



# 1-channel Type Temperature Controller with Built-in SSR

## SB1 Installation Manual

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Thank you for purchasing this RKC product. In order to achieve maximum performance and ensure proper operation of the instrument, carefully read all the instructions in this manual. Please place the manual in a convenient location for easy reference.

This manual describes the mounting, wiring and specifications only.

For detailed handling procedures and key operations, refer to separate **SB1 Instruction Manual (IMR02M04-E□)**.

The manual can be downloaded from the official RKC website: [http://www.rkcinst.com/english/manual\\_load.htm](http://www.rkcinst.com/english/manual_load.htm).

### Product check

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### Safety precautions



- To prevent injury to persons, damage to the instrument and the equipment, a suitable external protection device shall be required.
- All wiring must be completed before power is turned on to prevent electric shock, fire or damage to the instrument and the equipment.
- This instrument must be used in accordance with the specifications to prevent fire or damage to the instrument and the equipment.
- This instrument is not intended for use in locations subject to flammable or explosive gases.
- Do not touch high-voltage connections such as power supply terminals, etc. to avoid electric shock.
- RKC is not responsible if this instrument is repaired, modified or disassembled by other than factory-approved personnel. Malfunction may occur and warranty is void under these conditions.

#### High temperature caution:

The back side and the heat radiating cover of the SB1 will be at a high temperature when the power is ON or right after the power is turned OFF. Do not touch the surfaces to avoid being burned.

### CAUTION

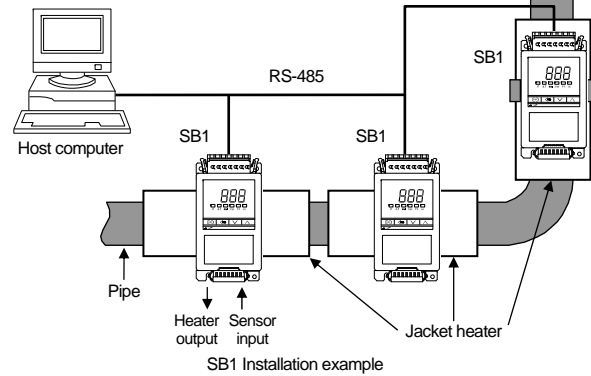
- This product is intended for use with industrial machines, test and measuring equipment. (It is not designed for use with medical equipment and nuclear energy plant.)
- This is a Class A instrument. In a domestic environment, this instrument may cause radio interference, in which case the user may be required to take additional measures.
- This instrument is protected from electric shock by reinforced insulation. Provide reinforced insulation between the wire for the input signal and the wires for instrument power supply, source of power and loads.
- Be sure to provide an appropriate surge control circuit respectively for the following:
  - If input/output or signal lines within the building are longer than 30 meters.
  - If input/output or signal lines leave the building, regardless of the length.
- This instrument is designed for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentation panel to avoid electric shock to operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.
- All wiring must be in accordance with local codes and regulations.
- To prevent instrument damage as a result of failure, protect the power line and the input/output lines from high currents with a suitable overcurrent protection device with adequate breaking capacity such as a fuse, circuit breaker, etc.
- A malfunction in this product may occasionally make control operations impossible or prevent alarm outputs, resulting in a possible hazard. Take appropriate measures in the end use to prevent hazards in the event of malfunction.
- Prevent metal fragments or lead wire scraps from falling inside instrument case to avoid electric shock, fire or malfunction.
- For proper operation of this instrument, provide adequate ventilation for heat dissipation.
- Do not connect wires to unused terminals as this will interfere with proper operation of the instrument.
- Turn off the power supply before cleaning the instrument.
- Do not use a volatile solvent such as paint thinner to clean the instrument. Deformation or discoloration may occur. Use a soft, dry cloth to remove stains from the instrument.
- To avoid damage to instrument display, do not rub with an abrasive material or push front panel with a hard object.

### NOTICE

- This manual assumes that the reader has a fundamental knowledge of the principles of electricity, process control, computer technology and communications.
- The figures, diagrams and numeric values used in this manual are only for explanation purpose.
- RKC is not responsible for any damage or injury that is caused as a result of using this instrument, instrument failure or indirect damage.
- RKC is not responsible for any damage and/or injury resulting from the use of instruments made by imitating this instrument.
- Periodic maintenance is required for safe and proper operation of this instrument. Some components have a limited service life, or characteristics that change over time.
- Every effort has been made to ensure accuracy of all information contained herein. RKC makes no warranty, expressed or implied, with respect to the accuracy of the information. The information in this manual is subject to change without prior notice.
- No portion of this document may be reprinted, modified, copied, transmitted, digitized, stored, processed or retrieved through any mechanical, electronic, optical or other means without prior written approval from RKC.

## 1. OUTLINE

SB1 is a 1 channel type temperature controller with built-in SSR designed for flexible heating solutions such as Heat trace of pipelines by controlling Jacket heater etc. Host computer can control up to 31 units of SB1 by communication. The setting data can be monitored or set by direct connection to the Host computer and the loader communication port installed in the SB1. The setting data can also be monitored or changed by using the display and the operation key.



## 2. MOUNTING

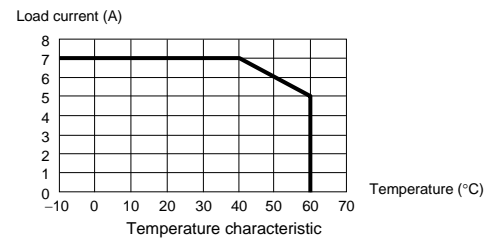


To prevent electric shock or instrument failure, always turn off the power before mounting or removing the instrument.

### 2.1 Mounting Cautions

(1) This instrument is intended to be used under the following environmental conditions. (IEC 61010-1) [OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2]

- Use this instrument within the following environment conditions:
  - Allowable ambient temperature: -10 to +60 °C (The allowable load current drops when the ambient temperature exceeds 40 °C.)



- Allowable ambient humidity: 5 to 95 %RH (Absolute humidity: MAX. W. C 29 g/m<sup>3</sup> dry air at 101.3 kPa)
- Installation environment conditions:
  - Indoor use Altitude up to 2000 m
  - Temperature of the Installation position (surface of a jacket heater): -10 to +100 °C
  - Do not use the following items at 70 °C or more:
    - Fitting and banding for pipe wrapping type
    - Strapping for pipe hanging type
    - Fitting for DIN rail mounting.
  - Diameter of the pipe (being covered with a jacket heater): φ 70 and φ 120 to 150

(3) Avoid the following conditions when selecting the mounting location:

- Rapid changes in ambient temperature which may cause condensation.
- Corrosive or inflammable gases.
- Direct vibration or shock to the mainframe.
- Water, oil, chemicals, vapor or steam splashes.
- Excessive dust, salt or iron particles.
- Excessive induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

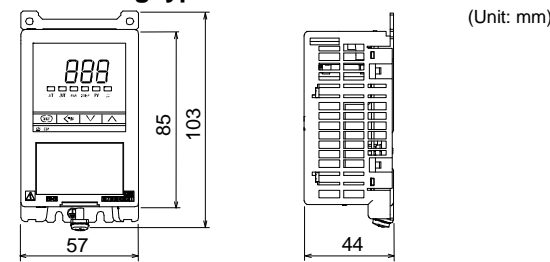
(4) Mount this instrument in the panel considering the following conditions:

- Make sure to mount inside a control panel. (Indoor use)
- Ensure at least 200 mm space on top and bottom of the instrument for maintenance and environmental reasons.
- If the ambient temperature rises above 60 °C, cool this instrument with a forced air fan, cooler, etc. Cooled air should not blow directly on this instrument.
- In order to improve safety and the immunity to withstand noise, mount this instrument as far away as possible from high voltage equipment, power lines, and rotating machinery.
  - High voltage equipment: Do not mount within the same panel.
  - Power lines: Separate at least 200 mm.
  - Rotating machinery: Separate as far as possible.

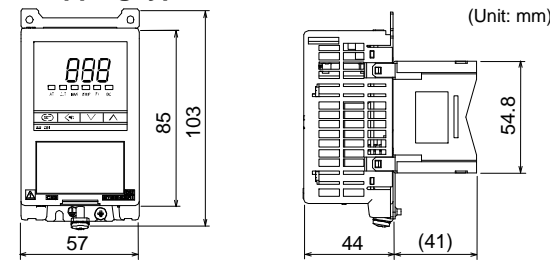
(5) In case this instrument is connected to a supply by means of a permanent connection, a switch or circuit-breaker shall be included in the installation. This shall be in close proximity to the equipment and within easy reach of the operator. It shall be marked as the disconnecting device for the equipment.

## 2.2 Dimensions

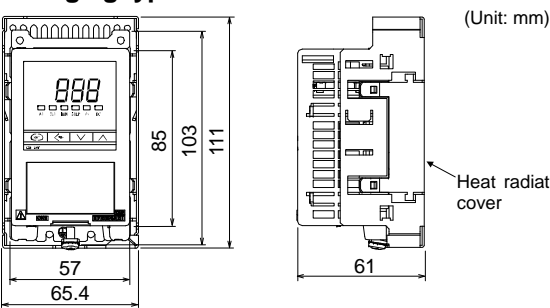
### Panel mounting type



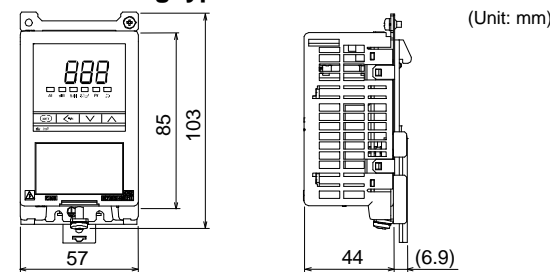
### Pipe wrapping type



### Pipe hanging type



### DIN rail mounting type



### Space required between SB1

Allow 30 mm or more between the instruments for proper heat radiation when mounting two or more SB1 controllers in parallel. When mounting the instruments vertically, allow 200 mm or more to have space for wiring to or from the connectors installed on the top and the bottom of the SB1.

### SB1 Mounting angle

Mount SB1 within 10 degrees from front to back and from side to side. To avoid malfunction, do not exceed this angle.

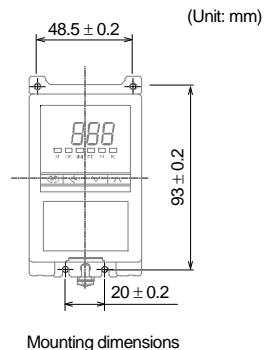
## 2.3 Mounting procedures

### Panel mounting

- Refer to 2.2 Dimensions and the diagram at right to confirm the installation position.
- Fix the SB1 to its installation position using M3 screws. Customer must provide the screws.

Recommended screw size: M3 size [Nominal length (L): 6 mm or more]  
Recommended tightening torque: 0.45 to 0.53 N·m (4.5 to 5.3 kgf·cm)

As the temperature of back side of SB1 becomes high, mount the instrument on a non-inflammable material (metal plate, etc.).



## Pipe wrapping

- Prepare a strapping for pipe wrapping type (not included) fitting the circumference of the pipe. Then attach a banding (head) to an edge of one side of the strapping.

When cutting the strapping, take caution to avoid being injured by the cut end.

- Insert the strapping into the through holes of the fitting for pipe wrapping type.

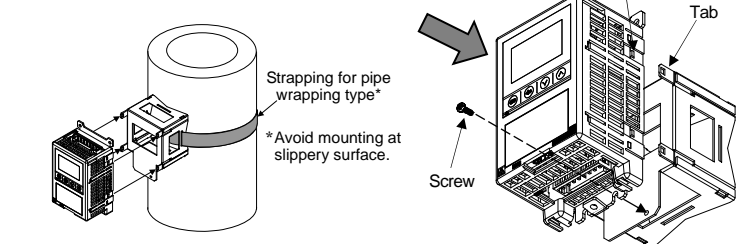
- Wrap the pipe with the strapping and then insert the edge without a banding into the banding (head).

Before inserting the strapping, confirm the installation position as the strapping cannot be released from the banding (head) once it has been inserted.

- Hold the fitting at the installation position and carefully fasten the strapping.

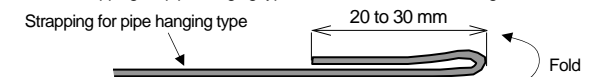
- Install SB1 into the fitting by overlapping the 4 tabs of the fitting and the 4 slots of SB1 until the lock clicks. After installation, insert the supplied screw through the hole on SB1 into the fitting and tighten it firmly.

For details, refer to the catalog of the strapping maker.  
Recommended banding and strapping [Model code: SB1P-B01]:  
Stainless steel banding and strapping (Manufactured by PANDUIT Corporation)  
Cross section: Extra heavy Width: 12.7 mm  
Banding (stainless steel banding)  
Holding power at wrapping: 30 N (3 kgf)  
Maximum clamping capacity: 60 N (6 kgf)



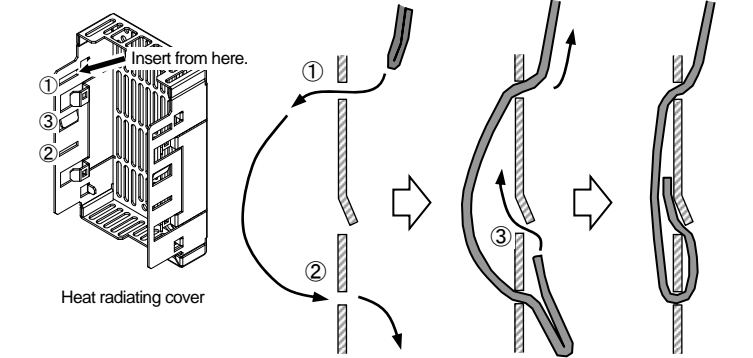
## Pipe hanging

- Fold the strapping for pipe hanging type at 20 to 30 mm from the edge.



Recommended banding and strapping [Model code: SB1P-B02]:  
Stainless steel banding and strapping (Manufactured by PANDUIT Corporation)  
Cross section: Heavy Width: 7.9 mm  
Allowable tensile force at hanging: 30 N (3 kgf)

- Secure the strapping by inserting an edge from inside of the Heat radiating cover. (Refer to the diagram below.)

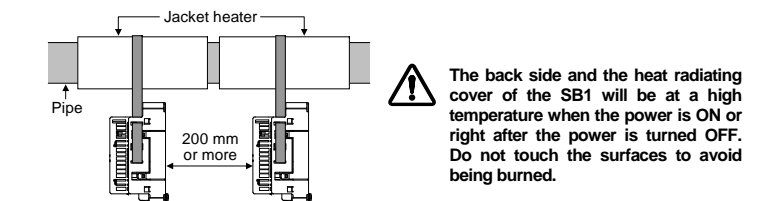


- Hang the strapping on the piping and secure the other edge of the strapping as described at No. 3.
- Mount the instrument to the Heat radiating cover.

The pipe hanging type may experience resonance between the pipe and the SB1. To avoid resonance, adjust the lengths of the strapping.

### Mounting space of SB1

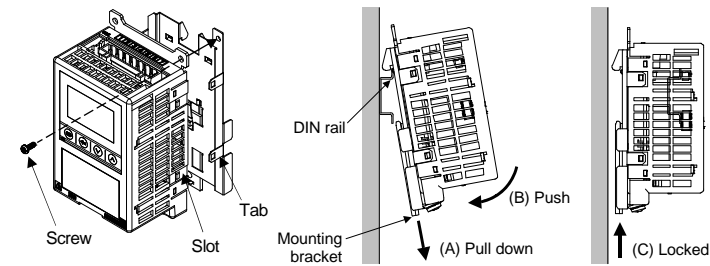
For pipe hanging type, allow sufficient space (200mm or more) between the instruments for heat radiation.



The back side and the heat radiating cover of the SB1 will be at a high temperature when the power is ON or right after the power is turned OFF. Do not touch the surfaces to avoid being burned.

### ■ DIN rail mounting

1. Install SB1 into the fitting by overlapping the 4 tabs of the fitting and the 4 slots of SB1 until the lock clicks. After installation, insert the supplied screw through the hole on SB1 into the fitting and tighten it firmly.
2. Pull down the mounting bracket at the bottom of the instrument (A). Attach the hooks on the top of the instrument to the DIN rail and push the lower section into place on the DIN rail (B).
3. Attach the hooks on the top of the instrument to the DIN rail and push the lower section into place on the DIN rail (B).



### 3. WIRING



To prevent electric shock or instrument failure, do not turn on the power until all wiring is completed. Make sure that the wiring is correct before applying power to the instrument.

#### 3.1 Wiring Cautions

- For thermocouple input, use the appropriate compensation wire.
- For RTD input, use low resistance lead wire with no difference in resistance between the three lead wires.
- To avoid noise induction, keep input/output signal wires away from instrument power line, load lines and power lines of other electric equipment.
- If there is electrical noise in the vicinity of the instrument that could affect operation, use a noise filter.
  - Shorten the distance between the twisted power supply wire pitches to achieve the most effective noise reduction.
  - Always install the noise filter on a grounded panel. Minimize the wiring distance between the noise filter output and the instrument power supply terminals to achieve the most effective noise reduction.
  - Do not connect fuses or switches to the noise filter output wiring as this will reduce the effectiveness of the noise filter.
- Allow approximately 5 seconds for contact output when the instrument is turned on. Use a delay relay when the output line is used for an external interlock circuit.
- Power supply wiring must be twisted and have a low voltage drop.
- This instrument is not provided with an overcurrent protection device. For safety install an overcurrent protection device (such as a fuse) with adequate breaking capacity close to the instrument. To connect a fuse to the instrument externally, select the one matches to the wiring conditions (such as wiring and load).
  - Fuse type: Time-lag fuse (Approved fuse according IEC 60127-2 and/or UL 248-14)
  - Fuse rating: Rated voltage 250 V AC, Rated current 25 A
- Use the connector below (sold separately) for the input/output connector (plug side).

#### Power supply/Event input/output/Communication connector [CN1] (upper-side connector)

Model code: SB1P-C02  
(Manufactured by WAGO Corporation: 721-2107/037-000)

Compatible cable diameter:  
12 AWG (2.5 mm<sup>2</sup>)  
Stripping length: 9 to 10 mm  
Wiring tool \*: SB1P-C13: Operating tool with partially isolated shaft type 2  
(Manufactured by WAGO Corporation: 210-720)

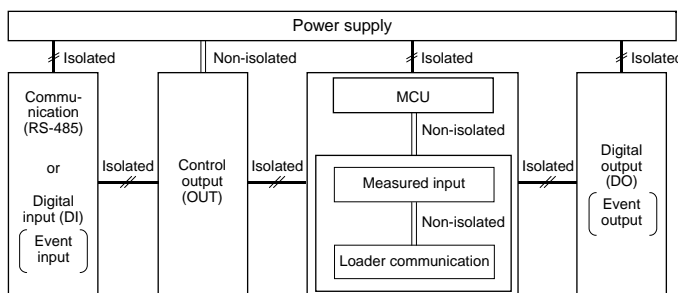
#### Measured input/Control output connector [CN2] (lower-side connector)

Model code: SB1P-C01  
(Manufactured by WAGO Corporation: 734-108/037-000)

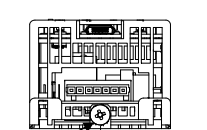
Compatible cable diameter:  
14 AWG (1.5 mm<sup>2</sup>)  
Stripping length: 6 to 7 mm  
Wiring tool \*: SB1P-C11: Operating tool with partially isolated shaft type 1  
(Manufactured by WAGO Corporation: 210-719)  
SB1P-C12: Push button (Connector operating lever)  
(Manufactured by WAGO Corporation: 734-230)

\* A small screwdriver can be used for wiring.

For isolated device input/output blocks, refer to the following:



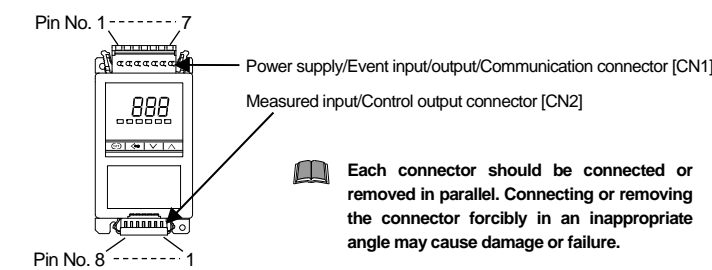
### 3.2 Protective Earth (PE) Terminal



Protective earth (PE) terminal  
SB1 bottom view

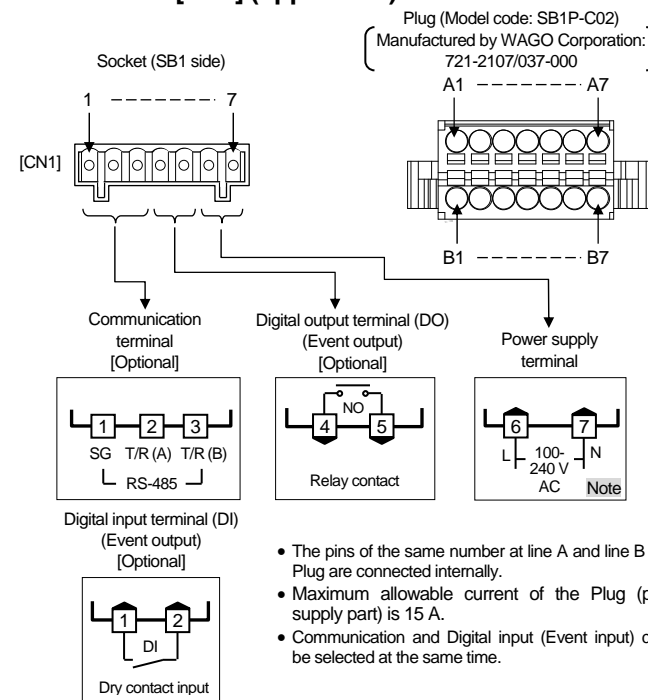
- Ground no other devices to the location where you ground this instrument.
- Avoid sharing earth lines with electric motors, motorized equipment, and other equipment that uses large amounts of electricity.
- In the earth system, be careful to earth each point and not to create an earth loop.
- Use wire of at least 2.0 mm<sup>2</sup> for earth lines.

### 3.2 Terminal Configuration



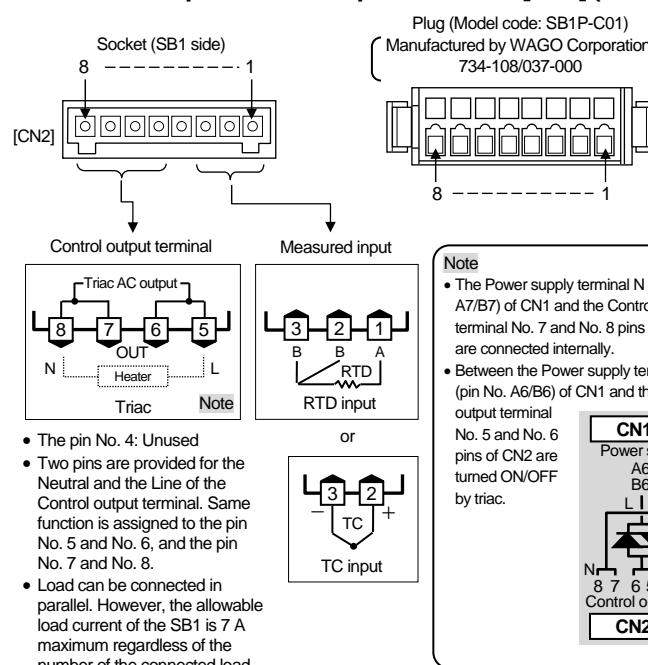
Each connector should be connected or removed in parallel. Connecting or removing the connector forcibly in an inappropriate angle may cause damage or failure.

#### ■ Power supply/Event input/output/Communication connector [CN1] (upper-side)



- The pins of the same number at line A and line B of the Plug are connected internally.
- Maximum allowable current of the Plug (power supply part) is 15 A.
- Communication and Digital input (Event input) cannot be selected at the same time.

#### ■ Measured input/Control output connector [CN2] (lower-side)



- The pin No. 4: Unused
- Two pins are provided for the Neutral and the Line of the Control output terminal. Same function is assigned to the pin No. 5 and No. 6, and the pin No. 7 and No. 8.
- Load can be connected in parallel. However, the allowable load current of the SB1 is 7 A maximum regardless of the number of the connected load.

### 4. SPECIFICATIONS

#### Measured input

Number of inputs:	1 point
Input type:	K, J (JIS-C1602-1995): 0 to 800 °C *, 0 to 999 °F * Pt100 (JIS-C1604-1997): 0 to 400 °C *, 0 to 800 °F *
• TC input	* Decimal point can be only set for communication data to be set by communication.
• RTD input	When selecting "With Decimal point" for communication data, SB1 displays the value rounded off to a whole number.
Sampling cycle:	0.25 seconds
Influence of external resistance:	Approx. 0.25 μV/Ω (Converted depending on TC types)
Influence of input lead:	Approx. 0.02 %/Ω of Measured value (PV) (RTD input) 10 Ω or less per wire
Input impedance:	1 MΩ or more
PV bias:	-199 to +999 °C [°F]
PV digital filter:	First order lag filter 0 to 100 seconds (0: Function OFF)

#### Digital input [optional]

Number of inputs:	1 point
Input method:	Dry contact input
Open state:	500 kΩ or more
Close state:	10 Ω or less
Contact current:	3.3 mA or less
Voltage at open:	Approx. 5 V DC
Capture judgment time:	0.25 seconds
Function:	SV1/SV2 selection, RUN/STOP transfer, AUTO/MAN transfer or Interlock release

#### Output

Number of outputs:	2 points
Output type:	• Triac output (control output)
Output method:	AC output (Zero-cross method)
Allowable load current:	7 A
	For the ambient temperature characteristic, refer to temperature characteristic graph (2.1 Mounting Cautions).
Load voltage:	100 to 240 V AC (Same as the power supply voltage)
Minimum load current:	50 mA
ON voltage:	1.5 V or less (at maximum load current)
Fuse:	Rated current 12.5 A (Not replaceable)
• Relay contact output (digital output)	
Contact type:	1a contact
Contact rating (Resistive load):	250 V AC 1 A, 30 V DC 0.5 A
Electrical life:	Electrical life: 150,000 times or more (Rated load)
Mechanical life:	20 million times or more (Switching: 360 times/min [no-load])

#### Control

Control type:	PID control
Additional function:	Autotuning, Startup tuning and Fine Tuning

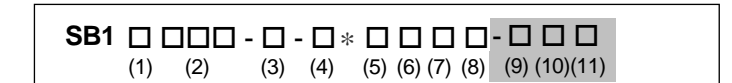
#### Communication

Interface:	Based on RS-485, EIA standard
	Multi-drop connection is available
Protocol:	RKC communication (ANSI X3.28-1976 subcategories 2.5 and A4) Modbus-RTU
Termination resistor:	Externally connected (Example: 120 Ω, 1/2W)

#### General specifications

Power supply voltage:	90 to 264 V AC [Including power supply voltage variation] (50/60 Hz) (Rating 100 to 240 V AC)
Power consumption (When a load is disconnected):	4.0 VA max. (at 100 V AC), Rush current: 5.6 A or less 6.7 VA max. (at 240 V AC), Rush current: 13.3 A or less Allowable current at crossover wiring: 15 A
Power consumption (When a load is disconnected in power saving mode):	3.0 VA max. (at 100 V AC) 5.2 VA max. (at 240 V AC) Allowable current at crossover wiring: 15 A
Power consumption (When a load is connected) [Ambient temperature: 40 °C]:	705 VA max. (When connecting a load equivalent to 7A at 100 V AC), Rush current: 5.6 A or less 1690 VA max. (When connecting a load equivalent to 7A at 240 V AC), Rush current: 13.3 A or less Allowable current at crossover wiring: 15 A
Allowable ambient temperature:	-10 to +60 °C
Allowable ambient humidity:	5 to 95 %RH (Absolute humidity: MAX.W.C 29 g/m <sup>3</sup> dry air at 101.3 kPa)
Installation environment conditions:	Indoor use Altitude up to 2000 m Approx. 130 g (Instrument only)
Weight:	
Standard	
Safety standards:	UL: UL 61010-1 cUL: CAN/CSA-C22.2 No.61010-1
CE marking:	EN61010-1 OVERVOLTAGE CATEGORY II, POLLUTION DEGREE 2 EN61326-1
• LVD:	
• EMC:	

### 5. MODEL CODE



□ : To preset specific settings for Event, specify the codes from No. 9 to No. 11. If not specified, these codes will not be printed on labels and all settings will be factory default.

- (1) Control Method  
F: PID control with AT (Reverse action)
- (2) Measured input and Range  
K04: Thermocouple K 0 to 800 °C KB1: Thermocouple K 0 to 999 °F  
J04: Thermocouple J 0 to 800 °C JAB: Thermocouple J 0 to 999 °F  
D17: RTD Pt100 0 to 400 °C DB4: RTD Pt100 0 to 800 °F
- (3) Control output  
T: Triac output
- (4) Power supply voltage  
4: 100 to 240 V AC
- (5) Digital output (DO)  
N: None 1: 1 point
- (6) Digital input (DI)/Communication function  
N: None 5: Communication function RS-485 (RKC communication)  
D: Digital input (1 point) 6: Communication function RS-485 (Modbus)
- (7) Mounting method  
N: Without fitting (Panel mounting)  
1: With fitting (Sold separately)
- (8) Quick start code  
N: No quick start code  
1: Specify quick start code
- (9) Event 1 type [Quick start code] and (10) Event 2 type [Quick start code]  
No code: No specify quick start code  
□: Refer to Event Type Code Table.
- (11) Digital output assignment [Quick start code]  
No code: No specify quick start code  
1: Event 1 3: Logical OR of Event 1 and Event 2  
2: Event 2 4: Logical AND of Event 1 and Event 2

#### ● Event Type Code Table

Code	Type	Code	Type
N	None	R	Deviation low with re-hold action
A	Deviation high	T	Deviation high/low with re-hold action
B	Deviation low	U	Band (High/Low individual setting)
C	Deviation high/low	V	SV high
D	Band	W	SV low
E	Deviation high with hold action	X	Deviation high/low (High/Low individual setting)
F	Deviation low with hold action	Y	Deviation high/low with hold action (High/Low individual setting)
G	Deviation high/low with hold action	Z	Deviation high/low with re-hold action (High/Low individual setting)
H	Process high	2	Control loop break alarm (LBA)
J	Process low	3	FAIL
K	Process high with hold action	4	Monitor during RUN
L	Process low with hold action	5	Output of the communication monitoring result
Q	Deviation high with re-hold action		

#### ■ Optional (Sold separately)

- Fitting  
SB1P-M01: Fitting for pipe wrapping type  
SB1P-M02: Fitting for pipe hanging type (Heat radiating cover)  
SB1P-M03: Fitting for DIN rail mounting type
- Connector  
SB1P-C01: Measured input /Control output connector [plug]  
(Manufactured by WAGO Corporation: 734-108/037-000)  
SB1P-C02: Power supply/Event input/output/Communication connector [plug]  
(Manufactured by WAGO Corporation: 721-2107/037-000)
- Wiring tool  
SB1P-C11: Operating tool for Measured input /Control output connector  
(Manufactured by WAGO Corporation: 210-719)  
SB1P-C12: Push button (Connector operating lever) for Measured input /Control output connector  
(Manufactured by WAGO Corporation: 734-230)  
SB1P-C13: Operating tool for Power supply/Event input/output/Communication connector  
(Manufactured by WAGO Corporation: 210-720)
- Strapping  
SB1P-B01: Strapping for pipe wrapping type  
Stainless steel strapping (Manufactured by PANDUIT Corporation)  
Cross section: Extra heavy Width: 12.7 mm Length: 594 mm  
SB1P-B02: Strapping for pipe hanging type  
Stainless steel strapping (Manufactured by PANDUIT Corporation)  
Cross section: Heavy Width: 7.9 mm Length: 1000 mm

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