



Thin Film Platinum RTDs
HEL-700 Series



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 $\pm 0.2\%$ (± 0.5 °C accuracy) or optional $\pm 0.1\%$ (± 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 ₀ = 1000 Ω R ₀ = 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 ₀ ±0.2% trim (standard) R ₀ ±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 ₀ ±ΔR ₀ : R ₀ ±0.2% trim (standard) R ₀ ±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 ⁻¹) | 0.00375 ±0.000029 | 0.003850 ±0.000010 | $R_T = R_0(1 + AT + BT^2 - 100CT^3 + CT^4)$ Where: R _T = Resistance (Ω) at temperature T (°C) R ₀ = 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 ⁻¹) | 3.81 x 10 ⁻³ | 3.908 x 10 ⁻³ | |
| B (°C ⁻²) | -6.02 x 10 ⁻⁷ | -5.775 x 10 ⁻⁷ | |
| C (°C ⁻⁴) | -6.0 x 10 ⁻¹² | -4.183 x 10 ⁻¹² | |

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 ¹ (Ω) | ±ΔT (°C) | ±ΔR ¹ (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 |

¹1000 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 |

¹NIST-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 |
| HEL-700 Series Thin Film Platinum RTDs | 705 TFE Teflon [®] , 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire | U 1000 Ω: 0.00375 Ω/Ω/°C | 0 Standard: ±0.2% | 12 12 inches | 00 none |
| | 707 fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire | T 100 Ω: 0.00385 Ω/Ω/°C (DIN Standard) | 1 Optional: ±0.1% | | C1 at 0 °C |
| | 711 TFE Teflon [®] , 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire | | | | C2 at 0 °C and 100 °C |
| | 712 fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire | | | | C3 at 0 °C, 100 °C and 260 °C |
| | 716 TFE Teflon [®] , 24 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire | | | | |
| | 717 fiberglass, 24 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire | | | | |

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Figure 3. All Available Standard Configurations



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



ADDITIONAL INFORMATION

The following associated literature is available at sensing.honeywell.com:

- Temperature Sensors Line Guide
- Thermal Sensors Range Guide

⚠ WARNING **PERSONAL INJURY**

DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.

Failure to comply with these instructions could result in death or serious injury.

⚠ WARNING **MISUSE OF DOCUMENTATION**

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

Failure to comply with these instructions could result in death or serious injury.

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