Temperature/Process Controller

FB100

Reinforced Insulation

RKC INSTRUMENT INC.
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.

High performance
High accuracy: 0.1%
Selectable sampling time: 50ms (Fast response) / 100ms (Standard) / 250ms (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

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

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.

Easy maintenance
The internal assembly of the FB100 can be removed from the front.

Numerous inputs and outputs
- Universal input
  Thermocouple, RTD, DC voltage - DC current
- Up to 2 points Communication
- Digital output
- Up to 3 points
  Digital input
  Remote setting input
  Up to 2 points
  CT input

User-friendly Keys and Display
- One-touch Operation on Mode Selection, Memory Area Selection and 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 indication 8V and PV

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".

High Performance
1/16 DIN size Controller

Analog retransmission output
- Heat control
- Cool control
- Heat/Cool control
- Position proportional control without FBR

Easy-to-maintain
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Plug-in lock released bar

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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.
- If start-up tuning does not calculate suitable PID values due to characteristics of application, start-up tuning (ST) is when the temperature differential of the measured value (PV) and temperature controller.
- Start-up tuning function can be set ON/OFF.
- Up to 32 controllers with 16 groups can be configured.

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.

Group RUN/STOP Function

When RUN/STOP mode is changed on one controller in a group, the mode of all other controllers in the same group will be also automatically changed.

- Up to 32 controllers with 16 groups can be configured.

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.

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 selectable to Only-once or always-ON.

- 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 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.

- 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.
Specifications

Input

• Universal input
  a) Temperature, Current, Low voltage input group
  b) Voltage/Current input : -100.0 to +100.0% of input span
  c) Temperature, Current, Low voltage input group
  d) Voltage/Current input : 0.0 to 10.0% of input span
  e) Voltage/Current input : 0.0 to 1000.0% of input span
  f) Voltage/Current input : 0.0 to 1000.0% of input span

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
  Selectable from the following:
  a) Close : Output off, Open : Output off
  b) Close : Output on, Open : Output off
  c) Close : Output off, Open : Output on

Performance

Measuring accuracy
  a) Thermocouple
  Type : K, J, T, E, PLII, U, L
  Less than +100°C (18°F) : ±0.1°C (±0.18°F)
  Between -199.9°C and +999.9°C : ±0.5°C (±0.9°F)
  More than 999.9°C : ±0.1% of reading + 1 digit
  Type : N, S, R, WSRe/W26Re
  Less than 0°C (32°F) : ±0.2°C (±0.36°F)
  0 to 100°C (32 to 183°F) : ±0.1°C (±0.18°F)
  More than 1000°C (1832°F) : ±0.1% of reading + 1 digit
  • Cold junction temperature compensation error
  ±1°C (1.8°F) [Between 5 and 40°C (41 and 104°F)]
  ±1.5°C (2.7°F) [Between -10 and 5°C (16 and 41°F), and
  40 and 50°C (104 and 122°F)]
  b) RTD
  Less than 200°C (392°F) : ±0.2°C (±0.4°F)
  More than 200°C (392°F) : ±0.1% of reading + 1 digit
  c) DC voltage and DC current
  ±0.1% of span

Autotuning
  a) For PID control (Direct action/Reverse action)
  b) For Heat/Cool PID control (For exchanger, air cooling)
  c) For Heat/Cool PID control (For exchanger, water cooling)
  d) For Heat/Cool PID control

Stop mode
  Up/Down individual setting

Sampling time
  0.1sec
  • 0.05sec/0.25sec is selectable.

Influence of external resistance
  0.2µV/1° (Thermocouple input)

Influence of lead resistance
  0.01% of reading/1 (RTD input)

Input break action
  Thermocouple input : Up-scale/Down-scale (Selectable)
  Voltage/Current input : 0.0 to 1000.0% of input span

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)
  Low level cut off : 0.00 to 25.00% of span

Control

Control method
  a) Brilliant II PID control
     • Direct action/Reverse action is selectable
  b) Brilliant II PID control (Heat/Cool type)
  c) Position proportioning control without feedback resistance
     • a), b), c) is selectable

Set-up tuning
  The condition to activate Start-up tuning is selectable among a) to g):
  a) At power-on, one-time tuning
  b) At SV change, one-time tuning
  c) At power-on and SV change, one-time tuning
  d) At power-off, always on
  e) At SV change, always on
  f) At power-on and SV change, always on
  g) Function off

Setting range
  a) Proportional band
     • Temperature input : 0 to input span (°C, °F)
     • Voltage/Current input : 0.0 to 1000.0% of input span

Control output, HBA output, FAIL output

Number of outputs
  Up to 2 points (OUT1, OUT2)

Output signal
  a) Relay contact output, Contact data
  b) Voltage pulse output, 0/12V DC

Output function
  a) Temperature, Current, Low voltage input group
  b) Voltage/Current input : 0.0 to 1000.0% of input span
  c) Voltage/Current input : 0.0 to 1000.0% of input span
  d) Voltage/Current input : 0.0 to 1000.0% of input span

Digital Output (DO)

Number of outputs
  Up to 2 points (DO 1 to 2)

Output function
  a) Event output, Heater break alarm (HBA), FAIL

Digital Output Area (recipe)

Number of areas
  8 areas (recipes)

Stored parameters
  Set value (SV), Event set values 1 to 4, LBA time, LBA dead band,
  Proportional band, Integral time, Derivative time,
  Cool side proportional band, Cool side integral time

Multiple Memory Area

Number of areas
  8 areas (recipes)
### Specifications

<table>
<thead>
<tr>
<th>Event (Alarm)</th>
<th>(Standard)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Event type</strong></td>
<td>Process high, Process low, Deviation high, Deviation low</td>
</tr>
</tbody>
</table>
| **Setting range** | a) Deviation alarm  
Event set value : input span to +input span  
Event action differential gap : 0 to input span  
b) Process alarm/Set value alarm  
Event set value : Same as input range  
Event action differential gap : 0 to input span  
c) MV alarm, FBR alarm  
-5.0 to +105.0%  
d) LBA  
LBA time : 0 to 7200 sec (LBA is OFF when 0 is set.)  
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)  
Hold action is activated at Power-up and STOP to RUN.  
Re-hold action is activated at Power-up, STOP to RUN and the control set value change.  
b) Event action is configurable in case of input abnormality.  
c) Energized/de-energized action is configurable.  
d) Delay timer : 0.0 to 600.0 sec  
e) Interlock (latch) function is configurable. |

### 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)  
0.2 sec (with measuring input sampling time of 0.1 sec)  
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)  
b) MODBUS-RTU |

### General Specifications |
| **Supply voltage** | a) 90 to 264V AC (50/60Hz, Selectable)  
Rating : 100 to 240V AC  
b) 24V AC ±10% (50/60Hz, Selectable)  
Rating : 24V AC  
c) 24V DC ±10%  
Rating : 24V DC |
| **Power consumption** | a) 100 to 240V AC type  
5.4VA (240V), 8.1VA (100V)  
b) 24V AC type  
5.3VA  
c) 24V DC type  
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) |

### Waterproof/Dustproof (Standard) |
| **Supply voltage** | a) 90 to 264V AC (50/60Hz, Selectable)  
Rating : 100 to 240V AC  
b) 24V AC ±10% (50/60Hz, Selectable)  
Rating : 24V AC  
c) 24V DC ±10%  
Rating : 24V DC |
| **Power consumption** | a) 100 to 240V AC type  
5.4VA (240V), 8.1VA (100V)  
b) 24V AC type  
5.3VA  
c) 24V DC type  
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) |

### 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) |

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### Memory backup |
| **Backed up by non-volatile memory (FRAM)** |
| **Number of writing** | Approx. 1,000,000,000,000,000 times. |
| **Data retaining period** | Approx. 10 years (Depending on storage and operating conditions.) |

### Ambient temperature |
| **-10 to +50°C (-14 to 122°F)** |
| **Ambient humidity** | 5 to 95% RH (Non condensing)  
Absolute humidity : MAX 0.2g/m³ 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

**Output 1** (OUT 1)
- Relay contact output
- Voltage pulse output (0/12V DC) [DC mA, V]
- Triac output
- Open collector output

**Output 2** (OUT 2)
- Not supplied
- Relay contact output
- Voltage pulse output (0/12V DC) [DC mA, V]
- Triac output
- Open collector output

**Power Supply**
- 24V AC/DC
- 100 to 240V AC

### Optional function

- Digital input 5 points
- Digital input 2 points + Remote setpoint input
- Digital input 2 points + Feedback resistance input
- Digital input 2 points + CT input 2 points
- Digital input 3 points + Communication 1 point
- Digital input 1 point + Communication 1 point + CT input 1 point
- Communication 2 point
- Communication 2 point + CT input 2 points
- Digital input 1 point + Remote setpoint input + Analog retransmission output 0 to 10V DC
- Digital input 1 point + Remote setpoint input + Analog retransmission output 0 to 5V DC
- Digital input 1 point + Remote setpoint input + Analog retransmission output 1 to 5V DC
- Digital input 1 point + Remote setpoint input + Analog retransmission output 0 to 20mA
- Digital input 1 point + Remote setpoint input + Analog retransmission output 4 to 20mA

### Case color
- Black case
- White case

### Quick start code
- No quick start code (Default setting)
- Specify quick start code 1
- Specify quick start code 1 and 2 (See page 11)

### Control Method
- 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]

### Input and range
- No quick start code [No Code]
- See Input range Code Table [No Code]

### Accessories (Sold separately)
- Current transformer for heater break alarm (HBA)
- Terminal Cover
- Front Cover

### Terminal Cover
- Model Code: KCA100-517

### Front Cover
- Model Code: KR100-36A

### Input Code Table

<table>
<thead>
<tr>
<th>Output Type</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 5V DC</td>
<td>4</td>
</tr>
<tr>
<td>0 to 2mA DC</td>
<td>7</td>
</tr>
<tr>
<td>0 to 10V DC</td>
<td>5</td>
</tr>
<tr>
<td>4 to 20mA DC</td>
<td>8</td>
</tr>
</tbody>
</table>

### Input Range Code Table

#### Thermocouple

<table>
<thead>
<tr>
<th>Code</th>
<th>Range</th>
</tr>
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<tbody>
<tr>
<td>K</td>
<td>≤-200.0°C to +400.0°C</td>
</tr>
<tr>
<td>J</td>
<td>-250.0°C to +750.0°C</td>
</tr>
<tr>
<td>T</td>
<td>-250.0°C to +750.0°C</td>
</tr>
<tr>
<td>S</td>
<td>-50.0°C to +1756.0°C</td>
</tr>
<tr>
<td>R</td>
<td>-75.0°C to +1321.0°C</td>
</tr>
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</table>

#### RTD

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<tbody>
<tr>
<td>Pt100</td>
<td>≤0.00 to +100.00°C</td>
</tr>
<tr>
<td>Pt101</td>
<td>≤0.00 to +100.00°C</td>
</tr>
<tr>
<td>Pt110</td>
<td>≤0.00 to +100.00°C</td>
</tr>
</tbody>
</table>

#### DC Current - voltage

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<tbody>
<tr>
<td>0 to 10mA</td>
<td>1.01</td>
</tr>
<tr>
<td>0 to 100mA</td>
<td>2.01</td>
</tr>
<tr>
<td>0 to 1V</td>
<td>3.01</td>
</tr>
<tr>
<td>0 to 5V</td>
<td>4.01</td>
</tr>
<tr>
<td>0 to 10V</td>
<td>5.01</td>
</tr>
<tr>
<td>0 to 15V</td>
<td>6.01</td>
</tr>
</tbody>
</table>

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

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*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.
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.
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- Quick start code tells the factory to ship with each parameter preset to the values detailed as specified by the customer.

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<thead>
<tr>
<th>Code</th>
<th>Output 1 (OUT 1)</th>
<th>Output 2 (OUT 2)</th>
<th>Digital Output 1 (DO 1)</th>
<th>Digital Output 2 (DO 2)</th>
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<tbody>
<tr>
<td>01</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 1</td>
<td>Event 2</td>
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<tr>
<td>02</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 1</td>
<td>Event 4</td>
</tr>
<tr>
<td>03</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 1 FAIL(De-energized)</td>
<td>Event 2</td>
</tr>
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<td>Control output 1</td>
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<td>Event 1 FAIL(De-energized)</td>
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<td>Event 4 FAIL(De-energized)</td>
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<td>Event 4 FAIL(De-energized)</td>
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<tr>
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<td>Control output 2</td>
<td>Event 4 FAIL(De-energized)</td>
<td>Event 4</td>
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<td>Control output 1</td>
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<td>Event 4 FAIL(De-energized)</td>
<td>Event 2</td>
</tr>
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<td>Event 4 FAIL(De-energized)</td>
<td>Event 4</td>
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<td>Event 2 Event 3</td>
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<td>11</td>
<td>Control output 1</td>
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<td>Control output 1</td>
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<td>Event 3 Event 2</td>
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<tr>
<td>13</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 3 Event 2</td>
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<tr>
<td>14</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 2 Event 3</td>
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<tr>
<td>15</td>
<td>Control output 1</td>
<td>Control output 2</td>
<td>Event 3 Event 2</td>
<td></td>
</tr>
</tbody>
</table>

**Default setting**

- 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

<table>
<thead>
<tr>
<th>Code</th>
<th>Di 1</th>
<th>Di 2</th>
<th>Di 3</th>
<th>Di4</th>
<th>Di 5</th>
<th>Selectable optional Code</th>
</tr>
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<tbody>
<tr>
<td>01</td>
<td>Unused</td>
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<td>02</td>
<td>Memory area selection (1 to 8)</td>
<td>Area set</td>
<td>RUN/STOP</td>
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</tr>
<tr>
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</tr>
<tr>
<td>13</td>
<td>RUN/STOP REMOTE/LOCAL Automation</td>
<td>Automation</td>
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<td>14</td>
<td>RUN/STOP REMOTE/LOCAL Automation</td>
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<td>RUN/STOP REMOTE/LOCAL Automation</td>
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<td>26</td>
<td>REMOTE/LOCAL Automation</td>
<td>Automation</td>
<td>Automation</td>
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<td></td>
</tr>
</tbody>
</table>

**Default setting**

- Communication 2 is for inter-controller communication.

### Example of Model Code and Quick start code

**Input:** Thermocouple K 0.0 to 400.0°C
**Control method:** PID control for heating (Output: 4 to 20mA DC)
**Digital input (Alarm):** 2 points (High, Default High, Deviation Low)

**Model code:** FB100-8N-□5/□2FK09

- **Output 1** (Heat output)
  - 4 - 20mA DC
- **Output 2** (Cool output)
  - None
- **Optional function**
  - Digital input 1 point
  - Digital input 2 point
  - Analog retransmission output 0 to 10V DC
- **Quick start code**
  - Specify quick start code 1 and 2
- **Control Method**
  - PID control with A1 (Reverse action)
- **Input and range**
  - K 0.0 to 400.0°C

**Quick start code**

- **Output Allocation**
  - OUT1: Control output 1, OUT2: Control output 2
  - D01 Event 1, D02 Event 2
  - *OUT2: Unused
  - *Digital output (D01, D02): Standard function

**Digital Input Allocation**

- Event 1
- Event 2
- Event 3
- Event 4
- CT type
- Communication 1 protocol

**Quick start code**

- Deviation High
- Deviation Low
- Deviation High/Low
- Band
- Deviation High with Alarm Hold
- Deviation Low with Alarm Hold
- Deviation High/Low with Alarm Hold
- Process High
- Process Low
- Process High with Alarm Hold
- Process Low with Alarm Hold
- Process High/Low with Alarm Hold
- Set value High
- MV value High
- Cool side MV value High
- Cool side MV value Low
External Dimensions

Unit : mm

Rear Terminals

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

Optional function terminals

1. Optional function: Code A
2. Optional function: Code B
3. Optional function: Code C
4. Optional function: Code D
5. Optional function: Code E
6. Optional function: Code F
7. Optional function: Code G
8. Optional function: Code H

Warning

- Before operating this product, read the instruction manual carefully to avoid incorrect operation.
- This product is intended for use with industrial machines, test and measuring equipment. It is not designed for use with medical equipment.
- If it is possible that an accident may occur as a result of the failure of the product or some other abnormality, an appropriate independent protection device must be installed.

Caution for export trade

All transactions must comply with laws, regulations, and treaties.

Caution for imitated products

As products imitating our product now appear on the market, be careful that you don't purchase these imitated products. We will not warrant such products nor bear the responsibility for any damage and/or accident caused by their use.

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(RIKA KOGYO CO.,LTD)

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