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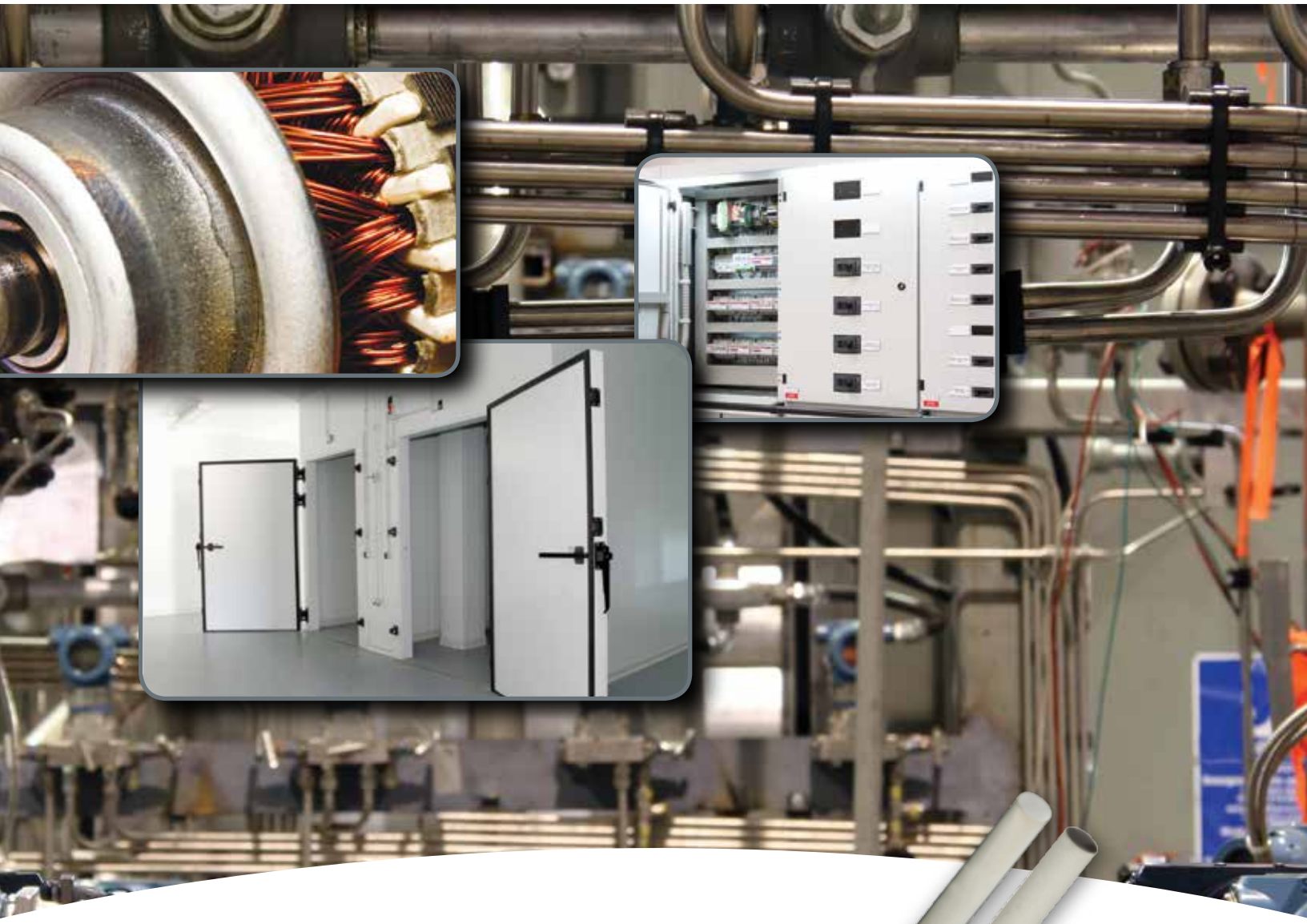


# Thin Film Platinum RTDs

## HEL-700 Series

Datasheet

# 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 ±0.2% (±0.5 °C accuracy) or optional ±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

# Thin Film Platinum RTDs, HEL-700 Series

**Table 1. Specifications**

| Characteristic | Condition | Parameter |
|---|---|---|
| Alpha:<br>$R_0$ = 1000 Ω<br>$R_0$ = 100 Ω | 0 °C | <br>0.00375 Ω/Ω/°C<br>0.00385 Ω/Ω/°C |
| Temperature range:<br>TFE Teflon<br>fiberglass | — | <br>-70 °C to 260 °C [-94 °F to 500 °F]<br>-75 °C to 540 °C [-100 °F to 1000 °F] |
| Temperature accuracy:<br>$R_0$ ±0.2% trim (standard)<br>$R_0$ ±0.1% trim (optional) | — | <br>±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, $R_0$ ±$\Delta R_0$:<br>$R_0$ ±0.2% trim (standard)<br>$R_0$ ±0.1% trim (optional) | 0 °C | <br>1000 Ω ±2 Ω<br>1000 Ω ±1 Ω |
| Linearity:<br>-40 °C to 125 °C<br>-75 °C to 540 °C | — | <br>±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 | — | <br>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 |
|---|---|---|
| Alpha α (°C$^{-1}$) | 0.00375 ±0.000029 | 0.003850 ±0.000010 |
| 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$^{-12}$ |

**Functional Behavior**

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

Where:
$R_T$ = Resistance (Ω) at temperature T (°C)
$R_0$ = Resistance (Ω) at 0 °C
T = Temperature (°C)

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

## 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 (°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 |

[1]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 |

[1]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**

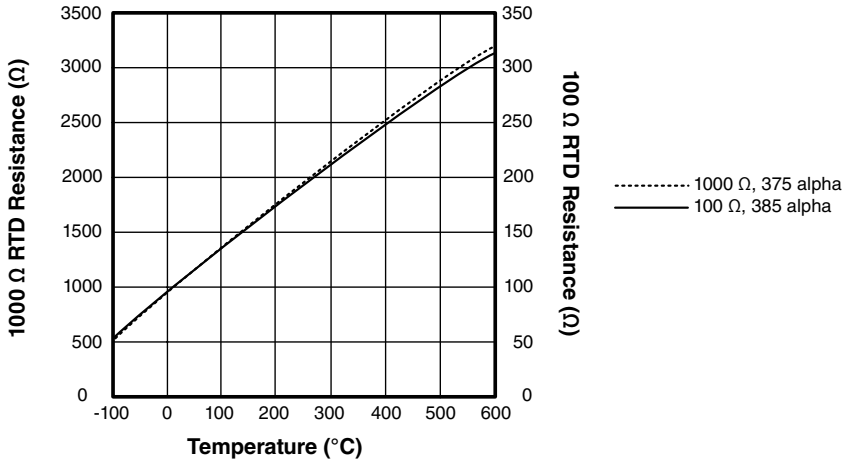



**Figure 2. Nomenclature and Ordering Guide**

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® insulted 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-** Product Series

| |
|---|
| **HEL-700** Series Thin Film Platinum RTDs |

**705-** Leadwire Insulation Material, Gauge and Number

| | |
|---|---|
| **705** | TFE Teflon®, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire |
| **707** | fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 2-wire |
| **711** | TFE Teflon®, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire |
| **712** | fiberglass, 28 gauge; 1000 Ω: 2-wire, 100 Ω: 3-wire |
| **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 |

**U-** Resistance and Alpha

| | |
|---|---|
| **U** | 1000 Ω: 0.00375 Ω/Ω/°C |
| **T** | 100 Ω: 0.00385 Ω/Ω/°C (DIN Standard) |

**0-** Resistance Trim

| | |
|---|---|
| **0** | Standard: ±0.2% |
| **1** | Optional: ±0.1% |

**12-** Leadwire Length

| | |
|---|---|
| **12** | 12 inches |

**C1** NIST Calibration Report

| | |
|---|---|
| **00** | none |
| **C1** | at 0 °C |
| **C2** | at 0 °C and 100 °C |
| **C3** | at 0 °C, 100 °C and 260 °C |

# Thin Film Platinum RTDs, HEL-700 Series

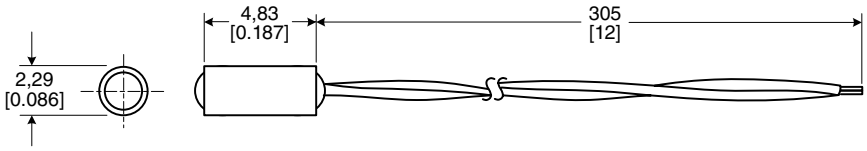
Figure 3. All Available Standard Configurations

| Teflon®-Insulated Leadwires | | Fiberglass-Insulated Leadwires | |
|---|---|---|---|
| **HEL-705** | | **HEL-707** | |
| 2-wire only |  | 2-wire only |  |
| **HEL-711** | | **HEL-712** | |
| 2-wire |  | 2-wire |  |
| 3-wire |  | 3-wire |  |
| **HEL-716** | | **HEL-717** | |
| 2-wire |  | 2-wire |  |
| 3-wire |  | 3-wire |  |

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

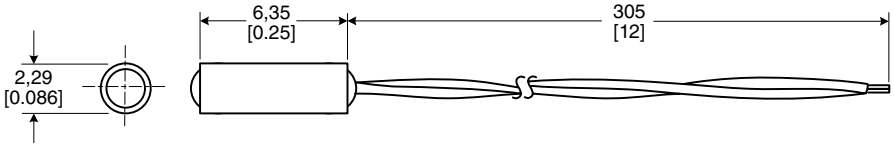
**HEL-705**

2-wire only




**HEL-707**

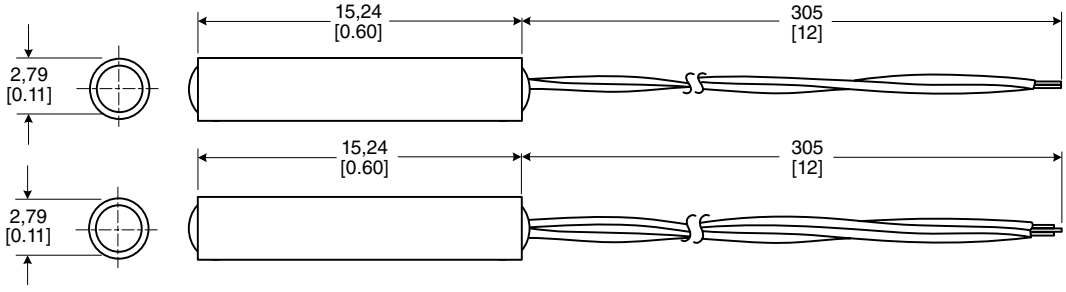
2-wire only




**HEL-711, HEL-712**

2-wire

3-wire




**HEL-716, HEL-717**

2-wire

3-wire

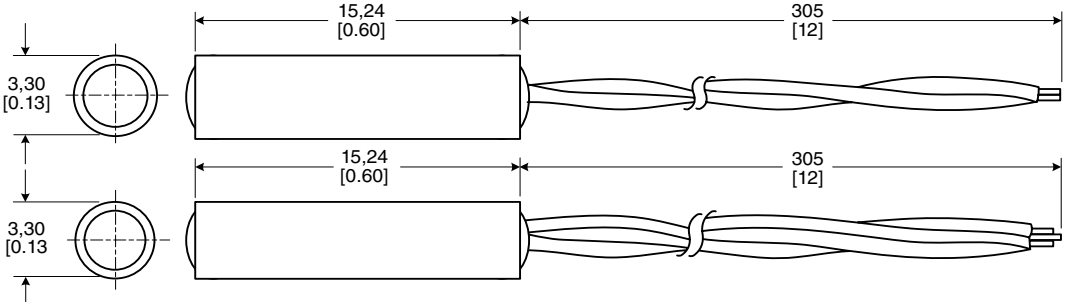
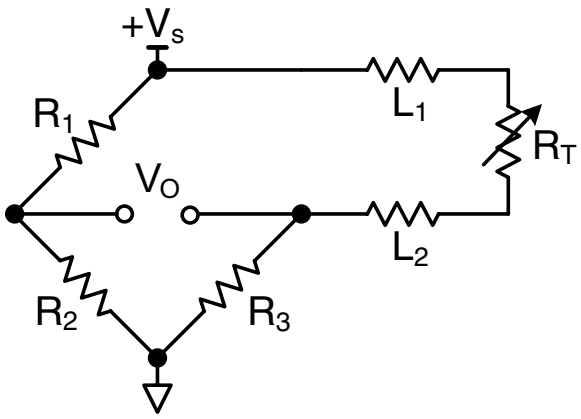
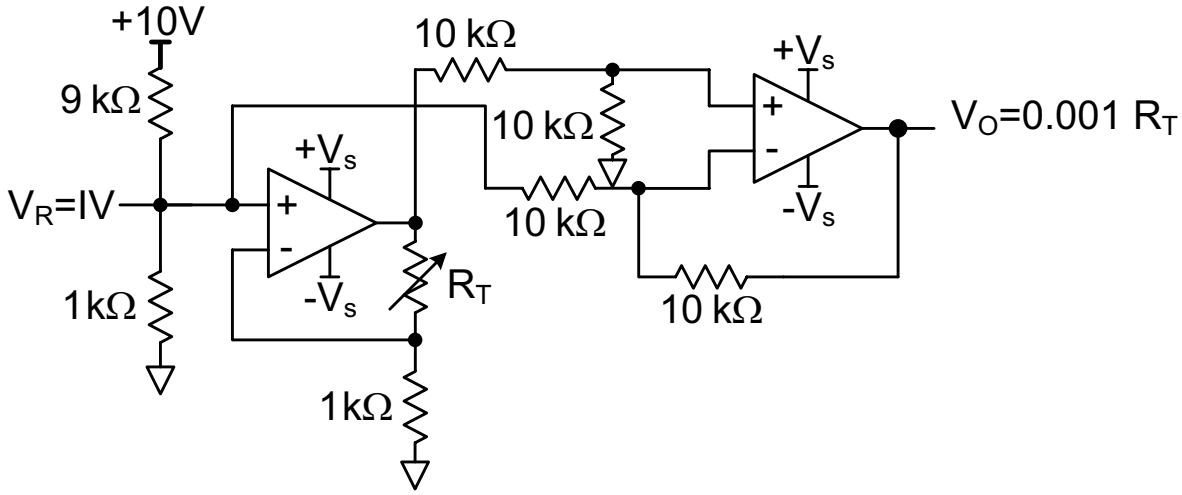


Figure 5. Circuits

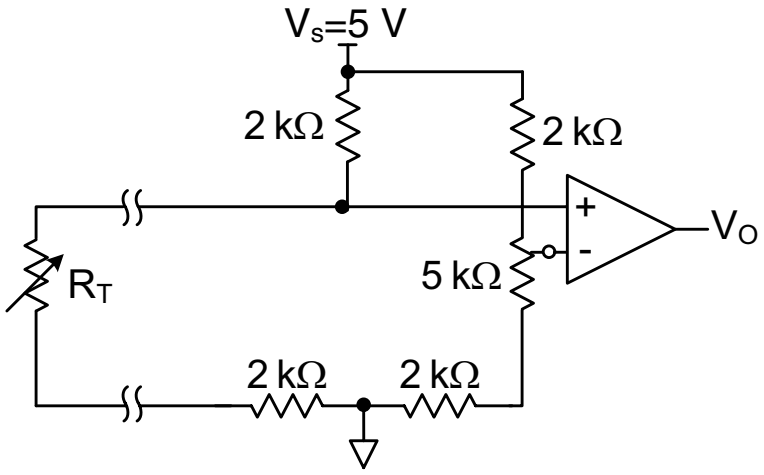
### Wheatstone Bridge 2-Wire Interface




### 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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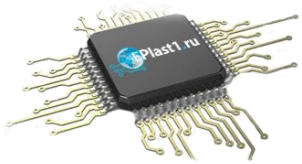


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