Instructions for Use of

LD-B10 Series Temperature controller of

Dry Transformer

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Preface

- Before installing, operating and running the temperature controller, please carefully read the manual. Keep the manual properly!
- The manual shall be in kept where it is accessible to, and shall be reserved by the end user!
- **The sensing cable plug and power line should be disconnected from the temperature controller first before the transformer is put to the high-voltage holding test so as not to cause any damage to the temperature controller!!!**
- To ensure normal operation of temperature controller it should be handled and installed with as much care as possible.
- Acute vibration will occur when you switch on the transformer, and much heat, low-frequency vibration and electromagnetic interference will be produced in normal operation. In order to enhance the reliability of the temperature controller, install the temperature controller on case of transformer or on the wall as far as possible.
- Welding on steel jacket of probe of the temperature controller by electric soldering iron is not allowed. It is not allowed to conduct temperature control test by open fire temperature measurement probe. When it is required to detect the output state of the temperature controller, please apply the analog output function of the controller. (User password: 1012)
- For external wiring, please refer to the wiring diagram on the back cover of the temperature controller / at the back of the box door. Check if the terminal is active or passive and refer to the description of the capacity of relay contact in the directions or wiring diagram
- Should you have any question or find any error when reading the directions or using the control, we shall be grateful if you could contact us promptly.
- No further notice will be given where the manual is modified or altered. If any insert is annexed to the manual, the wiring diagram and description in such insert shall prevail.

Contents

1. Introduction

Safe operation and working life of power transformers depends largely on the safety and reliability of transformer winding. If the temperature of transformer winding exceed the temperature which insulation withstand, it will damage the insulation. This is one of the most important reasons that transformers cannot operate normally.

LD-B10 series temperature controller of dry transformer (Referred to as temperature controller) is an intelligent controller designed especially for safe operation of dry transformer. The temperature controller features adoption of single chip computer technology and utilization of the platinum thermo-resistors embedded in the winding of the dry transformer for detection and display of temperature rise of the transformer windings. It can start or stop the cooling fan automatically for forced air cooling of windings and control over-temperature alarm and over-temperature tripping output so that the transformer will be operated safely.

2. Technical Indicators

2.1 Range of measurement: -30.0℃～240.0℃

2.2 Accuracy of measurement: Grade of accuracy: Grade 1(Grade 0.5 for temperature controller, Grade B for sensor)

Resolution 0.1℃

2.3 Operating conditions: Room temperature: -20℃～55℃

Relative humidity: < 95% (25℃)

Power frequency: 50Hz or 60Hz (±2Hz)

Power voltage: AC220V (+10%, -15%)

Or AC380V (3-phase 3-wire system) (+10%, -15%)

(Power voltage should be indicated before placing order, otherwise AC220V shall

govern)

2.4 Power consumption of temperature controller: ≤8W

2.5 Execution standard: Production standard: JB/T7631-2016 Electronic Thermo-controllers for Transformers

Certification passed: ISO9001:2008 Quality Management Systems-requirements

Test passed: IEC61000-4:2002 International Standard and GB/T17626-2008 Standard for Electromagnetic Compatibility Test and Measuring Technology

2.6 Relay contact output:

Capacity of contact of fan: 6A/250VAC (Cosφ=0.4) (Single-phase fan)

9A/380VAC (Cosφ=0.4) (Three-phase fan)

Control of output capacity: 5A/250VAC; 5A/30VDC (Resistance)

2.7 Protection class: IP40

Protection class of panel: IP54

3. Type and Classification of Function

Type	Function
LD-B10-220D (Ordinary type)	Three-phase circular measurement; Three-phase circular display/maximum value display and mutual switching between two functions; Input disconnection and trouble self-check display and output; Auto start and stop of cooling fan and output; Over-temperature alarm display and output; Over-temperature tripping display and output; Display of manual/auto modes of fan, output and mutual switching; Digital compensation for value displayed in each channel; Function of "black box"; Timed start, stop and control function of fan; Detection of output status.
LD-B10-220E	The same as Type D, with addition of 4~20mA analogue current output.
LD-B10-220F	The same as Type D, with addition of RS485 serial communications function.
LD-B10-220 G	The same as Type D, with addition of one-way transformer room temperature measurement and control.

LD-B10-220 I	The same as Type D, with addition of one-way transformer core temperature measurement and alarm.
LD-B10-220 L	The same as Type D, with addition of protection and alarm function for lack of phase and failure of fan.
LD-B10-220 C	The same as Type D, with addition of interlock control of P t100 and PTC on over-temp alarm and over-temp trip signal.

Note: Other special requirements for the temperature controller should be indicated when placing orders.

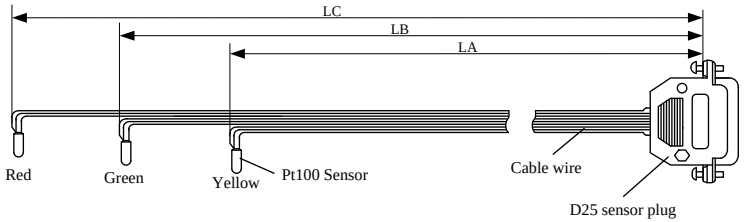
4. Sensing Cable Assembly

4.1 D25 sensing cable (3-wire system), cable length tolerances: ±2.5%

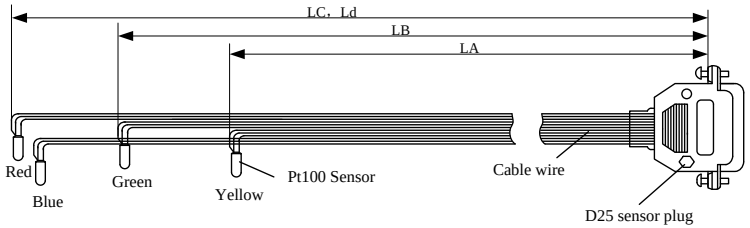
Note: Correspondence between line color and phase:

Yellow corresponds phase A; Green corresponds phase B;

Red corresponds phase C; Blue corresponds d-way.



Types D/E/F 3-way cable connection schematic diagram



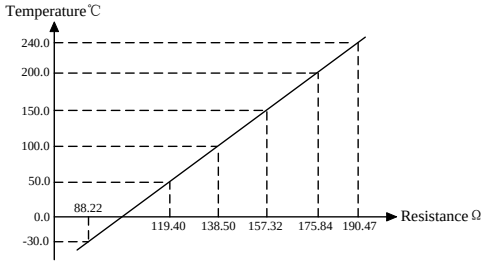
Types G/I 4-way cable connection schematic diagram

4.2 Sensor

4.2.1 Pt100 platinum resistor is a thermo-resistor with better linearity in the range of -30.0 ℃ ~240.0 ℃ and meets the requirements for Grade B set forth in GB/T8622-97--Technical Specification and Reference Table for Industrial Platinum Resistance.

4.2.2 Overall dimension: Φ4mm×40mm

4.2.3 Corresponding curves to the resistance and temperature of Pt100 platinum resistor:



4.3 Humidity module (Selection function)

4.3.1 Electrical parameters

4.3.1.1 Temperature range: 0.0℃～70.0℃

4.3.1.2 Humidity range: 0.0%RH～100.0%RH (Can be condensed)

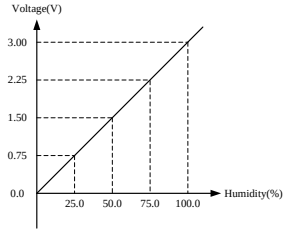
4.3.1.3 Detection range: 0.0%RH～99.0%RH

4.3.1.4 Save temperature range: -20.0℃～85.0℃

4.3.1.5 Save humidity range: Below 95% RH (Can be condensed)

4.3.1.6 Humidity detection accuracy: ±5%RH (Conditions: at 25℃, 60%RH)

4.3.2 Corresponding curves to the input moisture percentage and output voltage:



4.4 Interlock control of Pt100 and PTC on over-temp alarm and over-temp trip signal

4.4.1 Explanation of PTC (Selection function)

PTC is an abbreviation for positive temperature coefficient thermistor, which is a semiconductor resistor having a typical temperature sensitivity. When the temperature exceeds a certain value (Fixed temperature point not be adjustable), its resistance value will increase impulsively with increasing temperature, i.e., resistance mutation.

4.4.2 Logical relation of interlock control of Pt100 and PTC

4.4.2.1 Interlock control of Pt100 and PTC on over-temp alarm

4.4.2.1.1 When the temperature measured by Pt100 exceeds over-temp alarm value, in addition, PTC reaches the point of over-temp alarm and the resistance has mutated. Over-temp alarm signal will output in 6 seconds.

4.4.2.1.2 When the temperature measured by Pt100 exceeds over-temp alarm value, in addition, PTC has went wrong (Short circuit or open circuit, see table ‘PTC Status Inquiry’ below). Over-temp alarm signal will output in 6 seconds.

4.4.2.1.3 When PTC reaches the point of over-temp alarm and the resistance has mutated, in addition, all Pt100s have went wrong (Displaying ‘-OL-’ or ‘-OP-’ or ‘ -OH-’). Over-temp alarm signal will output in 6 seconds.

4.4.2.2 Interlock control of Pt100 and PTC on over-temp trip

4.4.2.2.1 When the temperature measured by Pt100 exceeds over-temp trip value, in addition, PTC reaches the point of over-temp trip and the resistance has mutated. Over-temp trip signal will output in 10 seconds.

4.4.2.2.2 When the temperature measured by Pt100 exceeds over-temp trip value, in addition, PTC has went wrong (Short circuit or open circuit, see table 'PTC Status Inquiry' below). Over-temp trip signal will output in 10 seconds.

4.4.2.2.3 When PTC reaches the point of over-temp trip and the resistance has mutated, in addition, all Pt100s have went wrong (Displaying '-OL-' or '-OP-' or '-OH-'). Over-temp trip signal will output in 10 seconds.

4.4.3 PTC Status Inquiry

Steps	**Display / Key**	**D1**	**D2**	**Instructions**	**Note**
1	SET	P	-Cd-	Enter function operating status	
2	SET	P	1000		
3	▲or▼	P	1006	Input password of PTC Status inquiry	Password should be correct
4	SET	P	P AH	PTC Status for over-temp trip	Good: Normal -OP-: Open circuit -OL-: Short circuit
5	SET	P	Good	Normal status	
6	SET	P	P AL	PTC Status for over-temp alarm	
7	SET	P	Good	Normal status	
8	SET	The controller exits PTC status inquiry and return to normal working status.			

4.4.4 About PTC ordering

4.4.4.1 Two options

4.4.4.1.1 PTCAL&PTCAH: Involved in controlling over-temp alarm and over-temp

trip signal output

4.4.4.1.2 PTCAH: Only involved in controlling over-temp trip signal output.

4.4.4.2 We offer PTCAL and PTCAH whose temperature point is as same as the controller setting for over-temp alarm and over-temp trip. Over-temp alarm PTC is PTC130, over-temp trip PTC is PTC150. PTC temperature point of resistance mutation is fixed value could not be adjustable. If users need to change the PTC temperature point, please make a note when ordering.

5. Display and Key

5.1 Display of working mode of temperature controller (Exemplified by ordinary type D temperature controller)

D1: One-bit code display, showing the measurement phase and prompting characters.

D2: Four-bit code display, showing the measured value and parameters.

Status	Display		LED light	Control output
	D1	D2		
Enter function operation	P	-Cd-	Circ-light and Max-light on	
Regular circular inspection	Phase	Corresponding temperature	Circ-light on	
Display of maximum value	Phase	Corresponding temperature	Max-light on	
Manual start of fan	Phase	Corresponding temperature	Fan-light and Hand-light on	Fan-closed

In excess of fan start value	Phase	Corresponding temperature	Fan-light on	Fan-closed
In excess of over-temperature alarm value	Phase	Corresponding temperature	Alarm-light on	Over-temperature alarm closed
In excess of over-temperature trip value	Phase	Corresponding temperature	Trip-light on	Over-temperature trip closed
In excess of measurement range	Phase	-OH- or -OL-	Fault-light on	Fault alarm closed
Sensor disconnected	Phase	-OP-	Fault-light on	Fault alarm closed
Temperature controller failure	Phase	-Er-	Fault-light on	Fault alarm closed

5.2 Function of key

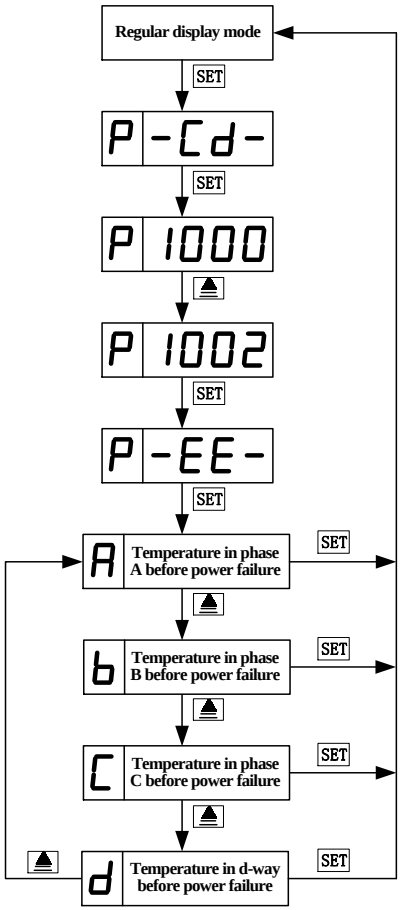
Key	**Function**
SET	Under normal working mode when the key is pressed, temperature controller will switch to the parameter setting mode and pressing the key in setting will come to the next step.
▲	Under the setting mode, pressing the key once will add one to the parameter displayed and if the key is held on, the number will be increased quickly. Under normal working mode pressing the key will change the fan from manual mode to auto mode or vice versa.
▼	Under the setting mode, pressing the key once will decrease one from the parameter displayed and if the key is held on, the number will be decreased quickly. Under normal working mode pressing the key will change the temperature controller from maximum value display to circular display in each phase or vice versa.

Note: In key operation, if no key is pressed, the temperature controller will return to normal working status automatically in about 100 seconds while the setting will become invalid.

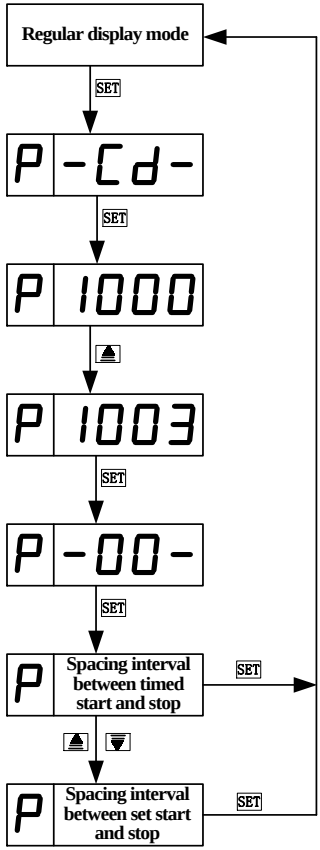
6. Parameter Setting

6.1 Function of "black box"

Under the function operation mode you can check the instantaneous temperature value of the winding in each phase before power failure. (D-way is available for types G/I only)



6.2 Excitation function of cooling fan (Timed start/stop of fan)



Note: The spacing interval is expressed in a unit of hour with a set range of 0~150. The auto operation time of the fan is set as 2 minutes by the software and user is unable to change it.

For example: If 0 is set, it indicates the fan has no timed start/stop function; If 24 is set, the fan will start or stop once at an interval of 24 hours. The user can set the spacing interval in light of the actual conditions.

6.3 Parameter setting function

Prompting characters for parameters have the following implications:

Ob: target value for start/stop of fan

dF: backlash of target value for start/stop of fan

AH: target value for over-temperature tripping

AL: target value for over-temperature alarm

ObJ: target value for start/stop of transformer room fan

dFJ: backlash of target value for start/stop of fan in transformer room

AHJ: target value for over-temperature tripping in transformer room

ALJ: target value for transformer core over-temperature alarm

Hb: target value for start/stop of dehumidification heater

HdF: backlash of target value for start/stop of dehumidification heater

Starting temperature of fan > Ob+dF

Stopping temperature of fan < Ob-dF

Starting temperature of fan in transformer room> ObJ+dFJ

Stopping temperature of fan in transformer room < ObJ-dFJ

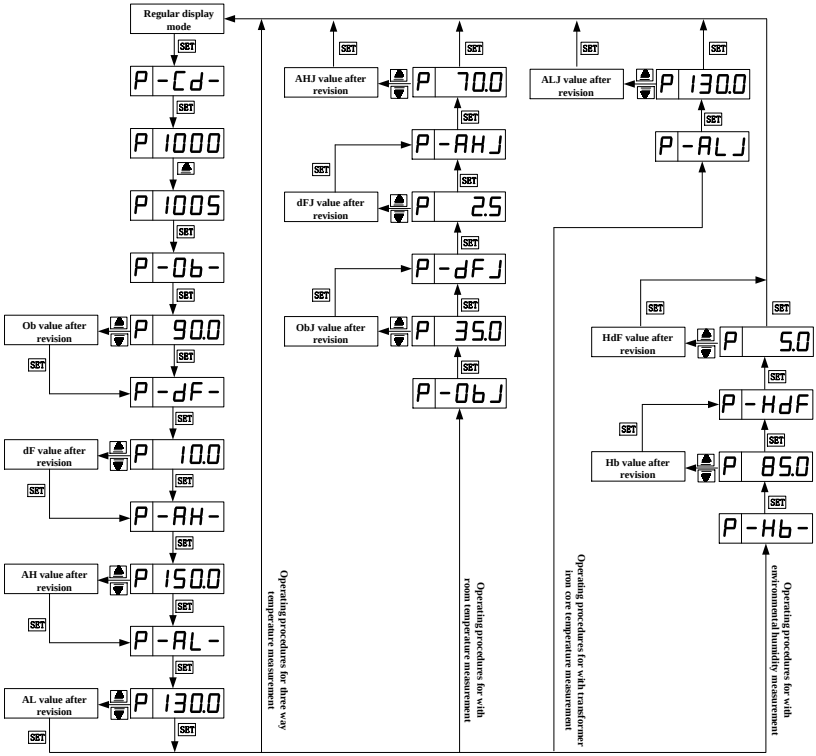
Starting temperature of dehumidification heater > Hb+HdF

Stopping temperature of dehumidification heater < Hb-HdF

Note:

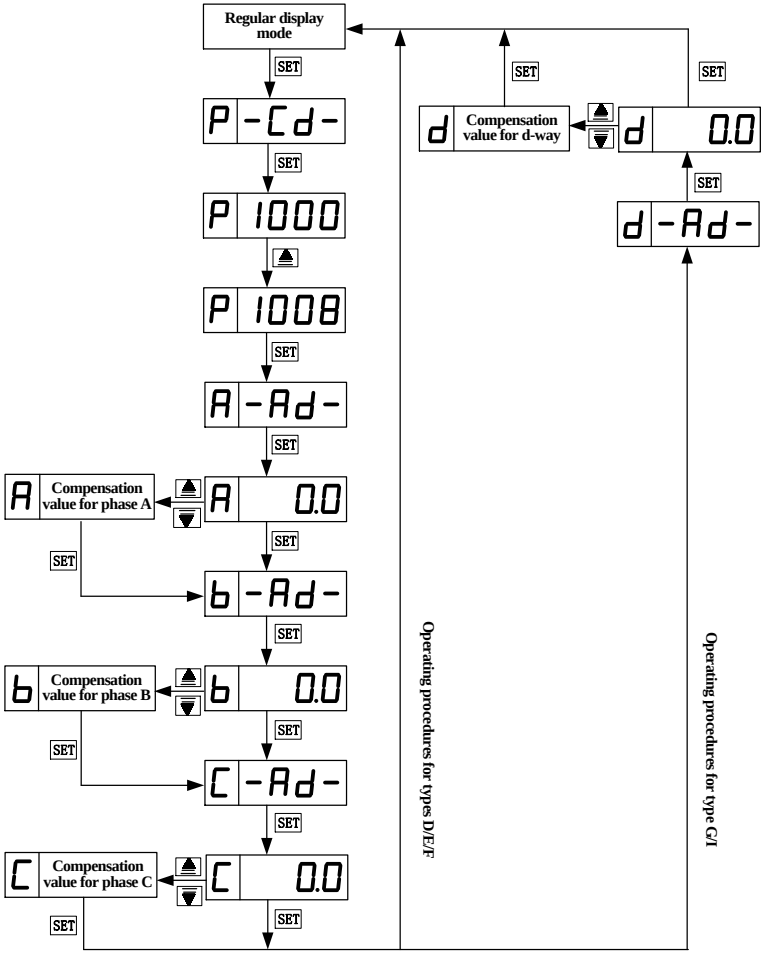
① The backlash of other target values than those for cooling fan, transformer room fan and dehumidification heater is all approved to be 0.3℃ tacitly.

② The parameters shown above are all for reference and specific set value shall be subject to the delivery label.


Regular display mode
SET
P-Cd-
P 1000
P 1005
P-Ob-
Ob value after revision
P 90.0
P-dF-
dF value after revision
P 10.0
P-AH-
AH value after revision
P 150.0
P-AL-
AL value after revision
P 130.0
Operating procedures for three way temperature measurement
AHJ value after revision
P 70.0
P-AHJ
dFJ value after revision
P 2.5
P-dFJ
ObJ value after revision
P 35.0
P-ObJ
Operating procedures for with room temperature measurement
ALJ value after revision
P 130.0
P-ALJ
Operating procedures for with transformer iron core temperature measurement
HdF value after revision
P 5.0
P-HdF
Hb value after revision
P 85.0
P-Hb-
Operating procedures for with environmental humidity measurement

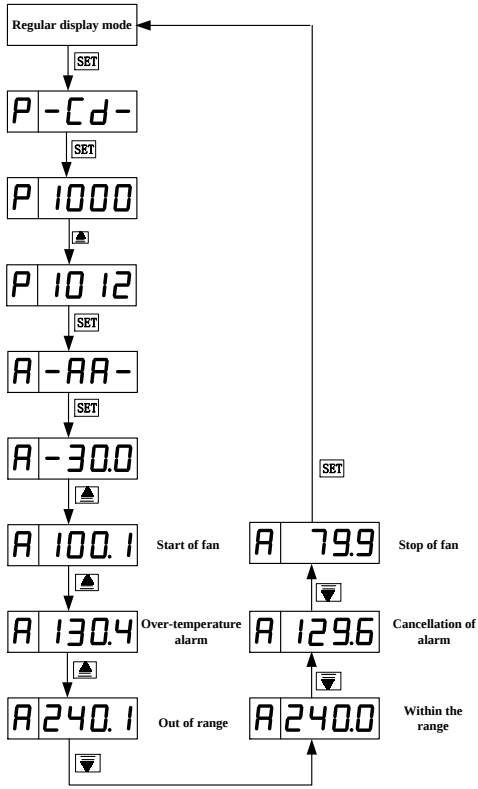
6.4 Procedures for setting digital compensation for measured value

When any error in the measured temperature value occurs owing to external causes such as sensor accuracy, you can go into the mode of setting digital compensation for measured value and calibrate the measured value. (Compensation range: -19.9℃~+19.9℃)



6.5 Operating procedures for detection of output status

The change in measured temperature can be simulated by digital setting to detect the output status of temperature controller and corresponding contact.



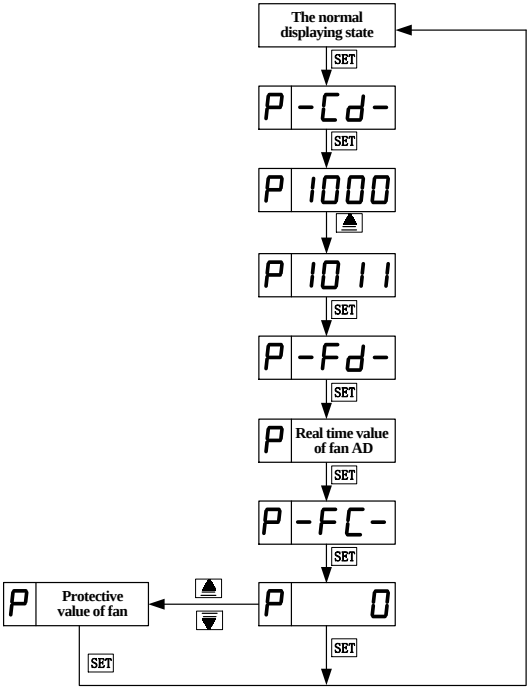
Note:

① To prevent the transformer from wrong tripping, the software doesn't support analogue function of over-temperature tripping!

② Type G/I temperature controller has no analogue function of failure output.

③ The actual operating temperature point shall be subject to the internal parameter of temperature controller (1005 function setting).

6.6 Operating procedures for setting protective value of fan



Note: ① When 0 is set for FC, there is no fan protection function;

When FC×50＞Fd, it is considered that fan is in normal;

When FC×50＜Fd, it is considered that fan is in failure and it will output alarm.

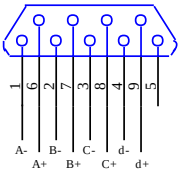
② Please connect same amount and same specification fans to 2 sets of fan terminals.

③ Start fan manually, check Fd, and then set the FC value that is larger than Fd/50.

④ If the fan protection is not correct after setting FC, please check the fan and fan wiring and make reference of 3 parts above.

7. 4~20mA Current Output (Type E)

7.1 Functional features



On the basis of the general-purpose function transmission of independent 3-way (4-way) 4~20mA current signals that are in linear correspondence with the measured temperature value (0.0℃~200.0℃) will link to the distant A/D card directly so as to set up a distributed control system(DCS).

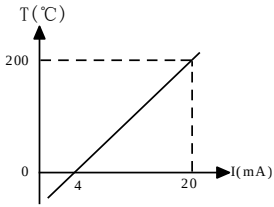
Within the temperature controller A-, B-, C- and d- are connected mutually, namely, with common catho. If your collecting system is in conflict with it, please specify before placing order. We usually provide 3-phase winding temperature current output. If you need an additional d-way temperature current output, please indicate before placing order.

7.2 Technical specifications for current output

7.2.1 Load resistance: R≤500Ω

Output accuracy: ±1%

7.2.2 Corresponding curve and relationship formula between measured temperature and output current of temperature controller:



Relationship formula between temperature and current: I= (16T/200)+4

Where: T stands for temperature value of winding in X-phase

I stands for current value corresponding to the temperature in the phase.

7.2.3 Conversion of output

If the user's collecting system calls for receipt of analogue voltage signals, 250Ω resistor with high accuracy may be connected in parallel directly at the existing current output end. Then 1V~5V voltage signals may be received immediately and connected to the load resistance R≥20KΩ.

8. RS485 Communications (Type F)

8.1 Functional features of temperature controller communications

Temperature controller has serial communication function and the operating status of the transformer and temperature controller can be monitored by the monitoring system.

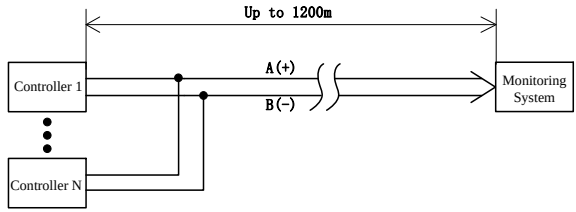
It usually utilized RS485 interface. If you need additional communication interface as RS232, RS422, please specify before ordering.

8.2 Technical indicators for communications:

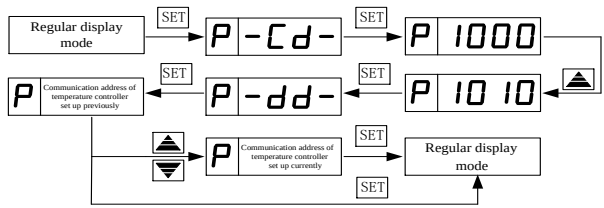
① Maximum communication distance: 1200m;

② Maximum number of temperature controller to be connected to: 28

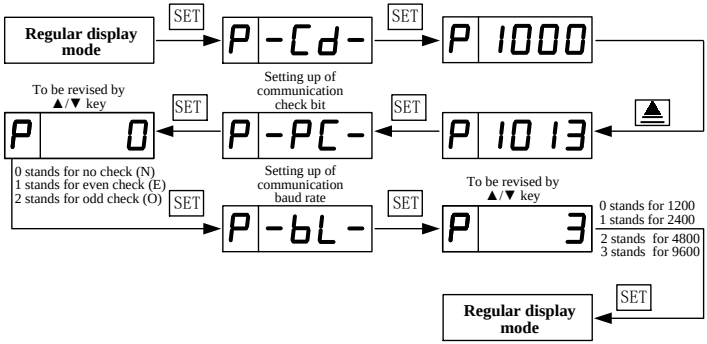
③ Schematic communications connection diagram



8.3 Procedures for setting up communication address of temperature controller



8.4 Procedures for setting up transmission check bit and baud rate of temperature controller



8.5 MODBUS RTU communication protocol

8.5.1 Definition of frame

Initial bit	Data length	Check bit	Stop bit
1 bit	8 bit	0 or 1 bit (To be set)	1 bit

8.5.2 Instructions on communications protocol

8.5.2.1 Function code in use:

① When function code is 0x03, temperature value readings in each phase of temperature controller should be taken.

② When function code is 0x04, output state readings of temperature controller relay should be taken.

8.5.2.2 Definition of register address:

8.5.2.2.1 Definition of register address for temperature value in each phase (0x03 function code):

Initial address	Description	Register address corresponding to some equipment

0x0000	Temperature data high 8-bit in phase A Temperature data low 8-bit in phase A	Temperature data in phase A	40001
0x0001	Temperature data high 8-bit in phase B Temperature data low 8-bit in phase B	Temperature data in phase B	40002
0x0002	Temperature data high 8-bit in phase C Temperature data low 8-bit in phase C	Temperature data in phase C	40003
0x0003	Temperature data high 8-bit for d-way. Temperature data low 8-bit for d-way.	Temperature data for d-way	40004

Note 1: If temperature controller measures 3-way, the initial address 0x0003 is retention address.

Note 2: Actual temperature in each phase is equal to the temperature data in each phase divided by 10.

Note 3: Definition of temperature data high 8-bit:

After PC transmits function code 0x03 and temperature controller sends back data, PC has to judge first whether temperature data are high 8-bit or temperature data low 8-bit. If the values for temperature data high 8-bit and temperature data low 8-bit are just as those shown in the table below, it indicates temperature controller is faulty and temperature value should not be calculated; Instead, corresponding working status of temperature controller should be shown based on the table below; If the value for temperature data high 8-bit is not shown in the table below, it indicates temperature controller is in normal operation and temperature value can be calculated based on the temperature data high 8-bit and temperature data low 8-bit.

Temperature data high 8-bit	Temperature data low 8-bit	Status of temperature controller	Description

0x70	0x00	-OP-	Open-circuit
0x60	0x00	-OH-	Out of upper limit
0x80	0x00	-OL-	Out of lower limit
0x50	0x00	-Er-	Fault

8.5.2.2.2 Definition of relay output register address (0x04 function code):

<table>
<tr><th>Initial address</th><th colspan="2">Description</th><th>Register address corresponding to some equipment</th></tr>
<tr><td rowspan="2">0x0000</td><td>Relay output data high 8-bit</td><td rowspan="2">For definition of data low 8-bit, refer to the following.</td><td rowspan="2">30001</td></tr>
<tr><td>Relay output data low 8-bit</td></tr>
</table>

Definition of data low 8-bit:

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0

▲: When temperature controller measures 3-way:

Where: Bit 5 stands for fan fault alarm output bit

Bit 3 stands for fault alarm output bit

Bit 2 stands for over-temperature alarm output bit

Bit 1 stands for over-temperature tripping output bit

Bit 0 stands for fan control output bit

▲: When temperature controller measures 4-way:

Where: Bit 5 stands for fan fault alarm output bit

Bit 4 stands for fault alarm output bit

Bit 3 stands for iron core over-temperature alarm output bit (Gauge Type I)

Bit 3 stands for transformer room fan control output bit (Gauge Type G)

Bit 2 stands for over-temperature alarm output bit

Bit 1 stands for over-temperature tripping output bit

Bit 0 stands for fan control output bit

Note: Each output bit status: Bit 0 stands for no action contact

Bit 1 stands for action contact

8.6 Communication examples

Assumption: When communication address of temperature controller (To measure 3-way) is 1; Temperature in phase A is in opening status (-OP-), temperature in phase B is 30.0℃ and temperature in phase C is 100.1℃; Fault alarm output and fan control output.

8.6.1.1 Computer issues order to send back data (Temperature readings in each phase are taken)

0x01	0x03	0x00	0x00	0x00	0x03	0x05	0xCB

8.6.1.2 Data sent back by temperature controller (Temperature value in each phase)

0x01	0x03	0x06	0x70	0x00	0x01	0x2C	0x03	0xE9	0x2B	0x0E

8.6.2.1 Computer issues order to send back data (Relay output readings are taken)

0x01	0x04	0x00	0x00	0x00	0x01	0x31	0xCA

8.6.2.2 Data sent back by temperature Controller (Relay output status)

0x01	0x04	0x02	0x00	0x09	0x79	0x36

9. Common Knowledge about Fault-handling on the site

Fault Symptoms	Potential causes	Remedies
Display not light after power on	Power line not connected properly or low voltage.	Check for input power.
“-OP-” blinks in X-phase and fault light is on.	1. Sensor is loose or in poor contact. 2. Sensor is broken.	1. Have the sensing joint screw tightened. 2. Replace the sensor.
“-OH-” blinks in X-phase and fault light is on.	Temperature out of upper limit of measurement or sensor measuring loop has a higher contact resistance.	Eliminate wire contact resistance.
“-OL-” blinks in X-phase and fault light is on.	Temperature out of lower limit of measurement or sensor measuring loop is short-circuited.	Check the measuring line of sensor.
“-Er-” blinks in the temperature controller and fault light is on.	Internal setting parameter is changed or internal fault of temperature controller	Contact the manufacturer at once.

Fan runs of itself before starting temperature is reached.	1. Under manual start mode. 2. Timed start/stop function of fan goes into effect.	1. Turn off the fan by pressing ▲. 2. Normal state.
Failure to turn off the fan manually after manual start of fan.	Then the measured temperature value is just between the positive and negative backlash values of fan.	Normal state.
Deviation in the display of three-phase temperature.	Difference in fixation depth of thermo-resistor.	Adjust fixed thermal resistance.
Regular display of temperature value in X-phase.	In the maximum value display mode.	Switch to the circular display mode by pressing ▼.
Not knowing what to do next after going into some operation status.	Keep pressing SET key to withdraw from the function operation mode and return to normal display mode.	

10. Fittings & Ordering

Type / Description	Type D	Type E	Type F	Type G	Type I
Temperature controller	●	●	●	●	●
Operational manual	●	●	●	●	●
Sensing cable assembly	●	●	●	▲	▲
Current Output cable		◆			
Communication cable of lower computer			◆		

▲: Combined with Type G and Type I is 4-way sensing cable assembly.

◆: The mating shall be in line with the actual output mode of the temperature controller, e.g., if the communication signal is output from terminal, communication cable of lower computer will be not equipped.

Introduction to RS485 serial communication: You can directly download the testing software from official website of our company: Http://www.fjlead.com.

Order Information

1. The user is requested to refer to the table of Function and Classification of Type in page 2 before placing orders for selection of applicable size and type.
2. Special technical requirements for temperature controller should be indicated when placing orders.

11. Service

◆ Any entity or individual that purchases or uses our products may enjoy our after-sale services.

◆ We guarantee quality and free repair or replacement if product found unsatisfactory in its performance within two years as of the date of delivery or eighteen months from the date of operation.

◆ If any damage to the product is caused by improper use, test or installation, unauthorized dismantling, sudden change in external power source or unexpected lightning, we shall provide no such guarantee.

◆ The product beyond the warranty period or the damaged one referred to in Paragraph 3 may be returned to our company for maintenance, but the user shall bear a given repairs cost.

Warranty Card

(Coupon kept by the user)

User			
Mailing address			
Telephone		Contact	
Postal code		Date of purchase	
Type		No. of delivery	
User's statement:			

Cutting line

Warranty Card

(Coupon returned to our company)

User			
Mailing address			
Telephone		Contact	
Postal code		Date of purchase	
Type		No. of delivery	
User's statement:			