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Temperature Controllers

USER MANUAL

Bulletin 900-TC8, 900-TC16, & 900-TC32

Series B

Allen-Bradley · Rockwell Software

Rockwell Automation

Important User Information

Because of the variety of uses for the products described in this publication, those responsible for the application and use of this control equipment must satisfy themselves that all necessary steps have been taken to assure that each application and use meets all performance and safety requirements, including any applicable laws, regulations, codes and standards.

The illustrations, charts, sample programs and layout examples shown in this guide are intended solely for purposes of example. Since there are many variables and requirements associated with any particular installation, Rockwell Automation does not assume responsibility or liability (to include intellectual property liability) for actual use based upon the examples shown in this publication.

Rockwell Automation publication SGI-1.1, *Safety Guidelines for the Application, Installation and Maintenance of Solid-State Control* (available from your local Allen-Bradley sales office), describes some important differences between solid-state equipment and electromechanical devices that should be taken into consideration when applying products such as those described in this publication.

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Safety Precautions

Safety Signal Words

This manual uses the following signal word to mark safety precautions for the Bulletin 900-TC8, 900-TC16, and 900-TC32 Temperature/Process Controllers.

These precautions provide important information for the safe application of the Temperature/Process 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

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.

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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.

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Appendix D

Glossary Definition of Terms D-1

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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
SV	Set value
AT	Auto-tuning
ST	Self-tuning
HB	Heater Burnout
HS	Heater Short ❶
EU	Engineering unit ❷
OC	Overcurrent
LBA	Loop Burnout Alarm

❶ A heater short indicates that the heater remains ON even when the control output from the Temperature Controller is OFF because the SSR has failed or for any other reason.

❷ "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 Input Type.
For example, when the input temperature setting 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.
For analog inputs, 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, refer to Appendix D, *Glossary*.

Series B Controllers

Series B Upgrades

Series B controllers have the following upgrades.

900-TC8x

Although the upgraded controllers are compatible with the previous controllers, terminal arrangements have been changed. Terminal sizes and panel mounting depth have not been changed.

Other changes are outlined in the following tables. Refer to the relevant pages in the manual for details.

900-TC16x

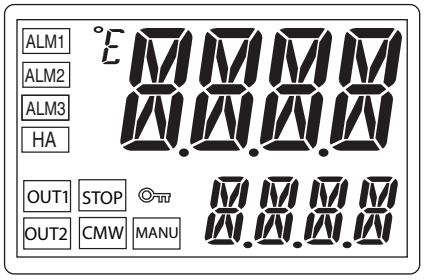
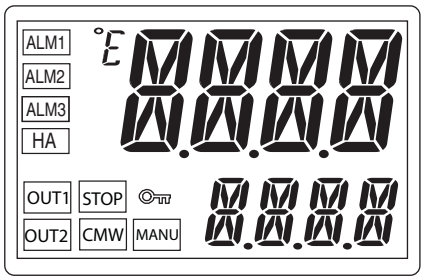
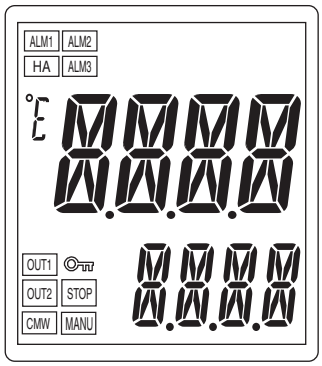
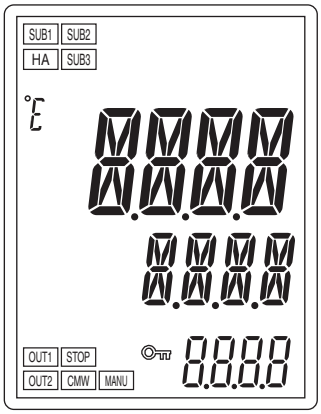
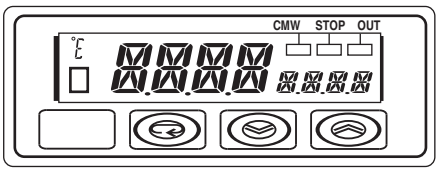
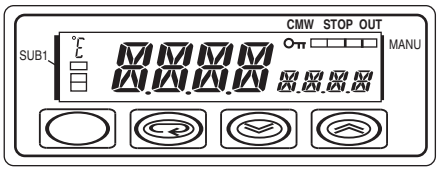
The upgraded controllers are basically compatible with the previous controllers. Terminal arrangements, terminal sizes, and panel mounting depth have not been changed.

900-TC32x

Model numbers have changed accompanying the introduction of universal input capability. The default setting of the input type parameter of the 900-TC32x (models with resistance thermometers) has been changed from a Pt100 resistance thermometer to a K thermocouple. Make sure the setting of the input type parameter agrees with the temperature sensor that is being used.

The terminal block has also been changed, which means the wiring methods and terminal arrangement are different.

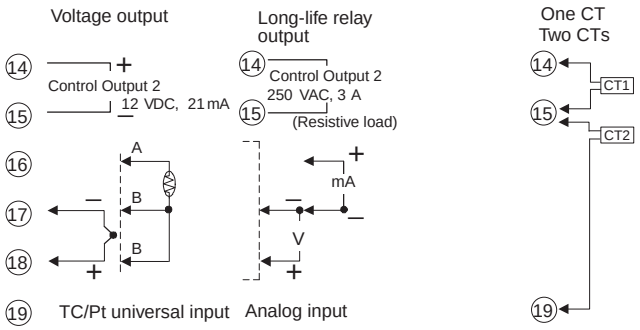
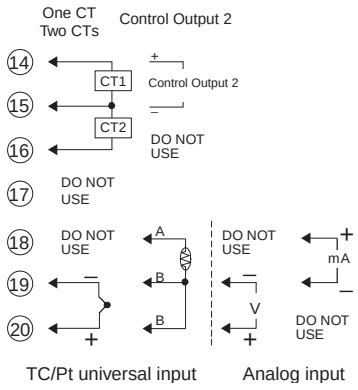
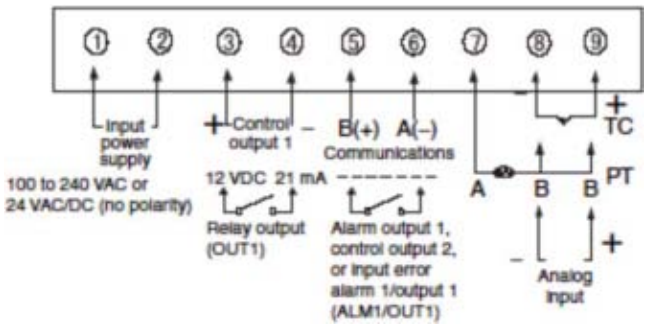
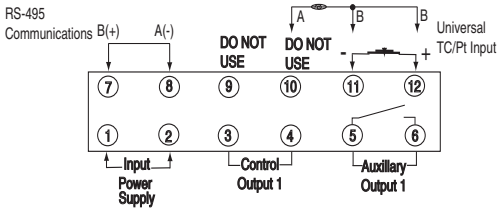
Table P.B

	Series A	Series B
900-TC16		 • ALM indicator was changed to SUB indicator
900-TC8	 • Number of displays: 2 (PV and SV)	 • Number of displays: 3 (PV, SV, and MV) ❶ • ALM indicator was changed to SUB indicator.
900-TC32	 • Display Segments – PV: 7 segments, SV: 7 segments • Character Heights – PV: 7 mm, SV: 3.5 mm	 • Display Segments – PV: 11 segments, SV: 11 segments • Character Heights – PV: 7.5 mm, SV: 3.6 mm • Changes to Display Contents – "AL" LED indicator eliminated, LED indicators and key indicator added

❶ A 2-level display is configured when shipped from the factory. A 3-level display is activated if parameters are initialized.

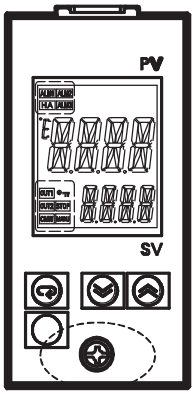
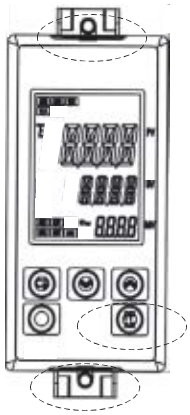
Terminal Arrangements

Table P.C — Terminal Arrangements

	Series A	Series B
900-TC8		 Terminals 16...20 were changed and 1...15 were not.
900-TC16	---	No change for terminal layout
900-TC32	 Number of terminals: 9 (1 to 9) Input terminals: 7 to 9 RS-485 communication terminals: 5 & 6	 • 100 to 240 VAC • 24 VAC/DC (no polarity) Number of terminals: 14 (1 to 14) Input terminals: 10 to 12 RS-485 communication terminals: 7 & 8

Body Removal

Table P.D — Body Removal

	Series A	Series B
900-TC8	• Removal using screws 	• Removal using hooks 
900-TC16	---	• No change for body removal
900-TC32	---	• No change for body removal

900-TC8, 900-TC16, & 900-TC32 Ratings

Table P.E — 900-TC8, 900-TC16, & 900-TC32 Ratings

	Series A	Series B
Input sensor types for thermocouple inputs	---	The following types of thermocouple input were added: W and PLII.
	Input range for E thermocouple: 0...600 °C	Input range increased for E thermocouple: -200...600 °C
Input accuracy	• Thermocouple: ±0.5% PV or ±1°C, whichever is greater) ±1 digit • Platinum resistance thermometer: (±0.5%PV or ±1°C, whichever is greater) ± 1 digit • Analog input: ±0.5% FS ± digit	• Thermocouple: ±0.3% PV or ±1°C, whichever is greater) ±1 digit • Platinum resistance thermometer: (±0.2%PV or ±.08°C, whichever is greater) ± 1 digit • Analog input: ±0.2% FS ± digit

900-TC8, 900-TC16, & 900-TC32 Ratings

Table P.E — 900-TC8, 900-TC16, & 900-TC32 Ratings

	Series A	Series B
Input sensor types for thermocouple inputs	---	The following types of thermocouple input were added: W and PLII.
	Input range for E thermocouple: 0...600 °C	Input range increased for E thermocouple: -200...600 °C
Input accuracy	• Thermocouple: ±0.5% PV or ±1°C, whichever is greater) ±1 digit • Platinum resistance thermometer: (±0.5%PV or ±1°C, whichever is greater) ± 1 digit • Analog input: ±0.5% FS ± digit	• Thermocouple: ±0.3% PV or ±1°C, whichever is greater) ±1 digit • Platinum resistance thermometer: (±0.2%PV or ±.08°C, whichever is greater) ± 1 digit • Analog input: ±0.2% FS ± digit
Influence of signal source resistance	• Thermocouple: 0.1°C/Ω (except B, R, S), 0.2°C/Ω (B, R, S) • Platinum resistance thermometer: 0.4°C/Ω	• Thermocouple: 0.1°C/Ω (for all specifications) • Platinum resistance thermometer: 0.1°C/Ω
Current outputs	• Current output resolution, approx.: 2,700	• Current output resolution, approx.: 10,000
Alarm outputs	• 250 VAC, 1A (900-TC16 & 900-TC32)	• 250VAC, 3A (900-TC16) • 250VAC, 2A (900-TC32)

Characteristics

Table P.F — Characteristics

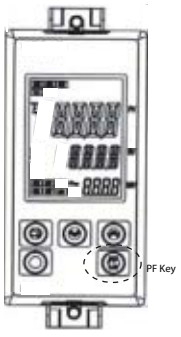
	Series A	Series B
Front Panel (900-TC8)	---	PV Status Display
		PF Key Added 
	---	PV/SP display selection for three-level display
Inputs	---	Square root extraction (for models with analog inputs)

Table P.F — Characteristics

	Series A	**Series B**
Outputs	---	Control output ON/OFF count alarm
	---	MV change rate limiter
Controls	---	40% AT
	---	Automatic cooling coefficient adjustment for heating/cooling control
Alarms	---	PV rate of change alarm
	---	OC alarm (only for models with heater burnout detection)
Other	---	Inverting direct/reverse operation using event inputs or communications commands

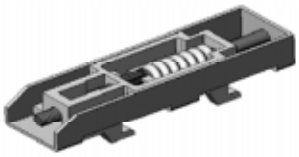
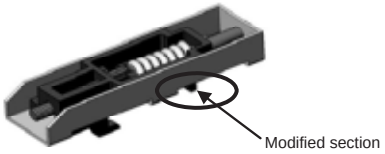
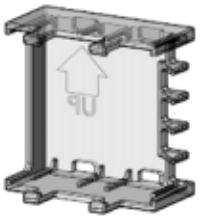
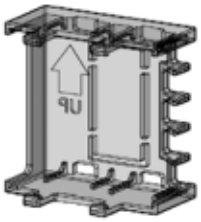
Communications Characteristics

Table P.G

	Series A	**Series B**
Communication Access Size	Double word access only	Word access and double word access
Communication Service	---	Composite Read from Variable Area and Composite Write to Variable Area
Communications buffer size	40 bytes	217 bytes
Baud rate	38.4 kbits/s max. (900-TC08, 900-TC16) 19.2 kbits/s max. (900-TC32)	57.6 kbits/s max.
External communications	RS-485/RS-232C external communications and communications via 900BuilderLite ™ *cannot* be used at the same time.	RS-485/RS-232C external communications and communications via 900BuilderLite ™ *can* be used at the same time.

Other Upgrades

Table P.H

	Series A	Series B
Mounting Bracket (900-TC8 only)		 Note: The mounting bracket for the Series A models cannot be used for Series B models.
Terminal Cover for 900-TC16		 Note: The terminal covers for the Series A models cannot be used for Series B models.
Terminal Cover for 900-TC8		Note: The terminal covers for the Series A models cannot be used for Series B models.

Option Units
(Series B Controller Compatible— One Option Unit per Controller)

This unit provides communications event input etc. functionality.

Table P.I

Bulletin No.	Name	Function	Cat. No. (Series)
900-TC8 (Series B)	Communications Unit	RS-232C communications❶	900-TC8232 (B)❹
		RS-485 communications	900-TC8COM(B)❹
	Event Input Unit	Event Input❷	900-TC8EIM(A)
900-TC16 (Series B)	Communications and 1-Phase Heater Burnout Unit and Heater Short	RS-485 communications with single-phase heater burnout (open) and heater short-circuit failure detection❸	900-TC16NCOM(B)❺❻
	Event Input Unit with 1-Phase Heater Burnout and Heater Short	Event Input with single-phase heater burnout (open) and heater short-circuit failure detection❷❸	900-TC16NEIM(B)❺
	Event Input Unit	Event Input❷	900-TC16NACEIM(B)❺
	Communications Unit	RS-485 communications	900-TCNACCOM(B)❺❻
	Communications and 3-Phase Heater Burnout and Heater Short Unit	RS-485 communications with 3-phase heater burnout (open) and heater short-circuit failure detection	900-TC16NCOMP3(B)❺❻
	Communications and Second Voltage (SSR) Output Unit	RS-485 communications and a second voltage (SSR) output	900-TC16NCOMV2(B)❺❻
	1-Phase Heater Burnout and second voltage (SSR) output	1-Phase Heater burnout (open) and heater short-circuit failure detection with a second control voltage (SSR) output	900-TC16P1V2(B)❺

❶ Enables direct RS-232 connection to personal computer using 900BuilderLite™ software. A Cat. No. 900-CP1X cable or equivalent is also required.
❷ Provides two event inputs. Allows selecting up to 4 different pre-configured set points, controller Run/Stop or Auto/Manual mode, from 2 external inputs.
❸ Heater burnout is not available for 0...20 or 4…20 mA analog output style 900-TC16 controllers such as the 900-TC16AC.
❹ To obtain 57.6 k baud rate, Series B communication units must be used with any Series A or Series B 900-TC8 controller catalog number.
❺ Series B option units must be used with Series B 900-TC16 controllers. Series A option units cannot be used with Series B controllers and vice versa.
❻ Series B provides 57.6 K baud rate.

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.J 11 — Segment Display Selection

												Symbol
A	B	C	D	E	F	G	H	I	J	K	L	M	Alphabet

												Symbol
N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Alphabet

The Character Select parameter in the Advanced Setting function group can be turned OFF to display the following 7-segment characters.

Table P.K 7 — Segment Characters

												Symbol
A	B	C	D	E	F	G	H	I	J	K	L	M	Alphabet

												Symbol
N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Alphabet

Bulletin 900 Input & Output Overview

I/O Configurations & Main Functions

Figure 1.1 — 900-TC8 I/O Configuration

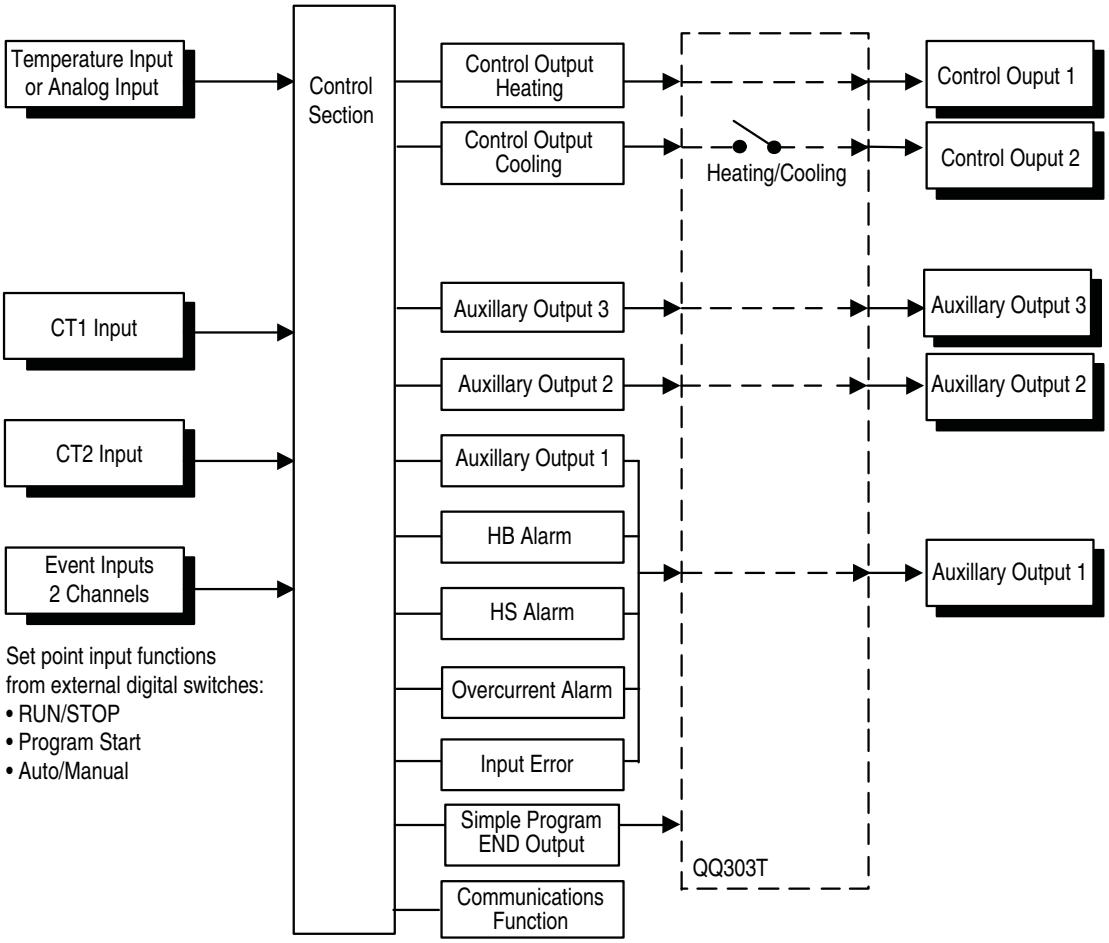


Figure 1.2 — 900-TC16 I/O Configuration

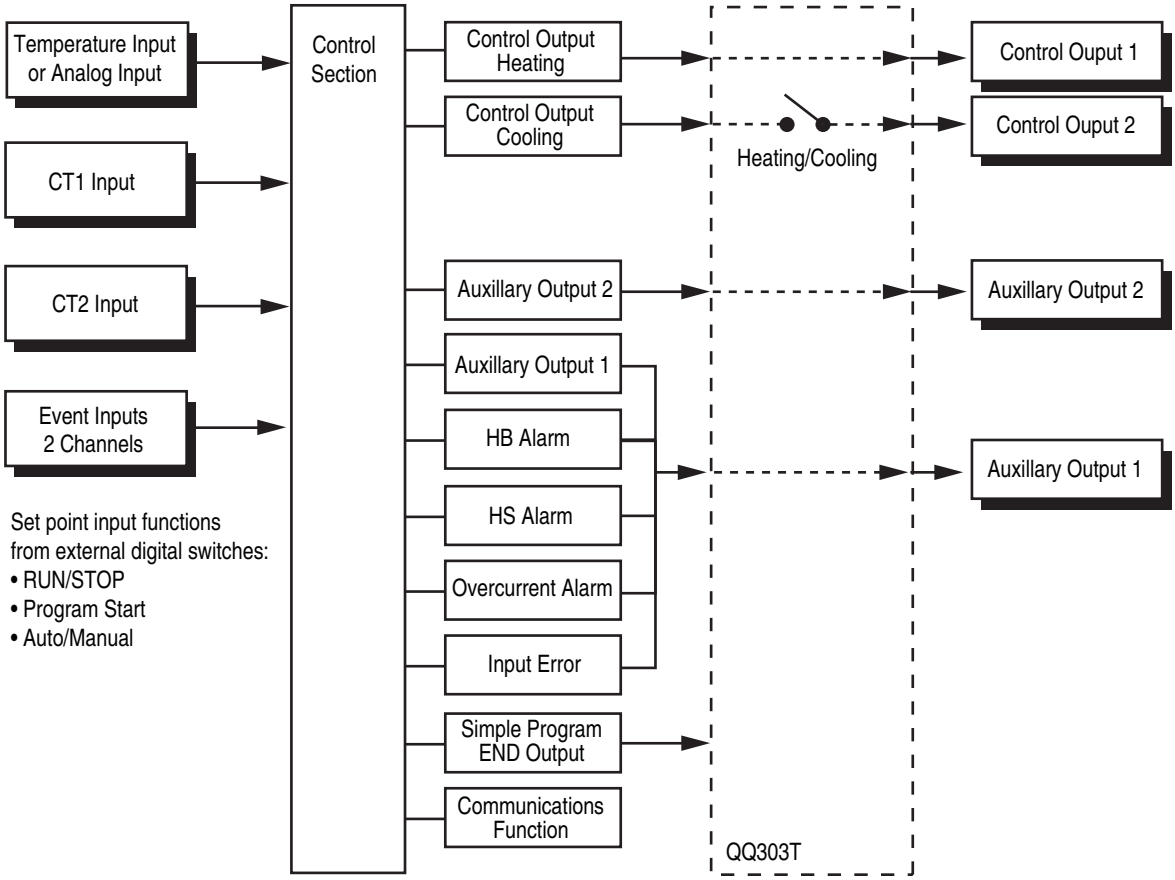
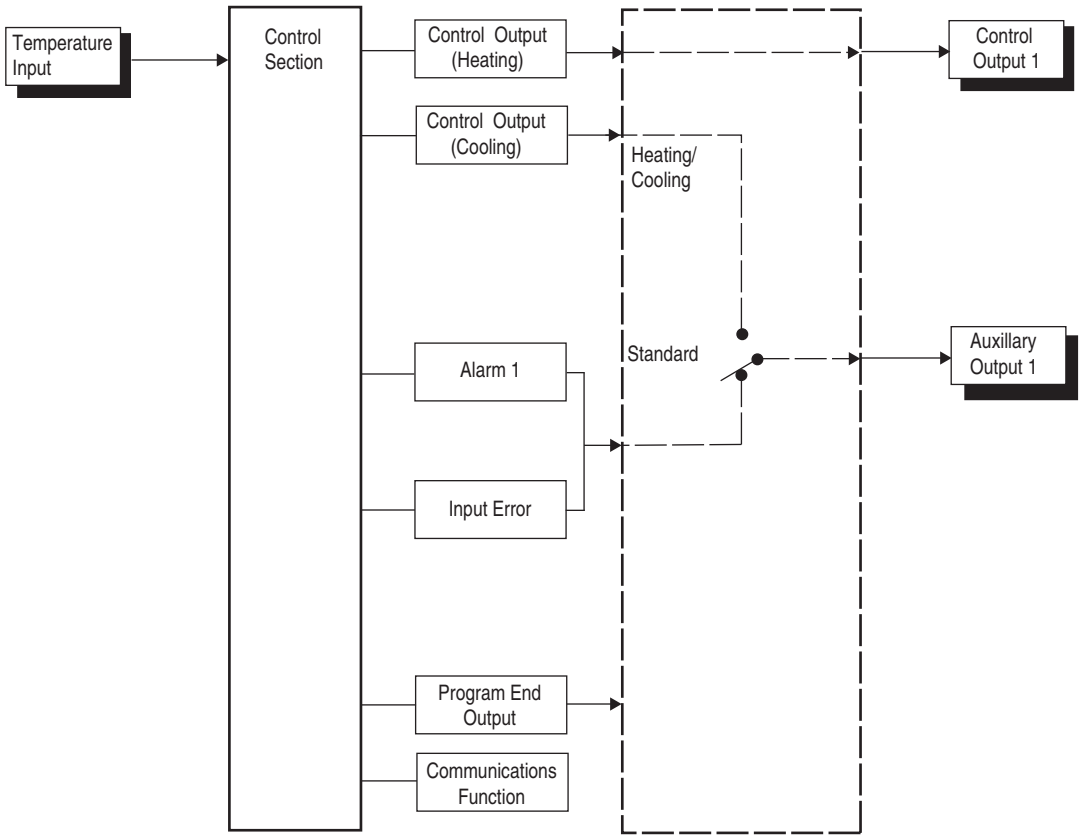


Figure 1.3 — 900-TC32 I/O Configuration



Bulletin 900-TC8, 900-TC16, and 900-TC32 temperature controllers allow the user to:

- Select from thermocouple and platinum RTD temperature sensors, plus non-contact temperature sensor and analog voltage or current inputs. ❶
- Individually assign the function for each output by changing the configured values of the following parameters: Control Output 1, Assignment, Control Output 2 Assignment❶, Aux 1 Assignment, Aux 2 Assignment ❶, and Aux 3 Assignment (900-TC8).
- Select heating and cooling control in addition to standard control
- Select AT (Auto-Tuning) and ST (Self-Tuning) as tuning functions
- Use multi-SP, switch between automatic and manual operation, start/reset the simple program function, and initiate the RUN/STOP function according to event input. ❶
- Use the Heater Burnout Alarm (HBA) and Heater Short Alarm (HSA) function. ❶
- Use the communications function (for units equipped with the optional communications function modules)
- Calibrate sensor input
- Configure the color of the PV display to switch between amber, red, and green, making the process status easy to understand at a glance.

❶ The Bulletin 900-TC32 Temperature Controller does not support this function

Features

- Watertight construction (equivalent to IP66 indoor use).
- Conform to cULus/IEC safety standards and EMC standards.

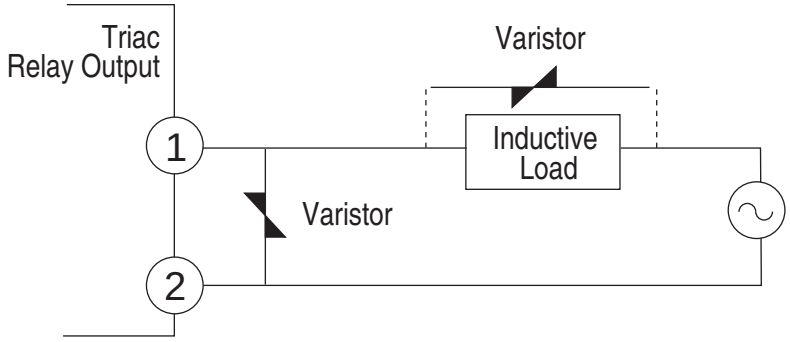
Main Functions

The following introduces the main functions of the Bulletin 900-TC8, 900-TC16, and 900-TC32 temperature controllers. For details on each function and how to use them, refer to 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, W, PL11
  - Infrared non-contact temperature sensor type: Type K thermocouple (10…70XC), K (60…120XC), K (115…165XC), K (160…260XC)
  - Platinum resistance thermometer: Pt100, JPt100
  - Analog millivolt input: 0…50 mV
- **High level analog inputs:** ❶
  - Current input:4…20 mA DC, 0 to 20 mA DC
  - Voltage input:1…5V DC, 0…5V DC, 0…10V DC
- **Control Output —** Control output is either an On/Off electro-mechanical relay (EMR) ON/OFF triac output (AC only)❶, On/Off voltage (input to solid-state relay) output, or analog current (DC: 4...20 mA or 0…20 mA) output ❶, Refer to Table 1.B or 1.D.
- **Triac Relay Outputs ❶ —** use semiconductors for switching when closing andopening the AC voltage circuit, thereby eliminating relay chatter and arcing and improving durability versus an EMR. However, if high levels of noise or surge are imposed between the output terminals, short-circuit faults may occasionally occur. If the triac output becomes permanently shorted, there is the danger of fire due to overheating of the heater element. To avoid this danger, design safety into the system, including measures to prevent excessive temperature rise and fire. Take countermeasures such as installing a surge absorber. As an additional safety measure, provide error detection in the control loop. Use the Loop Break Alarm (LBA) and Heater Short Alarm (HSA) that are provided for Bulletin 900 temperature controllers.

❶ The Bulletin 900-TC32 Temperature Controller does not support this function

Figure 1.4 — Triac Diagram



Select a surge absorber that satisfies the following conditions.

Table 1.A — Surge Absorber Selection

Voltage Used	Varistor Voltage	Surge Resistance
100…120V AC	240…270V	1000 A minimum
200…240V AC	440…470V	

- Always connect an AC load to the triac relay output. The output will not turn OFF if a DC load is connected.
- **Alarms —** Alarms are supported on the Bulletin 900 temperature controllers. 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 configuring the Standby Sequence, Alarm Hysteresis, Close in Alarm/Open in Alarm and Alarm Latch ON/OFF parameters.

  When the input error output is configured to ON, Alarm Output 1 turns ON when an input error occurs.

- **Control Adjustment —** Optimum PID constants can be configured easily by using the AT (Auto-Tuning) and ST (Self-Tuning) parameters.
- **Event Input —** When the optional event input unit is mounted, the following functions can be achieved by event input:

  Multiple set point selection (multi-SP max. 4 points), RUN/STOP mode change switching between automatic and manual operation, and starting/stopping the simple program. Refer to Table 1.C and 1.E.

- **HBA and HS Alarms —** The Heater Burnout Alarm (HBA) and Heater Short Alarm (HSA) and heater overcurrent function is supported by selecting the appropriate controller (900-TC8) or option module (900-TC16). Refer to Table 1.B for the TC8 and Table 1.E for the TC16.
- **Communications Function —** Personal computer (PC) communicationsare supported when the option communications unit is mounted on the temperature controller. Refer to Table 1.C and 1.E.

Note: The PC must have 900BuilderLite software installed.

Note: 900-TC protocol is an integrated general-purpose serial communications protocol.

Note: Modbus is a communications control method conforming to the RTU. Mode of Modicon Inc.'s Modbus Protocol.

Note: The 900-TC16 and 900-TC32 do not support the RS-232C interface.

Controller Hardware Versions

The following tables provide a list of controller base features with associated Cat. Nos.

900-TC8

Table 1.B — Controller Versions

DIN Size (mm)	No. of Alarms	Sensor Input Type	Power Supply Voltage	Control Output 1 Type	Control Output 2 Type	Supports Heater Burnout Alarm	Cat. No. for Enhanced 900-TC8 Line
1/8th DIN (48 x 96 x 78)	3	Thermocouple or RTD	100…240V AC	Relay On/Off	NA	Yes (1-Phase)	900-TC8RGTH1Z25
					NA	No	900-TC8RGTZ25
					Volt On/Off (SSR)	No	900-TC8RVGTZ25
					NA	Yes (3-Phase)	900-TC8RGTH3Z25
				Volts On/Off (SSR)	NA	Yes (1-Phase)	900-TC8VGTH1Z25
					NA	No	900-TC8VGTZ25
					Triac On/Off (3 A)	No	900-TC8VYGTZ25
					Volt On/Off (SSR)	No	900-TC8VVGTZ25
					NA	Yes (3-Phase)	900-TC8VGTH3Z25
				Analog	NA	No	900-TC8ACGTZ25
					Triac On/Off (3 A)	No	900-TC8ACYGTZ25
					Volt On/Off (SSR)	No	900-TC8ACVGTZ25
			24V AC/DC	Relay On/Off	NA	Yes (1-Phase)	900-TC8RGTH1U25
					NA	No	900-TC8RGTU25
				Volts On/Off (SSR)	NA	Yes (1-Phase)	900-TC8VGTH1U25
					NA	No	900-TC8VGTU25
				Analog	NA	No	900-TC8ACGTU25
		Analog Current and Voltage	100… 240V AC	Relay On/Off	NA	Yes (1-Phase)	900-TC8RABH1Z25
					NA	No	900-TC8RABZ25
				Volts On/Off (SSR)	NA	Yes (1-Phase)	900-TC8VABH1Z25
					NA	No	900-TC8VABZ25
					Triac On/Off (3 A)	No	900-TC8VYABZ25
				Analog	NA	No	900-TC8ACABZ25

Note: To implement the HBA and HSA 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 HBA or HSA is used, one of the alarm outputs will be disabled for each function used.

Table 1.C — Controller Option Units

	Event Out	Comms	Cat. No. for Enhanced Option Units	Series
Option Unit	—	RS232	900-TC8232B	B
	—	RS485	900-TC8COMB	B
	Yes	—	900-TC8EIMA	A

900-TC16

Table 1.D — Controller Versions

DIN Size (in mm)	Number of Alarms	Sensor Input Type	Power Supply Voltage	Control Output Type	Cat. No for Enhanced 900-TC16 Line
1/16th DIN	2	Thermocouple or RTD	100…240V AC	Relay On/Off	900-TC16RGTZ25
				Triac On/Off (3 A)	900-TC16YGTZ25
				Volts On/Off (SSR)	900-TC16VGTZ25
				Analog Current	900-TC16ACGTZ25
			24V AC/DC	Relay On/Off	900-TC16RGTU25
				Volts On/Off (SSR)	900-TC16VGTU25
				Analog Current	900-TC16ACGTU25
		Analog Current and Voltage	100…240V AC	Relay On/Off	900-TC16RABZ25
				Triac On/Off (3 A)	900-TC16YABZ25
				Volts On/Off (SSR)	900-TC16VABZ25
				Analog Current	900-TC16ACABZ25
			24V AC/DC	Relay On/Off	900-TC16RABU25
				Volts On/Off (SSR)	900-TC16VABU25
				Analog Current	900-TC16ACABU25

Table 1.E — Controller Option Units

Heater Burnout	Event Out	Comms	Voltage (SSR) Control Output 2	Cat. No. for Enhanced Option Units	Series
1-Phase HB	—	RS485	—	900-TC16NCOM	B
—	—	RS485	—	900-TC16NACCOM	
1-Phase HB	Yes	—	—	900-TC16NEIM	
—	Yes	—	—	900-TC16NACEIM	
3-Phase HB	—	RS485	—	900-TC16NCOMP3	
—	—	RS485	Yes	900-TC16NCOMV2	
1-Phase HB	—	—	Yes	900-TC16P1V2	

❶ Series B option units must be used with Series B controllers. DO NOT use series B option units with Series A controllers.

900-TC32

Table 1.F — Controller Versions

DIN Size (in mm)	Number of Alarms	Sensor Input Type	Power Supply Voltage	Control Output Type	Comm Function (RS-445)	Cat. No for Enhanced 900-TC32 Line
1/16th DIN	1	Thermocouple or RTD	100…240V AC	Relay On/Off	Yes	900-TC32CRGTZ25
				Volts On/Off (SSR)	Yes	900-TC32CVGTZ25
				Relay On/Off	No	900-TC32RGTZ25
				Volts On/Off (SSR)	No	900-TC32CVGTZ25
			24V AC/DC	Relay On/Off	Yes	900-TC32CRGTZ25
				Volts On/Off (SSR)	Yes	900-TC32CVGTZ25
				Relay On/Off	No	900-TC32RGTZ25
				Volts On/Off (SSR)	No	900-TC32CVGTZ25

Front Panels & General Functions

Figure 1.5 — Bulletin 900-TC8

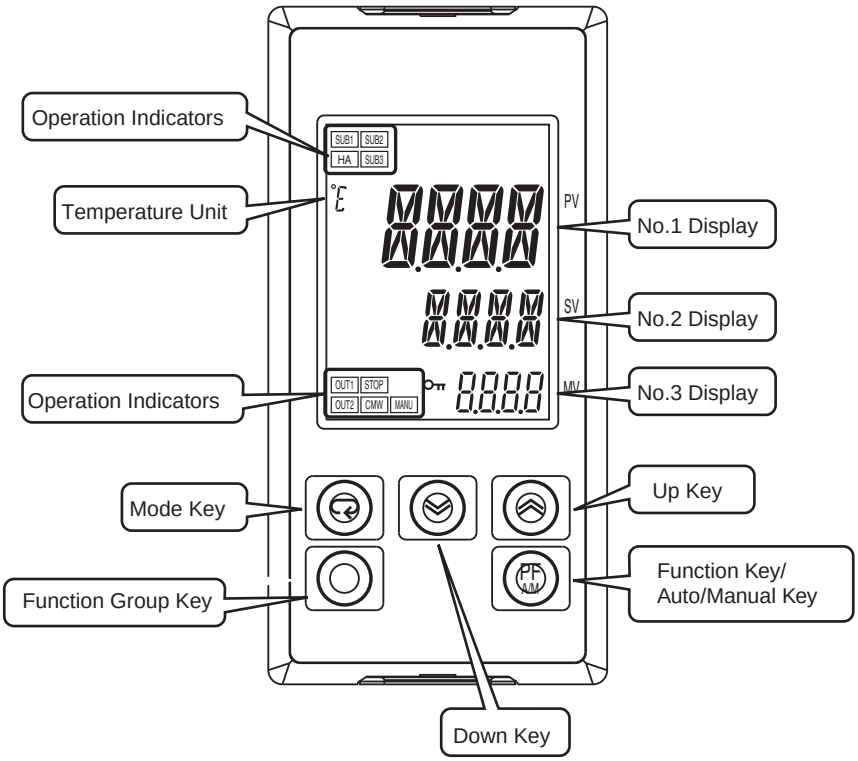


Figure 1.6 — Bulletin 900-TC16

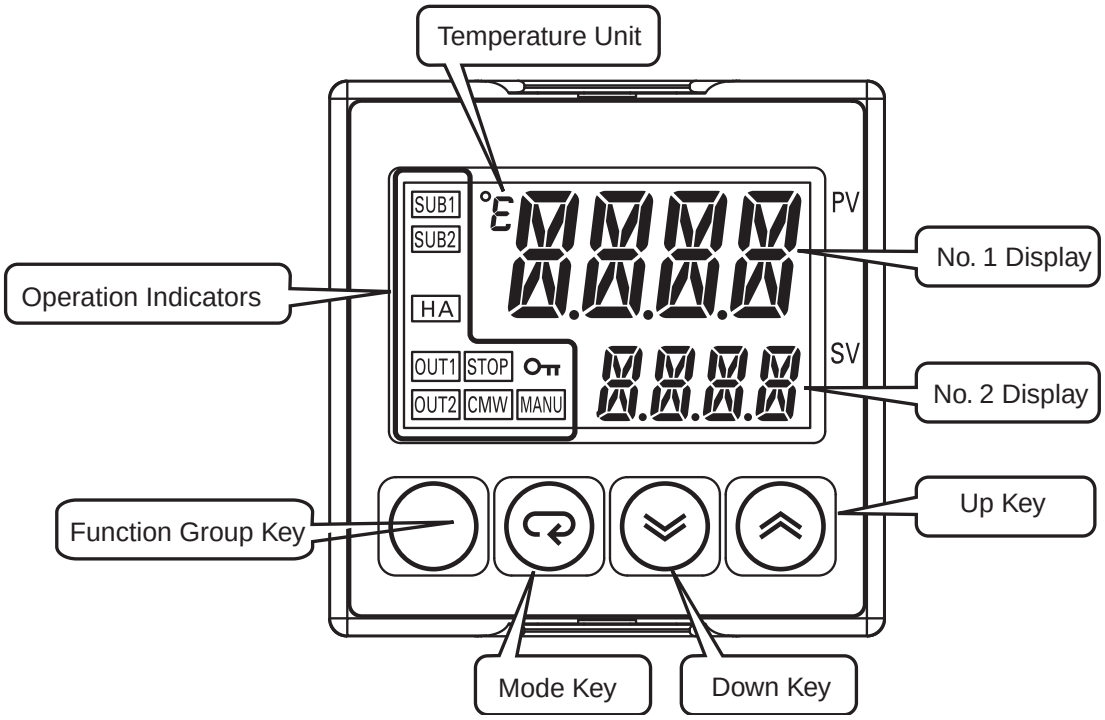
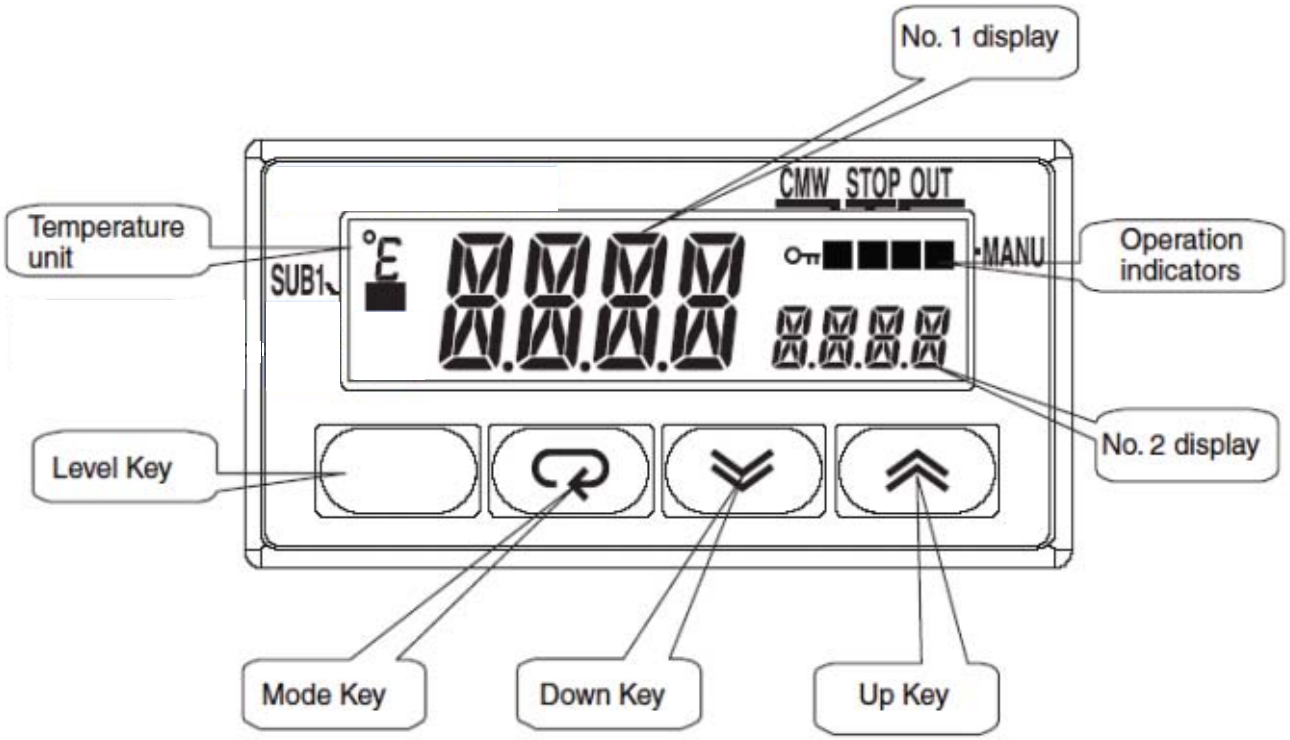
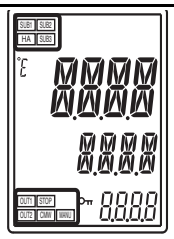


Figure 1.7 — Bulletin 900-TC32



Display Meanings



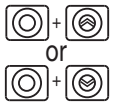
Display	Meaning
No. 1	Displays the Process Value or Parameter Type during configuration. Lights for approximately 1 second during startup.
No. 2	Displays the Set Point, parameter operation read value, manipulated variable, or during configuration, the value of the displayed (No. 1 display) parameter.
No. 3 (900-TC8 only)	Displays MV, soak time remaining, or multi SP. Lights for approximately 1 second during startup. A 2-level display is configured when shipped from the factory. A 3-level display is activated if parameters are initialized.

Operation Indicators 1,2,3...

Operation Indicator	Definition	Function
SUB 1	Sub 1	Lights when the function configured for the Auxiliary Output 1 Assignment parameter is ON.
SUB2	Sub 2	**900-TC8 and 900-TC16 Only:** Lights when the function configured for the Auxiliary Output 2 Assignment parameter is ON.
SUB3	Sub 3	**900-TC8 Only:** Lights when the function is configured for the Auxiliary Output 3 Assignment parameter is ON.
HA	Heater Burnout, Heater Short Alarm, Heater Overcurrent Detection Output Display	**900-TC8 and 900-TC16 Only:** Lights when a heater burnout, heater short alarm, or heater overcurrent occurs.
OUT1	Control Output 1	Lights when the control output function assigned to control output 1 turns ON. For a current output, however, OFF for a 0% output only.
OUT2	Control Output 2	**900-TC8 and 900-TC16 Only:** Lights when the control output function assigned to control output 2 turns ON. For a current output, however, OFF for a 0% output only.
STOP	Operation Stopped	Lights when operation is stopped. During operation, this indicator lights when operation is stopped by an event or by key input using the RUN/STOP function.
CMW	Communications Writing	Lights when communications writing is enabled and is not lit when it is disabled.
MANU	Manual Mode	Lights when the auto/manual mode is configured to manual mode.
	Key	Lights when setting change protect is ON (i.e., when the up and down Keys are disabled by protected status.
C or F	Temperature Unit	The temperature unit is displayed when the display unit parameter is configured to a temperature. Indication is determined by the currently selected Temperature Unit parameter value. When the parameter value 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.

Key	Definition	Function
	Function (Auto/Manual)	**900-TC8 Only:** This is a function key. When it is pressed for at least 1 second, the function configured in the PF Setting parameter will operate. Example: When A-M (auto/manual) is selected in the PF Setting parameter (initial value: A-M), the key operates as an auto/manual switch, switching between Auto Mode and Manual Mode. If the key is pressed for more than 1 second (regardless of key release timing), the mode will switch.
	Function Group Select	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	Press this key to select the various parameters within each function group. The selection of parameters can be reversed by holding this key down.
	Up	Each press of this key increments values displayed on the No. 2 (SV) display. Holding down this key continuously increments values.
	Down	Each press of this key decrements values displayed on the No. 2 (SV) display. Holding down this key continuously decrements values.
	Key Combination — Function Group and Mode Select	This key combination settings the Bulletin 900 to the Protect function group. For details on the Protect function group, refer to Chapter 5 , *Parameter Functions & Definitions*.
	Key Combination — Function Group and Up or Function Group and Down	To restrict changing parameter values and to prevent accidental or incorrect operations, these keys require simultaneously pressing of the ◎ key along with the ◎ or ◎ key. The ◎ key applies only to the parameter configured for the Password to Move to Protect function group . Refer to Chapter 5 for more detailed information on this function group.

Preparations

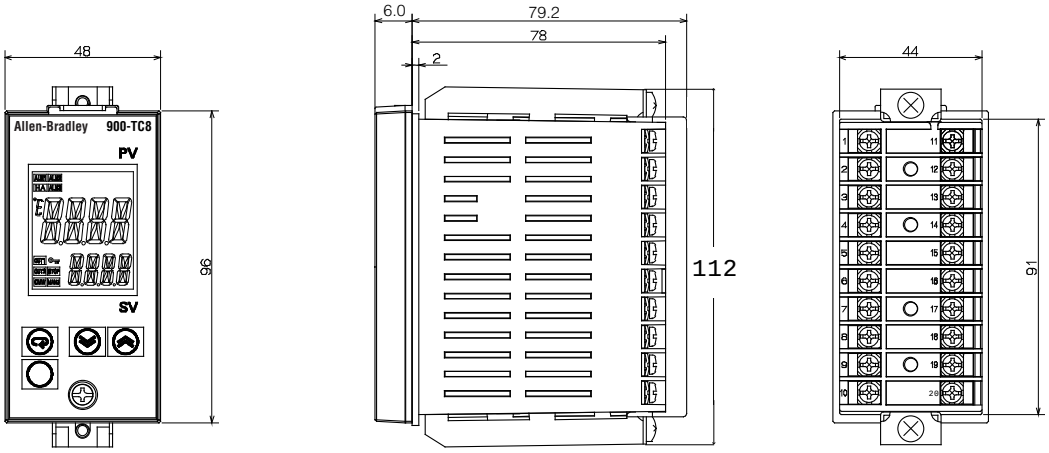
Hardware Installation

Approximate Dimensions

The recommended panel thickness for mounting the 900-TC16 and 900-TC32 is 1 to 5 mm and the 900-TC8 is 1 to 8 mm.

Note: Dimensions are in millimeters. Dimensions are not intended to be used for manufacturing purposes.To convert millimeters to inches, multiply by 0.0394.

Figure 2.1 — 900-TC8



Front View Side View Back View

Figure 2.2 — 900-TC16

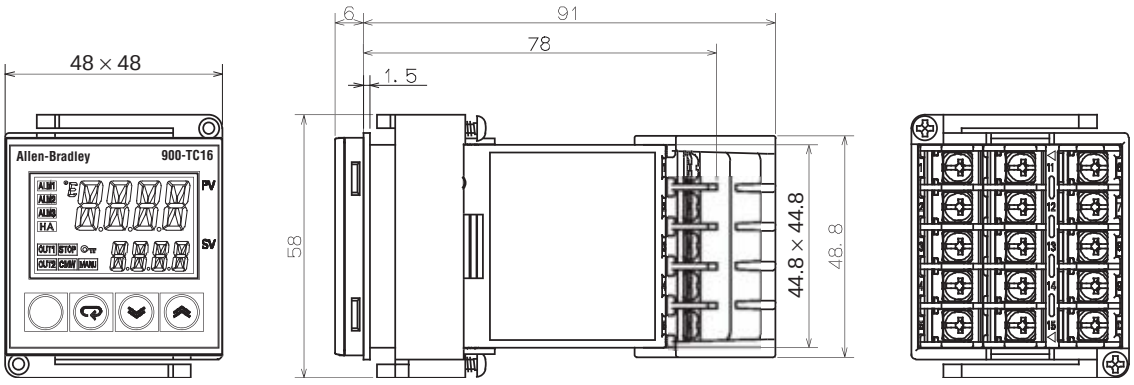
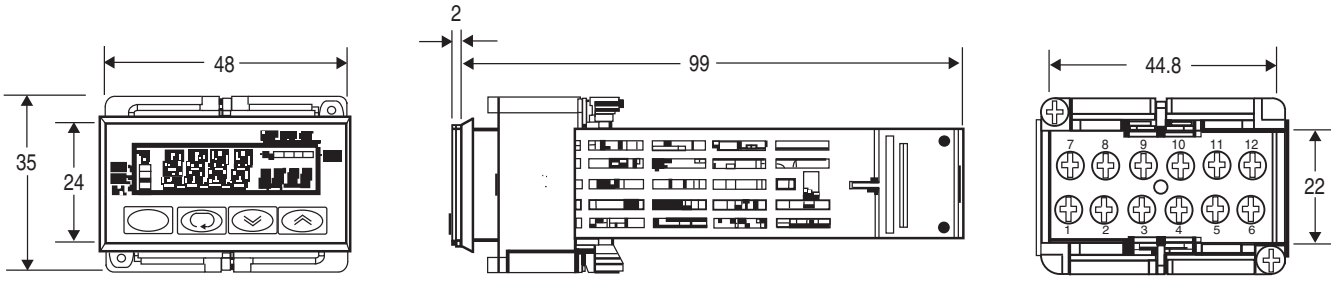


Figure 2.3 — 900-TC32



Panel Cutout Dimensions

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

Figure 2.4 — 900-TC8

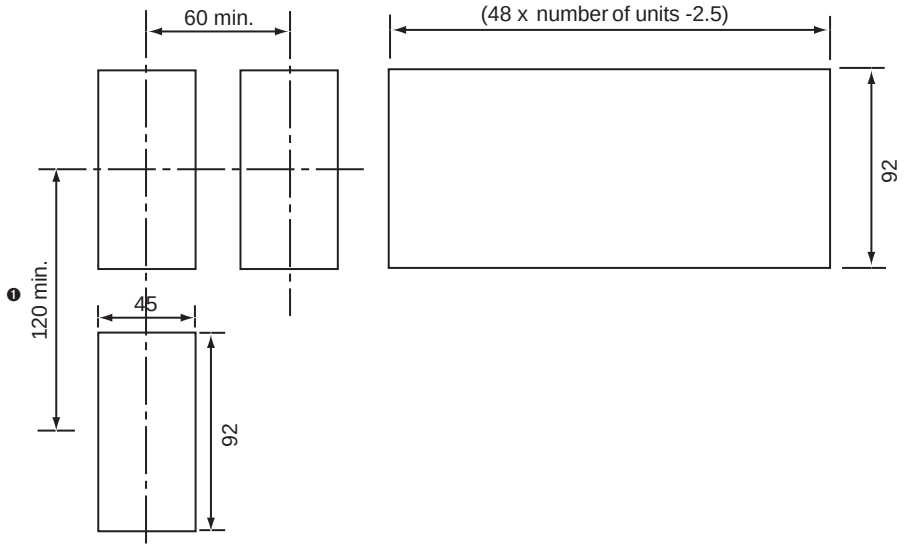


Figure 2.5 — 900-TC16

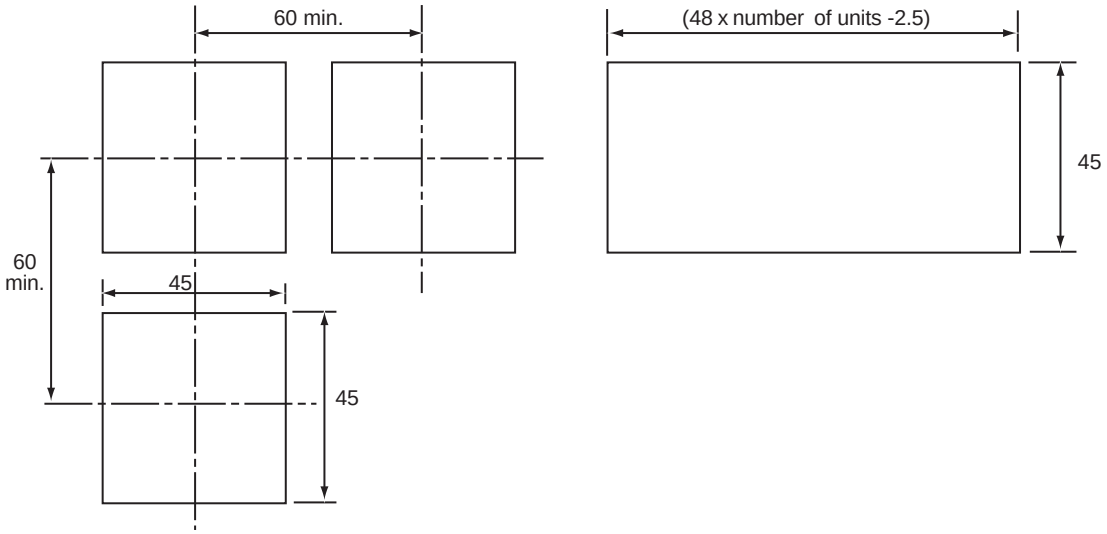
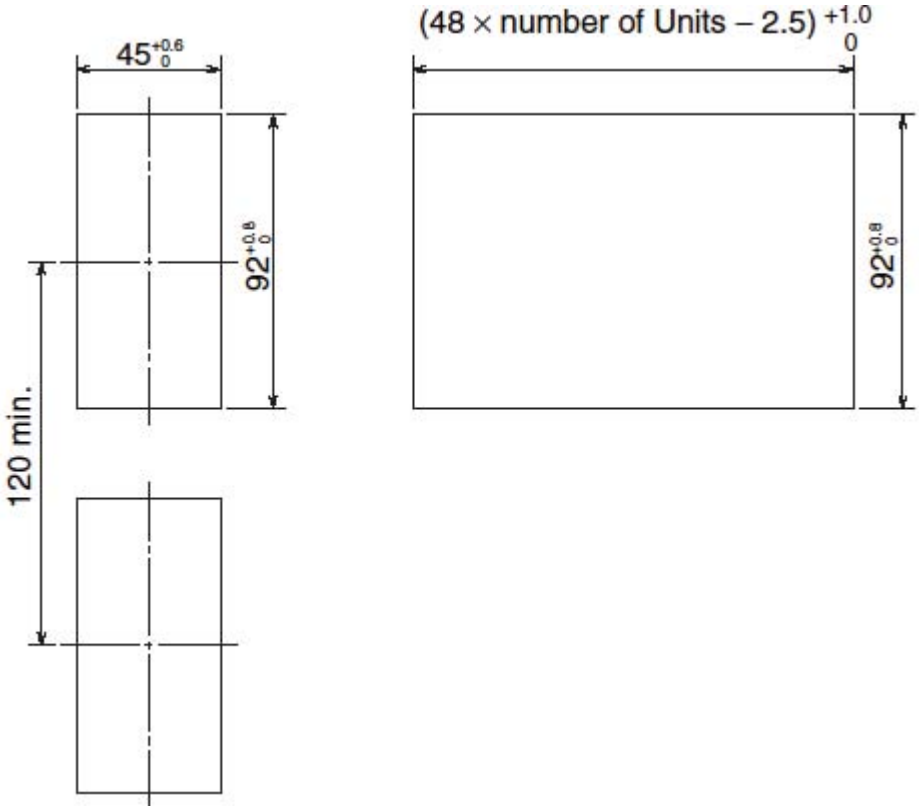


Figure 2.6 — 900-TC32



- Horizontal group-mounting of two or more temperature controllers, or mounting temperature controllers above each other may cause heat to build up inside the temperature controllers. This 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 Controller. These may cause electric shock, fire, or malfunction.
- Never disassemble, repair, or modify the Bulletin 900 Controller with line or field device power applied. Doing so may cause electric shock, fire, or malfunction.
- Do not use the Bulletin 900 Controller in flammable and explosive gas atmospheres.
- Use the Bulletin 900 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 Controller. If the settings are not appropriate for the control target, the 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 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 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 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 Controller is installed inside a control panel, the ambient temperature must be kept to under 55 °C, including the temperature around the controller.

  If the Bulletin 900 Controller is subjected to heat radiation, use a fan to cool the surface of the controller to under 55 °C.
- Never place heavy objects on, or apply pressure to the Bulletin 900 Controller as it may cause it to deform and deteriorate during use or storage.

ATTENTION

- Store within the following temperature and humidity ranges:

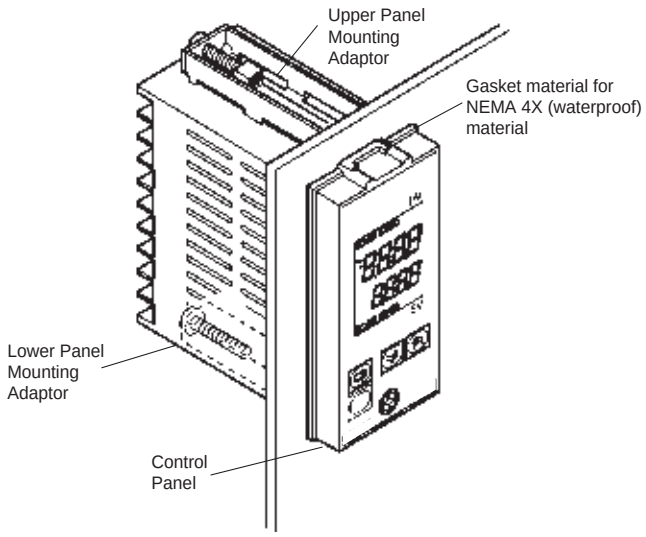
  Temperature: –25…+65 °C
  Humidity: 25…85% (with no icing or condensation)

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

Panel Mounting — 900-TC8

How to Attach the Bulletin 900-TC8 on the Panel

Figure 2.7 — 900-TC8



1. If water-proofing 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.

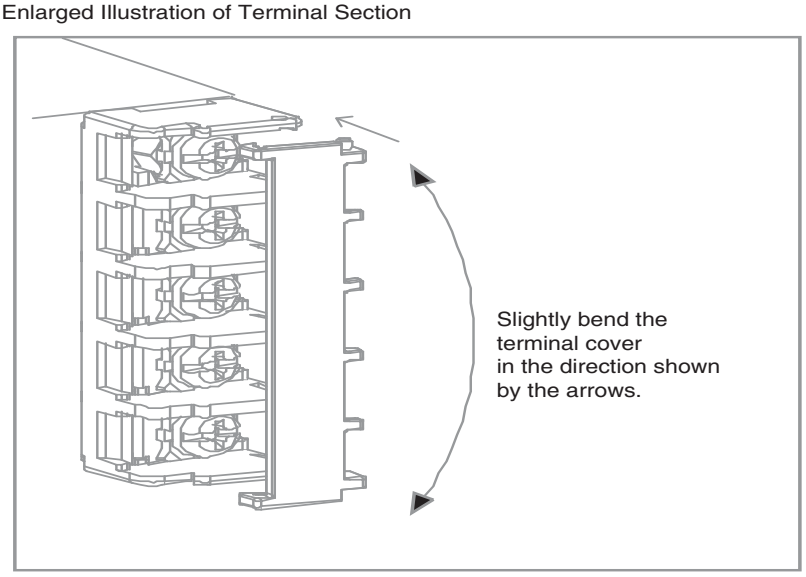
7. Install the controller so that it is horizontal (can read the display properly).

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.

Mounting the Terminal Cover

To attach the terminal cover to the terminal block, slightly bend the terminal cover, as shown below. The terminal cover cannot be attached in the opposite direction.

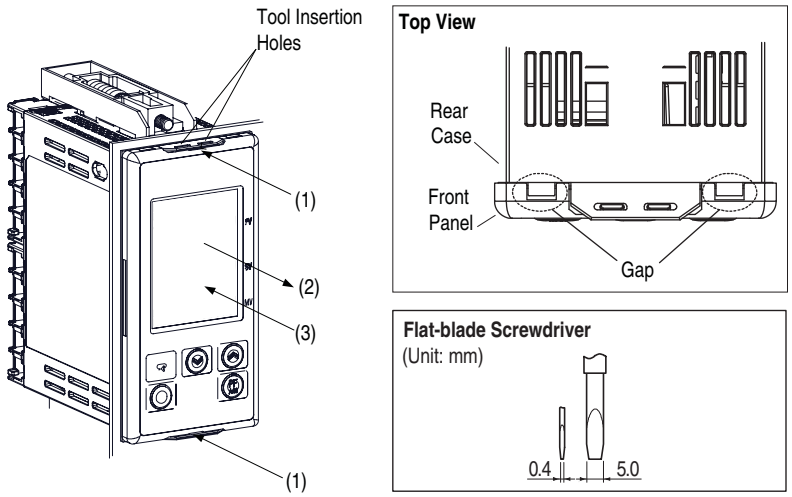
Figure 2.8 — 900-TC8 Mounting the Terminal Cover



900-TC8 (Series B) 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 2.9 — 900-TC8 (Series B) Case Removal while Panel-Mounted



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.

1. Insert a flat-blade screwdriver into the two tool insertion holes (one on the top and one on the bottom) to release the hooks.

2. Insert the flat-blade screwdriver in the gap between the front panel and the rear case (two on the top and two on the bottom), and use it to pry and pullout the front panel slightly. Then, pull out on the front panel gripping both sides. Be sure not to impose excessive force on the panel.

Setting Up the 900-TC8 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. (Series)❶	Function
Communications board	900-TC8COM (B)	RS-485 Communications support
	900-TC8232 (B)	RS-232 Communications support
Event input unit	900-TC8EIM (A)	Event input support

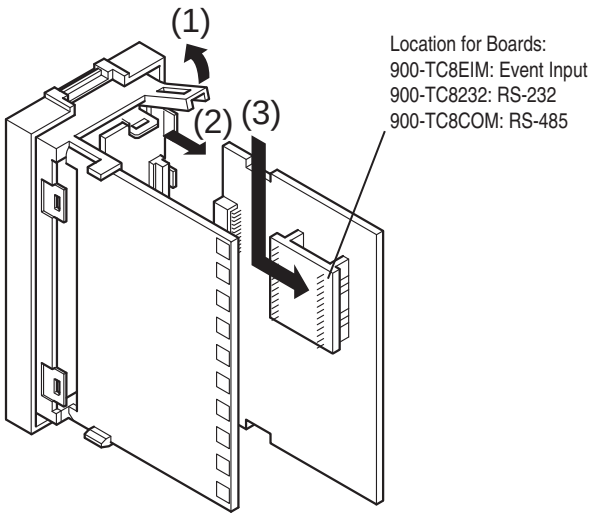
❶ One (1) unit per controller. This series of option units are compatible with Series A or Series B controllers.

Panel Mounting — 900-TC16

How to Attach the Bulletin 900-TC16 on the Panel

To prevent electrostatic damage to the board, make sure you are properly grounded before installing it. Follow the steps below.

Figure 2.10



1. Insert the controller through the hole in the panel from the front, and push the panel mounting adapter on from the rear. Push the adapter up to the back of the panel ensuring that the controller is pushed all the way in, removing any gap between the controller, panel, and adapter. Finally, use the two screws on the adapter to secure the unit in place. The recommended panel thickness is 1…5 mm.

2. To mount the Bulletin 900-TC16 so that it is waterproof, insert the waterproof packing on the Bulletin 900-TC16. The Bulletin 900-TC16 cannot be waterproofed when it is group-mounted in the horizontal fashion.

3. Maintain the specified mounting space between each controller.

4. Tighten the two screws on the adapter against the panel. Tighten the two screws alternately keeping the torque to approximately 0.29…0.39 N•m (2.57…3.45 lb-in.).

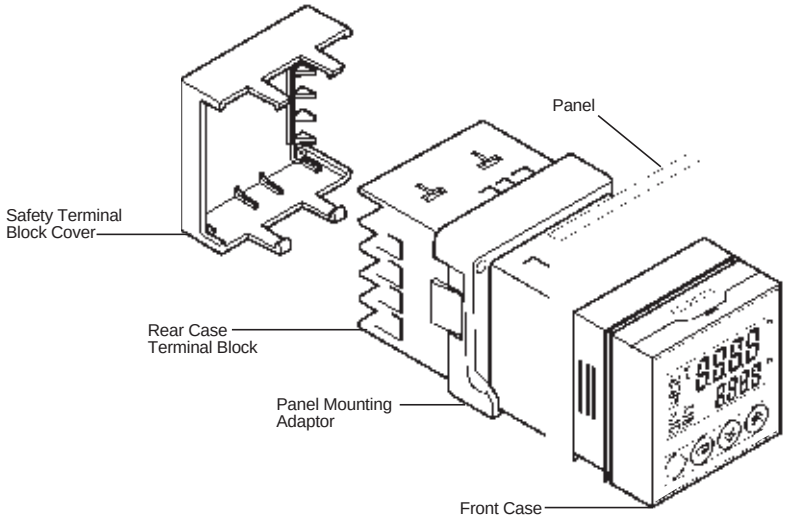
5. To allow heat to escape, do not block the area around the Bulletin 900-TC16 Temperature Controller. (Ensure that enough space is left for the heat to escape.) Do not block the ventilation holes on the casing.

6. Allow as much space as possible between the Bulletin 900-TC16 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).

How to Attach the 900-TC16 Wiring Terminal Block Cover

Figure 2.11



Make sure that the UP mark on the adapter is facing up, and then fit the terminal cover into the holes on the top and bottom. The Bulletin 900-TC16 is provided with a protective terminal block cover (finger protection per VDE 0106).

Setting Up the 900-TC16 Controller with the Optional Units

If RS-485 communications, Event Input, second Control Output, or Heater Burnout functions are required, mount the appropriate option unit in the Bulletin 900-TC16 controller.

900-TC16 Option Units

Table 2.B below provides the list of available options.

Table 2.B

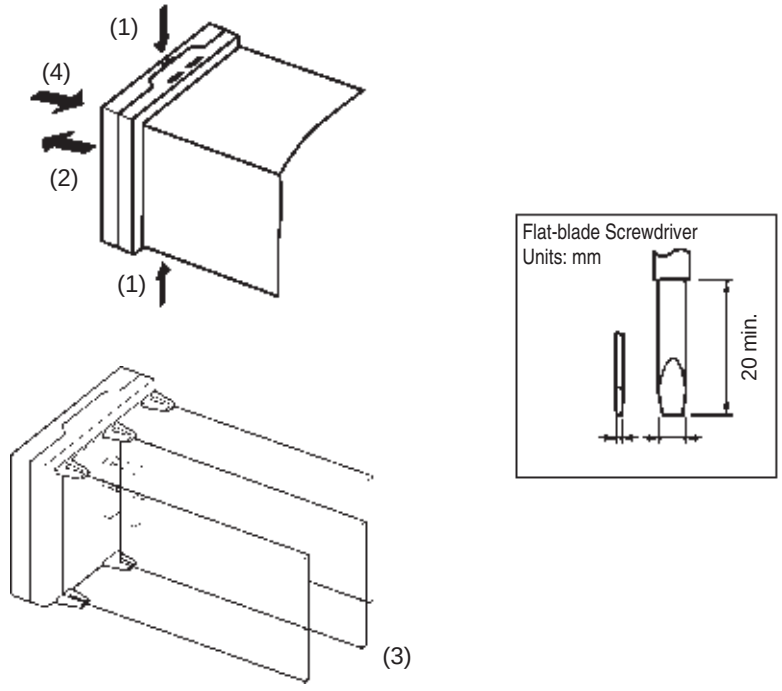
Function				900-TC16 Option Module Cat. No.(Series) ❶❷
Heater Burnout & Heater Short	Event Input	Comms.	Voltage (SSR) Control Output 2	
1-Phase HB	—	RS485	—	900-TC16NCOM (B)
—	—	RS485	—	900-TC16NACCOM (B)
1-Phase HB	Yes	—	—	900-TC16NEIM (B)
—	Yes	—	—	900-TC16NACEIM (B)
3-Phase HB	—	RS485	—	900-TC16NCOMP3 (B)
—	—	RS485	Yes	900-TC16NCOMV2 (B)
1-Phase HB	—	—	Yes	900-TC16P1V2 (B)

❶ One (1) option unit per controller.

❷ The option unit provides optical isolation (approximately 32V DC) between the controller electronics and the field input. Series B option units must be used with Series B controllers and vice versa.

Installing the Option Unit/Board in the Controller

Figure 2.12

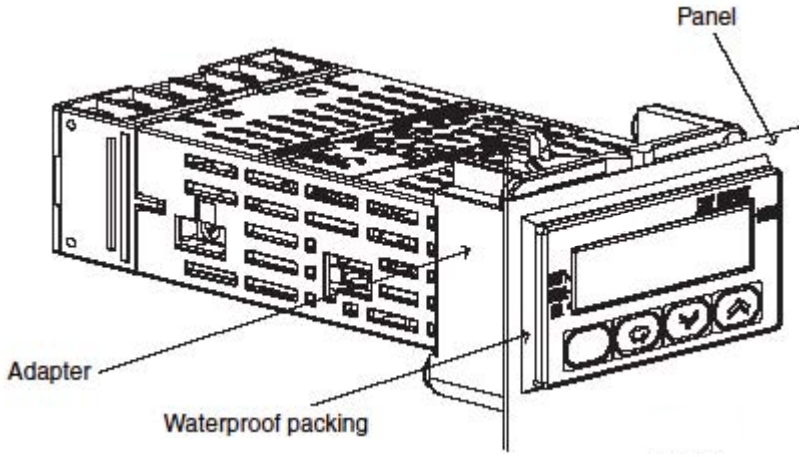


Note: When you remove the internal mechanism from the housing, never touch electric components inside or subject the internal mechanism to shock.

Panel Mounting — 900-TC32

Mounting to the Panel

Figure 2.13

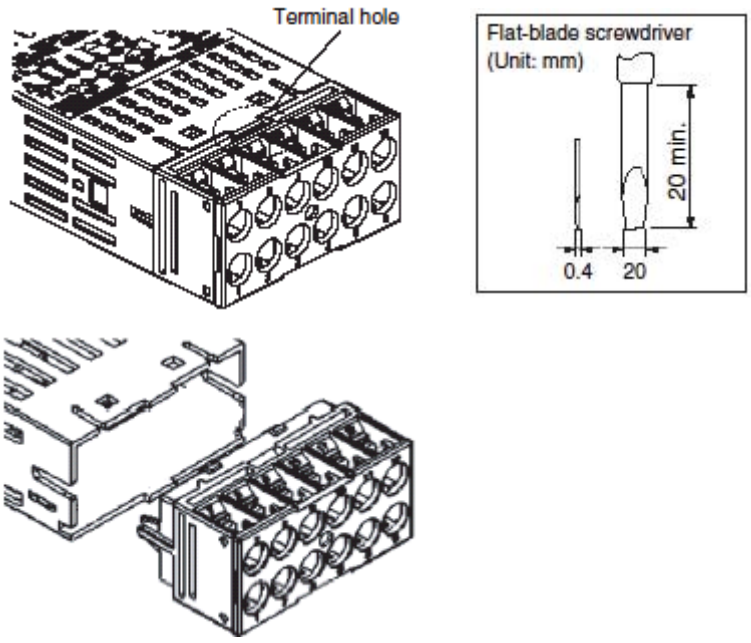


Note: For waterproof mounting, waterproof packing must be installed on the controller. Waterproofing is not possible when group mounting several controllers. Waterproof packing is not necessary when there is no need for the waterproofing function.

1. **For waterproof mounting:** Install waterproof packing on the controller.
2. Insert the 900-TC32 into the mounting hole in the panel.
3. Push the adapter from the terminals up to the panel, and temporarily fasten the 900-TC32
4. Tighten the two fastening screws on the adapter. Alternately tighten the two screws little by little to maintain a balance. Tighten the screws to a torque of 0.29 to 0.39 N·m.

The body of the controller can be replaced by removing the terminal block from the 900-TC32.

Figure 2.14



1. Insert a flat-blade screwdriver into the tool holes (one on the top and one on the bottom) to release the hooks. Do not apply excessive force.

2. Pull the terminal block out while the hooks are released.

Bulletin 900 Wiring Terminals

Figure 2.15 — 900-TC8 (Series B) Terminal Arrangement

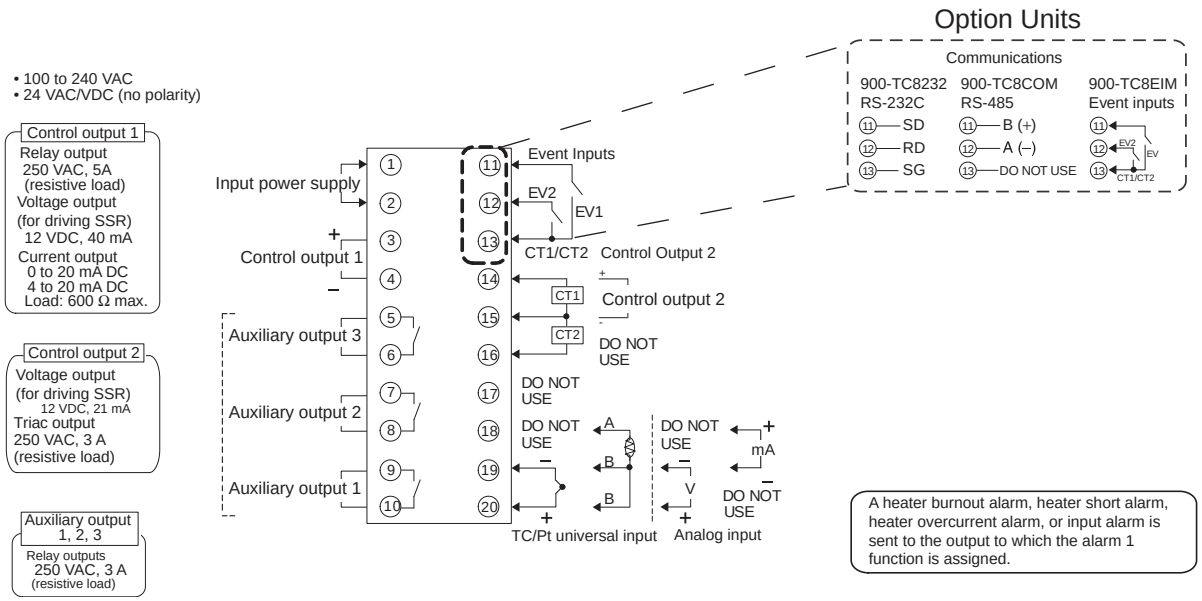


Figure 2.16 — 900-TC16 Terminal Arrangement

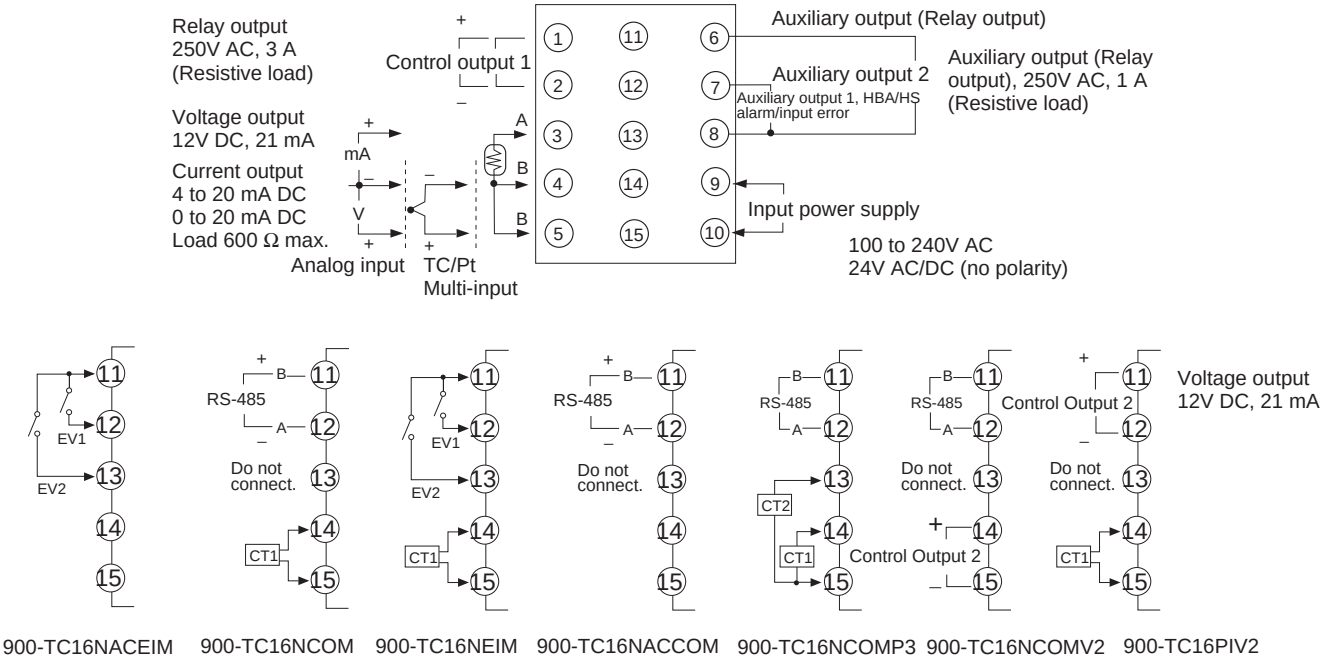
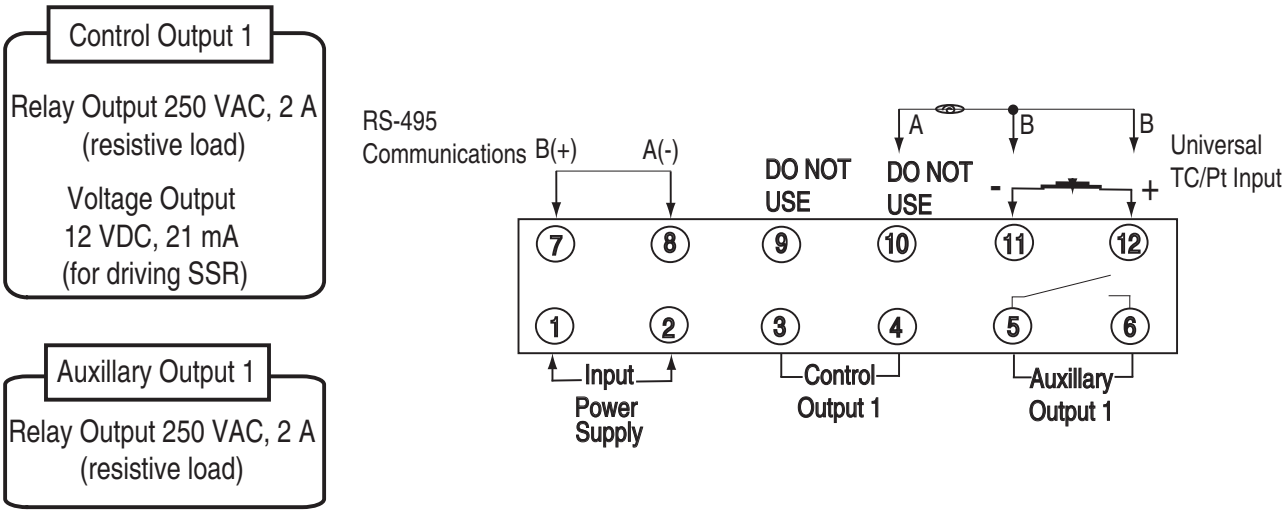


Figure 2.17 — 900-TC32 Terminal Arrangement



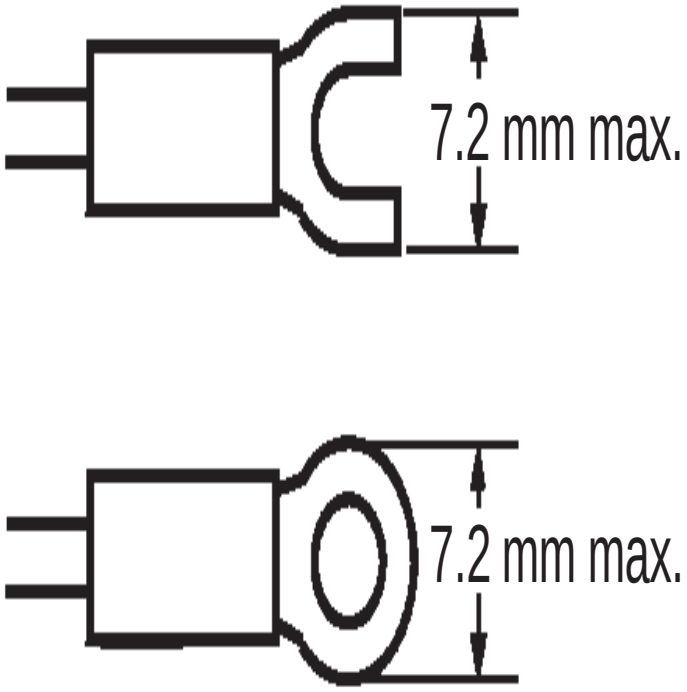
Wiring Guidelines and Precautions

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 Controller 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, 900-TC16, 900-TC32, and its low voltage sensors (e.g., thermocouple) lines from external noise.
- **For 900-TC32:** Use a shielded AWG24 to AWG18 (cross-sectional area of 0.205 to 0.823 mm2) twisted-pair cable. The stripping length is 6 to 8 mm.
- We recommend using solderless lugs when wiring to the Bulletin 900-TC8 and 900-TC16 screw terminals. However, if lugs are not used, the controller's screw terminals will accept two solid or stranded wires (no mixing) between 24 (0.205 mm^2)...14 (2.081 mm^2)AWG. Wire strip length 5...6 mm.
- **For 900-TC8 & 900-TC16:** Tighten the terminal screws properly. Tighten them to a torque 0.74…0.9 N•m (6.6…8 lb-in.) Loose screws may cause malfunction. **For 900-TC32:** Tighten the terminal screws to a torque of 0.5 N•m
- Use the type of solderless lugs referenced in Figure 2.18 for your proper Bulletin type.

Figure 2.18 — Wiring



Wiring

Power Supply

The controller requires an external power source for operation. For the 900-TC8 connect to terminals 1 and 2 and for the 900-TC16 connect to terminals 9 and 10. The following table shows the specifications.

Table 2.C

Input Power Supply	Bulletin 900-TC8	Bulletin 900-TC16
100…240V AC, 50/60 Hz	10VA	7.5VA
24V AC, 50/60 Hz	5.5VA	5VA
24V DC (not polarity sensitive)	4 W	3 W

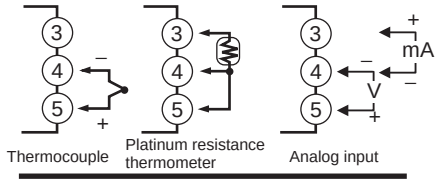
ATTENTION

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

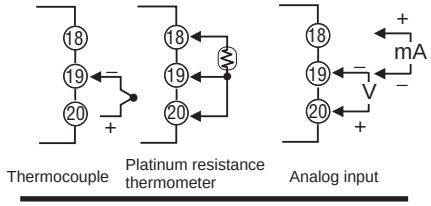
When mounting a noise filter on the power supply, make sure to first check the filter's voltage and current capacity, and then mount the filter as close as possible to the Bulletin 900 Controller. Reinforced insulation is applied to the power supply I/O sections.

Wiring Input/Sensor Devices

Connect sensors to the terminals as follows according to the Input Type and controller.



900-TC16 Input Sensor Wiring



900-TC8 Input Sensor Wiring

Input/Sensor Wiring Considerations

• When the thermocouple leads are extended, make sure to use shielded 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 the correct sensor type is configured and for thermocouples 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.

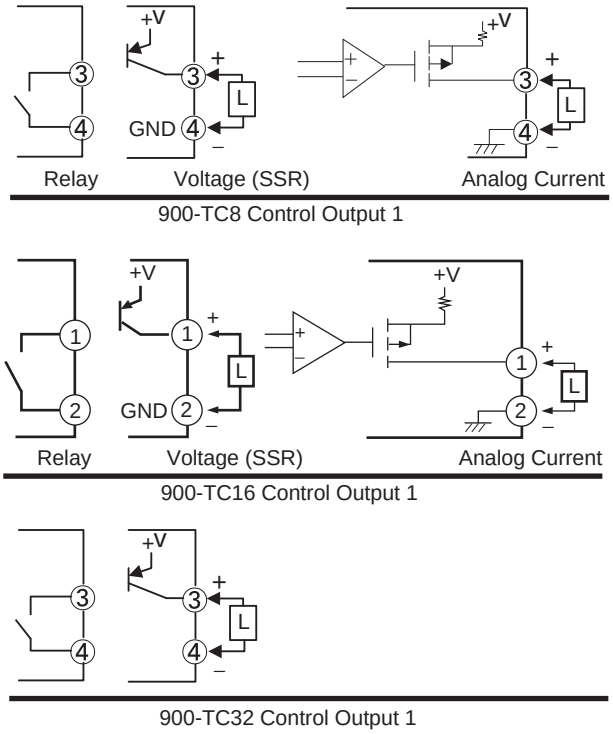
• If a cooling fan is used in the panel enclosure, prevent only the terminal block from being cooled when using thermocouples. Otherwise, this may result in a measurement error.

• 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 and recommended.

Wiring Control Output 1

The following diagrams show the available outputs and their internal equalizing circuits.

Figure 2.19



The following tables show the specifications for each output type.

Table 2.D — 900-TC8

Output Type	Output 1 Specifications
Relay	250V AC, 5 A (resistive load), electrical durability: 100,000 operations
Voltage (PNP)	PNP type, 12V DC +15%/–20%, 40 mA (with short-circuit protection). Series B 12V DC ± 15%.
Current	DC 4… 20 mA/DC 0…20 mA, resistive load: 600 Ω max. Resolution: Approx.10,000

Table 2.E — 900-TC16

Output Type	Output 1 Specifications
Relay	250V AC, 3 A (resistive load), electrical durability: 100,000 operations
Triac (AC) relay	250V AC, 3 A (resistive load), electrical durability: 1,000,000 operations
Voltage (PNP)	PNP type, 12V DC ±15%, 21 mA (with short-circuit protection)
Current	DC 4…20 mA/DC 0…20 mA, resistive load: 600 Ω max. Resolution: Approx. 10,000

Table 2.F — 900-TC32

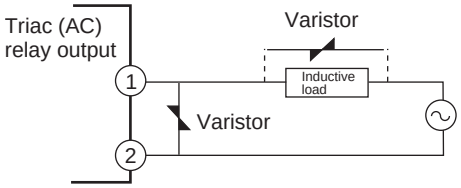
Output Type	Output 1 Specifications
Relay	250V AC, 2 A (resistive load), electrical durability: 100,000 operations
Voltage (PNP)	PNP type, 12V DC ±15%, 21 mA (with short-circuit protection)

Output Wiring Considerations

- Do NOT connect a DC load to the Triac (AC) relay.
- The PNP voltage (SSR) output (Control Output 1) is not electrically isolated from the controller's internal circuits. SSR Control Output 2 of the 900-TC16 is also not isolated. However, SSR Control Output 2 of the 900-TC8 is isolated. When using a grounded thermocouple, do not connect any 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.
- **For 900-TC8 & 900-TC16:** The 4...20 and 0…20 mA analog output is electrically isolated from the other controller circuits as follows:
  - Analog Output to Sensor Input: 500V AC 50/60 Hz for 1 minute
  - Analog Output to Alarm Output: 2000V AC 50/60 Hz for 1 minute
  - Analog Output to Input Power Supply: 2000V AC 50/60 Hz for 1 minute
- The life expectancy of the electro-mechanical relay outputs vary 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 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.
- **For 900-TC8 & 900-TC16:** Triac (AC) relay outputs use semiconductors for switching when closing and opening the circuit, thereby eliminating relay chatter and arcing and improving durability compared to an electro-mechanical relay output. However, if high levels of electrical noise or surge are imposed between the output terminals, short-circuit faults may occasionally occur. If the output becomes permanently shorted, there is the danger of fire due to overheating of the heater. Design safety into the system, including measures to prevent excessive temperature rise and fire. Take countermeasures such as installing a surge absorber. As an additional safety measure, provide error detection in the control loop. (Use the Loop Burnout Alarm

(LBA) and Heater Short Alarm (HSA) that are provided for the Bulletin 900 Controller.)

Figure 2.20



Select a surge absorber that satisfies the following conditions.

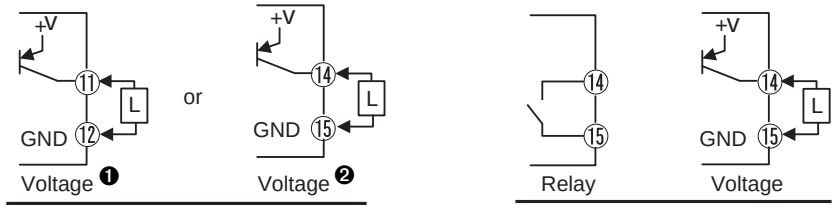
Table 2.G

Voltage Used	Varistor Voltage	Surge Resistance
100…120V AC	240…270V	1,000 A min.
200…240V AC	440…470V	

Control Output 2

- **For 900-TC8 & 900-TC16:** Output 2 is applied from terminals 11 and 12 or 14 and 15 with the 900-TC16, and from pins 14 and 15 with the 900-TC8. The following diagrams show the available outputs and their equal internal circuits.

Figure 2.21



❶ Option Unit: 900-TC16P1V2
❷ Option Unit: 900-TC16NCOMV2

The following table shows the specifications for each output type.

Table 2.H — 900-TC8

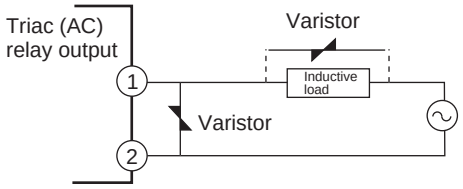
Output Type	Output 2 Specifications
Triac (AC) relay	250V AC, 3 A (resistive load), electrical durability: 1,000,000 operations
Voltage (PNP)	PNP type, 12V DC +15%/–20%, 21 mA (with short-circuit protection)

Table 2.I — 900-TC16

Output Type	Output 2 Specifications
Voltage (PNP)	PNP type, 12V DC ±15%, 21 mA (with short-circuit protection)

- Always connect an AC load to a Triac (AC) relay output. The output will not turn OFF if a DC load is connected.
- A voltage output (control output) is not electrically isolated from the internal circuits. Therefore, when using a grounded thermocouple, do not connect any of the control output terminals to earth ground. If control output terminals are connected to ground, errors will occur in the measured temperature values as a result of ground loop leakage current. With 900-TC8, however, voltage output (Control Output 2) is functionally isolated from the internal circuits.
- Control Output 2 of the 900-TC16 is a voltage output (SSR driver) only, and outputs across terminals 11(+) and 12(-), or 14(+) and 15(-).
- Control outputs 1 and 2 (voltage outputs) are not isolated.
- Triac (AC) relay outputs use semiconductors for switching when closing and opening the circuit, thereby eliminating relay chatter and arcing and improving durability compared to an electro-mechanical relay output. However, if high levels of electrical noise or surge are imposed between the output terminals, short-circuit faults may occasionally occur. If the output becomes permanently shorted, there is the danger of fire due to overheating of the heater. Design safety into the system, including measures to prevent excessive temperature rise and fire. Take countermeasures such as installing a surge absorber. As an additional safety measure, provide error detection in the control loop. (Use the Loop Burnout Alarm (LBA) and Heater Short Alarm (HSA) that are provided for the Bulletin 900.)

Figure 2.22



Select a surge absorber that satisfies the following conditions.

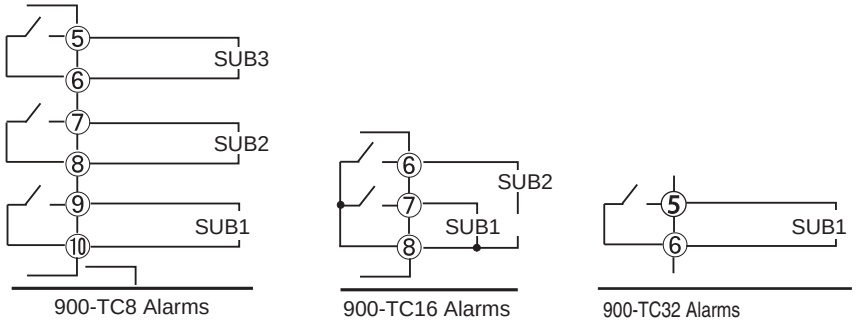
Table 2.J

Voltage Used	Varistor Voltage	Surge Resistance
100…120V AC	240…270V	1,000 A min.
200…240V AC	440…470V	

Wiring Auxiliary Outputs (1, 2, and 3)

- On the 900-TC8, Auxiliary Output 1 (SUB1) is output across terminals 9 and 10, Auxiliary Output 2 (SUB2) is output across terminals 7 and 8, and Auxiliary Output 3 (SUB3) is output across terminals 5 and 6.
- When the HBA or the HS Auxiliary is used with the 900-TC8, Auxiliaries are output across terminals 9 and 10.
- On the 900-TC8, when heating/cooling control is used, Auxiliary Output 3 becomes control output (cooling).
- On the 900-TC16, Auxiliary Output 1 (SUB1) is output across terminals 7 and 8, and Auxiliary Output 2 (SUB2) is output across terminals 6 and 8.
- On the 900-TC32, Auxiliary Output 1 (SUB1) is output across terminals 5 and 6.
- On the 900-TC32, when heating/cooling control is used, auxiliary output 1 becomes control output (cooling).
- When the HB, the HS, or heater overcurrent alarm is used with the 900-TC16, alarms are output across terminals 7 and 8.
- On the 900-TC16, when heating/cooling control is used, Auxiliary Output 2 becomes control output (cooling).
- When the Input Error Output parameter is configured to ON, the output assigned to Alarm Output 1 turns ON when an input error occurs.
- For models that have a Heater Burnout Alarm (not supported by 900-TC32), an OR of the alarm 1 function and the HB/HS or heater overcurrent alarm is sent to the output assigned to the alarm 1 function (auxiliary output 1). If ALM1 is to be used for HBA only, configured the Alarm 1 type to 0 and do not use Alarm function 1.
- The following diagrams show the internal equalizing circuits for Alarm Outputs 1, 2, and 3.

Figure 2.23



Note: ALM1, 2, 3 can be output to auxiliary output 1, 2, 3 or changed with the Advanced Function level.The auxiliary relay specifications are as follows:

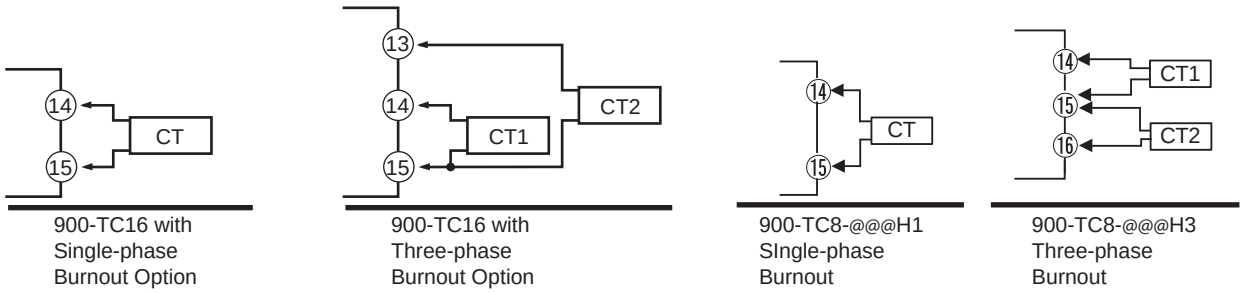
Table 2.K

900-TC8 and 900-TC16	SPST-NO 250V AC 3 A
900-TC32	SPST-NO 250V AC 2 A

Current Transformer (CT) Input

To determine if your controller supports the heater burnout function, refer to Table 1.B for 900-TC8 or Table 1.E for 900-TC16. If the heater burnout parameter function is used, connect a current transformer (CT) across the terminals indicated in the following drawings in Figure 2.24.

Figure 2.24

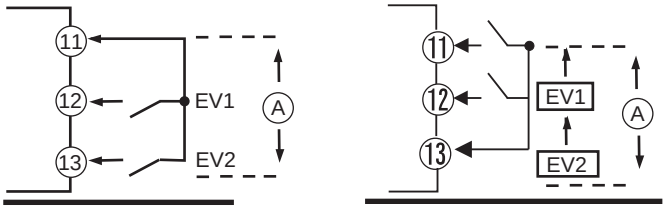


Wiring the Event Input

When the appropriate option event input unit is mounted in the Bulletin 900-TC8 or 900-TC16 controller, an event input function is available by wiring to the controllers terminals as shown in the following diagrams.

Figure 2.25

Ⓐ Do NOT apply an external voltage source to the Event Input Terminals



900-TC16 Contact Event Input

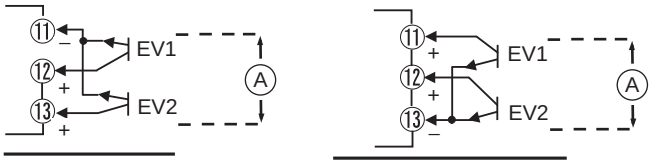
900-TC8 Contact Event Input

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.
- Non-contact input ON: residual voltage 1.5V max., OFF: leakage current 0.1 mA max.

Polarities using non-contact input are as follows:

Figure 2.26



900-TC16

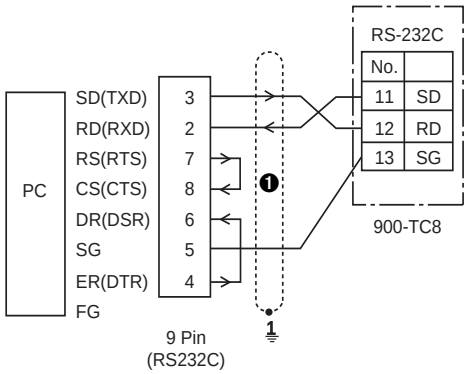
900-TC8

Ⓐ Do NOT apply an external voltage source to the Event Input Terminals

RS-232C Communication to a Personal Computer —Bulletin 900-TC8 Only

By using the appropriate option communications unit in the Bulletin 900-TC8 or 900-TC16 Controller, you can communicate with a personal computer.

Figure 2.27 — Communication Unit Connection Diagram



❶ RS232C for 900-TC8 only.

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: To configure the 900-TC8 using RS232 communication optional software (900BuilderLite) is available.

RS-485 Communication to a Personal Computer

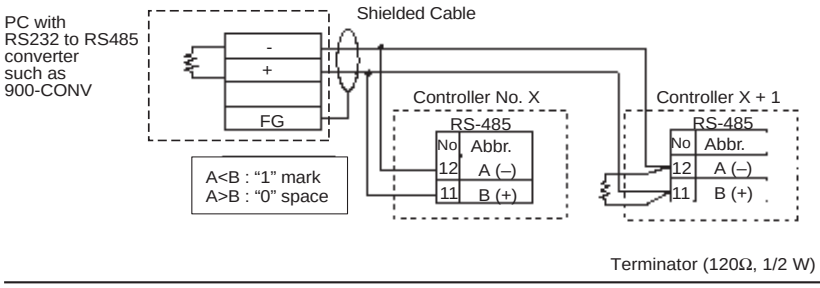
When the optional RS-485 communications unit is mounted in the Bulletin 900-TC8, 900-TC16, or 900-TS32, RS-485 communication with a personal computer is possible. Connect the RS-485 communications cable across controller terminals 11 and 12 for 900-TC8 or 900-TC16. Connect the RS-485 communications cable across controller terminals 7 and 8 for 900-TC32.

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

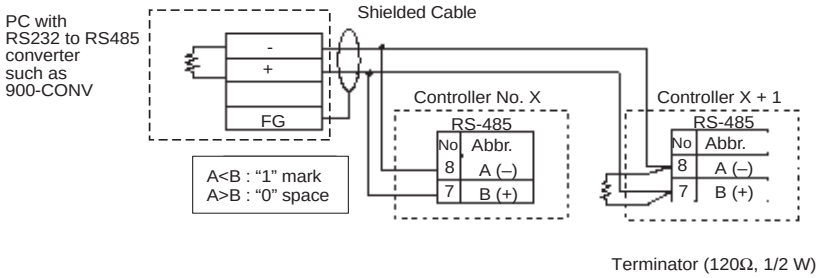
The minimum terminal resistance is 54 Ω (See Figure 2.28.)

Figure 2.28 — Communication Unit Connection Diagram

900-TC8 & 900-TC16

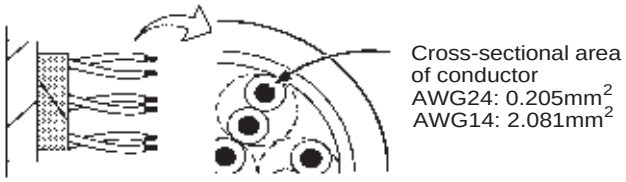


900-TC32



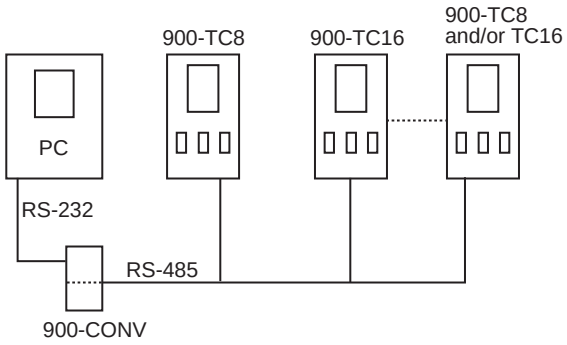
- The RS-485 connection can either be one-to-one or one-to-N. Up to 32 units including the personal computer can be connected one-to-N. **For 900-TC8 & 900-TC16:** Use shielded, twisted pair cable (24…14AWG), and keep the total length to 500 m or less. **For 900-TC32:** Use shielded, AWG24 to AWG18 twisted pair cable.

Figure 2.29



- 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 2.30



Note: The PC must have 900BuilderLite software installed to configure/monitor the Bulletin 900-TC8, 900-TC16, and/or 900-TC32 on an RS-485 network.

Using the Direct PC Communications Port

The direct PC communication port, available on the Series A and Series B Bulletin 900-TC, 900-TC16, and 900-TC32 Controllers, enables direct PC to controller communications without the use of a communication option unit. A 900-CPOEM1 USB to serial conversion cable is required. The cable is approximately 1 meter in length and connects to your PC's USB port and the controller's direct communication port (refer to Figure 3).

900BuilderLite[1] is used with the cable to configure the 900-TC8, 900-TC16, or 900-TC32 controller.

[1] 900 BuilterLite version 1.1 for Series A controllers and Version 1.2 for Series B controllers.

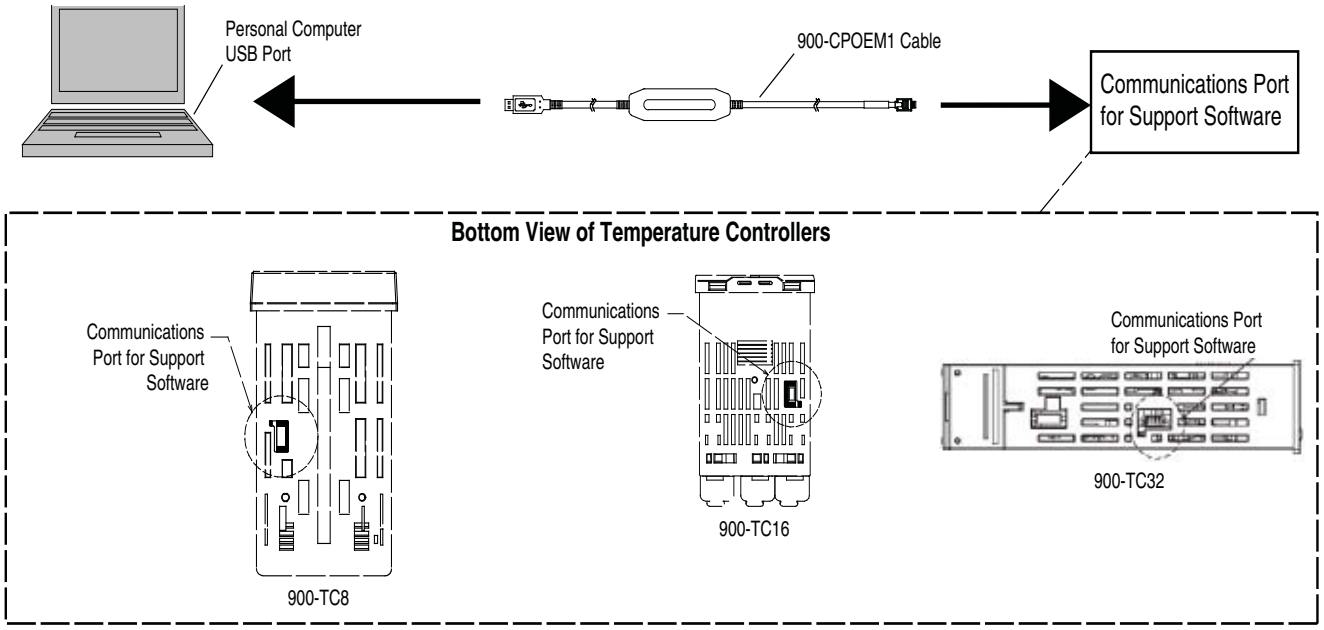
Procedure

Use the following procedure to connect the Temperature Controller to the personal computer using the USB-Serial Conversion Cable. The USB-Serial Conversion Cable is used to communicate with the COM port of the personal computer. To perform communications using USB-Serial Conversion Cable, configured the communications port (COM port) number to be used for the software to the COM port assigned to the Cable.

Hardware Installation

EXAMPLE

Figure 2.31 — Temperature Controller Connection Method



1. Turn ON the power to the Temperature Controller. **Note:** If the cable is connected when the power to the Temperature Controller is OFF, power will be supplied from the personal computer and impose a load on the internal circuits of the Temperature Controller.

2. Connect the cable.
   Connect the personal computer's USB port with the Support Software port on the Temperature Controller using the Cable. **Note:** Hold the connector when inserting or disconnecting the cable.

3. Install the driver.

Note: The driver is available free of charge from the Bulletin 900 Temperature Controller Website:
www.ab.com/industrialcontrols/products/relays_timers_and_temp_controllers/single_loop_temp_heater_controllers/900tc.html. Refer to the menu on the right and click on Get Software for Serial Conversion Cable.
Install the driver to enable the cable to be used with the personal computer. ❶

❶ *900 BuilterLite version 1.1 for Series A controllers and Version 1.2 for Series B controllers*

Driver Installation

When the cable is connected with the personal computer, the personal computer's operating system detects the product as a new device. At this time, install the driver using the installation wizard. For details on installation methods, refer to the user's manual for the 900-CPOEM1-Serial Conversion Cable.

When setting 900 BuilderLite for direct communication the port parameters of the direct communication port are fixed as shown in Table 2.L. Set the Bulletin 900 BuilderLite communication parameters to match those in Table 2.L

Table 2.L — Fixed Port Parameters

Parameter	Value
Communication Unit #	01
Communication Baud Rate	38.4 (Kbps)
Communication Data Length	7 (bits)
Communication Stop Bits	2 (bits)
Communication Parity	Even

Configuration & Basic Operation

Figure 3.1 — 900-TC8

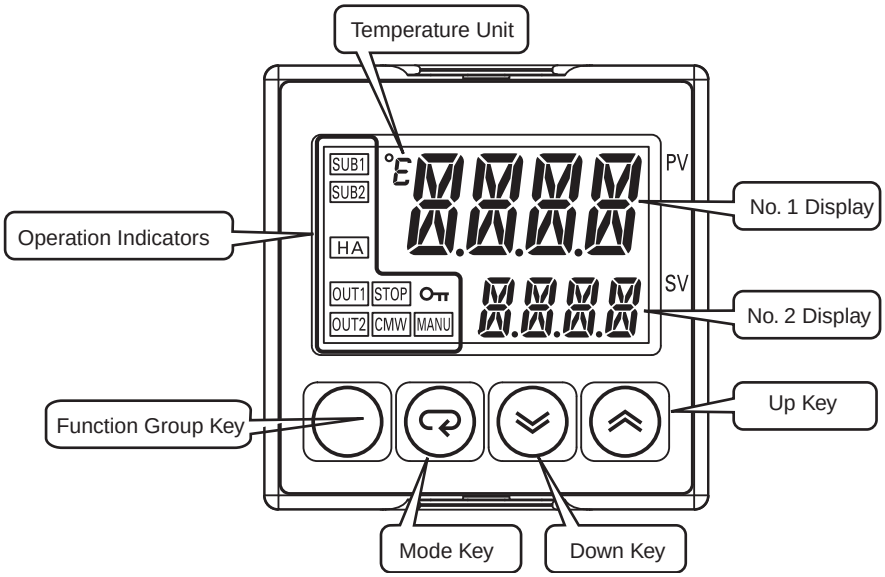


Figure 3.2 — 900-TC16

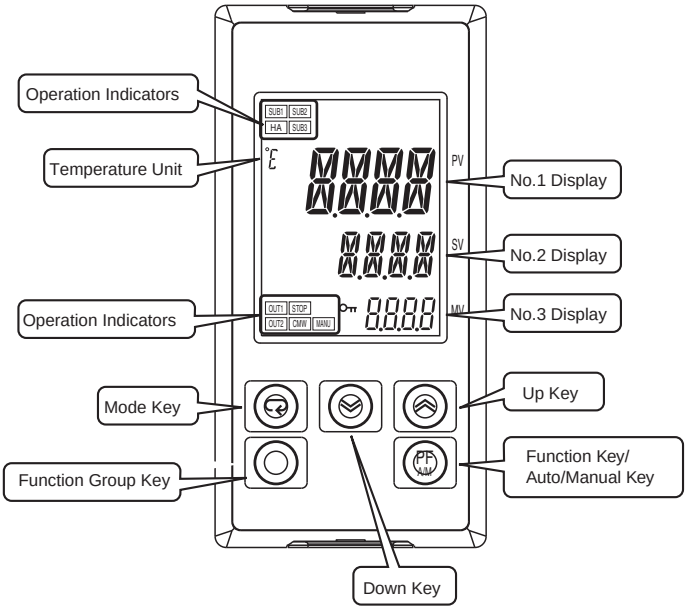
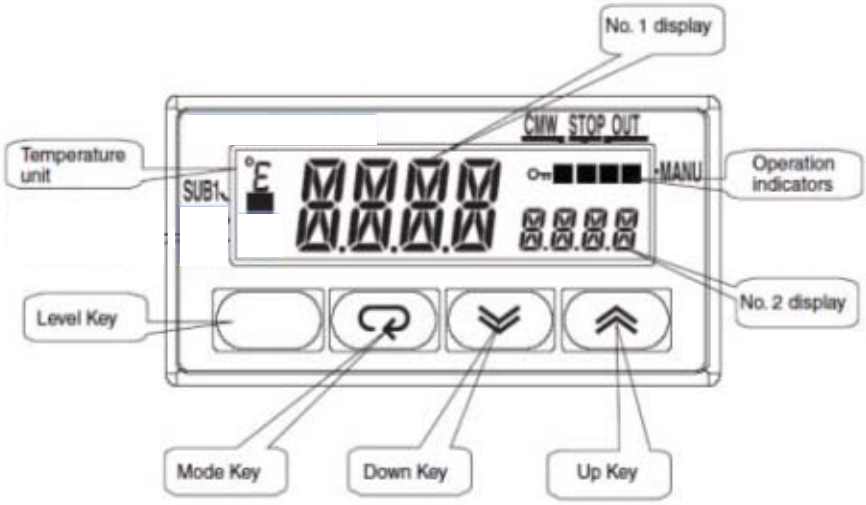


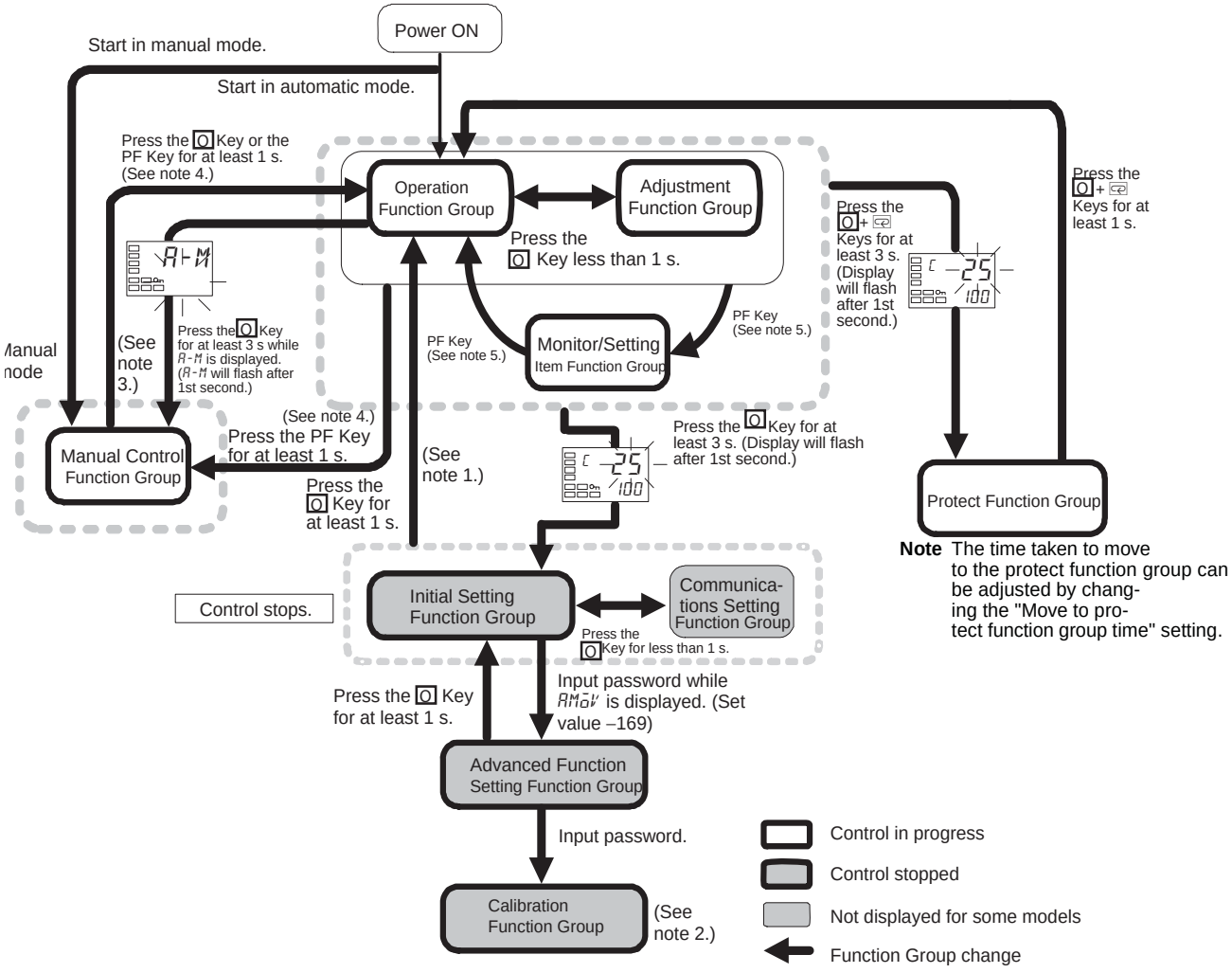
Figure 3.3 — 900-TC32



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 controller are divided into the following:

Figure 3.4 — Function Group Configuration



Note

(1) You can return to the operation function group by executing a software reset.

(2) You cannot move to other function groups by operating the keys on the front panel from the calibration function group. You must turn OFF the power supply.

(3) From the manual control function group, key operations can be used to move to the operation function group only.

(4) When the PF Setting is configured to A-M in models with a PF Key (900-TC8)

(5) When the PF Setting is configured to PFDP in models with a PF Key (900-TC8)

Table 3.A — Control Categories

Function Group	Control In Progress	Control Stopped
Protect	○	—
Operation	○	—
Adjustment	○	—
Manual Control	○	—
Monitor/Setting Item	○	—
Initial Setting	—	○
Advanced Setting❶	—	○
Calibration	—	○
Communications Setting	—	○

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

○ Indicates items that can be configured.

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, Adjustment, or Monitor/Setting Item 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.

Note: The key pressing time can be altered to your requirements. Refer to the Move to Protect function group Time parameter in the Advanced Setting function group.

- **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. This function group is typically selected during operation. During operation, the process value (PV), and manipulated variable (MV) can be monitored, and the SP, 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 from the Operation function group. 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, Heater Burnout Alarm (HBA), Heater Short Alarm (HSA), and PID constants. You can move to the top parameter of the Initial Setting, Protect, and Operation function groups from here.

- **Monitor/Setting Item Function Group (900-TC8)**— To switch to the Monitor/Setting Item function group press the PF key from the Operation or Adjustment group. The parameter(s) configured for Monitor/Setting Item 1 to 5 can be displayed. You can move from the Monitor/Setting Item to the Operation of Initial Setting function groups. Only the 900-TC8 supports this function group.

- **Manual Control Function Group** — When the ◯ key is pressed for at least 3 seconds from the Operation function group's auto/manual switching display, the Manual Control function group will be displayed. (The MANU indicator will light.) When the PF setting is configured to A-M (auto/manual) and PF key is pressed for more than 1 second in the Operation or Adjustment function group the Manual Control group will be displayed (900-TC8 only).This is the function group for changing the MV in manual mode. To return to the Operation function group, press the ◯ key for at least 1 second.

- **Initial Setting Function Group** — To move to the Initial Setting function group from the Operation or the Adjustment function group, press the ◯ key for at least 3 seconds. The PV display flashes after 1 second. This function group is for specifying the Input Type and selecting the control method, control period, setting direct/reverse action, and setting the alarm types. You can move to the Advanced Setting or Communications Setting function group from this function group. 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. (When moving from the Initial Setting function group to the Operation function group, all the indicators will light

Note: Pressing the ◯ key for at least 3 seconds in the Operation function group's auto/manual switching display will move to the Manual Control function group, and not the Initial Setting function group.

- **Advanced Setting Function Group** — To move to the Advanced Setting function group, set the Initial Setting/Communications Protect parameter in the protect function group to 0 and then, in the Initial Setting function group, input the password (**–169**). From the Advanced Setting function group, it is possible to move to the Calibration function group or to the Initial Setting function group. This function group is for setting the display auto-return time, event input assignments, standby sequence, and alarm hysteresis, and it is the function group for moving to the user calibration.

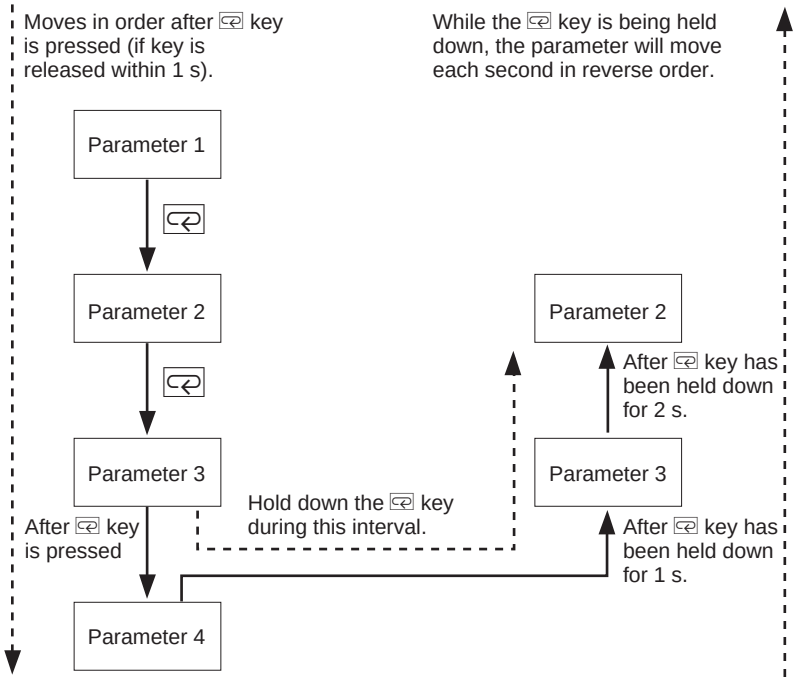
- **Communications Setting Function Group** — To move to the Communications Setting function group from the Initial Setting group, press the ◯ key once (for less than 1 second). When using the communications function, set the communications conditions in this group. Communicating with a personal computer (host computer) allows set points to be read and written, and Manipulated Variables (MV) to be monitored.

- **Calibration Function Group** — To move to the Calibration function group, input the password (**1201**) from the Advanced Setting group. The Calibration function group is for offsetting error in the input circuit. You cannot move to other function groups from the Calibration group by operating the keys on the front panel. To cancel this function group, turn the power OFF then back ON again.

Selecting Parameters

Within each function group, the parameter is changed in order (or in reverse order) each time the key is pressed. (In the Calibration function group, however, parameters cannot be changed in reverse order.) For details, refer to Parameter Functions & Definitions on page 5-1.

Figure 3.5 — Parameters



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 that the values are loaded into memory by pressing the key. The values and parameters setups are sometimes not changed (loaded) by merely pressing the or key.

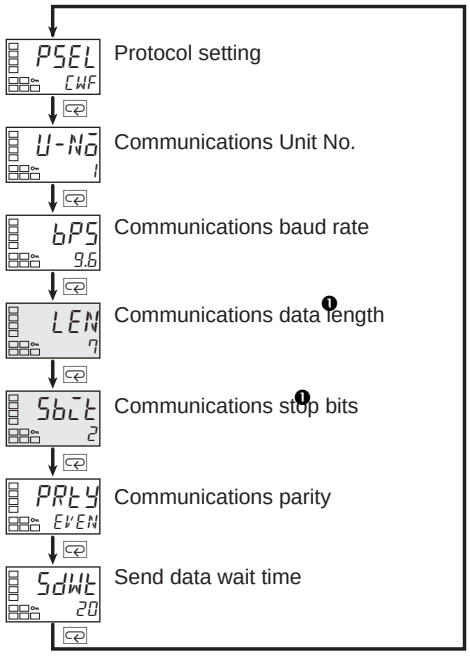
Communications Function

The Bulletin 900 temperature controller can be provided with a communications function that allows you to check and set controller parameters from a personal computer that has configuration and/or monitoring software installed. If the communications function is required, mount the appropriate option unit (refer to Table 1.C or 1.E) for the Bulletin 900 temperature controller.

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

1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.
2. Press the ○ key for less than 1 second to move from the Initial Setting function group to the Communications Setting function group.
3. Select the parameters as shown below by pressing the ↵ key.
4. Press the ⌃ or ⌄ key to change the parameter setting.

Figure 3.6 — Communications Setting Function Group



❶ The Communication Data Length and Communication Stop Bits parameter is displayed only when 900-TC communications are selected from the Protocol Setting parameter.

Setting Up Communications Parameter Data

Set the Bulletin 900 controller communication parameter specifications so that they match the communication parameter setup for the personal computer, using configuration/monitoring software such as 900BuilderLite. In a multidrop (RS-485) 1:N configuration, match the setting data except for the communications unit numbers on all 900-TC controllers. All Controllers must have unique communications unit numbers.

Table 3.B

Parameter	Symbol	Configurable (Monitor) Value	Selection Symbols	Default	Unit
Protocol setting	PSEL	900-TC or Modbus	CWF, Mod	900-TC	None
Communications Unit No.	U-No	0…99		1	None
Communications baud rate	bPS	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, 57.6	9.6	kbit/s
Communications data length †	LEN	7, 8		7	Bits
Communications stop bits †	Sbit	1, 2		2	Bits
Communications parity	PRTY	None, Even, Odd	None, Even, Odd	Even	None
Send data wait time	SdWE	0…99		20	ms

† The Communication Data Length and Communication Stop Bits parameter is displayed only when 900-TC communications are selected from the Protocol Setting parameter.

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.

EXAMPLE

Figure 3.7 — Explanation of Examples

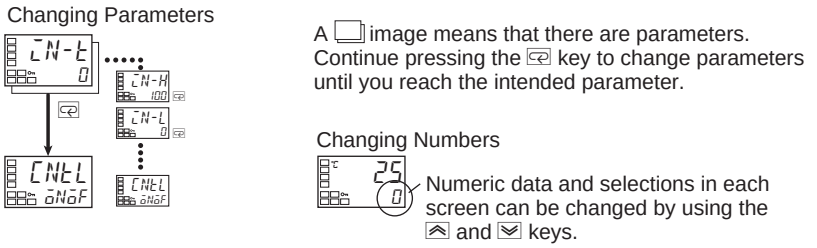


Figure 3.8 — Typical Example 1

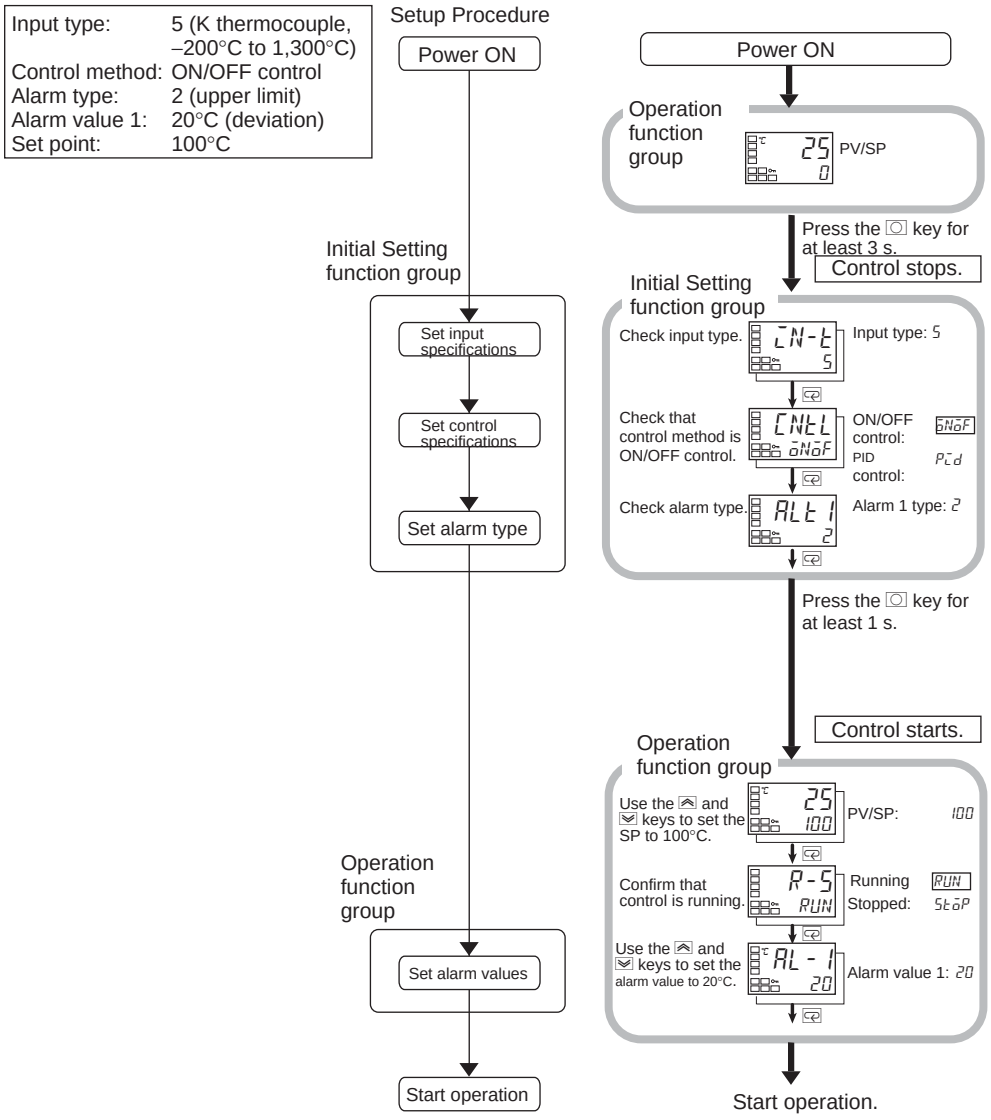
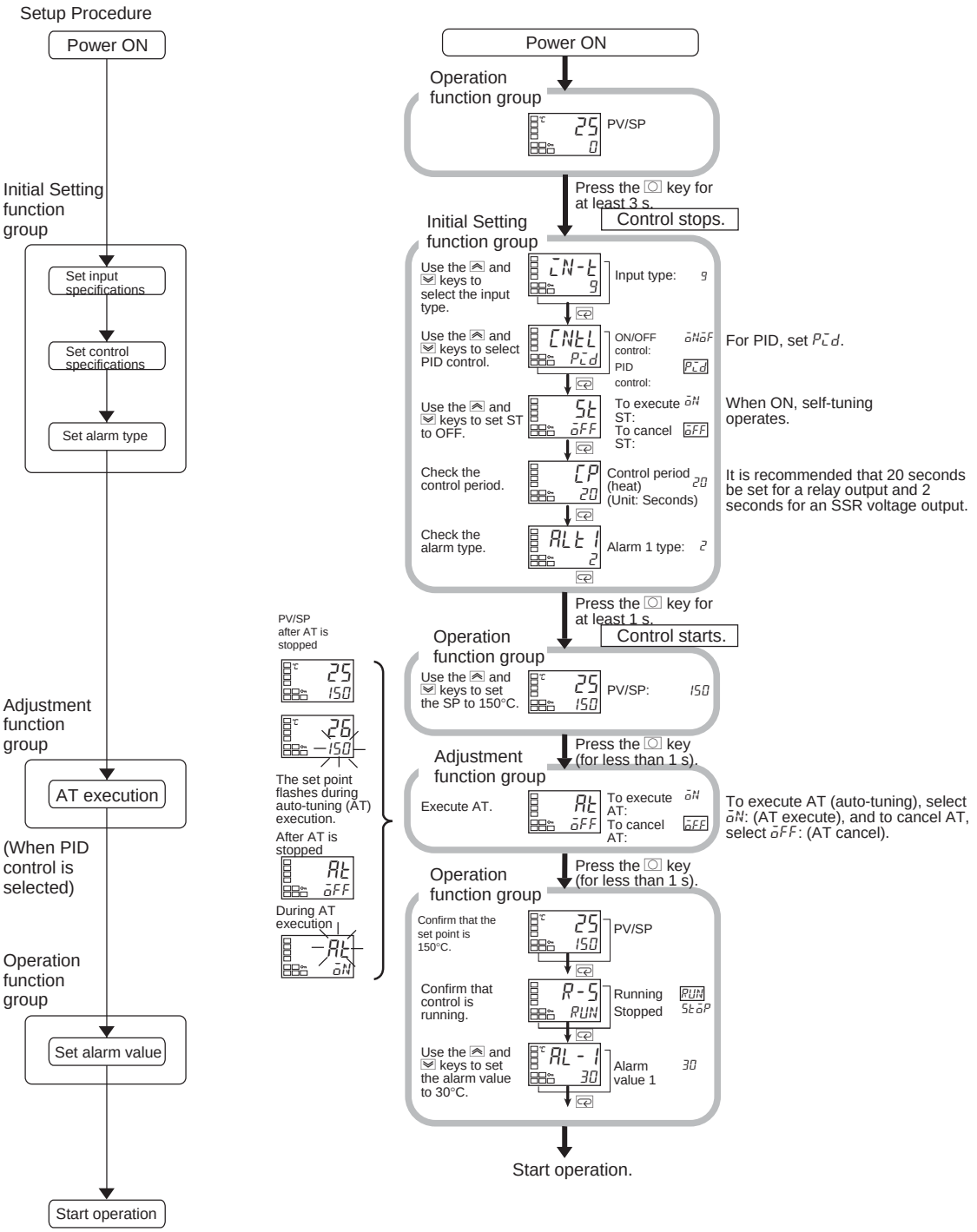


Figure 3.9 — Typical Example 2

Input type:	9 (T thermocouple, −200°C to 400°C)
Control method:	PID control
PID constants found using auto-tuning (AT).	
Alarm type:	2 upper limit
Alarm value 1:	30°C
Set point:	150°C



Configuring the Input Type

The Bulletin 900-TC8, 900-TC16, and 900-TC32 controller support three input/sensor types: (1) platinum resistance thermometer (RTD), (2) thermocouple, and (3) non-contact temperature sensor. The Bulletin 900-TC8 and 900-TC16 controller support a fourth input/sensor type, analog inputs.

Program/configure the Input Type matched to your sensor using the Input Type parameter (See Table 3.C). The Bulletin 900-TC8, 900-TC16, and 900-TC32 general controller specifications support two general types of Global Temperature (GT) inputs: (1) platinum resistance thermometer input and (2) thermocouple Input Types (refer to Table 3.C). The Bulletin 900-TC8 and 900-TC16 controller support a third a third GT input, analog inputs (refer to Table 3.D). Check the cat. no. of your Bulletin 900 components at purchase to ensure it matches your input requirements (refer to Tables 1.B and 1.D).

Input Type

Example Operation Procedure: Setting the Input Type to Thermocouple Type K (–20.0…500.0°C) (See Table 3.C, — List of Global Temperature (GT) 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 3.10 — Operation Function Group

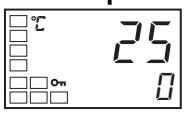


Figure 3.11 — Initial Setting Function Group

Input type

2. Press the ⌃ key to configure the Set Value for the type of sensor you are using. 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 6 as the Set Value (refer to Table 3.C).

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 3.12 — Set Value

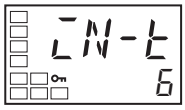


Table 3.C — List of Global Temperature (GT) Input Types

	Input Type	Specifications	Set Value	Input Temperature Setting Range
ControllerType with Thermocouple and Resistance Thermometer (RTD) Multi-input	Platinum Resistance Thermometer (RTD)	Pt100	0	–200…850 (°C)/–328…1,562 (°F)
			1	–199.9…500.0 (°C)/–327.8…932.0 (°F)
			2	0.0…100.0 (°C)/32.0…212.0 (°F)
		JPt100	3	–199.9…500.0 (°C)/–327.8…932.0 (°F)
			4	0.0…100.0 (°C)/32.0…212.0 (°F)
	Thermocouple	K	5	–200…1,300 (°C)/–328…2,372 (°F)
			6	–20.0…500.0 (°C)/-4.0…932.0 (°F)
		J	7	–100…850 (°C)/–148…1,562 (°F)
			8	–20.0…400.0 (°C)/-4.0…752.0 (°F)
		T	9	–200…400 (°C)/–328…752 (°F)
			10	–199.9…400.0 (°C)/–327.8…752.0 (°F)
		E	11	-200…600 (°C)/-300…1,100 (°F)
		L	12	–100…850 (°C)/–148…1,562 (°F)
		U	13	–200…400 (°C)/–328…752 (°F)
			14	–199.9…400.0 (°C)/–327.8…752.0 (°F)
		N	15	–200…1,300 (°C)/–328…2,372 (°F)
		R	16	0…1,700 (°C)/32…3,092 (°F)
		S	17	0…1,700 (°C)/32…3,092 (°F)
		B	18	100…1,800 (°C)/212…3,272 (°F)
	Infrared (non-contact) temperature sensor †	10…70°C	19	0…90 (°C)/32…194 (°F)
		60…120°C	20	0…120 (°C)/32…248 (°F)
		115…165°C	21	0…165 (°C)/32…329 (°F)
		140…260°C	22	0…260 (°C)/32…500 (°F)
	Millivolt input	0…50 mV	23	Either of the following ranges, by scaling: –1,999…9,999 –199.9…999.9
	Thermocouple	W	24	0…2,300 (°C)/0…3,200 (°F)
		PL II	25	0…1,300 (°C)/0…2,300 (°F)

† The non-contact infrared sensor must be configurable for a Type K thermocouple output within either of the four specified ranges. For example, in Omron ES1B or Calex EL Series (Convir) infrared sensor.

- The default is 5 (shaded).
- If an RTD is mistakenly connected while a setting for other than a platinum resistance thermometer is in effect, the controller error code 5.ERR will be displayed. To clear the 5.ERR display, check the wiring and then turn the controller power OFF and back ON.

Table 3.D — Analog Input Types *(not supported by 900-TC32)*

	Input Type	Specifications	Set Value	Process Input Setting Range
Models with Analog Input	Current input	4…20 mA	0	Either of the following ranges can be used by scaling –1,999…9,999 –199.9…999.9 –19.99…99.99 –1.999…9.999
		0…20 mA	1	
	Voltage input	1…5V	2	
		0…5V	3	
		0…10V	4	

- The default is 0 (shaded).

Selecting °C/°F

Temperature Units

The Bulletin 900 controller 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 3.13 — Operation Function Group

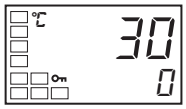
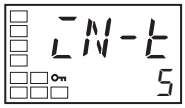


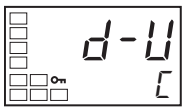
Figure 3.14 — Initial Setting



Input type

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

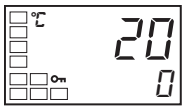
Figure 3.15 — Temperature Unit Parameter



Temperature unit

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

Figure 3.16 — Operation Function Group



The Operation function group is displayed when the Bulletin 900 controller 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).

Configuring the SP

Changing the SP

The set point cannot be changed when the Operation/Adjustment Protection parameter is set to 3. For details, refer to page 4-33, *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.

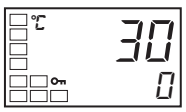
For 900-TC8 and 900-TC16 only: The Multi-SP parameter is used to switch between two or four pre-configured set point values. Refer to page 4-16, *Using the Event Input Feature — 900-TC8 & 900-TC16* for details.

Example Operation Procedure

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

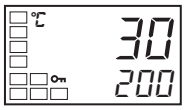
1. Normally, the PV/SP parameter is displayed. The current set point is 0 °C.

Figure 3.17



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 3.18



Selecting PID Control or ON/OFF Control

Overview

The Bulletin 900 Controller supports two control methods: (1) 2-PID control and (2) ON/OFF control. The control method is selected by the PID ON/OFF parameter in the Initial Setting function group. When this parameter is configured to PID, 2-PID control is set, and when configured to ONOF, ON/OFF control is set.

Note: The default is ON/OFF control.

2-PID Control

Controller configured/selected P, I, and D (Proportional, Integral, and Derivative) control parameters are set by the AT (Auto-Tuning) and ST (Self-Tuning) parameters, or by manual (user) setup. For manual (user) PID control, set the PID constants in the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters. For more details refer to page 3-30.

ON/OFF Control

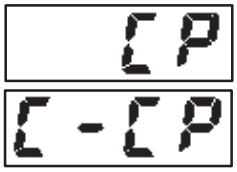
In the ON/OFF control method, the control output (MV) is turned ON when the process value (measured temperature, flow, etc.) is lower than the current set point, and the control output is turned OFF when the process value is higher than the current set point. This is known as reverse operation. Direct operation refers to control where the manipulated variable is increased according to the increase in the process value. Refer to page 3-25 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). This is sometimes referred to as timed proportional PID control.

Figure 3.19 — Control Period Parameter



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 you are using an ON/OFF voltage output (SSR) setting, a shorter time will not drastically impact the life of the SSR, since it is rated by the number of ON hours. If necessary, readjust the Control Period by trial operation to meet the needs of your application.

- You can configure the individual control period values in the Control Period (HEAT) and Control Period (COOL) parameters (Initial Setting function group). **Note:** The default is 20 seconds.
- The Control Period (COOL) parameter can be used only in the heating and cooling control method.
- When Control Output 1 is used as an analog current output, the Control Period (HEAT) parameter cannot be used.

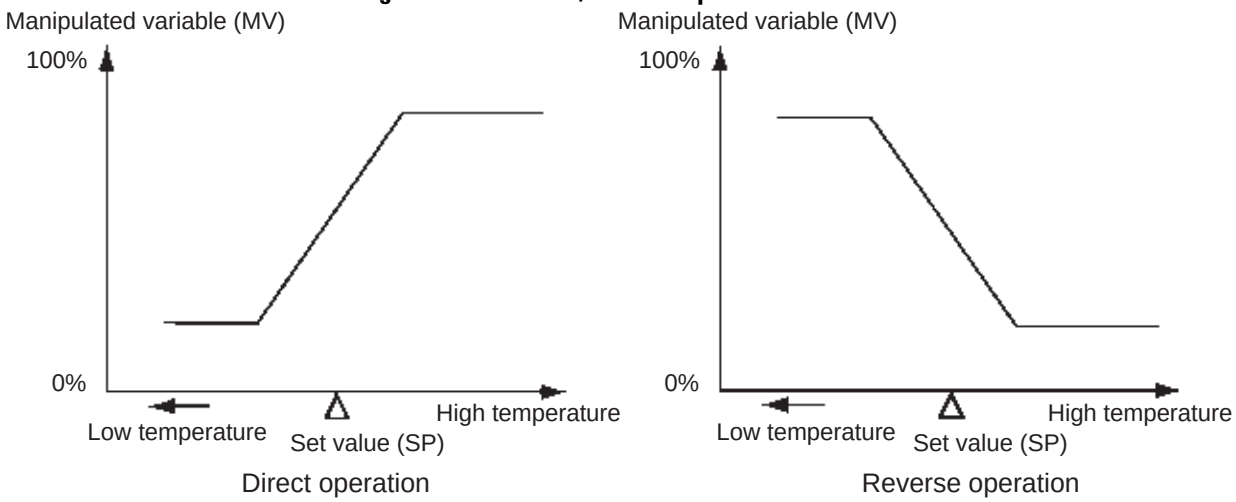
Note: The Control Period parameter allows what is typically called Time Proportioning ON/OFF Control to be done in the 2-PID method.

Direct/Reverse Operation

Figure 3.20 — Direct/Reverse Operation

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 (refer to Figure 3.21). Direct/reverse operation can be used in ON/OFF or PID control.

Figure 3.21 — 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

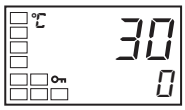
In this example, the Input Type, Temperature Unit, Direct/Reverse Operation, and Control Period (HEAT) parameters will be monitored.

The setup of parameters is as follows:

Input Type = 5: K thermocouple
Temperature Unit = C: °C
Direct/Reverse Operation = dR-R: reverse operation
Control Period (HEAT) = 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 3.22



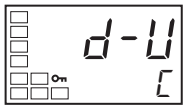
2. The Input Type is displayed. When you are monitoring/configuring the Input Type for the first time, the set value is 0: K type thermocouple default. (**0** is set if you have a platinum resistance thermometer compatible controller. To select a different sensor, press the ⋀ or ⋁ keys. This changes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

Figure 3.23

Input type

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

Figure 3.24



Temperature unit

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

Figure 3.25

Control period (heat)

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 3.26

Direct/reverse operation

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

Figure 3.27

7. Select the Move to Advanced Setting function group parameter by pressing the ↵ Key.

Figure 3.28

Assigned Output Functions

- The control and auxiliary outputs of the 900-TC8, 900-TC16, and 900-TC32 can be individually assigned a function by using the Control Output Assignment parameter in the Advanced Settings function group.
- The default function assignment for each output is shown in Table 3.E.

Table 3.E — Default Fuction Assignment

Parameter Name	Symbol	Initial Status
Control Output 1 Assignment	oUt 1	Control Output (heating)
Control Output 2 Assignment	oUt 2	Not assigned
Auxiliary Output 1 Assignment	Sub 1	Alarm 1
Auxiliary Output 2 Assignment	Sub 2	Alarm 2
Auxiliary Output 3 Assignment (900-TC8 only)	Sub 3	Alarm 3

Note: Each output is automatically initialized as shown below by changing the control mode

Note: Control Output 2 Assignment and Auxillary Output 2 Assignment are not supported by 900-TC32.

.

Table 3.F — 900-TC8 and 900-TC16

Parameter Name	Symbol	Without Control Output 2		With Control Output 2	
		Standard	Heating/ Cooling	Standard	Heating/ Cooling
Control Output 1 Assignment	oUt 1	Control output (heating)	Control output (heating)	Control output (heating)	Control output (heating)
Control Output 2 Assignment	oUt 2	Not assigned❶	Not assigned ❶	Not assigned	Control output (cooling)
Auxiliary Output 1 Assignment	Sub 1	Alarm 1❷	Alarm 1❷	Alarm 1❷	Alarm 1❷
Auxiliary Output 2 Assignment	Sub 2	Alarm 2❸	Control output (cooling)❸	Alarm 2❸	Alarm 2❸

❶ There is no control output 2 and no parameter assignment is displayed for that output.
❷ The Auxiliary Output 1 Assignment parameter becomes the program end output unless the Program Pattern parameter is configured to OFF.
❸ For the 900-TC8, the Auxiliary Output 3 Assignment parameter is set as the control output for cooling. (The Auxiliary Output 2 Assignment parameter is set for alarm 2).

Table 3.G — 900-TC32

Parameter Name	Symbol	Standard	Heating/Cooling
Control Output 1 Assignment	oUt 1	Control output (heating)	Control output (heating)
Auxiliary Output 1 Assignment	Sub 1	Alarm 1❷	Control output (cooling)

❷ The Auxiliary Output 1 Assignment parameter becomes the program end output unless the Program Pattern parameter is configured to OFF.

Alarms

It will be specified in this section when an alarm must be assigned (i.e., when an alarm must be set) for the Control Output 1 or 2 Assignment parameters, or for the Auxiliary Output 1 or 3 Assignment parameters. For example, if alarm 1 is set for the Control Output 1 Assignment parameter, then alarm 1 has been assigned.

EXAMPLE

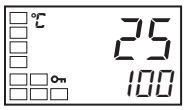
Operating Procedure

The following example configures the following control and auxiliary out assignments: Control Output 1: Control Output (Heating); Control Output 2:

Control Output (Cooling); Auxiliary Output 1: Alarm 1; Auxiliary Output 2: Alarm 2

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

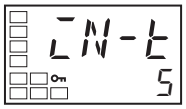
Figure 3.29



PV/SP

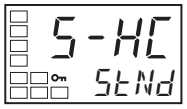
2. Select the Standard or Heating/Cooling Control Mode parameter by pressing the [↵] key.

Figure 3.30



Input type

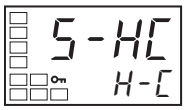
Figure 3.31



Standard or heating/cooling

3. Press the [∧] key to set the parameter to H-C (Heating/Cooling) Control Mode.
   Note: The following output assignments do not need to be set because they are set automatically as defaults by changing the control mode, but they are shown here as a reference for checking the assignments for each output.

Figure 3.32



4. Select the Move to Advanced Setting function group parameter by pressing the [↵] key.

Move to Advanced Setting Function Group

5. Press the [∨] key to enter the password (–**169**), and move from the Initial Setting function group to the Advanced Setting function group.

Figure 3.33

6. Select the Control Output 1 Assignment parameter by pressing the key.

Figure 3.34

7. Press the or key to set o.
(The default is o.)

Figure 3.35

8. Select the Control Output 2 Assignment parameter by pressing the key.

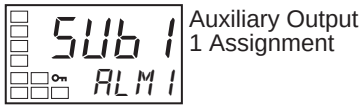
Figure 3.36

9. Press the or key to set C-o.
(When H-C is selected for the Standard or Heating/Cooling Control Mode parameter, the setting will be C-o.)

Figure 3.37

10. Select the Auxiliary Output 1 Assignment parameter by pressing the key.

Figure 3.38



11. Press the or key to set ALM1.
(The default is ALM1.)

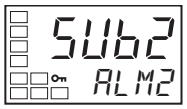
12. Select the Auxiliary Output 2 Assignment parameter by pressing the key.

Figure 3.39

Auxiliary Output
2 Assignment

13. Press the or key to set ALM2.
(The default is ALM2.)

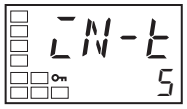
Figure 3.40



Auxiliary Output
2 Assignment

14. Press the key for at least 1 second to move from the Advanced Setting to the Initial Setting function group.

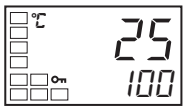
Figure 3.41



Input type

15. Press the key for at least 1 second to move from the Initial Setting function group to the Operation function group.

Figure 3.42



PV/SP

Auxiliary Output Opening or Closing in Alarm

Note: Refer to Page 5.73, Auxiliary Output * Open in Alarm (* = 1 to 3), for definition and furhter explanation of open in and close in alarm.

- When "close in alarm" is configured, the status of the auxiliary output is output unchanged. When "open in alarm" is configured, the status of the auxiliary output function is reversed before being output.
- Each auxiliary output can be configured independently.
- These configurations are made in the Auxiliary Output 1 to 3 Open in Alarm parameters (Advanced Setting function group).
- The default is N-o: Close in Alarm.
- When "open in alarm" is configured for the alarm 1 output, the open in alarm status is also applied to heater burnout, HS alarm, heater overcurrent, and input error outputs.

Table 3.H — Open In Alarm

	Auxiliary Output functions 1...3	Auxiliary Output	Indicators (SUB1...SUB3)
Open in Alarm	ON	ON	Lit
	OFF	OFF	Not lit

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 (HEAT) 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.

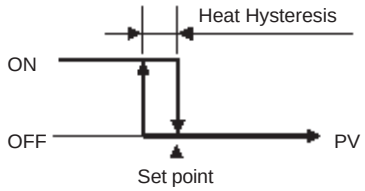
The default is ONOF.

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

Figure 3.43 — 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 3.44 — Reverse Operation with 3-Position Control

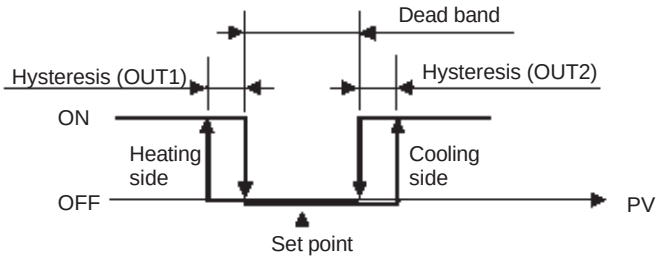


Table 3.I — Parameters

Symbol	Parameter Name and Group Location	Application
S-HC	Standard or Heating/Cooling: Initial Setting function group	For specifying the control method
CNTL	PID ON/OFF: Initial Setting function group	For specifying the control method
dREV	Direct/Reverse Operation: Initial Setting function group	For specifying the control method
C-db	Dead Band: Adjustment function group	Heating/cooling control
HYS	Hysteresis (heating): Adjustment function group	ON/OFF control
CHYS	Hysteresis (cooling): Adjustment function group	ON/OFF control

ON/OFF Control Setup

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

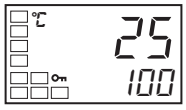
EXAMPLE

Operation Procedure: Configuring the PID ON/OFF and Hysteresis Parameters

In this example, first check that the PID ON/OFF parameter is set to dNOF in the Initial Setting function group. The Setpoint and Hysteresis parameters will also be adjusted.

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

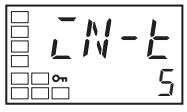
Figure 3.45



PV

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

Figure 3.46



Input type

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

Figure 3.47

PID•ON/OFF

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

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

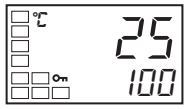
Setting the SP

Operating Procedure

In the second part of this example, the set point is modified to 200. The set value (i.e., the SP) is shown on the controller's bottom display.

1. Select the Process Value/Set Point parameter in the Operation function group.

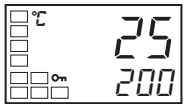
Figure 3.48



PV/SP

2. Use the ⌃ and ⌄ keys to change the SP. (In this example, it is configured to 200.)
The new set value can be loaded into controller memory by pressing the ↵ key, or it will go into effect after 2 seconds have elapsed. Next, set the hysteresis.

Figure 3.49



Setting the Hysteresis

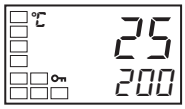
Operating Procedure

The third part of the example is to configure the hysteresis to 2.0°C.

1. Press the [O] key to move from the Operation function group to the Adjustment function group.

Figure 3.50

Figure 3.51

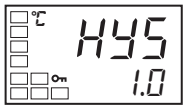


2. The Adjustment function group Display parameter will be displayed in the adjustment function group.

Figure 3.52

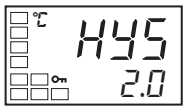
3. Select the Hysteresis (Heating) parameter by pressing the [↵] key.

Figure 3.53



4. Press the [∧] and [∨] keys to set the hysteresis (2.0 in this example). Either press the [↵] key or wait for at least 2 seconds after setting the hysteresis value to load the new value into controller memory.

Figure 3.54



5. To return to the Operation function group, press the [O] key for at least 1 second.

Determining PID Constants (AT, ST, Manual Setup)

AT (Auto-Tuning)

Figure 3.55

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.

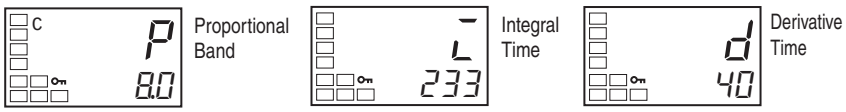
Either 40% AT or 100% AT can be selected depending on the width of MV variation in the limit cycle. In the AT Execute/Cancel parameter, specify AT-2 (100% AT) or AT-1 (40% AT). To cancel AT, specify off (AT cancel).

- Only 100% AT can be executed for heating and cooling control.
- AT cannot be executed when control has stopped or during ON/OFF control.
- The results of AT are reflected in the Proportional Band (P), Integral Time (I), and Derivative Time (D) parameters in the Adjustment function group.

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

Figure 3.56 — PID

Adjustment Level



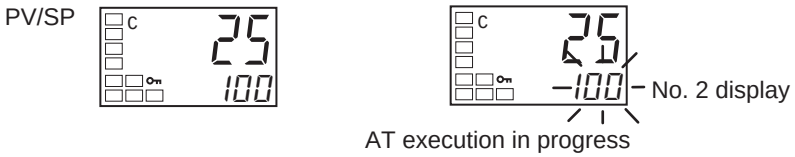
AT Description and Display Consideration

AT (Auto-Tuning) is started when you configure either AT-2 (100%) or AT-1 (40% AT).During execution of AT, the No. 1 display for the AT Execute/Cancel parameter blinks (refer to Figure 3.57). When AT ends, the AT Execute/Cancel parameter turns OFF, and the No. 1 display stops blinking.

Figure 3.57 — AT Execute/Cancel Parameter

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

Figure 3.58



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

AT Calculated Gain

The AT Calculated Gain parameter sets the gain when PID values are calculated using AT. When you need to enhance response, decrease the set value. When you need to enhance stability, increase the set value.

AT Hysteresis

The AT Hysteresis parameter configures the hysteresis when switching ON and OFF for the limit cycle operation during auto-tuning.

Limit Cycle MV Amplitude

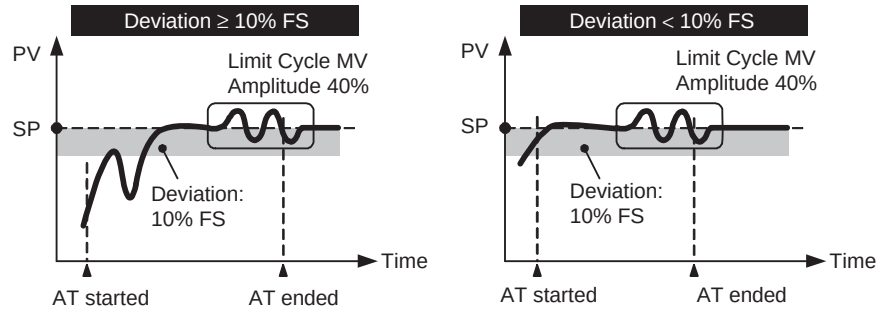
The Limit Cycle MV Amplitude parameter configures the MV amplitude for limit cycle operation during auto-tuning.

Note: This parameter is disabled for 100% AT.

40% AT

The width of the MV variation in the limit cycle can be changed in the Limit Cycle MV Amplitude parameter, but the AT execution time may be longer for 100% AT. The limit cycle timing varies according to the deviation (DV) at the start of auto-tuning execution is less than 10% FS

Figure 3.59 — Limit Cycling Times

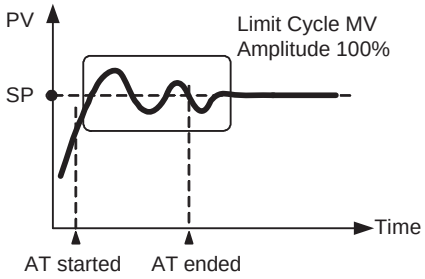


100% AT

Operation will be as shown in the following diagram, regardless of the deviation (DV) at the start of AT execution. To shorten the AT execution time, select 100% AT.

Note: The Limit Cycle MV Amplitude parameter is disabled at 100% AT.

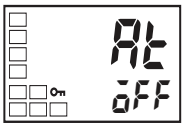
Figure 3.60 — Operation



EXAMPLE

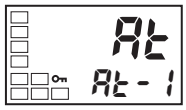
Operation Procedure: Execute 40% Auto-Tuning (AT)

Figure 3.61 — Adjustment Function Group



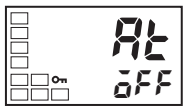
1. Press the ◯ Key to move from the Operation function group to the Adjustment function group.

Figure 3.62



2. Press the ⌃ Key to select at-1. The No. 1 display for AT Execute/Cancel will flash during AT execution.

Figure 3.63



3. oFF will be displayed when AT ends.

Figure 3.64

4. To return to the operation function group, press the ◯ Key.

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 3.65 — Self-Tuning Function

In the ST (Self-Tuning) function, the 900-TC controller continually executes step response tuning (SRT) from the start of program execution or when the set point is changed to calculate the PID constants to match 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**.

ST is executed when the ST parameter is set to ON in the Initial Setting function group.

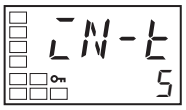
When the ST function is in operation, make sure to turn ON the power supply of the load connected to the control output (MV) simultaneously with or before starting operation of the Bulletin 900 controller. If power to the controller is turned ON before turning ON load power, self-tuning will not be performed properly and optimum control will not be achieved.

EXAMPLE

Operation Procedure: Execute Self-Tuning (ST)

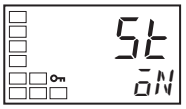
1. Press the [O] key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.66



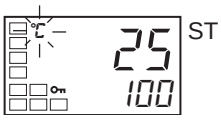
2. Select the ST parameter by pressing the [↵] key.

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



4. To return to the Operation function group, press the [O] key. The temperature display blinks during Self-Tuning (ST) execution, and stops when it is complete.

Figure 3.67



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 (SRT)

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.J

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 when the previous SRT was executed. ❶ 2. The difference between the controlled temperature at start of program execution and the set point is larger than both of the following: (proportional band x 1.27+4°C) and the ST stable range. 3. The controlled temperature at the start of program execution is less than the set point during reverse operation, and is greater than the set point during direct operation. 4. No reset from input error	1. The new set point differs from the set point used when the previous SRT was executed. ❶ 2. The set point change width is larger than both of the following: (proportional band x 1.27+4°C) and the ST stable range. 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. ❷ Equilibrium with the output at 0% when the power is turned ON is also all right. ❸

❶ The previous SRT-implemented set point is the set point used for calculating the PID constant for the previous SRT.

❷ In this state, the measurement point is within the ST stable range.

❸ 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 configure the value to determine the condition under which the ST function occurs.

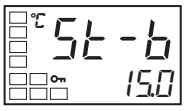
In this example, the ST stable range will be configured to 20 °C.

EXAMPLE

Operation Procedure

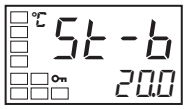
1. Select the ST Stable Range parameter by pressing the key in the Advanced Setting function group. To move to this function group, refer to page 4-31, *To Move to the Advanced Setting Function Group*.

Figure 3.68



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

Figure 3.69



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

RT (Robust Tuning)

Figure 3.70

When Auto-Tuning (AT) or Self-Tuning (ST) is executed with Robust-Tuning (RT) selected, PID constants are automatically configured by the controller that make it difficult for control performance to degenerate even when control object characteristics are frequently changing.

RT is configured in the Advanced Setting function group when the PID control mode is selected.

The RT mode cannot be selected when an analog input is configured.

Selecting the RT mode in the following cases will help to prevent the occurrence of hunting by the MV.

- When the set point temperature is often changed and varies in a wide range

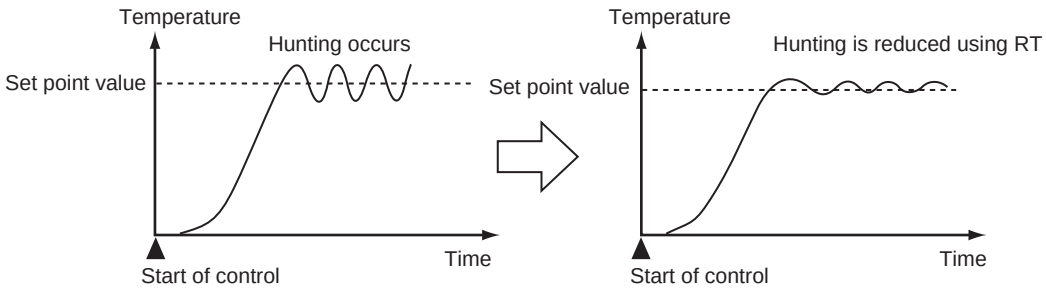
- When there are large variations in ambient temperatures due to factors such as seasonal changes or differences between day and night temperatures
- When there are large variations in air flow in the control cabinet
- When heater characteristics change depending on the control system temperature
- When an actuator with disproportional I/O, such as a phase-control-type power regulator, is used
- When a heater is used with fast response characteristics
- When the control object or sensor has slow response
- When hunting occurs in AT or ST for any reason

Note: PID constants are initialized to the factory settings when switching to RT. When RT is selected, the derivative time setting unit becomes second.

RT Features

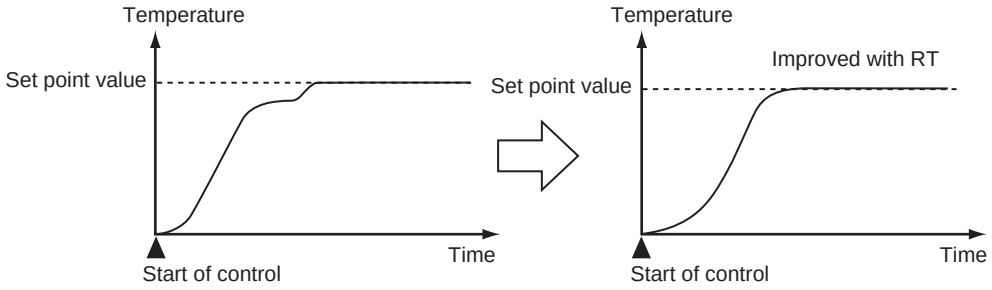
- Even when hunting occurs for PID constants when AT or ST is executed in normal mode, it is less likely to occur when AT or ST is executed in RT mode.

Figure 3.71 — Hunting



- When the temperature (PV) falls short of the set point for the PID constants when using AT or ST in normal mode, executing AT or ST in RT mode tends to improve performance.

Figure 3.72 — Executing AT or ST in RT Mode



- When the manipulated variable (MV) is saturated, the amount of overshooting may be somewhat higher in comparison to PID control based on AT or ST in normal mode.

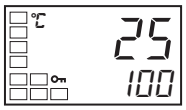
EXAMPLE

Operation Procedure

This example selects RT mode.

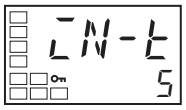
1. Press the [O] key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.73



2. Select the Move to Advanced Setting function group parameter by pressing the [↵] key.

Figure 3.74

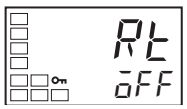


3. Use the [∨] key to enter **–169** (the password).
   It is possible to move to the Advanced Setting function group by pressing the [↵] key or leaving the setting for at least 2 seconds.

Figure 3.75

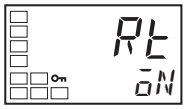
4. Press the key to select RT (Robust Tuning).

Figure 3.76



5. Press the key to select oN. oFF is the default.

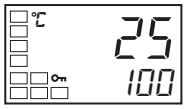
Figure 3.77



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.

Figure 3.78



Manual PID Setup

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

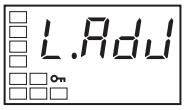
EXAMPLE

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.

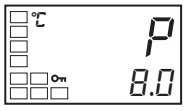
Figure 3.79



Adjustment Function Group Display

2. Select Proportional Band by pressing the ⏎ key.

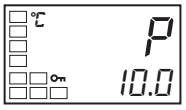
Figure 3.80



Proportional band

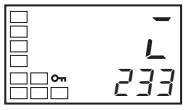
3. Press the ⏶ or ⏷ key to set the Proportional Band parameter to 10.0.

Figure 3.81



4. Select Integral Time by pressing the ⏎ key.

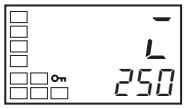
Figure 3.82



Integral time

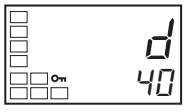
5. Press the ⏶ or ⏷ key to set the Integral Time parameter to 250.

Figure 3.83



6. Select Derivative Time by pressing the ⏎ key.

Figure 3.84



Derivative time

7. Press the ⩓ or ⩔ key to set the parameter to 45.

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

Figure 3.85

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

Note: Proportional/Action: 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.K — When P (Proportional Band) is Adjusted

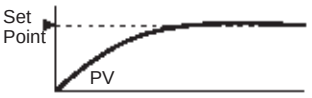
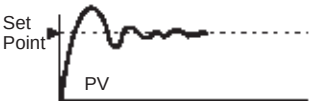
When P is increased		The curve rises gradually, and a long stable time is achieved, preventing overshoot.
When P is decreased		Overshoot and hunting occur, however the set point is quickly reached after which the curve stabilizes.

Table 3.L — When I (Integral Time) is Adjusted

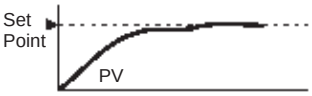
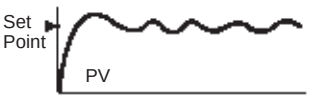
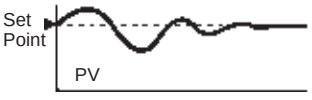
When I is increased		It takes a long time for the process value to reach the set point. It takes time to achieve a stable state, however there is little overshoot/undershoot and hunting.
When I is decreased		Overshoot/undershoot and hunting occur, and the curve rises quickly.

Table 3.M — 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, Bulletin 900-TC16 supports two alarm outputs, and Bulletin 900-TC32 supports one alarm output..

The controller alarm output conditions are determined by the combination of the selected Alarm Type, Alarm Value, 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.

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

Table 3.N — Alarm Values

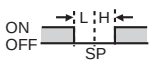
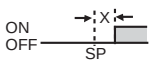
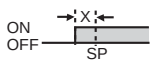
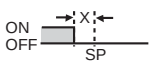
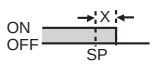
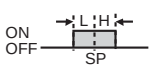
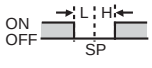
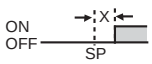
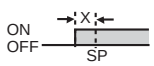
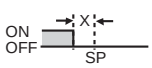
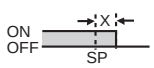
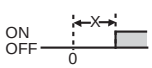
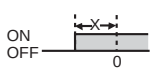
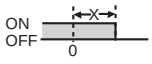
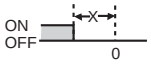
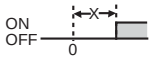
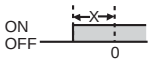
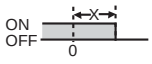
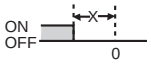
Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
0	Alarm function OFF	Output OFF	
1❶	Upper- and Lower-Limit (deviation range)		❷
2	Upper-limit (deviation)		
3	Lower-limit (deviation)		
4 ❶	Upper- and Lower-Limit range (deviation range)		❸
5 ❶❺	Upper- and Lower-Limit with standby sequence (deviation range)		❹
6	Upper-limit with standby sequence (deviation)		
7	Lower-limit with standby sequence (deviation)		
8	Absolute-value Upper-Limit		

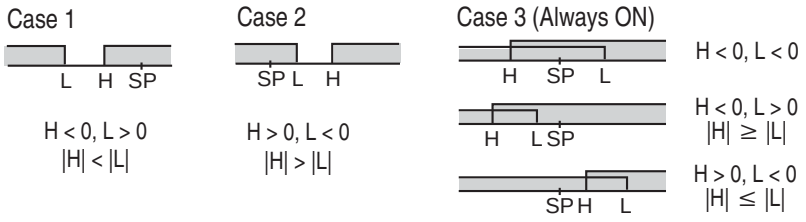
Table 3.N — Alarm Values

Set Value	Alarm Type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
9	Absolute-value Lower-Limit		
10	Absolute-value Upper-Limit with standby sequence		
11	Absolute-value Lower-Limit with standby sequence		
12	Loop Break Alarm (LBA) (Alarm 1 Type only)	—	
13	PV Change Rate Alarm	—	

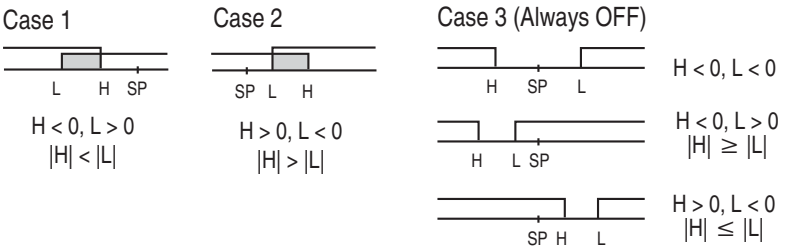
Note: Shading indicates default setting. Set the alarm type independently for each alarm in the Alarm 1 to 3 Type parameters in the Initial Setting function group. The default is 2 (Upper-limit alarm).

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

❷ Set value: 1 (Upper- and Lower-Limit alarm)



❸ Set value: 4 (Lower-Limit range)

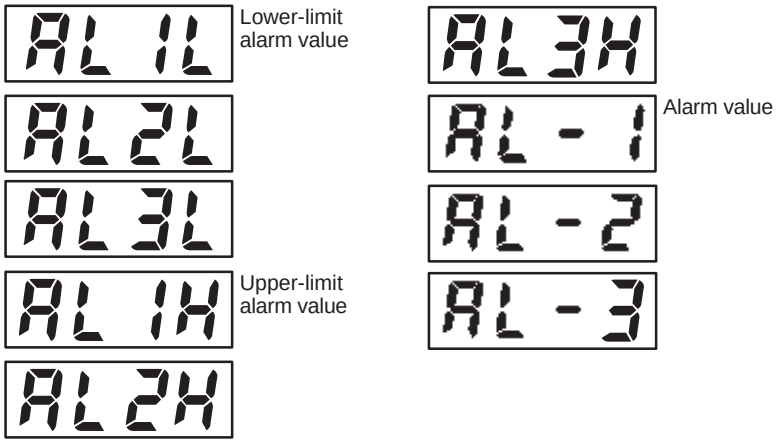


❹ Set value: 5 (Upper- and Lower-Limit with standby sequence)
For the Lower-Limit alarms in cases 1 and 2 above, the alarm is normally OFF if upper- and Lower-Limit hysteresis overlaps. In case 3, the alarm is always OFF.

❺ Set value: 5 (The alarm is always OFF if upper- and Lower-Limit alarm hysteresis with standby sequence overlaps.)

Alarm Value

Figure 3.86



Alarm types can be configured independently for each Alarm 1 to 3 in the Initial Setting function group. The default is 2 (Upper Limit Alarm.)

Alarm values are indicated by **X** in Table 3.M. 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. (Temperature units 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 to the Initial Setting function group.

Figure 3.87

Input type

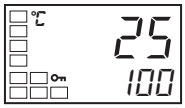
2. Select the Alarm 1 Type parameter by pressing the ↵ key. Check that the Alarm Type parameter is set to 2. **Note:** The default is Upper-Limit alarm.

Figure 3.88

Alarm 1 type

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

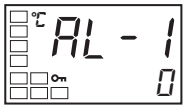
Figure 3.89



PV/SP

4. Select Alarm Value 1 by pressing ↵.

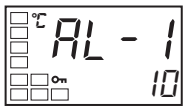
Figure 3.90



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 3.91



PV Change Rate Alarm

The change width (rate of change) for PV input values can be found in any time period. Differences with previous values in each set period are calculated, then an alarm is output if the result exceeds the alarm value. The PV rate of change calculation period can be configured in units of 250 ms.

If a positive value is configured for the alarm value, the PV will operate as a change rate alarm in the rising direction. If a negative value is configured, the PV will operate as a change rate alarm in the falling direction.

Precaution

If a shorter PV rate of change calculation period is configured, outputs for the PV change rate alarm may repeatedly turn ON and OFF for a short period of time. Therefore, it is recommended that the PV change rate alarm be used with the alarm latch turned ON.

Figure 3.92

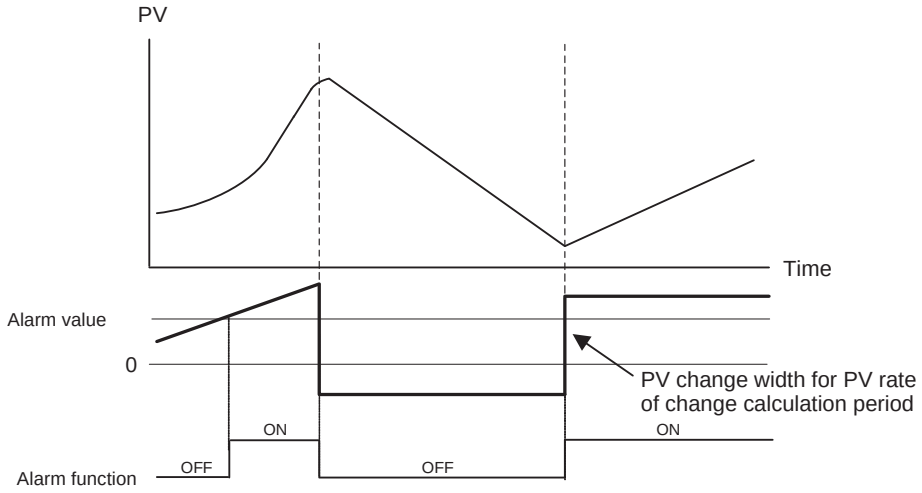


Table 3.0

Parameter Name	Configurable Range	Units	Default
PV Rate of Change Calculation Period	1...999	Sampling Cycle	4 (1 s)

Heater Burnout Alarm (HBA), Heater Short Alarm (HSA), and Heater Overcurrent Alarm (HOA)

HBA, HSA, and HOA Alarm Detection — 900-TC8 & 900-TC16 only

Heater burnout and heater overcurrent detection are executed by:

1. measuring heater current with an optional current transformer (single phase) **or**

2. transformers (3 -phase) while the control output for heating is ON, and HS detection is executed by measuring heater current while it is OFF.

For details, refer to the following table and figure below..

Note: Heater burnout, heater short, and heater overcurrent detection cannot be used with the control output for cooling.)

Table 3.P — Heater Burnout & Heater Overcurrent Detection

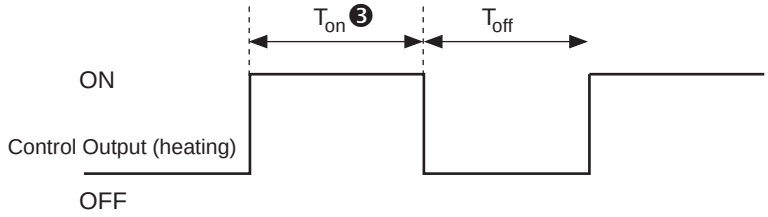
Heating Control Output Status					
Control Output (Heating)	**Operation Indicator**	**Power to Heater**	**HBA Output**	**HS Alarm Output**	**Heater Overcurrent Alarm**
ON	Lit	Yes (Normal) ❶	OFF	—	—
		No (Heater burnout)	ON	—	—
OFF	Not lit	Yes (HS alarm)	—	ON	—
		No (Normal) ❷	—	OFF	—
ON	Lit	Normal	—	—	OFF
		Heater overcurrent status ❸	—	—	ON

❶ In the above diagram, heater power is considered to be ON (normal) if the heater current, measured by the 900-CTX current transformer, is greater than the heater burnout detection current during the T_{on} interval. If the heater is burned out, the measured current decreases and falls below the heater burnout detection value. The configured controller output is then activated as the Heater Burnout Alarm.

❷ In the above diagram, heater power is considered to be OFF (normal) if the leakage current, measured by the 900-CTX current transformer, is less than the HS alarm current during the T_{off} interval. If the SSR output is short-circuited, the measured current increases beyond the HS alarm value. The output is then activated as the HS alarm.

❸ In the above diagram, it is regarded as normal when the heater current is less than the heater overcurrent detection current during the Ton period. Current is increased when excessive current flows to the heater, causing the heater overcurrent detection value to be exceeded and an OC (heater overcurrent) alarm to be output.

Figure 3.93



Note: Heater Burnout Alarms (HBA) are not detected if the control output (heating) ON time (T_{on}) - is 100 ms or less.

Note: Heater Short Alarms (HSA) are not detected if the control output (heating) OFF time (T_{off}) is 100 ms or less.

- For controller models with HBA, HSA, and HOA alarms, an OR output is established between the ALM 1 function and the HBA, HSA, and HOA alarm. If the ALM1 function is to be used for HBA, HSA, and HOA alarms only, set 0 as the ALM1 type and do not use ALM1.

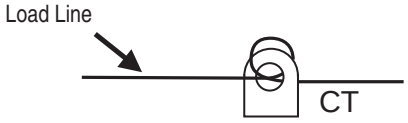
- Turn the heater power ON simultaneously or before turning power ON to the 900-TC8 or 900-TC16 controller. If the heater power is turned ON after turning ON the 900-TC8 and 900-TC16 power, the HBA will be activated.

- The temperature controller continues to attempt to control the system even when the HBA or HS alarm is active.

- The displayed current value may sometimes differ slightly from the actual current flowing to the heater.
  Use the Heater Current 1 Value Monitor, Heater Current 2 Value Monitor, Leakage Current 1 Monitor, and Leakage Current 2 Monitor parameters to check the actual current being used by the controller for alarm purposes.

- If there is little difference between the displayed current in normal and abnormal (i.e., alarm) states, detection may become unstable. To stabilize detection, configure an alarm a current value difference of at least 1.0 A for heaters of less than 10.0 A, and at least 2.5 A for heaters of 10.0 A or more. If the heater current is too low, loop the load line several times through a CT, as shown in the diagram below. Looping it through twice will double the detection current.

Figure 3.94 — Loop Load Line



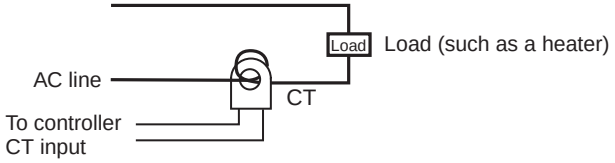
Installing Current Transformers (CT)

This function can be used with 900-TC8 controller models that have the HBA, HSA, and HOA alarms and 900-TC16 controllers with the heater burnout/heater short/heater overcurrent option unit installed.
For the 900-TC16, connect the CT in advance to terminals 14 and 15 (CT1), or 13 and 15 (CT2). For the 900-TC8, connect the CT in advance to terminals 14 and 15 (CT1) or 15 and 16 (CT2). Then pass the heater power line through the CT's hole.
For specifications, models and dimensions of current transformers that can be used with this Controller, refer to Appendix A.

Single-phase Heaters

For single-phase heaters, install the CT in the position shown in the following diagram.

Figure 3.95 — CT Position for Single-Phase Heaters



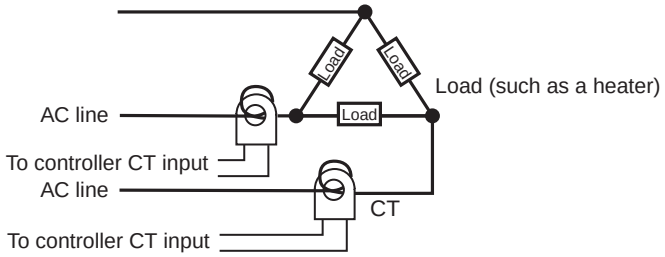
Three-phase Heaters

When a 3-phase power supply is used, regardless of the types of connecting lines, two current transformers (CTs) are required to detect heater burnout and HS.

1. **For Delta connecting power lines:** Refer to the following diagram for CT installation positions.

Note: Heater voltage fluctuations are not considered here. Take this into account when setting the detection current.

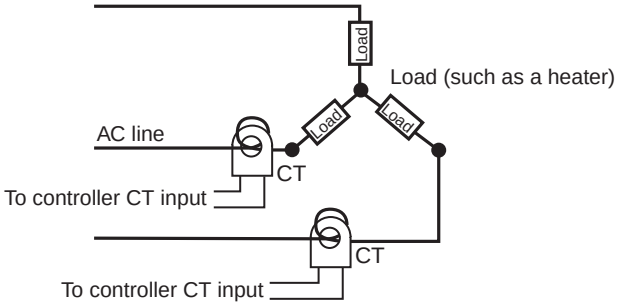
Figure 3.96 — CT Installation Positions, Delta Connecting Power Lines



2. **For Star (Y) connecting power lines:** Refer to the following diagram for CT installation positions.

Note: Heater voltage fluctuations are not considered here. Take this into account when setting the detection current.

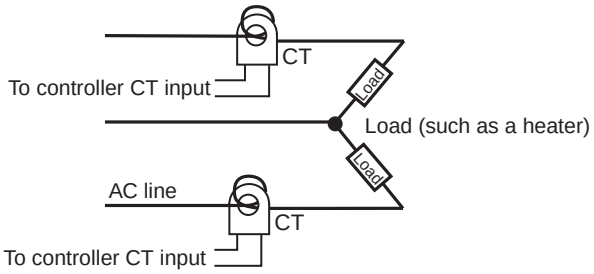
Figure 3.97 — CT Installation Positions, Start (Y) Connection Power Lines



3. **For V connecting power lines:** Refer to the following diagram for CT installation positions.

Note: Heater voltage fluctuations are not considered here. Take this into account when setting the detection current.

Figure 3.98 — CT Installation Positions, V Connecting Power Lines



How to Calculate Heater Current Detection Values

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

$$\text{Heater Burnout Detection 1/2 set value} = \frac{\text{Normal current value} + \text{Burnout current value}}{2}$$

$$\text{HS Alarm 1/2 set value} = \frac{\text{Leakage current value (output OFF)} + \text{HS current value}}{2}$$

$$\text{Heater overcurrent 1/2 set value} = \frac{\text{Normal current value} + \text{Overcurrent value}}{2}$$

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

- Make sure that the following conditions are satisfied:

  – When using a heater with a normal load current of less than 10.0 A: (Current value at normal operation) − (Current value at heater burnout) ≥ 1 A
  When the difference is less than 1 A, detection is unstable.

  – When using a heater with a normal load current of 10.0 A or more: (Current value at normal operation) − (Current value at heater burnout) ≥ 2.5 A
  When the difference is less than 2.5 A, detection is unstable.

- The allowable controller heater current range is 0.1…49.9 A. Heater burnout, HS, and heater overcurrent are not detected when the configured alarm value is 0.0 or 50.0.
  When the configured alarm value is 0.0, the Heater Burnout Alarm is always OFF, the HS, and HO Alarm is always ON.
  When the configured alarm value is 50.0, the Heater Burnout Alarm is always ON, and the HS Alarm is always OFF, and the HOA is always OFF.

- Configure the total current value for normal heater operation to 50 A or less. When a current value of 55.0 A is exceeded, FFFF is displayed in the Heater Current 1 (and 2) Value Monitor and Leakage Current 1 (and 2) Monitor parameters.

Application Examples

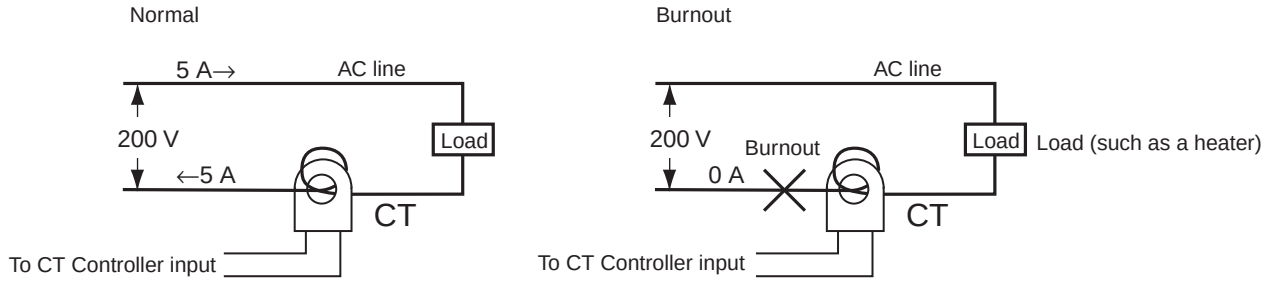
Single-Phase Heaters

EXAMPLE

Using a 200V AC, 1 kW Heater

The heater power supply provides 5 A when the current is normal, and 0 A when there is a burnout.

Figure 3.99



Therefore, the heater burnout detection current is calculated as follows:

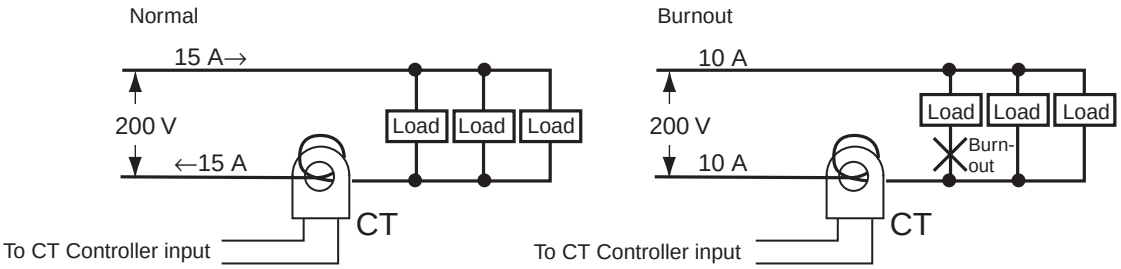
$$\text{Heater burnout detection current} = \frac{\text{(Normal current) + (Heater burnout current)}}{2} = \frac{5 + 0}{2} = 2.5\ [\text{A}]$$

EXAMPLE

Using Three 200V AC, 1 kW Heaters

The heater power supply provides 15 A when the current is normal, and 10 A when there is a burnout.

Figure 3.100 — Using Three 200V AZ, 1 kW Heaters



Therefore, the heater burnout detection current is calculated as follows:

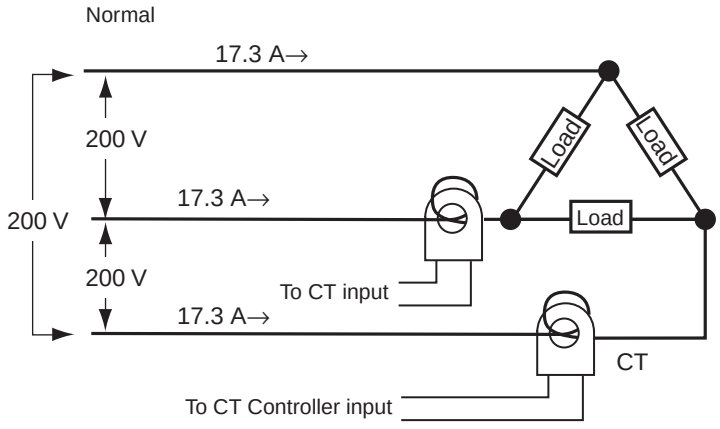
$$\text{Heater burnout detection current} = \frac{\text{(Normal current) + (Heater burnout current)}}{2} = \frac{15 + 10}{2} = 12.5\ [\text{A}]$$

EXAMPLE

Using Three-Phase Heaters, Delta Connecting Lines

The current when each phase is normal is 17.3 A ($\approx \sqrt{3} \times 10$ A).

Figure 3.101 — Delta Connecting Lines

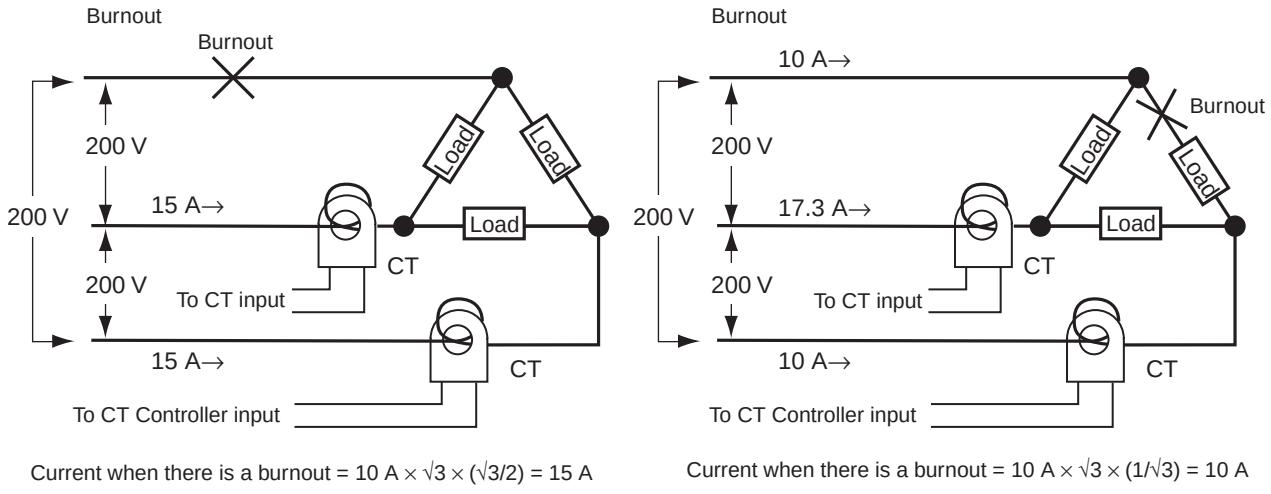


The heater burnout current when there is a burnout at the load line is as follows: (heater burnout detection current) = (17.3 + 15) / 2 ≈ 16.1 [A]

The heater burnout current when there is a burnout at the load is as follows:
(heater burnout detection current) = (17.3 + 10) / 2 ≈ 13.65 [A]

To enable detection in either case, use 16.1 A as the heater burnout detection current.

Figure 3.102 — Heater Burnout Detection



Current when there is a burnout = 10 A × √3 × (√3/2) = 15 A

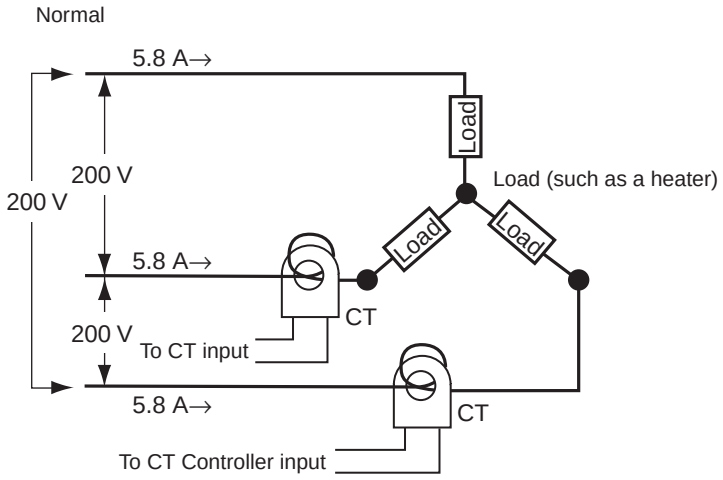
Current when there is a burnout = 10 A × √3 × (1/√3) = 10 A

EXAMPLE

Using Three 200V AC, 2 kW Heaters, Star Connecting Lines

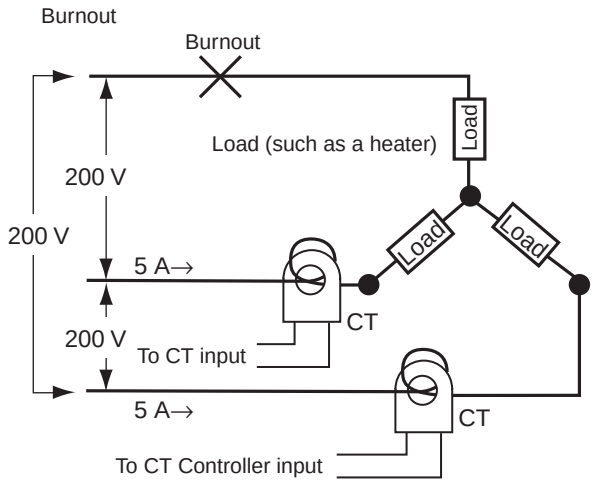
The current when each phase is normal is 5.8 A (≈ 10 A × (1 /√3)).

Figure 3.103 — Star Connecting Lines

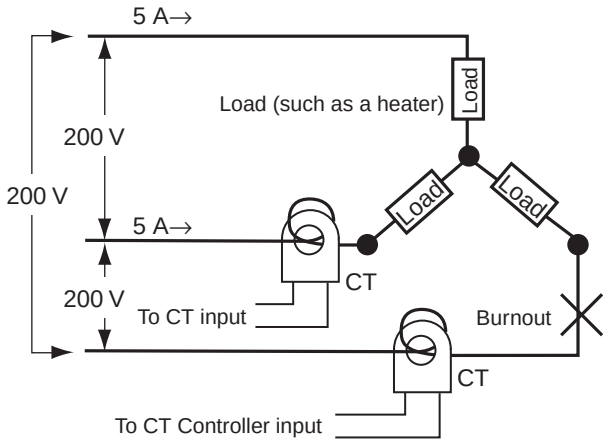


The heater burnout detection current for this connecting line is 5.4 A (= (5.8 + 5) / 2).

Figure 3.104 — Heater Burnout Detection



Current when there is a burnout = 10 A × (1/√3) × (√3/2) = 5 A

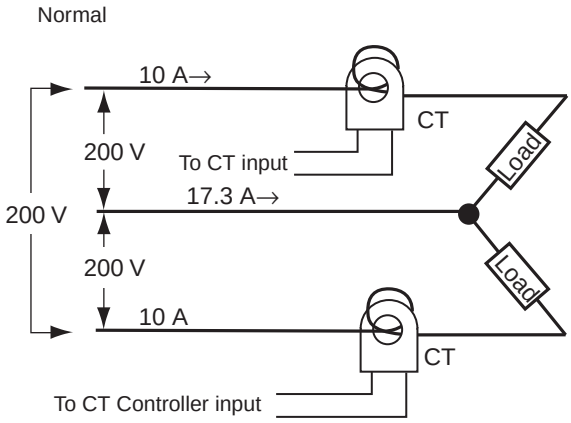


Current when there is a burnout = 10 A × (1/√3) × (√3/2) = 5 A

EXAMPLE

Using Two 200V AC, 2 kW Heaters, V Connecting Lines

Figure 3.105 — V Connecting Lines

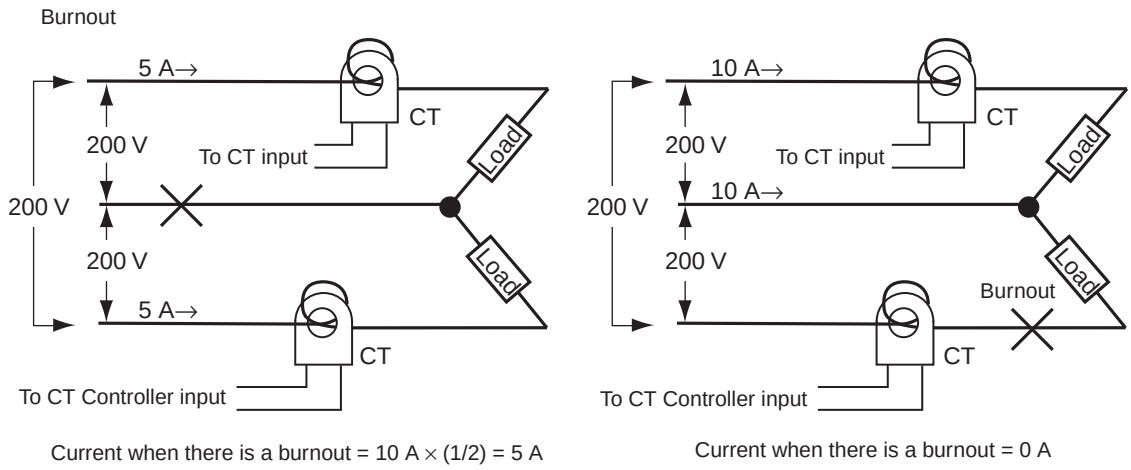


The heater burnout current when there is a burnout at the common is as follows:
Heater burnout detection current = (10 + 5) / 2 ≈ 7.5 [A]

The heater burnout current when there is a burnout at the load is as follows:
Heater burnout detection current = (10 + 0) / 2 ≈ 5 [A]

To enable detection in either case, use 7.5 A as the heater burnout detection current.

Figure 3.106 — Heater Burnout Detection



Heater Burnout Alarm (HBA) Setup

To activate the Heater Burnout Alarm (HBA), configure:

1. the Heater Burnout (HB) ON/OFF parameter to ON in the Advanced Setting function group, **and**

2. the Heater Burnout Detection 1 and Heater Burnout Detection 2 parameters in the Adjustment function group.

EXAMPLE

Operating Procedure: Moving to the Advanced Setting Function Group

In this example configure the Heater Burnout Detection 1 parameter to 2.5.

The Heater Burnout Detection parameter setting is already ON by default, so set the Heater Burnout Detection 1 parameter.

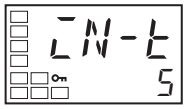
1. Move to the Advanced Setting function group.
   Press the [O] key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.107

PV/SP

2. Select Move to Advanced Setting function group by pressing the [↵] key.

Figure 3.108

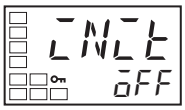


Input type

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.

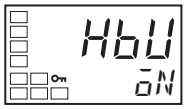
Figure 3.109

Moves to Advanced Setting Function Group



4. Select the Heater Burnout Detection parameter by pressing the [↵] key. Check that this parameter is set to ON (the default).
   Next, set the Heater Current 1 Value Monitor parameter.

Figure 3.110

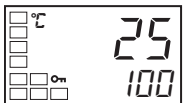


Heater burnout detection

Setting Heater Burnout Detection

1. 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.

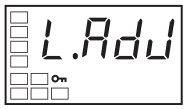
Figure 3.111



PV/SP

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

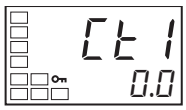
Figure 3.112



Adjustment function group display

3. Select the Heater Current 1 Value Monitor parameter by pressing the ↵ key. Check the current value. Next, set the Heater Burnout Detection 1 parameter.

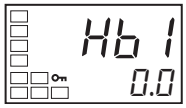
Figure 3.113



Heater current 1 value monitor

4. Select the Heater Burnout Detection 1 parameter by pressing the ↵ key. Refer to How to Calculate Heater Current Detection Values when making the settings.

Figure 3.114



Heater burnout detection 1

5. For this example, set 2.5. To return to the Operation function group, press the ○ key for less than 1 second.

Figure 3.115

HS Alarm Setup

To activate the HS alarm, set the HS Alarm Use parameter to ON in the Advanced Setting function group and set the HS Alarm 1 and HS Alarm 2 parameters in the Adjustment function group.

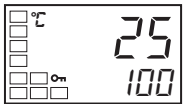
EXAMPLE

Operating Procedure: Moving to the Advanced Setting Function Group

The HS Alarm Use parameter setting is already ON by default, so set the HS Alarm 1 parameter to 2.5.

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.

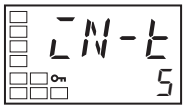
Figure 3.116



PV/SP

2. Select Move to Advanced Setting function group by pressing the [↵] key.

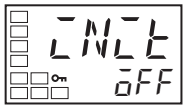
Figure 3.117



Input type

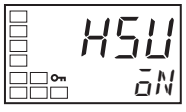
3. Press the [≫] key to enter the password (**–169**), and move from the Initial Setting function group to the Advanced Setting function group.
   The top parameter in the Advanced Setting function group is displayed.

Figure 3.118

Moves to Advanced Setting Function Group


4. Select the HS Alarm Use parameter by pressing the [↵] key.
   Check that this parameter is set to ON (the default).
   Next, set the Leakage Current 1 Monitor parameter.

Figure 3.119

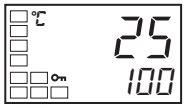


HS alarm use

HS Alarm Settings

1. 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.

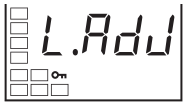
Figure 3.120



PV/SP

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

Figure 3.121



Adjustment function group display

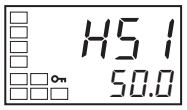
3. Select the Leakage Current 1 Monitor parameter by pressing the ⏎ key. Check the current value. Next, set the HS Alarm 1 parameter.

Figure 3.122

Leakage current 1 monitor

4. Select the HS Alarm 1 parameter by pressing the ⏎ key. Refer to *How to Calculate Heater Current Detection Values* when setting the values.

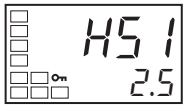
Figure 3.123



HS alarm 1

5. For this example, set 2.5. To return to the Operation function group, press the ○ key for less than 1 second.

Figure 3.124



Heater Overcurrent Alarm Set-up

To activate the heater overcurrent alarm (HOA), set the:

1. Heater Overcurrent Use parameter to ON in the Advanced Setting function group **and**

2. Heater Overcurrent Detection 1 and Heater Overcurrent Detection 2 parameters in the Adjustment function group.

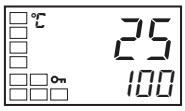
Note: This procedure configures the Heater Overcurrent Detection 1 parameter to 20.0.

Moving to the Advanced Setting Function Group

The default setting for the Heater Overcurrent Use parameter is ON, so set the Heater Overcurrent Detection 1 parameter

Move to the Advanced Setting function group. Press the ○ Key for at least three seconds to move from the Operation to the Initial Setting function group.

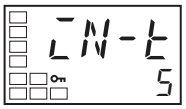
Figure 3.125



PV/SP

3. Press the ↵ Key to select the Move to Advanced Setting function group parameter. (For details on moving between function groups, refer to 4-8 Moving to the Advanced Setting function group.)

Figure 3.126

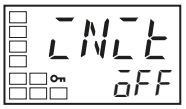


Input Type

4. Press the » Key to enter the password (-169), and move from the Initial Setting function group to the Advanced Setting function group.

Figure 3.127

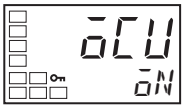
The top parameter in the Advanced Setting function group is displayed.



Move to the Advanced Setting function group

5. Press the Key to select the Heater Overcurrent Use parameter.Check that this parameter is set to ON (the default), and then set the Heater Overcurrent Detection 1 parameter.

Figure 3.128

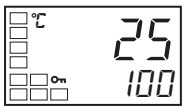


Heater Overcurrent Use

Configure Overcurrent Detection

1. Press the Key for at least one second to move from the Advanced Setting function group to the Initial Setting function group. Press the key again for at least one second to move to the Operation function group.

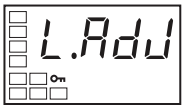
Figure 3.129



PV/SP

2. Press the Key for less than one second to move from the Operation function group to the adjustment function group.

Figure 3.130



Adjustment function group display

3. Press the Key to select the Heater Current 1 Value Monitor parameter.Check the current value, and then modify the Heater Overcurrent Detection parameter in step #8 to meet the requirements of your application.

Figure 3.131

Heater Current 1 Value Monitor

4. Press the Key to select the Heater Overcurrent Detection 1 parameter. Refer to Calculating Detection Current Values when setting the values.

Figure 3.132

Heater Overcurrent Detection 1

5. For this example, set 20.0. To return to the Operation function group, press the ○ Key for less than one second.

Figure 3.133

Set-up of the No. 3 Display

This section describes how to configure the No. 3 Display (900-TC8). The Multi-SP, MV or Soak Time Remain parameters can be displayed on the No. 3 display.

PV/SP Display Selection

The following table shows the set values and display contents for the PV/SP Display selection.

Table 3.Q — PV & SP Display Selection

Set Value	Display Contents
0	Only PV/SP is displayed (with no No. 3 display.)
1	PV/SP/Multi-SP and PV/SP/MV are displayed in order. ❶
2	PV/SP/MV and PV/SP/Multi-SP are displayed in order. ❶)
3	Only PV/SP/Multi-SP is displayed.
4	Only PV/SP/MV is displayed. ❶
5	PV/SP/Multi-SP and PV/SP/Soak time remain are displayed in order.
6	PV/SP/MV and PV/SP/Soak time remain are displayed in order. ❶
7	Only PV/SP/Soak time remain is displayed.

❶ A 2-level display is configured when shipped from the factory. (set value: 0). A 3-level display is activated if parameters are initialized. (set value: 4)

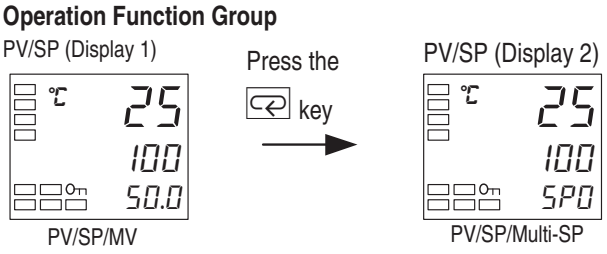
Note: For details on configuring the MV for heating and cooling control, refer to *MV Display for Heating and Cooling Control* below.

When 1, 2, 5, or 6 is selected, press the ◁ Key to display the next value set for the PV/SP display (display 2).

EXAMPLE

When the PV/SP Display Screen Parameter Is Set to 2

Figure 3.134



MV Display for Heating and Cooling Control

Select either the manipulated variable (heating) or manipulated variable (cooling) as the MV to be displayed for PV/SP/MV during heating and cooling control. The MV Display Selection parameter is displayed only when:

1. heating/cooling control is being performed and PV/SP/MV is selected in the PV/SP Display Screen parameter **or**
2. a Monitor/Setting Item Display parameter.

Table 3.R

Parameter Name	Set Value	Symbol	Display Contents
MV Display Selection	0	o	Manipulated variable (heating)
	C-0	C-o	Manipulated variable (cooling)

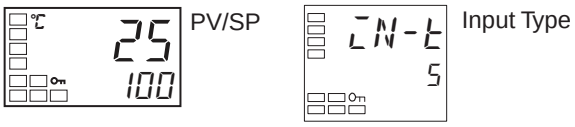
EXAMPLE

PV/SP/MV and PV/SP/Multi-SP on the Process Value/Set Point Display

This procedure displays PV/SP/MV and PV/SP/Multi-SP on the Process Value/Set Point display. The PV/SP Display Screen Selection parameter is set to 2.

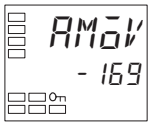
1. Press the ○ Key for at least three seconds to move from the Operation function group to the Initial Setting function group.

Figure 3.135



2. Press the Key to select the Move to Advanced Setting function group.

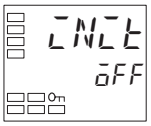
Figure 3.136



Move to Advanced Function Setting Level

3. Use the Key to enter the password ("-169"). It is possible to move to the Advanced Setting function group by either pressing the Key or waiting two seconds without pressing any key.

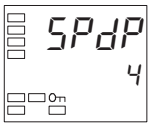
Figure 3.137



Parameter Initialization

4. Press the Key to select the PV/SP Display Screen Selection parameter.

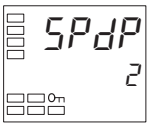
Figure 3.138 — PV/SP Display Screen



PV/SP Display Screen Selection

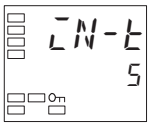
5. Use the and Keys to configure the parameter to a value of 2.

Figure 3.139



6. Press the Key for at least one second to move from the Advanced Setting function group to the Initial Setting function group.

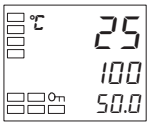
Figure 3.140



Input Type

7. Press the Key for at least one second to move from the Initial Setting function group to the Operation function group. The MV will be displayed on the No. 3 display.

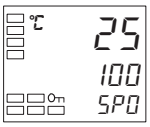
Figure 3.141



PV/SP

8. Press the ↵ Key to confirm that the Multi-SP is displayed on the No. 3 display.

Figure 3.142



PV/SP

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, either a) turn the temperature controller and load (e.g., heater) power ON simultaneously **or** b) turn the load power ON before the temperature controller. **Note:** 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.

   Note: Rather than 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. Refer to Appendix on page A-1 for additional information.

Notes:

Parameter Adjustments & 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 (configured value — See Table 3.C, — *List of Global Temperature (GT) Input Types*). There is no shift for analog inputs. Use scaling for fine adjustments.

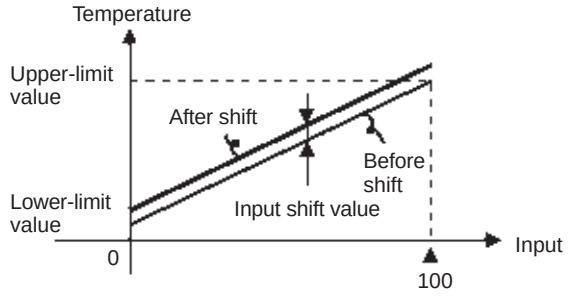
1-Point (Uniform) Shift

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 configured 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 (refer to 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 — Operation Function Group

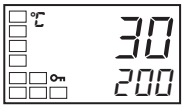
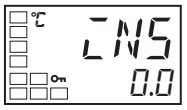


Figure 4.4 Adjustment Function Group

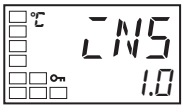
2. Select the Temperature Input Shift parameter by pressing the ↵ key.

Figure 4.5 — Temperature Input Shift



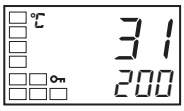
3. Press the ⩓ or ⩔ key to set 1.

Figure 4.6 — Set Shift Parameter



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 4.7 — Operation Function Group



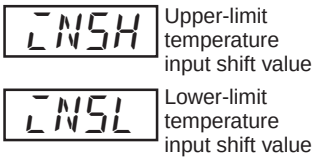
Note: The newly configured value or parameter is loaded into controller memory if you do NOT operate any key on the front panel for at least 2 seconds or by pressing the ○ or ↵ key.

2-Point Shift

Overview

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

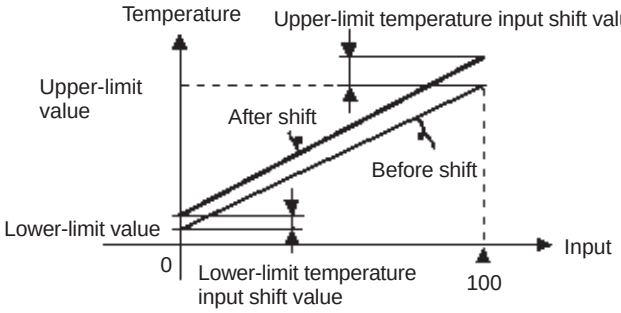
Figure 4.8 — Temperature Limit Shift Value



- The input temperature range of the 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 4.9 — Two-Point Shift



How to Calculate Input Shift Values

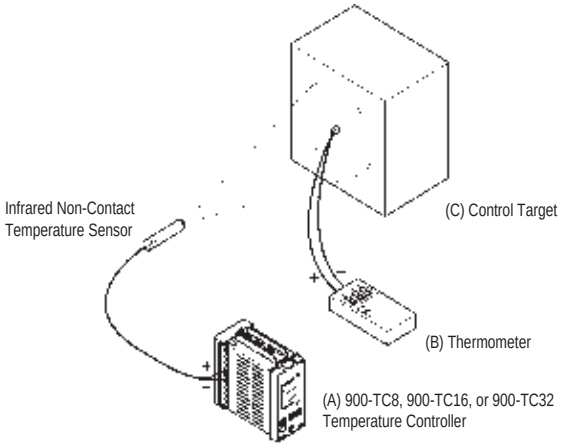
When a non-contact temperature sensor (for example, OMRON ES1B sensor) is connected to the Bulletin 900-TC8, 900-TC16, or 900-TC32, an offset of several degrees to several tenths of a degree can occur. For this reason, it may be desirable to offset the readout value by 1-point or 2-point shift as described here.

Preparations

1. Set to the temperature range to match the input specifications of the non-contact temperature sensor (refer to Table 3.C, — *List of Global Temperature (GT) Input Types*). **Note:** The non-contact infrared sensor is supported only in thermocouple Input Type Bulletin 900-TCX controllers. Refer to Table 1.B through Table 1.F.)

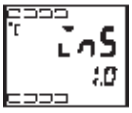
2. Prepare a thermometer (B) capable of measuring the temperature of the control target (C) as shown in Figure 4.10 so that 1-point shift or 2-point shift can be carried out.

Figure 4.10 — Configuration when Compensating a Non-Contact Infrared Temperature Sensor



Using the 1-Point Shift Method

Figure 4.11



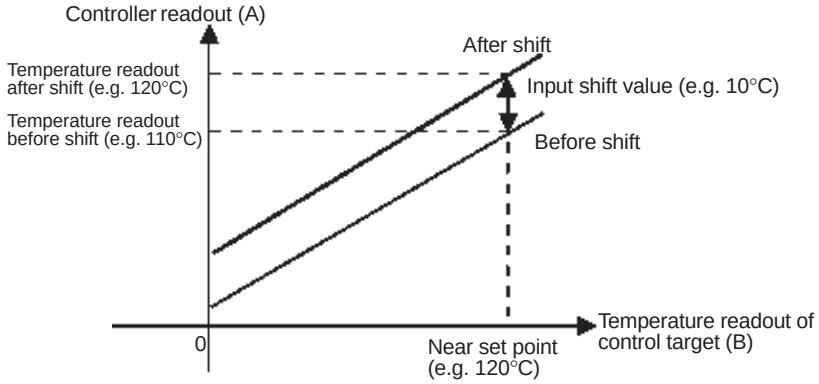
1. In the temperature control configuration shown in Figure 4.10, bring the set point to near the value at which the temperature of the control target is to be controlled. Assume that the control target temperature (C) and the control target temperature (B) match.

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 CNS.

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

   Figure 4.12 shows the effect of 1-point temperature input shift.

Figure 4.12 — One-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.

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 your temperature 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). Refer to Figure 4.10

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

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

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

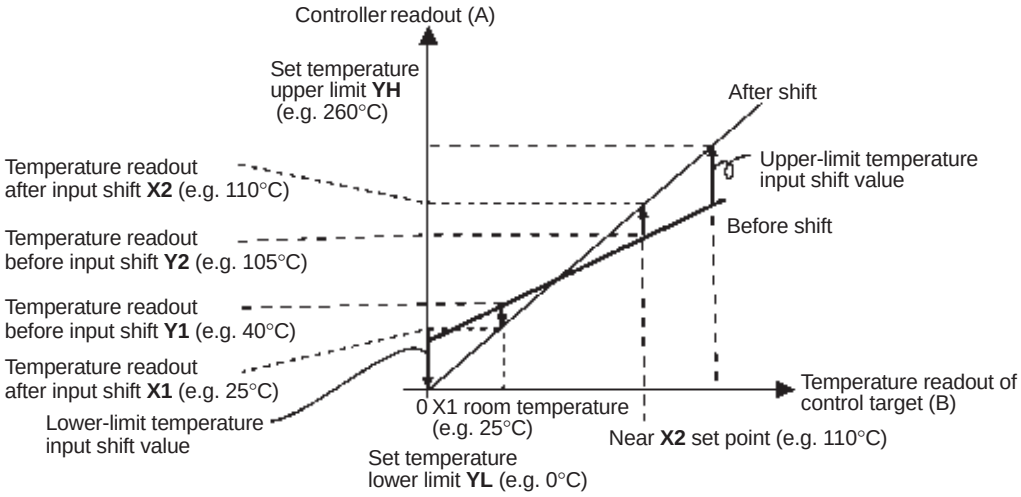
   – **Equation 2:** Use the following equation to calculate the Upper-Limit temperature input shift value.

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

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

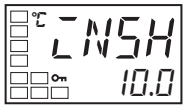
Note: For meanings of variables, refer to Figure –.

Figure 4.13 — Two-Point Temperature Input Shift



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

Figure 4.14 — Temperature Input Shift Value



Upper-limit temperature input shift value

Lower-limit temperature input shift value

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.

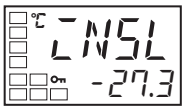
EXAMPLE

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.

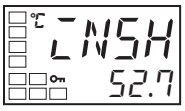
Lower-limit temperature input shift value:



Lower-limit temperature input shift value

$$CNSL = \frac{0-40}{105-40} \times \{(110-105)-(25-40)\} + (25-40) = -27.3°C$$

Upper-limit temperature input shift value:



Upper-limit temperature input shift value

$$CNSH = \frac{60-40}{105-40} \times \{(110-105)-(25-40)\} + (25-40) = -52.7°C$$

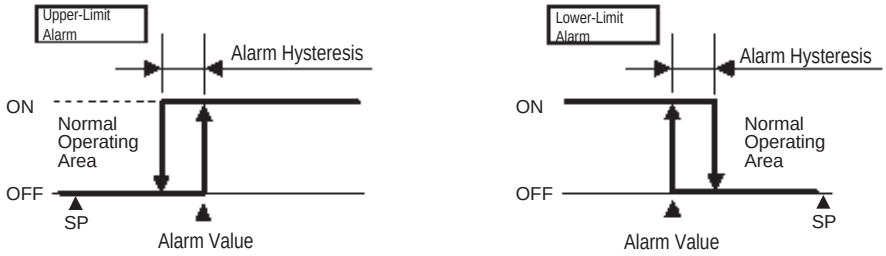
Alarm Functions/ Parameters

Alarm Hysteresis

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

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

Figure 4.15 — Hysteresis of Alarm Outputs



Alarm hysteresis is independently set for each alarm output in the Alarm Hysteresis 1…3 parameters (Advanced Setting function group).

Note: The default is 0.2 (°C or °F depending on your units selection) for temperature inputs and 0.02% of full scale (FS) for analog inputs.

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, refer to page 5-72, *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:

1. 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.
2. Use the PF key (900-TC8).
3. Use an event input (900-TC8 and 900-TC16).

Summary of Alarm Operations

The following figure summarizes the operation of alarms when the Alarm Type parameter is set to "lower-limit alarm with standby sequence" and "close in alarm" is set.

Figure 4.16 — Operation of Alarms Summary

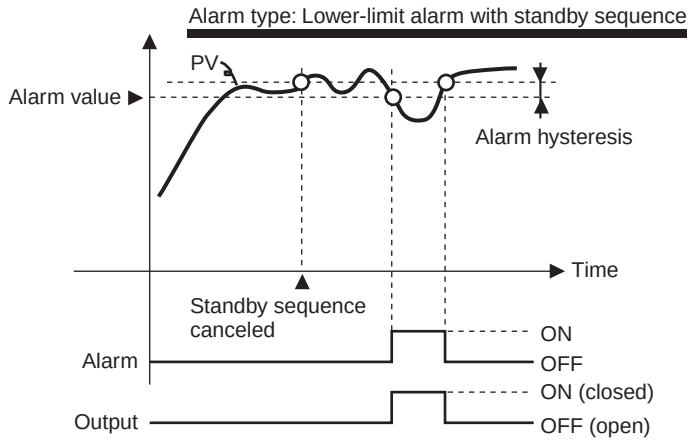
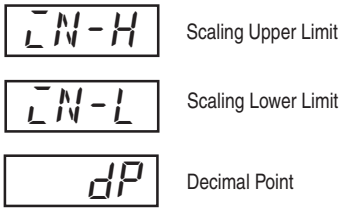


Table 4.A

Symbol	Parameter: Group	Description
AL H*	Alarm 1 to 3 Hysteresis: Initial Setting function group	Alarm
RESt	Standby Sequence: Advanced Setting function group	Alarm
* = 1 to 3		

Configuration of Scaling Upper-Limits and Scaling Lower-Limits for Analog Input

Figure 4.17



Overview

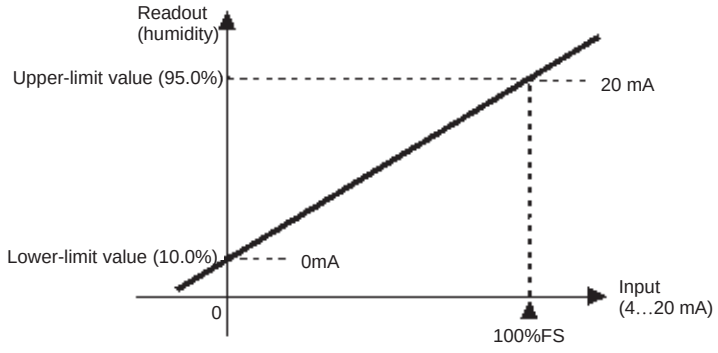
When an analog input sensor is selected, scaling to engineering units (e.g., lbs) that match the application is possible.

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. 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 to the right of the decimal point.

Figure 4.18 shows a scaling example of a 4…20 mA input, supported by 900-TC8 and 900-TC16. After scaling, the humidity sensor input can be directly read from the controller as a percentage of humidity. However, the display will not indicate%, only a value. The decimal point is configured one digit to the right.

Figure 4.18 — Input Scaling



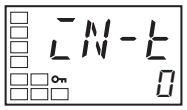
EXAMPLE

Operation Procedure

In this example, configure the scaling upper- and Lower-Limits so that inputs 4…20 mA 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.

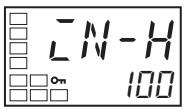
Figure 4.19



Input type

2. Select Scaling Upper-Limit by pressing ↵.

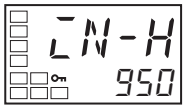
Figure 4.20



Scaling upper limit

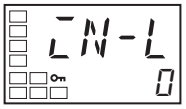
3. Press the ∧ or ∨ key to set the parameter to 950.

Figure 4.21



4. Select Scaling Lower-Limit by pressing ↵.

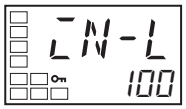
Figure 4.22



Scaling lower limit

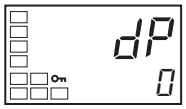
5. Press the ∧ or ∨ key to set the parameter to 100.

Figure 4.23



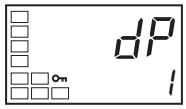
6. Select the decimal point position by pressing ↵.

Figure 4.24 — Press the ▲ or ▼ key to set the parameter to 1.



Decimal point

Figure 4.25



7. 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 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). To assign the function of your outputs and alarms based on the control mode use the Control Output X Assignment and Alarm Y Assignment parameters in the Advanced Settings function group. Refer to the table below

The following functions are assigned to outputs in the initial status.

Table 4.B — Output and Alarm Assignments

Parameter Name	Symbol	Initial Status
Control Output 1 Assignment	oUt1	Control output for heating
Control Output 2 Assignment (900-TC8 & 900-TC16 only)	oUt2	Not assigned
Auxiliary Output 1 Assignment	SUb1	Alarm 1
Auxiliary Output 2 Assignment (900-TC8 & 900-TC16 only)	SUb2	Alarm 2
Auxiliary Output 3 Assignment (900-TC8 only)	SUb3	Alarm 3

Each output assignment is automatically initialized as shown below when the control module is changed.

Table 4.C — Example: 900-TC8 & 900-TC16

		Without Control Output 2		With Control Output 2	
Parameter Name	**Symbol**	**Standard**	**Heating/Cooling**	**Standard**	**Heating/Cooling**
Control Output 1 Assignment	oUt 1	Control Output (heating)	Control Output (heating)	Control Output (heating)	Control Output (heating)
Control Output 2 Assignment	oUt2	Not assigned ❶	Not assigned ❶	Not assigned	Not assigned
Auxiliary Output 1 Assignment	Sub 1	Alarm 1 ❷	Alarm 1❷	Alarm 1 ❷	Alarm 1❷
Auxiliary Output 2 Assignment	Sub2	Alarm 2 ❸	Control Output (cooling) ❸	Alarm 2	Alarm 2

❶No parameter assignment is displayed because there is no control output

❷The output set for the Auxiliary Output 1 Assignment parameter becomes the program END output unless the program pattern is OFF.

❸ For the 900-TC8, the Auxiliary Output 3 Assignment parameter is set for control output (cooling) (the Auxiliary Output 2 Assignment parameter is set for alarm 2).

- The heating/cooling operation of the control outputs will switch when the Direct/Reverse Operation parameter is set to "direct."
- When DRS (Invert Direct/Reverse Operation) is assigned for an Event Input Assignment (1 or 2), control will start with the contents set for the Direct/Reverse Operation parameter inverted when the event input turns ON, and with the contents left according to the setting when the event input turns OFF. For details on event inputs and control combined with the Direct/Reverse Operation parameter, refer to Control by Inverting Direct/ Reverse Operation. This function is not supported by 900-TC32.
- When heating/cooling control is selected, the Dead Band and Cooling Coefficient parameters can be used.

Table 4.D — Example: 900-TC32

Parameter Name	**Symbol**	**Standard**	**Heating/Cooling**
Control Output 1 Assignment	oUt 1	Control output (heating)	Control output (heating)
Aux1 Output 1 Assignment	Sub2	Alarm 1❶	Control output (cooling)

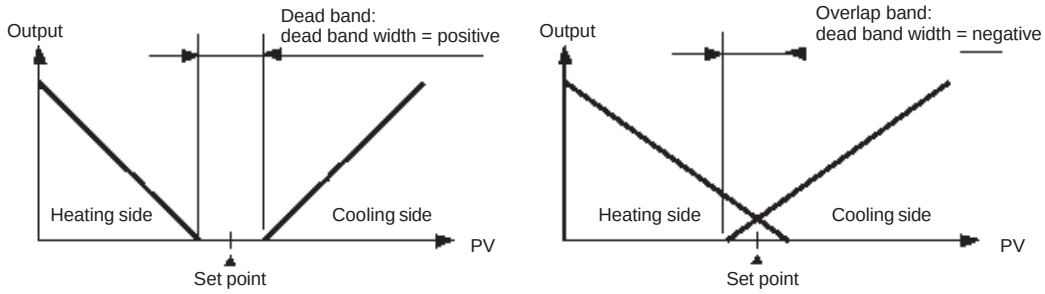
❶ The Auxiliary Output 1 Assignment parameter becomes the program end output unless the Program Pattern parameter is configured to OFF.

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 (refer to Figure 4.26). The dead band width is the configured value of the Dead Band parameter (Adjustment function group). Setting a negative value produces an overlap band. If an overlap band is configured the bumpless function may not operate when switching between automatic and manual operation.

Note: The default is 0.0 EU for controllers with temperature inputs and 0.00% full scale for controllers with analog inputs.

Figure 4.26 — Dead Band



Cooling Coefficient (Heating and Cooling Control)

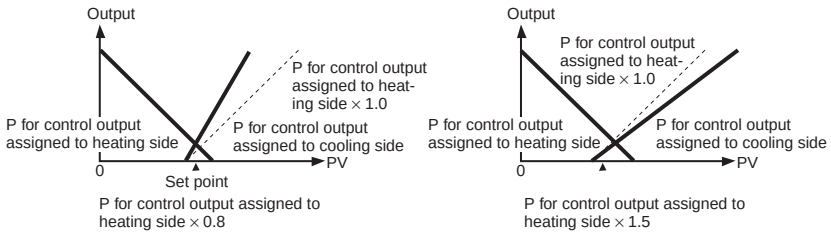
When the heating and cooling control mode and PID control method are selected, the Cooling Coefficient parameter can be used. If the heating and cooling functional characteristics of the control target greatly differ, this could limit satisfactory control performance from being obtained by the same PID 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:

P for control output assigned to heating side = P

P for control output assigned to cooling side = P for control output assigned to heating side × cooling coefficient

The cooling coefficient is multiplied by the P for the control output assigned to the heating side to obtain control with characteristics that differ from those of the control output assigned to the heating side.

Figure 4.27



Automatic Cooling Coefficient Adjustment

By executing AT during heating/cooling control, the cooling coefficient can be automatically calculated along with the PID parameters.

Table 4.E

Parameter Name	Setting Range	Default
Automatic Cooling Coefficient Adjustment	OFF: Disabled, ON: Enabled	OFF

Note: If there is strong non-linear gain for the cooling characteristics, such as when cooling water boils for cooling control, it may not be possible to obtain the optimum cooling coefficient at the Controller, and control may take the form of oscillating waves. If that occurs, increase the proportional band or the cooling coefficient to improve control.

Setup of Heating and Cooling

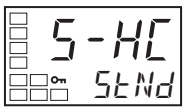
To configure the heating and cooling control mode, either set the Standard parameter or Heating and Cooling, Dead Band, and Cooling Coefficient (when using the PID method) parameters.

EXAMPLE

Operation Procedure: Heating and Cooling Control Selection
Standard or 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.

Figure 4.28



Standard or heating/cooling

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

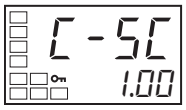
   stnd:: Standard control
   h-c: Heating and cooling control

EXAMPLE

Operation Procedure: Configuring the Cooling Coefficient
Cooling coefficient = 10

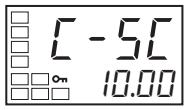
1. Select Cooling Coefficient in the Adjustment function group. In this example, set the parameter to 10.

Figure 4.29



Cooling coefficient

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



EXAMPLE

Operation Procedure: Configuring the Dead Band

Dead Band = 5

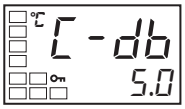
1. Select Dead Band in the Adjustment function group.

Figure 4.30

Dead band

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

Figure 4.31



Using the Event Input Feature — 900-TC8 & 900-TC16

Overview

When the appropriate option unit (refer to Tables 1.C and 1.E) is installed, discrete (ON/OFF) inputs can be wired to the Bulletin 900 to cause the controller to perform several pre-defined/configurable tasks. These inputs are generically called event inputs.

Setting Event Input

- Event inputs can be used for Multi-SP, RUN/STOP, Auto/Manual Switch, Program Start, Invert Direct/Reverse Operation, 100% AT Execute/Cancel, 40% AT Execute/Cancel, Setting Change Enable/Disable, and Alarm Latch Cancel.

- Of these, only the number of event inputs (0 to 2) set in the Number of Multi-SP Uses parameter (Initial Setting function group) are used for the multi-SP function.

- Event inputs (1 and 2) that are not used for the multi-SP function are assigned using the Event Input Assignment (1 and 2) parameters (Initial Setting function group).

- When using event inputs to switch the multi-SP, the event input assignment display will not appear. Whether the set value and event input assignments 1 and 2 will be displayed or hidden is shown in the tables below.

- Do not connect the contacts from the same switch to more than one 900-TC Controller.

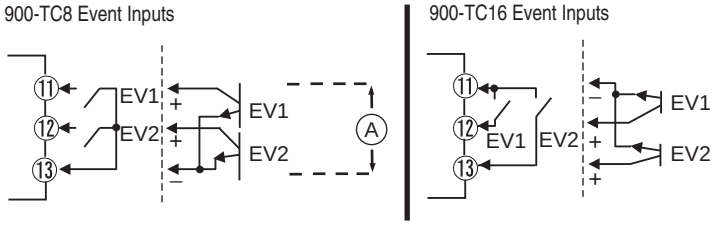
Table 4.F

Number of Multi-SP Uses	Event Input Assignment 1	Event Input Assignment 2
0	Displayed (Multi-SP not used)	
1	Hidden (Multi-SP, 2 Points).	Displayed (Event Input 2 not used as Multi-SP Switch).
2	Hidden (Multi-SP, 4 Points).	

Two set points are set externally by using the Number of Multi-SP Uses parameter

- Switching is possible between two set points (0 and 1) by setting the Number of Multi-SP Uses parameter to 1. The default setting is 1 and does not need to be changed to switch between two set points. Set points 0 and 1 are specified by the status of event input 1.

Figure 4.32 — Event Inputs



(A) DO NOT apply on external voltage source to the Event Input Terminals.

When you want to configure event inputs to change the controllers four pre-set 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.

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 proper option event input unit is mounted in the Bulletin 900 and the Number of Multi-SP Uses parameter is set to 1 or 2 (refer to Tables 4.G and 4.H).

Table 4.G — 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.H —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: 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 Uses parameter. in the adjustment function group.To change set points from the controller keypad, the multi-SP conditions are as follows.

When the option event input unit is:

- When the option event input unit is NOT mounted in the Bulletin 900, and Multi-SP is configured to ON.
- When the option event input unit is mounted in the Bulletin 900, 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 Uses parameter value and the selected set point.

Table 4.I

Multi-SP Uses Parameter Value	Selected Set Point
0	Select Set Point 0 value
1	Select Set Point 1 value
2	Select Set Point 2 value
3	Select Set Point 3 value

Note: The set point can also be switched using PC communications. This is supported by 900-TC8, 900-TC16, and 900-TC32.

Multi-SP Setup

EXAMPLE

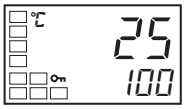
Operation Procedure: To Select Set Points (0/1/2/3)

The following example configures the Number of Multi-SP Uses parameter to 2 (Multi-SP, 4 points). Refer to Table 4.I.

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, refer to page 4-33, *Using the Key Protect Function Group*.

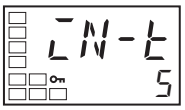
1. Press the ○ key for at least 3 seconds to move from the Operation function group to the Initial Setting function group.

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

Figure 4.36

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

Figure 4.37

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

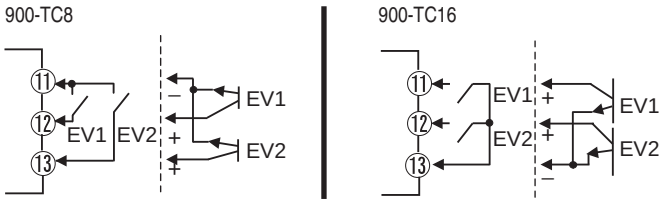
Figure 4.38

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 4.39 —Event Inputs



Note: Do not apply an external voltage source to the Event Input Terminals.

Operation Commands Other than Multi-SP

The following table shows the functions assigned when an Event Input Assignment (1 or 2) is displayed.

Table 4.J — When Event Input Assignment (1 or 2) is Displayed

Setting	Function
NONE	None
STOP	RUN/STOP
MANU	Auto/Manual
PRST	Program Start (See note 1.)
dRS	Invert Direct/Reverse Operation
AT-2	100% AT Execute/Cancel
AT-1	40% AT Execute/Cancel (See note 2.)
WTPT	Setting Change Enable/Disable
LAT	Alarm Latch Cancel

Note (1) PRST (Program Start) can be set even when the Program Pattern parameter is set to OFF, but the function will be disabled.
(2) This function can be set for heating/cooling control, but the function will be disabled.

When any of the following functions are set for an Event Input Assignment parameter, the same function cannot be set for another Event Input Assignment parameter: STOP (RUN/STOP), MANU (Auto/Manual Switch), PRST (Program Start), DRS (Invert Direct/Reverse Operation), AT-2 (100% AT Execute/Cancel), AT-1 (40% AT Execute/Cancel), WTPT (Setting Change Enable/Disable), or LAT (Alarm Latch Cancel). Turn event inputs ON and OFF while the power is being supplied. Event input ON/OFF changes are detected for inputs of 50 ms or longer. (However, inputs of 250 ms or longer is determined using logic operations.)

The functions are described in detail below. Event inputs 1 and 2 are taken as examples.

Executing RUN/STOP Controller Mode Change

When the Event Input Assignment 1 or Event Input Assignment 2 parameter is set to STOP (RUN/STOP), control is started (RUN) when event input 1 or 2 is OFF. Control is stopped when 1 or 2 is ON (refer to Table 4.K). While control is stopped, the controller's STP (stop) LED lights. Alarm outputs will operate according to the selected value(s).

Table 4.K

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 (refer to Table 4.F).

Switching Between Auto and Manual Control

When the Event Input Assignment 1 or Event Input Assignment 2 parameter is set to MANU (auto/manual), manual control will start when Event Input 1 or 2 turns ON. Auto control will start when the input turns OFF.

The MANU indicator will light during manual control.

Table 4.L

Setting	Input Contact	Control Mode
Event Input 1 or 2	OFF	Automatic
Event Input 1 or 2	ON	Manual

Controlling the Start of the Simple Program Function

When the Event Input Assignment 1 or Event Input Assignment 2 parameter is set to PRST (program start), the simple program will start when event input 1 or 2 turns ON. The program will be reset when the input turns OFF and the RUN/STOP status will automatically switch to STOP mode. If the program END output is ON, the program END output will turn OFF.

Table 4.M

Setting	Input Contact	Program Status
Event Input 1 or 2	OFF	reset
Event Input 1 or 2	ON	Start

Control by Inverting Direct/Reverse Operation

When DRS (Invert Direct/Reverse Operation) is set for the Event Input Assignment 1 or Event Input Assignment 2 parameter and the Direct/Reverse Operation parameter is set for reverse operation, control starts with direct operation (cooling control) when event input 1 or 2 turns ON and control starts with reverse operation (heating control) when the event input turns OFF.

Table 4.N

Setting	Input Contact	Direct/Reverse Operation Parameter	Status
Event Input 1 or 2	OFF	Direct operation (cooling)	Direct operation (cooling)
		Reverse operation (heating)	Reverse operation (heating)
Event Input 1 or 2	ON	Direct operation (cooling)	Reverse operation (heating)
		Reverse operation (heating)	Direct operation (cooling)

Switching 100% AT Execute/Cancel

When AT-2 (100% AT Execute/Cancel) is set for either the Event Input Assignment 1 or Event Input Assignment 2 parameter, 100% AT will be executed when event input 1 or 2 turns ON and will be cancelled when the input turns OFF.

Table 4.O

Setting	Input Contact	Status
Event input 1 or 2	OFF	100% AT cancelled
Event input 1 0r 2	ON	100% AT executed

Switching 40% ATExecute/Cancel

When AT-1 (40% AT Execute/Cancel) is set for either the Event Input Assignment1 or Event Input Assignment 2 parameter, 40% AT will be executed when event input 1 or 2 turns ON and will be cancelled when the input turns OFF

Table 4.P

Setting	Input	Status
Event Input 1 or 2	OFF	40% AT cancelled
Event Input 1 or 2	ON	40% AT executed

Switching Setting Change Enable/Disable

When WTPT (Setting Change Enable/Disable) is set for either the Event Input Assignment 1 or Event Input Assignment 2 parameter, the setting change will be disabled when event input 1 or 2 turns ON and will be enabled when the input turns OFF.

Table 4.Q

Setting	Input Contact	Status
Event input 1 or 2	OFF	Enabled
Event input 1 or 2	ON	Disabled

Switching Alarm Latch Cancel

When LAT (Alarm Latch Cancel) is set for either the Event Input Assignment 1or Event Input Assignment 2 parameter, all alarm latches (alarms 1 to 3, heater burnout, HS alarm, and heater over-current latch) will be cancelled when event input 1 or 2 turns ON.

Table 4.R

Setting	Input Contact	Status
Event input 1 or 2	OFF	---
Event input 1 or 2	ON	Cancelled

Parameters

Table 4.S

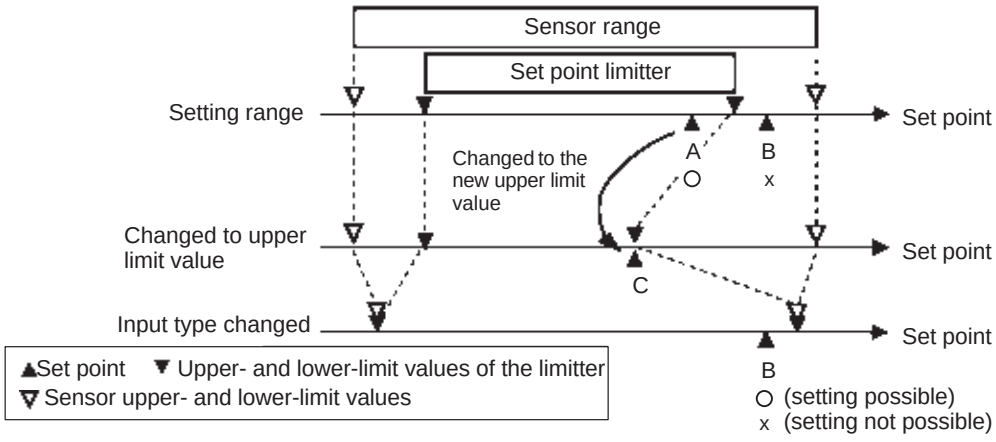
Symbol	Parameter: Level	Description
EV-1	Event Input Assignment 1: Initial Setting function group	Function of event input function
EV-2	Event Input Assignment 2: Initial Setting function group	
EV-M	Number of Multi-SP Uses: Initial Setting function group	

Configuring the SP Upper- and Lower-Limit Values

Set Point Limiter

The maximum allowable configuration range of the set point is limited by the set point limiter parameter. The set point limiter 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 limiter are configured from the Set Point Upper-Limit and Set Point Lower-Limit parameters in the Initial Setting function group, respectively.

Figure 4.40



Application Considerations

If a change is made to the set point upper and/or lower-limit value with the current set point outside the limiter 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 units are changed, the set point limiter is forcibly reset to that of the new sensor setting range.

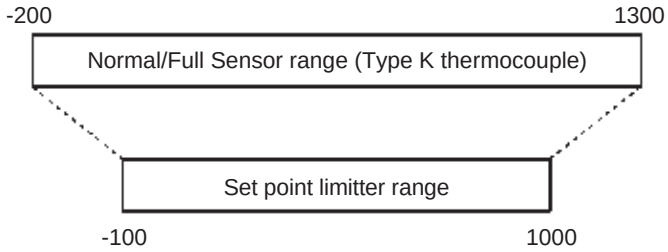
Table 4.T — Parameters

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 limiter when using a type K thermocouple (normal full range: –200…1300°C).

Figure 4.41



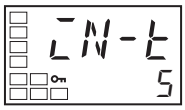
EXAMPLE

Operation Procedure: Configuring the Set Point Upper-Limit

Configure the Set Point Upper-Limit Value to 1000

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

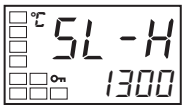
Figure 4.42



Input type

2. Select Set Point Upper-Limit parameter by using the ↵ key.

Figure 4.43

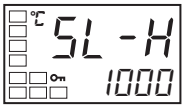


Set point upper-limit

3. Press the ⩓ or ⩔ key to set the value to 1000.

EXAMPLE

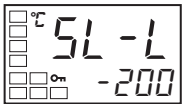
Operation Procedure: Configuring the Set Point Lower-Limit



Configure the Set Point Lower-Limit Value to –100.

1. Select Set Point Lower-Limit parameter in the Initial Setting function group by using the ↵ key.

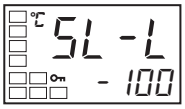
Figure 4.44



Set point lower limit

2. Press the ⩓ or ⩔ key to set the value to –100.

Figure 4.45



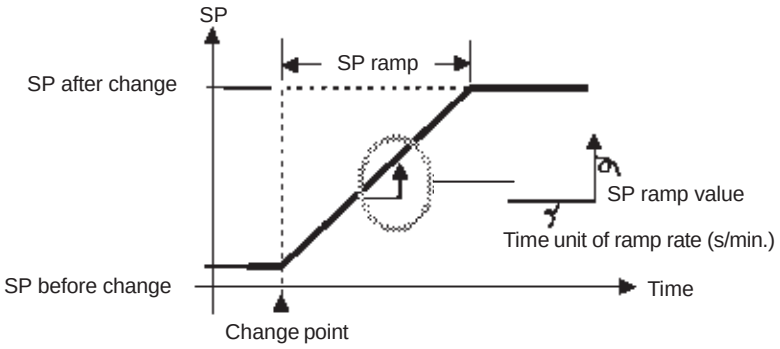
Note: The newly configured value or parameter is loaded into the controller memory if you do NOT operate any key on the front panel for at least 2 seconds or by pressing the ○ or ↵ key.

Executing the SP Ramp Function to Limit 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 seconds/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 and SP Ramp Time Unit parameters.

Note: When the SP Ramp Set Value is OFF (default), 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 of the SP ramp function is also the same during switching of the set points by the Multi-SP parameter.

Table 4.U

Symbol	Parameter: Function Group	Description
oL-H	MV Upper-Limit: Adjustment function group	To limit the manipulated variable
oL-L	MV Lower-Limit: Adjustment function group	To limit the manipulated variable
SL-H	Set Point Upper-Limit: Initial Setting function group	To limit the SP setting
SL-L	Set Point Lower-Limit: Initial Setting function group	To limit the SP setting
SPRt	SP Ramp Set Value: Adjustment function group	To limit the SP rate of change
SPRU	SP Ramp Time Unit: Advanced Setting function group	Unit for setting the SP
AL SP	Alarm SP Selection: Advanced Setting function group	Alarm SP selection

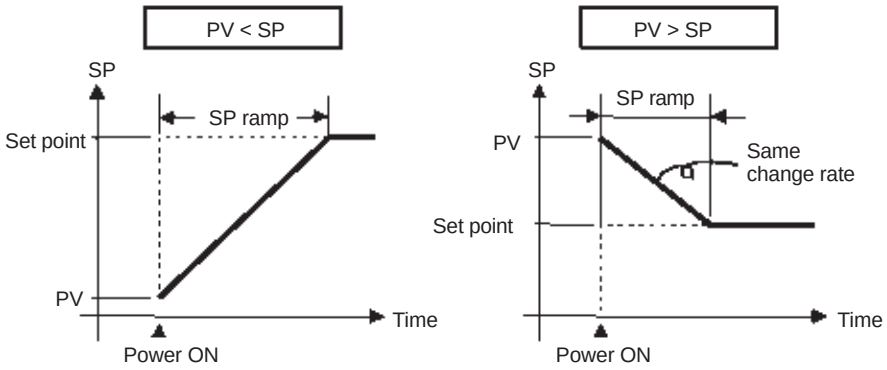
SP Ramp Application Considerations

SP Ramp Operation at Startup

If the SP ramp function is enabled when the Bulletin 900 controller 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 (refer to Figure 4.47).

Figure 4.47



Restrictions During SP Ramp Operation

Auto-tuning execution starts after the end of SP ramp.

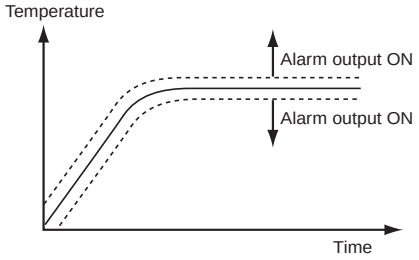
When control is stopped or an error occurs, the SP ramp function is disabled.

Alarms During SP Ramp Operation

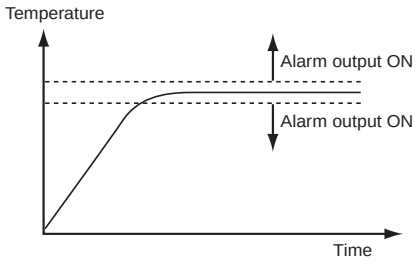
The operation of alarms during SP ramp operation depends on whether alarms are configured to be based on the ramp set point or the target set point (refer to the Figure 4.48). The set point to be used is configured in the Alarm SP Selection parameter.

Figure 4.48

Alarm SP Selection = Ramp SP (Alarm Type: 1 (Upper/Lower Limits))



Alarm SP Selection = Target SP (Alarm Type: 1 (Upper/Lower Limits))



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 in the Initial Setting/Communications Protect parameter. Refer to page 4-33, *Using the Key Protect Function Group*.

EXAMPLE

Operation Procedure: To Remove Protection and Move to the Advanced Setting Function Group

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 4.49

Operation/adjustment protect

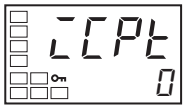
3. Press the ↵ key once to move to Initial Setting/Communications Protection.

Figure 4.50

Initial setting/communications protect

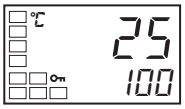
4. Configure the programmed value to 0.

Figure 4.51



5. Press the ○ and ↵ keys simultaneously for at least 1 second to return to the Operation function group.

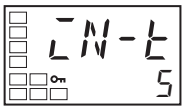
Figure 4.52



PV/SP

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

Figure 4.53



Input type

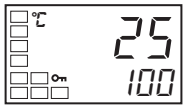
7. Select the Move to Advanced Setting function group parameter by pressing the [key] key.

Figure 4.54

Move to advanced function setting level

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

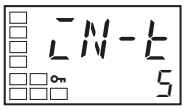
Figure 4.55



PV/SP

9. To return to the initial setting function group, press the [key] key for at least 1 second.

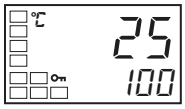
Figure 4.56



Move to Initial Setting Group

10. To return to the operation function group, press the [key] key for at least 1 second.

Figure 4.57



Move to Operation Function Group

Using the Key Protect Function Group

Key Protect

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

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

Operation/Adjustment Protection

To move to the Protect function group from the Operation or Adjustment function groups, press the ◯ and ⏎ keys simultaneously for at least 3 seconds.

Note: The key pressing time can be changed using the Move to Protect function group time in the Advanced Settings function group.

After the time interval, the controller display will look as follows:

Figure 4.58

Table 4.V shows the relationship between configured/set values and the range of protection.

When the Key Protect parameter is configured to 0, parameters are not protected.

Note: The default is 0..

Table 4.V — Relationship Between Configured/Set Values & Range of Protection

Level		Set Value			
		0	**1**	**2**	**3**
Operation Group	PV	Can be displayed	Can be displayed	Can be displayed	Can be displayed
	PV/SP	Can be displayed and changed	Can be displayed and changed	Can be displayed and changed	Can be displayed
	Others	Can be displayed and changed	Can be displayed and changed	Cannot be displayed and moving to other groups is not possible.	Cannot be displayed and moving to other groups is not possible.
Adjustment Group		Can be displayed and changed	Cannot be displayed and moving to other groups is not possible.	Cannot be displayed and moving to other groups is not possible.	Cannot be displayed and moving to other groups is not possible.

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 (refer to Table 4.W).

Figure 4.59

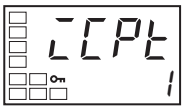


Table 4.W — Initial Setting/Communications Protection

	Function Group		
Set Value	**Initial Setting**	**Communications Setting**	**Advanced Setting**
0	Possible to reach	Possible to reach	Possible to reach
1 ❶	Possible to reach	Possible to reach	Not possible to reach
2	Not possible to reach	Not possible to reach	Not possible to reach

❶Default

Setting Change Protection

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

Figure 4.60

- The all protect indication (🔑) will light when Setting Change Protect is configured to ON.

Table 4.X

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.)

❶Default

The all protect indication (🔑) will light when Setting Change protect is configured.

PF Key Protect

Table 4.Y

Set Value	Description
OFF❶	PF Key enabled
ON	PF Key disabled (Operation as function key prohibited).

❶Default

Entering the Password to Move to the Protect Function Group

For additional system security, you can configure your controller so that you need to enter a user-defined Password to Move to the Protect function group. This user-defined password is configured using the Password to Move to Protect function group parameter located in the Protect function group. If a password is configured, before you can move to the Protect function group you must enter the previously configured password when the Move to Protect function group parameter is displayed. If no password is configured (configured to 0) the Move to Protect function group parameter will not be displayed and the Protect function group can be moved to directly without entering a password.

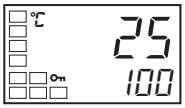
Setting the Password

EXAMPLE

Operating Procedure: To Configure the Password to 1234

Use the following procedure to configure the Password to Move to the Protect function group.

Figure 4.61



PV/SP

1. Press the ○ and ↵ keys simultaneously for at least the time configured in the Move to Protect function group time parameter to move from the Operation function group to the Protect function group.

Figure 4.62

2. Select the Password to Move to Protect function group parameter by pressing the ↵ key.

Figure 4.63

3. Press the ○ and ⌃ keys to set the parameter to 1234.
(To prevent configuring the password incorrectly, the ⌃ and ○ keys or ⌄ and ○ keys must be pressed simultaneously to set the password.)

Figure 4.64

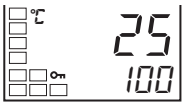
Note: Protection cannot be cleared or changed without the password. Be careful not to forget it.

EXAMPLE

Operating Procedure: To Move to the Protect Function Group With a Password of 1234

Use the following procedure to move to the Protect function group.

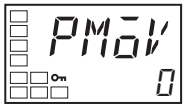
Figure 4.65



PV/SP

1. Press the ○ and ↵ keys simultaneously for at least the time configured in the Move to Protect function group time parameter to move from the Operation function group to the Protect function group.

Figure 4.66



2. Press the ⇈ key to configure the parameter to 1234 (password input).

Figure 4.67

3. Move to the Operation/Adjustment Protect parameter by pressing the ○ or ↵ key or leaving the setting for at least 2 seconds.

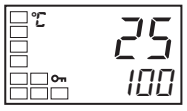
Figure 4.68

Operation/adjust-ment protect

EXAMPLE

Operating Procedure: With No Password Set

Figure 4.69



PV/SP

1. Press the ○ and ⏎ keys simultaneously for at least the time configured in the Operation/Adjustment Protect parameter to move from the Operation function group to the Protect function group.

   When a password is not configured, the Operation/Adjustment Protect parameter will be displayed.

Figure 4.70

Operation/adjustment protect

Communications Operation Command to Move to the Protect function group

The Write Variable operation command can be used via communications to write the password to the Move to Protect function group parameter. When the correct password is written, the display will change to the Operation/Adjustment Protect parameter and writing the parameters in the Protect function group will be enabled.

Note: If the Write Variable operation command is used to write the wrong password to the Move to Protect function group parameter after the correct parameter has been written, the Move to Protect function group parameter will be displayed and any Write Variable operation commands to write parameters in the protect function group will result in operation errors.

Note: If a password is not configured or if it is configured to 0, the display will change to the Operation/Adjustment Protect parameter and writing the parameters in the Protect function group will be enabled immediately.

PV Color Change

PV Color Change Function

Use the PV color change function to configure the color of the PV display (No. 1 display).

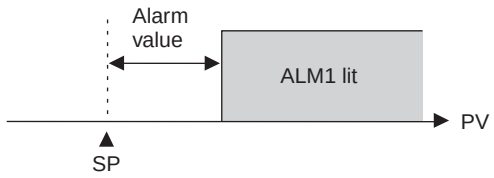
There are three display colors, orange, red, and green, and you can select from the following three modes and eight functions.

Figure 4.71

- **Constant:** This mode displays orange, red, or green all the time.
- **Linked to Alarm 1:** This mode switches the PV display color from red to green when Alarm 1 turns ON or from green to red when Alarm 1 turns ON.
- **Linked to PV stable band:** This mode switches the PV display color between red outside the PV stable band and green within PV stable band, or between green outside the PV stable band and red within PV stable band.
  Set the PV stable band in the PV Stable Band parameter (Advanced Setting function group).
- **Default:** The default is RED (red).

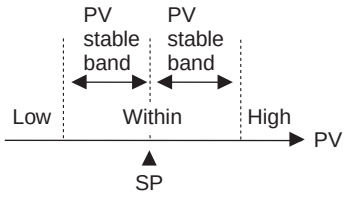
The following table shows the display functions that can be configured using the PV color change function.

Table 4.Z

Mode	Setting	Function	PV Color Change		Application Example
Constant	ōRG	Orange	Constant: Orange		To match the display color with other Controller models
	RED	Red	Constant: Red		To match the display color with other Controller models
	GRN	Green	Constant: Green		To match the display color with other Controller models
Linked to Alarm 1					
			ALM1 not Lit	**ALM1 Lit**	**Application Example**
	R-G	Red to Green	Red	Green	To display the PV reached signal
	G-R	Green to Red	Green	Red	To display error signals

Note: Shading indicates default setting.

Table 4.S (Continued)

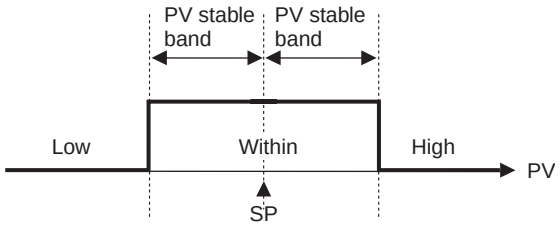
Mode	Setting	Function	PV Color Change			Application Example
Linked to PV Stable Band						
			Low	Within PV stable band	High	Application example
	R-G.R	Red to Green to Red	Red	Green	Red	To display stable status
	G-o.R	Green to Orange to Red	Green	Orange	Red	To display stable status
	o-G.R	Orange to Green to Red	Orange	Green	Red	To display stable status

Link to PV Stable Band

Figure 4.72

When the mode to link to the PV stable band is selected per Table 4.Z, the PV display color will change according to whether the present value (PV) is lower than, within, or higher than the PV stable band shown in Figure 4.73. The width of the PV stable band is configured with the SP as the center, as shown below.

Figure 4.73



The default band width is 5.0 (°C/°F) for controllers with Thermocouple/Resistance Thermometer Multi-Inputs and 5.0% FS for Controllers with Analog Inputs.

Setting

Configuring the PV Color Change to Indicate Stable Status

To display the PV as a constant green color (to indicated a stable condition) display when the PV is within ±15.0°C of the set point, configure the PV Color Change and PV Stable Band parameters.

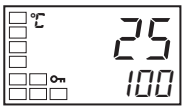
PV Color Change = R-GR (Red to Green to Red)

EXAMPLE

Operating Procedure

Note: Make sure you release the protection to Move to the Advanced Setting function group before you configure the PV Color Change and PV Stable Band parameters since both parameters are located in the Advanced Setting function group. (Refer to steps 1…8 on page 4-31.)

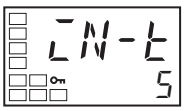
Figure 4.74



PV/SP

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

Figure 4.75



Input type

2. Select the Move to Advanced Setting function group parameter by pressing the ↵ key.

Figure 4.76

Move to advanced function setting level

3. Use the key to enter **–169** (the password).
   Move to the Advanced Setting function group by pressing the key or leaving the setting for at least 2 seconds.

Figure 4.77

Parameter initialization

4. Select the PV Color Change parameter by pressing the key.

Figure 4.78

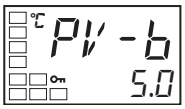
PV change color

5. Press the key to set the parameter to r-gr.

Figure 4.79

6. Select the PV Stable Band parameter by pressing the key.

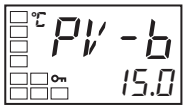
Figure 4.80



PV stable band

7. Use the key to set the parameter to 15.0.

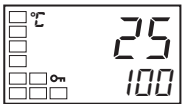
Figure 4.81



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

9. To return to the Operation function group, press the key for at least 1 second.

Figure 4.82



PV/SP

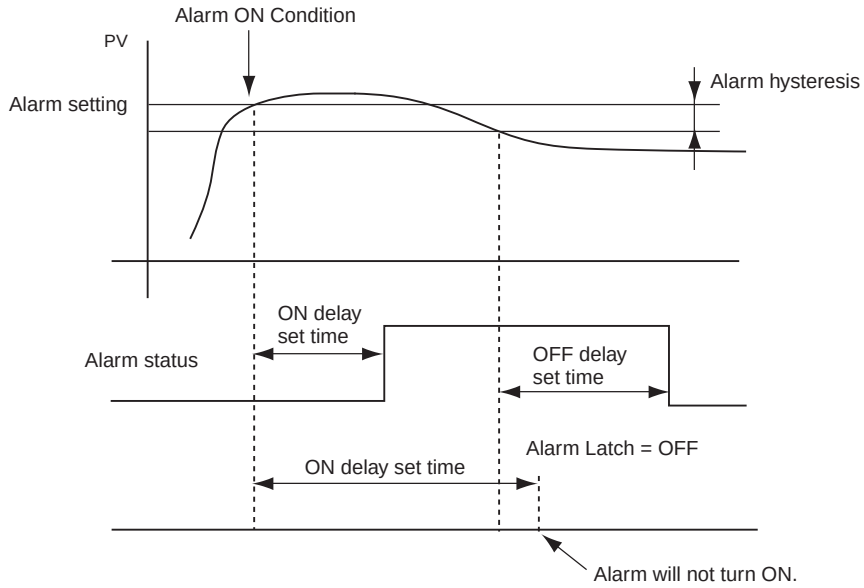
Alarm Delays

Alarm Delays

For 900-TC8 and 900-TC16, ON and OFF timed delays can be configured for the Alarm Outputs 1, 2, and 3. For 900-TC32, ON and OFF timed delays can be configured for the Alarm Output 1.The ON and OFF delay for Alarm 1 operate only for the alarm process function. If Alarm Output 1 is configured as an OR with other alarm functions (i.e., the Heater Burnout Alarm, HS Alarm, or input error output alarm), the time delay feature will not function for the other alarms. The ON and OFF delays for alarms 1, 2, and 3 also apply to the individual SUB1, SUB2, and SUB3 indicators and to communications status. The alarm ON delays will also function when power is turned ON or when moving from the Initial Setting function group to Operation function group (i.e., to software resets). All outputs will turn OFF and the OFF delays will not function when moving to the Initial Setting function group or when an alarm is output for an A/D converter error.

Operation of Alarm ON and OFF Timed Delays (for an Upper-limit Alarm)

Figure 4.83



- The alarm will not turn ON if the time that the alarm is ON is equal to or less than the configured ON delay configured time. Also, the alarm will not turn OFF if the time that the alarm is OFF is equal to or less than the OFF delay configured time.
- If an alarm turns OFF and then back ON during the ON delay time, the time will be reset from the last time the alarm turns ON. Also, if an alarm turns ON and then back OFF during the OFF delay time, the time will be remeasured from the last time the alarm turns OFF.

Parameters Related to Alarm Delays

Table 4.AA

Parameter Name	Symbol	Configurable Range
Alarm 1 ON delay	A1ON	0…999 (s)
Alarm 2 ON delay (900-TC8, 900-TC16)	A2ON	0…999 (s)
Alarm 3 ON delay (900-TC8)	A3ON	0…999 (s)
Alarm 1 OFF delay	A1OF	0…999 (s)
Alarm 2 OFF delay (900-TC8, 900-TC16)	A2OF	0…999 (s)
Alarm 3 OFF delay (900-TC8)	A3OF	0…999 (s)

Note: The default time values are 0 (i.e., the ON and OFF delays are disabled).

Note: The parameters are displayed when alarm functions are assigned and when the alarm type is configured to any type but 0 (none).

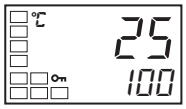
EXAMPLE

Operating Procedure

The following example procedure shows how to configure ON and OFF delay for Alarm Output 1.

An ON delay of 5 seconds and an OFF delay of 10 seconds will be configured.

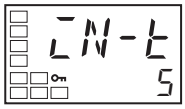
Figure 4.84



PV/SP

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

Figure 4.85



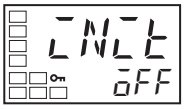
Input type

2. Select the Move to Advanced Setting function group parameter by pressing the ↵ key.

Figure 4.86

3. Press the ⩛ key to enter the password (**–169**) and move from the Initial Setting function group to the Advanced Setting function group.

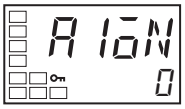
Figure 4.87



Parameter initialization

4. Press the ⊂ key to select the Alarm 1 ON Delay parameter.

Figure 4.88



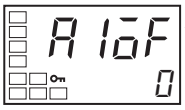
Alarm 1 ON delay

5. Press the ⩓ key to set the parameter to 5.

Figure 4.89

6. Press the ⊂ key to select the Alarm 1 OFF Delay parameter.

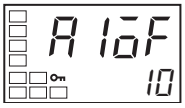
Figure 4.90



Alarm 1 OFF delay

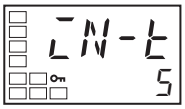
7. Press the ⩓ key to set the parameter to 10.

Figure 4.91



8. Press the ○ key for at least 1 second to move from the Advanced Setting function group to the Initial Setting function group.

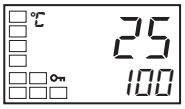
Figure 4.92



Input type

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

Figure 4.93



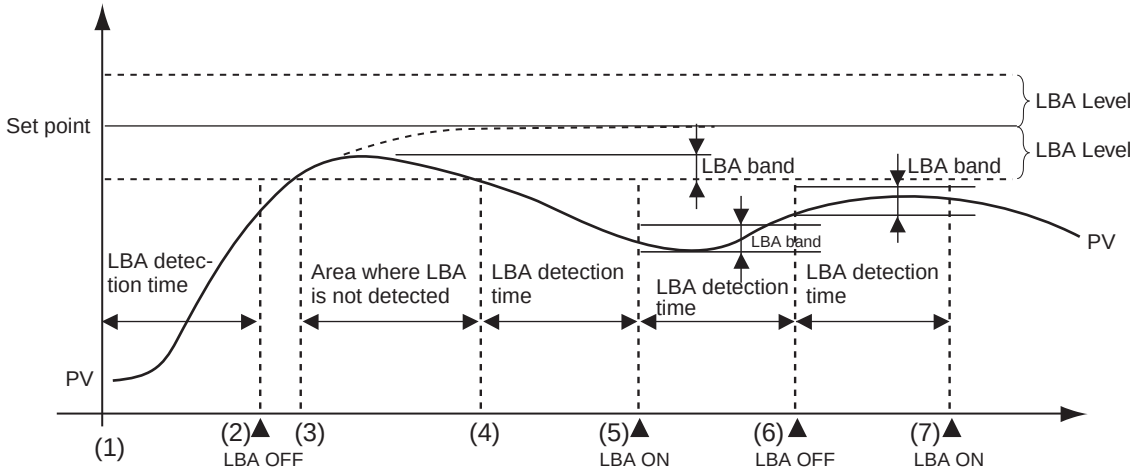
Loop Break Alarm

Loop Break Alarm (LBA)

With a Loop Break Alarm, there is assumed to be an error in the operation control loop if the control deviation (SP – PV) is greater than the threshold you configure in the LBA Level parameter and if the control deviation is not reduced by at least the value you configure in the LBA Detection Band parameter within the LBA Detection Time parameter.

Figure 4.94 provides an example of the operation of the Loop Break Alarm detection and time operation.

Figure 4.94



If the control deviation is reduced in the area between 1 and 2 (i.e., the set point is approached) and the amount the control deviation is reduced is at least equal to the LBA Band, the Loop Break Alarm will remain OFF.

The process value is within the LBA Level between 3 and 4, and thus Loop Break Alarm will not be detected. (The Loop Break Alarm will remain OFF.)

If the process value is outside the LBA Level between 4 and 5 and the control deviation is not reduced by at least the LBA Band within the LBA Detection Time, the Loop Break Alarm will turn ON.

If the control deviation is reduced in the area between 5 and 6 (i.e., the set point is approached) and the amount the control deviation is reduced is at least equal to the LBA Band, the Loop Break Alarm will turn OFF.

If the control deviation is reduced in the area between 6 and 7 (i.e., the set point is approached) and the amount the control deviation is reduced is less than the LBA Band, the Loop Break Alarm will turn ON.

- If the LBA Detection Time, LBA Level, LBA Detection Band, and PID settings are not appropriate, alarms may be detected inappropriately or alarms may not be output when necessary.
- Loop break alarms may be detected if unexpectedly large process disturbances occur continuously and a large deviation does not decrease.
- If a loop break occurs when the set point is near the ambient temperature, the temperature deviation in a steady state may be less than the LBA level, preventing detection of the loop break.
- If the set point is so high or low that it cannot be reached even with a saturated manipulated variable, a temperature deviation may remain even in a steady state and a loop break may be detected.
- Loop Break Detection in not possible if a fault occurs that causes an increase in temperature while control is being applied to increase the temperature (e.g., an SSR short-circuit fault).
- Loop Break Detection in not possible if a fault occurs that causes a decrease in temperature while control is being applied to decrease the temperature (e.g., a heater burnout fault).

Parameters Related to Loop Break Alarms

Table 4.AB

Parameter Name	Symbol	Sensor Type	Configurable Range (Units)	Application Considerations
LBA Detection Time	LbA		0…9999 (s)	Setting 0 disables the LBA function.
LBA Level	LbAL	Controllers with Thermocouple and Resistance Thermometer (RTD) inputs	0.1…999.9 (°C/°F) ❶	Default: 8.0 (°C/°F)
		Controllers with Analog Inputs	0.01…99.99 (%FS)	Default: 10.00% FS
LBA Band	LbAb	Controllers with Thermocouple and Resistance Thermometer (RTD) inputs	0.0…999.9 (°C/°F) ❶	Default: 3.0 (°C/°F)
		Controllers with Analog Inputs	0.00…99.99 (%FS)	Default: 0.20% FS

❶ Set NONE as the unit for analog inputs.

- A loop break alarm can be output by setting the Alarm 1 Type to 12 (LBA).
- A setting of 12 (LBA) can be configured for Alarm 2 or 3 but the setting will be disabled.
- Loop breaks are not detected during SP Ramp operation.
- Loop breaks are not detected during Auto-Tuning, Manual operation, or while the controller is stopped.
- If the Alarm 1 Latch parameter is configured to ON, the latch will be effective for the loop break alarm.

Automatically Setting the LBA Detection Time

- The LBA Detection Time is automatically configured by Auto-Tuning. (However, it is not configured automatically for heating/cooling control.)
- If the optimum LBA Detection Time is NOT obtained by Auto-Tuning, configure the LBA Detection Time parameter (Advance Setting function group).

Determining the LBA Detection Time

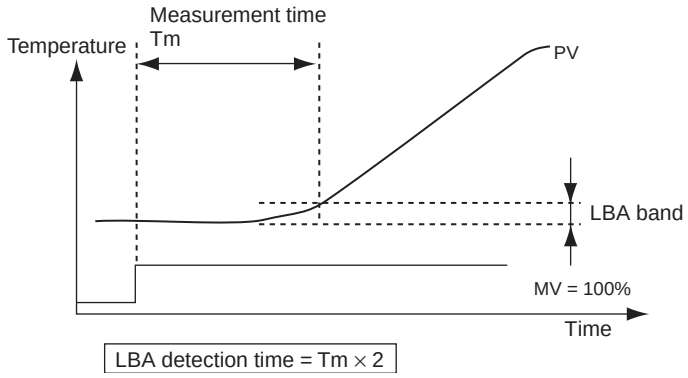
To manually configure the LBA detection time, configured the LBA Detection Time parameter to twice the LBA reference time given in the example below.

EXAMPLE

Procedure

1. Set the output to the maximum value.
2. Measure the time required for the change in the input to reach the LBA band.

Figure 4.95



3. Set the LBA Detection Time parameter to two times the measured time.

LBA Level

Configure the control deviation when the control loop is working properly.

The default is 8.0 (°C/°F) for Controllers with Thermocouple/Resistance Thermometer Multi-Inputs and 10.00% FS for Controllers with Analog Inputs.

LBA Band

There is assumed to be an error in the control loop if the control deviation is greater than the threshold configured for the LBA Level parameter and if the control deviation does not change by at least the value configured for the LBA Band parameter.

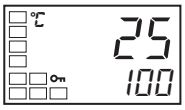
The default is 3.0 (°C/°F) for Controllers with Thermocouple/Resistance Thermometer Multi-Inputs and 0.20% FS for Controllers with Analog Inputs.

EXAMPLE

Operating Procedure: Loop Break Alarm Configurations

In this example, the LBA Detection Time is configured to 10, the LBA Level is configured to 8.0, and the LBA Band is configured to 3.0.

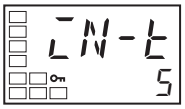
Figure 4.96



PV/SP

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

Figure 4.97



Input type

2. Select the Alarm 1 Type parameter by pressing the ↵ key.

Figure 4.98

Alarm 1 type

3. Press the ∧ key to configure the Alarm 1 Type parameter value to 12.

Figure 4.99

4. Select the Move to Advanced Setting function group parameter by pressing the ↵ key.

Figure 4.100

Move to Advanced
Setting Function Group

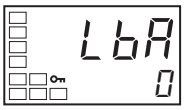
5. Press the ⩛ key to enter the password (**–169**), and move from the Initial Setting function group to the Advanced Setting function group.

Figure 4.101

Parameter initialization

6. Select the LBA Detection Time parameter by pressing the ⩥ key.

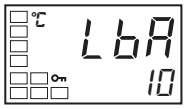
Figure 4.102



LBA detection time

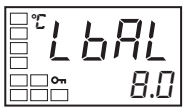
7. Press the ⩓ key to set the parameter to 10.

Figure 4.103



8. Select the LBA Level parameter by pressing the ⩥ key.

Figure 4.104



LBA level

9. Press the ⩓ key to set the parameter to 8.0. (**Note:** The default is 8.0.)

10. Select the LBA Band parameter by pressing the ⩥ key.

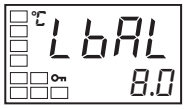
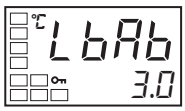


Figure 4.105

LBA band

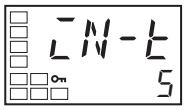
11. Press the ⩓ or ⩛ key to set the parameter to 3.0. (**Note:** The default is 3.0.)

Figure 4.106



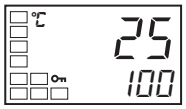
12. Press the ◯ key for at least 1 second to move from the Advanced Setting function group to the Initial Setting function group.

Figure 4.107



13. Press the ◯ key for at least 1 second to move from the Initial Setting function group to the Operation function group.

Figure 4.108



Performing Manual Control

Manual Operation

You (the operator) can take manual control of the manipulated variable when the PV/MV parameter is displayed in the Manual Control function group. The final MV (Manipulated Variable) used in automatic mode will be used as the initial manual MV when moving from automatic mode to manual mode. In manual mode, the change value will be fixed immediately and reflected in the actual MV (bumpless transfer).

- Manual operation can be used only for PID control.
- The automatic display return function will not operate in manual mode.
- Balanceless-bumpless operation will be performed for the MV when switching from manual operation to automatic operation. (Refer to the Note on page 4-53.)
- If a power interruption occurs during manual operation, manual operation will be restarted when power is restored using the same MV as when power was interrupted.
- Switching between automatic and manual operation is possible for a maximum of one million times.

Note: In balanceless-bumpless operation, the MV before switching is used initially after the switch and then gradually changed to achieve the proper value after switch to prevent radical changes in the MV after switching operation.

The overall manual operation is illustrated in the following figure.

Figure 4.109 — Overall Manual Operation

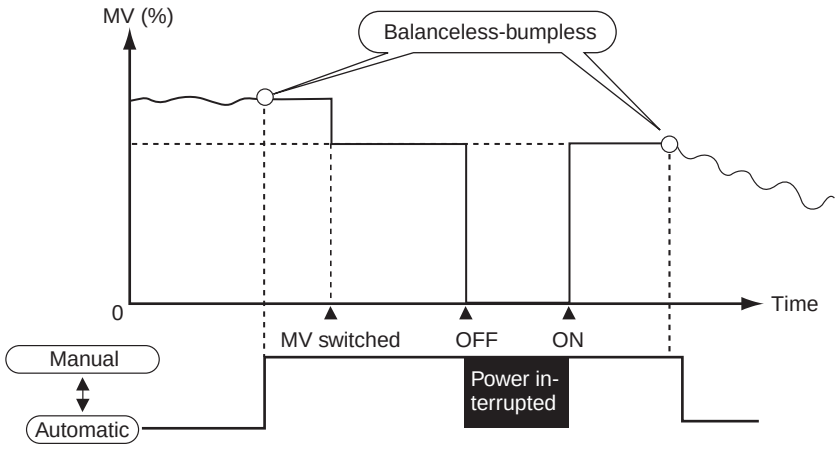


Table 4.AC —Related Displays and Parameters

Parameter Name	Symbol	Function Group	Remarks
PV/MV (Manual MV)		Manual Control function group	–5.0…105.0 (heating/cooling control: –105.0…105.0)
Auto/Manual Switch	A-M	Operation function group	Switches between automatic and manual modes.
Auto/Manual Select Addition	AMAd	Advanced Setting function group	Enables switching between automatic and manual modes.

Note: Refer to *Output Adjustment Functions* on page 4-75 for information on the priority for the MV.

Manual MV Limit Enable

When the Manual MV Limit Enable parameter is configured to ON (enabled), the MV limits will function and the setting range for the Manual MV parameter will be between the MV upper limit and the MV lower limit. When the parameter is configured to OFF (disabled), MV limits will not function.

Table 4.AD

Parameter Name	Setting Range	Default
Manual MV Limit Enable	OFF: Disabled, ON: Enabled	ON

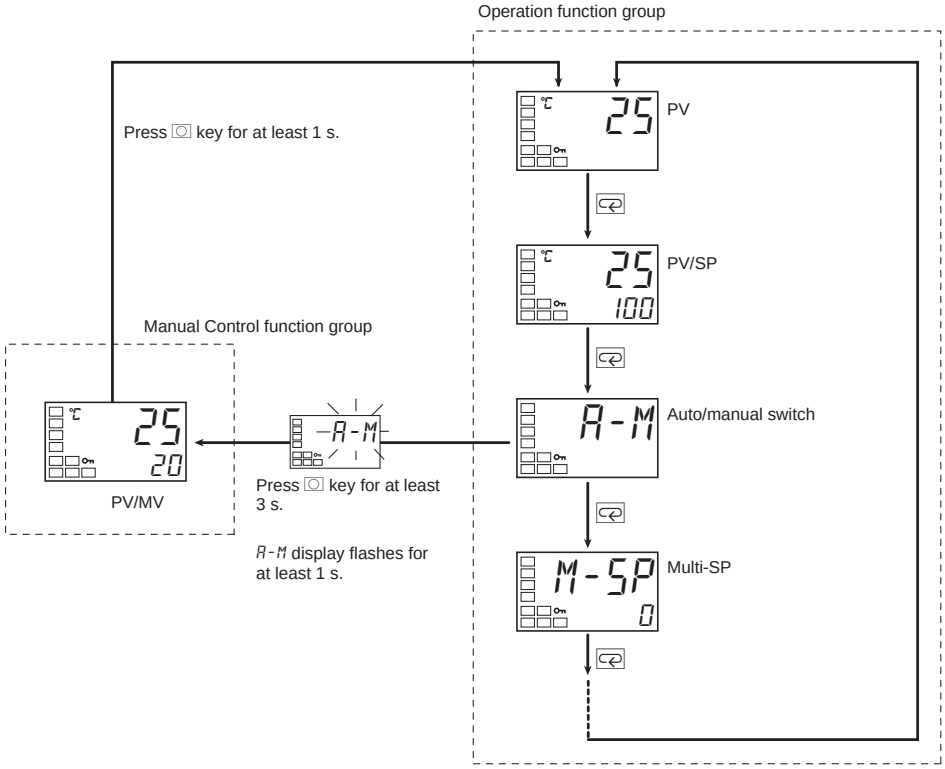
Moving to the Manual Control function group (Refer to Figure 4.110)

In the Operation function group select the Auto/Manual parameter and then press the ◎ key for at least 3 seconds to switch to the manual mode and to

display the Manual Control function group. It is not possible to move to any displays except for the PV/MV parameter during manual operation. Press the [O] key for at least 1 second from the PV/MV display in the Manual Control function group to return to automatic mode and display the top parameter in the Operation function group.

Note: To use the Manual Control mode, the Auto/Manual Select Addition parameter must first be configured to ON in the Advanced Setting function group (refer to Figure 4.115 on page 4-57).

Figure 4.110



For 900-TC8 and 900-TC16, if an event input is configured to MANU (Auto/Manual), the Auto/Manual Switch parameter will not be displayed. Use the event input to switch between automatic and manual modes.

Note: Even when controller operation is stopped, the manual control of the MV is given priority over other functions.
Controller auto-tuning and self-tuning will stop when the Manual Mode is entered.

Note: If the SP ramp function is operating, it will continue even when the manual mode is entered.

Using the PF Key to Move to the Manual Control Level

1. When the PF Setting parameter is configured to A-M (Auto/Manual), pressing the PF Key for at least one second while in the adjustment or operation group will change the mode to manual mode and move to the manual control function group. During manual operation it is not possible to move to any displays other than PV/MV (Manual MV). Press the PF Key for at least one second from the PV/MV display in the manual control mode to change the mode to automatic mode, move to the operation function group, and display the top parameter in the operation function group.

2. For 900-TC8 and 900-TC16, when MANU (Auto/Manual) is selected for an event input, the Auto/Manual Switch parameter is not displayed. In that case, switching between auto and manual mode is executed by using an event input.

Auto/Manual Select Addition

The Auto/Manual Select Addition parameter must be configured to ON in the Advance Setting function group before it is possible to move to manual mode. The default is OFF.

Note: 1. Priority of Manual MV and Other Functions
Even when operation is stopped, the manual MV is given priority over other functions. Auto-tuning and self-tuning will stop when manual mode is entered.

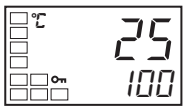
Note: 2. Manual MV and SP Ramp
If operating, the SP ramp function will continue even when manual mode is entered.

EXAMPLE

Operating Procedure

Use the following procedure to set the manipulated variable in Manual mode.

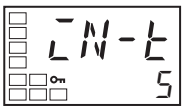
Figure 4.111



PV/SP

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

Figure 4.112



Input type

2. Select the PID ON/OFF parameter by pressing the [↵] key and select PID mode.

Figure 4.113

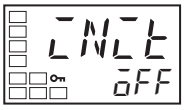
3. Select the Move to Advanced Setting function group parameter by pressing the [↵] key.

Figure 4.114

Move to Advanced Setting Function Group

Press the [≪] key to enter the password (**–169**), and move from the Initial Setting function group to the Advanced Setting function group.

Figure 4.115



Parameter initialization

4. Select the Auto/Manual Select Addition parameter by pressing the ↵ key.

Figure 4.116

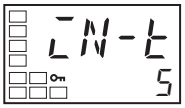
Auto/manual select addition

5. Use the ∧ key to set the parameter to ON.

Figure 4.117

6. Press the ○ key for at least 1 second to move from the Advanced Setting function group to the Initial Setting function group.

Figure 4.118

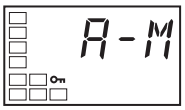


Input type

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

8. Select the Auto/Manual Switch parameter by pressing the ↵ key.

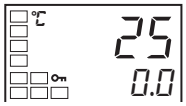
Figure 4.119



Auto/manual switch

9. Press the ○ key for at least 3 seconds to move from the Operation function group to the Manual Control function group.

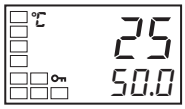
Figure 4.120



PV/MV

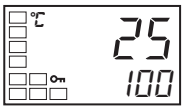
10. Press the ⩓ or ⩔ key to set the manual MV. (In this example, the MV is configured to 500%.) **Note:** The manual MV setting must be fixed, but values changed with key operations are reflected in the control output immediately.

Figure 4.121



11. Press the ⊙ key for at least 1 second to move from the Manual Control function group to the Operation function group.

Figure 4.122



EXAMPLE

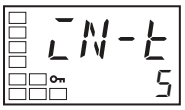
Auto/Manual Example Operating Procedure

In this example, A-M is configured for the PF Setting parameter (900-TC8 only).

1. Press the ⊙ Key for at least three seconds to move from the Operation to the Initial Setting function group.

Figure 4.123 — Operation function group

Figure 4.124 — Initial Setting function group



2. Select the Move to Advanced Setting parameter by pressing the ⊂ Key.

Figure 4.125

3. Select the PID ON/OFF parameter by pressing the ⌃ Key.

Figure 4.126

Move to Advanced Setting Group

4. Select the Move to Advanced Setting parameter by pressing the ↵ Key

5. Press the ⌄ Key to enter the password (-169), and move from the Initial Setting function group to the Advanced Setting function group.

Figure 4.127

Parameter Initialization

6. Select the Auto/Manual Select Addition parameter by pressing the ↵ Key.

Figure 4.128

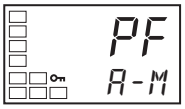
Auto/Manual Select Addition

7. Use the ⌃ Key to set the parameter to ON.

Figure 4.129

8. Press the ↵ Key to select the PF Setting parameter and confirm that it is set to "A-M." ("A-M" is the default setting.)

Figure 4.130



9. Press the [O] Key for at least one second to move from the Advanced Setting function group to the Initial Setting function group.

Figure 4.131

Input Type

10. Press the [O] Key for at least one second to move from the Initial Setting function group to the Operation function group.

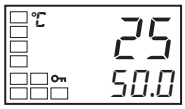
11. Press the PF Key for at least one second to move from the Operation to the Manual Control function group.

Figure 4.132

PV/MV

12. Press the [^] or [v] Key to set the manual MV. (In this example, the MV is set to 50.0%.)

Figure 4.133



Note: The manual MV setting must be saved, but values changed with key operations are reflected in the control output immediately.

13. Press the PF Key to move from the Manual Control function group to the Operation function group.

Figure 4.134

Using the Transfer Output

Transfer Output Function

Fort 900-TC8 and 900-TC16, if a control 1 output is an analog linear current output it can be used as a transfer output. To use the transfer output, configure the Transfer Output Type parameter to any setting other than OFF (refer to Table 4.AE).
When the Transfer Output Type parameter is configured to any setting other than OFF, the Transfer Output Upper-Limit and Transfer Output Lower-Limit parameters will be enabled.

Transfer Output Type

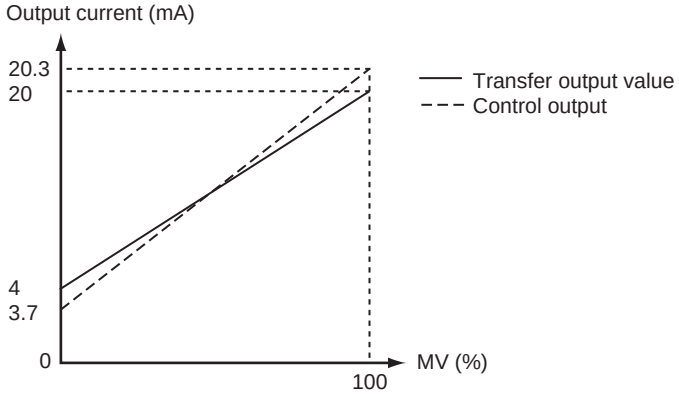
Table 4.AE — Using Transfer Input

Transfer Output Type	Symbol	Configurable Range
OFF ❶	oFF	—
Set Point	SP	SP Lower-Limit to SP Upper-Limit
Set Point during SP ramp	SP-M	SP Lower-Limit to SP Upper-Limit
PV	PV	Sensor setting range Lower-Limit to Sensor setting range Upper-Limit or Scaling Lower-Limit to Scaling Upper-Limit
MV Monitor (heating)	MV	–5.0…105.0 (heating/cooling control: 0.0…105.0) ❷
MV Monitor (cooling)	C-MV	0.0…105.0 ❷

❶ The default Transfer Output Type is OFF. If the Transfer Output Type is configured to OFF, the function assigned in the Control Output 1 Assignment parameter will be output to Control Output 1.

❷ The difference between the transfer output value and the linear current output value is illustrated in the following example and Figure 4.135.
If the linear output is used as the transfer output when the linear current output type is configured to 4…20 mA, 4.0 mA will be output for 0% and 20.0 mA will be output for 100%.
When a linear output is used for the control output, 3.7 mA is output for 0% and 20.3 mA is output for 100% when the control output for heating is selected to ensure that the control object is controlled at 0% and 100%.

Figure 4.135 — When the Linear Current Output Type is Set to 4 to 20 mA



Transfer Output Scaling

- Reverse scaling is possible by configuring the Transfer Output Lower-Limit parameter larger than the Transfer Output Upper-Limit parameter. If the Transfer Output Lower-Limit and Transfer Output Upper-Limit parameters are configured to the same value when 4…20 mA is configured, the transfer output will output continuously a 0% (4 mA) signal.

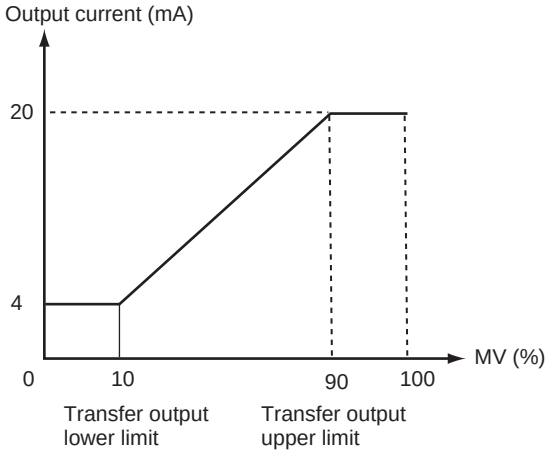
- If the SP, SP during SP ramp, or PV is selected as the Transfer Output Type, the Transfer Output Lower-Limit and Transfer Output Upper-Limit parameters will follow the values configured for the respective parameter's Upper- and Lower-Limits concerning changes in the Upper- and Lower-Limits of the SP limiter and temperature units.

- If the MV for heating or MV for cooling is selected as the Transfer Output Type, the Transfer Output Lower-Limit and Transfer Output Upper-Limit parameters will be initialized to 100.0 and 0.0, respectively, when a switch is made between standard control and heating/cooling control using the Standard or Heating/Cooling parameter.

- When the linear current type is configured as 4…20 mA, the transfer output Upper-Limit is configured to 90.0, and the transfer output Lower-Limit is configured to 10.0 is shown in the following graph (refer to Figure 4.136).

- For scaling from 0.0…100.0%, 0.0% will be the output for −5.0…0.0, and 100% will be the output for 100.0…105.0.

Figure 4.136 — When the Linear Current Output Type is Set to 4 to 20 mA

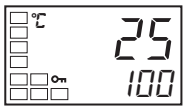


EXAMPLE

Operating Procedure

The following procedure configures the Transfer Output Type as a SP with a range (limit) of −50…200.

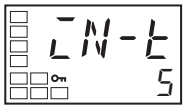
Figure 4.137 — Operation function group



PV/SP

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

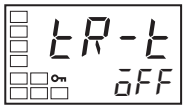
Figure 4.138



Input type

2. Select the Transfer Output Type parameter by pressing the rEY.

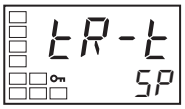
Figure 4.139



Transfer output type

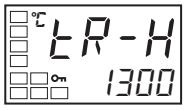
3. Press the ⩓ key to select SP (set point).

Figure 4.140



4. Select the Transfer Output Upper-Limit parameter by pressing the ⊂ key.

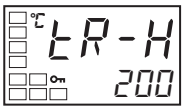
Figure 4.141



Transfer output upper limit

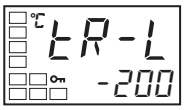
5. Use the ⩛ key to set the parameter to 200. The default is 1300.

Figure 4.142



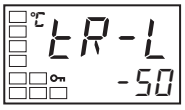
6. Select the Transfer Output Lower-Limit parameter by pressing the ⏎ key.

Figure 4.143



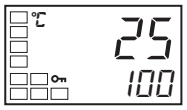
7. Use the ⩓ key to set the parameter to −50. The default is −200.

Figure 4.144



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

Figure 4.145

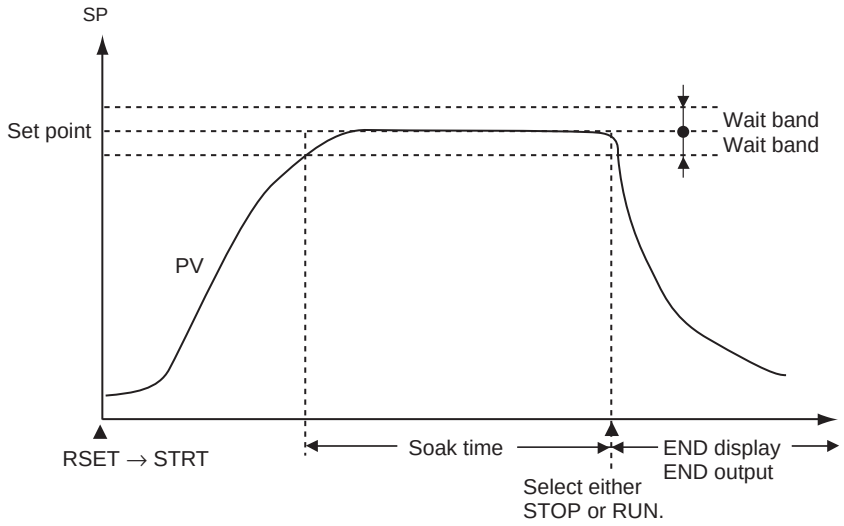


Using the Simple Program Function

Simple Program Function

The simple program function can be used to perform a simple one step ramp and soak operation.

Figure 4.146



The simple program will start when the Program Start parameter is changed from RSET to STRT. END will be displayed on the No. 2 display and the output assigned as the program end output will turn ON after the time configured in the Soak Time parameter has expired in the wait band. The Program Pattern parameter can be used to select moving to STOP mode or continuing operation in RUN mode after the program ends.

Table 4.AF —Parameters Related to the Simple Program Function

Parameter Name	Symbol	Configurable (Monitor) Values	Units	Display Function Group
Program Pattern	PtRN	OFF, STOP, CONT	—	Initial Setting
Program Start	PRSt	RSET, STRT	—	Operation
Soak Time	SoAK	1…9999	min or h	Adjustment
Soak Time Unit	t-U	m (minutes)/h (hours)	—	Advanced Setting
Wait Band	Wt-b	OFF or 0.1…999.9 ❶	°C or °F ❶ ❷	Adjustment
Soak Time Remain Monitor	SKtR	0…9999	min or h	Operation

❶ The configurable units for the Wait Band parameter is %FS for Controllers with Analog Inputs and the range is OFF or 0.01…99.99.

❷ Units configured for Controllers with Thermocouple/Resistance Thermometer Multi-inputs. Set NONE as the unit for Controllers with Analog Inputs.

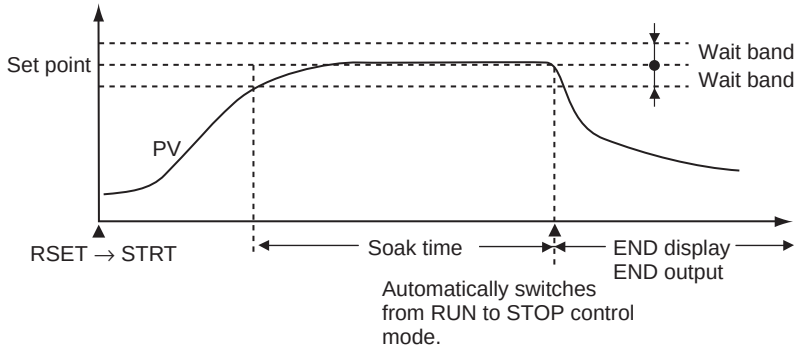
Program Pattern

Either of two program patterns (STOP or Continue) can be selected. The simple program operation will not be performed if the Program Pattern parameter is configured to OFF.

Pattern 1 (STOP)

Control will stop and the STOP control mode will be entered when the simple program has ended.

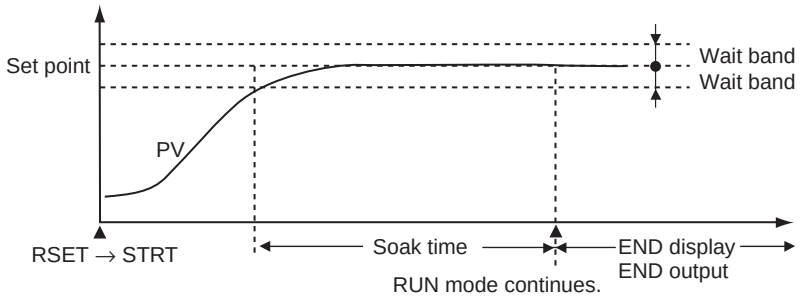
Figure 4.147



Pattern 2 (CONT)

Control will continue in RUN control mode when the simple program has ended.

Figure 4.148



Starting Method

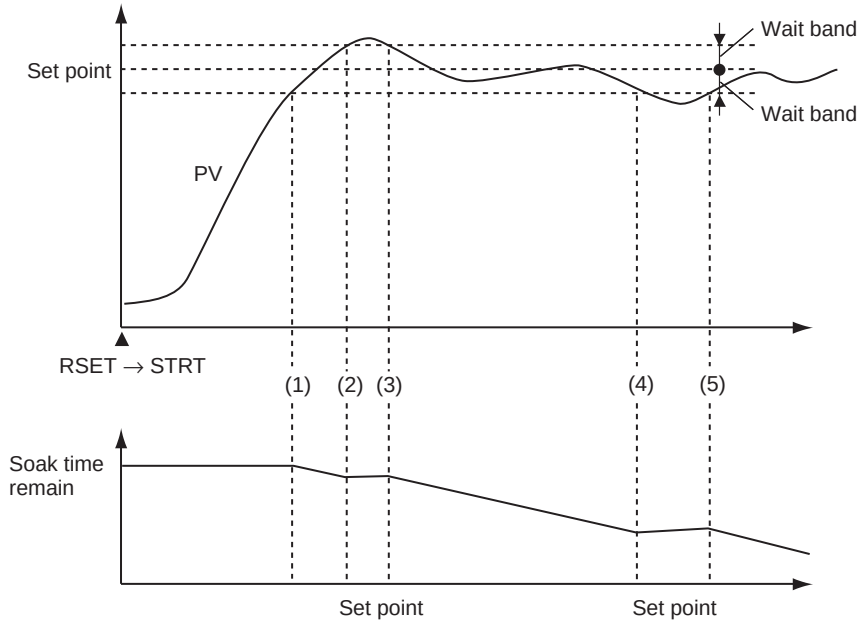
Any of the following three methods can be used to start the simple program.

- Setting the Program Start parameter to STRT.
- For 900-TC8 & 900-TC16: Turning ON an event input. (The program start must be assigned to an event input. Refer to the Note on page 4-68.)
- Starting with an Operation Command using communications. (When the program start is not assigned to an event input.)

Note: When an event input is used to start and reset the simple program, writing is performed to EEPROM. Be sure to consider the write life (1 million writes) of the EEPROM in the system design. When the program start is assigned to an event input, the Program Start parameter will function as a monitor display, and the RSET/STRT displays can be used to check when the event input has started or reset the simple program. When this is done, the Program Start parameter functions as a monitor display only and cannot be changed using key operations. If the Program Pattern parameter is configured to OFF, the event input assignment setting will be initialized to NONE.

Soak Time and Wait Band

Figure 4.149



The wait band is the fixed band within which the process value is stable in respect to the set point. The soak time is measured within the wait band. The timer that measures the soak time operates only when the process value is

within the wait band around the set point (i.e., SP ± wait band). In the pre-ceding diagram, the timer will be stopped between the start and (1), (2) and (3), and (4) and (5) and will measure the time only between (1) and (2), (3) and (4), and (5) and the end.

Note: If the wait band is configured to OFF, the wait band will be treated as infinity and the timer will measure time continuously after changing from RSET to STRT.

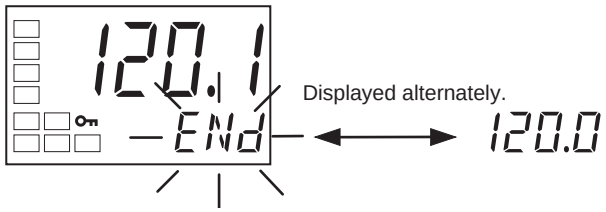
Operation at the Program End

Display at the Program End

When the program ends, the process value will be displayed on the No. 1 display (refer to Note below) and the set point and End will be alternately displayed on the No. 2 display at 0.5 second intervals.

Note: One of the following displays: PV/SP, PV only, or PV/MV.

Figure 4.150



Program End Output

In the case of 900-TC8 and 900-TC16, When the Program Pattern parameter is changed from OFF to STOP or CONT, the Auxiliary Output1 Assignment parameter will automatically be configured to the END output. When the Program Pattern parameter is changed from STOP or CONT to OFF, the Alarm 1 Output Assignment parameter will automatically be initialized to ALM1. The output assignment parameters can also be used to assign the program END output to any output.

In the case of 900-TC32, When the Program Pattern parameter is changed from OFF to STOP or CONT for the 900-TC32, the Auxiliary Output 1 Assignment parameter will automatically be set to the END output. When the Program Pattern parameter is changed from STOP or CONT to OFF, the Alarm 1 Output Assignment parameter will automatically be initialized to ALM1. When using heating/cooling control and the Program Pattern parameter is changed from OFF to STOP or CONT, the END output will not be assigned to an output. Use the output assignment parameters to assign the program END output to the desired output.

The program END output is also provided in communications status.

Clearing the Program End Status

The program END output and display will be cleared when the Program Start parameter is changed from STRT to RSET. The setting is changed from STRT to RSET while the Program Start parameter is displayed.

The program END status can also be cleared using an event input. If the program start function is assigned to an event, however, the program end status cannot be cleared from the Program Start parameter display, which will function only as a monitor display.

EXAMPLE

Operating Procedure

Perform the following procedure to use the simple program function.

In this example, the program pattern will be configured to STOP, the soak time to 10 min, and the wait band to 3.

Figure 4.151

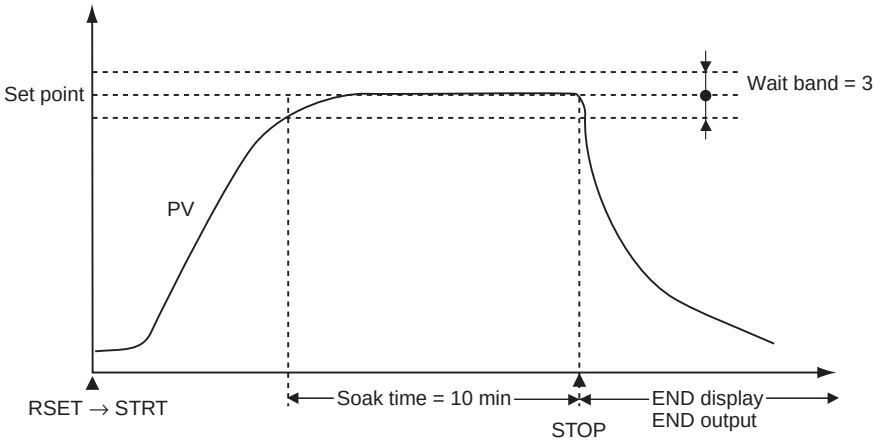
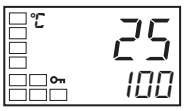
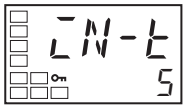


Figure 4.152 —Operation function group



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

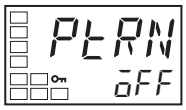
Figure 4.153



Input type

2. Select the Program Pattern parameter by pressing the ↵ key.

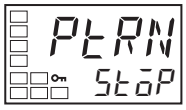
Figure 4.154



Program Pattern

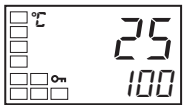
3. Use the ∧ key to set the parameter to STOP.

Figure 4.155



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

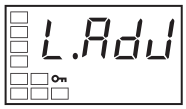
Figure 4.156



PV/SP

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

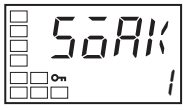
Figure 4.157



Adjustment function group display

6. Select the Soak Time parameter by pressing the ↵ key.

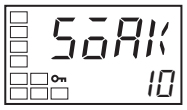
Figure 4.158



Soak time

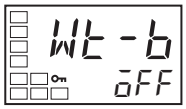
7. Use the ⇈ key to set the parameter to 10. (The soak time unit is configured in Soak Time Unit parameter in the Advance Setting function group. The default is M (minutes).

Figure 4.159



8. Select the Wait Band parameter by pressing the ⇆ key.

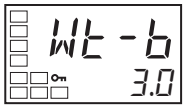
Figure 4.160



Wait band

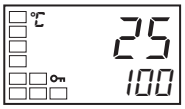
9. Use the ⇈ key to set the parameter to 3.0.

Figure 4.161



10. Press the ⊙ key to move from the Adjustment function group to the Operation function group.

Figure 4.162



PV/SP

EXAMPLE

Using a Simple Program

The program will be started by changing the configuration of the Program Start parameter. The following shows an example using a simple program with the program pattern configured to STOP.

Figure 4.163

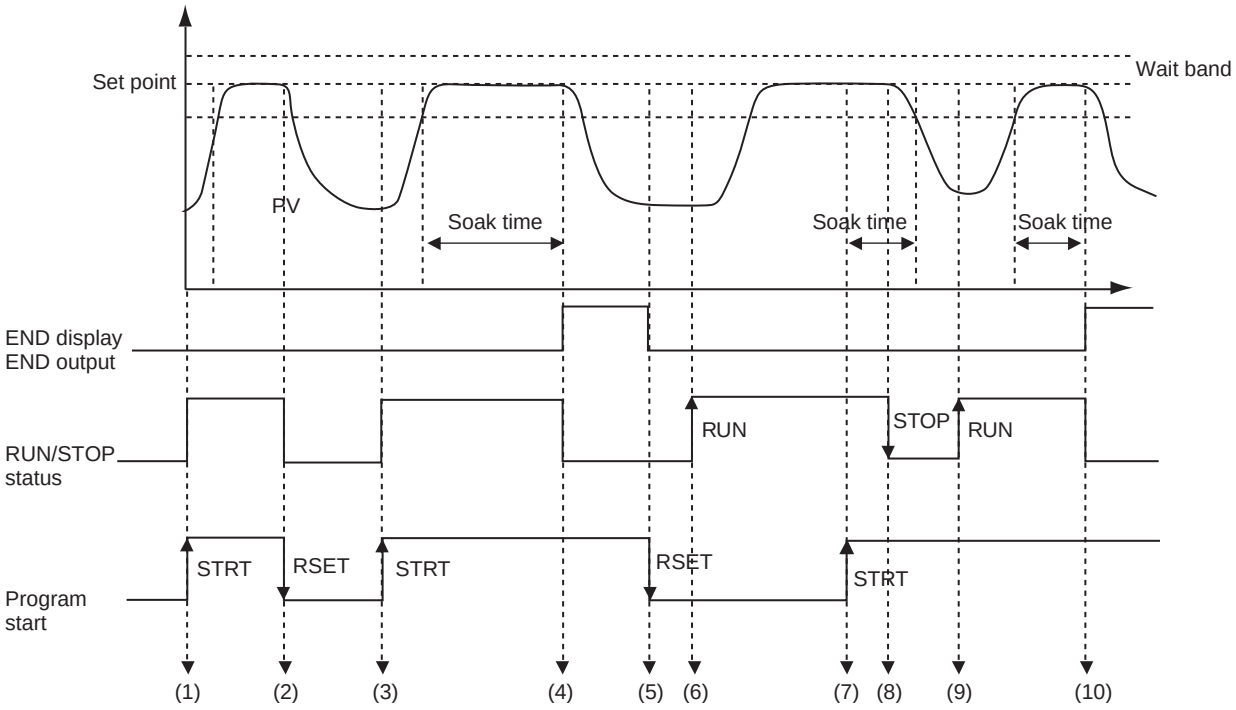


Table 4.AG

Timing	Description
(1)	The Program Start parameter was changed from RSET to STRT using either an event or key operations. The RUN/STOP status automatically changes to RUN mode when the above operation is performed.
(2)	The Program Start parameter was changed from STRT to RSET using either an event or key operations before the soak time expired. The RUN/STOP status automatically changes to STOP mode when the above operation is performed.
(3)	The Program Start parameter is again changed from RSET to STRT using either an event or key operations. The RUN/STOP status will automatically change to RUN mode when the above operation is performed.
(4)	The RUN/STOP status automatically changes to STOP mode when soak time expires. END flashes on the No. 2 display and the program END output turns ON.
(5)	The Program Start parameter is changed from STRT to RSET using either an event or key operations. The END display is cleared and the program END output turns OFF.
(6)	Key operations are used to switch the RUN/STOP status to RUN with the Program Start parameter configured to RSET (stopped). Normal control operation is started.
(7)	The Program Start parameter is changed from RSET to STRT after the process value stabilizes. The RUN/STOP status remains as RUN.
(8)	Key operations are used to change the RUN/STOP status to STOP (during program operation). Measuring the soak time is continued within the wait band. (Measuring the soak time stops when the process value leaves the wait band.)
(9)	Key operations are used to change the RUN/STOP status to RUN. Measuring the soak time is continued within the wait band (continuing from the time between (7) and (9)).
(10)	The RUN/STOP status automatically changes to STOP mode when the measured time reaches the soak time. END flashes on the No. 2 display and the program END output turns ON.

Output Adjustment Functions

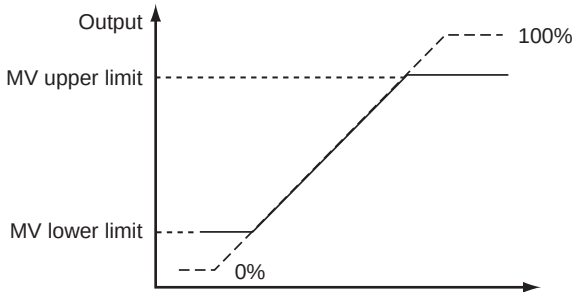
Output Limits

Output limits can be configured to limit the output using the Upper- and Lower-Limits to the calculated MV.

The following MV takes priority over the MV limits.

- Manual MV
- MV at stop
- MV at PV error

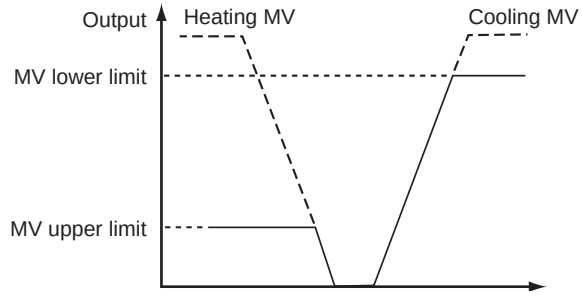
Figure 4.164



Note: 1. When the manual MV limit is enabled, the manual MV will be restricted by the MV limit.

Note: 2. For heating/cooling control, Upper- and Lower-Limits are configured of overall heating/cooling control. (They cannot be configured separately for heating/cooling.)

Figure 4.165



MV at Stop

You can configure the amount the MV is output during the controller STOP mode using the MV at Stop parameter. For heating/cooling control, the MV at Stop will apply to the cooling side if the MV is negative and to the heating side if the MV is positive.When configuring the MV at Stop parameter also configure the MV at Stop and Error Addition parameter (Advanced Setting function group) to ON. The default is 0.0, so an MV will not be output for either standard or heating/cooling control.

Table 4.AH

Parameter	Configurable Range	Unit	Default
MV at Stop	–5.0…105.0 for standard control –105.0…105.0 (heating/cooling control)	%	0.00

Note: The order of priority is as follows: Manual MV > MV at stop > MV at PV error.

MV at PV Error

You can configure the amount the MV is output during an input error condition. The MV at stop takes priority when stopped and the manual MV takes priority in manual mode.

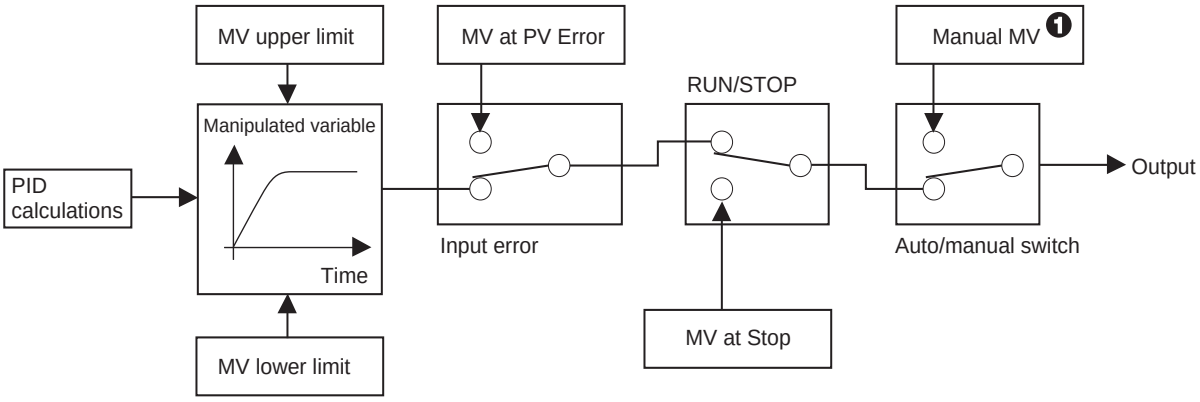
Table 4.AI

Parameter	Configurable Range	Unit	Default
MV at PV error	–5.0…105.0 for standard control –105.0…105.0 (heating/cooling control)	%	0.0

Note: The order of priority is as follows: Manual MV > MV at stop > MV at PV error.

The order of priority of the MVs is illustrated in the following diagram.

Figure 4.166



Using the Extraction of Square Root Parameter

Extraction of Square Roots

Figure 4.167 — Extraction of Square Root Enable

• For analog inputs, the Extraction of the Square Root parameter is provided for inputs so that differential pressure-type flow meter signals can be directly input.

• The default setting for the Extraction of Square Root parameter is OFF. The Extraction of Square Root Enable parameter must be configured to ON in order to use this function.

Figure 4.168 — Extraction of Square Root Low-cut Point

• If the PV input (i.e., the input before extracting the square root) is higher than 0.0% and lower than the low cut point configured in the Extraction of Square Root Low-Cut Point parameter, the results of extracting the square root will be 0.0%. If the PV input is lower than 0.0% or higher than 100.0%, extraction of the square root will not be executed, so the result will be equal to the PV input. The low-cut point is configured as normalized data for each input, with 0.0 as the lower limit and 100.0 as the upper limit for the input setting range.

Figure 4.169 —Extraction of the Square Root

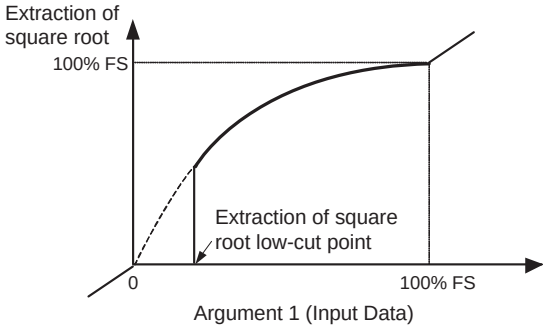


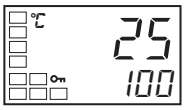
Table 4.AJ

Parameter Name	Configurable Range	Unit	Default
Extraction of the Square Root Enable	OFF: Disabled, ON: Enabled	---	OFF
Extraction of Square Root Low-cut Point	0.0...100	%	0.0

Operating Procedure

This procedure sets the Extraction of Square Root Low-cut Point parameter to 10.0%

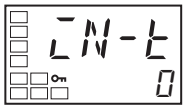
Figure 4.170 — Operation function group



PV/SP

1. Press the Key for at least three seconds to move from the Operation to the Initial Setting function group.

Figure 4.171



Input Type

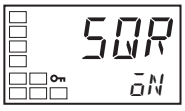
2. Press the Key to select the Extraction of Square Root Enable parameter.

Figure 4.172

Extraction of Square Root Enable

3. Use the Key to select ON.

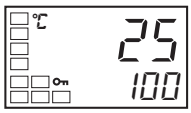
Figure 4.173



Extraction of Square Root Enable

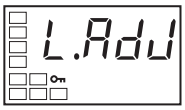
4. Press the ○ Key for at least one second to move from the Initial Setting to the Operation function group.

Figure 4.174



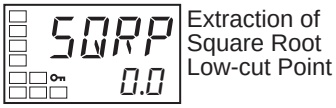
5. Press the ○ Key to move from the Operation function group to the Adjustment function group.

Figure 4.175



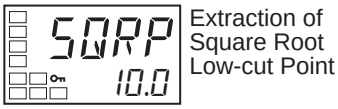
6. Select the Extraction of Square Root Low-cut Point parameter by pressing the ↵ Key Operating Procedure

Figure 4.176



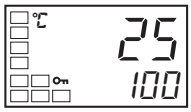
7.Use the ∧ Key to set the parameter to -10.0.

Figure 4.177



8. Press the ○ Key to return to the Operation function group.

Figure 4.178



Setting the Rate of MV Variation

The MV Change Rate Limit parameter sets the maximum allowable rate of change in the MV in units of percent per second. If the change in the MV exceeds this setting, the MV will be changed by the MV change rate limit until the calculated value is reached. This function is disabled when the setting is 0.0.

The MV Change Rate Limit parameter does not function in the following situations:

- In manual mode
- During ST execution (Cannot be configured when ST is ON.)
- During AT execution
- During ON/OFF control
- While stopped (during MV at Stop output)
- During MV at PV Error output

Table 4.AK

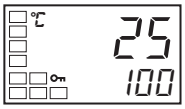
Parameter Name	Configuration Range	Units	Default
MV Change Rate Limit	0.0...100	%/s	0.0

Operating Procedure

This procedure sets the MV Change Rate Limit to parameter 5.0%/s. The related parameters are as follows:

PID·ON/OFF = PID
ST = OFF

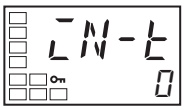
Figure 4.179 — Operation function group



PV/SP

1. Press the ◯ Key for at least three seconds to move from the Operation function group to the Initial Setting function group.

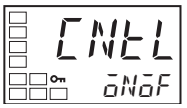
Figure 4.180



Input Type

2. Select the PID ON/OFF parameter by pressing the Key.

Figure 4.181



PID·ON/OFF

3. Use the Key to select 2-PID control.

Figure 4.182

PID·ON/OFF

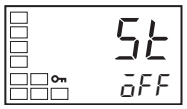
4. Press the Key to select the ST parameter.

Figure 4.183

ST

5. Press the Key to select OFF.

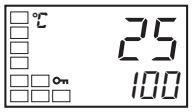
Figure 4.184



ST

6. Press the Key for at least one second to move from the Initial Setting to the Operation function group.

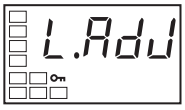
Figure 4.185



PV/SP

7. Press the Key to move from the Operation function group to the Adjustment function group.

Figure 4.186

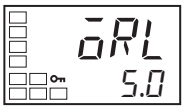


8. Press the Key to select the MV Change Rate Limit parameter.

Figure 4.187

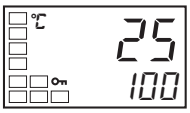
9. Use the Key to set the parameter to 5.0.

Figure 4.188



10. Press the Key to return to the Operation function group.

Figure 4.189



Setting the PF Key

PF Setting (Function Key)

Pressing the PF Key for at least one second executes the operation configured in the PF Setting parameter (900-TC8 only).

The possible operations are outlined in the below table.

Table 4.AL

Set Value	Symbol	Operation	Function
OFF	oFF	Disabled	Does not operate as function key
RUN	RUN	RUN	Specifies RUN status
STOP	StoP	STOP	Specifies STOP status
R-S	R-S	RUN/STOP reverse operation	Specifies reversing the RUN/STOP operation status
AT-2	At-2	100% AT Execute/Cancel	Specifies reversing the 100% AT Execute/Cancel status (see note 1)
AT-1	At-1	40% AT Execute/Cancel	Specifies reversing the 40% AT Execute/Cancel status

Table 4.AL

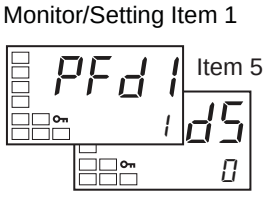
Set Value	Symbol	Operation	Function
LAT	LAt	Alarm Latch Cancel	Specifies canceling all alarm latches (see note 2)
A-M	A-M	Auto/Manual	Specifies reversing the Auto/Manual status (see note 3)
PFDP	PFdP	Monitor/Setting Item	Specifies the monitor/setting item display. Select the monitor setting item according to the Monitor/ Setting Item 1 to 5 parameters (advanced setting function group).

Note:

1. When AT cancel is specified, it means that AT is cancelled regardless of whether the AT currently being executed is 100% AT or 40% AT.
2. Alarms 1 to 3, heater burnout, HS alarms, and heater over-current latches are cancelled.
3. For details on auto/manual operations using the PF Key, refer Performing Manual Control.
4. Pressing the PF Key for at least one second executes operation according to the configured value. When the Monitor/Setting Item parameter is selected, however, the display is changed in order from Monitor/Setting Item 1 to 5 each time the key is pressed.
5. This function is enabled when PF Key Protect is OFF.

Monitor/Setting Item

Monitor/Setting Item



Setting the PF Setting parameter to the Monitor/Setting function makes it possible to display monitor/setting items using the function key. The following

table shows the details of the settings. For setting (monitor) ranges, refer to applicable parameter.

Table 4.AM — Setting Detail

Set Value	Operation/Function	Remarks Monitor/Setting	Symbol
0	Disabled		---
1	PV/SP/Multi-SP	Can be configured. (SP)	---
2	PV/SP/MV (see note)	Can be configured. (SP)	---
3	PV/SP/Soak time remain	Can be configured. (SP)	---
4	Proportional band (P)	Can be configured.	P
5	Integral time (I)	Can be configured.	I
6	Derivative time (D)	Can be configured.	d
7	Alarm value 1	Can be configured.	AL - 1
8	Alarm value upper limit 1	Can be configured.	AL 1H
9	Alarm value lower limit 1	Can be configured.	AL 1L
10	Alarm value 2	Can be configured.	AL -2
11	Alarm value upper limit 2	Can be configured.	AL -2H
12	Alarm value lower limit 2	Can be configured.	AL -2L
13	Alarm value 3	Can be configured.	AL - 3
14	Alarm value upper limit 3	Can be configured.	AL 3H
15	Alarm value lower limit 3	Can be configured.	AL 3L

Note: For details on MV settings for heating and cooling control, refer to MV Display for Heating and Cooling.

Configuring Monitor/Setting Items

Pressing the PF Key in wither the Operation or Adjustment function group displays the applicable monitor/settings items. Press the PF Key to display in order Monitor/Setting items 1 to 5. After Monitor/Setting Item 5 has been displayed, the display will switch to the top parameter in the Operation function group.

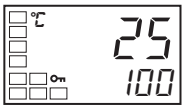
1. Items configured as disabled in the Monitor/Setting Items 1 to 5 parameters will not be displayed, and the display will skip to the next enabled item.

2. While a monitor/setting item is being displayed, the display will be switched to the top parameter in the Operation function group if the ↵ Key or the ○ Key is pressed.

Operating Procedure

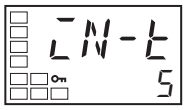
This procedure sets the PF Setting parameter to PFDP, and the Monitor/Setting Item 1 parameter to 7 (Alarm Value 1).

Figure 4.190 — Operation Function Group



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

Figure 4.191

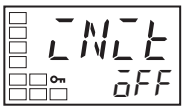


2. Select the Move to Advanced Setting function group parameter by pressing the ↵ Key.

Figure 4.192

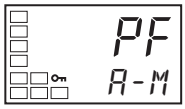
3. Press the ≫ Key to enter the password (-169). It is possible to move to the Advanced Setting function group by either pressing the ↵ Key or waiting two seconds without pressing any key.

Figure 4.193



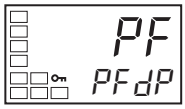
4. Press the ↵ Key to select the PF Setting parameter.

Figure 4.194



5. Press the ⌃ Key to select PFDP (Monitor/Setting Item).

Figure 4.195



PF Setting

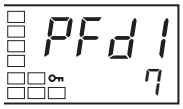
6. Press the ↵ Key to select the Monitor/Setting Item 1 parameter.

Figure 4.196

Monitor/Setting Item 1

7. Press the ⌃ Key to select 7 (Alarm Value 1).

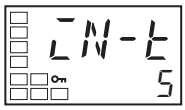
Figure 4.197



Monitor/Setting Item 1

8. Press the ○ Key for at least one second to move from the Advanced Setting to the Initial Setting function group.

Figure 4.198



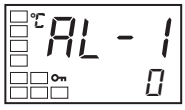
Input Type

9. Press the ○ Key for at least one second to move from the Initial Setting to the Operation function group.

Figure 4.199

10. Press the PF Key to display Alarm Value 1.

Figure 4.200



Monitor/Setting Item Display 1

Counting Control Output ON/OFF Operations

Control Output ON/OFF Count Function

With Control Output 1 and 2 ON/OFF outputs (relay outputs or voltage outputs for driving SSR), the number of times that a control output turns ON and OFF can be counted. Based on the control output ON/OFF count alarm configured value, an alarm can be output and an error can be displayed if the configured count value is exceeded.

The default configuration of the Control Output ON/OFF Alarm Setting parameter is 0. ON/OFF operations are not counted when this parameter is configured to 0. To enable counting ON/OFF operations, change the configuration to a value other than 0.

Control Output ON/OFF Counter Monitor Function

This function is not displayed when the Control Output 1 ON/OFF Alarm Setting and the Control Output 2 ON/OFF Alarm Setting parameter are set to 0, or when the control outputs are set for linear (analog) outputs.

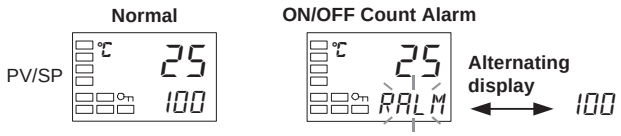
Table 4.AN

Parameter Name	Configurable Range	Unit	Default
Control Output 1 ON/OFF Count Monitor	0 to 9999	100 times	0
Control Output 2 ON/OFF Count Monitor (900-TC8 & 900-TC16)	0 to 9999	100 times	0

Display When ON/OFF Count Alarm Occurs

When an ON/OFF count alarm occurs, the PV display in the No. 1 display shown below alternates with the RALM display on the No. 2 display.

• PV
• PV/SP (Including the items displayed by setting the "PV/SP" Display Screen Selection parameter.)
• PV/Manual MV, PV/SP/Manual MV
• PV/SP displayed for the monitor/setting items



Control Output ON/OFF Count Alarm Function

If the ON/OFF counter exceeds the control output ON/OFF count alarm configured value, an ON/OFF count alarm will occur. The alarm status can be assigned to a control output or an auxiliary output, or it can be displayed at the

Controller. The ON/OFF count alarm configured value function is disabled by setting the ON/OFF count alarm configured value to 0.

Table 4.AO

Parameter Name	Configurable Range	Unit	Default
Control Output 1 ON/OFF Alarm Setting	0 to 9999	100 times	0
Control Output 2 ON/OFF Alarm Setting (900-TC8 & 900-TC16)	0 to 9999	100 times	0

ON/OFF Counter Reset Function

The ON/OFF counter can be reset for a specific control output.

Table 4.AP

Parameter Name	Configurable Range	Unit	Default
ON/OFF Counter Reset	0: Disable the counter reset function. 1: Reset the control output 1 ON/OFF counter. 2: Reset the control output 2 ON/OFF counter (900-TC8 & 900-TC16).	---	0

Note: After the counter has been reset, the control output ON/OFF count monitor value will be automatically returned to 0.

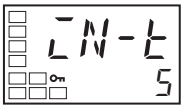
If an error occurs in the control output ON/OFF counter data, the ON/OFF count monitor value will be configured to 9999 and an ON/OFF count alarm will occur. The alarm can be cleared by resetting the ON/OFF counter.

Operating Procedure

This procedure sets the Control Output 1 ON/OFF Alarm Setting parameter to 10 (1,000 times).

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

Figure 4.201



Input Type

2. Select the Move to Advanced Setting function group parameter by pressing the ↵ Key.

Figure 4.202

Move to Advanced
Setting Function Group

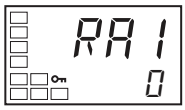
3. Use the ≫ Key to enter the password ("-169"). It is possible to move to the Advanced Setting function group by either pressing the ↵ Key or waiting two seconds without pressing any key.

Figure 4.203

Parameter
Initialization

4. Press the ↵ Key to select the Control Output 1 ON/OFF Count Alarm Set Value parameter.

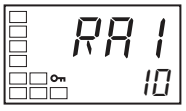
Figure 4.204



Control Output 1
ON/OFF
Counter Alarm
Set Value

5. Use the ≪ Key to set the parameter to 10.

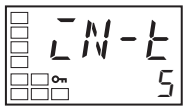
Figure 4.205



Control Output 1
ON/OFF
Counter Alarm
Set Value

6. Press the ○ Key for at least one second to move to the Initial Setting function group.

Figure 4.206



Input Type

7. Press the ○ Key for at least one second to move to the Operation function group.

Figure 4.207

Displaying PV/SV Status

PV and SV Status Display Functions

The PV in the PV/SP, PV, or PV/Manual MV Display and the control and alarm status specified for the PV status display function are alternately displayed in 0.5-s cycles.

Table 4.AQ — PV Status Display Function

Set Value	Symbol	Function
OFF	oFF	No PV status display
Manual	MANU	MANU is alternately displayed during manual control
Stop	StoP	STOP is alternately displayed while operation is stopped
Alarm 1	ALM1	ALM 1 is alternately displayed during Alarm 1 status.
Alarm 2	ALM2	ALM 2 is alternately displayed during Alarm 2 status.
Alarm 3	ALM3	ALM 3 is alternately displayed during Alarm 3 status.
Alarm 1 to 3 OR status	ALM	ALM is alternately displayed when Alarm 1, 2, or 3 is configured to ON.
Heater Alarm (See Note)	HA	HA is alternately displayed when a heater burnout alarm, HS alarm, or heater overcurrent alarm is ON.

The default is OFF.

"HA" can be selected for models that do not support heater burnout detection but the function will be disabled.

EXAMPLE

When STOP Is Selected for the PV Status Display Function

SV Status Display Function

The SP, Blank, or Manual MV in the PV/SP, PV, or PV/Manual MV Display and the control and alarm status specified for the SV status display function are alternately displayed in 0.5-s cycles.

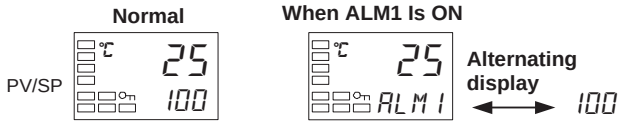
Table 4.AR — SV Status Display Function

Set Value	Symbol	Function
OFF	oFF	No SV status display
Manual	MANU	MANU is alternately displayed while operation is stopped.
Stop	StoP	STOP is alternately displayed while operation is stopped
Alarm 1	ALM 1	ALM 1 is alternately displayed during Alarm 1 status
Alarm 2	ALM 2	ALM 2 is alternately displayed during Alarm 2 status
Alarm 3	ALM 3	ALM 3 is alternately displayed during Alarm 3 status
Alarm 1 to 3 OR status	ALM	ALM is alternately displayed when Alarm 1, 2, or 3 is configured to ON.
Heater Alarm (See note.)	HA	HA is alternately displayed when a heater burnout alarm, HS alarm, or heater overcurrent alarm is ON.

The default is OFF.

Note: "HA" can be selected for models that do not support heater burnout detection, but the function will be disabled.

Example: When ALM1 Is Selected for the SV Status Display Function

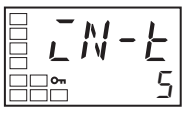


Operating Procedure

This procedure sets the PV Status Display Function parameter to ALM1.

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

Figure 4.208



2. Select the Move to Advanced Setting function group parameter by pressing the ↵ Key

Figure 4.209

Move to Advanced Setting Function Group

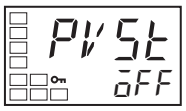
3. Use the ≫ Key to enter the password (-169). It is possible to move to the Advanced Setting function group by either pressing the ↵ Key or waiting two seconds without pressing any key.

Figure 4.210

Parameter Initialization

4. Press the ↵ Key to select the PV Status Display Function parameter.

Figure 4.211



PV Status Display Function

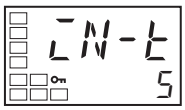
5. Press the ≪ Key to select ALM1.

Figure 4.212

PV Status Display Function

6. Press the ○ Key for at least one second to move to the Initial Setting

Figure 4.213 Initial Setting function group



Input Type

7. Press the ○ Key for at least one second to move to the Operation function group. If the Alarm 1 status is ON, PV and ALM1 will be alternately displayed.

Parameter Functions & 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 the protected parameters are not displayed regardless of the Conditions of Use.

About the Order in which Parameters are Described in This Chapter

Parameters are described in order 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, 900-TC16, and 900-TC32.

Alarms

This chapter describes when alarms are configured for the Control Output 1 or 2 Assignment parameters, or for the Auxiliary Output 1 or 3 Assignment parameters. For example, when alarm 1 is configured for the Control Output 1 Assignment parameter, it will be specified that alarm 1 is assigned.

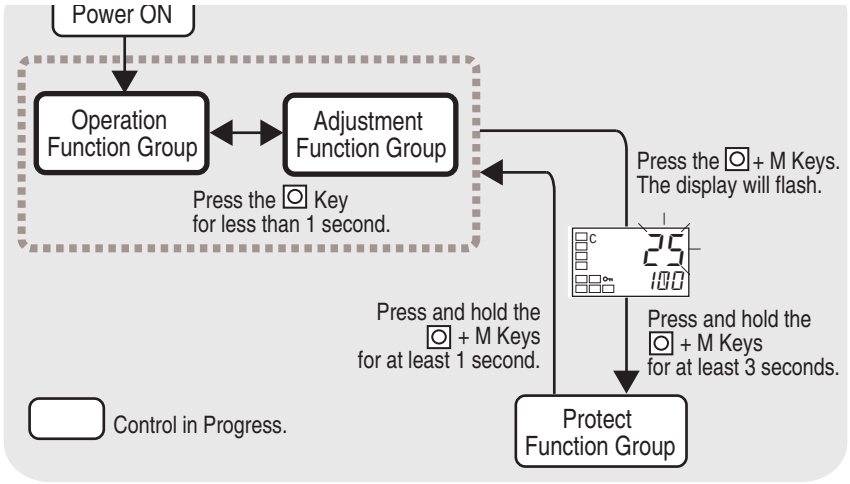
Protect Function Group

Four different modes of protection are provided within the Protect function group:

1. Operation/Adjustment protection
2. Initial Setting/Communications protection
3. Setting Change protection, and
4. PF key protect (900-TC8 only).

These protection parameters prevent unwanted operation of the controllers front panel keys in varying degrees.

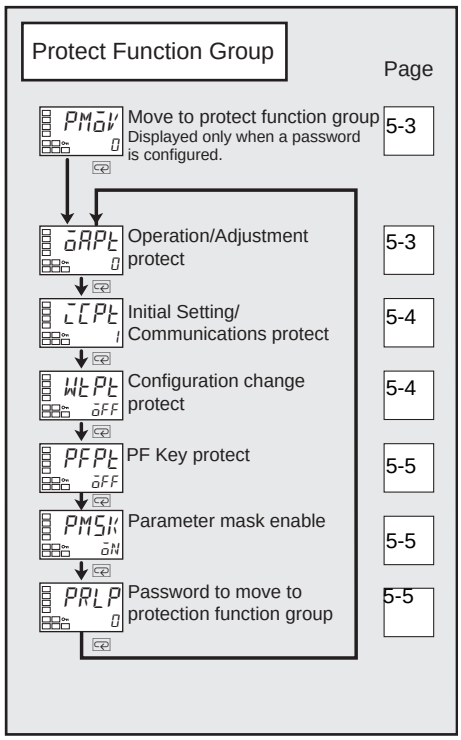
Figure 5.1



To move from the Operation function group to the Protect function group, press O and ↵ keys for 3 seconds (refer to Note) or more.

Note: The time taken to move to the Protect function group can be adjusted by changing the Move to Protect Function Group Time parameter setting.

Figure 5.2



Parameters that are protected will not be displayed and their values cannot be changed.

Move to Protect Function Group

Conditions of Use: The Password to Move to Protect function group parameter must NOT be set to 0.

Function: This parameter allows you to specify a password that must be entered to move to the Protect function group.

- The Operation/Adjustment Protect parameter will be displayed if the correct password is entered.

Related Parameters

- Password to Move to Protect function group (Protect function group, page 5-5).

Operation/Adjustment Protection

Function: These parameters specify 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

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

❶ Default Level of Protection: ◎ Can be displayed and changed. ○ Can be displayed.
X Cannot be displayed and moving to other function groups is NOT possible.

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

❶ Default. Level of Protection: ○ Able to reach, X Cannot reach.

Setting/Configuration Change Protection

Conditions of Use: Event Input Assignment 1 and 2 must NOT be configured to "Setting Change Enabled/Disabled"

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

Table 5.C — Setting/Configuration Change Protection

Configurable Range	Default
oN: Enabled, oFF: Disabled	oN

Table 5.D — 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

Note: The all protect indicator will light when configuration change protection is ON.

PF Key Protect

Conditions of Use: The Controller must have a PF Key (900-TC8)

Function: The PF Key Protect parameter enables and disables PF Key operation from the controller keypad (900-TC8).

Table 5.E PF Key Protect

Configured Value	Description
OFF	PF Key enabled from keypad
ON	PF Key disabled from keypad (Operation as a function key is prohibited.)

The shaded cell indicates the default.

Parameter Mask Enable

Conditions of Use: This parameter is displayed only when a parameter mask has been configured from the Software Setup Tool.

Function: This parameter turns the parameter mask function ON and OFF.

Table 5.F

Configurable Range	Default
ON: Enabled, OFF: Disabled	ON

Note: A parameter mask can be used to hide the display of parameters at the controller that are not needed. The parameter mask function is provided by the Software Setup Tool.

Password to Move to Protect Function Group

Function: This parameter is used to configure the Password to Move to the Protect function group.

To prevent setting the password incorrectly, the ⩓ and ○ keys or ⩔ and ○ keys must be pressed simultaneously to configure the password.

Table 5.G

Configuration Range	Default
–1999…9999	0

- Set this parameter to 0 when no password is to be configured.

Related Parameters

- Move to Protect function group (Protect function group, page 5-3)

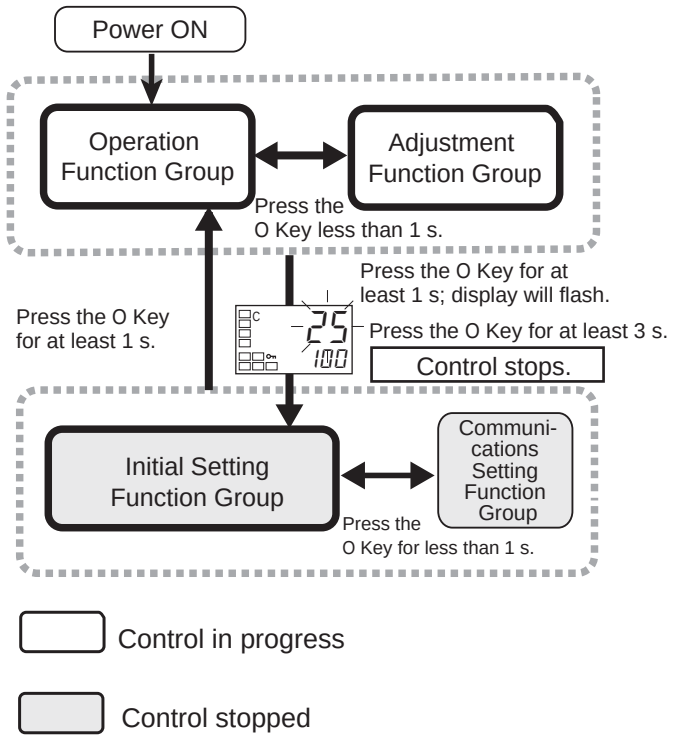
Note: Protection cannot be cleared or changed without the password. Be careful not to forget it.

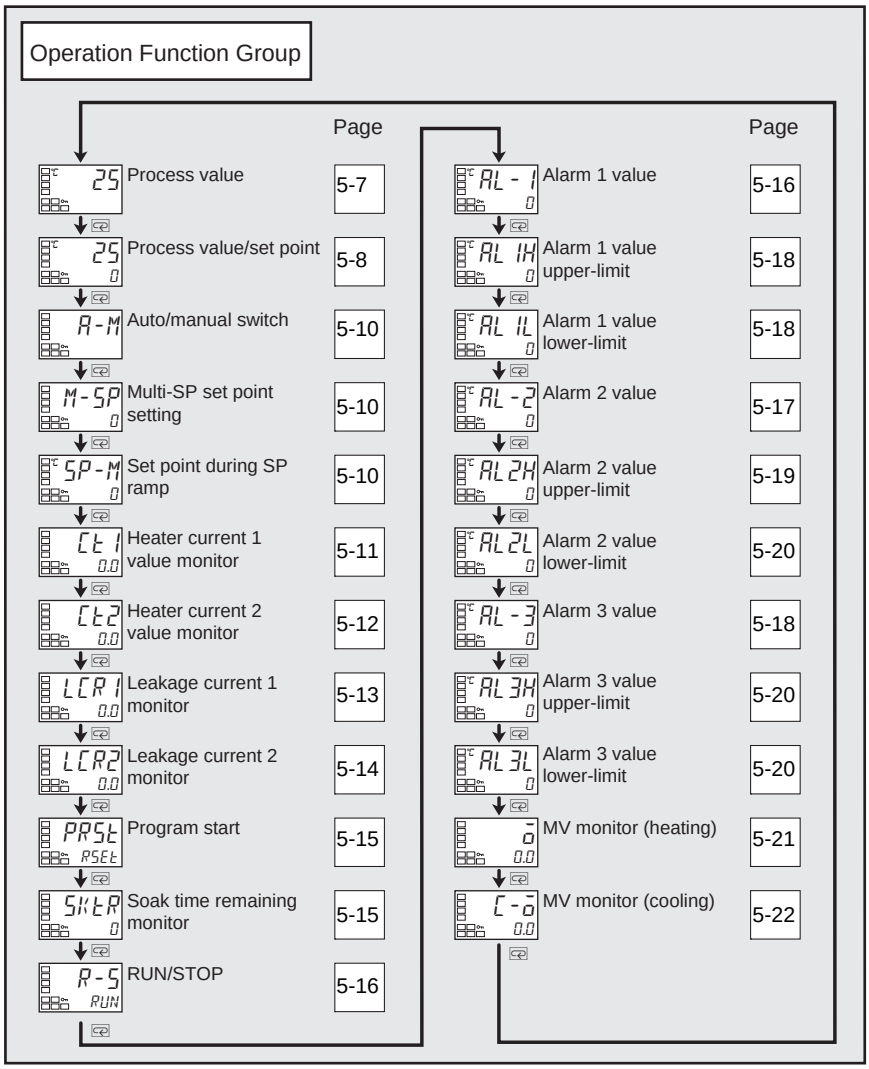
Operation Function Group

Use this function group when you want to carry out control operations on the Bulletin 900-TC8, 900-TC16, and 900-TC32. You can configure/set alarm values, monitor the manipulated variable (MV), and perform other operations within this function group.

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

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 and No. 3 (900-TC8 only) display.

Table 5.H

Parameter	Monitoring Range	Units
Process Value	**Temperature:** According to indication range for each sensor. **Analog:** Scaling lower limit -5% FS to Scaling upper limit +5% FS	EU

Note: When a temperature input (e.g., RTD) is selected, the decimal point position depends on the currently selected sensor, and when an analog input is selected, it depends on the Decimal Point parameter setting.

Related Parameters

Refer to the Initial Setting function group:

- Input Type (page 5-50)
- Set Point Upper-Limit, Set Point Lower-Limit (page 5-54)

PV/SP – Process Value/Set Point – No. 1 Display
PV/SP – Process Value/Set Point – No. 2 Display (900-TC8)

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

Table 5.I

Parameter	Monitoring Range	Units
Process Value	**Temperature:** According to indication range for each sensor. **Analog:** Scaling lower limit -5% FS to Scaling upper limit +5% FS	EU

Table 5.J

Parameter	Configurable Range	Units
Set Point	SP lower limit to SP upper limit	EU

No. 3 Display (900-TC8)

The following table shows the contents of the No. 3 display, according to the configuration of the PV/SP Display Screen Selection parameter.

Table 5.K

Configured Value	No. 3 Display Contents
0	Only the PV and SP are displayed. (The No. 3 display is not shown.)
1	PV/SP/Multi-Sp and PV/SP/MV are displayed in order.
2	PV/SP/MV and PV/SP/Multi-SP are displayed in order.
3	Only PV/SP/Multi-SP are displayed
4	PV/SP/MV are displayed

Table 5.K

Configured Value	No. 3 Display Contents
5	PV/SP/Multi-SP and PV/SP/Soak time remain are displayed in order.
6	PV/SP/MV and PV/SP/Soak time remain are displayed in order.
7	Only PV/SP/Soak time remain are displayed.

Note: When a temperature input (e.g., RTD) is selected, the decimal point position depends on the currently selected sensor, and when an analog input is selected, it depends on the Decimal Point parameter setting.

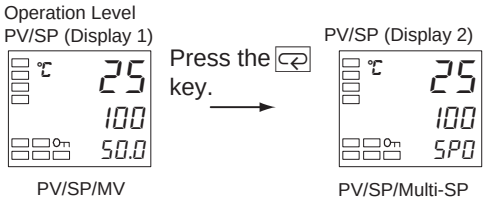
Note: A 2-level display is set when shipped from the factory.

Note: A 3-level display is activated if parameters are initialized.

Note: When 1, 2, 5, or 6 is selected, press the Key to display PV/SP (Display 2).

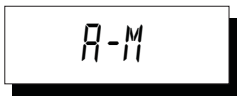
EXAMPLE

When the PV/SP Display Screen Selection Parameter is Set to 2:



Related Parameter

- Input Type
- Set Point Upper Limit, Set Point Lower Limit (Initial Setting function group, page 5-54)
- PV/SP Display Screen Selection (Advanced Setting function group, page 5-8)
- PV (Process Value) (Advanced Setting function group, page 5-7)



Auto Manual Switch

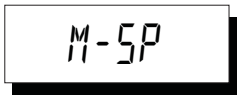
Conditions of Use: The Event Input Assignment 1 or 2 parameters must NOT be set to Auto/Manual and the Auto/Manual Select Addition parameter must be configured to ON. The control mode MUST be configured to 2-PID control.

Function: This parameter switches the Controller between automatic and manual modes when the PID control mode is used.

- If the ◎ key is pressed for at least 3 seconds when the Auto/Manual Switch parameter is displayed, the manual mode will be entered and the Manual Control function group will be displayed.
- This parameter will not be displayed if an event input is used to configure the controller to MANU (Auto/Manual).

Related Parameters

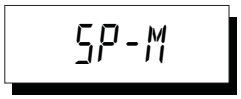
- PID ON/OFF (Initial Setting function group, page 5-55)
- Auto/Manual Select Addition (Advance Setting function group, page 5-87)



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. The ST (Self-Tuning) parameter must be OFF.

Function: This parameter allows you to monitor the value of the Set Point during a 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 not in ramp operation, the set point is the same as the set point displayed in the PV/SP parameter.

Table 5.L

Monitoring Range	Units
SP: Set Point Lower-Limit to Set Point Upper-Limit	EU

Related Parameters

- PV/SP (Operation function group, page 5-8)
- SP Ramp Set Value (Adjustment function group, page 5-41)
- Set Point Upper-Limit, Set Point Lower-Limit (Initial Setting function group, page 5-54

Heater Current 1 Value Monitor (900-TC8 &900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short (HSA) and Heater Overcurrent (HOA) alarms must be supported and one CTs wired to the controller. Alarm 1 must be assigned. The Heater Burnout Detection or Heater Overcurrent Use parameter must be set to ON. CT Number 1 must be wired to the controller.

Function: This parameter measures the heater current from a single CT input used for detecting heater alarm conditions in 1-phase heaters and displays the value on the controller.

- Heater burnout, heater short, and heater overcurrent conditions are not detected if the Control Output (heating) ON time is 100 ms or less.

Table 5.M

Monitoring Range	Units
0.0…55.0	A (Amps)

- FFFF is displayed when 55.0 A is exceeded.
- If a heater burnout detection 1 or heater overcurrent detection 1 alarm is output, the HA indicator will light and the No. 1 display for the heater current 1 value monitor will flash.

Related Parameters

Refer to the Advanced Setting function group:

- Heater Burnout Detection 1, Heater Burnout Detection 2 (page 5-30)
- HB ON/OFF (page 5-74)
- Heater Overcurrent Detection 1, Heater Overcurrent Detection 2 (page 5-26)
- Heater Overcurrent Use (page 5-99)
- Error Displays E1: (Chapter 6, page 6-5)

Heater Current 2 Value Monitor (900-TC8 &900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short (HSA) and Heater Overcurrent (HOA) alarms must be supported and two CTs wired to the controller. Alarm 1 must be assigned. The Heater Burnout Detection or Heater Overcurrent Use parameter must be set to ON. The second CT must be wired to the controller.

Function: This parameter measures the heater current from two CT inputs used for detecting heater alarm conditions in 3-phase heaters and displays the value on the controller.

Table 5.N

Monitoring Range	Units
0.0...55.0	A (Amps)

- Heater burnout, heater short, and heater overcurrent conditions are not detected if the Control Output (heating) ON time is 100 ms or less.
- FFFF is displayed when 55.0 A is exceeded.
- If a heater burnout detection 2 or heater overcurrent detection 2 alarm is output, the HA indicator will light and the No. 1 display for the heater current 2 value monitor will flash.

Related Parameters

Refer to the Advanced Setting function group:

- Heater Burnout Detection 1, Heater Burnout Detection 2 (page 5-30)
- HB ON/OFF (page 5-30)
- Heater overcurrent detection 1, Heater overcurrent detection 2 (page 5-30)
- Heater overcurrent use (page 5-30)
- Error Displays E.E2: (Chapter 6, page 6-5)

Leakage Current 1 Monitor (900-TC8 &900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short (HSA), and Heater Overcurrent (HOA) alarms must be supported. Alarm 1 must be assigned and CT Number 1 wired to the controller. The HS Alarm Use parameter must be set to ON.

Function: This parameter measures the heater current from the Number 1 CT input used for detecting a short-circuit condition in single-phase heaters.

The heater current is measured and the value is displayed.

Table 5.0

Monitoring Range	Units
0.0…55.0	A (Amps)

- HS alarm is not detected if the Control Output (heating) OFF time is 100 ms or less.
- FFFF is displayed when 55.0 A is exceeded.
- If an HS alarm 1 alarm is output, the HA indicator will light and the No. 1display for the leakage current 1 monitor will flash.

Related Parameters

Refer to the Advanced Setting function group:

- HS Alarm 1, HS Alarm 2 (page 5-31)
- Failure Detection (page 5-88)
- Error Displays LCR1 (Chapter 6, page 6-5)

Leakage Current 2 Monitor (900-TC8 &900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short (HSA), and Heater Overcurrent (HOA) alarms must be supported and two CTs (Number 1 and Number 2) wired to the controller. Alarm 1 must be assigned. The HS Alarm Use parameter must be set to ON.

Function: This parameter measures and displays the heater current from two CT inputs used for detecting short-circuit conditions in 3-phase heaters.

This parameter measures and displays the heater current value.

Table 5.P

Monitoring Range	Units
0.0…55.0	A (Amps)

- HS alarm is not detected if the Control Output (heating) OFF time is 100 ms or less.
- FFFF is displayed when 55.0 A is exceeded.
- If an HS alarm 2 alarm is output, the HA indicator will light and the No. 1display for the leakage current 2 monitor will flash.

Related Parameters

Refer to the Advanced Setting function group:

- HS Alarm 1, HS Alarm 2 (page 5-31)
- HS Alarm Use (page 5-88)
- Error Displays LCR2(Chpater 6, page 6-5)

PRSt Program Start

Conditions of Use: The Program Pattern parameter must NOT be set to OFF.

Function: This parameter starts and stops the simple program function.

Table 5.Q

Parameter	Function	Default
RSEt	Stops the simple program.(RSET)	RSEt
StRt	Starts the simple program. (STRT)	

- The RUN/STOP status LED will automatically switch to RUN when this parameter is set to STRT.
- The simple program will stop when this parameter is set to RSET.
- This parameter will function as a monitor display for the start/stop status of the simple program if an event input is selected to start the simple program.

Related Parameters

- Soak Time Remain, RUN/STOP (Operation function group, page 5-16)
- Soak Time, Wait Band (Adjustment function group, page 5-39)
- Program Pattern (Initial Setting function group, page 5-57)
- Soak Time Unit (Advanced Setting function group, page 5-96)

SMtR Soak Time Remain

Conditions of Use: The Program Pattern parameter must NOT be configured to OFF.

Function: This parameter measures and displays the soak time remaining for the simple program function.

Table 5.R

Monitoring Range	Units
0…9999	Minutes or hours

Related Parameters

- Program Start (Operation function group, page 5-15)
- Soak Time, Wait Band (Adjustment function group, page 5-40)
- Program Pattern (Initial Setting function group, page 5-57)
- Soak Time Unit (Advanced Setting function group, page 5-96)

RUN/STOP

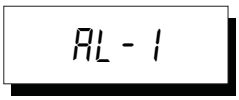
Conditions of Use: The Event Input Assignments 1 and 2 parameter must NOT be configured to RUN/STOP.

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

When RUN: is selected, the controller is running. When 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, and the parameter will NOT be displayed in the Operation function group.

Note: The default is RUN.



Alarm Value 1

Conditions of Use: Alarm 1 must be assigned. The alarm 1 type must not be 0, 1, 4, 5, or 12.

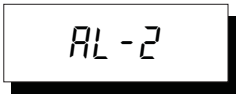
Function: This parameter sets the alarm value for alarm 1. This parameter is set to one of the input values "X" in the alarm type list. During temperature input, the decimal point position depends on the currently selected sensor, and during analog input it depends on the Decimal Point parameter setting.

Table 5.S

Configurable Range	Unit	Default
-1999 to 9999	EU	0

Related Parameters

- Input Type (Initial Setting function group, page 5-50),
- Scaling upper limit, Scaling lower limit, Decimal point (Initial Setting function group, page 5-52)
- Standby Sequence Reset (page 5-72), Auxiliary output open in alarm (page 5-73), Alarm 1 Hysteresis (page 5-61), Alarm 1 Latch (page 5-79) (Advanced Setting function group).
- Alarm 1 Type (Initial Setting function group, page 5-59)



Alarm Value 2 (900-TC8, 900-TC16)

Conditions of Use: Alarm 2 must be assigned. The alarm 2 type must not be 0, 1, 4, 5, or 12.

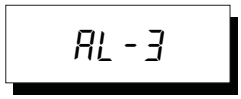
Function: This parameter sets the alarm value for alarm 2. This parameter is set to one of the input values "X" in the alarm type list. During temperature input, the decimal point position depends on the currently selected sensor, and during analog input it depends on the Decimal Point parameter setting.

Table 5.T

Configurable Range	Unit	Default
-1999 to 9999	EU	0

Related Parameters

- Input Type (Initial Setting setting function group, page 5-50)
- Scaling Upper Limit, Scaling Lower Limit, Decimal Point (Initial Setting function group, page 5-52)
- Standby Sequence Reset (page 5-72), Auxiliary Output open in alarm (page 5-73), Alarm 2 Hysteresis (page 5-62), Alarm 1 Latch (page 5-79) (Advanced Setting function group).
- Alarm 2 Type (Initial Setting function group, page 5-59)



Alarm Value 3 (900-TC8)

Conditions of Use: Alarm 3 must be assigned. The alarm 3 type must not be 0, 1, 4, 5, or 12.

Function: This parameter sets the alarm value for alarm 3. This parameter is set to one of the input values "X" in the alarm type list. During temperature input, the decimal point position depends on the currently selected sensor, and during analog input it depends on the Decimal Point parameter setting.

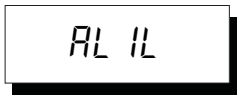
Table 5.U

Configurable Range	Unit	Default
-1999 to 9999	EU	0

Related Parameters

- Input Type, Scaling Upper Limit, Scaling Lower Limit, Decimal Point (Initial Setting function group, page 5-52)
- Standby Sequence Reset (page 5-72), Auxiliary Output open in alarm (page 5-73), Alarm 3 Hysteresis: (page 5-62), Alarm 3 Latch (page 5-79) (Advanced Setting function group).
- Alarm 3 Type (Initial Setting function group**,** page 5-59)

Upper-Limit Alarm Value 1



Lower-Limit Alarm Value 1

Conditions of Use: Alarm 1 must be assigned and the Alarm 1 Type must NOT be set to either 1, 4, or 5.

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, the decimal point position depends on the currently selected sensor, and when using an analog input it depends on the Decimal Point parameter setting.

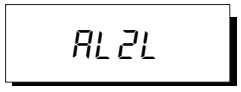
Table 5.V

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

Related Parameters

- Input Type (page 5-50), Scaling Upper-Limit, Scaling Lower-Limit, Decimal Point (page 5-52), Alarm 1 Type (page 5-59) (Initial Setting function group)
- Standby Sequence Reset (page 5-72), Auxiliary Output 1 Open in Alarm (page 5-73), Alarm 1 Hysteresis (page 5-61), Alarm 1 Latch (page 5-79) (Advanced Setting function group)

Upper-Limit Alarm Value 2



Lower-Limit Alarm Value 2 (900-TC8, 900-TC16)

Conditions of Use: Alarm 2 must be assigned and the Alarm 2 Type must NOT be set to either 1, 4, or 5.

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.

When using a temperature input, the decimal point position depends on the currently selected sensor, and when using an analog input it depends on the Decimal Point parameter setting.

Table 5.W

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

Related Parameters

- Input Type (page 5-50), Scaling Upper-Limit, Scaling Lower-Limit, Decimal Point (page 5-52), Alarm 2 Type (page 5-59) (Initial Setting function group)
- Standby Sequence Reset (page 5-72), Auxiliary Output 2 Open in Alarm (page 5-73), Alarm 2 Hysteresis (page 5-62), Alarm 2 Latch (page 5-79) (Advanced Setting function group)

Upper-Limit Alarm Value 3

Lower-Limit Alarm Value 3 (900-TC8 only)

Conditions of Use: Alarm 3 must be assigned and the Alarm 3 Type must NOT be set to either 1, 4, or 5.

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.

When using a temperature input, the decimal point position depends on the currently selected sensor, and when using an analog input it depends on the Decimal Point parameter setting.

Table 5.X

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

Related Parameters

- Input Type (page 5-50), Scaling Upper-Limit, Scaling Lower-Limit, Decimal Point (page 5-52), Alarm 3 Type (page 5-59) (Initial Setting function group)
- Standby Sequence Reset (page 5-72), Auxiliary Output 3 Open in Alarm (page 5-73), Alarm 3 Hysteresis (page 5-62), Alarm 3 Latch (page 5-79) (Advanced Setting function group)

MV Monitor (Heating)

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

Function: This parameter allows you to monitor the Manipulated Variable (for the heating Control Output).

Table 5.Y

Control Mode	Monitoring Range	Units
Standard	–5.0…105.0	%
Heating and cooling	0.0…105.0	%

- This parameter cannot be configured.
- During standard control, the manipulated variable is monitored. During heating/cooling control, the manipulated variables on the heating Control Output is monitored.

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

Related Parameter

- Manipulated Variable Display (Advanced Setting function group, page 5-78)

C-o MV Monitor (Cooling)

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

Function: This parameter is for monitoring the manipulated variable (cooling output) during heating and cooling control.

Table 5.Z

Control Mode	Monitoring Range	Units
Heating and cooling	0.0…105.0	%

- This parameter cannot be configured.
- During heating/cooling control the manipulated variable on the cooling Control Output is monitored.
- The default is OFF and the manipulated variable is NOT displayed.

Related Parameters

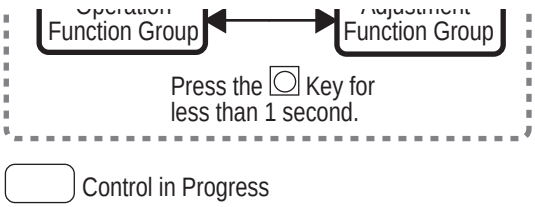
- Standard or Heating and Cooling (Initial Setting function group, page 5-55)
- Manipulated Variable Display (Advanced Setting function group, page 5-78)

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



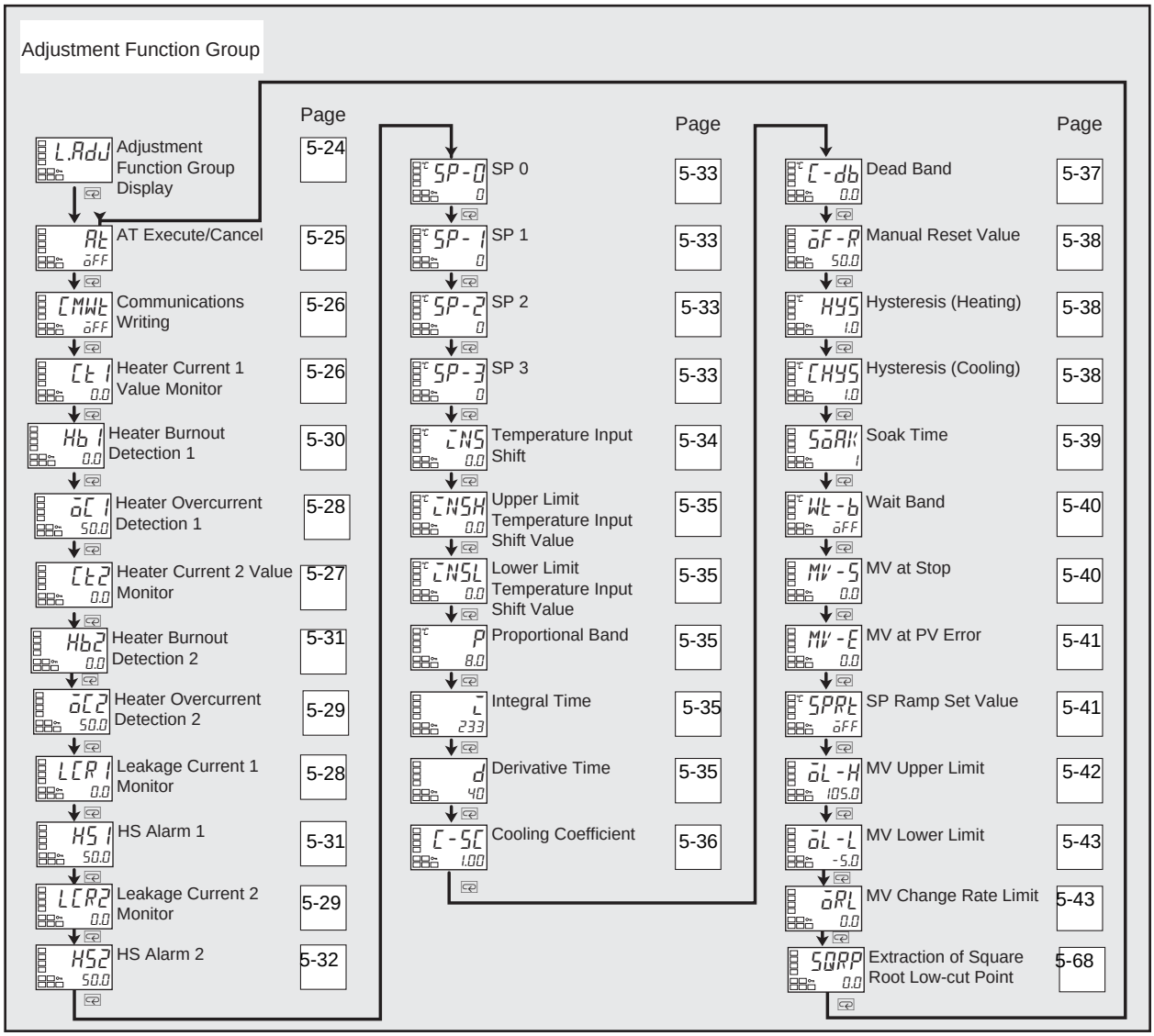
To move to the Adjustment function group from the Operation function group, press the ◎ key for less than 1 second.

1. Adjustment function group parameters can be changed after configuring the Operation/Adjustment Protect parameter to 0. Displays and moving to other function groups is not possible if the Operation/Adjustment Protect parameter is set from 1 to 3. Protection is set in the Protect function group.

2. The Set Point Parameters 0 to 3 in the Adjustment function group are the configured values for switching the set point during multi-SP input.

3. **For 900-TC8 and 900-TC16:** The following parameters are displayed for Controllers with CT Inputs: Heater Current 1 to 3 monitor, Leakage Current 1 to 3 monitor, Heater Burnout detections 1 to 3, HS Alarms 1 to 3, and Heater Overcurrent detection 1 to 3.

Figure 5.5



LAdd Adjustment Function Group Display

Function: This is the first parameter displayed after moving to the Adjustment function group. This parameter indicates that the Adjustment function group has been entered. (The Adjustment function group parameter will not be displayed again even if the ↵ key is pressed in the Adjustment function group to scroll through the parameters.)

AT Execute/Cancel

Conditions of Use: The Bulletin 900-TC8, 900-TC16, or 900-TC32 must be in operation (RUN), and the control method must be 2-PID control.

Function: This parameter allows you to initiate (turn 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 set by the controller forcibly changing the manipulated variable to calculate the characteristics of the control target.

Table 5.AA

Configurable Range	Default
OFF: AT Cancel	OFF
AT-2: 100% AT Execute	
AT-1: 40% AT Execute	

- Both 100% AT and 40% AT are supported for AT.
- Only 100% AT can be executed for heating and cooling control.
- **For 900-TC8 and 900-TC16:** This parameter will not be displayed when either 100% or 40% AT execute/cancel is set to be executed using an event input.
- This parameter is normally oFF. Press the ▲ Key and select AT-2 or AT-1 to execute AT. AT cannot be executed when control is stopped or during ON/OFF control.
- When AT execution ends, the parameter setting automatically returns to oFF.

Related Parameters

- Proportional Band, Integral Time, Derivative Time (Adjustment function group, page 5-35)
- PID ON/OFF (Initial Setting function group, page 5-55)

Communications Writing

Conditions of Use: An RS-232 (900-TC8 only) or RS-485 (900-TC8 and/or 900-TC16 and/or 900-TC32) communication option unit must be mounted in the controller.

Function: This parameter enables/disables writing of parameters to the temperature controller from a personal computer using communications.

Note: For 900-TC8 and 900TC16: This parameter is not displayed in the Adjustment function group if communications write Enable/Disable is configured for execution using an Event Input Assignment 1 and 2.

Note: 900BuilderLite software can write to the controller regardless of the Communications Writing status.

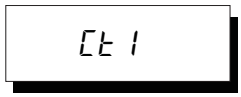
ON: Writing enabled

OFF: Writing disabled

Note: The default is OFF

Related Parameters

- MB Command Logic Switching (Advanced function group, page 5-82)
- Communication Unit No., Baud Rate, Data Bit, Parity, Stop Bit (Communications Setting function group, page 5-110)



Heater Current 1 Value Monitor (900-TC8, 900-TC16)

Conditions of Use: Heater burnout, heater short, and heater overcurrent detection must be supported. Alarm 1 must be assigned. The Heater Burnout ON/OFF or Heater Overcurrent use parameter must be configured to ON.

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

Table 5.AB

Monitoring Range	Units
0.0…55.0	A (Amps)

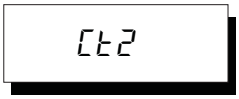
Note:

- Not all controllers support heater current monitor and heater burnout/short (refer to Tables 1.B and 1.E).
- If a heater fault (open/short or overcurrent) is less than or equal to 100 ms it is not detected.
- FFFF is displayed when 55.0 A is exceeded.
- If a Heater Burnout or overcurrent detection 1 Alarm condition is detected the HA indicator will light, and the value will flash on the No. 1 display.

Related Parameters

Refer to the Advanced Setting function group:

- Heater Burnout Detection 1, Heater Burnout Detection 2 (page 5-30)
- HB ON/OFF (page 5-74)
- Heater overcurrent detection 1, Heater overcurrent detection 2 (page 5-26)
- Heater overcurrent use (page 5-99)
- Error displays CT 1: (page 5-30)



Heater Current 1 Value Monitor (900-TC8, 900-TC16)

Conditions of Use: Heater burnout, heater short, and heater overcurrent detection must be supported (two CTs). Alarm 1 must be assigned. The Heater Burnout ON/OFF or Heater Overcurrent Use parameter must be set to ON.

Function: This parameter measures the heater current from the CT input used for detecting heater burnout.

This parameter measures and displays the heater current value

Note: If the Heater burnout or heater overcurrent fault is less than or equal to 100 ms it is not detected.

Table 5.AC

Monitoring Range	Units
0.0…55.0	A (Amps)

- FFFF is displayed when 55.0 A is exceeded.
- If a heater burnout detection 2 or heater overcurrent detection 2 alarm is output, the HA indicator will light and the No. 1 display for the heater current 2 value monitor will flash.

Related Parameters

- Heater Burnout Detection 1, Heater Burnout Detection 2 (Adjustment function group, page 5-30)
- HB ON/OFF (Advanced Setting function group, page 5-74)
- Heater overcurrent detection 1, Heater overcurrent detection 2 (Adjustment function group, page 5-30)
- Heater overcurrent use (Advanced Setting function group, page 5-99)
- Error Displays ct2: (page 5-30)

Leakage Current 1 Monitor (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout, (HBA) Heater Short (HSA) and Heater Overcurrent detection must be supported. Alarm 1 must be assigned. The HS Alarm parameter must be set to ON.

Function: This parameter measures the heater current from a single CT input used for detecting a short-circuit condition.

This parameter measures and displays the heater current when the heater is directed to be OFF by the controller.

Note: A Heater Short (HS) fault condition is not detected if its duration is 100 ms or less.

Table 5.AD

Monitoring Range	Units
0.0…55.0	A (Amps)

- FFFF is displayed when 55.0 A is exceeded.
- If a HS alarm 1 alarm is output, the HA indicator will light, and the leakage current value will flash on the No. 1 display.

Related Parameters

Refer to the Advanced Setting function group:

- HS Alarm 1, HS Alarm 2 (page 5-31)
- HS Alarm Use (page 5-88)
- Error Displays LCR1

LCR2 Leakage Current 2 Monitor (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA) and Heater Short (HSA) alarms and heater overcurrent detection must be supported (two CTs). Alarm 1 must be assigned. The HS Alarm parameter must be set to ON.

Function: This parameter measures the heater current from two CT inputs used for detecting a short-circuit condition.

This parameter measures and displays the heater current value.

Note: A Heater Short fault condition is not detected if its duration is 100 ms or less.

Table 5.AE

Monitoring Range	Units
0.0…55.0	A (Amps)

- FFFF is displayed when 55.0 A is exceeded.
- If an HS alarm 2 alarm is output, the HA indicator will light and the No. 1display for the leakage current 2 monitor will flash.

Related Parameters

Refer to the Advanced Setting function group:

- HS Alarm 1, HS Alarm 2 (page 5-31)
- HS Alarm Use (page 5-88)
- Error Displays LCR2

Hb 1 Heater Burnout Detection 1 (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA) and Heater Short (HSA) alarms and heater overcurrent detection must be supported. Alarm 1 must be assigned. The Heater Burnout Detection parameter must be set to ON. A single CT must be wired to the controller (single-phase heater operation).

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).

Table 5.AF

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

- 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.

Related Parameters

Refer to the Advanced Setting function group:

- Heater Current 1 Monitor (page 5-13)
- Heater Burnout Detection, Heater Burnout Latch, Heater Burnout Hysteresis (page 5-74)

Hb2 Heater Burnout Detection 2 (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA) and Heater Short (HSA) alarms and heater overcurrent detection must be supported. Alarm 1 must be assigned. The Heater Burnout Detection parameter must be set to ON. Two CTs must be wired to the controller.

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).

Table 5.AG

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

- 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.

Related Parameters

Refer to the Advanced Setting function group:

- Heater Current 1 Monitor (page 5-13)
- Heater Burnout Detection, Heater Burnout Latch, Heater Burnout Hysteresis (page 5-74)

HS1 HS Alarm 1 (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short (HSA) alarms and heater overcurrent detection must be supported. Alarm 1 must be assigned. The HS Alarm parameter must be set to ON. A single CT must be wired to the controller.

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

Table 5.AH

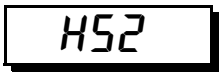
Configurable Range	Units	Default
0.0…50.0	A (Amps)	50.0

- The HS alarm is output when the heater current value goes above the setting of this parameter.
- When the configured value is 50.0, the HS alarm is turned OFF. When the configured value is 0.0, the HS alarm will turn ON.

Related Parameters

Refer to the Advanced Setting function group:

- Leakage Current 1 Monitor (page 5-13)
- HS Alarm, HS Alarm Latch, HS Alarm Hysteresis (page 5-89)



HS Alarm 2 (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA) and Heater Short (HSA) alarms and heater overcurrent detection must be supported (Two CTs). Alarm 1 must be assigned. The HS Alarm parameter must be set to ON. Two CTs must be wired to the controller.

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

Table 5.AI

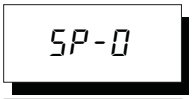
Configurable Range	Units	Default
0.0…50.0	A (Amps)	50.0

- The HS alarm is output when the heater current value goes above the setting of this parameter.
- When the configured value is 50.0, the HS alarm is turned OFF. When the configured value is 0.0, the HS alarm will turn ON.

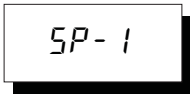
Related Parameters

Refer to the Advanced Setting function group:

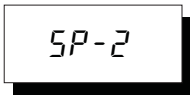
- Leakage Current 2 Monitor (page 5-14)
- HS Alarm Use, HS Alarm Latch, HS Alarm Hysteresis (page 5-88)



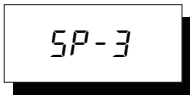
Set Point 0



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 (up to 4) set point values as long as the Multi-SP function is also configured.

For 900-TC8 or 900-TC16, the configured values configured in these 4 parameters can be selected (loaded into the controller) by operating the keys on the front panel or by event input.

Table 5.AJ

Configurable Range	Units	Default Value
Set Point Lower-Limit to Set Point Upper-Limit	EU	0

- 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.

Related Parameter

- PV/SP (Operation function group, page 5-8), Input Type (Initial Setting function group) (page 5-50)

  Refer to the Advanced Setting function group:

- Event Input Assignment 1 (page 5-66)
- Event Input Assignment 2 (page 5-66)
- Number of Multi-SP Uses (page 5-65)
- Multi-SP Uses (page 5-71)

Temperature Input Shift

Conditions of Use: The Input Type parameter must be configured as a temperature (thermocouple or RTD) input (this excludes a non-contact temperature sensor). The Input Shift Type parameter must be configured for One-Point Shift.

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 (refer to Figure 4.2).

Table 5.AK Input Shift

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

Related Parameter

- Input Type (Initial Setting function group, page 5-50)
- Input Shift Type (Advanced Setting function group, page 5-86)

Upper-Limit Temperature Input Shift Value,

Lower-Limit Temperature Input Shift Value

Conditions of Use: The Input Type parameter must be configured for a thermocouple on RTD sensor and the Input Shift Type parameter must be configured for 2-Point Shift. When using an infrared type sensor simply configure Input Type to infrared and Upper/Limit Input Shift is automatically allowed.

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. This allows a more accurate offset of the input range.

This parameter sets input shift values for each of the Upper- and Lower-Limits (2-point shift) of the input range are shown in Table 5.AL , Allowable Range.

Table 5.AL — Allowable Range

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

Related Parameter

- Input Type (Initial Setting function group, page 5-50)
- Input Shift Type (Advanced Setting function group, page 5-86)

Proportional Band,

Integral Time,

Derivative Time

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

Function: These three parameters allow you to manually configure the PID value parameters. Note that the PID parameters are automatically configured by the controller 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 deviation. 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 control temperature (process value) comes to agree with the set point.

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.AM

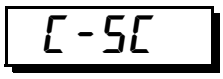
Parameters	Controller Type	Configurable Range		Units	Default
Proportional Band	With Thermocouple or Resistance Detector (RID)	0.1…999.9		°C or °F ❶	8.0
	With Analog Inputs			%FS	10.0
Integral Time		0…3999		Seconds	233
Derivative Time		RT is OFF	0…3999	Seconds	40
		RT is ON	0.0…999.9	Seconds	40.0

❶ Set NONE as the unit for Controllers with 0…50 Millivolt Inputs.

Note: If the settings for RT (robust tuning) are changed, the Proportional Band (P), Integral Time (I), and Derivative Time (D) will be initiated.

Related Parameter

- AT Execute/Cancel (Adjustment function group, page 5-25)



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 cooling Control Output side by adding the cooling coefficient to balance control between the heating and cooling sides (refer to Figure 4.26).

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

Cooling Control Output side P = Cooling coefficient x P (proportional band)

Table 5.AN

Configurable Range	Units	Default Value
0.01…99.99	None	1.00

Related Parameter

- Proportional Band (Adjustment function group, page 5-35)

C-db 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 (refer to 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.AO

Controller Type	Configurable Range	Units	Default
With Thermocouple or Resistance Thermometer (RTD)	–199.9…999.9	°C or °F ❶	0.0
With Analog Inputs	–19.99…99.99	%FS	0.00

❶ Set NONE as the units for Controllers with 0…50 Millivolt Inputs.

oF-R 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.AP

Configurable Range	Units	Default Value
0.0…100.0	%	50.0

Related Parameters

- PID ON/OFF (Initial Setting function group, page 5-55)
- Integral Time (Adjustment function group, page 5-35)

HYS Hysteresis (Heating)

CHYS Hysteresis (Cooling)

Conditions of Use: The control method must be ON/OFF control. For Hysteresis Cooling the control mode must be heating and cooling.

Function: This parameter allows you to configure the hysteresis function to help ensure stable operation during ON/OFF control. For more details, refer to page 3-26, *Hysteresis*.

- In the standard control mode, use the Hysteresis Heating parameter. The Hysteresis Cooling parameter cannot be used in standard control (refer to Figure 3.24).
- In the heating and cooling control mode, the Hysteresis parameter can be set independently for heating and cooling. Use the Hysteresis Heating parameter to configure the heating Control Output, and use the Hysteresis Cooling parameter to configure the cooling Control Output side hysteresis (refer to Figure 3.25).

Table 5.AQ

Parameters	Controller Type	Configurable Range	Units	Default
Hysteresis (heating)	With Thermocouple or Resistance Thermometer (RTD)	0.1…999.9	°C or °F ❶	1.0
	With Analog Inputs	0.01…99.99	%FS	0.10
Hysteresis (cooling)	With Thermocouple or Resistance Thermometer (RTD)	0.0…999.9	°C or °F ❶	1.0
	With Analog Inputs	0.01…99.99	%FS	0.10

❶ Set NONE as the unit for Controllers with 0…50 Millivolt Inputs.

Related Parameters

- PID ON/OFF, Standard or Heating/Cooling (Initial Setting function group, page 5-55)

Soak Time

Conditions of Use: The Program Pattern parameter must NOT be set to OFF.

Function: This parameter enables you to configure the soak or delay time for the control operation when using the simple program function.

Table 5.AR

Configurable Range	Units	Default
1…9999	Minutes or hours	1

Related Parameters

- Program Start, Soak Time Remain (Operation function group, page 5-15)
- Wait Band (Adjustment function group, page 5-40)
- Program Pattern (Initial Setting function group, page 5-57)
- Soak Time Unit (Advanced Setting function group, page 5-96)

WE-b Wait Band

Conditions of Use: The Program Pattern parameter must NOT be set to OFF.

Function: This parameter enables you to configure the stable band within which the soak time is measured for the simple program function.

Table 5.AS

Controller Type	Configurable Range	Units	Default
With Thermocouple or Resistance Thermometer (RTD)	OFF or 0.1…999.9	°C or °F ❶	Off
With Analog Inputs	OFF or 0.01…99.99	%FS	

❶ Set NONE as the unit for Controllers with 0…50 Millivolt Inputs.

Related Parameters

- Program Start, Soak Time Remain (Operation function group, page 5-15)
- Soak Time (Adjustment function group, page 5-39)
- Program Pattern (Initial Setting function group, page 5-57)
- Soak Time Unit (Advanced Setting function group, page 5-96)

MV-S MV at Stop

Conditions of Use: The control method must be configured for 2-PID control. The MV at Stop and Error Addition parameter must be configured to ON.

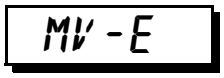
Function: This parameter allows you to configure the amount the MV (process output) is OPEN/ON when the RUN/STOP status changes from RUN to STOP.

Table 5.AT

Configurable Range	Units	Default
–5.0…105.0 for standard control –105.0…105.0 (heating/cooling control)	%	0.0

Related Parameters

- RUN/STOP (Operation function group, page 5-16)
- MV at Stop and Error Addition (Advance Setting function group, page 5-87)



MV at PV Error

Conditions of Use: The control must be configured for 2-PID control. The MV at Stop and Error Addition parameter must be ON.

Function: This parameter allows you to configure the amount the MV (process output) is Open/On when an input ERROR occurs.

Table 5.AU

Configurable Range	Units	Default
–5.0…105.0 for standard control –105.0…105.0 (heating/cooling control)	%	0.0

Related Parameters

- MV at Stop and Error Addition (Advance Setting function group, page 5-87)

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.

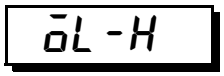
Note: The SP Ramp Time Unites parameter in the Advanced Setting function group allows you to enter seconds or minutes units.

Table 5.AV

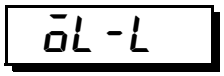
Parameter	Configurable Range	Units	Default Value
SP Ramp Value	OFF, 1…9999	EU	OFF

Related Parameters

- Input Type (page 5-50), Scaling Upper-Limit, Scaling Lower-Limit (page 5-52), Decimal Point, ST (page 5-56) (Initial Setting function group)
- SP Ramp Time Units (Advanced Setting function group, page 5-71)



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 Controller 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 cooling Control Output side during heating and cooling control is expressed as a positive value (refer to Table 5.AW).

Table 5.AW

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 cooling Control Output side during heating and cooling control is expressed as a negative value (refer to Table 5.AX).

Table 5.AX

Control Mode	Configurable Range	Units	Default Value
Standard	MV Upper-Limit –5.0…–0.1	%	–5.0
Heating and cooling	–105.0…+0.0	%	–105.0

Related Parameters

- PID ON/OFF (Initial Setting function group, page 5-55)
- ST (Initial Setting function group, page 5-56)

MV (Manipulated Variable) Change Rate Limit,

Condition of Use: 2-PID control must be used. ST must be OFF.

Function: The MV Change Rate Limit parameter allows you to configure the maximum allowable rate of change variation in the MV per second. If the current rate of change in the MV exceeds this setting, the MV will be changed to the configured MV change rate limit until the calculated value is reached. If the limit is set to 0.0, this function will be disabled.

The MV Change Rate Limit parameter will NOT operate in the following situations.

- In manual mode
- During ST execution (Cannot be set when ST is ON.)
- During AT execution
- During ON/OFF control
- While stopped (MV output during STOP)
- During MV output when error occurs

Table 5.AY

Configurable Range	Units	Default
0.0 to 100.00	%/s	0.0

Related Parameters

- Proportional Bband (Adjustment function group, page 5-35)

SQRP Extraction of Square Root Low-cut Point,

Condition of Use: The input type must be an analog input, and the Extraction of Square Root Enable parameter must be set to ON.

Function: This parameter sets the extraction of square root low-cut point used for the inputs. The low-cut point is used for extracting the square root for flow rate sensors. The data after extracting the square root is shown below.

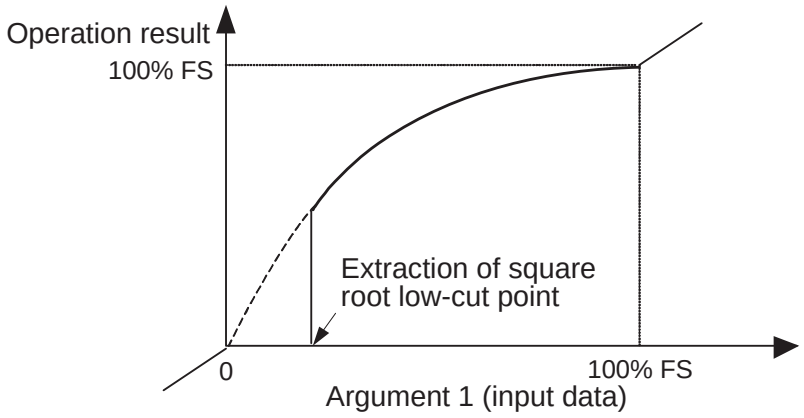


Table 5.AZ

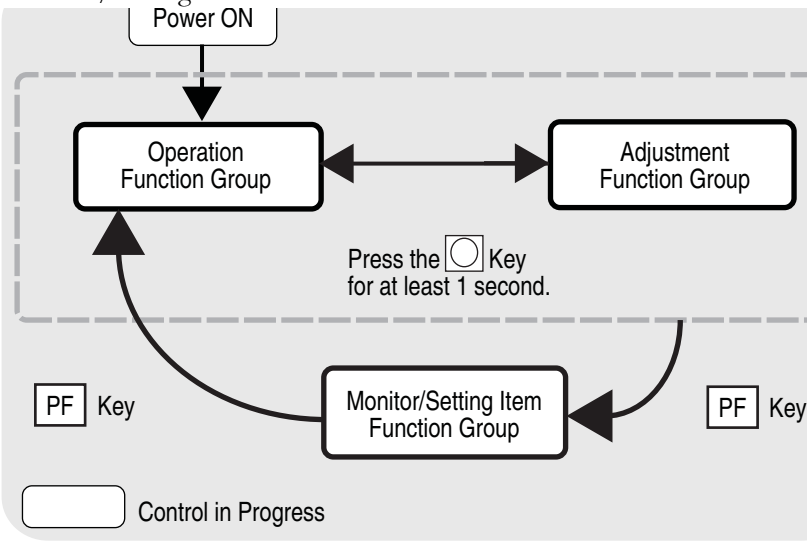
Configurable Range	Units	Default
0.0...100	%	0.0

Related Parameters

- Extraction of Square Root Enable (Initial Setting function group, page 5-44)

Monitor/Setting Item Level (900-TC8)

Monitor/setting items can be displayed by means of the PF function key when the PF Setting parameter (Advanced Setting function group) is configured to PFDP: Monitor/Setting Item.



Monitor/Setting Item Display 1 to 5

Conditions of Use: The PF Setting parameter must be configured to PFDP, and the Monitor/Setting Item 1 to 5 parameters must NOT be set to OFF.

Function: When the PF Key is configured to display monitor/setting items, pressing the PF Key will display in order the contents of the Monitor/Setting Item 1 to 5 parameters. The contents of these parameters are shown in the following table. For the setting (monitor) ranges, refer to the applicable parameters.

Table 5.BA

Set Value	Setting	Remarks	
		Monitor/Setting	Symbol
0	Disabled		---
1	PV/SP/Multi-SP	Can be set. (SP)	---
2	PV/SP/MP	Can be set. (SP)	---
3	PV/SP / Soak time remain	Can be set. (SP)	---
4	Proportional band (P)	Can be set.	P
5	Integral time (I)	Can be set.	I
6	Derivative time (D)	Can be set.	d
7	Alarm value 1	Can be set.	AL-1
8	Alarm value upper limit 1	Can be set.	AL1H
9	Alarm value lower limit 1	Can be set.	AL1L

Table 5.BA

Set Value	Setting	Remarks	
		Monitor/Setting	Symbol
10	Alarm value 2	Can be set.	AL-2
11	Alarm value upper limit 2	Can be set.	AL2H
12	Alarm value lower limit 2	Can be set.	AL2L
13	Alarm value 3	Can be set.	AL-3
14	Alarm value upper limit 3	Can be set.	AL3H
15	Alarm value lower limit 3	Can be set.	AL3L

Related Parameters

Refer to the Advanced Setting function group:

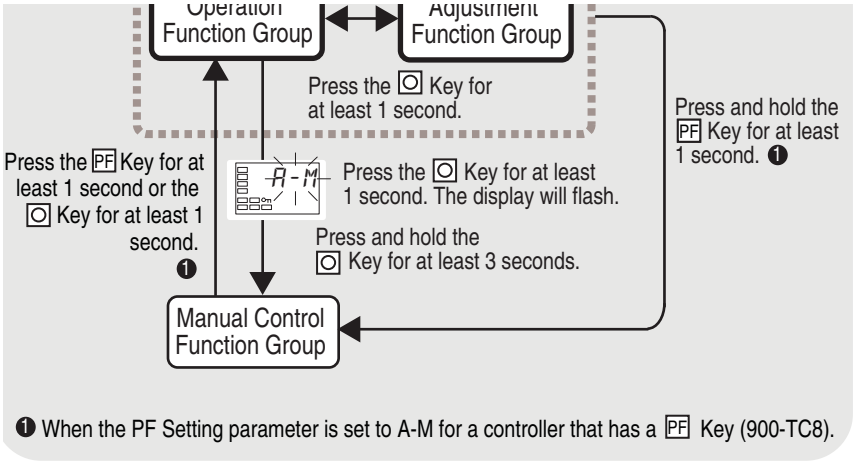
- PF setting (page 5-101)
- Monitor/setting items 1 to 5 (page 5-102)

Manual Control Function Group

When using the PID control mode, the MV Manipulated Variable (output) can be controlled by you from the controller keypad in manual mode if the PV/MV parameter is displayed.

Manual/Automatic mode changes will result in bumpless control of the MV (output). In automatic mode, the final MV will be used as the initial manual MV when moving from automatic mode to manual mode. In manual mode, the change value will be fixed immediately and reflected in the actual MV.

Figure 5.6



- To move from the Operation function group to the Manual Control function group, press the key for at least 3 seconds with the Auto/Manual Switch parameter displayed.

Note: In addition, this operation can be performed using the PF Key by setting the PF Key parameter (Advanced Setting function group) to A-M (Auto/Manual). For details on the setting method, refer to Performing Manual Control. This cannot be done during ON/OFF operation.

- The MANU indicator will light during manual control.
- It is not possible to move to any displays except for the PV/MV parameter during manual operation.
- To return to the Operation function group, press the key or the PF key in the Manual Control function group for at least 1 second.

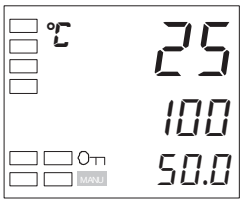
PV/MV (Manual MV)

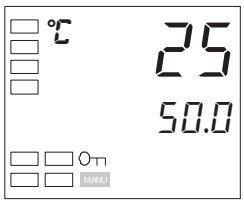
Function: When in manual control operation, the process value is displayed on the No. 1 display, and the manipulated variable (manual MV) is displayed on the No. 2 display, with a two display system. With a three display system

(900-TC8) the PV, SP and the Manual MV can be displayed if the third parameter is enabled (refer to the following graphics displays)

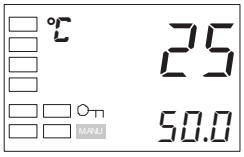
PV/SP/Manual MV

With No. 3 Display





Without No. 3 Display



Note: When the PV/SP Display screen selection parameter is 0.

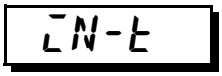
Table 5.BB

	Monitor Range	Units
Process value	Temperature: According to indication range for each sensor. Analog: Scaling lower limit -5% FS to Scaling upper limit +5% FS	EU
Set Point	SP lower limit to SP upper limit	EU

Table 5.BC

	Configurable Range		Units
MV (manual MV)	Standard control	–5.0…105.0 ❶	%
	Heating/cooling control	–105.0…105.0 ❶	

❶ When the MV Limit Enable Parameter is configured to ON, the configurable range will be the MV Lower Limit to MV Upper Limit.



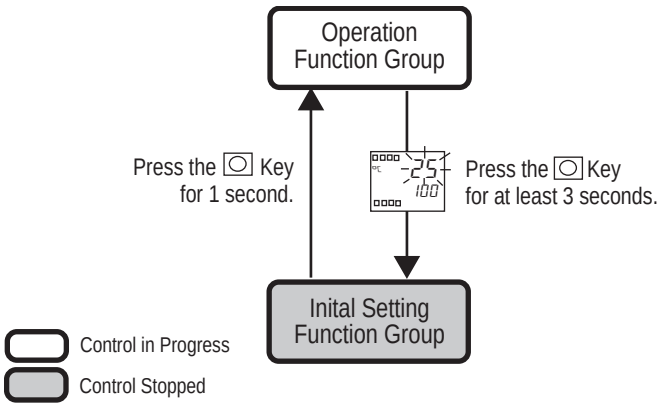
Related Parameters

- Standard or Heating/Cooling (Initial Setting function group, page 5-55)

Initial Setting Function Group

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

Figure 5.7

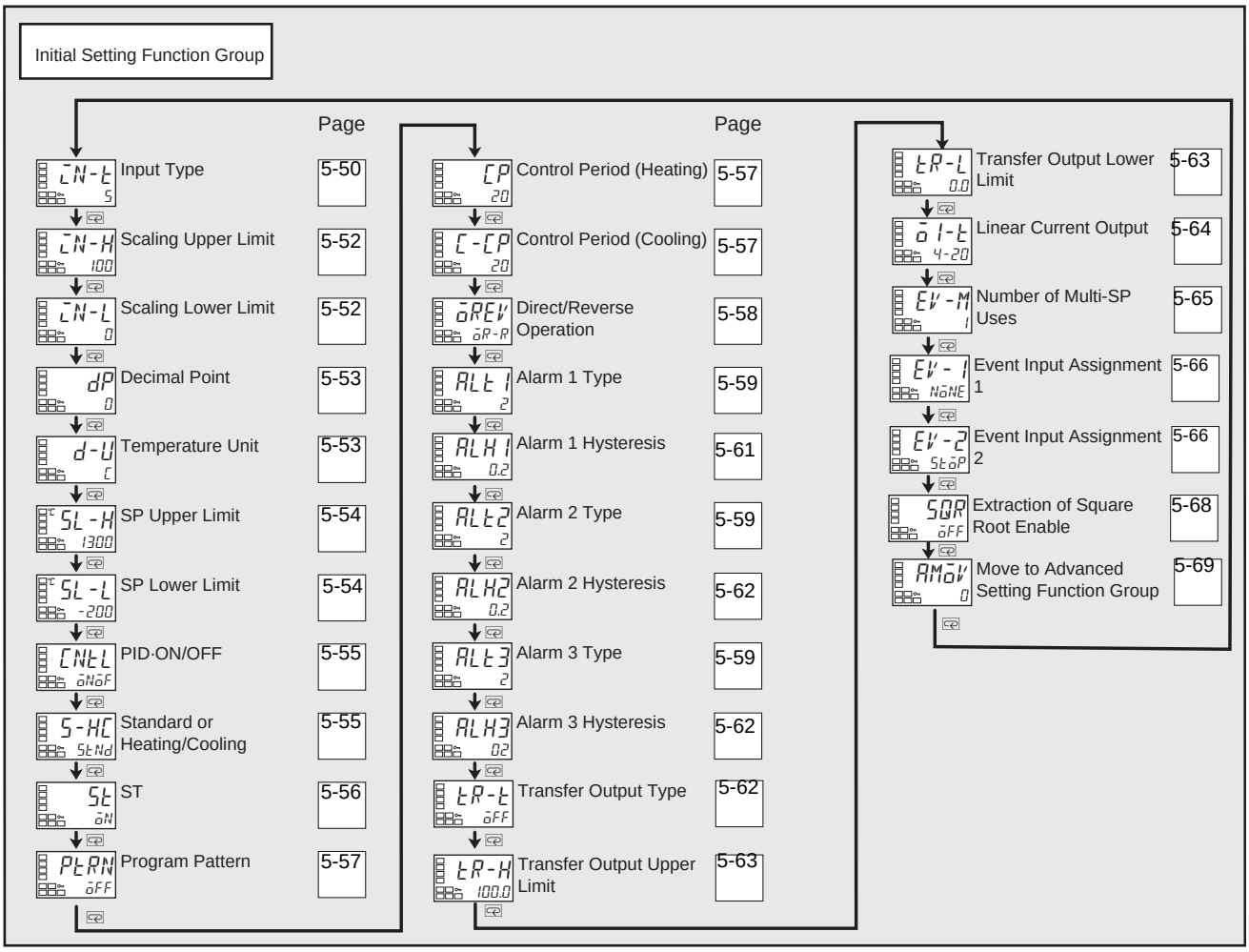


To move from the Operation function group to the Initial Setting function group, press key for 3 seconds with any parameter displayed except for auto/man switch parameter.

- 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.

- **For 900-TC8 and 900-TC16:** The Scaling Upper-Limit, Scaling Lower-Limit, and Decimal Point parameters are displayed when an analog input is selected as the Input Type.

Figure 5.8



Input Type

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

- When this parameter is changed, the set point limiter is changed to the defaults of the new Input Type. If the Input Type must be changed, re-configure your SP Upper-Limit and SP Lower-Limit parameters (Initial Setting function group).
- Select one of the Set Values from the following table. Defaults are as follows: ◘ Controllers with Thermocouple/Resistance Thermometer: 5 K thermocouple ◘ Controllers with Analog Inputs: 0 (current input, 4 to 20 mA) (not supported by 900-TC32).

- If a platinum resistance thermometer (RTD) is mistakenly connected while a setting for other than a platinum resistance thermometer is in effect, the controller error code S.ERR will be displayed. To clear the S.ERR display, check the wiring and then cycle the controller power.

Table 5.BD — Global Temperature (GT) Input Type Controllers

	Input Type	Specifications	Set Value	Input Temperature Range
Controller Type with Thermocouple and Resistance Thermometer (RTD) inputs	Platinum resistance thermometer (RTD)	Pt100	0	–200…850 (°C)/–300…1,500 (°F)
			1	–199.9…500.0 (°C)/–199.9…900.0 (°F)
			2	0.0…100.0 (°C)/0.0…210.0 (°F)
		JPt100	3	–199.9…500.0 (°C)/–199.9…900.0 (°F)
			4	0.0…100.0 (°C)/0.0…210.0 (°F)
	Thermocouple	K	5	–200…1,300 (°C)/–300…2,300 (°F)
			6	–20.0…500.0 (°C)/0.0…900.0 (°F)
		J	7	–100…850 (°C)/–100…1,500 (°F)
			8	–20.0…400.0 (°C)/0.0…750.0 (°F)
		T	9	–200…400 (°C)/–300…700 (°F)
			10	–199.9…400.0 (°C)/–199.9…700.0 (°F)
		E	11	-200…600 (°C)/-300…1,100 (°F)
		L	12	–100…850 (°C)/–100…1,500 (°F)
		U	13	–200…400 (°C)/–300…700 (°F)
			14	–199.9…400.0 (°C)/–199.9…700.0 (°F)
		N	15	–200…1,300 (°C)/–300…2,300 (°F)
		R	16	0…1,700 (°C)/0…3,000 (°F)
		S	17	0…1,700 (°C)/0…3,000 (°F)
		B	18	100…1,800 (°C)/300…3,200 (°F)
	Infrared Temperature Sensor ES1B	10…70 (°C)	19	0…90 (°C)/0…190 (°F)
		60…120 (°C)	20	0…120 (°C)/0…240 (°F)
		115…165 (°C)	21	0…165 (°C)/0…320 (°F)
		140...260 (°C)	22	0…260 (°C)/0…500 (°F)
	Millivolt input	0…50 mV	23	One of the following ranges depending on the scaling. –1,999…9,999 –199.9…999.9
	Thermocouple	W	24	0…2,000 (°C)/0…3,200 (°F)
		PLII	25	0…1,300 (°C)/0…2,300 (°F)

Note: Shaded box indicates default selection for the GT controller type.

Table 5.BE — Analog Input Type Controllers (900-TC8 & 900-TC16)

	Input Type	Specifications	Set Value	Input Temperature Range
Controller Type with Analog Inputs	Current input	4…20 mA	0	One of the following ranges depending on the scaling. –1,999…9,999 –199.9…999.9 –19.99…99.99 –1.999…9.999
		0…20 mA	1	
	Voltage input	1…5 V	2	
		0…5 V	3	
		0…10 V	4	

Note: Shaded box indicates default selection for the GT controller type.

Related Parameters

- Temperature Unit, Set Point Upper-Limit, Set Point Lower-Limit (Initial Setting function group, page 5-54)

Scaling Upper-Limit,

Scaling Lower-Limit,

Decimal Point

Conditions of Use: For 900-TC8 and 900-TC16, the Input Type must be configured as an analog input.

Function: When an analog input is selected as the Input Type, scaling to engineering units (EU) other than temperature 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.BF — 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	Scaling Upper-Limit –1999…–1	None	0

Table 5.BG Decimal Point

Parameter	Controller Type	Configurable Range	Default
Decimal Point	Controllers with Thermocouple/Resistance Thermometer (RTD) inputs	0…1	0
	Controllers with Analog Inputs	0…3	0

Table 5.BH

Configured Value	Meaning	Example
0	0 digits to the right of the decimal point	1234
1	1 digits to the right of the decimal point	123.4
2	2 digits to the right of the decimal point	12.34
3	3 digits to the right of the decimal point	1.234

Related Parameter

- Input Type (Initial Setting function group, page 5-50)

d-U Temperature Units (°C/°F) Selection

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

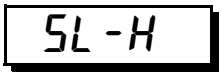
Function: This parameter allows you to configure the temperature input units to either °C or °F.

Table 5.BI

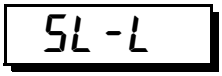
Selections	Default Units
C: °C F: °F	C

Related Parameter

- Input Type (Initial Setting function group, page 5-50)



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 default 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.BJ — Controllers with Thermocouple/Resistance Thermometer Inputs

Parameter	Input Type	Configurable Range	Units	Default
Set Point Upper-Limit	Temperature	SP Lower-Limit + 1 to Input range Upper-Limit	EU	1300
	Millivolt	SP Lower-Limit + 1 to scaling Upper-Limit	EU	100
Set Point Lower-Limit	Temperature	Input range Lower-Limit to SP Upper-Limit – 1	EU	–200
	Millivolt	Scaling Lower-Limit to SP Upper-Limit – 1	EU	0

Table 5.BK — Controllers with Analog Inputs (900-TC8 & 900-TC16)

Parameter	Configurable Range	Units	Default
Set Point Upper-Limit	SP Lower-Limit + 1 to scaling Upper-Limit	EU	100
Set Point Lower-Limit	Scaling Lower-Limit to SP Upper-Limit – 1	EU	0

Related Parameters

- Input Type (page 5-50), Temperature Units (°C/°F) Selection (page 5-53) (Initial Setting function group)

CNTL 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) parameter functions can only be used in the 2-PID control method.

Table 5.BL

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

Related Parameters

Refer to the Advanced Setting function group:

- AT Execute/Cancel (page 5-25), Manual Reset, Hysteresis heating, Hysteresis cooling (page 5-38)
- ST Stable Range (page 5-75)

S-HC Standard or Heating/Cooling

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

When using a 900-TC8X in the heating and cooling control mode, the Auxiliary Output 3 terminal (SUB3) is typically (default) used for cooling Control Output functions.

When using a 900-TC16X in the heating and cooling control mode, the Auxiliary Output 2 output terminal (SUB2) is typically (default) used for cooling Control Output functions.

When heating/cooling control is selected for the 900-TC32, the auxiliary output 1 terminal (SUB1) is assigned as the controloutput (cooling).

Table 5.BM

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

Related Parameters

- MV Monitor (Heating) (page 5-21), MV Monitor (Cooling) (page 5-22) (Operation function group)
- Cooling Coefficient, Dead Band (page 5-36), Hysteresis (heating), Hysteresis (Cooling) (page 5-38) (Adjustment function group)
- Control Period (Heat), Control Period (Cool) (Initial Setting function group, page 5-57)
- Control Output 1 Assignment (page 5-92), Control Output 2 Assignment (page 5-93), Auxiliary Output 1 Assignment (page 5-93), Auxiliary Output 2 Assignment (page 5-94), Auxiliary Output 3 Assignment (page 5-95) (Advance Setting function group)

St ST Self-Tuning

Conditions of Use: The Input Type must be configured for a 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 controller.

Table 5.BN

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

Related Parameters

- ST Stable Range (Advanced Setting function group, page 5-75)
- Input Type (page 5-50), PID ON/OFF (page 5-55) (Initial Setting function group)

PtRN Program Pattern

Function: This parameter allows you to select the type of control when using the simple program function. If the program functionis set to:

- OFF, the simple program will not operate.
- STOP, the RUN/STOP status will change to STOP after the soak time has expired.
- CONT, control will continue in RUN status after the soak time has expired.

Table 5.BO

Selections	Meaning	Default
oFF	Simple program function turned OFF	oFF
StoP	Go to STOP mode at end of program.	
CoNt	Continue in RUN mode at end of program.	

Related Parameters

- Program Start, Soak Time Remain (page 5-15), RUN/STOP (page 5-16) (Operation function group)
- Soak Time, Wait Band (Adjustment function group, page 5-39)
- Soak Time Unit (Advanced Setting function group, page 5-96)

CP Control Period (Heat)

C-CP Control Period (Cool)

Conditions of Use: The control method must be configured for 2-PID control. The cooling control and heating Control Outputs must be relay or voltage (SSR) types. For the Control Period (cool) parameter the control mode must be set to heating and cooling.

Function: This parameter allows you to configure the output period (control period) which is the minimum amount of time between ON cycles of the heating and cooling outputs. 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).

Table 5.BP

Parameter	Configurable Range	Units	Default Value
Control Period (heat)	0.5 or 1…99	Seconds	20
Control Period (cool)	0.5 or 1…99	Seconds	20

- When the standard control mode is selected, use the Control Period (cool) parameter. The Control Period (heat) parameter cannot be used.
- When the heating control output is an analog output the control period cannot be used.
- When the heating and cooling control mode is selected, the Control Period can be configured independently for the heating and cooling outputs. Use the Control Period (heat) parameter to set the Control Output 1 side control period, and use the Control Period (cool) parameter to set the cooling control period.

Related Parameter

- PID ON/OFF (Initial Setting function group, page 5-55)

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 the control method where the manipulated variable is increased according to the decrease in the process value.

Table 5.BQ

Selections	Default
oR-R: Reverse operation, oR-d: Direct operation	oR-R

AL t 1 Alarm Type for Alarm 1

Conditions of Use: Alarm 1 must be configured and 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, LBA, or PV change rate alarm.

Note: Refer to Table 5.BR for details.

Related Parameters

- Alarm value 1 (page 5-16); Alarm value upper limit 1, Alarm value lower limit 1(page 5-18 (Operation function group)
- Standby sequence reset (page 5-72); Auxiliary output 1 open in alarm (page 5-73); Alarm 1 latch (page 5-79) (Advanced Setting function group); Alarm 1 hysteresis (Initial Setting function Group, page 5-61)

AL t2 Alarm Type for Alarm 2 (900-TC8 & 900-TC16)

AL t3 Alarm Type for Alarm 3 (900-TC8)

Conditions of Use: Alarm 2 and 3 must be configured and supported by the controller hardware.

Function: These parameters allow you to configure the type of alarm operation for Alarm Output 2 and Alarm Output 3.

- For Alarm 2 and 3, you can select Alarm types: Deviation, Deviation range, Absolute Value, or PV change rate alarm (Note: cannot use LBA).

Related Parameters

- Alarm value 2 (page 5-17), Alarm value upper limit 2 (page 5-19), Alarm value lower limit 2 (page 5-19) (Operation function group)
- Standby sequence reset (page 5-72), Auxiliary output * open in alarm: (page 5-73), Alarm 2 hysteresis (page 5-62), Alarm 2 latch (page 5-79) (Advanced Setting function group)
- Alarm value 3 (page 5-18), Alarm value upper limit 3 (page 5-20), Alarm value lower limit 3 (page 5-20) (Operation function group)
- Standby sequence reset (page 5-72), Auxiliary output * open in alarm (page 5-73), Alarm 3 hysteresis (page 5-62), Alarm 3 latch (page 5-79) (Advanced Setting function group)

Table 5.BR — Details

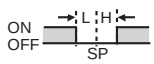
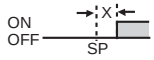
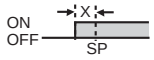
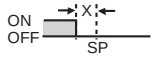
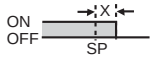
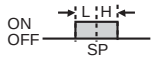
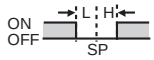
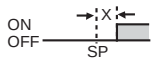
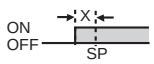
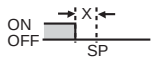
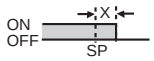
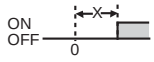
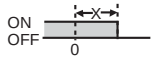
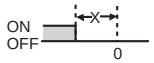
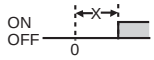
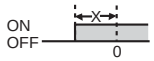
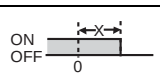
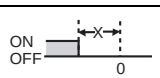
Set Value	Alarm type	Alarm Output Operation	
		When Alarm Value X is Positive	**When Alarm Value X is Negative**
0	Alarm function OFF	Output OFF	
1❶	Upper- and Lower-Limit (deviation range)		❷
2	Upper-limit (deviation)		
3	Lower-limit (deviation)		
4 ❶	Upper- and Lower-Limit range (deviation range)		❸
5 ❶❺	Upper- and Lower-Limit with standby sequence (deviation range)		❹
6	Upper-limit with standby sequence (deviation)		
7	Lower-limit with standby sequence (deviation)		
8	Absolute-value Upper-Limit		
9	Absolute-value Lower-Limit		
10	Absolute-value Upper-Limit with standby sequence		
11	Absolute-value Lower-Limit with standby sequence		

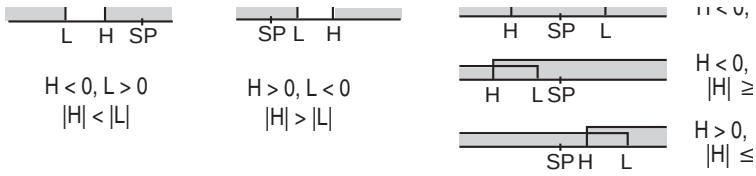
Table 5.BR — Details

Set Value	Alarm type	Alarm Output Operation	
		When Alarm Value X is Positive	When Alarm Value X is Negative
12	Loop Break Alarm (LBA) (Alarm 1 Type only)	—	
13	PV Change Rate Alarm	—	

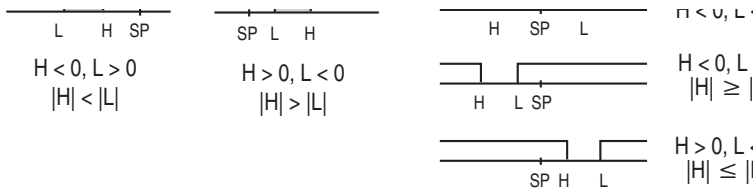
Note: Shading indicates default setting. Set the alarm type independently for each alarm in the Alarm 1 to 3 Type parameters in the Initial Setting function group. The default is 2 (Upper-limit alarm).

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

❷ Set value: 1 (Upper- and Lower-Limit alarm)



❸ Set value: 4 (Lower-Limit range)



❹ Set value: 5 (Upper- and Lower-Limit with standby sequence)
For the Lower-Limit alarms in cases 1 and 2 above, the alarm is normally OFF if upper- and Lower-Limit hysteresis overlaps. In case 3, the alarm is always OFF.

❺ Set value: 5 (The alarm is always OFF if upper- and Lower-Limit alarm hysteresis with standby sequence overlaps.)

Related Parameters

- Alarm Value 1…3 (Operation function group, page 5-16)
- Upper-Limit Alarm Value 1…3, Lower-Limit Alarm Value 1…3 (Operation function group, page 5-19)
- Standby Sequence Reset Method (page 5-72), Alarm 1…3 Open in Alarm, Alarm 1…3 Hysteresis (page 5-61), Alarm 1…3 Latch (Advanced Setting function group)

AL H 1 Alarm 1 Hysteresis

Conditions of Use: Alarm 1 must be assigned. The alarm 1 type must NOT be 0, 12, or 13.

ALH2 Alarm 2 Hysteresis

Conditions of Use: Alarm 2 must be assigned. The alarm 2 type must NOT be 0, 12, or 13.

ALH3 Alarm 3 Hysteresis

Conditions of Use: Alarm 3 must be assigned. The alarm 3 type must NOT be 0, 12, or 13.

Function: These parameters set the hysteresis (allowed deviation from the configured alarm value) for alarms 1, 2, and 3.

Table 5.BS

Controller Models	Configurable Range	Units	Default
Model with thermocouple/resistance thermometer universal input	0.1...999.9	°C or °F	0.2
Model with analog input	0.01...99.99	%FS	0.02

Note: Set *None* as the unit for 0 to 50 millivolt.

Related Parameters

- Alarm value 1 to 3 (page 5-16), Alarm value upper limit 1 to 3 (page 5-18), Alarm value lower limit 1 to 3 (page 5-18) (Operation function group)
- Alarm 1 to 3 type (Initial Setting function group, page 5-59)

tR-t Transfer Output Type (900-TC8, 900-TC16)

Conditions of Use: An analog current output must be assigned/configured

Function: This parameter allows you to configure the analog current output for a specific type of transfer output. Refer to Table 5.BU.

Note: If the analog current output is NOT used as a transfer output, configure this parameter to OFF (default).

Table 5.BT — Transfer Output Destination

Control Output 1 Type	Control Output 2 Type	Transfer Output Destination
Current Output	• No • Relay Output • Voltage Output (for driving SSR)	Control Output 1
• Relay Output • Voltage output (for driving SSR)	• No • Relay Output • Voltage Output (for driving SSR)	No

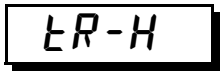
Note: Calibration is NOT supported for the transfer output.

Table 5.BU

Transfer Output Type Selection		Default
OFF	oFF	oFF
Set point	SP	
Set point during SP ramp	SP-M	
PV	PV	
MV monitor (heating)	MV	
MV monitor (cooling)	C-MV	

Related Parameter

- Transfer Output Upper-Limit, Transfer Output Lower-Limit (Initial Setting function group, page 5-63)



Transfer Output Upper-Limit

Transfer Output Lower-Limit

Conditions of Use: An analog current output must be assigned/configured. The Transfer Output Type parameter must NOT be set to OFF.

Function: This parameter allows you to configure the Upper- and Lower-Limit values specifically for the transfer output and separate from the actual function (e.g., Set Point Limits).

Table 5.BV

Transfer Output Type	Configurable Range		Default Transfer Output		Units
			Lower-Limit	Upper-Limit	
Set Point	SP Lower-Limit to SP Upper-Limit		SP Lower-Limit	SP Upper-Limit	EU
Set Point during SP Ramp	SP Lower-Limit to SP Upper-Limit				
PV	Temperature	Senor setting range Lower-Limit to sensor setting range Upper-Limit	Sensor Setting Range Lower-Limit	Sensor Setting Range Upper-Limit	
	Analog	Analog scaling Lower-Limit to analog scaling Upper-Limit	Scaling Lower-Limit	Scaling Upper-Limit	
MV Monitor (heating)	Standard	–5.0…105.0	0.0	100.0	%
	Heating/cooling	0.0…105.0			
MV Monitor (cooling)	0.0…105.0				

Related Parameter

- Transfer Output Type (Initial Setting function group, page 5-62)

o1-t Linear Current Output (900-TC8, 900-TC16)

Conditions of Use: Control output 1 must be an analog current output.

Function: This parameter allows you to configure the output type for the linear analog current outputs and select either 4…20 mA or 0…20 mA.

Table 5.BW

Analog Output Selection Types	Default
4-20: 4…20 mA 0-20: 0…20 mA	4-20

Note: Even when control output 1 is used as a control output or transfer output the 0 to 20 mA selection can be used.

Related Parameter

- Transfer Output Type (Initial Setting function group, page 5-62)

EV-M Number of Multi-SP Uses (900-TC8, 900-TC16)

Conditions of Use: An event input unit must be assigned. An optional event input unit must be installed in the controller.

Function: Multi-SP is a function for setting set points 0 to 3 in advance, and switching between these set points using a combination of event input ON/OFF signals. The number of Multi-SP Uses parameter is used to switch between using two and four preset set points.

Table 5.BX

Configurable Range	Default
0 to 2	1

Whether the Event Input Assignments 1 and 2 parameters are displayed or hidden is determined by the Number of Multi-SP Uses parameter setting.

Table 5.BY — Controllers with Event Inputs 1 and 2 (Two Event Inputs)

		Event Input Assignment 1	Event Input Assignment 2
Number or Multi-SP uses	0	Displayed (Multi-SP not used).	
	1	Hidden (Multi-SP, 2 points)	Displayed (Event input 2 not used as multi-SP switch).
	2	Hidden (Multi-SP, 4 points).	

The following tables show the relationships between ON/OFF combinations of event inputs 1 and 2 and selected set points.:

Table 5.BZ —Number of Multi-SP Uses: 1

Event input 1	Selected set point
OFF	Set point 0
ON	Set point 1

Table 5.CA — Number of Multi-SP Uses: 2

Event input 1	Event input 2	Selected set point
OFF	OFF	Set point 0
ON	OFF	Set point 1
OFF	ON	Set point 2
ON	ON	Set point 3

The following table shows the functions assigned when an Event Input Assignment (1 or 2) is displayed.

Table 5.CB

Selection	Function
NONE	None
STOP	RUN/STOP
MANU	Auto/Manual Switch
PRST	Program start (see note 1.)
dRS	Invert Direct/Reverse Operation
AT-2	100% AT Execute/Cancel
AT-1	40% AT Execute/ Cancel (see note 2)
WTPT	Setting Change Enable/Disable
LAT	Alarm Latch Cancel

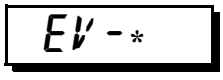
Note: 1 PRST (Program Start) can be configured even when the Program Pattern parameter is configured to OFF, but the function will be disabled.

Note: 2 This function can be configured for heating/cooling control, but the function will be disabled.

- When any of the following functions are configured for an Event Input Assignment parameter, the same function cannot be configured for another Event Input Assignment parameter: STOP (RUN/STOP), MANU (Auto/Manual Switch), PRST (Program Start), DRS (Invert Direct/Reverse Operation), AT-2 (100% AT Execute/Cancel), AT-1 (40% AT Execute/Cancel), WTPT (Setting Change Enable/Disable), or LAT (Alarm Latch Cancel).

Related Parameters

- SP0 to SP3 (Adjustment function group, page 5-33),
- Event input assignment 1 and 2 (Initial Setting function group, page 5-66), Multi-SP use (Advanced Setting function group, page 5-71)



Event Input Assignment (* 1 and 2) (900-TC8, 900-TC16)

Conditions of Use: An event input unit must be installed in the controller. Multi-SP must NOT be used.

Function: The following functions can be assigned to event inputs 1 and 2:

- RUN/STOP
- Auto/Manual Switch
- Program Start
- Invert Direct/Reverse Operation
- 100% AT Execute/Cancel
- 40% AT Execute/Cancel
- Setting Change Enable/Disable
- Alarm Latch Cancel

Default:

- Event Input Assignment 1: NONE
- Event Input Assignment 2: STOP.

Table 5.CC

Selection	Function
NONE	None
STOP	RUN/STOP
MANU	Auto/Manual
PRST	Program start (see note 1.)
dRS	Invert Direct/Reverse Operation
AT-2	100% AT Execute/Cancel
AT-1	40% AT Execute/ Cancel (see note 2)
WTPT	Setting Change Enable/Disable
LAT	Alarm Latch Cancel

Note: 1 PRST (Program Start) can be configured even when the Program Pattern parameter is configured to OFF, but the function will be disabled.

Note: 2 This function can be configured for heating/cooling control, but the function will be disabled.

Related Parameters

- SP0 to SP3 (Adjustment function group, page 5-33)
- Number of multi-SP uses (Initial Setting function group, page 5-65)

Extraction of Square Root Enable (900-TC8, 900-TC16)

Conditions of Use: An analog input must be supported.

Function: This parameter enables and disables square root extraction.

Table 5.CD

Setting Range	Default
oN: Enabled, oFF: disabled	None

Related Parameter

- Extraction of square root low-cut point (Adjustment function group, page 5-44)

Move to Advanced Setting Function Group

Conditions of Use: The Initial Setting/Communications Protect parameter must be set to 0.

Function: This parameter allows you to move to the Advanced Setting function group by entering the value **–169** when the parameter is displayed

Note: Once the value (**–169**) is displayed on the controller you can move to the Advanced Setting function group either by pressing the ↵ key or ○ key or by waiting for 2 seconds to elapse.

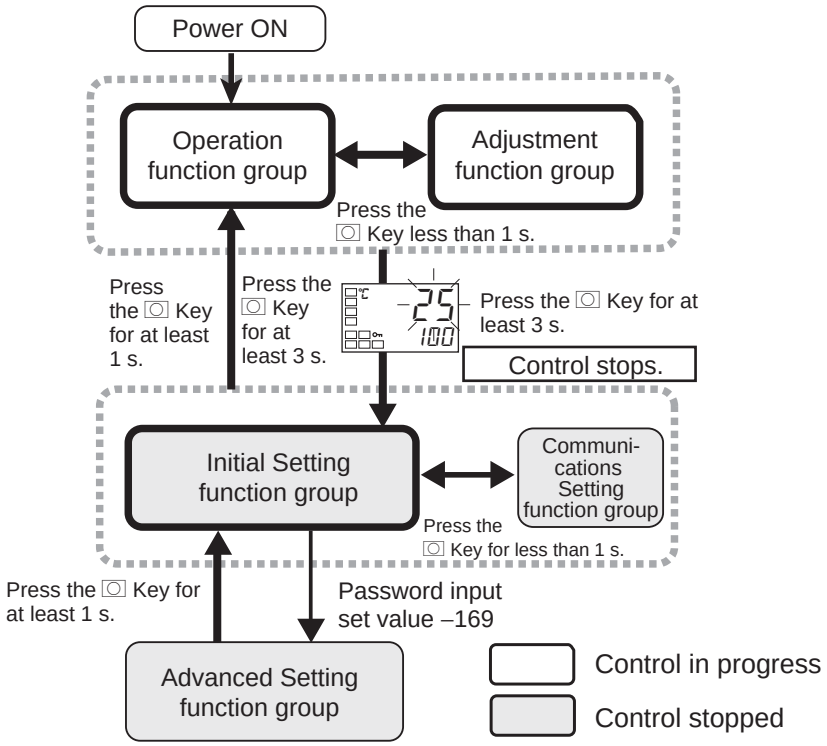
Related Parameter

- Initial Setting/Communications Protect (Protect function group, page 5-4)

Advanced Setting Function Group

This function group is for using the Bulletin 900 controller to its maximum capability.

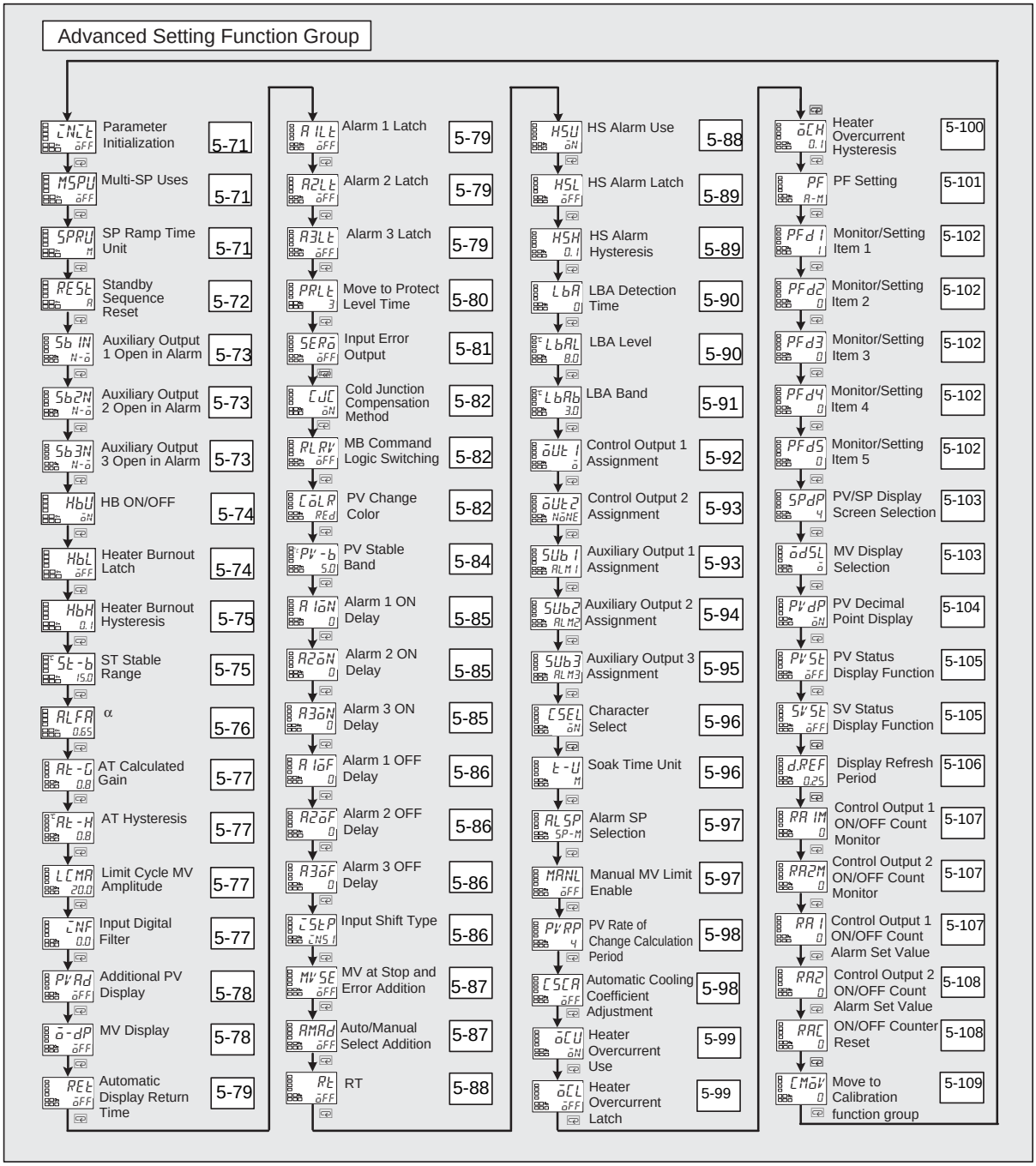
Figure 5.9



To move to this function group, enter the password (**–169**) in the Initial Setting function group (refer to page 5-48 for details).

Note: In order to enter the password the Initial Setting/Communications Protection must be set to 0.

Figure 5.10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INIT Parameter Initialize

Function: This parameter allows you to return/reset all of the controller's parameter settings to their initial/default values.

Table 5.CE

Parameter Selection	Default
oFF: Initialization is not executed.	oFF
FACt: Initializes to the factory settings described in the manual.	

MSPU Multi-SP Uses

Conditions of Use: The controller must NOT have an event input option unit installed or 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 is mounted in the Bulletin 900 controller, 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 Set Point Setting (Operation function group, page 5-10)
- Number of Multi-SP Uses (Initial Setting function group, page 5-65)

SPRU SP Ramp Time Units

Conditions of Use: The ST (Self-Tuning) parameter must be set to OFF.

Function: This parameter allows you to configure the time units for the rate of change during a SP ramp operation which you previously enabled by entering a value in the SP Ramp Set Value parameter (Adjustment function group).

Table 5.CF

Configurable Range	Default
S: EU/s, M: EU/min	M

Related Parameters

- Ramp SP Monitor (Operation function group, page 5-10)
- SP Ramp Set Value (Adjustment function group, page 5-41)

RESt Standby Sequence Reset Method

Conditions of Use: The Alarm Type for alarms 1…3 must be configured for 5, 6, 7, 10 or 11 (refer to Table 5.BR).

Note: Alarm 3 is not applicable for 900-TC16. Alarm 2 and 3 are not applicable for 900-TC32.

Function: Recall that with standby sequence configured the alarm output is temporarily disabled until AFTER the first alarm condition occurs. 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 (refer to Table 5.CG).

- **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 (refer to Figure 5.11).

Figure 5.11

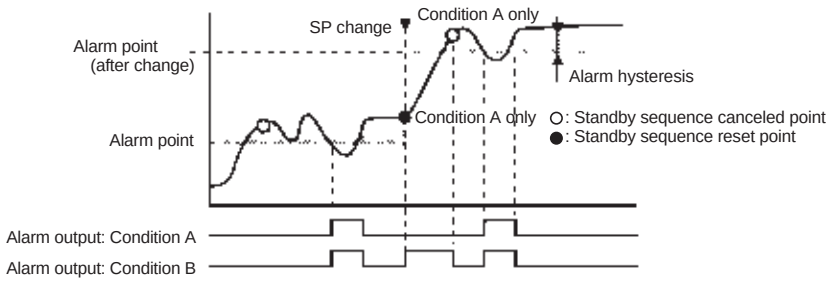


Table 5.CG

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

Related Parameters

- Alarm 1…3 Type(see note) (Initial Setting function group, page 5-59)
- Alarm 1…3 Latch (see note) (Advanced Setting function group, page 5-79)

Note: Alarm 3 is not applicable for 900-TC16. Alarm 2 and 3 are not applicable for 900-TC32.

Auxiliary Output * Open in Alarm (* = 1 to 3)

Conditions of Use: Auxiliary output, 1, 2, or 3 must be assigned.

Function: This parameter allows you to configure the output states of auxiliary outputs 1 to 3 [1].When the Close in Alarm parameter is configured, the status of the auxiliary output function is output unchanged with no alarm. When Open in Alarm is configured, the status of the auxiliary output function is reversed before being output. The following table shows the relationship between the auxiliary output function, auxiliary output, and operation displays (SUB1 to SUB3).

Table 5.CH

Alarm Parameter Mode	Auxiliary Output Function	Physical Auxiliary Output	Operation Display (SUB1 to SUB3)[1]
Close in Alarm	ON	ON	Lit
	OFF	OFF	Not lit
Open in Alarm	ON	OFF	Lit
	OFF	ON	Not lit

[1] Auxiliary output 3 (SUB 3) is NOT available for the 900-TC16. Auxiliary output 2 and 3 (SUB 2 and 3) are NOT available for the 900-TC32.
Note: The shaded cell signifies the default setting.

HbU HB ON/OFF (900-TC8, 900-TC16)

Conditions of Use: The controller hardware that supports the Heater Burnout (HB), Heater Short (HS), and Heater Overcurrent (HO), Alarm 1 must be configured and the appropriate number of Current Transformers (CT) to support the application are connected to the controller.

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

Table 5.CI

Selections	Default Selection
oN: Alarm Enabled oFF: Alarm Disabled	oN

HbL Heater Burnout Latch (900-TC8, 900-TC16)

Conditions of Use: The HB ON/OFF parameter must be configured to ON and the controller hardware must support the Heater Burnout (HB), Heater Short (HS), and heater overcurrent detection. Alarm 1 must also be configured to ON. The appropriate number of Current Transformers (CT) to support the application must be connected to the controller.

Function: When this parameter is configured to ON, the heater burnout alarm is held ON until one 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, **or**
- Controller power is cycled from ON to OFF.
- The latch is canceled by the PF key (900-TC8 only). PF Setting = LAT: Alarm Latch Cancel.
- The latch is canceled by an event input. (Event Input Assignment 1 and 2 = LAT: Alarm Latch Cancel).

Table 5.CJ

Selections	Default Selection
oN: Latch Enabled oFF: Latch Disabled	oFF

Related Parameter

- HB ON/OFF (Advanced Setting function group, page 5-74)
- Event Input Assignment 1 and 2 (Initial Setting function group, page 5-66)

HbH Heater Burnout Hysteresis (900-TC8, 900-TC16)

Conditions of Use: The Heater Burnout ON/OFF parameter must be configured to ON. The Heater Burnout Latch parameter must be set to OFF. Support (e.g., CT) hardware must be available, and heater burnout, heater short, and heater overcurrent detection supported. Alarm 1 must be assigned.

Function: This parameter allows you to configure the hysteresis (allowed deviation from the HB, HS or heater overcurrent set point) when such a condition is detected.

Table 5.CK

Configurable Range	Units	Default Value
0.1…50.0	A (Amps)	0.1

Related Parameter

- HB ON/OFF (Advanced Setting function group, page 5-74)
- Event Input Assignment 1 and 2 (Initial Setting function group, page 5-66)

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 (refer to Table 5.CL and Table 5.CL).

Table 5.CL — Self-Tuning Stable Range

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

Note: Analog inputs do not apply to ST Stable Range because units are °C or °F.

Related Parameters

- PID ON/OFF (Initial Setting function group, page 5-55)
- Input Type (Initial Setting function group, page 5-50)
- ST (Initial Setting function group, page 5-56)

α

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

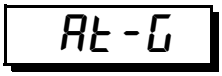
Function: This parameter allows you to configure the 2-PID constant for alpha (α). Normally, use this parameter at its default.

Table 5.CM — Alpha

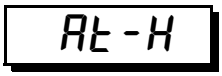
Configurable Range	Units	Default Value
0.00…1.00	None	0.65

Related Parameters

- PID ON/OFF (Initial Setting function group, page 5-55)
- ST (Initial Setting function group, page 5-56)



AT Calculated Gain



AT Hysteresis

Limit Cycle MV Amplitude

Conditions of Use: Control must be configured to 2-PID control. Normally use the default values for these parameters

Function: The AT Calculated Gain parameter sets the gain when PID values are calculated using AT. When emphasizing response, decrease the set value. When emphasizing stability, increase the set value. The AT Hysteresis parameter sets the hysteresis for limit cycle operation during auto tuning when switching ON and OFF. The Limit Cycle MV Amplitude parameter sets the MV amplitude for limit cycle operation during auto tuning.

Table 5.CN

Parameter	Configuration Range	Units	Default
AT Calculated Gain	0.1...10.0	---	0.8
AT Hysteresis	Universal input: 0.1...999.9	° C or ° F	0.8 (see note)
	Analog input 0.01...9.99	%FS	0.20
Limit Cycle MV Amplitude	5.0...50.0	%	20.0

Note: When temperature unit is °F, the default is 1.4.

Related Parameters

- AT execute/cancel (Adjustment function group, page 5-25)

Input Digital Filter

Function: This parameter allows you to configure the time constant of the controller's input digital filter. Figure 5.12 shows the effect on the input data after passing through the digital filter.

Figure 5.12

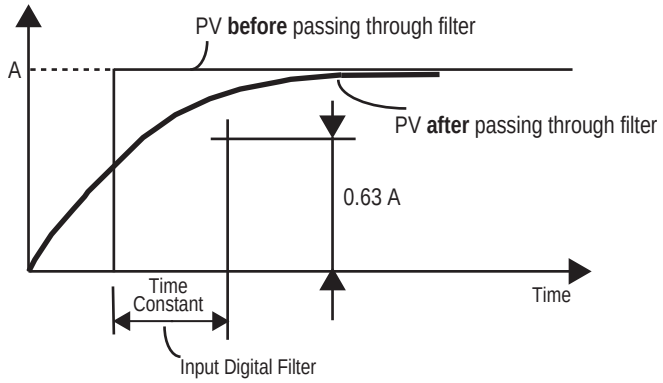


Table 5.CO

Configurable Range	Units	Default Value
0.0…999.9	Seconds	0.0

PUAd 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.CP

Selections	Default Selection
oN: Displayed oFF: Not displayed	oFF

o-dP Manipulated Variable (MV) 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 (heating) and Manipulated Variable (cooling) parameters are set to ON, and not displayed when these parameters are set to OFF.

Table 5.CQ

Selections	Default Selection
ōN: Displayed ōFF: Not displayed	ōFF

Related Parameters

- MV Monitor (heating) (page 5-21) MV Monitor (cooling) (page 5-22) (Operation function group)

rEt Automatic Display Return Time

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, Adjustment function group, or Monitor 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.CR

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

A1LE Alarm 1 Latch

A2LE Alarm 2 Latch

A3LE Alarm 3 Latch

Conditions of Alarm 1 Use: Alarm 1 function must be assigned and Alarm 1 Type must NOT be configured to 0.

Conditions of Alarm 2 Use: Alarm 2 function must be assigned and Alarm 2 Type must NOT be configured to 0 or 12.

Conditions of Alarm 3 Use: Alarm 3 function must be assigned and Alarm 3 Type must NOT be configured to 0 or 12. Controller must be 900-TC8 type.

Function: When this parameter is set to ON, the alarm function is held until one of the following conditions are satisfied:

- The power to the controller is cycled.
- The latch is cancelled by the PF Key. (PF Setting = LAT: Alarm Latch Cancel)
- The latch is cancelled by an event input.(Event Input Assignment 1 and 2 = LAT: Alarm Latch Cancel)
- The output is turned OFF when switching to the Initial Setting function group, communications function group, Advanced Setting function group, or calibration level.
- If an auxiliary output is set to close in alarm, the output is kept closed. If it is set to open in alarm, it is kept open.

Table 5.CS

Selections	Default Selection
ōN: ON ōFF: OFF	ōFF

Related Parameters

- Alarm Value 1 to 3 (Operation function group, page 5-16)
- Upper-Limit Alarm Value 1 to 3, Lower-Limit Alarm Value 1 to 3 (Operation function group, page 5-20)
- Alarm 1 to 3 Type (Initial Setting function group, page 5-59)
- Standby Sequence Reset Method (Advanced Setting function group, page 5-72)
- Auxiliary Output 1 to 3 Open in Alarm, (Advanced Setting function group, page 5-73)
- Event input assignment 1 and 2 (Initial Setting function group, page 5-66) HB ON/OFF: (page 5-74), PF setting: (page 5-101) (Advanced Setting function group)

PRLt 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, Adjustment function group, or Monitor/Setting function group.

Table 5.CT

Configurable Range	Units	Default Value
1…30	Seconds	3

Related Parameters

- Operation/Adjustment Protection, Initial Setting/Communications Protection, Setting Change Protection (Protect function group, page 5-1)

SERo Input Error Output

Conditions of Use: Alarm 1 must be assigned.

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

Note: For details on input errors, refer to Error displays.

The Alarm 1 output is:

- the ORed output of Alarm 1, HB Burnout alarm, HS Alarm, heater overcurrent alarm and the input error.
- 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, and when controller power is cycled ON to OFF.

Table 5.CU

Selections	Default Selection
oN: Enabled oFF: Disabled	oFF

Related Parameter

- Input Error (Error Display, page 6-1)

CJC Cold Junction Compensation Method

Conditions of Use: The Input Type must be thermocouple or non-contact infrared 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 5 to 22, 24, or 25.

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

Table 5.CV

Selections	Default Selection
ON: Internally OFF: Externally	ON

Related Parameter

- Input Type (Initial Setting function group, page 5-50)

RLPV MB Command Logic Switching

Note: Although this parameter is available, it is not used by the 900-TC8, 900-TC16, or 900-TC32 controller or configuration software. The default is OFF and should remain unchanged.

COLR PV Color Change

Function: The PV Color Change function allows you to change the color of the PV display (No. 1 display) based upon preset conditions defined in Table 5.CW.

There are three display colors (orange, red, and green) that you can select based on the following three modes listed below and eight settings shown in Table 5.CW.

Modes:

- **Constant:** This mode displays orange, red, or green all the time.
- **Linked to Alarm 1:** This mode switches the PV display color from red to green when Alarm 1 turns ON or from green to red when Alarm 1 turns ON.
- **Linked to PV Stable Band:** This mode switches the PV display color between red outside the PV Stable Band and green within PV Stable Band, or between green outside the PV stable band and red within PV stable band. Set the PV stable band in the PV Stable Band parameter in the Advanced Setting function group.

Note: The default of the PV is RED (red).

The following table shows the display functions that can be set using the PV color change function.

Table 5.CW — Settings

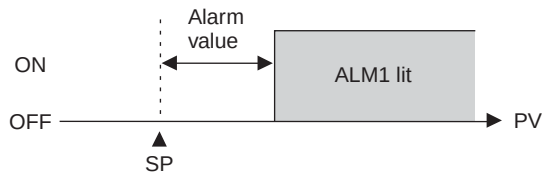
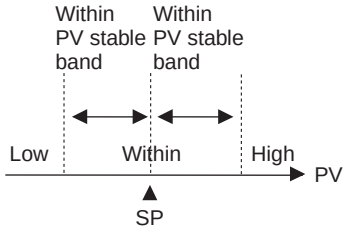
Mode	Setting	Function	PV Color Change		Application Example
Constant	ORG	Orange	Constant: Orange		To match the display color with other Controller models
	RED	Red	Constant: Red		To match the display color with other Controller models
	GRN	Green	Constant: Green		To match the display color with other Controller models
Linked to Alarm 1					
			ALM1 not lit	ALM1 lit	Application example
	R-G	Red to Green	Red	Green	To display the PV reached signal
	G-R	Green to Red	Green	Red	To display error signals

Table 5.CW — Settings

Mode	Setting	Function	PV Color Change			Application Example
Linked to PV stable band						
			Low	PV stable band	High	Application example
	R-G.R	Red to Green to Red	Red	Green	Red	To display stable status
	G-o.R	Green to Orange to Red	Green	Orange	Red	To display stable status
	o-G.R	Orange to Green to Red	Orange	Green	Red	To display stable status

Related Parameters

- PV Stable Band (Advanced Setting function group, page 5-84)

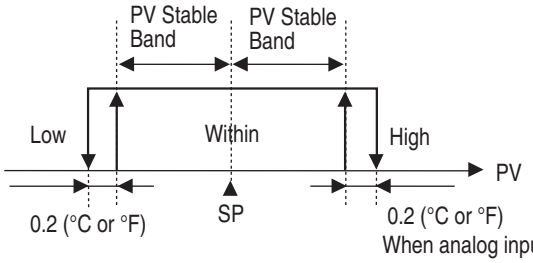
PV-b PV Stable Band

Function: This parameter allows you to configure the PV Stable Band width in °C, °F, or % full scale within which the PV display color is changed based on your configuration of the PV Color Change parameter.

- When the mode to link to the PV stable band is selected with the PV Color Change parameter, the PV display color will change according to whether the present value (PV) is lower than, within, or higher than the PV stable band, as shown in the following figure.

- There is a fixed hysteresis of 0.2 (°C or °F).

Figure 5.13



When analog inputs are used: 0.02 (% FS).

Table 5.CX

Controller Models	Configurable Range	Units	Default
Controllers with Thermocouple and Resistance Thermometer (RTD) inputs	0.1…999.9	°C or °F ❶	5.0
Controllers with Analog Inputs	0.01…99.99	%FS	5.00

❶ Set NONE as the unit for Controllers with Millivolt Inputs.

Related Parameter

- PV Color Change (Advanced Setting function group, page 5-82)

Alarm 1 ON Delay

Alarm 2 ON Delay

Alarm 3 ON Delay

Conditions of Use: Alarm 1 must be assigned, and the Alarm 1 Type parameter must NOT be 0, 12, or 13. Alarm 2 must be assigned, and the Alarm 2 Type parameter must NOT be 0, 12, or 13. Alarm 3 must be assigned, and the Alarm 3 Type parameter must NOT be 0, 12, or 13.

Function: When this parameter is enabled, Alarm 1, 2, or 3 outputs are prevented from turning ON until after the delay times you configure in these parameters has elapsed.

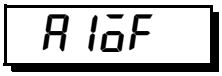
- To enable the alarm set the ON delay time at some value >0.
- To disable the ON delay, set 0.

Table 5.CY

Configurable Range	Units	Default
0…999	Seconds	0

Related Parameter

- Alarm 1…3 Type (Initial Setting function group, page 5-59)



Alarm 1 OFF Delay

Alarm 2 OFF Delay

Alarm 3 OFF Delay

Conditions of Use: Alarm 1 must be assigned, and the Alarm 1 Type parameter must NOT be 0, 12, or 13. Alarm 2 must be assigned, and the Alarm 2 Type parameter must NOT be 0, 12, or 13. Alarm 3 must be assigned, and the Alarm 3 Type parameter must NOT be 0, 12, or 13.

Function: Alarm 1, 2, or 3 outputs are prevented from turning OFF until after the delay time you configure in these parameters has elapsed.

- To enable the alarm set the OFF delay to some value >0.
- To disable the OFF delay, set 0.

Table 5.CZ

Configurable Range	Units	Default
0…999	Seconds	0

Related Parameter

- Alarm 1…3 Type (Initial Setting function group, page 5-59)

Input Shift Type

Conditions of Use: The sensor Input Type must be a thermocouple or resistance thermometer (RTD) input.

Function: This parameter allows you to configure the shift method for thermocouple or resistance thermometer inputs.

- When the Input Type is thermocouple or resistance thermometer, set either a 1-point shift or a 2-point shift.

Table 5.DA

Selections	Default
cNS1: 1-point shift, cNS2: 2-point shift	cNS1

Related Parameters

- Temperature Input Shift, Upper-Limit Temperature Input Shift Value, Lower-Limit Temperature Input Shift Value (Adjustment function group, page 5-34)
- Input Type (Initial Setting function group, page 5-50)

MV5E MV at Stop and Error Addition

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

Function: This parameter allows you to configure whether or not the MV at Stop and MV at PV Error parameters are to be displayed on the controller.

Table 5.DB

Selections	Default
ON: Displayed, OFF: Not displayed	OFF

Related Parameter

- MV at Stop, MV at PV Error (Adjustment function group, page 5-41)

AMAd Auto/Manual Selection Addition

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

Function: This parameter allows you to configure whether the Auto/Manual parameter is to be displayed on the controller.

Table 5.DC

Configurable Range	Default
ON: Displayed, OFF: Not displayed	OFF

Related Parameter

- Auto/Manual Switch (Operation function group, page 5-10)

rt Robust Tuning (RT)

Conditions of Use: The control method must be configured to 2-PID control. The Input Type must be configured to temperature input.

Function: This parameter executes robust tuning (RT).

- When Auto-tuning (AT) or Self-tuning (ST) is executed with RT selected, PID constants are automatically set which make it hard for control performance to degenerate even when control object characteristics have changed.
- Even when hunting occurs for PID constants when AT or ST is executed in normal mode, it is less likely to occur when AT or ST is executed in RT mode.

Table 5.DD

Selections	Default
oN: RT function OFF, oFF: RT function ON	oFF

Related Parameters

- AT Execute/Cancel (page 5-25), Proportional Band, Integral Time, Derivative Time (page 5-35) (Adjustment function group)
- PID ON/OFF (page 5-55), ST (page 5-56) (Initial Setting function group)

hsu Heater Short Alarm (HSA) Use (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short Alarms (HSA), and heater overcurrent detection must be supported. Alarm 1 must be assigned. Optional controller hardware and/or support hardware (e.g., CTs) must be installed.

Function: This parameter allows you to enable the controller to support the Heater Alarm functions

Table 5.DE

Configurable Range	Default
oN: Enabled, oFF: Disabled	oN

HSL Heater Short Alarm (HSA) Latch (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA), Heater Short Alarms (HSA), and heater overcurrent detection must be supported. Alarm 1 must be assigned. The HS Alarm parameter must be set to ON. Optional controller hardware and/or support hardware (e.g., CTs) must be installed.

Function: When the Alarm Latch parameter is set to ON, the HS alarm is held until either of the following conditions is satisfied:

- The HS alarm current is set to 50.0 A.
- The controller power is turned OFF then back ON again (e.g., power is reset).
- The latch id canceled by the PF key (900-TC8 only). PF Setting = LAT: Alarm Latch Cancel.
- The latch is canceled by an event input (event input assignment 1 and 2 = LAT: Alarm Latch Cancel).

Note: The Alarm output is also turned OFF when switching to the Initial Setting function group, Communications Setting function group, Advanced Setting function group, or Calibration function group.

Table 5.DF

Selections	Default
oN: Enabled, oFF: Disabled	oFF

Related Parameter

- HS Alarm Use (Advanced Setting function group, page 5-88)
- Event Input Assignment 1 and 2 (Initial Setting function group, page 5-66)
- HB ON/OFF, PF Settings (Advanced Setting function group, page 5-74)

HSH Heater Short Alarm (HSA) Hysteresis (900-TC8, 900-TC16)

Conditions of Use: Heater Burnout (HBA) and Heater Short Alarms (HSA) must be supported. Alarm 1 must be assigned. The HSA parameter must be set to ON. The HS Alarm Latch must be set to OFF. Optional controller hardware and/or support hardware (e.g., CTs) must be installed.

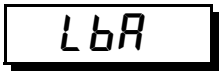
Function: This parameter allows you to configure the hysteresis (allowed deviation from setting) for the operation of the Heater Short Alarm (HSA).

Table 5.DG

Configurable Range	Units	Default
0.1…50.0	A (Amps)	0.1

Related Parameter

- HS Alarm Use (Advanced Setting function group, page 5-88)



Loop Break Alarm (LBA) Detection Time

Conditions of Use: Alarm 1 must be assigned. The Alarm Type must be set to 12 (LBA).

Function: This parameter allows you to enable or disable the LBA function and set the detection time interval. To disable the LBA function, set it to 0.

Table 5.DH

Configuration Range	Units	Default
0…9999	Seconds	0

Note: For more details concerning the LBA Detection Time refer to Section 4, *Loop Break Alarm* on page 4-47.

Related Parameters

- Alarm 1 Type (Initial Setting function group, page 5-59)
- LBA Level (page 5-90), LBA Band (page 5-91) (Advanced Setting function group)

Loop Break Alarm (LBA) Level

Conditions of Use: Alarm 1 must be assigned. The Alarm Type must be set to 12 (LBA). The LBA detection time must NOT be 0.

Function: This parameter allows you to configure the SP and PV process condition for the LBA Level parameter.

- If the deviation between the SP and PV exceeds the LBA Level, a control loop error is detected.

Table 5.DI

Controller Models	Configurable Range	Units	Default
Controllers with Thermocouple and Resistance Thermometer (RTD) Inputs	0.1…999.9	°C or °F ❶	8.0
Controllers with Analog Inputs	0.01…99.99	%FS	10.00

❶ Set NONE as the unit for Controllers with 0… 50 Millivolt Inputs.

Related Parameters

- Process Value/Set Point (Operation function group, page 5-8)
- Alarm 1 Type (Initial Setting function group, page 5-59)
- LBA Detection Time (page 5-90), LBA Band (page 5-91) (Advanced Setting function group)

Loop Break Alarm (LBA) Band

Conditions of Use: Alarm 1 must be assigned. The Alarm Type parameter must be set to 12 (LBA). The LBA Detection Time must NOT be 0.

Function: This parameter allows you to configure the LBA band.

- If a control deviation greater than the LBA Band is not reduced when the LBA Level is exceeded, a control loop error is detected.

Table 5.DJ

Controller Models	Configurable Range	Units	Default
Controllers with Thermocouple and Resistance Thermometer (RTD) Inputs	0.0…999.9	°C or °F ❶	3.0
Controllers with Analog Inputs	0.00…99.99	%FS	0.20

❶ Set NONE as the unit for Controllers with 0… 50 Millivolt Inputs.

Note: For more details concerning the LBA Band, refer to Section 4, *Loop Break Alarm* on page 4-47.

Related Parameters

- Process Value/Set Point (Operation function group, page 5-8)
- Alarm 1 Type (Initial Setting function group, page 5-59)
- LBA Detection Time, LBA Level (Advanced Setting function group, page 5-90)

oUt 1 Control Output 1 Assignment

Conditions of Use: The Transfer Output Type parameter must be set to OFF when the Control Output is an analog current output.

Function: This parameter allows you to configure the output function assigned to Control Output 1.

Table 5.DK

Control Output 1 Function		Default
noNE:	No control output function is assigned	o
o:	Heating control output is output	
C-o:	Cooling control output is output❶	
ALM 1:	Alarm 1 is output❷	
ALM2:	Alarm 2 is output❷	
ALM3:	Alarm 3 is output❷	
P.END:	Program end is output❷❸	
RALM:	Control output ON/OFF count alarm❷	

❶ If C-o (cooling Control Output) is assigned for standard control, a value equivalent to 0% is output.
❷ Can be selected for relay and voltage outputs only
❸ Can be selected only when the program pattern is not set to OFF, but the function is disabled.

Related Parameters

- Standard or Heating/Cooling (page 5-55), Program Pattern (page 5-57), Transfer Output Type (page 5-62) (Initial Setting function group)

oUt2 Control Output 2 Assignment (900-TC8 & 900-TC16)

Conditions of Use: Control Output 2 must be assigned/available. For a list of controllers or option units that provide Control Output 2 functionality refer to Tables 1.B and 1.E.

Function: This parameter sets the function to be assigned to Control Output 2.

Table 5.DL

Control Output 2 Function		Default
NONE:	No function is assigned to control output 2	NONE ❸
o:	Heating control output is output	
C-o:	Cooling control output is output❶	
ALM1:	Alarm 1 is output	
ALM2:	Alarm 2 is output	
ALM3:	Alarm 3 is output	
P.END:	Program end is output❷	
RALM:	Control output ON/OFF count alarm	

❶ If C-o is assigned for standard control, a value equivalent to 0% will be output.
❷ Can be selected only when the program pattern is not set to OFF, but the function is disabled.
❸ If the Standard or Heating/Cooling parameter is set to heating/cooling control, control automatically switches to C-o.

Related Parameters

- Standard or Heating/Cooling (page 5-55), Program Pattern (page 5-57), (Initial Setting function group)

Sub1 Auxiliary Output 1 Assignment

Conditions of Use: Auxiliary Output 1 must be assigned.

Function: This parameter allows you to configure the function assigned to Auxiliary Output 1.

Table 5.DM

Auxiliary Output 1 Function		Default
NONE:	No function is assigned to auxiliary output 1	ALM1 ❸
o:	Heating Control Output is output	
C-o:	Cooling Control Output is output ❶❹	
ALM1:	Alarm 1is output	
ALM2:	Alarm 2 is output	
ALM3:	Alarm 3 is output (900-TC8 only)	
P.END:	Program end is output ❷	
RALM:	Control output ON/OFF count alarm ❸	

❶ If C-o is assigned for standard control, a value equivalent to 0% will be output.
❷ Can be selected only when the program pattern is not set to OFF, but the function is disabled.
❸ If a setting is changed when the Program Pattern parameter is not set to OFF, control automatically switches to P.END.
❹ If the Standard or Heating/Cooling parameter is set to heating/cooling control, this parameter will automatically be set to C-6 (900-TC32).

Related Parameter

- Program Pattern (Initial Setting function group, page 5-57)

SUb2 Auxiliary Output 2 Assignment (900-TC8, 900-TC16)

Conditions of Use: Auxiliary Output 2 must be assigned.

Function: This parameter allows you to configure the function assigned to Auxiliary Output 2.

Table 5.DN

Auxiliary Output 2 Function		Default
NONE:	No function is assigned to auxiliary output 2	ALM2❸ (see note to follow)
o:	Heating Control Output is output	
C-o:	Cooling Control Output is output❶	
ALM1:	Alarm 1is output	
ALM2:	Alarm 2 is output	
ALM3:	Alarm 3 is output	
P.END:	Program end is output❷	
RALM:	Control output ON/OFF count alarm❷	

❶ If C-o is assigned for standard control, a value equivalent to 0% will be output.
❷ Can be selected only when the program pattern is not set to OFF.
❸ If the Standard or Heating/Cooling parameter is set to heating/cooling control when there is no Control Output 2 (900-TC16), control automatically switches to C-o.

Note: If the Standard or Heating/Cooling parameter is set to heating/cooling control, this parameter will automatically be set to c-o (900-TC32).

Related Parameters

- Standard or Heating/Cooling (page 5-55), Program Pattern (page 5-57), (Initial Setting function group)

SUb3

Auxillary Output 3 Assignment

Conditions of Use: Auxiliary Output 3 must be assigned (900-TC8 only).

Function: This parameter allows you to configure the function assigned to Auxiliary Output 3.

Table 5.DO

Auxiliary Output 3 Function		Default
NONE:	No function is assigned to auxiliary output 3	ALM3 ❸
o:	Heating Control Output is output	
C-o:	Cooling Control Output is output❶	
ALM 1:	Alarm 1is output	
ALM2:	Alarm 2 is output	
ALM3:	Alarm 3 is output	
P.END:	Program end is output❷	
RALM:	Control output ON/OFF count alarm❷	

❶ If C-o is assigned for standard control, a value equivalent to 0% will be output.
❷ Can be selected only when the program pattern is not set to OFF, but the function is disabled.
❸ If the Standard or Heating/Cooling parameter is set to heating/cooling control when there is no Control Output 2 (900-TC8), control automatically switches to C-o.

Related Parameters

- Standard or Heating/Cooling (page 5-55), Program Pattern (page 5-57), (Initial Setting function group)

CSEL Character Select LED

Function: This parameter allows you to select the LED display type for your controller. The following two types of displays are available:

- 11-segment display
- 7-segment display

Table 5.DP

Selections	Default
oN: 11-segment display, oFF: 7-segment display	oN

When set to oN, an 11-segment display is used.

t-U Soak Time Units

Conditions of Use: The Program Pattern parameter must NOT be set to OFF.

Function: This parameter allows you to configure the units of time used for the soak time when the simple program function is used.

Table 5.DQ

Selections	Default
M: Minutes, H: Hours	M

Related Parameters

- Program Start, Soak Time Remain (Operation function group, page 5-15)
- Soak Time, Wait Band (Adjustment function group, page 5-40)
- Program Pattern (Initial Setting function group, page 5-57)

AL SP Alarm SP Selection

Conditions of Use: Alarm 1, 2, and 3 functions must be assigned. The SP Ramp Set Value must NOT be set to OFF. The ST parameter must be set to OFF. The Alarm Type parameter must set to 1, 2, 3, 4, 5, 6, or 7.

Function: This parameter allows you to configure whether the set point that triggers a deviation alarm during SP ramp operation is the ramp SP or target SP.

Selections	Default
SP-M: Ramp SP, SP: SP	SP-M

Related Parameters

- SP Ramp Set Value (Adjustment function group, page 5-41)
- ST (Initial Setting function group, page 5-56)

MANL Manual MV Limit Enable

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

Function: This parameter allows you to configure whether the MV Upper Limit and MV Lower Limit parameters are to be enabled when in manual mode.

Table 5.DR

Selections	Default
oN: Enabled, oFF: Disabled	oFF

Related Parameter

- MV upper limit, MV lower limit (Adjustment Level function group, page 5-42)

PVRP PV Rate of Change Calculation Period

Conditions of Use: Alarms 1, 2, and 3 must be assigned. The alarm type must be set to 13.

Function: The change width (rate of change) can be found for PV input values in any set time period. Differences with previous values in each set period are calculated, and an alarm is output if the results exceed the alarm value.

The PV rate of change calculation period can be set in units of 250 ms (sampling period).

Table 5.DS

Configurable Range	Units	Default
1 to 999	Sampling period	4 (1 s)

Related Parameter

- Present value, Process value/set point (Operation function group, page 5-8) Alarm 1 to 3 type (Initial Setting function group, page 5-16)

CSCA Automatic Cooling Coefficient Adjustment

Conditions of Use: The control must be set to heating/cooling control and 2-PID control.

Function: By setting the Automatic Cooling Coefficient Adjustment parameter to ON, autotuning can be executed during heating/cooling control to automatically calculate the cooling coefficient at the same time as the PID parameters. If there is strong non-linear gain for the cooling characteristics, such as when cooling water boils for cooling control, it may not be possible to obtain the optimum cooling coefficient at the Controller, and control may take the form of oscillating waves. If that occurs, increase the proportional band or the cooling coefficient to improve control.

Table 5.DT

Selections	Default
oN: Enabled, oFF: Disabled	oFF

Related Parameter

- Cooling coefficient (Adjustment function group, page 5-36)

oCU Heater Overcurrent Use (900-TC8, 900-TC16)

Conditions of Use: Heater burnout, HS alarms, and heater overcurrent detection must be supported. Alarm 1 must be assigned.

Function: Configure this parameter to use the heater overcurrent alarm.

The PV rate of change calculation period can be set in units of 250 ms (sampling period).

Table 5.DU

Selections	Default
oN: Enabled, oFF: Disabled	oN

oCL Heater Overcurrent Latch (900-TC8, 900-TC16)

Conditions of Use: Heater burnout, HS alarms, and heater overcurrent detection must be supported (two CTs). Alarm 1 must be assigned.

Function: When you configure this parameter to ON, the HS alarm is held until any of the following conditions is satisfied:

- Heater overcurrent detection is set to 50.0 A.
- The controller power is cycled.
- The latch is cancelled by the PF Key. (900-TC8) PF Setting = LAT: Alarm Latch Cancel
- The latch is cancelled by an event input. (Event Input Assignment 1 and 2 = LAT: Alarm Latch Cancel)

Note: The output is turned OFF when switching to the Initial Setting function group, Communications function group, Advanced Setting function group, or calibration function group.

Table 5.DV

Selections	Default
oN: Enabled, oFF: Disabled	oFF

Related Parameters

- Heater overcurrent detection 1, Heater overcurrent detection 2 (Adjustment function group, page 5-26)
- Heater overcurrent use (Advanced Setting function group, page 5-99) Heater overcurrent hysteresis (Advanced Setting function group, page 5-100)
- Event input assignment 1 and 2 (Initial Setting function group, page 5-66)
- HB ON/OFF: page 5-74, PF setting (Advanced Setting function group, page 5-101)

Heater Overcurrent Hysteresis (900-TC8, 900-TC16)

Conditions of Use: Heater burnout, HS alarms, and heater overcurrent detection must be supported, and alarm 1 must be assigned. The Heater Overcurrent Use parameter must be set to ON, and the Heater Overcurrent Latch parameter must be set to OFF.

Function: This parameter allows you to configure the hysteresis (allowed deviation from setting) for heater overcurrent detection.

Table 5.DW

Configurable Range	Units	Default
0.1 to 50.0	A	0.1

Related Parameters

- Heater overcurrent use (Advanced Setting function group, page 5-99)

PF Setting

Conditions of Use: The PF Key must be supported (900-TC8)

Function: This parameter allows you to configure which function the PF Key will have.

Table 5.DX

Set Value	Setting	Function
OFF: oFF	Disabled	Does not operate as a function key
RUN: RUN	RUN	Specifies RUN status.
STOP: StoP	STOP	Specifies STOP status.
R-S: r-S	Reversing RUN/STOP operation	Specifies Reversing RUN/STOP operation status.
AT-2: At-2	100% AT Execute/Cancel	Specifies reversing 100% AT Execute/Cancel status ❶
AT-1: At-1	40% AT Execute/Cancel	Specifies reversing 40% AT Execute/Cancel status ❶
LAT: LAt	Alarm Latch Cancel	Specifies canceling alarm latches ❷
A-M: A-M	Auto/Manual	Specifies reversing Auto/Manual status ❸
PFDP: PFdP	Monitor/Setting Item	Specifies the monitor/setting item display. Select the monitor/setting item using the Monitor/Setting Item 1 to 5 parameters (Advanced Setting function group).

❶ When AT cancel is specified, it means that AT is cancelled regardless of whether the AT currently being executed is 100% AT or 40% AT.
❷ Alarms 1 to 3, heater burnout, HS alarms, and heater overcurrent latches are cancelled.
❸ For details on auto/manual operations using the PF Key, refer to Performing Manual Control

Related Parameters

- Monitor/setting item 1 to 5 (Advanced Setting function group, page 5-102)

PFd* Monitor/ Setting Item * (*: 1 to 5)

Conditions of Use: The PF Setting parameter must be configured to PFDP.

Function: When you configure the PF Key parameter to Monitor/Setting Item it enables using the function key to display monitor/setting items. The items that will be displayed are configured using the Monitor/Setting Item 1 to 5 parameters. The settings are listed in the following table.

Table 5.DY

Set Value	Parameter	Remarks Monitor/Setting	Symbol
0	Disabled		---
1	PV/SP/Multi-SP	Can be set. (SP)	---
2	PV/SP/MV	Can be set. (SP)	---
3	PV/SP/Soak time remain	Can be set. (SP)	---
4	Proportional band (P)	Can be set.	P
5	Integral time (I)	Can be set.	I
6	Derivative time (D)	Can be set.	d
7	Alarm value 1	Can be set.	AL-1
8	Alarm value upper limit 1	Can be set.	AL 1H
9	Alarm value lower limit 1	Can be set.	AL 1L
10	Alarm value 2	Can be set.	AL-2
11	Alarm value upper limit 2	Can be set.	AL2H
12	Alarm value upper limit 2	Can be set.	AL2L
13	Alarm value lower limit 2	Can be set.	AL-3
14	Alarm value 3	Can be set.	AL3H
15	Alarm value upper limit 3	Can be set.	AL3L

Note: The MV for heating and cooling control is set in the MV Display Selection parameter.

Related Parameter

- PF Setting (page 5-101), MV Display Selection (page 5-103) (Advanced Setting function group)

SPdP PV/SP Display Screen Selection

Conditions of Use: The No. 3 display must be supported (900-TC8)

Function: This parameter allows you to configure what will be displayed on the PV/SP Screen No. display and the order of the display. The default is 4.

Note: A 2- level display is set at the time of shipping from the factory (set value = 0). A 3- level display is activated if parameters are initialized (set value =4).

Table 5.DZ

Set Value	Display Contents
0	Only PV/SP is displayed (with no No. 3 display).
1	PV/SP/Multi-SP and PV/SP/MV are displayed in order ❶
2	PV/SP/MV and PV/SP/Multi-SP are displayed in order ❶
3	Only PV/SP/Multi-SP is displayed.
4	PV/SP/MV is displayed ❶
5	PV/SP/Multi-SP and PV/SP/Soak time remain are displayed in order ❶
6	PV/SP/MV and PV/SP/Soak time remain are displayed in order ❶
7	Only PV/SP/Soak time remain is displayed.

❶ The MV for heating and cooling control is configured in the MV Display Selection parameter.

Related Parameter

- Process Value Set Point (Operation function group, page 5-8)
- MV Display Selection (Advanced Setting function group, page 5-103)

odSL MV Display Selection

Conditions of Use: The No. 3 display must be supported(900-TC-8). Heating and cooling control must be used. The PV/SP Display Screen Selection parameter must be set to 1, 2, 4, or 6, or the Monitor/Setting Item 1 to 5 parameter must be set to 2.

Function: This parameter allows you to select the MV display for PV/SP/MV during heating and cooling control. Either heating MV or cooling MV can be selected.

Table 5.EA

Selections	Default
o: MV (heating) C-o: MV (cooling)	o

PVdP PV Decimal Point Display

Conditions of Use: The input type must be set to temperature input.

Function: The display below the decimal point in the PV can be hidden for temperature inputs. The PV decimals below the decimal point can be hidden by setting the PV Decimal Point Display parameter to OFF. When this parameter is set to ON, the display below the decimal point will appear according to the input type setting.

Table 5.EB

Selections	Default
oN:ON, oFF: OFF	ON

Related Parameter

- Input Type (Initial Setting function group, page 5-50)

PVST PV Status Display Function

Function: The PV in the No. 1 display for the PV/SP, PV, or PV/Manual MV Screen is alternately displayed in 0.5-second cycles with the control and alarm status specified for the PV status display function.

Table 5.EC

Selections	Default
oFF: No PV status display	oFF
MANU: MANU is alternately displayed during manual control.	
StoP: STOP is alternately displayed while operation is stopped.	
ALM 1: ALM1 is alternately displayed during Alarm 1 status.	
ALM2: ALM2 is alternately displayed during Alarm 2 status.	
ALM3: ALM3 is alternately displayed during Alarm 3 status.	
ALM: ALM is alternately displayed when Alarm 1, 2, or 3 is set to ON.	
HA: HA is alternately displayed when a heater burnout alarm, HS alarm, or heater overcurrent alarm is ON.	

Related Parameter

- Process value/set point, PV (Operation function group, page 5-8)
- PV/MV (manual MV) (Manual Control function group, page 5-47)

SV Status Display Function

Function: The SP, Blank, or Manual MV in the No. 2 display for the PV/SP, PV, or PV/Manual MV Screen is alternately displayed in 0.5-second cycles with the control and alarm status specified for the SV status display function.

Table 5.ED

Selections	Default
oFF: No SV status display	oFF
MANU: MANU is alternately displayed during manual control.	
StoP: STOP is alternately displayed while operation is stopped.	
ALM1: ALM1 is alternately displayed during Alarm 1 status.	
ALM2: ALM2 is alternately displayed during Alarm 2 status.	
ALM3: ALM3 is alternately displayed during Alarm 3 status.	
ALM: ALM is alternately displayed when Alarm 1, 2, or 3 is set to ON.	
HA: HA is alternately displayed when a heater burnout alarm, HS alarm, or heater overcurrent alarm is ON.	

Related Parameter

- Process value/set point, PV (Operation function group, page 5-8)
- PV/MV (manual MV) (Manual Control function group, page 5-47)

Display Refresh Period

Function: This parameter delays the display refresh period for monitor values. Only display refreshing is delayed, and the refresh period for process values used in control is not changed. This function is disabled by setting the parameter to OFF.

Table 5.EE

Selections	Units	Default
OFF, 0.25, 0.5, 1.0	Second	0.25

RA 1M

Control Output 1 ON/OFF Count Monitor

Conditions of Use: Control output 1 must be supported. Relay or voltage outputs (for driving SSR) must be used. The Control Output 1 ON/OFF Count Alarm Set Value parameter must NOT be set to 0.

Function: This parameter monitors the number of times that control output 1 is turned ON and OFF. This function is not displayed when the set value is 0, or when the control output is a linear (analog) output.

Table 5.EF

Monitor Range	Units
0 to 9999	100 times

RA2M

Control Output 2 ON/OFF Count Monitor (900-TC8 & 900-TC16)

Conditions of Use: Control output 2 must be supported. Relay or voltage outputs (for driving SSR) must be used. The Control Output 2 ON/OFF Count Alarm Set Value parameter must NOT be set to 0.

Function: This parameter monitors the number of times that control output 2 is turned ON and OFF. This function is not displayed when the set value is 0, or when the control output is a linear (analog) output

Table 5.EG

Monitor Range	Units
0 to 9999	100 times

RA 1

Control Output 1 ON/OFF Count Alarm Set Value (900-TC8, 900-TC16)

Conditions of Use: Control output 1 must be supported. Relay or voltage outputs (for driving SSR) must be used.

Function: An ON/OFF count alarm occurs when the ON/OFF counter exceeds the value set for this parameter. It is possible to assign ON/OFF

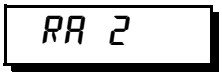
count alarms to auxiliary outputs and to have them displayed on the screen. This function is disabled when the set value is 0.

Table 5.EH

Configurable Range	Units	Default
0 to 9999	100 times	0

Related Parameter

- Control output 1 ON/OFF count monitor (Advanced Setting function group, page 5-107)



Control Output 2 ON/OFF Count Alarm Set Value (900-TC8, 900-TC16)

Conditions of Use: Control output 2 must be supported. Relay or voltage outputs (for driving SSR) must be used.

Function: An ON/OFF count alarm occurs when the ON/OFF counter exceeds the value set for this parameter. It is possible to assign ON/OFF count alarms to auxiliary outputs and to have them displayed on the screen. This function is disabled when the set value is 0.

Table 5.EI

Configurable Range	Units	Default
0 to 9999	100 times	0

Related Parameter

- Control output 2 ON/OFF count monitor (Advanced Setting function group, page 5-107)

ON/OFF Counter Reset

Conditions of Use: Control outputs 1 and 2 must be supported. Relay or voltage outputs (for driving SSR) must used.

Function: This parameter resets the ON/OFF counter for specified control outputs.

Table 5.EJ

Selections	Default
0: Disable the counter reset function	0
1: Reset the control output 1 ON/OFF counter	
2: Reset the control output 2 ON/OFF counter	

Note: After the counter has been reset, the count value will be automatically returned to 0.

Related Parameter

- Control output 1 ON/OFF count monitor, Control output 2 ON/OFF monitor (Advanced Setting function group, page 5-107)

Move to Calibration Group

Conditions of Use: Initial Setting/Communications Protect parameter must be set to 0.

Function: This parameter allows you to configure the Password to Move to the Calibration function group.

- Set the Password to Move to the Calibration function group. The password is **1201**.
- Move to the Calibration function group either by pressing the ↵ key or the ○ key or by waiting for 2 seconds to elapse.

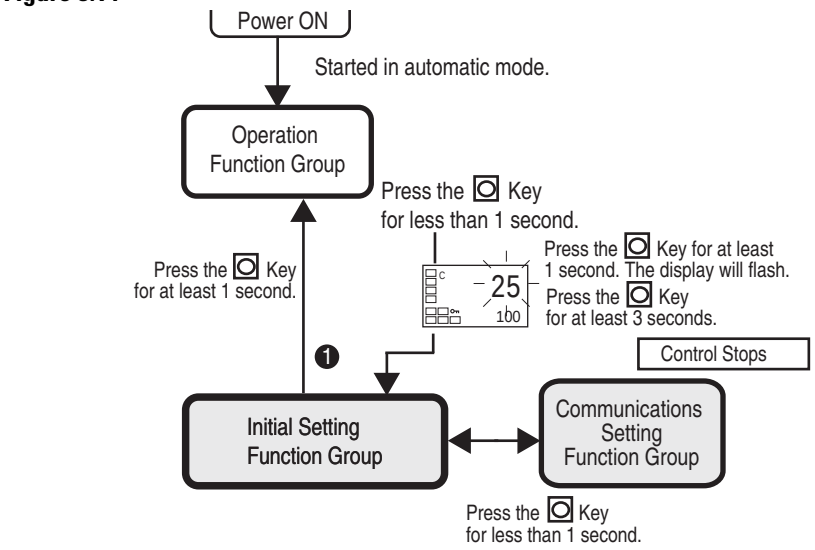
Related Parameter

- Initial Setting/Communications Protect (Protect function group, page 5-4)

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 controller configuration or monitoring software. The controller hardware must support communications through a RS232 option module (900-TC8) or RS485 option module (900-TC8, 900-TC16, and 900-TC32).

Figure 5.14



Protocol Setting

Communications Unit No.

Communications Baud Rate

Communications Data Length

Communications Stop Bits

Communications Parity

Send Data Wait Time

Conditions of Use: The 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 appropriate configuration or communication 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 controller power is reset.

Table 5.EK

Parameter	Symbol	Selection or Configurable Values	Settings	Default
Protocol Setting	PSEL	cwf, mod	900-TC or Modbus	CWF
Communications Unit No.	U-No	0…99	0…99	1
Communications Baud Rate	bPS	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, or 57.6 (kbit/s)	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, or 57.6 (kbit/s)	9.6
Communications Data Length	LEN	7, 8 (bit)	7, 8 (bit)	7
Stop Bits	Sbit	1, 2	1, 2	2
Communications Parity	PRTY	None, Even, Odd	None, Even, Odd	EVEN
Send Data Wait Time	SdWt	0…99	0…99 (ms)	20

Related Parameters

- Communications Writing (Adjustment function group, page 5-26)

Notes:

Troubleshooting & Error Indication

Error Displays

When an error occurs, the error contents are shown on the controller's No. 1 or No. 2 display.

This section describes how to check error codes on the display, and the actions to be taken to remedy the problems.

5.ERR Input Error

Meaning

The input value has exceeded the control range (refer to Note).

Note: Control Range
Resistance thermometer (RTD), 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)
- Analog input: –5% to +105% of scaling range

Action

Check the wiring of inputs for incorrect wiring polarity for improper or incorrect connections, and short-circuits and check the Input Type.

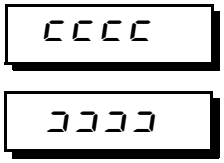
If no abnormality is found in the wiring and Input Type, turn the controller power OFF then back ON again.

If the display remains the same, the Controller must be replaced. If the display is restored, then the probable cause is electrical noise affecting the control system. Check for electrical noise. Reroute sensor wires away from high sources of electrical noise. Use shielded sensor wire and ground the shield at one end.

Note: With an RTD type input a break in the A, B, or B^1 line is regarded by the controller as a disconnection.

Operation at Error

- After an error occurs, the error is displayed and the alarm output functions as if the Upper-Limit has been exceeded.
- If you configure the Input Error Output parameter in the Advanced Setting function group to ON, the Alarm 1 output turns ON whenever an input error occurs.
- An error message is displayed when the PV, PV/SP, or PV/MV is displayed.
- The control output turns OFF when the manual MV, MV at stop, or MV at PV error is configured, the control output corresponds to the configured value.



Display Range Exceeded

Meaning

This is not an error, but rather, it is displayed if the process value (sensor input) exceeds the display range when the control range is larger than the display range.

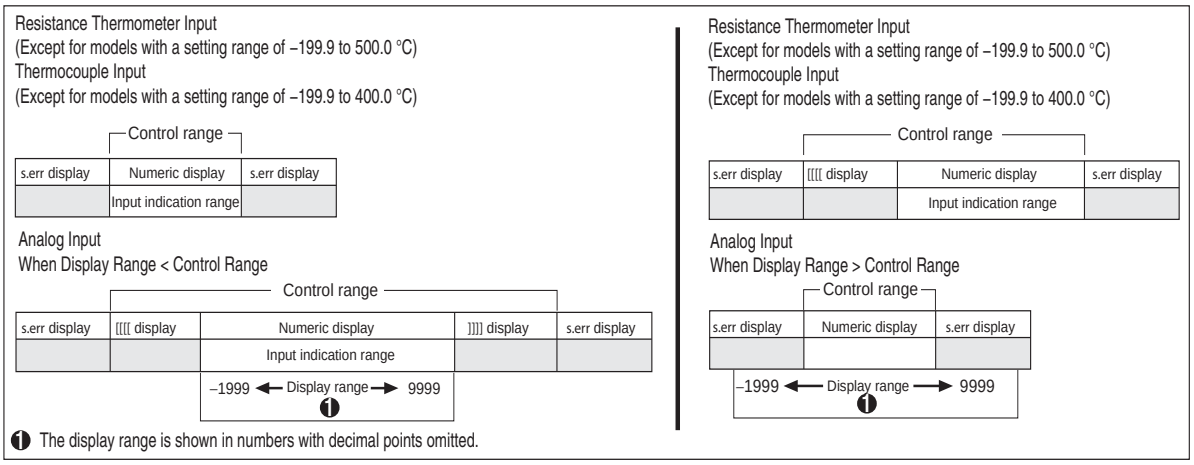
The display ranges are shown below (with decimal points omitted).

- When less than –1,999 cccc
- When more than 9,999 3333

Action

Control continues, allowing normal operation. The message is displayed when the PV, PV/SP, or PV/MV is displayed.

Figure 6.1



AD Converter Error

Meaning

There is an error in internal circuits.

Action

First, turn the controller power OFF then back ON again. If the display remains the same, the Controller must be repaired. If the display is restored, then the probable cause is electrical noise affecting the control system. Check for electrical noise.

Operation

- The control outputs and alarm outputs turn OFF.

Memory Error

Meaning

The controller's internal memory operation is in error.

Action

First, turn the controller power OFF then back ON again. If the display remains the same, the Controller must be repaired. If the display is restored, then the probable cause is electrical noise affecting the control system. Check for electrical noise. (Refer to *Actions* under the *Input Error* section on page 6-1.)

Operation at Error

Control Output and Alarm Output turn OFF. (Current output is approx. 0 mA).

Current Value Exceeds

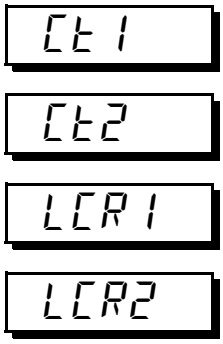
Meaning

This error is displayed when the Heater Current value (current from CT) exceeds 55.0 A.

Action

Control continues, allowing normal operation. The error message is displayed when the following items are displayed:

- Heater Current 1 value monitor
- Heater Current 2 value monitor
- Leakage Current 1 monitor
- Leakage Current 2 monitor



Heater Burnout Alarm (HBA)

Heater Short Alarm (HSA)

Heater Overcurrent

Meaning

When a Heater Burnout (HBA), a Heater Short Alarm (HSA) or Heater Overcurrent occurs, the No. 1 display in the applicable function group flashes.

Action

When either HBA, HSA, or Heater Overcurrent is detected, the HA indicator lights and the No. 1 display flashes for the applicable Heater Current 1 Value Monitor, Heater Current 2 Value Monitor, Leakage Current 1 Monitor, or Leakage Current 1 Monitor parameters in the Operation function group and Adjustment function group. Control continues, allowing normal operation if possible.

Troubleshooting

Checking Problems

If the Temperature Controller is not operating normally, check the following points before requesting repairs. If the problem persists, contact your Rockwell Automation representative for details on returning the product.

Table 6.A

Timing	Status	Meaning	Countermeasures	Page
Turning ON the power for the first time	Temperature unit (°C/°F) is flashing.	ST (Self-Tuning) is in progress (default setting: ON).	This is not a product fault. The temperature unit (°C/°F) flashes while ST (Self-Tuning) is being performed	3-33
	Temperature error is large. Input error (S.Err display)	Input Type mismatch	Check the sensor type and reset the Input Type correctly.	3-12
		Thermometer is not installed properly.	Check the thermometer installation location and polarity and install correctly.	2-17
	Communications are not possible.	Non-recommended adapter is being used.	Make sure that the connected device is not faulty.	Section 1 of *Communications User's Manual*

Timing	Status	Meaning	Countermeasures	Page
During operation	Overshooting Undershooting Hunting	ON/OFF control is enabled (default: ON/OFF control selected).	Select PID control and execute either ST (self-tuning) or AT (Auto-Tuning). When using self-tuning, turn ON the power supply to the Temperature Controller and load (heater, etc.) at the same time, or turn ON the load power supply first. Accurate self-tuning and optimum control will not be possible if the power supply to the load is turned ON after turning ON the power supply to the Temperature Controller.	3-30
		Control cycle is longer compared with the speed of rise and fall in temperature	Shorten the control cycle. A shorter control cycle improves control performance, but a cycle of 20 ms minimum is recommended in consideration of the service life of the relays.	3-17
		Unsuitable PID constant	Set appropriate PID constants using either of the following methods. Execute AT (autotuning). Set PID constants individually using manual settings.	3-30
		HS alarm operation fault	Use breeder resistance if the problem is due to leakage current. Also investigate the errors detected by the HS alarm function.	3-46
	Temperature is not rising	Specified operation is unsuitable for required control (default: Reverse operation)	Select either forward or reverse operation depending on the required control. Reverse operation is used for heating operations.	3-17
		Heater is burnt out or deteriorated.	Check whether heater burnout or deterioration have occurred. Also investigate the errors detected by the Heater Burnout Alarm.	3-46
		Insufficient heater capacity	Check whether the heater's heating capacity is sufficient.	—
		Cooling system in operation.	Check whether a cooling system is operating.	—
		Peripheral devices have heat prevention device operating.	Set the heating prevention temperature setting to a value higher than the configured temperature of the Temperature Controller.	—
	Output will not turn ON	Set to STOP (default: RUN)	Set the RUN/STOP mode to RUN. If STOP is lit on the display, control is stopped.	5-16
		Specified operation is unsuitable for required control (default: Reverse operation)	Select either forward or reverse operation depending on the required control. Reverse operation is used for heating operations.	3-17
		A high hysteresis is configured for ON/OFF operation (default: 1.0°C)	Set a suitable value for the hysteresis.	3-16
	Temperature Controller will not operate	Set to STOP (default: RUN)	Set the RUN/STOP mode to RUN. If STOP is lit on the display, control is stopped.	5-16

Timing	Status	Meaning	Countermeasures	Page
During operation (Continued)	Temperature error is large Input error (S.err display)	Thermometer has burnt out or short-circuited.	Check whether the thermometer has burnt out or short-circuited	—
		Thermometer lead wires and power lines are in the same conduit, causing noise from the power lines (generally, display values will be unstable).	Wire the lead wires and power lines in separate conduits, or wiring using a more direct path.	—
		Connection between the Temperature Controller and thermocouple is using copper wires.	Connect the thermocouple's lead wires directly, or connect a compensating conductor suitable for the thermocouple.	—
		Installation location of thermometer is unsuitable.	Check whether the location of the thermometer is suitable.	—
		Input shift is not configured correctly (default: 0°C)	Set a suitable input shift. If input shift is not required, configured the input shift value to 3.	4-1
	Keys will not operate	Setting change protect is ON.	Turn OFF setting change protect.	4-33
	Cannot shift levels	Operations limited due to protection.	Set the operation/adjustment protect, initial setting/communications protect, and setting change protect values as required.	4-33
After long service life	Control is unstable	Terminal screws may be loose.	Retighten terminal screws to the torque recommended in Section 2 for your controller.	2-17
		The internal components have reached the end of their service life.	The Temperature Controller's internal electrolytic capacitor depends on the ambient temperature, and load rate. The structural life depends on the ambient environment (shock, vibration). 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 welded or burned. Replace the Temperature Controller and all other Temperature Controllers purchased in the same time period.	—

Symptom: Cannot Communicate or a Communications Error Occurs

Table 6.B

Meaning	Countermeasures
The communications wiring is not correct	Correct the Wiring
The communications line has become disconnected	Connect the communications line securely and tighten the screws.
The communications cable is broken.	Replace the cable.
The communications cable is too long.	The total cable length is 500 m maximum for RS-485 and 15 m maximum for RS-232C communications.
The wrong communications cable has been used.	Use a shielded, AWG24 to AWG14 (cross-sectional area of 0.205 to 2.081 mm2) twisted-pair cable for the 900-TC8 or 900-TC16. Use a shielded, AWG24 to AWG18 (cross-sectional area of 0.205 to 0.823 mm2) twisted-pair cable for the 900-TC32.
More than the specified number os communications devices are connected to the same communications path for RS-485 communications	When 1: N RS-485 communications are used, a maximum of 32 nodes (including the host node) can be connected.
An end node has not been configured at each end of the communications line for RS-485 communications.	Set or connect terminating resistance at each end of the line. If the 900-TC8, 900-TC16, or 900-TC32 is the end node, use 120-Ω (1/2-W) terminating resistance. The combined terminating resistance with the host device must be at least 54 Ω.
The specified power supply voltage is not being supplied to the Controller.	Supply the specified power supply voltage.
The specified power supply voltage is not being supplied to an Interface Converter (such as the 900-CONVxx).	Supply the specified power supply voltage.
The same baud rate and communications method are not being used by all of the Controllers, host devices, and other devices on the same communications line.	Set the same values for the baud rate, protocol, data length, stop bits, and parity on all nodes.
The unit number specified in the command frame is different from the unit number configured by the Controller.	Use the correct unit number.
The same unit number as the Controller is being used for another node on the same communications line for RS-485 communications	Set each unit number for a unique node number.
There is a mistake in programming the host device.	Use a line monitor to check the commands. Check operation using a sample program.
The host device is detecting the absence of a response as an error before it receives the response from the Controller.	Shorten the send data wait time in the Controller or increase the response wait time in the host device.
The host device is detecting the absence of a response as an error after broadcasting a command.	The Controller does not return responses for broadcast commands.

Table 6.B

Meaning	Countermeasures
The host device sent another command before receiving a response from the Controller.	The response must always be read after sending a command (except for broadcast commands).
The host device sent the next command too soon after receiving a response from the Controller.	After receiving a response, wait at least 2 ms before sending the next command.
The communications line became unstable when Controller power was turned ON or interrupted, and the host device read the unstable status as data.	Initialize the reception buffer in the host device before sending the first command and after turning OFF the power to the Controller.
The communications data was corrupted from noise from the environment.	Try using a slower baud rate. Separate the communications cable from the source of noise. Use a shielded, twisted-pair cable for the communications cable. Use as short a communications cable as possible, and do not lay or loop extra cable. To prevent inductive noise, do not run the communications cable parallel to a power line. If noise countermeasures are difficult to implement, use an Optical Interface.

Notes:

Specifications

For the setting ranges for each sensor input, refer to page A-9.

Table A.A

Technical/Control				
Supply Voltage		100…240V AC, 50/60 Hz		24V AC, 50/60 Hz/24V DC
Operating Voltage Range		85 to 110% of rated supply voltage		
Power Consumption	900-TC16	7.5 VA		5 VA/3 W
	900-TC8	10 VA		5.5 VA/4 W
	900-TC32	5.5 VA		3 VA/2W
Recommended line fuse		Type: T2A, 250V AC, time lag, low shut-off capacity ❶		
Sensor Input ❶ ↓ Sensor Input ❷		Temperature Input Type Thermocouple: K, J, T, E, L, U, N, R, S, B, W, PL II Platinum resistance thermometer: Pt100, JPt100 Infrared temperature sensor: 10…70°C, 60…120°C, 115…165°C, 140…260°C Millivolt input: 0 to 50 mV		
		Supported by 900-TC8 & 900-TC16: Controllers with Analog Inputs Current input: 4…20 mA, 0…20 mA (Input impedance: 150 Ω max.) Voltage input: 1…5V, 0…5V, 0…10V (Input impedance: 1 MΩ max.)		
Control Output ↓		Relay Output	900-TC16	Relay output: SPST-NO, 250V AC, 3 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA Triac (AC) output SPST-NO, 250V AC, 3 A (resistive load), electrical durability: 1,000,000 operations Load power supply voltage: 75…250V AC ❸ Leakage current: 5 mA max. (250V AC, 60 Hz)
			900-TC8	Relay output: SPST-NO, 250V AC, 5 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA Triac (AC) output: SPST-NO, 250V AC, 3 A (resistive load), electrical durability: 1,000,000 operations Load power supply voltage: 75…250V AC❸ Leakage current: 5 mA max. (250V AC, 60 Hz)
			900-TC32	Relay output: SPST-NO, 250V AC, 2 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA

❶ Available from Little Fuse or Bussmann (part no. GDC-2A).

❷ For the setting ranges for each sensor input, refer to page A-9.

❸ Always connect an AC load to a Triac output. The output will not turn OFF if a DC load is connected.

Table A.A (Continued)

Technical/Control (Continued)				
Control Output (Continued)		Voltage Output	900-TC16	Output voltage 12V DC ±15% (PNP), max. load current 21 mA, with over-current protection circuit
			900-TC8	**Series B:** Output voltage 12V DC +15%/–20% (PNP), max. load current 40 mA, with over-current protection circuit **Series B:** Voltage Control Output 2: 12V DC +15%/–20% (PNP), max. load current 21 mA, with over-current protection circuit
			900-TC32	Output voltage 12V DC ±15% (PNP), max. load current 21 mA, withover-current protection circuit
		Analog Current Output	4…20 mA DC, 0…20 mA DC, Load: 600 Ω max., Resolution: approx. 10,000 (900-TC16 and 900-TC8)	
Auxiliary Output	900-TC16	SPST-NO, 250V AC, 3 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA		
	900-TC8	SPST-NO, 250V AC, 3 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA		
	900-TC32	SPST-NO, 250V AC, 2 A (resistive load), electrical durability: 100,000 operations Min. applicable load: 5V, 10 mA		
Event Input ❶ Supported by 900-TC8 & 900-TC16	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 or ON/OFF control		
Configuration Method		Digital setting using front panel keys, or 900 BuilderLite software		
Hysteresis		Controllers with Thermocouple/Resistance Thermometer (Global) Temperature		0.1…999.9°C or °F) (in units of 0.1°C or °F) ❷
		Controllers with Analog Inputs		0.01% to 99.99% FS (in units of 0.01% FS)
Proportional Band (P)		Controllers with Thermocouple/Resistance Thermometer (Global) Temperature		0.1…999.9°C or °F) (in units of 0.1 EU) ❷
		Controllers with Analog Inputs		0.1% to 999.9% FS (in units of 0.1% FS) 0.01% to 99.99% FS (in units of 0.01% FS)
Integral Time (I)		0…3,999 s (in units of 1 s)		
Derivative Time (D)		0…3,999 s (in units of 1 s) When RT is ON: 0.0…999.9 (in units of 0.1 s)		
Control Period		0.5, 1…99 s (in units of 1 s)		
Manual Reset Value		0.0%…100.0% (in units of 0.1%)		
Alarm Setting Range		–1,999…9,999 (decimal point position depends on Input Type)		
Sampling Period		250 ms		

❶ Controller sources power to inputs: 5V DC @ 7 mA

❷ Set NONE as the unit for controllers with 0…50 Millivolt Inputs.

Table A.A (Continued)

Technical/Control (Continued)				
Indication Accuracy (ambient temperature of 23°C)		Thermocouple ❶: (±0.3% of indication value or ±1 °C, whichever is greater) ±1 digit max. Platinum resistance thermometer: (±0.2% of indication value or ± 0.8 °C, whichever is greater) ±1 digit max. Analog input: ±0.2% FS ±1 digit max. CT input: ±5% FS ±1 digit max.		
Temperature Variation Influence ❷		Thermocouple (R, S, B, W, PL II) (±1% of PV or ±10°C, whichever is greater) ±1 digit max. Other thermocouples: (±1% of PV or ±4°C, whichever is greater) ±1 digit max.		
Voltage Variation Influence ❷		*K thermocouple at –100°C max: ±10°C max. Platinum resistance thermometer: (±1% of PV or ±2 °C, whichever is greater) ±1 digit max. Analog input: ±1% FS ±1 digit max. ❷		
General/Environmental				
Insulation Rresistance		20 MΩ min. (by 500V DC megger)		
Dielectric Strength		2300V AC 50 or 60 Hz 1 min. (between terminals of different function)		
Vibration	Operating	10…55 Hz, 20 m/s^2 (2 G) for 10 min. each in X, Y, and Z directions		
	Non-operating	10…55 Hz,20 m/s^2 for 2 hrs. each in X, Y, and Z directions		
Shock	Operating	100 m/s^2 (10 G) max., 3 times in each X, Y, Z axes directions.		
	Non-operating	300 m/s^2 (30 G) max., 3 times in each 3 axes, 6 directions.		
Protective Structure	Front panel	IP66		
	Rear case	IP20, terminals: IP00 (VDE 0106)		
Memory Protection		EEPROM (non-volatile memory) (number of writes: 100,000)		
Approximate Weight in grams (includes carton)		Total Unit	Adapter	Terminal Cover
	900-TC8	260	100	1.6 per cover
	900-TC16	150	10	10
	900-TC32	90	10	—
Ambient Temperature		–10…+55 °C (with no condensation or icing)		

❶ The indication of K thermocouples in the –200…1,300°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 not specified.
The indication of R and S thermocouples at a temperature of 200°C or less is ±3°C ±1 digit maximum.

❷ Ambient temperature: –10°C…23°C…55°C
Voltage range: –15…+10% of rated voltage

Table A.A (Continued)

General/Environmental (Continued)		
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)
Recommended Fuse		T2A, 250V AC, time lag, low shut off capacity
EMC	EMI	EN 61326
	Radiated Interference Electromagnetic Field Strength	EN 55011 Group 1, class A
	Noise Terminal Voltage	EN 55011 Group 1, class A
	EMS	EN 61326
	ESD Immunity	EN 61000-4-2
	Electromagnetic Field Immunity	EN 61000-4-3
	Burst Noise Immunity	EN 61000-4-4
	Conducted Disturbance Immunity	EN 61000-4-6
	Surge Immunity	EN 61000-4-5
	Power Frequency Magnetic Field Immunity	EN 61000-4-8
	Voltage Dip/Interrupting Immunity	EN 61000-4-11
Standards & Certifications		UL61010-1, CSA22.2 No. 1010.1; ULus IP66. Conforms to EN61326, EN61010-1

Heater Burnout Alarm (HBA), Heater Short Alarm (HSA), and Heater Overcurrent Alarm

Table A.B

Max. Heater Current	50 Amps AC
Input Current Readout Accuracy	±5% FS ±1 digit max.
HBA Setting Range	0.1…49.9 Amps (0.1 Amp units) 0.0 Amps: Heater Burnout Alarm output turns OFF. 50.0 Amps: Heater Burnout Alarm output turns ON. Min. detection ON time: 100 ms ❶
HSA Setting Range	0.1…49.9 Amps (0.1 Amp units) 0.0 Amps: HS alarm output turns ON. 50.0 Amps: HS alarm output turns OFF. Min. detection OFF time: 100 ms ❷
Heater Overcurrent Alarm Setting Range	0.1…49.9 Amps (0.1 Amp units) 0.0 Amps: Heater overcurrent Alarm turns ON. 50.0 Amps: Heater overcurrent Alarm turns OFF. Min. detection OFF time: 100 ms

❶ When the Control Output 1 ON time is less than 100 ms, heater fault detection and heater current measurement are not performed.

❷ When the Control Output 1 OFF time is less than 100 ms, HS alarm and leakage current measurement are not performed.

900-CPOEM1 USB-Serial Conversion Cable

Specifications

Table A.C

Item	Specifications
Applicable OS	Windows 2000/XP/Vista/to be compatible with Windows 7
Applicable Software	900 BuilderLite
Applicable Models	900-TC8, 900-TC16, & 900-TC32 Controllers (refer to Tables 1.B and 1.D)
USB Interface Rating	Conforms to USB Specification 1.1
DTE Speed	38,400 bps
Connector Specifications	Computer end: USB (type A plug) Temperature Controller end: Serial
Power Supply	Bus power (5V DC supplied from USB host controller)
Current Consumption	70 mA
Ambient Operating Temperature	0…55°C (with no condensation or icing)

Table A.C

Item	Specifications
Ambient Operating Humidity	10%…80%
Storage Temperature	–20…60°C (with no condensation or icing)
Storage Humidity	10%…80%
Altitude	2,000 m max.
Weight	Approx. 100 g

Compatible Operating Environment

A personal computer that includes the following specifications is required.

- USB port
- Windows 2000/XP/Vista and to be compatible with Windows 7

Appearance and Nomenclature

Figure A.1 — Appearance

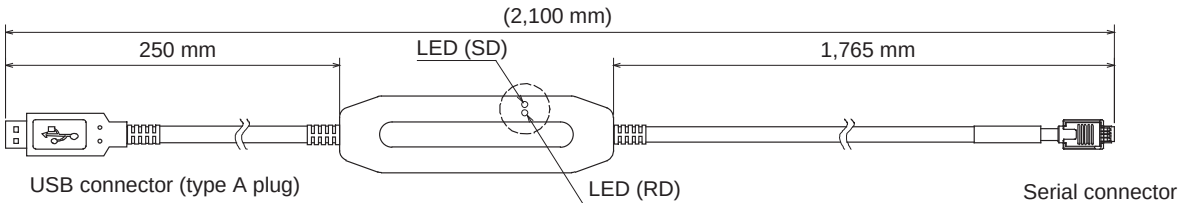


Table A.D — LED Indicator Display

Indicator	Color	Status	Meaning
SD	Yellow	Lit	Sending data from USB-Serial Conversion Cable
		Not lit	Not sending data from USB-Serial Conversion Cable
RD	Yellow	Lit	Sending data from USB-Serial Conversion Cable
		Not lit	Not sending data from USB-Serial Conversion Cable

Current Transformer (CT)

Specifications

Table A.E

Item	Specifications	
Model	900-CT1	900-CT2
Max. Continuous Current	50 A	120 A ❶
Dielectric Strength	1000V AC (1 minute)	
Vibration	50 Hz 98 m/S^2	
Approximate Weight	11.5 g	50 g

❶ The maximum continuous CT detection/display current of the Bulletin 900 controller 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.

Figure A.2 — Cat. No. 900-CT1

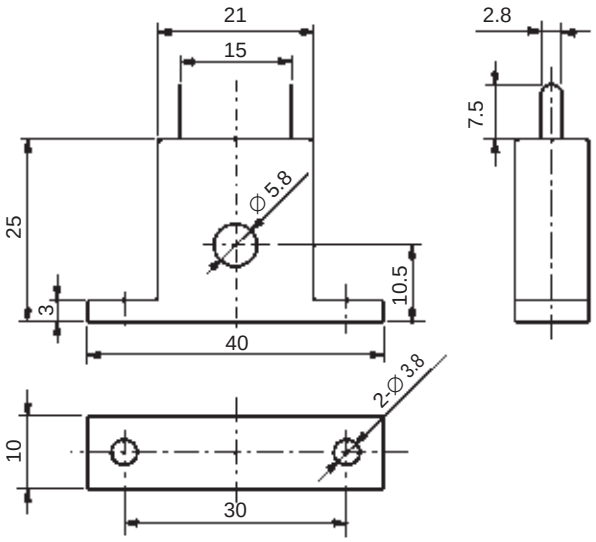
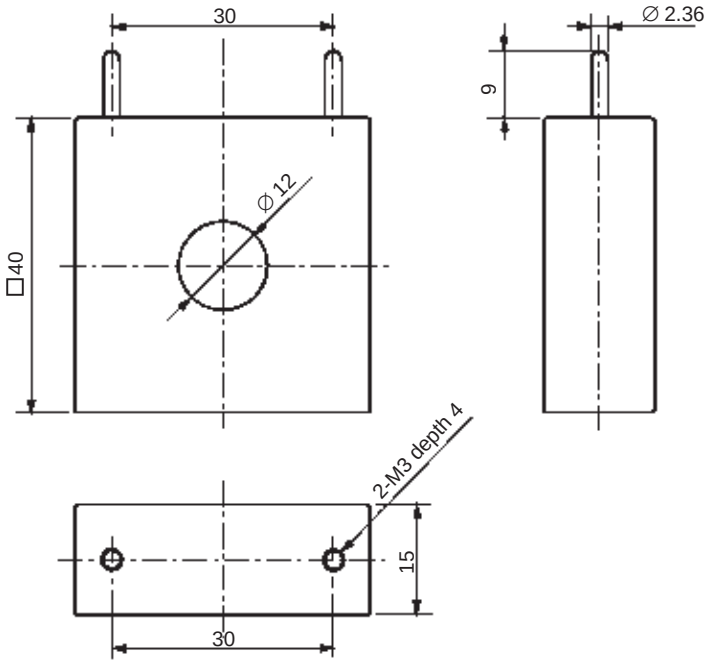


Figure A.3 — Cat. No. 900-CT2



Sensor Input Setting and Indication Ranges

Table A.F — List of Global Temperature (GT) Input Types

	Input Type	Specifications	Set Value	Input Setting Range	Input Indication Range
Controller Type with Thermocouple and Resistance Thermometer Multi-inputs	Resistance Thermometer	Pt100	0	–200…850 (°C)/–300…1,500 (°F)	-220…870 (°C)/-340…1540 (°F)
			1	–199.9…500.0 (°C)/–199.9…900.0 (°F)	-199.9…520 (°C)/-199.9…940 (°F)
			2	0.0…100.0 (°C)/0.0…210.0 (°F)	-20.0…120 (°C)/-40…250 (°F)
		JPt100	3	–199.9…500.0 (°C)/–199.9…900.0 (°F)	-199.9…520 (°C)/-199.9…940 (°F)
			4	0.0…100.0 (°C)/0.0…210.0 (°F)	-20.0…120 (°C)/-40…250 (°F)
	Thermocouple	K	5	–200…1,300 (°C)/–300…2,300 (°F)	-220…1320 (°C)/-340…2340 (°F)
			6	–20.0…500.0 (°C)/0.0…900.0 (°F)	-40…520 (°C)/-40…940 (°F)
		J	7	–100…850 (°C)/–100…1,500 (°F)	-120…870 (°C)/-140…1540 (°F)
			8	–20.0…400.0 (°C)/0.0…750.0 (°F)	-40…420 (°C)/-40…790 (°F)
		T	9	–200…400 (°C)/–300…700 (°F)	-220…420 (°C)/-340…740 (°F)
			10	–199.9…400.0 (°C)/–199.9…700.0 (°F)	-199.9…420 (°C)/-199.9…740 (°F)
		E	11	0…600 (°C)/0…1,100 (°F)	-220…620 (°C)/-340…1140 (°F)
		L	12	–100…850 (°C)/–100…1,500 (°F)	-120…870 (°C)/-140…1540 (°F)
		U	13	–200…400 (°C)/–300…700 (°F)	-220…420 (°C)/-340…740 (°F)
			14	–199.9…400.0 (°C)/–199.9…700.0 (°F)	-199.9...420 (°C)/-199.9…740 (°F)
		N	15	–200…1,300 (°C)/–300…2,300 (°F)	-220…1320 (°C)/-340…2340 (°F)
		R	16	0…1,700 (°C)/0…3,000 (°F)	-20…1720 (°C)/-40…3040 (°F)
		S	17	0…1,700 (°C)/0…3,000 (°F)	-20…1720 (°C)/-40…3040 (°F)
		B	18	100…1,800 (°C)/300…3,200 (°F)	0…1820 (°C)/0…3240 (°F)
	Infrared (non-contact) temperature sensor	10…70°C	19	0…90 (°C)/0…190 (°F)	-20…130 (°C)/-40…270 (°F)
		60…120°C	20	0…120 (°C)/0…240 (°F)	-20…160 (°C)/-40…320 (°F)
		115…165°C	21	0…165 (°C)/0…320 (°F)	-20…205 (°C)/-40…400 (°F)
		140…260°C	22	0…260 (°C)/0…500 (°F)	-20…300 (°C)/-40…580 (°F)
	Millivolt input	0…50 mV	23	Either of the following ranges, by scaling: –1,999…9,999 –199.9…999.9	5%... 105% of setting range. The display shows - 1999 to 9999 (numeric range with decimal point omitted).
	Thermocouple	W	24	0…2300 (°C)/0…3200 (°F)	-20…2320 (°C)/-40…3240 (°F)
		PL-II	25	0…1300 (°C)/0…2300 (°F)	-20…1320 (°C)/-40…2340 (°F)
Controllers with Analog Inputs	Current Input	4...20 mA	0	Any of the following ranges, by scaling: -1,999...9,999 -199.9...999.9 -19.99...99.99 -1.999...9.999	-5%...105% of setting range. The display shows -1999...9999 (numeric range with decimal point omitted).
		0...20 mA	1		
	Voltage Input	1...5 V	2		
		0...5 V	3		
		0...10 V	4		

- The default is 5 (°C/°F) for Controllers with Thermocouple/Resistance Thermometer Universal Inputs and 0 for Controllers with Analog Inputs.
- 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
  - W: W5Re/W26Re, ASTM E988-1990
  - JPt100: JIS C 1604-1989, JIS C 1606-1989
  - Pt100: JIS C 1604-1997, IEC 751
  - PLII: According to Platinel II Electromotive Force Table by Engelhard Corp.

Control Range

- Resistance thermometer and thermocouple input Temperature lower limit -20 °C to temperature upper limit +20 °C, or temperature lower limit -40 °C to temperature upper limit +40 °C
- Infrared input: same as input indication range
- Analog input: -5% to +105% of scaling range

Parameter Operations List

Function Groups

Global Temperature input:Controllers with Thermocouple/Resistance Thermometer (RTD) and Millivolt (0…50) Inputs

Analog input:Controllers with Analog (e.g., 4…20 mA, 1…5V DC, etc.) Inputs

Table B.A — Operation Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Process Value		Temperature: According to indication range for each sensor. Analog: Scaling lower limit -5% FS to Scaling upper limit+5% FS			EU	
Set Point		SP Lower-Limit to SP Upper-Limit		0	EU	
Auto/Manual Switch	A-M					
Multi-SP Set Point Setting	M-SP	0…3		0	None	
Set Point During SP Ramp	SP-M	SP Lower-Limit to SP Upper-Limit			EU	
Heater Current 1 Value Monitor	CT 1	0.0…55.0			A	
Heater Current 2 Value Monitor	CT2	0.0…55.0			A	
Leakage Current 1 Monitor	LCR 1	0.0…55.0			A	
Leakage Current 2 Monitor	LCR2	0.0…55.0			A	
Program Start	PRST	RSET, STRT	RSET STRT	RSET	None	
Soak Time Remain	SKTR	0…9999			min or h	
RUN/STOP	R-S	RUN/STOP	RUN STōP	RUN	None	
Alarm Value 1	AL - 1	–1999…9999		0	EU	
Alarm Value Upper-Limit 1	AL 1H	–1999…9999		0	EU	
Alarm Value Lower-Limit 1	AL 1L	–1999…9999		0	EU	
Alarm Value 2	AL -2	–1999…9999		0	EU	
Alarm Value Upper-Limit 2	AL2H	–1999…9999		0	EU	
Alarm Value Lower-Limit 2	AL2L	–1999…9999		0	EU	
Alarm Value 3	AL -3	–1999…9999		0	EU	
Alarm Value Upper-Limit 3	AL3H	–1999…9999		0	EU	
Alarm Value Lower-Limit 3	AL3L	–1999…9999		0	EU	
MV Monitor (heating)	ō	–5.0…105.5 (standard) 0.0…105.0 (heating/cooling)			%	
MV Monitor (cooling)	C-ō	0.0…105.0			%	

Table B.B — Adjustment Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Adjustment Level Display	L.AdJ					
AT Execute/Cancel	AT	OFF, AT Cancel AT-2: 100% AT Execute AT-1: 40% AT Execute	oFF AT-2 AT-1	OFF	None	
Communications Writing	CMWT	OFF, ON	oFF oN	OFF	None	
Heater Current 1 Value Monitor	CT1	0.0…55.0			A	
Heater Overcurrent Detection 1	oC1	0.0…50.0		50.0	A	
Heater Current 2 Value Monitor	CT2	0.0…55.0			A	
Heater Overcurrent Detection 2	oC2	0.0…50.0		50.0	A	
Leakage Current 1 Monitor	LCR1	0.0…55.0			A	
HS Alarm 1	HS1	0.0…50.0		50.0	A	
Leakage Current 2 Monitor	LCR2	0.0…55.0			A	
HS Alarm 2	HS2	0.0…50.0		50.0	A	
Heater Burnout Detection 1	Hb1	0.0…50.0		0.0	A	
Heater Burnout Detection 2	Hb2	0.0…50.0		0.0	A	
SP 0	SP-0	SP Lower-Limit to SP Upper-Limit		0	EU	
SP 1	SP-1	SP Lower-Limit to SP Upper-Limit		0	EU	
SP 2	SP-2	SP Lower-Limit to SP Upper-Limit		0	EU	
SP 3	SP-3	SP Lower-Limit to SP 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	Universal input: 0.1…999.9		8.0	°C or °F ❶	
		Analog input: 0.1…999.9		10.0	%FS	
Integral Time	I	0…3,999		233	Second	
Derivative Time	d	RT OFF: 0…3,999		40	Second	
		RT ON: 0.0…999.9		40.0	Second	
Cooling Coefficient	C-SC	0.01…99.99		1.00	None	

Table B.B — Adjustment Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Dead Band	C-db	Universal input: –199.9…999.9		0.0	°C or °F ❶	
		Analog input: –19.99…99.99		0.00	%FS	
Manual Reset Value	oF-R	0.0…100.0		50.0	%	
Hysteresis (heating)	HYS	Universal input: 0.1…999.9		1.0	°C or °F ❶	
		Analog input: 0.01…99.99		0.10	%FS	
Hysteresis (cooling)	CHYS	Universal input: 0.1…999.9		1.0	°C or °F ❶	
		Analog input: 0.01…99.99		0.10	%FS	
Soak Time	SoAK	1…9,999		1	min or h	
Wait Band	WE-b	Universal input: OFF, 0.1…999.9	oFF 0.1 to 999.9	OFF	°C or °F ❶	
		Analog input: OFF, 0.01…99.99	oFF 0.01 to 99.99	OFF	%FS	
MV at Stop	MV-S	–5.0…105.0 (standard) –105.0…105.0 (heating/cooling)		0.0	%	
MV at PV Error	MV-E	–5.0…105.0 (standard) –105.0…105.0 (heating/cooling)		0.0	%	
SP Ramp Set Value	SPRE	OFF or 1…9,999	oFF 1 to 9999	OFF	EU/s, EU/min	
MV Upper-Limit	oL-H	MV Lower-Limit +0.1 /105.0 (standard) 0.0…105.0 (heating/cooling)		105.0	%	
MV Lower-Limit	oL-L	–5.0 to MV Upper-Limit –0.1 (standard) –105.0…0.0 (heating/cooling)		–5.0 (standard) –105.0 (heating/cooling)	%	
MV Change Rate Limit	oRL	0.0...100.0 (0.0: MV Change Rate Limit Disabled)		0.0	%/s	
Extraction of Square Root Low-cut Point	SQRP	0.0...100.0		0.0	%	

❶ Set NONE as the unit for controllers with 0…50 Millivolt Inputs.

Table B.C — Initial Setting Function Group

Parameters	Characters	Setting (Monitor) Value		Display	Default	Unit	Set Value
Input Type	IN-t	Global Temperature (GT) Input	0:Pt100 1:Pt100 2:Pt100 3:JPt100 4:JPt100		5	None	
			5: K 6: K 7: J 8: J 9: T 10: T 11: E 12: L 13: U 14: U 15: N 16: R 17: S 18: B 19:10…70 °C 20:60…120 °C 21:115…165 °C 22:140...260 °C 23:0…50 mV 24: W 25: PLII				
		Analog Input	0: 4…20 mA 1: 0…20 mA 2: 1… V 3: 0… V 4: 0…10V		0	None	
Scaling Upper-Limit	IN-H	Scaling Lower-Limit +1…9,999			100	None	
Scaling Lower-Limit	IN-L	–1,999 to scaling Upper-Limit –1			0	None	
Decimal Point	dP	Universal input: 0…1			0	None	
		Analog input: 0…3			0	None	
Temperature Unit	d-U	°C, °F		C F	°C	None	
SP Upper-Limit	SL-H	SP Lower-Limit + 1 / input range Lower-Limit (temperature)			1300	EU	
		SP Lower-Limit + 1 / scaling Upper-Limit (analog)			100		

Table B.C — Initial Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
SP Lower-Limit	SL-L	Input range Lower-Limit to SP Upper-Limit – 1 (temperature)		–200	EU	
		Scaling Lower-Limit to SP Upper-Limit – 1 (analog)		0		
PID ON/OFF	CNTL	ON/OFF 2-PID	oNoF PId	ON/OFF	None	
Standard or Heating/Cooling	S-HC	Standard or heating/cooling	SEnd H-C	Standard	None	
ST	St	OFF, ON	oFF oN	ON	None	
Program Pattern	PtRN	OFF, STOP, CONT	oFF StoP CoNt	OFF	None	
Control Period (Heating)	CP	0.5 or 1…99	0.5 1 to 99	20	Second	
Control Period (Cooling)	C-CP	0.5 or 1…99	0.5 1 to 99	20	Second	
Direct/Reverse Operation	oREv	Reverse operation, direct operation	oR-R oR-d	Reverse operation	None	

Table B.C — Initial Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Alarm 1 Type	AL1	0:Alarm function OFF 1:Upper- and Lower-Limit alarm 2:Upper-limit alarm 3:Lower-limit alarm 4:Upper- and Lower-Limit range alarm 5:Upper- and Lower-Limit alarm with standby sequence 6:Upper-limit alarm with standby sequence 7:Lower-limit alarm with standby sequence 8:Absolute-value Upper-Limit alarm 9:Absolute-value Lower-Limit alarm 10:Absolute-value Upper-Limit alarm with standby sequence 11:Absolute-value Lower-Limit alarm with standby sequence 12:LBA (Loop Burnout Alarm) 13: PV change rate alarm		2	None	
Alarm 1 Hysteresis	AL1H	Universal input: 0.1…999.9		0.2	°C or °F ❷	
		Analog input: 0.01…99.99		0.02	%FS	

Table B.C — Initial Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Alarm 2 Type	AL2	Same settings as the alarm 1 type. NOTE: The 12: LBA (Loop Burnout Alarm) setting cannot be used.		2	None	
Alarm 2 Hysteresis	AL2H	Universal input: 0.1…999.9		0.2	°C or °F ❶	
		Analog input: 0.01…99.99		0.02	%FS	
Alarm 3 Type	AL3	Same settings as the alarm 2 type		2	None	
Alarm 3 Hysteresis	AL3H	Universal input: 0.1…999.9		0.2	°C or °F ❶	
		Analog input: 0.01…99.99		0.02	%FS	
Transfer output type	TR-T	OFF:OFF SP:Set point SP-M:Ramp set point PV:Process value MV:Manipulated variable (heating) C-MV:Manipulated variable (cooling)	OFF SP SP-M PV MV C-MV	OFF	None	
Transfer Output Upper-Limit	TR-H	❷		❷	❷	
Transfer Output Lower-Limit	TR-L	❷		❷	❷	
Linear Current Output	O1-T	4-20: 4…20 mA 0-20: 0…20 mA	4-20 0-20	4-20	None	
Number of Multi-SP Uses	EV-M	0…2		1	None	
Event Input Assignment 1	EV-1	NONE: None STOP: RUN/STOP MANU: Auto/manual switch PRST: Program start ❸ DRS: Invert Direct/Reverse Operation AT-2: 100% AT Execute/Cancel AT-1: 40% AT Execute/Cancel WTPT: Setting Change Enable/Disable LAT: Alarm Latch Cancel	NONE STOP MANU PRST DRS AT-2 AT-1 WTPT LAT	NONE	None	
Event Input Assignment 2	EV-2	NONE: None STOP: RUN/STOP MANU: Auto/manual switch PRST: Program start ❸ DRS: Invert Direct/Reverse Operation AT-2: 100% AT Execute/Cancel AT-1: 40% AT Execute/Cancel WTPT: Setting Change Enable/Disable LAT: Alarm Latch Cancel	NONE STOP MANU PRST DRS AT-2 AT-1 WTPT LAT	STOP	None	

Table B.C — Initial Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Extraction of Square Root Enable	SQR	OFF, ON	oFF on	OFF	None	
Move to Advanced Setting function group	AMov	–1999…9,999		0	None	

❶Set "None" as the unit for analog inputs
❷Initial Setting function group
❸PRST (Program Start) can be configured even when the Program Pattern parameter is configured to OFF, but the function will be disabled.

Table B.D

Transfer Output Type	Setting (Monitor) Range	Default (Transfer Output Upper/Lower-Limits) ❹	Unit
Set Point	SP Lower-Limit to SP Upper-Limit	SP Upper-Limit/Lower-Limit	EU
Set Point During SP Ramp	SP Lower-Limit to SP Upper-Limit	SP Upper-Limit/Lower-Limit	EU
PV	Temperature: Sensor setting range Lower-Limit to sensor setting range Upper-Limit	Input setting range upper/Lower-Limit	EU
	Analog: Scaling Lower-Limit to scaling Upper-Limit	Scaling upper/Lower-Limit	EU
MV Monitor (Heating)	Standard: –5.0…105.0 Heating/cooling: 0.0…105.0	100.0/0.0	%
MV Monitor (Cooling)	0.0…105.0	100.0/0.0	%

❹ Initialized when the transfer output type is changed.
Initialized if the Input Type, temperature unit, scaling upper/Lower-Limit, or SP upper/Lower-Limit is changed when the transfer output type is SP, ramp SP, or PV.
(When initialized by the initializing settings, it is initialized to 100.0/0.0.)

Table B.E — Manual Control Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Manual MV		–5.0…105.0 (standard)❺ –105.0…105.0 (heating/cooling)		0.0	%	

❺ When the Manual MV Limit Enable parameter is configured to ON, the setting range will be the MV lower limit to the MV upper limit

Monitor Setting Item Function Group
The contents displayed vary depending on the Monitor/Setting Value 1 to 5 (Advanced Setting function group).

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Parameter Initialization	INIT	OFF, FACT	oFF FACt	OFF	None	
Multi-SP Use	MSPU	OFF, ON	oFF oN	OFF	None	
SP Ramp Time Unit	SPRU	S: EU/second M: EU/minute	S M	M	None	
Standby Sequence Reset	RESt	Condition A, condition B	A b	Condition A	None	
HB ON/OFF	HbU	OFF, ON	oFF oN	ON	None	
Auxiliary Output 1 Open in Alarm	AL 1N	N-O: Open in alarm N-C: Close in alarm	N-o N-C	N-O	None	
Auxiliary Output 2 Open in Alarm	AL2N	N-O: Open in alarm N-C: Close in alarm	N-o N-C	N-O	None	
Auxiliary Output 3 Open in Alarm	AL3N	N-O: Open in alarm N-C: Close in alarm	N-o N-C	N-O	None	
Heater Burnout Latch	HbL	OFF, ON	oFF oN	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	ALFA	0.00…1.00		0.65	None	
AT Calculated Gain	At-G	0.1...10.0		0.8	None	
AT Hysteresis	At-H	Universal input: 0.1...999.9		0.8	°C or °F ❶	
		Analog input: 0.01...999.9		0.20	%FS	
Limit Cycle MV Amplitude	LCMA	5.0...50.0		20.0	%	
Input Digital Filter	INF	0.0…999.9		0.0	Second	
Additional PV Display	PVAd	OFF, ON	oFF oN	OFF	None	
MV Display	o-dP	OFF, ON	oFF oN	OFF	None	
Automatic Display Return Time	REt	OFF or 1…99	oFF 1 to 99	OFF	Second	
Alarm 1 Latch	A1Lt	OFF, ON	oFF oN	OFF	None	
Alarm 2 Latch	A2Lt	OFF, ON	oFF oN	OFF	None	
Alarm 3 Latch	A3Lt	OFF, ON	oFF oN	OFF	None	
Move to Protect function group Time	PRLt	1…30		3	Second	
Input Error Output	SERo	OFF, ON	oFF oN	OFF	None	

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Cold Junction Compensation Method	CJC	OFF, ON	oFF oN	ON	None	
MB Command Logic Switching	RLRV	OFF, ON	oFF oN	OFF	None	
PV Color Change	COLR	Orange, Red, Green	oRG	RED	None	
		Red to Green: When ALM1 is lit	REd GRN R-G			
		Green to Red: When ALM1 is lit	G-R			
		Red to Green to Red Within PV stable band: Green Outside stable band: Red	R-G.R			
		Green to Orange to Red Within PV stable band: Green Outside stable band: Green, Red	G-o.R			
		Orange to Green to Red Within PV stable band: Green Outside stable band: Green, Red	o-G.R			
PV Stable Band	PV-b	Universal input: 0.1…999.9		5.0	°C or °F ❶	
		Analog input: 0.01…99.99		5.00	%FS	
Alarm 1 ON Delay	A1ON	0…999 (0: ON Delay disabled)		0	Second	
Alarm 2 ON Delay	A2ON	0…999 (0: ON Delay disabled)		0	Second	
Alarm 3 ON Delay	A3ON	0…999 (0: ON Delay disabled)		0	Second	
Alarm 1 OFF Delay	A1OF	0…999 (0: OFF Delay disabled)		0	Second	
Alarm 2 OFF Delay	A2OF	0…999 (0: OFF Delay disabled)		0	Second	
Alarm 3 OFF Delay	A3OF	0…999 (0: OFF Delay disabled)		0	Second	
Input Shift Type	CSTP	INS1: Temperature input 1-point shift	CNS1	INS1	None	
		INS2: Temperature input 2-point shift	CNS2			
MV at Stop and Error Addition	MVST	OFF, ON	oFF oN	OFF	None	
Auto/Manual Select Addition	AMAd	OFF, ON	oFF oN	OFF	None	
RT	RT	OFF, ON	oFF oN	OFF	None	
HS Alarm Use	HSU	OFF, ON	oFF oN	ON	None	
HS Alarm Latch	HSL	OFF, ON	oFF oN	OFF	None	
HS Alarm Hysteresis	HSH	0.1…50.0		0.1	A	

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
LBA Detection Time	LbA	0…9999 (0: LBA function disabled)		0	Second	
LBA Level	LbAL	Universal input: 0.1…999.9		8.0	°C or °F ❶	
		Analog input: 0.01…99.99		10.00	%FS	
LBA Band	LbAb	Universal input: 0.0…999.9		3.0	°C or °F ❶	
		Analog input: 0.00…99.99		0.20	%FS	
Control Output 1 Assignment	oUt1	When Control Output 1 is a voltage (SSR) output: ❷ NONE: No assignment O: Control output (heating) C-O: Control output (cooling) ALM1: Alarm 1 ALM2: Alarm 2 ALM3: Alarm 3 P.END: Program end output ❸ RALM: Control output ON/OFF count alarm ❹	nonE o C-o ALM1 ALM2 ALM3 P.End RALM	O	None	
		When Control Output 1 is a linear analog output: ❷ NONE: No assignment O: Control output (heating) C-O: Control output (cooling)	nonE o C-o			
Control Output 2 Assignment	oUt2	NONE: No assignment O: Control output (heating) C-O: Control output (cooling) ALM1: Alarm 1 ALM2: Alarm 2 ALM3: Alarm 3 P.END: Program end output ❶ RALM: Control output ON/OFF count alarm ❹	nonE o C-o ALM1 ALM2 ALM3 P.End RALM	NONE	None	
Auxiliary Output 1 Assignment	Sub1	Same as Control Output 1 (except fixed as a relay output)		ALM1	None	
Auxiliary Output 2 Assignment	Sub2	Same as Control Output 1		ALM2	None	
Auxiliary Output 3 Assignment (900-TC8)	Sub3	Same as Control Output 1		ALM3	None	
Character Select	CSEL	OFF, ON	oFF oN	ON	None	
Soak Time Unit	t-U	M: Minutes; H: Hours	M H	M	None	
Alarm SP Selection	ALSP	SP-M: Ramp set point SP: Set point	SP-M SP	SP-M	None	
Manual MV Limit	MANL	OFF, ON	oFF oN	ON	None	

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
PV Rate of Change Calculation Period	PVRP	1...999		4	Sampling period	
Automatic Cooling Coefficient Adjustment	CSCA	OFF, ON	oFF oN	OFF	None	
Heater Overcurrent Use	OCU	OFF, ON	oFF oN	ON	None	
Heater Overcurrent Latch	oCL	OFF, ON	oFF oN	OFF	None	
Heater Overcurrent Hysteresis	oCH	0.1...50.0		0.1	A	
PF Setting	PF	OFF: OFF RUN: RUN STOP: STOP R-S: RUN/STOP AT-2: 100% AT execute/cancel AT-1: 40% AT execute/cancel LAT: Alarm Latch Cancel A-ML Auto/manual PFDP: Monitor/Setting Item	oFF RUN StoP R-S At-2 At-1 LAt A-M PFdP	A-M	None	
Monitor/Setting Item 1	PFd1	0: Disabled 1: PV/SP/Multi-SP 2: PV/SP/MV 3: PV/SP/Soak time remain 4: Proportional band (P) 5: Integral time (I) 6: Derivative time (D) 7: Alarm value 1 8: Alarm value upper limit 1 9: Alarm value lower limit 1 10: Alarm value 2 11: Alarm value upper limit 2 12: Alarm value lower limit 2 13: Alarm value 3 14: Alarm value upper limit 3 15: Alarm value lower limit 3		1	None	
Monitor/Setting Item 2	PFd2	0...15, same as Monitor Setting Item 1		0	None	
Monitor/Setting Item 3	PFd3	0...15, same as Monitor Setting Item 1		0	None	
Monitor/Setting Item 4	PFd4	0...15, same as Monitor Setting Item 1		0	None	
Monitor/Setting Item 5	PFd5	0...15, same as Monitor Setting Item 1		0	None	

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
PV/Display Screen Selection	SPdP	0: PV/SP 1: PV/SP/Multi-SP, PV/SP/MV 2: PV/SP/MV, PV/SP/Multi-SP 3: PV/SP/Multi-SP 4: PV/SP/MV 5: PV/SP/Multi-SP, PV/SP/ Soak Time Remain 6: PV/SP/MV, PV/SP/Soak Time Remain 7: PV/SP/Soak Time Remain		4	None	
MV Display Selection	odSL	O: MV (Heating) C-O: MV (Cooling)	o C-o	0	None	
PV Decimal Point Display	PVdP	OFF, ON	oFF oN	ON	None	
PV Status Display Function	PVSt	OFF: OFF MANU: Manual STOP: Stop ALM1: Alarm 1 ALM2: Alarm 2 ALM3: Alarm 3 ALM: Alarm 1 to 3 OR status HA: Heater alarm	oFF MANU StoP ALM1 ALM2 ALM3 ALM HA	OFF	None	
SV Status Display Function	SVSt	OFF: OFF MANU: Manual STOP: Stop ALM1: Alarm 1 ALM2: Alarm 2 ALM3: Alarm 3 ALM: Alarm 1 to 3 OR status HA: Heater alarm	oFF MANU StoP ALM1 ALM2 ALM3 ALM HA	OFF	None	
Display Refresh Period	d.REF	OFF, 0.25, 0.5, 1.0		.25	Second	
Control Output 1 ON/OFF Count Monitor	RA1M	0....9999		0	100 times	
Control Output 2 ON/OFF Count Monitor	RA2M	0....9999		0	100 times	
Control Output 1 ON/OFF Count Alarm Set Value	RA1	0....9999		0	100 times	

Table B.F — Advanced Setting Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set Value
Control Output 2 ON/ OFF Count Alarm Set Value	RA2	0....9999		0	100 times	
ON/OFF Counter Reset	RAC	0: Disable the counter reset function. 1: Reset the control output 1 ON/OFF counter. 2: Reset the control output 2 ON/OFF counter.		o	None	
Move to Calibration function group	CMōV	–1999…9,999		0	None	

❶ Set "None" as the unit for analog inputs (23: 0 to 50 mV).
❷ The setting range depends on whether control output 1 is a current output or voltage output (for driving SSR).
❸ P.END (program end output) can be configured even when the program pattern is configured to OFF, but the function will be disabled.
❹ Turns ON when either the control output 1 or 2 ON/OFF count alarm is ON.

Table B.G — Protect Function Group

Parameters	Characters	Setting (Monitor) Value	Display	Default	Unit	Set value
Move to Protect function group	PMōV	–1999…9,999		0	None	
Operation/Adjustment Protect	ōAPt	0…3		0	None	
Initial Setting/Communications Protect	ĪCPt	0…2		1	None	
Setting Change Protect	WtPt	OFF, ON	ōFF ōN	OFF	None	
PF Key Protect	PFPt	OFF, ON	ōFF ōN	OFF	None	
Parameter Mask Enable	PMSK	OFF, ON	ōFF ōN	ON	None	
Password to Move to Protect function group	PRLP	–1999…9,999		0	None	

Table B.H Communications Function Group

Parameters	Characters	Setting (monitor) value	Display	Default	Unit	Set value
Protocol Setting	PSEL	900-TC, Modbus	CWF Mōd	900-TC	None	
Communications Unit No.	U-Nō	0…99		1	None	
Communications Baud Rate	bPS	1.2, 2.4, 4.8, 9.6, 19.2, 38.4, or 57.6	1.2 2.4 4.8 9.6 19.2 38.4 57.6	9.6	kbps	
Communications Data Length	LEN	7, 8		7	Bit	

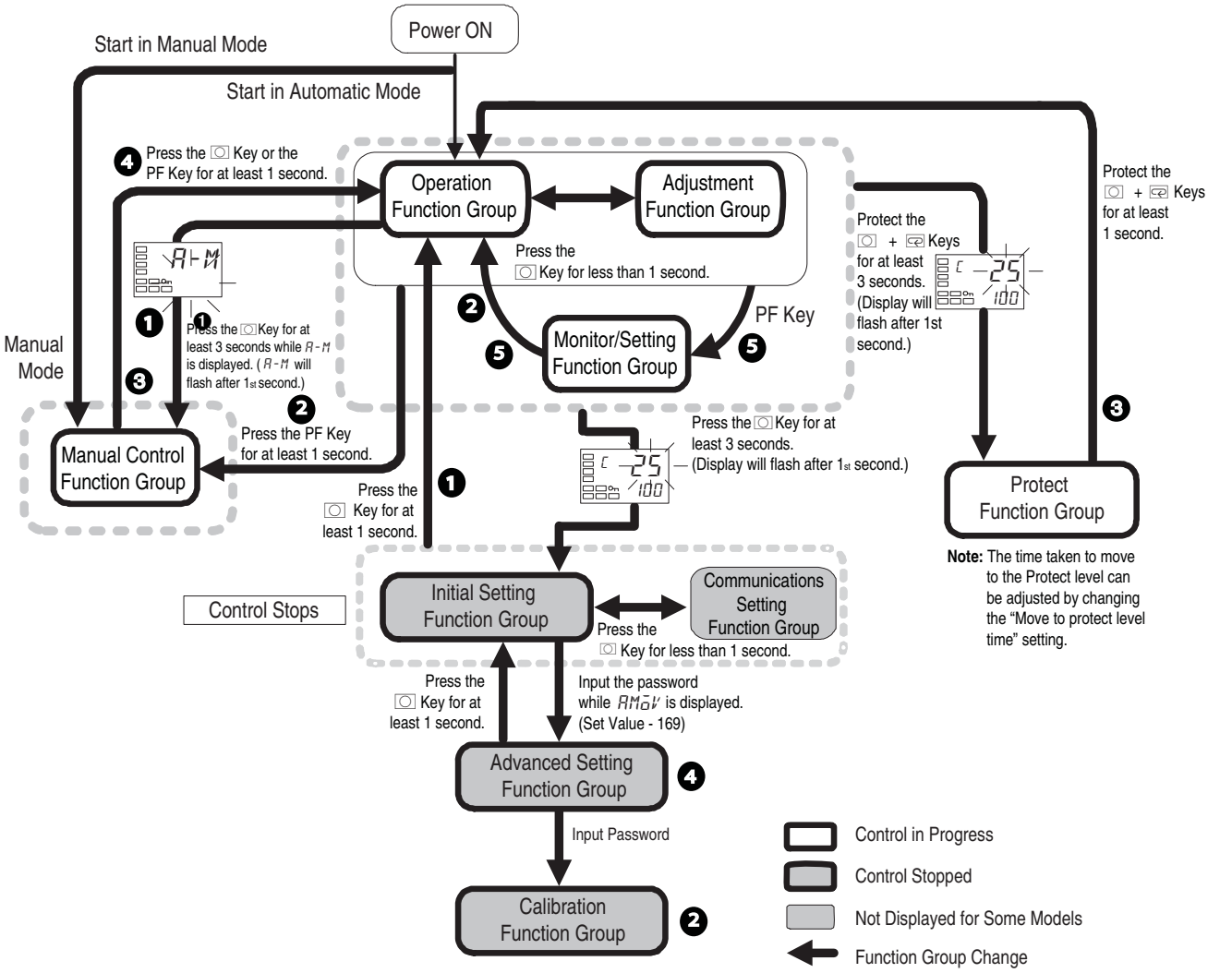
Table B.H Communications Function Group

Parameters	Characters	Setting (monitor) value	Display	Default	Unit	Set value
Communications Stop Bits	SbIt	1, 2		2	Bit	
Communications Parity	PRty	None, Even, Odd	NONE EVEN Odd	Even	None	
Send Data Wait Time	SdWt	0…99		20	ms	

Setup Function Group Diagrams

This diagram shows all of the function groups. 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 configuration and the conditions of use.

Figure B.1 — All Function Groups



❶ You can return to the operation level by executing a software reset. When the PF Setting parameter is crossovered to A-M for a Controller with a PF Key (900-TC8)

❷ It is not possible to move to other levels from the calibration level by operating the keys on the front panel. It can be done only by first turning OFF the power. When the PF Setting parameter is configured to PFDP for a Controller with a PF Key (900-TC8).

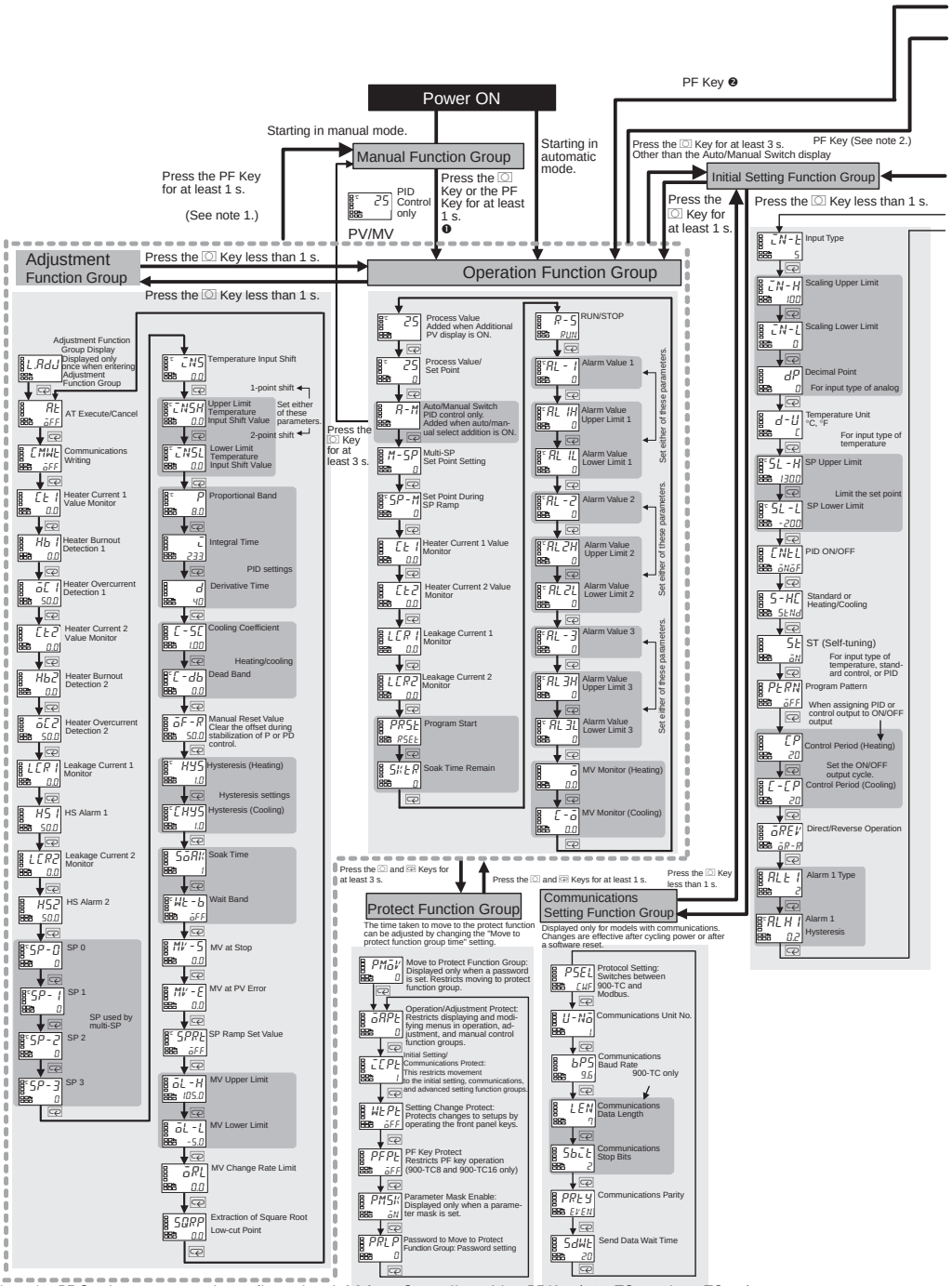
❸ From the manual control level, key operations can be used to move to the operation level only.

❹ When the PF Setting parameter is confingured to A-M for a Controller with a PF Key (900-TC8 only).

❺ When the PF Setting parameter is configured to PFDP for a Controller with a PF Key (900-TC8 only) From the manual control function group, key operations can be used to move to the operation function group only.

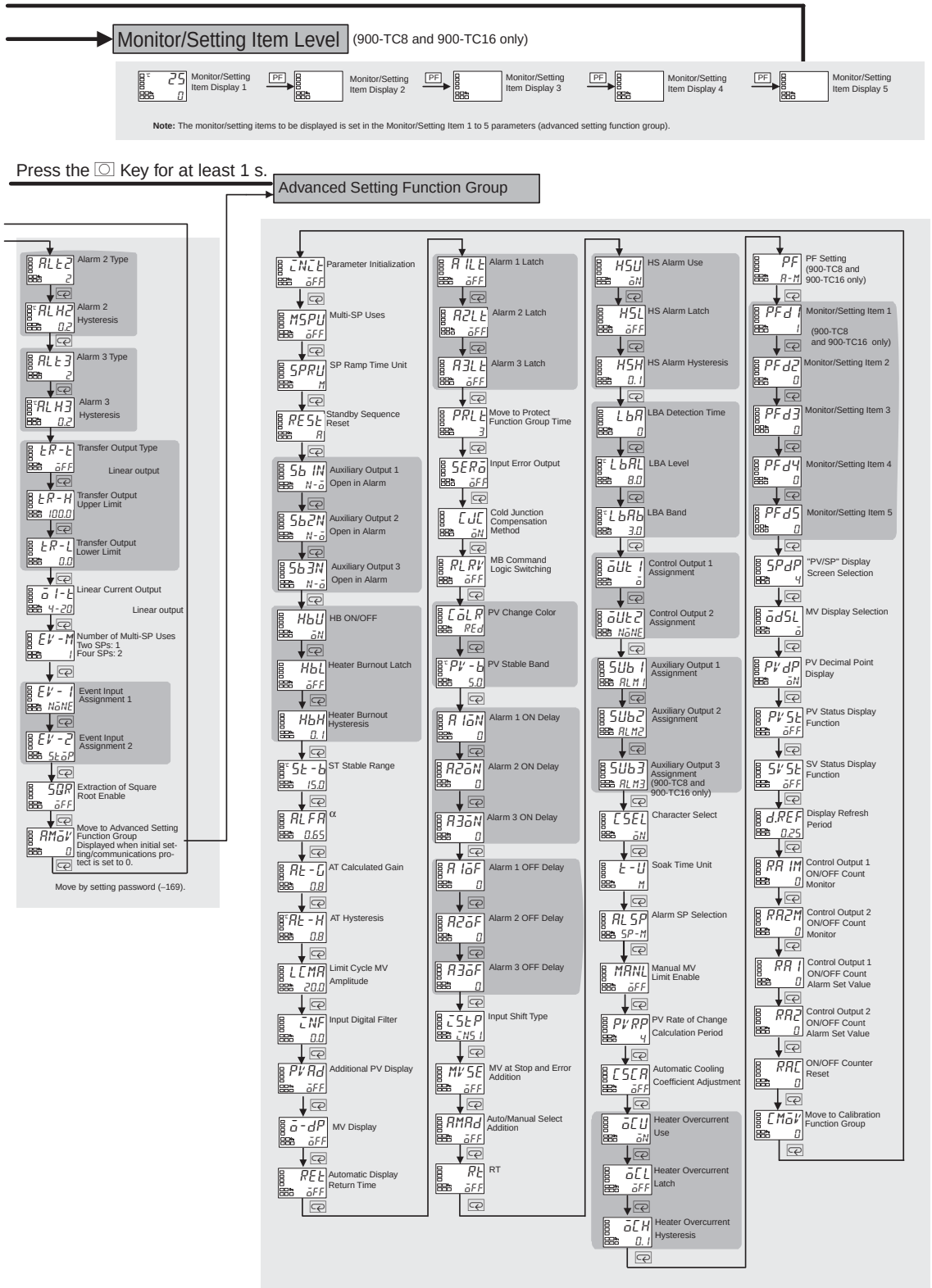
Parameter Flow

This section describes the parameters configured in each level. Pressing the ↵ Key at the last parameter in each level returns to the top parameter in that level.



❶ When the PF Setting parameter is configured to A-M for a Controller with a PF Key (900-TC8 and 900TC-16).

❷ When the PF Setting parameter is configured to PFDP for a Controller with a PF Key (900-TC8 and 900-TC16).


Monitor/Setting Item Level
(900-TC8 and 900-TC16 only)
Monitor/Setting Item Display 1
Monitor/Setting Item Display 2
Monitor/Setting Item Display 3
Monitor/Setting Item Display 4
Monitor/Setting Item Display 5
Note: The monitor/setting items to be displayed is set in the Monitor/Setting Item 1 to 5 parameters (advanced setting function group).
Press the Key for at least 1 s.
Advanced Setting Function Group
Alarm 2 Type
Alarm 2 Hysteresis
Alarm 3 Type
Alarm 3 Hysteresis
Transfer Output Type
Linear output
Transfer Output Upper Limit
Transfer Output Lower Limit
Linear Current Output
Linear output
Number of Multi-SP Uses
Two SPs: 1
Four SPs: 2
Event Input Assignment 1
Event Input Assignment 2
Extraction of Square Root Enable
Move to Advanced Setting Function Group
Displayed when initial setting/communications protect is set to 0.
Move by setting password (–169).
Parameter Initialization
Multi-SP Uses
SP Ramp Time Unit
Standby Sequence Reset
Auxiliary Output 1 Open in Alarm
Auxiliary Output 2 Open in Alarm
Auxiliary Output 3 Open in Alarm
HB ON/OFF
Heater Burnout Latch
Heater Burnout Hysteresis
ST Stable Range
α
AT Calculated Gain
AT Hysteresis
Limit Cycle MV Amplitude
Input Digital Filter
Additional PV Display
MV Display
Automatic Display Return Time
Alarm 1 Latch
Alarm 2 Latch
Alarm 3 Latch
Move to Protect Function Group Time
Input Error Output
Cold Junction Compensation Method
MB Command Logic Switching
PV Change Color
PV Stable Band
Alarm 1 ON Delay
Alarm 2 ON Delay
Alarm 3 ON Delay
Alarm 1 OFF Delay
Alarm 2 OFF Delay
Alarm 3 OFF Delay
Input Shift Type
MV at Stop and Error Addition
Auto/Manual Select Addition
RT
HS Alarm Use
HS Alarm Latch
HS Alarm Hysteresis
LBA Detection Time
LBA Level
LBA Band
Control Output 1 Assignment
Control Output 2 Assignment
Auxiliary Output 1 Assignment
Auxiliary Output 2 Assignment
Auxiliary Output 3 Assignment (900-TC8 and 900-TC16 only)
Character Select
Soak Time Unit
Alarm SP Selection
Manual MV Limit Enable
PV Rate of Change Calculation Period
Automatic Cooling Coefficient Adjustment
Heater Overcurrent Use
Heater Overcurrent Latch
Heater Overcurrent Hysteresis
PF Setting (900-TC8 and 900-TC16 only)
Monitor/Setting Item 1
(900-TC8 and 900-TC16 only)
Monitor/Setting Item 2
Monitor/Setting Item 3
Monitor/Setting Item 4
Monitor/Setting Item 5
"PV/SP" Display Screen Selection
MV Display Selection
PV Decimal Point Display
PV Status Display Function
SV Status Display Function
Display Refresh Period
Control Output 1 ON/OFF Count Monitor
Control Output 2 ON/OFF Count Monitor
Control Output 1 ON/OFF Count Alarm Set Value
Control Output 2 ON/OFF Count Alarm Set Value
ON/OFF Counter Reset
Move to Calibration Function Group

Calibration

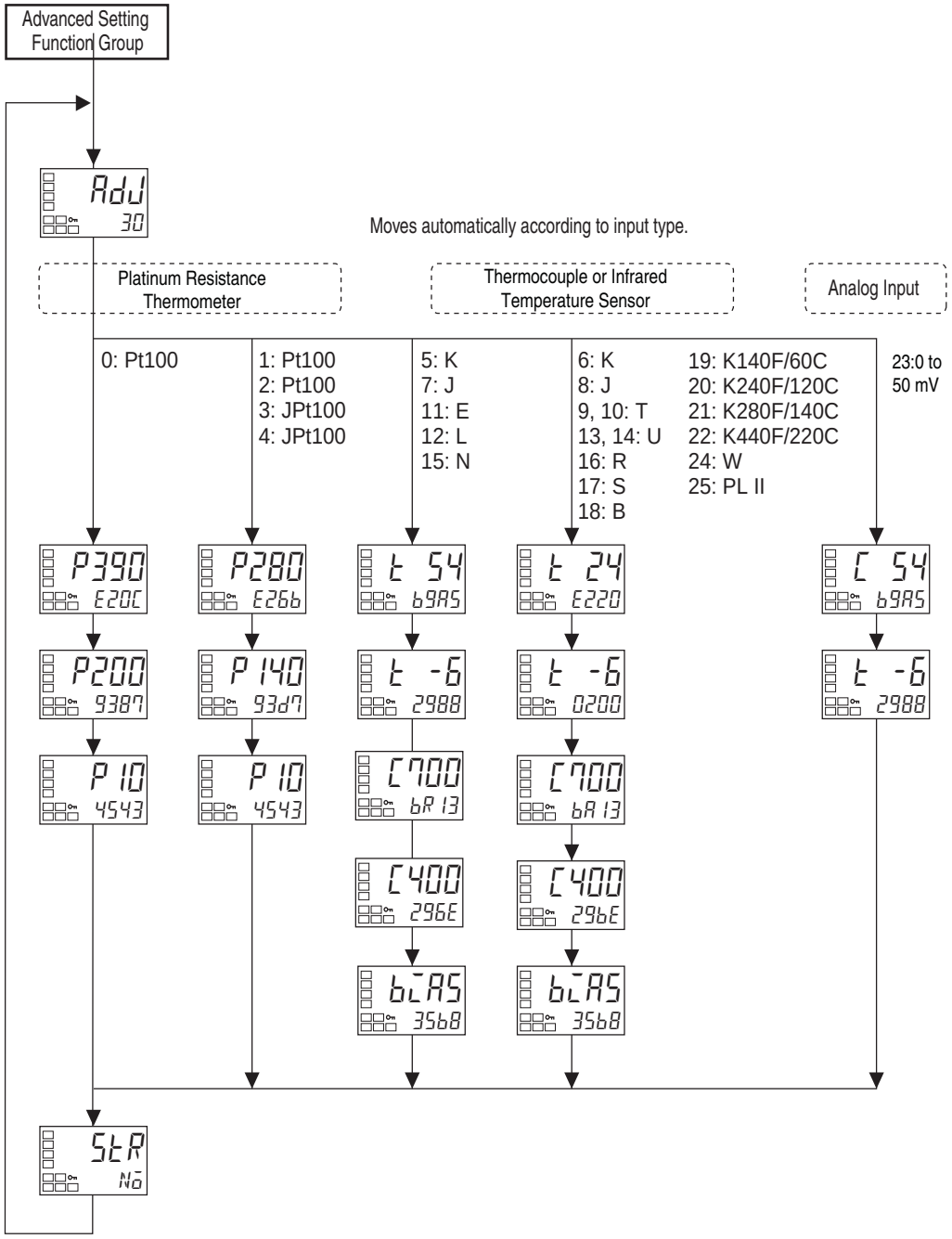
Parameter Structure

The Bulletin 900 Controller 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.

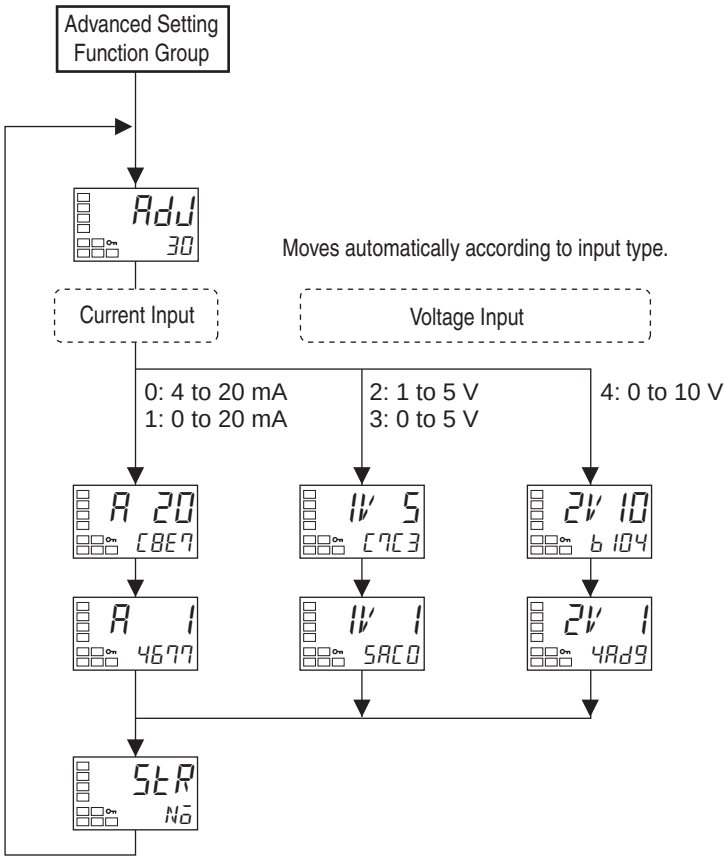
- To execute user calibration, enter the password **1201** at the Move to Calibration function group parameter in the Advanced Setting function group. The mode will be changed to the calibration mode, and AdJ will be displayed.
- The Move to Calibration function group parameter may not be displayed when the user is doing the calibration for the first time. If this happens, configured the Initial/Communications Protect parameter in the Protect function group to 0 before moving to the Advanced Setting function group.
- The calibration mode is ended by turning the controller power OFF.
- The parameter calibrations in the calibration mode are structured as shown in Figure C.1.

Figure C.1 — Controllers with Thermocouple/Resistance Thermometer Universal Inputs



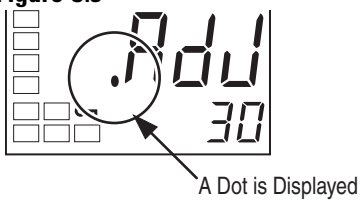
Controllers with Analog Inputs (900-TC8 & 900-TC16)

Figure C.2



When calibration has been performed after purchase, the user calibration information shown in the following illustration will be displayed when moving to the calibration level.

Figure C.3



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 perform the calibration. When the data is registered, it is also recorded that user calibration has been performed.

Prepare separate measuring devices and equipment for calibration. For details on how to handle measuring devices and equipment, refer to the respective instruction manuals.

User Calibration

Calibrating Input

The 900-TC8, 900-TC16, and 900-TC32 are correctly calibrated before they are shipped from the factory, and normally need not be calibrated by the user.

If, however, they must be calibrated by the user, use the parameters for calibrating temperature input and analog input. Rockwell Automation, however, cannot ensure the results of calibration by the user. Also, the factory calibration data is overwritten with the latest user calibration results. The default calibration settings CANNOT be restored after user calibration. Perform user calibration with care.

When the user calibrates the Bulletin 900 Controller, the Input Type currently selected in parameters is calibrated.

The following 26 Input Types can be calibrated:

- Thermocouple: 16 types
- Non-contact temperature sensor: 4 types
- Analog input: 1 type
- Platinum resistance thermometer: 5 types

Controllers with Analog Inputs (900-TC8 and 900-TC16):

- Current input: 2 types
- Voltage input: 3 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 Controller.

When calibration data is registered, it is registered regardless of whether or not the Bulletin 900 Controller 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.

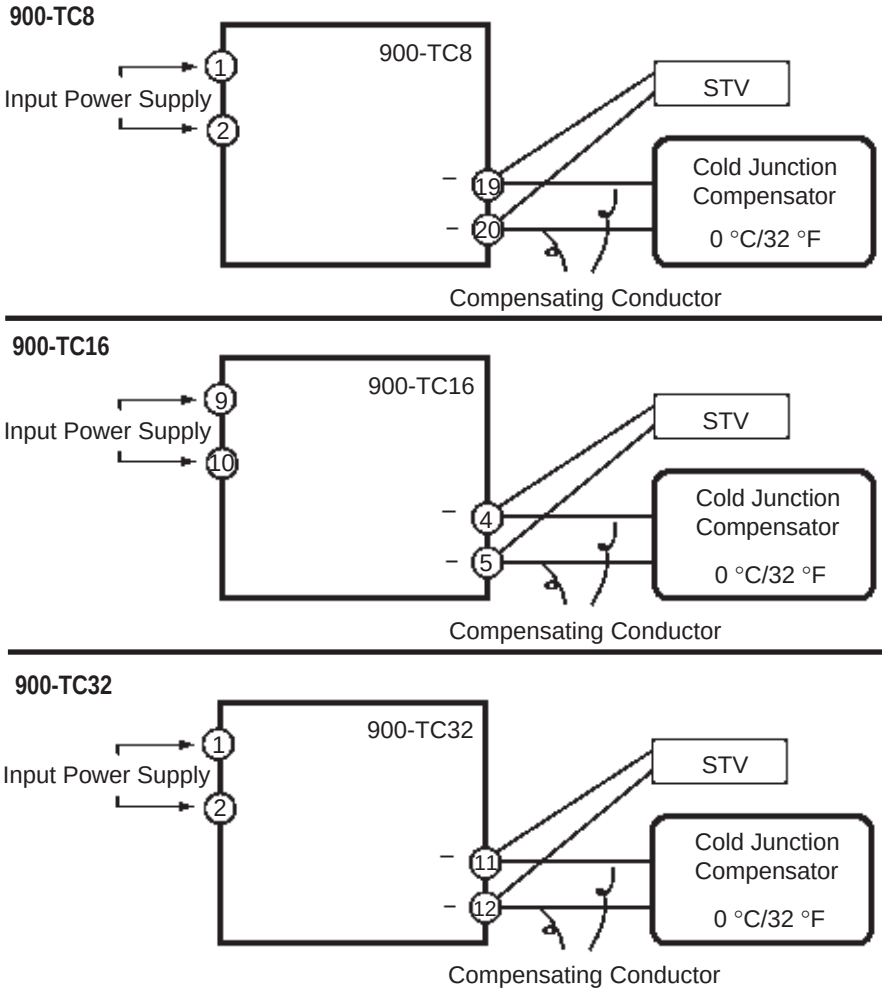
Calibrating Thermocouples

Calibrate according to the type of thermocouple, thermocouple 1 group (Input Types 5, 7, 11, 12, 15), and thermocouple 2 group (Input Types 6, 8, 9, 10, 13, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25).

When calibrating, do not cover the bottom of the controller. Also, do not touch the input terminals (pin numbers 4 and 5 on the 900-TC16, 19 and 20 on the 900-TC8, and 11 and 12 on the 900-TC32) or the compensating conductor on the controller.

Preparations

Figure C.4 — Set the Cold Junction Compensator



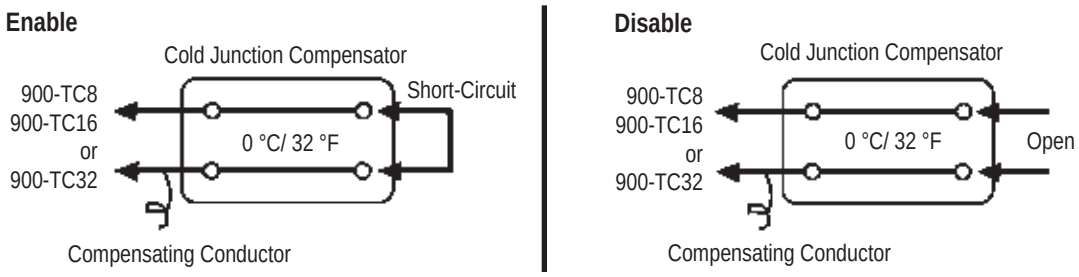
- Set the cold junction compensator designed for compensation of internal thermocouples to 0°C. However, make sure that internal thermocouples are disabled (tips are open).

- 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, W or PLII, 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 Type 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.5 — Connecting the Cold Junction Compensator

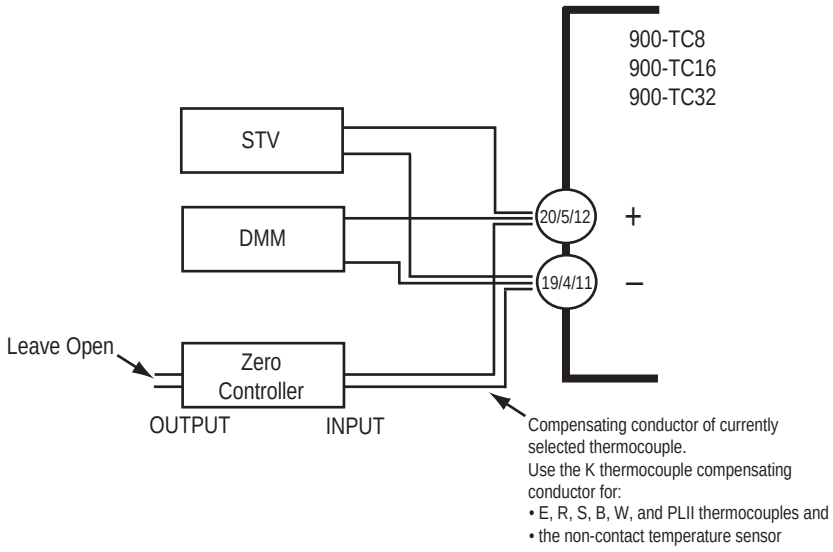


This example describes how to calibrate the Bulletin 900 Controller when a thermocouple input is currently selected.

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 the figure below) to the thermocouple input terminals (refer to Figure C.6 below).

Figure C.6 — Example, Zero Controller



3. Turn the power ON.

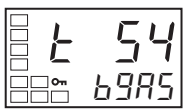
4. Move to the Calibration function group. This starts the 30-minute timer. This timer provides an approximate timer for aging. After 30 minutes, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

Figure C.7

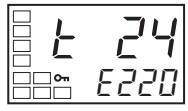
5. Press the ↵ key to set the Bulletin 900 Controller to the state below. The No. 2 display at this time displays the currently entered count value entered in Hexadecimal. Set the STV as follows:
   - Input Types 5, 7, 11, 12, 15: Set to 54 mV.
   - Input Types 6, 8, 9, 10, 13, 14, 16, 17, 18, 19, 20, 21, 22, 24, 25: Set to 24 mV.

Figure C.8

Input Types 5, 7, 11, 12, 15:



Input Types 6, 8, 9, 10, 13, 14, 16, 17, 18, 19, 20, 21, 22:

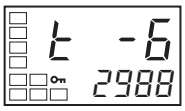


Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup. If the count

value is outside the specified range, the Number 2 display will flash and the count value will NOT be temporarily registered.

6. Press the ↵ key to set the Bulletin 900 Controller to the state below. Set STV to –6 mV. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup. If the count value is outside the specified range, the Number 2 display will flash and the count value will NOT be temporarily registered.

Figure C.9

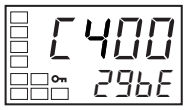


7. Press the ↵ Key. The display changes as shown above.. Set the STV to 700 mV.
   Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ Key to temporarily register the calibration settings. If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

Figure C.10

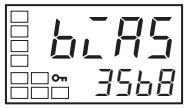
8. Press the ↵ Key. The display changes as shown on the left.Set the STV to 400 mV. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ Key to temporarily register the calibration settings. If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered

Figure C.11



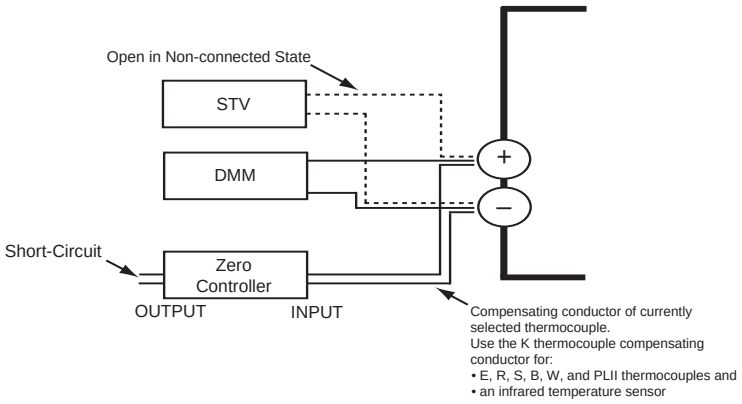
9. When the ↵ Key is pressed, the status changes as shown to the left.

Figure C.12



10. Change the wiring as follows

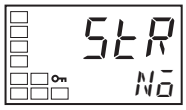
Figure C.13



Disconnect the STV to enable the thermocouple of the cold junction compensator. When doing this, be sure to disconnect the wiring on the STV side.

11. Allow the count value on the No. 2 display to fully stabilize, then press the ⩛ Key to temporarily register the calibration settings.

Figure C.14



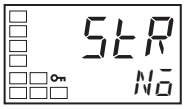
12. When the ⏎ Key is pressed, the status changes as shown to the left. The data to be temporarily registered is not displayed if it is not complete. Press the ⩓ Key. The No. 2 display changes to YES. Release the key and wait two seconds or press the ⏎ Key. This stores the temporarily registered calibration data to EEPROM. To cancel the saving of temporarily registered calibration data to EEPROM, press the ⏎ Key (while no is displayed in the No. 2 display) without pressing the ⩓ Key.

13. The calibration mode is ended by turning the power OFF

14. Allow the count value on the No. 2 display to fully stabilize, then press the ⩛ key to temporarily register the calibration setup.

15. Press the ↵ key. The No. 2 display changes to the state below. Note that the data to be temporarily registered is not displayed if it is not complete.

Figure C.15



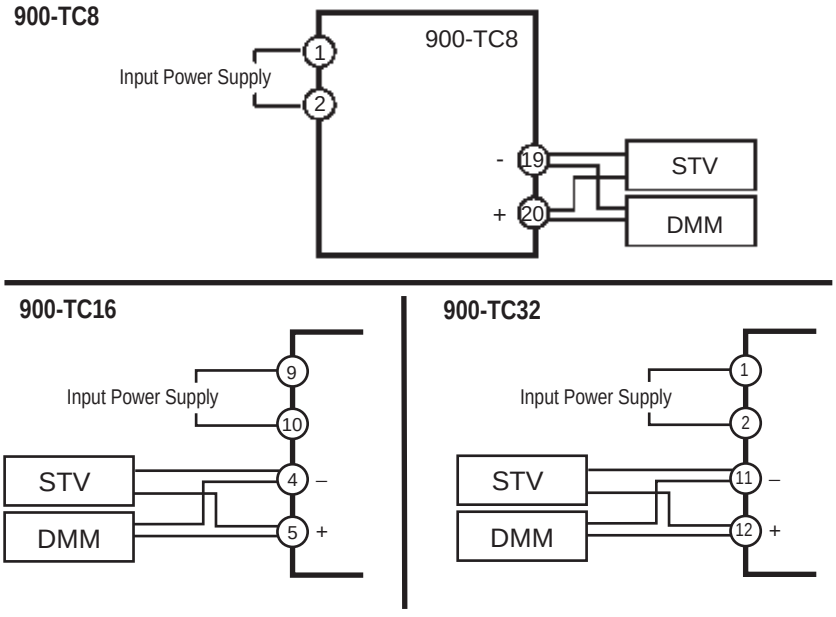
16. Press the ∧ key. The No. 2 display changes to YES. Release the key and wait 2 seconds or press the ↵ key. This stores the temporarily registered calibration data to EEPROM. To cancel storage of temporarily registered calibration data to memory, press the ↵ key without pressing the ∧ key.

17. The calibration mode is ended by turning the power OFF.

Calibrating 0…50 mV Analog Input

This example describes how to calibrate when 0…50 mV input (Input Type 23) is currently selected on a Bulletin 900-TC8, 900TC16, or 900-TC32 Controller supporting Global Temperature (GT) inputs.

Figure C.16



1. Connect the power supply.

2. Connect an STV and DMM to the analog input terminals, as shown in the figures above.

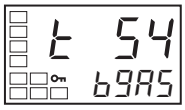
3. Turn the power ON.

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.17

5. Press the ↵ key to set the Bulletin 900 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.

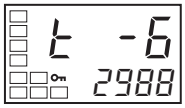
Figure C.18



6. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration settings.
If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

7. Press the ↵ key to set the Bulletin 900 to the state below. Set STV to –6mV.

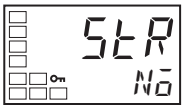
Figure C.19



8. Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration setup. If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

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 the saving of temporarily registered calibration data to EEPROM, press the ↵ key (while no is displayed in the No. 2 display) without pressing the ⌃⌃ key.

Figure C.20

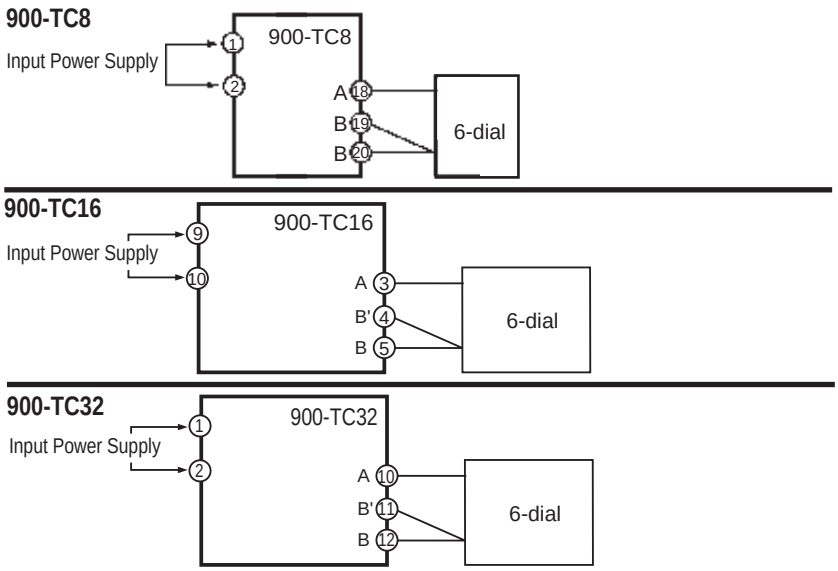


10. The calibration mode is ended by turning the controller power OFF.

Calibrating Platinum Resistance Thermometers

This example describes how to calibrate the Bulletin 900 Controller when it is connected to a platinum resistance thermometer.

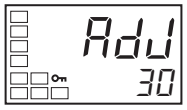
Figure C.21



When calibrating a platinum resistance thermometer use wires of the same thickness as those used to connect the Bulletin 900 Controller.

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.22



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 in Hexadecimal. Set the 6-dial as follows:
   - Input Type 0: 390 Ω
   - Input Type 1, 2, 3 or 4: 280 Ω

Figure C.23

6. Allow the count value on the No. 2 display to fully stabilize, then press the ≫ key to temporarily register the calibration setup. If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

7. Press the ↵ Key to display the count value for each input type. The No. 2 display at this time shows the currently entered count value in hexadecimal.Set the 6-dial as follows:
   - Input type 0: 200 Ω
   - Input type 1, 2, 3 or 4: 140 Ω

Figure C.24

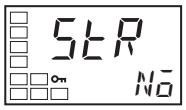
8. Allow the count value on the No. 2 display to fully stabilize, then press the ≫ key to temporarily register the calibration setup.
   If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.
   When the ↵ key is pressed, the status changes as shown in Figure C.25. Set the 6-dial to 10 Ω

9. Allow the count value on the No. 2 display to fully stabilize, then press the ≫ Key to temporarily register the calibration settings.If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

10. When the ↵ Key is pressed, the status changes as shown to the left. The data to be temporarily registered is not displayed if it is not complete. Press the ▲ Key. The No. 2 display changes to yes. Release the key and wait two seconds or press the ↵ Key. This stores the temporarily registered calibration data to EEPROM.To cancel the saving of temporarily registered calibration data to EEPROM, press the ↵ Key (while no is displayed in the No. 2 display) without pressing the ▲ Key.

11. The calibration mode is quit by turning the power OFF.

Figure C.25



Calibrating Analog Input (e.g., 4…20 mA Analog Input)

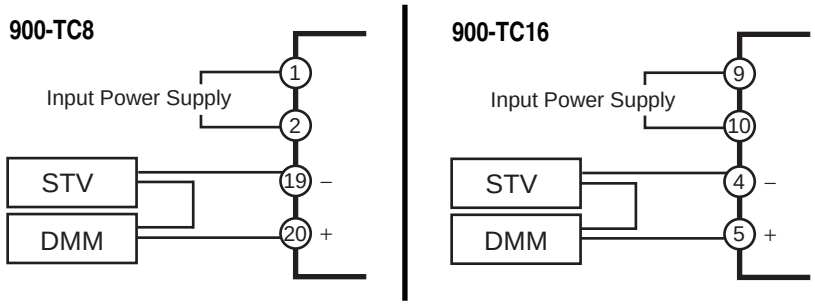
Calibrating an Analog Current Input (900-TC8 & 900-TC16)

In this example, calibration is shown for a Controller with an Analog current Input (Input Type 0 or 1).

1. Connect the power supply.

2. Connect an STV and DMM to the current input terminals, as shown in the following diagram.

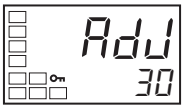
Figure C.26



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 have elapsed, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

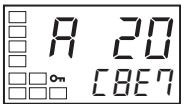
Figure C.27



5. When the ↵ key is pressed, the status changes as shown in Figure C.28. The No. 2 display at this time shows the currently entered count value in hexadecimal. Set the STV to 20 mA.

   Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration settings.
   If this count value is outside of the specified range, the No. 2 display will flash and the count value will NOT be temporarily registered.

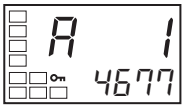
Figure C.28



6. When the ↵ key is pressed, the status changes as shown in Figure C.29. Set the STV to 1 mA.

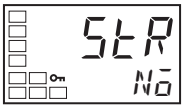
   Allow the count value on the No. 2 display to fully stabilize, then press the ⌄⌄ key to temporarily register the calibration settings.
   If this count value is outside of the specified range, the No. 2 display will flash and the count value will NOT be temporarily registered.

Figure C.29



7. When the ↵ key is pressed, the status changes as shown in Figure C.30. The data to be temporarily registered is not displayed if it is not complete.
   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 the saving of temporarily registered calibration data to EEPROM, press the ↵ key (while no is displayed in the No. 2 display) without pressing the ⌃⌃ key.

Figure C.30



8. The calibration mode is ended by turning the controller power OFF.

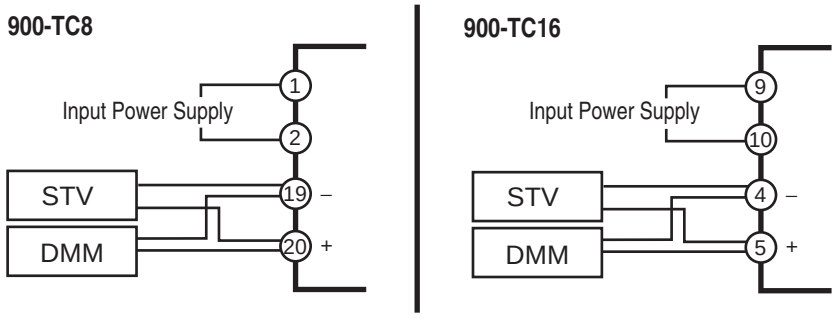
Calibrating an Analog Voltage (e.g., 1…5V DC) Input (900-TC8 & 900-TC16)

In this example, calibration is shown for a Controller with an Analog Voltage Input (Input Type 2, 3, or 4).

1. Connect the power supply.

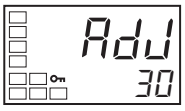
2. Connect an STV and DMM to the voltage input terminals, as shown in the following diagram.

Figure C.31



3. Turn the power ON.

Figure C.32



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 have elapsed, the No. 2 display changes to 0. You can advance to the next step in this procedure even if 0 is not displayed.

5. When the ↵ key is pressed, the status changes as shown in the figure below.
   The No. 2 display at this time shows the currently entered count value in hexadecimal. Set the STV as follows:
   - Input Type 2 or 3: 5V
   - Input Type 4: 10V

   Allow the count value on the No. 2 display to fully stabilize, then press the ▼ key to temporarily register the calibration settings.
   If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

Figure C.33

Input Type 2 or 3:

Input Type 4:

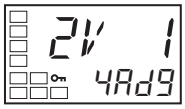
6. When the ↵ key is pressed, the status changes as shown in the figure below.
Set the STV to 1V.

Allow the count value on the No. 2 display to fully stabilize, then press the ⇓ key to temporarily register the calibration settings.
If this count value is outside of the specified range, the No. 2 display will flash and the count value will not be temporarily registered.

Figure C.34

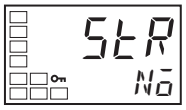
Input Type 2 or 3:

Input Type 4:



7. When the ↵ key is pressed, the status changes as shown in the figure below.
The data to be temporarily registered is not displayed if it is not complete.
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 the saving of temporarily registered calibration data to EEPROM, press the ↵ key (while no is displayed in the No. 2 display) without pressing the ⇑ key.

Figure C.35



8. The calibration mode is ended by turning the power OFF.

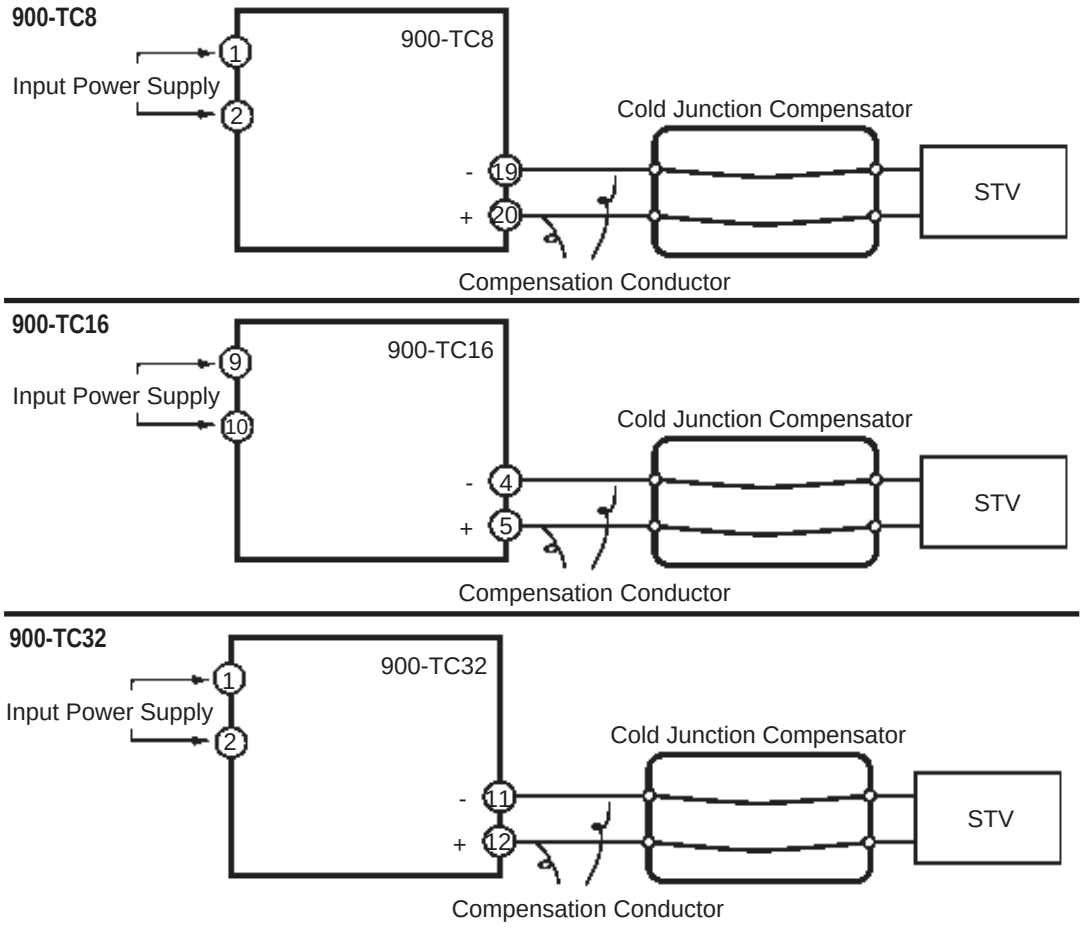
Checking Indication Accuracy

- After calibrating input, make sure to check indication accuracy to make sure that the Bulletin 900 Controller has been correctly calibrated.
- Operate the Bulletin 900 Controller in the PV/SP monitor mode.
- Check the indication accuracy at the Upper- and Lower-Limits and mid-point.

Checking Accuracy of a Thermocouple or Non-Contact Temperature Sensor

- **Preparation:** The following figure shows the required device connection. Make sure that the Bulletin 900 Controller 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 configured the Input Type to the K thermocouple.

Figure C.36

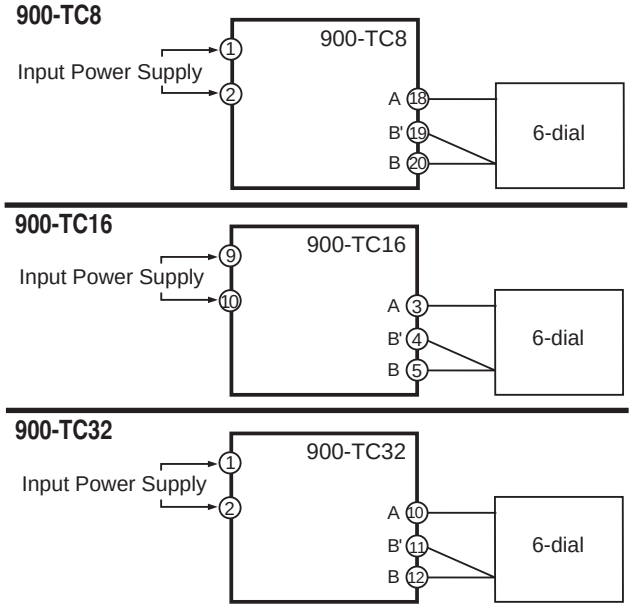


- **Operation:** Make sure that the cold junction compensator is at 0°C, and configured STV output to the voltage equivalent to the starting power of the value to be checked. The cold junction compensator and compensation conductor are not required when an external cold junction compensation method is used.

Checking Indication Accuracy of a Platinum Resistance Thermometer

- **Preparation:** The following figure shows the required device connection:

Figure C.37



- **Operation:** Set the 6-dial to the resistance equivalent to the check value.

Analog Input (900-TC & 900-TC16)

- **Preparation:** The following figures show the required device connection:

Figure C.38 — Controller with a Thermocouple/Resistance Thermometer Multi-input (Analog Input)

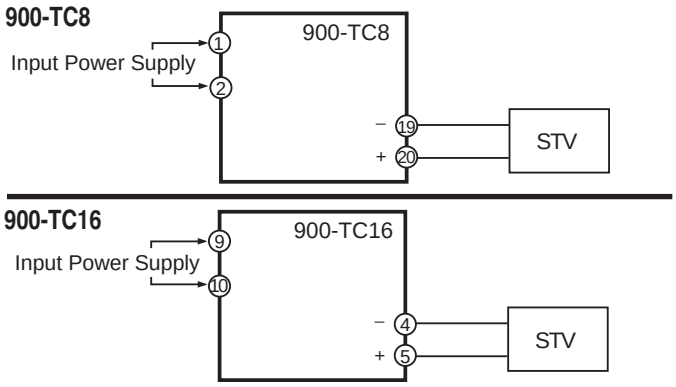


Figure C.39 — Current Input for a Controller with an Analog Input

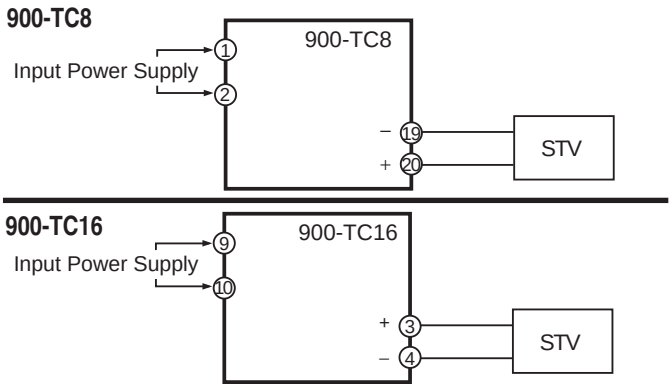
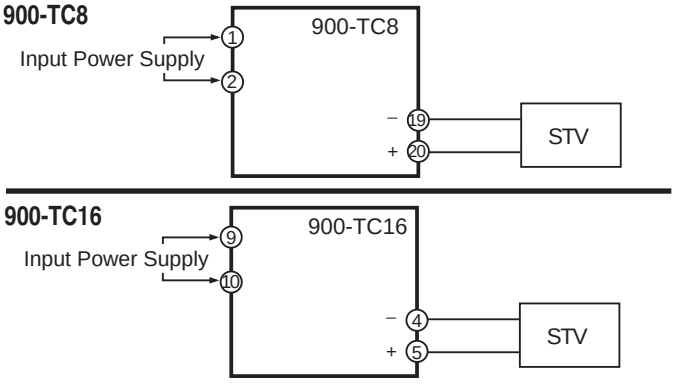


Figure C.40 — Voltage Input for a Controller with an Analog Input



- Operation
  Set the STV output to the voltage or current equivalent to the check value.

Glossary

Adaptive Tuning: Used 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 (Deutsches Institut für Normung): 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 freezing 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 up set.

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.

Japanese Industrial Standards (JIS): A Japanese agency that establishes and maintains standards for equipment and components. Its function is similar to Germany's Deutsches Institut für Normung.

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 configured 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 configured value dial or moving the offset screw on the control panel. The auto-reset function automatically adjusts the configured 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 configured 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.

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www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 900-UM007D-EN-E - January 2011
Supersedes Publication 900-UM007C-EN-D - October 2008

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