



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




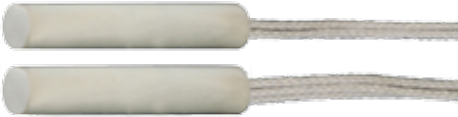


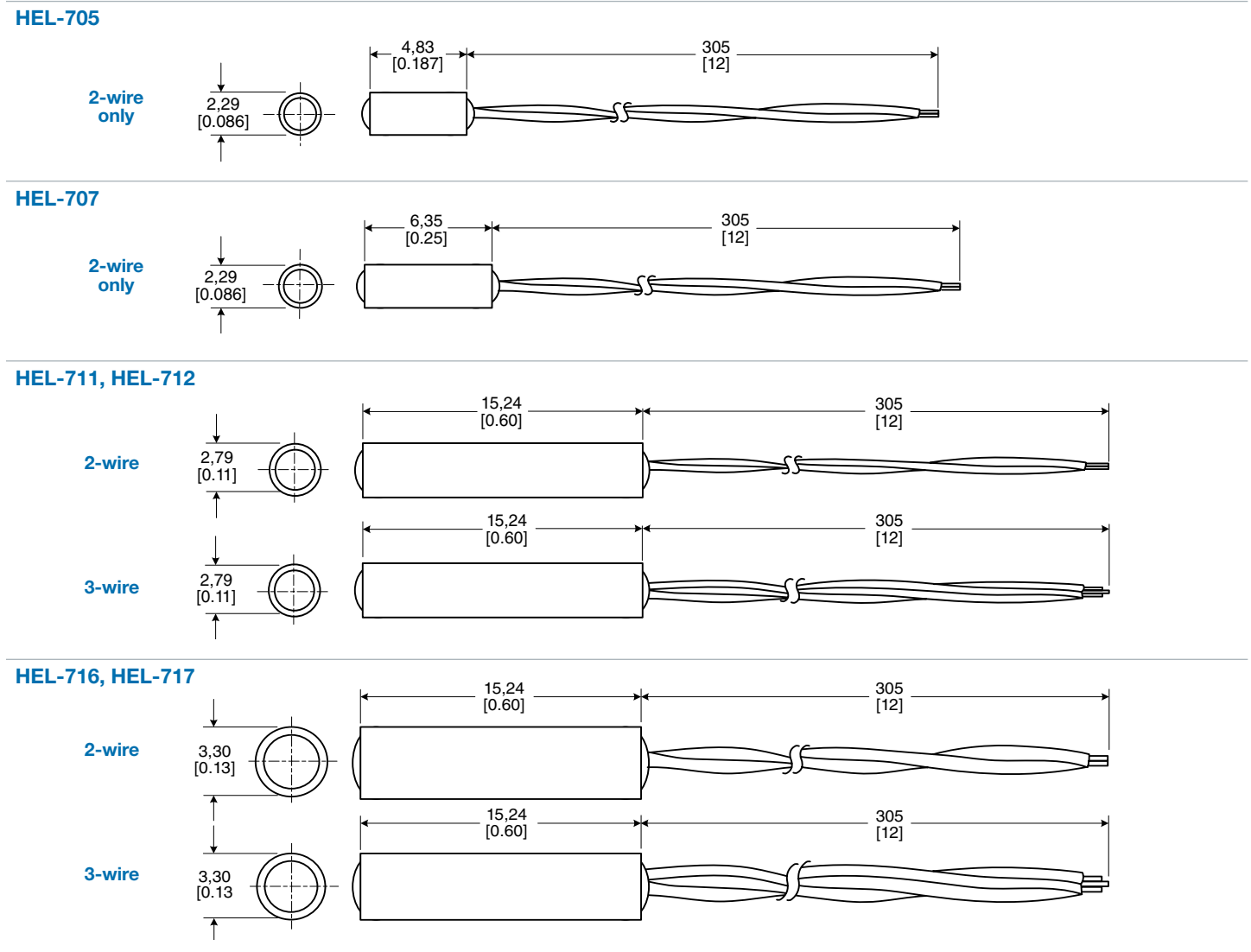
| Teflon®-Insulated Leadwires | | Fiberglass-Insulated Leadwires | |
|-----------------------------|---|--------------------------------|--|
| HEL-705 |  | HEL-707 |  |
| HEL-711 |  | HEL-712 |  |
| HEL-716 |  | HEL-717 |  |

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

