LD－BK10 (A) Temperature Controlling Device of Dry Transformer

User Guide

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1. Features

LD-BK10(A) Temperature Controlling Device of Dry Transformer is a instrument which is used fitting in with the LD－B10 series of intelligent circular digital controller of Dry Transformer. Compared with the functions of the other series controllers, the more functions of this device are below：

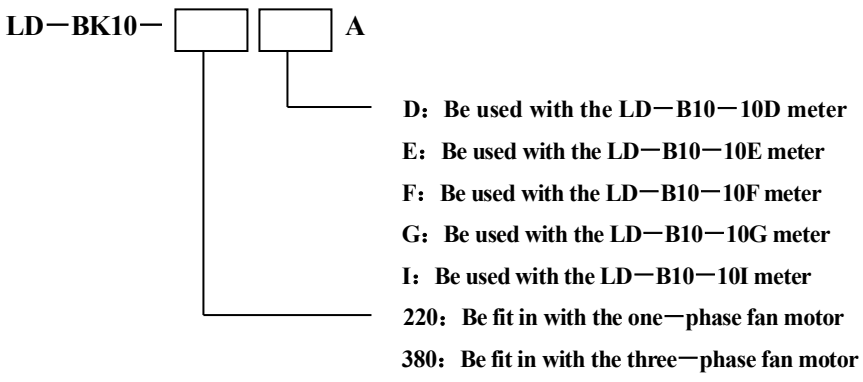
1) **The fan start & stop state indicator light is additional;**
2) **The over-temperature sound alarm function is additional;**
3) **The fan short circuit protect function is additional;**
4) **It can be extended the contact capability(That can be configured 220VDC/5A)，and increased output contact route number (Please illuminate specially on order form as if user need the special functions).**

2. Principal Technical Parameters

1) **Measure Scope：0.0～200.0℃ or -30.0～240.0℃ (Sensor Pt100)**
2) **Accuracy：0.5 FS**
3) **Resolution：0.1℃**
4) **Normal Service Condition：**
   Environment Temperature: -10～+55℃
   Humidity < 85%
   Power Supply (Optional): Single-phase 220VAC(+10%，-15%)
   Three-phase 380VAC(Three-phase four-wire system)(+10%，-15%)
   Frequency: 50Hz or 60Hz (±2Hz)
5) **Compensation Scope of the Display Value：±19.9℃**
6) **Relay output of the contact：Fan contact capacity：9A/250VAC**
   Other output contact capacity：7A/250VAC
7) **The Dimensions of the device box: 370×300×110mm (h × w × d)**
8) **Standard**
   ⑴ Production Standard：JB/T7631-2005 《Resistive thermometers of transformers》
   ⑵ Passed Certification Standard：ISO9002 International Quality System Certification
   ⑶Passed Testing Standard：IEC61000-4：1995 International Standard and GB/T 17626-1998《Electromagnetic compatibility testing and measurement techniques》

3. The Introduction of the Model and Function

1) **The Model and Function of the BK10(A) series controllers**



2) The Model and Function of the B10 series controllers

Model	Function
LD-B10-10D	Three-phase circular display/maximum value display and exchange; input circuit open alarm display and output; self-check fault alarm display and output; over-temperature alarm display and output; over temperature trip display and output; fan automatic control/manual control and exchange; digital compensation of three-phase display value; time start and stop control of the fan; control output function test; "black box" function.
LD-B10-10E	Including all the LD-B10-10D functions, besides, the function of three independent current output 4~20mA is additional.
LD-B10-10F	Including all the LD-B10-10D functions, besides, the function of series communication of RS-485 is additional (maximum communication distance is 1200m).
LD-B10-10G	Including all the LD-B10-10D functions, besides, the function of machine room environment temperature measure, display and control is additional.
LD-B10-10I	Including all the LD-B10-10D functions, besides, the function of transformer iron core temperature measure, display and alarm is additional.

4. Face & Side Board Arrangement

H1: The fan motor stopping indicator (Red)

H2: The fan motor operating indicator (Green).

S0: The main switch of the power source.

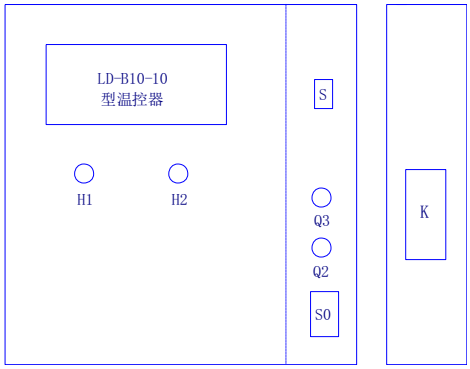
S: The hand control button of the alarm bell.

K: Door lock

Q2: The fuse of the power source of the main circuit.

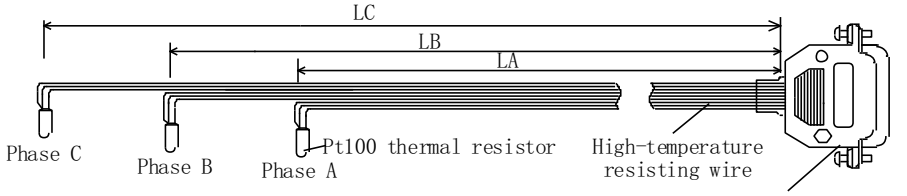
（Only for signal-phase connection）

Q3: The fuse of the power source of the control circuit.

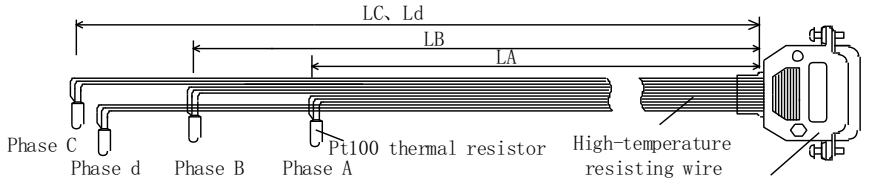


5. The connection of sensor cable socket

1) The connection of sensor cable socket



D/E/F type of controllers



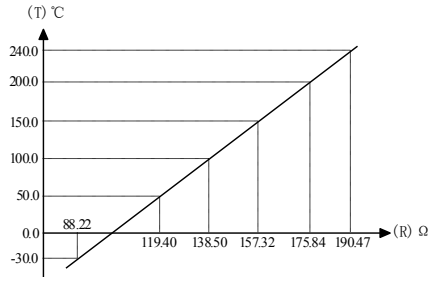
G/I type of controllers

2) Sensor

⑴ Pt100 resistor is a kind of the thermistors with good linearity in the range of -30.0~240.0℃, it meets the demands of grade B of GB/T8622-97《Industrial Platinum Resistors Technical Conditions and Graduation Tables》

⑵ Outer Size：Φ3×25mm or Φ4×40mm

⑶ The Relation Curve between Temperature and Resistance of the Pt100:



6. The key Function and Setting Parameters

1) Key Function

(1) SET key

When the controller is in the normal working state, press SET key, the parameters setting state will be on (The process is below). If you want to change the parameter value, you can press △ or ▽ key.

(2) △ Key (Increase key)

In the parameter setting state, press △ key once, the displayed parameter value will be plus one, hold it, the high- speed increasing state will be on. In the normal working state, press this key, the manual control state and the automatic control state of the fan motor will be exchanged each other.。

(3) ▽ Key (Decrease key)

In the parameter setting state, press ▽ key once, the displayed parameter value will be minus one, hold it, the high-speed decreasing state will be on. In the normal working state, press this key, the maximum measured value displaying state and the three-phase circular displaying state will be exchanged each other.。

(4) After the parameters setting process, as soon as the SET key is pressed, the normal working state will be returned.

2) Parameters Setting

(1) Temperature Control Value Setting Steps

①The Operating Steps of D、E、F

Step	Display / Press	PV	SV	Caption	Note	
1	SET	-Cd-	1000	Enter parameter setting state.		
2	△or▽	-Cd-	1005	Input the password of parameter setting process 1005.	If the password is wrong, the parameter value can not be set.	
3	SET	-Ob-	90.0	Set the fan start temperature objective value to 90.0℃.	Setting scope is 0.0～200.0℃	All the parameter values can be changed by using △ and ▽ key.
4	SET	-dF-	10.0	Set the objective difference value of fan start to 10.0℃. The fan will start at the temperature of 90+10=100℃，and stop at the temperature of 90-10=80℃.	Setting scope is 0.0～15.0	
5	SET	-AH-	150.0	The over temperature trip value has been set to 150.0℃.	Setting scope is 0.0～200.0℃	
6	SET	-AL-	130.0	The over temperature alarm value has been set to 130.0℃.		
7	SET	Confirm the changed parameters values and the controller will return from the parameter setting state to the normal working state.				

②The Operating Steps of G

Step	Display / Press	PV	SV	Caption	Note	
⋮	The steps 1~6 are the same as the table of The Operating Steps of D、E、F					
7	SET	-ObJ	35.0	Set transformer room fan start temperature objective value has been set to 35.0℃.	Setting scope is 0.0～200.0℃	All the parameter values can be changed by using △
8	SET	-dFJ	2.5	Set the room fan temperature objective difference value start to 2.5℃. The transformer room cooling fan will start at the temperature of 37.5℃，and stop at the temperature of 32.5℃.	Setting scope is 0.0～15.0	
9	SET	-AHJ	70.0	The room over temperature trip value has been set to 70℃.	Setting scope is 0.0～200.0℃	
10	SET	Confirm the changed parameters values and the controller will return from the parameter setting state to the normal working state.				

③The Operating Steps of I

Step	Display / Press	PV	SV	Caption	Note	
⋮	The steps 1~6 are the same as the table of The Operating Steps of D、E、F					
7	SET	-ALJ	130.0	The iron core over temperature alarm value has been set to 100.0℃.	Setting scope is 0.0～200.0℃	
8	SET	Confirm the changed parameters values and the controller will return from the parameter setting state to the normal working state.				

(2) Display Value Digital Compensation Setting Steps

Step	Display / Press	PV	SV	Caption	Note
1	SET	-Cd-	1000	Enter parameter setting state.	
2	△or▽	-Cd-	1008	Input the password of parameter setting process 1008.	If the password is wrong, the compensation value can not be set.
3	SET	The temperature value of phase A	A 0.0	Enter the compensation value setting state of phase A. The latest compensated Value is 0.0℃.	Compensation value can be set as plus or minus. Set scope is 0.0~±19.9℃.
4	△or▽	Display compensated temperature value of phase A	A 1.5	The compensation value of phase A has been set to 1.5℃.	
5	To set the compensation value of phase B & C in the same method. The operate and display process are the same to phase A.				
6	SET	Confirm the compensated value that has been set and controller returns to normal state from setting state.			

NOTE：①Pressing SET key to switch to another phase，a moment waiting is needed，and then you can adjust it.

②In setting process, if any key is not be pressed in more than 100 seconds, the controller will return to the normal working state automatically, and the above set process is ineffective.

(3) "Black Box" State

The temperature values of every phase windings just before the power cutting off can be showed in the "black box" state of controller.

Step	Display / Press	PV	SV	Caption
1	SET	-Cd-	1000	Enter parameter setting state.

2	△or▽	-Cd-	1002	Input the password of "black box" operating 1002. If the code is wrong, the state can not get on.
3	SET	Show the temperature value of phase A winding just before power cut off.	EE A	
4	△	Show the temperature values of phase B &C	EE b、EE C or EE d	Three-phase values can be showed circularly by pressing △key continuously.
5	SET	Controller returns from the "black box" operating state to the normal working state.		

(4)Cooling Fan Time Start & Stop State

Step	Display / Press	PV	SV	Caption	Note
1	SET	-Cd-	1000	Enter parameter setting state.	
2	△or▽	-Cd-	1003	Input the password of time start & stop operating process 1003.	If password is wrong, the fan time start & stop function can not be set.
3	SET	-00-	0	Enter the fan time start & stop function setting state.	
4	△or▽	-00-	5	The interval value of fan running is set to 5 hours.	The interval unit is an hour, and the setting scope is 0~150. That is, if the interval value is set to zero, the fan can not be time start, if the interval value is set to 24, the fan will start at every 24 hours intervals.
5	SET	The controller returns from the time start and stop setting state to the normal working state.			

Note: The fan time running lasts two minutes every time.

(5) The Control Output Function Test Steps

Step	Display / Press	PV	SV	Caption	Note
1	SET	-Cd-	1000	Enter parameter setting state.	
2	△or▽	-Cd-	1012	Input password of output function test process 1012.	If the password is wrong, the output function can not be tested
3	SET	-30.0	EE A	The simulated start temperature value is -30.0℃.	
4	△	100.1	EE A	The displayed value imitates to exceed the over temperature fan starting value 100.0℃.	Fan must operate and the fan indicator light.
5	△	130.4	EE A	The displayed value imitates to exceed the over temperature alarm value 130℃(the difference value is 0.3℃).	The over temperature alarm indicator must be light and the output contacts AL must be closed.
6	△	240.1	EE A	The displayed value exceeds the upper measure scope 240.0℃, and doesn't reach the "-OH-" value.	The output contacts ER must be closed.
7	▽	239.9	EE A	Return to the measure scope -30.0~240.0℃.	The output contacts Er open.
8	▽	129.6	EE A	The displayed value imitates lower than the over temperature alarm value 130.0℃(the difference value is 0.3℃).	The over temperature alarm indicator turns off (green), and the output contacts AL open.
9	▽	79.9	EE A	The displayed value imitates lower than the fan stop value (80.0℃).	Fan stops and the fan running indicator is off.
10	△or▽	The above processes can be repeated.			
11	SET	The controller returns from the output function testing state to the normal working state.			

Caution:

①To avoid causing a mistaken trip of the transformer, the over temperature trip state is not permitted to imitate.

②If the fan is in the circuit open or running jammed situations, please solve the breakdown at first, then you can carry out the output function testing!

③If the measure scope is -30~240℃，the third step displays -30.0，and the sixth step displays 240.1，and the seventh step displays 240.0。

7. The Introduction of 4~20mA Analogue Current Output Controller

1) Function characteristic

On the basis of the common functions of controller, there are three or four independent 4~20mA output currents which are linear with the three phases measured temperature values. They can be directly connected to the distant A/D card to build a centralized and dispersed monitoring system.

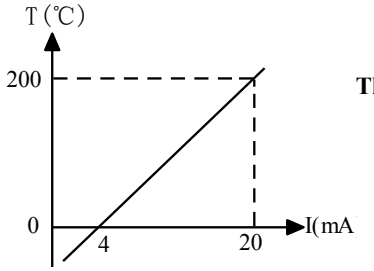
In the controller, the terminals A+, B+, C+, d+ are connected together each other, if user's collecting system is not suitable for it, please inform us in advance. Usually, there are only three-analogue current outputs, if the d channel current output is required, please inform us before ordering it.

2) Technique require of current output

The maximum load resistance R≤500Ω;

Output current accuracy: ±1%

3) The Relation Curve and Function Formula between the Measured Temperature Value and Output Current



The relation formula between the temperature and current:

I= (16T/200)+4

T: The measured temperature values (℃)

I: The output current (mA)

4) The Output Exchange

If the analogue voltage signal is required for the user's collecting system, you can connect a high accuracy resistor of 250Ω parallel to the current output terminals, and then, the analogue voltage signal of 1~5V is needed.

8. The Introduction of Communication Controller

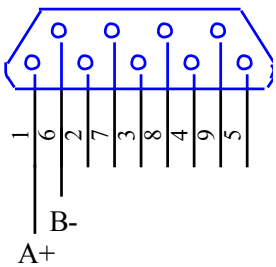
1) The Feature of Communication Function

A RS-485 series communication function is provided for in these controllers, otherwise, a RS-485 to RS-232 exchanger is fitted with, too.

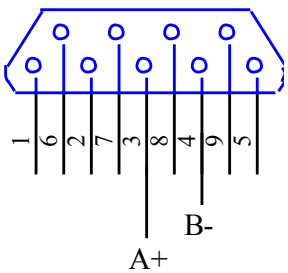
The RS485/RS232 exchanger can work by using computer internal power supply and don't need another outside one.

The arrangements of the exchanger pins are as follows:

9-pin Plug of RS485/RS232 exchanger



9-pin socket of RS485/RS232 exchanger

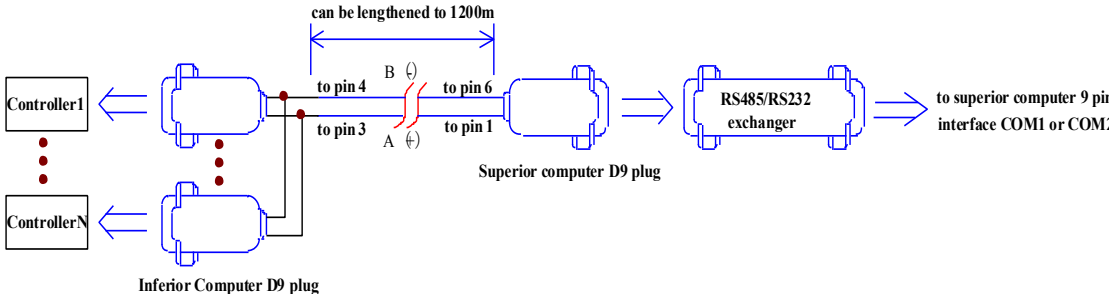


2) The Communication Technical Parameters:

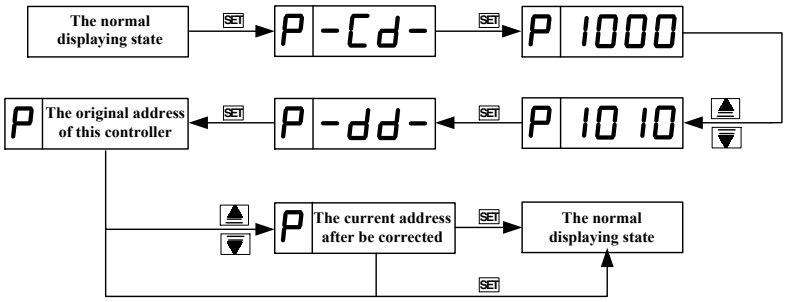
2.1 Communication Distance: ≦1200m

2.2 The Maximum Capacity of Connecting Controllers:28

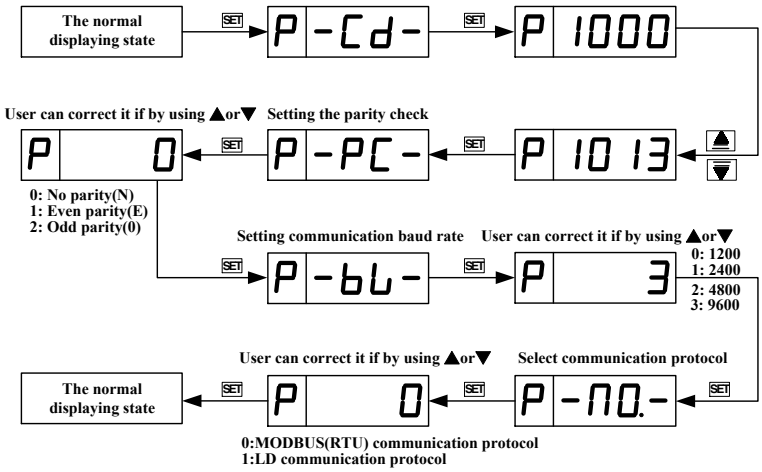
2.3 The Schematic Diagram of Communication Connection



3) The Communication Address Setting Steps



4) The Setting Steps of transmission baud rate, parity check and Protocol



5) MODBUS RTU Communication Protocol

5.1 The Definition of Frame

Start Bit	Data Length	Parity bit	Stop Bit
1 Bit	8 Bit	0 or 1 Bit (set)	1 Bit

5.2 The Content of Communication Protocol (format of message)

5.2.1 Superior Computer Sending Command(The contents of command are as follows):

Address	1~255
Function code	## h
Start address high 8-bit	00 h
Start address low 8-bit	## h
Data number word high 8-bit	00 h
Data number word low 8-bit	## h
CRC check low 8-bit	
CRC check high 8-bit	

Note: When the function code is 03h, the controller feeds back the temperature value.

When the function code is 04H, the controller feeds back the relay output state.

5.2.2 Controller Feeds Back Data:

5.2.2.1 Feeding Back the Temperature Value of Every Phase:

When the superior computer reads the temperature value of every phase, the value of the data number word of superior computer is 0001h~0004h (The start address of superior computer sees Note 1).

Address	**1~255**
Function code	**03h**
Byte number of data	**word number of data * 2**
Phase A temperature value high 8-bit	**The actual temperature value of every phase = Temperature data of every phase /10**
Phase A temperature value low 8-bit	
. . .	
Channel D temperature value high 8-bit	
Channel D temperature value low 8-bit	
CRC check low 8-bit	
CRC check high 8-bit	

Note: 1) The introduction of start address

Start Address	Caption	
0000h	**Phase A temperature data high 8-bit**	**Phase A temperature data**
	Phase A temperature data low 8-bit	
0002h	**Phase B temperature data high 8-bit**	**Phase B temperature data**
	Phase B temperature data low 8-bit	
0004h	**Phase C temperature data high 8-bit**	**Phase C temperature data**
	Phase C temperature data low 8-bit	
0006h	**Channel D temperature data high 8-bit**	**Channel D temperature data**
	Channel D temperature data low 8-bit	

When the controller only measures three-phase temperature, the start address 0006h is reserved.

Note: 2) The introduction of temperature data high 8-bit:

After superior computer sending function code 03H and controller feeding back data, the superior computer judges the temperature value data at first. If the high and low 8-bit of temperature value data are all the same as the following table, the controller is in the faulty state, the temperature value is ineffective, and the controller state must be displayed according to the following table; if the temperature data high 8-bit is not same as the following table, the controller is in the normal working state, the temperature value can be calculated according to the high and low 8-bit of the temperature data.

Temperature data high 8-bit	Temperature data low 8-bit	Controller state	Caption
70H	**00H**	**—OP—**	**Open circuit**
60H	**00H**	**—OH—**	**Over high limit**
80H	**00H**	**—OL—**	**Over low limit**
50H	**00H**	**—Er—**	**fault**

5.2.2.2 Feeding Back Controller Relay Output State:

When the superior computer reads the controller relay output state, the word value of the data number of superior computer is 0001h, and the start address of superior computer is 0000h.

Address	**1~255**
Function code	**04h**
Byte number of the data	**02h**
Output state data high 8-bit	**00h**
Output state data low 8-bit	**See the following**
CRC check low 8-bit	
CRC check high 8-bit	

The definition of the output state data low 8-bit is as follows:

a) Controller measures three-phase temperature:

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Φ	Φ	Φ	Φ	×	×	×	×

bit3: The fault alarm output bit

bit2: Over temperature alarm output bit

bit1: Over temperature trip output bit

bit0: Fan control output bit

b) Controller measures Four-channel temperature:

bit7	bit6	bit5	bit4	bit3	bit2	bit1	bit0
Φ	Φ	Φ	×	×	×	×	×

bit4: The fault alarm output bi

bit3: Iron core over temperature alarm output bit

bit2: Over temperature alarm output bit

bit1: Over temperature trip output bit

bit0: Fan control output bit

Note：The state of every output bit：

0－The corresponding contact is open

1－The corresponding contact is closed

6) For Example

When the communication address is 1(The controller measures three-phase temperature); Phase A is in open state，the temperature of Phase B is 30℃，the temperature of Phase C is 30℃；And the fault alarm and fan control output.

6.1.1. Superior Computer Sending Command (Reading the temperature value of every phase)

01h	03h	00h	00h	00h	03h	05h	0CBh

6.1.2. Controller Feeds Back Data (The temperature value of every phase)

01h	03h	06h	70h	00h	01h	2Ch	03h	0E8h	0EAh	0CEh

6.2.1. Superior Computer Sending Command (Reading the relay output state)

01h	04h	00h	00h	00h	01h	31h	0CAh

6.2.2. Controller Feeds Back Data (The relay output state)

01h	04h	02h	00h	09h	79h	36h

9. Fittings Lists and Ordering

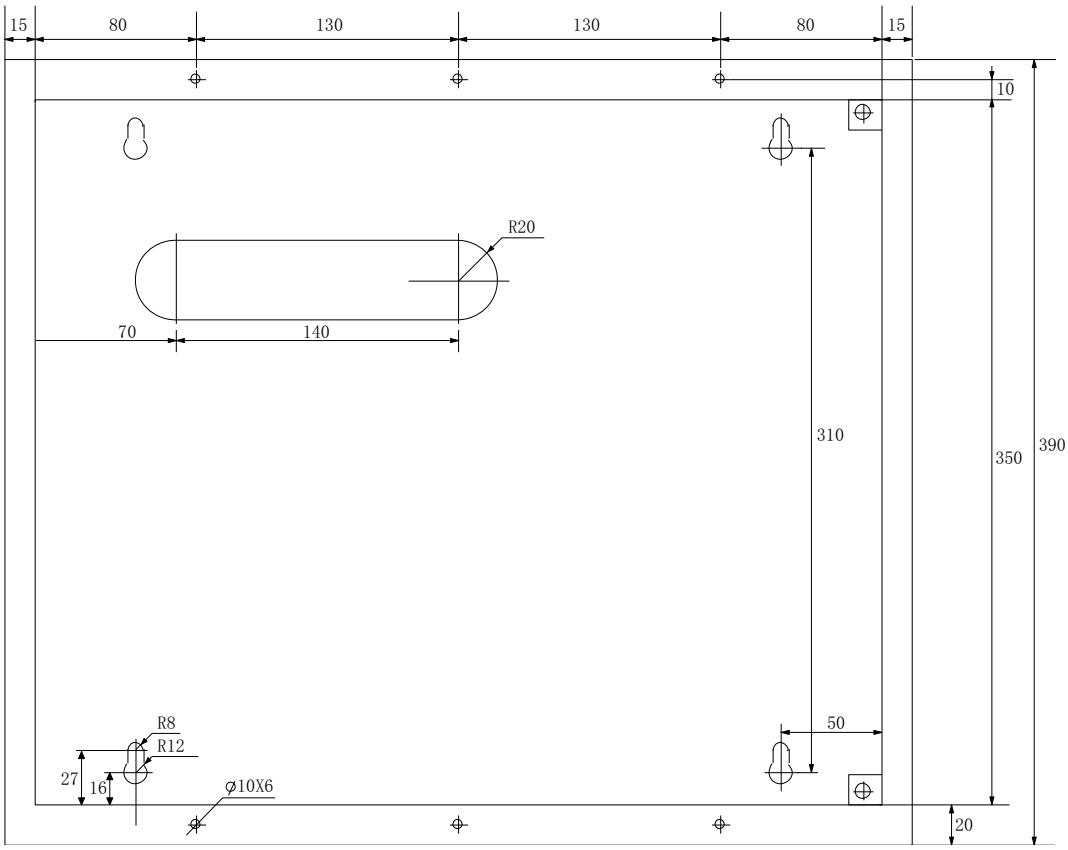
Name \ model	D	E	F	G	I
Controller	●	●	●	●	●
Sensor Cable	●	●	●	●*	●*
Communication cable			●		
Communication light disk			●		
RS485/RS232 exchanger			●		
Power lines	●	●	●	●	●
User Guide、Guarantee Card	●	●	●	●	●

● * ： **The sensor cable of 4-channel is supplied for model G & I.**

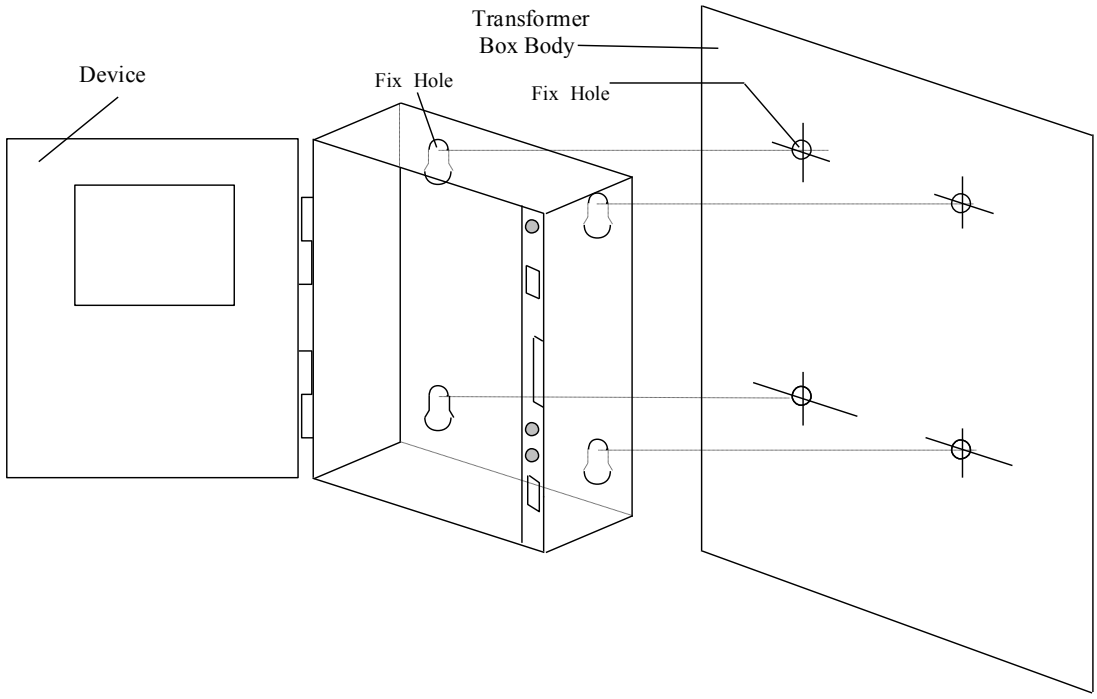
Ordering Guide

1. **Before ordering, please reed <<The Introduction of the Model and Function>> carefully and select the suitable model (see page 2)**
2. **Normally, the length of sensor cable is 5m, current output cable is 2m, communication cable is 2m (to superior computer) +2m (to inferior computer) and they are supplied by manufacturer. If user has some exact requirement of the cable length, please inform us on order form.**
3. **If user has some special requirement for the controller, please inform us on order form, too.**

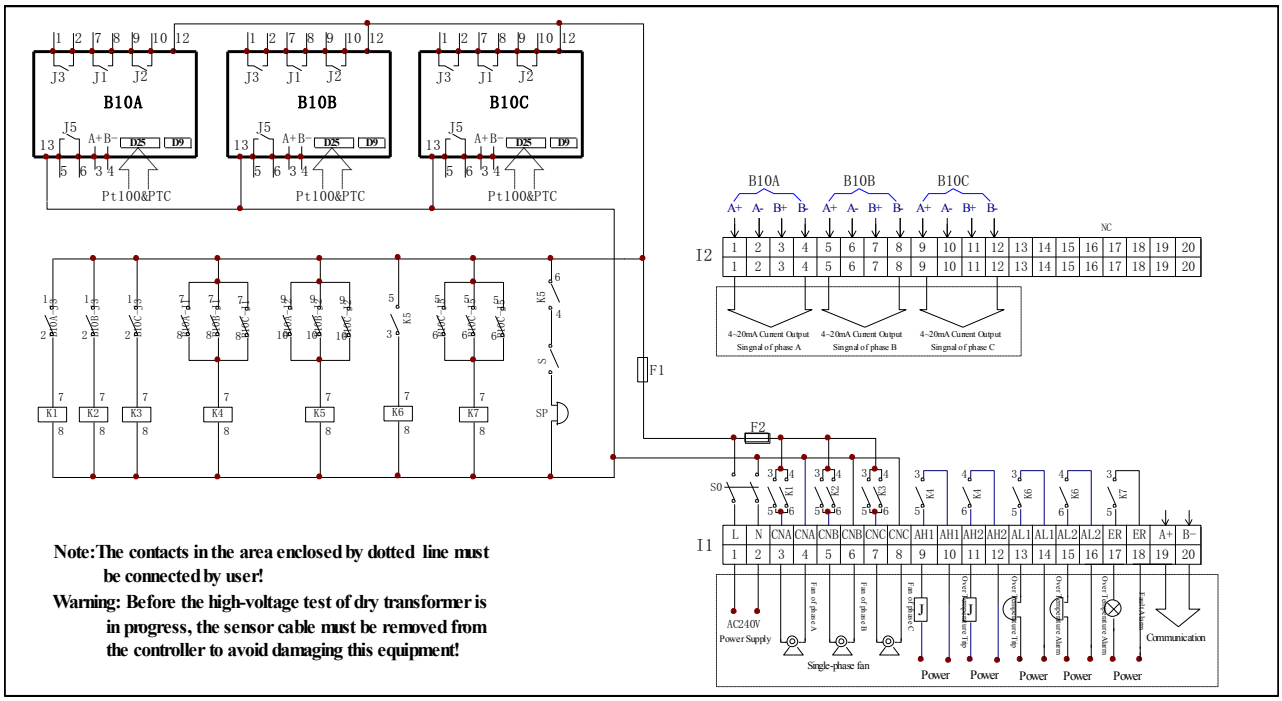
10. The Installing Hole Dimensions and The Installing Diagram of Controller



Appendix2: The Installing Diagram of Controller



Appendix 3: The Output Connection of Dry Transformer Controller



1. The Electrical Connection of the Controller Output Terminals

I1: Terminal 1&2 is connected to the power supply (AC240V)

Terminal 3&4 is connected to the single-phase fan of phase A (with internal power supply)

Terminal 5&6 is connected to the single-phase fan of phase B (with internal power supply)

Terminal 7&8 is connected to the single-phase fan of phase C (with internal power supply)

Terminal 9&10 is connected to the over-temperature trip signal output contacts for remote transmission (without internal power supply)

Terminal 11&12 is connected to the over-temperature trip signal output contacts for remote transmission (without internal power supply)

Terminal 13&14 is connected to the over-temperature alarm signal output contacts for remote transmission (without internal power supply)

Terminal 15&16 is connected to the over-temperature alarm signal output contacts for remote transmission (without internal power supply)

Terminal 17&18 is connected to the monitor fault & sensor circuit open signals output contacts for remote transmission (without internal power supply)

Terminal 19&20 is connected to the RS485 communication signal.

I2: Terminal 1~4 is connected to the 4~20mAcurrent output signal of phase A.

Terminal 5~8 is connected to the 4~20mAcurrent output signal of phase B.

Terminal 9~12 is connected to the 4~20mAcurrent output signal of phase C.

Terminal 13~20 is no connection, and can be defined by user.

2. Over-temperature alarm, over-temperature trip Pt100 and PTC interlock logic

2.1 Action parameter

Pt100 Over-temperature alarm temperature action value：130.4℃

Pt100 Over-temperature alarm temperature cancel value：129.6℃

Pt100 Over-temperature trip temperature action value：150.4℃

Pt100 Over-temperature trip temperature cancel value：149.6℃

Over-temperature alarm PTC130 action value：>1360Ω±10Ω

Over-temperature alarm PTC130 cancel value：<520Ω±10Ω

Over-temperature trip PTC150 action value：>1360Ω±10Ω

Over-temperature trip PTC150 cancel value：<520Ω±10Ω

2.2 Interlock logic

Over-temperature alarm	**Action condition**	**① If any phase of Pt100 temperature value is over 130.4℃ and over 6 seconds, the over-temperature alarm PTC130 value is more than 1360Ω.** **② If the three phase of Pt100 is failure OH,OP,OL), the over-temperature alarm PTC130 value is more than 1360Ω.** **③ If any phase of over-temperature alarm PTC130 is short-circuited or open-circuited, any phase of Pt100 temperature measuring value is greater than 130.4 ℃ and more than six seconds.**
	Release condition	**① The three phase of Pt100 temperature measuring values are less than 129.6℃, or the over-temperature alarm PTC130 value is less than 520Ω.** **② If the three phase of Pt100 is failure OH,OP,OL), the over-temperature alarm PTC130 value is less than 520Ω.** **③ If any phase of over-temperature alarm PTC130 is short-circuited or open-circuited, the three phase of Pt100 temperature measuring values are less than 129.6℃.** **④If any phase of over-temperature alarm PTC130 is short-circuited or open-circuited,and the three phase of Pt100 is failure OH,OP,OL), the over-temperature alarm output is forbidden.**
Over-temperature trip	**Action condition**	**① When the over-temperature alarm has been output, any phase of Pt100 temperature measuring value is greater than 150.4 ℃ and more than 6 seconds, and over-temperature trip PTC150 value is more than 1360Ω.** **② When the over-temperature alarm has been output, and the three phase of Pt100 is failure(OH,OP,OL), over-temperature trip PTC150 value is more than 1360Ω.** **③When the over-temperature alarm has been output, and any phase of over-temperature alarm PTC150 is short-circuited or open-circuited, any phase of Pt100 temperature measuring value is greater than 150.4 ℃ and more than six seconds.**
	Release condition	**① When the over-temperature alarm has been output, the three phase of Pt100 temperature measuring values are less than 149.6℃, or the over-temperature trip PTC150 value is less than 520Ω.** **② When the over-temperature alarm has been output, and the three phase of Pt100 is failure(OH,OP,OL), the over-temperature trip PTC150 value is less than 520Ω.** **③ When the over-temperature alarm has been output, and any phase of over-temperature alarm PTC150 is short-circuited or open-circuited, the three phase of Pt100 temperature measuring values are less than 149.6℃.** **④ When the over-temperature alarm has been output, and any phase of over-temperature alarm PTC150 is short-circuited or open-circuited, and the three phase of Pt100 is failure(OH,OP,OL), the over-temperature trip output is forbidden.** **⑤ When the over-temperature alarm hasn't been output, the over-temperature trip output is forbidden.**

3. PTC status can be queried through the following steps

Step	Display / Press	PV	SV	Caption	Remarks
1	SET	-Cd-	1000		
2	▲	-Cd-	1006	PTC status querying password	Enter the correct password
3	SET	good	P AH	Over-temperature trip PTC status	Both trip PTC and alarm PTC have three statuses: Good: Normal -OP-: Open-circuited -OL-: Short-circuited
4	SET	good	P AL	Over-temperature alarm PTC status	
5	SET	The controller exits PTC query status, returns to normal working status.			

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Disclaimer: the contents listed in this manual are for reference and the manufacturer reserves the right to change the contents.