Digital PID Controller

BGK81/BGK84/BGK85/BGK87/BGK89
INSTRUCTION MANUAL

BGK80B-E1

Carefully read all the instructions in this manual. Please place this manual in a convenient location for easy reference.

<div style="border:1px solid">

⚠️ **WARNING**

- An external protection device must be installed if failure of this instrument could result in damage to the instrument, equipment or injury to personnel   .
- All wiring must be completed before power in turned on to prevent electric shock, fire or damage to instrument and equipment   .
- This instrument must be used in accordance with the specifications to prevent fire or damage to instrument and 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.

</div>

CAUTION

- 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.
- This instrument is design for installation in an enclosed instrumentation panel. All high-voltage connections such as power supply terminals must be enclosed in the instrumentati on panel to avoid electric shock by operating personnel.
- All precautions described in this manual should be taken to avoid damage to the instrument or equipment.
- All wiring must be in accordance with local codes and regulations.
- Always observe precautions described in this manual. Otherwise serious injury or accident may result.
- Do not allow metal fragments or lead wire scraps to fall inside this instrument. This may cause electric shock, fire or malfunction.
- Firmly tighten each terminal screw at the specified torque. Otherwise electric shock or fire may result.
- Do not place any obstacle around this instrument in order not to impede radiation of heat. And do not close ventilation holes.
- Do not connect wires to unused terminals.
- Before cleaning the instrument, always turn off the power supply.
- Remove stains from this instrument using a soft, dry cloth. Do not use a volatile solvent such as thinner in order to avoid deformation or discoloration.
- Do not rub nor strike the display unit of this instrument with a hard object.

1. PRODUCT CHECK

BGK81 (Size:48x48mm)
BGK84 (Size:48x96mm)
BGK85 (Size:96x48mm)
BGK87 (Size:72x72mm)
BGK89 (Size:96x96mm)

□ □ □□ - □ □ * □□ - □
(1) (2) (3)   (4) (5) (6) (7)   (8)

(1) Control action

   F: PID reverse action with autotuning   N: No control

(2) Input type,(3) Range code: See "8. INPUT RANGE TABLE"

(4) Control output [OUT]:   N: No control output

   M:Relay contact   V: Voltage pulse
   8: Current(DC4 ~ 20 mA)   5: DC0-5VDC
   6: DC0-10VDC   T: Trigger (for triac driving)

(5) Remark: N: No

(6) Alarm 1[AL1 for high alarm]   See "5.5 Initial Setting "

   N: No alarm
   A: Deviation high alarm   H: Process high alarm
   B: Low deviation alarm   J: Process low alarm

(7) Alarm 2[AL2 for low alarm]   See "5.5 Initial Setting "

   N: No alarm
   A: Deviation high alarm   H: Process high alarm
   B: Low deviation alarm   J: Process low alarm

(8) Power

   A: 220VAC   B: 85-265VAC   D: 24VDC   E: 24VAC

〈Example〉

Model:BGK89

Code: FKA4-MN*AN-B

📖 Check MODEL and CODE is very important when ordering.

Specification:
Model of the controller:BGK89
Size: 96mm x 96mm
Control action: PID reverse action
Input: K type thermocouple
Out put: Relay output
Alarm: 1 deviation high alarm (AL1)
Power: AC85-265V

2. MOUNTING

2.1 Mounting Cautions

(1) Use this Instrument within the following ambient temperature and ambient humidity.
- Allowable ambient temperature: 0 to 50°C
- Allowable ambient humidity: 45 to 85% RH

(2) Avoid the following 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 induction noise, static electricity, magnetic fields or noise.
- Direct air flow from an air conditioner.
- Exposure to direct sunlight.
- Excessive heat accumulation.

2.2 Dimensions

BGK81 (Unit:mm)

BGK84 BGK85 (Unit:mm)

BGK87 (Unit:mm)

BGK89 (Unit:mm)
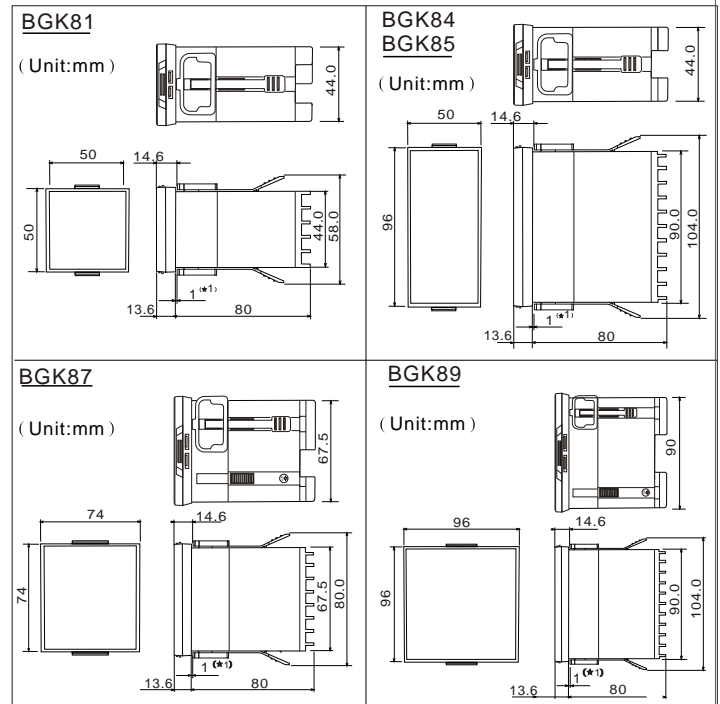
2.3 Mouting Procedures

(1) Prepare the panel cutout as specified in 2.2 Dimensions.
(2) Insert the instrument through the panel cutout.
(3) insert the mounting bracket into the mounting
    groove of the instrument.（Fig.1）
(4) Pull till chick sounds to the direction
    shown by the arrow.(Fig.2)
(5) The other mounting bracket should be installed
    the same way described in 3. to 4.

Mounting bracket
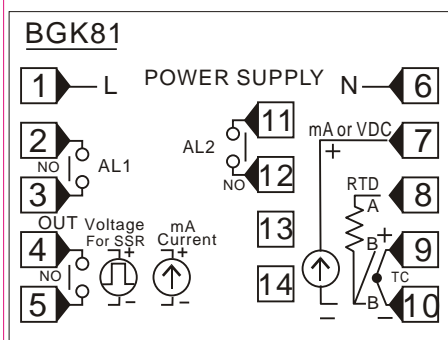
（Fig.1）

（Fig.2）
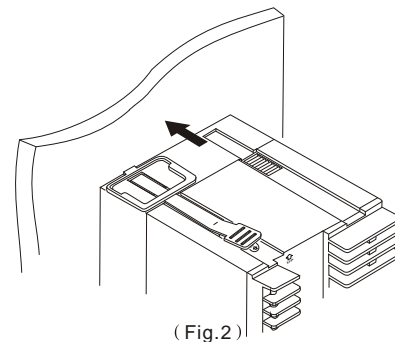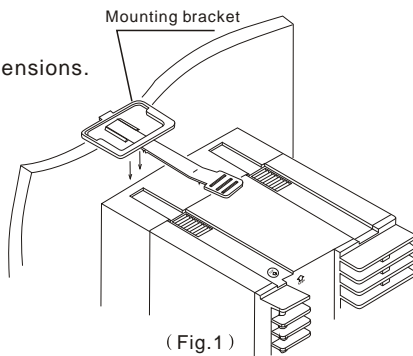
3. WIRING

3.1 Wiring cautions

(1) For thermocouple input, use the specified compensation wire.
(2) For RTD input , use leads with low resistance and having no resistance differences among the 3 leads.
(3) Conduct input signal wiring away from instrument power, electric equipment power and load lines to avoid noise induction.
(4) Conduct instrument power wiring so as not to be influenced by noise from the electric equipment power. If the instrument may be affected
     by external noise, a noise filter should be used.
   * Shorten the distance between twisted power supply wire pitches. The
     shorter the distance between the pitches, the more effective for noise
     reduction.
   * Install the noise filter on the panel which is always grounded and minimize
     the wiring distance between the noise filter output side and the instrument
     power terminals.
   * Do not install fuses and/or switches on the filter output signal since this may lessen filter effect.

Twist these leadwires

instrument power

IN   Noise filter   OUT

Shorten distance between pitches

Minimize distance

Instrument power terminals

(5) For wiring, use wires conforming to the domestic standard of each country.
(6) Abot 4 to 5 seconds are required as the preparation time for contact output after power on. Use a delay relay when the output line is used for an
     external interlock circuit.
(7) This instrument has no power supply switch nor fuses. Therefore, install the fuse close to the instrument and the switch, if required.
     *Recommended fuse rating: Rated voltage; 250V Rated current; 1A   * Fuse type; Time-lag fuse
(8) Do not excessively tighten the terminal screws. In addition, use the solderless terminal appropriate to the screw size.
(9) To the instrument with power supply of 24V, please be sure to supply the power from SELV circuit.
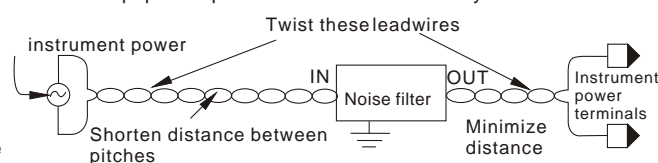
3.2 Terminal Configuration

CAUTION	(1)All the under hookups are only for reference.
	(2)For wiring, please according to the hookup label which was glued on the plastic case of controller.

BGK81

POWER SUPPLY

1 — L
2 — AL1 NO
3 — OUT Voltage For SSR
4 — NO
5
N — 6
AL2 — 11
NO — 12
13
14
mA or VDC — 7
RTD A — 8
B — 9
TC B — 10
mA Current

Power supply voltage:

AC220V±10%
(Frequency: 50/60Hz，Rating: 200~240V Ac)
22 to 26 V AC
(Frequency: 50/60Hz，Rating: 24V AC)
22 to 26V DC（Rating: 24V Dc）
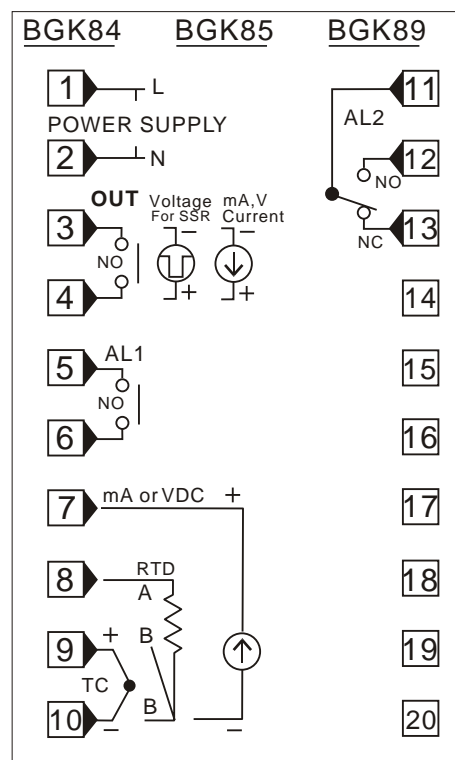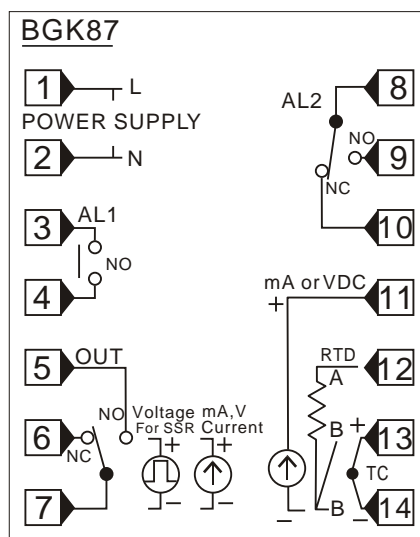
Power consumption:
5VA max (at 24V AC)   160mA max (at 24V DC)
7VA max(at 100V AC)   10VA max (at 240V AC)

Alarm outut rated:
Relay contact output :   250V AC, 3A (Resistive load)

Control output rated :
Relay contact output: 250V AC,3A(Resistive load)
Voltage pulse output: 0/12 V DC (Load resistance 600 Ω or more)
Current output: 4 to 20mA DC (Load resistance 500 Ω or less)
Trigger output(for triac driving):100A or less

BGK87

1 — L
POWER SUPPLY
2 — N
3 — AL1 NO
4
5 — OUT
6 — NO NC Voltage For SSR mA,V Current
7
AL2 — 8 NO
9 NC
10
mA or VDC — 11
RTD A — 12
B — 13
TC B — 14

BGK84   BGK85   BGK89

1 — L
POWER SUPPLY
2 — N
3 — OUT NO Voltage For SSR mA,V Current
4
5 — AL1 NO
6
7 — mA or VDC +
8 — RTD A
9 — B TC
10 — B
AL2 — 11 NO
12
NC — 13
14
15
16
17
18
19
20

The terminal arrangement of BGK85 is as shown in the
following diagram, but the terminal configuration of
BGK85 is the same as that of BGK84.

4. PARTS DESCRIPTION
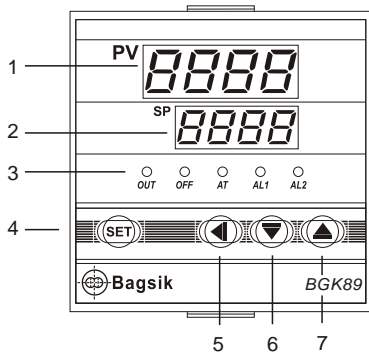
1. Measured value (PV) display [Green]
   * Displays PV or various parameter symbols
2. Set value (PV) display [Red]
   * Displays SV or various parameter set values
3. Indication lamps
   *Control output lamps (OUT,OFF)
   [Green] OUT:Light when output is turned on.
   [Red]OFF:Light when output is turned off.

*Autotuning (AT) [Green]
  Flashes when autotuning is activated.

*Alarm output lamps (AL1,AL2)
  [Red]
  AL1: Lights when alarm 1 output is turned on.
  Al2: Lights when alarm 2 output is turned on.

| CAUTION | To avoid damage to instrument, never use a sharp object to press keys. |

4. **SET** (Set key)
   Used for parameter calling up and set value registration
5. ◄ Shift & Assistant key
6. ▼ (Down key) Decrease numbers
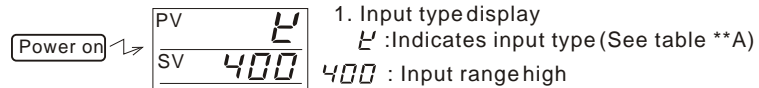7. ▲ (Up key) Decrease numbers

5. SETTING

5.1 Calling up procedure of each mode
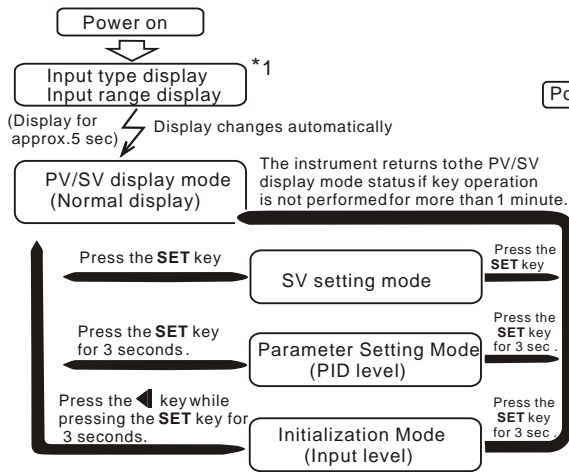
*1. Input type and input range display

This instrument immediately confirms input type and range following power on.
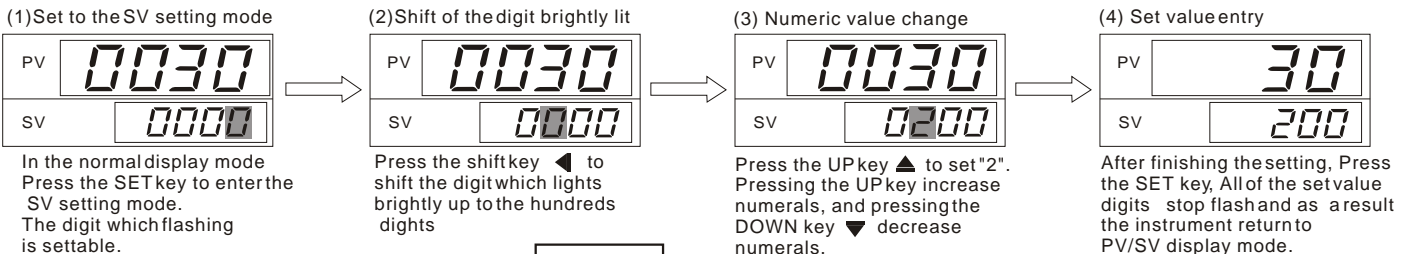Example: For a controlleer with the K thermocouple input type and range from 0 to 1300°C.

1. Input type display
   $Ч$:Indicates input type (See table **A)
   $Ч00$: Input range high

A: Input type table(see "14.0 Input range table")

Display	Ч	Ⅎ	Ε	5	Γ	Ь	ᴦ
Input	Thermocouple						
	K	J	E	S	T	B	R

Display	Pr	U1	U2
Input	Resistance thermometer	Standard analog signal (Voltage and current)	
	Pt100	DC0-10V,(**DC 0-20mA)	DC2-10V,(**DC 4-20mA)

** For the current input (0-20mA or 4-20mA) specification, a resistor of 500 Ω must be connected between the input terminals.

5.2 Setting set value(SV)   Example: Following is an example of set value(SV) to 200°C

(1)Set to the SV setting mode	(2)Shift of the digit brightly lit	(3) Numeric value change	(4) Set value entry
In the normal display mode Press the SET key to enter the SV setting mode. The digit which flashing is settable.	Press the shift key ◄ to shift the digit which lights brightly up to the hundreds dights	Press the UP key ▲ to set "2". Pressing the UP key increase numerals, and pressing the DOWN key ▼ decrease numerals.	After finishing the setting, Press the SET key, All of the set value digits stop flash and as a result the instrument return to PV/SV display mode.

| Caution | *Even if the displayed value is changed, it is not registered. To register it, press the SET key. |

5.3 Setting parameters other than set value (SV)

The setting procedures are the same as those of example (2) to (4) in the above "Setting set value (SV)". Press the SET key after the setting end shifts to the next parameter. When no parameter setting is required, return the instrument to the PV/SV display mode.

5.4 PID level (Parameter List)

Press the "**SET** "key for 3 seconds to PID level:
After the value be registered ,you can press "SET"key for 3 seconds to return the instrument to the PV/SV display mode.
The following parameter symbols are displayed one by one every time the SET key is pressed.
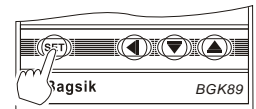

#1: Factory set value

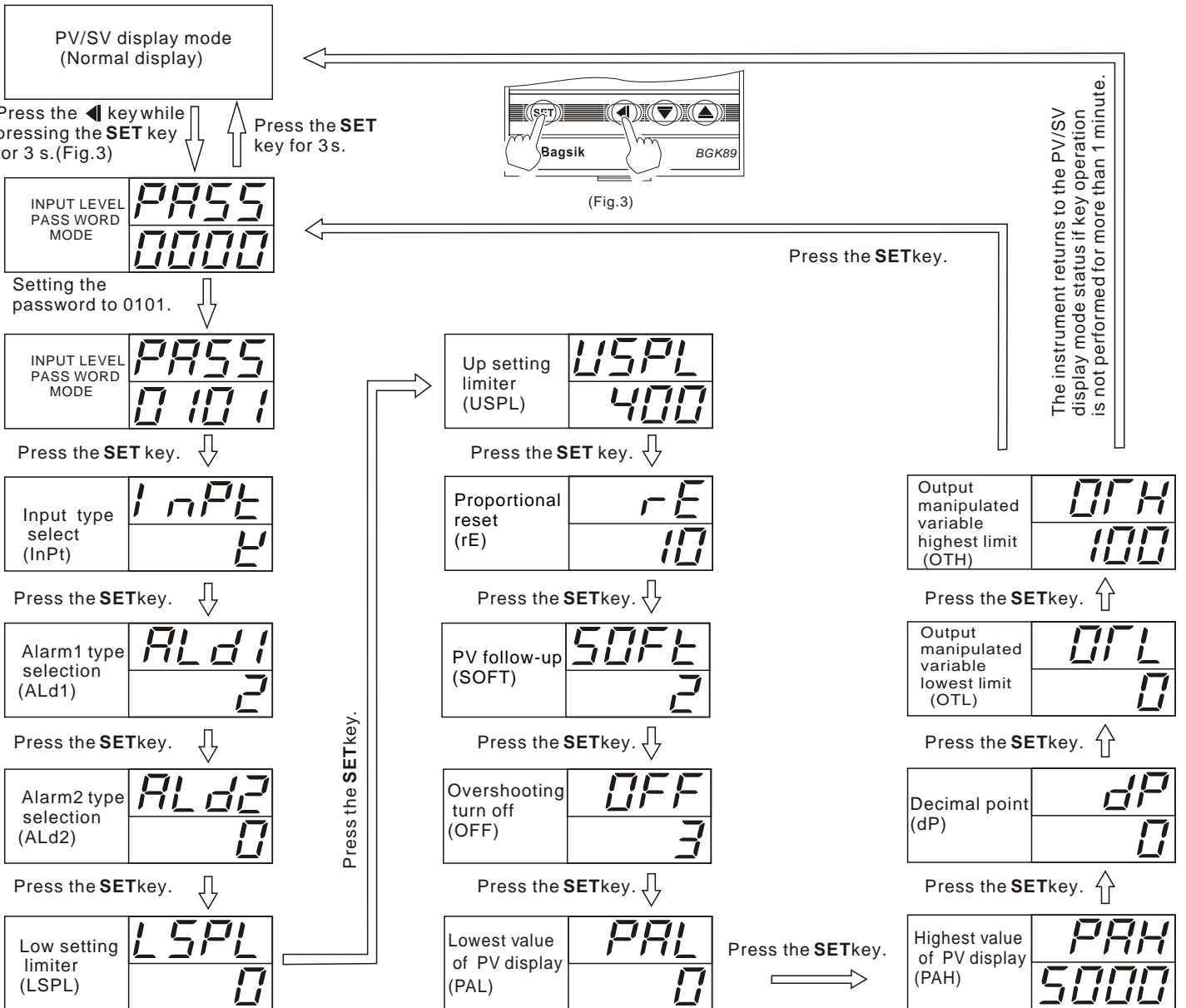| Symbol	Name	Setting range	Description	#1
AL1	Alarm1 set value (AL1)	Deviation or Process alarm, -1999 to 9999	Set the alarm1 set value . Alarm differential gap=HYS,when P≠0	10
AL2	Alarm2 set value (AL2)	Deviation or Process alarm, -1999 to 9999	Set the alarm2 set value . Alarm differential gap=HYS,when P 0	200
SC	PV bias	-1999 to +9999	Sensor correction is made by adding bias value to measured value(PV).	0.0
HYS	Differential gap for alarm or output	0 to 9999	Out differential gap=HYS,when P=0 (ON/OFF action) Alarm differential gap=HYS,when P ≠ 0(PID action)	0

Symbol	Name	Setting range	Description	#1
P	Proportional band	0.0~999.9	ON/OFF control if set to 0 (0.0) ON/OFF action differential gap=HYS	20.0
I	Integral time	0~3600 seconds	Set the time of integral action to eliminate the offset occurring in proportional control.	150
d	Derivative time	0.0~999.9 seconds	Set the time of derivative action to improve control stability by preparing for output changes.	30.0
⌐	Proportioning cycle	1.0~200.0 seconds	Relay contact output :20S Voltage pulse (for SSR) :2S	20.0 or 2.0
At	Auto tuning (At)	0:AT end or cancel 1:AT start or execution	Use AT function to automatically calculate and set the optimize PID value for your system. Turns the autotuning ON/OFF	0
LCY	Set data lock (LCK)	0: All parameters can be changed 1: Only SV can be changed 2: No parameters can be changed	Performs set data change enable/disable.	0

5.5 Initial Setting (Parameter List)
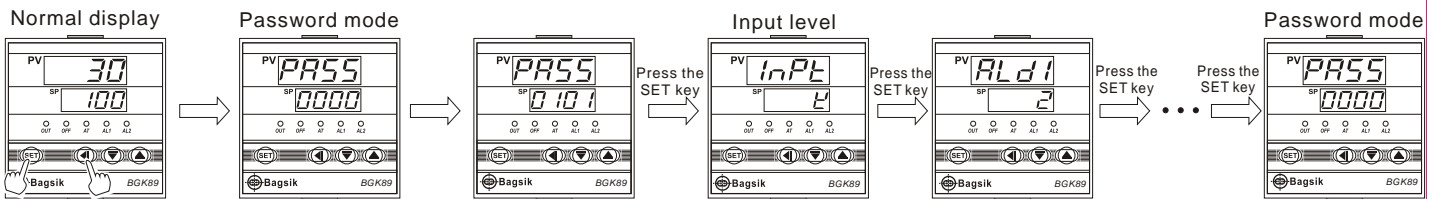
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After the value be registered,when no parameter setting is required,Press the SET key for 3 s to return the instrument to the normal display. The following parameter symbols are displayed one by one every time the SET key is pressed.

#1: Factory set value

Symbol	Name	Description	#1
InPt	Main input type select (InPt)	Input type selection as:thermocouple(TC),RTD,etc. See **A "INPUT TYPE SYMBOL TABLE"	K
ALd1	Alarm1 type selection (ALd1)	Select the type of alarm1 range:0~4　See **B "ALARM TYPE TABLE"	2
ALd2	Alarm2 type selection (Ald2)	Select the type of alarm2 range:0~4　See **B "ALARM TYPE TABLE"	0
LSPL	Low setting limiter (LSPL)	Set lower point within input see 14. chapter "INPUT RANGE TABLE"	0
USPL	Up setting limiter (USPL)	Set higher point within input see 14. chapter "INPUT RANGE TABLE"	400
rE	Proportional reset (rE)	Overshooting restricted by the proportional effect.	10
SOFt	PV follow-up (SOFT)	PV variable-value control, （Setting range: 0 to 10） PV will response slower if SOFT is bigger.	2
OFF	Overshooting turn off (OFF)	Output forced turning off when the PV value overshooting . （Setting range: 0 to 100）	3
PAL	Lowest value of PV display (PAL)	Lowest value display when analog signal inputs,Such as 4-20mA input. The value of PV display when input 4 mA. Only for standard analog signal input.	0
PAH	Highest value of PV display (PAH)	Highest value display when analog signal inputs,Such as 4-20mA input. The value of PV display when input 20 mA. Only for standard analog signal input.	5000
dP	Decimal point (dP)	Only for standard analog signal input (current or voltage inputs) . Range:0~3	0
OTL	Output manipulated variable lowest limit (OTL)	Output manipulated variable lowest limit . Range : 0 to 100%	0
OTH	Output manipulated variable highest limit (OTH)	Output manipulated variable highest limit . Range : 0 to 100%	100

**A: INPUT TYPE SYMBOL TABLE

InPt Setting	ʄ	ل	E	S	ɾ	b	r	Pt	U1	U2
Input type	K	J	E	S	T	B	R	Pt100	DC0-10V,(**DC 0-20mA)	DC2-10V,(**DC 4-20mA)
Range	-50 to1350°C	-50 to1000°C	-50 to1000°C	-50 to1750°C	-20 to400°C	50 to1800°C	-20 to1750°C	-199.9 to600.0°C	-1999 to9999	-1999 to9999

1**,All input change in the above groups is possible by keyboard. For BGK81-N, BGK84-N,BGK85-N,BGK87-N,BGK89-N , only thermocouple and Pt100 can be changed by key board.

2**,For the current input (0-20mA or 4-20mA) specification, a resistor of 500Ω must be connected between the input terminals.

**B: ALARM TYPE TABLE

▲:SV　△:Alarm set value

CODE	ALd1	Alarm1 mode specification
N	0	No Alarm
A	2	AL1≥0 — Deviation high alarm — HYS Alarm ON — LOW · SV▲ · △SV+AL1 · HIGH AL1<0 — Deviation high alarm — HYS Alarm ON — LOW △SV+AL1 ▲SV HIGH
B	4	AL1≥0 — Low deviation alarm — Alarm ON HYS — LOW SV-AL1△ SV▲ HIGH AL1<0 — Low deviation alarm — Alarm ON HYS — LOW SV▲ △SV-AL1 HIGH
H	1	Process high alarm — HYS Alarm ON — LOW △AL1 AL1Value HIGH
J	3	Process low alarm — Alarm ON HYS — LOW △AL1 AL1Value HIGH

CODE	ALd2	Alarm2 mode specification
N	0	No Alarm
A	2	AL2≥0 — Deviation high alarm — HYS Alarm ON — LOW · SV▲ · △SV+AL2 · HIGH AL2<0 — Deviation high alarm — HYS Alarm ON — LOW △SV+AL2 ▲SV HIGH
B	4	AL2≥0 — Low deviation alarm — Alarm ON HYS — LOW SV-AL2△ SV▲ HIGH AL2<0 — Low deviation alarm — Alarm ON HYS — LOW SV▲ △SV-AL2 HIGH
H	1	Process high alarm — HYS Alarm ON — LOW △AL2 AL2Value HIGH
J	3	Process low alarm — Alarm ON HYS — LOW △AL2 AL2Value HIGH

NOTE: Alarm differential gap=HYS,when P≠0(PID action)

6. PID AUTOTUNING (AT) FUNCTION

■ Autotuning (AT) start
1) Press the "SET" key for 3 seconds to PID level.
2) Looking for the parameter "AT ".
3) Set "AT" value from 0 to 1.
4) Press the "SET" key start auto tuning.
5) Press the "SET" key for 3 seconds to return to the instrument to the PV/SV display mode.
   (If AT be started ,the AT lamp will be lighted on and the lamp is flashing)
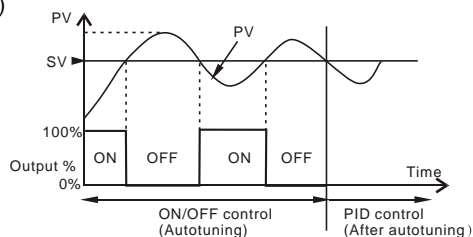
Autotuning (AT) automatically measures, calculates and sets the optimum PID. The following conditions are necessary to carry out autotuning and the conditions which will cause the autotuning to stop.

📖 Caution for using the Autotuning (AT)
When a temperature change(UP and/or Down) is 1℃ or less per minute during Autotuning, Autotuning may be cancelled before calculating PID values. In that case, adjust the PID

values manually. It is possible to happen when the set value is around the ambient temperature or is close to the maximum temperature achieved by the load.

■ Requirements for AT start
Start the autotuning when all following conditions are satisfied:
(1) Prior to starting the AT function, end all the parameter settings other than PID.
(2) Confirm the LCK function has not been engaged.

📖 When the autotuning is finished, the controller will automatically return to PID control.

■ Requirements for AT cancellation
The autotuning is canceled if any of the following conditions exist.
(1) When the parameter "AT " value is changed.
(2) When the power is turned off.
(3) When power failure longer than 20ms occurs.

📖 If the AT is canceled, the controller immediately changes to PID control. The PID values will be the same as before AT was activated.

📖 When AT is completed, the controller immediately changes to PID control. If the control system does not allow the AT cycling process, set each PID constant manually to meet the needs of the application.

7.ERROR DISPLAYS

■ Error display

Erro [Flashing]	RAM failure(Incorrect set date write or check sensor and sensor connection,etc.)	Turn off the power once. If an error occurs after the power is turned on again, please contact sales office or the agent.

■ Overscale and Underscale

Measured value(PV) [Flashing]	PV is outside of input range	
HHHH [Flashing]	**Overscale:** PV is above the high input display range limit.	⚠ **WARNING** — To prevent electric shock, always turn off the power before replacing the sensor.
LLLL [Flashing]	**Underscale:** PV is below the low input display range limit.	Check input type, input range, sensor and sensor connection..

8. INPUT RANGE TABLE

Input type			Code	
K	0 to 100 ℃	K	A1
	0 to 200 ℃	K	A2
	0 to 400 ℃	K	A4
	0 to 600 ℃	K	A6
	0 to 800 ℃	K	A8
	0 to 1000 ℃	K	A0
	0 to 1300 ℃	K	B3
	0 to 1350 ℃	K	B4

Input type			Code	
J	0 to 100 ℃	J	A1
	0 to 200 ℃	J	A2
	0 to 300 ℃	J	A3
	0 to 400 ℃	J	A4
	0 to 600 ℃	J	A6
	0 to 800 ℃	J	A8
	0 to 1000 ℃	J	A0

Input type			Code	
S	*1 0 to 1000 ℃	S	A0
	*1 0 to 1600 ℃	S	B6
	*1 0 to 1750 ℃	S	B8

Input type			Code	
B	*1 50 to 1300 ℃	B	B3
	*1 50 to 1800 ℃	B	B8

Input type			Code	
T	0 to 100 ℃	T	A1
	0 to 200 ℃	T	A2
	0 to 300 ℃	T	A3
	0 to 400 ℃	T	A4

Input type			Code	
E	0 to 100 ℃	E	A1
	0 to 200 ℃	E	A2
	0 to 300 ℃	E	A3
	0 to 400 ℃	E	A4
	0 to 500 ℃	E	A5
	0 to 600 ℃	E	A6
	0 to 800 ℃	E	A8
	0 to 1000℃	E	A0

Input type			Code	
R	*1 0 to 600 ℃	R	A6
	*1 0 to 1000 ℃	R	A0
	*1 0 to 1300 ℃	R	B3
	*1 0 to 1750 ℃	R	B8

Input type		Code	
0 to 5VDC *3	-1999 to 9999 or	V	03
1 to 5VDC *3	-199.9 to 999.9 or	V	08
0 to 10VDC	-19.99 to 99.99 or	V	04
2 to 10VDC	-1.999 to 9.999	V	09
4 to 20mA *2		A	03
0 to 20mA *2		A	02

Input type			Code	
Pt100	0.0 to 100.0 ℃	D	D1
	0.0 to 200.0 ℃	D	D2
	0.0 to 300.0 ℃	D	D3
	0.0 to 400.0 ℃	D	D4
	0.0 to 500.0 ℃	D	D5
	0.0 to 600.0 ℃	D	D6
	-199.9 to +100.0 ℃	D	E1
	-199.9 to +200.0 ℃	D	E2
	-199.9 to +600.0 ℃	D	E6
	-100.0 to +100.0 ℃	D	F1
	-100.0 to +200.0 ℃	D	F2
	-50.0 to +50.0 ℃	D	G0
	-50.0 to +100.0 ℃	D	G1
	-50.0 to +200.0 ℃	D	G2

(*1) 0 to 400°C: Accuracy is not guaranteed.
(*2) For the current input (0-20mA or 4-20mA) specification, a resistor of 500Ω must be connected between the input terminals.
(*3) For (0-5VDC or 1-5VDC) input specification, must be custom made.

Bagsik