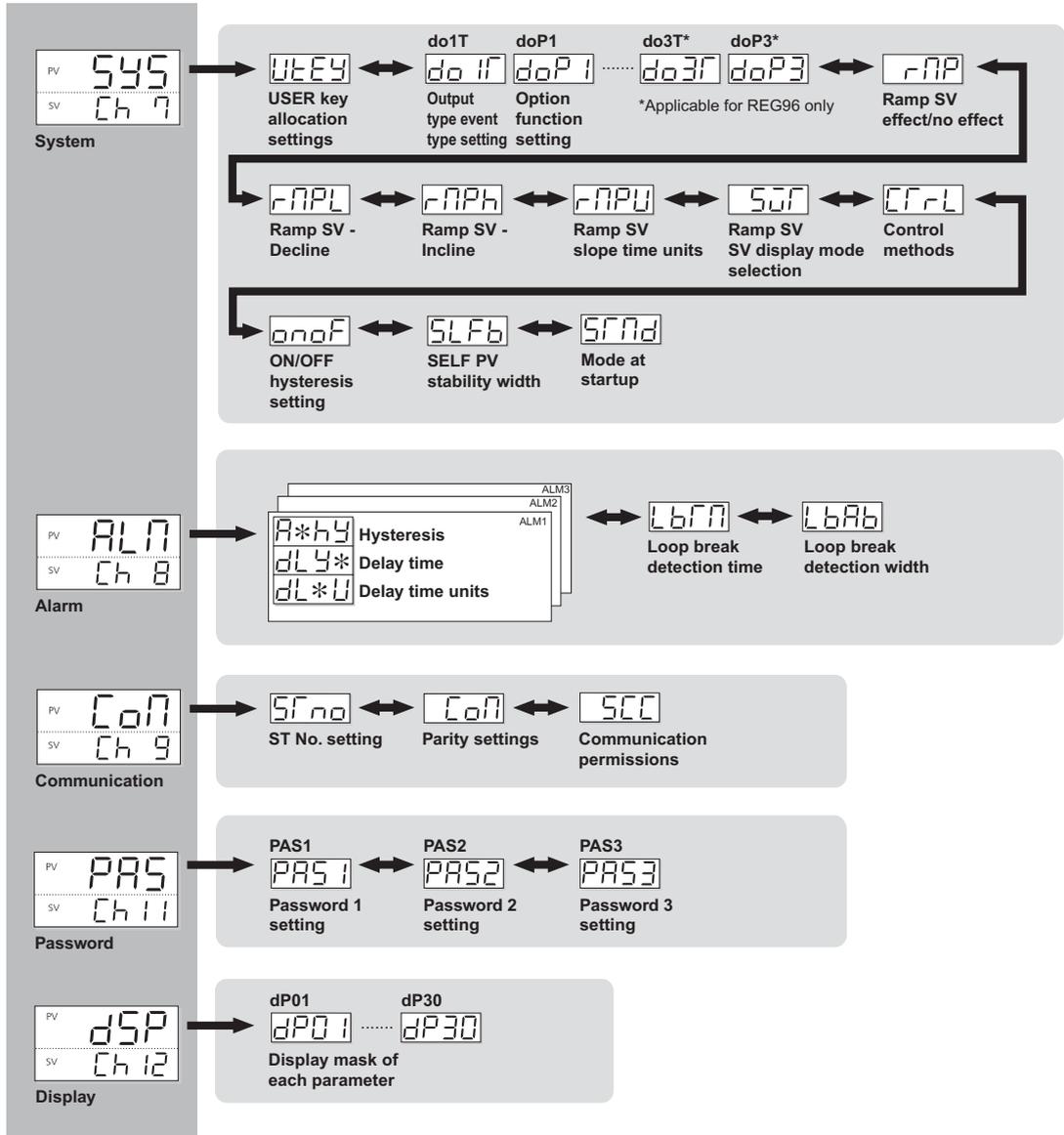
## Parameters Flowchart

### Parameters Overview

The parameters are divided into 12 channels. Each channel contains one series of parameters. Refer to the following graphics for a detailed explanation of each channel:







## Parameters List

### Operation Parameters (Ch1)

The following list shows the operational range of set values for parameters that are limited:

- When one of the following parameters is changed all the initial parameter setting values have to be reconfigured:
  - PV input lower limit (Pvb)
  - PV input upper limit (PvF)
  - decimal place position (Pvd)
- When a parameter that has **RST** indicated in the *Remarks*, turn off the power once, and then re-start the controller.

Operation parameters handle all operation controls. The operation menu includes the following items:

Display	Parameter Name		Function	Setting Range	Remarks
MAN	Man	Manual setting	Switches between auto/manual modes	oFF (auto) / on (manual)	
STBY	STbY	Standby setting	Switches the operation mode between run and standby	oFF (run) / on (standby)	
PrG	PrG	Ramp/Soak Operation command	Switches between ramp/soak operation states	<ul style="list-style-type: none"> <li>● oFF (stop/finish)</li> <li>● rUn (run)</li> <li>● hLd (hold)</li> </ul>	
AT	AT	Auto-Tuning	Used for setting the constants for $P$ , $L$ and $d$ by Auto-tuning.	<ul style="list-style-type: none"> <li>● oFF (stop/finish)</li> <li>● on (normal type)</li> <li>● Lo (low PV type)</li> </ul>	
LACH	LACH	Alarm latch cancel	Cancels the DO output latch state	oFF / rST (latch reset)	
SvN	Svn	Selecting SV number during SV selection	Chooses the SV No. used for control	<ul style="list-style-type: none"> <li>● Sv0 (SV=SV0)</li> <li>● Sv1 (SV=SV1)</li> <li>● Sv2 (SV=SV2)</li> <li>● Sv3 (SV=SV3)</li> <li>● Sv4 (SV=SV4)</li> <li>● Sv5 (SV=SV5)</li> <li>● Sv6 (SV=SV6)</li> <li>● Sv7 (SV=SV7)</li> <li>● di (not used)</li> </ul>	(1)

Display	Parameter Name		Function	Setting Range	Remarks
<i>PLn1</i>	PLn1	Currently selected PID No.	Chooses the PID group No. used for control	Pid0 (PID Ch) Pid1 (PID group No. 1) Pid2 (PID group No. 2) Pid3 (PID group No. 3) Pid4 (PID group No. 4) Pid5 (PID group No. 5) Pid6 (PID group No. 6) Pid7 (PID group No. 7) di (not used)	(2)
<i>AL1</i> <i>AL1L</i> <i>AL1h</i> ... <i>AL3</i> <i>AL3L</i> <i>AL3h</i>	AL1 AL1L AL1h ... AL3 AL3L AL3h	AL1 Setting AL1L Setting AL1h Setting ... AL3 Setting AL3L Setting AL3h Setting	Sets the alarm set value	0...100% FS (Absolute Alarm) -100...100% FS (Deviation Alarm)	(3)
<i>LoC</i>	LoC	Key lock	Specifies whether or not to allow the change of parameters.	0 (no lock) 1 (all lock) 2 (all but SV locked)	
<p>1 No digital input selection available on SV No. selection                  2 No digital input selection available on PID group No. selection                  3 Displays changes according to the DO No. and the selected alarm type</p>					

### Control Parameters (Ch2)

This section explains parameters related to PID and other controls. The PID menu contains the following items:

Display	Parameter Name		Function	Setting Range	Remarks
<i>P</i>	P	Proportional band	Sets the proportional band for the PID parameter. Setting to 0.0 will revert to ON/OFF control	0.0...999.9%	
<i>I</i>	I	Integration time	Sets the integration time for the PID parameter. Setting "0" will turn off integration	0...3200 sec	
<i>D</i>	D	Derivative time	Sets the derivative time for the PID parameter. Setting "0.0" will turn off derivative	0.0...999.9 sec	
<i>HYS</i>	HYS	ON/OFF control hysteresis	Sets the hysteresis width for the on/off control. Sets the control output to normal or reverse	0...50% FS	

Display	Parameter Name		Function	Setting Range	Remarks
<i>CoL</i>	CoL	Cooling proportional band coefficient	Sets the cooling proportional band coefficient Setting "0.0" will turn the cooling into an on/off control	0.0...100.0	(4)
<i>db</i>	db	Deadband/ Overlap	Shifts the set value for the cooling proportional band	-50...50%	
<i>bAL</i>	bAL	Output convergence value	Offset value for calculating the MV output value	-100...100%	
<i>Ar</i>	Ar	Anti-reset windup	Sets the range of integration	0...100% FS	
<i>rEv</i>	rEv	Sets normal/reverse operations	Sets the control output to normal or reverse	rv-- (heat (reverse) / cool (none)) no-- (heat (normal) / cool (none)) rvno (heat (reverse) / cool (normal)) norv (heat (normal) / cool (reverse)) rvrv (heat (reverse) / cool (reverse)) nono (heat (normal) / cool (normal))	<b>RST</b>
<i>SvL</i>	SvL	SVlimit (lower)	Sets the lower limit for SV	0...100% FS	
<i>Svh</i>	Svh	SVlimit (upper)	Sets the upper limit for SV		
<i>TC1</i>	TC1	OUT1 cycle time	Sets the cycle time of the control output (OUT1) (Contact, SSR drive)	1...150 sec	(5)
<i>TC2</i>	TC2	OUT2 cycle time	Sets the cycle time of the control output (OUT2) (Contact, SSR drive)		(4) (5)
<i>PCL1</i>	PCL1	OUT1 lower limit	Sets the lower limit of the control output (OUT1)	-3.0...103.0%	
<i>PHC1</i>	PHC1	OUT1 upper limit	Sets the upper limit of the control output (OUT1)		
<i>PLC2</i>	PLC2	OUT2 lower limit	Sets the lower limit of the control output (OUT2)		(4)
<i>PHC2</i>	PHC2	OUT2 upper limit	Sets the upper limit of the control output (OUT2)		
<i>PCUT</i>	PCUT	Selects the output limiter type	Sets the type of output limiter	0 to 15	
<p><b>4</b> Displayed when OUT2 model is selected</p> <p><b>5</b> Applicable to Relay and SSR output only</p>					

### PID Palette Parameters (Ch3)

Saves the palette values of PV and PID. Up to seven sets can be saved. It consists of the following functions:

Display	Parameter Name		Function	Setting Range	Remarks
<i>Sv1</i>	Sv1	SV set value 1	Sets the SV value	SV lower limit (SVL) to SV upper limit (SVH) %FS	
<i>P1</i>	P1	Proportional band 1	Sets the proportional band	0.0...999.9%	
<i>I1</i>	I1	Integration time 1	Sets the integration time	0...3200 sec	
<i>d1</i>	D1	Derivative time 1	Sets the derivative time	0.0...999.9 sec	
<i>hys1</i>	HYS1	ON/OFF Control hysteresis 1	Sets the hysteresis when using ON/OFF control	0...50% FS	
<i>CoL1</i>	CoL1	Cooling proportional band 1	Sets the cooling proportional band	0.0...100.0	(4)
<i>db1</i>	db1	Dead band 1	Sets the dead band	-50.0...50.0% FS	(4)
<i>bAL1</i>	bAL1	Output convergence value 1	Offset value added to the control output	-100.0...100.0% FS	
<i>Ar1</i>	Ar1	Anti-reset windup 1	Sets the anti-reset windup	0...100% FS	
<i>rEv1</i>	rEv1	Normal/reverse setting 1	Sets the control output to normal or reverse	rv-- (heat (reverse) / cool (none)) no-- (heat (normal) / cool (none)) rvno (heat (reverse) / cool (normal)) norv (heat (normal) / cool (reverse)) rvrv (heat (reverse) / cool (reverse)) nono (heat (normal) / cool (normal))	<b>RST</b>
<b>NOTE:</b> With the same functions as previous, 7 palette exists. (For example: Sv1, Sv2, ..., Sv7).					
<i>SvMH</i>	SvMH	Sets the maximum SV selection number	Sets the maximum selectable number when selecting SV with the user key	Sv0 (Local SV) Sv1 (SV=SV1) Sv2 (SV=SV2) Sv3 (SV=SV3) Sv4 (SV=SV4) Sv5 (SV=SV5) Sv6 (SV=SV6) Sv7 (SV=SV7) di (not used)	

Display	Parameter Name		Function	Setting Range	Remarks
<i>PL IN</i>	PL1M	Sets the max PID selection number	Sets the maximum selectable number when selecting PID with the user key	Pid0 (PID Ch) Pid1 (PID group No. 1) Pid2 (PID group No. 2) Pid3 (PID group No. 3) Pid4 (PID group No. 4) Pid5 (PID group No. 5) Pid6 (PID group No. 6) Pid7 (PID group No. 7) di (not used)	
<b>4</b> Displayed when OUT2 model is selected					

**Ramp/Soak Parameters (Ch4)**

Create a pattern of temperatures using ramp soak combinations. You can create a temperature pattern up to 16 steps:

Display	Parameter name		Function	Setting range	Remarks
<i>PTn</i>	PTn	Ramp/Soak Activation Pattern	Sets which steps to execute in the Ramp/Soak operation pattern	0 (uses steps 1 to 4) 1 (uses steps 5 to 8) 2 (uses steps 1 to 8) 3 (uses steps 9 to 12) 4 (uses steps 13 to 16) 5 (uses steps 9 to 16) 6 (uses steps 1 to 16) di (not used)	(6)
<i>TIMU</i>	TiMU	Ramp/soak time units	Sets the units used when setting the ramp/soak time	hh.MM (hour:min) MM.SS (min:sec)	
<i>Sv-1</i>	Sv-1	Ramp/soak 1 seg/SV Setpoint value	Sets the SV	0...100% FB	
<i>TM1r</i>	TM1r	Ramp/soak 1seg ramp time	Sets the ramp time	00:00...99:59 (hour:min/min:sec)	
<i>TM1S</i>	TM1S	Ramp/soak 1 seg soak time	Sets the soak time		
<b>NOTE:</b> With the same functions as previous, total 16 steps can be sets (For example: Sv-1, Sv-2, ..., Sv16).					

Display	Parameter name		Function	Setting range	Remarks
<i>nod</i>	Mod	Ramp/soak mode	Sets the program operation method	0 (P-ON: Off, End: Maintain, OFF: Maintain, Repeat: Off) 1 (P-ON: Off, End: Maintain, OFF: Maintain, Repeat: On) 2 (P-ON: Off, End: Maintain, OFF: Standby, Repeat: Off) 3 (P-ON: Off, End: Maintain, OFF: Standby, Repeat: On) 5 (P-ON: Off, END: Standby, OFF: Maintain, Repeat: On) 6 (P-ON: Off, END: Standby, OFF: Standby, Repeat: Off) 7 (P-ON: Off, END: Standby, OFF: Standby, Repeat: On) 8 (P-ON: On, End: Maintain, OFF: Maintain, Repeat: Off) 9 (P-ON: On, End: Maintain, OFF: Maintain, Repeat: On) 10 (P-ON: On, End: Maintain, OFF: Standby, Repeat: Off) 11 (P-ON: On, End: Maintain, OFF: Standby, Repeat: On) 12 (P-ON: On, END: Standby, OFF: Maintain, Repeat: Off) 13 (P-ON: On, END: Standby, OFF: Maintain, Repeat: On) 14 (P-ON: On, END: Standby, OFF: Standby, Repeat: Off) 15 (P-ON: On, END: Standby, OFF: Standby, Repeat: On)	<b>RST</b>
<i>GSot</i>	GSot	guarantee soak ON/OFF	Sets the guarantee soak on or off	oFF (guarantee soak off) on (guarantee soak on)	
<i>GS-L</i>	GS-L	guarantee soak band (lower)	Sets the lower limit for the guarantee soak band	0...50% FS	
<i>GS-h</i>	GS-h	guarantee soak band (upper)	Sets the upper limit for the guarantee soak band		
<i>PvST</i>	PvST	PV start	Sets whether or not to start ramp soak with PV.	oFF (PV start off) on (PV start on)	
<i>ConT</i>	ConT	Continue mode	Sets how to restart when the controller is restored after a power loss during ramp soak	rES (Reset) Con (Continue) ini (Restart)	(6)

Display	Parameter name		Function	Setting range	Remarks
<i>PrnM</i>	PTnM	Sets the max pattern selection	Choosing pattern with the user key sets it to the maximum possible number	0 to 6, di	
<i>PMin</i>	PMin	Pattern selection Min setting	Choosing pattern with the user key sets it to the minimum possible number	0 to 6, di	
<b>6</b> Do not change this parameter during the ramp soak operation. Be sure to set <b>PrG</b> to oFF before changing the parameter					

### Monitor Parameters (Ch5)

The monitor allows you to verify/view the ramp soak progress, control output, remaining time and other status of the controller. The settings cannot be changed in these parameters:

Display	Parameter Name		Function	Setting Range	Remarks
<i>STAT</i>	STAT	Ramp/soak progress	Displays the progress of the ramp/soak	oFF (ramp/soak is stopped) 1-rP (Step 1 Ramp) ... 16rP (Step 16 Ramp) 16Sk (Step 16 Soak) End (ramp/soak is finished)	
<i>Mv1</i>	Mv1	Control Output Display (MV1)	Displays the output value of the control output (OUT1)	-3.0...103.0%	
<i>Mv2</i>	Mv2	Control Output Display (MV2)	Displays the output value of the control output (OUT2) (during dual control)		(4)
<i>TM1</i>	TM1	Remaining time on timer 1	Displays the remaining time on timer 1	0...9999 sec / 0...9999 min	
<b>NOTE:</b> With the same function as TM1, same for TM1 to TM3. (TM3 applicable on REG96 only)					
<i>FALT</i>	FALT	Error source display	Displays the source of a detected error	0bit:PFB input underflow 1bit:PFB input overflow 8bit: PV input underflow 9bit: PV input overflow 10bit: underrange 11bit: overrange 12bit: RSV underrange 13bit: RSV overrange 14bit: range setting error 15bit: EEPROM error	

Display	Parameter Name		Function	Setting Range	Remarks
<i>pLno</i>	PLno	Current palette No.	Displays the PID palette No. currently selected	0 to 7	
<i>pTno</i>	PTno	Current pattern No.	Displays the pattern No. of the ramp soak currently selected	0 to 6	
4 Displayed when OUT2 model is selected					

### Setup Parameters (Ch6)

Sets up the input range, output range and other items for the controller.

Display	Parameter Name		Function	Setting Range	Remarks
<i>pVr</i>	PvT	PV input type	Sets the type of input sensor	0 (JPT 100Ω) 1 (PT 100Ω) 2 (J) 3 (K) 4 (R) 5 (B) 6 (S) 7 (T) 8 (E) 9 (no function) 10 (no function) 11 (no function) 12 (N) 13 (PL-2) 14 (no function) 15 (0 V...5 V / 0 mA...20 mA) 16 (1 V...5 V/4 mA...20 mA) 17 (0 mV...10 V) 18 (2 V...10 V) 19 (0 mV...100 mV)	
<i>pVb</i>	Pvb	PV input lower limit	Sets a lower limit for PV input	-1999...9999%	<b>RST</b>
<i>pVf</i>	PvF	PV input upper limit	Sets the upper limit for PV input	-1999...9999%	<b>RST</b>
<i>pVd</i>	PVd	Decimal position	Sets the position of the decimal point for PV/SV display	0 (no decimal point) 1 (one decimal place) 2 (two decimal places)	<b>RST</b>
<i>pVu</i>	PvU	Unit display	This is the procedure for specifying the units of the PV/SV display	°C/°F	
<i>pVoF</i>	PvoF	PV input offset	Sets the amount of offset for PV input	-100...100% FS	

Display	Parameter Name		Function	Setting Range	Remarks
<i>SvoF</i>	SvoF	SV offset	Sets the amount of shift in SV	-50...50% FS	
<i>TF</i>	TF	PV input filter	Sets the time constant for the PV input filter	0.0...120.0 sec	
<i>Adj0</i>	Adj0	PV display Zero adjustment	Adjusts the zero side in the PV display	-50...50% FS	
<i>AdjS</i>	AdjS	PV display Span adjustment	Adjusts the span side in the PV display		
<i>rCJ</i>	rCJ	Cold Junction Compensation	Sets whether cold junction compensation is performed	oFF (Off) / oN (On)	
<i>C1r</i>	C1r	OUT1 range	Sets the range of the control output (OUT1)	0-20 (0 mA...20 mA) 4-20 (4 mA...20 mA)	(7)
<i>C2r</i>	C2r	OUT2 range	Sets the range of the control output (OUT2)	0-20 (0 mA...20 mA) 4-20 (4 mA...20 mA)	(7)
<i>FLo1</i>	FLo1	Output 1 set value during FALT	Sets the output value for the control output (OUT1) during FALT	-3.0...103.0%	
<i>FLo2</i>	Sb	Output 2 set value during FALT	Sets the output value for the control output (OUT2) during FALT	-3.0...103.0%	(4)
<i>SFo1</i>	SFo1	Soft start OUT1 set value	Sets the output value for the control output (OUT1) during soft start	-3.0...103.0%	
<i>SFTM</i>	SFTM	Soft Start detection time	Sets the time from power-on to soft start completion	00:00...99:59 (hour:min)	(8)
<i>Sbo1</i>	Sbo1	OUT1 set value during standby	Sets the output value for the control output (OUT1) during standby	-3.0...103.0%	
<i>Sbo2</i>	Sbo2	OUT2 set value during standby	Sets the output value for the control output (OUT2) during standby	-3.0...103.0%	(4)
<i>SbMd</i>	SbMd	Standby mode setting	Sets the alarm output, PV/SV display in standby mode	More information are provided in the following table	
<b>4</b> Displayed when OUT2 model is selected <b>7</b> Displayed when OUT1 or OUT2 model is analog current output models. <b>8</b> Make sure to set the time to 00:00 during dual control					

The following table resume the setting range for the *Sbnd* parameter:

	<b>ALM display/output</b>	<b>PV/SV display</b>
0	OFF	ON
1	ON	ON
2	(not used)	
3	(not used)	
4	(not used)	
5	ON	OFF
6	OFF	OFF
7	(not used)	

## System Parameters (Ch7)

This section explains system parameters, which specify the basic operations and controls of the temperature controller. The following settings are available:

Display	Parameter Name		Function	Setting Range	Remarks
<i>UtEY</i>	UtEY	USER key allocation settings	Sets the function of the [USER] key	0 (no function) 1 (Switches between STbY ON/OFF) 2 (Switches between Auto/Manual) 3 (no function) 4 (Do not set) 5 (Starts AT (standard)) 6 (Starts AT (low PV)) 7 (Do not set) 8 (Ramp SV HOLD) 9 (Ramp/soak RUN/OFF) 10 (Ramp/soak RUN/HOLD) 11 (Do not set) 12 (Latch cancel (all)) 13 (Latch cancel (DO1)) 14 (Latch cancel (DO2)) 15 (Latch cancel (DO3)) 16 (no function) 17 (no function) 18 (no function)) 19 (no function)) 20 (no function)) 21 (no function) 22 (no function) 23 (SV No.+1 (send)) 24 (PID No. +1 (send)) 25 (Do not set) 26 (Pattern No.+1 (send)) 27 (SV No. + 1, PID No. + 1 (send))	
<i>do1T</i>	do1T	DO1 output event type	Sets the function of DO1 (Mainly for Alarm)	0-102	(3)
<i>doP1</i>	doP1	DO1 option function setting	Assigns the four types of option functions in bit units	0000-1111 ● bit0: event output latch function ● bit1: error alarm function ● bit2: non-excitation output alarm function ● bit3: hold reset function	
<b>NOTE:</b> With the same previous function, applicable for DO2 and DO3.					
<i>rMP</i>	rMP	ramp SV ON/OFF	Set the ramp SV ON/OFF	OFF / ON	

Display	Parameter Name		Function	Setting Range	Remarks
<i>rMPL</i>	rMPL	Ramp SV - Decline	Sets the rate of ramp SV upslope	0...100% FS/° C (Industrial value)	
<i>rMPH</i>	rMPH	Ramp SV - Incline	Specifies the rate of ramp SV upslope		
<i>rMPU</i>	rMPu	Ramp SV slope time units	Sets the time unit for the ramp SV slope	hoUr (slope degree/hr) Min (slope degree/min)	
<i>SvT</i>	SvT	Ramp SV / SV display mode selection	Displays either the target SV or current SV during ramp operations	rMP (Display current ramp SV) TrG (Display target SV)	
<i>CTrL</i>	CTrL	Control methods	Allows you to select the control method	Pid (Pid control) FUZY (Fuzzy Pid control) SELF (Self-tuning control) Pid2 (Pid2 control)	(10)
<i>onoF</i>	onoF	HYS mode setting	Selects the hysteresis operation during two state action	OFF: Performs two state action at SV±HYS/2 ON: Performs two state action at SV, SV+HYS and SV, SV-HYS	
<i>STMd</i>	STMd	Startup mode	Sets the operation mode when starting up	AUTo (Auto mode startup) MAn (Manual mode startup) rEM (Remote mode startup) STbY (Standby mode startup)	
<p><b>3</b> Display changes according to the DO number and the selected alarm type.  <b>10</b> To select control method hysteresis mode, change the parameter "P=0"</p>					

### Alarm Parameters (Ch8)

The Alarm menu consists of the following:

Display	Parameter Name		Function	Setting Range	Remarks
<i>A1hY</i>	A1hY	ALM1 hysteresis	Sets the hysteresis for alarm output 1 ON/OFF	0...50% FS	
<i>dLY1</i>	dLY1	ALM1 delay	Sets the delay before detecting alarm output 1	0...9999 [sec/min]	
<i>dL1U</i>	dL1U	ALM1 delay time units	Sets the delay time units for alarm output 1	SEC / Min	
<p><b>NOTE:</b> These 3 previous functions are the same for ALM2 to ALM3.</p>					
<i>LbTM</i>	LbTM	Loop break detection time	Sets the time before detecting for a broken loop	0...9999 sec	
<i>LbAb</i>	LbAb	Loop break detection range (°C)	Sets the temperature range before detecting for a broken loop	0...100% FS	

## Communication Parameters (Ch9)

The Communication menu consists of the following function/parameters:

Display	Parameter Name		Function	Setting Range	Remarks
STno	STno	Station No.	Sets the station number. <b>NOTE:</b> Need to restart the controller once station No change.	1 to 247	<b>RST</b> (11)
BCoM	CoM	Baud Rate/ Parity setting	Sets the baud rate and parity check	96od (9600 bps/odd) 96ev (9600 bps/even) 96no (9600 bps/none) 19od (19200 bps/odd) 19ev (Default) (19200 bps/even) 19no (19200 bps/none)	<b>RST</b>
SCC	SCC	Communication permissions	Sets whether or not overwriting is possible from the master side (PC and etc.).	<ul style="list-style-type: none"> <li>• r (read only)</li> <li>• rW (read and write)</li> </ul>	<b>RST</b>
<b>11</b> Station number No 32 to No 247 is forbidden to use. Maximum up to 31 units can be connected only.					

## Password Setup Parameters (Ch11)

Sets the password. Passwords can be set at three levels:

Display	Parameter Name		Function	Setting Range	Remarks
PAS1	PAS1	Password1 setup	Sets password 1	0000...FFFF	
PAS2	PAS2	Password2 setup	Sets password 2	0000...FFFF	
PAS3	PAS3	Password3 setup	Sets password 3	0000...FFFF	

## Display Parameters (Ch12)

Sets the parameter mask function. Optional parameters can be set not to display.  
For details on the parameter mask function:

Display	Parameter Name		Function	Setting Range	Remarks
dP01 ... dP30	dP01 ... dP30	Parameter mask of each parameter	Sets the parameters to be displayed or not displayed.	Value different depending on the model code	(12)
<b>12</b> Refer to the Zelio Control, REG Communication and ZelioControl Soft Installation User Guide for Mask and Unmask optional parameters. Use the ZelioControl Soft to do Mask and Unmask action.					



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## Main Functions of REG48/REG96

# 4

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### What Is in This Chapter?

This chapter contains the following topics:

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## ON-OFF Control

### Overview

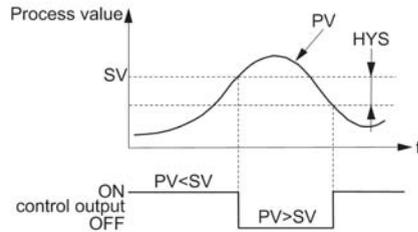
Acts as an ON/OFF control when the PID parameter is set to  $P = 0.0$  ( $P_{LD}$  [h82]). ON/OFF control switches the control output to ON (100%) or OFF (0%) according to the size relationship of PV and SV. The output hysteresis can be set under the parameter  $HYS$  ( $P_{LD}$  [h82]).

Suitable to use when the accuracy is not require.

### Reverse Operation (heat control)

Reverse operation is used to control the heating function. "Set the  $HYS$ " to an appropriate value according to the control target.

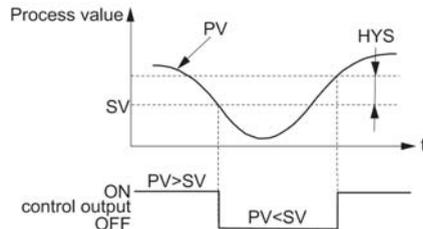
Parameter	Setpoint value
$P$ (Configure in CH 2)	0.0
$r\bar{E}\bar{u}$ (Configure in CH2)	rv--
$HYS$ (Configure in CH2)	Arbitrary (factory setting: 1°C)



## Normal Operation (cooling control)

Normal Operation is used to implement cooling function.

Parameter	Setpoint value
$P$ (Configure in CH 2)	0.0
$r\bar{E}\bar{u}$ (Configure in CH 2)	no--
$HYS$ (Configure in CH 2)	Arbitrary (factory setting: 1°C)



### NOTE:

- During ON/OFF control, the I and D settings do not affect control.
- The manual operation during ON/OFF control will become MV=100% when  is pressed, and MV=0% when  is pressed.
- If the hysteresis width is narrow, and PV and SV are nearly equal, the output may frequently switch ON and OFF. Note that it may affect the operation life of the contact output.

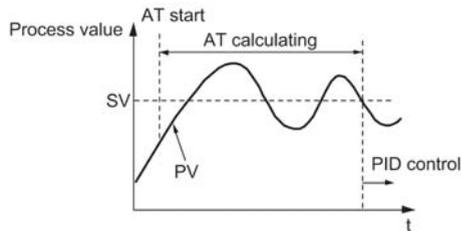
## Auto-Tuning

### Overview

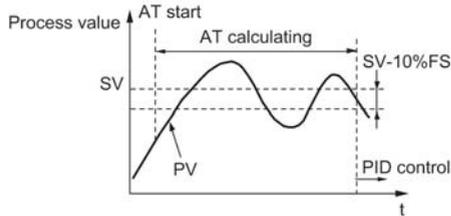
Run Auto-Tuning (AT) to set the PID parameter automatically.

Setpoint value	Behavior	Function
0FF	Stop/Finish	Stops or finishes Auto-Tuning
0n	Normal type	The standard auto-tuning for SV reference. Choose this auto-tuning in most situations.
L0	Low PV type	Auto-tuning for SV-10% reference. Choose this when you want to suppress the overshoot when tuning.

Normal Type:



Low PV Type:



### NOTE:

Set the following parameters before running Auto-Tuning.

- PV input type / PV input upper limit / PV input lower limit / Decimal position / PV input filter in the setup channel menu `SEF CH 6`
- OUT1 proportion cycle (OUT2 proportion cycle) in the PID channel menu `PID CH 2`.

## Running Auto-Tuning

The following table explains how to set the Auto-Tuning:

Step	Action
1	Display the operation menu $OP\ E\ CH\ I$ .
2	Display auto-tuning $RT$ and choose the tuning type. Choose the standard type $ON$ or low PV type $LD$ according to the control target.
3	Press the $(SEL)$ key to start auto-tuning. The MAN/AT/SELF indication LED will blink during auto-tuning. When auto-tuning has successfully completed, MAN/AT/SELF LED will turn off and overwrites the PID.

### NOTE:

- PID parameter which is set after auto tuning will be maintained even when the power is turned off. However, the PID value will not be changed if the power is turned off during Auto-Tuning. In this case, run again the Auto-Tuning.
- The equipment will use ON/OFF (2 position) control during Auto-Tuning, so there may be a large change in PV according to the process. Do not use auto-tuning for processes that do not permit a large change in PV. Do not use auto-tuning for processes such as pressure control and flow control that have a fast response.
- Auto-tuning is not behaving normally if it has not finished after four or more hours. In these cases, recheck parameters such as input/output wiring, control output behavior (normal/reverse), and input sensor type.
- Rerun auto-tuning if there is a large change in SV, a change in the PV input type, or a change in the control target conditions that reduces the effectiveness of the controls.
- You can run auto-tuning when the control type is set to "fuzzy" or "PID2".
- You cannot run auto-tuning in manual mode or standby mode.
- When using the PID selection function, the auto-tuning result will store in the selected PID group.
- Auto tuning is forcibly terminated when SV changes because of the ramp soak function, remote SV function, or ramp SV.

## Self-Tuning

### Overview

Self-tuning Control is a control which automatically calculates the value of PID, under the condition that the control target or Setpoint value (SV) changes.

Self-tuning is especially effective for situations when a high level of control is not needed, but auto-tuning cannot be run due to frequent changes in the control target conditions.

When a high level of control is required, choose PID control, fuzzy PID control, or PID2 control.

### Conditions Where Self-Tuning Can Be Used

Self-tuning is used in the following situations:

- When temperature rises when the power is turned on
- When temperature rises when SV changes (or when the controller decides it is necessary)
- When the controller decides it is necessary because the controls have become unstable

### Conditions Where Self-Tuning Cannot Be Used

Self-tuning cannot be used in the following situations:

- During control standby
- During ON/OFF (2-position) control
- During auto-tuning
- During ramp soak progress
- When there is a detected error in the input
- When set for dual output
- When any of the P, I, D, Ar parameters are set to manual
- During manual mode
- During soft start progress

### Conditions To Halt Self-Tuning

Halt self-tuning in the following situations:

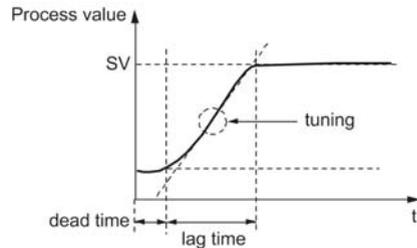
- When there is a change in SV (This includes the case where SV changes because of the ramp soak function, remote SV function, or ramp SV)
- When self-tuning has not finished after running for nine or more hours

## Setting Self-Tuning

The following table explains how to set the Self-tuning:

Step	Action
1	Turn on power of the controller and set the SV value.
2	Display the system menu <code>545 [h87]</code> .
3	Display the controller parameter <code>[Frl]</code> and choose self-tuning <code>SELF</code> .
4	Press the <b>(SEL)</b> key to set the value.
5	Turn off power of the controller.
6	Turn on power of the control target equipment and the controller. Turn on power of the control equipment first. See the following graphic.

Self-Tuning will begin:



### NOTE:

- The equipment will not tune correctly if power of the controller is turned on first.
- To reset self-tuning, set the control method (`[Frl]`) to PID (`Pld`) once before changing back to self-tuning.

## PID Control

### Overview

PID control runs as long as the parameter is set to  $P \neq 0.0$  ( $P_{\text{Ld}}$  [h82]) and  $FFL = \text{PID}$  (545 [h87]). The PID control calculates PID based on the set values for parameters  $P$ ,  $I$ ,  $D$  and  $FF$  then output the calculated result (-3% to 103%). Each parameter can be set either by manually tuning the values or by running auto-tuning (AT) to automatically set the values.

### Setting PID Control

The following table explains how to set the PID control:

Step	Action
1	Display the system menu 545 [h87].
2	Display the control parameter $FFL$ and choose PID controls $P_{\text{Ld}}$ .
3	Press the (SEL) key to set the value.

## Fuzzy PID Control

### Overview

Related to normal PID controls, fuzzy PID control acts with small overshoot. You will need to run auto-tuning to set the PID parameter when using fuzzy control.

### Setting Fuzzy PID Control

The following table explains how to the Fuzzy PID control

Step	Action
1	Display the system menu <i>545 [k87]</i> .
2	Display the control parameter <i>Pid</i> and choose fuzzy <i>FUZY</i> .
3	Press the (SEL) key to set the value.

## PID2 Control

### Overview

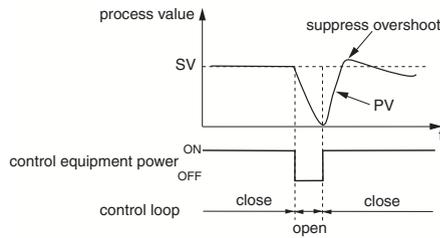
In case the power supply of the control target goes ON > OFF > ON, this PID2 Control can suppress the amount of overshoot. This control introduces an algorithm to prevent the calculated PID result from becoming a miscalculation, even when the control loop is open.

You will need to run auto-tuning to set the PID parameter when using PID2 Control.

### Setting PID2 Control

The following table explains how to set the PID2 Control:

Step	Action
1	Display the system menu <code>545 [h87]</code> .
2	Display the control parameter <code>[FPL]</code> and choose PID2 ( <code>Pld2</code> ).
3	Press the <b>SEL</b> key to set the value.

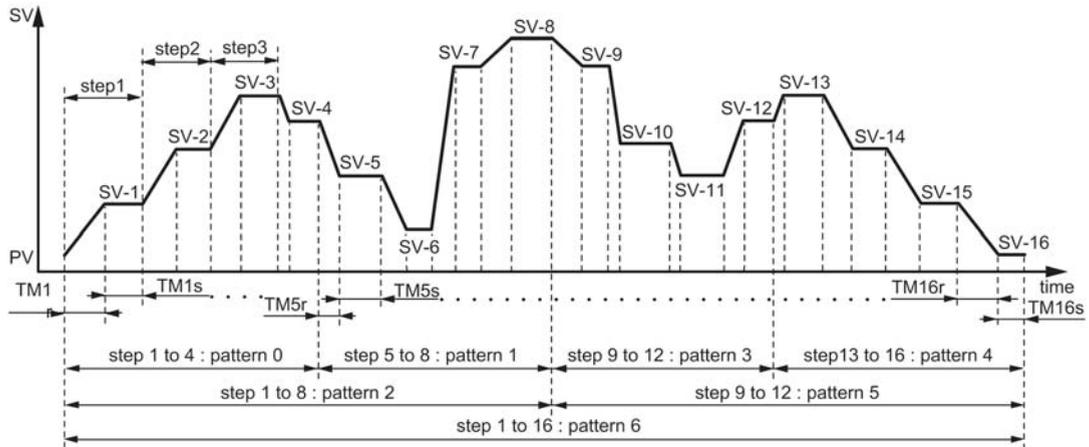


## Ramp/Soak Function

### Overview

Automatically runs after setting the times for the SV changes.

You can choose up to sixteen steps for the SV setting and seven types of ramp soak operation patterns.



### NOTE:

- When using the system in the restore mode  $\text{Con} = \text{continue (Con)}$  in the ramp/soak menu  $\text{PRG} \text{ [h84]}$ , do not set the ramp/soak control command  $\text{PRG}$  of the operation menu  $\text{APE} \text{ [h81]}$  to hold  $\text{hld}$  during the ramp period at the beginning of the pattern.
- When PV start  $\text{PVS}$  of the ramp/soak menu  $\text{PRG} \text{ [h84]}$  is  $\text{on}$ , set the pattern parameter  $\text{PRn}$  of ramp/soak  $\text{PRG} \text{ [h84]}$  to  $\text{PRn} = 0, 2, 6$  (setting that starts with 1seg ramp).
- Do not set the startup mode  $\text{SFn} = \text{standby mode } \text{Sbn}$  of the system menu  $\text{SYS} \text{ [h87]}$  and the restore mode  $\text{Con} = \text{continue (Con)}$  of the ramp/soak menu  $\text{PRG} \text{ [h84]}$  at the same time.

## Creating a Ramp Soak Operation Pattern

Set the following items to create a pattern:

Parameters	Description
Pattern	Sets which steps to use from the following seven types: <ul style="list-style-type: none"> <li>● Steps 1 to 4</li> <li>● Steps 5 to 8</li> <li>● Steps 9 to 12</li> <li>● Steps 13 to 16</li> <li>● Steps 1 to 8</li> <li>● Steps 9 to 16</li> <li>● Steps 1 to 16</li> </ul>
Target SV	Sets the controlled temperature.
Ramp time	Sets the time to reach the target SV from the current SV.
Soak time	Sets the time to maintain the specified SV.

The following steps will explain how to run the specified pattern 0 in SV-1 to SV-4.:

Steps	Action
1	Display the ramp/soak menu <i>PRG CH04</i>
2	Display pattern parameter <i>PRn</i> and choose pattern <i>0000</i>
3	Display the time parameter <i>TIME</i> and choose minute:second ( <i>mmss</i> ) Sets the units of time. Besides minute:second ( <i>mmss</i> ) you can also choose hour:minute ( <i>hhmm</i> ).
4	Display the target value <i>SV-1</i> and set the target temperature.
5	Display the ramp time parameter <i>TIMEr</i> and set the ramp time.
6	Display the soak time parameter <i>TIMEs</i> and set the soak time.
7	Repeat steps 4 through 7 and set the remaining parameters.

## Activating the Ramp/Soak Command

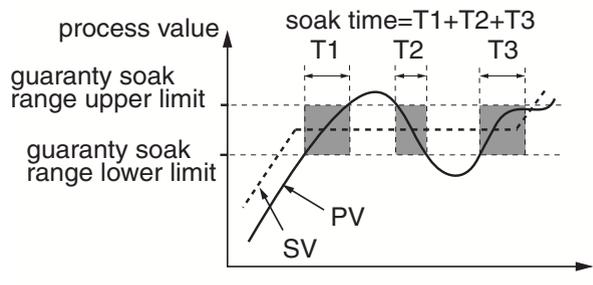
The following table explains how to activate the Ramp/Soak Command:

Step	Action
1	Press and hold the <b>(SEL)</b> key to display the channel menu of the setting mode, then use the <b>(▲)</b> or <b>(▼)</b> keys to display <i>oPE [h]l</i> .
2	Press and hold the <b>(SEL)</b> key then use the <b>(▲)</b> or <b>(▼)</b> keys to display <i>Prū</i> . <b>NOTE:</b> The Ramp/Soak operation can be interrupted by choosing hold <i>hld</i> . This interruption can be canceled by choosing <i>rūn</i> .
3	Press and hold the <b>(SEL)</b> key then use the <b>(▲)</b> or <b>(▼)</b> keys to display <i>rūn</i> when the bottom section of the screen begins to blink.
4	Press the <b>(SEL)</b> key to confirm the setting. The Ramp/Soak function will begin. <b>NOTE:</b> When the Ramp/Soak is completed <i>End</i> will be displayed.
5	Press the <b>(A/M)</b> key to return to PV/SV display of the operation mode.

## Guarantee Soak

This function guarantees the soak time. Only soak time within the specified range of temperature for SV is counted towards soak time.

As seen in the figure below, only the sum of the shaded areas is counted as soak time. The operation moves onto the next step when the total soak time equals the specified soak time.



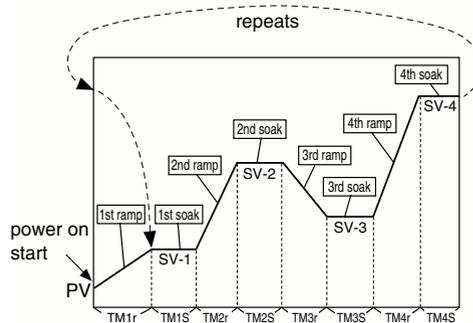
The following steps will explain how to set an example guarantee soak range with an upper limit of 5°C and a lower limit of 3°C:

Step	Action
1	Display the ramp soak menu $Prg \ [Ch] \ 4$
2	Display guarantee ON/OFF parameter $Guar \ 0n$ and choose $0n$
3	Display the guarantee soak lower limit parameter $Guar \ -L$ and set the lower limit.
4	Display the guarantee soak upper limit parameter $Guar \ -h$ and set the upper limit.
5	Press the key $(SEL)$ to set the value.

### Ramp/Soak Mode Setting

The following table shows the items that can be set:

Power On Start	Ramp Soak Starts running from the current PV
Ending Output	Show the ending output during OFF after ramp soak has been completed.
OFF Output	Show the output during OFF after ramp soak has been completer.
Repeat Behavior	After finishing the last step in ramp soak, the process starts again from first step.



You can choose from the following 16 types of modes according to the combination of run method options:

Setting	Power On Start	Ending Output	OFF Output	Repeat Behavior
0999	Off	Continuous control	Continuous control	Off
1999	Off	Continuous control	Continuous control	On
2999	Off	Continuous control	Standby	Off
3999	Off	Continuous control	Standby	On
4999	Off	Standby	Continuous control	Off
5999	Off	Standby	Continuous control	On
6999	Off	Standby	Standby	Off
7999	Off	Standby	Standby	On
8999	On	Continuous control	Continuous control	Off
9999	On	Continuous control	Continuous control	On
1099	On	Continuous control	Standby	Off
1199	On	Continuous control	Standby	On
1299	On	Standby	Continuous control	Off
1399	On	Standby	Continuous control	On
1499	On	Standby	Standby	Off
1599	On	Standby	Standby	On

## Alarm Function (Assigned by Digital Output event type)

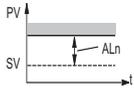
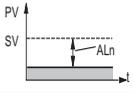
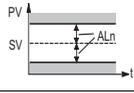
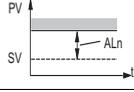
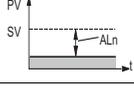
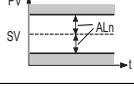
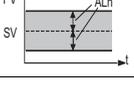
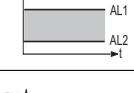
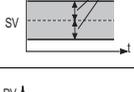
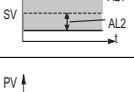
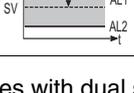
Digital Output event (DO) divided into those related to alarms and those not related. To set up the alarm function, follow the below sequence:

Step	Action
1	Set the System Menu: <ul style="list-style-type: none"> <li>● Set DO events type for DO1 to DO3 (DO3 only available on REG96)</li> </ul> <b>NOTE:</b> For more about the DO event type related to alarms, see below alarm action type codes ( <i>see page 78</i> ).
2	Set DO option in CH7 doPn (n=1 to 3)
3	Set Alarm Menu for Delay and Hysteresis in CH8 (n=1 to 3): <ul style="list-style-type: none"> <li>● Anhy</li> <li>● dLyn</li> <li>● DLnU</li> </ul>
4	Set the operation Menu for alarm trigger value in CH1.

### Do Event Type (Related to Alarm)

The following table presents the alarm action type codes:

Class	DO1 to DO3	Alarm type	Behavior diagram
	0	No alarm	—
Absolute Alarm	1	Upper-limit absolute value.	
	2	Lower-limit absolute value.	
	3	Upper-limit absolute value (with hold).	
	4	Lower-limit absolute value (with hold).	

Class	DO1 to DO3	Alarm type	Behavior diagram
Deviation Alarm	5	Upper-limit deviation.	
	6	Lower-limit deviation.	
	7	Upper/lower limits deviation.	
	8	Upper-limit deviation (with hold).	
	9	Lower-limit deviation (with hold).	
	10	Upper/lower limits deviation (with hold).	
Range Alarm	11	Range upper/lower limits deviation (ALN1/2 independent operation).	
	12	Range upper/lower limits absolute value.	
	13	Range upper/lower limits deviation.	
	14	Range upper limit absolute value and lower limit deviation.	
	15	Range upper limit deviation and lower limit absolute value.	

The following table presents the Alarm Action Type Codes with dual set values:

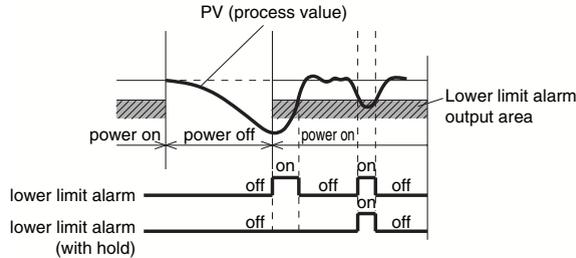
Class	DO1 to DO3	Alarm type	Behavior diagram
Upper/ Lower limit Alarm	16	Upper/lower limits absolute value.	
	17	Upper/lower limits deviation.	
	18	Upper limit absolute value and lower limit deviation.	
	19	Upper limit deviation and lower limit absolute value.	
	20	Upper/lower limits absolute value (with hold).	
	21	Upper/lower limits deviation (with hold).	
	22	Upper limit absolute value and lower limit deviation (with hold).	
	23	Upper limit deviation and lower limit absolute value (with hold).	

Class	DO1 to DO3	Alarm type	Behavior diagram
Range Alarm	24	Range upper/lower limits absolute value.	
	25	Range upper/lower limits deviation.	
	26	Range upper limit absolute value and lower limit deviation.	
	27	Range upper limit deviation and lower limit absolute value.	
	28	Range upper/lower limits absolute value (with hold).	
	29	Range upper/lower limits deviation (with hold).	
	30	Range upper limit absolute value and lower limit deviation (with hold).	
	31	Range upper limit deviation and lower limit absolute value (with hold).	

- **ALn** Set value of Alarm 1 and Alarm 2
- **PV** Process Value
- **SV** Setpoint Value

**NOTE:**

The alarm will not turn ON immediately when the process value gets into the alarm band and enters again. If without hold, alarm may turn on when starting up.



- When alarm action code is changed, alarm set value may also become different from previous settings.
- When alarm action type code is changed, turn off the power once, and then re-start the controller, before starting control.
- ALn: AL1 to AL3 show the alarm set values.
- ALnh: AL1h to AL3h show the alarm set values.
- ALnL: AL1L to AL3L show the alarm set values.

**DO Event Type (Not related to Alarm)**

The following table presents the DO events type (not related to alarm):

Class	DO1 to DO3	Function
Ramp/Soak delay start	35	Delay start enable
Break	41	Loop break alarm 1
Condition Output	51	During auto-tuning
	52	Normal operation
	53	Standby
	54	Manual mode
	55	Remote mode
	56	During ramp SV

<b>Class</b>	<b>DO1 to DO3</b>	<b>Function</b>
Ramp/ Soak Event Output	60	OFF state
	61	RUN state
	62	HOLD state
	63	GS (guaranteed soak) state
	65	END state
Time Signal	71	Time signal (1st segment)
	72	Time signal (2nd segment)
	73	Time signal (3rd segment)
	74	Time signal (4th segment)
	75	Time signal (5th segment)
	76	Time signal (6th segment)
	77	Time signal (7th segment)
	78	Time signal (8th segment)
	79	Time signal (9th segment)
	80	Time signal (10th segment)
	81	Time signal (11th segment)
	82	Time signal (12th segment)
	83	Time signal (13th segment)
	84	Time signal (14th segment)
	85	Time signal (15th segment)
	86	Time signal (16th segment)
	87	Time signal (17th segment)
	88	Time signal (18th segment)
	89	Time signal (19th segment)
	90	Time signal (20th segment)
	91	Time signal (21st segment)
	92	Time signal (22nd segment)
	93	Time signal (23rd segment)
	94	Time signal (24th segment)
	95	Time signal (25th segment)
	96	Time signal (26th segment)
	97	Time signal (27th segment)
	98	Time signal (28th segment)
	99	Time signal (29th segment)

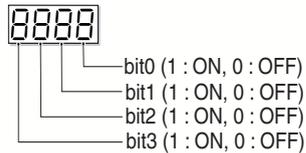
Class	DO1 to DO3	Function
Time Signal	100	Time signal (30th segment)
	101	Time signal (31st segment)
	102	Time signal (32nd segment)

### Setting DO Option Function

It allows to set for each DO:

- event settings
- option functions

The DO events are set by each digit as follow:



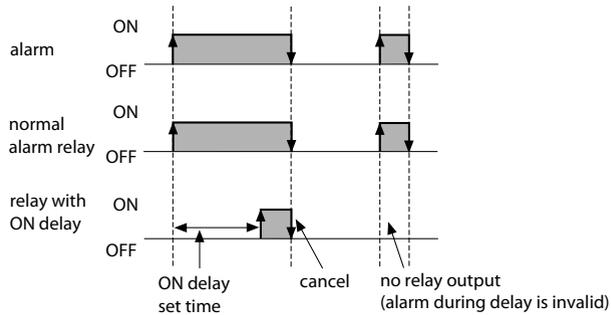
bit	Function	Description
bit0	Event output latch function	Latches (maintains) the DO when the events starts
bit1	Error alarm function	Outputs when the unit receives an input error <i>UUUU</i> or <i>LLLL</i> is displayed. Set DO event to 0 when using this function.
bit2	Non-excitation output alarm function	Reverses the output signal and outputs it through the DO terminal when the event starts.
bit3	Hold reset function	When using an alarm with hold, the hold function will reset when any of the following operations occur: <ul style="list-style-type: none"> <li>● SV change</li> <li>● Alarm type change</li> <li>● Alarm set value change</li> <li>● Standby cancel</li> <li>● Power reset</li> </ul>

## Setting the Alarm menu

The Alarm menu can be configured using the:

- Hysteresis function  
The hysteresis band is preserved during alarm output.
- Delay function  
When events (including alarm) occur, the digital output does not begin outputting immediately. Instead, the event continues for a specified period of time before outputting digital output. This is called a delay function because there is a delay between the event and the outputting to digital output.

The figure below is an example of Alarm delay



The following explains how to set an alarm delay and hysteresis:

Step	Action
1	Display the alarm menu <i>ALM CH 00</i> .
2	Display hysteresis 1 <i>H 1h4</i> .
3	Display delay time 1 <i>dLY 1</i> and set the delay.
4	Display delay time units 1 <i>dL U</i> and set the units to minutes or seconds.
5	Set the values for alarm 2 to alarm 3 as necessary
6	Press the key (SEL) to set the value.

**Setting the Operation menu (Alarm trigger value)**

The following explains how to set an alarm value when DO used as an alarm output an alarm output:

Step	Action
1	Display the alarm menu <i>AL1 CH1</i> .
2	Set the alarm 1 set value <i>AL1</i> or <i>AL1L</i> and <i>AL1H</i> . <b>NOTE:</b> The parameters displayed will vary according to the type of alarm.
3	Repeat Step 2 up to alarm 3 as necessary.
4	Press the key <b>SEL</b> to set the value.

## Soft Start

### Overview

When turning on the equipment (including the temperature controller), the Soft Start function suppresses the MV to become maximum output. It places an upper limit on MV output for a specified amount of time after power is turned on.

This function is useful for effects such as suppressing the heater output during equipment startup, or lightening the load.

#### NOTE:

- The Soft Start function cannot be used simultaneously with the valve control functions and the dual control.
- During manual mode, the manual output value has priority, but Soft Start will continue to keep track of the set time period.

### Normal Control

After the specified time has passed after switching on the equipment (or if  $SSFTN = 0$ ), the Soft Start function ends and normal controls begin:

Display	Parameter	Function
$SF_{01}$	MV1 Soft Start output Setpoint value	Places a limit on MV1 output after power is turned on for a time period set in $SSFTN$ .
$SSFTN$	Soft Start set time	Sets the time for soft start to function after turning power on. Setting "0" will turn off soft start.

### How to set the Soft Start

**NOTE:** Do not use auto-tuning at the same time.

The following table explains how to set Soft Start output set value and set time:

Step	Action
1	Display the setup menu. $SET CH 6$ .
2	Display soft start output 1 $SF_{01}$ and set the output value.
3	Display soft start set time $SSFTN$ and set the time.
4	Press the <b>(SEL)</b> key to set the value.
5	Turn off the power once, and then re-start the controller to begin soft start. (When the soft start function is turned on, the lower display will alternate showing SoFT and SV.)



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## Other Functions of REG48/REG96

# 5

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### What Is in This Chapter?

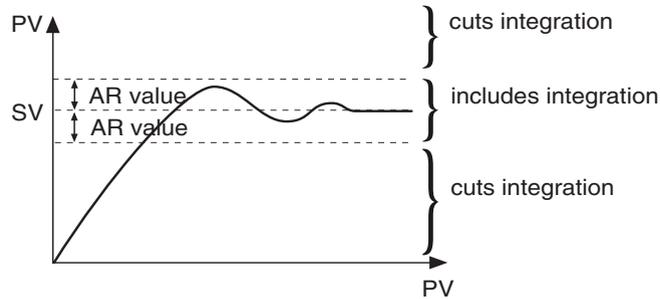
This chapter contains the following topics:

Topic	Page
Anti-reset windup (Ar) and Output Convergence Value (bAL)	90
MV Limit	91
Ramp SV	93
SV Selection	95
PID Selection	97
Error Output	99
Standby Output	100

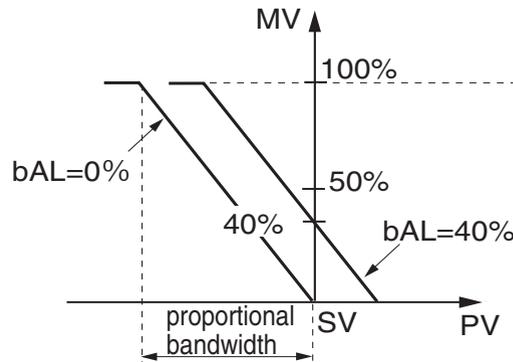
## Anti-reset windup (Ar) and Output Convergence Value (bAL)

### Overview

The anti-reset windup function  $Ar$  cuts integration that falls outside of the Ar set range that is centered around SV. Running auto-tuning will set the optimum values for  $P$ ,  $I$ , and  $d$  parameters, as well as Ar.



The output convergence value function  $bAL$  outputs to PV and SV a calculated result of the PID computed MV plus the bAL offset. (The factory setting of bAL is 0% for single output, 50% for dual output.)



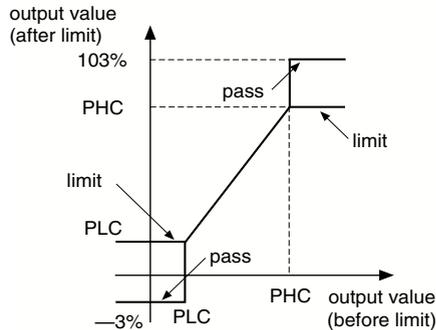
**NOTE:** Ar1 to Ar7 and bAL1 to bAL7 have the same function as in each PID group.

## MV Limit

### Overview

The MV limit function allows you to choose whether to limit the MV or let it pass through maximum and minimum MV.

### MV Limit Settings Values



The following are the MV limit values that can be set:

PCUT	MV1		MV2	
	PHC1	PLC1	PHC2	PLC2
0 9999	103%	-3%	103%	-3%
1 9999	103%	limit	103%	-3%
2 9999	limit	-3%	103%	-3%
3 9999	limit	limit	103%	-3%
4 9999	103%	-3%	103%	limit
5 9999	103%	limit	103%	limit
6 9999	limit	-3%	103%	limit
7 9999	limit	limit	103%	limit
8 9999	103%	-3%	limit	-3%
9 9999	103%	limit	limit	-3%

PCUT	MV1		MV2	
	PHC1	PLC1	PHC2	PLC2
1088	limit	-3%	limit	-3%
1188	limit	limit	limit	-3%
1288	103%	-3%	limit	limit
1388	103%	limit	limit	limit
1488	limit	-3%	limit	limit
1588	limit	limit	limit	limit

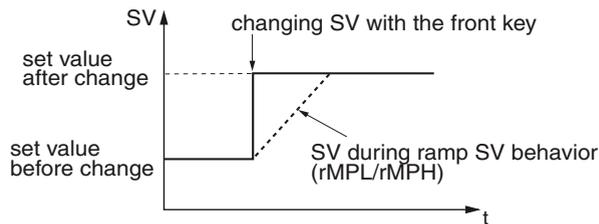
## Ramp SV

### Overview

The ramp SV function suppresses a sudden change in SV (step change) when changing SV. It allows SV to change smoothly according to the set slope of temperature per unit of time. This smooth SV change allows you to minimize the effect of the change on controls.

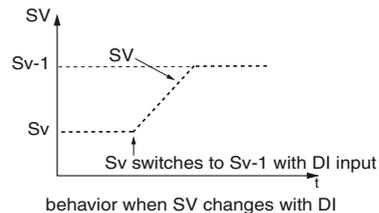
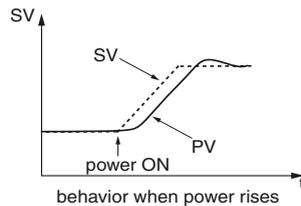
You can set both inclining temperature and declining temperature slopes, and choose from "minutes" or "hours" for the time units.

The curve below shows the current value or the target value during ramp SV.



The SV lamp will blink while ramp SV is running. (When not displaying parameters or Ch.).

When you turn on the power while ramp SV is in effect, ramp SV will begin using the starting value of PV (PV start).



Ramp SV function operates differently from normal PV start if the power is turned on during the input error or released standby:

State at PV start	Operation
Standby	PV tracking (maintains the state where SV=PV. The Ramp SV does not operate.
Auto or manual	Starts the Ramp SV from the current SV (PV start is off).

## CAUTION

### UNEXPECTED APPLICATION BEHAVIOR

Do not turn on the device during an input error or released standby.

**Failure to follow these instructions can result in injury or equipment damage.**

### Setting the Ramp SV

The following explains how to set the Ramp SV:

Step	Action
1	Display the system menu <i>545 Ch 7</i> .
2	Set both Ramp SV decline <i>rPPL</i> and incline.
3	Set the unit of time for the slope <i>rPPU</i> during ramp SV.
4	Press the  key to set the value.

#### NOTE:

- Ramp SV can be used with remote SV or SV selection functions.
- Ramp SV cannot be used at the same time with Ramp/Soak.
- Coming out of a standby state will begin PV start.
- The controller parameters have to be checked after changing PV scale.

## SV Selection

### Overview

The SV selection function can record and switch up to eight sets of SV information to the palette menu settings. It is effective when the SV used during a process are numerous and the set values have been previously decided.

### Setting the SV selection function

The following table explains how to set the SV information:

Step	Action
1	Display the palette menu $PLT [h]$ .
2	Display SV setting 1 $SV1$ and set SV1. <b>NOTE:</b> Set SV setting 2 through SV setting 7 the same way.
3	Press the $(SEL)$ key to set the value.

### Switching SV methods

There is four methods allowing the user to switch SV:

- using  $SVn$  parameter.
- Press the User Key.
- Press  $SVn$  parameter via the Communication function.

The following table explains how to switch SV using  $SVn$  parameter:

Step	Action
1	Display the operation $OP [h]$ menu.
2	Display the selected SV number $SVn$ and choose the SV number.
3	Press the $(SEL)$ key to set the value.

The following table explains how to switch SV using the User Key:

Step	Action
1	Display the operation <i>PLF [h]</i> menu.
2	Display max selected SV number <i>SVnH</i> . and set the SV number by choosing it with the User Key.
3	Display the User Key function setting <i>UEY</i> and set it to SV selection function.
4	On the PV/SV display, pressing the user key will switch you from the currently selected SV to the next SV.

The following table explains how to switch SV using *SVnB* parameter via the Communication Function:

Step	Action
1	In the communication, overwrite the set value to the selected SV number <i>SVnB</i> .

## PID Selection

### Overview

The SV selection function can record and switch up to eight sets of PID parameters from the Palette menu setting.

It is effective when the control equipment changes the target often and must frequently change the PID parameters.

### CAUTION

#### UNEXPECTED EQUIPMENT OPERATION

Do not switch normal and reverse operation during control.

**Failure to follow these instructions can result in injury or equipment damage.**

### Setting the PID selection

The following table explains how to set the PID selection:

Step	Action
1	Display the palette menu <i>PLT [h03]</i> .
2	Display proportional bandwidth setting 1 <i>P1</i> and set P1.
3	Set <i>L1</i> and <i>d1</i> in the same way. The following parameters have to be set as necessary: <ul style="list-style-type: none"> <li>● ON/OFF control hysteresis <i>hys1</i></li> <li>● cooling proportional band <i>COL1</i></li> <li>● Dead band <i>db1</i></li> <li>● balance <i>BR1</i></li> <li>● anti-reset windup <i>RR1</i></li> <li>● normal/reverse setting <i>REU1</i></li> </ul>
4	Press the  key to set the value.

### Switching SV methods

The PID parameter selection (P, i, D normal and reverse setting) can be change:

- using *PLN1* parameter
- using the User Key

The following table explains how to switch using  $PID$  parameter:

Step	Action
1	Display the operation $OPR [h88]$ menu
2	Display the selected PID number $PID$ and choose the PID number.
3	Press the $(SEL)$ key to set the value.

**NOTE:** When the user key function code is 27 (SV No.+1, PID No.+1 (send)) and the initial PID No. and SV No. are different, the first time you press the user key, PID No. will become the same as SV No. Also the SVMX parameter value becomes the maximum selectable number for PID No. and SV No.

The following table explains how to switch using the User Key:

Step	Action
1	Display the operation $PLR [h88]$ menu.
2	Display max selected PID number $PID$ , and set the PID number by choosing it with the User Key.
3	Display the User Key function setting $UEY$ and set it to PID selection function.
4	On the PV/SV display, pressing the user key will switch you from the currently selected PID to the next PID.

## Error Output

### Overview

When the error output specification function has concluded that the equipment has an error, it halts the temperature controls and maintains the control output at a previously specified value. There is an error in PV if any of the following conditions occur:

- burnout upper limit
- burnout lower limit
- underage (PV < -5% FS)
- overage (105% < PV)

### Setting the Error Output function

The following table explains how to set the error output function:

Step	Action
1	Display the Setup menu $\overline{SEF}$ $[h88]$ .
2	Display the FALT output 1 set value $F_{Lo1}$ and set the output value. <b>NOTE:</b> For dual control, set $F_{Lo2}$ the same way.
3	Press the $\overline{SEL}$ key to set the value.

## Standby Output

### Overview

This function is used to set the:

- control output value
- alarm output
- PV/SV display

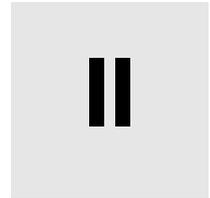
### Setting the Standby Output Function

The following table explains how to set the standby output function:

Step	Action
1	Display the setup menu $\zeta \zeta \zeta \zeta \zeta \zeta$ .
2	Display the standby mode setting ( <i>see page 56</i> ) $\zeta \zeta \zeta \zeta$ and set the: <ul style="list-style-type: none"><li>● control output value</li><li>● alarm output</li><li>● PV/SV display</li></ul>
3	Display the standby control output 1 set value $\zeta \zeta \zeta \zeta$ and set the output value. <b>NOTE:</b> For dual control, set $\zeta \zeta \zeta \zeta$ the same way.
4	Press the (SEL) key to set the value.

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## Appendices





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# REG48/REG96 Error Message and Factory Settings

# 6

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## What Is in This Chapter?

This chapter contains the following topics:

Topic	Page
Error Indications	104
Return to Factory Default Setting Function	105

## Error Indications

### Display During Equipment Error

This controller has a display function to indicate several types of error code shown below. If any of the error code is displayed, please eliminate the cause of error immediately. After the cause is eliminated, turn off the power once, and then re-start the controller:

Display	Possible cause	Control output
UUUU	<ul style="list-style-type: none"> <li>● Thermocouple burnout.</li> <li>● Resistance bulb sensor (A) burnout.</li> <li>● PV exceeds upper limit of the range by 5%FS.</li> </ul>	Output as setting value when an error occurs (set in parameter Flo1 or Flo2).
LLLL	<ul style="list-style-type: none"> <li>● Resistance bulb sensor B or C wire burnout.</li> <li>● Resistance bulb sensor (between A &amp; B or A &amp; C) short.</li> <li>● PV is below limit of the range by 5%FS.</li> <li>● Burnout or short in the voltage input.</li> </ul>	
LLLL	<ul style="list-style-type: none"> <li>● PV &lt; -199.9</li> </ul>	
Err (SV flickers)	incorrect setting (Pvb/PvF).	
PV is displayed	<ul style="list-style-type: none"> <li>● H'4000 is added into the dP30 set value.</li> <li>● SbMd set value is set at 4 to 7, and STbY is ON.</li> </ul>	Normal control <ul style="list-style-type: none"> <li>● The controller does not have to be restarted.</li> </ul>
SV is displayed	<ul style="list-style-type: none"> <li>● H'2000 is added into the dP30 set value.</li> <li>● SbMd set value is set at 4 to 7, and STbY is ON.</li> </ul>	Normal control <ul style="list-style-type: none"> <li>● The controller does not have to be restarted.</li> </ul>
Parameters may no be displayed	<ul style="list-style-type: none"> <li>● Check the settings of dP01 to dP30.</li> <li>● Check the password function.</li> </ul>	Normal control <ul style="list-style-type: none"> <li>● The controller does not have to be restarted.</li> </ul>

**NOTE:** The error display does not appear even when it must appear depending on the setting of parameter SbMd *SET CH 6*.

## Return to Factory Default Setting Function

### Setting the Return to Factory Default Setting Function

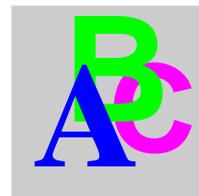
Follow the steps below to return all values to the factory default setting:

Steps	Actions
1	Display the password setup <i>PR5 CH 11</i>
2	Display <i>PR5 1</i> and set <i>FE01</i>
3	Display <i>PR5 2</i> and set <i>FE02</i>
4	Display <i>PR5 3</i> and set <i>FE03</i>
5	Press the  to return to the PV display
6	Press and hold the  key to display <i>PR5 1</i>
7	Press  key to display to display <i>PR5 5</i> and set <i>FE00</i>
8	When the <i>PR5 5</i> setting returns to <i>0000</i> , the values have finished returning to their factory default settings.



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