Allen-Bradley

Temperature Controller

Bulletin No. 900-TC8

User Manual

Rockwell Automation

Important User Information

Solid state equipment has operational characteristics differing from those of electromechanical equipment. "*Safety Guidelines for the Application, Installation and Maintenance of Solid State Controls*" (Publication SGI-1.1 available from your local Rockwell Automation Sales Office or online at **http://www.ab.com/manuals/gi**) describes some important differences between solid state equipment and hard-wired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation, Inc. with respect to use of information, circuits, equipment, or software described in this manual.

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Throughout this manual we use notes to make you aware of safety considerations:

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss

Attention statements help you to:

- identify a hazard
- avoid a hazard
- recognize the consequences

IMPORTANT

Identifies information that is critical for successful application and understanding of the product.

European Communities (EC) Directive Compliance

If this product has the CE mark it is approved for installation within the European Union and EEA regions. It has been designed and tested to meet the following directives.

EMC Directive

This product is tested to meet the Council Directive 89/336/EC Electromagnetic Compatibility (EMC) by applying the following standards, in whole or in part, documented in a technical construction file:

EN 61326 EMC Requirements — Electrical Equipment for Control, Measurement and Laboratory Use

This product is intended for use in an industrial environment.

Low Voltage Directive

This product is tested to meet Council Directive 73/23/EEC Low Voltage, by applying the safety requirements of EN 61010-1 Safety Requirements for Electrical Equipment for Control, Measurement and Laboratory Use — General Requirements. For specific information, see the appropriate sections in this publication, as well as the Allen-Bradley publication Industrial Automation Wiring and Grounding Guidelines For Noise Immunity, Publication 1770-4.1.

This equipment is classified as open equipment and must be mounted in an enclosure during operation to provide safety protection.

Notes:

Parameter Adjustments and Application Considerations

Chapter 4

Parameter Functions and Definitions

Chapter 5

Troubleshooting and Error Indication

Chapter 6

Appendix A

Appendix B

Calibration

Appendix C

Safety Precautions

Safety Signal Words

This manual uses the following signal word to mark safety precautions for the Bulletin 900-TC8.

These precautions provide important information for the safe application of the Bulletin 900-TC8 Temperature Controller. You must make sure to follow the instructions provided in all safety precautions.

ATTENTION

Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss

Conventions Used in This Manual

Meanings of Abbreviations

The following abbreviations are used in parameter names, figures, and in text explanations. These abbreviations mean the following:

Table P.A

Symbol	Term
PV	Process value
SP	Set point
AT	Auto-tuning
ST	Self-tuning
EU	Engineering unit ❶

❶ "EU" stands for Engineering Unit. EU is used as the minimum unit for engineering units such as °C, m, and g. The size of EU varies according to the selected input type. For example, when the configured input temperature range is –200…+1300°C, 1 EU is 1°C, and when the input temperature setting range is –20.0…+500.0°C, 1 EU is 0.1°C. In the case of analog input, the size of EU varies according to the decimal point position of the scaling setting, and 1 EU becomes the minimum scaling unit.

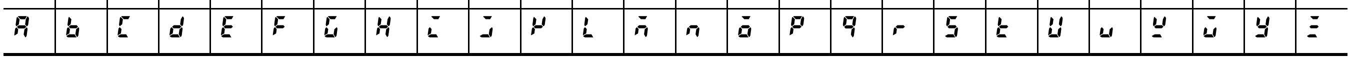
Note: For additional definitions of terms used in this manual, see Appendix D, *Glossary*.

How to Read Display Symbols

The following table shows the relationship between the symbols exhibited on the controller's front panel displays to alphabet characters.

Table P.B

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z

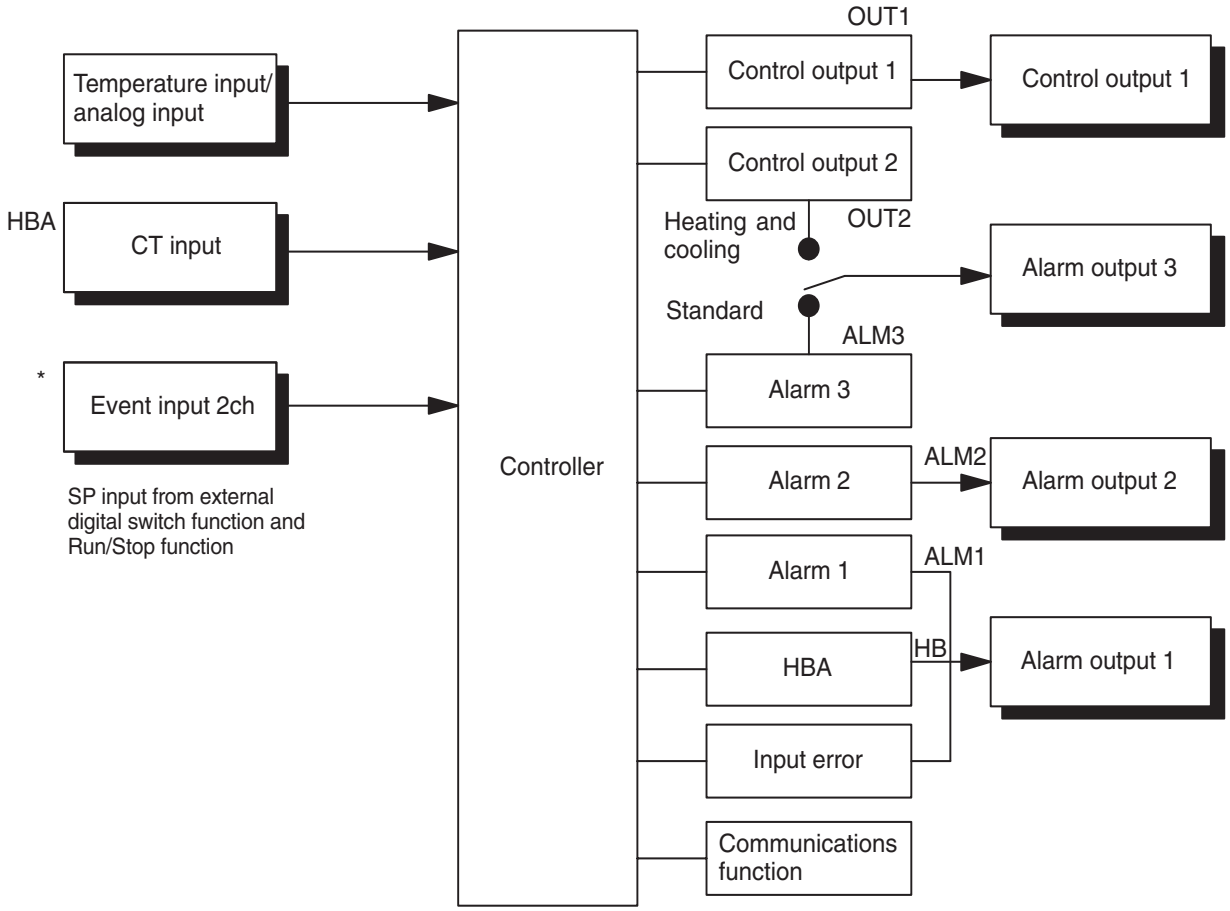


Bulletin 900-TC8 Input and Output Overview

I/O Configuration and Main Functions

I/O Configuration

Figure 1.1



The Bulletin 900-TC8 temperature controller allows the user to carry out the following:

- Select from thermocouple and platinum RTD temperature sensors, plus non-contact temperature sensor and analog input
- Select heating and cooling control in addition to standard control
- Select AT (auto-tuning) and ST (self-tuning) as tuning functions
- Use multi-SP and the RUN/STOP function according to event input (for units equipped with the event input function)

- Use the HBA (heater burnout alarm) function (for units equipped with the heater burnout alarm function)
- Use the communications function (for units equipped with either the optional Cat. No. 900-TC8232 or Cat. No. 900-TC8COM communications function modules)
- Calibrate sensor input
- The Bulletin 900-TC8 features a watertight construction (NEMA4X).
- The Bulletin 900-TC8 conforms to cULus/IEC safety standards and EMC standards.

Main Functions

The following introduces the main functions of the Bulletin 900-TC8. For details on each function and how to use the functions, see Chapter 3 and onward.

- Input Sensor Types — The following input sensors can be connected for temperature input:
  - Thermocouple: K, J, T, E, L, U, N, R, S, B
  - Infrared non-contact temperature sensor type: Type K thermocouple (10…70**X**C), K (60…120**X**C), K (115…165**X**C), K (160…260**X**C)
  - Platinum resistance thermometer: Pt100, JPt100
  - Analog input: 0…50 mV
- Control Output — Control output is either an On/Off electro-mechanical relay, On/Off voltage (solid-state relay) output, or analog current (DC: 4...20 mA) output depending on the model of Bulletin 900-TC8.

  If you select heating and cooling control on the Bulletin 900-TC8, alarm 3 output is used as cooling output. So, use alarm 1 and/or 2 if an alarm is needed in heating and cooling control.
- Alarms — Alarms are supported on the Cat. No. 900-TC8. You can configure the alarm type and alarm value, or upper- and lower-limit alarms.

  If necessary, a more comprehensive alarm function can be achieved by setting the Standby Sequence, Alarm Hysteresis, Close in Alarm/Open in Alarm and Alarm Latch ON/OFF parameters.

  When the input error output is set to ON, alarm output 1 turns ON

when an input error occurs.

- Control Adjustment — Optimum PID constants can be configured easily by AT (auto-tuning) and ST (self-tuning).
- Event Input — When the option event input unit Cat. No. 900-TC8 is mounted in the Bulletin 900-TC8, the following functions can be achieved by event input:

  Multiple set point selection (multi-SP max. 4 points) and RUN/STOP mode change.
- HBA — The heater burnout alarm (HBA) function is supported by selecting the appropriate controller. See Table 1.A.
- Communications Function — Personal computer (PC) communications are supported when the option communications unit 900-TC8232 or 900-TC8COM is mounted on the Bulletin 900-TC8. **Note:** The PC must have 900Builder software installed.

Hardware Versions

The following table provides the list of controller base features with associated cat. nos.

Table 1.A

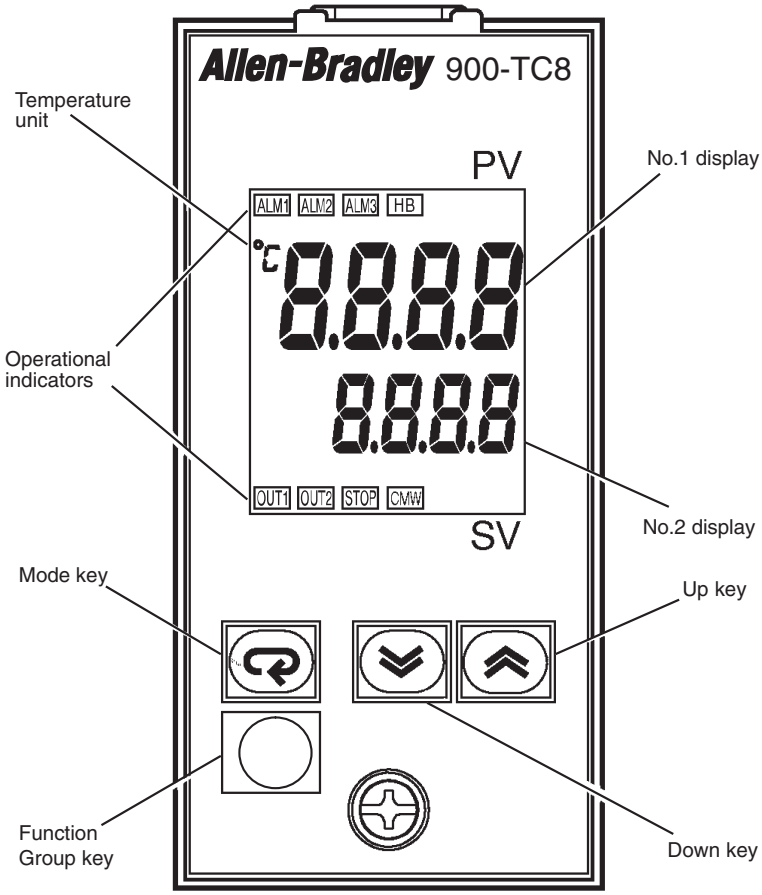
DIN Size (Dimensions) (mm)	Power Supply Voltage	No. of Alarms Supported	Control Output Type	Supports Heater Burnout Alarm	Controller Cat. No. with Thermocouple Support	Controller Cat. No. with Platinum RTD Support
1/8 DIN (48 x 96 x 78)	100…240V AC	3	Relay output	No	900-TC8RTZ25	900-TC8RPZ25
				Yes	900-TC8RTHZ25	900-TC8RPHZ25
			Voltage output (for driving SSR)	No	900-TC8VTZ25	900-TC8VPZ25
				Yes	900-TC8VTHZ25	900-TC8VPHZ25
			4...20 mA analog output	No	900-TC8ACTZ25	900-TC8ACPZ25
	24V AC/DC	3	Relay output	No	900-TC8RTU25	900-TC8RPU25
				Yes	900-TC8RTHU25	900-TC8RPHU25
			Voltage output (for driving SSR)	No	900-TC8VTU25	900-TC8VPU25
				Yes	900-TC8VTHU25	900-TC8VPHU25
			4...20 mA analog output	No	900-TC8ACTU25	900-TC8ACPU25

Note: To implement the Heater Burnout Alarm (HBA) function, a current transformer (Cat. No. 900-CT1 or 900-CT2) is required. A current transformer is **not** provided with the controller.

Note: When the heating and cooling function or the heater burnout alarm is used, one of the alarm outputs will be disabled for each function used.

Front Panel and Displays

Figure 1.2



Display Meanings

- **No. 1 Display —** Displays the Process Value or parameter type. Lights for approximately one second during startup.
- **No. 2 Display —** Displays the Set Point, parameter operation read value, manipulated variable, or set value (setup) of the parameter.

- **Operational Indicators**
  - ALM1 (alarm 1)
    Lights when alarm 1 output is ON.
  - ALM2 (alarm 2)
    Lights when alarm 2 output is ON.
  - ALM3 (alarm 3)
    Lights when alarm 3 is ON.
  - HB (heater burnout alarm display)
    Lights when a heater burnout is detected.
  - OUT1, OUT2 (control output 1, control output 2)
    Lights when control output 1 and/or control output 2 are ON.
  - STOP
    Lights when the control function of the Bulletin 900-TC8 has stopped.
  - CMW (communications writing control)
    Lights when communications writing is "enabled" and is out when it is "disabled."

- Temperature Unit — The temperature unit is displayed when the display unit parameter is set to a temperature. Indication is determined by the currently selected Temperature Unit parameter value. When this parameter is configured for °C, C is displayed, and when configured for °F, F is displayed. The display flashes during self-tuning (ST) operation.

Basic Keypad Functions

The following describes the basic functions of the front panel keys.

- ○ function group select key — Press this key to select the desired function group. The groups are selected in the following order: "Operation function group" ←→ "Adjustment function group", "Initial Setting function group" ←→ "Communications Setting function group".

- ↵ mode select key — Press this key to select the various parameters within each function group.

- ⌃ up key — Each press of this key increments values displayed on the No. 2 (SV) display. Holding down this key continuously increments values.

- ⌄ down key — Each press of this key decrements values displayed on the No. 2 (SV) display. Holding down this key continuously decrements values.

- ○ + ↵ key combination — This key combination sets the Bulletin 900-TC8 to the "Protect function group." For details on the Protect function group, see Chapter 5 — *Parameter Functions and Definitions*.

Notes:

Preparations

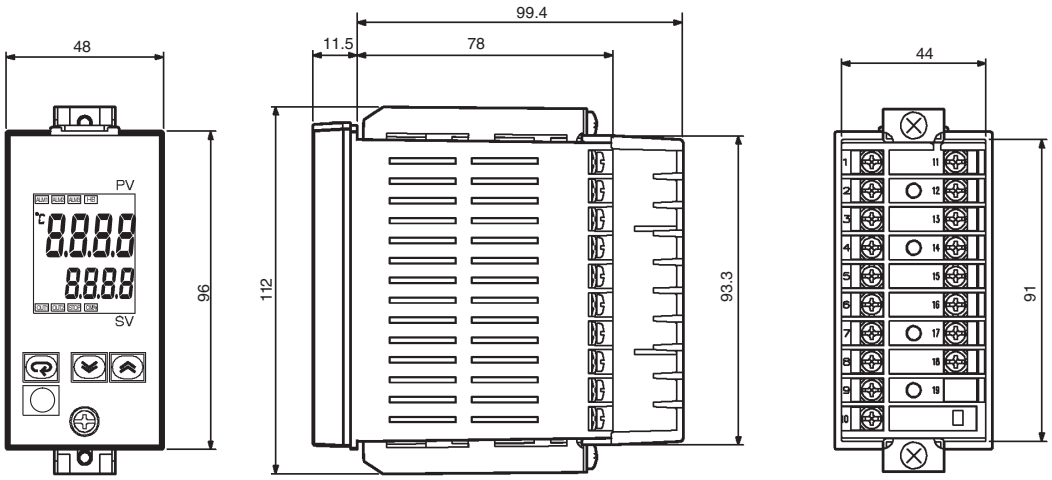
Hardware Installation

Approximate Dimensions

Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.

Note: To convert millimeters to inches, multiply by 0.0394.

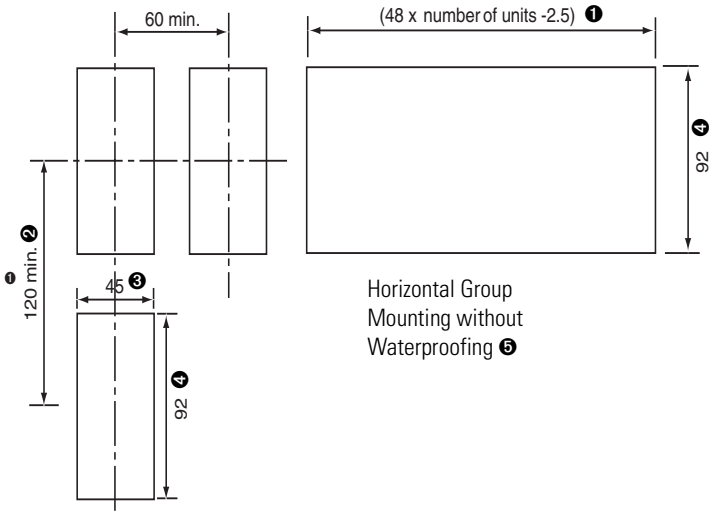
Figure 2.1



Panel Cutout Dimensions

Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.

Figure 2.2



❶ Tolerance: +1.0…–2.5 mm
❷ Maintain the specified mounting space between each controller. Controllers must not be group mounted vertically.
❸ Tolerance: +0.6…0.0 mm
❹ Tolerance: +0.8…0.0 mm
❺ This is a configuration in which the controllers are contiguously mounted (side-by-side). Therefore, the water-proof gasket cannot provide protection.

- Horizontal group-mounting two or more temperature controllers, or mounting temperature controllers above each other may cause heat to build up inside the temperature controllers, which will shorten their service life. When mounting temperature controllers like this, consider forced cooling measures such as a cooling fan.

- If forced air cooling is used, limit cooling to the terminal block. Rapid variation or transients in temperature at the terminal block may result in a measurement error.

System Wiring and Installation Guidelines

ATTENTION

Risk of Electrical Shock

- Devices are Open Type, Listed Process Control Equipment and must be mounted in an enclosure.
- More than one disconnect switch may be required to de-energize the equipment before servicing.
- Signal inputs are SELV, limited energy.
- To reduce risk of fire or electrical shock, do not interconnect the outputs of different Class 2 circuits.
- Disconnect all power (including field device) before installing and/or servicing.
- Do not touch the controller's wiring terminals while the power is ON. Doing so may cause an electric shock.

ATTENTION

- Do not allow metal fragments or lead wire scraps to fall inside the Bulletin 900-TC8 Temperature Controller. These may cause electric shock, fire, or malfunction.
- Never disassemble, repair, or modify the Bulletin 900-TC8 Temperature Controller with line or field device power applied. Doing so may cause electric shock, fire, or malfunction.
- Do not use the Bulletin 900-TC8 Temperature Controller in flammable and explosive gas atmospheres.
- Use the Bulletin 900-TC8 Temperature Controller within the rated supply voltage. Not doing so may cause controller damage or fire.
- Configure all controller settings according to the control target of the Bulletin 900-TC8 Temperature Controller. If the settings are not appropriate for the control target, the Bulletin 900-TC8 Temperature Controller may operate in an unexpected manner, resulting in damage to the product or personal injury.
- To maintain safety in the event of a product malfunction, always take appropriate safety measures, such as installing an alarm on a separate line to prevent excessive temperature rise. If a malfunction prevents proper control, an accident may result.
- Do not wire unused terminals.
- Make sure to observe correct polarity when wiring the controller terminals.
- Power supply, input, output, and communication terminals (for models with communications) have basic insulation between them.
  When double insulation is required, apply supplemental insulation defined in IEC 60664 that is suitable for the maximum operating voltage with clearances or solid insulation.

ATTENTION

- Do not use the Bulletin 900-TC8 Temperature Controller in the following places which might exceed its specifications:
  - Places subject to dust or corrosive gases (in particular, sulfide gas, and ammonia gas)
  - Places subject to high humidity, condensation, or freezing
  - Places subject to direct sunlight
  - Places subject to vibration and large shocks
  - Places subject to splashing liquid or oily atmosphere
  - Places directly subject to heat radiated from heating equipment
  - Places subject to intense temperature changes

- To allow heat to escape, do not block the area around the Bulletin 900-TC8 Temperature Controller. (Ensure that enough space is left for the heat to escape.) Do not block the ventilation holes on the casing.

- Cleaning: Do not use paint thinner or the equivalent. Use standard grade alcohol to clean the Bulletin 900-TC8 Temperature Controller.

- Use within the following temperature and humidity ranges:

  Temperature: –10…+55°C,
  Humidity: 25…85% (with no icing or condensation)

  If the Bulletin 900-TC8 is installed inside a control panel, the ambient temperature must be kept to under 55°C, including the temperature around the Bulletin 900-TC8.

  If the Bulletin 900-TC8 is subjected to heat radiation, use a fan to cool the surface of the Bulletin 900-TC8 to under 55°C.

- Never place heavy objects on, or apply pressure to the Bulletin 900-TC8 as it may cause it to deform and deteriorate during use or storage.

ATTENTION

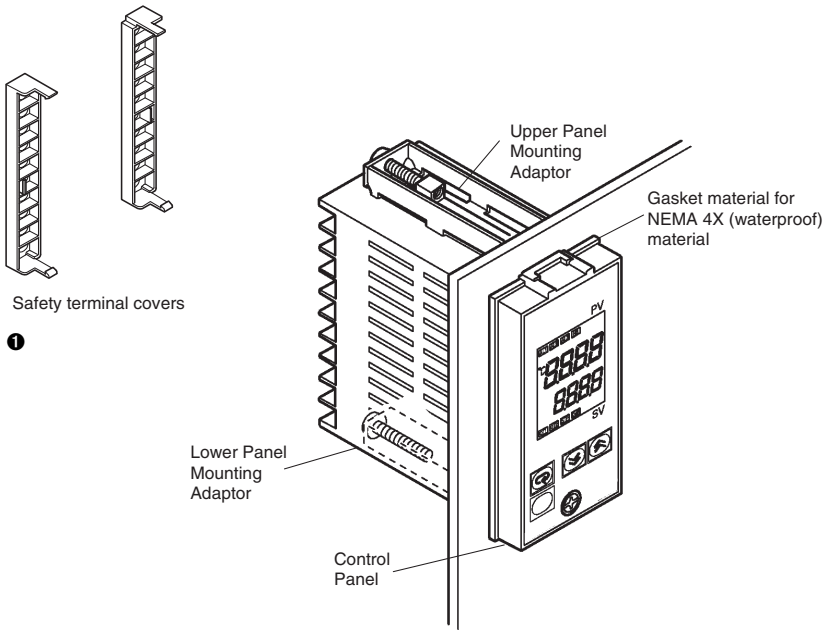
- Store within the following temperature and humidity ranges:

  Temperature: –25…+65°C,
  Humidity: 25…85% (with no icing or condensation)

- Avoid using the Bulletin 900-TC8 in places near a radio, television set, or wireless installation. These devices can cause radio disturbances which may adversely affect the performance of the Bulletin 900-TC8.

Panel Mounting

Figure 2.3



❶ VDE 0106 compliant

How to Attach the Bulletin 900-TC8 on the Panel

1. If water-proofing (NEMA 4X) is required, ensure the gasket material is inserted between the front of the controller's case and the control panel.

2. Insert the Bulletin 900-TC8 into the mounting hole in the panel (1…8 mm panel thickness).

3. Pull the upper and lower panel mounting adapters along the Bulletin 900-TC8 body from the rear of the case up to the panel, and fasten temporarily.

4. Tighten the upper and lower adapter mounting screws alternately with only one turn of the screwdriver at a time to maintain an even torque balance. Tighten the screw until the ratchet mechanism operates.

5. To allow heat to escape, do not block the area around the Bulletin 900-TC8 Temperature Controller. (Ensure that enough space is left for the heat to escape.) Do not block the ventilation holes on the casing.

6. Allow as much space as possible between the Bulletin 900-TC8 and devices that generate powerful high-frequency noise (e.g., high-frequency welders, high-frequency sewing machines) or surges.

7. Install the controller so that it is horizontal (can read the display properly).

Note: When group mounting two or more Bulletin 900-TC8s, make sure that the surrounding temperature does not exceed the allowable operating temperature given in the specifications.

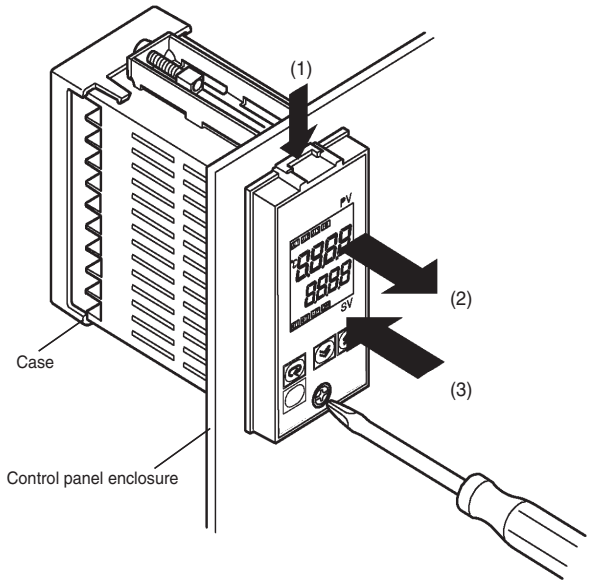
How to Attach the Safety Terminal Cover

After you have completed your I/O and power wiring, fit the safety terminal covers onto the upper and lower hooks. Attach the terminal covers so that the PC mark faces to the outside as you look at the terminals from the rear. If the covers are attached the other way, the finger protection (per VDE 0106) integrity is reduced and the fixture can no longer be attached.

Case Removal while Panel-Mounted

The control unit can be removed from its case whether or not it is mounted on the control panel. This allows you to perform maintenance or to add option units without opening the control panel enclosure or removing the terminal compartment.

Figure 2.4



IMPORTANT Ensure controller and I/O power is OFF before removing the internal mechanism. When you remove the internal mechanism from the housing, never touch electric components inside or subject the internal mechanism to shock.

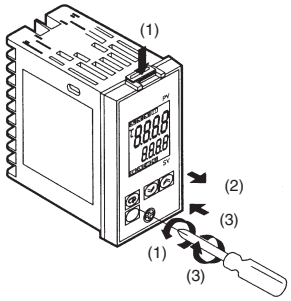
Select a Phillips style screwdriver that can be used on the lower front screw of the control unit. **Note:** Ensure all power is removed from the controller.

1. Loosen the lower front screw (turning left) while pushing down on the hook on the upper surface of the front panel.

2. Grasp both sides of the control unit and draw (pull) it out.

3. Ensure that the waterproof packing is in place before replacing the control unit in the case. Re-tighten the lower front screw (turning right) to a torque of 0.3…0.5 Nm (2.66…4.43 lb-in.) while pushing down on the hook on the upper surface of the front panel.

Figure 2.5



Setting Up the Controller with the Optional Units

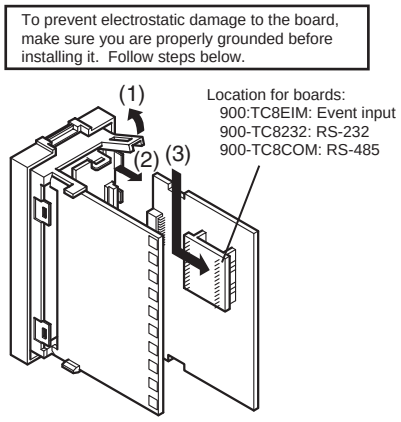
If RS-232, RS-485 communications inputs are required, mount the RS-232 communications unit (Cat. No. 900-TC8232), the RS-485 communications unit (Cat. No. 900-TC8COM), or the event input unit (Cat. No. 900-TC16EIM) in the Bulletin 900-TC8 controller. These units provide optical isolation (approx. 32V DC) between the controller electronics and field input.

Table 2.A

Name	Cat. No. ❶	Function
Communications board	900-TC8COM	RS-485 Communications support
	900-TC8232	RS-232 Communications support
Event input unit	900-TC8EIM	Event input support

❶ One (1) unit per controller.

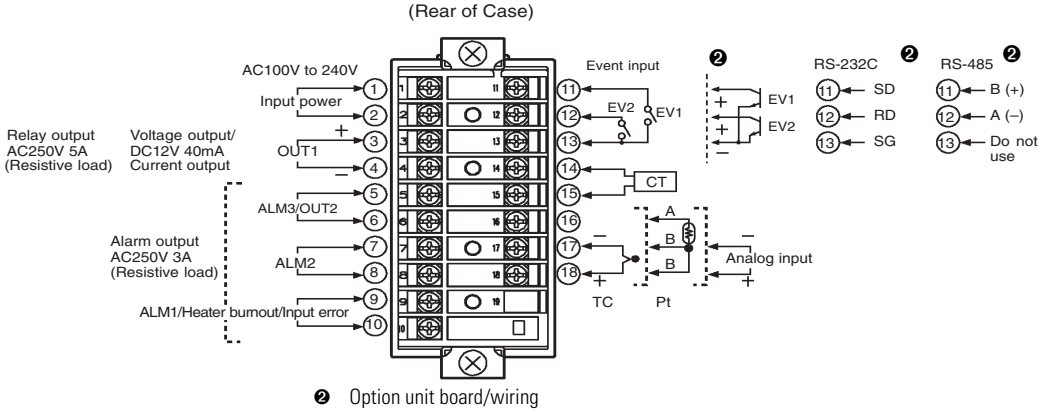
Figure 2.6



Bulletin 900-TC8 Wiring Terminals

Terminal Arrangement

Figure 2.7



❷ Option unit board/wiring

Wiring Guidelines and Precautions

ATTENTION

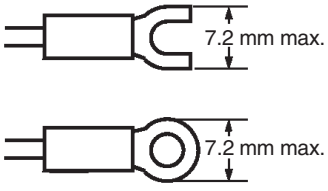
- Do not wire unused terminals.
- Make sure to observe correct polarity when wiring the controller terminals.
- To reduce induction noise, separate the high-voltage or large-current power lines from other lines, and avoid parallel or common wiring with the power lines when you are wiring to the terminals. We recommend using separating pipes, ducts, or shielded lines.
- Allow as much space as possible between the Bulletin 900-TC8 and devices that generate powerful high-frequency noise (e.g., high-frequency welders, high-frequency sewing machines) or surges.

- Separate input leads and power lines in order to protect the Bulletin 900-TC8 and its lines from external noise.
- Use AWG24 or larger twisted pair shielded cable.

Figure 2.8

- We recommend using solderless lugs when wiring to the Bulletin 900-TC8 screw terminals. However, if lugs are not used, the controller's screw terminals will accept two solid or stranded wires (no mixing) between 24…14 AWG.
- Tighten the terminal screws properly. Tighten them to a torque 1.13…1.36 Nm (10…12 lb-in.) Loose screws may cause malfunction.
- Use the following type of solderless lugs for M3.5 screws.

Figure 2.9



Wiring

Power Supply

The controller requires an external power source for operation. Connect to terminals 9 and 10. The following table shows the specifications.

Table 2.B

Input Power Supply	Bulletin 900-TC8
100…240V AC, 50/60 Hz	5.4 VA @ 120V AC, 9 VA @ 240V AC
24V AC, 50/60 Hz	5.0 VA
24V DC (not polarity sensitive)	4 W

ATTENTION

Use a power supply matched to the power specifications of the Bulletin 900-TC8. Also, make sure that rated voltage is attained within 2 seconds of turning the power ON.

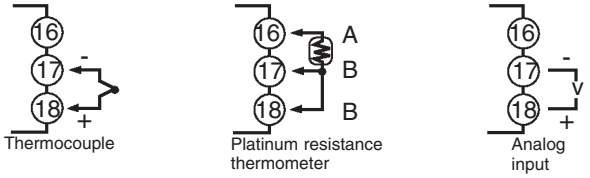
When mounting a noise filter on the power supply, make sure to first check the filter's voltage and current capacity, and then mount the filter as close as possible to the Bulletin 900-TC8.

Standard insulation is applied to the power supply I/O sections. If reinforced insulation is required, connect the input and output terminals to a device without any exposed current-carrying parts or to a device with standard insulation suitable for the maximum operating voltage of the power supply I/O section.

Wiring Input/Sensor Devices

Connect sensors to terminals 16…18 as follows according to the input type.

Figure 2.10



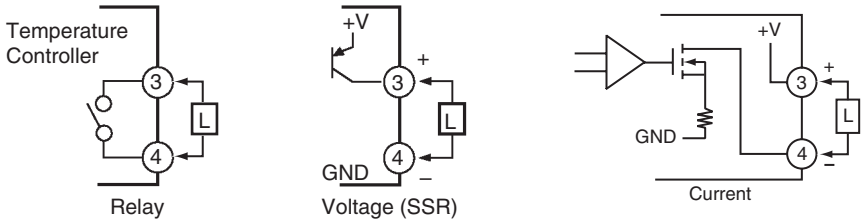
Input/Sensor Wiring Considerations

- When the thermocouple leads are extended, make sure to use thermocouple extension wire matched to the type of thermocouple.
- For a thermocouple, make sure to follow the polarity color code convention.
- If there is a large error in the measurement values, make sure that input compensation has been properly configured.
- RTDs can be either 2- or 3-wire types. If a 3-wire type is used, the controller provides lead wire resistance compensation up to 5 Ω resistance. If using 24 AWG lead wire, this is approximately 59 m of wire. Use larger gauge wire if longer length is required.
- For RTDs, the controller source is approximately 1 mA of current.
- If a cooling fan is used in the panel enclosure, prevent only the terminal block from being cooled when using thermocouples. Otherwise, this may result in a measurement error.
- To reduce induced electrical noise, the leads on the temperature controller's terminal block must be wired separately from large-voltage/large-current power leads. Also, avoid wiring leads in parallel with power leads or in the same wiring path. Other methods such as separating conduits and wiring ducts, or using shield wire are also effective.

Wiring Control Output 1

Terminals 3 and 4 are for control output. The following diagrams show the available outputs and their internal equalizing circuits.

Figure 2.11



The following table shows the specifications for each output type.

Table 2.C

Output Type	Specifications
Relay	5 A @ 250V AC, 10 A @ 30V DC (max. resistive load), electrical life: 100,000 operations 5V, 10 mA (min. resistive load)
Voltage (PNP type)	12V DC $^{+15\%}_{-20\%}$ 40 mA max (with over-current limit protection)
Current	DC 4...20 mA, load: 600 ohms max., resolution: approx. 2,600

Output Wiring Considerations

- The PNP voltage output (control output) is not electrically isolated from the controller's internal circuits. When using a grounded thermocouple, do not connect the control output terminals to earth ground. If the control output terminals are connected to earth ground, errors will occur in the measured temperature values as a result of ground loop leakage current.

- The 4...20 mA analog output is electrically isolated from the other controller circuits as follows:

  – Analog Output to Sensor Input: 500 VAC 50/60 Hz for 1 minute
  – Analog Output to Alarm Output: 2000 VAC 50/60 Hz for 1 minute
  – Analog Output to Input Power Supply: 2000 VAC 50/60 Hz for 1 minute

- The life expectancy of the output relays varies greatly with the switching capacity and other switching conditions. Always use the output relays within their rated load and electrical life expectancy. If an output relay is used beyond its life expectancy, its contacts may become fused or burned.

- Use the Bulletin 900-TC8 Temperature Controller within the rated load. Not doing so may cause damage or fire.

- Attach a surge suppressor or noise filter to peripheral devices that generate noise (in particular, motors, transformers, solenoids, magnetic coils, or other equipment that have an inductance component).

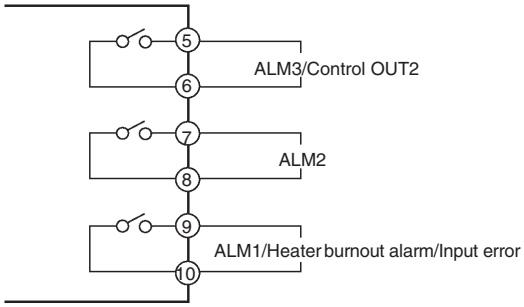
- About 4 seconds are required for control and/or alarm outputs to turn ON when the power is initially turned ON to the controller. Take this into consideration when the temperature controller is incorporated into a sequence circuit.

Wiring Alarm Outputs

On the Bulletin 900-TC8, Alarm Output 1 (ALM1) is across terminals 9 and 10, Alarm Output 2 (ALM2) is across terminals 7 and 8 and Alarm Output 3 (ALM3) is across terminals 5 and 6. When heating and cooling control is used, Alarm Output 3 (ALM3) is used as the cooling output (OUT2).

- When the Input Error Output parameter is configured to ON, alarm output 1 turns ON when an input error occurs.
- When the option unit (Cat. No. 900-TC8232 or 900-TC8COM) is mounted on the Bulletin 900-TC8, an OR of alarm output 1 and the heater burnout alarm will be output. To disable alarm output 1 and output only the heater burnout alarm on terminals 7 and 8, configure the mode of the alarm output 1 to a zero value condition.
- The equivalent circuits for alarm output 1, 2, and 3 are shown in the following diagram.

Figure 2.12



Alarm relay specifications are as follows:

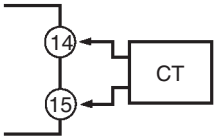
Table 2.D

Type	Voltage	Steady-State Resistive Current
SPST-NO	250V AC/30V DC	3 A/5 A (max. resistive load) electrical life: 100,000 operations
	1V	1 mA (min. resistive load)

Current Transformer (CT) Input

To determine if your controller supports the Heater Burnout function, see Table 1.A. If the Heater Burnout parameter function is used, connect a current transformer (CT) across terminals 14 and 15. For CT dimensions, see p. A-4, *Approximate External Dimensions*.

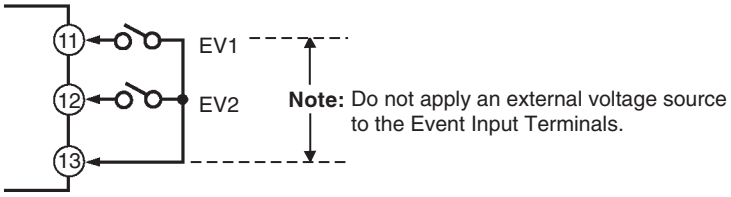
Figure 2.13



Wiring the Event Input

When the option event input unit Cat. No. 900-TC8EIM is mounted in the Bulletin 900-TC8 and event input is used, connect to terminals 11…13.

Figure 2.14

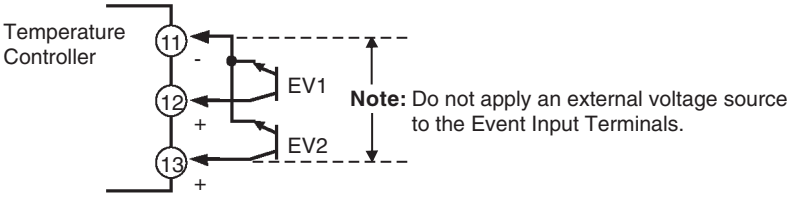


Use event inputs under the following conditions:

- The output current from the controller is approximately 7 mA @ 5V.
- Contact input ON: 1 KΩ max., OFF: 100 KΩ min.
- No-contact input ON: residual voltage 1.5V max., OFF: leakage current 0.1 mA max.

Polarities using non-contact input are as follows:

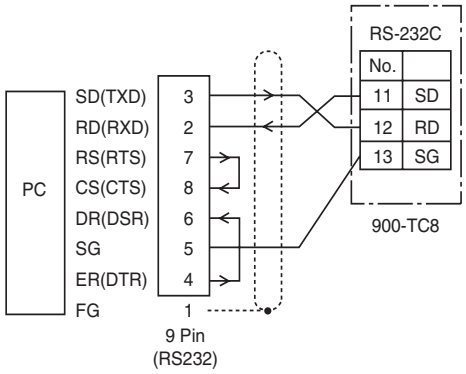
Figure 2.15



Communication (RS-232C) to a Personal Computer (Requires 900Builder Software)

When the option communications unit Cat. No. 900-TC8232 is mounted in the Bulletin 900-TC8 for communicating with a personal computer, connect the RS-232C communications cable across terminals 11, 12, and 13.

Figure 2.16 Communication Unit Connection Diagram



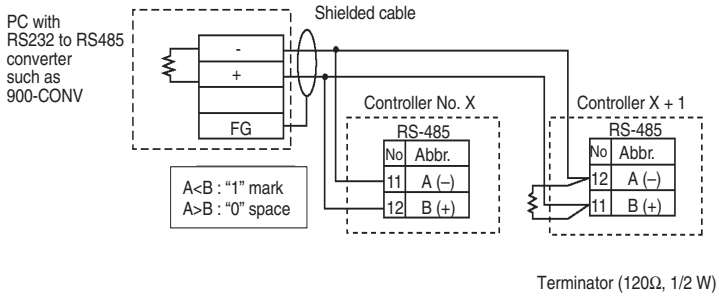
The RS-232C connection is one-to-one (PC to one Bulletin 900-TC8). The maximum cable length for RS-232 is 15 m. An optional 3 m RS-232C interface cable (Cat. No. 900-CP1x) is available as an extension cable if necessary. If you make your own cable, use shielded, twisted pair cable (AWG 28 or larger).

Note: The PC must have 900Builder software installed to configure/monitor the Bulletin 900-TC8.

Communication (RS-485) to a Personal Computer (Requires 900Builder Software)

When the optional communications unit Cat. No. 900-TC8COM is mounted in the Bulletin 900-TC8, RS-485 communication with a personal computer is possible. Connect the RS-485 communications cable across controller terminals 11 and 12.

Figure 2.17 Communication Unit Connection Diagram

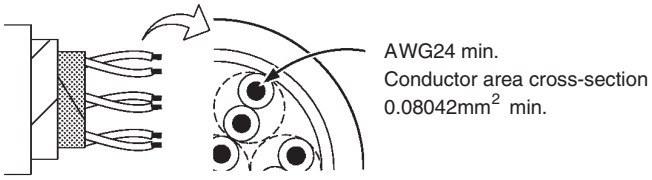


- Specify both ends of the transmission path including the personal computer as the end node (that is, connect termination resistors to both ends).

  The maximum terminal resistance is 54 Ω (See Figure 2.17.)

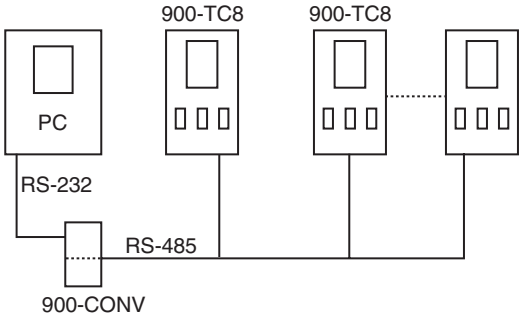
- The RS-485 connection can either be one-to-one or one-to-N. Up to 32 units including the personal computer can be connected one-to-N. Use shielded, twisted pair cable (24…14AWG), and keep the total length to 500 m or less.

Figure 2.18



- To use a PC on an RS-485 link/network connection, a Bulletin 900-CONV RS-232-to-RS-485 or equivalent converter is required.

Figure 2.19

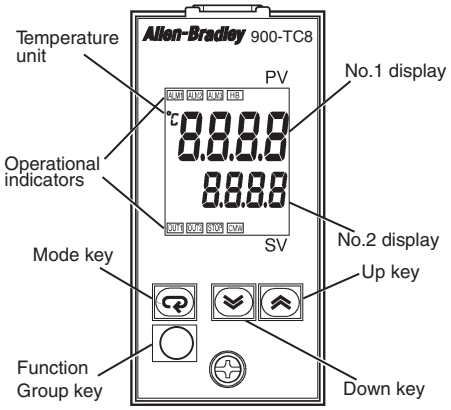


Note: The PC must have 900Builder software installed to configure/monitor the Bulletin 900-TC8.

Notes:

Configuration and Basic Operation

Figure 3.1



How Function Groups Are Configured and Operating the Keys on the Front Panel

Parameters are divided into control categories, each called a function group. Each of the items/values that can be configured in these function groups is called a parameter. The function groups on the Bulletin 900-TC8 are divided into the following:

Figure 3.2

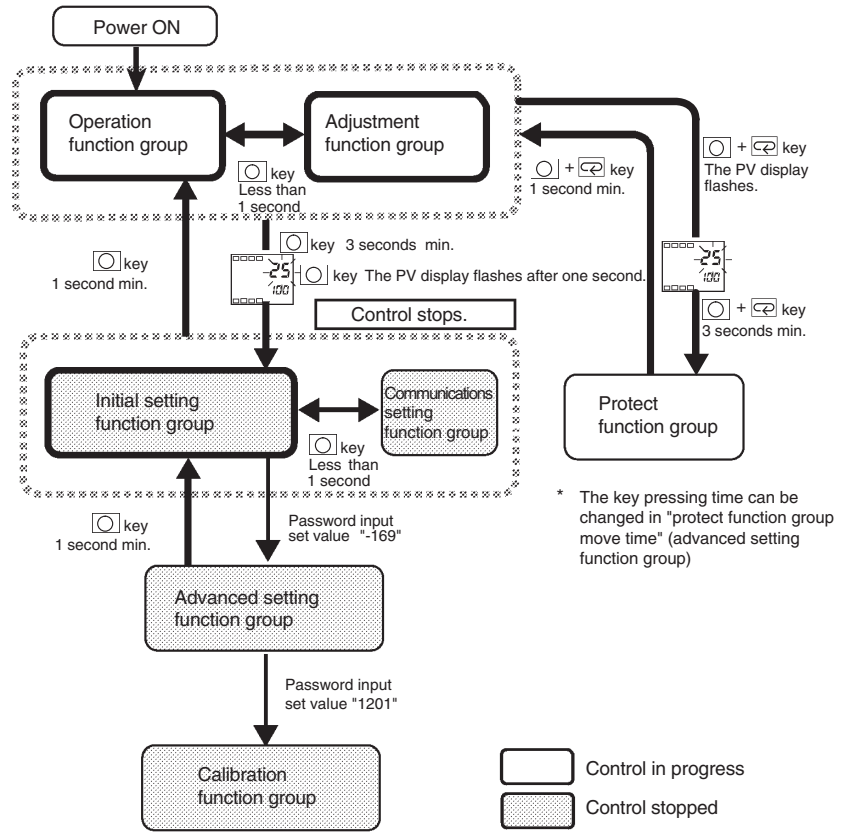


Table 3.A

	Control in Progress	Control Stopped
Protect function group	○	—
Operation function group	○	—
Adjustment function group	○	—
Initial Setting function group	—	○
Advanced Setting function group ❶	—	○
Calibration function group	—	○
Communications Setting function group	—	○

○ Indicates items that can be configured.

❶ To activate the Advanced Setting function group, set the Protect function group of the Initial/Communications Protect to 0.

Of these control categories, the Initial Setting, Communications Setting, Advanced Setting, and Calibration function groups can be used only when control has stopped. Note that controller outputs are stopped/reset when any of these four function groups are selected.

- **Protect Function Group —** To move to this function group, simultaneously press the ○ and ↩ keys for at least 3 seconds in the Operation or Adjustment function group. This function group is used to prevent unwanted or accidental modification of parameters. Protected parameters will not be displayed, and so the parameters in that function group cannot be modified.

- **Operation Function Group —** This function group is displayed when you turn the power ON. You can move to the Protect, Initial Setting, and Adjustment function groups from this point.

  Normally, select this function group during operation. During operation, the process value (PV), set point (SP), and manipulated variable (MV) can be monitored, and the Alarm Value and Upper- and Lower-Limit Alarm parameters can be monitored and modified.

- **Adjustment Function Group —** To move to this function group, press the ○ key for less than 1 second.

  This function group is used to enter configuration values and offset values for control. This function group contains parameters for AT (auto-tuning), communications writing enable/disable, hysteresis, multi-SP, input shift values, heater burnout alarm (HBA), and PID constants. You can move to the top parameter of the Initial Setting and Operation function groups from here.

- **Initial Setting Function Group —** To move to this function group, press the ◎ key for at least 3 seconds from the Operation or Adjustment function group. The PV display flashes after 1 second. This function group is for specifying the input type, selecting the control mode, control period, setting direct/reverse action, and alarm type. You can move to the Advanced Setting or Communications Setting function group from here. To return to the Operation function group, press the ◎ key for at least 1 second. To move to the Communications Setting function group, press the ◎ key for less than 1 second.

- **Advanced Setting Function Group —** To select this function group, after setting the Protect function group of the Initial/Communications Protect to 0, you must enter the password (**–169**) in the Initial Setting function group.

  You can move to the Calibration or the Initial function group from here.

  This function group is for setting the automatic return of display mode, MV limitter, event input assignment, standby sequence, alarm hysteresis, ST (self-tuning), and for moving to the user Calibration function group.

- **Communications Setting Function Group —** To move to this function group, press the ◎ key for less than 1 second in the Initial Setting function group. When communications are required, set the communications conditions in this function group. Communicating with a personal computer (host computer) allows set points to be read and written, and manipulated variables to be monitored.

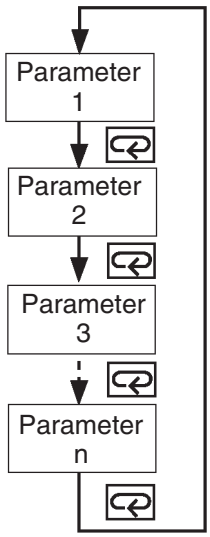
- **Calibration Function Group —** To move to this function group, you must enter the password (**1201**) in the Advanced Setting function group. This function group is for offsetting deviation in the input circuit.

  You cannot move to other function groups by operating the keys on the front panel from the Calibration group. To cancel this function group, turn the controller's power OFF then back ON again.

Selecting Parameters

To select the various parameters associated with each function group, press the mode ⏎ key. Each press of the ⏎ key advances to the next parameter within the group. For details on each parameter, see Chapter 5 — *Parameter Functions and Definitions*.

Figure 3.3



Changing Parameters and Loading Values into Controller Memory

If you press the ↵ key at the final parameter, the display returns to the top parameter for the current function group.

To change parameter value or configuration (setup), modify the setting by using the ⌃ or ⌄ key, and either leave the setting alone/unchanged for at least 2 seconds or press the ↵ key. This loads the present value displayed into the controller's memory.

When another function group is selected, the parameter and value on the display are the ones currently loaded into controller memory.

When you turn the controller power OFF, ensure the values are loaded into memory by pressing the ↵ key. The values and parameters setup are sometimes not changed (loaded) by merely pressing the ⌃ or ⌄ key.

Communications Function

The Bulletin 900-TC8 can be provided with a communications function that allows you to check and set controller parameters from a personal computer that has 900Builder software installed. If the communications function is required, mount the option unit Cat. No. 900-TC8232 or 900-TC8COM in the Bulletin 900-TC8.

Follow the procedure below to move to the Communications Setting function group.

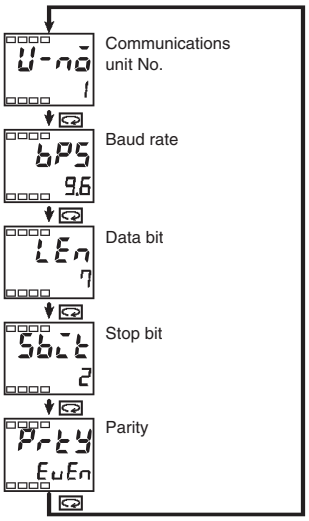
1. Press the ○ key for at least 3 seconds in the Operation function group. This moves to the Initial Setting function group.

2. Press the ○ key for less than 1 second. The Initial Setting function group moves to the Communications Setting function group.

3. Pressing the ↵ key advances the parameters as shown in the following figure.

4. Press the ∧ or ∨ key to change the parameter values.

Figure 3.4



Setting Up Communications Parameter Data

Set the Bulletin 900-TC8 communication parameter specifications so that they match the communication parameter setup for the personal computer using 900Builder software. In a multidrop (RS-485) 1:N configuration, match the setting data except the communications unit numbers on all units. Unique communications unit numbers must be configured for each controller/device in an RS-485 system.

Table 3.B

Parameter	Displayed Characters	Configurable (Monitor) Value	Default Value	Units
Communications Unit No.	U-no	0…99	1	None
Baud Rate	bPS	1.2, 2.4, 4.8, 9.6, 19.2	9.6	kbps
Data Bit	LEn	7, 8	7	bit
Stop Bit	Sbit	1, 2	2	bit
Parity	Prty	None, even, odd	Even	None

Initial Setup Examples

The ⊙ and ⏎ keys are used to switch between configuration menus, and the amount of time that you hold the keys down determines which configuration menu you move to. This section describes two typical examples.

Figure 3.5 Typical Example

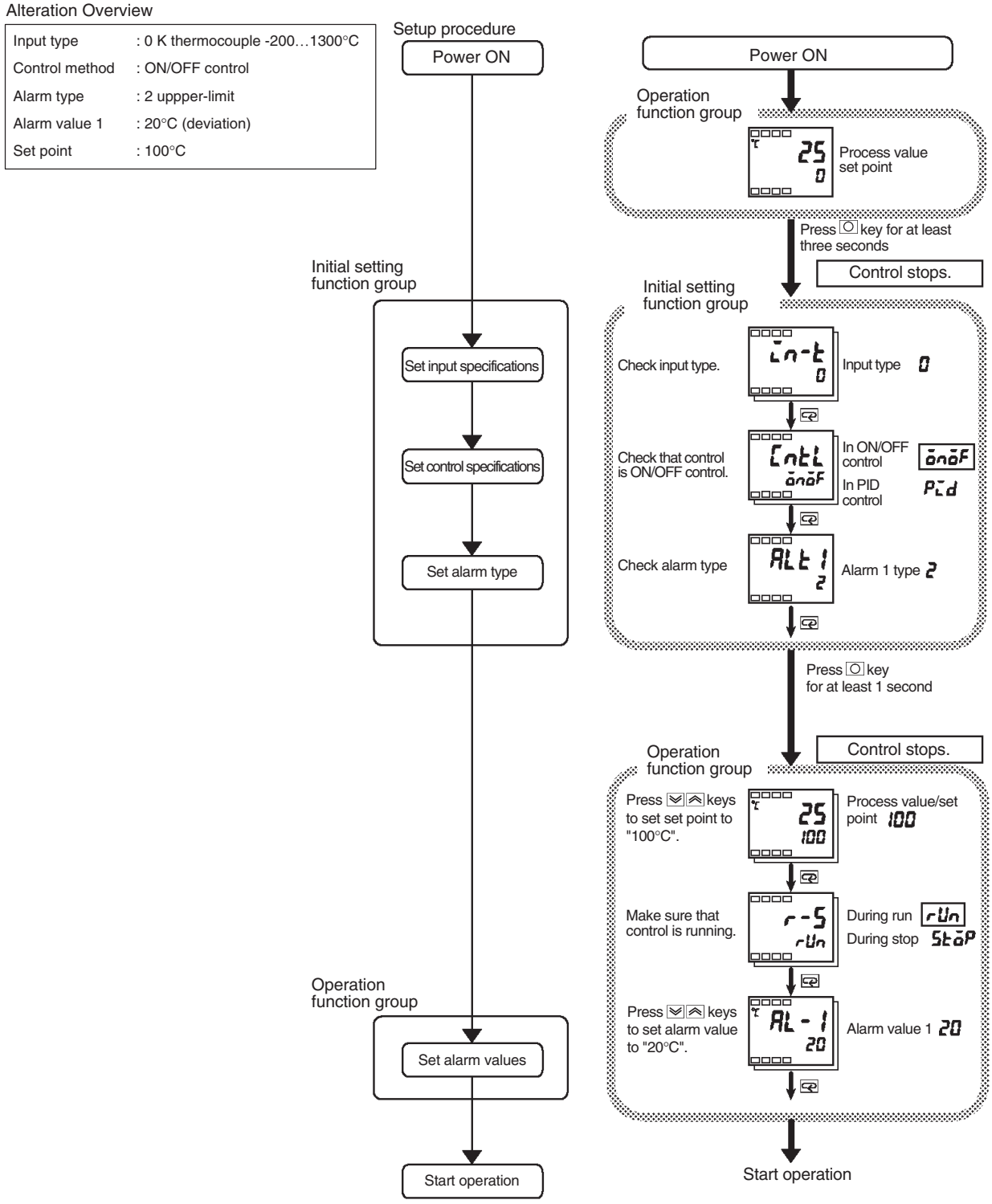
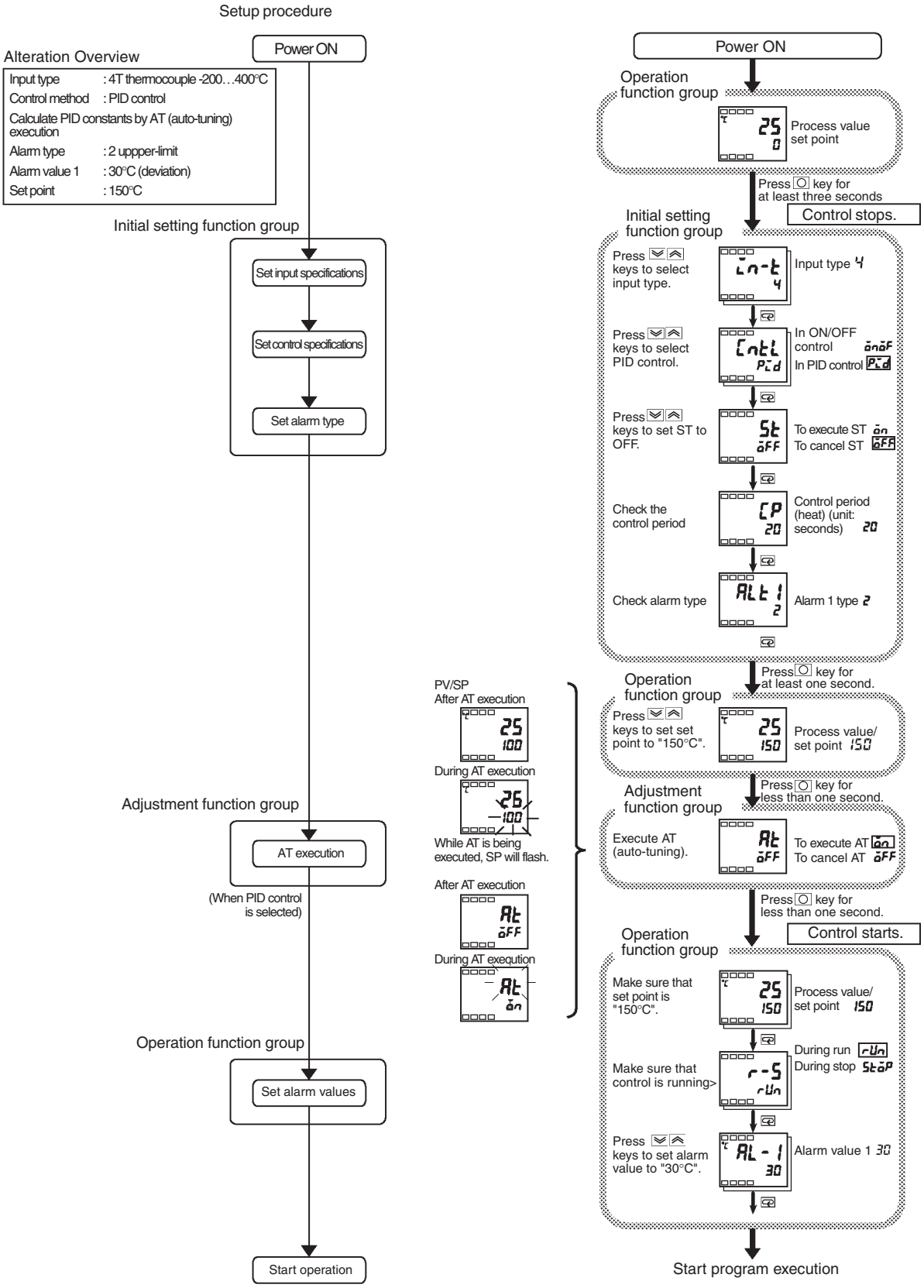


Figure 3.6 Typical Example 2



Configuring the Input Type

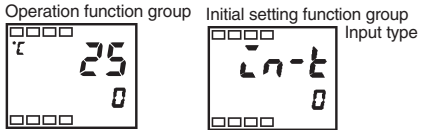
The Bulletin 900-TC8 supports four input/sensor types: platinum resistance thermometer (RTD), thermocouple, non-contact temperature sensor, and 0…50 mV analog input. Program/configure the input type matched to the sensor using the Input Type parameter (see Table A.D, *List of Input Types*). The Bulletin 900-TC8 general controller specifications support two types of inputs, platinum resistance thermometer input types and thermocouple input type, whose set values differ. Check the cat. no. of your Bulletin 900-TC8 at purchase to ensure it matches your input requirements (see Table 1.A).

Input Type

Example Operation Procedure — Setting the Input Type to ***Thermocouple Type K (–20.0…500.0°C) (see Table A.D, List of Input Types)***

1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

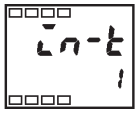
Figure 3.7



2. Press the ∧ key to configure the Set Value for the desired sensor. Entering the Set Value will configure the controller for the applicable input type and range. Example: When you use K thermocouple (–20.0…+500.0°C), enter 1 as the Set Value.

   Note: The selected Set Value is loaded into controller memory if you do not operate the keys on the front panel for 2 seconds after changing the parameter, or by pressing the ○ or ↵ keys. This applies to changing all values and/or parameters.

Figure 3.8



Selecting °C/°F

Temperature Units

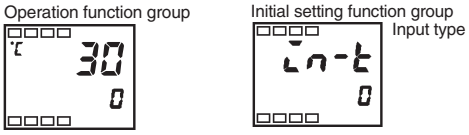
The Bulletin 900-TC8 allows you to select either °C or °F as the temperature unit.

Configure the temperature units in the Temperature Unit parameter of Initial Setting function group. **Note:** The default is °C.

Example Operation Procedure — Select °C

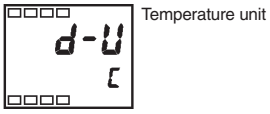
1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.9



2. Select the Temperature Unit parameter by pressing the ↵ key. Press the ∧ or ∨ key to select either °C (C) or °F (F).

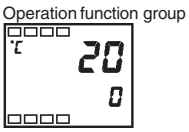
Figure 3.10



3. To return to the Operation function group press the ○ key for at least 1 second.

Configuring the SP

Figure 3.11



The Operation function group is displayed when the Bulletin 900-TC8 is turned ON. The upper display (No. 1) shows the process value (PV), and the lower display (No. 2) shows the set point (SV or SP).

Changing the SP

The set point cannot be changed when the Operation/Adjustment Protection parameter is set to 3. For details, see p. 4-28, *Using the Key Protect Function Group*.

To change the set point, press the ∧ or ∨ key in the PV/SP parameter (Operation function group), and load/program the desired value. The new set point is loaded/programmed into memory 2 seconds after you have specified the new value.

The Multi-SP parameter is used to switch between two or four pre-configured set point values. See p. 4-16, *Using the Event Input Feature* for details.

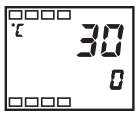
Example Operation Procedure

In this example, the set point will be changed from 0°C to 200°C.

1. Normally, the PV/SP parameter is displayed. The set point is 0°C.

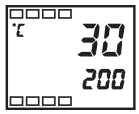
Figure 3.12

Operation function group



2. Press the ⩓ or ⩔ key until the set point displayed is 200°C. To load the value into the controller memory, either press the ◯ key or wait 2 seconds.

Figure 3.13



Selecting PID Control or ON/OFF Control

Overview

The Bulletin 900-TC8 supports two control methods, 2-PID control and ON/OFF control. The control method is selected by the PID/ON/OFF parameter in the Initial Setting function group. When this parameter is set to PID, 2-PID control is set, and when set to onOF, ON/OFF control is set.
Note: The default is ON/OFF control.

2-PID Control

PID control parameters are set by AT (auto-tuning), ST (self-tuning), or manual setup. For PID control, set the PID constants in the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters. For more details see p. 3-18.

ON/OFF Control

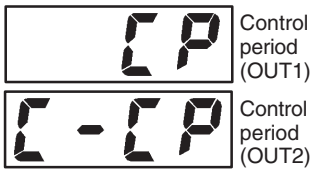
In the ON/OFF control method, the control output (MV) is turned ON when the process value is lower than the current set point, and the control output is turned OFF when the process value is higher than the current set point. This is known as reverse operation. Direct operation refers to control where the manipulated variable is increased according to the increase in the process value. See p. 3-15 for more details.

Configuring the Output Parameters

Control Period

The Control Period parameter is used in the PID control method and allows you to adjust the minimum amount of time between ON cycles of the ON/OFF output (MV).

Figure 3.14



A shorter period may provide better ON/OFF control performance, we recommend setting the control period to 20 seconds or more. In the case of electromechanical relay outputs, doing this will improve its life expectancy. If necessary, readjust the Control Period by trial operation to meet the needs of your application.

- Configure the control value period in the Control Period (OUT1) and Control Period (OUT2) parameters (Initial Setting function group). **Note:** The default is 20 seconds.
- The Control Period (OUT2) parameter can be used only in heating and cooling control method.

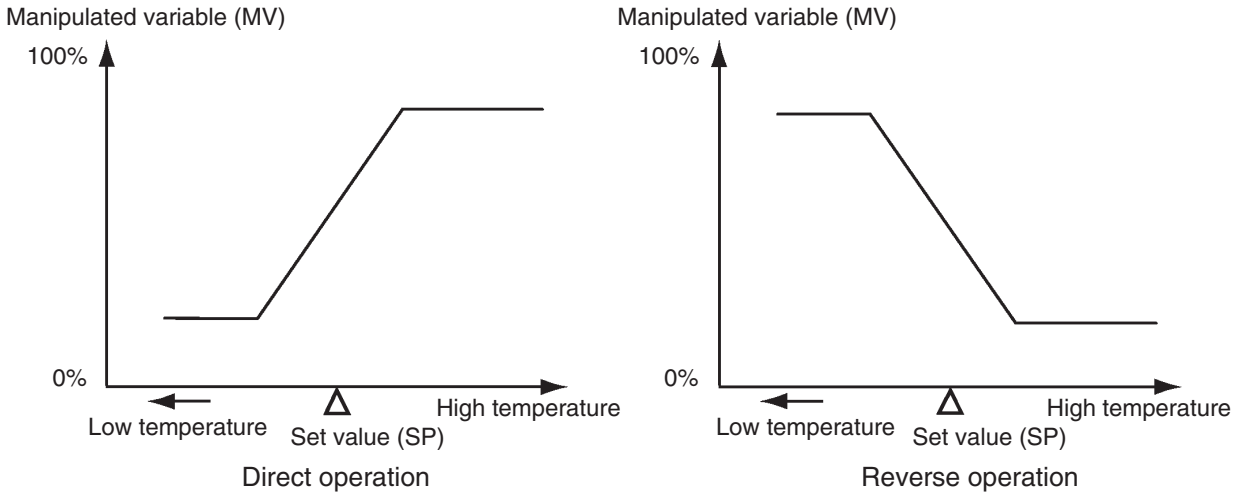
Note: The Control Period parameter allows what is typically called "time proportioning" ON/OFF control to be done in the 2-PID method.

Direct/Reverse Operation

Figure 3.15

Direct operation refers to control where the manipulated variable (MV) is increased according to the increase in the process value (PV). Alternatively, reverse operation refers to control where the manipulated variable (MV) is decreased according to the increase in the process value (see Figure 3.16). Direct/reverse operation can be used in ON/OFF or PID control.

Figure 3.16 Direct/Reverse Operation



For example, when the process value (PV) temperature is lower than the set point (SP) temperature in a heating control system, the manipulated variable (OUT1) increases (ON) by the difference between the PV and SP values.

Accordingly, this becomes reverse operation in a heating control system, or alternatively, direct operation in a cooling control system.

Direct/reverse operation is set in the Direct/Reverse Operation parameter (Initial Setting function group). **Note:** The Direct/Reverse Operation parameter default is reverse operation.

Example Operation Procedure

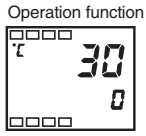
In this example, the Input Type, Temperature Unit, Direct/Reverse Operation, and Control Period (OUT1) parameters will be monitored.

The setup of parameters is as follows:

Input Type = 0: K thermocouple
Temperature Unit = C: °C
Direct/Reverse Operation = dir-r: reverse operation
Control Period (OUT1) = 20 seconds

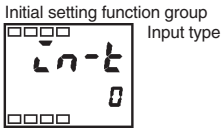
1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.17



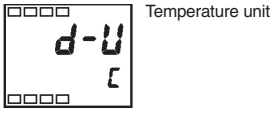
2. The Input Type is displayed. When you are monitoring/configuring the Input Type for the first time, the set value is 0: K type thermocouple default. (**0** is set if you have a platinum resistance thermometer compatible controller [see Table 1.A].) To select a different sensor, press the ⩓ or ⩔ keys. This changes the Set Value (see Table 3.A) to match your desired sensor input.

Figure 3.18



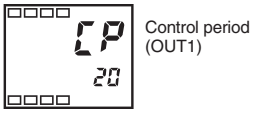
3. Select the Temperature Unit parameter by pressing the ⊂ key. **Note:** The default is C: °C. To configure F: °F, press the ⩓ key.

Figure 3.19



4. Select the Control Period (OUT1) parameter by pressing the ⊂ key. **Note:** The default is 20.

Figure 3.20

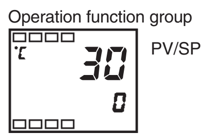


5. Select the Direct/Reverse Operation parameter by pressing the ⮐ key. **Note:** The default is or-r : reverse operation. To configure or-d: direct operation, press the ⮝ key.

Figure 3.21

6. To return to the Operation function group press the ◯ key for at least 1 second.

Figure 3.22



Note: The newly configured value or parameter is loaded into controller memory if you do **not** operate any key on the front panel for at least 2 seconds or by pressing the ◯ or ⮐ key.

Executing the ON/OFF Control Method

Overview

In the reverse operation ON/OFF control method, the control output (MV) turns OFF when the controlled temperature (PV) reaches the user-defined set point. When the control output (MV) turns OFF, the controlled temperature begins to fall and the control output turns ON again. This operation is repeated at a certain point. At this time, how much the temperature must fall before the control output turns ON again is determined by the Hysteresis (OUT1) parameter. Also, how much the manipulated variable must be adjusted in response to the increase or decrease in the process value is determined by the Direct/Reverse Operation parameter.

ON/OFF Control Parameters

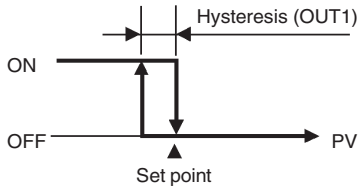
Switching between the 2-PID control method and ON/OFF control method is carried out by the PID/ON/OFF parameter (Initial Setting function group). When this parameter is configured to PId, 2-PID control is selected, and when configured to onoF, ON/OFF control is selected. **Note:** The default is onoF.

Hysteresis

In the ON/OFF control method, hysteresis is used to provide a margin/differential for switching the control output ON when the controlled temperature moves away from the required set point. The Hysteresis parameter is used to give stability to the output around the set point.

The hysteresis value for control output (OUT1) and control output (OUT2) functions are configured in the Hysteresis (OUT1) and Hysteresis (OUT2) parameter functions respectively. In standard heating or cooling control, the Hysteresis (OUT1) setting is used as the hysteresis setting (Adjustment function group) regardless of the control mode, heating control or cooling control.

Figure 3.23 Reverse Operation



3-Position Control

In the heating and cooling control method, a dead band (an area where both control outputs are 0) can be configured for either the heating or cooling side of the set point. This makes 3-position control possible.

Figure 3.24 Reverse Operation with 3-Position Control

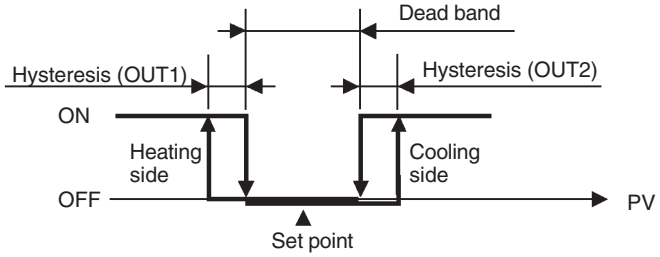


Table 3.C Control Parameters

Symbol	Parameter Name and Group Location	Description
S-HC	Standard/Heating and Cooling: Initial Setting function group	For specifying the control method
CntL	PID/ON/OFF: Initial Setting function group	For specifying the control method
orEv	Direct/Reverse Operation: Initial Setting function group	For specifying the control method
C-db	Dead Band: Adjustment function group	Heating and cooling control
C-SC	Cooling Coefficient: Adjustment function group	Heating and cooling control
HYS	Hysteresis (OUT1): Adjustment function group	ON/OFF control
CHYS	Hysteresis (OUT2): Adjustment function group	ON/OFF control

ON/OFF Control Setup

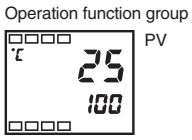
To execute ON/OFF control, configure the PID/ON/OFF parameter.

Example Operation Procedure — Configuring the PID/ON/OFF Parameter

In this example, first check that the PID/ON/OFF parameter is set to onoF in the Initial Setting function group.

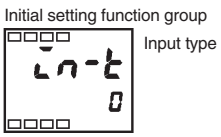
1. Press the O key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.25



2. Display the Input Type parameter in the Initial Setting function group.

Figure 3.26



3. Select the PID/ON/OFF parameter by pressing the ↵ key.

Figure 3.27

PID / ON/OFF

4. Check that the configured control method parameter is **onoF** (**Note:** ON/OFF is the default).

Determining PID Constants (AT, ST, Manual Setup)

AT (Auto-Tuning)

Figure 3.28

Overview

When you configure the controller to execute auto-tuning, the optimum PID constants for the current set point during program execution are automatically configured by the controller forcibly changing the manipulated variable (MV) to calculate the characteristics (called the limit cycle method) of the control target.

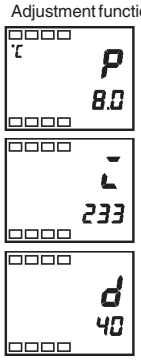
To have the controller execute AT (auto-tuning), specify **on**: AT execute, and to cancel AT (auto-tuning), specify **oFF**: AT cancel.

Note: AT (auto-tuning) cannot be executed during ON/OFF control.

The result of a controller AT cycle (auto-tuning) can be viewed/monitored from the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters in the Adjustment function group.

Figure 3.29

Adjustment function group



Proportional band

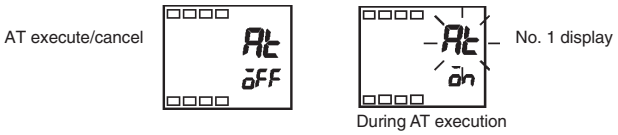
Integrated time

Derivative time

AT Description and Display Consideration

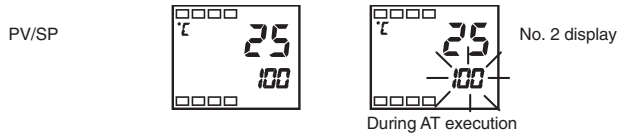
AT (auto-tuning) is started when you configure the AT Execute/Cancel parameter to ON. During execution of AT, the No. 1 display for the AT Execute/Cancel parameter blinks (see Figure 3.30). When AT ends, the AT Execute/Cancel parameter turns OFF, and the No. 1 display stops blinking.

Figure 3.30



If you move to the Operation function group during AT execution, the No. 2 display blinks to indicate that AT is being executed.

Figure 3.31

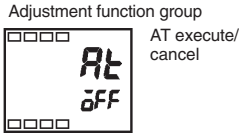


Note: Only the Communications Writing, RUN/STOP, and AT Execution/Cancel parameters can be changed during AT execution. Other parameters cannot be changed.

Example Operation Procedure — Execute Auto-Tuning (AT)

1. Press the ○ key for less than 1 second to move from the Operation function group to the Adjustment function group.

Figure 3.32

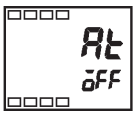


2. Press the ∧ key to start execution of AT. On is displayed during AT execution.

Figure 3.33

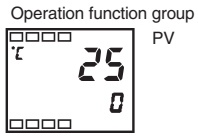
3. oFF is displayed when AT ends.

Figure 3.34



4. To return to the Operation function group, press the ◯ key.

Figure 3.35



Note: The newly configured value or parameter is loaded into controller memory if you do **not** operate any key on the front panel for at least 2 seconds or by pressing the ◯ or ↵ key.

Note: When control characteristics are already known, either from experience or from a previous AT cycle, the PID parameters can be configured directly from the keypad to adjust control. PID parameter values are set in the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters in the Adjustment function group.

ST (Self-Tuning)

Figure 3.36

In the ST (self-tuning) function, the controller executes its tuning process from the start of program execution to calculate the PID constants matched to the actual control target.

Once the self-tuning PID constants have been calculated, ST is not executed during the next control operation cycle as long as the set point remains unchanged.

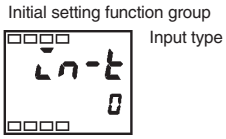
Example Operation Procedure — Execute Self-Tuning (ST)

ST (self-tuning) is executed when the ST parameter is set to ON in the Initial Setting function group.

When the ST function is in operation, make sure to turn the power supply of the load connected to the control output (MV) ON simultaneously with or before starting operation of the Bulletin 900-TC8.

1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

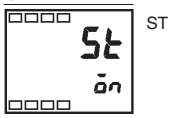
Figure 3.37



2. Select the ST parameter by pressing the ↵ key.

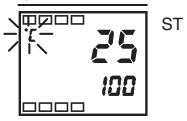
3. Press the ∧ key to select on. **Note:** The default is ON.

Figure 3.38



4. To return to the Operation function group, press the ○ key. The temperature display blinks during self-tuning (ST) execution, and stops when it is complete.

Figure 3.39



Note: When control characteristics are already known either from experience or previous use of the AT or ST parameter, the individual PID parameters can be set directly to adjust control. PID parameters are set in the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters in the Adjustment function group.

Conditions that Start Self-Tuning (ST)

Self-tuning by Step Response Tuning (SRT) is started when either of the two following major conditions are met:

- Program execution is started.
- The set point is changed.

The following table provides some additional details:

Table 3.D

At Start of Program Execution (Self-Tuning ON)	When Set Point is Changed (Self-Tuning ON)
1. The set point at the start of program execution differs from the set point (see Note 1) when the previous SRT was executed. 2. The difference between the controlled temperature at start of program execution is larger than the current proportional band (1.27+4°C) or the ST stable range, whichever is larger. 3. The controlled temperature at the start of program execution is smaller than the set point during reverse operation, and is larger than the set point during direct operation. 4. No reset from input error	1. The new set point differs from the set point (see Note 1) used when the previous SRT was executed. 2. The set point change width is larger than current proportional band1.27+4°C or the ST stable range whichever is larger. 3. During reverse operation, the new set point is larger than the set point before the change; and during direct operation, the new set point is smaller than the set point before the change. 4. The temperature is in a stable state (see Note 2). (An equilibrium state [see Note 3] is acceptable when the output is 0% when the power is turned ON.)

Note 1: The previous SRT-implemented set point is called the set point obtained by calculating the PID constant by the previous SRT.

Note 2: In this state, the measurement point is within the ST stable range.

Note 3: In this state, the change width of the PV every 60 seconds is at the ST stable range or less.

New PID constants are not calculated by self-tuning (ST) for the currently configured set point in the following instances:

- When the PID constants have been changed manually with ST set to ON.
- When auto-tuning (AT) has been executed.

Self-Tuning (ST) Stable Range

The self-tuning (ST) stable range is a mechanism which allows you to determine the condition under which the ST (self-tuning) function occurs.

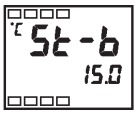
In this example, the ST stable range will be configured to 20°C.

Example Operation Procedure

1. Select the ST Stable Range parameter by pressing the ↵ key in the Advanced Setting function group. To move to this function group, see p. 4-26, *To Move to the Advanced Setting Function Group*.

Figure 3.40

Advanced setting level function



ST stable range

2. Set to 20°C (deviation) using the ∧ key. **Note:** The default is 15°C.

Figure 3.41

Note: Ensure the value is loaded into controller memory by waiting 2 seconds or pressing the ○ key.

Manual PID Setup

The individual PID values can be manually set in the Proportional Band, Integral Time, and Derivative Time parameters in the Adjustment function group.

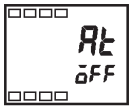
Example Operation Procedure

In this example, the Proportional Band parameter will be configured to 10.0, the Integral Time parameter will be configured to 250, and the Derivative Time parameter will be configured to 45.

1. Press the ○ key to move from the Operation function group to the Adjustment function group.

Figure 3.42

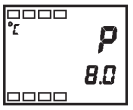
Adjustment function group



AT execute/ cancel

2. Select Proportional Band by pressing the ↵ key.

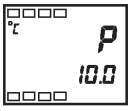
Figure 3.43



Proportional band

3. Press the ⇈ or ⇊ key to set the Proportional Band parameter to 10.0.

Figure 3.44



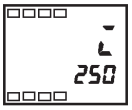
4. Select Integral Time by pressing the ↵ key.

Figure 3.45

Integrated time

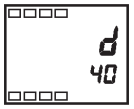
5. Press the ⇈ or ⇊ key to set the Integral Time parameter to 250.

Figure 3.46



6. Select Derivative Time by pressing the ↵ key.

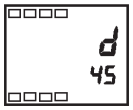
Figure 3.47



Derivative time

7. Press the ⇈ or ⇊ key to set the parameter to 45.

Figure 3.48



8. To return to the Operation function group, press the ○ key.

Note: This also loads the derivative time into controller memory.

Note: When PID values I (integral time) and D (derivative time) are set to 0, control is executed according to proportional operation, and the default set point becomes the center value of the proportional band. In this case, a related parameter is Manual Reset Value (Adjustment function group)

The following diagrams provide a basic explanation of how adjusting the P, I, and D parameter values impact system operation.

Table 3.E When P (Proportional Band) is Adjusted

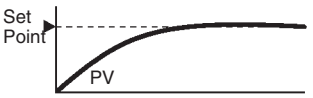
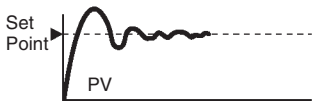
When P is increased		The curve rises gradually, and a long stable time is achieved, preventing overshoot.
When P is decreased		Overshoot and hunting occur, however the set point is quickly reached after which the curve stabilizes.

Table 3.F When I (Integral Time) is Adjusted

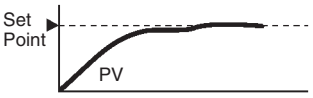
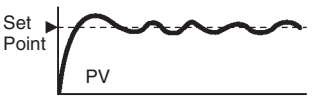
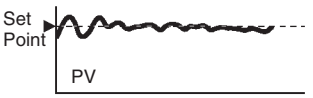
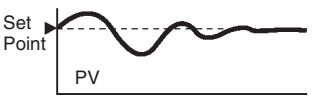
When I is increased		It takes a long time for the process value to reach the set point. It takes time to achieve a stable state, however there is little overshoot/undershoot and hunting.
When I is decreased		Overshoot/undershoot and hunting occur, and the curve rises quickly.

Table 3.G When D (Derivative Time) is Adjusted

When D is increased		Overshoot/undershoot and stable time are reduced, however, fine hunting occurs on changes in the curve it self.
When D is decreased		Overshoot/undershoot increase, and it takes time for the process value to reach the set point.

Alarm Outputs

Alarm Types

The Bulletin 900-TC8 supports up to three alarm outputs.

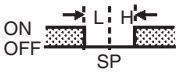
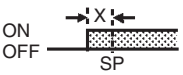
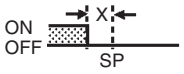
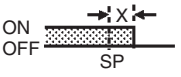
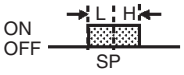
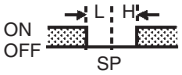
The controller alarm output conditions are determined by the combination of the selected Alarm Type, Alarm Hysteresis, and Set Point (SP) parameters.

Alarm types are configured independently for each alarm output using the Alarm 1 and Alarm 2 Type parameters (Initial Setting function group). **Note:** The default Set Value is 2: upper-limit (deviation).

Configure the Alarm Type and alarm output operation based on pre-defined conditions using the Set Value number.

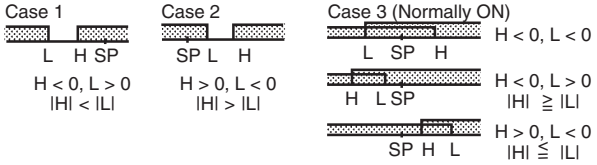
The following table describes the Alarm Type, Alarm Value, Upper-Limit Alarm, and Lower-Limit Alarm parameters.

Table 3.H

Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
0	Alarm function OFF	Output OFF	
1 ❶	Upper- and lower-limit (deviation range)		❷
2 ❸	Upper-limit (deviation)		
3	Lower-limit (deviation)		
4 ❶	Upper- and lower-limit range (deviation range)		❹
5 ❶❻	Upper- and lower-limit alarm with standby sequence (deviation range)		❺

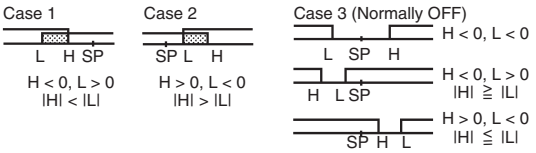
❶ With set values 1, 4, and 5, the upper- and lower-limit values can be configured independently for each alarm point, and are expressed as L and H.

❷ Set value: 1 upper- and lower-limit alarm



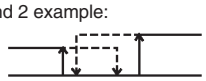
❸ Default

❹ Set value: 4 upper- and lower-limit range



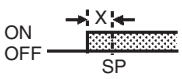
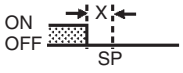
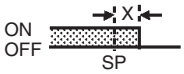
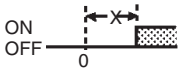
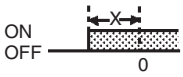
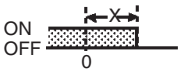
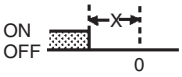
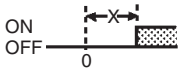
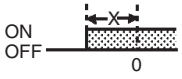
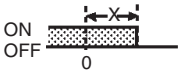
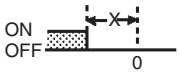
❺ Set value: 5 upper- and lower-limit alarm with standby sequence
* For the above upper- and lower-limit alarm
- In cases 1 and 2, the alarm is normally OFF if upper- and lower-limit values of hysteresis overlap.
- In case 3, the alarm is normally OFF.

Cases 1 and 2 example:



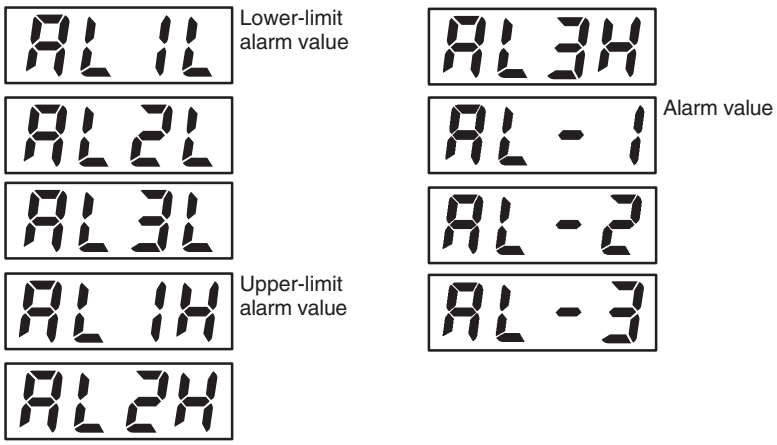
❻ Set value: 5 upper- and lower-limit alarm with standby sequence
The alarm is normally OFF if upper- and lower-limit values of hysteresis overlap.

Table 3.H (Continued)

Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
6	Upper-limit alarm with standby sequence (deviation)		
7	Lower-limit alarm with standby sequence (deviation)		
8	Upper-limit (absolute-value)		
9	Lower-limit (absolute-value)		
10	Upper-limit with standby sequence (absolute-value)		
11	Lower-limit with standby sequence (absolute-value)		

Alarm Value

Figure 3.49



Alarm values are indicated by **X** in Table 3.H. When the upper and lower limit values are set independently, H is displayed for the upper limit value, and L is displayed for the lower limit value.

To set alarm deviation, use the Upper- and Lower-Limit Alarm parameters. Set the upper and lower limits in each of the Alarm Upper Limit 1 to 3 and Alarm Lower Limit 1 to 3 parameters (Operation function group).

Example Operation Procedure

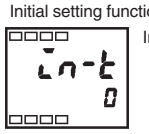
In this example, alarm 1 will be set to the upper-limit alarm. The following shows related parameters and setups. In this example, the alarm output is active when the set point is exceeded by 10°C. (The temperature unit in this example is °C.)

Parameters to configure:

Alarm 1 Type = 2: upper-limit alarm (deviation)
Alarm Value 1 = 10 (10° greater than SP)

1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.50

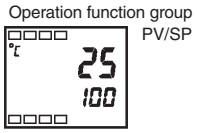


2. Select the Alarm 1 Type parameter by pressing the ↵ key. Check that the Alarm Type parameter is set to 2. **Note:** The default is upper-limit alarm.

Figure 3.51

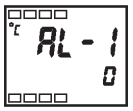
3. To return to the Operation function group press the ○ key for at least 1 second.

Figure 3.52



4. Select Alarm Value 1 by pressing ↵.

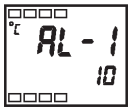
Figure 3.53



Alarm value 1

5. Press the ∧ key to configure the parameter to 10. This value is loaded into memory by waiting 2 seconds or pressing the ↵ key.

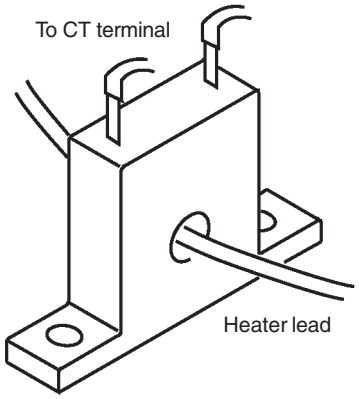
Figure 3.54



Heater Burnout Alarm (HBA)

HBA Detection

Figure 3.55



Heater burnout detection works as follows.

1. You must connect the current transformer (CT) to terminals 14 and 15, and insert the heater lead through the CT hole. For specifications, models, and external dimensions of current transformers that can be used on this controller, see p. A-3, *Current Transformer (CT)*.

2. When current flows through the heater lead, the current transformer generates an AC current proportional to the heater current value. The ON/OFF output type Bulletin 900-TC8 measures this AC current to calculate the current flowing to the heater.

3. If the heater is burned out, the current measured at the current transformer decreases. This value is compared with the value you configure as the heater burnout value, and the alarm output (ALM1) becomes active as the heater burnout alarm.

For the controller to measure the heater current from the CT, configure the heater burnout value in the Heater Burnout Detection parameter (Adjustment function group). To monitor the current value of the current transformer, use the Heater Current Monitor parameter.

When you are **not** using the HBA function, set the Heater Burnout parameter (Advanced Setting function group) to OFF.

HBA Operating Conditions

1. The HBA function can be used when the ON/OFF type controller ordered has this function (see Table 1.A). Make sure to connect the CT to the Bulletin 900-TC8, and pass the heater lead through the CT hole.

2. Turn the heater ON at the same time as or before turning power on to the ON/OFF type Bulletin 900-TC8. If the heater is turned ON after turning the Bulletin 900-TC8 ON, the heater burnout alarm will activate.

Notes:

- Control is continued even if the heater burnout alarm is active. That is, the Bulletin 900-TC8 attempts to control the heater on which the heater burnout alarm has occurred.

- For the heater burnout alarm to activate, the alarm condition must exist (ON) for 190 ms or more.

- The measured current value may sometimes differ slightly from the actual current flowing to the heater. Check the current value in an actual operating state in the Heater Current Monitor parameter.

- If there is little difference between the current in a normal state and the current in the burnout state, detection may become unstable. On a heater of current 10.0 A or less, maintain a difference of 1.0 A or more. On a heater of current 10.0 A or more, maintain a difference of 2.5 A or more.

- The HBA function cannot be used when the heater is controlled by an analog output type system. Also, 3-phase heaters cannot be used.

HBA Setup

To activate the heater burnout alarm, configure the HBA Used parameter (Advanced Setting function group) to ON and configure the heater burnout activation/trip value in the Heater Burnout Detection parameter (Adjustment function group).

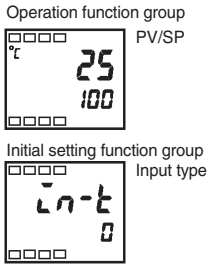
Example Operation Procedure

In this example, configure the Heater Burnout Detection value to 2.5.

The default of the Heater Burnout parameter is already ON, so set the Heater Burnout Detection value.

1. Move to the Advanced Setting function group. Press the [O] key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.56



2. Then move to Advanced Setting function group by pressing the [↵] key.

Figure 3.57

3. Press the [≪] key to enter the password (**–169**), and move from the Initial Setting function group to the Advanced Setting function group. The top parameter in the Advanced Setting function group is displayed.

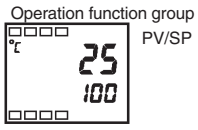
Figure 3.58

4. Select the HBA Used parameter by pressing the ↵ key. Make sure that this parameter is set to ON (default). Next, set the Heater Current Value Monitor parameter.

Figure 3.59

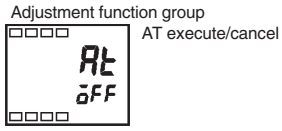
5. Press the ○ key for at least 1 second to move from the Advanced Setting function group to the Initial Setting function group and then to the Operation function group.

Figure 3.60



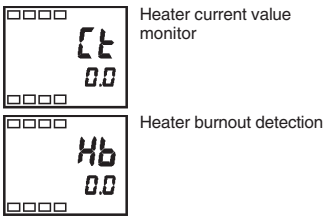
6. Press the ○ key for less than 1 second to move from the Operation function group to the Adjustment function group.

Figure 3.61



7. Select the Heater Current Value Monitor parameter by pressing the ↵ key. Check the current value. Next, set the Heater Burnout Detection parameter.

Figure 3.62



8. Select the Heater Burnout Detection parameter by pressing the ↵ key.

Figure 3.63

9. Configure the current value as a reference value. Adjust this value so that there is a large difference between the current flowing to the heater lead when heater operation is normal and the current flowing when a heater burnout occurs. For example, set 2.5. To return to the Operation function group, press the ○ key for less than 1 second.

How to Calculate Heater Current Detection Values

- Calculate the heater current value to be configured by the following equation:

$$\text{Configured Value} = \frac{(\text{current value at normal operation} + \text{current value at heater burnout})}{2}$$

- To calculate the value of the heater burnout when two or more heaters are connected through the CT, use the current value of the smallest heater connected, **or** the current value when one of the heaters burns out if all the heaters have the same current value.

- Make sure that the following conditions are satisfied:

  – Heater current of 10.0 A or less:
  Current value at normal operation – current value at heater burnout ≥ 1 A
  (When the resultant current is less than 1 A, detection is unstable.)

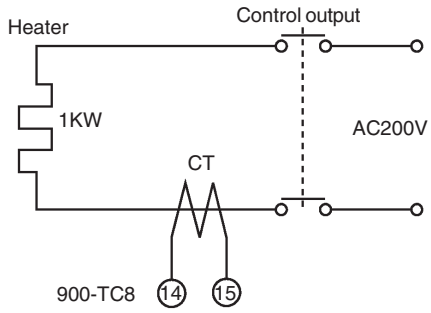
  – Heater current of 10.0 A or more:
  Current value at normal operation – current value at heater burnout ≥ 2.5 A
  (When the resultant current is less than 2.5 A, detection is unstable.)

- The allowable heater burnout range is 0.1…49.9 A. Heater burnout is not detectable when the configured value is 0.0 or 50.0. When the configured value is 0.0, the heater burnout alarm is always OFF, and if the configured value is 50.0, the heater burnout alarm is always ON.

- Configure the total current value at normal heater operation to 50 A or less. When configured to 55.0 A, FFFF is displayed in the Heater Current Monitor parameter.

EXAMPLE

When using a 200V AC, 1 kW heater:



Current during normal operation $= \frac{1000}{200} = 5\ A (<10\ A)$

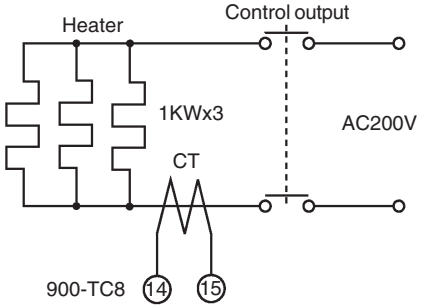
Current at heater burnout $= 0\ A$

Set value $= \frac{5+0}{2} = 2.5\ A$

(Current at normal operation –
Current at heater burnout) $= (5-0) = 5\ A\ (\geq 1\ A)$

EXAMPLE

When using three 200V AC, 1 kW heaters:



Current during normal operation =

$\frac{1000}{200} \times 3 = 15\ A\ (\geq 10\ A)$

Current at burnout of one heater $= \frac{1000}{200} \times 2 = 10\ A$

Set value $= \frac{15+10}{2} = 12.5\ A$

(Current at normal operation –
Current at heater burnout) $= (15-10) = 5\ A\ (\geq 2.5\ A)$

Table 3.I Parameters

Symbol	Parameter: Function Group	Description
CE	Heater Current Value Monitor: Adjustment function group	For heater current value monitor
Hb	Heater Burnout Detection: Adjustment function group	For HBA detection
HbH	Heater Burnout Hysteresis: Advanced Setting function group	For HBA detection
HbL	Heater Burnout Latch: Advanced Setting function group	For HBA detection

System Setup/Operational Considerations

1. Allow at least a 30 minute warm-up period for the system to fully stabilize.

2. When self-tuning is used, turn the temperature controller and load (e.g., heater) power ON simultaneously or turn the load power ON before the temperature controller. If the load is turned ON before the temperature controller, correct self-tuning and optimum control are no longer possible.

   When operation is started after system warm-up, turn the power to the system OFF once after warm-up is completed, and then turn the temperature controller and load power ON simultaneously. (Instead of turning the temperature controller power ON again, moving from the STOP to the RUN mode is also possible.)

3. The temperature controller may be subject to the influence of radio interference if used near a radio, TV, or wireless equipment. See Appendix A for additional information.

Notes:

Parameter Adjustments and Application Considerations

Shifting Input Values

Overview

The Input Shift parameter allows you to configure the controller to compensate for possible deviation of the measured temperature (PV) to the actual temperature at the source (control target). The controller supports two types of input shifts: 1-point and 2-point. The input shift type is automatically matched to the sensor currently selected by the Input Type parameter (set value — see Table A.D, *List of Input Types*).

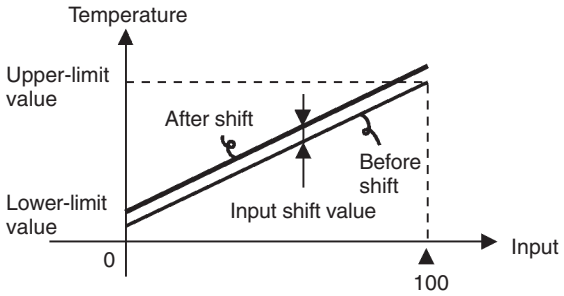
1-Point (Uniform) Shift

Overview

Figure 4.1

With 1-point shift operation, the Temperature Input Shift parameter (Adjustment function group) is applied to the entire temperature input range in a uniform or consistent manner. In other words, the adjusted value is applied equally to each input/sensor value read by the controller and displayed as such. For example, if the input shift value is set to 1.2°C, the process value is treated by the controller as 201.2°C after input shift is applied when the measured process value is 200°C. (See Figure 4.2.)

Figure 4.2 One-Point Shift

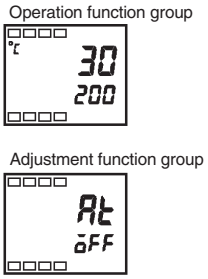


Example Operation Procedure — Operation Function Group

In this example, apply a 1°C by 1-shift to the input value of a type K thermocouple sensor.

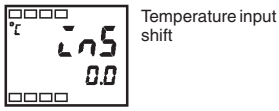
1. Press the ○ key to move from the Operation function group to the Adjustment function group.

Figure 4.3



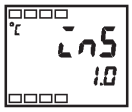
2. Select the Temperature Input Shift parameter by pressing the ↵ key.

Figure 4.4



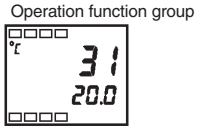
3. Press the ▲ or ▼ key to set 1.

Figure 4.5



4. To return to the Operation function group, press the ○ key. The process value is 1°C larger than before the shift was applied.

Figure 4.6



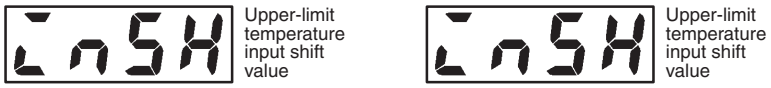
Note: The newly configured value or parameter is loaded into controller memory if you do **not** operate any key on the front panel for at least 2 seconds or by pressing the ○ or ↵ key.

2-Point Shift

Overview

The 2-point shift can only be applied to a non-contact sensor (infrared type K thermocouple).

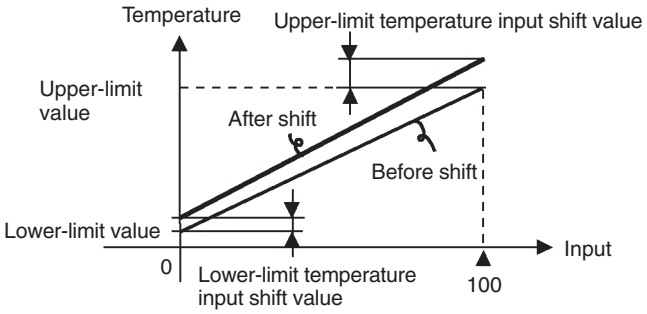
Figure 4.7



- The input temperature range of non-contact temperature sensors can be shifted by setting an individual value for the upper and lower end points of the sensor range. This means that the shift can be applied equally across the range with separate values for each end of the range. For example, if the upper-limit value is set to 2°C and the lower-limit value is set to 1°C, the sensor range is shifted by an average of 1.5°C at the 50% input.

- Set the upper-limit value in the Upper-Limit Temperature Input Shift value parameter and the lower-limit value in the Lower-Limit Temperature Input Shift value parameter.

Figure 4.8 Two-Point Shift



How to Calculate Input Shift Values (2-Point Shift)

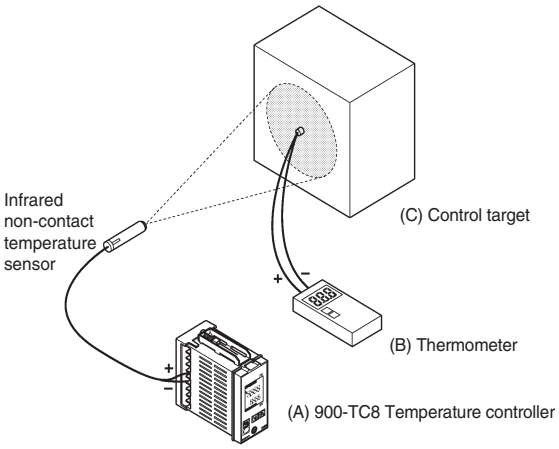
When a non-contact temperature sensor (for example, OMRON ES1A sensor) is connected to the Bulletin 900-TC8, an offset of several degrees to several tenths of a degree can occur. For this reason, it may be desirable to offset the readout value by 1-point or 2-point shift as described here. **Note:** 2-point shift can be carried out only on non-contact temperature sensors, and cannot be set for other input types.

Preparations

1. Set to the temperature range to match the input specifications of the non-contact temperature sensor (see Table A.D, *List of Input Types*). (The non-contact infrared sensor is supported only in thermocouple input type Bulletin 900-TC8 controllers. See Table 1.A.)

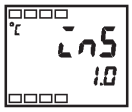
2. Prepare a thermometer (B) capable of measuring the temperature of the control target (C) as shown in Figure 4.9 so that 1-point shift or 2-point shift can be carried out.

Figure 4.9 Configuration when Compensating a Non-Contact Infrared Temperature Sensor



Using the 1-Point Shift Method

Figure 4.10



1. In the temperature control configuration shown in Figure 4.9, bring the set point to near the value at which the temperature of the control target is to be controlled. Assume that the control target temperature (C) and the control target temperature (B) match.

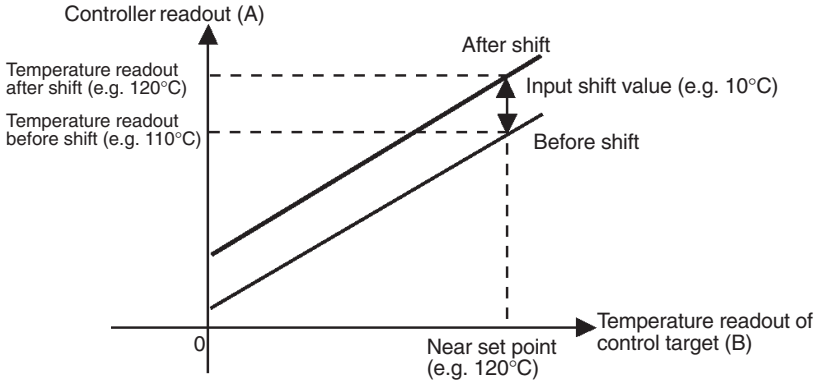
2. Check the control target temperature (B) and the controller readout (A). Take the value from the following equation as the Input Shift Value, and configure the same numerical value to in5.

   Control target temperature (B) – Controller readout (A) =
   Input shift value

   Figure 4.11 shows the effect of 1-point temperature input shift.

3. After you have configured the 1-point input shift value, check the controller readout (A) and control target temperature (B). If they are almost the same, this completes temperature input shift procedure.

Figure 4.11 One-Point Temperature Input Shift



Using the 2-Point Shift Method

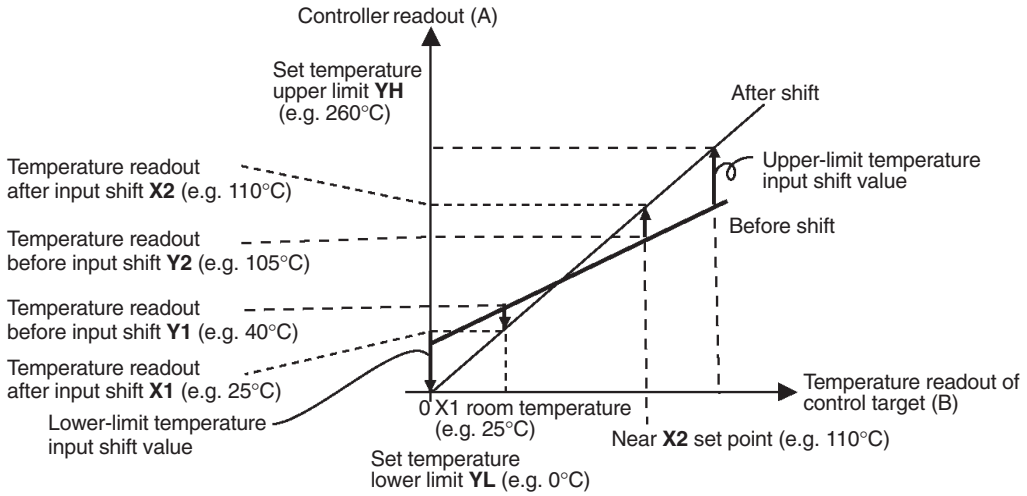
Use the 2-point input shift method if you want to increase the accuracy of the readout values across the range of a non-contact sensor.

1. When using the 2-point shift method, shift the controller readout at two points: the first, near room temperature; and the second, near the value at which the temperature of the control target is to be controlled. Therefore, for this procedure, bring the control target temperature to near room temperature and to near the set point, and check control target temperature (B) and controller readout (A). See Figure 4.9.

2. Using equations 1 and 2 (p. 4-6), calculate the upper- and lower-limit temperature input shift values from the readout and temperature to be shifted that you obtained in step 1.

Figure 4.12 shows the effect of shift by 2-point temperature input shift.

Figure 4.12 Two-Point Temperature Input Shift



– **Equation 1:** Use the following equation to calculate the lower-limit temperature input shift value.

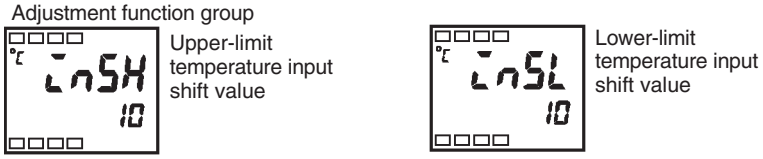
$$\text{InSL} = \frac{YL - Y1}{Y2 - Y1} \times \{(X2 - Y2) - (X1 - Y1)\} + (X1 - Y1)$$

– **Equation 2:** Use the following equation to calculate the upper-limit temperature input shift value.

$$\text{InSH} = \frac{YH - Y1}{Y2 - Y1} \times \{(X2 - Y2) - (X1 - Y1)\} + (X1 - Y1)$$

Note: For meanings of variables, see Figure 4.12.

Figure 4.13



3. After you have configured the calculated values for InSL and InSH, check/compare controller readout (A) with the control target temperature (B).

4. Although the input shift was carried out at two points, close to room temperature (ambient temperature), and near to the set point, you may want to consider selecting points close to each end of the sensor range to improve accuracy across the full range of the sensor measurement range.

Note: Before selecting these values, check that they will not damage the control application if applied.

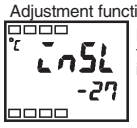
EXAMPLE

In this example, we use the non-contact (infrared) sensor type K thermocouple 0…260°C specification to do a 2-point shift.

YL and YH in equations 1 and 2 are set temperature lower limit (YL = 0°C) and set temperature upper limit (YH = 260°C). Check the temperature of the control target.

When the room temperature (X1) is 25°C, the readout on the controller (Y1) is 40°C, and when the temperature near the set point (X2) is 110°C, the readout on the controller (Y2) becomes 105°C.

Lower-limit temperature input shift value:

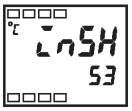


$$\text{InSL} =$$

$$\frac{0-40}{105-40} \times \{(110-105)-(25-40)\} + (25-40) =$$

–27.3°C

Upper-limit temperature input shift value:



$$\text{InSH} =$$

$$\frac{260-40}{105-40} \times \{(110-105)-(25-40)\} + (25-40) =$$

–52.7°C

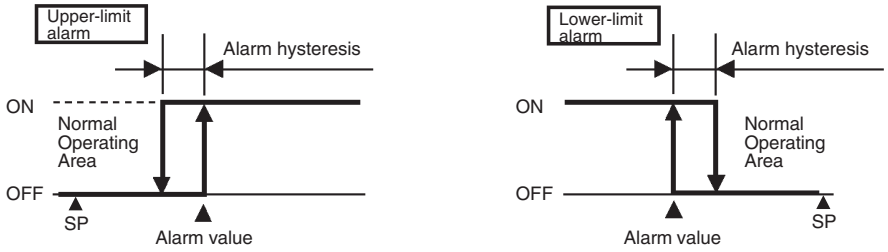
Alarm Functions/ Parameters

Alarm Hysteresis

You can configure/program how much deviation (hysteresis) is allowed from the alarm value before the alarm comes on and resets.

The hysteresis of alarm outputs when alarms are switched ON/OFF can be set as follows:

Figure 4.14



Alarm hysteresis is independently set for each alarm output in the alarm Hysteresis 1 to 3 parameters (Advanced Setting function group). **Note:** The default is 0.2 (°C or °F depending on your units selection).

Standby Alarm Sequence

Standby alarm sequence is a function which allows you to configure the alarm outputs to be temporarily disabled until after the **first** alarm condition occurs. From then on, the alarm output is active for all future alarm conditions.

For example, in a standard heating application, if you used the standard low alarm configuration, the alarm would be active as soon as you switch the controller ON. However, with standby sequence, the alarm output is disabled during the first warm-up, and the temperature has to rise above the alarm set point before the alarm can become active. Then, if the temperature falls below the alarm set point, the output is active.

Restart

As mentioned above, the standby sequence is canceled **after** the first real alarm clears. If desired, it can be restarted later by the Standby Sequence parameter (Advanced Setting function group). For details, see p. 5-37, *Standby Sequence Reset Method*.

Alarm Latch

Alarm latch is a function where you can configure the alarm output once turned ON to stay ON regardless of the process temperature.

The alarm latch function can be canceled by turning the controller power OFF. (Note, however, that it can also be canceled by switching to the Initial Setting function group, Communications Setting function group, Advanced Setting function group, or Calibration function group.

Alarm Output Close in Alarm or Open in Alarm

When the Bulletin 900-TC8 alarm output(s) is configured to close in alarm, the status of the alarm output is normally open. When it is configured to open in alarm, the status of the alarm output is inverted or normally closed in relay logic terms (see Table 4.A).

The alarm type (see Table 3.H) and Close in Alarm (normally open)/Open in Alarm (normally closed) parameters can be configured independently for each alarm output.

The Close in Alarm/Open in Alarm condition is configured in the Alarm 1 to 3 Open in Alarm parameters (Advanced Setting function group). **Note:** The default is **n-o**: close in alarm.

When Alarm 1 Open in Alarm parameter (Advanced Setting function group) is configured to open in alarm, the heater burnout alarm and input error output also become open in alarm.

The alarm output turns OFF (relay contact open) during a power interruption to the controller, and stays off for about 2 seconds after power is turned ON, regardless of the close in alarm/open in alarm configuration.

Table 4.A

Parameter Configuration	Alarm Condition	Alarm Output	Alarm LCD
Close in alarm 	ON	ON	Lit
	OFF	OFF	Out
Open in alarm 	ON	OFF	Lit
	OFF	ON	Out

Summary of Alarm Operations

Figure 4.15 visually summarizes the descriptions of different alarm operations when alarm type is set to lower-limit alarm with standby sequence and the Bulletin 900-TC8 is configured to close in alarm.

Figure 4.15

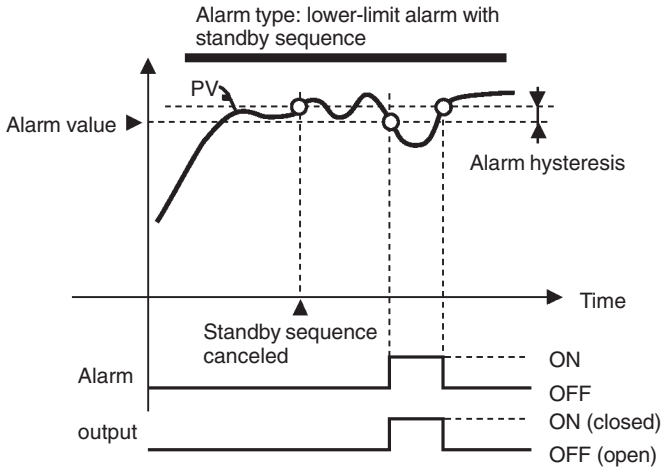


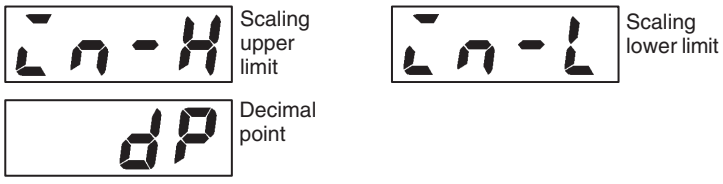
Table 4.B Alarm Parameters

Symbol	Parameter: Function Group	Description
AL Hx	Alarm 1 to 3 Hysteresis: Advanced Setting function group	Alarm
rESt	Standby Sequence Reset Method: Advanced Setting function group	Alarm
AL xn	Alarm 1 to 3 Open in Alarm: Advanced Setting function group	Alarm

x = output 1 to 3

Configuration of Scaling Upper Limits and Scaling Lower Limits (Analog Input)

Figure 4.16



Overview

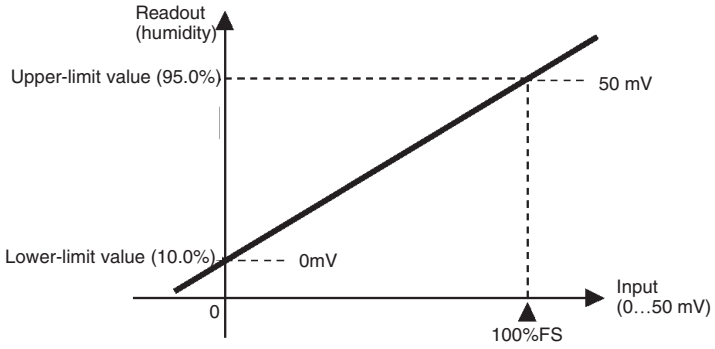
When an analog input (0…50 mV voltage input) is selected, scaling to engineering units (e.g., lbs) that match the application is possible.

Scaling is configured in the Scaling Upper Limit, Scaling Lower Limit, and Decimal Point parameters (Initial Setting function group). These parameters cannot be used when a temperature input type (e.g., RTD) is selected.

The Scaling Upper Limit parameter allows you to configure the physical quantity to be expressed by the upper limit input value, and the Scaling Lower Limit parameter sets the physical quantity to be expressed by the lower-limit value. The Decimal Point parameter specifies the number of digits past the decimal point.

Figure 4.17 shows a scaling example of a 0…50 mV input. After scaling, the sensor input can be directly read from the controller as a percentage of humidity. However, the display will not indicate %, only a value.

Figure 4.17 Input Scaling

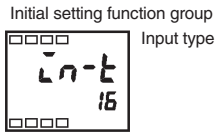


Example Operation Procedure

In this example, configure the scaling upper- and lower-limits so that inputs 0…50 mV become 10.0%…95.0%.

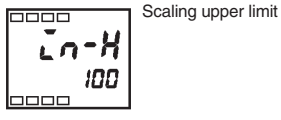
1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 4.18



2. Select Scaling Upper Limit by pressing ↵.

Figure 4.19



3. Press the ∧ or ∨ key to set the parameter to 950.

Figure 4.20

4. Select Scaling Lower Limit by pressing ↵.

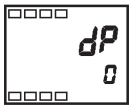
Figure 4.21

5. Press the ⇈ or ⇊ key to set the parameter to 100.

Figure 4.22

6. Select the decimal point position by pressing ↵.

Figure 4.23



7. Press the ⇈ or ⇊ key to set the parameter to 1.

Figure 4.24

8. To return to the Operation function group press the ○ key for at least 1 second.

Note: The newly configured value or parameter is loaded into controller memory if you do **not** operate any key on the front panel for at least 2 seconds or by pressing the ○ or ↵ key.

Executing the Heating and Cooling Control Mode

Overview

Several forms/modes of heating, cooling, or heating and cooling control can be used with Bulletin 900-TC8 controllers. The heating and cooling control mode operates when H-C: heating and cooling is selected in the Standard/Heating and Cooling parameter (Initial Setting function group). Select the control mode according to the Table 4.C.

Table 4.C Output to Control Mode Assignment

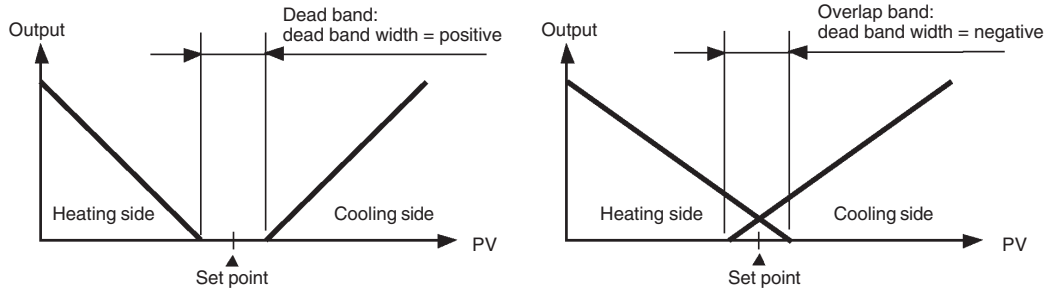
Setting		Output	
Control Mode	**Direct/Reverse Operation**	**Control Output 1**	**Control Output 2 (ALM 3)**
Standard control	Reverse operation	Control output (heat)	—
Standard control	Direct operation	Control output (cool)	—
Heating and cooling control	Reverse operation	Control output (heat)	Control output (cool)
Heating and cooling control	Direct operation	Control output (cool)	Control output (heat)

Note: The default is heating control (standard control mode, reverse operation).

Dead Band (Heating and Cooling Control)

When the heating and cooling control mode is selected, the Dead Band parameter can be used. The dead band is configured with the set point as its center (see Figure 4.25). The dead band width is the configured value of the Dead Band parameter (Adjustment function group). Setting a negative value produces an overlap band. **Note:** The default is 0.0% EU.

Figure 4.25 Dead Band



Cooling Coefficient (Heating and Cooling Control)

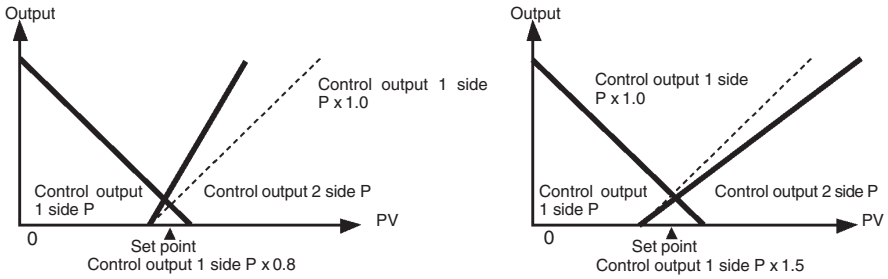
When the heating and cooling control mode and PID control method are selected, the Cooling Coefficient parameter can be used. If the heating and cooling functional characteristics of the control target greatly differ, this could limit satisfactory control performance from being obtained by the same PID values. To reduce the possibility of this occurring, adjust the proportional band (P) at the cooling side of the set point using the cooling coefficient to balance control between the heating and cooling sides. In heating and cooling control the proportional band, (P) at the heating or cooling side is calculated by the following formula:

Control output 1 (heating side): P = P

Control output 2 (cooling side): P = P x cooling coefficient

The control output 2 (cooling side) coefficient is applied to control output 1 (heating side) proportional band (P) to obtain control whose characteristics differ from those on the control output 1 side.

Figure 4.26 Cooling Coefficient



Setup of Heating and Cooling

To configure the heating and cooling control mode, set the Standard/Heating and Cooling, Dead Band, and Cooling Coefficient (when using the PID method) parameters.

Example Operation Procedure — Heating and Cooling Control Selection

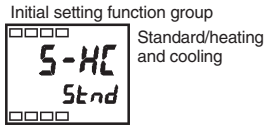
Standard/heating and cooling = Heating and cooling

1. Press the ◎ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

2. Select heating and cooling control in the Initial Setting function group.

   Stnd: Standard control
   H-C: Heating and cooling control

Figure 4.27

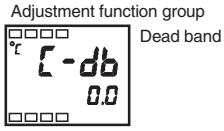


Example Operation Procedure — Configuring the Dead Band

Dead band = 5

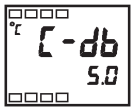
1. Select Dead Band in the Adjustment function group.

Figure 4.28



2. Press the ⌃ key to set the parameter to 5.0. The setting range is –199.9…+999.9.

Figure 4.29

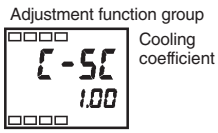


Example Operation Procedure — Configuring the Cooling Coefficient

Cooling coefficient = 10

1. Select Cooling Coefficient in the Adjustment function group. In this example, set the parameter to 10.

Figure 4.30



2. Press the ⩓ key to set the parameter to 10.00. The setting range is 0.01…99.99.

Figure 4.31

Using the Event Input Feature

Overview

Discrete (ON/OFF) inputs can be wired to the Bulletin 900-TC8 (option unit Cat. No. 900-TC8EIM installed) to cause the controller to perform several pre-defined/pre-configured tasks. These inputs are generically called event inputs. The pre-defined functions provided are controller RUN/STOP control and/or multi-set point selection.

Setting Event Input

RUN/STOP operation of the controller and multi-set point capability can be executed by Event Input Assignments 1 and 2 parameters (see Table 4.D).

The Number of Multi-SP Uses parameter is used when the number of preset set points is 2 or 4. This parameter determines display or non-display of the Event Input Assignment 1 and Event Input Assignment 2 parameters.

RUN/STOP is assigned to inputs not used for multi-SP of event inputs 1 and 2 by the Event Input Assignment 1 and 2 parameters (Advanced Setting function group).

Table 4.D

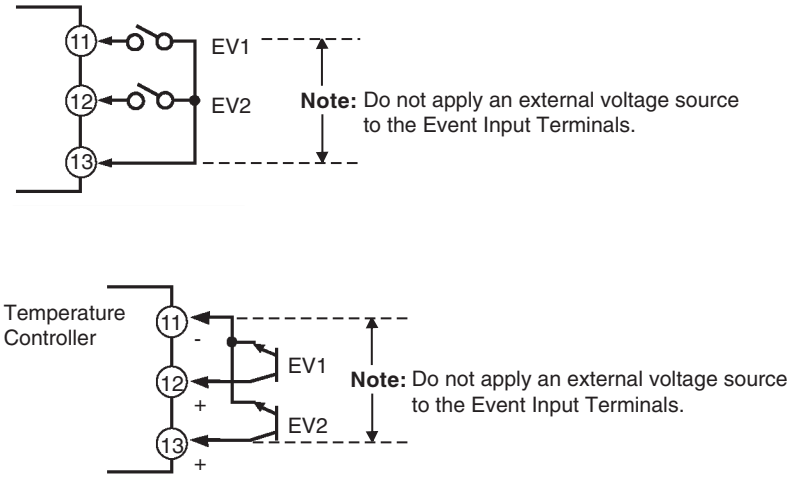
Number of Multi-SP Uses Parameter	Configuration		Event Input Function	
	Event Input Assignment 1 Parameter	Event Input Assignment 2 Parameter	Event Input 1	Event Input 2
0	NONE or STOP ❶		NONE or RUN/STOP switching ❶	
1	— (not displayed)	NONE or STOP	Multi-SP 2 set points (set point 0/1 switching)	NONE or RUN/STOP switching
2	— (not displayed)		Multi-SP 4 set points (set point 0/1/2/3 switching)	

❶ STOP (RUN/STOP) switching of the controller can be configured only for one of event input assignments 1 or 2. The configured event input can be used for RUN/STOP. The setting on the other side becomes NONE.

When you want to configure event inputs to change set points, you must properly configure the Number of Multi-SP Uses parameter.

Two set points (0 or 1) can be selected when the Number of Multi-SP Uses parameter is set to 1 (default). This setting need not be changed. Set point 0 or 1 is specified by the ON/OFF state of event input 1.

Figure 4.32 Event Inputs



Multi-SP

Selecting Multi-SP by Event Input

Multi-SP by event input is a function for setting the value of set points 0…3 in advance, and selecting these set points by a combination of event inputs 1 and 2.

Multi-SP selection from external (event) inputs can be used when the option event input unit Cat. No. 900-TC8EIM is mounted in the Bulletin 900-TC8 and the Number of Multi-SP Uses parameter is set to 1 or 2 (see Tables 4.D, 4.E, and 4.F).

Table 4.E When Number Of Multi-SP Uses Parameter is Set to 1

Event Input 1	Selected Set Point
OFF	Use set point 0
ON	Use set point 1

Table 4.F When Number of Multi-SP Uses Parameter is Set to 2

Event Input 1	Event Input 2	Selected Set Point
OFF	OFF	Use set point 0
ON	OFF	Use set point 1
OFF	ON	Use set point 2
ON	ON	Use set point 3

Note: Event input can be used when the option event input unit Cat. No. 900-TC8EIM is mounted in the Bulletin 900-TC8. Select event input ON/OFF while the Bulletin 900-TC8 is turned ON. In order for the controller to begin the multi-set point function the physical input must be ON for 50 ms minimum.

Selecting Multi-SP by Keypad Operation

You can select set points 0…3 from the controller keypad by properly configuring the value of the Multi-SP parameter. To change set points from the controller keypad, the multi-SP conditions are as follows:

- When the option event input unit Cat. No. 900-TC8EIM is not mounted in the Bulletin 900-TC8, and Multi-SP is configured to ON.
- When the option event input unit Cat. No. 900-TC8EIM is mounted in the Bulletin 900-TC8, the Number of Multi-SP Uses parameter is configured to 0 and the Multi-SP parameter is configured to ON.

The following table shows the relationship between the Multi-SP parameter value and the selected set point.

Table 4.G

Multi-SP Value	Selected Set Point
0	Set point 0
1	Set point 1
2	Set point 2
3	Set point 3

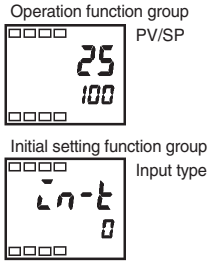
Multi-SP Setup

Example Operation Procedure — to Select Set Points (0/1/2/3)

Before you configure the Number of Multi-SP Uses parameter, you must first cancel protection from the Advanced Setting function group. For additional details on how to cancel key protection, see p. 4-28, *Using the Key Protect Function Group*.

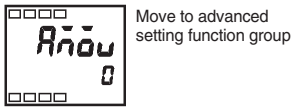
1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 4.33



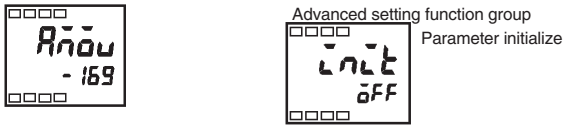
2. Select Move to Advanced Setting Function Group by pressing the ↵ key.

Figure 4.34



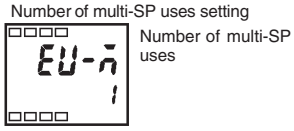
3. Press the ⩛ key to enter the password (**–169**) to cancel protection. You can now move to the Advanced Setting function group by pressing the ⊂⊃ key or leaving the setting for at least 2 seconds.

Figure 4.35



4. Select Number of Multi-SP Uses parameter by pressing the ⊂⊃ key.

Figure 4.36



5. Press the ⩓ key to set the parameter to 2. This allows set point change from event input (see Table 4.D).

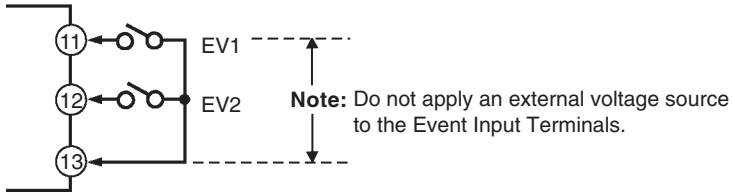
Figure 4.37

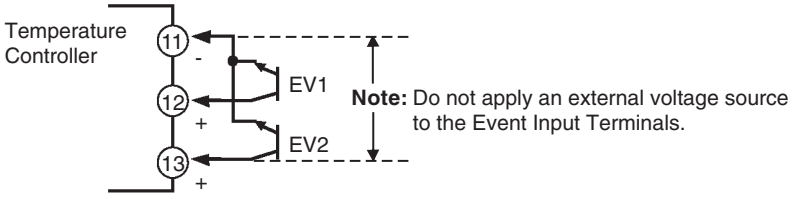
6. To return to the Initial Setting function group press the ⊙ key for at least 1 second.

7. To return to the Operation function group press the ⊙ key for at least 1 second.

Set points 0, 1, 2, and 3 are selected according to the ON/OFF states of event inputs 1 and 2.

Figure 4.38 Event Inputs





Executing RUN/STOP Controller Mode Change

When the Event Input Assignment 1 or Event Input Assignment 2 parameter is set to RUN/STOP (see Table 4.I), control is started (RUN) when event input 1 or 2 is OFF. Control is stopped when 1 or 2 is ON (see Table 4.H). While control is stopped, the controller's STP (stop) LED lights.

Table 4.H

Setting	Input Contact	Controller Mode
Event input 1 or 2	ON	STOP
Event input 1 or 2	OFF	RUN

Note: The Multi-SP Uses parameter must be configured to 0 or 1 for RUN/STOP control by event inputs to function (see Table 4.I).

Event input assignments 1 and 2 are as follows according to the Number of Multi-SP Uses setting.

Table 4.I

	Number of Multi-SP Uses Parameter Setting		
	0	1	2
Event Input Assignment 1	None or RUN/STOP	Not displayed (none)	Not displayed (none)
Event Input Assignment 2	None or RUN/STOP	None or RUN/STOP	Not displayed (none)

- When the Number of Multi-SP Uses parameter is configured to either 1 or 2, and the Event Input Assignment parameter 1 or 2 is set to Not Displayed, the setting automatically becomes none.
- When the Number of Multi-SP Uses parameter is set to 0, it is possible that both event input assignments 1 and 2 can be ON, and RUN/STOP is assigned to only one event assignment. The other event assignment is automatically set to OFF.

Table 4.J Parameters

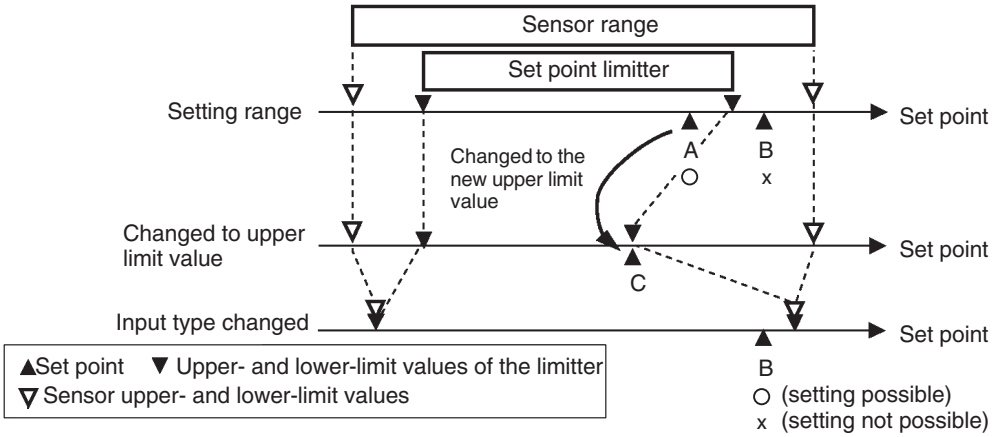
Symbol	Parameters: Function Group	Description
Eu-1	Event Input 1 Assignment: Advanced Setting function group	For selecting the event input function
Eu-2	Event Input 2 Assignment: Advanced Setting function group	
Eu-n	Number of Multi-SP Uses: Advanced Setting function group	

Configuring the SP Upper and Lower Limit Values

Set Point Limitter

The maximum allowable configuration range of the set point is limited by the set point limitter function. The set point limitter is used to prevent someone from configuring the set point to some value outside the maximum range called for by the application, thereby preventing the control target from reaching an abnormal temperature. The upper- and lower-limit values of the set point limitter are configured from the Set Point Upper Limit and Set Point Lower Limit parameters in the Initial Setting function group, respectively.

Figure 4.39



Application Considerations

- If a change is made to the set point upper and/or lower limit value with the current set point outside the limitter range, the set point is forcibly changed by the controller to the sensor's upper SP limit or lower SP limit value, whichever is closer.
- When the input type or temperature unit are changed, the set point limitter is forcibly reset to the sensor setting range.

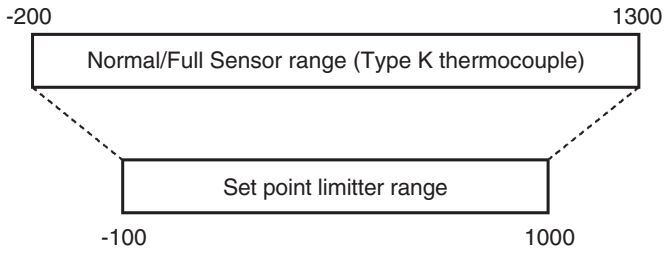
Table 4.K Parameters

Symbol	Parameters: Function group	Description
SL-H	Set Point Upper Limit: Initial Setting function group	For limiting the SP setting
SL-L	Set Point Lower Limit: Initial Setting function group	

Set Point Limit Setup

To configure the Set Point Upper and Lower Limit parameters, you must be in the Initial Setting function group. This example describes how to configure the set point limitter when using a type K thermocouple (normal full range: –200…1300°C).

Figure 4.40

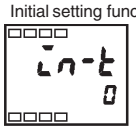


Example Operation Procedure — Configuring the Set Point Upper Limit

Configure the Set Point Upper Limit value to 1000.

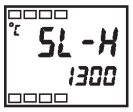
1. Press the [O] key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 4.41



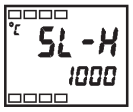
2. Select Set Point Upper Limit.

Figure 4.42



3. Press the [^] or [v] key to set the value to 1000.

Figure 4.43

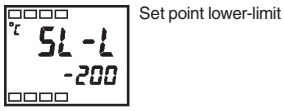


Example Operation Procedure — Configuring the Set Point Lower Limit

Configure the Set Point Lower Limit value to –100.

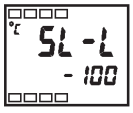
1. Select Set Point Lower Limit in the Initial Setting function group.

Figure 4.44



2. Press the [^] or [v] key to set the value to –100.

Figure 4.45



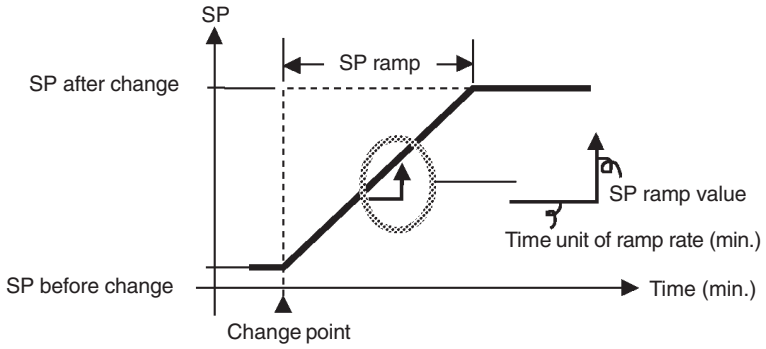
Note: The newly configured value or parameter is loaded into controller memory if you do **not** operate any key on the front panel for at least 2 seconds or by pressing the [O] or [R] key.

Executing the SP Ramp Function (Limiting the SP Rate of Change)

SP Ramp

With the SP ramp function, the controller can limit the rate at which a change in the set point will impact the control according to the user-defined SP ramp value. The time interval in minutes which the set point is limited is referred to as the SP ramp.

Figure 4.46



The maximum allowed rate of change during SP ramp is specified by the SP Ramp Set Value parameter. **Note:** The SP Ramp Set Value default is OFF, and the SP ramp function is disabled.

Changing the ramp set point can be monitored in the Set Point during SP Ramp parameter (Operation function group). Use this parameter when monitoring the SP ramp.

Operation is also the same during switching of the set points by the Multi-SP parameter.

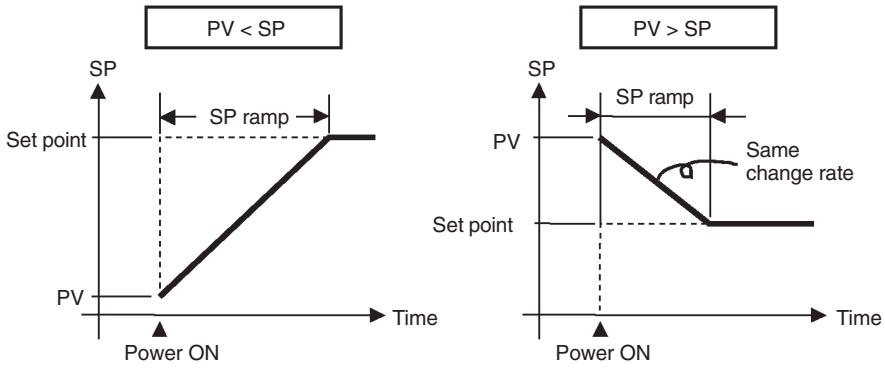
SP Ramp Application Considerations

SP Ramp Operation at Startup

If the SP ramp function is enabled when the Bulletin 900-TC8 is turned ON, or when RUN is switched to from STOP, the process value (PV) may reach the Set Point SP ramp value in the same way as when the set point is changed. In this case, operation is carried out by the controller with the process value regarded as the set point before the change was made.

The direction the SP ramp changes is according to the relationship between the process value and the set point (see Figure 4.47).

Figure 4.47



Restrictions During SP Ramp Operation

- Auto-tuning execution starts after the end of SP ramp.
- When control is stopped or an error occurs, the SP ramp function is disabled.

Table 4.L Parameters

Symbol	Parameters: Function Group	Description
SL-H	Set Point Upper Limit: Initial Setting function group	For limiting SP setting
SL-L	Set Point Lower Limit: Initial Setting function group	For limiting SP setting
SPrt	SP Ramp Set Value: Advanced Setting function group	For limiting SP change rate

To Move to the Advanced Setting Function Group

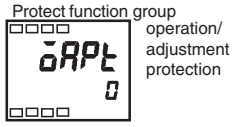
By default, the Advanced Setting function group is protected and you cannot directly move to this function group. To move to this function group you must first cancel the protection applied by the Protect function group. See p. 4-28, *Using the Key Protect Function Group*.

Example Operation Procedure

1. Press the ○ and ↵ keys simultaneously for at least 3 seconds in the Operation function group.

2. The controller moves to the Protect function group, and Operation/Adjustment Protection is displayed.

Figure 4.48



3. Press the ↵ key once to move to Initial Setting/Communications Protection.

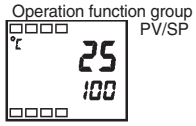
Figure 4.49

4. Configure the programmed value to 0.

Figure 4.50

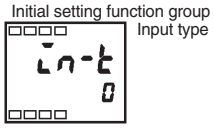
5. Press the ○ and ↵ keys simultaneously to return to the Operation function group.

Figure 4.51



6. Press the ○ key for at least 3 seconds to move to the Initial Setting function group from the Operation function group.

Figure 4.52



7. Select the Move to Advanced Setting Function Group parameter by pressing the ↵ key.

Figure 4.53

8. Press the ▲▼ keys to enter the password (**–169**), and either press the ↵ key or leave the setting for at least 2 seconds to move to the Advanced Setting function group from the Initial Setting function group.

Figure 4.54

Advanced setting function group

Using the Key Protect Function Group

Key Protect

The Key Protect feature prevents some keypad functions from working. Three different modes of protection are provided: Operation/Adjustment protection, Initial Setting/Communications protection, and Configuration Change protection.

To move to the Protect function group, press the ○ and ↵ keys simultaneously for at least 3 seconds.

The Key Protect feature restricts the type of parameters that can be used.

Operation/Adjustment Protection

Figure 4.55

Protect function group

The following table shows the relationship between configured/set values and the level of protection.

When the Key Protect parameter is configured to 0, parameters are not protected. **Note:** The default is 0.

Table 4.M Operation Protection

Function Group		Configured/Set Value			
		0 ❶	1	2	3
Operation Function Group	PV	○	○	○	○
	PV/SP	◎	◎	◎	○
	Other	◎	◎	X	X
Adjustment Function Group		◎	X	X	X

Level of Protection:

◎ Can be displayed and changed.

○ Can be displayed.

X Cannot be displayed and moving to other levels is not possible.

❶ Default

Initial Setting/Communications Protection

This portion of the Key Protect function group restricts movement by keypad operation to the Initial Setting function group, Communications Setting function group, and Advanced Setting function group (see Table 4.N).

Figure 4.56

Note: The default is 1.

Table 4.N Initial Setting/Communications Protection

Set Value	Initial Setting Function Group	Communications Setting Function Group	Advanced Setting Function Group
0	○	○	○
1 ❷	○	○	X
2	X	X	X

Level of Protection:

○ Moving to other function groups is possible.

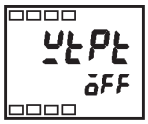
X Moving to other function groups is **not** possible.

❷ Default

Configuration Change Protection

This portion of the Protect group protects controller setup from being changed by operating the keys on the front panel.

Figure 4.57



Note: The default is OFF.

Table 4.O Configuration Change Protection

Configured Value	Description
OFF ❶	Setup can be changed by key operation.
ON	Setup cannot be changed by key operation. (The Protect function group can be changed.)

❶ Default

Parameter Functions and Definitions

Conventions Used in This Chapter

About the Parameter Display

Parameters are displayed on the controller only when the item(s) listed in the Conditions of Use section for each parameter is satisfied. However, the configuration of protected parameters is still valid, and is not displayed regardless of the Conditions of Use.

About the Order in which Parameters are Described in This Chapter

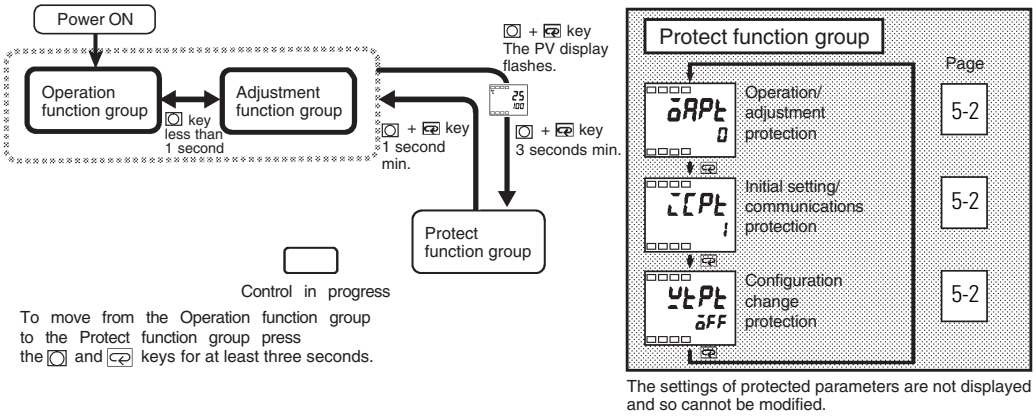
Parameters are described function group by function group.

The first page of each function group section lists the parameters available in that function group. The parameter names in this list are listed in the order that they are displayed on the Bulletin 900-TC8.

Protect Function Group

Three different modes of protection are provided within the Protect function group of the Bulletin 900-TC8: the Operation/Adjustment protection, Initial Setting/Communications protection, and Configuration Change protection. These protection parameters prevent unwanted operation of the keys on the front panel in varying degrees.

Figure 5.1



Operation/Adjustment Protection,

Initial Setting/Communications Protection,

Configuration Change Protection

Operation/Adjustment Protection

Function: This parameter specifies the range of parameters to be protected.

Table 5.A shows the relationship between the configured/set values and the range of protection.

Table 5.A Operation/Adjustment Protection

Function Group		Configured/Set Value			
		0 ❶	**1**	**2**	**3**
Operation function group	PV	○	○	○	○
	PV/SP	◎	◎	◎	○
	Other	◎	◎	X	X
Adjustment function group		◎	X	X	X

Level of Protection:

◎ Can be displayed and changed.

○ Can be displayed.

X Cannot be displayed and moving to other function groups is **not** possible.

❶ Default

Note: Parameter items are not protected when the configured/set value is 0.

Initial Setting/Communications Protection

This portion of the Protect function group restricts movement by keypad to the Initial Setting function group, Communications Setting function group, and Advanced Setting function group.

Table 5.B Initial Setting/Communications Protection

Configured Value	Initial Setting Function Group	Communications Setting Function Group	Advanced Setting Function Group
0	○	○	○
1 ❶	○	○	X
2	X	X	X

Level of Protection:

○ Move to other function groups possible.

X Move to other function groups is not possible.

❶ Default

Configuration Change Protection

This portion of the Protect function group restricts changes to controller setup by key operation.

Table 5.C Configuration Change Protection

Configured Value	Description
OFF ❷	Setup can be changed by key operation.
ON	Setup cannot be changed by key operation. (The Protect function group can be changed.)

❷ Default

Operation Function Group

Use this function group when you want to carry out control operations on the Bulletin 900-TC8. You can configure/set alarm values or monitor the manipulated variable (MV) with this function group.

Note: This function group is displayed immediately after the power is turned ON. To select other function groups, simultaneously hold down the ○ key, or the ○ and the ↵ key.

Figure 5.2

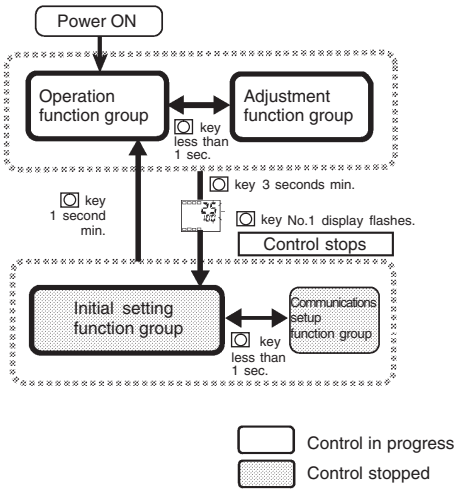
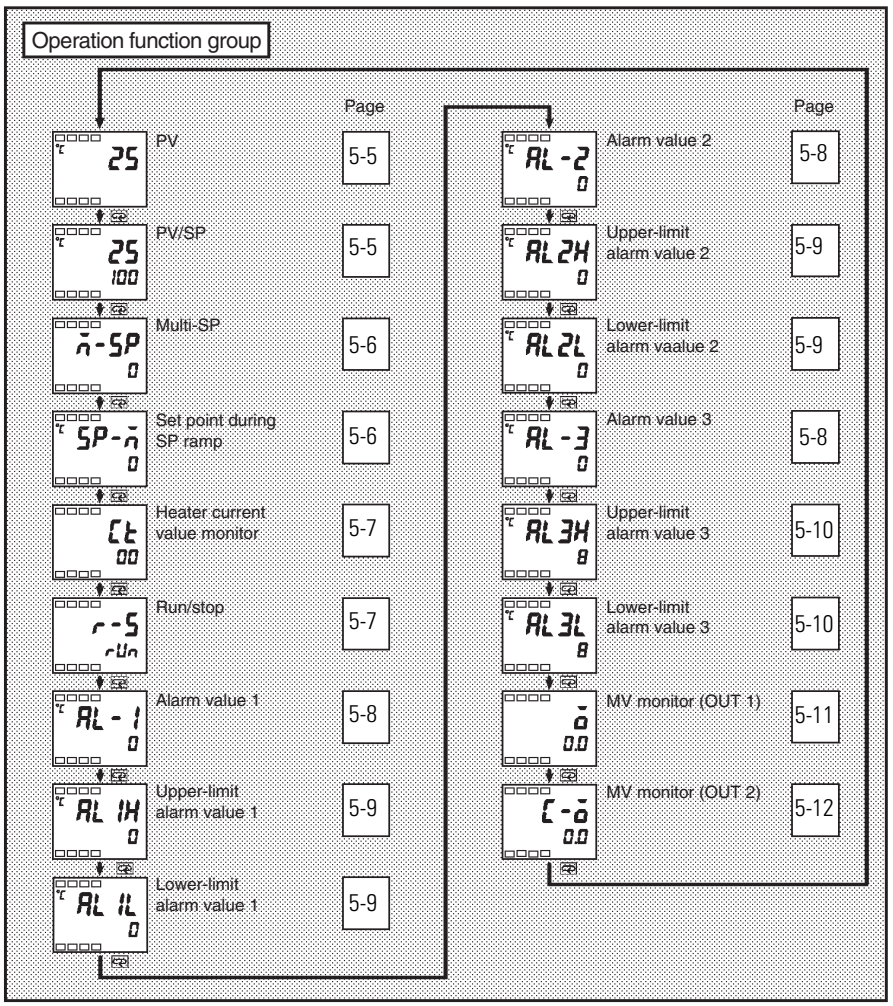


Figure 5.3



PV (Process Value)

Conditions of Use: The Additional PV Display parameter must be set to ON.

Function: The process value (PV) is displayed on the No. 1 display, and nothing is displayed (blank) on the No. 2 display.

Table 5.D

	Monitoring Range	Units
Process Value	Input indication range (see p. A-5)	EU

Note: The decimal point position is dependent on the selected sensor.

Related Parameters

- Input Type (Initial Setting function group) (p. 5-23)
- Set Point Upper Limit, Set Point Lower Limit (Initial Setting function group)

PV/SP (Process Value/Set Point)

Function: The process value is displayed on the No. 1 display, and the set point is displayed on the No. 2 display.

Table 5.E

	Monitoring Range	Units
Process Value	Input indication range (See p. A-5)	EU
Set Point	Set Point lower limit to Set Point upper limit parameter	EU

Note: The decimal point position is dependent on the selected sensor.

Related Parameter

PV (Process Value) (p. 5-5)

Multi-SP (Set Point 0…3)

Conditions of Use: The Multi-SP Uses parameter must be set to ON.

Function: The Multi-SP feature allows you to configure up to four different set points (SP 0…3) in the Adjustment function group. Either of these pre-configured values can be selected by operating the keys on the front panel or by external input signals (event input) for use by the controller. In the parameter, enter set points 0…3 to display the Multi-SP value.

Set Point during SP Ramp

Conditions of Use: The SP Ramp Set Value parameter must not be configured to OFF.

Function: This parameter allows you to monitor the Set Point during SP Ramp function.

Ramp is a function for restricting the amount the set point can change, from the current value to a new value, as a rate of change.

The currently configured value is displayed when using the SP Ramp Set Value parameter in the Advanced Setting function group.

When the set point is out of the preset ramp rate, the set point is matched to the set point set in the PV/SP parameter.

Table 5.F

Monitoring Range	Units
SP: Set Point lower limit to Set Point upper limit	EU

Related Parameters

- PV/SP (Operation function group) (p. 5-5)
- SP Ramp Set Value (Advanced Setting function group) (p. 5-36)
- Set Point Upper Limit, Set Point Lower Limit (Initial Setting function group) (p. 5-25)

Ct Heater Current Value Monitor

Conditions of Use: The Heater Burnout parameter must be configured to ON.

Function: This parameter allows you to monitor the measured heater current value from the current transformer (CT) input used for detecting heater burnout.

Table 5.G

Monitoring Range	Units
0.0…55.0	A (Amps)

Note: When the current exceeds 55.0 A, FFFF is displayed.

Related Parameter

- Heater Burnout Detection (Adjustment function group) (p. 5-15)
- HBA Used (Advanced Setting function group) (p. 5-43)

r-S RUN/STOP

Conditions of Use: The RUN/STOP function must **not** be configured for event input assignments 1 and 2.

Function: This parameter allows you to change and monitor the operational (RUN/STOP) mode of the controller.

When rUn: run is selected, the controller is running. When StoP: stop is selected, the controller is stopped. When the controller is stopped, the STOP LED display lights.

When the RUN/STOP function is being controlled by an event input, the RUN/STOP function cannot be initiated by operating the keys on the controller front panel.

Note: The default is rUn.

Alarm Value 1,

Alarm Value 2,

Alarm Value 3

Conditions of Use: The alarm type must be set to either no alarm or a setting other than upper and lower limit alarm. The control mode must be set to standard control (Alarm Value 3).

Function: This parameter allows you to configure the input value X in the alarm type list.

This parameter is used for configuring the alarm value that will trigger alarm outputs 1, 2, and 3.

When using a temperature input (e.g., RTD), the decimal point position is dependent on the currently selected sensor. When using an analog input it is dependent on the Decimal Point parameter setting.

The Alarm Type must be set to something other than upper and lower limit alarm.

Table 5.H

Configurable Range	Units	Default Value
–1999…+9999	EU	0

Related Parameters

- Input Type (p. 5-23), Scaling Upper Limit, Scaling Lower Limit, Decimal Point (Initial Setting function group) (p. 5-24)
- Alarm 1 to 3 type (p. 5-29)
- Alarm 1 to 3 Open in Alarm, Alarm 2 Open in Alarm, Alarm 1 to 3 Hysteresis, Standby Sequence Reset Method (p. 5-37), Alarm 1 to 2 Latch (Advanced Setting function group)

Upper-Limit Alarm Value 1,

Lower-Limit Alarm Value 1

Conditions of Use: Alarm 1 type must be configured to either upper and lower limits, upper and lower limit range, or upper- and lower-limit with standby sequence.

Function: This parameter allows independent configuration of the upper- and lower-limit alarm values when the mode for configuring the upper and lower limits is selected for Alarm 1 Type (Initial Setting function group).

This parameter sets the upper and lower limit alarm values for alarm 1.

When using a temperature input (e.g., RTD), the decimal point position is dependent on the currently selected sensor. When using an analog input it is dependent on the Decimal Point parameter setting.

Table 5.I

Configurable Range	Units	Default Value
–1999…+9999	EU	0

Related Parameters

- Alarm 1 Type (Initial Setting function group) (p. 5-29)
- Standby Sequence Reset Method (p. 5-37), Alarm 1 Open in Alarm (p. 5-38), Alarm 1 Hysteresis (p. 5-39), Alarm 1 Latch (Advanced Setting function group)

Upper-Limit Alarm Value 2,

Lower-Limit Alarm Value 2

Conditions of Use: Alarm 2 type must be set to upper and lower limits, upper and lower limit range, or upper- and lower-limit alarm with standby sequence.

Function: This parameter allows independent configuration of the upper- and lower-limit alarm limit values when the mode for configuring the upper and lower limits is selected for Alarm 2 Type (Initial Setting function group).

This parameter sets the upper and lower limit alarm values for alarm 2.

The decimal point position is dependent on the currently selected sensor.

Table 5.J

Configurable Range	Units	Default Value
–1999…+9999	EU	0

Related Parameters

- Alarm 2 Type (Initial Setting function group) (p. 5-30)
- Standby Sequence Reset Method (p. 5-37), Alarm 2 Open in Alarm, Alarm 2 Hysteresis (p. 5-41), Alarm 2 Latch (Advanced Setting function group)

Upper-Limit Alarm Value 3,

Lower-Limit Alarm Value 3

Conditions of Use: The control mode must be standard control. Alarm 3 type must be set to either upper and lower limits, upper and lower limit range or upper- and lower-limit alarm with standby sequence.

Function: This parameter allows independent configuration of the upper- and lower-limit alarm limit values when the mode for setting the upper and lower alarm limits is selected for Alarm 3 Type (Initial Setting function group).

This parameter sets the upper and lower alarm limit values for alarm 3.

The decimal point position is dependent on the currently selected sensor.

Table 5.K

Configurable Range	Units	Default Value
–1999…+9999	EU	0

Related Parameters

- Alarm 1 Type (Initial Setting function group) (p. 5-29)
- Standby Sequence Reset Method (p. 5-37), Alarm 3 Open in Alarm, Alarm 3 Hysteresis (p. 5-42), Alarm 3 Latch (Advanced Setting function group)

MV Monitor (OUT1)

Conditions of Use: The Manipulated Variable (MV) display parameter must be set to ON.

Function: This parameter allows you to monitor the Manipulated Variable (output 1). Table 5.L shows output to mode assignment.

Note: The default of the Manipulated Variable Display parameter is OFF and the manipulated variable is not displayed.

Table 5.L Output to Control Mode Assignment

Setting		Output	
Control Mode	**Direct/Reverse Operation**	**Control Output 1**	**Control Output 2 (ALM 3)**
Standard control	Reverse operation	Control output (heat)	—
Standard control	Direct operation	Control output (cool)	—
Heating and cooling control	Reverse operation	Control output (heat)	Control output (cool)
Heating and cooling control	Direct operation	Control output (cool)	Control output (heat)

Table 5.M

Control Mode	Monitoring Range	Units
Standard	0.0…100.0	%
Heating and cooling	0.0…100.0	%

Related Parameter

Manipulated Variable Display (Advanced Setting function group) (p. 5-49)

MV Monitor (OUT2)

Conditions of Use: The control method must be heating and cooling control. The Manipulated Variable Display must be set to ON.

Function: This parameter is for monitoring the manipulated variable (output 2) during heating and cooling control. Table 5.L shows output to mode assignment.

Table 5.N

Control Mode	Monitoring Range	Units
Heating and cooling	0.0…100.0	%

Related Parameters

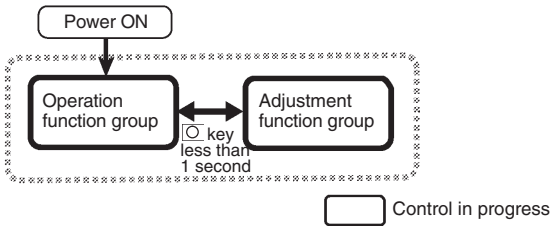
- Standard/Heating and Cooling (Initial Setting function group) (p. 5-27)
- Manipulated Variable Display (Advanced Setting function group) (p. 5-49)

Adjustment Function Group

This function group is for executing AT (auto-tuning) or setting up the controller.

This function group provides you with basic controller setup parameters for PID (Proportional Band, Integral Time, Derivative Time) plus heating and cooling control parameters.

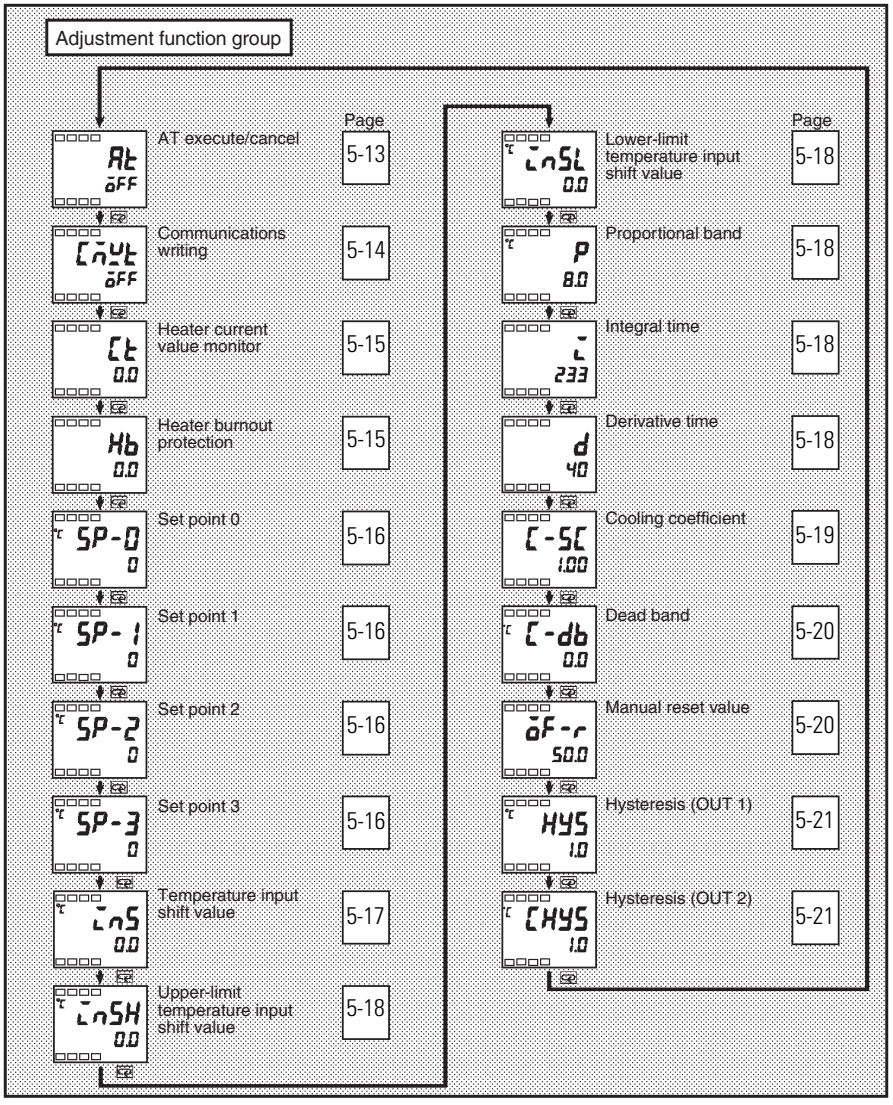
Figure 5.4



To move to the Adjustment function group from the Operation function group, press the key for less than 1 second.

Note: You can change the Adjustment function group parameters by configuring Operation/Adjustment Protection to 0. If the Protect function group is configured to 1…3, Adjustment function group parameters **cannot** be displayed.

Figure 5.5



AT Execute/Cancel

Conditions of Use: The Bulletin 900-TC8 must be in operation (RUN), and the control method must be 2-PID control.

Function: This parameter allows you to initiate (ON) the controller's AT (auto-tuning) function.

When you initiate auto-tuning, the optimum PID parameters (Proportional Band, Integral Time, and Derivative Time) for the current set point during program execution are automatically configured by the controller forcibly changing the manipulated variable to calculate the characteristics of the control target.

- Normally, the AT parameter is configured to oFF. If you press the ⩓ or ⩔ keys, the parameter is turned ON and AT is executed by the controller. AT cannot be executed when control has stopped or during ON/OFF control.
- When AT execution ends, the AT parameter automatically returns to the oFF configuration.

Related Parameters

- Proportional Band, Integral Time, Derivative Time (Adjustment function group) (p. 5-18)
- PID/ON/OFF (Initial Setting function group) (p. 5-26)

Communications Writing

Conditions of Use: An RS-232 (Cat. No. 900-TC8232) or RS-485 (Cat. No. 900-TC8COM) communication unit must be mounted in the Bulletin 900-TC8 controller.

Function: This parameter enables/disables writing of parameters to the Bulletin 900-TC8 from a personal computer. Note: 900Builder software can write to the controller regardless of the Communications Writing status.

ON: Writing enabled

OFF: Writing disabled

Note: The default is OFF

Related Parameters

Communication Unit No., Baud Rate, Data Bit, Parity, Stop Bit (Communications Setting function group) (p. 5-54)

Ct Heater Current Value Monitor

Conditions of Use: The Heater Burnout Alarm (HBA) Used parameter must be set to ON.

Function: This parameter measures and displays the current value in amps (A) of the heater by using a current transformer (CT) input. This hardware is also used to detect a heater burnout condition.

Note: Not all controllers support heater current monitor and heater burnout. See Table 1.A.

Table 5.0

Monitoring Range	Units
0.0…55.0	A (Amps)

Note: FFFF is displayed when 55.0 A is exceeded.

Related Parameters

- Heater Burnout Detection (Adjustment function group) (p. 5-15)
- HBA Used (Advanced Setting function group) (p. 5-43)

Hb Heater Burnout Detection

Conditions of Use: The Heater Burnout Alarm (HBA) Used parameter must be set to ON.

Function: This parameter allows you to configure the current value in amps (A) at which the electrical Heater Burnout Alarm Output parameter becomes active (ON).

- When the heater current value falls below the configured parameter value, the heater burnout alarm output goes ON. When the current is equal to or greater than the value, the alarm is OFF.
- When the configured value is 0.0, the heater burnout alarm is always OFF. When the configured value is 50.0, the heater burnout alarm is always ON.

Table 5.P

Configurable Range	Units	Default Value
0.0…50.0	A (Amps)	0.0

Related Parameters

- HBA Used (Advanced Setting function group) (p. 5-43)
- Heater Current Value Monitor (Adjustment function group) (p. 5-7)
- Heater Burnout Latch (Advanced Setting function group) (p. 5-43)
- Heater Burnout Hysteresis (Advanced Setting function group) (p. 5-44)

Set Point 0,

Set Point 1,

Set Point 2,

Set Point 3

Conditions of Use: The Number of Multi-SP Uses parameter must be configured to either 1 or 2, and the Multi-SP Uses parameter must be configured to ON.

Function: These parameters allow you to configure multiple set point values when the Multi-SP function is also configured.

The configured values set in these parameters can be selected by operating the keys on the front panel or by event input.

- While operating (RUN) if a change is made to a set point (SP 0, SP 1, SP 2, or SP 3) it takes effect approximately 2 seconds after entering the value, or upon depressing the ○ or ↵ key.
- When using a temperature input, the decimal point position is dependent on the selected sensor.
- When using an analog input, the decimal point position is dependent on the setting of the Decimal Point position parameter.

Table 5.Q

Configurable Range	Units	Default Value
Set Point lower limit to Set Point upper limit	EU	0

Related Parameters

- Number of Multi-SP Uses (Advanced Setting function group) (p. 5-34)
- PV/SP (Operation function group), Input Type (Initial Setting function group) (p. 5-5)
- Input Type (Initial Setting function group) (p. 5-23)
- Event Input Assignment 1 (Advanced Setting function group) (p. 5-35)
- Event Input Assignment 2 (Advanced Setting function group) (p. 5-35)
- Multi-SP Uses (Advanced Setting function group) (p. 5-36)

Temperature Input Shift

Conditions of Use: The Input Type parameter must be configured as a temperature input. However, this excludes a non-contact temperature sensor.

Function: Sometimes an error may exist between the measured temperature (PV) and the actual temperature at the control target. To offset this error, add your configured input shift value to the input (PV). The result is displayed on the controller as the new measurement value (PV) and used for control.

Note: The entire input range is shifted by the input shift value (1-point shift). If the input shift value is set to –1°C, the process is controlled to a value obtained by subtracting 1°C from the actual temperature (see Figure 4.2).

Table 5.R Input Shift

Configurable Range	Units	Default Value
–199.9…+999.9	°C or °F	0.0

Related Parameter

Input Type (Initial Setting function group) (p. 5-23)

Upper-Limit Temperature Input Shift Value,

Lower-Limit Temperature Input Shift Value

Conditions of Use: The Input Type parameter must be configured for a non-contact temperature sensor type.

Function: Whereas the entire input range is shifted by a fixed value (1-point shift) in the Temperature Input Shift parameter, this function shifts the input range by two points (2-point shift) at the upper and lower limits. 2-point shift is useful for non-contact temperature sensors since the end point (0 and SPAN) difference is typically not the same. (See Figure 4.8.)

This parameter sets input shift values for each of the upper and lower limits (2-point shift) of the input range (Table 5.S shows the allowable range).

Table 5.S Upper/Lower Limit Temperature Input Shift

Configurable Range	Units	Default Value
–199.9…+999.9	°C or °F	0.0

Related Parameter

Input Type (Initial Setting function group) (p. 5-23)

Proportional Band,

Integral Time,

Derivative Time

Conditions of Use: The control method must be 2-PID control.

Function: These three parameters configure the PID value parameters. Note that PID is automatically set when either the Auto-Tune (AT) or Self-Tune (ST) parameters are executed.

Proportional action: P refers to control in which the Manipulated Variable (MV) is proportional to the deviation (control error).

Integral action: I gives a control action that is proportional to the time integral of the control error. With proportional control, there is normally an offset (control error). So, proportional action is used in combination with integral action. As time passes, this control error disappears, and the set point comes to agree with the control temperature (process value).

Derivative action: D gives a control action that is proportional to the time derivative of the control error. As proportional control and integral control correct for errors in the control result, the control system will be late in responding to sudden changes in temperature. Derivative action enables control that is proportional to a predicted process output to correct for future error.

Table 5.T

Parameter	Configurable Range	Units	Default Value
Proportional Band	0.1…999.9	EU	8.0
Integral Time	0…3999	Seconds	233
Derivative Time	0…3999	Seconds	40

Related Parameter

AT Execute/Cancel (Adjustment function group) (p. 5-13)

Cooling Coefficient

Conditions of Use: The control mode must be heating and cooling with the 2-PID control method configured.

Function: If the heating and cooling characteristics of the control target differ greatly, preventing satisfactory control characteristics from being obtained by the same PID parameters, adjust the proportional band (P) at the control output 2 side by adding the cooling coefficient to balance control between the heating and cooling sides (see Figure 4.26).

In the heating and cooling control mode, control output 2 side P is calculated by the following formula to configure the cooling coefficient:

Control output 2 side P = Cooling coefficient x P (proportional band)

Table 5.U

Configurable Range	Units	Default Value
0.01…99.99	None	1.00

Related Parameter

Proportional Band (Adjustment function group) (p. 5-18)

Dead Band

Conditions of Use: The control system must be configured for the heating and cooling control mode.

Function: This parameter allows you to configure the output dead band width in a heating and cooling control system. A negative value configures an overlap band.

This parameter sets an area in which the control output is **0** centering around the set point in a heating and cooling control system (see Figure 4.25).

The decimal point setting follows that of the currently configured sensor. When using an analog input, the decimal point setting follows the Decimal Point position configuration.

Table 5.V

Configurable Range	Units	Default Value
–199.9…+999.9	EU	0.0

Manual Reset Value

Conditions of Use: The control mode must be standard control with the 2-PID control method configured. In addition, the Integral Time parameter must be set to 0.

Function: This parameter allows you to configure the manipulated variable to remove offset during stabilization of P or PD control.

Table 5.W

Configurable Range	Units	Default Value
0.0…100.0	%	50.0

Related Parameters

- PID/ON/OFF (Initial Setting function group) (p. 5-26)
- Integral Time (Adjustment function group) (p. 5-18)

Hysteresis (OUT1),

Hysteresis (OUT2)

Conditions of Use: The control method must be ON/OFF control.

Function: This parameter allows you to configure the hysteresis function to help ensure stable operation during ON/OFF control. For more details, see p. 3-16, *Hysterisis*.

- In the standard control mode, use the Hysteresis (OUT1) parameter. The Hysteresis (OUT2) parameter cannot be used in standard control (see Figure 3.23).
- In the heating and cooling control mode, the Hysteresis parameter can be set independently for heating and cooling. Use the Hysteresis (OUT1) parameter to configure the control output 1 side hysteresis, and use the Hysteresis (OUT2) parameter to configure the control output 2 side hysteresis. (See Figure 3.24.)
- The decimal point setting follows that of the currently configured sensor. When using an analog input, the decimal point setting follows the Decimal Point position configuration.

Table 5.X

Configurable Range	Units	Default Value
0.1…999.9	EU	1.0

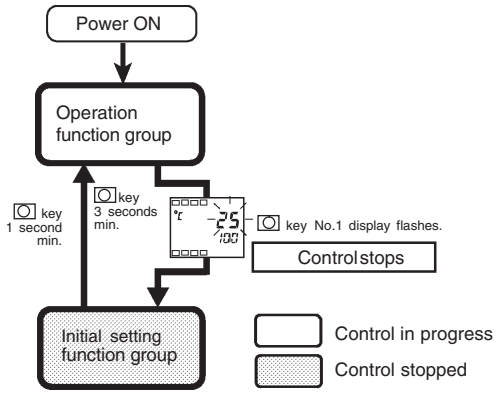
Related Parameter

PID/ON/OFF (Initial Setting function group) (p. 5-26)

Initial Setting Function Group

This function group is for configuring the basic parameters of the Bulletin 900-TC8. In this function group, you can set the Input Type parameter for selecting the sensor input to be connected to the Bulletin 900-TC8, limit the range of set points, or set the alarm mode.

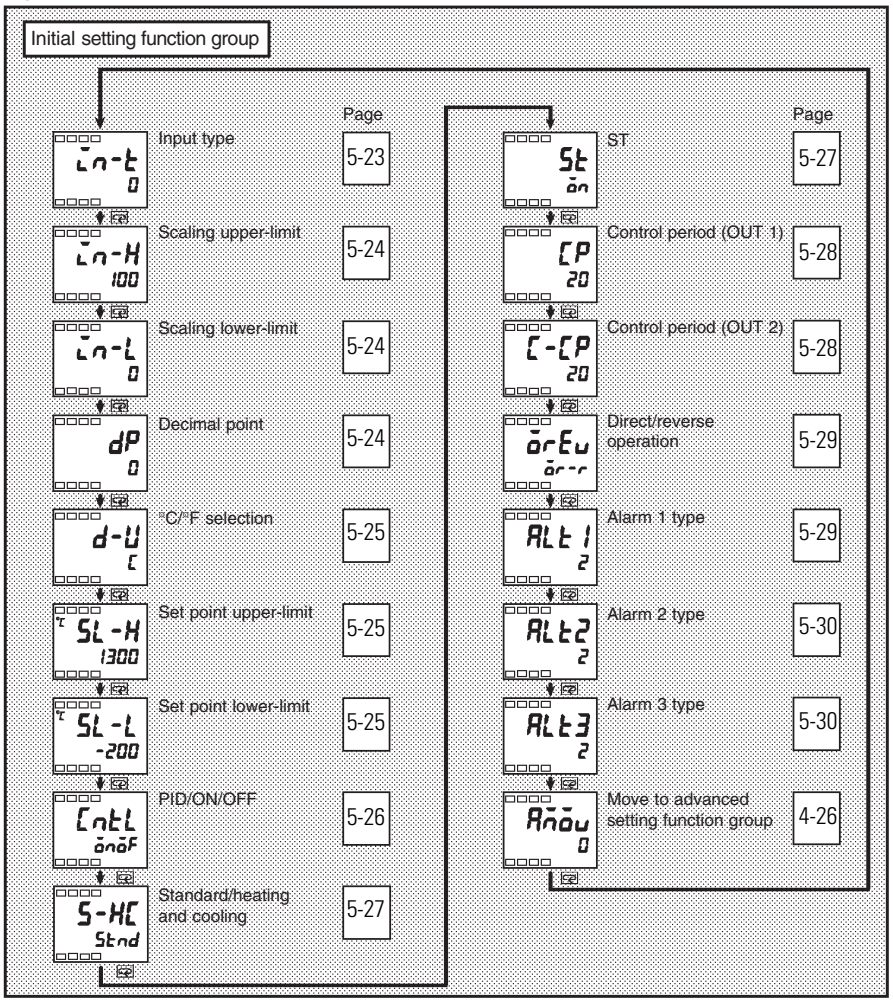
Figure 5.6



To move from the Operation function group to the Initial Setting function group, press ◎ key for 3 seconds or more.

- The Initial Setting function group is not displayed when the Initial/Communications protection is set to 2. However, it can be used when the Initial Setting/Communications Protection is set to 0 or 1.
- The Scaling Upper Limit, Scaling Lower Limit, and Decimal Point parameters are displayed when an analog input is selected as the input type.

Figure 5.7



Input Type

Function: This parameter allows you to configure the sensor type by entering a corresponding code (Set Value).

If the Input Type parameter is changed (Set Value modified), the set point limits are changed to the default of the newly selected input type. If the set point limits must be changed, you can configure the Set Point Upper Limit and Set Point Lower Limit parameters (found in Initial Setting function group).

To configure a sensor type, select the code (Set Value) according to Table A.D, *List of Input Types*. The defaults are as follows.

- Platinum resistance thermometer: 0: platinum resistance thermometer Pt100 (requires a specific controller cat. no.; see Table 1.A)
- Thermocouple: 0: K thermocouple (requires specific controller cat. no.; see Table 1.A)

Related Parameters

°C/°F Selection, Set Point Upper Limit, Set Point Lower Limit (Initial Setting function group) (p. 5-25)

Scaling Upper Limit,

Scaling Lower Limit,

Decimal Point

Conditions of Use: The input type must be configured as an analog (0…50 mV) input.

Function: When voltage input is selected as the input type, scaling to other engineering units (EU) is possible. Set the upper limit in the Scaling Upper Limit parameter and the lower limit in the Scaling Lower Limit parameter.

The Decimal Point parameter specifies the decimal point position of the system parameters (Set Point, etc.) whose unit is set to EU.

Table 5.Y Scaling Upper Limit, Scaling Lower Limit Parameters

Parameter	Configurable Range	Units	Default Value
Scaling Upper Limit	Scaling lower limit +1…9999	None	100
Scaling Lower Limit	–1999 to scaling upper limit –1	None	0

Table 5.Z Decimal Point Parameter: Default is 0: 0 Digits Past Decimal Point

Configured Value	Meaning	Example
0	0 digits to the right of the decimal point	1234
1	1 digit to the right of the decimal point	123.4

Related Parameter

Input Type (Initial Setting function group) (p. 5-23)

°C/°F Selection

Conditions of Use: The input type must be configured for a temperature input (RTD, non-contact, or thermocouple).

Function: This parameter allows you to configure the temperature input units to either °C or °F.

Table 5.AA

Selections	Default Units
C: °C F: °F	C

Related Parameter

Input Type (Initial Setting function group) (p. 5-23)

Set Point Upper Limit,

Set Point Lower Limit

Function: These parameters allow you to configure the maximum allowable range for an operator to enter the set point value. The SP can be configured within the range defined by the upper and lower limit values in the Set Point Upper Limit and Set Point Lower Limit parameters. If an attempt is made to enter a SP value outside the upper or lower limit from the keypad the set point display will flash at the configured maximum upper- or lower-limit value.

If the temperature input type or temperature units are changed, the set point upper limit and set point lower limit are forcibly changed by the controller to the upper and lower limits of the newly configured sensor.

For a temperature input, the decimal point position is dependent on the currently selected sensor. For an analog input, it is dependent on the Decimal Point parameter setting.

Table 5.AB

Parameter	Configurable Range	Units	Default Value ❶
Set Point Upper Limit	Set point lower limit +1 to sensor range upper limit	EU	1300
	Platinum resistance thermometer	EU	850
Set Point Lower Limit	Sensor range lower limit to set point upper limit –1	EU	–200

❶ Range of Pt100 (Platinum RTD). See table 5.X.

Related Parameters

Input Type (p. 5-23), °C/°F Selection (p. 5-25) (Initial Setting function group)

PID/ON/OFF

Function: This parameter allows you to configure the controller for either the 2-PID control or ON/OFF control method.

The auto tuning (AT) and self tuning (ST) functions can only be used in the 2-PID control method.

Table 5.AC

Selections	Default Selection
PID: 2-PID onOF: ON/OFF	onOF

Related Parameters

- AT Execute/Cancel (p. 5-13), Manual Reset, Hysteresis (OUT1), Hysteresis (OUT2) (Adjustment function group) (p. 5-21)
- ST Stable Range (Advanced Setting function group) (p. 5-45)

S-HC Standard/Heating and Cooling

Conditions of Use: The Bulletin 900-TC8 (see Table 1.A) must support the Alarm 3 Output.

Function: This parameter allows you to configure the controller for the standard control mode or heating and cooling control mode.

When the heating and cooling control mode is selected, the alarm 3 output terminal ALM3 is used for control output 2 side functions (see Table 4.C). So, alarm 3 cannot be used as an alarm output.

Table 5.AD

Selections	Default Selection
Stnd: Standard H-C: Heating and cooling	Stnd

Related Parameters

- MV Monitor (OUT1), MV Monitor (OUT2) (Operation function group) (p. 5-12)
- Alarm Value 1 (p. 5-8), Upper-Limit Alarm Value 3, Lower-Limit Alarm Value 3 (Operation function group) (p. 5-10)
- Hysteresis (OUT2) (p. 5-21), Cooling Coefficient, Dead Band (p. 5-20) (Adjustment function group)
- Control Period (OUT2) (Initial Setting function group) (p. 5-28)
- Alarm 3 Type (Initial Setting function group) (p. 5-30)
- Alarm 3 Hysteresis (p. 5-42), Alarm 3 Open in Alarm (p. 5-41) (Advanced Setting function group)

ST ST Self-Tuning

Conditions of Use: The input type must be set to temperature input with the standard control mode and 2-PID control method enabled.

Function: This parameter allows you to configure the controller to execute the self-tuning function. The ST (self-tuning) function executes tuning from the start of program execution to calculate the PID constants matched to the control target of the application. When the ST function is in operation, make sure to turn the power supply of the load connected to the control out put ON simultaneously with or before starting operation of the Bulletin 900-TC8.

Table 5.AE

Parameter	Selections	Default Selection
ST	oFF: ST function OFF on: ST function ON	on

Related Parameters

- ST Stable Range (Advanced Setting function group) (p. 5-45)
- Input Type (p. 5-23), PID/ON/OFF (p. 5-26) (Initial Setting function group)

Control Period (OUT1),

Control Period (OUT2)

Conditions of Use: The control method must be configured for 2-PID control.

Function: This parameter allows you to configure the output period (control period) which is the minimum amount of time between ON cycles of the output. Set the control period taking the control characteristics and the electrical life expectancy of the output devices into consideration (especially if a mechanical relay is used).

- When the standard control mode is selected, use the Control Period (OUT1) parameter. The Control Period (OUT2) parameter cannot be used (see Table 4.C).

- When the heating and cooling control mode is selected, the control period can be set independently for the heating and cooling outputs. Use the Control Period (OUT1) parameter to set the control output 1 side control period, and use the Control Period (OUT2) parameter to set the control output 2 side control period (see Table 4.C).

Table 5.AF

Parameter	Configurable Range	Units	Default Value
Control Period (OUT1)	1…99	Second	20
Control Period (OUT2)	1…99	Second	20

Related Parameter

PID/ON/OFF (Initial Setting function group) (p. 5-26)

Direct/Reverse Operation

Function: This parameter allows you to configure the controller for the direct or reverse operation of the manipulated variable (MV). Direct operation refers to the control method where the manipulated variable is increased according to the increase in the process value. Alternatively, reverse operation refers to control method where the manipulated variable is increased according to the decrease in the process value.

Table 5.AG

Selections	Default Selection
or-r: Reverse operation or-d: Direct operation	or-r

Alarm Type for Alarm 1

Conditions of Use: The Alarm 1 Type must be supported by the controller.

Function: This parameter allows you to configure the type of alarm operation for Alarm Output 1. Select one of the following alarm 1 types:

Deviation/Deviation range/Absolute value

See the alarm 1…3 type list, Table 5.AH.

Related Parameters

- Alarm Value 1 (Operation function group) (p. 5-8)
- Upper-Limit Alarm Value 1, Lower-Limit Alarm Value 1 (Operation function group) (p. 5-9)
- Standby Sequence Reset Method (p. 5-37), Alarm 1 Open in Alarm, Alarm 1 Hysteresis (p. 5-39) (Advanced Setting function group)

Alarm Type for Alarm 2

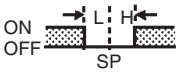
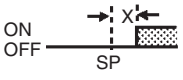
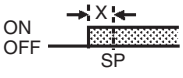
Alarm Type for Alarm 3

Conditions of Use: The Alarm 2, 3 Type must be supported. The control mode must be set to standard control.

Function: These parameters allow you to configure the type of alarm operation for alarm output 2 and alarm output 3. Select one of the following alarm 2, 3 types:

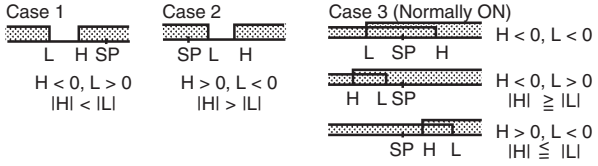
Deviation/Deviation range/Absolute value

Table 5.AH

Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
0	Alarm function OFF	Output OFF	
1 ❶	Upper- and lower-limit (deviation range)		❷
2 ❸	Upper-limit (deviation)		

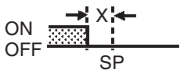
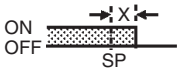
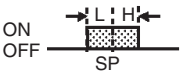
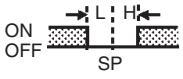
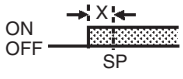
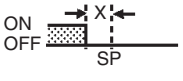
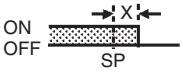
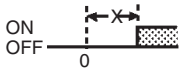
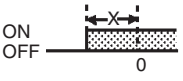
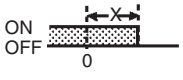
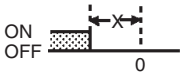
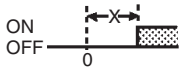
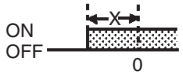
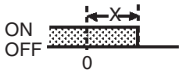
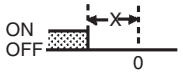
❶ With set values 1, 4, and 5, the upper- and lower-limit values can be set independently for each alarm point, and are expressed as L and H.

❷ Set value: 1 upper- and lower-limit alarm



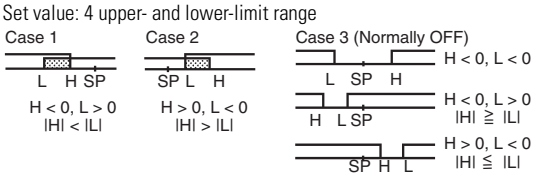
❸ Default

Table 5.AH (Continued)

Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
3	Lower-limit (deviation)		
4 ❶	Upper- and lower-limit range (deviation range)		❷
5 ❶❹	Upper- and lower-limit with standby sequence (deviation range)		❸
6	Upper-limit with standby sequence (deviation)		
7	Lower-limit with standby sequence (deviation)		
8	Upper-limit (absolute-value)		
9	Lower-limit (absolute-value)		
10	Upper-limit with standby sequence (absolute-value)		
11	Lower-limit with standby sequence (absolute-value)		

❶ With set values 1, 4, and 5, the upper- and lower-limit values can be set independently for each alarm point, and are expressed as L and H.

❷ Set value: 4 upper- and lower-limit range

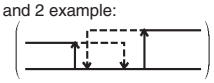


❸ Set value: 5 upper- and lower-limit alarm with standby sequence

* For the above upper- and lower-limit alarm

- In cases 1 and 2, the alarm is normally OFF if upper- and lower-limit values of hysteresis overlap.
- In case 3, the alarm is normally OFF.

Cases 1 and 2 example:



❹ Set value: 5 upper- and lower-limit alarm with standby sequence

The alarm is normally OFF if upper- and lower-limit values of hysteresis overlap.

Note: Alarm types are set independently for each alarm in the Alarm 1 to 3 Type parameters (Initial Setting function group). The default is 2: Upper-limit alarm.

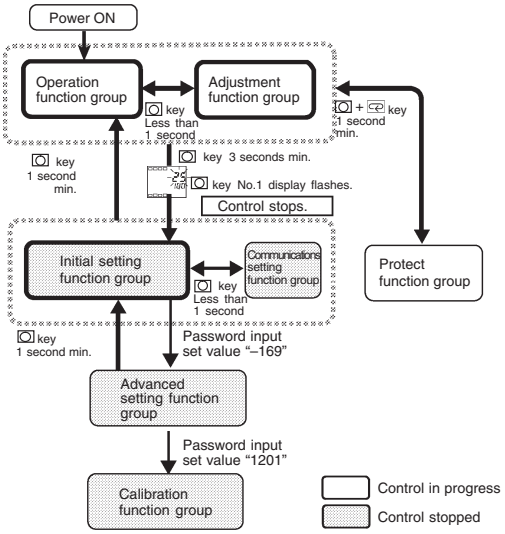
Related Parameters

- Alarm Value 1…3 (Operation function group) (p. 5-8)
- Upper-Limit Alarm Value 1…3, Lower-Limit Alarm Value 1…3 (Operation function group) (p. 5-9)
- Standby Sequence Reset Method (p. 5-37), Alarm 1…3 Open in Alarm, Alarm 1…3 Hysteresis (p. 5-41) (Advanced Setting function group)

Advanced Setting Function Group

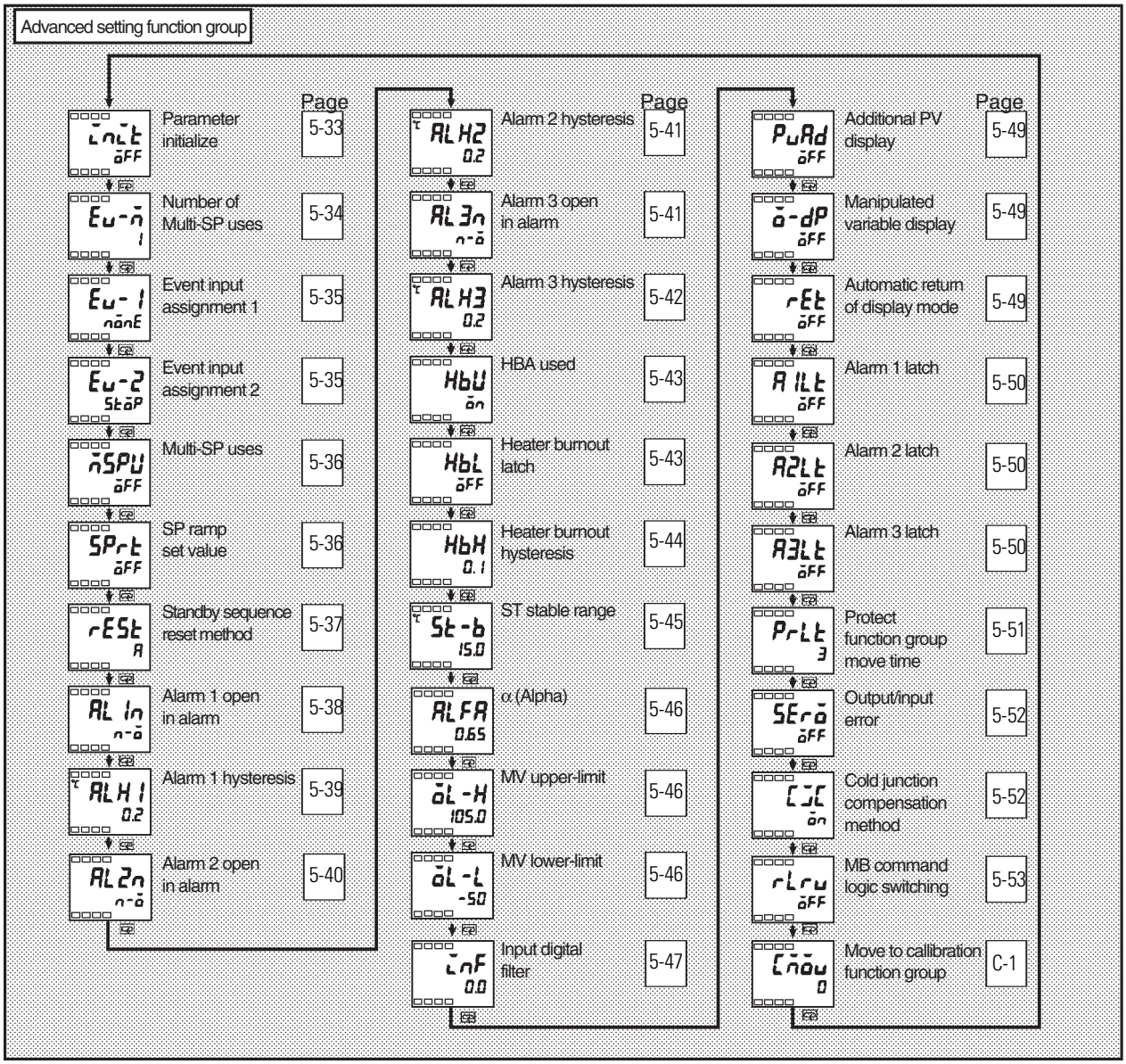
This function group is for using the Bulletin 900-TC8 to its maximum capability. To move to this function group, enter the password (**–169**) in the Initial Setting function group.

Figure 5.8



- The parameters in this function group can be used when Initial Setting/Communications Protection is set to 0.
- You can move to the Calibration function group by entering the password (**1201**).

Figure 5.9



Parameter Initialize

Function: This parameter allows you to return/reset all parameter settings to their initial/default values.

ON: Initializes all parameters.

OFF: Turns the Bulletin 900-TC8 OFF after returning parameter settings to their defaults.

Number of Multi-SP Uses

Conditions of Use: The optional event input unit (Cat. No. 900-TC8EIM) must be mounted in the Bulletin 900-TC8 to use this parameter.

Function: The Multi-SP function allows you to configure set points 0…3 in advance, and to select either one of these preset set point values to be used in the control application by a combination of event inputs 1 and 2.

The Number of Multi-SP Uses parameter is used when the number of preset/pre-configured set points is 2 or 4. This parameter also determines display or non-display of the Event Input Assignment 1 and Event Input Assignment 2 parameters.

The value of the Number of Multi-SP Uses parameter determines which functions are assigned to Event Inputs 1 and 2.

Table 5.AI

Number of Multi-SP Uses Parameter	Setting		Event Input Function	
	Event Input Assignment 1 Parameter	Event Input Assignment 2 Parameter	Event Input 1	Event Input 2
0	NONE or STOP ❶		NONE or RUN/STOP switching ❶	
1 ❷	— (not displayed)	NONE or STOP	Multi-SP 2 set points (set point 0/1 switching)	NONE or RUN/STOP switching
2	— (not displayed)		Multi-SP 4 set points (set point 0/1/2/3 switching)	

❶ STOP (RUN/STOP) switching can be used only on one of the event input assignments 1 or 2. The event input on the side that is set/configured can be used. The setting on the other side automatically becomes NONE.

❷ Default

Table 5.AJ When the Number of Multi-SP Uses Parameter is Set to 1

Event Input 1	Selected Set Point
OFF	Use set point 0
ON	Use set point 1

Table 5.AK When the Number of Multi-SP Uses Parameter is Set to 2

Event Input 1	Event Input 2	Selected Set Point
OFF	OFF	Use set point 0
ON	OFF	Use set point 1
OFF	ON	Use set point 2
ON	ON	Use set point 3

Event inputs can be used when the option event input unit Cat. No. 900-TC8EIM is mounted in the Bulletin 900-TC8. Select event input ON/OFF while the Bulletin 900-TC8 is turned ON. In order for the controller to begin the multi-set point function, the physical input must be ON for 50 ms minimum.

Note: The Multi-SP Uses parameter default is 1.

Related Parameters

- Event Input Assignment 1 (Advanced Setting function group) (p. 5-35)
- Event Input Assignment 2 (Advanced Setting function group) (p. 5-35)
- Multi-SP Uses (Advanced Setting function group) (p. 5-36)
- Set Point 0, Set Point 1, Set Point 2, Set Point 3 (Adjustment function group) (p. 5-16)

Event Input Assignment 1,

Event Input Assignment 2

Conditions of Use: The Number of Multi-SP Uses parameter must be set to 0 or 1. (See table 5.AJ.) The optional event input unit (Cat. No. 900-TC8EIM) must be mounted in the controller.

Function: The Event Input Assignment 1 or 2 parameter allows you to configure event input 1 or 2 to control the RUN/STOP mode of the controller. The following functions are assigned as event input 1 or event input 2 (see Table 5.M):

Table 5.AL

Settings	Function
nonE	None
StoP	RUN/STOP

Note: The default is nonE for event input assignment 1 and StoP for event input assignment 2.

Related Parameters

- Set Point 0, Set Point 1, Set Point 2, Set Point 3 (Adjustment function group) (p. 5-16)
- Number of Multi-SP Uses (Advanced Setting function group) (p. 5-34)

nSPU Multi-SP Uses

Conditions of Use: The Number of Multi-SP Uses parameter must be set to 0.

Function: This parameter allows you to configure the controller for multi-SP selection (0…3) by operating the keys (▼ ▲) on the front of the controller.

If the option event input unit (Cat. No. 900-TC8EIM) is mounted in the Bulletin 900-TC8, this parameter can be used only when the Number of Multi-SP Uses parameter is set to 0 and Multi-SP Uses parameter is set to ON.

- on: You can select set points 0…3 from the controller's keypad.
- oFF: You **cannot** select set points 0…3 from the controller's keypad.

Note: The default: OFF

Related Parameters

- Multi-SP (Operation function group) (p. 5-6)
- Number of Multi-SP Uses (Advanced Setting function group) (p. 5-34)

SPrt SP Ramp Set Value

Conditions of Use: Self tuning (ST) must be configured to OFF.

Function: If a large change is made to the value of the set point, it is possible the rate the system reacts may exceed the desired limit. This parameter allows you to configure the maximum rate of set point change. Configure the maximum permissible change width per unit of time (minute) as the SP Ramp value. However, note, that when the SP Ramp value is set to OFF, the SP ramp function is disabled.

When using a temperature input, the decimal point position of the SP Ramp value is dependent on the currently selected sensor, and when using an analog input it is dependent on scaling.

Table 5.AM

Parameter	Configurable Range	Units	Default Value
SP Ramp Value	OFF, 1…9999	EU	OFF

Related Parameters

Input Type (p. 5-23), Scaling Upper Limit, Scaling Lower Limit (P. 5-24), Decimal Point, ST (p. 5-27) (Initial Setting function group)

Standby Sequence Reset Method

Conditions of Use: The Alarm Type for alarms 1…3 must be configured for "with standby sequence" (see Table 5.AH).

Function: Recall that with standby sequence configured the alarm output is temporarily disabled until **after** the first alarm condition occurs (for more details, see p. 4-8). This parameter allows you to configure the conditions (A or B) for enabling alarm reset after the standby sequence of the alarm has been canceled.

The alarm output is turned OFF when switching to either the Initial Setting function group, Communications Setting function group, Advanced Setting function group, or Calibration function group (see Table 5.AN).

- **Condition A:** Control started (including power ON), and set point, alarm value (upper/lower-limit alarm value) or input shift value (upper/lower-limit temperature input shift value) changed
- **Condition B:** Power ON

The following example shows the reset action when the Alarm Type is lower-limit alarm with standby sequence (see Figure 5.10).

Figure 5.10

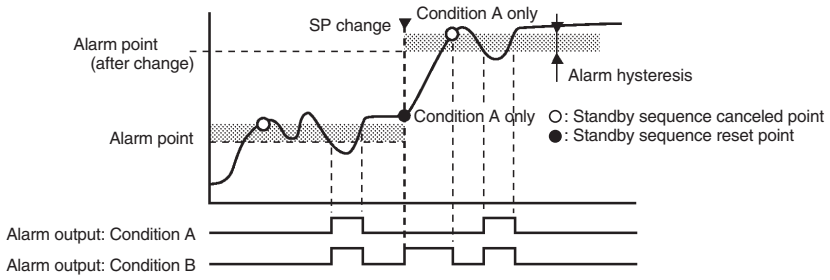


Table 5.AN

Selections	Default Selection
A: Condition A b: Condition B	A

Related Parameters

- Alarm 1 to 3 Type (Initial Setting function group) (p. 5-30)
- Alarm 1 to 3 Latch (Advanced Setting function group) (p. 5-50)

AL 1n Alarm 1 Open in Alarm

Conditions of Use: The Alarm 1 function must be supported by the controller.

Function: This parameter allows you to configure the physical output states of Alarm 1 (see Table 5.AO).

When the Bulletin 900-TC8 Alarm parameter mode is configured for Close in Alarm and no alarm condition exists, the status of the alarm output is normally open (OFF), so when an alarm condition occurs, the alarm output closes. When set to Open in Alarm and no alarm condition exists, the status of the alarm output is inverted or normally closed. The following table shows the relationship among Alarm Output Condition, Alarm Output, and Output LCDs.

Note: When Alarm 1 Open in Alarm parameter is configured to Open in Alarm, the Heater Burnout alarm and Input Error output also become open in alarm.

Table 5.AO

Alarm Parameter Mode	Alarm Condition	Alarm Output (Relay)	Output LCDs
Close in alarm	ON	ON	Lit
	OFF	OFF	Out
Open in alarm	ON	OFF	Lit
	OFF	ON	Out

Table 5.AP

Alarm Mode Selections	Default Selection
n-o: Close in alarm n-C: Open in alarm	n-o

Related Parameters

- Alarm Value 1 (p. 5-8), Upper-Limit Alarm Value 1, Lower-Limit Alarm Value 1 (p. 5-9) (Operation function group)
- Alarm 1 Type (p. 5-29), Standard/Heating and Cooling (p. 5-27) (Initial Setting function group)
- Alarm 1 Hysteresis (p. 5-39), Standby Sequence Reset Method, Alarm Latch (p. 5-50) (Advanced Setting function group)

Alarm 1 Hysteresis

Conditions of Use: The Alarm 1 function must be supported by the controller.

Function: This parameter allows you to configure the hysteresis (deviation from the alarm value) of Alarm Output 1.

When using an analog input, the decimal point setting follows the decimal point position setting.

Table 5.AQ

Configurable Range	Units	Default Value
0.1…999.9	°C or °F	0.2

Related Parameters

- Alarm Value 1 (p. 5-8), Upper-Limit Alarm Value 1, Lower-Limit Alarm Value 1 (p. 5-8) (Operation function group)
- Alarm 1 Type (p. 5-29), Standard/Heating and Cooling (p. 5-27) (Initial Setting function group)
- Alarm 1 Open in Alarm (p. 5-38), Standby Sequence Reset Method, Alarm 1 Latch (p. 5-50) (Advanced Setting function group)

Alarm 2 Open in Alarm

Conditions of Use: The Alarm 2 function must be supported by the controller.

Function: This parameter allows you to configure the physical output states of Alarm 2 (see Table 5.AR).

When the Bulletin 900-TC8 Alarm parameter mode is configured for Close in Alarm and no alarm exists, the status of the alarm output is normally open (OFF) so when an alarm condition occurs, the alarm output closes (ON). When set to Open in Alarm and no alarm condition exists, the status of the alarm output is output inverted or normally closed and the alarm output is ON. The following table shows the relationship among Alarm Output conditions, Alarm Output, and Output LCDs.

Table 5.AR

Alarm Parameter Mode	Alarm Condition	Alarm Output (Relay)	Output LCDs
Close in alarm	ON	ON	Lit
	OFF	OFF	Out
Open in alarm	ON	OFF	Lit
	OFF	ON	Out

Table 5.AS

Alarm Mode Selections	Default Selection
n-o: Close in alarm n-C: Open in alarm	n-o

Related Parameters

- Alarm Value 2 (p. 5-8), Upper-Limit Alarm Value 2, Lower-Limit Alarm Value 2 (p. 5-9) (Operation function group)
- Alarm 2 Type (Initial Setting function group) (p. 5-30)
- Alarm 2 Hysteresis (p. 5-41), Standby Sequence Reset Method (p. 5-37), Alarm 2 Latch (Advanced Setting function group)

Alarm 2 Hysteresis

Conditions of Use: The Alarm 2 function must be supported by the controller.

Function: This parameter allows you to configure the hysteresis (deviation from the alarm value) of Alarm Output 2.

When using an analog input, the decimal point setting follows the decimal point position setting.

Table 5.AT

Configurable Range	Units	Default Value
0.1…999.9	°C or °F	0.2

Related Parameters

- Alarm Value 2 (p. 5-8) (Operation function group)
- Upper-Limit Alarm Value 2, Lower-Limit Alarm Value 2 (Operation function group) (p. 5-9)
- Alarm 2 Type (p. 5-30) (Initial Setting function group)
- Alarm 2 Open in Alarm (p. 5-40), Standby Sequence Reset Method, Alarm 2 Latch (p. 5-50) (Advanced Setting function group)

Alarm 3 Open in Alarm

Conditions of Use: The Alarm 3 function must be supported. The control mode must be set to standard control. **Note:** In the heating and cooling control mode, Alarm 3 is used for control.

Function: This parameter allows you to configure the physical output states of Alarm 3 (see Table 5.AU).

When the Bulletin 900-TC8 Alarm parameter mode is configured for Close in Alarm and no alarm exists, the status of the alarm output is normally open (OFF) so when an alarm condition occurs, the alarm output closes (ON). When set to Open in Alarm and no alarm condition exists, the status of the alarm output is output inverted or normally closed and the alarm output is ON. The following table shows the relationship among Alarm Output conditions, Alarm Output, and Output LCDs.

Table 5.AU

Alarm Parameter Mode	Alarm Condition	Alarm Output (Relay)	Output LCDs
Close in alarm 	ON	ON	Lit
	OFF	OFF	Out
Open in alarm 	ON	OFF	Lit
	OFF	ON	Out

Table 5.AV

Alarm Mode Selections	Default Selection
n-o: Close in alarm n-C: Open in alarm	n-o

Related Parameters

- Alarm Value 3 (p. 5-8), Upper-Limit Alarm Value 3, Lower-Limit Alarm Value 3 (p. 5-10) (Operation function group)
- Alarm 3 Type (Initial Setting function group) (p. 5-30), Standard/Heating and Cooling (p. 5-27) (Initial Setting function group)
- Alarm 3 Hysteresis (p. 5-42), Standby Sequence Reset Method (p. 5-37), Alarm 3 Latch (Advanced Setting function group)

Alarm 3 Hysteresis

Conditions of Use: The Alarm 3 function must be supported. Control must be set to standard control.

Function: This parameter allows you to configure the hysteresis of Alarm Output 3.

When using an analog input, the decimal point setting follows the decimal point position setting.

Table 5.AW

Configurable Range	Units	Default Value
0.1…999.9	°C or °F	0.2

Related Parameters

- Alarm Value 3 (p. 5-8) (Operation function group)
- Upper-Limit Alarm Value 3, Lower-Limit Alarm Value 3 (Operation function group) (p. 5-10)
- Alarm 3 Type (p. 5-30) (Initial Setting function group)
- Alarm 3 Open in Alarm (p. 5-41), Standby Sequence Reset Method (p. 5-37), Alarm 3 Latch (Advanced Setting function group)

HBA (Heater Burnout Alarm) Used

Conditions of Use: The controller that supports the Heater Burnout Alarm parameter must be ordered (see Table 1.A) to use this parameter.

Function: This parameter allows you to configure the operation of the Heater Burnout Alarm.

Table 5.AX

Selections	Default Selection
on: Heater Burnout Alarm Enabled oFF: Heater Burnout Alarm Disabled	on

Heater Burnout Latch

Conditions of Use: The HBA Used parameter must be configured to ON and the controller must support HBA.

Function: When this parameter is configured to ON, the heater burnout alarm is held ON until either of the following reset conditions are satisfied:

- The Alarm Output is turned OFF when switching to the Initial Setting function group, Communications Setting function group, Advanced Setting function group, or Calibration function group, **or**
- Heater burnout detection is set to 0.0 A, and the controller power is turned OFF then back ON again (power is reset).

Table 5.AY

Selections	Default Selection
on: Heater Burnout Latch Enabled oFF: Heater Burnout Latch Disabled	oFF

Related Parameter

HBA Used (Advanced Setting function group) (p. 5-43)

Heater Burnout Hysteresis

Conditions of Use: The Heater Burnout Latch parameter must be set to OFF.

Function: This parameter allows you to configure the hysteresis (deviation from the HBA set point) when HBA is detected.

Table 5.AZ

Configurable Range	Units	Default Value
0.1…50.0	A	0.1

Related Parameter

HBA Used (Advanced Setting function group) (p. 5-43)

St-b ST (Self-Tuning) Stable Range

Conditions of Use: Control must be configured for a temperature input, standard control mode, PID control method, and Self-Tuning (ST) set to ON.

Function: This parameter allows you to configure the value for determining the conditions under which ST (self-tuning) occurs. This parameter cannot be used when the Self-Tuning (ST) parameter is set to OFF.

Table 5.BA Self-Tuning Stable Range

Configurable Range	Units	Default Value
0.1…999.9	°C or °F	15.0

Related Parameters

- PID/ON/OFF (Initial Setting function group) (p. 5-26)
- Input Type (Initial Setting function group) (p. 5-23)
- ST (Initial Setting function group) (p. 5-27)

Table 5.BB

At Start of Program Execution (Self-Tuning ON)	When Set Point is Changed (Self-Tuning ON)
1. The set point at the start of program execution differs from the set point (see Note 1 below) when the previous SRT was executed. 2. The difference between the controlled temperature at start of program execution is larger than the current proportional band (1.27+4°C) or the ST stable range, whichever is larger. 3. The controlled temperature at the start of program execution is smaller than the set point during reverse operation, and is larger than the set point during direct operation. 4. No reset from input error	1. The new set point differs from the set point (see Note 1 below) used when the previous SRT was executed. 2. The set point change width is larger than current proportional band1.27+4°C or the ST stable range whichever is larger. 3. During reverse operation, the new set point is larger than the set point before the change; and during direct operation, the new set point is smaller than the set point before the change. 4. The temperature is in a stable state (see Note 2 below). (An equilibrium state [see Note 3 below] is acceptable when the output is 0% when the power is turned ON.)

Note 1: The previous SRT-implemented set point is called the set point obtained by calculating the PID constant by the previous SRT.

Note 2: In this state, the measurement point is within the ST stable range.

Note 3: In this state, the change width of the PV every 60 seconds is at the ST stable range or less.

New PID constants are not calculated by self-tuning (ST) for the currently configured set point in the following instances:

- When the PID constants have been changed manually with ST set to ON.
- When auto-tuning (AT) has been executed

α

Conditions of Use: Control must be configured for 2-PID control method, and the ST parameter must be set to OFF.

Function: This parameter allows you to configure the 2-PID constant for alpha (α). Normally, use this parameter at its default.

Table 5.BC Alpha

Configurable Range	Units	Default Value
0.00…1.00	None	0.65

Related Parameters

- PID/ON/OFF (Initial Setting function group) (p. 5-26)
- ST (Initial Setting function group) (p. 5-27)

MV (Manipulated Variable) Upper Limit,

MV (Manipulated Variable) Lower Limit

Conditions of Use: The control method must be 2-PID control, and the ST parameter must be set to OFF.

Function: The MV Upper Limit and MV Lower Limit parameters allow you to configure the upper and lower limits allowed for the manipulated variable. If the current manipulated variable calculated by the Bulletin 900-TC8 exceeds your configured MV upper- or lower-limit value, then the current value

becomes the upper or lower limit MV value. Your configured MV limits will **not** be exceeded by the controller.

MV Upper Limit

The configurable ranges allowed during the standard control and heating and cooling control modes are different.

The manipulated variable at the control output 2 side during heating and cooling control (see Table 5.L) is expressed as a negative value (see Table 5.BD).

Table 5.BD MV Upper Limit

Control Mode	Configurable Range	Units	Default Value
Standard	MV lower limit +0.1…105.0	%	105.0
Heating and cooling	0.0…105.0	%	105.0

MV Lower Limit

The configurable ranges allowed during the standard control and heating and cooling control modes are different.

The manipulated variable at the control output 2 side during heating and cooling control (see Table 5.L) is expressed as a negative value (see Table 5.BE).

Table 5.BE MV Lower Limit

Control Mode	Configurable Range	Units	Default Value
Standard	–5.0 to MV upper limit –0.1	%	–5.0
Heating and cooling	–105.0…+0.0	%	–105.0

Related Parameters

- PID/ON/OFF (Initial Setting function group) (p. 5-26)
- ST (Initial Setting function group) (p. 5-27)

Input Digital Filter

Function: This parameter allows you to configure the time constant of the controller's input digital filter. Figure 5.11 shows the effect on the input data after passing through the digital filter.

Figure 5.11

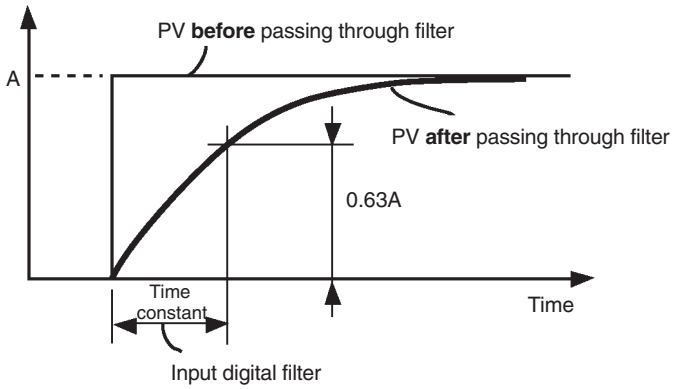


Table 5.BF

Configurable Range	Units	Default Value
0.0…999.9	Second	0.0

PVAd Additional PV Display

Function: This parameter allows you to configure the controller so that only the PV is displayed. It is added to the top of the Operation function group. It gives you the option of displaying the PV and SP (normal) or just the PV.

Table 5.BG

Selections	Default Selection
on: Displayed oFF: Not displayed	oFF

o-dP Manipulated Variable Display

Function: This parameter allows you to configure whether or not the manipulated variable is displayed.

The manipulated variable is displayed when the manipulated variable monitor (OUT1) and (OUT2) parameters are set to ON, and not displayed when these parameters are set to OFF.

Table 5.BH

Selections	Default Selection
on: Displayed oFF: Not displayed	oFF

rEt Automatic Return of Display Mode

Function: If you do not operate any of the keys on the front panel for the time set by this parameter in the Operation function group and Adjustment function group, the display automatically returns to the PV/SP display.

This function is disabled (display does not change automatically) when this parameter is configured to OFF.

Table 5.BI

Configurable Range	Units	Default Value
OFF, 1…99	Second	OFF

Alarm 1 Latch,

Alarm 2 Latch,

Alarm 3 Latch

Conditions of Alarm 1 Use: The Alarm 1 function must be ON.

Conditions of Alarm 2 Use: The Alarm 2 function must be ON.

Conditions of Alarm 3 Use: The Alarm 3 function must be ON, and control must be the Standard Control mode.

Function: When this parameter is set to ON and an alarm condition occurs, the alarm function is held until the controller power is turned OFF. Note, however, that the latch is canceled when switching to the Initial Setting function group, Advanced Setting function group, or Calibration function group.

When the alarm output function is set to open in alarm, the closed alarm output is held, and when configured to closed in alarm, the open output is held.

Table 5.BJ

Selections	Default Selection
ON: ON OFF: OFF	OFF

Related Parameters

- Alarm Value 1 to 3 (Operation function group) (p. 5-8)
- Upper-Limit Alarm Value 1 to 3, Lower-Limit Alarm Value 1 to 3 (Operation function group) (p. 5-10)
- Alarm 1 to 3 Type (Initial Setting function group) (p. 5-30)
- Standby Sequence Reset Method (Advanced Setting function group) (p. 5-37)
- Alarm 1 to 3 Open in Alarm, Alarm 1 to 3 Hysteresis (Advanced Setting function group (p. 5-39…p. 5-42)

Protect Function Group Move Time

Function: This parameter allows you to configure the control panel key pressing time required to move to the Protect function group from the Operation function group or the Adjustment function group.

Table 5.BK

Configurable Range	Units	Default Value
1…30	Second	3

Related Parameters

Operation/Adjustment Protection, Initial Setting/Communications Protection, Setting Change Protection (Protect function group) (p. 5-2)

Output Input Error

Function: When this parameter is configured to ON, the Alarm 1 output turns ON at an input error condition. Note, however, that the Alarm 1 operation LED display does not light.

- The alarm 1 output is the ORed output of alarm 1, HBA used, and the input error.
- The alarm 1 output is turned OFF when controller operation is switched to the Initial Setting function group, Communications Setting function group, Advanced Setting function group, or Calibration function group.

Table 5.BL

Selections	Default Selection
on: Internally oFF: Externally	on

Related Parameter

Input Error (Error Display) (p. 6-1)

Cold Junction Compensation Method

Conditions of Use: The input type must be thermocouple or non-contact temperature sensor.

Function: This parameter allows you to specify whether cold junction compensation is to be performed internally by the controller or to be performed externally when the Input Type setting value is No. 0…15, 17, or 18.

The cold junction compensation external setting is valid when the temperature difference is measured using two thermocouples or two non-contact sensors.

Table 5.BM

Selections	Default Selection
on: Internally oFF: Externally	on

Related Parameter

Input Type (Initial Setting function group) (p. 5-23)

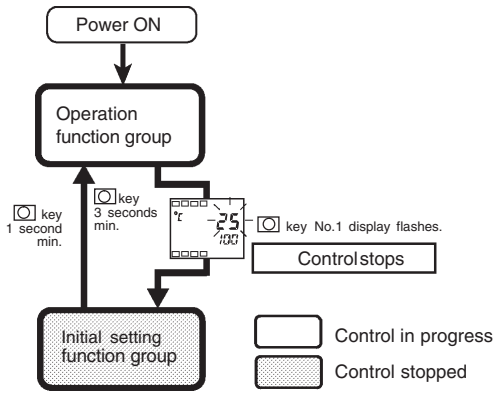
rLrw MB Command Logic Switching

Note: Although this parameter is available, it is not used by the controller or 900Builder software. The default is OFF and should remain unchanged.

Communications Setting Function Group

This function group allows you to configure the controller's communication parameters, enabling interface to a personal computer that is running the 900Builder software application. The controller hardware must support communications through a Cat. No. 900-8232 or Cat. No. 900-8COM option board.

Figure 5.12



Communications Unit No.,

Baud Rate,

Communications Data Length,

Communications Stop Bit,

Communications Parity

Conditions of Use: Communications function must be supported by the controller.

Function: These parameters allow you to match the communications specifications of the controller(s) with the personal computer which has the 900Builder software. If a 1:N connection is being used (RS-485), ensure that the communications specifications for all devices in the system are the same except for the unit number. Each device needs an individual unit number for RS-485 communication.

Note: Each parameter is enabled when the power is reset.

Table 5.BN

Parameter	Displayed Characters	Configurable Value	Range	Default
Communications Unit No. (RS-485)	U-nō	0, 1…99	0…99	1
Baud Rate	bPS	1.2/2.4/4.8/9.6/ 19.2 kbps	1.2/2.4/4.8/9.6/ 19.2 kbps	9.6 kbps
Communications Data Length	LEn	7/8 bit	7/8 bit	7 bit
Communications Stop Bit	SbīT	1/2	1/2	2
Communications Parity	PrtY	nōnE/EuEn/ōdd	None/even/odd	EuEn

Related Parameters

Communications Writing (Adjustment function group) (p. 5-14)

Notes:

Notes:

Troubleshooting and Error Indication

When an error has occurred, the No. 1 display alternately indicates error codes together with the current display item.

This section describes how to check error codes on the display, and the actions you must take to remedy the problem.

S.Err Input Error

Meaning

The input value exceeds the input indication range (when the input indication range is within –1999 (–199.9) to 9999 (999.9).

- **Platinum resistance thermometer, thermocouple input:** Temperature setting lower limit –20°C to temperature setting upper limit +20°C (temperature setting lower limit –40°F to temperature setting upper limit +40°F)
- **Non-contact input:** Same as input indication range
- **Analog input:** –5%…+105% of scale range

See Figure 6.1 for details.

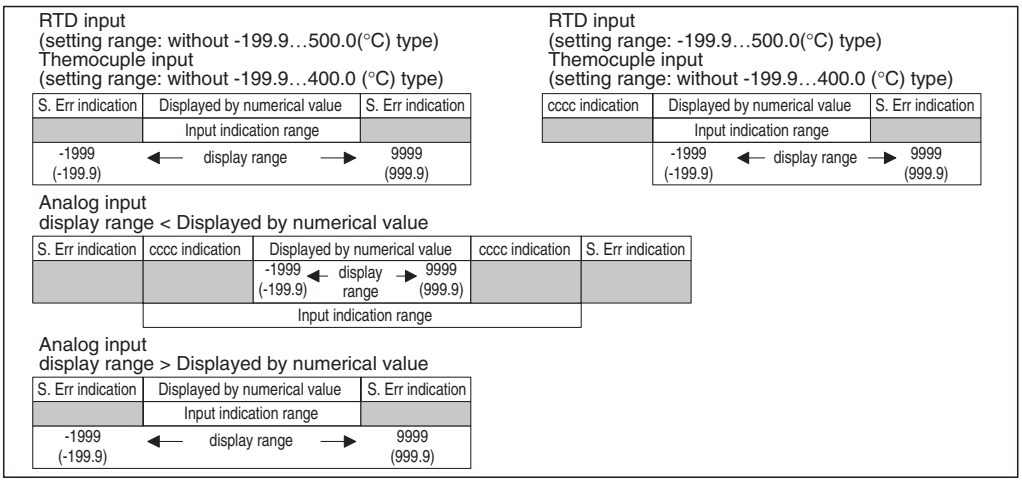
Action

Check the wiring of inputs for miswiring, loose connections (open circuit), short-circuits, and the correct input type selection. If no abnormality is found in the wiring and input type, turn the controller power OFF then back ON again. If the display remains the same, the Bulletin 900-TC8 must be replaced. If the display is restored, then a probable cause can be electrical noise affecting the control system. Check for sources of electrical noise.

Operation at Error

- After the error occurs, the error is displayed, and control output functions turn OFF.
- Alarm outputs function as if the upper limit value has been exceeded.
- An error message is displayed when process value or PV/SP are displayed.

Figure 6.1



E111 Memory Error

Meaning

Internal memory operation is in error.

Action

First, turn the controller power OFF then back ON again. If the display remains the same, the Bulletin 900-TC8 must be replaced. If the display is restored, then a probable cause can be electrical noise affecting the control system. Check for sources of electrical noise.

Operation at Error

Control output and alarm outputs turn OFF.

H.Err HB Error

Meaning

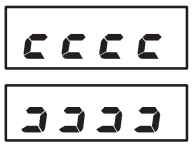
Internal controller circuits are in error.

Action

First, turn the controller power OFF then back ON again. If the display remains the same, the Bulletin 900-TC8 must be replaced. If the display is restored, then a probable cause can be electrical noise affecting the control system. Check for sources of electrical noise.

Operation at Error

Control output functions turn OFF. An error message is displayed when process value or PV/SP are displayed.



Display Over Range

Meaning

Though this is not an error, this is displayed when the process value exceeds the display range when the control range is larger than the display range –1999 (–199.9) … 9999 (999.9).

- When less than –1999 (–199.9): cccc
- When more than 9999 (999.9): 3333

Action

Control continues, allowing normal operation. An error message is displayed when process value or PV/SP are displayed.

Current Exceeds Value

Meaning

This error is displayed when the heater current value exceeds 55.0 A.

Action

Control continues, allowing normal operation. An error message is displayed when Heater Current Value Monitor is displayed.

Specifications

For the setting ranges for each sensor input, see p. A-5.

Table A.A

Technical/Control			
Supply voltage		100…240V AC, 50/60 Hz	24V AC, 50/60 Hz or 24V DC
Operating voltage range		85…110% of rated supply voltage	
Power consumption		5.4 VA @ 120V AC, 9 VA @ 240V AC	5 VA/4 W
Recommended line fuse		Type: T2A, 250V AC, time lag, low shut-off capacity ❶	
Sensor input	Thermocouple	K, J, T, E, L, U, N, R, S, B	
	Platinum resistance thermometer (RTD)	Pt100, JPt100 (1 mA controller source current)	
	Non-contact temperature sensor (simulates Type K thermocouple)	K10…70°C, K60…120°C, K115…165°C, K160…260°C	
	Voltage input	0…50 mV	
Control output	ON/OFF Relay output	SPST-NO, 250V AC @ 5 A or 30V DC @ 10 A (resistive load), electrical life: 100,000 operations, min. applicable load 5V, 10 mA	
	ON/OFF Voltage output (PNP type)	DC 12V $^{+15\%}_{-20\%}$ %FS, max. load current 40mA With current limit protection circuit.	
	Analog Current output	DC, 4...20 mA, load: 600 ohms max., resolution: apprx. 2,600	
Alarm output		SPST-NO, 250V AC @ 3 A or 30V DC @ 5 A (resistive load), electrical life: 100,000 operations, min. applicable load 1V, 1 mA	
Event Input ❷	Contact	ON: 1 kΩ max.; OFF: 100 kΩ min.	
	Non-contact	ON: residual voltage 1.5V max.; OFF: leakage current 0.1 mA max.	
Control method		2-PID (auto-tune and self-tune) or ON/OFF control	
Configuration method		Digital setting using front panel keys or 900Builder software	
Indication method		7-segment digital LED display and LED indicators	
Indication accuracy	Thermocouple	(±0.5% of indication value or ±1°C, whichever is greater) ± 1 digit max. ❸	
	Platinum resistance thermometer	(±0.5% of indication value or ±1°C, whichever is greater) ±1 digit max.	
	Analog input	±5%FS±1 digit max.	
	CT input	±5%FS±1 digit max.	
Hysteresis		0.1…999.9 EU (in units of 0.1 EU)	
Proportional band (P)		0.1…999.9 EU (in units of 0.1 EU)	
Integral time (I)		0…3999 (in units of 1 second)	
Derivative time (D)		0…3999 (in units of 1 second)	
Control period		1…99 (in units of 1 second)	

❶ Available from Little Fuse or Bussmann (part no. GDC-2A).

❷ Controller sources power to inputs: 5V DC @ 7 mA

❸ The indication of K thermocouples in the –200…+1300°C range, T and N thermocouples at a temperature of –100°C or less, and U and L thermocouples at any temperature is ±2°C±1 digit maximum. The indication of B thermocouples at a temperature of 400°C or less is unrestricted. The indication of R and S thermocouples at a temperature of 200°C or less is ±3°C±1 digit maximum.

Table A.A (Continued)

Technical/Control (Continued)		
Manual reset value		0.0…100.0% (in units of 0.1%)
Alarm setting range		–1999…+9999 (decimal point position dependent on input type)
Sampling period		500 ms
Other functions		According to controller model
General/Environmental		
Insulation resistance		20 MΩ min. (by 500V DC megger)
Dielectric strength		2000V AC 50 or 60 Hz 1 min.
Vibration	Operating	10…55 Hz, 10 m/s^2 (1 G) for 10 min. each in X, Y, and Z directions
	Non-operating	10…55 Hz, 20 m/s^2 (2 G) for 2 hrs. each in X, Y, and Z directions
Shock	Operating	200 m/s^2 (20 G) max., 3 times in each 3 axes, 6 directions. Relay: 100 m/s^2 (10 G)
	Non-operating	300 m/s^2 (30 G) max., 3 times in each 3 axes, 6 directions. Relay: 100 m/s^2 (10 G)
Protective structure	Front panel	Type 4X
	Rear case	IP20, terminals: IP00 (VDE 0106)
Memory protection		EEPROM (non-volatile memory) (number of writes: 100,000)
Weight (includes carton)		Approx. 390 g (13.8 ounces)
Ambient temperature		–10…+55°C (with no condensation or icing)
Ambient humidity		Relative humidity 25…85% (no condensation)
Storage temperature		–25…+65°C (with no condensation or icing)
Altitude		2,000 m or less
Installation environment		Installation Category II, Pollution Class 2 (IEC 61010-1 compliant)
EMC	Emission enclosure	EN55011 Group 1 class A
	Emission AC mains	EN55011 Group 1 class A
	Immunity ESD	EN61000-4-2: 4 KV contact discharge (level 2); 8 KV air discharge (level 3)
	Immunity RF-interference	EN61000-4-3; 10V/m (amplitude modulated, 80 MHz …1 GHz) (level 3) 10V/m (pulse modulated, 900 MHz)
	Immunity conducted disturbance	EN61000-4-6: 10V (0.15…80 MHz) (level 3)
	Immunity burst	EN61000-4-4: 2 KV power line (level 3); 2 kV I/O signal-line (level 4)
	Surge immunity	EN61000-4-5: 1 KV line to line (level 2); 2 kV line to ground (level 3)
	Voltage dips/short interruptions	EN61000-4-11: 100%/0.5 period
Standards		UL3121-1, CSA22.2 No. 1010.1 UL Type 4X. Conforms to EN61326, EN61010-1

Heater Burnout Alarm (HBA)

Table A.B

Max. heater current	Single-phase AC 50 A
Input current readout accuracy	±5%FS±1 digit max.
Heater burnout alarm setting range	0.1…49.9 A (0.1 A units) 0.0 A: Heater burnout alarm output turns OFF. 50.0 A: Heater burnout alarm output turns ON.
Min. detection ON time ❶	190 ms

❶ When the control output ON time is less than 190 ms, heater burnout detection and heater current measurement are not carried out.

Current Transformer (CT)

Specifications

Table A.C

Item	Specifications	
Model	900-CT1	900-CT2
Max. continuous current	50 A	120 A ❷
Dielectric strength	1000V AC (1 minute)	
Vibration	50 Hz 98 m/S^2	
Weight	Approx. 11.5 g	Approx. 50 g

❷ The maximum continuous current of the Bulletin 900-TC8 is 50 A.

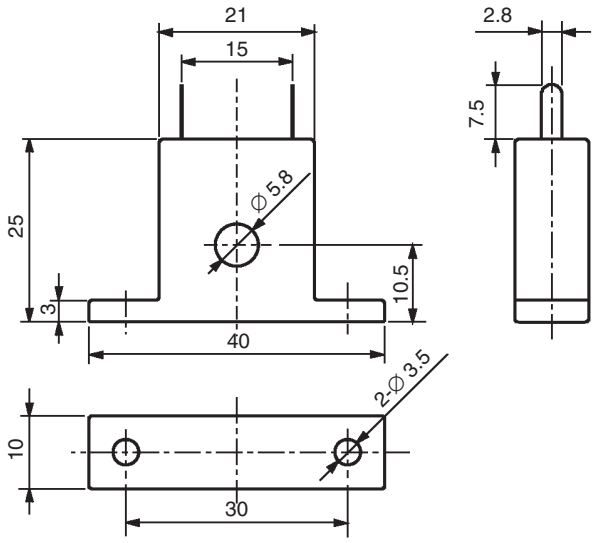
Approximate External Dimensions

Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.

Note: To convert millimeters to inches, multiply by 0.0394.

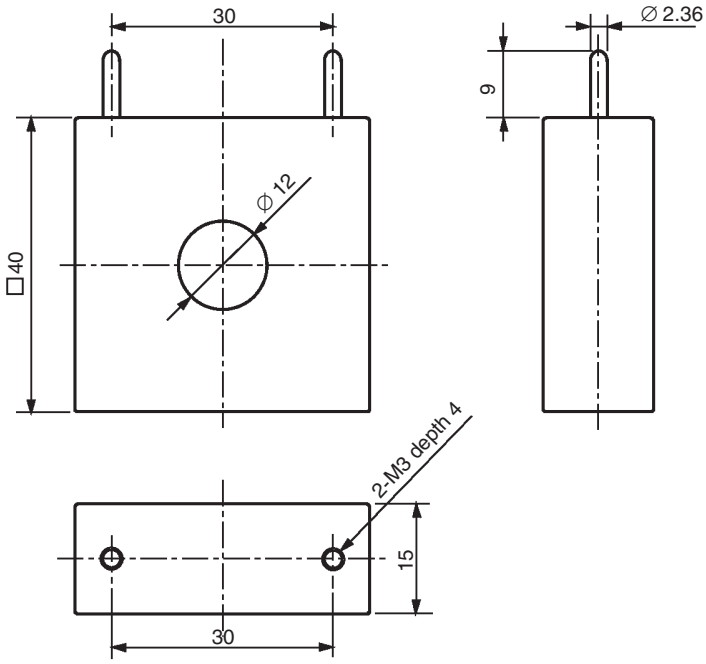
Cat. No. 900-CT1

Figure A.1



Cat. No. 900-CT2

Figure A.2



Sensor Input Setting and Indication Ranges

Table A.D List of Input Types

	Input Type	Specifications	Set Value	Input Temperature Range
Platinum resistance thermometer input type	Platinum resistance thermometer	Pt100	0 ❶	–200…+870°C/–340…+1540°F
			1	–199.9…+520.0°C/–199.9…+940.0°F
			2	–20.0…120.0°C/–40.0…250.0°F
		JPt100	3	–199.9…+520.0°C/–199.9…+940.0°F
			4	–20.0…120.0°C/–40.0…250.0°F
Thermocouple input type	Thermocouple	K	0 ❷	–220…+1320°C/–340…+2340°F
			1	–40.0…+520.0°C/–40.0…940.0°F
		J	2	–120…+870°C/–140…+1540°F
			3	–40…+420.0°C/–40.0…790.0°F
		T	4	–220…+420°C/–340…+740°F
			17	–199.9…+420°C/–199.9…+740°F
		E	5	–20.0…620°C/–40.0…1140°F
		L	6	–120…+870°C/–140…+1540°F
		U	7	–220…+420°C/–340…+740°F
			18	–199.9…+420°C/–199.9…+740°F
		N	8	–220…+1320°C/–340…+2340°F
		R	9	–20.0…1720°C/–40.0…3040°F
		S	10	–20.0…1720°C/–40.0…3040°F
		B	11	0…1820°C/0…3240°F
	Non-contact temperature sensor based on type K Thermocouple	K10…70°C	12	–20.0…130°C/–40.0…270°F
		K60…120°C	13	–20.0…160°C/–40.0…320°F
		K115…165°C	14	–20.0…205°C/–40.0…400°F
		K160…260°C	15	–20.0…300°C/–40.0…580°F
	Analog input	0…50 mV	16	One of following ranges depending on the results of scaling: –1999…+9999, –199.9…+999.9

❶ Default setting for RTD-compatible controllers (see Table 1.A)
❷ Default setting for thermocouple controllers (see Table 1.A)

The applicable standards for each of the above input ranges are as follows:

- K, J, T, E, N, R, S, B: JIS C1602-1995, IEC 584-1
- L: Fe-CuNi, DIN 43710-1985
- U: Cu-CuNi, DIN 43710-1985
- JPt100: JIS C 1604-1989, JIS C 1606-1989
- Pt100: JIS C 1604-1997 IEC 751

Control Range

- Platinum resistance thermometer and thermocouple input:
  - –20°C of temperature setting lower limit to +20°C of the temperature setting upper limit, or
  - –40°F of temperature setting lower limit to +40°F of the temperature setting upper limit
- Non-contact temperature input: Same as input indication range
- Analog input: –5%…+105% of scaling range

Parameter Operations List

Table B.A Operation Function Group

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
PV		Sensor input indication range				EU
PV/SP		SP lower limit to SP upper limit			0	EU
Multi-SP	ā-SP	0…3			0	None
Set Point during SP Ramp	SP-ā	SP lower limit to SP upper limit				EU
Heater Current Value Monitor	Ct	0.0…55.0				A
RUN/STOP	r-S	RUN/STOP	rUn, StōP	RUN	None	
Alarm Value 1	AL-1	–1999…+9999			0	EU
Upper-Limit Alarm Value 1	AL 1H	–1999…+9999			0	EU
Lower-Limit Alarm Value 1	AL 1L	–1999…+9999			0	EU
Alarm Value 3	AL-3	–1999…+9999			0	EU
Upper-Limit Alarm Value 3	AL3H	–1999…+9999			0	EU
Lower-Limit Alarm Value 3	AL3L	–1999…+9999			0	EU
MV Monitor (OUT1)	ō	–5.0…+105.0 (standard)				%
		0.0…105.0 (heating and cooling)				%
MV Monitor (OUT2)	C-ō	0.0…105.0				%

Table B.B Adjustment Function Group

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
AT Execute/Cancel	At	ON, OFF	ōn, ōFF	ōFF	None	
Communications Writing	CōMt	ON, OFF	ōn, ōFF	ōFF	None	
Heater Current Value Monitor	Ct	0.0…55.0			A	
Heater Burnout Detection	Hb	0.0…50.0		0	A	
Set Point 0	SP-0	SP lower limit to upper limit		0	EU	
Set Point 1	SP-1	SP lower limit to upper limit		0	EU	
Set Point 2	SP-2	SP lower limit to upper limit		0	EU	
Set Point 3	SP-3	SP lower limit to upper limit		0	EU	
Temperature Input Shift	InS	–199.9…+999.9		0.0	°C or °F	
Upper-Limit Temperature Input Shift Value	InSH	–199.9…+999.9		0.0	°C or °F	
Lower-Limit Temperature Input Shift Value	InSL	–199.9…+999.9		0.0	°C or °F	
Proportional Band	P	0.1…999.9		8.0	EU	
Integral Time	I	0…3999		233	Second	

Table B.B Adjustment Function Group (Continued)

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
Derivative Time	d	0…3999		40	Second	
Cooling Coefficient	C-SC	0.01…99.99		1.00	None	
Dead Band	C-db	–199.9…999.9		0.0	EU	
Manual Reset Value	oF-r	0.0…100.0		50.0	%	
Hysteresis (OUT1)	HYS	0.1…999.9		1.0	EU	
Hysteresis (OUT2)	CHYS	0.1…999.9		1.0	EU	

Table B.C Initial Setting Function Group

Parameter Name	Symbol	Setting (Monitor) Value			Display	Default	Unit	Set Value
Input Type*	In-t	Platinum resistance thermometer	0: Pt100 1: Pt100 2: Pt100	3: JPt100 4: JPt100			None	
		Thermocouple	0: K 1: K 2: J 3: J 4: T 17: T 5: E	6: L 7: U 8: N 18: T 9: R 10: S 11: B			None	
		Non-contact temperature sensor	12: K10…70°C 13: K60…120°C	14: K115…165°C 15: K160…260°C				
		Analog input	16: 0…50 mA					
Scaling Upper Limit	In-H	Scaling lower limit +1…9999					None	
Scaling Lower Limit	In-L	–1999 to scaling upper limit –1					None	
Decimal Point	dP	0,1					None	
Temperature Unit	d-U	°C, °F			C, F	None		
Set Point Upper Limit	SL-H	SP lower limit +1 to input range lower value (temperature)					EU	
		SP lower limit +1 to scaling upper limit (analog)					EU	
Set Point Lower Limit	SL-L	Input range lower limit to SP upper limit –1 (temperature)					EU	
		Scaling lower limit to SP upper limit –1 (analog)					EU	
PID/ON/OFF	CntL	2-PID, ON/OFF			PId, onoF	ON/OFF		
Standard/Heating and Cooling	S-HC	Standard, heating and cooling			Stnd, H-C	Standard		
ST	St	ON, OFF			on, oFF	ON		
Control Period (OUT1)	CP	1…99					Second	

Table B.C Initial Setting Function Group (Continued)

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
Control Period (OUT2)	C-CP	1…99			Second	
Direct/Reverse Operation	orEu	Direct operation, reverse operation	or-d, or-r	Reverse operation		
Alarm 1 Type	ALt1	0: Alarm function OFF 1: Upper- and lower-limit (deviation range) 2: Upper-limit (deviation) 3: Lower-limit (deviation) 4: Upper- and lower-limit range (deviation range) 5: Upper- and lower-limit alarm with standby sequence (deviation range) 6: Upper-limit alarm with standby sequence (deviation) 7: Lower-limit alarm with standby sequence (deviation) 8: Upper-limit (absolute-value) 9: Lower-limit (absolute-value) 10: Upper-limit with standby sequence (absolute-value) 11: Lower-limit with standby sequence (absolute-value)			None	
Alarm 2 Type	ALt2	Same as alarm 1 type			None	
Alarm 3 Type	ALt3	Same as alarm 1 type		2	None	
Move to Advanced Setting Function Group	Aadu	–1999…+9999			None	

Table B.D Advanced Function Setting Function Group

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
Parameter Initialize	InIt	ON, OFF	on, oFF	OFF	None	
Number of Multi-SP Uses	Eu-n	0…2		1	None	
Event Input Assignment 1	Eu-1	None, RUN/STOP	nonE, StoP	None	None	
Event Input Assignment 2	Eu-2	None, RUN/STOP	nonE, StoP	RUN/STOP	None	
Multi-SP Uses	nSPU	ON, OFF	on, oFF	OFF	None	
SP Ramp Set Value	SPrt	OFF, 1…9999	oFF, 1 to 9999	OFF	EU	
Standby Sequence Reset Method	rESt	Condition A, Condition B	A, b	Condition A	None	
Alarm 1 Open in Alarm	AL 1n	Open in alarm/Close in alarm	n-o, n-C	Close in alarm	None	
Alarm 1 Hysteresis	ALH1	0.1…999.9		0.2	EU	
Alarm 2 Open in Alarm	AL2n	Open in alarm/Close in alarm	n-o, n-C	Close in alarm	None	
Alarm 2 Hysteresis	ALH2	0.1…999.9		0.2	EU	
Alarm 3 Open in Alarm	AL3n	Open in alarm/Close in alarm	n-o, n-C	Close in alarm	None	
Alarm 3 Hysteresis	ALH3	0.1…999.9		0.2	EU	

Table B.D Advanced Function Setting Function Group (Continued)

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
HBA Used	HbU	ON, OFF	on, oFF	ON	None	
Heater Burnout Latch	HbL	ON, OFF	on, oFF	OFF	None	
Heater Burnout Hysteresis	HbH	0.1…50.0		0.1	A	
ST Stable Range	St-b	0.1…999.9		15.0	°C or °F	
α (Alpha)	ALFA	0.00…1.00		0.65	None	
MV Upper Limit	oL-H	MV lower limit +0.1…105.0 (standard)		105.0	%	
		0.0…105.0 (heating and cooling)		105.0	%	
MV Lower Limit	oL-L	–5.0 to MV upper limit –0.1 (standard)		–5.0	%	
		–105.0…0.0 (heating and cooling)		–105.0	%	
Input Digital Filter	inF	0.1…999.9		0.0	Second	
Additional PV Display	PVAd	ON, OFF	on, oFF	OFF	None	
Manipulated Variable Display	o-dP	ON, OFF	on, oFF	OFF	None	
Automatic Return of Display Mode	rEt	OFF, 1…9999	oFF, 1 to 9999	OFF	Second	
Alarm 1 Latch	A1Lt	ON, OFF	on, oFF	OFF	None	
Alarm 2 Latch	A2Lt	ON, OFF	on, oFF	OFF	None	
Alarm 3 Latch	A3Lt	ON, OFF	on, oFF	OFF	None	
Protect Function Group Move Time	PrLt	1…30		3	Second	
Output Input Error	SEro	ON, OFF	on, oFF	OFF	None	
Cold Junction Compensation Method	CJC	ON, OFF	on, oFF	ON	None	
MB Command Logic Switching	rLru	ON, OFF	on, oFF	OFF	None	
Move to Calibration Function Group	Cnou	–1999…+9999		0	None	

Table B.E Protect Function Group

Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
Operation/Adjustment Protection	oAPt	0…3			0	None
Initial Setting/Communications Protection	iCPt	0…2			1	None
Setup Change Protection	StPt	ON, OFF	on, oFF	OFF	None	

Table B.F Communications Setting Function Group

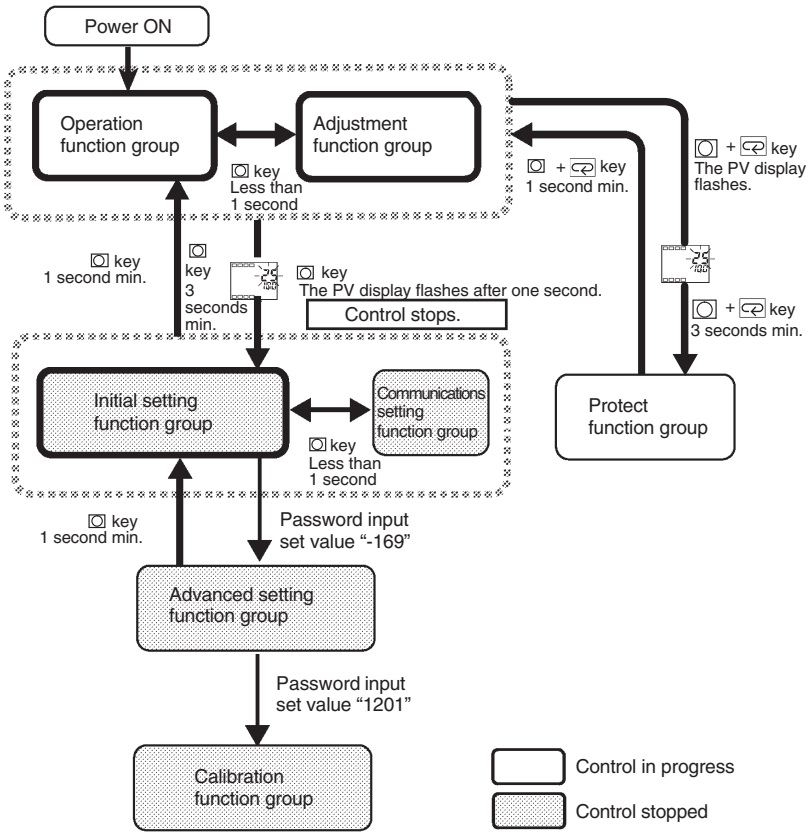
Parameter Name	Symbol	Setting (Monitor) Value	Display	Default	Unit	Set Value
Communication Unit No.	U-no	0…99		1	None	
Baud Rate	bPS	1.2, 2.4, 4.8, 9.6, 19.2	1.2, 2.4, 4.8, 9.6, 19.2	9.6	kbps	
Data Bit	LEn	7, 8		7	bit	
Stop Bit	Sbit	1, 2		2	bit	
Parity	Prty	None, Even, Odd	nonE, EuEn, odd	Even	None	

Setup Function Groups Diagram

The following diagram shows an overview of the setup function groups on the Bulletin 900-TC8. To move to the Advanced Setting function group and Calibration function group, you must enter passwords. Some parameters are not displayed depending on the Protect function group setting and the conditions of use.

Control stops when you move from the Operation function group to the Initial Setting function group.

Figure B.1



Parameter Flow

If you press the mode key at the last parameter in each function group, you return to the top parameter in that function group.

Figure B.2

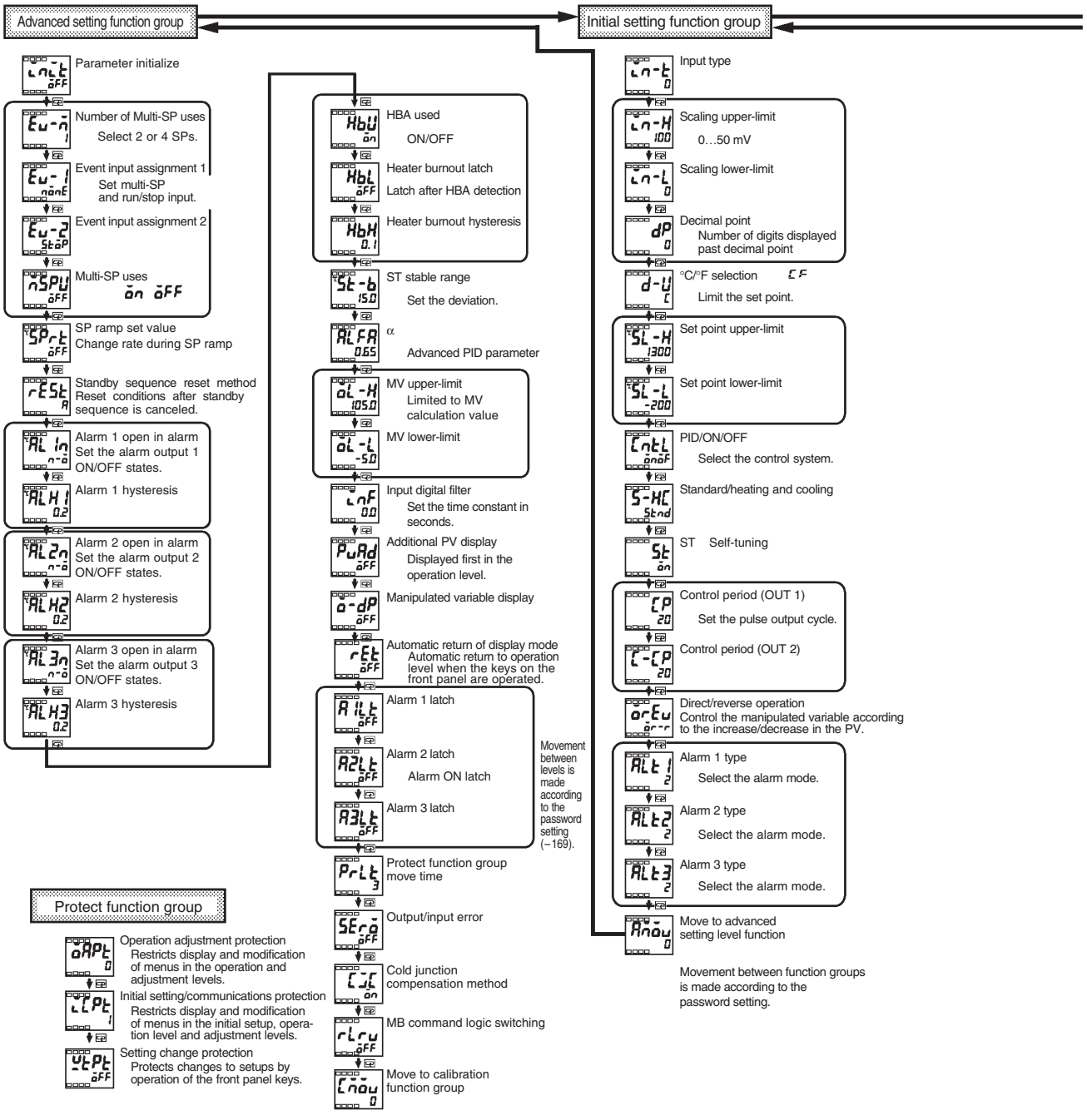
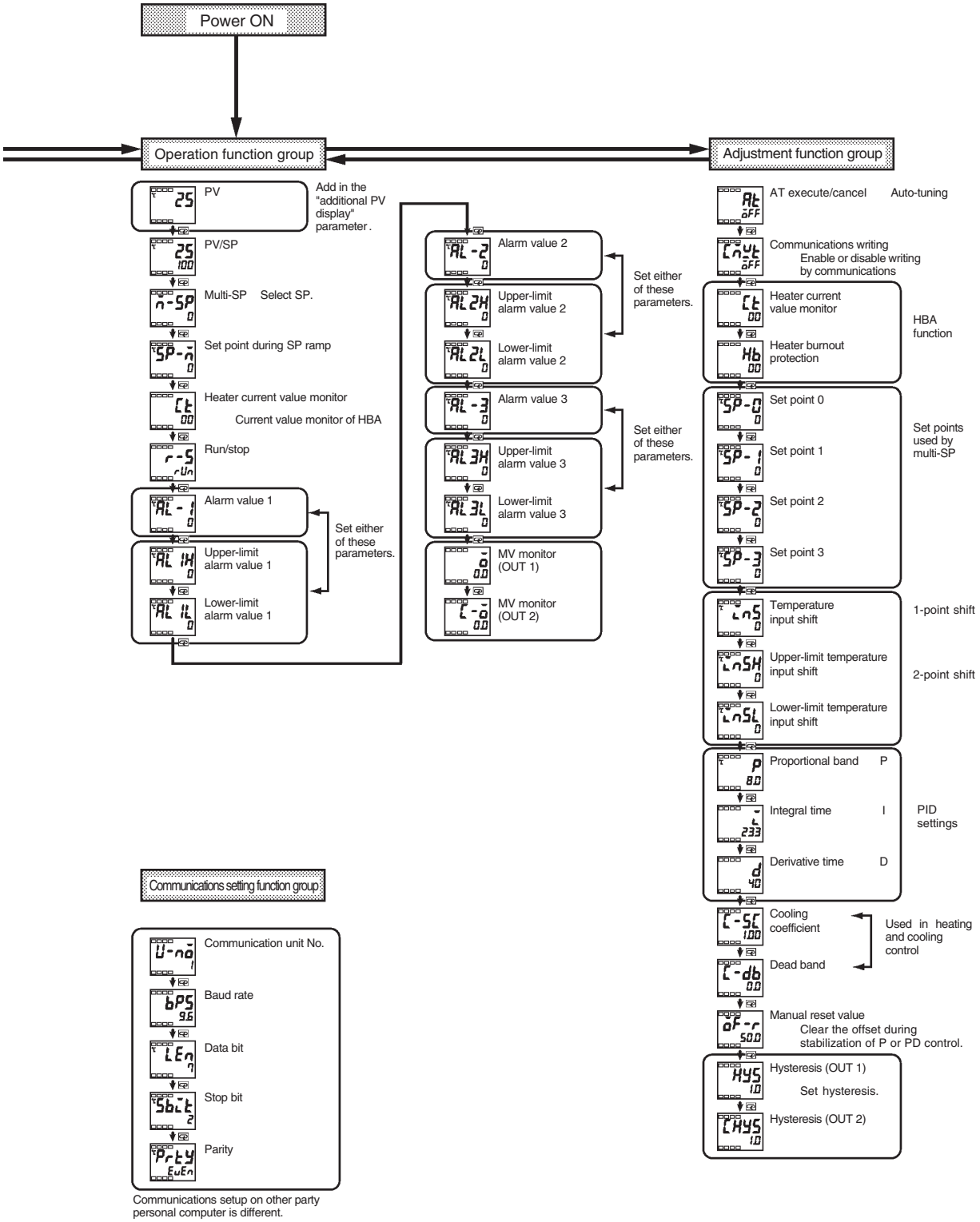


Figure B.2 (Continued)



Notes:

Calibration

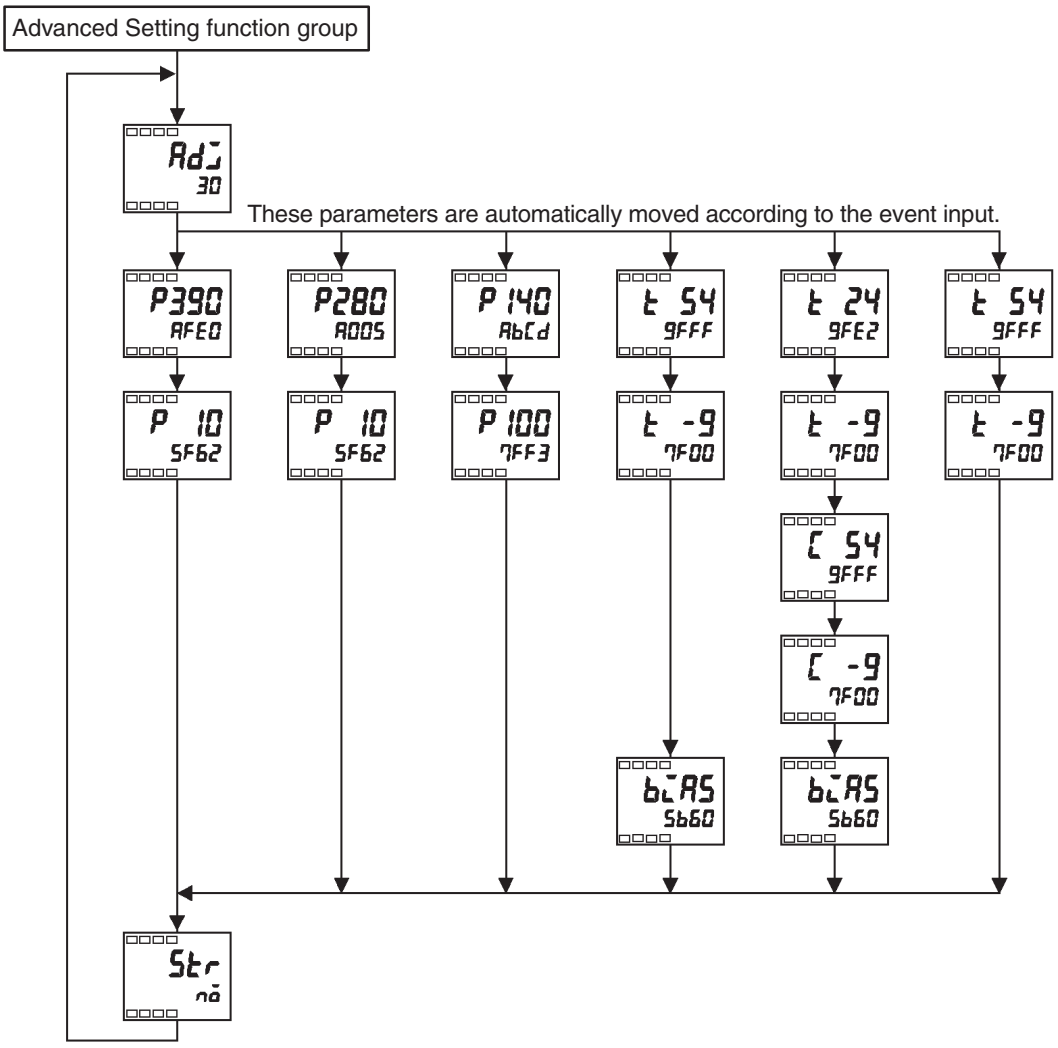
Parameter Structure

The Bulletin 900-TC8 is correctly calibrated before it is shipped from the factory, and normally need not be calibrated by the user. If, however, it must be calibrated by the user, use the parameters for calibrating temperature input and analog input.

Note: Rockwell Automation cannot ensure the results of calibration by the user. Also, factory calibration data is overwritten with the user's settings and the factory default calibration settings cannot be returned after user calibration.

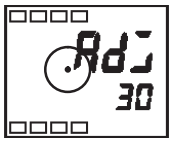
- To calibrate the Bulletin 900-TC8, enter the password **1201** at the Move to Calibration Function Group parameter in the Advanced Setting function group. RdJ is displayed.
- However, note that the Move to Calibration Function Group parameter might not be displayed when, for example, the user is calibrating the Bulletin 900-TC8 for the first time. If this happens, set the Initial/Communications Protection parameter in the Protect function group to 0 before moving to the Advanced Setting function group.
- The calibration mode is quit by turning the power OFF.
- The parameters in the Calibration function group are structured as follows:

Figure C.1



Once the user has calibrated the Bulletin 900-TC8, a dot will be displayed when moving to the Calibration function group, to indicate that the Bulletin 900-TC8 has already been calibrated by the user.

Figure C.2



Dot is displayed.

User Calibration

Calibrating Input

When the user calibrates the Bulletin 900-TC8, the input type currently selected in parameters is calibrated. The following 22 input types can be calibrated.

- Thermocouple: 12 types
- Non-contact temperature sensor: 4 types
- Analog input: 1 type
- Platinum resistance thermometer: 5 types

Registering Calibration Data

The new calibration data for each item is temporarily registered. It can be officially registered as calibration data only when all items have been calibrated to new values. Therefore, be sure to temporarily register all items when you calibrate the Bulletin 900-TC8.

When calibration data is registered, it is registered regardless of whether or not the Bulletin 900-TC8 has been calibrated by the user.

Prepare separate measuring devices and equipment for calibration. For details on how to handle measuring devices and equipment, see the respective sensor manufacturer's instruction manuals.

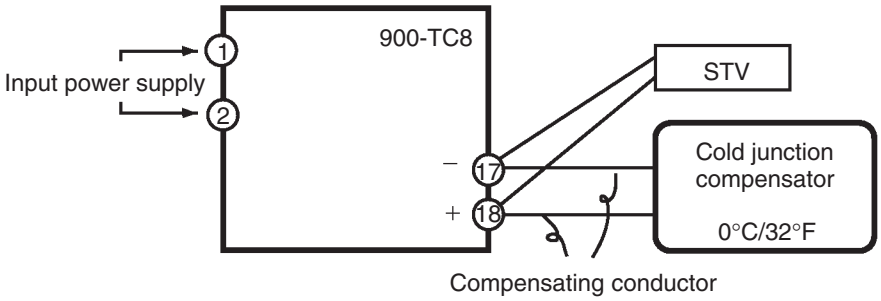
Calibrating Thermocouples

Calibrate according to the type of thermocouple, thermocouple 1 group (input types 0, 2, 5, 6, 8), and thermocouple 2 group (input types 1, 3, 4, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18).

When calibrating, do not cover the bottom of the Bulletin 900-TC8. Also, do not touch the input terminals (nos. 8 and 9) or compensating conductor on the Bulletin 900-TC8.

Preparations

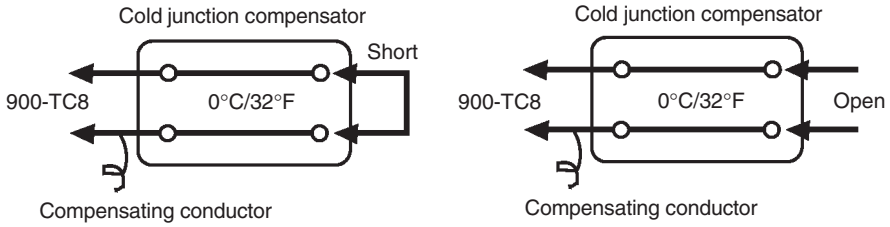
Figure C.3



- Set the cold junction compensator designed for compensation of internal thermocouples to 0°C. However, make sure that internal thermocouples are disabled (tips are open).
- In the above figure, STV refers to a standard DC current/voltage source.
- Use the compensating conductor designed for the selected thermocouple. However, note that when thermocouples R, S, E, B, or a non-contact temperature sensor is used, the cold junction compensator and the compensating conductor can be substituted with the cold junction compensator and the compensating conductor for thermocouple K.

Connecting the Cold Junction Compensator — Correct process values cannot be obtained if you touch the contact ends of the compensating conductor during calibration of a thermocouple. Accordingly, short-circuit (enable) or open (disable) the tip of the thermocouple inside the cold junction compensator as shown in the figure below to create a contact or non-contact state for the cold junction compensator.

Figure C.4

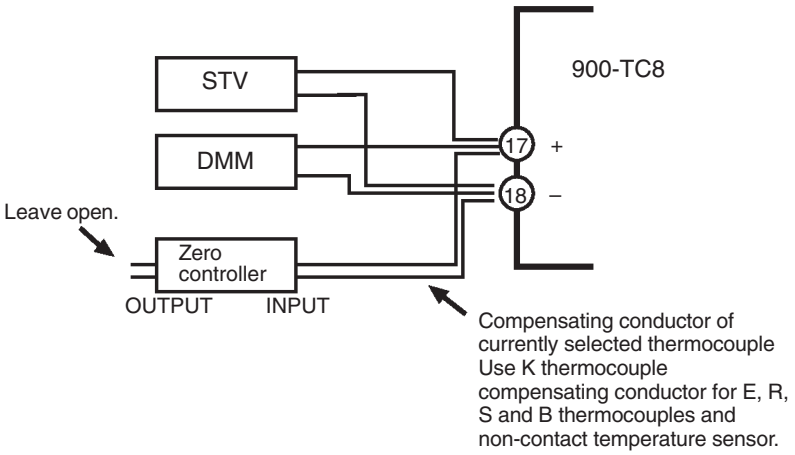


This example describes how to calibrate the Bulletin 900-TC8 when thermocouple input is currently selected on a Bulletin 900-TC8 supporting a thermocouple temperature sensor.

1. Connect the power supply.

2. Connect a standard DC current/voltage source (STV), precision digital multimeter (DMM), and contact junction compensator (e.g., zero controller as in figure) to the thermocouple input terminals, as shown in the figure below.

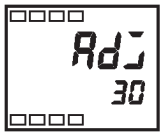
Figure C.5



3. Turn the power ON.

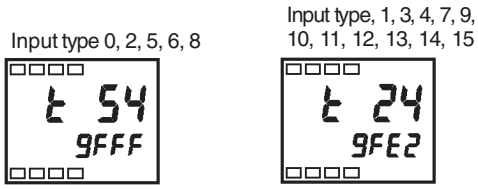
4. Move to the Calibration function group. This starts the 30-minute timer. This timer provides an approximate timer for aging. After 30 minutes, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

Figure C.6



5. Press the ↵ key to set the Bulletin 900-TC8 to the state below. The No. 2 display at this time displays the currently entered count value entered in Hexadecimal. Set the STV as follows:
   - Input types 0, 2, 5, 6, 8: Set to 54 mV.
   - Input types 1, 3, 4, 7, 9, 10, 11, 12, 13, 14, 15, 17, 18: Set to 24 mV.

Figure C.7



Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup.

6. Press the ↵ key to set the Bulletin 900-TC8 to the state below. Set STV to –9 mV. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup.

Figure C.8

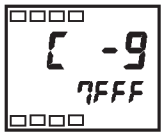
7. Press the ↵ key. The No. 2 display changes to the state below when the input type is 1, 3, 4, 7, 9, 10, 11, 12, 13, 14, or 15.

8. Set STV to 54 mV. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup.

Figure C.9

9. Press the ↵ key. The No. 2 display changes to the state below when the input type is 1, 3, 4, 7, 9, 10, 11, 12, 13, 14, 15, 17, or 18. Set STV to –9 mV.

Figure C.10



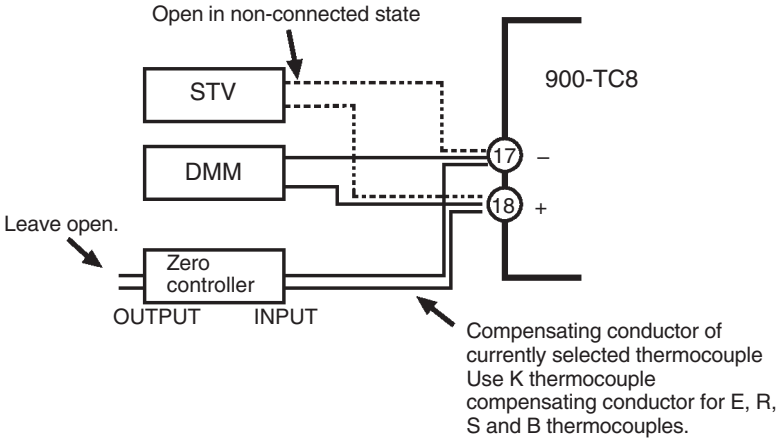
10. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup.

11. Press the ↵ key to set the Bulletin 900-TC8 to the state below.

Figure C.11

12. Change the wiring as follows:

Figure C.12

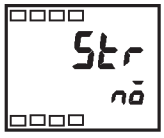


Disconnect the STV to enable the thermocouple of the cold junction compensator. When doing this, make sure to disconnect the wiring on the STV side.

13. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup.

14. Press the ↵ key. The No. 2 display changes to the state below. Note that the data to be temporarily registered is not displayed when it is not entirely prepared.

Figure C.13



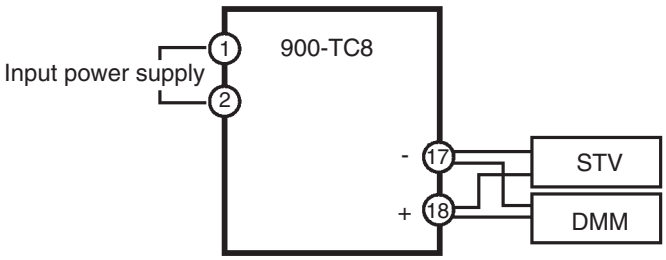
15. Press the ⌃⌃ key. The No. 2 display changes to YES. Release the key and wait 2 seconds or press the ↵ key. This stores the temporarily registered calibration data to EEPROM. To cancel storage of temporarily registered calibration data to memory, press the ↵ key without pressing the ⌃⌃ key.

16. The calibration mode is quit by turning the power OFF.

Calibrating Analog Input

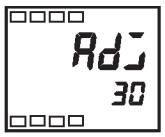
This example describes how to calibrate when 0…50 mV input (input type 16) is currently selected on a Bulletin 900-TC8 supporting thermocouple input.

Figure C.14



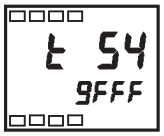
1. Connect the power supply.
2. Connect an STV and DMM to the analog input terminals, as shown in the figure above.
3. Turn the power ON.
4. Move to the Calibration function group. This starts the 30-minute aging timer. This timer provides an approximate timer for aging. After 30 minutes, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

Figure C.15



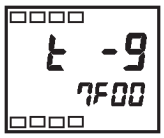
5. Press the ↵ key to set the Bulletin 900-TC8 to the state below. The No. 2 display at this time displays the currently entered count value entered in Hexadecimal. Set the STV to 54 mV.

Figure C.16



6. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄ key to temporarily register the calibration setup.
7. Press the ↵ key to set the Bulletin 900-TC8 to the state below. Set STV to –9mV.

Figure C.17



8. Allow the count value on the No. 2 display to fully stabilize, then press the ⩛ key to temporarily register the calibration setup.

9. Press the ⏎ key. The No. 2 display changes to the state below. Note that the data to be temporarily registered is not displayed when it is not entirely prepared. Press the ⩙ key. The No. 2 display changes to YES. Release the key and wait 2 seconds or press the ⏎ key. This stores the temporarily registered calibration data to EEPROM. To cancel storage of temporarily registered calibration data to memory, press the ⏎ key without pressing the ⩙ key.

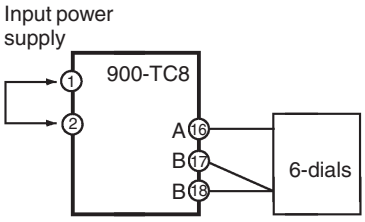
Figure C.18

10. The calibration mode is quit by turning the power OFF.

Calibrating Platinum Resistance Thermometers

This example describes how to calibrate the Bulletin 900-TC8 when it is connected to a platinum resistance thermometer.

Figure C.19



When calibrating a platinum resistance thermometer use wires of the same thickness as those used to connect the Bulletin 900-TC8.

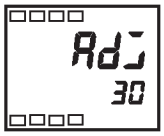
1. Connect the power supply.

2. Connect a precision resistance box (called 6-dial in this manual) to the platinum resistance thermometer input terminals.

3. Turn the power ON.

4. Move to the Calibration function group. This starts the 30-minute aging timer. This timer provides an approximate timer for aging. After 30 minutes, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

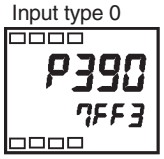
Figure C.20



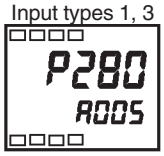
5. Press the ↵ key to display the count value for each input type. The No. 2 display at this time displays the currently entered count value entered in Hexadecimal. Set the 6-dial as follows:
   - Input type 0: 390 Ω
   - Input type 1 or 3: 280 Ω
   - Input type 2 or 4: 140 Ω

Figure C.21

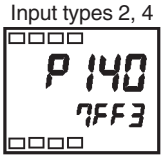
Input type 0



Input types 1, 3



Input types 2, 4



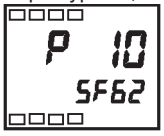
6. Allow the count value on the No. 2 display to fully stabilize, then press the ↡ key to temporarily register the calibration setup.

7. Press the ↵ key to set the Bulletin 900-TC8 to the state below. Set the 6-dial as follows:
   - Input type 0: 10 Ω
   - Input type 1 or 3: 10 Ω
   - Input type 2 or 4: 100 Ω

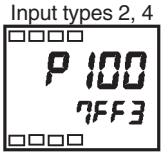
Figure C.22

Input type 0

Input types 1, 3



Input types 2, 4



8. Allow the count value on the No. 2 display to fully stabilize, then press the ↡ key to temporarily register the calibration setup.

9. Press the ↵ key. The No. 2 display changes to the state below. Note that the data to be temporarily registered is not displayed when it is not entirely prepared.

Figure C.23

10. Press the ⩓ key. The No. 2 display changes to YES. Release the key and wait 2 seconds or press the ↵ key. This stores the temporarily registered calibration data to EEPROM. To cancel storage of temporarily registered calibration data to memory, press the ↵ key without pressing the ⩓ key.

11. The calibration mode is quit by turning the power OFF.

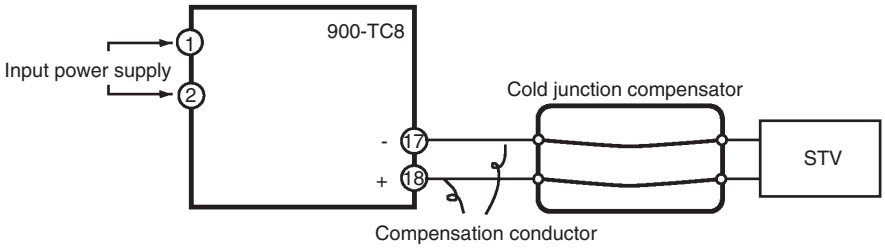
Checking Indication Accuracy

- After calibrating input, make sure to check indication accuracy to make sure that the Bulletin 900-TC8 has been correctly calibrated.
- Operate the Bulletin 900-TC8 in the PV/SP monitor mode.
- Check the indication accuracy at the upper and lower limits and mid-point.

Thermocouple or Non-Contact Temperature Sensor

- **Preparation:** The following figure shows the required device connection. Make sure that the Bulletin 900-TC8 and cold junction compensator are connected by a compensating conductor for the thermocouple that is to be used during actual operation. For the non-contact temperature sensor, connect a K thermocouple, and set the input type to the K thermocouple.

Figure C.24

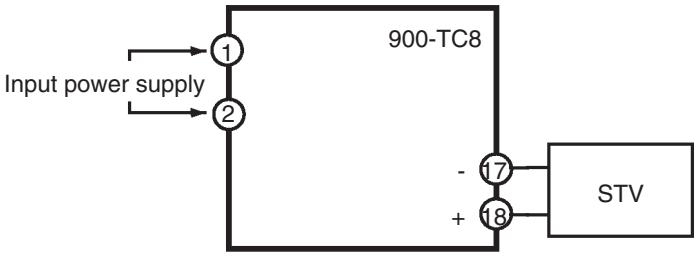


- **Operation:** Make sure that the cold junction compensator is at 0°C, and set STV out put to the voltage equivalent to the starting power of the check value. The cold junction compensator and compensation conductor are not required when an external cold junction compensation method is used.

Platinum Resistance Thermometer

- **Preparation:** The following figure shows the required device connection:

Figure C.25

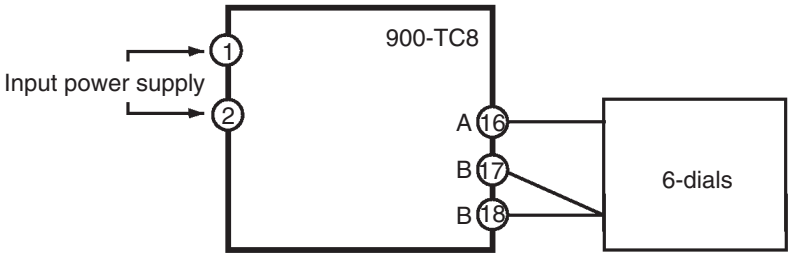


- **Operation:** Set the 6-dial to the resistance equivalent to the check value.

Analog Input

- **Preparation:** The following figure shows the required device connection:

Figure C.26



- **Operation:** Set the STV output to the voltage of the check value.

Glossary

Adaptive Tuning: Use to continuously monitor and optimize PID constants while the controller operates. Three tuning algorithms are used to recalculate the PID constants within 500 ms after the process value stabilizes at set point: step-response method, disturbance tuning, and hunting tuning.

Anti-Reset Wind-Up (ARW): A feature of PID controllers that prevents the integral (auto-reset) circuit from operating when the temperature is outside the proportional band.

Alpha (α): This represents the temperature coefficient of the change in electrical resistance of a material. For each °C in temperature the electrical resistance changes. It is the defining parameter for platinum resistance temperature detectors (RTD sensors). The unit of measure is ohms/ohms/°C.

Analog: Data collected and represented by continuously variable quantities, such as voltage measurement or temperature variation.

Auto-Tuning: This feature automatically calculates then resets the PID values based on temperature control performance over a sampled period. In some of the controllers, auto-tuning also optimizes the settings for fuzzy logic control values.

CE: A marking on products that comply with European Union requirements pertaining to safety and electromagnetic compatibility.

Celsius: A temperature scale in which water freezes at 0°C and boils at 100°C at standard atmospheric pressure. The formula to convert Fahrenheit temperatures to Celsius is as follows: °F = (1.8 x °C) +32.

Cold Junction Compensation: Electronic means of compensating for the ambient temperature at the cold junction of a thermocouple so it maintains a reference to 0°C.

Contact Output: Relay control outputs are often available in these contact forms:

- **Form A Contact (SPST-NO):** Single-pole, single-throw relays use the normally open and common contacts to switch power. The contacts close when the relay coil is energized and open when power is removed from the coil.
- **Form B Contact (SPST-NC):** Single-pole, single-throw relays use the normally closed and common contacts. These contacts open when the relay coil is energized and close when power is removed from the coil.
- **Form C Contact (SPDT):** Single-pole, double-throw relays use the normally open, normally closed, and common contacts. The relay can be wired as a Form A or Form B contact.

Control Action: The control output response relative to the difference between the process variable and the set point. For reverse action (usually heating), as the process decreases below the set point, the output increases. For direct action (usually cooling), as the process increases above the set point, the output increases.

Control Mode: The type of control action used by the controller can include ON/OFF, time-proportioning, PD, and PID. Other combinations and refinements are used.

CSA: Canadian Standards Association is an independent testing laboratory that establishes commercial and industrial standards, as well as tests products and certifies them.

C-UL: This symbol appearing in literature and marked on products indicates Canadian recognition of Underwriters Laboratories, Inc. approval of particular product classes. The C-UL approval may stand in place of Canadian Standards Association certification. All references to C-UL are based on prior listing or recognition from the original UL file.

Dead Band: The time period in a control system between a change in stimuli and any measurable response in the controlled variable. In the deadband, specific conditions can be placed on control output actions. Operators select the dead band width. It is usually above the heating proportional band and below the cooling proportional band.

Derivative: The rate of change in a process variable which forms the "D" in a PID control algorithm. This control action anticipates the rate of change of the process and compensates to minimize overshoot and undershoot. Derivative control is an instantaneous change of the control output in the same direction as the proportional error. This is caused by a change in the process variable (PV) that decreases over the derivative time.

Deviation: A departure of a controlled variable from a command such as set point.

Deviation Indication: A system of indication in which a departure of a detected value from the set point is indicated.

DIN (Deutsche Industrial Norm): A German standards agency that sets world-recognized engineering and industrial standards.

DIN 43760: The standard that defines the characteristics of a 100 **Ω** platinum RTD having a resistance vs. temperature curve specified by a = 0.00385 **Ω** per degree.

Drift: A gradual change over a long period of time that affects the reading or value. Changes in ambient temperature, component aging, contamination, humidity, and line voltage all contribute to drift.

Droop: Controllers using only proportional control can settle at a value below the actual set point once the system stabilizes. This offset is corrected with the addition of Integral control in the control algorithm.

Electromagnetic Compatibility: To conform with CE's EMC requirements, equipment or a system must operate without introducing significant electromagnetic disturbances to the environment or be affected by electromagnetic disturbances.

Electromagnetic Interference: There are many possible sources for electromagnetic interference (EMI) in an industrial control setting. It can originate as electrical or magnetic noise caused by switching AC power on inside the sine wave. EMI interferes with the operation of controls and other devices.

Electromechanical Relay: A power switching device that completes or interrupts a circuit by physically moving electrical contacts into contact with each other. These are used primarily for ON/OFF control operation.

Event: A programmable ON/OFF output signal. Events can control peripheral equipment or processes, or act as an input for another control loop. Event input boards are an option for most Rockwell controllers.

Fahrenheit: A temperature scale that has 32° at the ice point and 212° at the boiling point of water at sea level. To convert Fahrenheit to Celsius, subtract 32 from °F and multiply the remainder by 0.556.

Full Indication: A system of indication in which a detected value is indicated with a setting range.

Fuzzy Logic: A rule-based control algorithm that enables control devices to make subjective judgments in a way similar to human decision-making. Within a process controller, fuzzy logic uses some basic information about the system, which is input by the user, to emulate the way an expert operator who was manually controlling the system would react to a process upset.

Heat Sink: An object that conducts and dissipates heat away from an object in contact with it. Solid-state relays usually use a finned aluminum heat sink to dissipate heat.

Hot Junction and Cold Junction: If a thermocouple is generating a voltage, this means that there is a temperature difference between the two ends of the thermocouple. The hot end is the one that makes contact with the temperature process being controlled. The cold end is at the sensor input terminals.

Hunting: Oscillation of the process temperature between the set point and the process variable. Derivative control is used in the control algorithm to reduce hunting.

Hysteresis (Dead Band): A temperature band between the ON and OFF of an output in the ON/OFF control action. No heating or cooling takes place. The band occurs between the ON and OFF points.

Infrared: The portion of the electromagnetic spectrum with wavelengths ranging from one to 1000 microns. These wavelengths are ideal for radiant heating and non-contact temperature sensing.

Input Digital Filter: A device used to sample the input slower than the scan rate to allow the controller to monitor an input that changes very rapidly and still have sufficient information from the process to control it.

Input Scaling: The ability to scale input readings (% of full scale) to the engineering units of the process variable.

Input Type: The type of device used to provide a signal of temperature change. These include thermocouples, RTDs, linear or process current, or voltage inputs.

Integral Action (I): Control action that eliminates offset, or droop, between set point and actual process temperature. This is the "I" in the PID control algorithm.

Joint Industrial Standards (JIS): A Japanese agency that establishes and maintains standards for equipment and components. Its function is similar to Germany's Deutsche Industrial Norm.

Linearity: A measure of the deviation of an instrument's response from a straight line.

Loop Break Alarm: This alarm indicates a problem in the control loop, e.g., a sensor has become disconnected or a problem has developed with the final control element.

Manipulated Variable: The final output percentage (0…100%) that will be sent to a control element. This percentage can be related to a valve position, a 4…20 mA signal, or the amount of ON time from a pulsed control output.

Manipulated Variable Limiting: A control option used when the process cannot handle the full output of the heater or final control device. To limit the manipulated variable, the user programs the controller so that it never sends a 100% output to the final control element.

Manual Mode: A selectable mode that has no automatic control aspects. The user sets the output levels.

Multiple Set Points: Two or more set points independent from each other which can be set in the temperature controller.

National Electrical Manufacturers Association (NEMA): The United States organization that establishes specifications and ratings for electrical components and apparatus. Conformance by manufacturers is voluntary. However, Underwriters Laboratories will test products to NEMA ratings for operating performance and enclosure ratings.

National Institute of Standards and Technology (NIST): Formerly the National Bureau of Standards, this United States agency is responsible for establishing scientific and technical standards.

NEMA 4X: This enclosure rating specification certifies that a controller's front panel resists water washdown and is corrosion-resistant in indoor usage.

Normal Action: A control action which will increase the control output if the process value is higher than the set point. This action is suitable for a cooling system.

Offset: A controlled deviation (the difference in temperature between the set point and the actual process temperature) remaining after a controlled system reaches its steady state. The offset (droop) is created by the correlation between the thermal capacity of the controlled system and the capacity of heating equipment.

ON/OFF Control Action: A control action which turns the output fully on until the set point is reached, and then turns off. Also called "two-position" control action.

Overshoot: The number of degrees by which a process exceeds the set point temperature.

Process Variable: The parameter that is controlled or measured, such as temperature, relative humidity, flow, and pressure.

Proportional Band: The range of temperature in which a manipulated variable is proportionate to any deviation from the set point.

Proportional Control Action (P): A control action in which the manipulated variable is proportionate to any deviation from the set point.

Proportional Period: A cycle of ON and OFF operations of the output relay in a time-division proportional control action.

Proportional Control Plus Derivative Function (PD): A time-proportioning controller that has a derivative function. The derivative function monitors the rate at which a system's temperature is either increasing or decreasing and adjusts the cycle time of the controller to minimize overshoot or undershoot.

Proportioning Control with Integral and Derivative Functions (PID): A time-proportioning controller that has integral and derivative functions. The integral function automatically raises the stabilized system temperature to match the set point temperature to eliminate the difference caused by the time-proportioning function. The derivative function monitors the rate of rise or fall of the system temperature and automatically adjusts the cycle time of the controller to minimize overshoot and undershoot. Also called "three-mode" control.

Range: The difference between the lower and upper limits of a measurement quantity.

Rate Action (D): The controller senses the rate of change of temperature and provides an immediate change of output to minimize the eventual deviation.

Remote Set Point: A remote set point allows a controller to receive its set point from a source other than itself.

Reset (Auto Reset) Action: There is a manual adjustment that can be applied to the offset by changing the set value dial or moving the offset screw on the control panel. The auto-reset function automatically adjusts the set value to eliminate offset.

Resistance Temperature Detector (RTD): A coil of wire, usually platinum, whose resistance increases linearly with a rise in temperature. RTDs generally have a higher accuracy rating than thermocouples.

Reverse Action: A control action in which the output power will be inversely proportional to the deviation. An increase in the process variable will cause a decrease in the output power, making this action suitable for a heating system.

Serial Communications: A method of transmitting information between devices by sending all bits serially over a communication channel. RS-232 is used for point-to-point connections of a single device, usually over a short distance. RS-485 communicates with multiple devices on a single, common cable over longer distances.

Set Point: The value set on the process or temperature controller to control the system.

Soft Start: A method of applying power gradually over a period of seconds to controlled devices such as heaters, pumps and motors. This lengthens the service life of the load by limiting in-rush current to inductive loads.

Solid State Relay (SSR): A switching device with no moving parts that completes or interrupts a circuit electrically.

Thermal Response: The time required for the response curve of the temperature sensor to rise to a specified percentage level (usually either 63% or 90%).

Thermocouple Sensor: A device that converts heat to electricity. Usually made of two wires, each of a different metal or alloy. The wires are joined at one end, known as the hot end. The hot end makes thermal contact with the process to be controlled. The cold end terminals are connected to the sensor input. Voltages are created at both the hot and cold ends. The controller measures the cold end temperature to determine the hot end temperature.

Underwriters Laboratories (UL): This independent testing laboratory establishes commercial and industrial standards, as well as tests and certifies products in the US. They also offer testing to Canadian Standards Association requirements with products bearing the cUL marking.

Undershoot: This is the amount by which the process variable falls below the set point before it stabilizes.

Zero Cross Switching: Used in solid-state relays, this action provides output switching only at or near the zero-voltage crossing point of the AC sine wave. It reduces electromagnetic interference and high inrush currents during initial turn-on.

Notes:

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