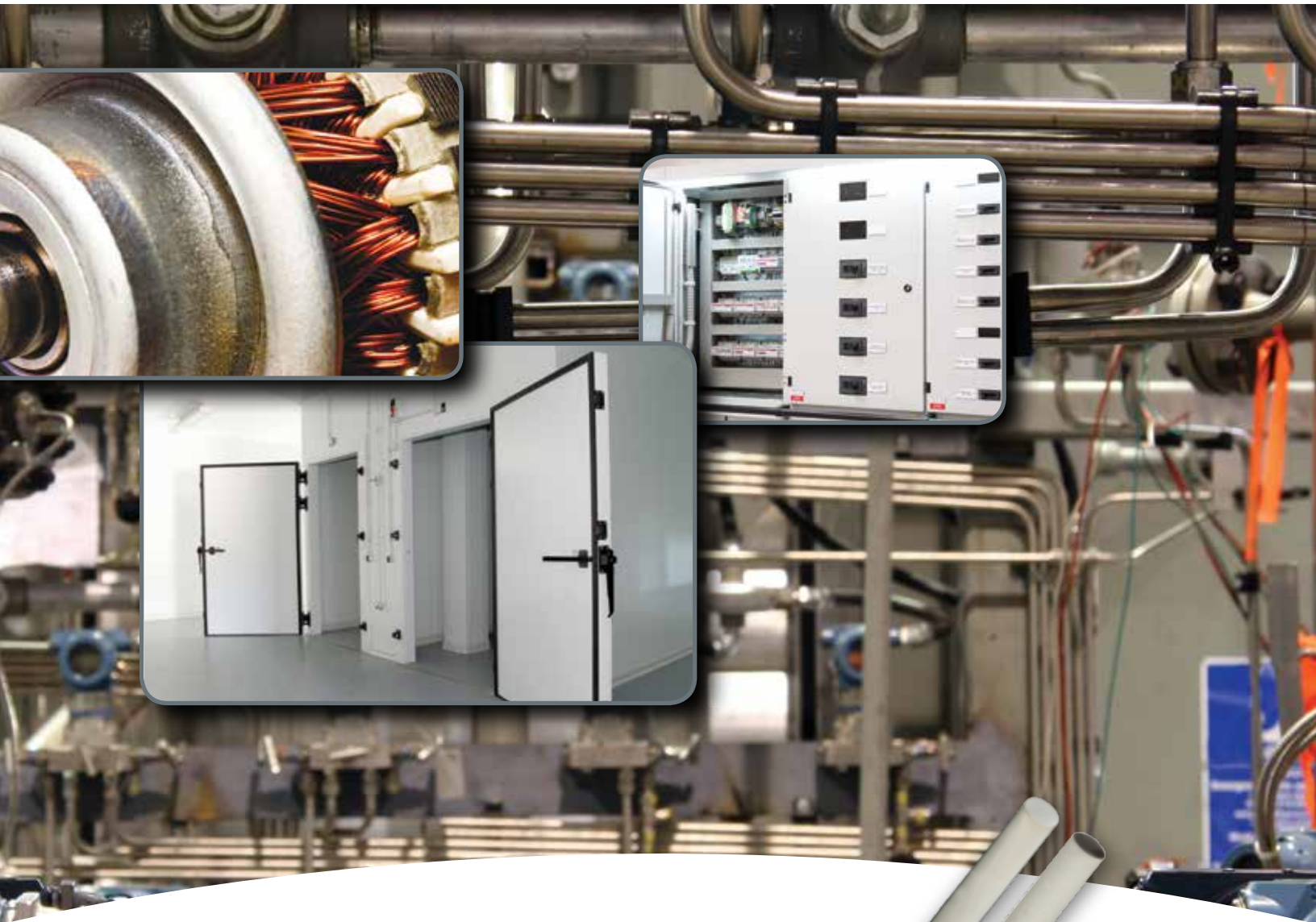
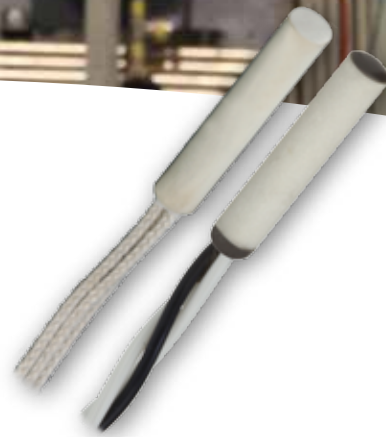




# Thin Film Platinum RTDs

## 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  $\pm 0.2\%$  ( $\pm 0.5$  °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

# Thin Film Platinum RTDs, HEL-700 Series

**Table 1. Specifications**

| Characteristic                                                                                                                                            | Condition                      | Parameter                                                                                                             |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| Alpha:<br>R <sub>0</sub> = 1000 Ω<br>R <sub>0</sub> = 100 Ω                                                                                               | 0 °C                           | 0.00375 Ω/Ω/°C<br>0.00385 Ω/Ω/°C                                                                                      |
| Temperature range:<br>TFE Teflon<br>fiberglass                                                                                                            | —                              | -70 °C to 260 °C [-94 °F to 500 °F]<br>-75 °C to 540 °C [-100 °F to 1000 °F]                                          |
| Temperature accuracy:<br>R <sub>0</sub> ±0.2% trim (standard)<br>R <sub>0</sub> ±0.1% trim (optional)                                                     | —                              | ±0.5°C or 0.8% of temperature, whichever is greater<br>±0.3°C or 0.6% of temperature, whichever is greater            |
| Base resistance and interchangeability, R <sub>0</sub> ±ΔR <sub>0</sub> :<br>R <sub>0</sub> ±0.2% trim (standard)<br>R <sub>0</sub> ±0.1% trim (optional) | 0 °C                           | 1000 Ω ±2 Ω<br>1000 Ω ±1 Ω                                                                                            |
| Linearity:<br>-40 °C to 125 °C<br>-75 °C to 540 °C                                                                                                        | —                              | ±0.1% of full scale<br>±2.0% of full scale                                                                            |
| Time constant                                                                                                                                             | water at 3 ft/s<br>still water | <0.5 s for 0.086 in O.D.<br><1.0 s for 0.086 in O.D.                                                                  |
| Operating current                                                                                                                                         | —                              | 2 mA max. minimal self heating errors of 1 °C;<br>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:<br>case<br>Teflon®-insulated leads<br>fiberglass-insulated leads                                                                   | —                              | high purity alumina<br>nickel-coated stranded copper, epoxy potting<br>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         | $R_T = R_0(1 + AT + BT^2 - 100CT^3 + CT^4)$<br>Where:<br>R <sub>T</sub> = Resistance (Ω) at temperature T (°C)<br>R <sub>0</sub> = Resistance (Ω) at 0 °C<br>T = Temperature (°C)<br>$A = \alpha + \frac{\alpha\delta}{100}$ $B = \frac{-\alpha\delta}{100^2}$ $C_{T<0} = \frac{-\alpha\beta}{100^4}$ |
| 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.**

# Thin Film Platinum RTDs, HEL-700 Series

Table 3. Accuracy vs Temperature

| Temperature<br>(°C) | Tolerance                |             |                          |             |
|---------------------|--------------------------|-------------|--------------------------|-------------|
|                     | Standard Trim<br>(±0.2%) |             | Optional Trim<br>(±0.1%) |             |
|                     | ±ΔR <sup>1</sup><br>(Ω)  | ±ΔT<br>(°C) | ±ΔR <sup>1</sup><br>(Ω)  | ±ΔT<br>(°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<br>(°C) | Standard Temperature Point<br>(±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

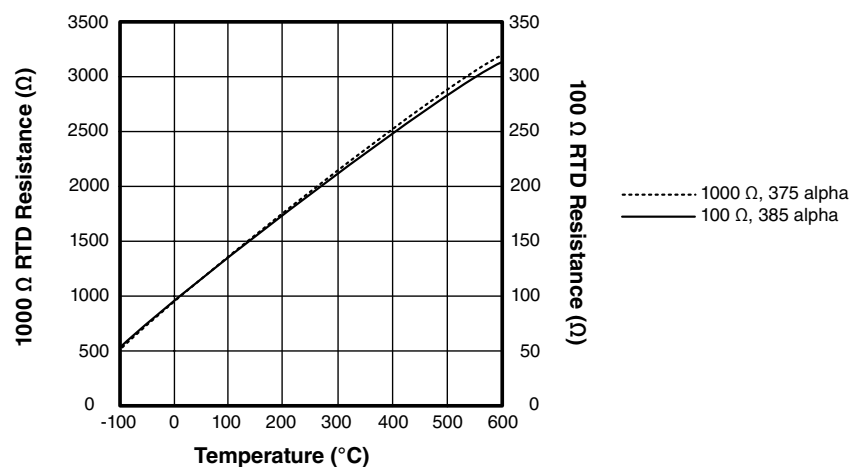


Figure 2. Nomenclature and Ordering Guide

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<sup>®</sup> 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><br>Thin Film<br>Platinum RTDs | <b>705</b> TFE Teflon <sup>®</sup> , 28 gauge;<br>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;<br>1000 Ω: 2-wire, 100 Ω: 2-wire               | <b>T</b> 100 Ω: 0.00385 Ω/Ω/°C<br>(DIN Standard) | <b>1</b> Optional: ±0.1% |                     | <b>C1</b> at 0 °C                    |
|                                                     | <b>711</b> TFE Teflon <sup>®</sup> , 28 gauge;<br>1000 Ω: 2-wire, 100 Ω: 3-wire |                                                  |                          |                     | <b>C2</b> at 0 °C and 100 °C         |
|                                                     | <b>712</b> fiberglass, 28 gauge;<br>1000 Ω: 2-wire, 100 Ω: 3-wire               |                                                  |                          |                     | <b>C3</b> at 0 °C, 100 °C and 260 °C |
|                                                     | <b>716</b> TFE Teflon <sup>®</sup> , 24 gauge;<br>1000 Ω: 2-wire, 100 Ω: 3-wire |                                                  |                          |                     |                                      |
|                                                     | <b>717</b> fiberglass, 24 gauge;<br>1000 Ω: 2-wire, 100 Ω: 3-wire               |                                                  |                          |                     |                                      |

# Thin Film Platinum RTDs, HEL-700 Series

Figure 3. All Available Standard Configurations

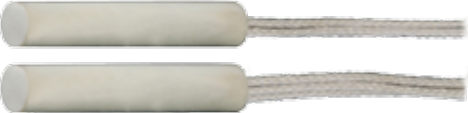
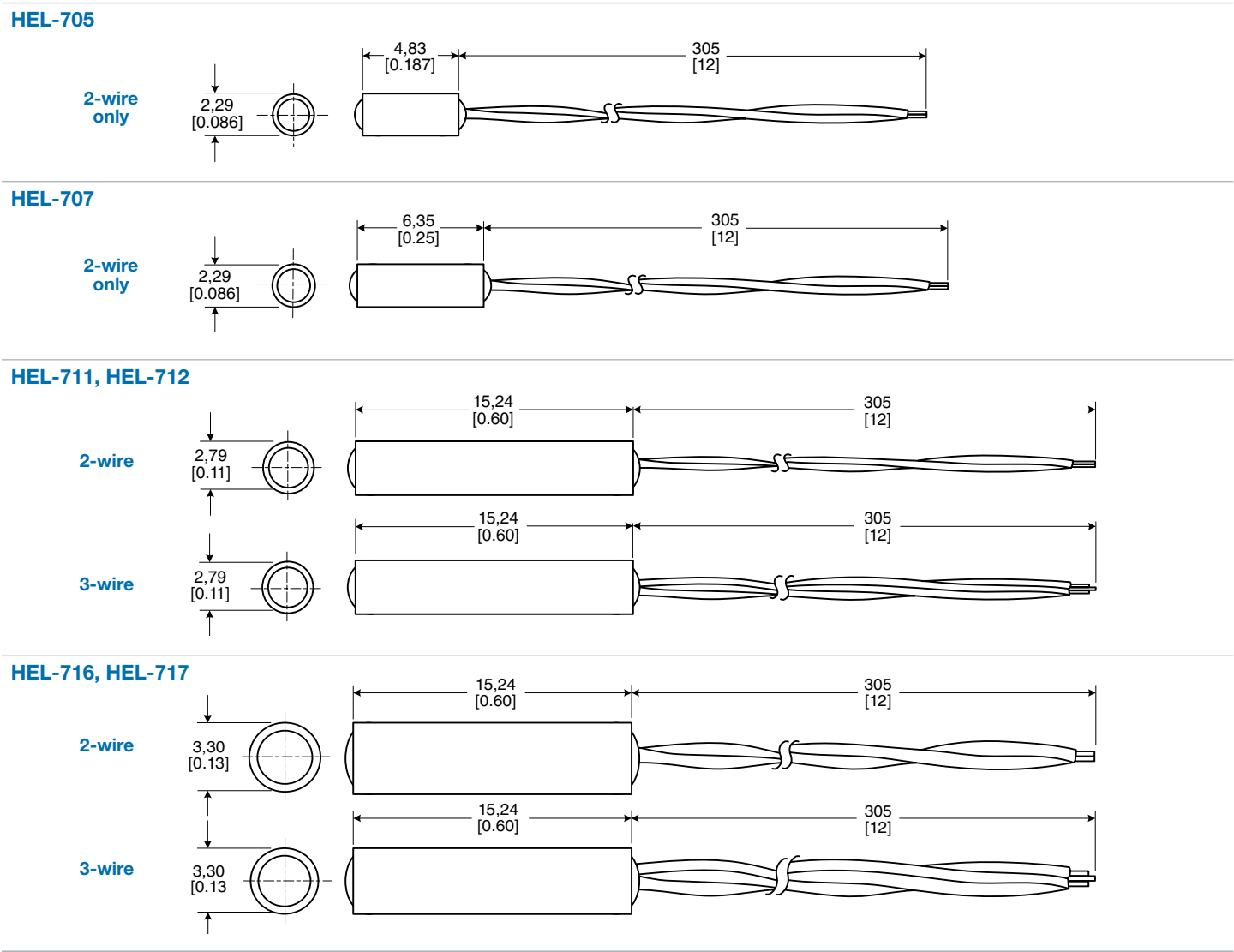
| Teflon®-Insulated Leadwires |                                                                                                                       | Fiberglass-Insulated Leadwires |                                                                                                                        |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------|--------------------------------|------------------------------------------------------------------------------------------------------------------------|
| 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>  |

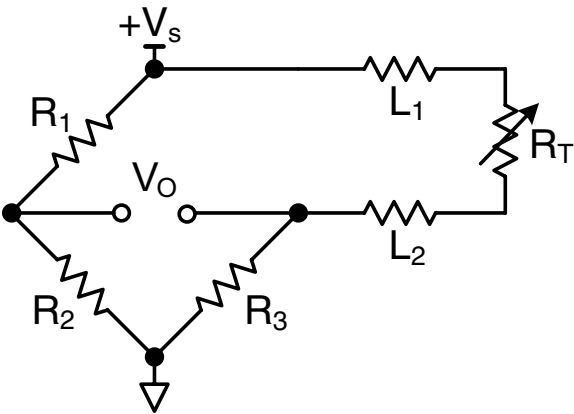
Figure 4. Dimensional Drawings (For reference only: mm [in].)



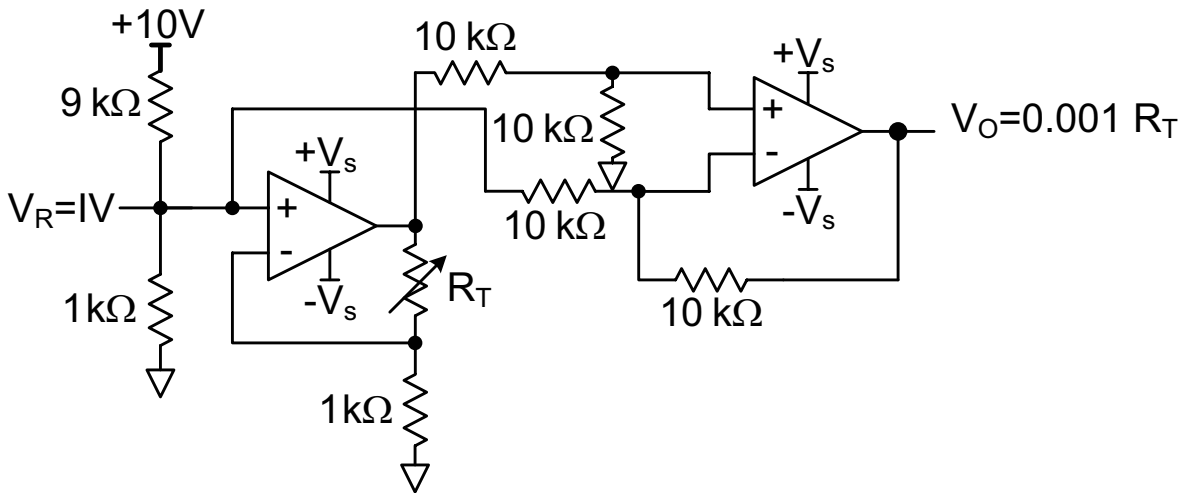
# Thin Film Platinum RTDs, HEL-700 Series

Figure 5. Circuits

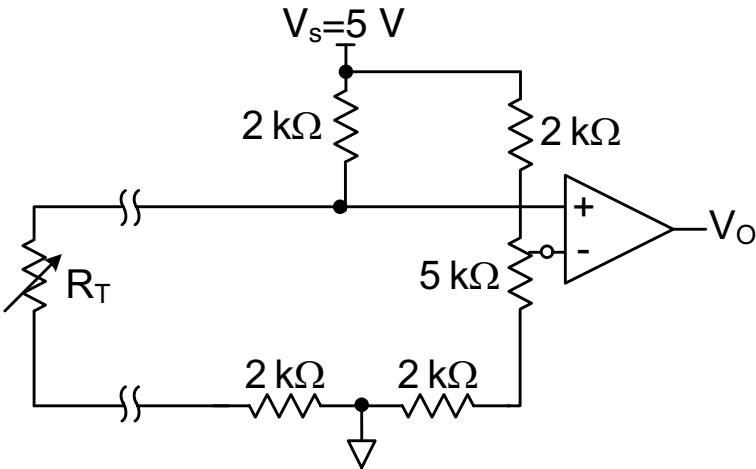
## Wheatstone Bridge 2-Wire Interface



## Linear Output Voltage



## Adjustable Point (Comparator) Interface



## ADDITIONAL INFORMATION

The following associated literature is available at [sensing.honeywell.com](http://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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