

# USER'S OPERATING MANUAL FOR DIGITAL TEMPERATURE CONTROLLER

(Models: AI 5441 / 5841 / 5741 / 5941 / 5641



## SPECIFICATIONS: -

### DISPLAY

TYPE : 4- Digit 7 segment LED

Model no.	AI-5441	AI-5841	AI-5741	AI-5941	AI-5641
Display height	0.39"	0.39"	0.56"	0.56"	0.39"

STATUS LED'S : OP 1 : Main Control Output

### INPUT

Sensor input : J/K/Pt-100  
Range : See table

Sensor Type	Range	Resolution	Accuracy
Fe-k(J) T/C	0 ~ 760°C	1 °C	} ± 1 °C
Cr-AL(K) T/C	-99 ~ 1300°C	1 °C	
Pt-100(RTD)	-50 ~ 450°C	1 °C	

Resolution : 1°C  
CJC for TC : Built in automatic  
LWC for Pt-100 : Built in upto 18E max.

### RELAY OUTPUT

Contact type : N/O, CM, N/C  
Contact Rating : 5A @ 250VAC or 30 VDC  
Life expectancy : > 5,00,000 operations  
Isolation : Inherent

### SSR DRIVE OUTPUT

Drive Capacity : 12V @ 30mA.  
Isolation : Non-Isolated.

### FUNCTION

Output 1 : Main Control output

### ENVIRONMENTAL

Operating Range : 0 ~50°C, 5~90% Rh  
Storage Humidity : 85% Rh (Non-condensing)

### POWER SUPPLY

Supply Voltage : 90~270VAC, 50/60Hz.  
Consumption : 4W Maximum.

### PHYSICAL

Housing : ABS Plastic

Model no.	AI-5441	AI-5841	AI-5741	AI-5941	AI-5641
Weight (gms.)					

## SAFETY INSTRUCTION

This controller is meant for temperature control applications. It is important to read the manual prior to installing or commissioning of controller. All safety related instruction appearing in this manual must be followed to ensure safety of the operating personnel as well as the instrument.

## GENERAL

- ❖ The controller must be configured correctly for intended operation. Incorrect configuration could result in damage to the equipment or the process under control or it may lead personnel injury.
- ❖ The controller is generally part of control panel and in such a case the terminals should not remain accessible to the user after installation.

## MECHANICAL

- ❖ The Controller in its installed state must not come in close proximity to any corrosive/combustible gases, caustic vapors, oils, steam or any other process by products.
- ❖ The Controller in its installed state should not be exposed to carbon dust, salt air, direct sunlight or radiant heat.
- ❖ Ambient temperature and relative humidity surrounding the controller must not exceed the maximum specified limit for proper operation of the controller.
- ❖ The controller in its installed state must be protected against excessive electrostatic or electromagnetic interferences. Ventilation holes provided on the chassis of the instrument are meant for thermal dissipation hence should not be obstructed in the panel.

## ELECTRICAL

- ❖ The controller must be wired as per wiring diagram & it must comply with local electrical regulation.
- ❖ Care must be taken not to connect AC supplies to low voltage sensor input.
- ❖ Circuit breaker or mains s/w with fuse (275V/1A) must be installed between power supply and supply terminals to protect the controller from any possible damage due to high voltage surges of extended duration.
- ❖ Circuit breaker and appropriate fuses must be used for driving high voltage loads to protect the controller from any possible damage due to short circuit on loads.
- ❖ To minimize pickup of electrical noise, the wiring for low voltage DC and sensor input must be routed away from high current power cables. Where it is impractical to do this, use shielded ground at both ends.
- ❖ The controller should not be wired to a 3-Phase supply with unearthed star connection. Under fault condition such supply could rise above 264 VAC which will damage the controller.
- ❖ The Electrical noise generated by switching inductive loads might create momentary Fluctuation in display, alarm latch up, data loss or permanent damage to the instrument. To reduce this use snubber circuit across the load.

**⚠ CAUTION:** To prevent the risk of electrical shock, switch off the power before making/removing any connection or removing the controller from its enclosure.

## MECHANICAL INSTALLATION

The label on the controller identifies the serial number, wiring connections and batch number.

### OVER ALL DIMENSIONS & PANEL CUT OUT (IN MM)

MODEL:-AI-5441/5741/5941

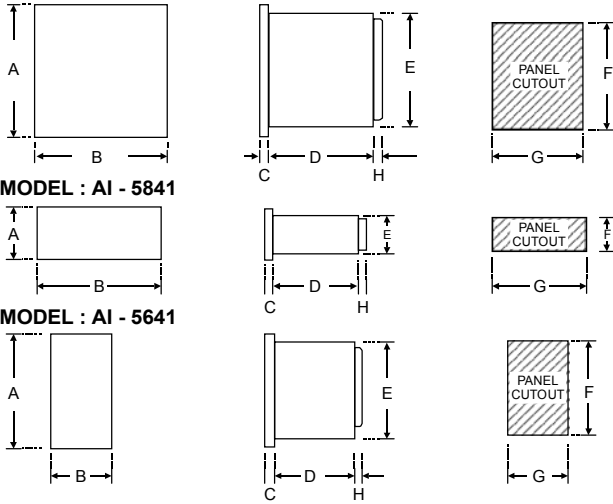


TABLE : 1

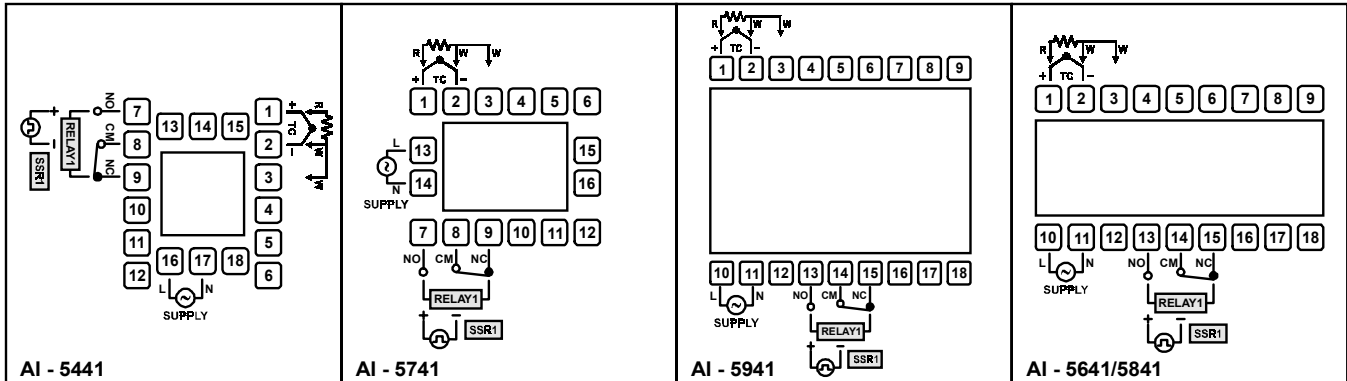
Dim Model	A	B	C	D	E	F	G	H
AI-5441	48	48	8	110	43	44	44	9
AI-5741	72	72	10	65	66	68	68	9
AI-5941	96	96	10	65	89	92	92	9
AI-5841	48	96	10	110	43	44	92	9
AI-5641	96	48	10	110	89	92	44	9

### INSTALLATION GUIDELINES

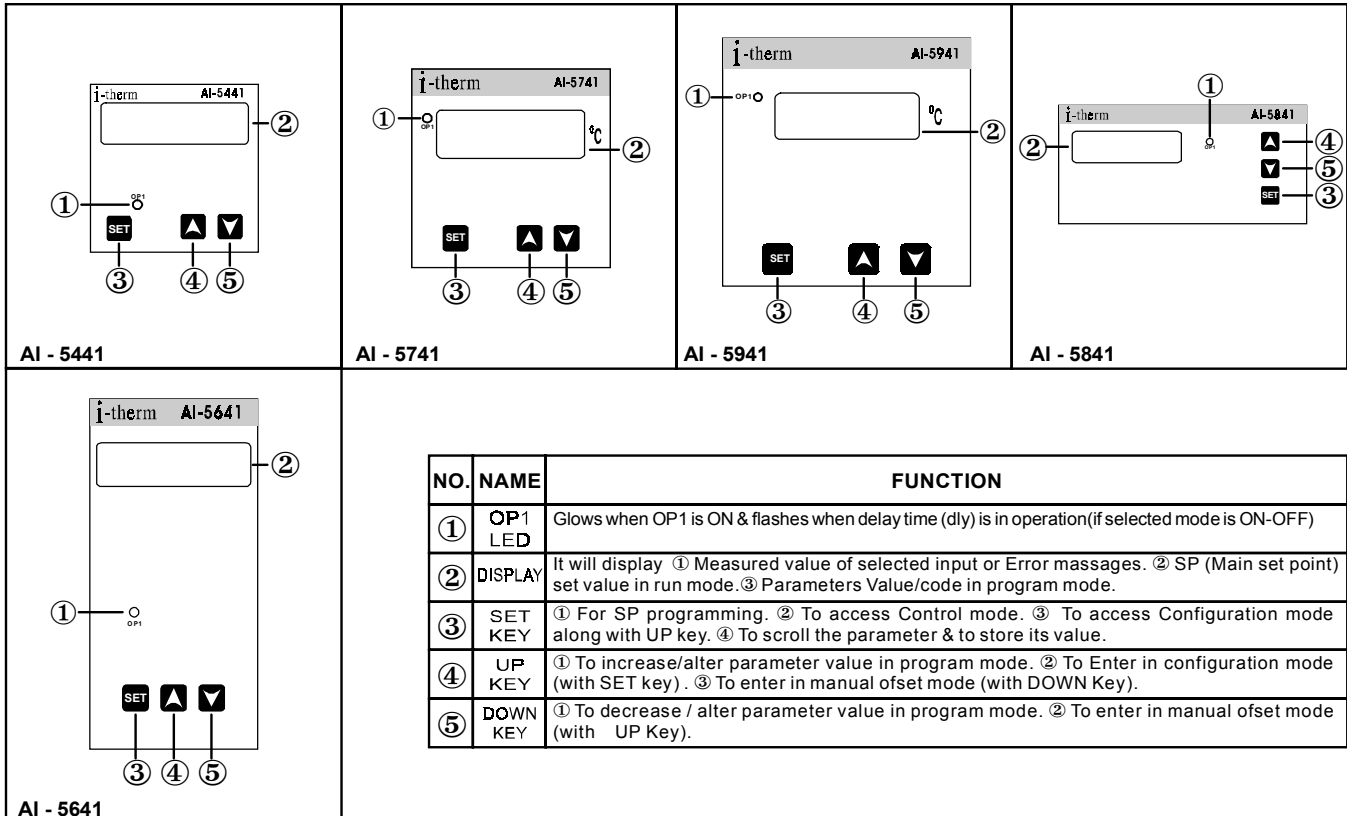
1. Prepare the cut-out with proper dimension as shown in figure.
2. Remove clamp from controller
3. Push the controller through panel cut-out and secure the controller in its place by tightening the side clamp.

### ELECTRICAL INSTALLATION

The electrical connection diagram is shown on the controller enclosure as shown below.



### FRONT PANEL LAYOUT



NO.	NAME	FUNCTION
①	OP1 LED	Glowes when OP1 is ON & flashes when delay time (dly) is in operation (if selected mode is ON-OFF)
②	DISPLAY	It will display ① Measured value of selected input or Error messages. ② SP (Main set point) set value in run mode. ③ Parameters Value/code in program mode.
③	SET KEY	① For SP programming. ② To access Control mode. ③ To access Configuration mode along with UP key. ④ To scroll the parameter & to store its value.
④	UP KEY	① To increase/alter parameter value in program mode. ② To Enter in configuration mode (with SET key) . ③ To enter in manual offset mode (with DOWN Key).
⑤	DOWN KEY	① To decrease / alter parameter value in program mode. ② To enter in manual offset mode (with UP Key).

## POWER UP:

At power on ; following sequence will be prompted on the display for 1 sec. till it reaches to Home display mode.



In home display mode; by pressing SET key once, user can view the set value of SP. If SET key pressed again, user can view Ramp rate.(if unable in config).

## PROGRAMMING

### USER LIST : To access the user list press SET key once.

(All following selected parameter's code as shown in shaded will be displayed for 01 sec. followed by their values / options)

PARAMETER	DISPLAY	RANGE	DESCRIPTION	DEFAULT
Control Set Point	<b>SP</b> > 0	LSPL ~ HSPL	User can change the SP value using UP/ DOWN keys. If keys pressed once; SP value changes by one count. While holding the key will result in change of value at faster rate. Reaching on desired SP value, press SET key once again. This will store the new SP value and move to next parameter.	0°C
Ramp Rate	<b>RATE</b> > 5.0	0.0 °C to 25.0 °C	If required; User can set ramp rate/min for SP (set value) to minimize overshoot. In this; controller will always start the ramp from PV up to SP (set value). If user sets non zero value of this parameter, ramp rate will be activated. If set to DSBL in config. list; this mode will be de-activated.	Disable

### CONTROL LIST : To enter in this mode press SET key for 3 sec. User can set the control parameters.

(All following selected parameter's code as shown in shaded will be displayed for 01 sec. followed by their values / options)

PARAMETER	DISPLAY	RANGE	DESCRIPTION	DEFAULT
Proportional Band	<b>Pb</b> > 5.0	0.5 to 99.9°C	This parameter will be prompted only if selected control action is T.P. It sets bandwidth over which the output power is adjusted depending upon the error (SV-PV). The value of this parameter is automatically set by Auto tune function.	5.0°C
Cycle Time	<b>CYCL</b> > 16.0	0.5 to 100.0 Sec.	This parameter will be prompted only if selected control action is PID. User can set this value based on process being controlled & type of output being selected. For Relay o/p, cycle time should be larger (>12sec) & for SSR o/p, cycle time should be lower (<10sec).	16.0 Sec.
Control Hysteresis	<b>HYSL</b> > 2	1 to 25 °C	This parameter will appear only if selected control action is ON-OFF. It sets the dead band between the ON and OFF switching of the output. The larger value of hysteresis minimize the number of ON-OFF operation to the load. This increases the life of actuators like contactors but also produces large errors (between PV & SV)	2°C
Delay 1	<b>DLY</b> > 0	0 to 500 Sec.	This parameter will appear only if selected control action is ON-OFF. It sets the main output restart time where o/p once turned off will turn ON only after restart time, regardless difference between PV & SP in Heat or Cool mode. If set to '0'; o/p will be switched without delay. Delay will be applicable also in case of every power ON.	120 Sec.
Lock code	<b>LOCK</b> > 0	1 ~ 9999	In Default code (0) user gets 3 min. at Power ON to alter control/config list. After the time is over; user can alter only SP. To get access of all list & parameters again; user has to switched the power OFF & then ON. If user has set lock code other than default he has to enter the same code here. else user can only view the parameters.	0

### CONFIGURATION MODE :

① To enter in this mode; press & hold SET & UP key together for 3 sec. ② Press UP or DOWN key to scroll between parameter options. ③ Press SET key to move on to next parameter.

(all following selected parameter's code as shown in shaded will be displayed for 01 sec. followed by their values / options)

PARAMETER	DISPLAY	DESCRIPTION	DEFAULT														
Input type	<b>INPT</b> > TC-J ↓ ↑ TC-P ↓ ↑ rtd	This parameter value is set according to the type of sensor (Thermocouple or RTD input) connected to the controller's input terminals. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Sensor Type</th> <th>Range</th> <th>Resolution</th> <th>Accuracy</th> </tr> </thead> <tbody> <tr> <td>Fe-k(J) T/C</td> <td>0 ~ 760°C</td> <td>1 °C</td> <td rowspan="3">} ± 1 °C</td> </tr> <tr> <td>Cr-AL(K) T/C</td> <td>-99 ~ 1300°C</td> <td>1 °C</td> </tr> <tr> <td>Pt-100(RTD)</td> <td>-50 ~ 450°C</td> <td>1 °C</td> </tr> </tbody> </table>	Sensor Type	Range	Resolution	Accuracy	Fe-k(J) T/C	0 ~ 760°C	1 °C	} ± 1 °C	Cr-AL(K) T/C	-99 ~ 1300°C	1 °C	Pt-100(RTD)	-50 ~ 450°C	1 °C	J
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PARAMETER	DISPLAY	DESCRIPTION	DEFAULT
Lower Set Point limit	LSPL > 0	Sets the minimum limit for set point adjustment. It can be set from minimum specified range of selected sensor to HSPL value.	0 °C
Higher Set Point limit	HSPL > 760	Sets the maximum limit for set point adjustment. It can be set from maximum specified range of selected sensor to LSPL value.	760 °C
Process value offSet	OFSt > 0	The function of this parameter is to add/subtract a constant value to the measured PV to obtain the final PV for control applications. This parameter value can be altered; (i) To compensate for known thermal gradient (ii) To match the display values with another recorder or indicator measuring the same PV.	0 °C
Input Filter	FLtr > 0.5	The controller is equipped with an adaptive digital filter which is used to filter out any extraneous pulses on the PV. The filtered PV Value is used for all PV dependent functions. If the PV signal is fluctuating due to noise, increase the filter time constant value.	0.5 °C
Control mode for O/P 1	mode > tP ↓ ↑ OnOff	User can select between ON-OFF or t.p action algorithm to be adopted for output.	PID
Control Logic for O/P 1	LOGC > HEAT ↓ ↑	This parameter will appear only if selected control mode is ON-OFF. User can select heating logic in which OP1 will remain ON till PV < SP. (PV increases when output is ON.)	HEAT
	LOGC > COOL	This parameter will appear only if selected control mode is ON-OFF. User can select cooling logic in which OP1 will remain ON till PV > SP. (PV decreases when output is ON.)	
Ramp rate	rAtE > EnbL ↓ ↑	This parameter will be prompted only if OCP (over shoot control point) is disabled. User can set the desired RAMP rate in USER list.	Disable
	rAtE > dsbL	The RATE parameter will not be prompted in USER list.	
Lock code	LOCK > 0	User can set code between 1 to 9999 to prevent unauthorized access to parameter setting.	0

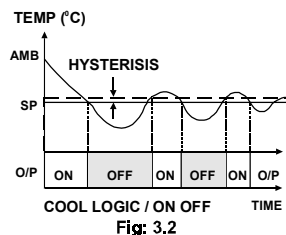
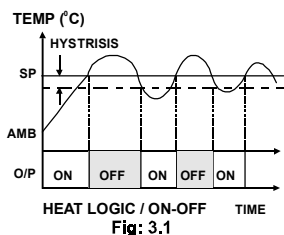
**MANUAL RESET (offset adjustment) :** To enter in this mode press UP & DOWN keys together for 3 sec.

PARAMETER	LOWER DISPLAY	UPPER DISPLAY	DESCRIPTION	DEFAULT
Auto tuning mode	SPOF	n0	This parameter will appear only if selected C.A is time proportional. (For more details: refer user guide.)	0 °C

**USER GUIDE:**

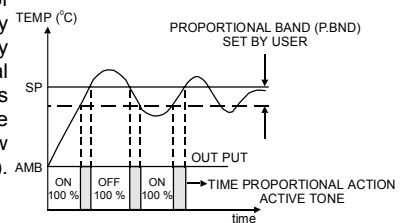
**1) ON-OFF ACTION:**

In this mode, output (Relay/SSR) remains ON till actual temperature reaches to the set point value. On reaching to SP; output turns to OFF condition & remains OFF till actual temperature drops down (in heat logic) or raises (in cool logic) equal to hysteresis set by user. (As shown in fig. 3.1 & 3.2).



**2) TIME PROPORTIONAL ACTION:**

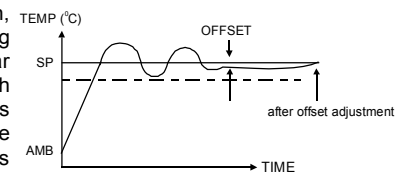
In this mode, ON time and OFF time of output (Relay/SSR) varies proportionally in every cycle (cycle time settable by user); depending the deviation of actual value w.r.t. set value. This action starts /continues only when actual temperature enters or is within the band (pbnd) below the set point. (Which is settable by user). (As shown in fig. 3.3)



**Fig: 3.3**

**3) MANUAL RESET (OFFSET ADJUSTMENT):**

In some application, after adopting-Time proportionating action; system may stabilize at particular temperature over a period of time which can be different than the set value. This steady state (error) offset can be eliminated by setting the value of this parameter equal to and opposite to the existing offset. (As shown in fig.3.4)



**Fig: 3.4**

**ABBREVIATION**

C.A. : Control Action	NC : Normally Close terminal of relay	SP : Set Point Value(set temp.)
CJC : Cold junction compensation	NO : Normally Open terminal of relay	SSR : Solid State Relay
CM : Common terminal of relay	OP1 : Output 1	T.P. : Time Proportional
EMI : Electro magnetic interference	OP2 : Output 2	
LWC : Lead wire (Length) compensation	PV : Process Value (actual temp.)	