

Autonics High Accuracy PID Temperature Controller TK4 SERIES

INSTRUCTION MANUAL



Thank you for choosing our Autonics product. Please read the following safety considerations before use.

Safety Considerations

※Please observe all safety considerations for safe and proper product operation to avoid hazards. ※⚠ symbol represents caution due to special circumstances in which hazards may occur.

- Warning** Failure to follow these instructions may result in serious injury or death.
- Caution** Failure to follow these instructions may result in personal injury or product damage.

Warning

- Fail-safe device must be installed when using the unit with machinery that may cause serious injury or substantial economic loss. (e.g. nuclear power control, medical equipment, ships, vehicles, railways, aircraft, combustion apparatus, safety equipment, crime/disaster prevention devices, etc.) Failure to follow this instruction may result in fire, personal injury, or economic loss.
- Install on a device panel to use. Failure to follow this instruction may result in electric shock.
- Do not connect, repair, or inspect the unit while connected to a power source. Failure to follow this instruction may result in electric shock or fire.
- Check "Connections" before wiring. Failure to follow this instruction may result in fire.
- Do not disassemble or modify the unit. Failure to follow this instruction may result in electric shock or fire.

Caution

- When connecting the power input and relay output, use AWG 20 (0.50mm²) cable or over and tighten the terminal screw with a tightening torque of 0.74-0.90Nm. When connecting the sensor input and communication cable without dedicated cable, use AWG 28-26 cable or over and tighten the terminal screw with a tightening torque of 0.74-0.90Nm. Failure to follow this instruction may result in fire or malfunction due to contact failure.
- Use the unit within the rated specifications. Failure to follow this instruction may result in fire or product damage.
- Use dry cloth to clean the unit, and do not use water or organic solvent. Failure to follow this instruction may result in electric shock or fire.
- Do not use the unit in the place where flammable/explosive/corrosive gas, humidity, direct sunlight, radiant heat, vibration, impact, or salinity may be present. Failure to follow this instruction may result in fire or explosion.
- Keep metal chip, dust, and wire residue from flowing into the unit. Failure to follow this instruction may result in fire or product damage.

Ordering Information

TK	4	N	-1	4	R	N
	OUT2 control output ²⁾	Standard	N	None	※Select in case of standard control (heating or cooling)	
	OUT1 control output ²⁾	Heating & Cooling	R	Relay output		
	Power supply	S	SSR drive output (standard ON/OFF, cycle control, phase control)			
		C	Current output or SSR drive output selectable			
		2	24VAC 50/60Hz, 24-48VDC			
		4	100-240VAC 50/60Hz			
	Input/Output option ¹⁾	1	Standard	Alarm output 1+CT input ¹⁾		
		2	Standard	Heating & Cooling Alarm output 2 ²⁾		
		N	Standard	Alarm output 1+Alarm output 2		
		D	Heating & Cooling	Digital input (DI-1, DI-2)		
		R	Standard	Alarm output 1+Transmission output		
		T	Standard	Transmission output		
		S	Standard	Alarm output 1+RS485 communication output		
		M	Standard	RS485 communication output		
	Size	N	DIN W48×H24mm			
		SP	DIN W48×H48mm (11pin plug type) ³⁾			
		S	DIN W48×H48mm (terminal block type)			
		M	DIN W72×H72mm			
		W	DIN W96×H48mm			
		H	DIN W48×H96mm			
		L	DIN W96×H96mm			
	Digit	4	9999 (4-digit)			
	Item	TK	Temperature / Process Controller			

- In case of TK4N/SP Series, option control selection and digital input will be limited due to number of terminals.
- "S" represents SSR drive output support models which SSR function (standard ON/OFF, cycle, phase) control are available. "C" represents selectable current and SSR drive output support models.
- Select "R" or "C" type in case of using heating & cooling control and "N" type in case of using standard control.
- Does not support in AC/DC voltage type model.
- Does not support in TK4N.
- The CT input model of TK4N is selectable only for standard model which has alarm output 1.
- The heating & cooling model of TK4N-1□□□ has only alarm output 2.
- Only for TK4S-□□□□, OUT2 output terminal is used as DI-2 input terminal.
- 11Pin socket (PG-11, PS-11(N)) for TK4SP: sold separately.

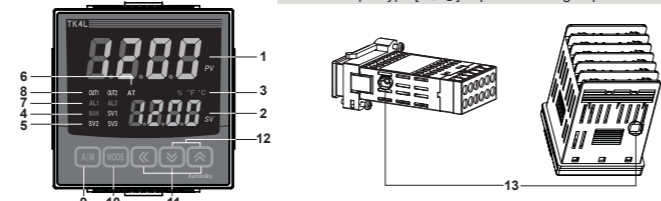
※Shaded descriptions are upgraded or added functions from the before TK Series. ※The above specifications are subject to change and some models may be discontinued without notice. ※Be sure to follow cautions written in the instruction manual, user manual and the technical descriptions (catalog, homepage).

Specifications

Series	TK4N	TK4SP	TK4S	TK4M	TK4W	TK4H	TK4L
Power supply	AC voltage	100-240VAC~50/60Hz	—	—	—	—	—
Allowable voltage range	AC/DC voltage	—	24VAC~50/60Hz, 24-48VDC=	—	—	—	—
Power consumption	AC voltage	Max. 6VA	Max. 8VA	Max. 8VA	Max. 8VA	Max. 8VA	Max. 8VA
Display method	AC/DC voltage	—	Max. 8VA (24VAC 50/60Hz), max. 5W (24-48VDC)	—	—	—	—
Character size	7-segment (PV: red, SV: green, other display part: green, yellow, red) LED method	4.5×7.2mm	7.0×14.0mm	9.5×20.0mm	8.5×17.0mm	7.0×14.6mm	11.0×22.0mm
Input type	PV (W+H)	—	—	—	—	—	—
RTD	SV (W+H)	—	—	—	—	—	—
Thermocouple	K, J, E, T, L, N, U, R, S, B, C, G, PLII (13 types)	—	—	—	—	—	—
Analog	Voltage: 0-100mVDC=, 0-5VDC=, 1-5VDC=, 0-10VDC= (4 types)	—	—	—	—	—	—
Current: 0-20mA, 4-20mA (2 types)	—	—	—	—	—	—	—
Display accuracy	RTD	—	—	—	—	—	—
Thermocouple	AI room temperature (23°C ±5°C); (PV ±0.3% or ±1°C, select the higher one) ±1-digit ¹⁾	—	—	—	—	—	—
Analog	Out of room temperature ranges: (PV ±0.5% or ±2°C, select the higher one) ±1-digit	—	—	—	—	—	—
CT input	AI room temperature (23°C ±5°C); ±0.3% F.S. ±1-digit	—	—	—	—	—	—
Out of room temperature ranges: ±0.5% F.S. ±1-digit	—	—	—	—	—	—	—
Control output	Relay	—	—	—	—	—	—
SSR	—	—	—	—	—	—	—
Current	—	—	—	—	—	—	—
Alarm output	Relay	—	—	—	—	—	—
Transmission	—	—	—	—	—	—	—
Communication	—	—	—	—	—	—	—
Option input	Digital input	—	—	—	—	—	—
Control method	Heating, Cooling	—	—	—	—	—	—
Heating & Cooling	—	—	—	—	—	—	—
Hysteresis	—	—	—	—	—	—	—
Proportional band (P)	—	—	—	—	—	—	—
Integral time (I)	—	—	—	—	—	—	—
Derivative time (D)	—	—	—	—	—	—	—
Control period (T)	—	—	—	—	—	—	—
Manual reset value	—	—	—	—	—	—	—
Sampling period	—	—	—	—	—	—	—
Dielectric strength	—	—	—	—	—	—	—
Vibration	—	—	—	—	—	—	—
Relay life cycle	Mechanical	—	—	—	—	—	—
Electrical	—	—	—	—	—	—	—
Insulation resistance	—	—	—	—	—	—	—
Moisture immunity	—	—	—	—	—	—	—
Memory retention	—	—	—	—	—	—	—
Environment	Ambient temp.	—	—	—	—	—	—
-ment	Ambient humi.	—	—	—	—	—	—
Protection	—	—	—	—	—	—	—
Approval	—	—	—	—	—	—	—
Weight ²⁾	—	—	—	—	—	—	—

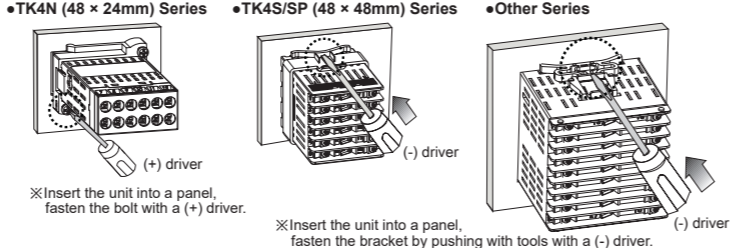
※1: ○At room temperature range (23°C±5°C)
 ・Thermocouple K, J, T, N, E type, below -100°C / Thermocouple L, U, PLII, Cu50Ω, DPT 50Ω: (PV ±0.3% or ±2°C, select the higher one) ±1-digit
 ・Thermocouple C, G, R, S type, below 200°C: (PV ±0.3% or ±3°C, select the higher one) ±1-digit
 ・Thermocouple B type, below 400°C: there is no accuracy standards.
 ○Out of room temperature range
 ・RTD Cu50Ω, DPT50Ω: (PV ±0.5% or ±3°C, select the higher one) ±1-digit
 ・Thermocouple R, S, B, C, G type: (PV ±0.5% or ±5°C, select the higher one) ±1-digit
 ・Others, below -100°C: within ±5°C
 In case of TK4SP Series, ±1°C will be added to the degree standard.
 ※2: The weight includes packaging. The weight in parenthesis is for unit only.
 ※Environment resistance is rated at no freezing or condensation.

Unit Description



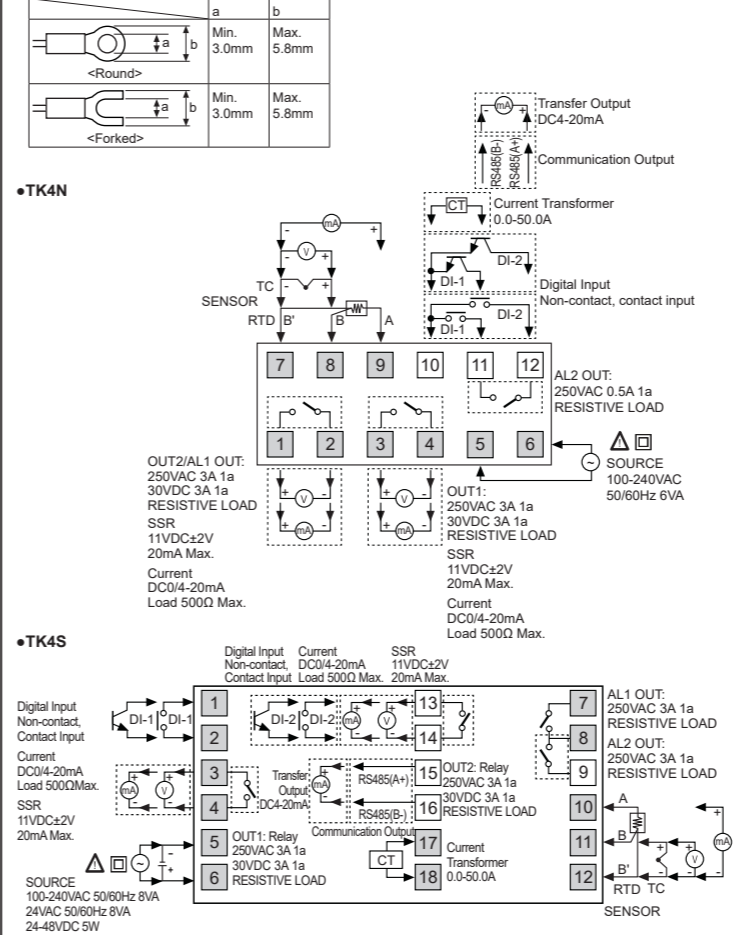
- Measured value (PV) display part:** RUN mode: It displays currently measured value (PV). Setting mode: It displays the parameter.
- Set value (SV) display part:** RUN mode: It displays the set value (SV). Setting mode: It displays the set value of the parameter.
- Unit (%C/F%) indicator:** It displays the unit set at display unit [unit] in parameter 3 group. (In case of TK4N, % is not supported).
- Manual control indicator:** It turns ON during manual controlling.
- Multi SV indicator:** One of SV1 to 3 lamps will be ON in case of selecting multi SV function.
- Auto tuning indicator:** It flashes by 1 sec. when executing auto tuning.
- Alarm output (AL1, AL2) indicator:** It turns ON when the alarm output is ON.
- Control output (OUT1, OUT2) indicator:** It turns ON when the control output is ON. ※During cycle/phase controlling in SSRP function model (TK4□4S□), when MV is over 5.0%, it turns ON. ※To use current output, when MV is 0.0% in manual control, it turns OFF. Otherwise, it always turns ON. When MV is over 3.0% in auto control, it turns ON and when MV is below 2.0%, it turns OFF.
- Key:** It is used when switching auto control to manual control.
- TK4N/S/SP** do not have the key. The key operates switching simultaneously.
- key:** It is used when entering parameter groups, returning to RUN mode, moving parameter, saving the set value.
- key:** It is used when entering the set value changing mode and moving or changing up/down digit.
- Digital input key:** When pressing + keys for 3 sec. at the same time, it operates the function (RUN/STOP, alarm clear, auto tuning) set at digital input key [di - v] in parameter 5 group.
- PC loader port:** It is the PC loader port for serial communication to set parameter with DAQMaster installed in PC. Use this for connecting SCM-US (USB/Serial converter, sold separately).

Installation

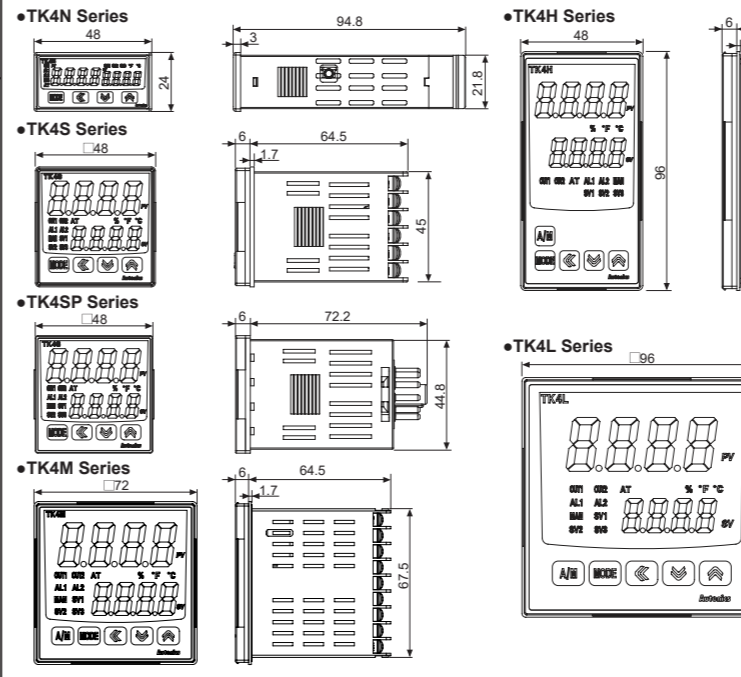


Connections

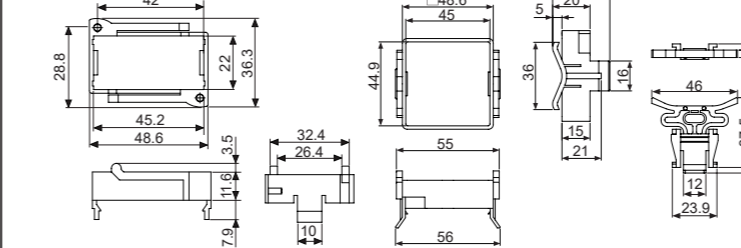
※Standard model has shaded terminals only.
 ※When the operation mode of heating & cooling OUT2 relay output model is heating or cooling control, the OUT2 is usable as alarm output 3 (except TK4N Series).
 ※When the operation mode of heating & cooling OUT2 current output model is heating or cooling control, the OUT2 is usable as transmission output 2.
 ※Use terminals of size specified below.



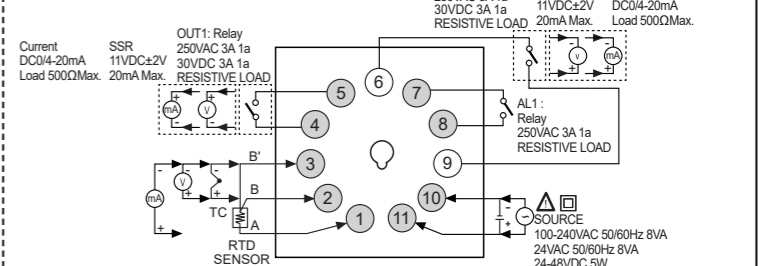
Dimensions



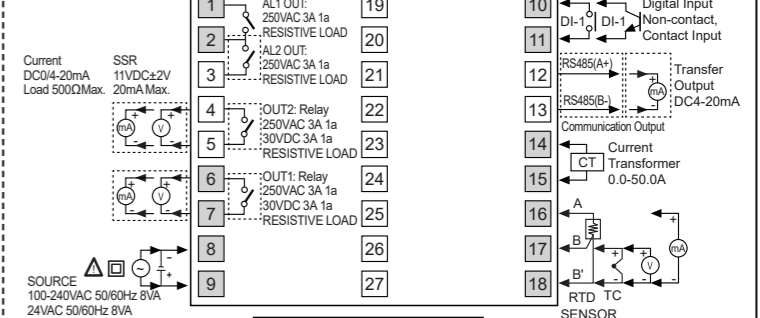
Bracket



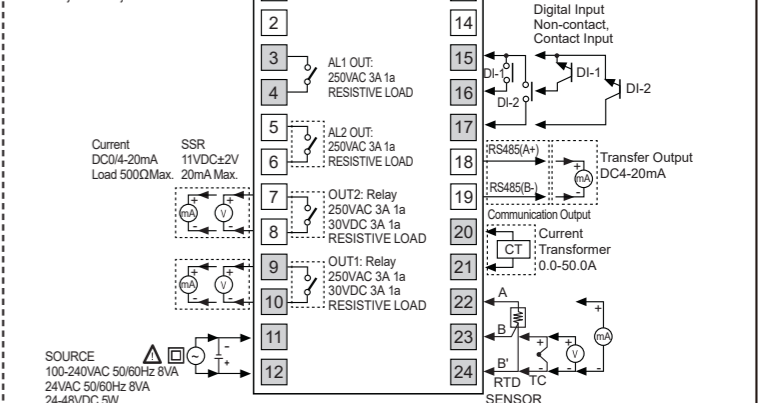
TK4SP



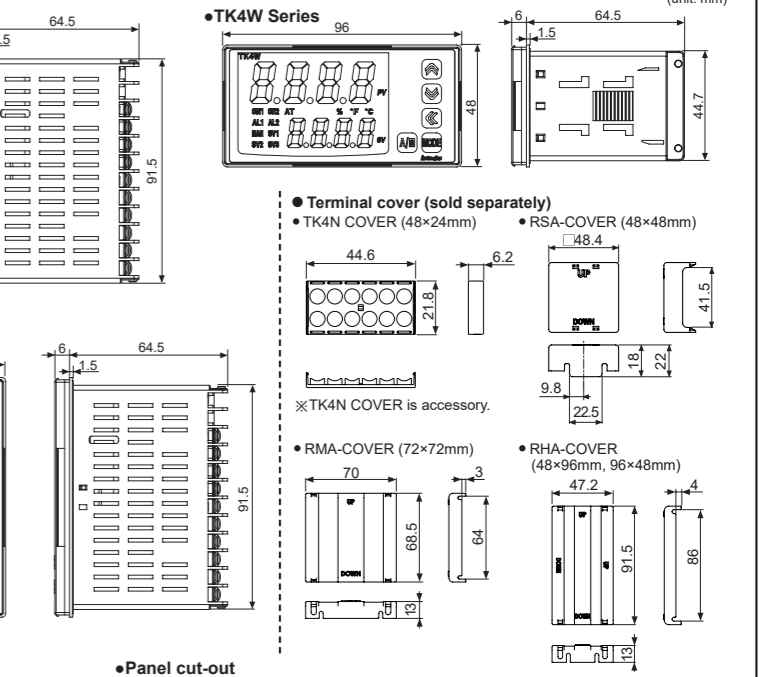
TK4M



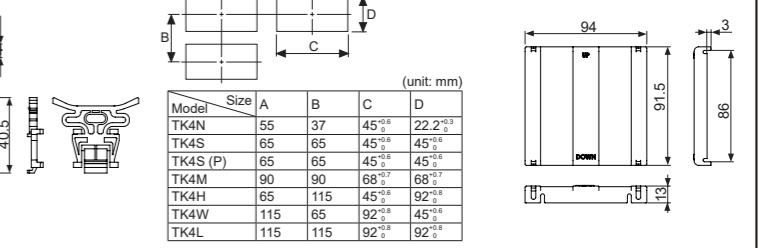
TK4H, TK4W, TK4L



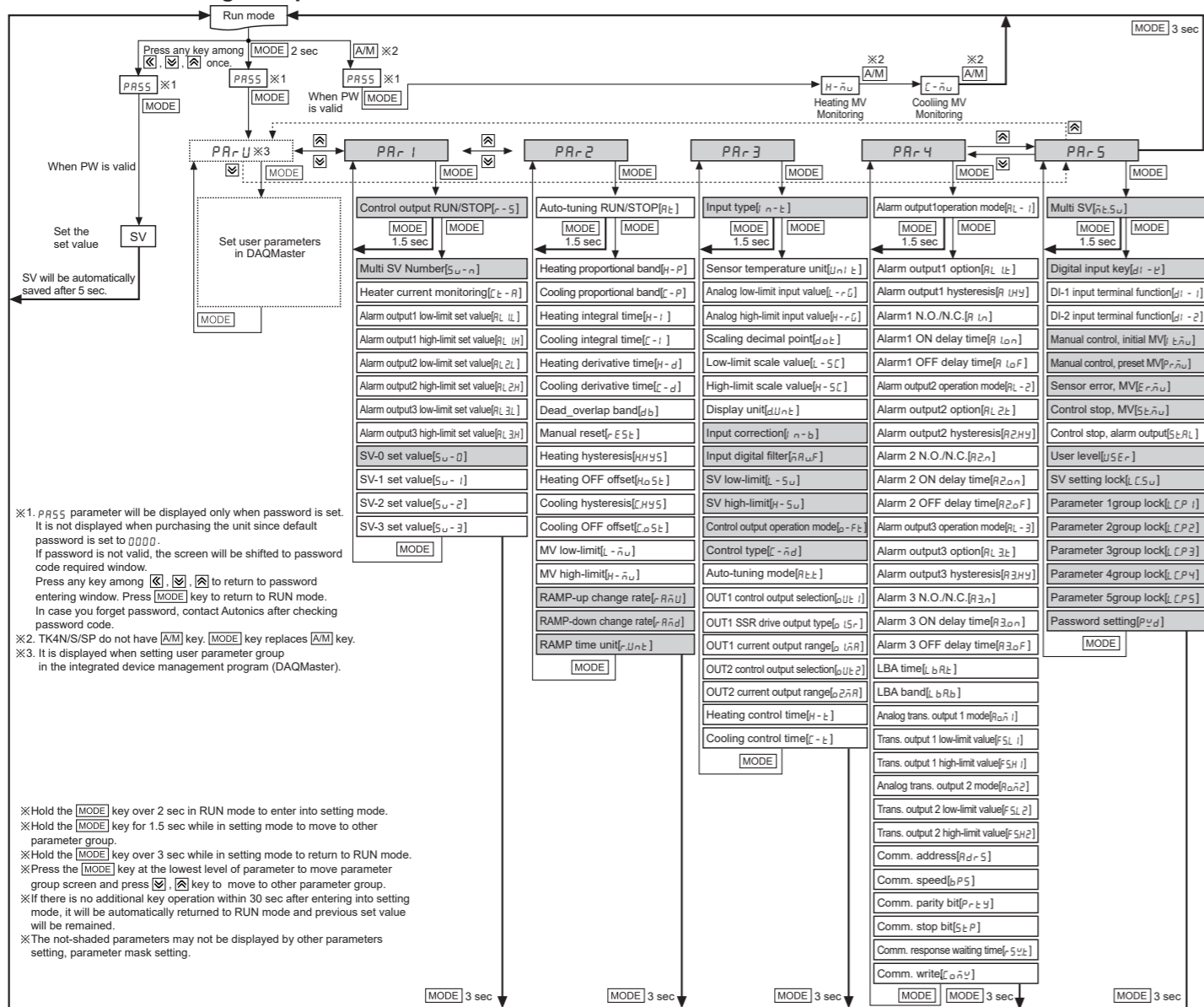
Terminal cover (sold separately)



Panel cut-out



Flow Chart for Setting Group



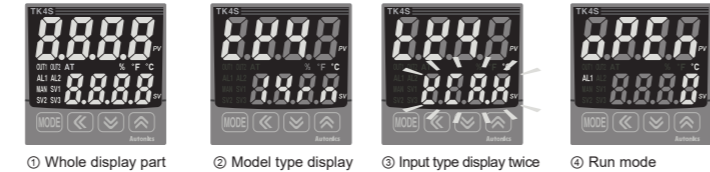
Input Types and Range

Input type	Decimal point	Display	Input range (°C)	Input range (°F)
Thermocouple	K (CA)	1	-200 to 1350	-328 to 2463
	J (IC)	0.1	-199.9 to 999.9	-328 to 1472
	E (CR)	0.1	-199.9 to 800.0	-328 to 1472
	T (CC)	1	-200 to 400	-328 to 752
	B (PR)	1	-199.9 to 999.9	-328 to 1652
	R (PR)	1	-199.9 to 999.9	-328 to 1652
	S (PR)	1	-199.9 to 999.9	-328 to 1652
	N (NN)	1	-200 to 1300	-328 to 2372
	C (TT) ^{*1}	1	0 to 2300	32 to 4172
	G (TT) ^{*2}	1	0 to 2300	32 to 4172
RTD	L (IC)	0.1	-200 to 900	-328 to 1652
	U (CC)	0.1	-199.9 to 900.0	-328 to 1652
	Platine II	1	-199.9 to 400.0	-328 to 752.0
	Cu 50Ω	0.1	-199.9 to 200.0	-328 to 392.0
	Cu 100Ω	0.1	-199.9 to 200.0	-328 to 392.0
	JPT 100Ω	0.1	-199.9 to 650.0	-328 to 1202
	DPT 50Ω	0.1	-199.9 to 650.0	-328 to 1202
	DPT 100Ω	0.1	-199.9 to 650.0	-328 to 1202
	Nickel 120Ω	0.1	-199.9 to 650.0	-328 to 1202
	Analog	Voltage	0-10V	-1999 to 9999
Current		0-20mA	-1999 to 9999	(Display point will be changed according to decimal point position.)

*1: C (TT): Same temperature sensor as former W5 (TT)
*2: G (TT): Same temperature sensor as former W (TT)

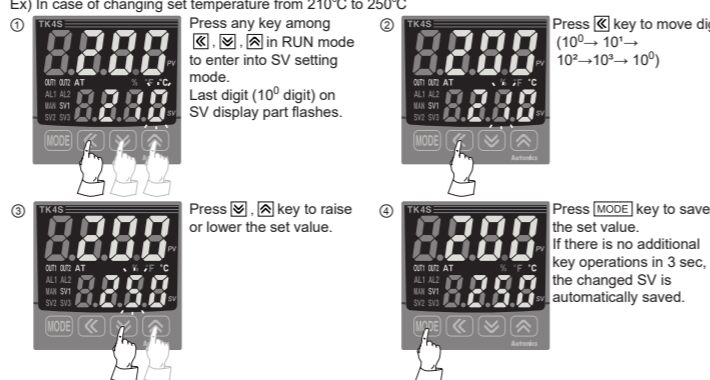
Initial Display When Power ON

When power is supplied, whole display parts flash for 1 sec. Afterwards, model name and input sensor type will be flash twice and then it enters into RUN mode.



Set Value (SV) Setting

You can set the temperature to control with [K], [J], [E] keys. Set range is within SV low-limit value [L - 5u] to SV high-limit value [H - 5u].

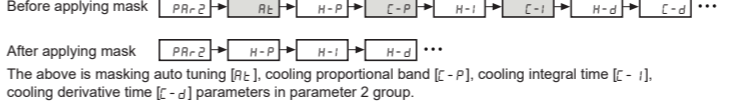


Parameter Reset

Press [K] + [J] + [E] to reset all parameters in memory to default value. Set [n1] parameter to '4E5' to reset all parameters. In case password function is on, it is required to enter valid password to reset parameters. Password is also reset.

Parameter Mask

This function is able to hide unnecessary parameters to user environment or less frequently used parameters in parameter group. You can set this in the integrated device management program (DAQMaster). Masked parameters are not only displayed. The set value of masked parameters are applied. For more information, refer to the DAQMaster user manual.



User Parameter Group [PR-U] Setting

This function is able to set the frequently used parameters to the user parameter group. You can quickly and easily set parameter settings. User parameter group can have up to 30 parameters in the integrated device management program (DAQMaster). For more information, refer to the DAQMaster user manual.



The above is setting user parameter group in the DAQMaster with alarm output 1 low-limit value [RL 1], alarm output 1 high-limit value [RL 1H], SV-0 set value [5u-0] parameter of parameter 1 group, heating hysteresis [H45], cooling hysteresis [H45] parameters of parameter 2 group, input correction [n-b] parameter of parameter 3 group, alarm output 1 hysteresis [H45], alarm output 2 hysteresis [H45] parameters of parameter 4 group.

Auto-tuning

Auto-tuning measures the control subject's thermal characteristics and thermal response rate, and then determines the necessary PID time constant. Application of the PID time constant realizes fast response and high precision temperature control. (When setting control type [C-d] is set as P, it is displayed.) Set [n1] parameter to [n1] in parameter 2 group to start auto-tuning. To stop auto-tuning, change the set as [bF]. (It maintains P, I, D values of before auto-tuning.) If sensor break error [bPE] occurs during auto-tuning, it stops this operation. If the measured temperature is over or below the input range, it operates continuously. During auto-tuning operation, whole parameters are only available to check.

Alarm

Alarm operation

Mode	Name	Alarm operation	Description
oFF	—	—	No alarm output
dUCC	Deviation high-limit alarm	OFF H ON SV PV 100°C 110°C High deviation: Set as 10°C High deviation: Set as -10°C	If deviation between PV and SV as high-limit is higher than set value of deviation temperature, the alarm output will be ON.
JJdU	Deviation low-limit alarm	ON H OFF PV SV 90°C 100°C Low deviation: Set as 10°C Low deviation: Set as -10°C	If deviation between PV and SV as low-limit is higher than set value of deviation temperature, the alarm output will be ON.
JdUc	Deviation high/low-limit alarm	ON H OFF H ON PV SV PV SV 90°C 100°C 120°C Low deviation: Set as 10°C, High deviation: Set as 20°C	If deviation between PV and SV as high/low-limit is higher than set value of deviation temperature, the alarm output will be ON.
CdUJ	Deviation high/low-limit alarm	OFF H ON H OFF PV SV PV SV 90°C 100°C 120°C Low deviation: Set as 10°C, High deviation: Set as 20°C	If deviation between PV and SV as high/low-limit is lower than set value of deviation temperature, the alarm output will be OFF.
PuCC	Absolute value high-limit alarm	OFF H ON H ON PV SV PV SV 90°C 100°C 110°C Absolute-value: Set as 90°C Absolute-value: Set as 110°C	If PV is higher than the absolute value, the output will be ON.
JJPu	Absolute value low-limit alarm	ON H OFF H OFF PV SV PV SV 90°C 100°C 110°C Absolute-value: Set as 90°C Absolute-value: Set as 110°C	If PV is lower than the absolute value, the output will be ON.
LbR	Loop break alarm	—	It will be ON when it detects loop break.
5bR	Sensor break alarm	—	It will be ON when it detects sensor disconnection.
HbR	Heater break alarm	—	It will be ON when CT detects heater break.

*H: Alarm output [] hysteresis [H45]

Alarm option

Mode	Name	Description
RL - A	Standard alarm	If it is an alarm condition, alarm output is ON. If it is a clear alarm condition, alarm output is OFF.
RL - b	Alarm latch	If it is an alarm condition, alarm output is ON and maintains ON status.
RL - C	Standby sequence 1	First alarm condition is ignored and from second alarm condition, standard alarm operates. When power is supplied and it is an alarm condition, this first alarm condition is ignored and from the second alarm condition, standard alarm operates.
RL - d	Alarm latch and standby sequence 1	If it is an alarm condition, it operates both alarm latch and standby sequence. When power is supplied and it is an alarm condition, this first alarm condition is ignored and from the second alarm condition, alarm latch operates.
RL - E	Standby sequence 2	First alarm condition is ignored and from second alarm condition, standard alarm operates. When re-applied standby sequence and if it is alarm condition, alarm output does not turn ON. After clearing alarm condition, standard alarm operates.
RL - F	Alarm latch and standby sequence 2	Basic operation is same as alarm latch and standby sequence 1. It operates not only by power ON/OFF, but also alarm set value, or alarm option changing. When re-applied standby sequence and if it is alarm condition, alarm output does not turn ON. After clearing alarm condition, alarm latch operates.

*Condition of re-applied standby sequence for standby sequence 1, alarm latch and standby sequence 1: Power ON
Condition of re-applied standby sequence for standby sequence 2, alarm latch and standby sequence 2: Power ON, changing set temperature, alarm temperature [RL 1, RL 2] or alarm operation [RL - 1, RL - 2], switching STOP mode to RUN mode.

Factory Default

SV setting group [5u]				Password input parameter			
Parameter	Factory default	Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
5u	0	PR55	0001				
Parameter 1 group [PR-1]				Parameter 2 group [PR-2]			
Parameter	Factory default	Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
r-5	rUn	RL 1H	1550	RL 3H	1550	5u-3	0000
5u-n	5u-0	RL 2L	1550	5u-0	0000		
Ct-A	00	RL 2H	1550	5u-1	0000		
RL 1L	1550	RL 3L	1550	5u-2	0000		

Parameter 3 group [PR-3]

Parameter	Factory default	Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
RL 1	oFF	H-d	0000	H-oSt	000	rARU	000
H-P	0 100	C-d	0000	CH45	002	rARd	000
C-P	0 100	db	0000	CoSt	000	rARt	n1 n
H-1	0000	rESt	0500	L-nu	-1000		
C-1	0000	HH45	002	H-nu	1000		

Parameter 4 group [PR-4]

Parameter	Factory default	Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
RL 1	dUCC	RL 2n	no	LbRt	0000	bP5	95
RL 1H	AL - A	RL 2on	0000	LbRb	002	PrY	noE
RL 1L	001	RL 2oF	0000	RL 2i	Pu	StP	2
RL 1n	no	RL - 3	oFF	F5L 1	-200	r54t	20
RL 1on	0000	RL 3t	RL - A	F5H 1	1350	Co4Y	EnR
RL 1oF	0000	RL 3Y	001	RL 2P	Pu		
RL 2	JJdU	RL 3n	no	F5L 2	-200		
RL 2t	AL - A	RL 3on	0000	F5H 2	1350		
RL 2H	001	RL 3oF	0000	RL 2S	01		

Parameter 5 group [PR-5]

Parameter	Factory default	Parameter	Factory default	Parameter	Factory default	Parameter	Factory default
RL 5	1	Prnu	0000	LCP 1	oFF	Prd	0000
di - 5	StoP	Ernu	0000	LCP 2	oFF		
di - 1	oFF	Stnu	0000	LCP 3	oFF		
di - 2	oFF	StRL	0000	LCP 4	oFF		
Lbnu	RL 5o	USEr	Stnd				

*Shaded parameters are for the heating&cooling model.

User Manual

For the detail information and instructions, please refer to user manual and user manual for communication, and be sure to follow cautions written in the technical descriptions (catalog, homepage). Visit our homepage (www.autonics.com) to download manuals.

Comprehensive Device Management Program[DAQMaster]

DAQMaster is a comprehensive device management software for setting parameters and monitoring processes. DAQMaster can be downloaded from our website at www.autonics.com.

Item	Minimum specifications
System	IBM PC compatible computer with Pentium III or above
Operations	Windows 98/NT/XP/Vista/7/8/10
Memory	256MB+
Hard disk	1GB+ of available hard disk space
VGA	Resolution: 1024x768 or higher
Others	RS232C serial port (9-pin), USB port

Cautions during Use

- Follow instructions in 'Cautions during Use'. Otherwise, it may cause unexpected accidents.
- Check the polarity of the terminals before wiring the temperature sensor.
- For RTD temperature sensor, wire it as 3-wire type, using cables in same thickness and length. For thermocouple (CT) temperature sensor, use the designated compensation wire for extending wire.
- Keep away from high voltage lines or power lines to prevent inductive noise. In case installing power line and input signal line closely, use line filter or varistor at power line and shielded wire at input signal line.
- Do not use near the equipment which generates strong magnetic force or high frequency noise.
- Do not apply excessive power when connecting or disconnecting the connectors of the product.
- Install a power switch or circuit breaker in the easily accessible place for supplying or disconnecting the power.
- Do not use the unit for other purpose (e.g. voltmeter, ammeter), but temperature controller.
- When changing the input sensor, turn off the power first before changing.
- After changing the input sensor, modify the value of the corresponding parameter.
- 24VAC, 24-48VDC power supply should be insulated and limited voltage/current or Class 2, SELV power supply device.
- Do not overlapping communication line and power line.
- Use twisted pair wire for communication line and connect ferrite bead at each end of line to reduce the effect of external noise.
- Make a required space around the unit for radiation of heat.
- For accurate temperature measurement, warm up the unit over 20 min after turning on the power.
- Make sure that power supply voltage reaches to the rated voltage within 2 sec after supplying power.
- Do not wire to terminals which are not used.
- This unit may be used in the following environments.
 - Indoors (in the environment condition rated in 'Specifications')
 - Altitude max. 2,000m
 - Pollution degree 2
 - Installation category II

Major Products

- Photoclectric Sensors
- Fiber Optic Sensors
- Door Sensors
- Door Side Sensors
- Area Sensors
- Proximity Sensors
- Pressure Sensors
- Rotary Encoders
- Connector/Sockets
- Switching Mode Power Supplies
- Control Switches/Lamps/Buttons
- I/O Terminal Blocks & Cables
- Stepper Motors/Drivers/Motion Controllers
- Graphic/Logic Panels
- Field Network Devices
- Laser Marking System (Fiber, CO₂, Nd:YAG)
- Laser Welding/Cutting System
- Temperature Controllers
- Temperature/Humidity Transducers
- SSRs/Power Controllers
- Counters
- Timers
- Panel Meters
- Tachometer/Pulse (Rate) Meters
- Display Units
- Sensor Controllers

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