

**FLUKE**®

**Hart Scientific**®

**5623B**

*Platinum Resistance Thermometer  
User's Guide*

## Limited Warranty & Limitation of Liability

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Hart's warranty obligation is limited, at Hart's option, to refund of the purchase price, free of charge repair, or replacement of a defective product which is returned to a Hart authorized service center within the warranty period.

To obtain warranty service, contact your nearest Hart authorized service center or send the product, with a description of the difficulty, postage, and insurance prepaid (FOB Destination), to the nearest Hart authorized service center. Hart assumes no risk for damage in transit. Following warranty repair, the product will be returned to Buyer, transportation prepaid (FOB Destination). If Hart determines that the failure was caused by misuse, alteration, accident or abnormal condition or operation or handling, Hart will provide an estimate or repair costs and obtain authorization before commencing the work. Following repair, the product will be returned to the Buyer transportation prepaid and the Buyer will be billed for the repair and return transportation charges (FOB Shipping Point).

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# 1 Before You Start

## 1.1 Symbols Used

Table 1 lists the International Electrical Symbols. Some or all of these symbols may be used on the instrument or in this manual.

**Table 1** International Electrical Symbols

Symbol	Description
	AC (Alternating Current)
	AC-DC
	Battery
	CE Complies with European Union Directives
	DC
	Double Insulated
	Electric Shock
	Fuse
	PE Ground
	Hot Surface (Burn Hazard)
	Read the User's Manual (Important Information)
	Off
	On

Symbol	Description
	Canadian Standards Association
CAT II	OVERVOLTAGE (Installation) CATEGORY II, Pollution Degree 2 per IEC1010-1 refers to the level of Impulse Withstand Voltage protection provided. Equipment of OVERVOLTAGE CATEGORY II is energy-consuming equipment to be supplied from the fixed installation. Examples include household, office, and laboratory appliances.
	C-TIC Australian EMC Mark

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## 1.2 Safety Information

Use this instrument only as specified in this manual. Otherwise, the protection provided by the instrument may be impaired.

The following definitions apply to the terms “Warning” and “Caution”.

“Warning” identifies conditions and actions that may pose hazards to the user.

“Caution” identifies conditions and actions that may damage the instrument being used.

### 1.2.1 Warnings

To avoid personal injury, follow these guidelines.

- **DO NOT** use this instrument to measure the temperature of any hazardous live component.
- Use of this instrument at high temperatures for extended periods of time can cause the handle to become hot.
- Follow all safety guidelines listed in the user’s manual.
- Calibration Equipment should only be used by Trained Personnel.

### 1.2.2 Cautions

To avoid possible damage to the instrument, follow these guidelines.

- **DO NOT** drop or bang the probe in any way. This will cause damage to the probe internally and affect its calibration.
- Read Section 5 entitled “PRT Care and Handling Guidelines” before removing the PRT from the shipping box. Incorrect handling can damage the PRT and void the warranty.
- Keep the shipping container in case it is necessary to ship the PRT. Incorrect packaging of the PRT for shipment can cause irreparable damage.

## **1.3 Authorized Service Centers**

Please contact one of the following authorized Service Centers to coordinate service on your Hart product:

### **Hart Scientific, Inc.**

799 E. Utah Valley Drive  
American Fork, UT 84003-9775  
USA

Phone: +1.801.763.1600  
Telefax: +1.801.763.1010  
E-mail: support@hartscientific.com

### **Fluke Nederland B.V.**

Customer Support Services  
Science Park Eindhoven 5108  
5692 EC Son  
NETHERLANDS

Phone: +31-402-675300  
Telefax: +31-402-675321  
E-mail: ServiceDesk@fluke.nl

### **Fluke Int'l Corporation**

Service Center - Instrimpex  
Room 2301 Sciteck Tower  
22 Jianguomenwai Dajie  
Chao Yang District  
Beijing 100004, PRC  
CHINA

Phone: +86-10-6-512-3436  
Telefax: +86-10-6-512-3437  
E-mail: xingye.han@fluke.com.cn

### **Fluke South East Asia Pte Ltd.**

Fluke ASEAN Regional Office  
Service Center

83 Clemenceau Avenue  
#15-15/06 Ue Square  
239920  
SINGAPORE

Phone: +65-737-2922

Telefax: +65-737-5155

E-mail: [antng@singa.fluke.com](mailto:antng@singa.fluke.com)

When contacting these Service Centers for support, please have the following information available:

- Model Number
- Serial Number
- Complete description of the problem

## 2 Introduction

### 2.1 General

The Platinum Resistance Thermometers (PRT) model 5623B is designed to be a secondary standard interpolating instrument converting temperature to resistance. The 5623B assembly design allows for exposure to very cold temperature ( $-100^{\circ}\text{C}$ ) and is an ideal reference for verification, monitoring or calibrating control sensors in located in freezers or incubators. The 5623B may also be used as a temperature standard for calibration of industrial sensors. The PRT is used with a readout device to detect temperature changes or actual temperature. The 5623B covers the range from  $-100^{\circ}\text{C}$  to  $156^{\circ}\text{C}$ . Standard length is 6 inches. Custom lengths are available on request.

### 2.2 Recalibration

The recalibration of the 5623B PRT should be scheduled according to the user's company Quality Assurance requirements. Normally, a PRT is recalibrated annually. Unless the PRT is used only over a limited range, calibration over the full range of the PRT ( $-100^{\circ}\text{C}$  to  $156^{\circ}\text{C}$ ) is recommended. For information on recalibrating your 5623B, contact an Authorized Hart Scientific Service Center for an RMA number and current pricing (see Section 1.3).

Depending on the user's Quality Assurance requirements, the PRT drift should be checked periodically at the Triple Point of Water (TPW). Section 7, Troubleshooting, provides information on drift with respect to mechanical shock and oxidation.

### 3 Specifications and Warranty

<b>Temperature range</b>	-100 °C to 156 °C
<b>Nominal resistance at 0.01 °C</b>	100 Ω ± 0.1 Ω
<b>Temperature coefficient</b>	0.003925 Ω/Ω/ °C
<b>Drift†</b>	± 0.01 °C at 0.010 °C
<b>Hysteresis</b>	± 0.01 °C maximum
<b>Sheath dimensions, length x diameter</b>	152 mm x 6.35 mm (6 in x 0.25 in)
<b>Sheath material</b>	Inconel™ 600
<b>Transition junction temperature range‡</b>	-100 °C to 156 °C
<b>Minimum immersion length§ (&lt; 5 mK error)</b>	114 mm (4.5 in)
<b>Lead-wire cable type</b>	Teflon™ -insulated, 22 AWG, silver-plated stranded copper
<b>Lead-wire length</b>	609.6 cm (240 in)
<b>Calibration</b>	Includes manufacturer's NVLAP-accredited calibration

†After 100 hrs at max temp

‡Temperatures outside this range inhibit performance and may cause irreparable damage.

§Per ASTM E 644

## 4 Installation

### 4.1 Lead Wire Identification

The 5623B PRT is equipped with a four-wire cable (see Figure 1). Four lead wires are used to cancel lead wire resistance. For best results, the readout device should be equipped to handle four-terminal resistors.



**Figure 1** PRT Schematic

The lead wires are two different colors. Lead wire pairs attached to each end of the sensor are identified by red and white insulation.

## 5 PRT Care and Handling Guidelines

### 5.1 PRT Care



*CAUTION: READ THIS SECTION BEFORE REMOVING THE PRT FROM THE SHIPPING BOX OR CASE*

Care must be taken in handling the PRT to maintain calibration accuracy. Care should still be used when handling the PRT even though the Inconel™ sheath is durable and provides good protection for the sensor. Correct handling of the PRT will prolong the life expectancy. When not in use, the PRT should be stored in an optional protective case that can be purchased from Hart Scientific.

The handle is designed to be immersed.

### 5.2 PRT Handling Guidelines

- **DO** keep the thermometer as clean as possible.
- **DO** immerse the thermometer in the appropriate liquid for the temperature range. If a dry block is used, the well diameter should allow the PRT to comfortably slip in and out without excess movement. For best results, immerse the thermometer as deep as possible to avoid “stem effect” (the temperature error caused by the conduction of heat away from the sensor).
- **DO** allow sufficient time for the thermometer to stabilize before making measurements. This allows for the best accuracy.
- **DO** use the correct drive current with the thermometer to prevent error in temperature or resistance. Hart Scientific recommends 1mA.
- **DO** use the protective shipping box provided or other protection when the thermometer is not in use.
- **DO NOT** subject the thermometer to any physical shock or vibration.
- **DO NOT** use pliers or other devices to squeeze the sheath. This action can permanently damage the PRT.
- **DO NOT** subject the thermometer to temperatures above the highest specified operating temperature.
- **DO NOT** expose the thermometer’s handle or cables to extreme temperatures. The temperature limits of the handle and cables are:  $-100^{\circ}\text{C}$  to  $156^{\circ}\text{C}$ .
- **DO NOT** screw a clamp down so tight that it dents the sheath. This can permanently damage the PRT.

## 6 Operation

### 6.1 General

For best results, be familiar with the operation of the heat source and the readout instrument. Be sure to follow the manufacturer's instructions for the readout instrument and the heat source.

### 6.2 Immersion Requirements

Stem effect can cause measurement errors for any thermometer not immersed in the fluid at least 114 mm (4.5 inches). This error is due to heat lost or gained by the sensing element through the thermometer stem. In addition, heat losses occur due to radiation losses from the sensing element to the housing.

The immersion depth for standards is dependent on several factors including accuracy requirements and type of liquid. Therefore, we recommend a 114 mm (4.5 inches) minimum immersion depth. The handle is designed to be immersed. The temperature limits of the handle are  $-100^{\circ}\text{C}$  to  $156^{\circ}\text{C}$ . Temperatures outside these limits can damage the handle and the probe. Convection of heat from the heat source must be kept within the handle limits.

The exact immersion depth required can be determined by performing a gradient test taking measurements approximately every 1.27 cm (.5 inches) until there is a significant difference in readings. Allow the thermometer to stabilize at each new depth. Plot the results to see the stem effect.

### 6.3 Thermal EMF

Two factors contribute to thermal EMF, chemical consistency and physical consistency. Variations in chemical structure due to impurities can contribute to thermal EMF. Also, discrepancies in crystal structure can contribute to thermal EMF. These factors are minimized by annealing the full length of wire before construction of the PRT.

Likewise, connection to extension lead wires and readout instruments can be a source of thermal EMF. The thermal EMF is caused by a difference in temperature between two connections. If the two connections are the same temperature, there will be little or no thermal EMF effects. However, if there is a substantial temperature difference between connections, the thermal EMF effects will be significant. Therefore, cover or insulate any exposed bridge or galvanometer terminals to lessen the source of error. The effects of thermal EMF can be canceled by using an AC bridge or a DC bridge with reversible current.

# 7 Troubleshooting

## 7.1 Troubleshooting

In the event that the probe appears to function abnormally, this section may be of use in solving the problem. Several possible problem conditions are described along with likely causes and solutions. If a problem arises, please read this section carefully and attempt to understand and solve the problem. If the probe seems faulty or the problem cannot otherwise be solved, contact an Authorized Hart Scientific Service Center (see Section 1.3) for assistance. Be sure to have the model number and serial number of your probe available.

Problem	Causes and Solutions
Data changes greater than 0.1°C are observed	<ul style="list-style-type: none"> <li>Mechanical shock can cause temperature errors as great as 0.5°C. If this is observed, first measure and record the <math>R_{tp}</math>.</li> </ul>
Data changes less than 0.1°C	<ul style="list-style-type: none"> <li>Slight mechanical shock can cause temperature errors less than 0.1°C.</li> </ul>
Data unstable	<ul style="list-style-type: none"> <li>If the data is unstable at the Triple Point of Water (TPW), check the connector. If the connector is correct, contact an Authorized Hart Scientific Service Center (see Section 1.3). The PRT may be damaged.</li> <li>If the data is unstable at high temperatures, it may be due to electrical noise in the system. Reduce the temperature and observe the data. If it is stable, electrical noise is interfering with the measurements at high temperatures. Check the grounding of the readout device and the heat source. A faulty ground on either device could interfere with high temperature measurements. A ground wire attached to the metal sheath of the PRT may help to reduce electrical noise interference.</li> </ul>
Temperature readout different than expected, e.g. the heat source is set at 150°C, the PRT measures 125°C.	<ul style="list-style-type: none"> <li>Measure the PRT resistance at TPW.</li> <li>If the resistance of the PRT is less than the rated resistance, e.g. 70 <math>\Omega</math>, there may be a short in the sensor. Contact an Authorized Hart Scientific Service Center (see Section 1.3).</li> <li>If the resistance of the PRT is only a few ohms, there may be a short in the four lead-wires. Contact an Authorized Hart Scientific Service Center (see Section 1.3).</li> <li>If the PRT is open, the resistance will be "Out of Limits" or in the kilo-ohm or mega-ohm range. Contact an Authorized Hart Scientific Service Center (see Section 1.3).</li> </ul>