Cryogenic Temperature Sensor /Monitor Manuals

Models:

Cryo Temp Sensor	Henox	**Cryo Temp Monitor**	D18i
	CCR	**Cryo Temp Controller**	M36i
	Diode		M72i
	PT100		
	PTCO		
	RUO2		
	Ultra-RUO2		

Version: V 2.6

Hynhe Technology (Guangzhou) Co., LTD

Visit www.hynhe.com for more product information

CONTENT

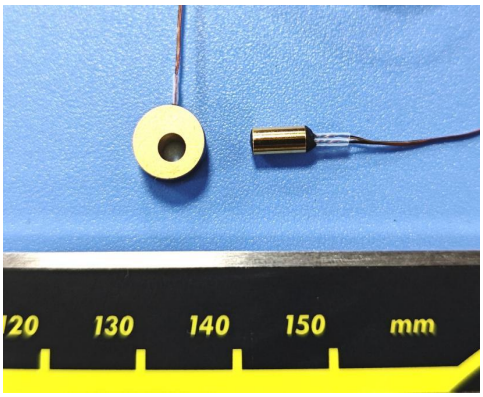
Maintain Secrecy

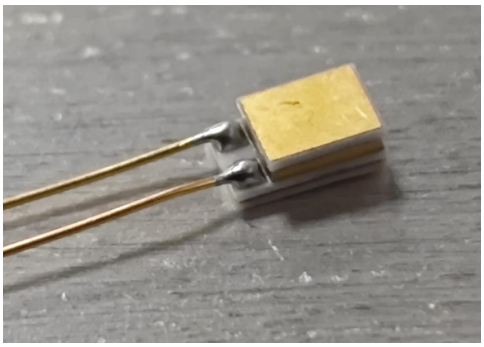
Chapter 1, Henox Cyo Temp Sensor Introduction

1. Henox Product Introduction(ZrON)

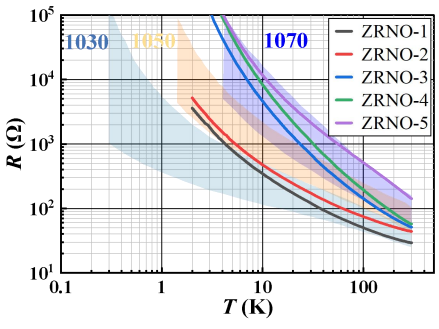
The Henox sensor is a ZrON cryogenic sensor, which is made by sputtering coating on sapphire wafer and combined with high-precision lithography and packaging technology. Henox cryo temperature sensor has high sensitivity, fast thermal response, good repeatability, at the same time it also has superior magnetic field resistance, due to its versatility, they are widely used in a variety of cryo temperature applications, such as superconducting magnet, particle accelerator, space satellite, nuclear magnetic resonance system, cryo temperature system and research science, etc.

[Feature]

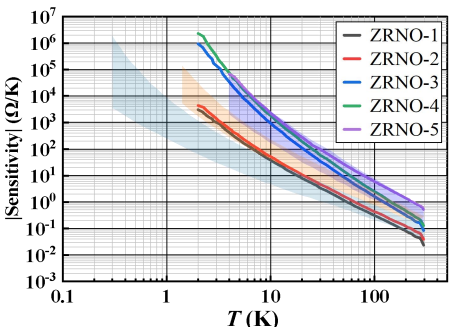




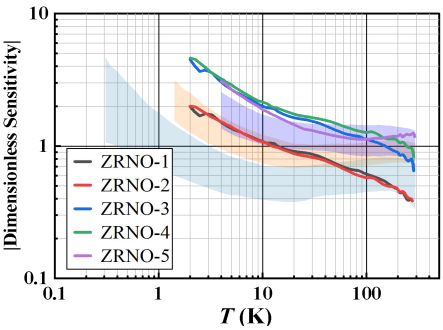
- Low magnetic field induction error
- High sensitivity at cryo temperatures and good sensitivity in a wide range
- Excellent magnetic field resistance, and is insensitive to the magnetic field.
- Large working temperature zone, temperature range from 100 mK to 420 K (depending on model)
- The bare chip cryo temperature sensor has fast characteristic thermal response time: 1.5 ms at 4.2 K and 50 ms at 77 K.
- A variety of models and packages are available to meet your temperature measurement requirements.
- Excellent repeatability and stability.
- Prevent excessive vibration and fall, pay attention to the installation



Henox R-T relationship



Henox typical sensitivity



Henox dimensionless sensitivity

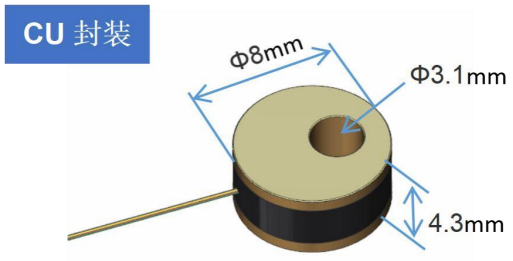
2. Henox Model Selection

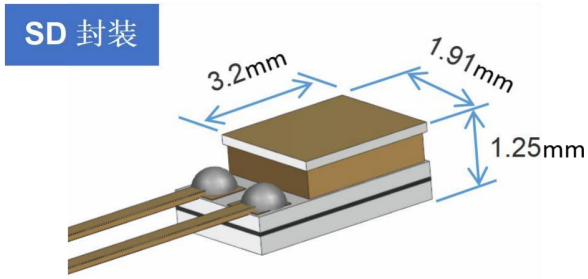
Henox, sensor model selection				
Model Description: ① For example, HX-1050-CU-C1.4L, "HX-1050-CU" means the Henox1050 series CU package, and "C1.4L" means the 1.4K-325K temperature calibration. The suffix letters are as follows: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K				
	Name	Series	Package	Temperature range
Calibration	HX	1010 / 1030 / 1030H / 1050	CU / AA / SD	C1.4E / C1.4L
	HX	1070	CU / AA / SD	C2.8E / C2.8L
Uncalibratio	HX	1010 / 1030 / 1030H / 1050 / 1070	CU / AA / SD	___

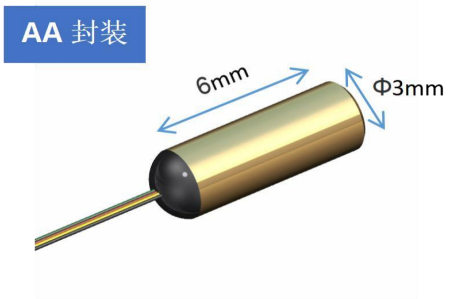
Packaging materials Gold-plated oxygen-free copper, epoxy resin	**Four core phosphor bronze lead** Polyimide insulation, wire diameter 34AWG, standard 1m. (Customization for extension)

The Henox Package

The packaging material of Hynhe sensor is gold-plated copper block and epoxy resin. The sensor is standard equipped with a 1-meter lead(SD package 20mm lead) with a diameter of 34 AWG and an outer layer of polyimide insulation.





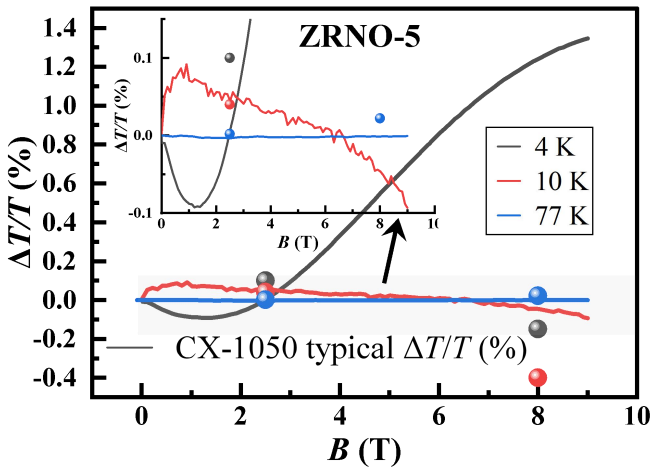


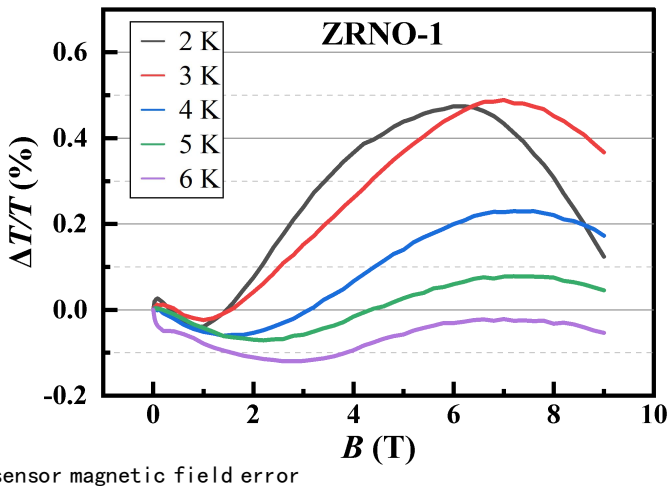
3. Henox Accuracy

	Type	Temp	1010 Accuracy	1030 Accuracy	1050 Accuracy	1070 Accuracy
Full scale calibration	1.4K-310K High precision calibration	1.4 K	± 5 mk	± 5 mk	± 5 mk	n/a
		4.2K	± 5 mk	± 5 mk	± 5 mk	± 5 mk
		10K	± 6 mk	± 6 mk	± 6 mk	± 6 mk
		20K	± 9 mk	± 9 mk	± 9 mk	± 9 mk
		77K	± 25 mk	± 25 mk	± 16 mk	± 16 mk
		300K	± 75 mk	± 75 mk	± 40 mk	± 40 mk
	2.8K-310K Standard calibration	4.2K			±30mk	
		10K	TBD	TBD	± 30 mk	TBD
		20K			± 35 mk	
		77K			± 50m K	
		300K			± 300m K	

The Henox cryogenic sensor accuracy

4. Magnetic field data





Henox cryogenic sensor magnetic field error

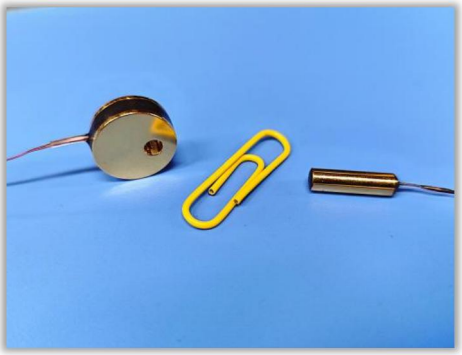
		B (T)		
	T (K)	2.5 T	8 T	14 T
CX-1050	2	1.3	3.1	3.9
	4	0.1	-0.15	-0.85
	10	0.04	-0.4	-1.1

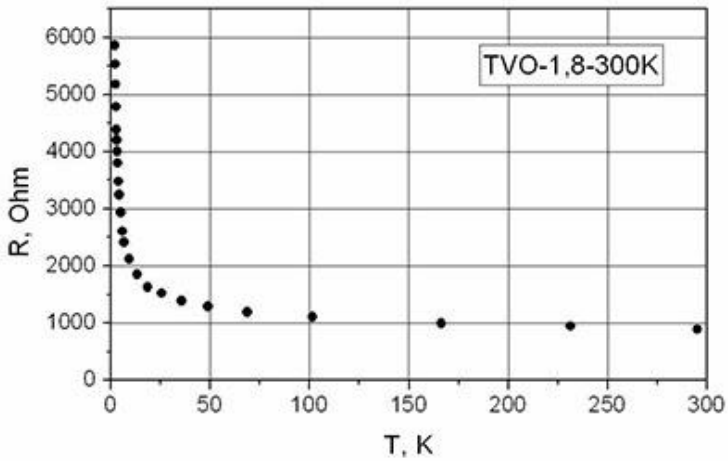
Typical magnetic field error for the LakeShore-Cenox

Chapter 2, CCR Cryogenic Temp Sensor

1. CCR Product Introduction

CCR carbon ceramic cryogenic thermometer is a resistance sensor with negative temperature coefficient, with excellent mechanical, thermal and environmental performance, with good cost performance, so it is widely used in scientific research and industry throughout the field of cryo temperature. The CCR developed by Hynhe Technology can be measured from low temperature 2.8K to high temperature 310 K.





CCR A typical R-T relationship

[Feature]

- Long-term stability: 30 mK @ 4.2 K / 15 yrs
- Short-term repeatability: ± 5 mk @ 4.2 K
- Typical dissipation:10^-7W@4.2K
- Recommended incentive current: 3 uA (> 1000 Ω) / 10 uA (<1000 Ω)
- It has high sensitivity at 4.2K, and the higher the resistance value, the less affected by the magnetic field, and the thermometer installation direction and the magnetic field direction are also related.
- Low neutron radiation error <1% for F <1017N / cm².
- Low ionizing radiation error <1% 1 MGy after exposure.
- The sensor is greatly affected by stress to prevent excessive vibration and fall, and attention should not be excessive stress during installation.
- The sensor cannot be used above the temperature above room temperature, and the overtemperature use will cause the accuracy deviation.

2. CCR Model Selection

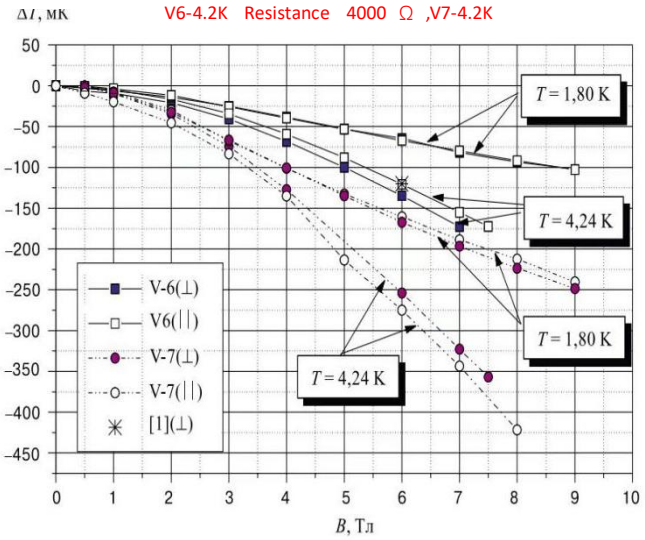
CCR sensor model selection				
Model Description: ①CCR-4K4-CD-C2.8E, "CCR-4K4-CD" indicates the CD package of the CCR4K4 series, and "C2.8E" indicates the temperature calibration of 2.8K-310K. The suffix letters indicate: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K ②CCR-BARE-P3: CCR unencapsulated three-point calibration (4K,77K,300K).				
	Name	Series	Package	Temperature range
Calibration	CCR	4K1.5 / 4K2.5 / 4K4	CD / AA / BARE	C2.8E
Uncalibratio	CCR	4K1.5 / 4K2.5 / 4K4	CD / AA / BARE	———
Three point calibration	CCR	——	BARE	P3

3. CCR Accuracy

	Calibration temperature area	temperature	accuracy
Full scale calibration	2.8K-310K (multiple to 2.0K)	4.2K	±30mk
		10K	±50mk
		20K	±100mk
		77K	±1.5K
		300K	±2.5K
Three points calibration (Need Consult)		4.2K	2 times resistance difference ± 8 Ω
		77K	2 times resistance difference ± 5 Ω
		300K	2 times resistance difference ± 5 Ω

CCR cryogenic sensor accuracy

4. Magnetic field data



Temp| Resistance |Sensitivity

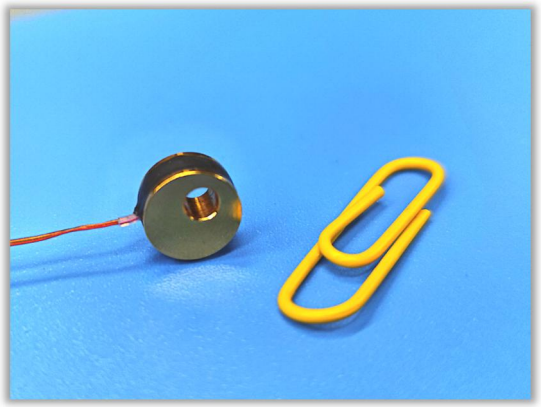
温度	实测电阻	灵敏度	dT（K）		
			B=3T	B=6T	B=9T
4.24K	1496.08	45.3	-0.28	-0.86	-1.48
	1747.94	56.4	-0.27	-0.8	-1.38
	2436.2	273	-0.077	-0.233	-0.399
	3001.7	407	-0.064	-0.193	-0.329
	3423.6	435	-0.068	-0.206	-0.352
	4143.3	638	-0.057	-0.17	-0.29
	4420.7	750	-0.051	-0.154	-0.264
	5219.22	1000	-0.048	-0.143	-0.246

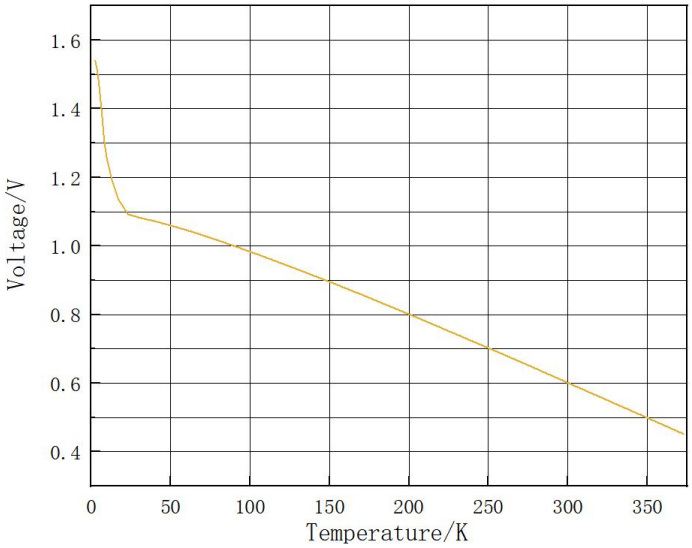
CCR cryogenic sensor magnetic field error

Chapter 3, Silicon Diode Cryo Temperature Sensor

1. Diode Product Introduction

Diode temperature sensor is a commonly used temperature measuring sensor in the field of cryo temperature, Silicon diode developed by Hynhe technology can measure the temperature range from 2. 8K to 350K, cryo temperature sensor sensitivity; in addition to the individual calibration curve, and can use the standard curve, so it has good interchangeability;





The typical V - T relationship

[Feature]

- Recommended incentive current: 10 uA ± 0.05%
- Typical dissipation: 6uW@300K/10uW@77.3K/15uW@4.2K
- Short-term repeatability: ± 20 mk @ 4.2 K
- Standard curves can be used with high interchangeability.
- Maximum reverse voltage: 40V.
- Maximum current before damage: 1 mA continuously or instantaneous 100 mA.
- It is not recommended to use it in a magnetic field environment.
- The sensor should not be used above the temperature above room temperature, and the overtemperature use will cause the accuracy deviation.
- The sensor is greatly affected by the stress, so note that there should be no excessive stress during the installation.

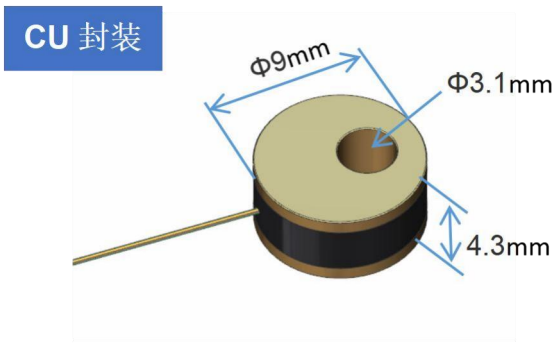
The above features and parameters are used for reference only. Due by working condition, connection mode and installation stress.

2. Diode Model Selection

Diode sensor model selection				
Model Description: ① Diode-CU-C2.8E, "CCR-CU" means Diode series CU packaging, "C2.8E" means 2.8K-310K temperature calibration. The suffix letters are as follows: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K				
	name	series	package	Temperature range
Calibration	Diode	____	CU	C2.8E
Uncalibration	Diode	____	CU	____
Standard	Diode	____	CU	S2.8N

Packaging materials Gold-plated oxygen-free copper, epoxy resin	**Four core phosphor bronze lead** Polyimide insulation, wire diameter 34AWG, standard 1m. (Customization for extension)

Diode Package



3. Diode Accuracy

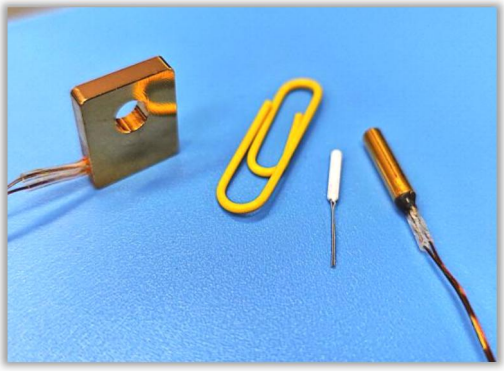
	Calibration temperature area	Temperature	Accuracy
Full scale calibration	2.8K-310K	4.2K	±30mk
		10K	±50mk
		20K	±80mk
		77K	±500mK
		300K	±1K
standard curve	n/a	2.8-350K	±1k

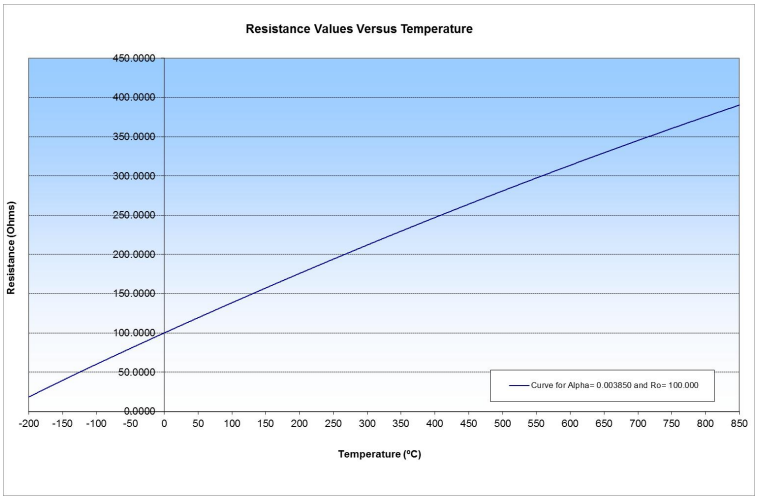
The Diode cryogenic sensor accuracy

Chapter 4, PT 100 Cryo Temperature Sensor

1. PT 100 Product Introduction

PT 100 sensor is a commonly used temperature measuring sensor in cryo temperature and industrial fields. The PT 100 developed by Hynhe Technology adopts ceramic packaging, which can be measured from cryo temperature 1 3.8K to high temperature 930K, and has high repeatability and stability, and the PT 100 temperature sensor has a universal standard curve.

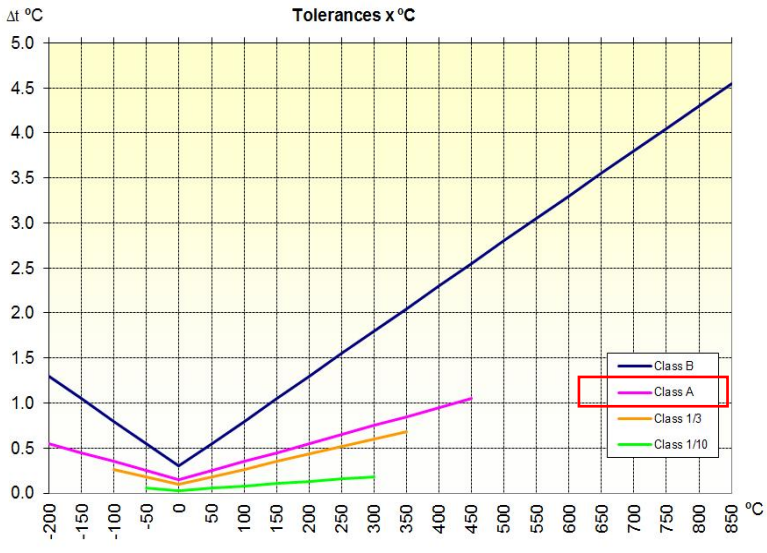




The typical R - T relationship

[Feature]

- Recommended incentive current: 1 mA
- Recommended incentive dissipation: 100uW@273.15K
- Short-term repeatability: ± 10 mk @ 77 K.
- Standard curves can be used, with high interchangeability.
- Below 40K, it is not recommended in a magnetic field environment.
- Can be used in a radiation environment.
- The sensor should not be used above the temperature above room temperature, and the overtemperature use will cause the accuracy



Hynhe PT 100 is ClassA, if you need a higher level, can

Different grade of PT 100

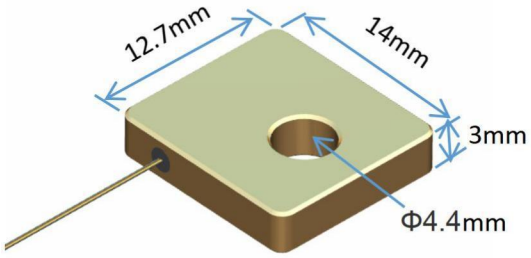
2. PT100 Model Selection

PT100 model sensor selection				
Model Description: ① PT100-AM-C13.8E, "PT100-AM" indicates the PT100 series AM package, "C13.8E" indicates the 13.8K-310K temperature calibration. The suffix letters indicate: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K.				
	Name	Series	Package	Temperature range
Calibration	PT100	——	AM / AA / BARE	C13.8E
Uncalibration	PT100	——	AM / AA / BARE	——
Standard	PT100	——	AM / AA / BARE	S13.8E / S13.8M

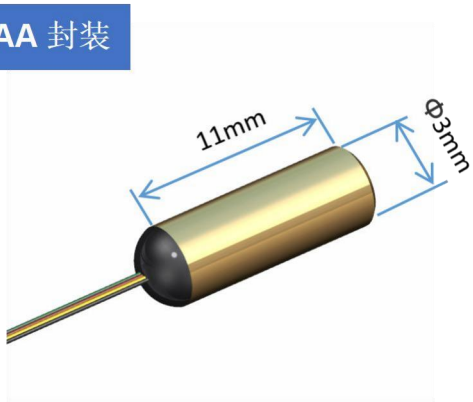
Packaging materials Gold-plated oxygen-free copper, epoxy resin	**Four core phosphor bronze lead** Polyimide insulation, wire diameter 34AWG, standard 1m. (Customization for extension)

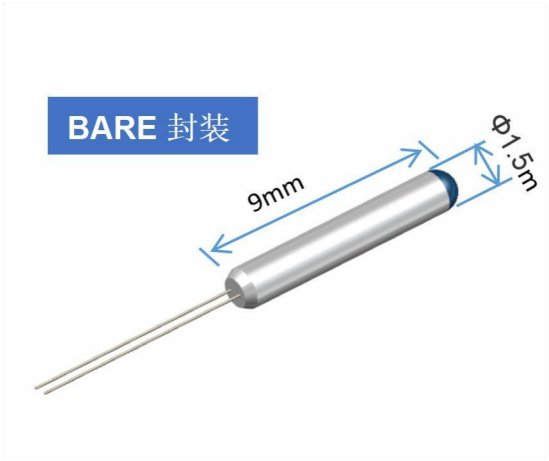
PT 100 Package

AM 封装



AA 封装





3. PT100 Accuracy

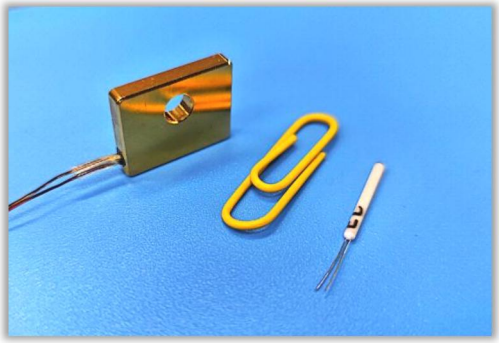
	Calibration temperature area	temperature	accuracy
Full scale calibration	2.8K-310K	20K	±100mk
		77K	±100mk
		300K	±500mk
standard curve		20K	±2k
		77K	±0.8k
		300K	±0.5k

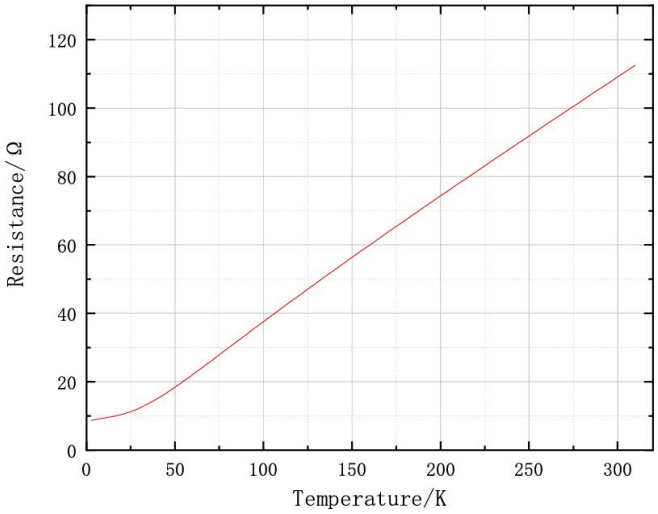
Introduction of the accuracy of the PT 100 sensor

Chapter 5, PTCO Cryo Temperature Sensor

1. PTCO Product Introduction

Relative to the PT 100, the PTCO sensor developed by Hynhe Technology can measure the temperature of 1K-400K. Below 14K, it will still have a good sensitivity. And its sensitivity below 10K, suitable for temperature measurement in the liquid helium temperature zone. The PTCO sensor can also be used in a magnetic field below 2T, with high interchangeability.



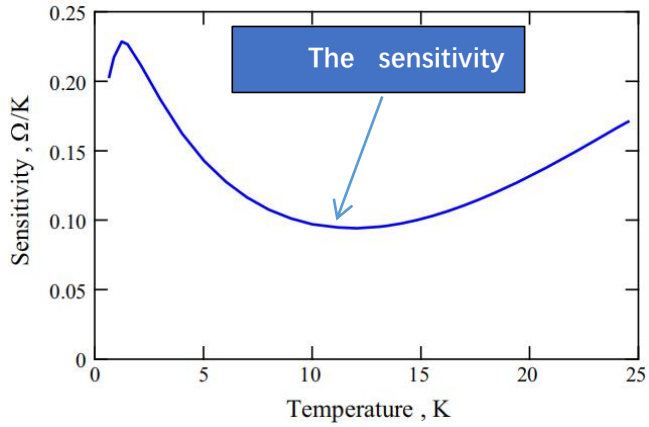


Typical R-T relationship

[Feature]

- Recommended incentive current: 1 mA
- Recommended incentive dissipation: 100uW@273.15K
- Short-term repeatability: ± 10 mk @ 77 K.
- It can be used in a magnetic field environment below 2T.
- Can be used in a radiation environment.
- The sensor cannot be used beyond the highest temperature of its temperature measurement range, and the over range usage will cause the accuracy deviation.
- The sensor is greatly affected by the stress, so note that there should be no excessive stress during the installation.

The above features and parameters are used for reference



Typical sensitivity of

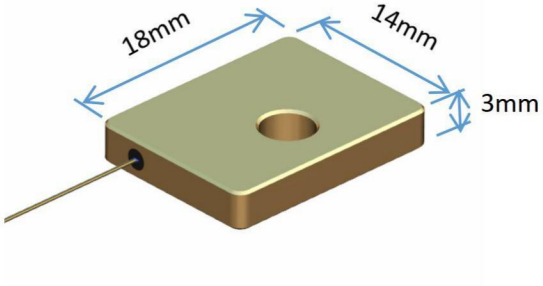
2. PTCO Model Selection

PTCO model sensor selection				
Model Description: ① PT100-AM-C13.8E, "PT100-AM" indicates the PT100 series AM packaging, and "C13.8E" indicates the 13.8K-310K temperature calibration. The suffix letters indicate: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K.				
	Name	Series	Package	Temperature range
Calibration	PTCO	——	AM / AA / BARE	C2.8E
Uncalibratio	PTCO	——	AM / AA / BARE	——

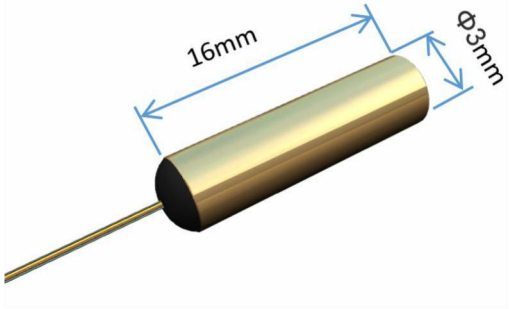
Packaging materials Gold-plated oxygen-free copper, epoxy resin	**Four core phosphor bronze lead** Polyimide insulation, wire diameter 34AWG, standard 1m. (Customization for extension)

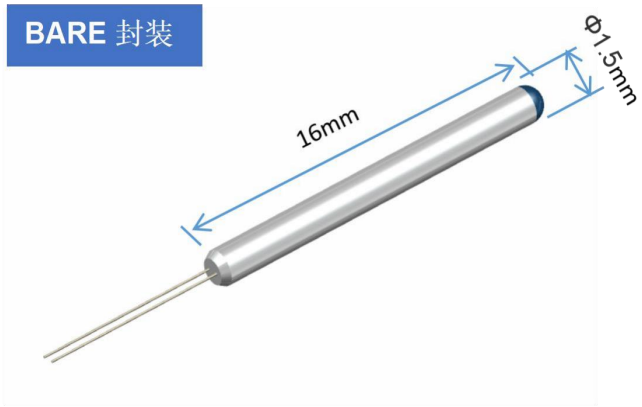
PTCO Package

AM 封装



AA 封装





3. PTCO Accuracy

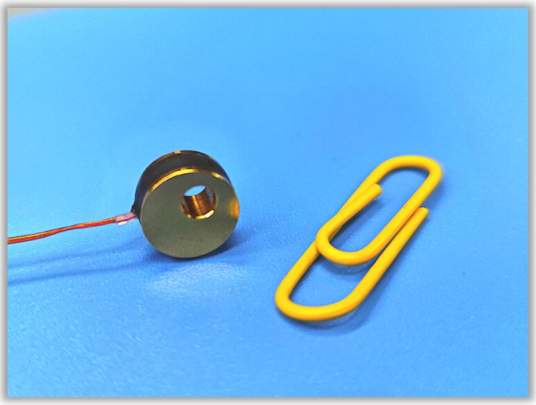
	Calibration temperature area	temperature	accuracy
Full scale calibration	2.8K-310K	4.2K	±100mk
		20K	±100mk
		77K	±100mk
		300K	±500mk

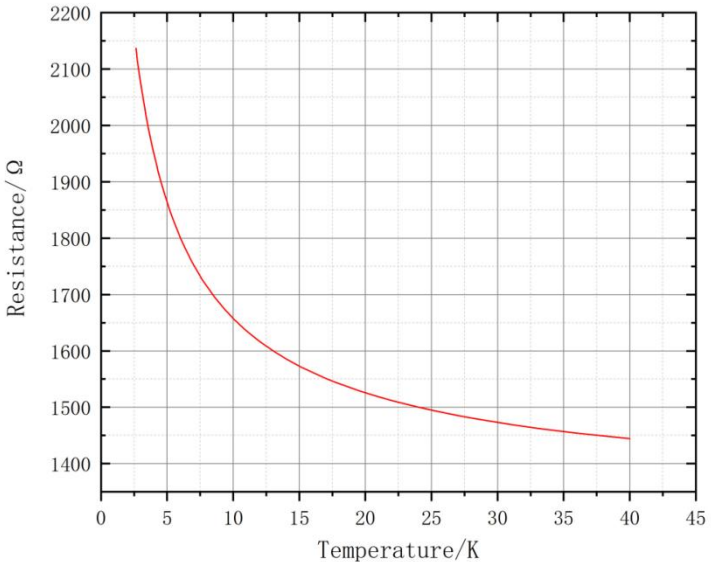
Introduction of the accuracy of the PT 100 sensor

Chapter 6, RUO2 Cryo Temperature Sensor

1. RUO2 Product Introduction

RUO2 cryo temperature sensor is a commonly used temperature measuring sensor in the field of cryo temperature. RUO2 developed by Hynhe Technology The temperature sensor can measure the temperature range from 0.1K to 40K, with high repeatability and stability, and RUO2 The temperature sensor has a general standard curve with little interference by the magnetic field.





RUO2 typical R-T relationship

[Feature]

- Recommended incentive current: 10 uA
- Recommended incentive dissipation: 1.93x10^-7W@4.2K
- Reproducibility: ±15mk@4.2K
- Above 40K, it is not suitable for use as a thermometer characteristic.
- Less affected by the magnetic field, with a low magnetic field error.
- The sensor should not be used above the temperature above room temperature, and the overtemperature use will cause the accuracy deviation.
- The sensor is greatly affected by the stress, so note that there should be no excessive stress during the installation.

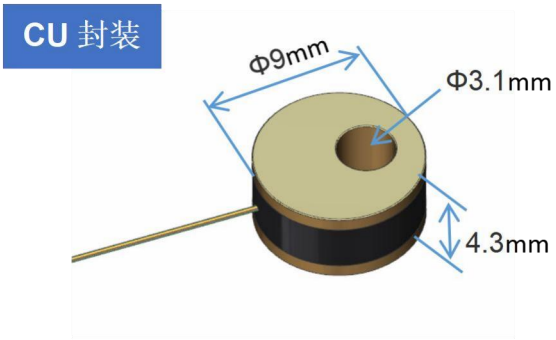
The above features and parameters are used for reference only. Due by working condition, connection mode and

2. RUO2 Model Selection

Ruo2 Model sensor selection				
Model Description: ① RUO2-CU-S2.8B-A, "RUO2-CU" indicates the RUO2 series CU package, "S2.8B" indicates the 2.8K-40K standard curve, and "A" at the end indicates the A grade accuracy. Suffix letters: B-40K, E-310K, L-325K, N-350K, M-400K, H-500K, J-800K				
	Name	Package	Temperature range	Accuracy level
Standard	RUO2	CU	S2.8E	A / B

Packaging materials Gold-plated oxygen-free copper, epoxy resin	**Four core phosphor bronze lead** Polyimide insulation, wire diameter 34AWG, standard 1m. (Customization for extension)

RUO2 Package



3. RUO2 Accuracy

Curve form	Model	Temperature	Accuracy
Standard curve	RUO2-CU-D9L4.3-2.8-A	4.2K	±100mk
		10K	±300mk
		20K	±500mk
		40K	±1.5k
	RUO2-CU-D9L4.3-2.8-B	4.2K	±200mk
		10K	±500mk
		20K	±1k
		40K	±2.5k
Calibration curve		Consult for calibration	

RUO2 Introduction of sensor accuracy

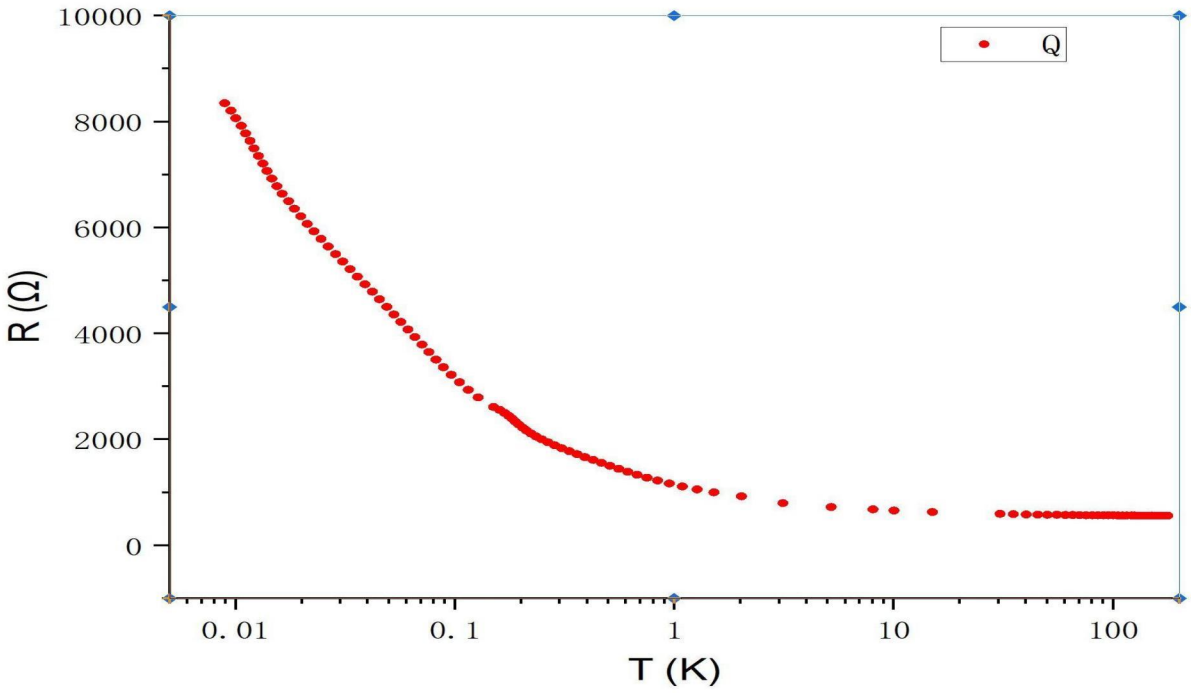
4. Magnetic field data

Temperature (K)	Error dT(K)				
	0T	2.5T	4T	8T	12T
2	0.000	n/a	n/a	n/a	n/a
3	0.000	-0.032	-0.059	-0.105	-0.136
4	0.000	-0.021	-0.043	-0.083	-0.109
8	0.000	-0.015	-0.022	-0.040	-0.062
16	0.000	-0.029	-0.048	-0.105	-0.181
23	0.000	-0.017	-0.052	-0.172	-0.310

RUO2 Different magnetic field errors of the sensor (unit: K)

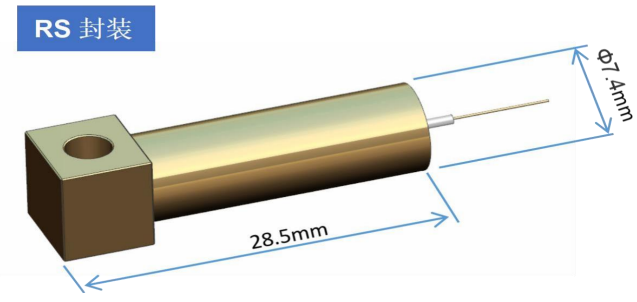
Chapter 7: ULTRA-RUO2 Cryogenic Sensor (RUO2-RS)

The ULTRA-RUO2 cryogenic sensor is engineered specifically for ultra-low-temp environments below 10 mK. Its packaging has been optimized to suppress measurement noise, including radiative heat loads and RF interference. When paired with our M72i AC bridge or Lakeshore's Model 372 bridge, it enables real-time monitoring and precise control at temperatures below 50 mK, and is widely deployed in dilution refrigerators.



Key Features

- Temperature range: 5 mK – 30 K
- Accuracy: ±10 mK @ 4.2 K
- Repeatability: ±15 mK @ 4.2 K
- Not recommended for use under radiation or magnetic-field environments.
- High sensitivity at millikelvin temperatures.
- Handle with care—avoid shocks or drops to maintain sensor accuracy.



Calibration is currently available down to 1.25 K only. For calibration below 1.25 K, please inquire.

Chapter 8, Cryo Temperature Sensor lead Line

1. Introduction to Leads

- Material: Phosphorus bronze.
- Wire diameter: 34 AWG (single root diameter: 0.16mm).
- Kapton Insulation layer, single line insulation 1000V, 2000V.
- Maximum service temperature: 227℃ (about 500K).
- Phosphorous bronze side by side four-core wire, suitable for all low-temperature use, low heat leakage, low magnetoresistance, is the ideal choice for use under the magnetic field.
- Four-wire measurement: four-wire measurement can eliminate the offset error caused by the line resistance, is the best measurement choice. However, for the diode sensor, the user can use a 2-wire measurement as required.

2. Lead Extension and Customization

The standard lead length of the Hynhe combination technology sensor is 1m, and it also provides customized leads of 2m, 3m, 4m and 5m. However, increasing the lead line will add additional difficulty to the packaging and calibration of the sensor, making it more cumbersome.

If you need to add additional lead length, you can consult for customization.

Chapter 9, Cryo Temperature Sensor Installation

The correct installation of the low-temperature sensor is crucial to its use; the improper installation method will cause the difference in temperature measurement. Here are some relevant installation instructions:

1. Clean the Installation Surface

Before the installation of cryo temperature sensor, the sensor surface and the surface of the installation position should be kept clean and clean, no debris, hair, handprint and other clean foreign bodies fall on the surface, which are the key factors affecting the thermal conduction of the sensor. It can be wiped with a dust-free cloth with acetone, and then wiped with alcohol. When the surface solvent is clean, the sensor can be installed.

2. Increase the Thermal Conductivity Area

For the installation surface, it looks smooth and smooth, but there are still some small pores and grooves on the surface after infinite amplification. It is recommended that a layer of Apiezon® N thermal conductivity can be applied on the thermometer thermal contact surface to fill the micropores of the contact surface and increase the thermal conductivity. Note that N fat can not be oversmeared, but a large amount of N fat will affect the thermal conductivity.

3. Installation and Connection Mode

For partial packaging, it itself has a single M3 screw hole position. The user can use the existing hole position to lock the installation with screws. The selection of screws is also extremely important, because the contraction of screws and packaging copper block at cryo temperature, coupled with the mechanical vibration of the system itself, will also lead to the loosening of the temperature sensor. Stainless steel screws are not recommended, because the shrinkage rate of stainless steel screws at cryo temperature is less than that of the copper packaging block. As the temperature decreases, there will be a risk of loosening, but with the combination of elastic pad in the middle, the effect will be better. Hynhe technology recommends the use of M3 beryllium copper screw + double stack self-locking washer + stainless steel flat cushion

combination, at cryo temperature due to the difference of material shrinkage has the effect, to prevent the loosening caused by different material shrinkage at cryo temperature, torsion 1.3-1.4N * m is appropriate. For AA cylindrical packaging, a small amount of Apiezon® N thermal lipid was applied before mounting to enhance the thermal contact and then completely inserted into the mounting hole position. It can also be epoxidized to the mounting surface, but the thermal conductivity is relatively poor, so the thermometer response becomes slower.

4. Heat Sink Treatment

The heat transmitted through the wire will also affect the temperature measurement of the sensor. When the sensor is installed, it is recommended that the lead be wound near the installation temperature to ensure that the wire is at the same temperature as the sensor.

5,Thermal Radiation Shielding

Even in the vacuum environment, there are two surfaces with temperature difference, do not need the help of other media, but also through the form of electromagnetic wave radiation heat transfer, which is also one of the reasons for the sensor temperature measurement error, so this is also to be considered when installation, generally will increase the surface bright radiation copper cover.

6. Measure the Noise Interference

Measurement noise is a common problem in the measurement of the sensor, usually these noise interference will be transmitted through the lead, affecting the true measurement value of the sensor, causing the measurement deviation or large fluctuations, which are difficult to find and difficult to eliminate, but we can take some measures to reduce the noise interference. For true cavity external cables, it is recommended to use twisted pair with shielding, V + and V-twisted pair, I + and I-twisted pair, and metal shield grounding to minimize measurement signal interference. Reducing the length of the external cable is also an effective way to reduce interference. In addition, need to increase the distance with some large frequency conversion equipment or high power equipment.

Chapter IX. Packaging

Suitable for products	graphic
Three-point calibration of the TBO resistance	 A4 cardboard 15 Pcs/board; place;  Anti-static bag for outer packaging 100-200 pieces / bag;  Dry agent 2 packages dampproof
With a package and a lead sensor	 6.5x6.5x1.5cm Plastic box;  Dry agent 2 packages dampproof;  1 USB disk, including curve; place;  Anti-static bag outer packing 12 boxes / bag

Chapter 10 Appendix

1. Appendix 1: Description of Harmful Substances of the Product

Name	Hazardous substances or elements					
	Lead Pb	Mercury Hg	Cadmium Cd	Six-valent cadmium Cr（VI）	Polybrominated biphenyl PBB	PBDE
Sensor	×	○	○	○	○	○

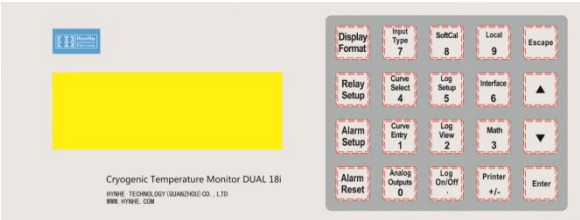
○: Indicate that the content of the harmful substance in all homogeneous materials of the component is below the limit requirements specified in GB / T 26572 standard; Indicates that the hazardous substance contained in all of the homogeneous materials for th is part is below the limit requirements specified in GB/T 26572.

×: Indicate that the content of the harmful substance at least in a homogeneous material of the component exceeds the limit requirements specified by GB / T 26572 standard; Indicates that he hazardous substance containedin at least one of the homogeneous material used for this part is above the limit requirement of GB/T 26572.

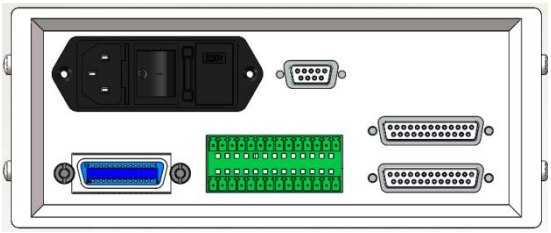
2, Appendix 2: Hynhe D18i Temp Monitor /M36i /M72i Temp Controller

2.1, D18i Monitor

Import Specifications	incoming channel	8 channel
	curve	8 bars, each with a maximum capacity of 200 points
	Sensor support	Diode: Si / GaAlAs Resistance type: Platinum, Cernox, Carbon-glass, ROX, Germanium
	Measurement method	4 Line method
	driving source	Eight constant flow sources
Convention	report to the police	High temperature and low temperature beep prompt
	Relay output (optional)	8 relays, 30VDC (5A)
	analog output	± 10V, which can be configured to send a voltage proportional to the temperature to
	communication mode	Serial port (9-pin D-sub), port rate: 9600 GPIB: IEEE488.2
	show	4x20 character backlit LCD, display screen
	size	435 mm long 89 mm height 369 mm wide



D18i Monitor Front side



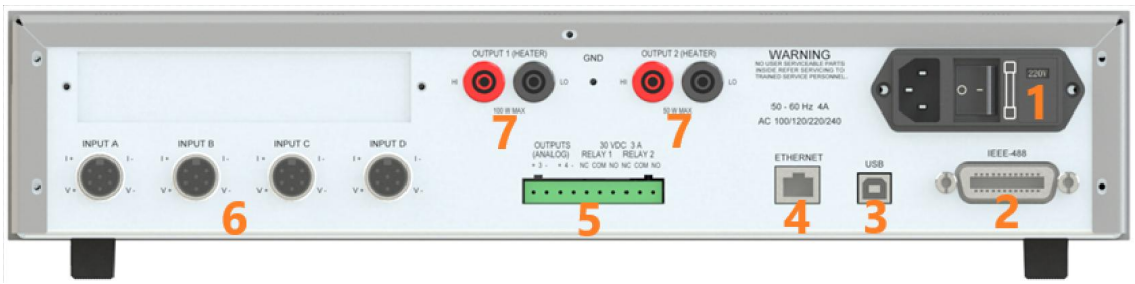
D18i Monitor rear side

2.2, M36i Controller

Import Specifications	incoming channel	4-channel, single-channel independent excitation source	
	insulate	The sensor input is optically isolated from the other circuits	
	A/D resolution ratio	24 The	
	Maximum update rate	10rdg/s （100ms/rdg）	
	curve	59 (20 standard curves, 39 user curves, each holding 200 points)	
	filter	The verage filtered from 2 to 64 points	
	Sensor support	Diode: Si / GaAlAs Resistance type: Platinum, Cernox, Carbon-glass, ROX, Germanium	
	Measurement method	4 Line method	
	driving source	Constant current bidirectional current, reducing the thermal	
Temperature Control	Control loop	2	
	PID regulate	self-regulation	
	PID parameter	P (scale): 0 to 1000 with a set resolution of 0.1 I (integral): 0 to 1000 with a set resolution of 0.1	
	Domain mode	10 temperature areas, containing P, I, D control, manual heater output,	
	Set-point temperature change rate	0.1K/min - 100K/min	
Output		Heat 25 Ω	Heat at 50 Ω
	Output type	Variable DC electric current source	
	Digital-to-analog conversion resolution	16 The	
	maximum power	Output 1:100W / Output	Output 1:50W / output 2:50W
	maximum current	Output 1:2A / output	Output 1:1A / output 2:1A
	working voltage	50V	
	Heater load resistance value	10-100 Ω	
	Output gear	3	
Convention	report to the police	High temperature and low temperature beep prompt	
	relay output	Two relays, which can be used with the alarm function	
	analog output	± 10V, which can be configured to send a voltage proportional to	
	communication mode	① Serial port (USB): USB-TypeB, baud rate: 57600 ② GPIB: IEEE488.2	
	show	8 lines, 40 columns, 240 * 64 pixels, graphics LCD, screen, with LED	
	memory	128K(EEPROM)+32K(NOVRAM)	
	protect	Over-current protection, temperature over-limit protection, heater	

	size	435 mm long 89 mm height 369 mm wide

M36i Front side



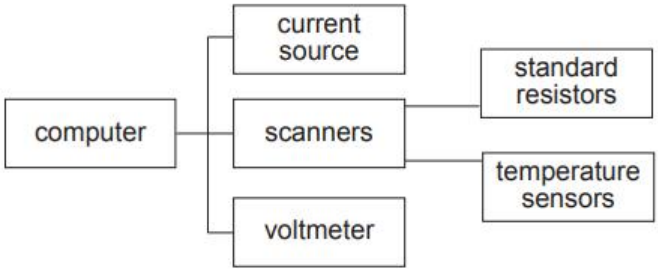
M36i Rear side

1. Power line input component	5. Terminal block with relay and analog voltage output
2. IEEE-488 interface	6. Sensor input
3. USB Type-B interface	7. Heater output
4. RJ45 Ethernet interface	

2.3, M72i Controller

Input Specification	Input Type	AC 4-wire differential, Resistance
	Max Channels	16 channels (requires 16-channel scanner option)
	Excitation Current	22 ranges, 1 pA – 31.6 mA (RMS)
	Voltage Input Range	12 ranges, 2 µV – 632 mV (RMS)
	Sensor Types	PTC / NTC
Output Type (Sensor Heater)	Type	Variable DC current
	Control Modes	Closed-loop PID, Zone PID, Open-loop, Warm-up
	DAC Resolution	16-bit
	Current Ranges	100 mA, 31.6 mA, 10 mA, 3.16 mA, 1 mA, 316 µA, 100 µA, 31.6 µA
	Max Output Power	1 W, 100 mW, 10 mW, 1 mW, 100 µW, 10 µW, 1 µW, 0.1 µW
	Heater Resistance	25 Ω heater / 50 Ω heater
Output Type (Main Heater)	Type	Variable DC current source
	Control Modes	Closed-loop PID, Zone PID, Open-loop, Warm-up
	DAC Resolution	16-bit
	Max Power	10 W
	Max Current	0.634 A / 0.45 A
	Voltage	+15.8 V / +22.4 V
Analog Output	Type	Variable DC current
	Control Modes	Open-loop, Still mode, Monitor mode
	Voltage Range	±10 V
	Max Current	100 mA
	Max Power	1 W
	Accuracy	±2.5 mV
Communications	Serial (USB)	USB-TMPeB, Baud 57600
	GPIB	IEEE-488.2
	LAN	TCP/IP, RJ45
	Alarms	High/Low temperature audible alerts
	Relay Outputs	2 relays, programmable for alarm functions
	Main Unit Size	435 mm W × 89 mm H × 368 mm D
	Weight	6.8 kg
	Scanner Size	135 mm W × 66 mm H × 157 mm D (125 mm connector clearance)

3, Appendix 3: High Precision Dilution Refrigerator Calibration System



The High-precision calibration system of Hynhe technology is composed of dilution refrigerator, eight and half bit meter, high-precision constant current source and fast channel switch, which can realize the mk level temperature control calibration of various diodes and RTD sensors within the temperature range of 1K-310K.

The calibration process is carried out by installing the standard sensor and the measured sensor on a homogeneous temperature calibration copper block. The homogeneous temperature calibration copper block is on the cold plate of the dilution refrigeration machine, and the lead of the sensor makes the corresponding multi-stage heat sink treatment, which can reduce the influence of thermal potential. The calibration chamber is vacuum environment, equipped with radiation screen, with resistance heating device, so that the average temperature calibration copper block can be in a isotemperature environment, so that the whole calibration environment is in a very high stable state.