



### FEATURES

- Linear resistance vs temperature
- Accurate and Interchangeable
- Excellent stability
- Small for fast response
- Wide temperature range
- 3-packaging options

HEL-700 Thin Film Platinum RTDs (Resistance Temperature Detectors) provide excellent linearity, accuracy, stability and interchangeability. Resistance changes linearly with temperature. Laser trimming provides  $\pm 0.3^\circ\text{C}$  interchangeability at  $25^\circ\text{C}$ .

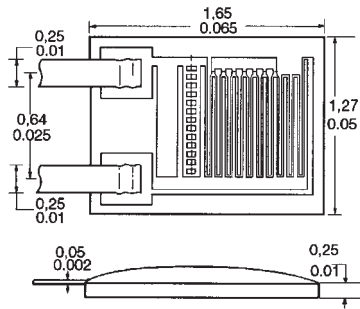
### TYPICAL APPLICATIONS

- HVAC - room, duct and refrigerant equipment
- Electronic assemblies - thermal management, temperature compensation
- Process control - temperature regulation

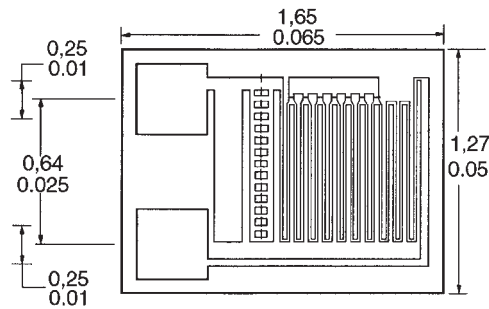
1000 $\Omega$ , 375 alpha provides 10X greater sensitivity and signal-to-noise. Both 1000 $\Omega$  and 100 $\Omega$  provide interchangeabilities of  $\pm 0.6^\circ\text{C}$  or better from  $-100^\circ\text{C}$  to  $100^\circ\text{C}$ , and  $\pm 3.0^\circ\text{C}$  at  $500^\circ\text{C}$ .

### MOUNTING DIMENSIONS (for reference only)

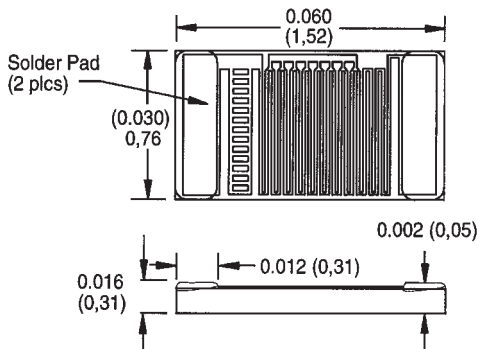
#### HEL-700 Ribbon Lead



#### HEL-700 Radial Chip



#### HEL-700 SMT (Axial) Flip Chip



### ORDER GUIDE

HEL-700	Thin Film Platinum RTD
-U	1000 $\Omega$ , 0.00375 $\Omega/\Omega/^\circ\text{C}$
-T	100 $\Omega$ , 0.00385 $\Omega/\Omega/^\circ\text{C}$ DIN Standard
-0	$\pm 0.2\%$ Resistance Trim (Standard)
-1	$\pm 0.1\%$ Resistance Trim (Optional)
-A	Radial Ribbon Lead
-B	Radial Chip
-C	SMT Axial Flip Chip (1000 $\Omega$ ONLY)

Fig. 1: Linear Output Voltage

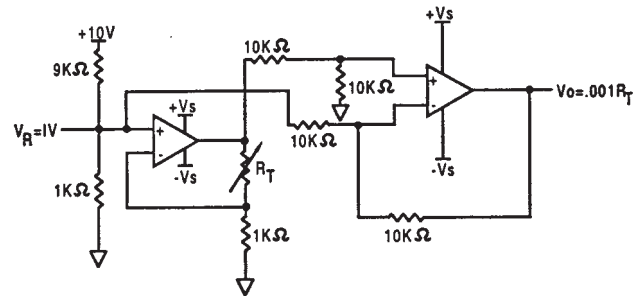
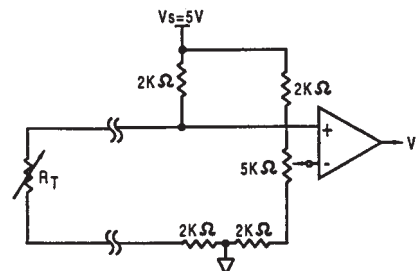


Fig. 2: Adjustable Point (Comparator) Interface



Temperature

# Temperature Sensors

## Platinum RTDs

HEL-700

### FUNCTIONAL BEHAVIOR

$$R_T = R_0(1 + AT + BT^2 - 100CT^3 + CT^4)$$

$R_T$  = Resistance ( $\Omega$ ) at temperature  $T$  ( $^{\circ}\text{C}$ )

$R_0$  = Resistance ( $\Omega$ ) at  $0^{\circ}\text{C}$

$T$  = Temperature in  $^{\circ}\text{C}$

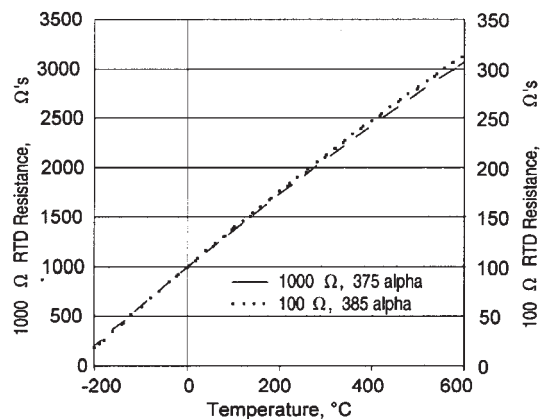
$$A = \alpha + \frac{\alpha \delta}{100} \quad B = \frac{-\alpha \delta}{100^2} \quad C_{T < 0} = \frac{-\alpha \beta}{100^4}$$

### CONSTANTS

<b>Alpha, <math>\alpha</math> (<math>^{\circ}\text{C}^{-1}</math>)</b>	0.00375 $\pm 0.000029$	0.003850 $\pm 0.000010$
<b>Delta, <math>\delta</math> (<math>^{\circ}\text{C}</math>)</b>	$1.605 \pm 0.009$	$1.4999 \pm 0.007$
<b>Beta, <math>\beta</math> (<math>^{\circ}\text{C}</math>)</b>	0.16	0.10863
<b>A (<math>^{\circ}\text{C}^{-1}</math>)</b>	$3.81 \times 10^{-3}$	$3.908 \times 10^{-3}$
<b>B (<math>^{\circ}\text{C}^{-2}</math>)</b>	$-6.02 \times 10^{-7}$	$-5.775 \times 10^{-7}$
<b>C (<math>^{\circ}\text{C}^{-4}</math>)</b>	$-6.0 \times 10^{-12}$	$-4.183 \times 10^{-12}$

Both  $\beta = 0$  and  $C = 0$  for  $T > 0^{\circ}\text{C}$

### RESISTANCE VS TEMPERATURE CURVE



### ACCURACY VS TEMPERATURE

HEL-700 platinum RTDs are available in two base resistance trim tolerances:  $\pm 0.2\%$  or  $\pm 0.1\%$ . The corresponding resistance interchangeability and temperature accuracy for these tolerances are:

Tolerance	Standard $\pm 0.2\%$		Optional $\pm 0.1\%$	
Temperature ( $^{\circ}\text{C}$ )	$\pm \Delta R^*$ ( $\Omega$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )	$\pm \Delta R^*$ ( $\Omega$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )
-200	6.8	1.6	5.1	1.2
-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

\*1000 $\Omega$  RTD. Divide  $\Delta R$  by 10 for 100 $\Omega$  RTD.

### CAUTION

#### PRODUCT DAMAGE

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take normal ESD precautions when handling this product.

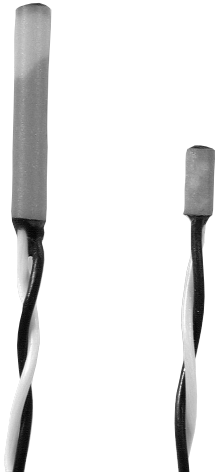
### SPECIFICATIONS

Sensor Type	Thin film platinum RTD; $R_0 = 1000 \Omega @ 0^{\circ}\text{C}$ ; $\alpha = 0.00375 \Omega/\Omega/^{\circ}\text{C}$ $R_0 = 100 \Omega @ 0^{\circ}\text{C}$ ; $\alpha = 0.00385 \Omega/\Omega/^{\circ}\text{C}$
Temperature Range	$-200$ to $+540^{\circ}\text{C}$ ( $-300$ to $+1000^{\circ}\text{F}$ )
Temperature Accuracy	$\pm 0.5^{\circ}\text{C}$ or $0.8\%$ of temperature, $^{\circ}\text{C}$ ( $R_0 \pm 0.2\%$ trim), whichever is greater $\pm 0.3^{\circ}\text{C}$ or $0.6\%$ of temperature, $^{\circ}\text{C}$ ( $R_0 \pm 0.1\%$ trim), whichever is greater (optional)
Base Resistance and Interchangeability, $R_0 \pm \Delta R_0$	$1000 \pm 2 \Omega$ ( $\pm 0.2\%$ ) @ $0^{\circ}\text{C}$ $1000 \pm 1 \Omega$ ( $\pm 0.1\%$ ) @ $0^{\circ}\text{C}$ (optional)
Linearity	$\pm 0.1\%$ of full scale for temperatures spanning $-40^{\circ}$ to $+125^{\circ}\text{C}$ $\pm 2.0\%$ of full scale for temperatures spanning $-200^{\circ}$ to $+540^{\circ}\text{C}$
Time Constant	$< 0.15$ seconds in water @ 3 ft./sec. $< 1$ second on metal surfaces: $< 4$ seconds in air @ 10 ft./sec.
Operating Current	2 mA max. For self-heating errors of $1^{\circ}\text{C}$ 1 mA recommended
Stability	Better than $0.25^{\circ}\text{C}/\text{year}$ : $0.05^{\circ}\text{C}/5$ years for occupied environments
Self-Heating	0.3 mW/ $^{\circ}\text{C}$
Insulation Resistance	$> 50 \text{ M}\Omega @ 50 \text{ VDC @ } 25^{\circ}\text{C}$
Case Material	99% alumina support, vapor deposited alumina passified resistance portion, refractory glass passified overall
Lead Material – Ribbon	Platinum ribbon, $0.002 \times 0.010 \times 0.16$ in. long nominal
Lead Pull Strength – Ribbon	200 grams nominal pulling up from surface

# Temperature Sensors

## Platinum RTDs

HEL-700 Series



### FEATURES

- Linear resistance vs temperature
- Accurate and interchangeable
- Excellent stability
- Teflon or fiberglass lead wires
- Wide temperature range
- Ceramic case material

### TYPICAL APPLICATIONS

- HVAC – room, duct and refrigerant equipment
- Instrument and probe assemblies – temperature compensation
- Process control – temperature regulation

HEL-700 Series elements are fully assembled, ready to use directly or in probe assemblies without the need for fragile splices to extension leads.

The 1000Ω, 375 alpha version, provides 10X greater sensitivity and signal-to-noise. Optional NIST calibrations improve accuracy to ±0.03°C at 0°C.

### ORDER GUIDE

<b>HEL-705</b>	28 ga. TFE Teflon, 2-wire only
<b>HEL-707</b>	28 ga. Fiberglass, 2-wire only
<b>HEL-711</b>	28 ga. TFE Teflon (2-wire 1000Ω, 3-wire 100Ω)
<b>HEL-712</b>	28 ga. Fiberglass (2-wire 1000Ω, 3-wire 100Ω)
<b>HEL-716</b>	24 ga. TFE Teflon (2-wire 1000Ω, 3-wire 100Ω)
<b>HEL-717</b>	24 ga. Fiberglass (2-wire 1000Ω, 3-wire 100Ω)
<b>-U</b>	1000Ω, 0.00375 Ω/Ω/°C
<b>-T</b>	100Ω, 0.00385 Ω/Ω/°C DIN Standard
<b>-0</b>	±0.2% Resistance Trim (Standard)
<b>-1</b>	±0.1% Resistance Trim (Optional)
<b>-12</b>	Lead wire length, 12 inches
<b>-00</b>	No NIST calibration
<b>-C1</b>	NIST @ 0°C
<b>-C2</b>	NIST @ 0 & 100°C
<b>-C3</b>	NIST @ 0, 100 & 260°C

### MOUNTING DIMENSIONS (for reference only)

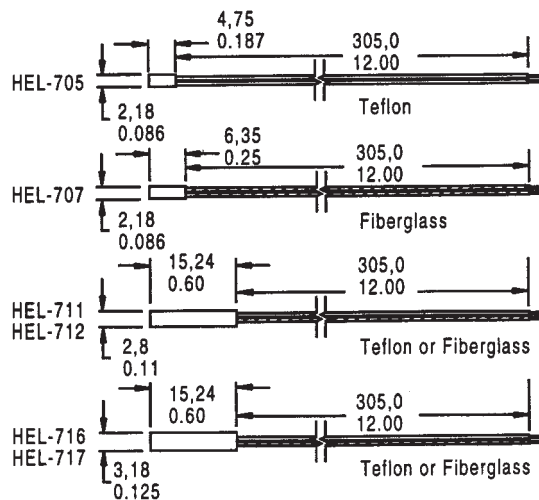


Fig. 1: Wheatstone Bridge 2-Wire Interface

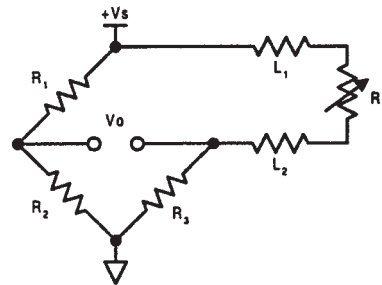


Fig. 2: Linear Output Voltage

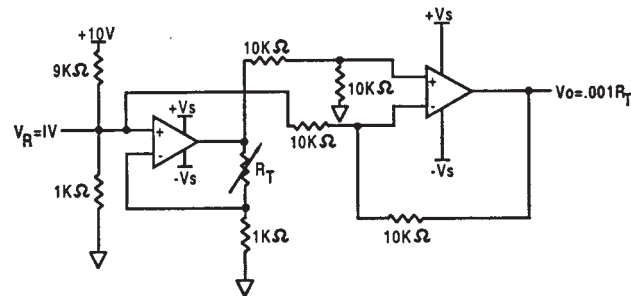
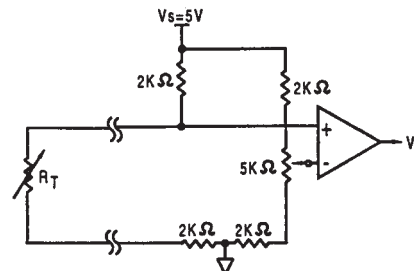


Fig. 3: Adjustable Point (Comparator) Interface



### CAUTION PRODUCT DAMAGE

The inherent design of this component causes it to be sensitive to electrostatic discharge (ESD). To prevent ESD-induced damage and/or degradation, take normal ESD precautions when handling this product.

Temperature

# Temperature Sensors

## Platinum RTDs

HEL-700 Series

### FUNCTIONAL BEHAVIOR

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$T$  = Temperature in  $^{\circ}\text{C}$

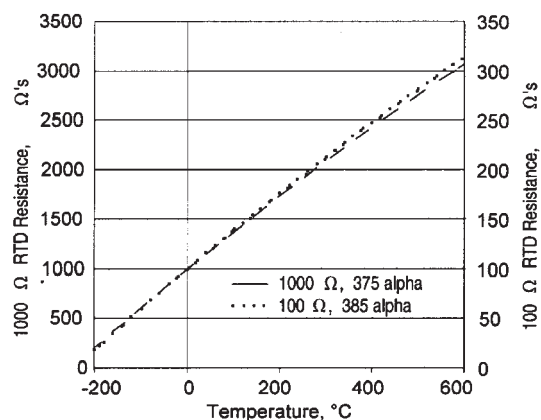
$$A = \alpha + \frac{\alpha \delta}{100} \quad B = \frac{-\alpha \delta}{100^2} \quad C_{T < 0} = \frac{-\alpha \beta}{100^4}$$

### CONSTANTS

<b>Alpha, <math>\alpha</math> (<math>^{\circ}\text{C}^{-1}</math>)</b>	0.00375 $\pm 0.000029$	0.003850 $\pm 0.000010$
<b>Delta, <math>\delta</math> (<math>^{\circ}\text{C}</math>)</b>	$1.605 \pm 0.009$	$1.4999 \pm 0.007$
<b>Beta, <math>\beta</math> (<math>^{\circ}\text{C}</math>)</b>	0.16	0.10863
<b>A (<math>^{\circ}\text{C}^{-1}</math>)</b>	$3.81 \times 10^{-3}$	$3.908 \times 10^{-3}$
<b>B (<math>^{\circ}\text{C}^{-2}</math>)</b>	$-6.02 \times 10^{-7}$	$-5.775 \times 10^{-7}$
<b>C (<math>^{\circ}\text{C}^{-4}</math>)</b>	$-6.0 \times 10^{-12}$	$-4.183 \times 10^{-12}$

Both  $\beta = 0$  and  $C = 0$  for  $T > 0^{\circ}\text{C}$

### RESISTANCE VS TEMPERATURE CURVE



### ACCURACY VS TEMPERATURE

Temperature ( $^{\circ}\text{C}$ )	Standard $\pm 0.2\%$		Optional $\pm 0.1\%$	
	$\pm \Delta R^*$ ( $\Omega$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )	$\pm \Delta R^*$ ( $\Omega$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )
-200	6.8	1.6	5.1	1.2
-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

\*1000 $\Omega$  RTD. Divide  $\Delta$  by 10 for 100 $\Omega$  RTD.

### NIST CALIBRATION

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.

Calibration	1 Point	2 Point	3 Point
T ( $^{\circ}\text{C}$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )	$\pm \Delta T$ ( $^{\circ}\text{C}$ )
-200	0.9	—	—
-100	0.5	0.27	0.15
0	0.03	0.03	0.03
100	0.4	0.11	0.07
200	0.8	0.2	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

### SPECIFICATIONS

Sensor Type	Thin film platinum RTD; $R_0 = 1000 \Omega @ 0^{\circ}\text{C}$ ; $\alpha = 0.00375 \Omega/\Omega/^{\circ}\text{C}$ $R_0 = 100 \Omega @ 0^{\circ}\text{C}$ ; $\alpha = 0.00385 \Omega/\Omega/^{\circ}\text{C}$
Temperature Range	TFE Teflon: $-200^{\circ}$ to $+260^{\circ}\text{C}$ ( $-320^{\circ}$ to $+500^{\circ}\text{F}$ ) Fiberglass: $-75^{\circ}$ to $+540^{\circ}\text{C}$ ( $-100^{\circ}$ to $+1000^{\circ}\text{F}$ )
Temperature Accuracy	$\pm 0.5^{\circ}\text{C}$ or 0.8% of temperature, $^{\circ}\text{C}$ ( $R_0 \pm 0.2\%$ trim), whichever is greater $\pm 0.3^{\circ}\text{C}$ or 0.6% of temperature, $^{\circ}\text{C}$ ( $R_0 \pm 0.1\%$ trim), whichever is greater (optional)
Base Resistance and Interchangeability, $R_0 \pm \Delta R_0$	$1000 \pm 2 \Omega$ ( $\pm 0.2\%$ ) @ $0^{\circ}\text{C}$ $1000 \pm 1 \Omega$ ( $\pm 0.1\%$ ) @ $0^{\circ}\text{C}$ (optional)
Linearity	$\pm 0.1\%$ of full scale for temperatures spanning $-40^{\circ}$ to $+125^{\circ}\text{C}$ $\pm 2.0\%$ of full scale for temperatures spanning $-75^{\circ}$ to $+540^{\circ}\text{C}$
Time Constant	$< 0.5$ sec. 0.85 inch O.D. in water at 3 ft/sec; $< 1.0$ sec, 0.85 inch O.D. in still water
Operating Current	2 mA maximum for self heating errors of $< 1^{\circ}\text{C}$ ; 1 mA recommended
Stability	$< 0.25^{\circ}\text{C}/\text{year}$ ; $0.05^{\circ}\text{C}$ per 5 years in occupied environments
Self Heating	$< 15$ mW/ $^{\circ}\text{C}$ for 0.85 O.D. typical
Insulation Resistance	$> 50$ M $\Omega$ at 50 VDC at $25^{\circ}\text{C}$
Construction	Alumina case; Epoxy potting (Teflon leads); Ceramic potting (fiberglass leads)
Lead Material	Nickel coated stranded copper, Teflon or Fiberglass insulated