Mineral Insulated Resistance Thermometers

- **High Accuracy and Stability**
- **Good Linearity**
- **No Compensating Cable**
- **No Cold Junction Compensation**

General Description

Platinum Resistance Sensors offer the highest standard of accuracy and stability of any temperature sensor. They also exhibit good linear response, covering a temperature range from -200ºC to +650ºC. They are easy to apply and require no special cables or cold junction reference. Platinum resistance sensors are finding increasing favour in industry, where their high accuracy, repeatability and stability are vital. Our minerally insulated RTDs are manufactured from superior grade materials. In addition we provide technical expertise, advice, design and a manufacturing facility second to none.

RTD Types

The following types of RTD are available:

PT100 - Platinum, 100Ω at 0ºC
PT130 - Platinum, 130Ω at 0ºC
PT1000 - Platinum, 1000Ω at 0ºC
Cu100 - Copper, 100Ω at 0ºC
Ni100 - Nickel, 100Ω at 0ºC

Applicable Standards

Resistance Values
BS EN 60751:1996
IEC 60751:1983
JIS C1604:1997
BS3G.148:1981
Tables of resistance values for PT100 RTDs are available from Thermocouple Instruments/British Rototherm.

Manufacture
BS EN 60751:1996
IEC 60751:1983

Tolerances
BS EN 60751:1996
IEC 60751:1983

Resistance Thermometers

Resistance Detectors

All our resistance detectors/elements are manufactured by RTD Products, a specialist division of Thermocouple Instruments/British Rototherm.

Detectors manufactured by RTD Products are of the partially supported wire-wound type. These offer the best available balance of accuracy, stability and ruggedness.

A wide range of sizes are available, down to as small as 0.75 mm diameter. Duplex windings are produced in several sizes.

Thermocouple Instruments Resistance Temperature Detectors are capable of withstanding vibration and acceleration levels of up to 30g over the frequency range 10Hz to 1kHz. Detector accuracy will remain unaffected by large changes in pressure.

Detectors are available as standard in tolerance classes A and B. Closer tolerance devices, commonly known as 1/3, 1/5 or 1/10 DIN. These offer tolerances of 1/3, 1/5 or 1/10 of the class B figures. Tolerances for PT100 RTDs are shown overleaf.

Sheaths and Conductors

RTDs are available in 2, 3 or 4 wire configurations with a range of sheath materials and conductor materials.

Standard sheath materials include 316 Stainless Steel, 321 Stainless Steel and Inconel® 600. For high temperature applications, a nickel sheath is preferred. Conductors are usually either copper or nickel.

The tables below show the most common sheath/conductor combinations.

RTD - 2 Wire Configuration			
Sheath material	Outside Diameter		
	3.0	4.5	6.0
316 Stainless steel	❶❷	❶❷	❶❷
321 Stainless Steel	❶❷	❶❷	❶❷
Inconel® 600	❶❷		❶❷

RTD - 3 Wire Configuration			
Sheath material	Outside Diameter		
	3.0	4.5	6.0
316 Stainless steel	❶❷	❶❷	❶❷
321 Stainless Steel	❶❷	❶❷	❶❷
Inconel® 600	❶❷		❶❷

RTD - 4 Wire Configuration			
Sheath material	Outside Diameter		
	3.0	4.5	6.0
316 Stainless steel	❶	❶	❶❷
321 Stainless Steel	❶	❶	❶❷
Inconel® 600	❶		❶❷

❶ = Simplex ❷ = Duplex

High Temperature RTDs

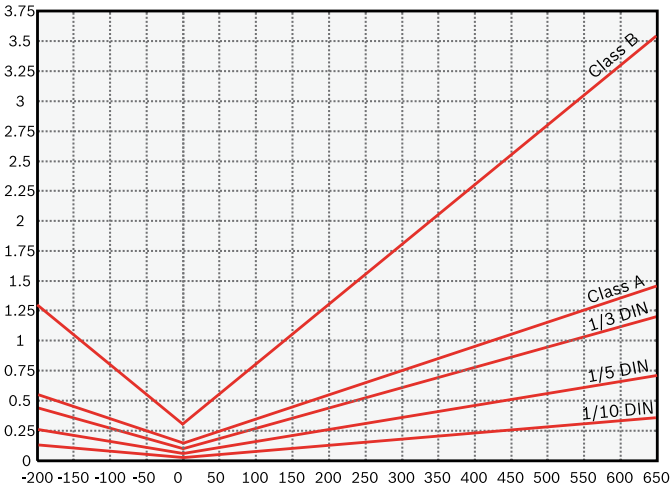
At temperatures above 500ºC, the platinum wires used in the construction of RTD elements are susceptible to 'poisoning' from a variety of sources. The result is rapid drifting of the reading, normally upwards. The most common causes are:-

The Sheath Material - iron vapour contamination effectively rules out the use of stainless steels and most nickel alloys. Pure nickel is the preferred material.

Oil and Grease - traces of oil left inside the protecting tube, or on the element itself, give off poisonous gases at high temperature. Absolute cleanliness is essential in RTD production.

Tolerances

Tolerances for PT100 Resistance Temperature Detectors are shown below in tabular and graphical format.



Temp ºC	Tolerance									
	CLASS B		CLASS A		1/3 DIN		1/5 DIN		1/10 DIN	
	±ºC	± Ω	±ºC	± Ω	±ºC	± Ω	±ºC	± Ω	±ºC	± Ω
-200	1.3	0.56	0.55	0.24	0.44	0.19	0.26	0.11	0.13	0.06
-100	0.8	0.32	0.35	0.14	0.27	0.11	0.16	0.06	0.08	0.03
0	0.3	0.12	0.15	0.06	0.10	0.04	0.06	0.02	0.03	0.01
100	0.8	0.30	0.35	0.13	0.27	0.10	0.16	0.05	0.08	0.03
200	1.3	0.48	0.55	0.20	0.44	0.16	0.26	0.10	0.13	0.05
300	1.8	0.64	0.75	0.27	0.60	0.21	0.36	0.13	---	---
400	2.3	0.79	0.95	0.33	0.77	0.26	---	---	---	---
500	2.8	0.93	1.15	0.38	---	---	---	---	---	---
600	3.3	1.06	1.35	0.43	---	---	---	---	---	---
650	3.6	1.13	1.45	0.46	---	---	---	---	---	---
700	3.8	1.17	---	---	---	---	---	---	---	---
800	4.3	1.26	---	---	---	---	---	---	---	---
850	4.6	1.34	---	---	---	---	---	---	---	---

Fittings

A wide range of termination glands and adjustable compression fittings are available to suit RTDs of all diameters.

Cold End Terminations

Springloaded Terminal Blocks

Available as a high grade ATEX approved moulded Ryton® block, or as general purpose ceramic version. Both terminal blocks can accommodate sheath sizes from 3.0 mm to 6.0 mm diameter, and can be fitted with up to six terminals. The Ryton block is suitable for temperatures up to 260ºC, and when used in conjunction with an appropriate Thermocouple Instruments connection head, provides a complete assembly approved to ATEX EExde IIC.

Both terminal blocks are fitted with 2 x M4 screws mounted on 33 mm centres.

Transmitter Baseplate

RTDs can be manufactured with DIN mounting plates to suit temperature transmitters. We can offer a full range of ATEX approved transmitters, from fixed range devices to HART® smart devices.

Moulded Plugs

The 3PS plug is a standard round pin moulded plug suitable for 3.0 mm, 4.5 mm and 6.0 mm diameter RTDs. Maximum ambient temperature is 270ºC. A duplex version is also available.

A miniature version is also available, with flat pins.
Both standard and miniature connections can be supplied in socket end versions.

An alternative range of high temperature plug and socket combinations is available with ceramic bodies.

Standard Seals

A wide variety of standard and custom designed seals can be manufactured to suit specific applications.

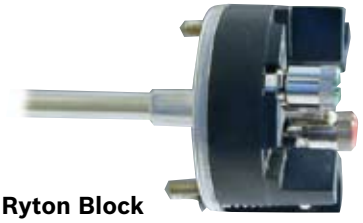
The C Pot is a stainless steel crimped-on epoxy resin seal, suitable for 3.0 mm, 4.5 mm and 6.0 mm diameter RTDs. Maximum ambient temperature is 105ºC when fitted with PVC tail wires and 180ºC when fitted with PTFE tail wires and high temperature epoxy. A high temperature glazed seal version is available, with ceramic beaded tail wires, suitable for temperatures up to 350ºC.

The PS1 Pot is a standard crimped-on stainless steel seal for 3.0 mm diameter RTDs.

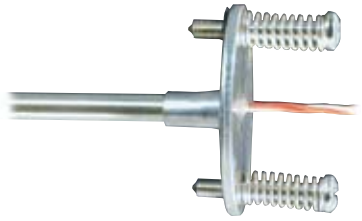
Threaded Seals

The A Pot is an M8 threaded epoxy resin seal for 3.0 mm and 4.5 mm RTDs.
The B Pot is an M10 threaded epoxy resin seal for 3.0 mm, 4.5 mm and 6.0 mm, or 8.0 mm RTDs.

Locknuts can be supplied. Maximum ambient temperature is 105ºC when fitted with PVC tail wires and 180ºC when fitted with PTFE tail wires and high temperature epoxy.



Ryton Block



Transmitter Baseplate

3PS Plug

C Pot

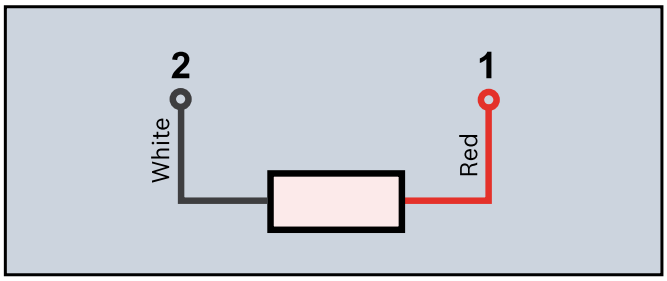
PS1 Pot

A Pot

B Pot

Wiring Configurations

2-Wire Connection

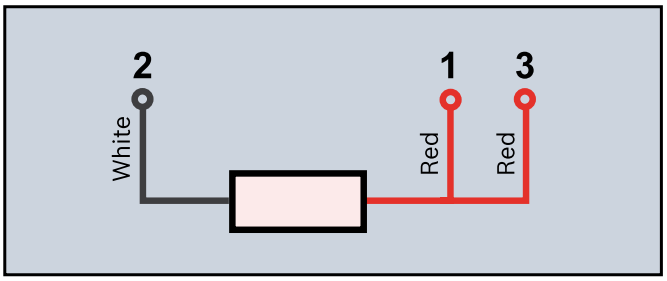


This method allows NO compensation for lead resistance, which is effectively added to the thermometer resistance.

Only suitable for low accuracy applications such as domestic appliances, motor vehicles or where lead lengths are very short.

Typically leads made from 7/0.2mm copper will add a positive offset of almost 0.5ºC/m.

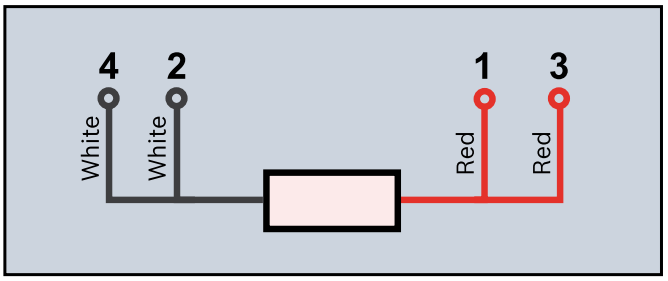
3-Wire connection



By far the most common configuration for industrial applications, the 3-wire system allows for effective compensation of lead resistance and also compensates for changes in lead resistance when wires pass through temperature variations (temperature coefficient of resistance of copper is greater than platinum).

Remaining errors with this system are mostly due to variations in resistance between the 3 wires.

4-Wire Connection

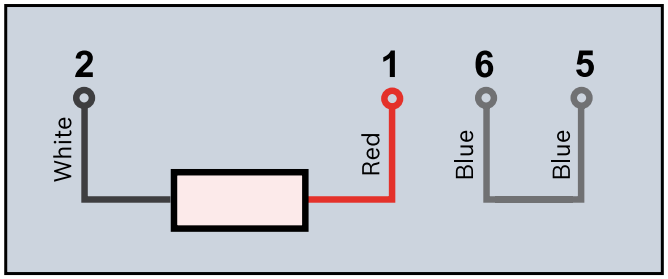


Must be used when the highest accuracy is needed, particularly where lead runs are long, providing almost total rejection of lead resistance and temperature effects.

This system is becoming more common as “Intelligent Transmitters” become more popular, as these almost always can use the 4-wire system.

Mineral insulated resistance sensors are becoming much more popular in recent years, for their robust, vibration resistant properties, these are normally made using 4 core MI cable, so there is no economic reason not to use all four.

4-Wire Compensated



An unusual system where a “Compensating Loop” of wire, equal in resistance to the thermometer leads is connected to balance their effect. This is normally achieved in a bridge circuit, by connecting the loop in the opposite leg to the sensor.

The method can give good results, but is not commonly used with modern instrumentation.

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