

## Thin Film Platinum RTDs

### HEL-700 Series

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# Thin Film Platinum RTDs

The HEL-700 Series Thin Film Platinum RTDs (Resistance Temperature Detectors) are designed to monitor or control critical temperatures in industrial applications. They provide a linear change in resistance versus temperature, combining high linearity, stability, accuracy, and wide temperature range in a small, fast-response package.

The HEL-700 Series is designed to measure temperatures from -75 °C to 540 °C [-100 °F to 1000 °F] with high accuracy. These fully-assembled elements are ready-to-use in probe assemblies, without the need for fragile splices to extension leads.

These products are manufactured using a thin layer of platinum deposited on an alumina substrate and are laser trimmed to a resistance interchangeability of a standard  $\pm 0.2\%$  ( $\pm 0.5$  °C accuracy) or optional  $\pm 0.1\%$  ( $\pm 0.3$  °C accuracy). The sensor chip is then glassed, wired and potted or ceramic fired to result in a cylindrical alumina package with either TFE Teflon®- or fiberglass-insulated lead wires.

## Key Features

- Wide temperature range
- Interchangeable
- Accurate
- Linear resistance vs temperature
- Fast response
- Laser trimmed
- Ceramic case material
- TFE Teflon® or fiberglass leadwires
- Multiple small sizes
- Ready-to-use, fully assembled elements

## Potential Applications

Temperature sensing for monitoring, compensation and regulation in:

### INDUSTRIAL

- HVAC equipment
- Instrument and probe assemblies
- Process control
- Motor windings and bearings
- Battery packs
- Environmental chambers
- Ovens and kilns
- Drill holes in large objects

### MEDICAL

- Autoclaves

### AEROSPACE/DEFENSE

- Aircraft
- Space vehicles

WIDE TEMPERATURE RANGE • INTERCHANGEABLE • ACCURATE

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**Table 1. Specifications**

Characteristic	Condition	Parameter
Alpha: R <sub>0</sub> = 1000 Ω R <sub>0</sub> = 100 Ω	0 °C	0.00375 Ω/Ω/°C 0.00385 Ω/Ω/°C
Temperature range: TFE Teflon fiberglass	—	-70 °C to 260 °C [-94 °F to 500 °F] -75 °C to 540 °C [-100 °F to 1000 °F]
Temperature accuracy: R <sub>0</sub> ±0.2% trim (standard) R <sub>0</sub> ±0.1% trim (optional)	—	±0.5°C or 0.8% of temperature, whichever is greater ±0.3°C or 0.6% of temperature, whichever is greater
Base resistance and interchangeability, R <sub>0</sub> ±ΔR <sub>0</sub> : R <sub>0</sub> ±0.2% trim (standard) R <sub>0</sub> ±0.1% trim (optional)	0 °C	1000 Ω ±2 Ω 1000 Ω ±1 Ω
Linearity: -40 °C to 125 °C -75 °C to 540 °C	—	±0.1% of full scale ±2.0% of full scale
Time constant	water at 3 ft/s still water	<0.5 s for 0.086 in O.D. <1.0 s for 0.086 in O.D.
Operating current	—	2 mA max. minimal self heating errors of 1 °C; 1 mA recommended
Stability	occupied environments	<0.25 °C /year; 0.05 °C /5 years
Self heating	—	<15 mW/°C typ. for 0.086 in O.D.
Insulation resistance	50 Vdc at 25 °C	>50 MΩ
Construction/material: case Teflon®-insulated leads fiberglass-insulated leads	—	high purity alumina nickel-coated stranded copper, epoxy potting nickel-coated stranded copper, ceramic potting

**Table 2. Constant Values (β = 0 and C = 0 for T > 0 °C)**

Constant	1000 Ω	100 Ω	Functional Behavior
Alpha α (°C <sup>-1</sup> )	0.00375 ±0.000029	0.003850 ±0.000010	$R_T = R_0(1 + AT + BT^2 - 100CT^3 + CT^4)$ Where: R <sub>T</sub> = Resistance (Ω) at temperature T (°C) R <sub>0</sub> = Resistance (Ω) at 0 °C T = Temperature (°C) $A = \alpha + \frac{\alpha\delta}{100}$ $B = \frac{-\alpha\delta}{100^2}$ $C_{T<0} = \frac{-\alpha\beta}{100^4}$
Delta δ (°C)	1.605 ±0.009	1.4999 ±0.007	
Beta β (°C)	0.16	0.10863	
A (°C <sup>-1</sup> )	3.81 x 10 <sup>-3</sup>	3.908 x 10 <sup>-3</sup>	
B (°C <sup>-2</sup> )	-6.02 x 10 <sup>-7</sup>	-5.775 x 10 <sup>-7</sup>	
C (°C <sup>-4</sup> )	-6.0 x 10 <sup>-12</sup>	-4.183 x 10 <sup>-12</sup>	

## CAUTION

### PRODUCT DAMAGE

- Ensure proper ESD (Electrostatic Discharge) precautions are followed when handling this product.

**Failure to comply with these instructions may result in product damage.**

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Table 3. Accuracy vs Temperature

Temperature (°C)	Tolerance			
	Standard Trim (±0.2%)		Optional Trim (±0.1%)	
	±ΔR <sup>1</sup> (Ω)	±ΔT (°C)	±ΔR <sup>1</sup> (Ω)	±ΔT (°C)
-100	2.9	0.8	2.4	0.6
0	2.0	0.5	1.0	0.3
100	2.9	0.8	2.2	0.6
200	5.6	1.6	4.3	1.2
300	8.2	2.4	6.2	1.8
400	11.0	3.2	8.3	2.5
500	12.5	4.0	9.6	3.0
600	15.1	4.8	10.4	3.3

<sup>1</sup>1000 Ω RTD. Divide Δ by 10 for 100 Ω RTD.

Table 4. NIST Calibration

Temperature (°C)	Standard Temperature Point (±ΔT (°C))		
	1	2	3
-100	0.5	0.27	0.15
0	0.03	0.03	0.03
100	0.4	0.11	0.07
200	0.8	0.02	0.08
300	1.2	0.33	6.2
400	1.6	0.5	8.3
500	2.0	0.8	9.6
600	2.6	1.2	10.4

<sup>1</sup>NIST-traceable calibration provides resistance readings at 1, 2 or 3 standard temperature points to yield a resistance versus temperature curve with 10x better accuracy.

Figure 1. Resistance vs Temperature

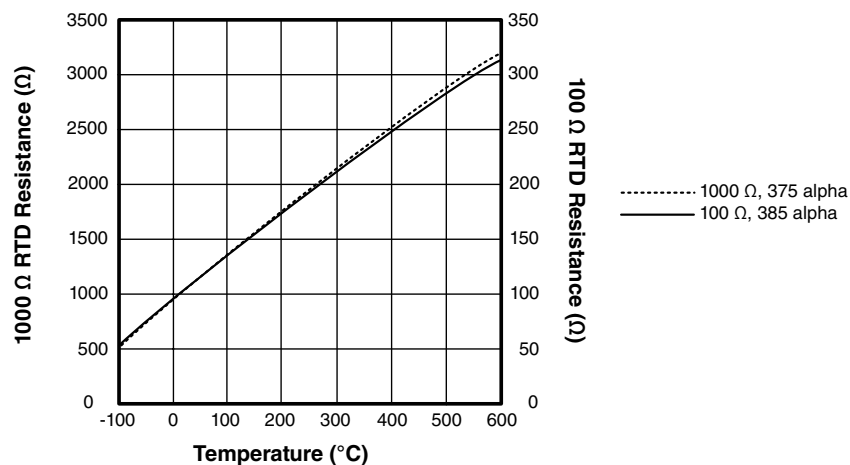


Figure 2. Nomenclature and Ordering Guide

For example, a **HEL-705-U-0-12-C1** part number defines an HEL-700 Series Thin Film RTD with two, 28 gauge TFE Teflon® insulated leadwires, an alpha of 1000 Ω: 0.00375 Ω/Ω/°C, a standard ±0.2% trim resistance, 12 inch leadwires, and a NIST calibration report at 0 °C.

HEL-	705-	U-	0-	12-	C1
Product Series	Leadwire Insulation Material, Gauge and Number	Resistance and Alpha	Resistance Trim	Leadwire Length	NIST Calibration Report
<b>HEL-700 Series</b> Thin Film Platinum RTDs	<b>705</b> TFE Teflon®, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire	<b>U</b> 1000 Ω: 0.00375 Ω/Ω/°C	<b>0</b> Standard: ±0.2%	<b>12</b> 12 inches	<b>00</b> none
	<b>707</b> fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire	<b>T</b> 100 Ω: 0.00385 Ω/Ω/°C (DIN Standard)	<b>1</b> Optional: ±0.1%		<b>C1</b> at 0 °C
	<b>711</b> TFE Teflon®, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire				<b>C2</b> at 0 °C and 100 °C
	<b>712</b> fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire				<b>C3</b> at 0 °C, 100 °C and 260 °C
	<b>716</b> TFE Teflon®, 24 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire				
	<b>717</b> fiberglass, 24 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire				

# Thin Film Platinum RTDs, HEL-700 Series

Figure 3. All Available Standard Configurations





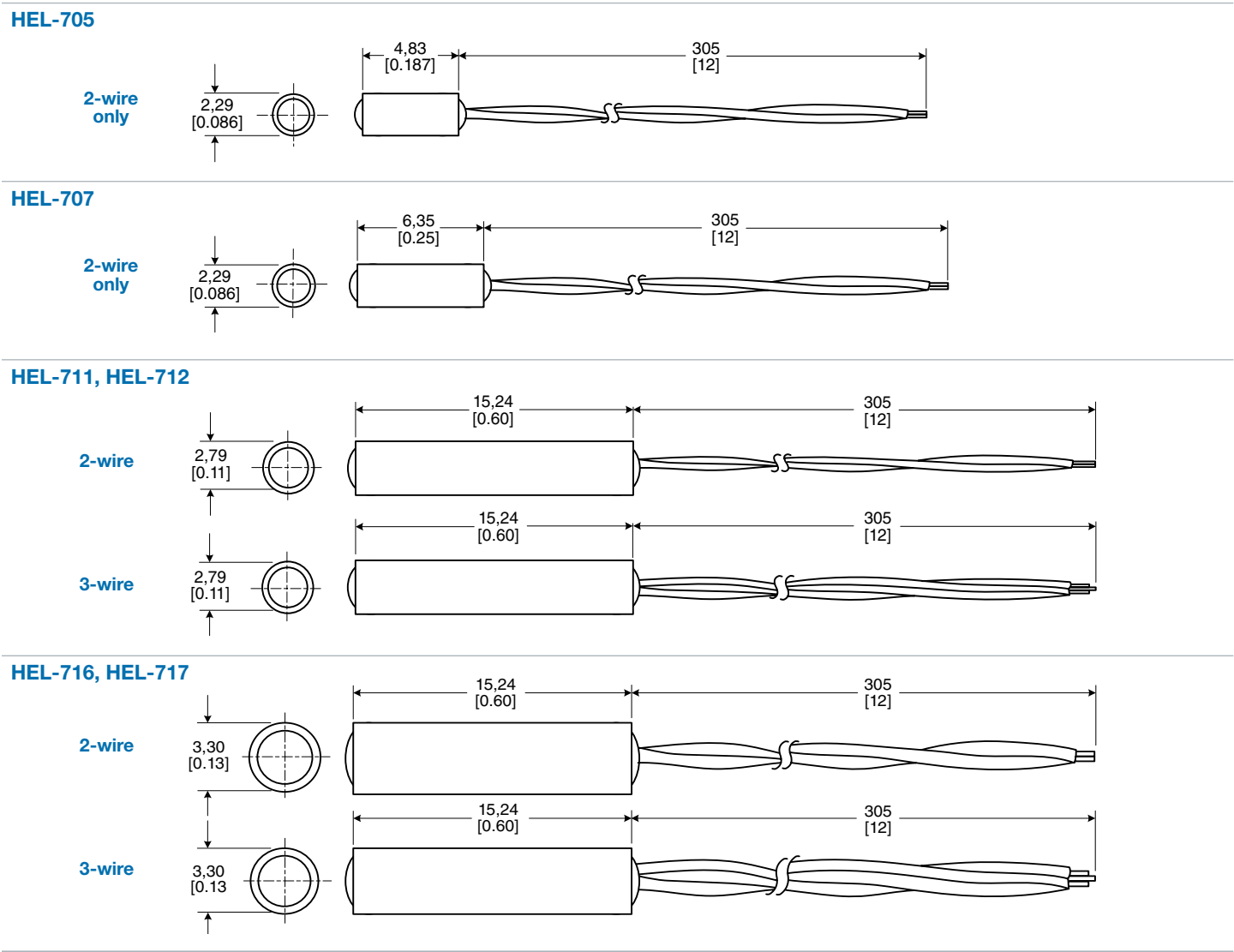
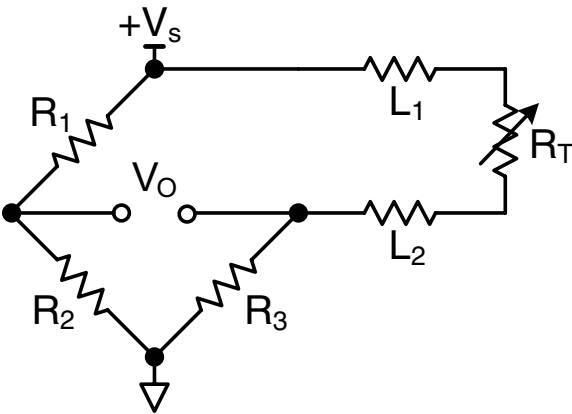
Teflon®-Insulated Leadwires		Fiberglass-Insulated Leadwires	
HEL-705	<div>2-wire only</div> 	HEL-707	<div>2-wire only</div> 
HEL-711	<div>2-wire</div> <div>3-wire</div> 	HEL-712	<div>2-wire</div> <div>3-wire</div> 
HEL-716	<div>2-wire</div> <div>3-wire</div> 	HEL-717	<div>2-wire</div> <div>3-wire</div> 

Figure 4. Dimensional Drawings (For reference only: mm [in].)

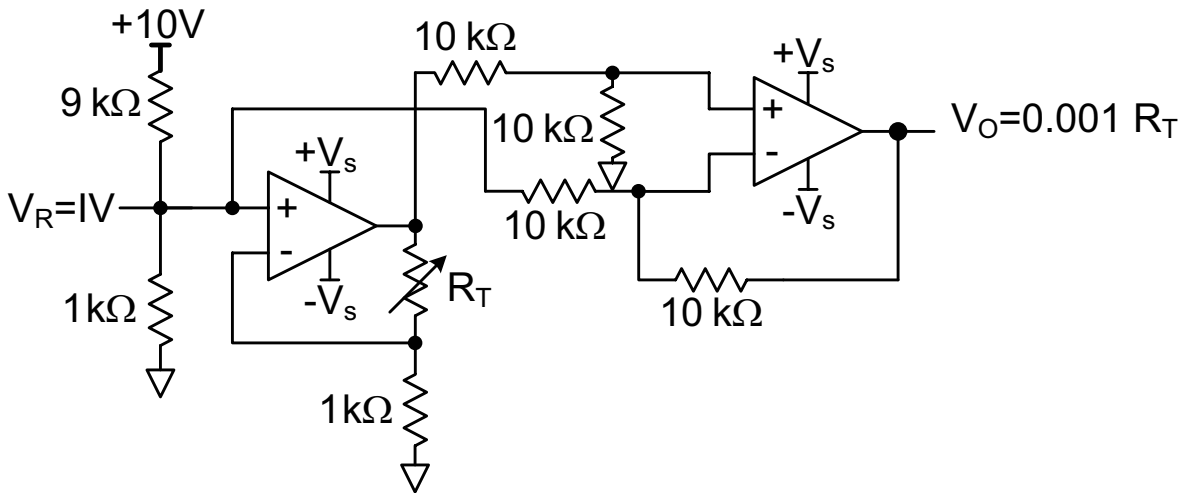


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Figure 5. Circuits  
Wheatstone Bridge 2-Wire Interface



Linear Output Voltage



Adjustable Point (Comparator) Interface

