# CONTROLLER

**Temperature/Process Controller**

# FB100

Green RoHS compliant

CE c℧us ✓

▣ Reinforced Insulation

**RKC**® **RKC INSTRUMENT INC.**

# High Performance 1/16 DIN size Controller

A 1/16 DIN unit (48x48mm) has been added to the FB series high performance and highly reliable controllers.
High performance control is achieved in a small installation space.

\* Some functions on FB100 may be limited compared to FB900/400

Green · RoHS compliant
CE · cᴿᵁus · C
□ Reinforced Insulation

**NEW**
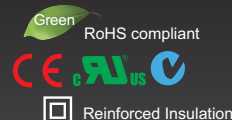
**Temperature/Process Controller**

## FB100

**High Performance** Controller

(Actual size)

## ● High performance

High accuracy : 0.1%
Selectable sampling time:
  50msec (Fast response) /100ms (Standard) /250msec (High resolution)
Brilliant II PID Control
  • Selectable PID control algorithm
    PV Derivative PID:  suitable for fixed setpoint control (Factory setting)
    Deviation derivative PID: suitable for ramp control using
                              ramp-to-setpoint function and cascade control
  • Ramp-to-setpoint/Output change rate limiter
  • Advanced Heat/Cool PID algorithm with Undershoot Suppression

## ● Easy maintenance

The internal assembly of the FB100 can be removed from the front.
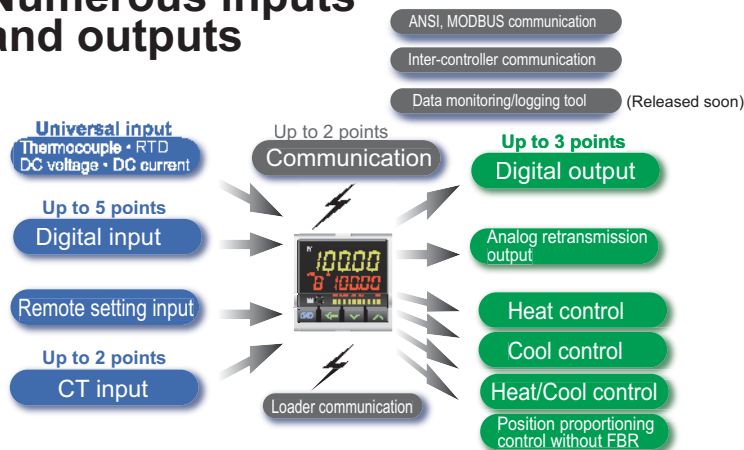
Plug-in lock released bar
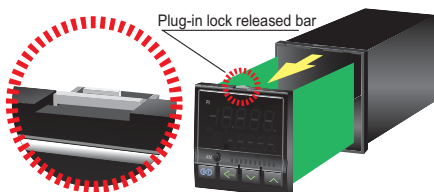
## ● Panel space saving: 74mm depth

The FB100 has very short depth as a 1/16 DIN size controller. The FB100 was designed with a mounting bracket that allows close horizontal mounting of as many as six units.

74mm

ECO
Panel space saving

## □ Reinforced Insulation

Reinforced insulation retains its insulating ability even when basic insulation breaks down. The power circuits in our instruments are designed with reinforced insulation and will save costs by eliminating the need for additional safety measures to prevent break-down shock.

<Requirements for electrical equipment according to safety standards>

The safety standards on electrical equipment (JISC 1010-1 and IEC 61010-1) require that the secondary side of the equipment which may be touched by the operator should be double insulated or reinforcement insulated\* from high voltage that would result in electric shock.

• Insulation safeguarding personnel from electric shock which is equal to double insulation or higher is called "reinforced insulation".

## ● Numerous inputs and outputs

ANSI, MODBUS communication
Inter-controller communication
Data monitoring/logging tool (Released soon)

Universal input
Thermocouple · RTD
DC voltage · DC current

Communication

Up to 3 points
Digital output

Up to 5 points
Digital input

Analog retransmission output

Remote setting input

Heat control

Up to 2 points
CT input

Cool control

Loader communication

Heat/Cool control

Position proportioning control without FBR

### User-friendly Keys and Display

One-touch Operation on Mode Selection, Memory Area Selection and Monitor

AUTO/MAN
LOC/REM
RUN/STOP
Memory area select
Monitor

Easy-to-read 5 Digit LED Display

Bar Graph display (10 LED segments)
• Control output value
• Setting value (SV)
• Measured value (MV)
• CT1/CT2 input
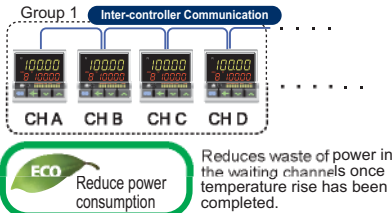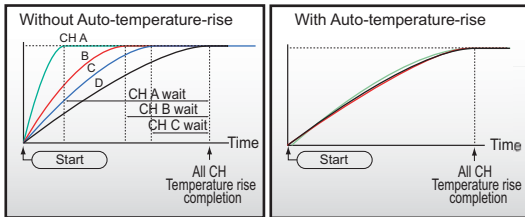• Deviation between SV and PV

Elastomer key tops

# Inter-controller Communication

Inter-controller communication achieves more precise cascade control and ratio control by sending data via digital communication while conventional cascade controllers send data to slave controllers by analog signal with less resolution.

## Auto-temperature-rise with Learning Function

Auto-temperature-rise with learning function achieves temperature uniformity at ramp-up without partial thermal expansion even when using multiple FB100 controllers.
• Up to 32 controllers with 16 groups can be configured.
• Auto-temperature-rise function is not available with position proportional PID control type.

Without Auto-temperature-rise
With Auto-temperature-rise

CH A
B
C
D
CH A wait
CH B wait
CH C wait
Time
Start
All CH Temperature rise completion

Time
Start
All CH Temperature rise completion

Group 1 — Inter-controller Communication
CH A   CH B   CH C   CH D

ECO Reduce power consumption

Reduces waste of power in the waiting channels once temperature rise has been completed.

## Temperature Ratio Setting

If the master controller changes the control set value, the slave controllers will also change the set values by following preset ratios to the master.
• Up to 32 controllers with 16 groups can be configured.

SV — Inter-controller Communication
Master    Slave
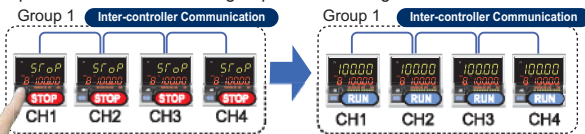Ratio SV   Ratio SV   Ratio SV
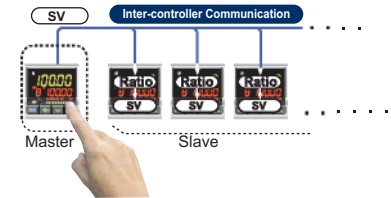
## Cascade Control

It is effective when a thermal time-delay exists between the heat source and a control point. A maximum of 31 slave controllers can be connected to one master controller.

MV — Inter-controller Communication
Master    Slave
Ratio SV   Ratio SV
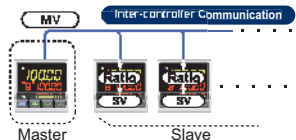
## Group RUN/STOP Function

When RUN/STOP mode is changed on one controller in a group, the mode of all the other controllers in the same group will be also automatically changed.
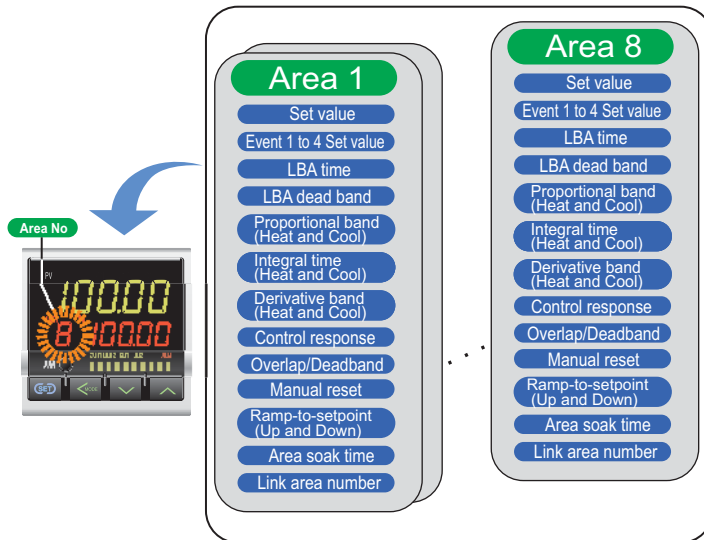• Up to 32 controllers with 16 groups can be configured.

Group 1 — Inter-controller Communication
STOP STOP STOP STOP
CH1  CH2  CH3  CH4

Group 1 — Inter-controller Communication
RUN RUN RUN RUN
CH1  CH2  CH3  CH4

(Note) Time lag among controllers caused by inter-controller communication is Max.70ms x number of controllers connected.
Please consider the time lag of inter-controller communication for high-speed process control in which process changes rapidly.
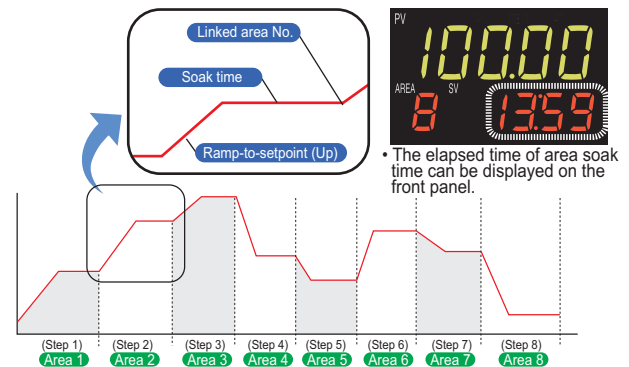
# Recipe (Multi-memory Area) Function

The FB100 has Multi-memory Area function which stores up to 8 sets of control parameters. Parameters in a memory area can be changed at one time by selecting the memory area number through key operation, DI, or communication.
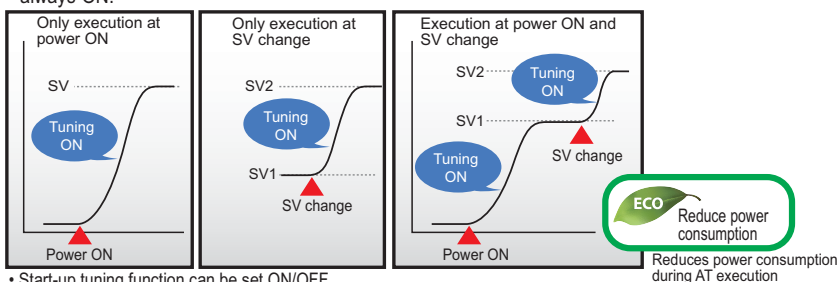
### Area 1
- Set value
- Event 1 to 4 Set value
- LBA time
- LBA dead band
- Proportional band (Heat and Cool)
- Integral time (Heat and Cool)
- Derivative band (Heat and Cool)
- Control response
- Overlap/Deadband
- Manual reset
- Ramp-to-setpoint (Up and Down)
- Area soak time
- Link area number

### Area 8
- Set value
- Event 1 to 4 Set value
- LBA time
- LBA dead band
- Proportional band (Heat and Cool)
- Integral time (Heat and Cool)
- Derivative band (Heat and Cool)
- Control response
- Overlap/Deadband
- Manual reset
- Ramp-to-setpoint (Up and Down)
- Area soak time
- Link area number

Area No

## ● Ramp/Soak Program Control

Up to 16-segment ramp/soak control is available by using the Memory Area function: area soak time, link area number, ramp-to-setpoint Up and Down.

Linked area No.
Soak time
Ramp-to-setpoint (Up)

PV  100.00
AREA 8   SV 13.59

• The elapsed time of area soak time can be displayed on the front panel.

(Step 1) Area 1   (Step 2) Area 2   (Step 3) Area 3   (Step 4) Area 4   (Step 5) Area 5   (Step 6) Area 6   (Step 7) Area 7   (Step 8) Area 8

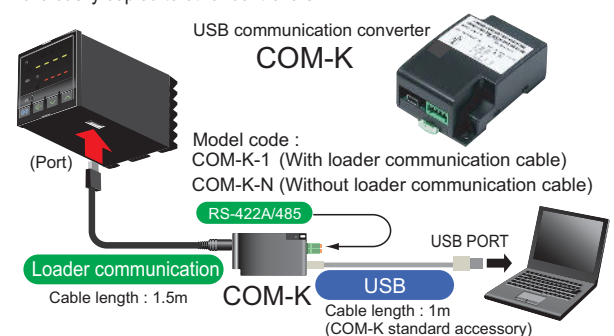# Start-up tuning to eliminate time for autotuning

Start-up tuning eliminates time required for conventional autotuning as it calculates optimum PID values by temperature characteristics at start up. It is useful in applications which require a long time for conventional autotuning. The timing of activation of start-up tuning can be selected from at power-up, at setpoint change, and at power-up/setpoint change. It is also settable to Only-once or always-ON.

Only execution at power ON
SV
Tuning ON
Power ON

Only execution at SV change
SV2
SV1
Tuning ON
SV change

Execution at power ON and SV change
SV2
SV1
Tuning ON
Tuning ON
Power ON
SV change

ECO Reduce power consumption

Reduces power consumption during AT execution

• Start-up tuning function can be set ON/OFF.
• Heater power needs to be turned on simultaneously with or before turning on power to the temperature controller.
• Start-up tuning (ST) is when the temperature differential of the measured value (PV) and set value (SV) is at least twice the proportional band at the start of start-up tuning (ST).
• If start-up tuning does not calculate suitable PID values due to characteristics of application, use Autotuning function.
• Start-up tuning function is not available with position proportional PID control type.

# Easy parameter setup via USB loader port

The FB series has a standard loader port to connect to a PC USB port via COM-K: USB communication converter.
Using Win-UCI software on the PC, parameter settings can be easily saved on the PC in CSV format, and the same parameter settings are easily copied to other controllers.

USB communication converter
COM-K

(Port)

Model code :
COM-K-1 (With loader communication cable)
COM-K-N (Without loader communication cable)

RS-422A/485
USB PORT

Loader communication
Cable length : 1.5m
COM-K
USB
Cable length : 1m
(COM-K standard accessory)

• The loader port is only for parameter setup.
• The power to COM-K is supplied from the PC via the USB port so no power supply is necessary.

3

# Specifications

## Input

| Input | • Universal input<br>a) Temperature, Current, Low voltage input group<br>  Thermocouple : K, J, E, T, R, S, B, N (JIS/IEC)<br>      PLII (NBS), W5Re/W26Re (ASTM)<br>      U, L (DIN)<br>  RTD : Pt100 (JIS/IEC), JPt100 (JIS)<br>    • 3-wire system<br>  Low voltage  (Input impedance :  More than 1MΩ)<br>    0 to 1V DC, 0 to 100mV, 0 to 10mV DC<br>    -100 to +100mV DC, -10 to +10mV DC<br>  Current (Input impedance :  50Ω)<br>    4 to 20mA, 0 to 20mA<br>b) High voltage input group<br>  High voltage  (Input impedance :  1MΩ)<br>    -1 to +1V DC, 0 to 5V DC, 1 to 5V DC, 0 to 10V DC<br>  (Use dip switch to change input group.) |
|---|---|
| Sampling time | 0.1sec<br>• 0.05sec/0.25sec is selectable. |
| Influence of external resistance | 0.2μV/Ω (Thermocouple input) |
| Influence of lead resistance | 0.01% of reading/Ω  (RTD input)<br>• Maximum 10Ω  per wire |
| Input break action | Thermocouple input : Up-scale/Down-scale (Selectable)<br>RTD input :       Up-scale<br>Low voltage input :  Up-scale/Down-scale (Selectable)<br>Current input :     Value around 0mA<br>High voltage input :  Value around 0V |
| Input short action | Down-scale  (RTD input) |
| Input digital filter | 0.1 to 100.0 sec. (OFF when 0 is set.) |
| PV bias | -span to +span |
| PV ratio | 0.500 to 1.500 |
| Square root extraction | PV = √(Input value x PV ratio + PV bias)<br>Low level cut off : 0.00 to 25.00% of span |

## Control

| Control method | a) Brilliant II PID control<br>  • Direct action/Reverse action is selectable<br>b) Brilliant II PID control (Heat/Cool type)<br>c) Position proportioning control without feedback resistance<br>  • a), b), c) is selectable |
|---|---|
| Autotuning | a) For PID control (Direct action/Reverse action)<br>b) For Heat/Cool PID control (For extruder, air cooling)<br>c) For Heat/Cool PID control (For extruder, water cooling)<br>d) For Heat/Cool PID control |
| Start-up tuning | The condition to activate Start-up tuning is selectable among a) to g).<br>a) At power-on, one-time tuning<br>b) At SV change, one-time tuning<br>c) At power-on and SV change, one-time tuning<br>d) At power-on, always on<br>e) At SV change, always on<br>f) At power-on and SV change, always on<br>g) Function off<br>(Not available for Heat/Cool PID control type) |
| Setting range | a) Proportional band :<br>    Temperature : 0 to input span (°C,°F)<br>    Voltage/Current input : 0.0 to 1000.0% of input span<br>     (ON/OFF control when P = 0)<br>    • Differential gap at ON/OFF control (High/Low individual setting) :<br>    Temperature input : 0 to input span (°C,°F)<br>    Voltage/Current input : 0.0 to 10.0% of input span<br>b) Integral time : 0 to 3600 sec or 0.0 to 1999.9 sec (selectable)<br>          (PD control when I = 0)<br>c) Derivative time : 0 to 3600 sec or 0.0 to 1999.9 sec (selectable)<br>          (PI control when D = 0)<br>d) Cool side proportional band :<br>    Temperature input : 1(0.1, 0.01) to input span (°C,°F)<br>    Voltage/Current input : 0.1 to 1000.0% of input span<br>e) Cool side Integral time :<br>    0 to 3600 sec or 0.0 to 1999.9 sec (selectable)<br>          (PD control when I = 0)<br>f) Cool side Derivative time :<br>    0 to 3600 sec or 0.0 to 1999.9 sec (selectable)<br>          (PI control when I = 0)<br>g) Overlap/Deadband<br>    Temperature input :  -span to +span (°C,°F)<br>    Voltage/Current input : -100.0 to +100.0% of input span<br>h) Control response : Slow, Medium, Fast<br>i) Ramp-to-setpoint<br>    0 to span per Time<br>    (Time is settable between 1 and 3600 sec)<br>    Up/Down individual setting<br>j) Output limiter : -5.0 to +105.0% (High/Low individual setting)<br>k) Output change rate limiter : 0.0 to 100.0%/sec<br>          (Up/Down individual setting)<br>l) Proportional cycle time : 0.1 to 100.0 sec<br>m) Cool side proportional cycle time : 0.1 to 100.0 sec<br>n) Manual reset : -100.0 to +100.0%<br>o) Output at Control Stop mode : -5.0 to +105.0%<br>          (Heat side/Cool side individual setting) |

## Position Proportional Control

| Motor time | 5 to 1000 sec |
|---|---|
| Integral output limiter | OFF, 0.1 to 250.0% of motor time |
| Neutral zone | 0.1 to 10.0% |
| Differential gap | 0.1 to 5.0% |
| Output at Control Stop mode | Selectable from the following :<br>a) Close : Output off, Open : Output off<br>b) Close : Output on, Open : Output off<br>c) Close : Output off, Open : Output on |

## Performance

| Measuring accuracy | a) Thermocouple<br>    Type : K, J, T, E, PLII, U, L<br>    Less than -100°C (-148°F) : ±1.0°C (±1.8°F)<br>    -100 to +500°C (-148 to 932°F) : ±0.5°C (±0.9°F)<br>    More than 500°C (932°F) : ±(0.1% of reading + 1 digit)<br>    Type : N, S, R, W5Re/W26Re<br>    Less than 0°C (32°F) : ±2.0°C (±3.6°F)<br>    0 to 1000°C (32 to 1832°F) : ±1.0°C (±1.8°F)<br>    More than 1000°C (1832°F) : ±(0.1% of reading + 1 digit)<br>    Type B<br>    Less than 400°C (752°F) : ±70.0°C (±126°F)<br>    400 to 1000°C (752 to 1832°F) : ±1.0°C (±1.8°F)<br>    More than 1000°C (1832°F) : ±(0.1% of reading + 1 digit)<br>    • Cold junction temperature compensation error<br>    ±1.0°C (1.8°F) [Between 5 and 40°C (41 and 104°F)]<br>    ±1.5°C (2.7°F) [Between -10 and 5°C (16 and 41°F), and<br>              40 and 50°C (104 and 122°F)]<br>b) RTD<br>    Less than 200°C (392°F) : ±0.2°C (±0.4°F)<br>    More than 200°C (392°F) : ±(0.1% of reading + 1 digit)<br>c) DC voltage and DC current<br>    ±(0.1% of span) |
|---|---|
| Close horizontal mounting error | ±1.5°C (2.7°F) |
| Insulation resistance | More than 20MΩ (500V DC) between measured terminals and ground<br>More than 20MΩ (500V DC) between power terminals and ground<br>More than 20MΩ (500V DC) between measured and power terminals |
| Dielectric voltage | 1500V AC for one minute between measured terminals and ground<br>1500V AC for one minute between power terminals and ground<br>2300V AC for one minute between measured and power terminals |

## Output

| Number of outputs | Up to 2 points (OUT1, OUT2) |
|---|---|
| Output function | Control output, HBA output, FAIL output<br>• See output allocation table (page 7) |
| Output signal | a) Relay contact output, Form a contact<br>    250V AC 3A (Resistive load)<br>    • Electric life : 100,000 cycles or more<br>b) Voltage pulse output,  0/12V DC<br>    (Load resistance : More than 600Ω)<br>c) Current output, 4 to 20mA DC, 0 to 20mA DC<br>    (Load resistance : Less than 600Ω)<br>d) Continuous voltage output,<br>    0 to 5V DC, 1 to 5V DC, 0 to 10V DC<br>    (Load resistance : More than 1kΩ)<br>e) SSR (Triac) output, Rated current : 0.5A<br>f) Open collector output (Sink type)<br>    Load voltage : Less than 30V DC<br>    Load current : Less than 100mA<br>    ON voltage : Less than 2V (at maximum load current) |

## Digital Output (DO)                    (Standard)

| Number of outputs | Up to 2 points (DO 1 to 2) |
|---|---|
| Output function | Event output, Heater break alarm (HBA), FAIL |
| Output signal | Relay contact output, Form a contact<br>250V AC 1A (Resistive load) |

## Multi-Memory Area (recipe)

| Number of areas | 8 areas (recipes) |
|---|---|
| Stored parameters | Set value (SV), Event set values 1 to 4, LBA time, LBA dead band,<br>Proportional band, Integral time, Derivative time,<br>Cool side proportional band, Cool side integral time<br>Cool side derivative time, Overlap/Deadband, Manual reset<br>Control response parameter, Ramp-to-setpoint (Up/Down)<br>Soak time, Linking area number |
| Soak time | 0 min 00 sec to 199 min 59 sec or<br>0 hr 0 min to 99 hr 59 min<br>(selectable) |
| Linking area number | OFF, 1 to 8 |

# Specifications

## Event (Alarm) (Standard)

| | |
|---|---|
| Number of events | Up to 4 points |
| Event type | Process high, Process low, Deviation high, Deviation low Deviation high/low, Band, Set value high, Set value low, MV value high, MV value low, Cool side MV value high, Cool side MV value low, FBR value high, FBR value low,, LBA (Control loop break alarm) • LBA is assignable to event 4. |
| Setting range | a) Deviation alarm<br>    Event set value : -input span to +input span<br>    Event action differential gap : 0 to input span<br>b) Process alarm/Set value alarm<br>    Event set value : Same as input range<br>    Event action differential gap : 0 to input span<br>c) MV alarm, FBR alarm<br>    -5.0 to +105.0%<br>d) LBA<br>    LBA time : 0 to 7200 sec (LBA is OFF when 0 is set.)<br>    Dead band : 0 to input span |
| Output terminals | Assignable to digital output (DO 1 to 2) or Output 2 (OUT2) • See output allocation table (page 7) |
| Other functions | a) Hold/Re-hold action (Valid for deviation/band/process alarm only)<br>  • Hold action is activated at Power-up and STOP to RUN.<br>   Re-hold action is activated at Power-up, STOP to RUN<br>   and the control set value change.<br>b) Event action is configurable in case of input abnormality.<br>c) Energized/de-energized action is configurable.<br>d) Delay timer : 0.0 to 600.0 sec<br>e) Interlock (latch) function is configurable. |

## Heater Break Alarm (HBA) (Optional)

| | |
|---|---|
| Number of alarms | 2 points (1 point per CT input) |
| CT Type and input range | CTL-6-P-N : 0 to 30A<br>CTL-12-S56-10L-N : 0 to 100A |
| Display range | 0.0 to 100.0A |
| Display accuracy | ±(5% of input value + 1 digit) or 2A  (whichever is larger) |
| Output terminals | Assignable to output 2 or digital output (DO 1 to 2) • See output allocation table (page 7) |

## Digital Input (DI) (Optional)

| | |
|---|---|
| Number of inputs | Up to 5 points (DI 1 to 5) |
| Input method | Non-voltage contact input |
| Function | Memory area selection (Area set/No area set is selectable) RUN/STOP, Remote/Local, Auto/Manual, Alarm interlock reset • Selectable • See digital input allocation table (page 7) |

## Remote Setpoint Input (Optional)

| | |
|---|---|
| Input | a) Low voltage group<br>    0 to 1V DC, 0 to 100mV DC, 0 to 10mV DC<br>b) High voltage group<br>    0 to 5V DC, 1 to 5V DC, 0 to 10V DC<br>c) Current group<br>    4 to 20mA DC, 0 to 20mA DC<br>• Universal input<br>• Not isolated from measured input |
| Sampling time | 0.1 sec (with measuring input sampling time of 0.05 sec)<br>0.2 sec (with measuring input sampling time of 0.1 sec)<br>0.5 sec (with measuring input sampling time of 0.25 sec) |
| Accuracy | ±0.1% of span |

## Analog Retransmission Output (AO) (Optional)

| | |
|---|---|
| Number of outputs | 1 point |
| Output type | Measured value (PV), Set value (SV) Manipulated value (MV), Deviation (between PV and SV) • Selectable |
| Output signal | 4 to 20mA DC, 0 to 20mA DC<br> (Load resistance : Less than 600Ω)<br>0 to 1V DC, 0 to 5V DC, 1 to 5V DC, 0 to 10V DC<br> (Load resistance : More than 1kΩ) |
| Resolution | Approx. 1/4000 |
| Output accuracy | ±0.1% of span |

## Feedback Resistance (FBR) Input (Optional)

| | |
|---|---|
| Resistance value | Standard : 100 to 10kΩ (factory default 135Ω) |
| Sampling time | 0.1 sec (with measuring input sampling time of 0.05 sec)<br>0.2 sec (with measuring input sampling time of 0.1 sec)<br>0.5 sec (with measuring input sampling time of 0.25 sec) |

## Communications (Optional)

| | |
|---|---|
| Communication method | COM1 : RS-485 |
| Communication speed | 2400bps, 4800bps, 9600bps, 19200bps, 38400bps |
| Protocol | a) ANSI X3.28 sub-category 2.5A4 (RKC standard)<br>b) MODBUS-RTU |
| Bit format | a) RKC standard protocol<br>    Start bit : 1<br>    Data bit : 7 or 8<br>    Parity bit : 1 (odd or even) or none<br>    Stop bit : 1 or 2<br>b) MODBUS protocol<br>    Start bit : 1<br>    Data bit : 8 (binary or byte data)<br>    Parity bit : 1 (odd or even) or none<br>    Stop bit : 1 or 2 |
| Maximum connection | 32 units (Including host) |

## Inter-controller Communication (Optional)

Function : Auto-temperature-rise, Cascade control,
         Temperature ratio setting, Group STOP/RUN

## Loader communication

| | |
|---|---|
| Protocol | ANSI X3.28 sub-category 2.5A4 (RKC standard) |
| Communication speed | 38400bps |
| Bit format | Start bit : 1, Data bit : 8, Parity bit : none, Stop bit : 1 |
| Maximum connection | 1 unit (Address : 0) |

## Waterproof/Dustproof (Standard)

NEMA4X, IP66
• Waterproof/Dustproof protection only effective from the front in panel mounted installation.

## General Specifications

| | |
|---|---|
| Supply voltage | a) 90 to 264V AC (50/60Hz, Selectable)<br>    Rating : 100 to 240V AC<br>b) 24V AC ±10% (50/60Hz, Selectable)<br>    Rating : 24V AC<br>c) 24V DC ±10%<br>    Rating : 24V DC |
| Power consumption | a) 100 to 240V AC type<br>    5.4VA (240V), 8.1VA (100V)<br>b) 24V AC type<br>    5.3VA<br>c) 24V DC type<br>    142mA |
| Rush current | Less than 12A |
| Power failure | A power failure of 20m sec or less will not affect the control action. If power failure of more than 20m sec occurs, controller will restart with the state of HOT start 1, HOT start 2 or COLD start (selectable) |
| Memory backup | Backed up by non-volatile memory (FRAM)<br>• Data retaining period : Approx. 10 years<br>• Number of writing : Approx. 1,000,000,000,000,000 times. (Depending on storage and operating conditions.) |
| Ambient temperature | -10 to +50°C (14 to 122°F) |
| Ambient humidity | 5 to 95% RH (Non condensing)<br>• Absolute humidity : MAX.W.C 29g/m$^3$ dry air at 101.3kPa |
| Weight | Approx. 150g |
| Operating environment | Free from corrosive and flammable gas and dust. Free from external noise, vibration, shock and exposure to direct sunlight. |
| Compliance with Standards | CE Mark, UL, C-UL, C-Tick mark |

# Model and Suffix Code

| Specifications | | | Model and Suffix Code | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Hardware coding only | | | | | | Quick start code 1 | | | | |
| | | | | | | ① | ② | ③ | ④ | ⑤ | ⑥ | ⑦ | ⑧ | | ⑨ | |
| | | (48 x 48mm 1/16 DIN size) | **FB100** − | | − | − * | / | | − | | | | | | /Y | |
| ① | Output 1 (OUT 1) | Relay contact output | **M** | | | | | | | | | | | | | |
| | | Voltage pulse output (0/12V DC) | **V** | | | | | | | | | | | | | |
| | | DC mA, V — See Output Code Table | □ | | | | | | | | | | | | | |
| | | Triac output | **T** | | | | | | | | | | | | | |
| | | Open collector output | **D** | | | | | | | | | | | | | |
| ② | Output 2 (OUT 2) *1 | Not supplied | | **N** | | | | | | | | | | | | |
| | | Relay contact output | | **M** | | | | | | | | | | | | |
| | | Voltage pulse output (0/12V DC) | | **V** | | | | | | | | | | | | |
| | | DC mA, V — See Output Code Table | | □ | | | | | | | | | | | | |
| | | Triac output | | **T** | | | | | | | | | | | | |
| | | Open collector output | | **D** | | | | | | | | | | | | |
| ③ | Power Supply | 24V AC/DC | | | **3** | | | | | | | | | | | |
| | | 100 to 240V AC | | | **4** | | | | | | | | | | | |
| ④ | Optional function *2, *3 | Not supplied | | | | **N** | | | | | | | | | | |
| | | Digital input 5 points | | | | **A** | | | | | | | | | | |
| | | Digital input 2 points + Remote setpoint input | | | | **B** | | | | | | | | | | |
| | | Digital input 2 points + Feedback resistance input | | | | **C** | | | | | | | | | | |
| | | Digital input 2 points + CT input 2 points | | | | **D** | | | | | | | | | | |
| | | Digital input 3 points + Communication 1 point | | | | **E** | | | | | | | | | | |
| | | Digital input 1 point + Communication 1 point + CT input 1 point | | | | **F** | | | | | | | | | | |
| | | Communication 2 points | | | | **G** | | | | | | | | | | |
| | | Communication 1 point + CT input 2 points | | | | **H** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 0 to 1V DC | | | | **3** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 0 to 5V DC | | | | **4** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 0 to 10V DC | | | | **5** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 1 to 5V DC | | | | **6** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 0 to 20mA | | | | **7** | | | | | | | | | | |
| | | Digital input 1 point + Remote setpoint input + Analog retransmission  output 4 to 20mA | | | | **8** | | | | | | | | | | |
| ⑤ | Case color | White case | | | | | **N** | | | | | | | | | |
| | | Black case | | | | | **A** | | | | | | | | | |
| ⑥ | Quick start code | No quick start code (Default setting) | | | | | | **N** | | | | | | | | |
| | | Specify quick start code 1 | | | | | | **1** | | | | | | | | |
| | | Specify quick start code 1 and 2 (See page 11) | | | | | | **2** | | | | | | | | |
| ⑦ | Control Method | No quick start code | | | | | | | **No Code** | | | | | | | |
| | | PID control with AT (Reverse action) ♦ | | | | | | | **F** | | | | | | | |
| | | PID control with AT (Direct action) | | | | | | | **D** | | | | | | | |
| | | Heat/Cool PID control with AT | | | | | | | **G** | | | | | | | |
| | | Heat/Cool PID control with AT for extruder (Air cooling type) | | | | | | | **A** | | | | | | | |
| | | Heat/Cool PID control with AT for extruder (Water cooling type) | | | | | | | **W** | | | | | | | |
| | | Position proportional PID control without FBR | | | | | | | **Z** | | | | | | | |
| ⑧ | Input and range | No quick start code | | | | | | | | **No Code** | | | | | | |
| | | See Input range Code Table | | | | | | | | □□□ | | | | | | |
| ⑨ | Instrument version | Version symbol | | | | | | | | | **/Y** | | | | | |

♦ Default setting
• Digital output (DO1, DO2) : Standard function
*1 : When Heat Control or Cool Control is selected, output 2 is available for Event Output, HBA Output and FAIL Output. See Output Allocation Table (page 7).
*2 : See Digital Input (DI) Allocation Table (page 7).
*3 : When HBA (heater break alarm) is used , select the "CT input" from the model code.

## Accessories (Sold separately)

### ● Current transformer for heater break alarm (HBA)



| Model code | (Unit : mm) |
|---|---|
| CTL−6−P−N (0 to 30A) | |
| CTL−12−S56−10L−N (0 to 100A) | |

CTL−6−P−N

CTL−12−S56−10L−N
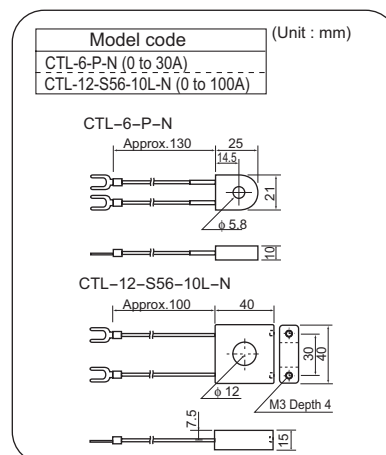
### ● Terminal Cover



Model Code : KCA100-517

### ● Front Cover



Model Code : KRB100-36A

## Output Code Table

| Output Type | Code | Output Type | Code |
|---|---|---|---|
| 0 to 5V DC | **4** | 0 to 20mA DC | **7** |
| 0 to 10V DC | **5** | 4 to 20mA DC | **8** |
| 1 to 5V DC | **6** | | |

## Input Range Code Table

### Thermocouple

| Input | Code | Range | Input | Code | Range | Input | Code | Range |
|---|---|---|---|---|---|---|---|---|
| K | K 35 | -200.0 to +400.0℃ | J | J C7 | -200.0 to +700.0℉ | PLII (NBS) | A 02 | 0 to 1390℃ |
| | K 40 | -200.0 to +800.0℃ | | J C6 | -328.0 to +1200.0℉ | | A A2 | 0 to 2534℉ |
| | K 09 | 0.0 to 400.0℃ | | J B6 | 0.0 to 800.0℉ | W5Re/W26Re (ASTM) | W 03 | 0 to 2300℃ |
| | K 10 | 0.0 to 800.0℃ | | J B9 | -328 to +2192℉ | | W A2 | 0 to 4200℉ |
| | K 41 ♦ | -200 to +1372℃ | | J A1 | 0 to 800℉ | U (DIN) | U 04 | 0.0 to 600.0℃ |
| | K 02 | 0 to 400℃ | | J A2 | 0 to 1600℉ | | U B2 | 32.0 to 1112.0℉ |
| | K 04 | 0 to 800℃ | T | T 19 | -200.0 to +400.0℃ | L (DIN) | L 04 | 0.0 to 900.0℃ |
| | K C6 | -250.0 to +800.0℉ | | T C2 | -328.0 to +752.0℉ | | L A9 | 32.0 to 1652.0℉ |
| | K C4 | -328.0 to +400.0℉ | S | S 06 | -50 to +1768℃ | | | |
| | K A4 | 0 to 800.0℉ | | S A7 | -58 to +3214℉ | | | |
| | K C5 | -328 to +2502℉ | R | R 07 | -50 to +1768℃ | | | |
| | K A1 | 0 to 800℉ | | R A7 | -58 to +3214℉ | | | |
| | K A2 | 0 to 1600℉ | E | E 21 | -200.0 to +700.0℃ | | | |
| J | J 27 | -200.0 to +400.0℃ | | E 06 | -200 to +1000℃ | | | |
| | J 32 | -200.0 to +800.0℃ | | E A9 | -328.0 to +1292.0℉ | | | |
| | J 08 | 0.0 to 400.0℃ | | E B1 | -328 to +1832℉ | | | |
| | J 09 | 0.0 to 800.0℃ | B | B 03 | 0 to 1800℃ | | | |
| | J 15 | -200 to +1200℃ | | B B2 | 0 to 3272℉ | | | |
| | J 02 | 0 to 400℃ | N | N 02 | 0 to 1300℃ | | | |
| | J 04 | 0 to 800℃ | | N A7 | 0 to 2372℉ | | | |

♦ Default setting

### RTD

| Input | Code | Range |
|---|---|---|
| Pt100 | D 34 | -100.00 to +100.00℃ |
| | D 35 | -200.0 to +850.0℃ |
| | D 21 | -200.0 to +200.0℃ |
| | D C8 | -199.99 to +199.99℉ |
| | D C9 | -328.0 to +1562.0℉ |
| | D D1 | -200.0 to +200.0℉ |
| JPt100 | P 29 | -100.00 to +100.00℃ |
| | P 30 | -200.0 to +640.0℃ |
| | P C8 | -199.99 to +199.99℉ |
| | P C9 | -328.0 to +1184.0℉ |
| | P D1 | -200.0 to +200.0℉ |

### DC Current・voltage

| Input | Code | Range |
|---|---|---|
| 0 to 10mV | 1 01 | |
| 0 to 100mV | 2 01 | |
| 0 to 1V | 3 01 | 0.0 to 100.0% |
| 0 to 5V | 4 01 | |
| 0 to 10V | 5 01 | |
| 1 to 5V | 6 01 | |

| Input | Code | Range |
|---|---|---|
| 0 to 20mA*1 | 7 01 | |
| 4 to 20mA*1 | 8 01 | 0.0 to 100.0% |
| -100 to +100mV | 9 01 | |
| -1 to +1V | 9 02 | |
| -10 to 10mV | 9 03 | |

*1 : Shunt resistor is not required for current input.

## Quick start code

- Quick start code tells the factory to ship with each parameter preset to the values detailed as specified by the customer.
  Quick start code is not necessarily specified when ordering, unless the preset is requested.
  These parameters are software selectable items and can be re-programmed in the field via the manual.

| | Specifications | Quick start code | ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ |
|---|---|---|---|
| ① | Output allocation | (See output allocation table) | □□ |
| ② | Digital input allocation | (See Digital input allocation table) | □□ |
| ③ | Remote setpoint input signal | No Remote setpoint input signal | N |
| | | 0 to 10mV DC | 1 |
| | | 0 to 100mV DC | 2 |
| | | 0 to 1V DC | 3 |
| | | 0 to 5V DC | 4 |
| | | 0 to 10V DC | 5 |
| | | 1 to 5V DC | 6 |
| | | 0 to 20mA DC | 7 |
| | | 4 to 20mA DC | 8 |
| ④ | Event 1 type | No event 1 | N |
| | | (See event type code table) | □ |
| ⑤ | Event 2 type | No event 2 | N |
| | | (See event type code table) | □ |
| ⑥ | Event 3 type | No event 3 | N |
| | | (See event type code table) | □ |
| ⑦ | Event 4 type | No event 4 | N |
| | | (See event type code table) | □ |
| | | Control loop break alarm (LBA) | 5 |
| ⑧ | CT type | No CT1 and CT2 | N |
| | | CT1 : CTL-6-P-N,  CT2 : No use | P |
| | | CT1 : CTL-12-S56-10L-N, CT2 : No use | S |
| | | CT1 : CTL-6-P-N,  CT2 : CTL-6-P-N | T |
| | | CT1 : CTL-12-S56-10L-N, CT2 : CTL-12-S56-10L-N | U |
| ⑨ | Communication 1 | No communication 1 (COM1) | N |
| | | ANSI/RKC standard protocol | 1 |
| | | MODBUS protocol | 2 |
| | | Inter-controller protocol | A |

### Event Code Table
(Programmable)

| Code | Event type |
|---|---|
| A | Deviation High |
| B | Deviation Low |
| C | Deviation High/Low |
| D | Band |
| E | Deviation High with Alarm Hold |
| F | Deviation Low with Alarm Hold |
| G | Deviation High/Low with Alarm Hold |
| H | Process High |
| J | Process Low |
| K | Process High with Alarm Hold |
| L | Process Low with Alarm Hold |
| Q | Deviation High with Alarm Re-Hold |
| R | Deviation Low with Alarm Re-Hold |
| T | Deviation High/Low with Alarm Re-Hold |
| V | Set value High |
| W | Set value Low |
| 1 | MV value High |
| 2 | MV value Low |
| 3 | Cool side MV value High |
| 4 | Cool side MV value Low |

- Default setting when no quick start code is specified.
  CT type : CTL-6-P-N
  Communication 2 :ANSI/RKC standard protocol
- Communication 2 is for inter-controller communication.

### Output Allocation Table
♦ Default setting

| Code | Output 1 (OUT 1) | Output 2 (OUT 2) | Digital Output 1 (DO 1) | Digital Output 2 (DO 2) |
|---|---|---|---|---|
| 01♦ | Control output 1 | Control output 2 | Event 1 | Event 2 |
| 02 | Control output 1 | Control output 2 | Event 1 | Event 4 |
| 03 | Control output 1 | Control output 2 | Event 1 | HBA |
| 04 | Control output 1 | Control output 2 | Event 1 | FAIL (De-energized) |
| 05 | Control output 1 | Control output 2 | Event 4 | HBA |
| 06 | Control output 1 | Control output 2 | Event 4 | FAIL (De-energized) |
| 07 | Control output 1 | Control output 2 | HBA | FAIL (De-energized) |
| 08 | Control output 1 | HBA | Event 1 | Event 2 |
| 09 | Control output 1 | HBA | Event 1 | Event 4 |
| 10 | Control output 1 | HBA | Event 1 | FAIL (De-energized) |
| 11 | Control output 1 | HBA | Event 4 | FAIL (De-energized) |
| 12 | Control output 1 | FAIL (De-energized) | Event 1 | Event 2 |
| 13 | Control output 1 | FAIL (De-energized) | Event 1 | Event 4 |
| 14 | Control output 1 | Event 1 | Event 2 | Event 3 |
| 15 | Control output 1 | Event 4 | Event 1 | Event 2 |

- Energized/De-energized is configurable except for the FAIL output.
  (Factory default setting: Energized)
- (Caution)
- Invalid for a non-existing output/input function.
- When used as heating/cooling control/position proportioning control, select any code of 01 to 07.
- Remote/Local transfer can be done during cascade control and ratio control by inter-controller communication.

### Digital input (DI) Allocation Table
♦ Default setting

| Code | DI 1 | DI 2 | DI 3 | DI4 | DI 5 | Selectable optional Code |
|---|---|---|---|---|---|---|
| 01♦ | Unused | | | | | ——— |
| 02 | Memory area selection (1 to 8) | | | Area set | RUN/STOP | A |
| 03 | Memory area selection (1 to 8) | | | Area set | | |
| 04 | Memory area selection (1 to 8) | | | Area set | AUTO/MANUAL | |
| 05 | Memory area selection (1 to 8) | | | Area set | Alarm interlock reset | |
| 06 | Memory area selection (1 to 8) | | | RUN/STOP | | |
| 07 | Memory area selection (1 to 8) | | | RUN/STOP | AUTO/MANUAL | |
| 08 | Memory area selection (1 to 8) | | | RUN/STOP | Alarm interlock reset | |
| 09 | Memory area selection (1 to 8) | | | | AUTO/MANUAL | |
| 10 | Memory area selection (1 to 8) | | | | Alarm interlock reset | |
| 11 | Memory area selection (1 to 8) | | | AUTO/MANUAL | Alarm interlock reset | |
| 12 | Memory area selection (1 to 8) | | | | | |
| 13 | RUN/STOP | REMOTE/LOCAL | AUTO/MANUAL | | | A, E |
| 14 | RUN/STOP | REMOTE/LOCAL | Alarm interlock reset | | | |
| 15 | RUN/STOP | AUTO/MANUAL | Alarm interlock reset | | | |
| 16 | REMOTE/LOCAL | AUTO/MANUAL | Alarm interlock reset | | | |
| 17 | RUN/STOP | REMOTE/LOCAL | | | | A, B, C, D, E |
| 18 | RUN/STOP | AUTO/MANUAL | | | | |
| 19 | RUN/STOP | Alarm interlock reset | | | | |
| 20 | REMOTE/LOCAL | AUTO/MANUAL | | | | |
| 21 | REMOTE/LOCAL | Alarm interlock reset | | | | |
| 22 | AUTO/MANUAL | Alarm interlock reset | | | | |
| 23 | RUN/STOP | | | | | A, B, C, D, E, F 3, 4, 5, 6, 7, 8 |
| 24 | REMOTE/LOCAL | | | | | |
| 25 | AUTO/MANUAL | | | | | |
| 26 | Alarm interlock reset | | | | | |

---

### Example of Model Code and Quick start code

**Specifications**

Input : Thermocouple K 0.0 to 400.0℃
Control method : PID control for heating (Output : 4 to 20mA DC)
Digital Output (Alarm) : 2 points (Deviation High, Deviation Low)
Analog retransmission output : 0 to 10V DC
Digital input : 1 point (RUM/STOP)

**Model code**  FB100-8N-□*5/□-2FK09

| | |
|---|---|
| Output 1 (Heat output) | 4 - 20mA DC |
| Output 2 (Cool output) | None |
| Optional function | Digital input : 1 point / Remote setpoint input : 1 point / Analog retransmission output 0 to 10V DC |
| Quick start code | Specify quick start code 1 and 2 |
| Control Method | PID control with AT (Reverse action) |
| Input and range | K 0.0 to 400.0℃ |

Power supply voltage
Case color

**Quick start code**  0123-□ABNN-NN

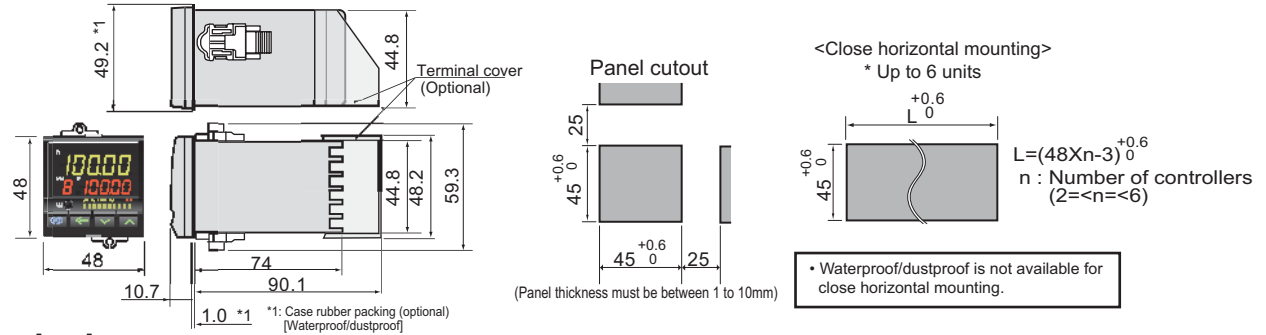| | |
|---|---|
| Output Allocation | OUT1: Control output 1, OUT2: Control output 2 / DO1: Event 1, DO2: Event 2 |
| | * OUT2 : Unused |
| | * Digital output (DO1, DO2) : Standard function |
| Digital Input Allocation | DI1: RUN/STOP |
| Event 1 | Deviation High |
| Event 2 | Deviation Low |
| Event 3 | None |
| Event 4 | None |
| CT type | None |
| Communication 1 protocol | None |

Remote setpoint input

# External Dimensions

Unit : mm



49.2 *1  44.8  Terminal cover (Optional)

48  44.8  48.2  59.3

48

10.7  74  90.1  1.0 *1  *1: Case rubber packing (optional) [Waterproof/dustproof]

**Panel cutout**

25

45 $^{+0.6}_{0}$

45 $^{+0.6}_{0}$  25

(Panel thickness must be between 1 to 10mm)

**<Close horizontal mounting>**
* Up to 6 units

L $^{+0.6}_{0}$

45 $^{+0.6}_{0}$

$L=(48Xn-3)^{+0.6}_{0}$
n : Number of controllers
(2=<n=<6)

• Waterproof/dustproof is not available for close horizontal mounting.

# Rear Terminals



• Use a solderless terminal for screw size M3, width 5.8mm or less.

| No | Description | |
|---|---|---|
| 1 | AC ⌐ L    AC ⌐ L    DC + | Power supply |
| 2 | 100-240V ⌐ N   24V ⌐ N   24V − | |
| 3 | NO Triac + | Control output (OUT2) (1) Relay contact output |
| 4 | (1) (2) (3) (4) (OUT2) | (2) Voltage pulse/ Current/ Voltage (3) SSR (Triac) (4) Open collector |
| 5 | NO Triac + | Control output (OUT1) (1) Relay contact output |
| 6 | (1) (2) (3) (4) (OUT1) | (2) Voltage pulse/ Current/ Voltage (3) SSR (Triac) (4) Open collector |

| No | Description | |
|---|---|---|
| 7 | COM | Digital output 1, 2 (DO 1, 2) |
| 8 | NO (DO2) | |
| 9 | NO (DO1) | Relay contact output |
| 10 | A | Measured input |
| 11 | B | (A) Thermocouple (B) RTD |
| 12 | (1) (2) (3) | (C) Voltage/ Current |

## Optional function terminals

| No | Optional function: Code A Description | |
|---|---|---|
| 13 | COM | Digital input |
| 14 | DI 1 | DI1 to DI5 |
| 15 | DI 2 | |
| 16 | DI 3 | Non voltage contact input |
| 17 | DI 4 | |
| 18 | DI 5 | |

| No | Optional function: Code B Description | |
|---|---|---|
| 13 | COM | Digital input |
| 14 | DI 1 | DI1 to DI2 |
| 15 | DI 2 | Non voltage contact input |
| 16 | | |
| 17 | + | Remote setpoint |
| 18 | IN − | input |

| No | Optional function: Code C Description | |
|---|---|---|
| 13 | COM | Digital input |
| 14 | DI 1 | DI1 to DI2 |
| 15 | DI 2 | Non voltage contact input |
| 16 | OPEN (O) | |
| 17 | (W) | Feedback resistance input |
| 18 | CLOSE (C) | |

| No | Optional function: Code D Description | |
|---|---|---|
| 13 | COM | Digital input |
| 14 | DI 1 | DI1 to DI2 |
| 15 | DI 2 | Non voltage contact input |
| 16 | COM | |
| 17 | CT1 | CT1,CT2 input |
| 18 | CT2 | |

| No | Optional function: Code E Description | |
|---|---|---|
| 13 | SG COM | Communication 1 |
| 14 | T/R(A) | RS-485 |
| 15 | T/R(B) | |
| 16 | DI 1 | Digital input DI1 to DI3 |
| 17 | DI 2 | |
| 18 | DI 3 | Non voltage contact input |

| No | Optional function: Code F Description | |
|---|---|---|
| 13 | SG COM | Communication 1 |
| 14 | T/R(A) | RS-485 |
| 15 | T/R(B) | |
| 16 | DI 1 | Digital input (DI1) Non voltage contact input |
| 17 | CT1 | CT1 input |
| 18 | | |

| No | Optional function: Code G Description | |
|---|---|---|
| 13 | SG | Communication 1 |
| 14 | T/R(A) | RS-485 |
| 15 | T/R(B) | |
| 16 | SG | Communication 2 |
| 17 | T/R(A) | RS-485 |
| 18 | T/R(B) | |

| No | Optional function: Code H Description | |
|---|---|---|
| 13 | SG | Communication 1 |
| 14 | T/R(A) | RS-485 |
| 15 | T/R(B) | |
| 16 | COM | |
| 17 | CT1 | CT1,CT2 input |
| 18 | CT2 | |

| No | Optional function: Code 3,4,5,6,7,8 Description | |
|---|---|---|
| 13 | COM | Digital input (DI1) |
| 14 | DI 1 | Non voltage contact input |
| 15 | + | Remote setpoint |
| 16 | IN − | input |
| 17 | + | Analog retransmission |
| 18 | AO − | output |