

**HITACHI PROGRAMMABLE CONTROLLER**

# **HIDIC EH-150**

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**RESISTANCE THERMOMETER  
INPUT MODULE (EH-PT4)  
INSTRUCTION MANUAL**

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# 1 . Introduction

This manual describes how to operate properly the EH-PT4(Temperature detective resistance module), which is one of the special function module of EH-150 Programmable Logic controller(PLC). Please read carefully this manual to familiarize yourself with the procedures respectively of installation, operation, and maintenance and inspection.

Please be sure to read the related application manuals, too.

**Table 1.1 Reference Manual list**

No.	Document	Manual No.
1	About the detailed operation method of the programming unit	H-PE02-1*
	1) Instruction word programmer (PGM-CHH) Instruction word programmer manual	H-PE01-1*
	2) Portable indication programmer(PGM-GPH) Portable indication programmer manual	NJI-299*
	3) LADDER EDITOR FOR WINDOWS Programming manual	NB325C*
2	EH-150 application manual	NJI-280*

“\*” means revision of manual and up to A, B, C in order.

## Reference

What is Resistance Thermometer element ?

Measurement principle is based on the property of metals, that the resistance of metals changes linear depending on the temperature. PT100 is normally used as the metal. (The resistance of the platinum is 100  $\Omega$  at 0 °C)

Voltage drop of the thermometer element can be measured by supplying a constant current of 1 through 5 mA ( 2 mA in this module) to the resistance thermometer element, and therefore the temperature can be calculated by the voltage drop.

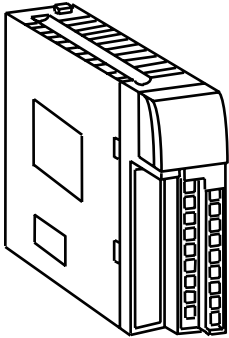
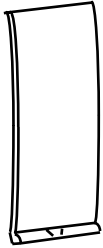
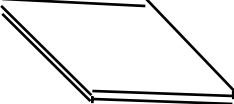
Use a resistance thermometer element complying with IEC 751 for this module.

### 1.1 Before Use

The resistance thermometer module (Here after EH-PT4) has been carefully manufactured, but you are kindly advised to make the following checks on receipt of it.

- (1) Check whether the module is the right one or not.
- (2) Check whether the module was not damaged during transportation.
- (3) Check the contents of the package, as below.

**The 1.2 Package contents list of EH-PT4 module**

No.	Contents	Quantity	Remarks
1	EH-PT4	1	
2	I/O cover	1	
3	Operation manual	1	

## 1.2 Precautions on Use

- (1) Before the installation and removal of the module, turn off the power.
- (2) Before the connection of the external wiring and removal of the terminal board, turn off the power.
- (3) The terminal board handles fine signals. Therefore upon handling the module or wiring, be careful not to apply a voltage on it by mistake or leave it under the influence by excessive static electricity.
- (4) Upon the connection of external wiring, before work, eliminate static electricity by touching a grounded metal bar to prevent it from being damaged by excessive static electricity charged on the human body. To prevent a malfunction due to static electricity do not touch the terminal during power feeding.
- (5) When the connection cable to a resistance thermometer element is cut, the temperature conversion data becomes abnormal. If the temperature data exceeds the normal range to protect the external devices, adjust the control system so that the external devices operate with safety.
- (6) If the resistance of a resistance thermometer element (RTD) exceeds 250 ohm(corresponding to about 410°C ) at PT100, or 2500 ohm(corresponding to about 410°C ) at PT1000, except when the line is broken, the temperature conversion data is unstable.

## 1.3 Features

- (1) EH-PT4 applies for two kinds of platinum resistance thermometer elements: Pt100(IEC 751) and Pt1000.
- (2) Temperature measurement range: Three kinds of ranges(selected by switch)

Resistance thermometer elements	Temperature measurement range(°C)	Accuracy(°C)
Pt100	-50 to + 400	± 3
Pt100	-20 to + 40	± 0.5
Pt1000	-50 to + 400	± 6

- (3) Because the accuracy of the temperature measurement range -20 to +40°C is ± 0.5°C,EH-PT4 is suitable for exact measurement.
- (4) Temperature conversion data: 15 bits with sign.
- (5) Number of Inputs: 4 channels, 3-wire system.

### 1.4 Principle of Operation

The EH-PT4 is able to measure the temperature by supplying constant current to PT100/1000 and by measuring the voltage drop of it, which is based on the linearity between the resistance of PT100 and the temperature. The operation of the input part of EH-PT4 is shown below.

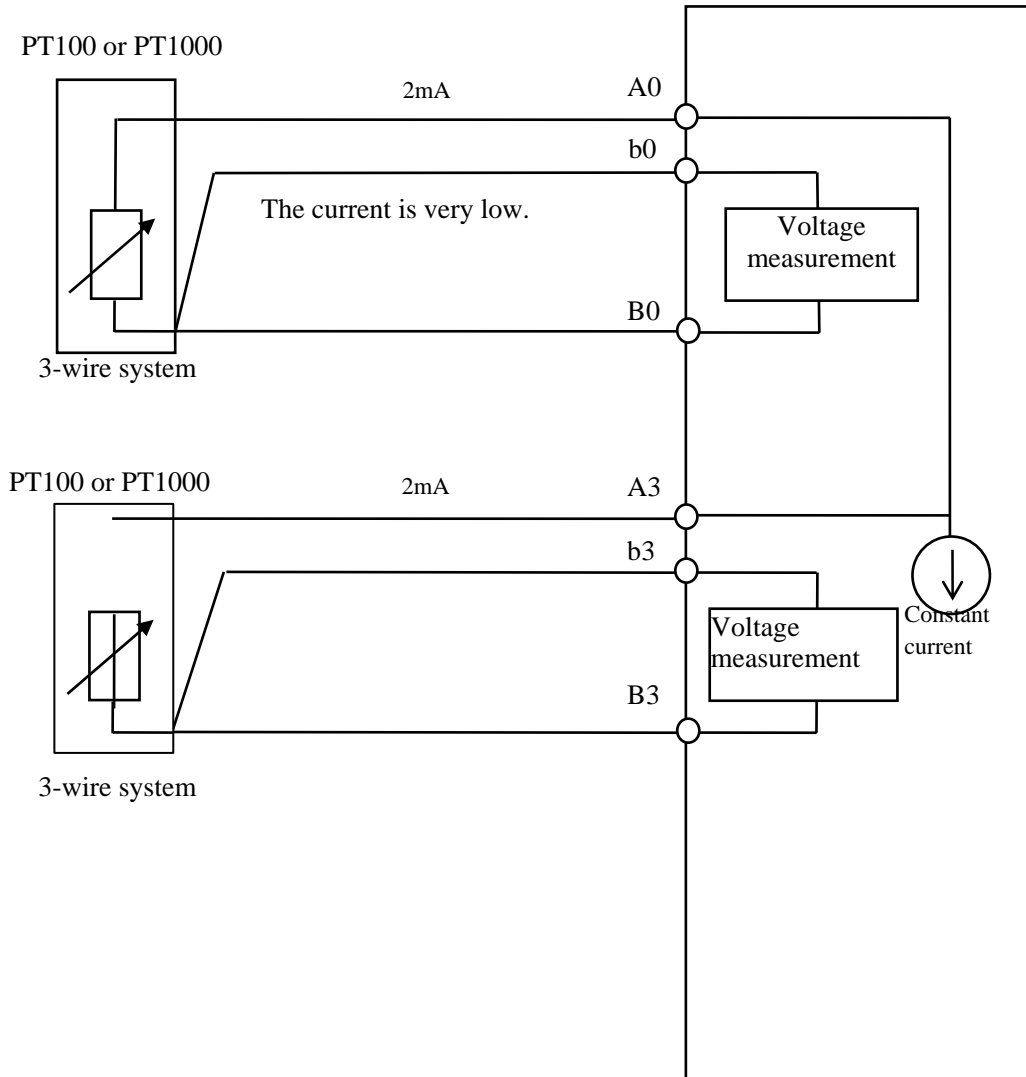
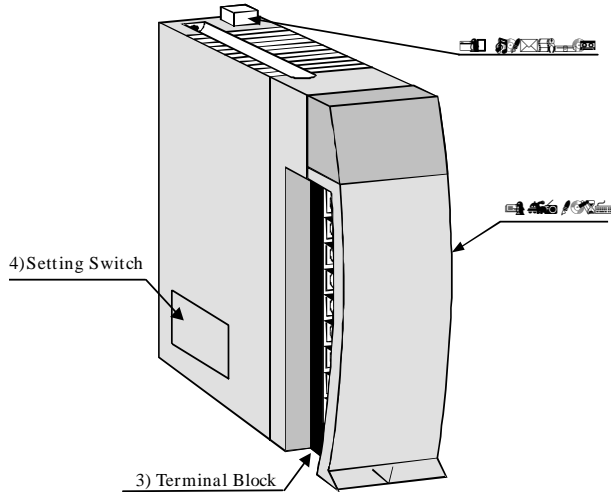


Fig. 1.4 Principle of Operation

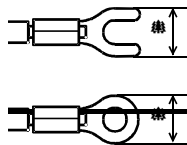
# 2 Structure and Nameplate

## 2.1 Structure and Name of Each Part

Name and function of each part	Type	EH-PT4
	Weight	Approx. 180 g
	Dimensions(mm)	



No.	Name	Function	Remarks
1)	Lock button	This is used when removing the module from the base unit. After it is installed to the base unit, the fixation can be reinforced using screws. In this case, use M4x10mm screws.	
2)	I/O cover	This is the cover attached to the terminal block area.	
3)	Terminal block	This is the terminal block for connecting input signals. The terminal block can be connected or disconnected.	
4)	Setting Switch	This is used for setting of temperature range.	Refer chapter 6.
Item	Detailed explanation		Remarks
Operation explanation	The module receives input signals from outside. While the module energized, The CPU module recognizes the status of the loaded module and when it matches the I/O assignment information included in the user program. Input information is received according to the contents of the user program.		
Terminal block	The screws for the terminal block are M3 screws. Use a crimp terminal that fits the screw diameter. The maximum thickness of the cable should be only up to 0.75 SQ, The recommended crimp terminal is indicated below.		



□ ■ ● ○

Unit:mm



## 3. Specification

### 3.1 Specification list

Table 3.1 shows the specifications of EH-PT4.

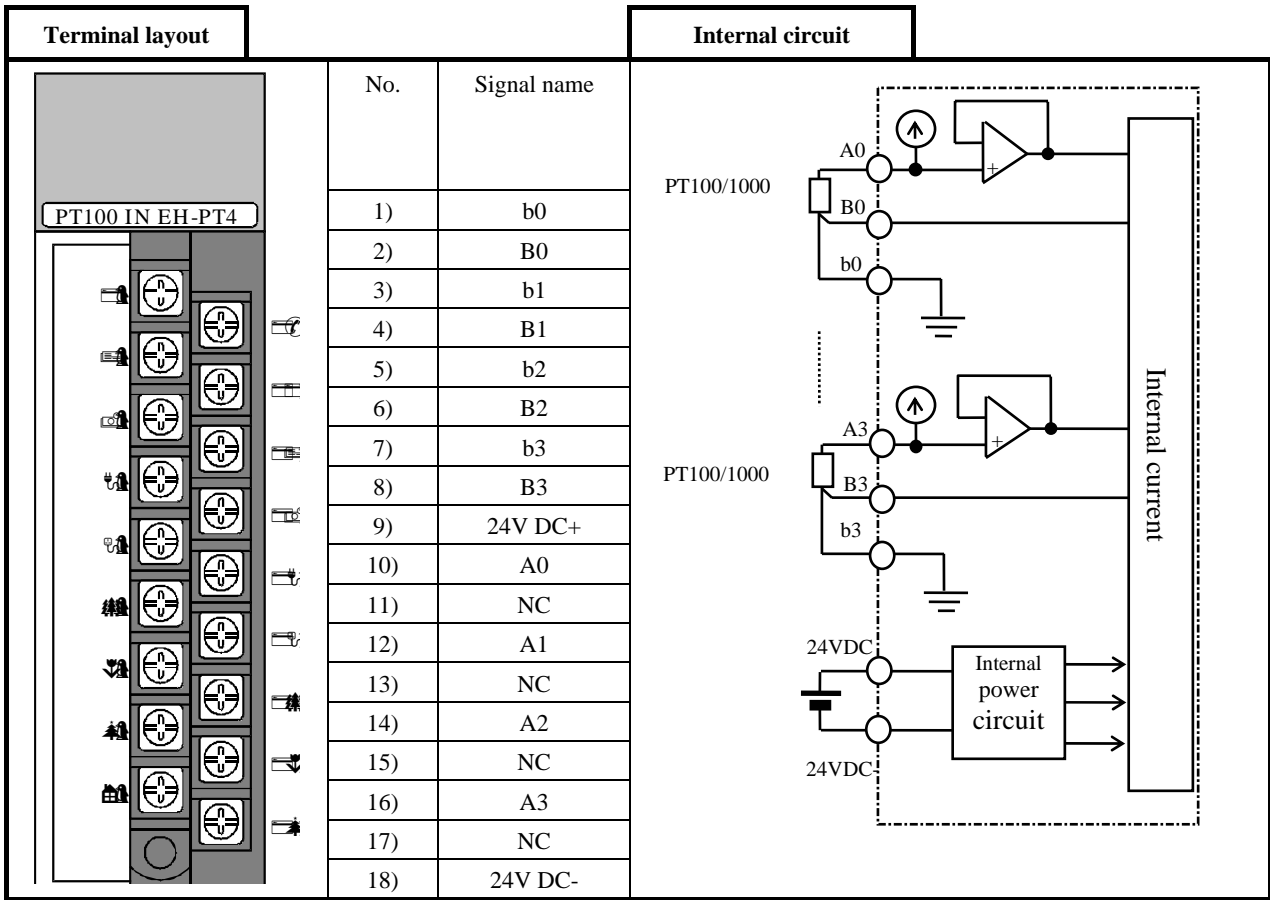
**Table 3.1 Specification**

Item		Specification
Type		EH-PT4
Resistance temperature detective		Platinum resistance thermometer element Pt100 (IEC 751) Platinum resistance thermometer element Pt1000
Temperature conversion data		15 bits with sign (In normal state the lowest two bits are always "0")
Accuracy (Note 1)	-20 to + 40 °C (Pt100)	± 0.5 °C
	-50 to + 400 °C (Pt100)	± 3 °C
	-50 to + 400 °C (Pt1000)	± 6 °C
Temperature measurement range		-20 to +40 °C / -50 to +400 °C (2 mA constant current method)
Number of channels		4 channels
Conversion time		Apprx. 1s / 4 channels
Insulation	Between channel and PC	Photocoupler insulation
	Between channels	Non-insulation
External power supply		24V DC ±10% 100 mA max.
Internal current consumption (5 V DC)		200 mA max.
External wiring resistance		400 ohm max. / channel
External wiring		Shielded wire
Additional function		Linearization
Error detection -20 to +40 °C (Pt100) -50 to +400 °C (Pt100/ Pt1000)		H7FFF is outputted at -25 °C or less, or at +45 °C or higher H7FFF is outputted at -60 °C or less, or at +410 °C or higher
Processing in case of disconnection (Note 2)		H7FFF is outputted to channel.

Note 1: The above accuracies are the values when 10 minutes after power ON. Just after power ON, the values may increase slightly. Because a PT100/1000 has a potential error.

Note 2: This is the case when the current terminal wiring is broken. In case the voltage terminal wiring is broken, the data becomes unspecified. ("H" of "H7FFF" means the following data is hexadecimal.)

**3.2 Terminal layout and internal circuit**

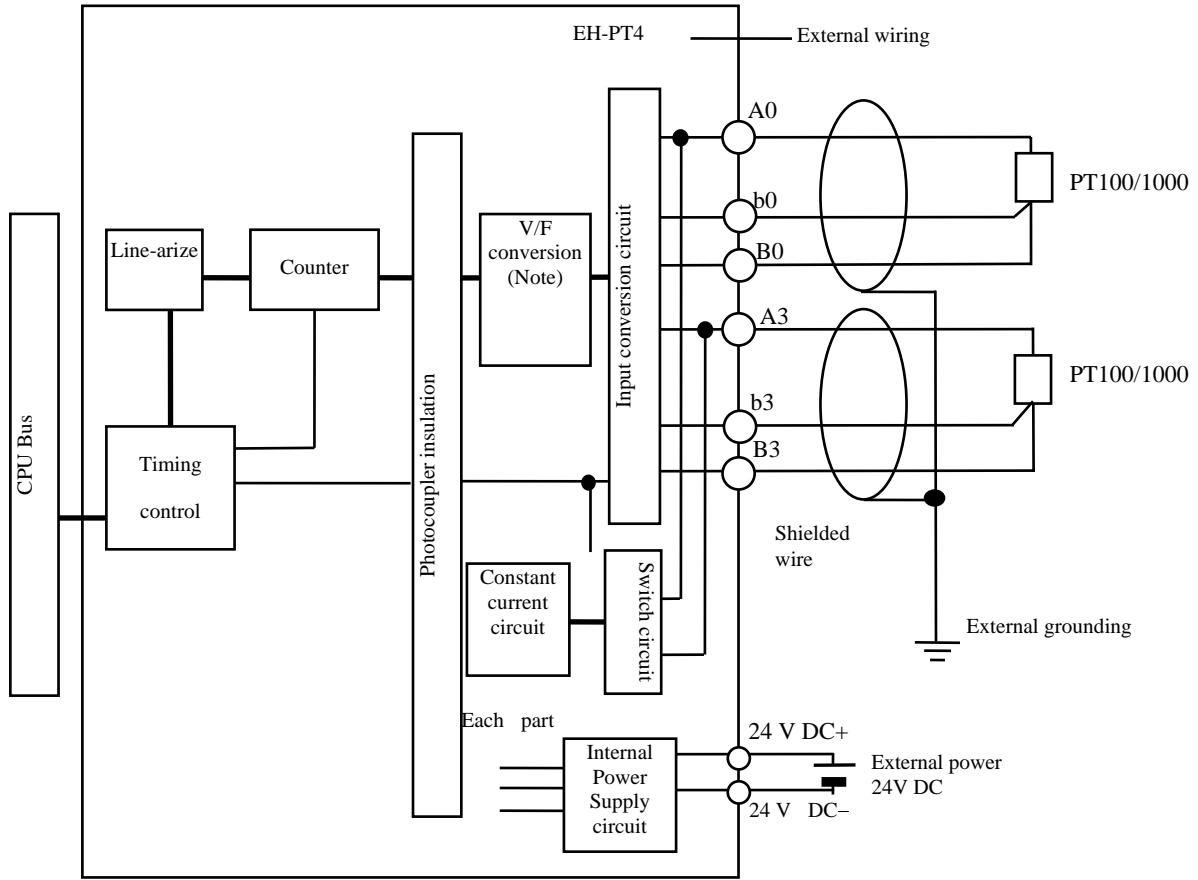


Note 1) Current terminals and a voltage terminals of unused channels should be wired. The data will become H7FFF.

# 4. Block Diagram

## 4.1 Internal Block Diagram

Fig. 4.1 shows the internal block diagram.

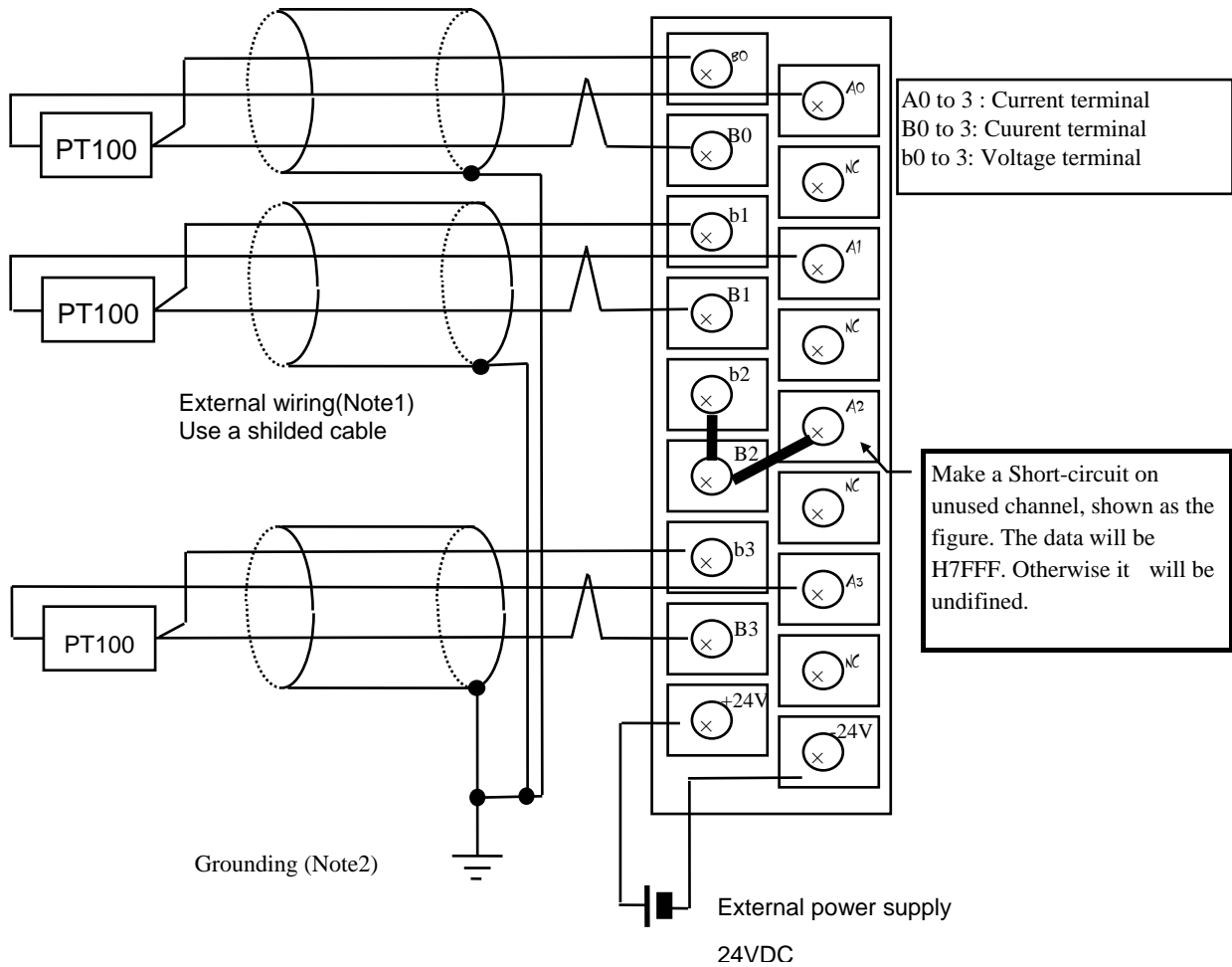


**Fig.4.1 Internal Block Diagram**

Note: V/F conversion refers to the conversion of voltage(V) to frequency(F).

# 5. External Wiring

## 5.1 Wiring



**Fig. 5.1 External Wiring**

Note 1: The external wire length should be less than 200 m for each channel. In addition, the total resistance of the wires of each channels to be connected to the current terminals (A0 to A3, B0 to B3) should be less than 400 ohm.

Note 2: Earth the shield of the cable for the one side or the both sides, which depends on the environment.

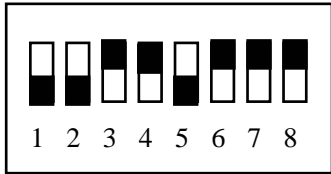
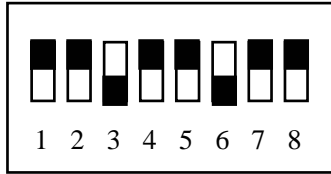
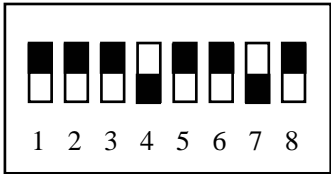
Note 3: The earth terminal on the power supply module and External power supply 24 VDC must be connected to the earth, otherwise the data will be undefined.

## 6. Setting

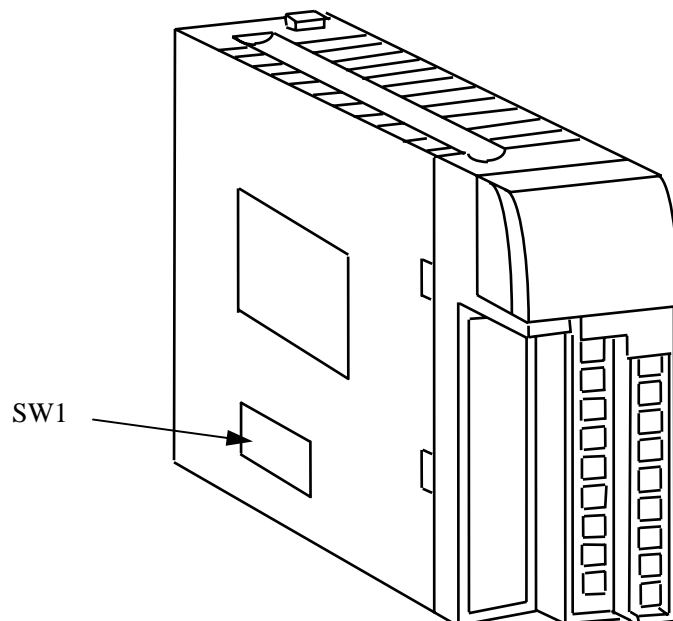
### 6.1 Setting of temperature range

This module can be set to three temperature ranges by the dip switch shown below.

**Table 6.1 Temperature range setting**

Temperature measurement range	Setting switch		
Pt100 -20 to +40	ON		1, 2, 5 ON
Pt100 -50 to +400	ON		3, 6 ON
Pt1000 -50 to +400	ON		4, 7 ON

Note: Do not use the setting which is not written in table, otherwise the data will be undefined.



# 7. Collection of Temperature Data

## 7.1 I/O Allocation

The temperature data of each channel is collected in the CPU as the temperature conversion data corresponding to the temperature.

(1) I/O assignment setting

Please assign as “WX4W” by your programming software.

(2) I/O allocation

Depending on the module installation position, the temperature conversion data is stored in the word input number shown below.

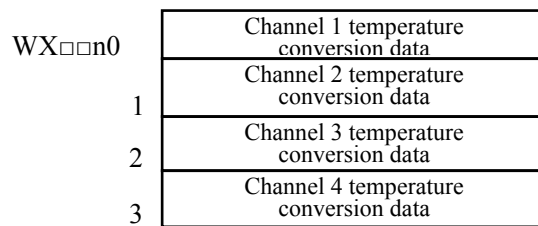
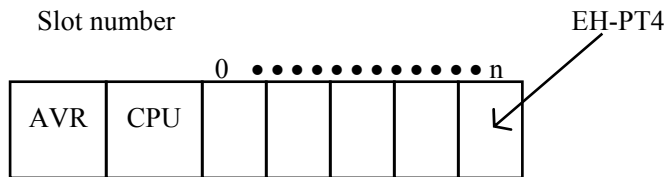


Figure 7.1

The setting of □□n is determined by the module installation position, as shown below.



Allocation address WX□□□

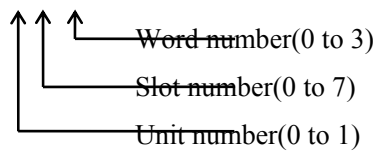


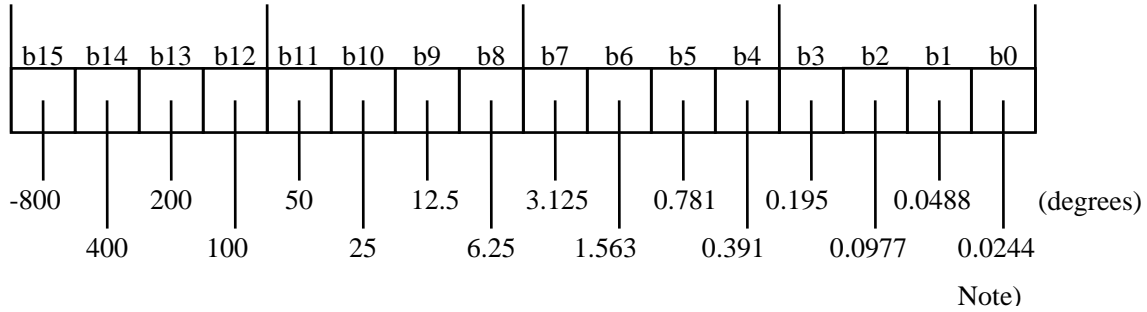
Figure 7.2

**7.2 Temperature Data**

(1) Content of the measured value in WX\*\* [ range : -50 to +400°C ](Pt100/ Pt1000)

The meaning of the each bit(b0 to b15) is shown below.

The each bit has own temperature. The total of the bit “1” is the measured temperature.



< Example >

(1) HF800 = “1111 1000 0000 0000”  
 (HF) (H8) (H0) (H0)

-800 + 400 + 200 + 100 + 50 = -50 (°C)

(2) H0600 = “0000 0110 0000 0000”  
 (H0) (H6) (H0) (H0)

25 + 12.5 = 37.5 (°C)

If the measured value is out of the range( less than -51 or more than 410), the data will be H7FFF.

The relation between the measured value (in WX\*\*) and the actual temperature is shown below.

$$\text{Temperature (}^\circ\text{C)} = \frac{\text{The measured data in WX** (signed decimal data)}}{40.96}$$

Note) bit 0 is normally “0”.

The relation between the measured value and the temperature

)The measured value (hexadecimal) -50 to +400°C

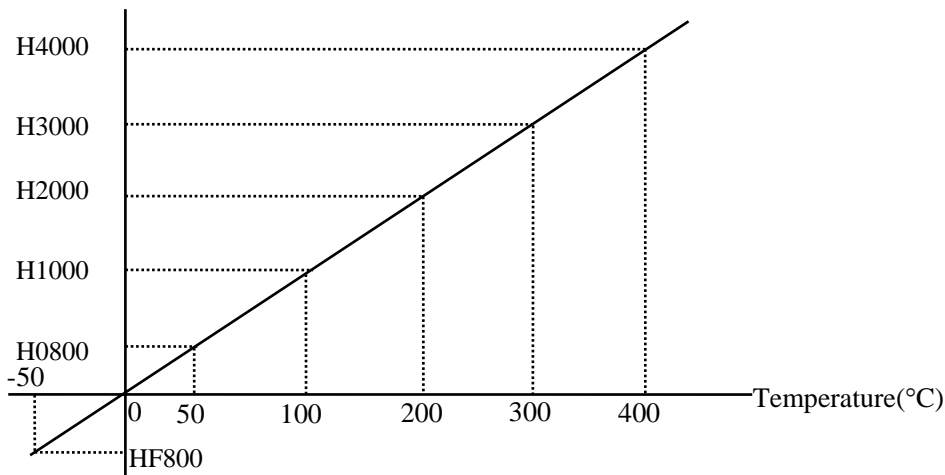


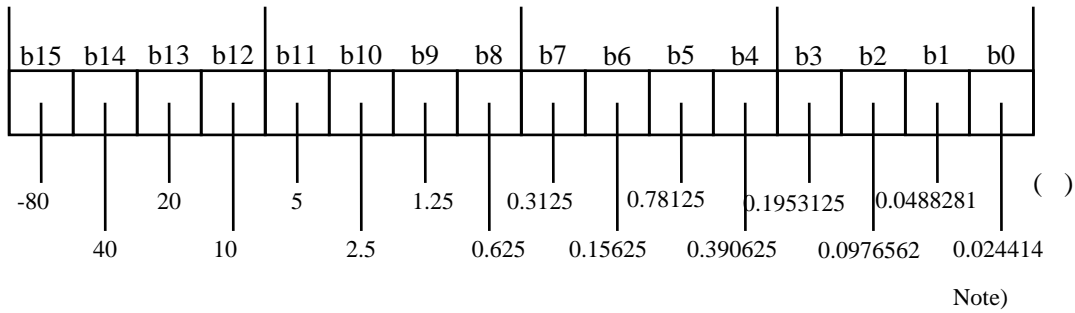
Figure 7.3

7. Collection of Temperature

(2) Content of temperature conversion data range : -20 to +40 (Pt100)

The meaning of the each bit(b0 to b15) is shown below.

The each bit has own temperature. The total of the bit "1" is the measured temperature.



< Example >

(1) HE000 = "1110 0000 0000 0000"  
 (HE) (H0) (H0) (H0)

$$-800 + 40 + 20 = -20 (^{\circ}\text{C})$$

(2) H0600 = "0000 0110 0000 0000"  
 (H0) (H6) (H0) (H0)

$$2.5 + 1.25 = 3.75 (^{\circ}\text{C})$$

If the measured value is out of the range( less than -25 or more than 45), the data will be H7FFF.

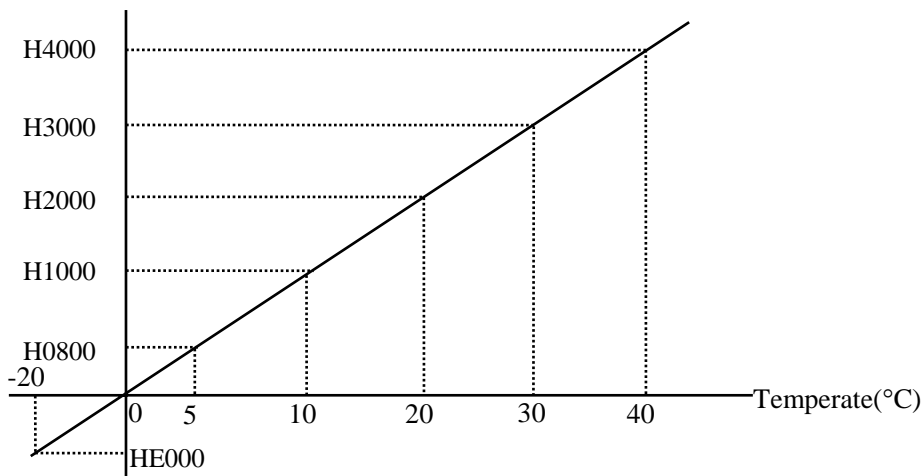
The relation between the measured value (in WX\*\*) and the actual temperature is shown below.

$\text{Temperature } (^{\circ}\text{C}) = \frac{\text{The measured data in WX** (signed decimal data)}}{409.6}$
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Note) bit 0 is normally "0".

Relation between the temperature and temperature conversion data

)The measured value (hexadecimal) -20 to +40 °C



**Figure 7.4**



**7.3 Example of Calculation**

Following example program converts the hexa data in WR0 to BCD 4 digit data in WM006. If the temperature is negative, R0 will be "1".

EXT (DM000,WR0000)	(1)
DM000 = DM000 S* 100	(2)
DM002 = DM000 S/ 4096	(3)
R0 = DM002 S< 0	(4)
ABS (WM004,WM002)	(5)
BCD (WM006,WM004)	(6)

- (1)WR0 is extended to double word data because the calculation with sign can be operated by double word.
- (2)(3)Since the calculation with radix point is impossible, DM0 is multiplied by 100 and divided by 4096.
- (4) If the temperature is negative, R0 will be "1".
- (5)WM2 is converted to the absolute value WM4.
- (6)WM4 is converted to BCD 4 digits value.

**7.4 Correspondence Table between Temperature and Temperature Data**

(1)Pt100/Pt1000 -50 to +400 °C range

**Table 7.4.1 Pt100 -50 to +400 °C range Temperature conversion data**

Temperature (°C) Note1)	Decimal data	Hexadecimal data	Pt100 resistance (□) Note 2)	Temperature (°C) Note1)	Decimal data	Hexadecimal data	Pt100 resistance (□) Note 2)
-60	63078	F666	72.33	110	4506	1199	142.29
-55	63283	F733	78.32	120	4915	1333	146.06
-50	63488	F800	80.31	130	5325	14CC	149.82
-45	63693	F8CC	82.29	140	5734	1666	153.58
-40	63898	F999	84.27	150	6144	1800	157.31
-35	64102	FA66	86.25	160	6554	1999	161.04
-30	64307	FB33	88.22	170	6963	1B33	164.76
-25	64512	FC00	90.19	180	7373	1CCC	168.46
-20	64717	FCCC	92.16	190	7782	1E66	172.16
-15	64922	FD99	94.12	200	8192	2000	175.84
-10	65126	FE66	96.09	210	8602	2199	179.51
-5	65331	FF33	98.04	220	9011	2333	183.17
0	0	0000	100.00	230	9421	24CC	186.82
5	205	00CC	101.95	240	9830	2666	190.45
10	410	0199	103.90	250	10240	2800	194.07
15	614	0266	105.85	260	10650	2999	197.69
20	819	0333	107.79	270	11059	2B33	201.29
25	1024	0400	109.73	280	11469	2CCC	204.88
30	1229	04CC	111.67	290	11878	2E66	208.45
35	1434	0599	113.61	300	12288	3000	212.02
40	1638	0666	115.54	310	12698	3199	215.57
45	1843	0733	117.47	320	13107	3333	219.12
50	2048	0800	119.40	330	13517	34CC	222.65
55	2253	08CC	121.32	340	13926	3666	226.17
60	2458	0999	123.24	350	14336	3800	229.67
65	2662	0A66	125.16	360	14746	3999	233.17
70	2867	0B33	127.07	370	15155	3B33	236.65
75	3072	0C00	128.98	380	15565	3CCC	240.13
80	3277	0CCC	130.89	390	15974	3E66	243.59
85	3482	0D99	132.80	400	16384	4000	247.04
90	3686	0E66	134.70	410	16794	4199	250.48
95	3891	0F33	136.60				
100	4096	1000	138.50				

Note 1) At the range from -50 to +400 °C of Pt100, the input temperature range is from -50 to +400 °C. But the temperature data is output from -60 to +410 °C.

Note 2) In case of Pt1000, the resistance is 10 times of PT100.

## 7.Collection of Temperature Data

(1)Pt100 -20 to +40 range

**Table 7.4.2 Pt100 -50 to +40 °C range Temperature conversion data**

Temperature (°C) Note1)	Decimal data	Hexadecimal data	Pt100 resistance ( $\square$ )
-25	55296	D800	90.19
-20	57344	E000	92.16
-15	59392	E800	94.12
-10	61440	F000	96.09
-5	63488	F800	98.04
0	0	0000	100.00
5	2048	0800	101.95
10	4096	1000	103.90
15	6144	1800	105.85
20	8192	2000	107.79
25	10240	2800	109.73
30	12288	3000	111.67
35	14336	3800	113.61
40	16384	4000	115.54
45	18432	4800	117.47

Note 1) At the range from -20 to +40 °C of Pt100, the input range is from -20 to +40 °C. But the temperature data is output from -25 to +45 °C.

# 8. Error Detection Processing

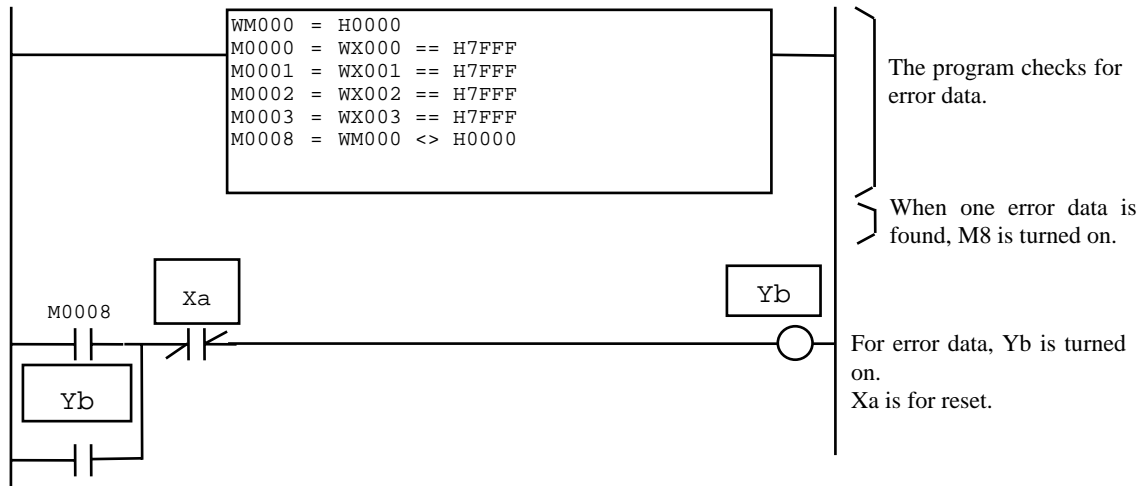
## 8.1 Measured Temperature Range over

(1) Interlock

If temperature conversion data is over the measuring range or current terminal wiring is disconnected, the temperature conversion data becomes H7FFF.

If H7FFF is read, it is necessary to make a program externally for detection the error.

Example of an error detection program



Please take a proper countermeasure by using the coil Yb.

Set the numbers of the “a” and “b” corresponding to the actual system.

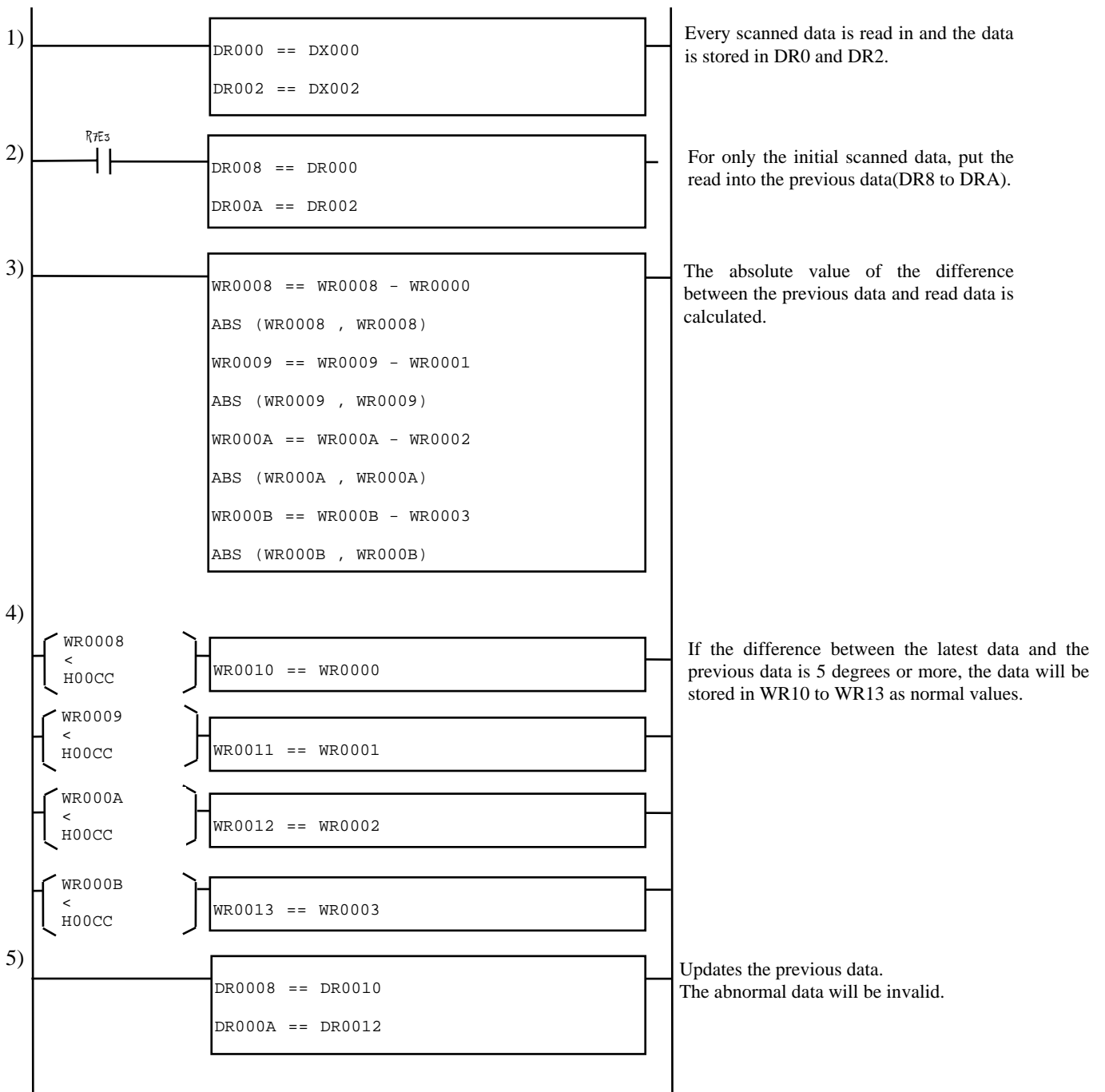
## 8.2 Treatment for a Sudden Change of Temperature Conversion Data

When the temperature conversion data is changed suddenly due to the disconnection of external wiring or influence of noise, the system judges it to be an abnormal condition.

In the example shown below, every scanned data is read in. If the difference between the latest data and the previous data is 5 degrees or more, the latest data is ignored as abnormal data.

Note: Please change each value for your system.

### Example of program



This sample program does not output any signal for the abnormal data. Please make additional circuits depending on the situation.

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# 9. Mounting

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## 9.1 Installation

EH-PT4 module can be installed on both the basic base and expansion base.

(1)Precaution on installation

Upon the installation of the EH-150 series, consider the operability, maintainability and environment.

(a)For use in proper ambient temperature range

- Secure a sufficient space allowing a good ventilation.
- Do not install the module just over a device generating a great amount of heat(such as heater, transformer and large capacity resistor).
- If the ambient temperature around the module exceeds 55 , set a fan or air conditioner to keep the temperature below 55 .

(b) Do not install the module in panel provided with a high-voltage device.

(c) Keep more than 300 mm away from a high-voltage line and power line.

(d) Installing the basic base 1,000 mm through 1,600 mm from the floor improves the operability.

(e) Secure a clearance of more than 50 mm between the upper and lower sections of the module for ventilation and maintenance. For the right and left directions, secure a clearance of more than 10 mm.

(f) Never pull out or inset a alive line of the module.

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## 9.2 Mounting Method

(1)Check of the connector

Before and after the installation, check the following two points.

- (a) Is there any abnormality on the connector of the basic base or extensive base?
- (b)Is there any abnormality in the connector or the module side?

(2) External wiring

Before running, confirm the following items:

- (a)Check whether the connection of the external wiring is right.
- (b)Check whether the terminal block and the module are stabilized.

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## 9.3 Maintenance and Inspection

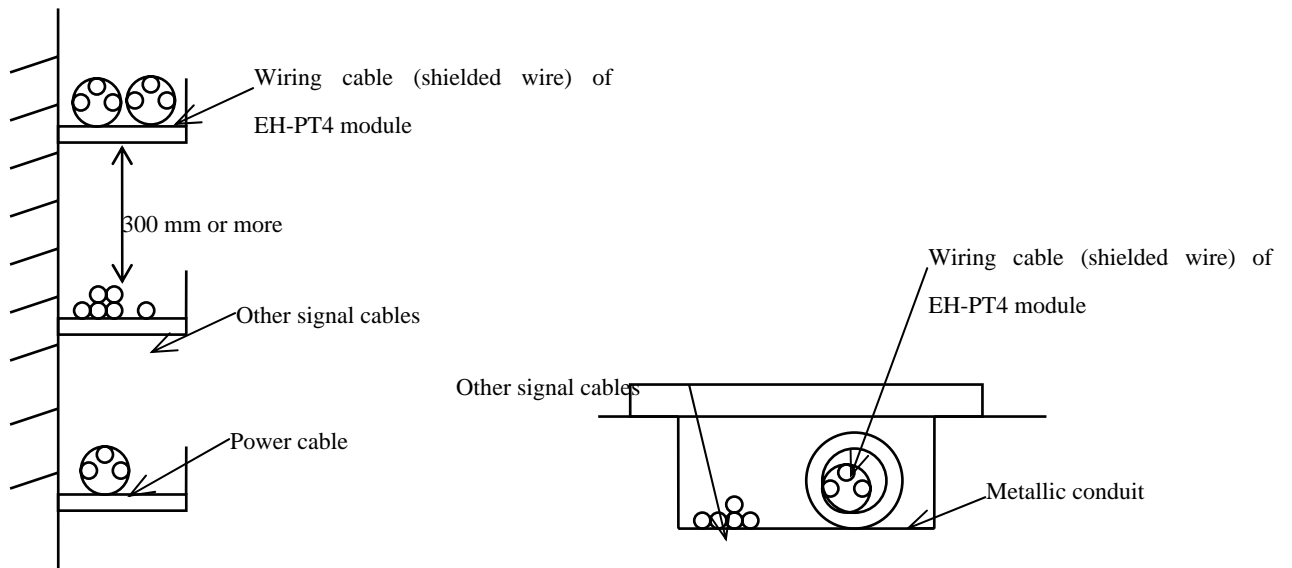
Perform periodic inspection every six months according to the procedure mentioned below.

(1) Remove dust and dirt off the terminal board.

(2) Confirm that the fixing screws of the external wiring terminal board and module are tightened firmly.

### 9.4 Precautions on External Wiring

Because the external wiring of the EH-PT4 handles fine signals, be sure to use a shielded wire to suppress the influence of external noise and place the wire separately from the power line and signal line of different voltage.

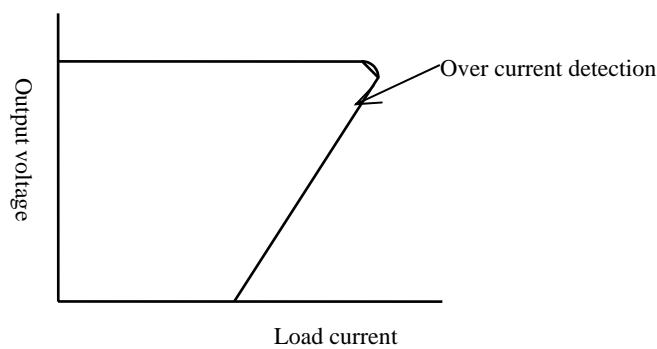


Note) Weld joints of metallic conduits and ground the welded metallic conduits. (Grounding in accordance with local legal requirements)

**Fig. 9.1 Wire Separation by Conduits or Ducts**

**Caution**

Use an external power supply which the over current protection character is as below



**Fig. 9.2 Over current protection character**

# 10. Example of Programming

## 10.1 Example of Programming 1

(1) Control contents

- (a) The program keeps the liquid temperature 10 to 12 °C higher than the ambient temperature.
- (b) When the temperature difference between the upper part and the lower part of the liquid is 3°C or higher, the program turns a stirrer on.
- (c) When the temperature of the liquid exceeds 50 °C or the temperature difference between the upper part and the lower part of the liquid exceeds 8 °C, the program turns a temperature error lamp ON and starts a cooler.
- (d) When an error data is found, the program turns a data error lamp ON and starts the cooler.
- (e) When an error data is found, the program turns a data error lamp ON and starts the cooler.
- (f) When errors are detected, the program stops a heater.

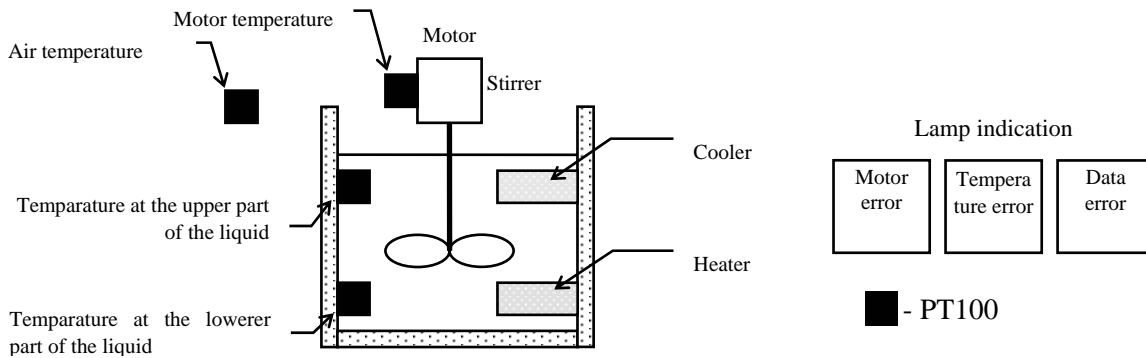
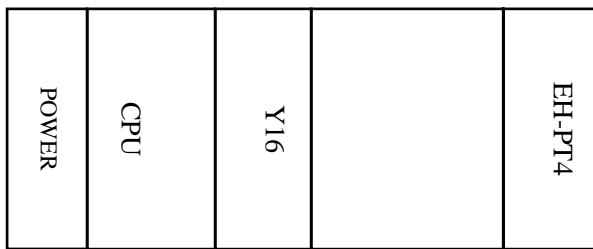


Figure 10.1 External device

(2) Configuration and allocation



Basic base

Install EH-PT4 on the fourth slot.

Use the relay output module installed on the slot 0 to output to the external device.

Figure 10.2 PLC configuration

- Y0: Motor
- Y1: Cooler
- Y2: Heater
- Y3: Motor error lamp
- Y4: Temperature error lamp
- Y5: Data error lamp
- WX40: Ambient temperature
- WX41: Temperature at the upper part of the liquid
- WX42: Temperature at the lower part of the liquid
- WX43: Motor temperature

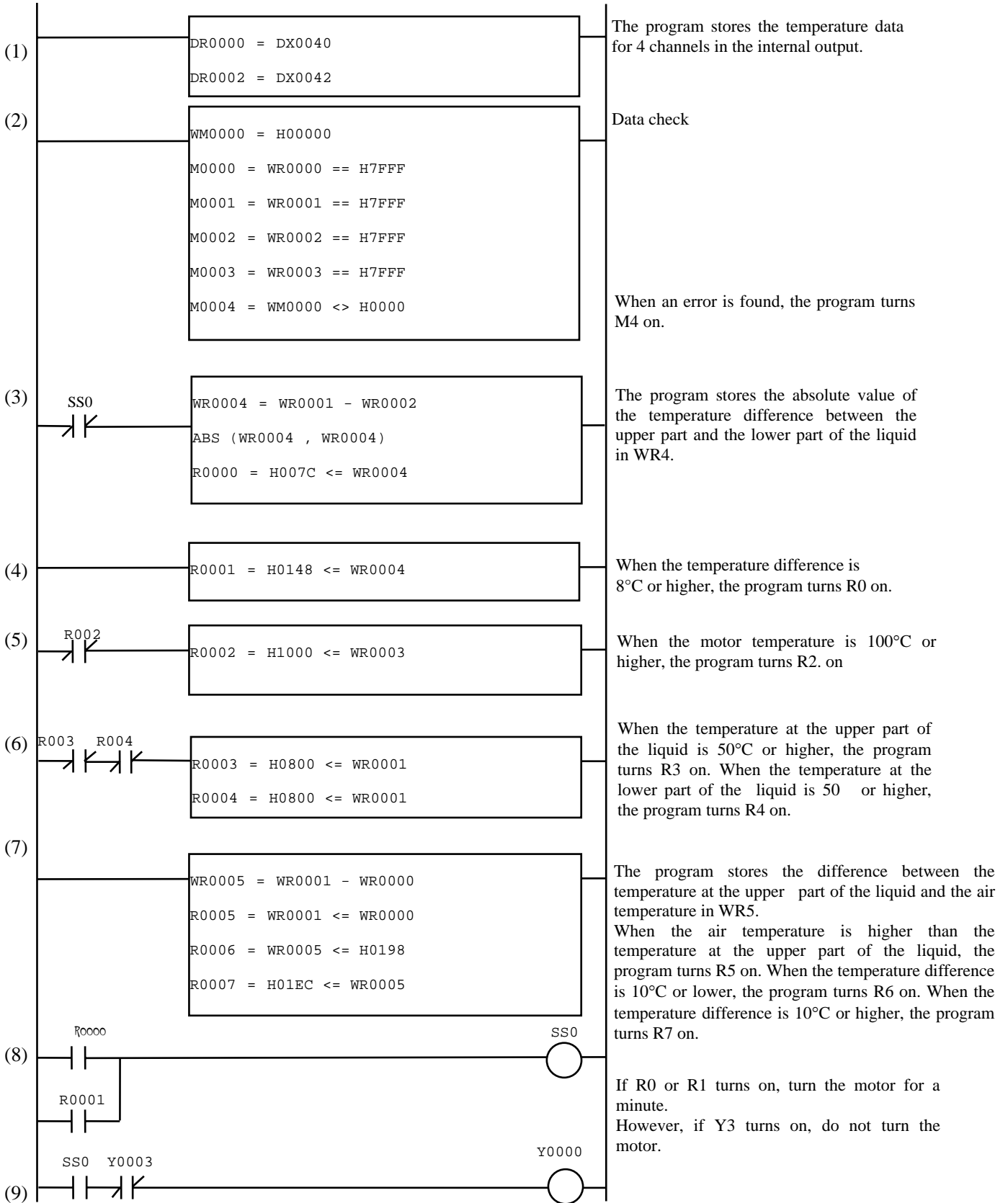
Setting of temperature range  
Pt100, -50 to +400 °C



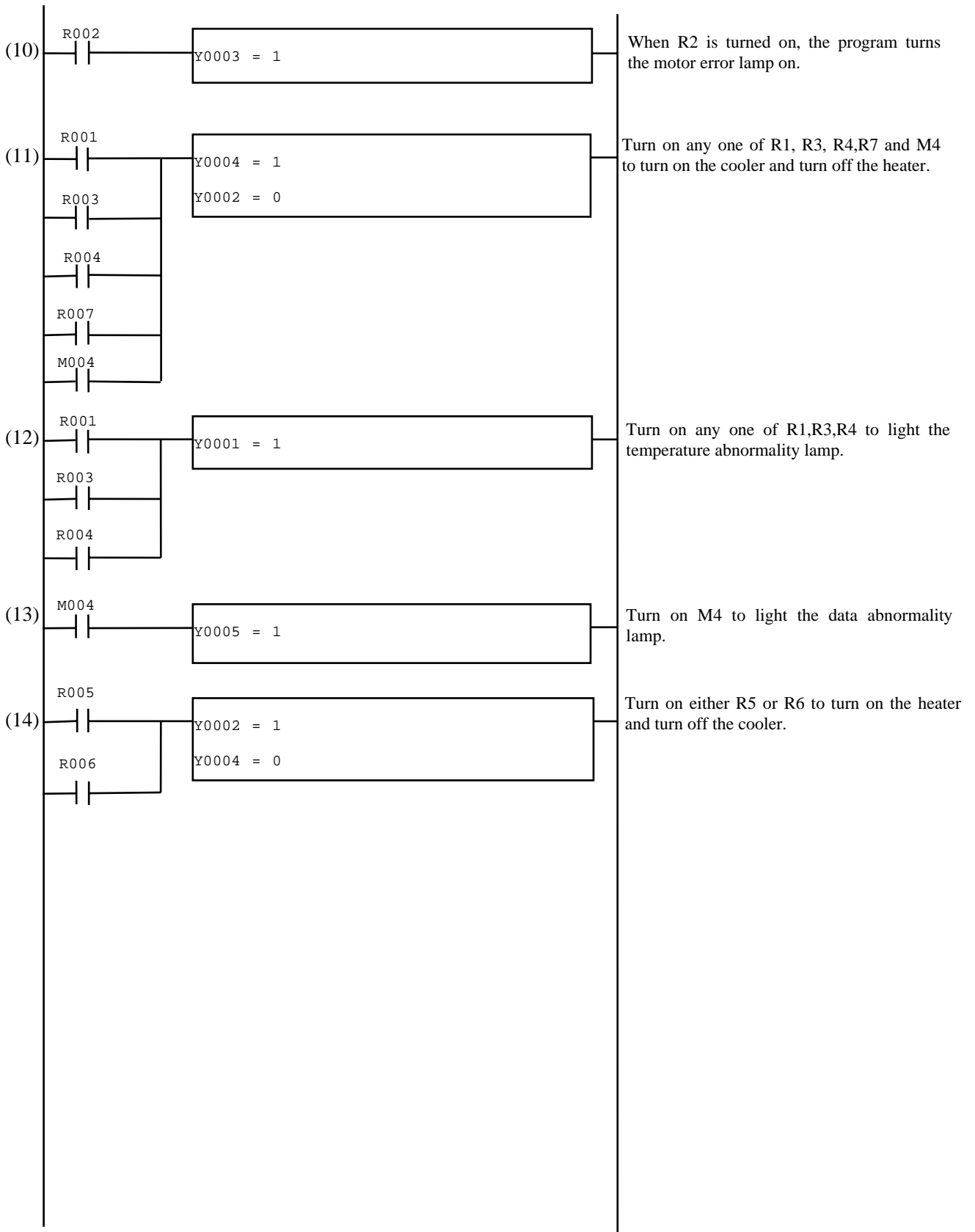


## 10. Example of Programming

### (3) Program



10.Program

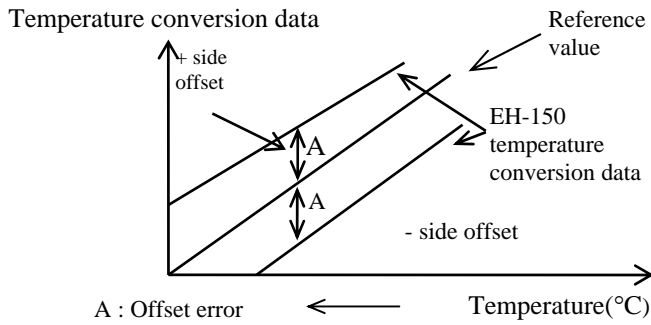


## 10.2 Example of Programming 2(Offset adjustment)

The resistance thermometer element itself has a built-in error, although it is very low, which may influence the temperature conversion data as a offset error. The offset error depends on the aged deterioration also. The offset error can be adjusted by the following sample program but not completely because the offset is not constant in whole range.

( The offset error means the constant deviation from the reference value.)

Example of offset



Note: In order to know the offset, please measure the reference value by the device, which has higher accuracy than EH-PT4 or by a high accuracy resistor instead of the resistance thermometer .

(1) Adjustment

Please adjust the offset according to the following table.

Offset error	Temperature conversion data
1°C	H0028 - H002C
2°C	H0050 - H0054
3°C	H0078 - H007C
4°C	H00A0 - H00A4
5°C	H00CC - H00D0

If the measured data is bigger than the reference value, subtract the offset value from the measured value.

(2) Sample program

In case that the channel 2 has +2°C offset, subtract H0050 from the temperature conversion data WX0042.

```

WR0000 = WX0040
WR0001 = WX0041
WR0002 = WX0042 - H0050
WR0003 = WX0043
    
```

---

# 11 Troubleshooting

If you have some problem, please find the cause according to the following countermeasures. In case the problem is not solved after these countermeasures, please contact us.

If you have a spare module, replace and see the condition.

---

## 11.1 The Allocation Error “41” is indicated in CPU.

- (1) Check the I/O assignment in CPU.
- (2) Check the connection between the module and base.
- (3) Problems might be caused from other modules. Please check the other modules.

---

## 11.2 Data Error in a certain channel

The type of data errors are (a) data instability, (b) loss of accuracy and (c) the data is H7FFF.

- (1) Check the wiring of the corresponding channel.
- (2) Check if the wiring is placed on the same route as the power line (if so, noise is induced.)
- (3) Check if the terminal board screws are tightened securely.
- (4) Check if the PT100/1000 complies with IEC 751.
- (5) Check if the external wiring resistance (current terminal wiring ) is less than 400 ohm.
- (6) Check if a measured temperature is out of the range of EH-PT4.

---

## 11.3 Data Error in all channels

In case that the all the data are H7FFF.

- (1) If there is an unused channel, check if the current terminal is correct.
- (2) Check the output voltage of external power supply. Check if the wiring of the current terminal is disconnected.
- (3) Check the capacity of the external power supply. (Output current 1A or more)

### Precautions

- (1) Before replacing the module, make sure to turn off the power.
- (2) Upon returning a module for a repair, notify us of the details of the abnormal condition.
- (3) For troubleshooting, the following tools are necessary.
  - (a) Screwdriver (+ / -)
  - (b) Digital multi-meter, circuit tester
  - (c) Oscilloscope (depending on the case)

## 12. Appendix

### 12.1 Calculation of External Wiring Resistance

Assuming that the cross section and length of tinned annealed copper wire are  $S(\text{mm}^2)$ , and  $L(\text{m})$ , the resistance  $R(\text{ohm})$  of the wire is

$$R \approx 0.01854 \times L / S$$

For example, for a cable whose cross section is  $0.18 \text{ mm}^2$  and length is 200 m, the resistance is

$$R \approx 0.01854 \times 200 / 0.18 = 20.6 \text{ ohm}$$

Because the current terminal of EH-PT4 doubles in both ways, the resistance also doubles  $20.6 \text{ ohm} \times 2 = 41.2 \text{ ohm}$ .

Because this resistance is the value when the ambient temperature around the wire is  $20^\circ\text{C}$ , if the ambient temperature is over  $20^\circ\text{C}$ , the resistance rises.

The rise per  $1^\circ\text{C}$  is about 0.4%.

In case the ambient temperature is  $40^\circ\text{C}$ , the resistance is

$$\begin{aligned} R &= 41.2 \times (1 + 0.004(40 - 20)) \\ &\approx 44.5 \text{ ohm} \end{aligned}$$

Concerning the details of resistance, investigate individually for each wire. It may be slightly different from the calculated value.

#### Reference

In the case of Hitachi twisted shielded cable (CO-DS-IREVV-SX,(10 pairs to 52)),the maximum conductor resistance in the cross section of  $0.18\text{mm}^2$  under the temperature  $20^\circ\text{C}$  is  $121.5 \text{ ohm/}$  (according to Hitachi's Guide Book).