ALTEC®

Microprocessor-Controlled Multi-Channel Temperature Controller D4

INSTRUCTION MANUAL

Table of Contents

1 Introduction

2 Features

- Microprocessor-based design.
- Built-in EEPROM stores parameter value permanently.
- Monitor and control 4 channels temperature simultaneously.
- PID control algorithm.
- Accepts thermocouples, Pt100 and standard signal input.
- Viewing all channel's working status simultaneously.
- Multi-channel measured value cycled display.
- Modular output unit, various output type selectable.
- Relay output, drive 250VAC/5A resistance load.
- Logic output, drive SSR.
- Self-diagnosis function, indicates failure information with specific code.
- Upper/Lower limit alarm.
- Easy to operate, use 5 keys to finish all operations.
- Wide range input switching mode power supply.

3 Order Code

4	4	0	0	–	C	0		

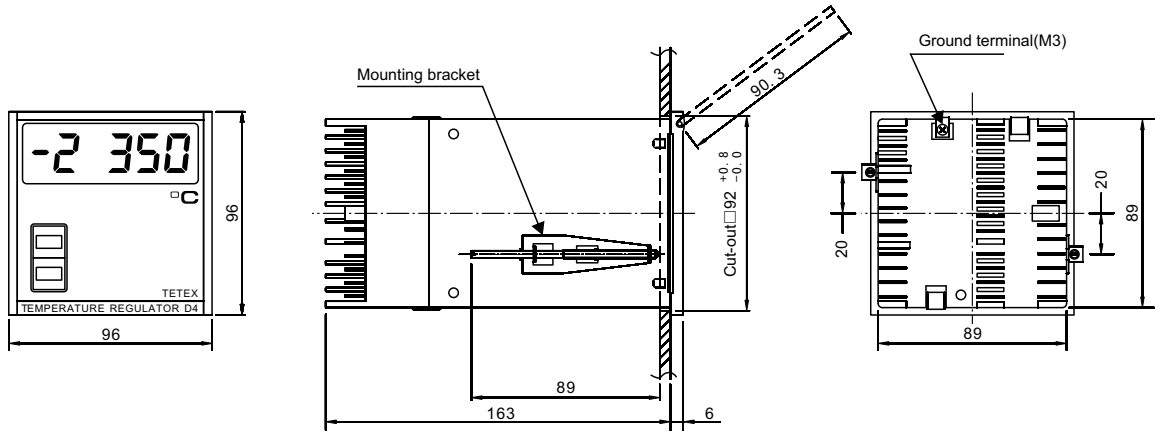
	Input	
1	Pt100	℃
2	Thermocouple	℃
5	Standard signal	%

9	Function	Output
	4 Two-States controller or 2 Tri-States Controller	Heating: Relay/Logic Cooling: Relay/Logic

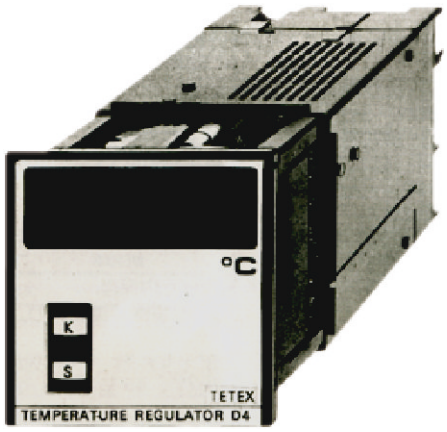
4 Package and Storage

5 Mechanical Installation

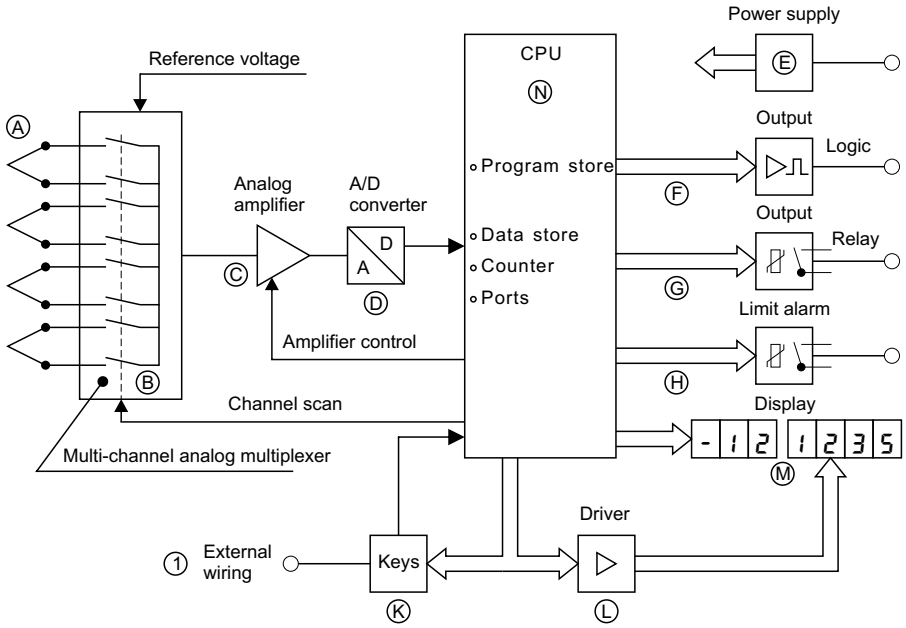
5.1 Outline Dimensions



5.2 Disassembly



6 Principle of Operation



As illustrated in the above diagram, the input signal A (suppose the input signal is thermocouple) will be sent to the analog amplifier C. Then the signal will be amplified and sent to A/D converter D. The amplification gain of amplifier C was controlled by CPU according to the type of input signal.

The data from A/D converter D will be further processed in CPU N.

Then the controller compares the setpoint with the measured value and regulates the output to make the measured value to be closed to the setpoint according to the built-in algorithm.

The logic output unit F acts in 1.28x(sample cycle).

The response time of relay output unit G is about 10 seconds.

Once a channel's measured value is higher than the high alarm value or lower than the low alarm value, the alarm unit H will output a continuous alarm signal.

The setpoint and parameters was entered using the keypad unit K and these value will be stored in the controller's non-volatile EEPROM.

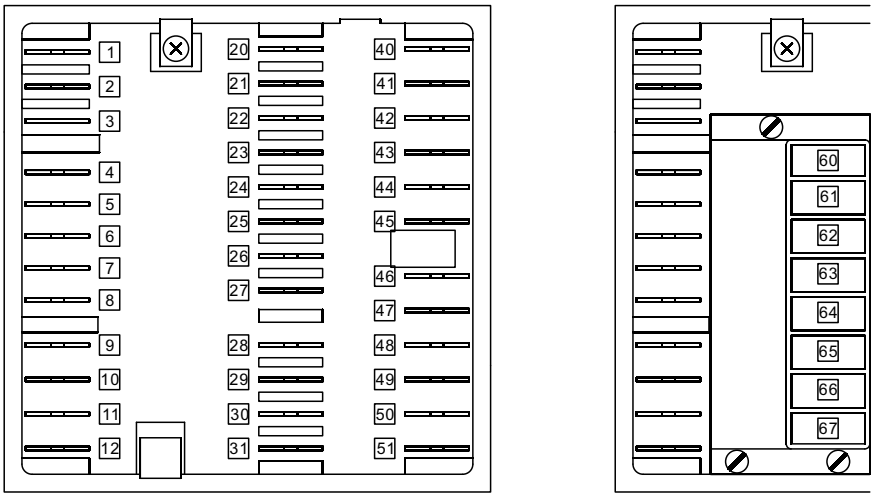
The "external wiring" unit was used to configure the measurement range, set the type of sensors and configure the operation mode(Two-States controller or Tri-States controller).

The display unit M was controlled by CPU N and driver unit L. The D4 controller was powered by the switching mode power supply(SMPS) E, the voltage is 92~262VAC/45~65Hz or 100-340VDC.

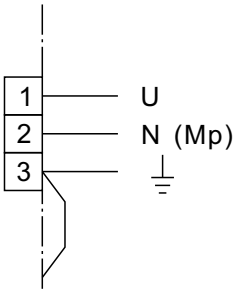
7 Electrical Connection

There are 36 pieces of twin-lead flat connectors at the rear of the controller. The controller core must be fixed in the case when connecting or disconnecting to prevent the flat terminals from being plugged out.

Please adopt appropriate interference-suppression measures during wiring.



7.1 Power Supply



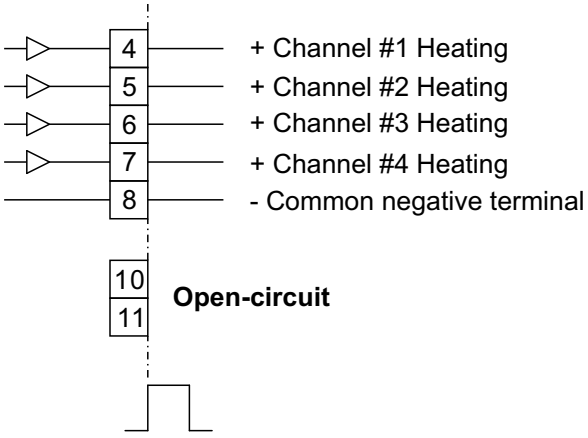
Voltage: 110~240VAC; +10%-15%; 45~65Hz
or: 120~310VDC; +10%-15%

Connect terminal 3 to ground

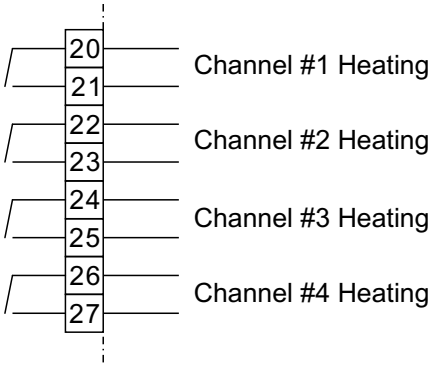
7.2 Outputs

7.2.1 Four Two-Step Controller

Model: 4400-C09.0



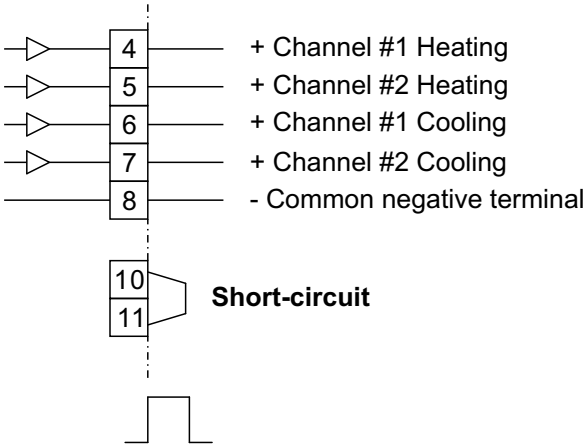
Logic Output Connections
Output 0/20mA max. 25V
The logic output was not isolated



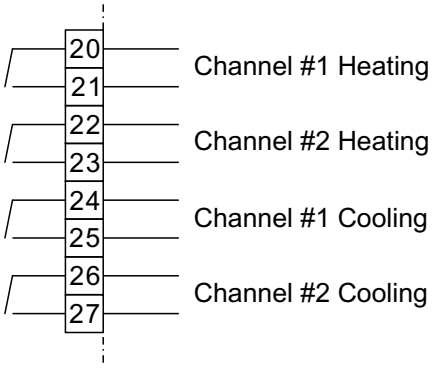
Relay Output Connections
Max. switching capacity 1.0kW with resistance load
(Max. 250VAC/5A)

7.2.2 Two Three-Step Controller

Model: 4400-C09.0

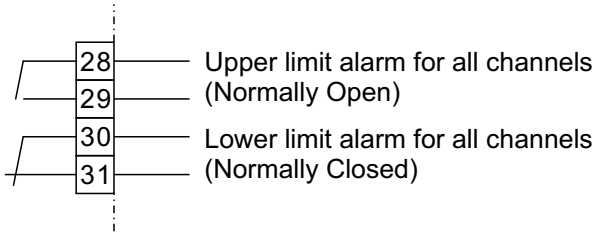


Logic Output Connections
Output 0/20mA max. 25V
The logic output was not isolated



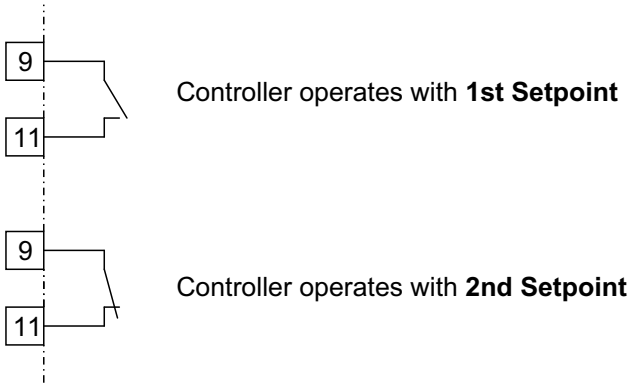
Relay Output Connections
Max. switching capacity 1.0kW with resistance load
(Max. 250VAC/5A)

7.3 Alarm Output



Max. switching capacity 1.2kW with resistance load
(Max. 250VAC/5A)

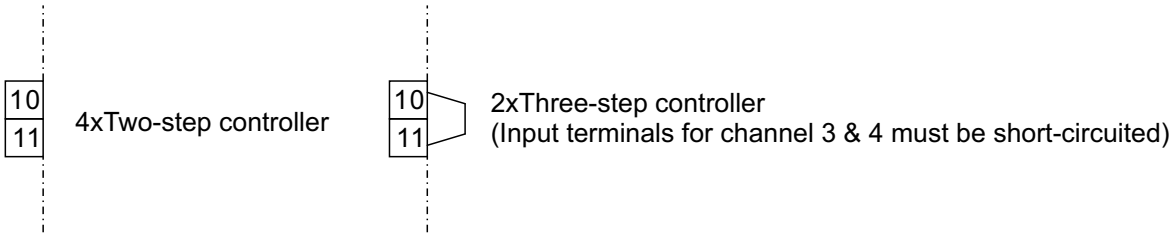
7.4 Setpoint Selection



Note: The wire's length between terminal 9 & 11 must be as short as possible.

7.5 Select Operation Mode: Two-step or Three-step Controller

(Only for model 4400-C09.0)



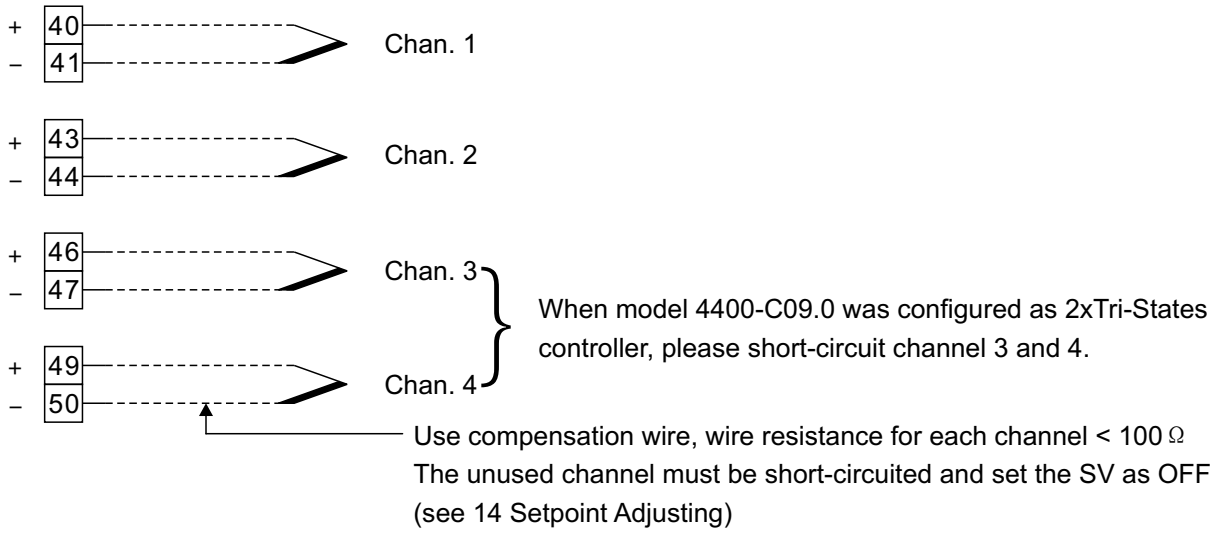
Two-step controller
The outputs have 2 states: Heating and No action

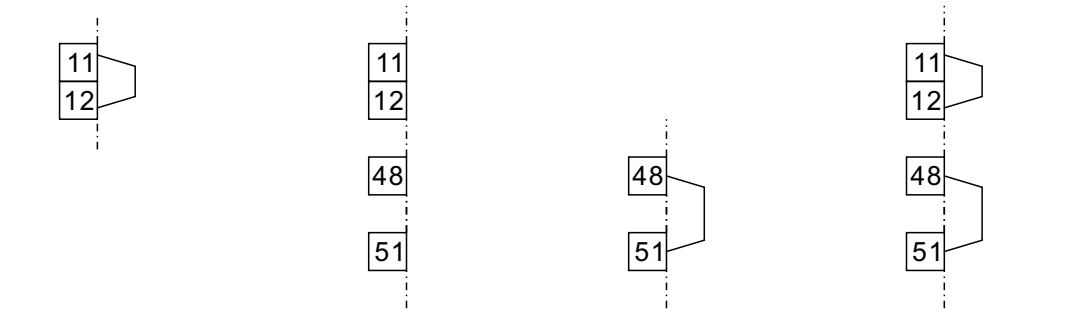
Three-step controller
The outputs have 3 states: Heating, Cooling and No action

7.6 Input signal connections

In order to avoid electrical noise to the input signal, the signal line should be away from the power/load lines and please use shield cables.

7.6.1 Thermocouples

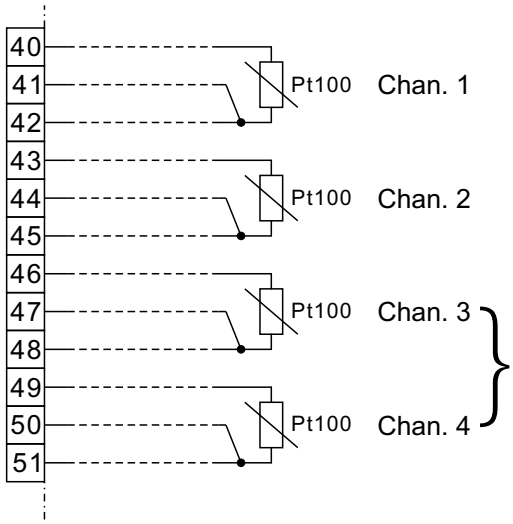




Type J(Fe-CuNi) Type E(NiCr-CuNi) Type K(NiCr-Ni) Type S(PtRh-Pt)

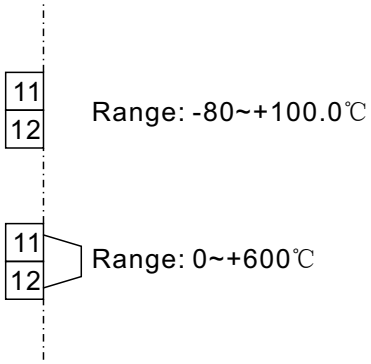
The selected thermocouple type affect all channels.

7.6.2 RTDs



Use 3-wire compensation wiring configuration.
Permissible resistance of each channel's wire < 10 Ohm.
The unused channel must be short-circuited and set the setpoint as OFF.

Select measurement range(all channels)



Note:
After changing the configuration of terminal 11 & 12, the controller must be reset(power off then power on), thus to make the measurement range selection takes action on all channels.

8 Interference Suppression

When the controller was mounted near a device which generates interference signals, in order to improve the reliability of the operation, some necessary interference suppression measures must be adopted.

1. Use shield cable for input signals and keep the input signal cable away from power line or other load lines, do not route the input signal cables with power line in the same cable raceway.

2. Make the shorting wire between terminals 10, 11, 12, 48 and 51 as short as possible and away from power line.

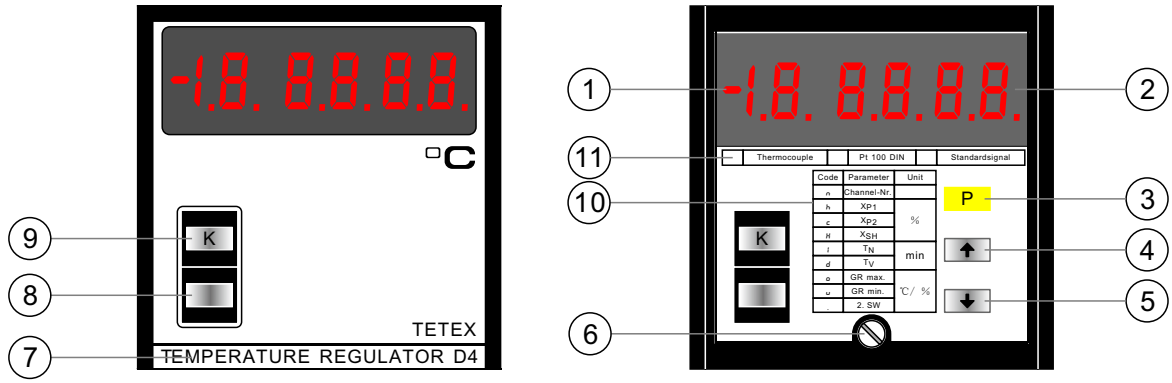
3. The shorting wire for selecting 2nd Setpoint (terminals 9 & 11) must be shield cable and connect the shield to ground and keep the wire away from power lines. To make the wire between terminals 9 & 11 as short as possible, suggest use a small relay which was mounted near the controller to control the connection between terminal 9 and 11.

4.In order to improve the reliability and safety, the controller case and ground terminal must be grounded properly.

5. In order to improve the reliability, please apply appropriate RC network for the high-power contactor or other electromagnetic devices which share the same power supply line with the controller to suppress peak voltage interference.

6. When using the logic output signal, the cable between controller and solid state relay(SSR) must be away from other power line or load lines.

9 User Interface

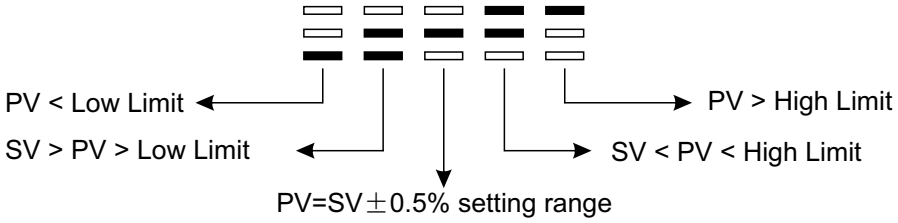


1. LED Display 1: Indicates channel No., heating(+), cooling(-)
2. LED Display 2: Indicates setpoint, measured value, failure code, parameters and status
3. P button: Select Parameters
4. Up key: Increase value
5. Down key: Decrease value
6. Controller core fixing screw
7. Front plate
8. S Button: Select setpoint
9. K button: Select channel and status indication
10. Parameter code list
11. Input signal identifier

10 Status Indication

After power on the controller, the status(the difference between measured value and setting value) of each channel will be displayed in LED Display 2. Thus the user can obverse the working status for each channel at a glance.

The horizontal segment of the 7-seg LED was used to indicate the working status, there are 5 types of working status for each channel:



PV: Process Value or Measured Value
SV: Setting Value or Setpoint

11 Measured Value Cycle Display

When the controller works in “Status Indication” mode, press button S and hold for about 3 seconds, the controller will enter the ″Measured Value Cycle Display″ mode, in this mode, each channel’s channel number and its measured value will be displayed in the LED display sequentially every one second.

When the controller works in “Measured Value Cycle Display” mode, press button K to enter “Measured Value Display” mode.

12 Measured Value Display

When the controller works in “Status Indication” mode, press button K to select the 1st channel and at this time the measured value of channel 1 will be displayed in the LED display. The next channel will be selected when you press the K button again. When the last channel’s measured value was displayed, the controller will then return back to “Status Indication” mode.

During the control process, when a channel’s heating relay was active, a “+” sign will appear before this channel’s channel number.

During the control process, for the Tri-States controllers, when a channel’s cooling relay was active, a “-” sign will appear before this channel’s channel number.

13 Setpoint Adjusting

Select the desired channel using the button K.

Press button S and hold on, as long as button S was depressed, the Setting Value will be displayed in the LED display.

Hold S key and press UP and DOWN key to alter the Setting Value. When altering the setting value, S button must be depressed. If you release S button, the display of the LED will disappear for a moment, at this time, the new setting value has been stored in the non-volatile memory. When you adjust the setting value to the minimum value, the code OFF will appear in the LED display, this indicates this channel has been closed, the status of the closed channel won't be displayed in the "operation status indications" mode.

All the unused channels must be set as OFF.

Setpoint adjustable range:

Thermocouple	Setpoint adjustable range
Type E	0~450°C
Type J	0~450°C
Type K	0~1200°C
Type S	0~1600°C

Pt100	Setpoint adjustable range
	0~600°C
	-80~100.0°C

Standard signal	Setpoint adjustable range	
DC Voltage	0~10V	0~100%
DC Current	0~20mA	0~100%
DC Current	4~20mA	0~100%

14 Parameters Viewing and Adjusting

Open the front plate of the controller, the parameter list can be found on the aluminum data plate.

To view and/or modify a channel parameter, please follow the below instructions:
Press button K to select the desired channel, then press button P and hold for about 3 seconds, this reveals the 1st parameter code and its value, at this time, the value can be altered using the UP and DOWN key. If there is no button operation within 3 seconds or after finish altering the value and press P button or after finish altering the value and press K button, the altered value will be stored in the non-volatile memory of the controller.

Every time you press the P button, the next parameter and its value will appear, the parameters will be displayed as per the following sequence:

SN	Code	Parameter	Adjustable Range	Comments
1	n	Channel number	0~19	
2	h	Proportional band X_{p1}(%)	0.1~9.9/10~99%	
3	c	Proportional band X_{p2}(%)	0.1~9.9/10~99	Only with three-step controller
4	H	Dead band X_{SH}(%)	0.1~9.9/10~99	Only with three-step controller
5	i	Integral Time T_N(min.)	0.0~9.9/10~99min	
6	d	Derivative Time T_V(min.)	0.0~9.9/10~99min	
7	o	Upper limit value (as deviation from setpoint)	Thermocouple: 0~900°C RTD: 0~900°C(Measurement range 0~600°C) 0~90°C(Measurement range -80~100°C) Standard signal: 0~90%	
8	u	Lower limit value (as deviation from setpoint)	Ditto	
9	.	2nd setpoint (°C, %)	Thermocouple: Type E 0~450 Type J 0~450°C Type K 0~999°C Type S 0~999°C Pt100: 0~600°C -80.0~99.9°C Standard signal: 0~99.9%	

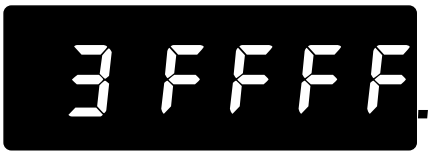
15 Failure Indication

The controller itself has the built-in self-diagnosis function, when breakdown appears during running, the type of failure can be identified by certain code.

The common failures:
* Sensor failure in thermocouple circuit.
* Short-circuit/Open-circuit in RTD circuit.
* Input analog circuit fails.

When the thermocouple fails or the RTD was short-circuited, the controller will enter status indication mode instantly, the failure channel will be indicated:

Select the failure channel using button K, the LED display:



A controller analog circuit fault is indicated by:

16 Optimization

The control parameters' value can not only be set according one's practical experience but also can be figured out by doing experiments. These parameters will be stored in the controller's EEPROM and can be stored for 10 years without power supply.

16.1 Two-step controller

Suppose we set the control parameters' value as below:
X_{P1}=0.1 T_N=0.0 T_V=0.0
And set setpoint in normal range.

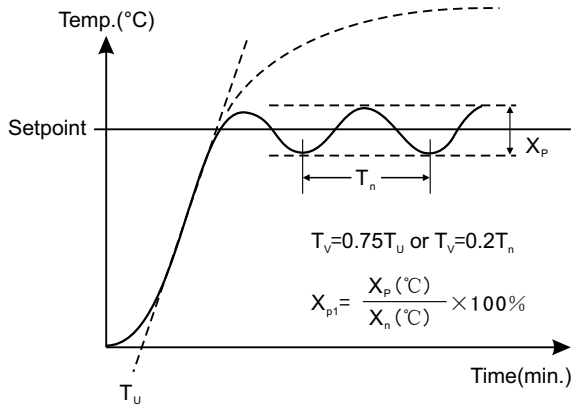
At this time, the controlled system's temperature will oscillate, the control parameters can be figured out according to the reaction curve's oscillation amplitude and period.

Assume the amplitude of oscillation is X_P(°C) and the period is T_N(min.) and the sensor's measurement range is X_N(°C), then the parameters can be figured out:

Proportional band $X_{P1}=\frac{X_P(°C)}{X_n(°C)}\times 100\%$

Integral time $T_N = T_n$

Derivative time $T_V = 0.2T_n$



For example:

Assume that there is a system which was controlled by the D4 controller, and the parameters was set as X_{P1}=0.1, T_N=0.0, T_V=0.0 and the oscillation occurs, the amplitude X_P=20°C, period T_N=15 minutes, the temperature sensor is type J thermocouple, the control parameter can be calculated as:

Temperature range X_n=450°C

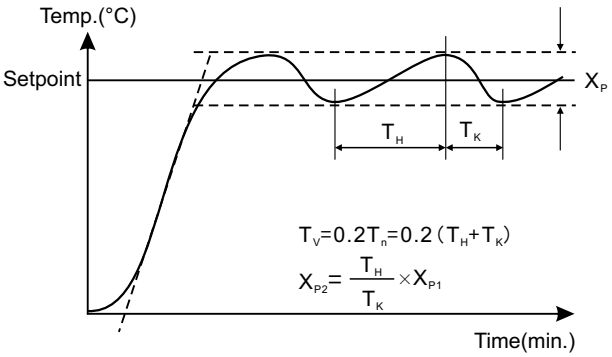
Proportional band $X_{P1}=\frac{X_P}{X_n}=\frac{20}{450}=4.4\%$

Integral time $T_N = T_n$ = 15 Minutes
Derivative time $T_V = 0.2T_n$ = 3 Minutes

16.2 Three-step controller

The control parameter for three-step controller can also be figured out using the same method.

For example:
Assume the system was controlled by the D4 controller, and the parameters was set as X_{P1}=0.1, T_N=0.0, T_V=0.0 and the oscillation occurs, the amplitude X_P=20°C, period T_H=10 minutes, T_K=5 minutes, the temperature sensor is type J thermocouple, the control parameter can be calculated as:



$$X_{P1}=\frac{X_P}{X_n}=\frac{20}{450}=4.4\%$$

$$X_{P2}=\frac{T_H}{T_K}\times X_{P1}=\frac{10}{5}\times 4.4\%=8.8\%$$

$T_N=T_n=T_H+T_K=15$ minutes

$T_V=0.2T_n=3$ minutes

Technical Data

Inputs

Thermocouple	Setpoint adjustable range	Measurement range
Type E (NiCr-CuNi)	0~450°C	-14~485°C
Type J (Fe-CuNi)	0~450°C	-14~850°C
Type K (NiCr-Ni)	0~1200°C	-9~1290°C
Type S (PtRh-Pt)	0~1600°C	-9~1719°C
Permissible line resistance	≤100Ω	
Sensor failure monitoring circuit	Built-in	
Cold junction compensation	Built-in	

RTD	Setpoint adjustable range	Measurement range
Pt100	-80~450°C	-94.4~114.4°C
Pt100	0~600°C	-15~646°C
Measuring circuit	3-wire compensation	
Open-circuit monitoring	Built-in	
Short-circuit monitoring	Built-in	

Standard signal	Setpoint adjustable range	Measurement range
0~10V	0~100%	-8~108%
0~20mA	0~100%	-8~108%
4~20mA	0~100%	-8~108%

Control Parameters

Control Algorithm	Proportional Integral Derivative(PID)
Proportional Band X_P	0~9.9/0~99% of adjustable range
Dead band X_{SH}	0~9.9/0~99% of adjustable range
Derivative Time T_V	0~9.9 min./10~99 min.
Integral Time T_N	0~9.9 min./10~99 min.
Control Accuracy	±0.2%FS+1 digit

Outputs

Relay output	4 contacts, NO Max. switching capacity 1.2kW with resistance load (max.250V AC, 6A) Lifetime > 10^6 witching operations
Logic output	4 ways signal, not electrical isolated 0/20mA, max. 25V
Current signal	4~20mA or 0~20mA DC(max. 16V) Not electrical isolated
Triac	Max. 264V AC, 1A Electrical isolated To trigger high-power triac
Alarm outputs	Full-scale low alarm: 1 contact, Normally Closed Full-scale high alarm: 1 contact, Normally Open Max. switching capacity 1.2kW with resistance load (max.250V AC, 6A) Lifetime > 10^6 switching operations

General Data

Power supply	92~264V AC; 45~65Hz Power consumption: Max. 5W
Environmental	Operation Temperature: 0~50℃ Storage Temperature: -20~70℃ Relative Humidity: < 85%RH
Mounting	Panel size: 96mm×96mm Cut-out: 92mm×92mm Depth: 165mm
Weight	Approx. 0.85Kg