

Sensors & Instruments Product Guide



RTDs | Thermocouples | Thermistors | Humidity | Assemblies | Transmitters | Monitors | Controllers

Minco: Providing Temperature Sensing Solutions for Demanding Applications

For nearly 60 years, Minco has been designing and manufacturing advanced products for some of the world's most demanding applications. Our offering includes temperature sensing and control solutions, thermal heating solutions, flex circuit solutions, and integrated products—coupled with broad assembly capabilities.

Sensors



Instruments



Flexible Thermofoil™ Heaters



Flex Circuits



Minco's products are supported by expert engineering services to help customers plan and integrate Minco components into their products, delivering proven quality and performance in thousands of applications worldwide.

Superior temperature sensing solutions

Minco works diligently to provide the best temperature sensing and instrumentation solutions for your application. We have hundreds of off-the-shelf solutions to meet your immediate requirements, and have designed thousands of custom sensing packages to seamlessly operate in a wide range of applications.



Minco builds sensors from start to finish ensuring exceptional product quality. As a company, we strive for cost-effective solutions through efficient design and easy installation. This allows you to save time and money without sacrificing accuracy and reliability.



Minco today: global and growing

Minco's engineering and manufacturing facilities employ over 600 people worldwide. More than 300,000 ft² (27,900 m²) of manufacturing space provides the capacity and infrastructure to support a variety of applications for global customers in diverse markets.

Minco's seamless operational capabilities allow us to design and manufacture integrated components from prototype to production, which simplifies the supply chain and improves our response time.



Minco is ISO 9001:2008 / AS9100:2009 (Rev.C)/EN9100 / SJAC9100 (Registrar: TÜV) certified and we have the capabilities to meet many other quality assurance, process, and product specifications per your requirements.

Minco Fast Facts

Founded: 1956

Organization: Privately held

Headquarters: Minneapolis, Minnesota, USA

Worldwide employees: 600+

President and CEO: Dana Schurr

Offering: Heaters, flex circuits, sensors and instruments, integrated products, assembly

Customers and markets: Medical implants, medical diagnostics, aerospace, defense, semiconductor, power generation, oil and gas, rotating machinery, building automation, industrial and commercial

MINCO



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**Look for the Minco Truck
to order STOCKED PARTS!**

ASSEMBLIES

PROBES

ACCESSORIES

INSTRUMENTS

SANITARY SENSORS

MINIATURE SENSORS

STATOR RTDs

HVAC SENSORS

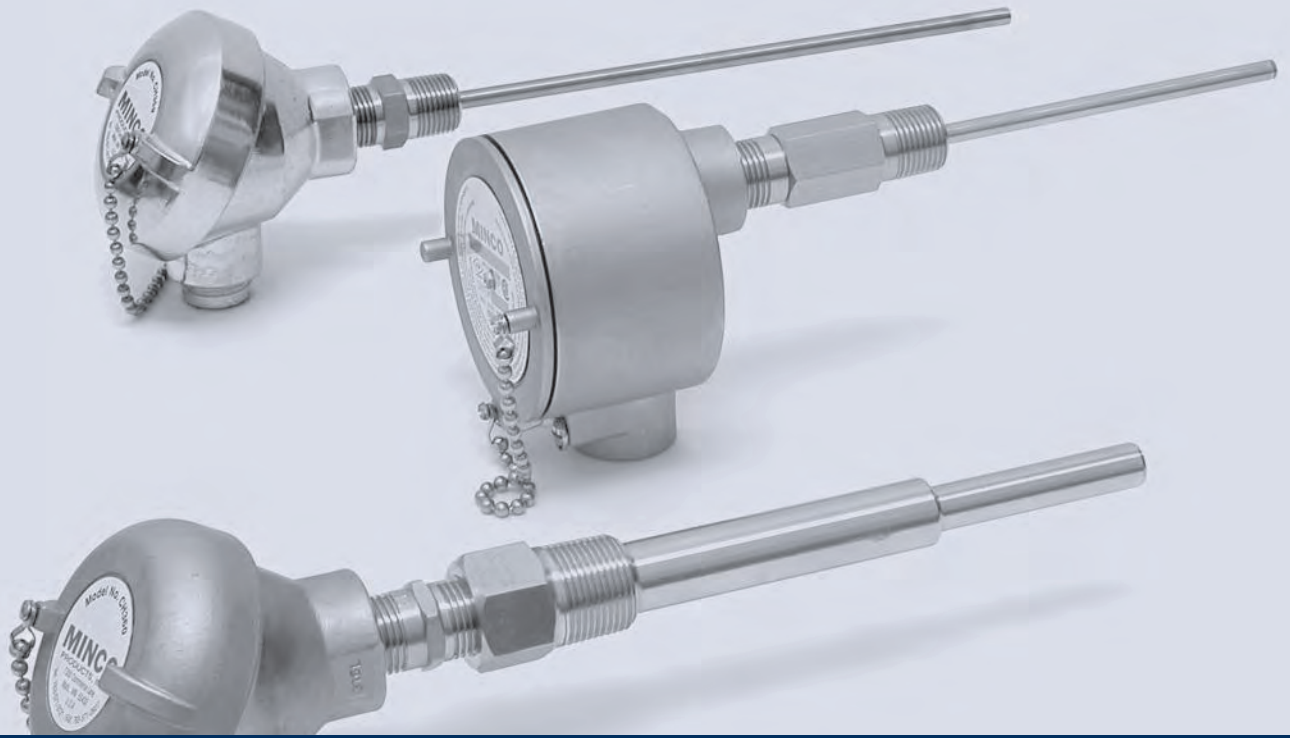
THERMAL-RIBBONS

ELEMENTS

TECHNICAL INFORMATION

REFERENCE





► SECTION 1: ASSEMBLIES

- Easy-to-order temperature sensor assemblies to fit a variety of applications
- RTDs, thermocouples, and transmitters
- Fittings, connection heads, and thermowells included
- Tip-sensitive, high temperature, explosionproof, and flameproof options

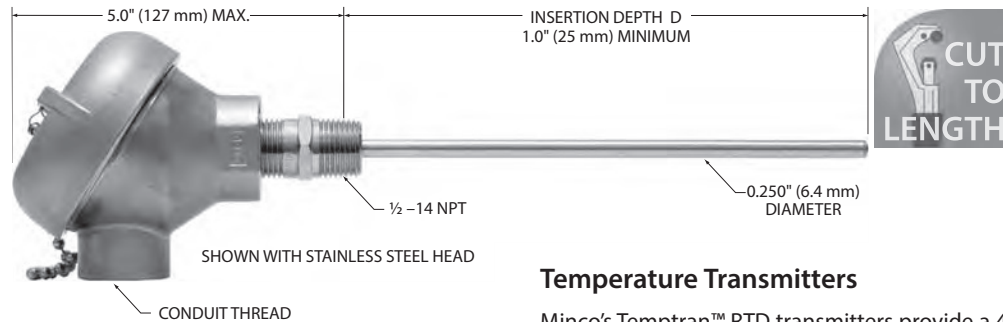
To specify custom assemblies see:

| | |
|--------------|-----------|
| Probes | Section 2 |
| Accessories | Section 3 |
| Transmitters | Section 4 |

To specify humidity assemblies see Section 8

| | |
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Tip-sensitive Spring-loaded RTDs



Overview

Fast and accurate readings from bearings, blocks, and other solids. Minco's spring-loaded holder ensures solid contact in drilled holes and has a built-in oil seal. The sensing probe features a copper alloy tip for quick response to temperature changes.

- Tip-sensitive RTD probe for use to 260°C (500°F)
- Spring-loaded holder with fluid seal
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.

Holder: Stainless steel with Viton O-ring.

Connection head: Cast iron, aluminum, or stainless steel.

Pressure rating: 50 psi (3.4 bar).

Insulation resistance: 100 megohms minimum at 100 VDC, leads to case.

Connection: Terminal block for wires to AWG 14.

Time constant: Typical value in moving water:

Single element: 1.5 seconds.

Dual element: 3.0 seconds.

Sensing Elements

| Element | | Code |
|--|--------------------|------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | ▼PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | ▼PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | PE |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | CA |
| (dual) | 10 Ω ±0.5% at 25°C | CC |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | NA |

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Special high-accuracy calibration: For high system accuracy, specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

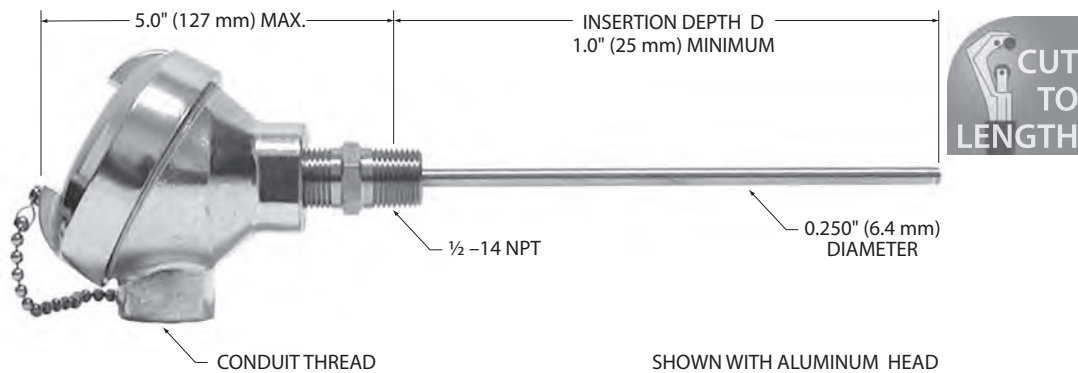
Specification and order options

| | |
|--|--|
| AS5004 | Assembly number ▼ AS5004: Single element RTD ▼ AS5005: Dual element RTD |
| PA | Sensing element from table |
| 60 | Insertion depth D: Specify in 0.1" increments (Ex: 60 = 6.0 inches) ▼ :15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 140, 160, 180, 200, 240, 300, 360 |
| Z | Leads per sensing element: Y = 2 leads ▼ Z = 3 leads (required for CA and CC elements) X = 4 leads (PD elements only) |
| 1 | Conduit thread: ▼ 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| A | Connection head: C = Cast iron ▼ A = Aluminum S = Stainless steel |
| To order sensor assembly, stop here. | |
| To order with transmitters (single platinum element only) add: | |
| 211 | Temptran™ transmitter model: 211 = TT211: Fixed Range (2-lead RTDs) 508 = TT508: Programmable (2 & 3-lead RTDs) 511 = TT511: HART® Programmable (2, 3, & 4-lead RTDs) |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS5004PA60Z1A211A1 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Tip-sensitive Spring-loaded Thermocouples



Overview

Fast and accurate readings from bearings, blocks, and other solids. Minco's spring-loaded holder ensures solid contact in drilled holes and has a built-in oil seal. The sensing probe features a copper alloy tip for quick response to temperature changes.

- Tip-sensitive Thermocouple for use to 260°C (500°F)
- Spring-loaded holder with fluid seal
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.
 Holder: Stainless steel with Viton O-ring.
 Connection head: Cast iron, aluminum, or stainless steel.

Pressure rating: 50 psi (3.4 bar).

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case. Ungrounded junctions only.

Connection: Terminal block for wires to AWG 14.

Time constant: Typical value in moving water:

Grounded junction: 1.5 seconds.
 Ungrounded junction: 7 seconds

Temperature Transmitters

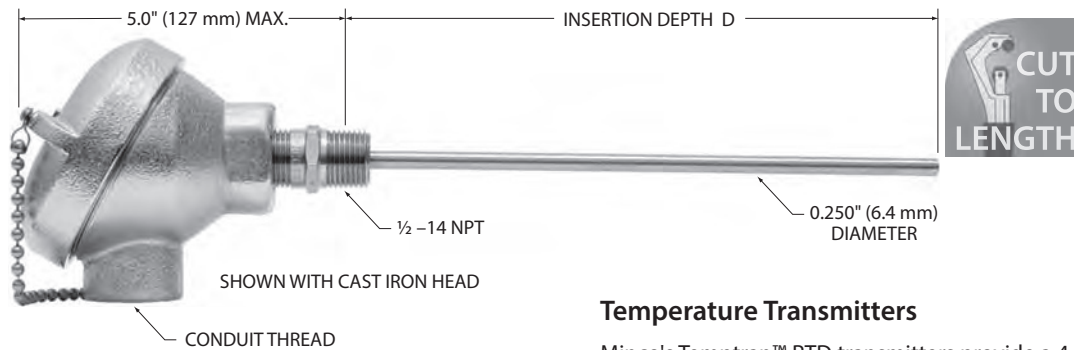
Minco's Temptran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Specification and order options

| | |
|---|--|
| AS5192 | Assembly number ▼ AS5191: Single junction ▼ AS5192: Dual junction |
| E | Junction type: ▼ E = Chromel-Constantan J = Iron-Constantan ▼ K = Chromel-Alumel T = Copper-Constantan |
| U | Junction grounding: G = Grounded ▼ U = Ungrounded |
| 120 | Insertion depth D: Specify in 0.1" increments (Ex: 120 = 12.0 inches) ▼: 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120 |
| P | |
| 1 | Conduit thread: ▼ 1 = 1/2 - 14 NPT ▼ 2 = 3/4 - 14 NPT |
| A | Connection head: C = Cast iron ▼ A = Aluminum S = Stainless steel |
| To order sensor assembly, stop here. | |
| To order with transmitter, add: | |
| 509 | Temptran™ transmitter model: 205 = TT205: Fixed Range, Miniature 509 = TT509: Programmable, Hockey Puck 511 = TT511: HART® Programmable, Hockey Puck |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| AS5192EU120P1A509A = Sample part number | |

▼ = **STANDARD OPTIONS**
 Specifications subject to change

Tip-sensitive Direct Immersion RTDs



Overview

Mount sensors directly in fluid flow for fast response. Probes are rated to 100 psi (6.9 bar). For use in non-corrosive fluids only.

- RTD probe for use to 260°C (500°F)
- Adjustable fluid seal fitting
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.
 Fitting: Stainless steel, silicone rubber O-ring.
 Connection head: Cast iron, aluminum, or stainless steel.

Pressure rating: 100 psi (6.9 bar).

Insulation resistance: 100 megohms minimum at 100 VDC, leads to case.

Connection: Terminal block for wires to AWG 14.

Time constant: Typical value in moving water:
 Single element: 2.0 seconds.
 Dual element: 5.0 seconds.

Sensing elements

| Element | | Code |
|--|--------------------|------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | ▼PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | PE |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | CA |
| (dual) | 10 Ω ±0.5% at 25°C | CC |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | NA |

Temperature Transmitters

Minco's Tempran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

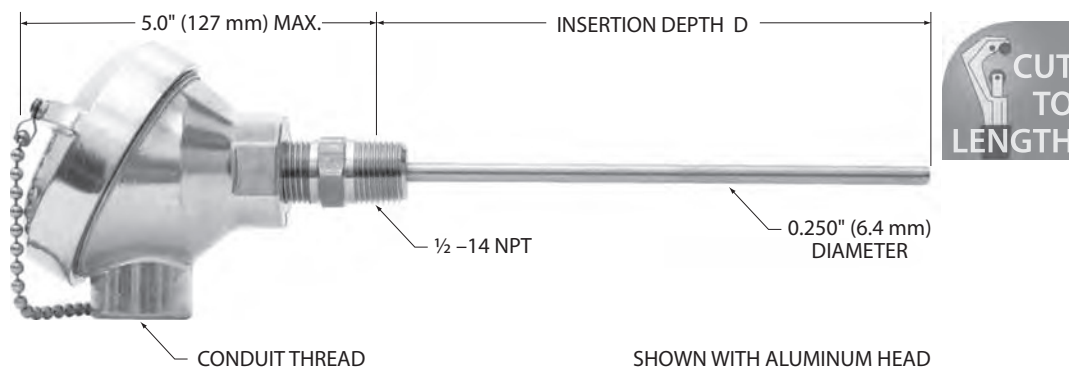
Special high-accuracy calibration: For high system accuracy, specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

Specification and order options

| | |
|--|---|
| AS5200 | Assembly number ▼AS5200: Single element ▼AS5201: Dual element |
| PD | Sensing element from table |
| 100 | Insertion depth D: Specify in 0.1" increments (Ex: 100 = 10.0 inches) ▼:15, 20, 30, 40, 50, 60, 70, 80, 90, 100, 110, 120, 140, 160, 180, 200, 240, 300, 360 |
| Z | Leads per sensing element: Y = 2 leads ▼Z = 3 leads (required for CA and CC elements) X = 4 leads (PD elements only) |
| 1 | Conduit thread: ▼1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| A | Connection head: C = Cast iron ▼A = Aluminum S = Stainless steel |
| To order sensor assembly, stop here. To order with transmitters (single platinum element only) add: | |
| 508 | Tempran™ transmitter model: 211 = TT211: Fixed Range (2-lead RTDs) 508 = TT508: Programmable (2 & 3-lead RTDs) 511 = TT511: HART® Programmable (2, 3, & 4-lead RTDs) |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS5200PD100Z1A508A1 = Sample part number | |

▼ = STANDARD OPTIONS
 Specifications subject to change

Tip-sensitive Direct Immersion Thermocouples



Overview

Mount sensors directly in fluid flow for fast response. Probes are rated to 100 psi (6.9 bar). For use in non-corrosive fluids only.

- Thermocouple for use to 260°C (500°F)
- Adjustable fluid seal fitting
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.
 Fitting: Stainless steel, silicone rubber O-ring.
 Connection head: Cast iron, aluminum, or stainless steel.

Pressure rating: 100 psi (6.9 bar).

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case. Ungrounded junctions only.

Connection: Terminal block for wires to AWG 14.

Time constant: Typical value in moving water:

Grounded junction: 1.5 seconds.
 Ungrounded junction: 7 seconds.

Temperature Transmitters

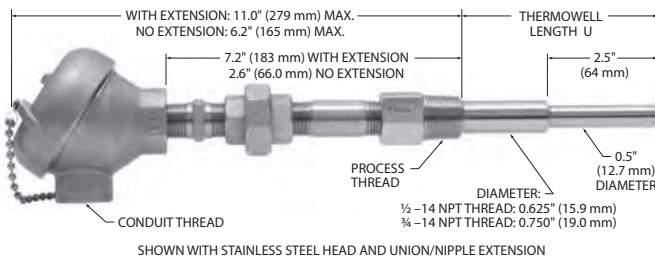
Minco's Tempran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Specification and order options

| | |
|---|---|
| AS5205 | Assembly number AS5205: Single junction AS5206: Dual junction |
| E | Junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan |
| U | Junction grounding: G = Grounded U = Ungrounded |
| 215 | Insertion depth D: Specify in 0.1" increments (Ex: 215 = 21.5 inches) |
| P | |
| 1 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| C | Connection head: C = Cast iron A = Aluminum S = Stainless steel |
| To order sensor assembly, stop here. | |
| To order with transmitter, add: | |
| 509 | Tempran™ transmitter model: 205 = TT205: Fixed Range, Miniature 509 = TT509: Programmable, Hockey Puck 511 = TT511: HART® Programmable, Hockey Puck |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| AS5205EU215P1C509A = Sample part number | |

▼ = STANDARD OPTIONS
 Specifications subject to change

Tip-sensitive RTDs with Thermowells



Overview

Thermowells protect sensors from the effects of fluid flow and pressure. These assemblies are spring-loaded for positive probe contact against the bottom of the thermowell. The probe's copper alloy tip provides superior time response and reduces error from stem conduction.

- 316 stainless steel thermowell
- Tip-sensitive RTD probe for use to 260°C (500°F)
- Spring-loaded probe
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.
 Connection head: Cast iron, aluminum, or stainless steel.
 Thermowell: 316 stainless steel.
 Extension: Stainless steel.

Pressure rating: 7000 psi (483 bar) at 21°C, reducing to 6300 psi (433 bar) at 260°C.

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5".

Insulation resistance: 100 megohms minimum at 100 VDC, leads to case.

Connection: Terminal block for wires to AWG 14.

Time constant: 17 seconds typical in moving water.

Sensing elements

| Element | | Code |
|--|--------------------|------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | ▼PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | PE |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | CA |
| (dual) | 10 Ω ±0.5% at 25°C | CC |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | NA |

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

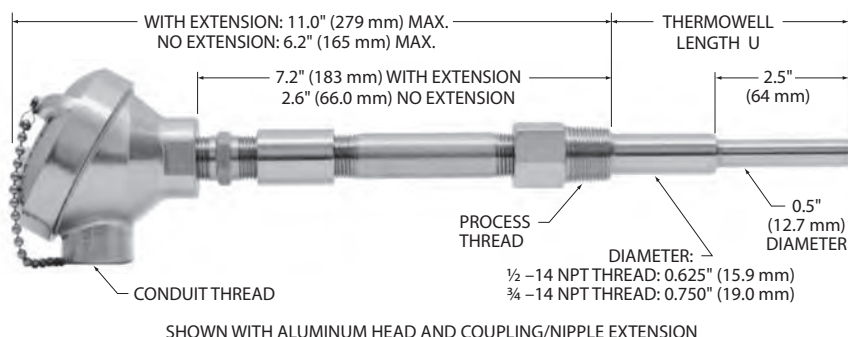
Special high-accuracy calibration: For high system accuracy, specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

Specification and order options

| | |
|--|---|
| AS5140 | Assembly number ▼AS5140: Single element RTD ▼AS5141: Dual element RTD |
| CA | Sensing element from table |
| 60 | Thermowell length U: Specify in 0.1" increments (Ex: 60 = 6.0 inches) ▼:15, 20, 25, 30, 40, 45, 60, 75, 90, 100, 105, 120, 150 |
| Z | Leads per sensing element: Y = 2 leads ▼Z = 3 leads (required for CA and CC elements) X = 4 leads (PD elements only) |
| 1 | Conduit thread: ▼1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| A | Connection head: C = Cast iron ▼A = Aluminum S = Stainless steel |
| 1 | Thermowell process thread: ▼1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| U | Extension option: P = Coupling/nipple extension ▼N = No extension ▼U = Union/Nipple extension |
| To order sensor assembly, stop here. To order with transmitters (single platinum element only) add: | |
| 508 | Temptran™ transmitter model: 211 = TT211: Fixed Range (2-lead RTDs) 508 = TT508: Programmable (2 & 3-lead RTDs) 511 = TT511: HART® Programmable (2, 3, & 4-lead RTDs) |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS5140CA60Z21A1U508A1 = Sample part number | |

▼ = STANDARD OPTIONS
 Specifications subject to change

Tip-sensitive Thermocouples with Thermowells



Overview

Thermowells protect sensors from the effects of fluid flow and pressure. These assemblies are spring-loaded for positive probe contact against the bottom of the thermowell. The probe's copper alloy tip provides superior time response and reduces error from stem conduction.

- 316 stainless steel thermowell
- Tip-sensitive thermocouple for use to 260°C (500°F)
- Spring-loaded probe
- Cast iron, stainless steel, or aluminum connection head

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.
Connection head: Cast iron, aluminum, or stainless steel.
Thermowell: 316 stainless steel.
Extension: Stainless steel.

Pressure rating: 7000 psi (483 bar) at 21°C, reducing to 6300 psi (433 bar) at 260°C.

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5".

Insulation resistance: 10 megohms min. at 100 VDC, leads to case. Ungrounded junctions only.

Connection: Terminal block for wires to AWG 14.

Time constant: Typical value in moving water.
Grounded junction: 17 seconds.
Ungrounded junction: 22 seconds.

Temperature Transmitters

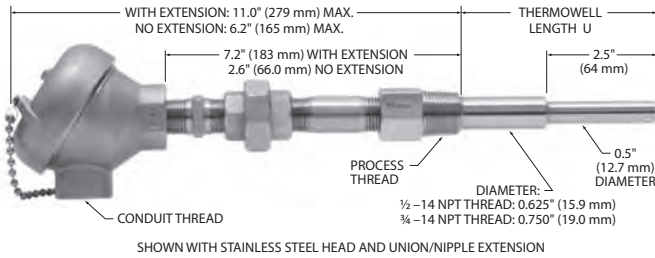
Minco's Temptran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Specification and order options

| | |
|---|--|
| AS5145 | Assembly number AS5145: Single junction TC AS5146: Dual junction TC |
| E | Junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan |
| U | Junction Grounding: G = Grounded U = Ungrounded |
| 135 | Thermowell length U: Specify in 0.1" increments (Ex: 135 = 13.5 inches) |
| P | |
| 1 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| C | Connection head: C = Cast iron A = Aluminum S = Stainless steel |
| 1 | Thermowell process thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| U | Extension option: P = Coupling/nipple extension N = No extension U = Union/Nipple extension |
| To order sensor assembly, stop here. To order with transmitter, add: | |
| 509 | Temptran™ transmitter model: 205 = TT205: Fixed Range, Miniature 509 = TT509: Programmable, Hockey Puck 511 = TT511: HART® Programmable, Hockey Puck |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| AS5145EU135P1C1U509A = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

550°C RTDs with Thermowells



Overview

Sense temperature in high-pressure fluids and gases. These assemblies are spring-loaded for positive probe contact against the bottom of the thermowell.

- 316 stainless steel thermowell
- RTD probe for use to 550°C (1022°F)
- Spring-loaded probe
- Cast iron, stainless steel, or aluminum connection head

Note: For temperatures less than 260°C (500°F), assemblies using tip-sensitive sensors are recommended.

Specifications

Temperature range:

Thermowell and sensor: -100 to 550°C (-148 to 1022°F).

Connection head:

- Cast iron: 260°C (500°F) max.
- Aluminum: 316°C (600°F) max.
- Stainless steel: 121°C (250°F) max.

Material:

- Probe: 316 stainless steel.
- Connection head: Cast iron, aluminum, or stainless steel.
- Thermowell: 316 stainless steel.
- Extension: Stainless steel.

Pressure rating: 7000 psi (483 bar) at 21°C, reducing to 2500 psi (172 bar) at 550°C.

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5".

Insulation resistance: 10 megohms min. at 100 VDC, leads to case.

Connection: Terminal block for wires to 14 AWG.

Time constant: 23 seconds typical in moving water.

Sensing elements

| Element | | Code |
|--|--------------------|------|
| Platinum (0.00391 TCR) | 100 Ω ±0.1% at 0°C | PB |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | PD |

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Special high-accuracy calibration: For high system accuracy, specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

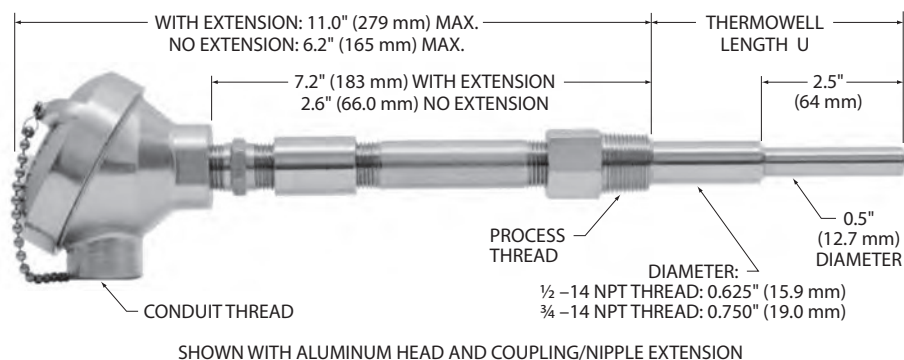
Specification and order options

| | |
|--|--|
| AS5160 | Assembly number AS5160 |
| PB | Sensing element from table |
| 105 | Thermowell length U: Specify in 0.1" increments (Ex: 105 = 10.5 inches) |
| Z | Leads per sensing element: Y = 2 leads Z = 3 leads X = 4 leads (PD elements only) |
| 2 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| C | Connection head: C = Cast iron A = Aluminum S = Stainless steel |
| 1 | Thermowell process thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| U | Extension option: P = Coupling/nipple extension N = No extension U = Union/Nipple extension |
| To order sensor assembly, stop here. | |
| To order with transmitters add: | |
| 508 | Temptran™ transmitter model: 211 = TT211: Fixed Range (2-lead RTDs) 508 = TT508: Programmable (2 & 3-lead RTDs) 511 = TT511: HART® Programmable (2, 3, & 4-lead RTDs) |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS5160PB105Z2C1U508A1 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

550°C Thermocouples with Thermowells



Overview

Sense temperature in high-pressure fluids and gases. These assemblies are spring-loaded for positive probe contact against the bottom of the thermowell.

Note: For temperatures less than 260°C (500°F), assemblies using tip-sensitive sensors are recommended.

- 316 stainless steel thermowell
- Thermocouple probe for use to 550°C (1022°F)
- Spring-loaded probe
- Cast iron, aluminum or stainless steel connection head

Specifications

Temperature range:

Thermowell and sensor: -100 to 550°C (-148 to 1022°F).

Connection head:

Cast iron: 260°C (500°F) max.

Aluminum: 316°C (600°F) max.

Stainless steel: 121°C (250°F) max.

Material:

Probe: 316 stainless steel.

Connection head: Cast iron, aluminum, or stainless steel.

Thermowell: 316 stainless steel.

Extension: Stainless steel.

Pressure rating: 7000 psi (483 bar) at 21°C, reducing to 2500 psi (172 bar) at 550°C.

Standard U dimensions:

2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5".

Insulation resistance: 10 megohms min. at 100 VDC, leads to case. Ungrounded junctions only.

Connection: Terminal block for wires to 14 AWG.

Time constant: 60 seconds typical in moving water.

Temperature Transmitters

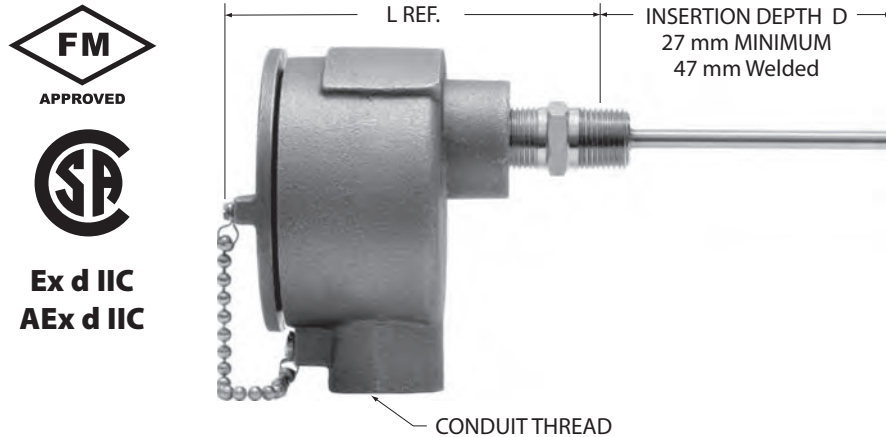
Minco's Temptran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Specification and order options

| | |
|---|---|
| AS5165 | Assembly number: AS5165 |
| K | Junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel |
| U | Junction Grounding: G = Grounded U = Ungrounded |
| 135 | Thermowell length U: Specify in 0.1" increments (Ex: 135 = 13.5 inches) |
| P | |
| 1 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| C | Connection head: C = Cast iron A = Aluminum S = Stainless steel |
| 1 | Thermowell process thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT |
| U | Extension option: P = Coupling/nipple extension N = No extension U = Union/Nipple extension |
| To order sensor assembly, stop here. To order with transmitter, add: | |
| 509 | Temptran™ transmitter model: 205 = TT205: Fixed Range, Miniature 509 = TT509: Programmable, Hockey Puck 511 = TT511: HART® Programmable, Hockey Puck |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| AS5165KU135P1C1U509A = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

Explosionproof/Flameproof RTD Sensors



Overview

Explosionproof and flameproof rating for hazardous areas where accurate temperature sensing is critical.

- Tip sensitive, all stainless or MgO filled probes available
- Hazardous area rated
- High temp process temperature options (600°C) available. Contact Minco for more information.

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

Probe: Stainless steel (tip sensitive models have copper alloy tip).
Holder: Stainless steel.
Connection head:
Copper free aluminum alloy (CH104)
316 stainless steel (CH106).

Pressure rating: See table on next page.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case.

Connection: Terminal block for wires to 14 AWG.

Time constant: Typical value in moving water.

Tip sensitive:

- Single element 1.5 seconds.
- Dual element 5 seconds.

All stainless and MgO filled: 10 seconds.

Explosionproof and flameproof ratings:

National and Canadian Electrical Code:

- Class I, Divisions 1 and 2, Groups B, C, and D,
- Class II, Groups E, F, and G,
- T6 (Ta = 40°C),
- T2 (Ta = 260°C). Ta limited to 160°C for CSA Class II locations.

National Electrical Code (Article 505):

- Class I, Zones 1 and 2, AEx d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Canadian Electrical Code (IEC 60079):

- Zones 1 and 2, Ex d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Assembly numbers

| Probe diameters | 0.215" (5.5 mm) | | 0.236" (6.0 mm) | | 0.250" (6.4 mm) | |
|----------------------------|-----------------|-------|-----------------|-------|-----------------|--------|
| Number of elements | Single | Dual | Single | Dual | Single | Dual |
| Tip-sensitive | AS760 | AS761 | AS700 | AS701 | ▼AS720 | ▼AS721 |
| All stainless | AS762 | AS763 | AS702 | AS703 | AS722 | AS723 |
| MgO filled (platinum only) | | | AS704 | | AS724 | AS725 |

Connection head and fitting options

CH104: Aluminum IP65, Type 3 and 4.

CH106: 316 stainless steel IP66, Type 3, 4, and 4X.

| Fitting | Process thread | Pressure Rating | L REF. | Code | Minimum Insertion Depth (mm) |
|--------------------------|----------------|--------------------|---------------|------|------------------------------|
| Welded | 1/2 - 14 NPT | 200 psi (13.8 bar) | 4.4" (112 mm) | 0* | 47 |
| Welded | G 1/2 | 200 psi (13.8 bar) | 4.2" (107 mm) | 2* | 47 |
| Adjustable spring-loaded | 1/2 - 14 NPT | 50 psi (3.4 bar) | 5.7" (144 mm) | ▼4 | 27 |
| Adjustable spring-loaded | G 1/2 | 50 psi (3.4 bar) | 5.7" (144 mm) | 6 | 27 |
| Fixed spring-loaded | 1/2 - 14 NPT | None | 4.4" (112 mm) | 8** | 27 |

* 0.250 diameter only for all stainless and MgO probes (not available in tip-sensitive, 0.215" diameter or 0.236" diameter probes).

** 0.236 and 0.250 diameters only for fixed spring-loaded fittings.

Note: Connection head dimensions are found on pages 3-2 to 3-3.

Sensing elements

| Element | Code | Code | |
|---|------|--------|------|
| | | Single | Dual |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | PA | PAPA | |
| Platinum (0.00385 TCR) 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | ▼PD | PDPD | |
| Platinum (0.00385 TCR) 100 Ω ±0.06% at 0°C (Meets EN60751, Class A) | PM | PMPM | |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | PE | PEPE | |
| Platinum (0.00375 TCR) 1000 Ω ±0.12% at 0°C | PW | PWPW | |
| Copper (0.00427 TCR) (dual) 10 Ω ±0.2% at 25°C 10 Ω ±0.5% at 25°C | CA | | |
| | | CCCC | |
| Nickel (0.00672 TCR) 120 Ω ±0.5% at 0°C | NA | NANA | |
| Nickel (0.00618 TCR) 100 Ω ±0.22% at 0°C | NB | NBNB | |

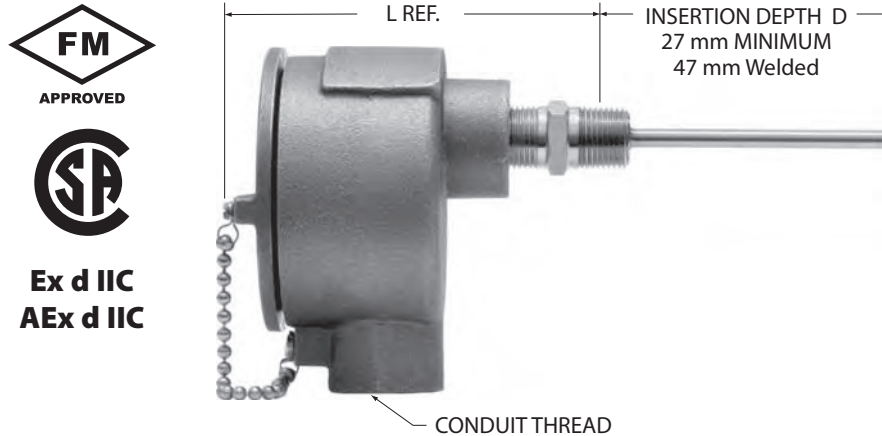
Specification and order options

| | |
|--|--|
| AS720 | Assembly number from table |
| 4 | Fitting from table |
| PD | Sensing element from table |
| 100 | Insertion depth D (mm): See table for minimums ▼:76, 100, 127, 150, 178, 200, 229, 250, 279, 305, 350, 406, 457, 500, 610 |
| Z | Leads per sensing element: Y = 2 leads (n/a for copper) ▼Z = 3 leads X = 4 leads |
| 3 | Conduit thread: ▼3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| AS7204PD100Z3A0X0X= Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Explosionproof/Flameproof Thermocouple Sensors



Overview

Explosionproof and flameproof rating for hazardous areas where accurate temperature sensing is critical.

- Tip sensitive, MgO filled probes available
- Hazardous area rated

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

Probe: Stainless steel (tip sensitive models have copper alloy tip).

Holder: Stainless steel.

Connection head:

- Copper free aluminum alloy (CH104)
- 316 stainless steel (CH106).

Pressure rating: See table on next page.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case. Ungrounded junctions only.

Connection: Terminal block for wires to 14 AWG.

Time constant: Typical value in moving water.

Tip sensitive:

- Grounded 1.5 seconds.
- Ungrounded 7 seconds.

MgO filled:

- Grounded: 1.5 seconds.
- Ungrounded: 5.0 seconds.

Explosionproof and flameproof ratings:

National and Canadian Electrical Code:

- Class I, Divisions 1 and 2, Groups B, C, and D,
- Class II, Groups E, F, and G,
- T6 (Ta = 40°C),
- T2 (Ta = 260°C). Ta limited to 160°C for CSA Class II locations.

National Electrical Code (Article 505):

- Class I, Zones 1 and 2, AEx d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Canadian Electrical Code (IEC 60079):

- Zones 1 and 2, Ex d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Contact Minco if transmitter is required

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

▼ = STANDARD OPTIONS
Specifications subject to change

Connection head and fitting options

CH104: Aluminum IP65, Type 3 and 4.

CH106: 316 stainless steel IP66, Type 3, 4, and 4X.

| Fitting | Process thread | Pressure Rating | L REF. | Code | Minimum Insertion Depth (mm) |
|--------------------------|----------------|--------------------|---------------|------|------------------------------|
| Welded | 1/2 - 14 NPT | 200 psi (13.8 bar) | 4.4" (112 mm) | 0* | 47 |
| Welded | G 1/2 | 200 psi (13.8 bar) | 4.2" (107 mm) | 2* | 47 |
| Adjustable spring-loaded | 1/2 - 14 NPT | 50 psi (3.4 bar) | 5.7" (144 mm) | 4 | 27 |
| Adjustable spring-loaded | G 1/2 | 50 psi (3.4 bar) | 5.7" (144 mm) | 6 | 27 |
| Fixed spring-loaded | 1/2 - 14 NPT | None | 4.4" (112 mm) | 8** | 27 |

* Welded fitting only available with 0.250 MgO filled probes [minimum insertion (2.5" 63mm)]

** 0.236 and 0.250 diameters only for fixed spring-loaded fittings.

Note: Connection head dimensions are found on pages 3-2 to 3-3.

Assembly numbers

| Probe diameters | 0.215" (5.5 mm) | | 0.236" (6.0 mm) | | 0.250" (6.4 mm) | |
|--------------------|-----------------|-------|-----------------|-------|-----------------|-------|
| | Single | Dual | Single | Dual | Single | Dual |
| Number of elements | | | | | | |
| Tip-sensitive | AS766 | AS767 | AS706 | AS707 | AS726 | AS727 |
| MgO filled | | | AS708 | AS709 | AS728 | AS729 |

Specification and order options

| | |
|---|--|
| AS706 | Assembly number from table |
| 4 | Fitting from table |
| E | Junction type from table |
| U | Junction Grounding: G = Grounded U = Ungrounded |
| 100 | Insertion depth D (mm): See table for minimums |
| P | |
| 3 | Conduit thread: 3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| AS7064EU100P3A0X0X = Sample part number | |

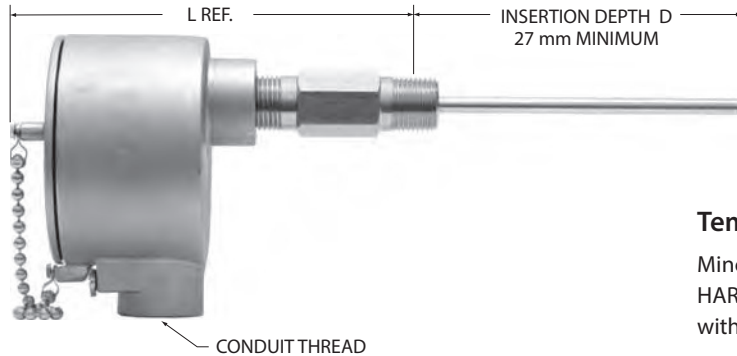
Junction types

| Thermocouple Junction | |
|-----------------------|---|
| Chromel-Constantan | E |
| Iron-Constantan | J |
| Chromel-Alumel | K |
| Copper-Constantan | T |

▼ = STANDARD OPTIONS

Specifications subject to change

Explosionproof/Flameproof RTDs with Transmitters



Ex d IIC
AEx d IIC

Overview

- Tip sensitive, all stainless or MgO filled RTD probe
- Temptran™ transmitter for long signal path

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

- Probe: Stainless steel (tip sensitive models have copper alloy tip).
- Holder: Stainless steel.
- Connection head:
 - Copper free aluminum alloy (CH104)
 - 316 stainless steel (CH106).

Pressure rating: See table on next page.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case.

Connection: Terminal block for wires to 14 AWG.

Time constant: Typical value in moving water.

Tip sensitive:

- Single element 1.5 seconds.
- Dual element 5 seconds.

All stainless and MgO filled: 10 seconds.

Explosionproof and flameproof ratings:

- National and Canadian Electrical Code:
 - Class I, Divisions 1 and 2, Groups B, C, and D,
 - Class II, Groups E, F, and G,
 - T6 (Ta = 40°C),
 - T2 (Ta = 260°C). Ta limited to 160°C for CSA Class II locations.

National Electrical Code (Article 505):

- Class I, Zones 1 and 2, AEx d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Canadian Electrical Code (IEC 60079):

- Zones 1 and 2, Ex d IIC,
- T6 (Ta = 40°C), T2 (Ta = 260°C).

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA or HART® Protocol signal that can be sent over long distances with a simple 2-wire system.

Leadwires:

- 2-lead RTD: TT211, TT520, TT521
- 3-lead RTD: TT520, TT521
- 4-lead RTD: TT520, TT521

Physical: Epoxy potted for moisture resistance.

See Section 4 for complete temperature transmitter specifications.

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

Assembly numbers

| Probe diameters | 0.215" (5.5 mm) | 0.236" (6.0 mm) | 0.250" (6.4 mm) |
|-----------------|-----------------|-----------------|-----------------|
| Tip-sensitive | AS760 | AS700 | AS720 |
| All stainless | AS762 | AS702 | AS722 |
| MgO filled | | AS704 | AS724 |

Sensing elements

| Element | | Code: Single |
|------------------------|---|--------------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00385 TCR) | 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.06% at 0°C (Meets EN60751, Class A) | PM |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | PE |
| Platinum (0.00375 TCR) | 1000 Ω ±0.12% at 0°C | PW |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | CA |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | NA |
| Nickel (0.00618 TCR) | 100 Ω ±0.22% at 0°C | NB |

▼ = STANDARD OPTIONS
Specifications subject to change

Connection head and fitting options

CH104: Aluminum IP65, Type 3 and 4.

CH106: 316 stainless steel IP66, Type 3, 4, and 4X.

| Fitting | Process thread | Pressure Rating | L REF. | Head | Code | Minimum Insertion Depth (mm) |
|--------------------------|----------------|--------------------|---------------|-------|------|------------------------------|
| Welded | 1/2 - 14 NPT | 200 psi (13.8 bar) | 4.4" (112 mm) | CH104 | 0* | 47 |
| Welded | 1/2 - 14 NPT | 200 psi (13.8 bar) | 4.2" (106 mm) | CH106 | 1* | 47 |
| Welded | G 1/2 | 200 psi (13.8 bar) | 4.2" (107 mm) | CH104 | 2* | 47 |
| Welded | G 1/2 | 200 psi (13.8 bar) | 4.0" (101 mm) | CH106 | 3* | 47 |
| Adjustable spring-loaded | 1/2 - 14 NPT | 50 psi (3.4 bar) | 5.7" (144 mm) | CH104 | 4 | 27 |
| Adjustable spring-loaded | 1/2 - 14 NPT | 50 psi (3.4 bar) | 5.4" (138 mm) | CH106 | 5 | 27 |
| Adjustable spring-loaded | G 1/2 | 50 psi (3.4 bar) | 5.7" (144 mm) | CH104 | 6 | 27 |
| Adjustable spring-loaded | G 1/2 | 50 psi (3.4 bar) | 5.4" (138 mm) | CH106 | 7 | 27 |
| Fixed spring-loaded | 1/2 - 14 NPT | None | 4.4" (112 mm) | CH104 | 8** | 27 |
| Fixed spring-loaded | 1/2 - 14 NPT | None | 4.2" (106 mm) | CH106 | 9** | 27 |

* 0.250 diameter only for all stainless and MgO probes.
(not available in tip-sensitive, 0.215" diameter or 0.236" diameter probes)

** 0.236 and 0.250 diameters only for fixed spring-loaded fittings.
Note: Connection head dimensions are found on page 3-2.

Temperature transmitter range codes

Popular ranges below. More range codes starting on page 4-20 and at www.minco.com

| Code | Range | |
|------|------------------|--------------|
| EO | -50 to 100°C | -58 to 212°F |
| BC | -30 to 30°C | -22 to 86°F |
| S | -17.8 to 37.8°C | 0 to 100°F |
| AC | -17.8 to 93.3°C | 0 to 200°F |
| AN | -17.8 to 148.9°C | 0 to 300°F |
| AG | -17.8 to 260°C | 0 to 500°F |
| AP | -6.7 to 21.1°C | 20 to 70°F |
| A | -6.7 to 48.9°C | 20 to 120°F |
| N | 0 to 50°C | 32 to 122°F |
| C | 0 to 100°C | 32 to 212°F |
| J | 0 to 150°C | 32 to 302°F |
| K | 0 to 200°C | 32 to 392°F |
| V | 10 to 65.6°C | 50 to 150°F |
| P | 37.8 to 179.4°C | 100 to 355°F |
| BH | 50 to 150°C | 122 to 302°F |

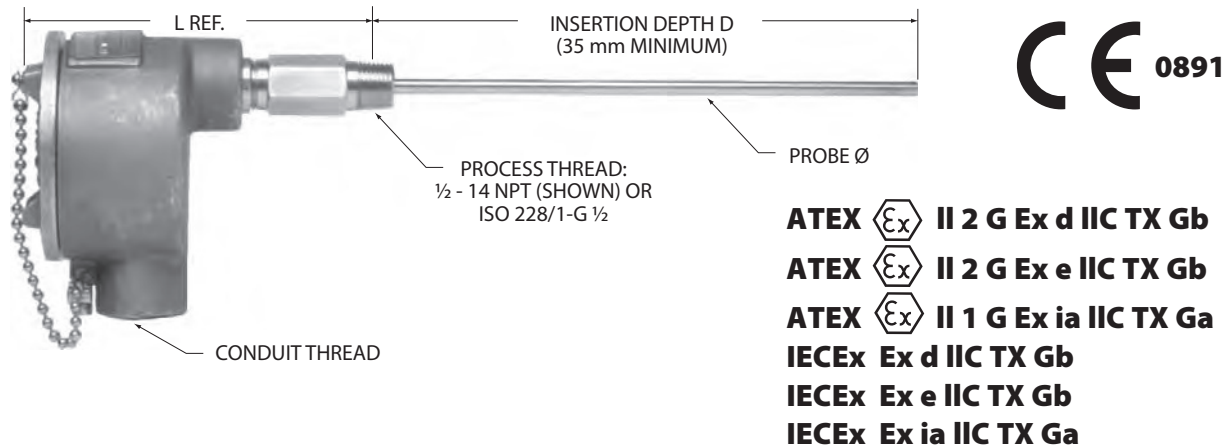
▼ = STANDARD OPTIONS




Specifications subject to change

Specification and order options

| | |
|--|---|
| AS720 | Assembly number from table |
| 4 | Fitting from table |
| PD | Sensing element from table |
| 100 | Insertion depth D (mm): See table for minimums ▼:76, 100, 127, 150, 178, 200, 229, 250, 279, 305, 350, 406, 457, 500, 610 |
| Z | Leads per sensing element: Y = 2 leads (n/a for copper) ▼Z = 3 leads X = 4 leads |
| 3 | Conduit thread: 3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| 1 | Temptran™ code: 1 = TT518: Programmable Hockey Puck (2 or 3-lead RTDs) 2 = TT519: Programmable Hockey Puck (Thermocouple only) 4 = TT211: Fixed range Rectangular (2-lead RTDs) 7 = TT521: HART® Programmable Hockey Puck (2, 3, or 4-lead RTDs or Thermocouples) |
| N | Temperature range code from table |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS7204PD100Z3A0X0X1N1 = Sample part number | |

Flameproof, Increased Safety and Intrinsic Safety RTD Sensors – Per European and International Requirements



ATEX  **II 2 G Ex d IIC TX Gb**
ATEX  **II 2 G Ex e IIC TX Gb**
ATEX  **II 1 G Ex ia IIC TX Ga**
IECEX Ex d IIC TX Gb
IECEX Ex e IIC TX Gb
IECEX Ex ia IIC TX Ga

Overview

Complies with European standards for electrical apparatus for potentially explosive atmospheres: ATEX Directive 94/9/EC and International IECEx certification schemes for explosive atmospheres.

- Flameproof assemblies can be used in Zones 1 or 2
- Increased safety assemblies can be used in Zones 1 or 2
- Intrinsic safety assemblies can be used in Zones 0, 1 or 2 when used with an appropriate barrier
- Features tip-sensitive, all stainless or MgO filled RTD probe for fast response
- Spring-loaded holder ensures good probe contact
- U.S. or metric threads

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

- Tip-sensitive probe: Stainless steel with copper alloy tip.
- All stainless RTD: Stainless steel.
- MgO filled RTD: Stainless steel.
- Fittings: Stainless steel.
- Connection head:
 - CH356: 316 stainless steel IP66, Type 3, 4, and 4X.
 - CH357: Aluminum alloy IP65, Type 3 and 4.
 - CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Pressure rating:

- Spring-loaded holder: 50 psi (3.4 bar).
- Fluid seal fitting: 100 psi (6.9 bar).

Insulation resistance: 100 megohms min. at 100 VDC, leads to probe case.

Connection: Terminal block for wires up to AWG 14.

Time constant: Typical value in moving water.

Tip sensitive:

- Single element 1.5 seconds.
- Dual element 7 seconds.
- All stainless and MgO filled: 10 seconds.

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Fitting options

| Fitting | Process Thread | L REF. | | Code | Pressure Rating |
|----------------------------|----------------|---------------|---------------|------|-------------------|
| | | CH356 | CH357/CH358 | | |
| Fluid Seal | 1/2 - 14 NPT | | 4.6" (116 mm) | 0* | 50psi (3.4 bar) |
| Fluid Seal | G 1/2 | | 4.4" (111 mm) | 1* | 50psi (3.4 bar) |
| Set screw spring-loaded | 1/2 - 14 NPT | 5.3" (135 mm) | 5.6" (143 mm) | 2 | 50psi (3.4 bar) |
| Set screw spring-loaded | G 1/2 | 5.0" (128mm) | 5.4" (136 mm) | 3 | 50psi (3.4 bar) |
| Fixed spring-loaded | 1/2 - 14 NPT | 4.5" (115 mm) | | 4 | None |
| Welded | 1/2 - 14 NPT | 4.2"(107 mm) | 4.5" (115 mm) | 6** | 200psi (13.8 bar) |
| Welded | G 1/2 | 4.0" (101 mm) | 4.3" (109 mm) | 7** | 200psi (13.8 bar) |
| Release knob spring-loaded | 1/2 - 14 NPT | 5.4" (137 mm) | 5.7" (145 mm) | 8 | 50psi (3.4 bar) |
| Release knob spring-loaded | G 1/2 | 5.2" (132 mm) | 5.5" (140 mm) | 9 | 50psi (3.4 bar) |

* Not available with CH356 stainless steel connection head.

** 0.250" (6.4mm) for all stainless and MgO only (not available in tip-sensitive or 0.236" diameter models).

RTD Assembly Numbers

| Probe Diameters | 0.236" (6.0mm) | | 0.250" (6.4mm) | |
|-----------------|----------------|-------|----------------|-------|
| | Single | Dual | Single | Dual |
| Tip Sensitive | AS800 | AS801 | AS810 | AS811 |
| All Stainless | AS802 | AS803 | AS812 | AS813 |
| MgO Platinum | AS804 | | AS814 | AS815 |

Notes:

CH356: 316 stainless steel IP66, Type 3, 4, and 4X.

CH357: Aluminum alloy IP65, Type 3 and 4.

CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Get more information on connection heads on pages 3-2 to 3-3.

Sensing elements

| Element | Code | Code | |
|--|------|--------|------|
| | | Single | Dual |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | PA | PAPA | |
| Platinum (0.00385 TCR) 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | PD | PDPD | |
| Platinum (0.00385 TCR) 100 Ω ±0.06% at 0°C (Meets EN60751, Class A) | PM | PMPM | |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | PE | PEPE | |
| Platinum (0.00375 TCR) 1000 Ω ±0.12% at 0°C | PW | PWPW | |
| Copper (0.00427 TCR) 10 Ω ±0.2% at 25°C | CA | | |
| (dual) 10 Ω ±0.5% at 25°C | | CCCC | |
| Nickel (0.00672 TCR) 120 Ω ±0.5% at 0°C | NA | NANA | |
| Nickel (0.00618 TCR) 100 Ω ±0.22% at 0°C | NB | NBNB | |

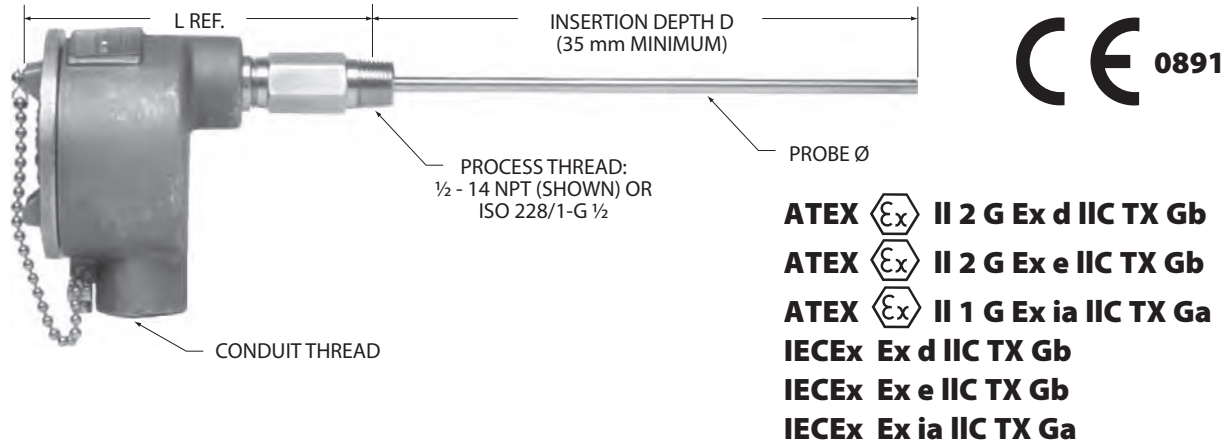
Specification and order options

| | |
|---|--|
| AS800 | Assembly number from table |
| 4 | Fitting from table |
| PD | Sensing element from table |
| 100 | Insertion depth D (in mm): (35-3000 mm) |
| X | Leads per sensing element: Y = 2 leads (n/a for copper) Z = 3 leads X = 4 leads (n/a for dual models) |
| 3 | Conduit thread: 3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT 5 = M20 x 1.5 |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel E = Aluminum, epoxy coated |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| AS8004PD100X3A0X0X = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Flameproof, Increased Safety and Intrinsic Safety Thermocouple Sensors – Per European and International Requirements



Overview

Complies with European standards for electrical apparatus for potentially explosive atmospheres: ATEX Directive 94/9/EC and International IECEx certification schemes for explosive atmospheres.

- Flameproof assemblies can be used in Zones 1 or 2
- Increased safety assemblies can be used in Zones 1 or 2
- Intrinsic safety assemblies can be used in Zones 0, 1 or 2 when used with an appropriate barrier
- Features tip-sensitive or MgO filled thermocouple probe for fast response
- Spring-loaded holder ensures good probe contact
- U.S. or metric threads

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

- Tip-sensitive probe: Stainless steel with copper alloy tip.
- MgO filled thermocouple: Stainless steel.
- Fittings: Stainless steel.
- Connection head:
 - CH356: 316 stainless steel IP66, Type 3, 4, and 4X.
 - CH357: Aluminum alloy IP65, Type 3 and 4.
 - CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Pressure rating:

- Spring-loaded holder: 50 psi (3.4 bar).
- Fluid seal fitting: 100 psi (6.9 bar).

Insulation resistance: 100 megohms min. at 100 VDC, leads to probe case. Ungrounded junction models only on thermocouples.

Connection: Terminal block for wires up to AWG 14.

Time constant: Typical value in moving water.

Tip sensitive:

Single element 1.5 seconds.

Dual element 7 seconds.

All stainless and MgO filled: 10 seconds.

Temperature Transmitters

Minco's Temptran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Contact Minco if transmitter is required.

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

▼ = STANDARD OPTIONS

Specifications subject to change

Fitting options

| Fitting | Process Thread | L REF. | | Code | Pressure Rating |
|----------------------------|----------------|---------------|---------------|------|-------------------|
| | | CH356 | CH357/CH358 | | |
| Fluid Seal | 1/2 - 14 NPT | | 4.6" (116 mm) | 0* | 50psi (3.4 bar) |
| Fluid Seal | G 1/2 | | 4.4" (111 mm) | 1* | 50psi (3.4 bar) |
| Set screw spring-loaded | 1/2 - 14 NPT | 5.3" (135 mm) | 5.6" (143 mm) | 2 | 50psi (3.4 bar) |
| Set screw spring-loaded | G 1/2 | 5.0" (128mm) | 5.4" (136 mm) | 3 | 50psi (3.4 bar) |
| Fixed spring-loaded | 1/2 - 14 NPT | 4.5" (115 mm) | | 4 | None |
| Welded | 1/2 - 14 NPT | 4.2"(107 mm) | 4.5" (115 mm) | 6** | 200psi (13.8 bar) |
| Welded | G 1/2 | 4.0" (101 mm) | 4.3" (109 mm) | 7** | 200psi (13.8 bar) |
| Release knob spring-loaded | 1/2- 14 NPT | 5.4" (137 mm) | 5.7" (145 mm) | 8 | 50psi (3.4 bar) |
| Release knob spring-loaded | G 1/2 | 5.2" (132 mm) | 5.5" (140 mm) | 9 | 50psi (3.4 bar) |

* Not available with CH356 stainless steel connection head.

** 0.250" (6.4mm) for MgO only (not available in tip-sensitive or 0.236" diameter models).

Thermocouple Assembly Numbers

| Probe Diameters | 0.236" (6.0mm) | | 0.250" (6.4mm) | |
|--------------------|----------------|-------|----------------|-------|
| | Single | Dual | Single | Dual |
| Number of elements | AS806 | AS807 | AS816 | AS817 |
| Tip Sensitive | AS806 | AS807 | AS816 | AS817 |
| MgO | AS808 | AS809 | AS818 | AS819 |

Notes:

CH356: 316 stainless steel IP66, Type 3, 4, and 4X.

CH357: Aluminum alloy IP65, Type 3 and 4.

CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Get more information on connection heads on pages 3-2 to 3-3.

Junction types

| Thermocouple Junction | Code |
|-----------------------|------|
| Chromel-Constantan | E |
| Iron-Constantan | J |
| Chromel-Alumel | K |
| Copper-Constantan | T |

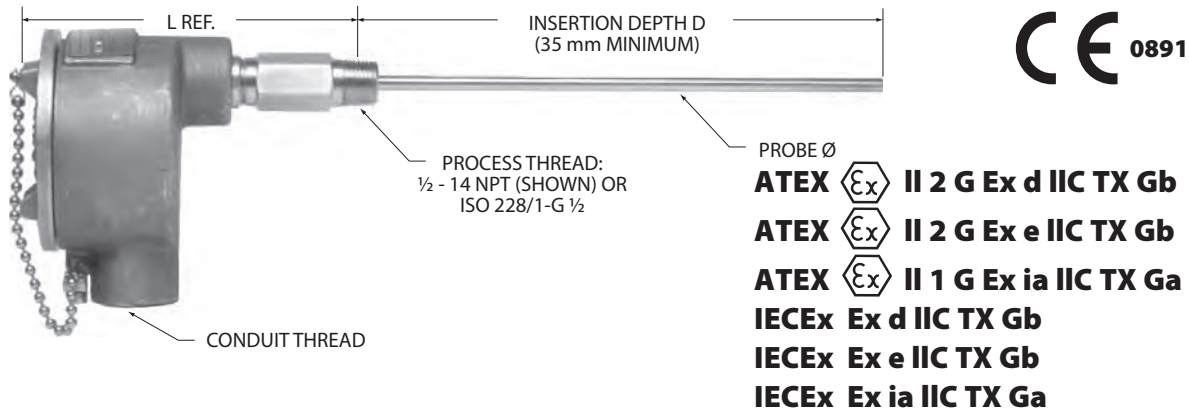
Specification and order options

| | |
|--|--|
| AS806 | Assembly number from table |
| 4 | Fitting from table |
| E | Junction type from table |
| U | Junction Grounding: G = Grounded U = Ungrounded |
| 450 | Insertion depth D (in mm): (35-3000 mm) |
| P | |
| 3 | Conduit thread: 3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT 5 = M20 x 1.5 |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel E = Aluminum, Epoxy coated |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| AS8064EU450P3A0X0X= Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Flameproof, Increased Safety and Intrinsic Safety RTDs with Transmitters – Per European and International Requirements



Overview

Complies with European standards for electrical apparatus for potentially explosive atmospheres: ATEX Directive 94/9/EC and International IECEx certification schemes for explosive atmospheres.

- Flameproof assemblies can be used in Zones 1 or 2
- Increased safety assemblies can be used in Zones 1 or 2
- Intrinsic safety assemblies can be used in Zones 0, 1 or 2 when used with an appropriate barrier
- Features tip-sensitive, all stainless or MgO filled RTD probe for fast response
- Spring-loaded holder ensures good probe contact
- U.S. or metric threads

Specifications

Temperature range:

- 50 to 260°C (-58 to 500°F)
- 50 to 600°C (-58 to 1112°F) for MgO Probes

Material:

- Tip-sensitive probe: Stainless steel with copper alloy tip.
- All stainless RTD: Stainless steel.
- MgO filled RTD: Stainless steel.
- Fittings: Stainless steel.
- Connection head:
 - CH356: 316 stainless steel IP66, Type 3, 4, and 4X.
 - CH357: Aluminum alloy IP65, Type 3 and 4.
 - CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Pressure rating:

- Spring-loaded holder: 50 psi (3.4 bar).
- Fluid seal fitting: 100 psi (6.9 bar).

Insulation resistance: 100 megohms min. at 100 VDC, leads to probe case.

Connection: Terminal block for wires to 14 AWG.

Time constant: Typical value in moving water.

Tip sensitive:

Single element 1.5 seconds.

All stainless and MgO filled: 10 seconds.

Temperature Transmitters

Minco's Temptan™ RTD transmitters provide a 4 to 20 mA or HART® Protocol signal that can be sent over long distances with a simple 2-wire system.

Leadwires:

- 2-lead RTD: TT211, TT520, TT521
- 3-lead RTD: TT520, TT521
- 4-lead RTD: TT520, TT521

Physical: Epoxy potted for moisture resistance.

See Section 4 for complete temperature transmitter specifications.

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, IECEx and ATEX), visit www.minco.com.

▼ = STANDARD OPTIONS
Specifications subject to change

Fitting options

| Fitting | Process Thread | L REF. | | Code | Pressure Rating |
|----------------------------|----------------|---------------|---------------|------|-------------------|
| | | CH356 | CH357/CH358 | | |
| Fluid Seal | 1/2 - 14 NPT | | 4.6" (116 mm) | 0* | 50psi (3.4 bar) |
| Fluid Seal | G 1/2 | | 4.4" (111 mm) | 1* | 50psi (3.4 bar) |
| Set screw spring-loaded | 1/2 - 14 NPT | 5.3" (135 mm) | 5.6" (143 mm) | 2 | 50psi (3.4 bar) |
| Set screw spring-loaded | G 1/2 | 5.0" (128mm) | 5.4" (136 mm) | 3 | 50psi (3.4 bar) |
| Fixed spring-loaded | 1/2 - 14 NPT | 4.5" (115 mm) | | 4 | None |
| Welded | 1/2 - 14 NPT | 4.2" (107 mm) | 4.5" (115 mm) | 6** | 200psi (13.8 bar) |
| Welded | G 1/2 | 4.0" (101 mm) | 4.3" (109 mm) | 7** | 200psi (13.8 bar) |
| Release knob spring-loaded | 1/2 - 14 NPT | 5.4" (137 mm) | 5.7" (145 mm) | 8 | 50psi (3.4 bar) |
| Release knob spring-loaded | G 1/2 | 5.2" (132 mm) | 5.5" (140 mm) | 9 | 50psi (3.4 bar) |

* Not available with CH356 stainless steel connection head.

** 0.250" (6.4mm) for all stainless and MgO only

(not available in tip-sensitive or 0.236" diameter models).

RTD Assembly Numbers

| Probe Diameters | 0.236" (6.0mm) | 0.250" (6.4mm) |
|--------------------|----------------|----------------|
| Number of elements | Single | Single |
| Tip Sensitive | AS800 | AS810 |
| All Stainless | AS802 | AS812 |
| MgO Platinum | AS804 | AS814 |

Notes:

CH356: 316 stainless steel IP66, Type 3, 4, and 4X.

CH357: Aluminum alloy IP65, Type 3 and 4.

CH358: Epoxy coated aluminum alloy IP66, Type 3, 4, and 4X.

Get more information on connection heads on pages 3-2 to 3-3.

Temperature transmitter range codes

Popular ranges below. More range codes on pages 4-20 and at www.minco.com

| Code | Range |
|------|------------------------------|
| EO | -50 to 100°C -58 to 212°F |
| BC | -30 to 30°C -22 to 86°F |
| S | -17.8 to 37.8°C 0 to 100°F |
| AC | -17.8 to 93.3°C 0 to 200°F |
| AN | -17.8 to 148.9°C 0 to 300°F |
| AG | -17.8 to 260°C 0 to 500°F |
| AP | -6.7 to 21.1°C 20 to 70°F |
| A | -6.7 to 48.9°C 20 to 120°F |
| N | 0 to 50°C 32 to 122°F |
| C | 0 to 100°C 32 to 212°F |
| J | 0 to 150°C 32 to 302°F |
| K | 0 to 200°C 32 to 392°F |
| V | 10 to 65.6°C 50 to 150°F |
| P | 37.8 to 179.4°C 100 to 355°F |
| BH | 50 to 150°C 122 to 302°F |

Sensing elements

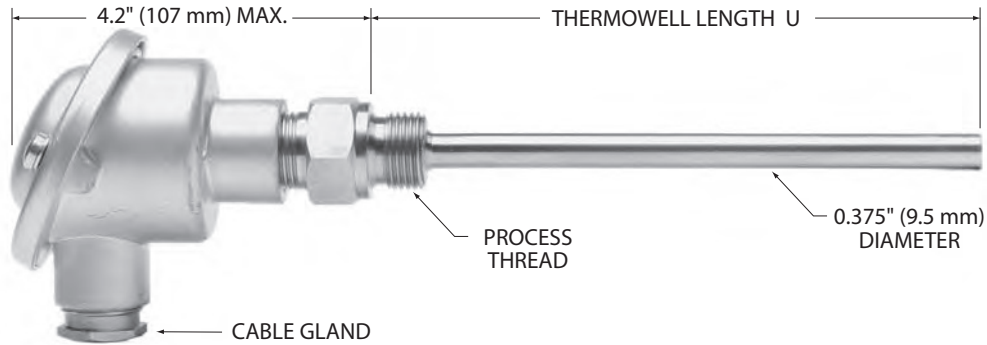
| RTD sensing element | Code |
|---|------|
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00385 TCR) 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | PD |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | PE |

Specification and order options

| | |
|--|---|
| AS800 | Assembly number from table |
| 4 | Fitting from table |
| PD | Sensing element from table |
| 100 | Insertion depth D (in mm): (35-3000 mm) |
| Y | Leads per sensing element: Y = 2 leads (n/a for copper) Z = 3 leads X = 4 leads |
| 3 | Conduit thread: 3 = 1/2 - 14 NPT 4 = 3/4 - 14 NPT 5 = M20 x 1.5 |
| A | Connection head material: A = Aluminum S = 316 Stainless Steel E = Aluminum, Epoxy coated |
| 0 | Extension: 0 = No Extension 2 = 1/2 NPT Nipple (2")/Union (2.6" length adder) 3 = 1/2 NPT Nipple (3")/Union (3.6" length adder) 4 = 1/2 NPT Nipple (4")/Union (4.6" length adder) 6 = 1/2 NPT Nipple (6")/Union (6.6" length adder) |
| X0X | No Thermowell |
| 1 | Temptran™ code: 1 = TT518: Programmable Hockey Puck (2 or 3-lead RTDs) 2 = TT519: Programmable Hockey Puck (Thermocouple only) 4 = TT211: Fixed range Rectangular (2-lead RTDs) 7 = TT521: HART® Programmable Hockey Puck (2, 3, or 4-lead RTDs or Thermocouples) |
| N | Temperature range code from table |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS8004PD100Y3A0X0X1N1 = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

Eurostyle Sensors



Overview

These low priced assemblies come complete with thermowells, spring-loaded probes, and connection heads. They provide accurate sensing and quick response in liquid or air streams. Specify U.S. or metric thread for global compatibility.

- Compact, economical RTD or thermocouple assembly
- Metric straight thread or U.S. tapered thread
- Tip-sensitive probe for use to 260°C (500°F)
- Optional European Form B connection head to DIN 43729
- Stainless steel thermowell

Temperature Transmitters

Minco's Temptran™ RTD transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

Special high-accuracy calibration: For high system accuracy, specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Material:

Probe: Stainless steel with copper alloy tip.

Connection head: Cast aluminum.

Thermowell: 300 series stainless steel.

Pressure rating: 2755 psi (190 bar) at 25°C, reducing to 493 psi (34 bar) at 600°C.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case. Ungrounded junctions only on thermocouples.

Connection: Terminal block for wires to 14 AWG.

Time constant: Typical in moving water:

RTD: 35 seconds.

Thermocouple: 27 seconds.

▼ = STANDARD OPTIONS

Specifications subject to change

Sensing elements

| RTD sensing element | | Code |
|--|--|----------|
| Platinum (0.00392 TCR) | 100 Ω \pm 0.5% at 0°C | PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω \pm 0.1% at 0°C | PD |
| Platinum (0.00385 TCR) | 100 Ω \pm 0.5% at 0°C | PE |
| Copper (dual) (0.00427 TCR) | 10 Ω \pm 0.2% at 25°C 10 Ω \pm 0.5% at 25°C | CA CC |
| Nickel (0.00672 TCR) | 120 Ω \pm 0.5% at 0°C | NA |

RTD specification and order options

| | |
|--|---|
| AS5240 | Assembly number: AS5240: Single element RTD AS5241: Dual element RTD |
| PD | Sensing element from table |
| 40 | TW length U in 0.1" increments [Ex: 40 = 4.0 inches (102 mm)] |
| Z | Leads per sensing element: Y = 2 leads Z = 3 leads (required for CA/CC) X = 4 leads (single element only) |
| 2 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT 3 = PG cable gland (Eurostyle only) |
| A | Connection head: A = Standard aluminum head E = Eurostyle aluminum head |
| 1 | TW process thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT 3 = ISO 228/1 - G 1/2 |
| To order sensor assembly, stop here. To order with transmitters, add: | |
| TT520 | Temptran™ model: TT520: Programmable (2, 3, & 4-lead RTDs) TT521: HART® Programmable (2, 3, & 4-lead RTDs) |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| 1 | Calibration: 1 = Nominal calibration 2 = Match calibrated, 0.75% total system accuracy. For other calibration options, contact Minco |
| AS5240PD40Z2A1TT520A1 = Sample part number | |

Thermocouple specification and order options

| | |
|--|--|
| AS5245 | Assembly number: AS5245: Single junction TC AS5246: Dual junction TC |
| E | Junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan |
| G | Junction grounding: G = Grounded U = Ungrounded |
| 135 | TW length U in 0.1" increments Specify in 0.1" increments [Ex: 135 = 13.5 inches (343 mm)] |
| P | |
| 3 | Conduit thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT 3 = PG cable gland (Eurostyle only) |
| E | Connection head: A = Standard aluminum head E = Eurostyle aluminum head |
| 3 | TW process thread: 1 = 1/2 - 14 NPT 2 = 3/4 - 14 NPT 3 = ISO 228/1 - G 1/2 |
| To order sensor assembly, stop here. To order with transmitters, add: | |
| TT520 | Temptran™ model: 520 = TT520: Programmable, Hockey Puck 521 = TT521: HART® Programmable, Hockey Puck |
| A | Temperature range codes starting on page 4-20 or at www.minco.com |
| AS5245EG135P3E3520A = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

Specifying Custom Assemblies

The standard assemblies in this section will fit a wide variety of installations. However, for more versatility you can create new assemblies from the probes, accessories, and transmitters in the pages listed.

Follow these steps:

1. Choose a probe

Select an RTD or thermocouple from Section 2. The section includes tip-sensitive, high temperature, and fast response models. Some have integral fittings or bayonet lockcaps.

Factors to consider are:

- Temperature rating
- Compatibility with receiving instruments
- Probe style and diameter
- Accuracy vs. cost

2. Add a fitting

See Section 3 for probe mounting fittings. Adjustable fittings, combined with cut-to-length probes, allow instant fabrication of assemblies to any length required. Included are spring-loaded holders, pressure fittings, and bayonet-style fittings.

Factors to consider are:

- Temperature rating
- Probe diameter
- Correct NPT threads
- Pressure ratings
- Compatibility with environment

3. Select a thermowell

Thermowells protect sensors from the effects of fluid flow and pressure. See Section 3 for a variety of well styles and materials.

Factors to consider are:

- Pressure rating
- Compatibility with fluid media
- Insertion depth
- Correct NPT thread

4. Attach a connection head

Finish off your assembly with a connection head for termination to remote extension wires. See page 3-2 for specifications.

Factors to consider are:

- Connection head size
- Temperature rating
- Correct pipe threads for fitting and conduit
- Number of terminals or wire nuts
- Hazardous area requirements

5. Install a transmitter

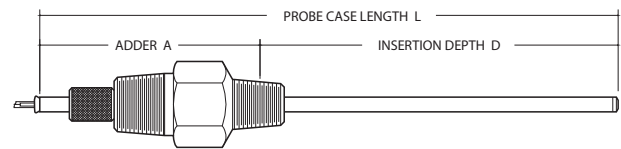
Transmitters convert sensor output to a 4 to 20 mA current signal, immune to leadwire resistance. See Section 4 for RTD and thermocouple transmitters.

Factors to consider are:

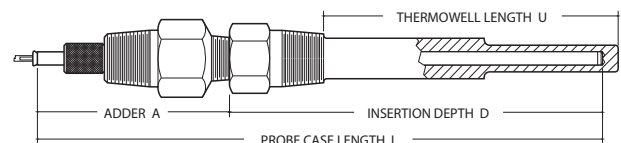
- Transmitter accepts sensor input
- Transmitter fits connection head
- Ambient temperature range acceptable

6. How to calculate probe length

All Minco fittings have probe length adders to help you determine total probe length. Total length L is the insertion depth D plus the adder A.




Thermowell drawings show an adder to convert thermowell length U to insertion depth D. Then use D plus the fitting adder A to find total probe length L.



▼ = STANDARD OPTIONS
Specifications subject to change



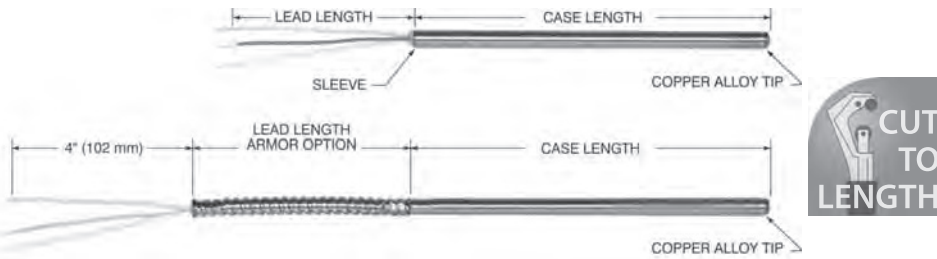
▶ SECTION 2: PROBES

- RTDs and thermocouples in a variety of configurations for easy installation
- Tip-sensitive and fast response probes for quick and accurate temperature sensing
- High temperature probes to 650°C for extreme environments
- Single and dual elements offer high reliability
- Cut-to-length models are marked with  (see page 2-18 for instructions)

| | |
|--|--------------|
| Tip-sensitive RTDs and thermocouples..... | 2-2 to 2-3 |
| Fast Response RTDs..... | 2-4 to 2-5 |
| Bayonet mount tip-sensitive RTDs, thermocouples..... | 2-6 to 2-7 |
| Electrically isolated RTDs, thermocouples..... | 2-8 to 2-9 |
| 550°C RTDs, thermocouples..... | 2-10 to 2-11 |
| 600°C RTDs..... | 2-12 |

| | |
|--|--------------|
| Mineral-insulated RTDs..... | 2-13 |
| Compact plug sensor..... | 2-14 |
| Integrated sensor transmitter..... | 2-15 |
| Conductivity level sensor..... | 2-16 to 2-17 |
| How to shorten cut-to-length probes..... | 2-18 |
| PFA, FEP encapsulation..... | 2-18 |

Tip-sensitive RTDs & Thermocouples



Overview

The probe sensing tip is constructed of copper alloy which is twenty times more conductive than stainless steel. The sensors react more quickly to changes and indicate tip temperature instead of stem temperature. The result is better accuracy in thermowells, bearings, and other installations. Minco recommends 0.250" diameter probes for use in thermowells.

- Copper alloy tip for fast response
- Accurate sensing to 260°C (500°F)
- Non-armor models can be user-shortened

Specifications

Temperature range:

Thermocouple: -184 to 260°C (-300 to 500°F).

RTD: -50 to 260°C (-58 to 500°F).

Case:

Stainless steel with copper alloy tip.

Minimum case length:

Thermocouple: 2.5" (63.5 mm).

- RTD:**
- Single element probes: 2.8" (71.1 mm).
 - Dual element probes: 4.0" (101.6 mm).

Maximum case length:

48" (1220 mm), longer on special order.

Leads:

Thermocouple: Solid thermocouple wire, AWG 20 (except AWG 24 on model TC355). Specify PTFE insulation, stainless steel overbraid, or stainless steel armor.

RTD: 2, 3, or 4 leadwires, stranded copper with PTFE insulation. AWG 22, except 0.188" diameter dual probes AWG 24. For 2-lead RTDs add 0.03 Ω per foot (0.05 Ω per foot for 0.188" diameter dual probes) of combined case and lead length to element tolerance. Copper (CA, CC) models must have 3 leads.

Time constant:

Thermocouple: Typical value in moving water:

- Grounded junction: 1.5 seconds.
- Ungrounded junction: 7 seconds.

RTD:

- 2.0 seconds typical in moving water.
- 3.0 seconds for dual element models.

Pressure rating:

100 psi (6.9 bar).

Insulation resistance:

Thermocouple: 10 megohms minimum at 100 VDC, leads to case, ungrounded junctions only.

RTD:

- Single element probes: 1000 megohms min. at 500 VDC, leads to case.
- Dual element probes: 100 megohms min. at 100 VDC, between elements and leads to case.

Vibration:

Withstands 10 to 2000 Hz at 20 G's min. per MIL-STD-202, Method 204, Test Condition D.

Shock:

Withstands 100 G's min. sine wave shock of 8 milliseconds duration.

Model numbers: Thermocouples

| | Model for probe diameter: | | |
|-----------------|---------------------------|-----------------|-----------------|
| | 0.188" (4.8 mm) | 0.215" (5.5 mm) | 0.250" (6.4 mm) |
| Single junction | ▼ TC354 | ▼ TC356 | ▼ TC358 |
| Dual junction | ▼ TC355 | ▼ TC357 | ▼ TC359 |

Specification and order options: Thermocouples

| | |
|------------------------------------|--|
| TC356 | Model number from table |
| T | Junction type: ▼ E = Chromel-Constantan ▼ J = Iron-Constantan ▼ K = Chromel-Alumel ▼ T = Copper-Constantan |
| G | Junction grounding: ▼ G = Grounded ▼ U = Ungrounded |
| 120 | Case length: Specify in 0.1" increments: Ex: 120 = 12.0 inches ▼ : 60, 120, 240 |
| T | Covering over leadwires: ▼ T = PTFE only G = Glass braid only S = Stainless steel overbraid A = Stainless steel armor |
| 80 | Lead length in inches: ▼80 |
| TC356TG120T80 = Sample part number | |

▼ = STANDARD OPTIONS
 Specifications subject to change

Model numbers: RTD's

| Element | Model for probe diameter: | | |
|--|---------------------------|--------------------|--------------------|
| | 0.188" (4.8 mm) | 0.215" (5.5 mm) | 0.250" (6.4 mm) |
| Single element RTDs: No armor over leads | | | |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | ▼S54PA | ▼S51PA | ▼S53PA |
| Platinum (0.00385 TCR) 100 Ω ±0.06% at 0°C (Meets EN60751, Class A) | ▼S554PM | ▼S551PM | ▼S553PM |
| Platinum (0.00385 TCR) 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | ▼S854PD | ▼S851PD | ▼S853PD |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | S884PE | S881PE | S883PE |
| Copper (0.00427 TCR) 10 Ω ±0.2% at 25°C | S54CA | S51CA | S53CA |
| Nickel (0.00672) 120 Ω ±0.5% at 0°C | S54NA | S51NA | S53NA |
| Single element RTDs: With armor over leads | | | |
| Add element code (Ex: S154__ =S154NA) | ▼S154__ | ▼S151__ | ▼S153__ |
| Dual element RTDs: No armor over leads | | | |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | ▼S59PA | ▼S56PA | ▼S57PA |
| Platinum (0.00385 TCR) 100 Ω ±0.06% at 0°C (Meets EN60751, Class A) | S559PM | S856PM | S557PM |
| Platinum (0.00385 TCR) 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | ▼S859PD | ▼S856PD | ▼S857PD |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | S889PE | S886PE | S887PE |
| Copper (0.00427 TCR) 10 Ω ±0.5% at 25°C | | S56CC | S57CC |
| Nickel (0.00672) 120 Ω ±0.5% at 0°C | S59NA | S56NA | S57NA |
| Dual element RTDs: With armor over leads | | | |
| Add element code (Ex: S159__ =S159NA) | S159__ | S156__ | ▼S157__ |



STOCKED PARTS AVAILABLE

Specification and order options: RTD's

| S59PA | Model number from table |
|----------------------------------|--|
| 120 | Case length: Specify in 0.1" increments (Ex: 120 = 12.0 inches) ▼ : 40, 50, 60, 70, 80, 90, 100, 110, 120, 140, 160, 180, 200, 240 |
| Z | # of leads per sensing element: Y = 2 leads ▼ Z = 3 leads (req'd for copper elements) ▼ X = 4 leads (PD only) |
| 36 | Lead length in inches ▼ : 36, 80, 120 |
| S59PA120Z36 = Sample part number | |

Minco also offers probes equivalent to those shown on this page with the added certifications of:

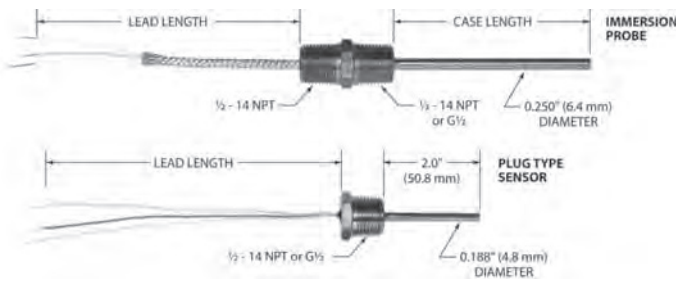
- ATEX Ex ia and EX e (Zones 0 and 1)
- IECEx Ex ia and EX e (Zones 0 and 1)
- TR CU (EAC) Ex ia and EX e (Zones 0 and 1)

▼ = **STANDARD OPTIONS**

Specifications subject to change



Fast Response Immersion RTDs



Overview

You can mount these probes directly in fluid streams for accurate, reliable sensing. Time constant is just 2 seconds, compared to 10 seconds for an ordinary stainless probe or up to 50 seconds for a thermowell. The result is more accurate monitoring of dynamic processes.

- Pressure rating 1500 psi (103 bar)
- Quick reaction to changing fluid and gas temperatures
- NPT (U.S.) or metric threads
- ATEX, IECEx and TR CU (EAC) Ex e and Ex ia options available

Specifications

Temperature range: -269 to 260°C (-452 to 500°F).

Case material:

S623, S628: 316 stainless steel.

S634, S639: 304/305 stainless steel.

Case length:

Minimum case length: 1.5" (38.1 mm).

Maximum case length: 48" (1220 mm), longer on special order.

Time constant: Typical value in moving water:

S623, S628: 4 seconds.

S634, S639: 2 seconds.

Pressure rating: 1500 psi (103 bar).

Leads: 2, 3, or 4 leadwires, AWG 22, stranded copper with PTFE insulation, stainless steel braid, or stainless steel armor.

For 2-lead RTDs add 0.03 Ω per foot of combined case and lead length to element tolerance.

Insulation resistance: 1000 megohms minimum at 500 VDC, leads to case.

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Sensing elements

| RTD sensing element | | Code |
|--|---------------------|------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | ▼PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | PE |
| Platinum (0.00385 TCR) (N/A for model S602) | 1000 Ω ±0.1% at 0°C | ▼PF |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | CA |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | NA |

Specification and order options:

Immersion probes

These probes have welded fittings to mount directly into fluid vessels. Add a connection head for termination of extension leads.

| | |
|-----------------------------------|--|
| S623 | Model number: ▼S623: 1/2 - 14 NPT thread [2] S628: ISO 228/1-G1/2 process thread (1/2 - 14 NPT on leads end) |
| PF | Sensing element from table ▼: PD, PF |
| 60 | Case length: Specify in 0.1" increments (Ex: 60 = 6.0 inches) ▼: 20, 60, 120 |
| Z | Number of leads: Y = 2 leads X = 4 leads (PD only) ▼Z = 3 leads (required for copper elements) |
| 72 | Lead length in inches ▼: 72 |
| T | Covering over leadwires: ▼T = PTFE only A = Stainless steel armor S = Stainless steel braid |
| S623PF60Z72T = Sample part number | |

Plug type sensors

Save space and get accurate readings with this compact, easy-to-install probe.

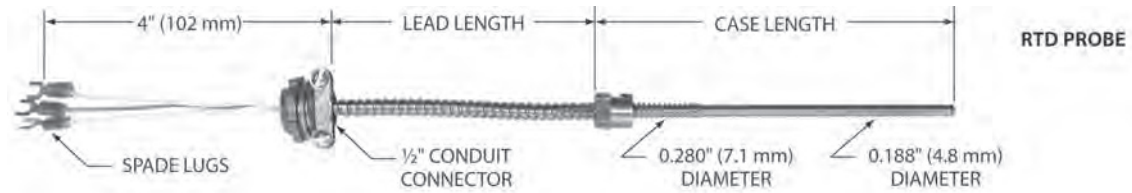
| | |
|---------------------------------|---|
| S634 | Model number: S634: 1/2 - 14 NPT thread S639: ISO 228/1-G1/2 thread |
| NA | Sensing element from table |
| Y | Number of leads: Y = 2 leads X = 4 leads (PD only) Z = 3 leads (required for copper elements) |
| 24 | Lead length in inches |
| T | Covering over leadwires: T = PTFE only S = Stainless steel braid |
| S634NAY24T = Sample part number | |



STOCKED PARTS AVAILABLE

Specifications subject to change

Bayonet Mount Tip-sensitive RTDs



Overview

Bayonet mounting provides easy and inexpensive spring-loaded installation of probes into solids. All models have a copper alloy tip for fast time response and increased tip sensitivity.

See page 3-9 for bayonet fittings or page 3-10 for metric fittings.

- Lockcap and spring for twist-and-release spring-loading
- Accurate sensing to 260°C (500°F)
- ATEX, IECEx and TR CU (EAC) Ex e and Ex ia options available

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Case: Stainless steel with copper alloy tip.

Minimum case length: 3.0" (76.2 mm).

Maximum case length: 48" (1220 mm), longer on special order.

Time constant: 2 seconds typical in moving water.

Leads: 2, 3, or 4 leadwires, AWG 22, stranded copper with PTFE insulation, stainless steel armor, and 1/2" conduit connector. For 2-lead RTDs add 0.03 Ω per foot of combined case and lead length to element tolerance.

Insulation resistance: 1000 megohms min. at 500 VDC, leads to case.

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Model numbers

| RTD sensing element | | Model |
|------------------------|--|---------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | ▼S44PA |
| Platinum (0.00385 TCR) | 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | ▼S844PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | S874PE |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | S44CA |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | ▼S44NA |

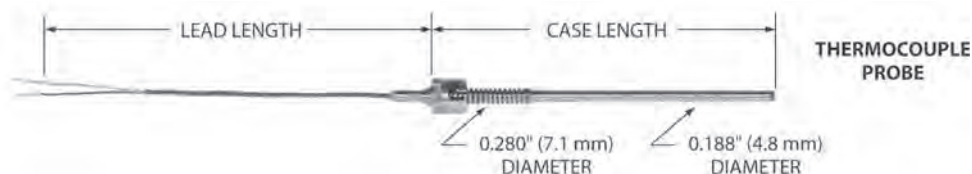
Specification and order options

| S44PA | Model number from table |
|----------------------------------|---|
| 120 | Case length: Specify in 0.1" increments (Ex: 120 = 12.0 inches) ▼: 49, 55, 120 |
| Z | Number of leads: Y = 2 leads ▼Z = 3 leads (required for copper elements) X = 4 leads (PD only) |
| 80 | Lead length in inches ▼: 80 |
| S44PA120Z80 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Bayonet Mount Tip-sensitive Thermocouples



Overview

Bayonet mounting provides easy and inexpensive spring-loaded installation of probes into solids. All models have a copper alloy tip for fast time response and increased tip sensitivity.

See page 3-9 for bayonet fittings or page 3-10 for metric fittings.

- Lockcap and spring for twist-and-release spring-loading
- Accurate sensing to 260°C (500°F)
- ATEX, IECEx and TR CU (EAC) Ex e and Ex ia options available

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Case: Stainless steel with copper alloy tip.

Minimum case length: 3.0" (76.2 mm).

Maximum case length: 48" (1220 mm), longer on special order.

Leads: Solid thermocouple wire, AWG 20 (single) or AWG 24 (dual). Specify PTFE insulation, glass braid insulation, stainless steel braid over glass braid, or stainless steel armor over PTFE.

Time constant: Typical value in moving water:

Grounded junction: 1.5 seconds.

Ungrounded junction: 7 seconds.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case, ungrounded junctions only.

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202, Method 204, Test Condition D.

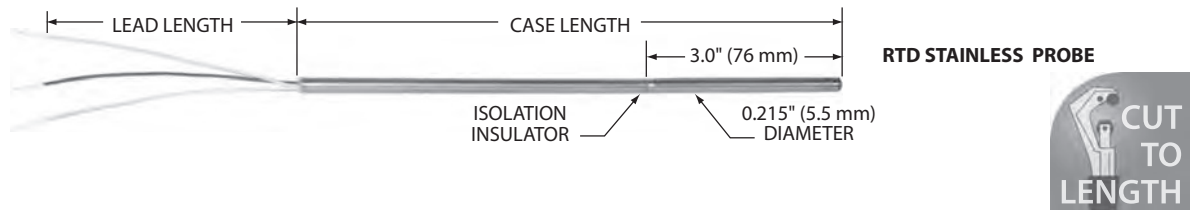
Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Specification and order options

| | |
|------------------------------------|--|
| TC360 | Model number: ▼TC360 = Single junction ▼TC361 = Dual junction |
| J | Junction type: E = Chromel-Constantan ▼J = Iron-Constantan ▼K = Chromel-Alumel T = Copper-Constantan |
| G | Junction grounding: ▼G = Grounded ▼U = Ungrounded |
| 30 | Case length: Specify in 0.1" increments (Ex: 95 = 9.5 inches) ▼: 30, 120 |
| A | Covering over leadwires: T = PTFE only G = Glass braid ▼A = Stainless steel armor S = Stainless steel overbraid |
| 120 | Lead length in inches ▼: 120 |
| TC360JG30A120 = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

Electrically Isolated RTDs



Overview

- Electrically isolated sensing tip for “hot” bearings
- Accurate sensing to 260°C (500°F)
- Copper alloy tip for fast time response and increased tip sensitivity
- ATEX, IECEx and TR CU (EAC) Ex e and Ex ia options available

Specifications

Dielectric strength of isolation insulator: 1000 volts RMS at 60 Hz for 30 seconds, between case sections, 1 mA max. leakage current.

Pressure rating: 30 psi (2.1 bar).

Vibration: Withstands 10 to 2000 Hz at 20 G’s minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G’s minimum sine wave shock of 8 milliseconds duration.

Isolated tip RTDs

| RTD sensing element | | Model |
|--|--------------------|----------|
| Platinum (0.00392 TCR) | 100 Ω ±0.5% at 0°C | ▼ S52PA |
| Platinum (0.00385 TCR) (Meets EN60751, Class B) | 100 Ω ±0.1% at 0°C | ▼ S852PD |
| Platinum (0.00385 TCR) | 100 Ω ±0.5% at 0°C | S882PE |
| Copper (0.00427 TCR) | 10 Ω ±0.2% at 25°C | S52CA |
| Nickel (0.00672 TCR) | 120 Ω ±0.5% at 0°C | S52NA |

Temperature Range: -50 to 260°C (-58 to 500°F).

Case: Stainless steel with copper alloy tip.

Minimum case length: 4.0" (101.6 mm).

Maximum case length: 48" (1220 mm), longer on special order.

Leads: 2, 3, or 4 leadwires, AWG 22, stranded copper with PTFE insulation. For 2-lead RTDs add 0.03 Ω per foot of combined case and lead length to element tolerance.

Time constant: 2 seconds typical in moving water.

Insulation resistance: 1000 megohms min. at 500 VDC, leads to case.

Specification and order options

| | |
|----------------------------------|--|
| S52PA | Model number from isolated tip table |
| 240 | Case length: Specify in 0.1" increments (Ex: 240 = 24.0 inches) ▼: 120, 180, 240 |
| Z | Number of leads: Y = 2 leads ▼ Z = 3 leads (required for copper elements) X = 4 leads (PD only) |
| 36 | Lead length in inches ▼: 36, 120 |
| S52PA240Z36 = Sample part number | |

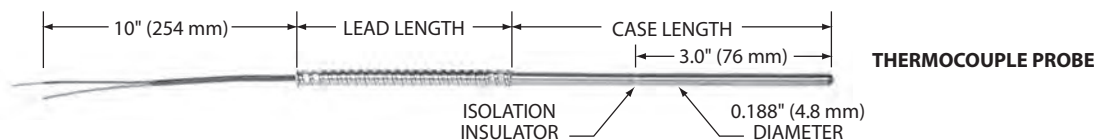


STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**

Specifications subject to change

Electrically Isolated Thermocouples



Overview

- Electrically isolated sensing tip for “hot” bearings
- Accurate sensing to 260°C (500°F)
- Copper alloy tip for fast time response and increased tip sensitivity
- ATEX, IECEx and TR CU (EAC) Ex e and Ex ia options available

Time constant: Typical value in moving water:

Grounded junction: 1.5 seconds.

Ungrounded junction: 7 seconds.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case, ungrounded junctions only.

Specifications

Dielectric strength of isolation insulator: 1000 volts RMS at 60 Hz for 30 seconds, between case sections, 1 mA max. leakage current.

Pressure rating: 30 psi (2.1 bar).

Vibration: Withstands 10 to 2000 Hz at 20 G’s minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G’s minimum sine wave shock of 8 milliseconds duration.

Temperature Range: -50 to 260°C (-58 to 500°F).

Case: Stainless steel with copper alloy tip.

Minimum case length: 4.0” (101.6 mm).

Maximum case length: 48” (1220 mm), longer on special order.

Leads: Solid thermocouple wire, AWG 20 (AWG 24 for stainless steel braid option). Specify PTFE insulation or PTFE with stainless steel armor and shrink tubing over all.

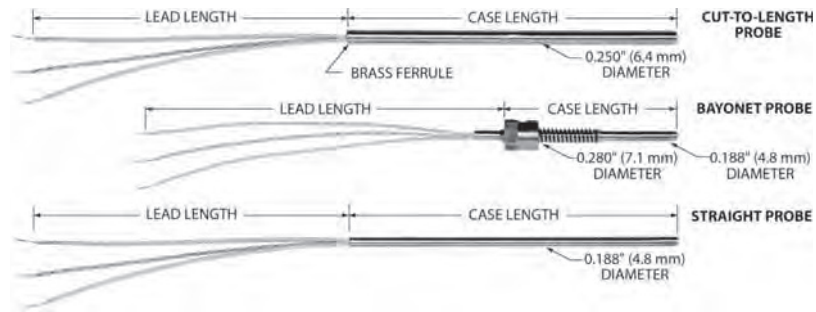
Specification and order options

| | |
|-------------------------------------|--|
| TC2198 | Model number: TC2198 |
| J | Junction type: E = Chromel-Constantan ▼ J = Iron-Constantan ▼ K = Chromel-Alumel T = Copper-Constantan |
| U | Junction grounding: ▼ G = Grounded ▼ U = Ungrounded |
| 60 | Case length: Specify in 0.1” increments (Ex: 60 = 6.0 inches) ▼ : 60, 120 |
| T | Covering over leadwires: ▼ T = PTFE only ▼ A = Stainless steel armor plus shrink tubing S = SS braid over PTFE (5” min. case length) |
| 120 | Lead length in inches ▼ : 120 |
| TC2198JU60T120 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

550°C RTD Probes



Overview

Install these probes in steam lines, exhaust gases, or wherever you need precise readings of elevated temperatures. RTD probes feature high temperature ceramic elements, assembled into stainless steel cases in a configuration that provides long-term reliable service.

Models S80 and S81 can be shortened by the user. You can stock standard lengths and cut them to the size required with an ordinary tubing cutter.

Bayonet-style probes have a lockcap and spring for spring-loaded installation. See page 3-9 for more information on bayonet fittings.

- 0.250" diameter cut-to-length RTDs
- 0.188" diameter straight and bayonet RTDs

Specifications

Temperature range:

-100 to 550°C (-148 to 1022°F).

Leadwires: 500°C (932°F) max.

Case: 316 stainless steel.

Minimum case length:

0.250" diameter: S80, S81: 4.0" (101.6 mm).

0.188" diameter: S71, S72: 2.0" (50.8 mm)
S73, S74: 3.0" (76.2 mm).

Maximum case length: 48" (1220 mm), longer on special order.

Pressure rating: 1500 psi (103 bar).

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Leads: 2 or 3 leadwires, AWG 22, stranded copper with mica/glass insulation. For 2-lead RTDs add 0.04 Ω per foot of combined case and lead length to element tolerance.

Time constant: 10 seconds typical in moving water.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case.

Model numbers:

Straight probe: Ø 0.188" (4.8 mm)

| Element | | Model |
|-------------------------|--------------------|--------|
| Platinum (0.00391 TCR) | 100 Ω ±0.1% at 0°C | S71PB |
| Platinum (0.00385 TCR)* | 100 Ω ±0.1% at 0°C | ▼S72PD |

Bayonet probe: Ø 0.188" (4.8 mm)

| Element | | Model |
|-------------------------|--------------------|--------|
| Platinum (0.00391 TCR) | 100 Ω ±0.1% at 0°C | ▼S73PB |
| Platinum (0.00385 TCR)* | 100 Ω ±0.1% at 0°C | ▼S74PD |

Cut-to-length: Ø 0.250" (6.4 mm)

| Element | | Model |
|-------------------------|--------------------|--------|
| Platinum (0.00391 TCR) | 100 Ω ±0.1% at 0°C | ▼S80PB |
| Platinum (0.00385 TCR)* | 100 Ω ±0.1% at 0°C | ▼S81PD |

*Meets EN60751, Class B

Specification and order options

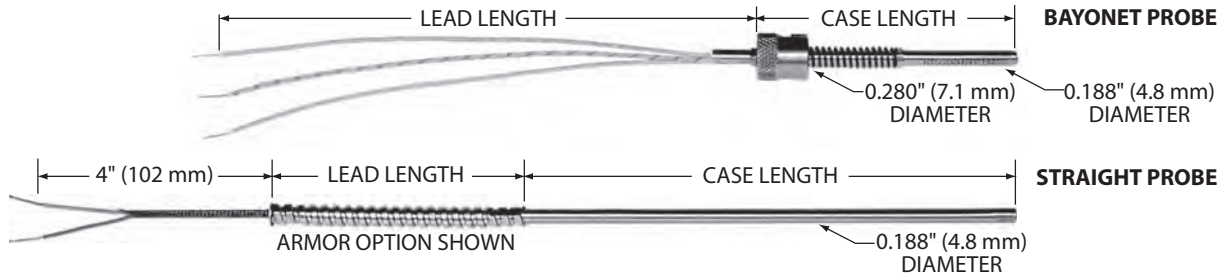
| | |
|----------------------------------|---|
| S74PD | Model number from table |
| 240 | Case length: Specify in 0.1" increments (Ex: 240 = 24.0 inches) ▼: 20, 30, 120, 240 |
| Z | Number of leads: Y = 2 leads ▼Z = 3 leads |
| 36 | Lead length in inches ▼: 36, 120 |
| S74PD240Z36 = Sample part number | |



STOCKED PARTS AVAILABLE

▼ = STANDARD OPTIONS
Specifications subject to change

550°C Thermocouple Probes



Overview

Install these probes in steam lines, exhaust gases, or wherever you need precise readings of elevated temperatures.

Bayonet-style probes have a lockcap and spring for spring-loaded installation. See page 3-9 for more information on bayonet fittings.

Specifications

Temperature range:

-100 to 550°C (-148 to 1022°F).

Leadwires: 500°C (932°F) max.

Case: 316 stainless steel.

Minimum case length: 2.5" (63.5 mm)

Maximum case length: 48" (1220 mm), longer on special order.

Pressure rating: 1500 psi (103 bar).

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202, Method 204, Test Condition D.

Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Leads: Solid thermocouple wire, AWG 20. Specify glass braid insulation, stainless steel overbraid, or stainless steel armor.

Time constant: 7 seconds typical in moving water.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case, ungrounded junctions only.

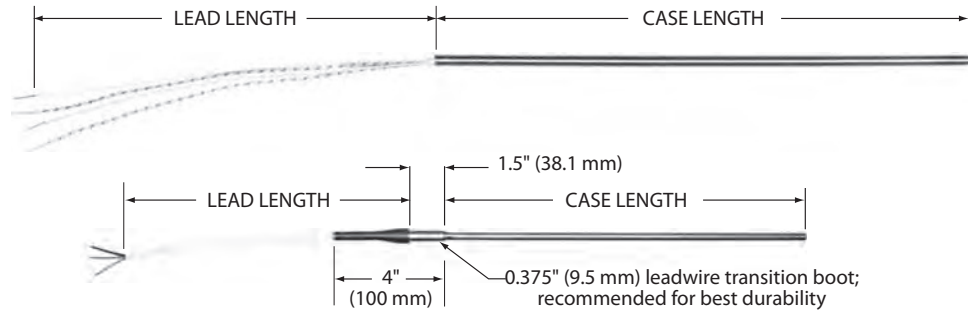
Specification and order options

| | |
|------------------------------------|---|
| TC173 | Model number: ▼TC173: Straight probe ▼TC171: Bayonet mount |
| E | Junction type: ▼E = Chromel-Constantan J = Iron-Constantan ▼K = Chromel-Alumel T = Copper-Constantan |
| U | Junction grounding: ▼G = Grounded ▼U = Ungrounded |
| 60 | Case length: Specify in 0.1" increments (Ex: 45 = 4.5 inches) ▼: 30, 60, 120, 180 |
| G | Covering over leadwires: ▼G = Glass braid only ▼S = Stainless steel overbraid A = Stainless steel armor |
| 120 | Lead length in inches ▼: 120 |
| TC173EU60G120 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

600°C RTDs



Overview

These RTDs cover the full temperature scale of the international standard EN60751. Precision sensing elements are capable of measurements from -200 to 600°C (-328 to 1112°F) with typical ice point drift less than $\pm 0.05^\circ\text{C}$.

- Platinum elements to EN60751, Class A or B
- English and metric diameters

Specifications

Element: Platinum, 100 Ω at 0°C, TCR = 0.00385 $\Omega/\Omega/^\circ\text{C}$.

Temperature range: -200 to 600°C (-328 to 1112°F). Reduced temperature rating for leads and last 2" (50 mm) of case — see leadwire chart.

Case: 316 stainless steel.

Minimum case length: 2.0" (50.8 mm).

Maximum case length: 48.0" (1220 mm), longer on special order.

| Probe diameter | Model |
|-----------------|-------|
| 0.188" (4.8 mm) | ▼S914 |
| 0.236" (6.0 mm) | ▼S912 |
| 0.250" (6.4 mm) | ▼S913 |

Tolerance: EN60751 Class A or B.

Class A: $\pm 0.06\%$

Class B: $\pm 0.12\%$

Repeatability: Meet IEC requirements. Typical shift less than 0.05°C (0.02 Ω) at 0°C after ten cycles over range.

Stability: Meet IEC stability specifications after 250 hours exposure to extremes of temperature range. Typical drift is less than 0.05°C (0.02 Ω) at 0°C.

Vibration: Will withstand 10 to 5000 Hz at 2 G's minimum per EN60751.

Shock: Will withstand 250 mm drop onto 8 mm thick steel plate (approximately 1400 G's for 0.08 ms).

Time constant: 10 seconds typical in moving water.

Pressure rating: 1000 psi (69 bar) at 25°C.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

Leadwire options:

| Code | Description | Max. temp.* |
|------|---|-----------------|
| ▼G | Mica/glass insulated stranded copper, AWG 22. | 600°C 1112°F |
| T | PTFE insulated stranded copper, AWG 22. | 260°C 500°F |
| C | AWG 24, PTFE insulated, stranded copper wires with silver-plated copper braid and PTFE over all (4 leads only). | 260°C 500°F |

* Temperature rating for leads and last 2" of case.

Specification and order options

| | |
|--|--|
| S914 | Model number from table |
| PD | 100 Ω Platinum, 0.00385 TCR |
| 06 | Tolerance at 0°C: ▼06 = $\pm 0.06\%$, EN60751 Class A 12 = $\pm 0.12\%$, EN60751 Class B |
| G | Leadwire code from table |
| 40 | Case length: Specify in 0.1" increments (Ex: 40 = 4.0 inches) ▼: 40, 60, 90, 120, 180 |
| Z | Number of leads: ▼Z = 3 leads X = 4 leads |
| 120 | Lead length in inches ▼: 120 |
| BS | Probe termination: ▼BS = Boot and spring B = Boot only ▼N = No boot or spring |
| S914PD06G40Z120BS = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Mineral-insulated RTDs

Overview

Mineral-insulated RTDs provide excellent performance, even when exposed to high levels of shock and vibration in tough industrial environments. Typical applications include process control and steam turbine efficiency measurement.

Probes can be bent around a mandrel diameter at least 3 times the probe diameter without kinking.

Custom designed RTDs and thermocouples are available.

- Mineral MgO packing protects element from shock and contamination
- Field bendable
- Inconel or stainless steel sheath
- High precision RTD elements for stable, repeatable measurements
- Dual sensing element model S953 is excellent for redundancy and failure protection

Specifications

Element: Platinum, 100 Ω at 0°C, TCR=0.00385 $\Omega/\Omega/^\circ\text{C}$.

Temperature range: Reduced to 260°C (500°F) for leadwires and potting boot.

S932, S933: -200 to 650°C (-328 to 1202°F).

S942, S943, S944: -200 to 550°C (-328 to 1022°F).

S953: -200 to 260°C (-328 to 500°F).

Tolerance: EN60751 Class B ($\pm 0.12 \Omega = \pm 0.3^\circ\text{C}$) or Class A ($\pm 0.06 \Omega = \pm 0.15^\circ\text{C}$)

Repeatability: Meets EN60751 requirements. Typical shift less than 0.05°C (0.1°F) when cycled over temperature range.

Stability: Meets EN60751 specifications after 250 hours exposure to extremes of temperature range. Typical drift of less than 0.05°C (0.1°F) at 0°C.

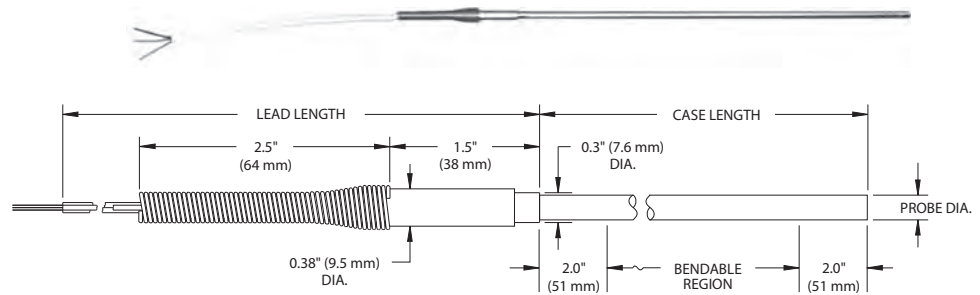
Vibration: Withstands 10 to 5000 Hz at 2 G's per EN60751. Also withstands 50 to 250 Hz at 50 G's at 500°C.

Shock: Withstands a 1 meter drop onto an 8 mm steel plate (1 meter is 4 times the EN60751 height requirement of 250 mm).

Time constant: 10 seconds typical in moving water.

Pressure rating: 69 bar (1000 psi) at 25°C.

Insulation resistance: 10 megohms minimum at 100 VDC.



Single element models

| Probe diameter | Max. temp. | Case material | Model |
|-----------------|----------------|---------------------|-------|
| 0.236" (6.0 mm) | 550°C (1022°F) | 316 stainless steel | ▼S942 |
| 0.236" (6.0 mm) | 650°C (1202°F) | Inconel 600 | ▼S932 |
| 0.250" (6.4 mm) | 550°C (1022°F) | 316 stainless steel | ▼S943 |
| 0.250" (6.4 mm) | 650°C (1202°F) | Inconel 600 | ▼S933 |
| 0.188" (4.8 mm) | 550°C (1022°F) | 316 stainless steel | ▼S944 |

Dual element model

| Probe diameter | Max. temp. | Case material | Model |
|-----------------|----------------|---------------------|-------|
| 0.250" (6.4 mm) | 550°C (1022°F) | 316 stainless steel | S953 |

Specification and order options

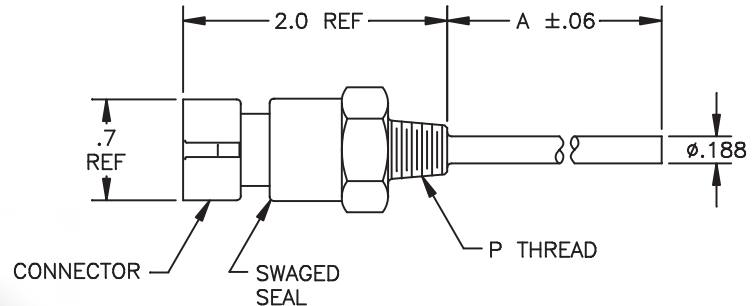
| | |
|--|--|
| S933 | Model number from table |
| PD | 100 Ω platinum, 0.00385 TCR |
| 06 | Tolerance at 0°C: ▼06 = $\pm 0.06\%$, EN60751 Class A (NA for dual element S953) 12 = $\pm 0.12\%$, EN60751 Class B |
| T | Leadwire insulation: ▼T = PTFE leadwires C = PTFE cable (4 lead only, NA for dual element S953) |
| 30 | Case length: Specify in 0.1" increments (Ex: 30 = 3.0 inches) ▼: 30, 40, 120, 180 |
| Z | Number of leadwires: Y = 2 leads per element ▼Z = 3 leads per element X = 4 leads per element |
| 120 | Lead length in inches ▼: 120 |
| BS | Lead exit configuration: (B or BS option recommended for best lead exit strength) ▼BS = Potting boot and strain relief spring B = Potting boot ▼N = No potting boot or spring |
| S933PD06T30Z120BS = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change



Compact Plug Sensor



Overview

The S205459 is a platinum RTD temperature sensor with convenient plug in connection.

- Sensor measuring and operating range is from -50 to 300°F (-45.5 to 148.9°C).
- Connection is made using an industry-standard Packard/Delphi: Metri-pack 150 connector

Specifications

Temp Range: -50 to 300°F (-45.5 to 148.9°C)

Case Material: 316 Stainless Steel

Connector: Packard /Delphi METRI-PACK 150

Pressure Rating:

Stainless Steel: 1500 psi

Brass: 500 psi

Insulation Resistance: 1000 megaohms min at 500 V

Vibration: Withstands 10 to 2000 Hz at 20 G's min per MIL-STD-202, Method 204 Test Condition D

Shock: Withstands 100 G's min sine wave shock of 8 milliseconds duration.

Sensor Housing: Stainless steel sensor end with a choice of NPT threads; end connector (Packard/Delphi: Metri-pack 150)

Specification and order options

| | |
|-------------------------------------|--|
| S205459 | Model number: S205459 Compact Plug Sensor |
| PD | Element Type: ▼PD Platinum (0.00385 TCR) 100Ω +/- 0.12% at 0°C ▼PF Platinum (0.00385 TCR) 1000Ω +/- 0.12% at 0°C |
| 20 | Case Length: ▼10 = 1.0" ▼20 = 2.0" ▼30 = 3.0" ▼40 = 4.0" |
| P2 | Thread size: ▼P2 = 1/8 -27 NPT ▼P4 = 1/4 -18 NPT ▼P6 = 3/8 -18 NPT ▼P8 = 1/2 -14 NPT |
| S | Case Material: ▼S = Stainless Steel |
| S205459PD20P2S = Sample Part Number | |

Contact Minco to learn more about custom design options for your application.

S205459 Mating Cable Assembly

- 72" Shielded cable
- 2-conductor, AWG #18, copper braid shield with drain wire
- Terminated with a female Metri-pack 150 connector

Specification and order options:

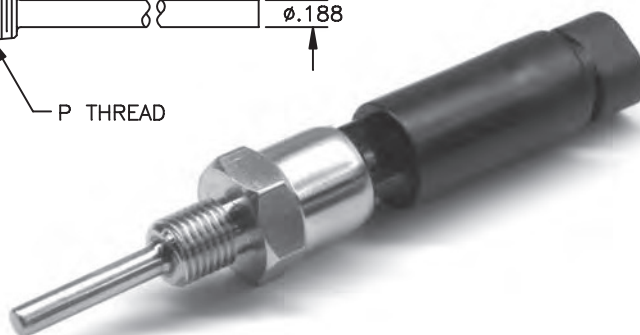
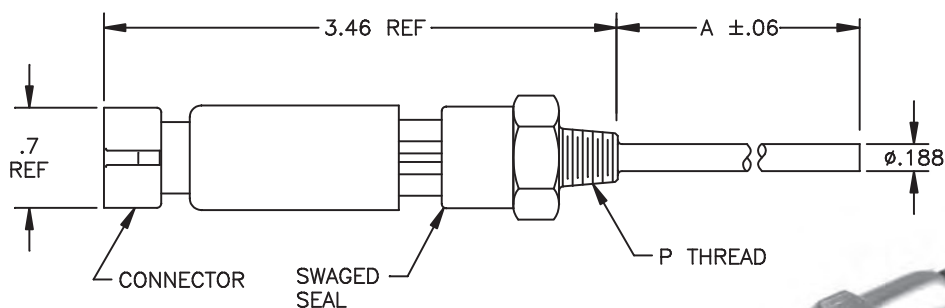
S205459 Mating Cable Assembly

| | |
|----------------------------------|------------------------|
| AC203350 | Model Number: AC203350 |
| L72 | 72" lead length |
| AC203350L72 = Sample Part Number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Integrated Sensor/Transmitter



Overview

The TT363 is an integrated platinum RTD temperature sensor with 4-20mA current loop output. Combines transmitter capability with a platinum sensing element in a single package for an easier-to-install temperature sensing solution.

- Power and signal are provided through a 4-20mA current loop connection.
- Sensor measuring and operating range is from -50 to 300°F (-45.5 to 148.9°C).
- The high-temperature plastic case and electronics can be used in applications with an ambient temperature up to 185°F (85°C).
- Connection is made using an industry-standard Packard/Delphi: Metri-pack 150 connector.

Specifications

Output: 4-20mA over range specified, linear with temperature.

Sensor Operating Temperature: -50 to 300°F (-45.5 to 148.9°C)

Ambient Temperature:

Operation: -40 to 185°F (-40 to 85°C), non-condensing

Storage: -67 to 212°F (-55 to 100°C), non-condensing

Supply Voltage: 7.6 to 35VDC, reverse polarity protected

Loop resistance: Maximum allowable resistance of the signal-carrying loop, including wires and load resistors given by: $R_{loopmax} = (V_{supply} - 7.6) / .02Amps$

Warmup drift: Less than +/-0.025mA; stable within 30 minutes.

Ambient temperature error: Less than +/-0.15mA

Voltage Stability: Change in loop current $< \pm 0.01$ mA from 7.6 to 35 VDC

Sensor Housing: Stainless steel sensor case with a choice of NPT threads; transmitter body is nylon with 30% glass plastic encapsulation; end connector (Packard/Delphi: Metri-pack 150)

Specification and order options

| | |
|-----------------------------------|--|
| TT363 | Model number: TT363 Temperature Sensor/Transmitter |
| AN | Range Code: Temperature range code [AN = -17.8 to 148.9°C(0 to 300°F)] |
| 20 | Case Length: 10 = 1.0" 20 = 2.0" 30 = 3.0" 40 = 4.0" |
| P2 | Thread size: P2 = 1/8 -27 NPT P4 = 1/4 -18 NPT P6 = 3/8 -18 NPT P8 = 1/2 -14 NPT |
| S | Case Material: S = Stainless Steel |
| TT363AN20P2S = Sample Part Number | |

Contact Minco to learn more about custom design options for your application.

TT363 Mating Cable Assembly

- 72" Shielded cable
- 2-conductor, AWG #18, copper braid shield with drain wire
- Terminated with a female Metri-pack 150 connector

Specification and order options:

TT363 Mating Cable Assembly

| | |
|----------------------------------|------------------------|
| AC203350 | Model Number: AC203350 |
| L72 | 72" lead length |
| AC203350L72 = Sample Part Number | |

Specifications subject to change

Conductivity Level Sensor



Overview

The LT364 Level Sensor provides point fluid detection with virtually any conductive fluid. Two 316 stainless steel pins provide for operation in mildly corrosive fluids within plastic or metal containers. Fluid presence is measured by passing a low voltage AC signal between the stainless steel probes. The use of an AC voltage eliminates the effects of galvanic corrosion on the probes. Power to the sensor and output from the sensor is derived from a current loop. Sensor output is 8 mA with fluid present and 16 mA with no fluid present.

- No calibration necessary.
- Injection molded, high-temperature plastic case.
- Electronics can be used in applications with an ambient temperature up to 185°F (85°C).
- Connection is made using an industry-standard Packard/Delphi Metri-pack 150 connector providing an easy-to-connect, polarized connection.

Application Ideas

- Radiator low-fluid level detection
- Pump recovery tanks
- Fluid leak detection
- Parts washers
- Automated test equipment

Specifications

Sensor Output:

8 mA ± 1 mA with fluid present and 16 mA ± 1 mA with no fluid present

Ambient Temperature (electronics):

Operation: -40 to 185°F, non-condensing
Storage: -67 to 212°F, non-condensing

Supply Voltage: 7.6 to 35VDC, reverse polarity protected

Loop resistance: Maximum allowable resistance of the signal-carrying loop, including wires and load resistors given by: $R_{loopmax} = (V_{supply} - 7.6) / .02 \text{ Amps}$

Voltage Stability: Change in loop current < ±0.1 mA from 7.6 to 35 VDC

Sensor Housing: $\frac{3}{8}$ - 18 NPT process thread, nylon with 30% glass plastic encapsulation; end connector is Packard/Delphi Metri-pack 150.

Weight: Approximately 2.5 oz (70 g)

Specification and order options

| | |
|--|---------------------------------|
| L015 | Model number: L015 Level Sensor |
| <i>Variable lengths are available. Contact Minco to learn more about custom design options for your application.</i> | |

LT364 Mating Cable Assembly

- 72" Shielded cable
- 2-conductor, AWG #18, copper braid shield with drain wire
- Terminated with a female Metri-pack 150 connector

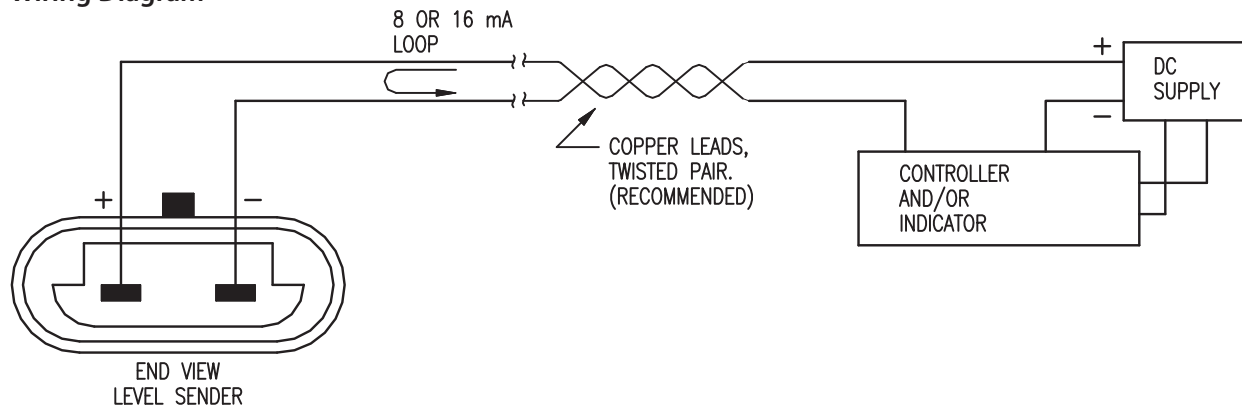
Specification and order options

LT364 Mating Cable Assembly

| | |
|----------------------------------|------------------------|
| AC203350 | Model Number: AC203350 |
| L72 | 72" lead length |
| AC203350L72 = Sample Part Number | |

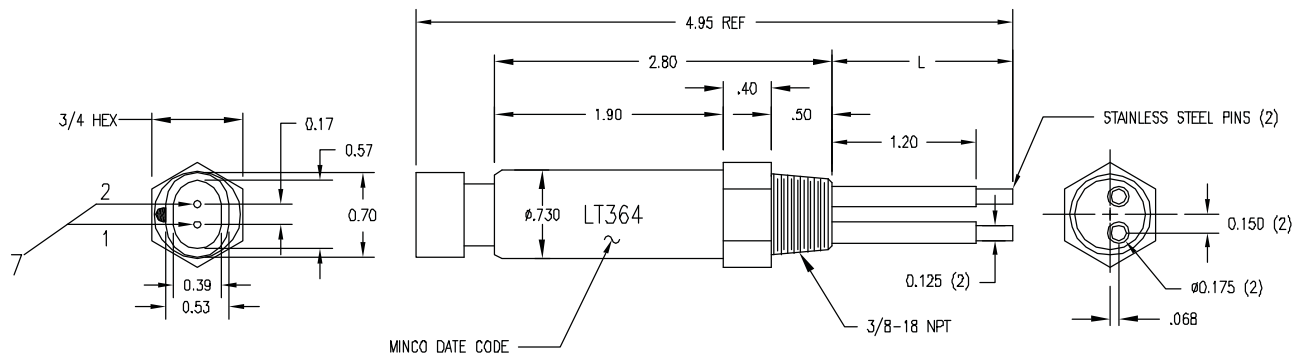
▼ = **STANDARD OPTIONS**
Specifications subject to change

Wiring Diagram

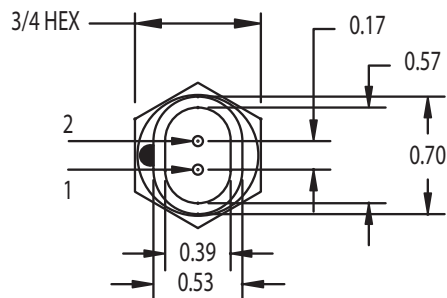


Dimensional Drawings

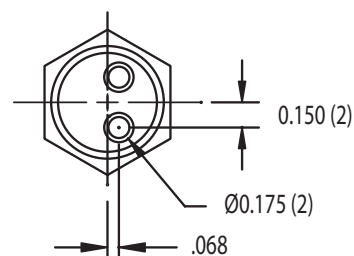
Side View



Connection End



Measurement End



▼ = STANDARD OPTIONS
Specifications subject to change

How to Shorten Cut-to-length Probes



Shorten probes easily with a tubing cutter

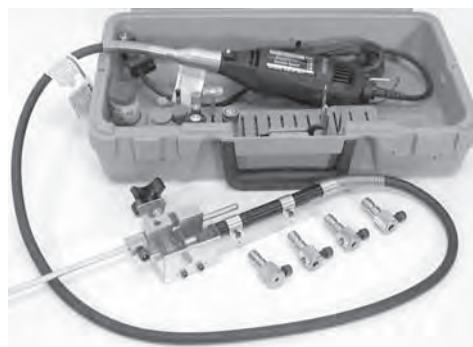
Overview

Many probe models can be cut to the required length using an ordinary tubing cutter. Cut-to-length models are marked with the icon shown at right.



Benefits are:

- You can keep standard lengths in inventory, and shorten them as needed for urgent requirements
- Stocking and shortening probes, instead of ordering a few pieces at a time, may let you take advantage of quantity discounts
- Minco stocks most cut-to-length probes and can trim and ship them within 24 hours of your call



The AC101248 probe cutting system makes clean, precise cuts.

How to shorten probes

Remove the PTFE or brass ferrule from the lead exit end of the probe. Mark the proper length, then cut, going slowly to avoid crimping the case or damaging the leads. Use a good quality tubing cutter that is intended to cut stainless steel tubing or conduit. The cutter must have a sharp blade to prevent "rolling in" during cutting of the tubing. Suitable models are available from Imperial Eastman and Sears Industrial.

After cutting, discard the hollow tube section, carefully deburr the cut end, and replace the ferrule. You can slit the PTFE ferrule for easier installation.

If you use many cut-to-length probes consider the AC101248 probe cutting system. It includes an electric Dremel™ tool (120 VAC @ 60 Hz), flexible shaft, and accessories to allow clean, precise cuts. The system includes a convenient carrying case and comes with easy to follow instructions.

PFA or FEP Encapsulation Tubing

Protect probes from chemical attack

Overview

The tube is sealed at one end and can be easily heat-shrunk onto any probe. Supplied separately.

Specification and order options

| | |
|---------------------------------------|---|
| AC100375 | Model number |
| L120 | Length: 120 = 12.0" 240 = 24.0" Can be cut to any length |
| P | Encapsulation type: P = clear PFA F = clear FEP |
| 188 | Probe diameter: 125 = 0.125" (3.2 mm) 188 = 0.188" (4.8 mm) 215 = 0.215" (5.5 mm) 250 = 0.250" (6.4 mm) |
| AC100375L120P188 = Sample part number | |

FEP Specifications

FEP: Fluorinated Ethylene Propylene
Temperature range: -70 to 200°C (-94 to 392°F).
Maximum temperature 204°C (400°F)

Excellent dielectric insulation properties, chemically resistant, unaffected by weather, extreme heat, or cold temperatures.

PFA Specifications

PFA: Perfluoroalkoxy
Temperature range: -70 to 260°C (-94 to 500°F).
Maximum temperature 260°C (500°F)

Combines attributes of PTFE and FEP, chemically resistant to all common solvents, maintains mechanical strength at high temperatures.

Specifications subject to change



▶ SECTION 3: ACCESSORIES

- A wide selection of fittings and accessories adapt sensors to any installation
- Adjustable fittings with cut-to-length probes provide off-the-shelf versatility
- Choose from a variety of materials to meet your critical environment requirements

| | |
|------------------------------------|--------------|
| Connection heads..... | 3-2 to 3-3 |
| Spring-loaded holders..... | 3-4 |
| Fluid immersion fittings..... | 3-5 |
| Economy thermowells..... | 3-6 |
| HVAC thermowells..... | 3-6 |
| Reduced tip thermowells..... | 3-7 |
| Tapered thermowells..... | 3-7 |
| Flanged thermowells..... | 3-8 |
| Bayonet fittings..... | 3-9 |
| Extensions..... | 3-9 |
| Metric accessories..... | 3-10 |
| Feedthroughs..... | 3-11 |
| Leadwire and cable seal..... | 3-12 to 3-13 |
| Elastomer rubber-filled cable..... | 3-14 |
| Extension wire..... | 3-15 |

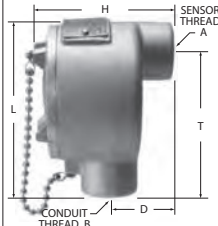
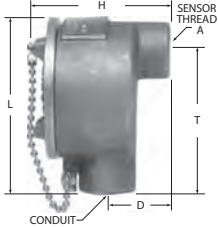
Connection Heads

| Dimensions in inches (mm) | | Body/gasket material | IP/NEMA Rating | Max Temp. | Pipe thread codes | Temptran™ models | Approx. weight | Model |
|---|--|---|--------------------------|---------------|-------------------|-----------------------------------|--------------------|--------|
| CH103 3.5 (89) H 3.5 (89) L 1.9 (48) D 1.9 (48) T | | Nickel-plated cast iron with SS chain/silicone gasket | IP55 Type 3 and 4 | 316°C (600°F) | P1, P2, P3, P4 | All models except TT220 and TT221 | 2.0 lbs. (0.9 kg.) | ▼CH103 |
| CH366 3.0 (76) H 3.7 (94) L 1.37 (35) D 1.9 (48) T | | White polypropylene (FDA approved)/neoprene gasket | IP55 Type 3 and 4 | 110°C (230°F) | P3 only | All models except TT220 and TT221 | 0.2 lbs. (0.1 kg.) | ▼CH366 |
| CH359 3.5 (89) H 3.5 (89) L 2.0 (51) D 1.75 (44) T | | Aluminum/silicone gasket | IP55 Type 3 and 4 | 316°C (600°F) | P1, P2, P3, P4 | All models except TT220 and TT221 | 0.8 lbs. (0.4 kg.) | ▼CH359 |
| CH301 2.33 (59.2) H 4.25 (108) L 1.25 (31.8) D 3.60 (91.4) T | | Aluminum/neoprene gasket | IP55 Type 3 and 4 | 115°C (240°F) | CH301: P3 only | Miniature TT111 and TT211 models | 0.5 lbs. (0.2 kg.) | ▼CH301 |
| CH302: P2 only | | | | | ▼CH302 | | | |
| CH360 3.5 (89) H 3.5 (89) L 2.0 (51) D 1.75 (44) T | | 316 SS with silicone gasket | IP56 Type 3, 4 and 4x | 316°C (600°F) | P1, P2, P3, P4 | All models except TT220 and TT221 | 1.8 lbs. (0.8 kg.) | ▼CH360 |
| CH335/CH339 2.5 (64) Ø 3.5 (89) H 0.95 (20) D | | 300 series SS with Buna N O-ring | IP56 Type 3, 4 and 4x | 121°C (250°F) | P3 only | All models except TT220 and TT221 | 2.6 lbs. (1.2 kg.) | ▼CH335 |
| | | 300 series SS with Buna N O-ring and chain | IP56 Type 3, 4 and 4x | 121°C (250°F) | P3 only | All models except TT220 and TT221 | 2.6 lbs. (1.2 kg.) | CH339 |

| Dimensions in inches (mm) | | Body/gasket material | Hazardous location rating | IP/NEMA Rating | Max Temp. | Approx. weight | Model |
|--|--|------------------------------------|---|---------------------------|----------------|--------------------|--------|
| Explosionproof/flameproof heads FM/CSA approved | | | | | | | |
| CH104: 4.60 (116.8) L 3.50 (88.9) H 1.63 (41.4) D 3.35 (85.1) T | | Copper-free aluminum/Buna-N O-ring | Division 1; Division 2 Class I, Groups B, C, D; Class II, Groups E, F, G; Class I, Zone 1, AEx d IIC; Zone 1, EX d IIC; T6 (Ta = 40°C), T2 (Ta = 260°C) | IP65 Type 3 and 4 | 121°C* (250°F) | 1.5 lbs. (0.7 kg.) | ▼CH104 |
| CH106: 4.20 (106.7) L 3.50 (88.9) H 1.35 (34.3) D 3.22 (81.8) T | | Stainless steel/Buna-N O-ring | | IP66 Type 3, 4, and 4X | 121°C* (250°F) | 2.4 lbs. (1.1 kg.) | ▼CH106 |

*Maximum temperature increases to 500°F (260°C) if O-ring is removed. Environmental rating drops to Type 3, IP54.

▼ = STANDARD OPTIONS
Specifications subject to change

| Dimensions in inches (mm) | Body/gasket material | Hazardous location rating | IP/NEMA Rating | Max Temp. | Approx. weight | Model | | |
|--|--|--|--|-----------------------------|------------------|-----------------------|-----------------------|------------|
| Explosionproof heads FM/CSA approved | | | | | | | | |
| CH405/CH407/ CH342/CH343/ CH330/CH328: 4.60 (116.8) L 3.60 (91.4) H 1.63 (41.4) D 3.70 (96.0) T |  | Copper-free aluminum | Division 1; Class I, Groups A, B, C, D; | IP54 Type 3 | 260°C (500°F) | CH405 | | |
| | | Copper-free aluminum/ Buna-N O-ring | Class II, Groups E, F, G; Class III (FM approved only) | IP65 Type 3 and 4 | 121°C (250°F) | 1.4 lbs. (0.6 kg.) | CH407 | |
| | | Copper-free aluminum, gray epoxy coat, no chain/ Buna-N O-ring | Division 1; Class I, Groups B, C, D; | IP66 Type 3, 4 and 4X | | 1.4 lbs. (0.6 kg.) | CH342 | |
| | | Copper-free aluminum, gray epoxy coat, with chain/ Buna-N O-ring | Class II, Groups E, F, G; | | | | CH343 | |
| | | Note: The following models have lower cost but no FM/CSA approval or label. | | | | | | |
| | | Aluminum/ Buna-N O-ring | Division 1; Class I, Groups B, C, D; | IP65 Type 3 and 4 | 121°C (250°F) | 1.4 lbs. (0.6 kg.) | CH330 | |
| Aluminum with FDA approved white epoxy coat, no chain/Buna-N O-ring | Class II, Groups E, F, G; Class III | IP66 Type 3, 4 and 4X | | | CH328 | | | |
| Flameproof heads CENELEC/ATEX approved Ex II 2G Ex d IIC T6 | | | | | | | | |
| CH357/CH358: 4.49 (114) L 3.60 (91.4) H 1.63 (41.4) D 3.78 (96.0) T CH356: 4.20 (106.7) L 3.50 (88.9) H 1.35 (34.3) D 3.22 (81.8) T |  | Copper-free aluminum/ Buna-N O-ring | Zone 1, Group IIC | IP65 Type 3 and 4 | 55°C (104°F) | 1.4 lbs. (0.6 kg.) | ▼ CH357 | |
| | | Copper-free aluminum, epoxy coated/Buna-N O-ring | Zone 1, Group IIC | IP66 Type 3, 4 and 4X | | 1.4 lbs. (0.6 kg.) | CH358 | |
| | | Stainless steel/Buna-N O-ring | | | | 121°C (250°F) | 2.4 lbs. (1.1 kg.) | ▼ CH356 |

Notes:

- View photos of terminal boards under accessories at www.minco.com
- All Temptran™ transmitter models may be used with connection heads on these pages.
 - AC103133 dual miniature Temptran™ mounting kit fits CH104, CH106, and CH356. CH106 and CH356 also require AC103625 modification.
 - AC103528 dual miniature Temptran™ mounting kit fits CH342, CH343, CH405, CH407, CH328, CH330, CH357, and CH358.
 - See Section 4 for more information.

Replacement terminal boards

| Model | 6-position board | 8-position board |
|-------|------------------|------------------|
| CH103 | AC103029 | AC101926 |
| CH104 | AC1039 | AC101122 |
| CH106 | AC1039 | AC101122 |
| CH301 | AC101377T6 | |
| CH302 | AC101377T6 | |
| CH328 | AC1039 | AC101122 |
| CH330 | AC1039 | AC101122 |
| CH331 | AC100427 | |
| CH335 | AC100427 | AC101926 |
| CH339 | AC100427 | AC101926 |
| CH342 | AC1039 | AC101122 |
| CH343 | AC1039 | AC101122 |
| CH356 | AC1039 | AC101122 |
| CH357 | AC1039 | AC101122 |
| CH358 | AC1039 | AC101122 |
| CH359 | AC100427 | AC101926 |
| CH360 | AC100427 | AC101926 |
| CH405 | AC1039 | AC101122 |
| CH407 | AC1039 | AC101122 |

Specifications subject to change

Specification and order options

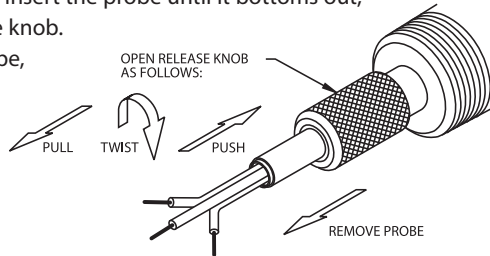
| CH104 | Model number from table | | |
|--------------------------------|--|-----------|-----------|
| P2 | Pipe thread code: | Thread A | Thread B |
| | ▼P1 = | 3/4 - 14 | 1/2 - 14 |
| | ▼P2 = | 3/4 - 14 | 3/4 - 14 |
| | ▼P3 = | 1/2 - 14 | 1/2 - 14 |
| | ▼P4 = | 1/2 - 14 | 3/4 - 14 |
| | P5 (CH356 only) = | 1/2 - 14 | M20 x 1.5 |
| P6 (CH356 only) = | 3/4 - 14 | M20 x 1.5 | |
| T | Connection type: | | |
| | ▼T = Terminal board for wires AWG 14 or smaller ▼W = Wire nuts for wires AWG 14 to 22 | | |
| 6 | Number of terminal posts or wire nuts: | | |
| | ▼: 0, 6 8 (see terminal board table at right for model options) | | |
| | T0: transmitter mounting hardware W0: empty enclosure | | |
| CH104P2T6 = Sample part number | | | |

Spring-loaded Holders

Exclusive Minco user-friendly design!

Minco's spring-loaded holders provide a quick and simple installation and removal of probe sensors — pull out and twist the knob, insert the probe until it bottoms out, and release the knob.

To remove probe, pull out and twist the knob.



Spring pressure holds the probe tip in contact with the measuring surface for faster response and more reliable measurements. Many models feature a rubber O-ring that doesn't crimp the probe but prevents oil leakage to 50 psi (3.4 bar) at up to 260°C. High temperature models are usable to 450°C. Nylon versions provide electrical insulation.



ALL PARTS STOCKED

Note: Available up to 10 pieces or contact Minco Customer Service

| Fluoroelastomer O-ring seal: 50 psi pressure rated fluid seal | | | | | | | | |
|---|----------------------------|-----------------------------|--------------|----------------|-------------------------|--------------------------|-------------------|-------------------|
| | Body material | Temperature range | Thread "CH" | Process thread | Hex size | Adder "A" (Total length) | Probe Ø inch (mm) | Model |
| | 300 series stainless steel | -40 to 260°C (-40 to 500°F) | 3/4 - 14 NPT | 1/2 - 14 NPT | 1 1/8" (29 mm) | 3.6" (91 mm) | 0.188 (4.8) | ▼ FG114-1 |
| | | | | | | | 0.215 (5.5) | ▼ FG110-1 |
| | | | | | | | 0.250 (6.4) | ▼ FG113-1 |
| | 316 stainless steel | -40 to 260°C (-40 to 500°F) | 3/4 - 14 NPT | 1/2 - 14 NPT | 1 1/8" (29 mm) | 3.6" (91 mm) | 0.188 (4.8) | FG914 |
| | | | | | | | 0.215 (5.5) | FG912 |
| | | | | | | | 0.250 (6.4) | FG911 |
| | Nylon | -40 to 120°C (-40 to 248°F) | 3/4 - 14 NPT | 1/2 - 14 NPT | 1" (25 mm) wrench flats | 3.6" (91 mm) | 0.188 (4.8) | FG314 |
| | | | | | | | 0.215 (5.5) | FG310 |
| | | | | | | | 0.250 (6.4) | FG313 |
| | 300 series stainless steel | -40 to 260°C (-40 to 500°F) | 1/2 - 14 NPT | 1/2 - 14 NPT | 7/8" (22 mm) | 2.6" (66 mm) | 0.125 (3.2) | FG216N |
| | | | | | | | 0.188 (4.8) | FG214N |
| | | | | | | | 0.215 (5.5) | FG210N |
| | | | | | | | 0.250 (6.4) | FG213N |
| | | | | | | | 0.236 (6.0) | FG215N |
| | 300 series stainless steel | -40 to 260°C (-40 to 500°F) | None | 1/8 - 27 NPT | 5/8" (16 mm) | 3.6" (91 mm) | 2.8" (71 mm) | 0.125 (3.2) FG116 |
| | | | | | | | 0.188 (4.8) | FG112 |
| | | | | | | | 0.215 (5.5) | FG111 |
| | | | | | | | 0.250 (6.4) | FG117 |
| | 300 series stainless steel | -40 to 260°C (-40 to 500°F) | None | 1/4 - 18 NPT | 5/8" (16 mm) | 1.9" (48 mm) | 0.188 (4.8) | FG101072 |
| | | | | | | | 0.215 (5.5) | FG101078 |
| | | | | | | | 0.250 (6.4) | FG101080 |

| High temperature: No pressure rating or fluid seal | | | | | | | | |
|--|----------------------------|-----------------------------|--------------|----------------|--------------|--------------------------|-------------------|---------|
| | Body material | Temperature range | Thread "CH" | Process thread | Hex size | Adder "A" (Total length) | Probe Ø inch (mm) | Model |
| (Set screw installation) | 300 series stainless steel | -40 to 450°C (-40 to 842°F) | 1/2 - 14 NPT | 1/2 - 14 NPT | 7/8" (22 mm) | 2.3" (58 mm) | 0.188 (4.8) | ▼ FG801 |
| | | | | | | | 0.215 (5.5) | ▼ FG802 |
| | | | | | | | 0.250 (6.4) | ▼ FG810 |

▼ = STANDARD OPTIONS
Specifications subject to change

Fluid Immersion Fittings

Overview

Install probes directly into fluid streams and pressure vessels. Simply position the fitting on the probe and tighten the sealing nut.

Be sure to check the pressure ratings of probes intended for direct immersion.

Fluid seal fittings are best for moderate temperatures and pressures. Pressure fittings, constructed of stainless steel, can withstand corrosive media and greater extremes of pressure and temperature.



ALL PARTS STOCKED

Note: Available up to 10 pieces or contact Minco Customer Service

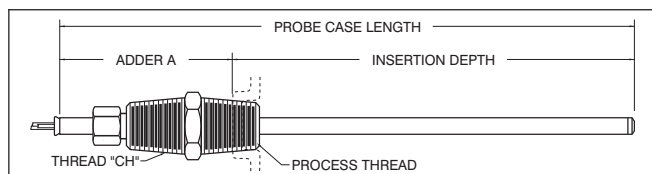
ACCESSORIES

| Fluid seal fittings to 260°C (500°F) | | | | | | |
|--------------------------------------|-----------------|--------------|----------------|-----------------------------|----------------------|--------|
| | Body material | Thread "CH" | Process thread | Adder "A" (Total length) | Probe Ø inch (mm) | Model |
| | Brass | None | 1/8 - 27 NPT | 1.2" min. (31 mm) | 0.188 (4.8) | ▼FG143 |
| | | None | 1/4 - 18 NPT | | | ▼FG140 |
| | | None | 1/8 - 27 NPT | | 0.215 (5.5) | ▼FG126 |
| | | None | 1/4 - 18 NPT | | | ▼FG120 |
| | | None | 1/8 - 27 NPT | | 0.250 (6.4) | ▼FG151 |
| | | None | 1/4 - 18 NPT | | | ▼FG130 |
| | Stainless steel | 1/2 - 14 NPT | 1/2 - 14 NPT | 2.4" (61 mm) | 0.188 (4.8) | ▼FG142 |
| | | | | | 0.215 (5.5) | ▼FG122 |
| | | | | | 0.250 (6.4) | ▼FG132 |

Note: Fluid seal fittings are rated to 200 psi (17 bar) when using the repositionable silicone rubber O-ring. They are rated to 500 psi (34 bar) when using the non-repositionable compression ring. These fittings come with both the O-ring and the compression ring.

| Pressure fittings to 871°C (1600°F) | | | | | | |
|-------------------------------------|---------------------|--------------|----------------|-----------------------------|----------------------|-----------|
| | Body material | Thread "CH" | Process thread | Adder "A" (Total length) | Probe Ø inch (mm) | Model |
| | 316 stainless steel | None | 1/8 - 27 NPT | 1.5" min. (39 mm) | 0.188 (4.8) | FG141T3P2 |
| | | None | 1/4 - 18 NPT | | | FG141T3P4 |
| | | None | 1/2 - 14 NPT | | | FG141T3P8 |
| | | None | 1/8 - 27 NPT | | 0.250 (6.4) | FG141T4P2 |
| | | None | 1/4 - 18 NPT | | | FG141T4P4 |
| | | None | 1/2 - 14 NPT | | | FG141T4P8 |
| | 316 stainless steel | 1/2 - 14 NPT | 1/2 - 14 NPT | 2.9" (74 mm) | 0.125 (3.2) | FG145T2 |
| | | | | | 0.188 (4.8) | FG145T3 |
| | | | | | 0.250 (6.4) | FG145T4 |

Note: Pressure fittings are rated to 1500 psi (103 bar) at 25°C/77°F, reducing to 500 psi (34 bar) at 630°C/1166°F. The probe cannot be repositioned after installation.



To determine the ideal probe length add the insertion depth to the adder A for the fitting you will use.

▼ = **STANDARD OPTIONS**
Specifications subject to change



Economy and HVAC Thermowells

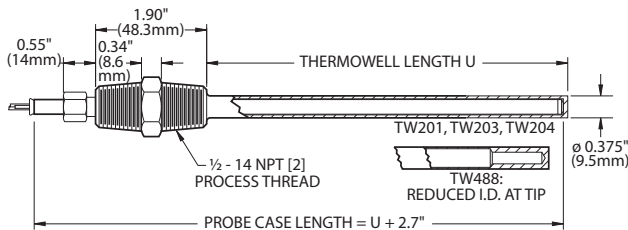


Overview

Thermowells protect probes from pressure, flow, and corrosion. The models on this page have integral fittings for probe and connection head mounting.

Immerse the thermowell at least 2.5" (65 mm) for accurate readings. The well should extend beyond the center of the fluid stream without touching the opposite wall. Installation in an elbow or tee may be necessary for sufficient immersion in small pipes.

For fastest time response, Minco can furnish thermowells with heat sink compound in the tip. This eliminates the air gap between the probe and inside wall of the well and can reduce time constant by as much as 50%. Order AC101750.



Economy thermowell specifications

Models: TW204 / TW201 / TW203

Probes: use with tip-sensitive probes on pages 2-2 to 2-3

Body material: 300 series stainless steel, nickel-plated brass sealing nut with brass compression ring

Temperature limit: 260°C (500°F)

Pressure rating: 1000 psi (69.9) bar

Hex size: 7/8" (22 mm)

Standard U dimension: 0.1" increments to 48"

| Probe diameter | Thread "CH" | Process Thread | Model |
|-----------------|-------------|----------------|-------|
| 0.188" (4.8 mm) | 1/2-14 NPT | 1/2-14 NPT | TW204 |
| 0.215" (5.5 mm) | | | TW201 |
| 0.250" (6.4 mm) | | | TW203 |

HVAC thermowell specifications

Model: TW488

Probes: use with HVAC probes on page 8-19

Body material: 316 stainless steel, nickel-plated brass sealing nut with silicone rubber O-ring

Temperature limit: 260°C (500°F)

Pressure rating: 1880 psi (129.7) bar

Hex size: 7/8" (22 mm)

Standard U dimension:

3.0, 6.0, 12.0, and 18.0". Other lengths are available.

| Probe diameter | Thread "CH" | Process Thread | Model |
|---------------------|-------------|----------------|-------|
| 0.250" (6.4 mm) | 1/2-14 NPT | 1/2-14 NPT | TW488 |
| Tip 0.188" (4.8 mm) | | | |

Specification and order options

| | |
|-------------------------------|--|
| TW203 | Model number |
| U | |
| 60 | Thermowell length U: Specify in 0.1" increments (Ex: 60 = 6.0 inches) |
| TW203U60 = Sample part number | |



STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**
Specifications subject to change

Reduced Tip and Tapered Thermowells



Reduced Tip Thermowell



Tapered Thermowell

Overview

Protect probes from pressure, flow, and corrosive fluids. Thermowells on this page are machined from solid bar stock. Specify reduced tip style for fast response, tapered style for maximum rigidity in high flow conditions.

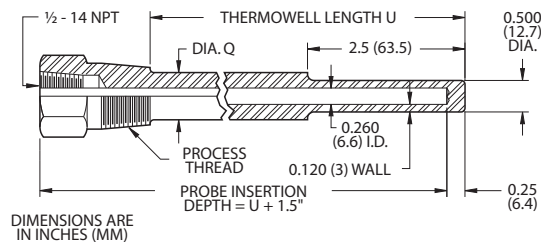
Immerse the thermowell at least 2.5" (65 mm) for accurate readings. The well should extend beyond the center of the fluid stream without touching the opposite wall. Installation in an elbow or tee may be necessary for sufficient immersion in small pipes.

Spring-loaded probe installation is recommended, using either spring-loaded holders or bayonet-mount probes. 0.250" diameter probes provide the best fit.

For fastest time response, Minco can furnish thermowells with heat sink compound in the tip. This eliminates the air gap between the probe and inside wall of the well and can reduce time constant by as much as 50%. Order AC101750.

Contact Minco Sales and Customer Service for other thermowell styles and materials.

Reduced tip thermowell specifications



Temperature limit:

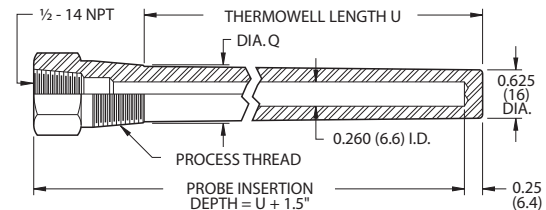
Stainless steel: 900°C (1650°F).

Monel: 538°C (1000°F).

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5". Other dimensions available.

| Body material | Process thread (NPT) | | |
|---------------------|----------------------|----------------|----------------|
| | 1/2 - 14 | 3/4 - 14 | 1 - 11 1/2 |
| 304 stainless steel | TW239 | TW228 | TW238 |
| 316 stainless steel | ▼TW222 | ▼TW248 | TW234 |
| Monel | TW1204 | TW447 | TW1231 |
| Diameter Q | 0.625" (16 mm) | 0.750" (19 mm) | 0.875" (22 mm) |
| Hex size | 1.125" (29 mm) | | 1.375" (35 mm) |

Tapered thermowell specifications



Temperature limit:

Stainless steel: 900°C (1650°F).

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5". Other dimensions available.

| Body material | Process thread (NPT) | |
|---------------------|----------------------|----------------|
| | 3/4 - 14 | 1 - 11 1/2 |
| 304 stainless steel | TW477 | TW252 |
| 316 stainless steel | ▼TW1218 | ▼TW1237 |
| Diameter Q | 0.875" (22 mm) | 1.06" (27 mm) |
| Hex size | 1.125" (29 mm) | 1.375" (35 mm) |

Pressure ratings

| Body material | Temperature | | |
|---------------------|---------------------|---------------------|---------------------|
| | 21°C (70°F) | 538°C (1000°F) | 650°C (1200°F) |
| 304 stainless steel | 7000 psi 483 bar | 4500 psi 310 bar | 1650 psi 114 bar |
| 316 stainless steel | 7000 psi 483 bar | 5100 psi 352 bar | 2500 psi 172 bar |
| Monel | 6500 psi 448 bar | 1500 psi 103 bar | |

Specification and order options

| | |
|-------------------------------|---|
| TW222 | Model number from table |
| U | |
| 45 | Thermowell length U: Specify in 0.1" increments (Ex: 45 = 4.5 inches) ▼: 25, 45, 60 |
| TW222U45 = Sample part number | |



STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**

Specifications subject to change

Flanged Thermowells

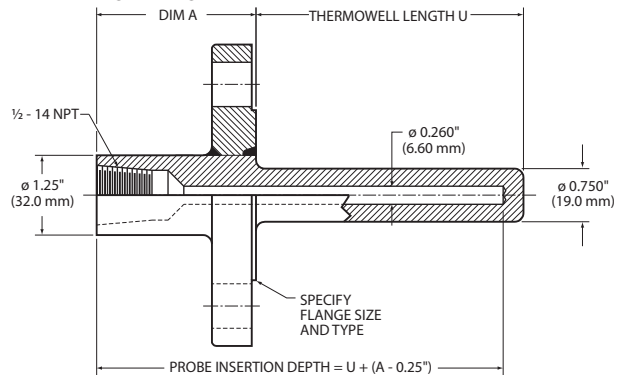
Overview

Flanged thermowells are available in three standard flange sizes: 1.0", 1.5", and 2.0" per ANSI B16.5. Specify U dimension and pressure rating.

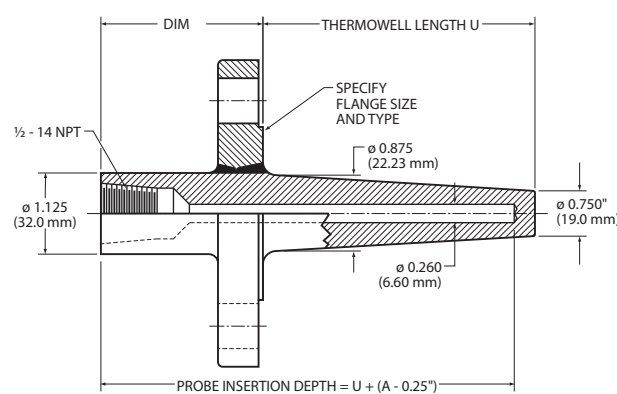
Immerse the thermowell at least 2.5" (65 mm) for accurate readings. The well should extend beyond the center of the fluid stream without touching the opposite wall. Installation in an elbow or tee may be necessary for sufficient immersion in small pipes.



TW1219 Flanged Straight Thermowell



TW1220 Flanged Tapered Thermowell



Specifications - Models TW1219 / TW1220

Body material: 316 stainless steel.

Temperature limit: 607°C (1125°F).

Pressure rating: Specify flange pressure rating.
(1 bar = 14.5 psi).

| Pressure rating | Dimension A |
|------------------------|--------------|
| 150, 300, 400, 600 psi | 2.25" (64mm) |
| 900, 1500, 2500 psi | 3.25" (83mm) |

Thread: 1/2-14 NPT internal thread.

Probe diameter: 0.250" (6.4 mm).

Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5". Other dimensions available.

Specification and order options:

| | |
|--|--|
| TW1219 | Model number: TW1219 = Straight TW1220 = Tapered |
| U | |
| 105 | Thermowell length U: Specify in 0.1" increments (Ex: 105 = 10.5 inches) |
| S | |
| 10 | Flange size: 10 = 1.0" 15 = 1.5" 20 = 2.0" |
| F | |
| 300 | Pressure rating in pounds per square inch |
| RF | Flange type: RF = Raised face RTJ = Ring type joint |
| TW1219U105S10F300RF = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Bayonet Fittings, Extensions





ALL PARTS STOCKED

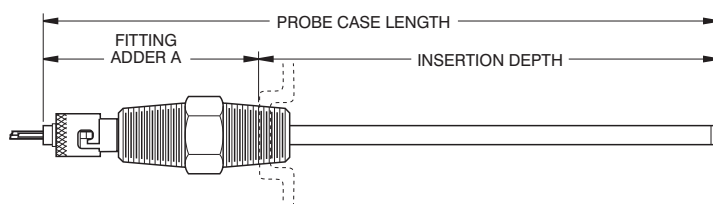
Bayonet adapter style

Bayonet fittings are for spring-loaded installation of probes equipped with springs and lockcaps. Insert the probe, hook the lockcap over the pin on the fitting, and release.

Note: Available up to 10 pieces or contact Minco Customer Service

| Bayonet adapter style | Body material | Thread "CH" | Process thread | Hex size | Adder "A" | Probe diameter | Model |
|---|---------------------|---------------|----------------|--------------|-------------------|-----------------|----------|
|  | 303 stainless steel | None | 1/8" - 27 NPT | None | 1.2" min. (31 mm) | 0.188" (4.8 mm) | ▼FG180 |
|  | 316 stainless steel | 1/2" - 14 NPT | 1/2" - 14 NPT | 7/8" (22 mm) | 2.4" (61 mm) | 0.188" (4.8 mm) | ▼FG144T3 |

Note: Temperature limit: 871°C (1600°F)



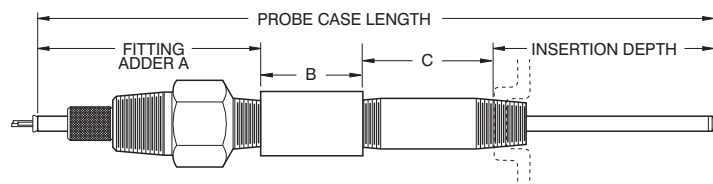
Extension nipples, couplings, unions

Extensions in assemblies serve to isolate connection heads from process connections in order to clear pipe insulation or limit heat conduction into the head. Choose from galvanized or stainless steel nipples, couplings, and unions.

Nipples are short lengths of pipe to extend connection heads away from processes. Couplings and unions have two 1/2" - 14 NPT female threads to join nipples to other fittings. Unions allow installation without rotating the connection head.

| Style | Length | Galvanized steel to 260°C (500°F) | Stainless steel to 871°C (1600°F) |
|---|------------------------|---|------------------------------------|
|  <p>Nipple</p> | 1.2" (34 mm) | FG563 Adder C: 0.2" (5mm) | FG537 Adder C: 0.2" (5mm) |
| | 2.0" (51 mm) | ▼FG556L20 Adder C: 1.0" (25mm) | ▼FG579L20 Adder C: 1.0" (25mm) |
| | 3.0" (76 mm) | ▼FG556L30 Adder C: 2.0" (51mm) | ▼FG579L30 Adder C: 2.0" (51mm) |
| | 4.0" (102 mm) | ▼FG556L40 Adder C: 3.0" (76mm) | ▼FG579L40 Adder C: 3.0" (76mm) |
| | 6.0" (152 mm) | ▼FG556L60 Adder C: 5.0" (127mm) | ▼FG579L60 Adder C: 5.0" (127mm) |
|  <p>Coupling</p> | Same as Adder B length | ▼FG602 Adder B: 1.7" (43mm) | ▼FG854 Adder B: 1.4" (36mm) |
|  <p>Union</p> | Same as Adder B length | ▼FG709 (no fluid seal) Adder B: 1.9" (48 mm) | ▼FG714 Adder B: 1.6" (41 mm) |

Note: All threads are 1/2" - 14 NPT [2].



▼ = **STANDARD OPTIONS**
Specifications subject to change

ACCESSORIES

Metric Accessories

Overview

Metric fittings and thermowells help you design your equipment to meet global standards. Use these fittings to install Minco sensors in process lines, rotating machinery, and all types of industrial equipment.

Special threads and accessories are available. See Eurostyle Sensors Assemblies on page 1-22.





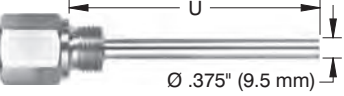
Fluid seal spring-loaded holders: Spring-loaded holders provide fast installation and simple adjustment or removal of probes. Minco's unique designs work with straight probes and provide sealing for the typical oil pressures found in rotating machines.

Fluid seal fittings: Fluid seal fittings are a low cost solution where a connection head is not required.

Bayonet adapters: Bayonet adapters work with Minco's spring-loaded bayonet fitted probes.

Adapter bushings: Adapter bushings allow fitting 1/2 - 14 NPT fittings into metric threaded process connections.

Thermowells: Thermowells provide high-pressure protection and allow probe replacement without opening the system.

| | Body material | Temp. limit | Pressure rating | Thread "CH" | Process thread | Hex size | Probe diameter | Model |
|--|---|----------------|--|-----------------------|--------------------------|-----------------|-----------------|------------|
|  <p>Fluid seal spring-loaded holder Probe length adder A: 3.6" (91mm)</p> | 303 series stainless steel per DIN 1.4300, AISI 303 | 260°C (500°F) | 3.4 bar (50 psi) | 3/4 - 14 NPT | G 1/2 ISO 229/1 parallel | 1 1/16" (27 mm) | 0.188" (4.8 mm) | MFG812P477 |
| | | | | | | | 0.215" (5.5 mm) | MFG812P546 |
| | | | | | | | 0.250" (6.4 mm) | MFG812P635 |
|  <p>Fluid seal fitting Probe length adder A: 1.1" min. (28 mm)</p> | Brass | 260°C (500°F) | Silicone rubber O-ring: 17.2 bar (250 psi) Brass compression ring: 34.5 bar (500 psi) | None | R 1/4 ISO 7/1 tapered | 9/16" (14 mm) | 0.250" (6.4 mm) | MFG816 |
|  <p>Bayonet adapter Probe length adder A: 1.2" (31 mm)</p> | 303 series stainless steel per DIN 1.4300, AISI 303 | 871°C (1600°F) | No fluid seal | None | R 1/8 ISO 7/1 tapered | None | 0.188" (4.8 mm) | MFG817 |
|  <p>Adapter bushing Probe length adder A: 1.2" (31 mm)</p> | 303 series stainless steel per DIN 1.4300, AISI 303 | 871°C (1600°F) | No fluid seal | 1/2 - 14 NPT (Female) | G 1/2 ISO 229/1 parallel | 1 1/16" (27 mm) | All | ▼ MFG811 |
|  <p>Thermowell Probe length = U + 30 mm + fitting adder A (U= 13 mm min./1200 mm max.)</p> | 303 series stainless steel per DIN 1.4300, AISI 303 | 871°C (1600°F) | 190 bar (2755 psi) at 25°C, reducing to 34 bar (493 psi) at 600°C | 1/2 - 14 NPT (Female) | G 1/2 ISO 229/1 parallel | 1 1/16" (27 mm) | 0.250" (6.4 mm) | MTW1208 |

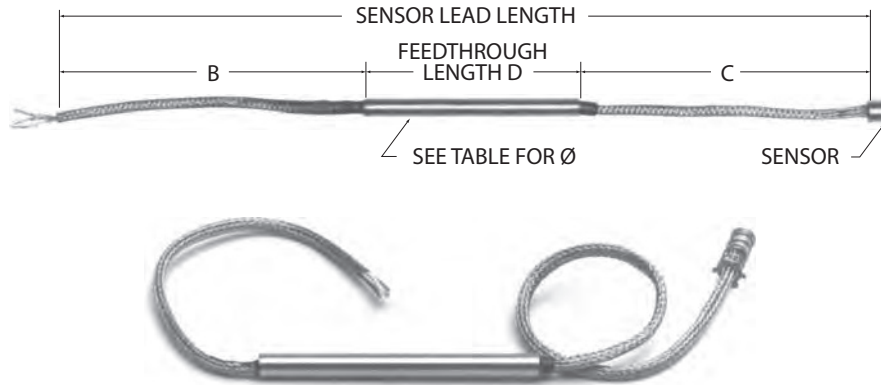
Thermowell specification and order options

| | |
|----------------------------------|--|
| MTW1208 | Model number |
| U | |
| 100 | Thermowell length U: Specify in millimeters Minimum: 13 mm Maximum: 1200 mm |
| MTW1208U100 = Sample part number | |

▼ = STANDARD OPTIONS

Specifications subject to change

Feedthroughs - Prevent Oil Seepage



ACCESSORIES

Overview

Feedthroughs provide an oil-tight-seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. The pressure rating to 25 psi (1.7 bar) is suitable for most oil and coolant pump systems.

Feedthroughs can be ordered as an accessory to any sensor in this guide. When ordering feedthroughs with case style B bearing sensors, the spring and retaining ring are automatically included. Fluid seal fittings allow easy installation of feedthroughs into standard NPT threaded machine housings. See page 3-4, 3-5 or 3-10 (metric) for fluid seal fittings, or page 3-12 for transitions through housings.

Specifications

Material: Stainless steel with epoxy potting.

Temperature limit: 149°C (300°F).

Pressure limit: 25 psi (1.7 bar).

| Sheath Ø | Max. Cable Ø | Model |
|-----------------|----------------|-------|
| 0.188" (4.8 mm) | 0.12" (3.0 mm) | AC958 |
| 0.215" (5.5 mm) | 0.14" (3.6 mm) | AC717 |
| 0.250" (6.4 mm) | 0.17" (4.3 mm) | AC718 |
| 0.375" (9.5 mm) | 0.26" (6.6 mm) | AC961 |

Specification and order options

| | |
|----------------------------------|--|
| AC717 | Model number from table |
| B6 | Lead length B or C in inches (specify one): B = Lead end C = Sensor end |
| D250 | Feedthrough length D in 0.01" increments: Min. length: 1.6" (40.6 mm) (Ex: 250 = 2.50") |
| AC717B6D250 = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change



FG Series Cable Seals

Prevent oil wicking with bearing embedment sensors



STOP OIL SEEPAGE!

Overview

Minco's FG series cable seals prevent oil wicking with bearing embedment sensors in rotating equipment. They were specifically designed for use with Minco's innovative elastomer filled cables to prevent oil wicking along the sensor cable. FG series seals can also be used to seal around individual leadwires and rigid tubing. The seals include a grommet that provides a tight seal and also allows adjustment of the cable or leadwire position.

Configurations

FG series cable seals are available in three configurations, all of which perform the same basic function of providing an adjustable, oil-tight seal on Minco elastomer filled cables, leadwires, rigid probes or feed-through tubing.

| FG1015 | FG3015 | FG4015 |
|--|---|---|
| | | |
| | | |
| <ul style="list-style-type: none"> • Feed-through grommet | <ul style="list-style-type: none"> • Split grommet | <ul style="list-style-type: none"> • Feed-through or split grommet • ATEX and IECEx certified |

Installation

The split grommet fits over the cable where access to the cable ends isn't practical. The feed-through grommet requires the cables to be threaded through the grommet. Tightening the fitting compresses the grommet, forming the seal. To adjust the position of the cables in the seal, simply loosen the fitting to decompress the grommet and pull the wire or cable through the grommet to the desired position and retighten the fitting.

Note:

- Plugs are provided to fill unused holes on 6-hole and split grommets.
- Insulated leadwires must be used; do not use bare stranded leadwires.
- Wires must be oil sealed on sensor end.

Specifications

| | |
|-------------------------------|--|
| Fitting material | Stainless steel (303 or 316) |
| Grommet material | Fluoroelastomer or Neoprene |
| Temperature range (grommet) | Fluoroelastomer: -40 to 90°C (-40 to 194°F) Neoprene: -40 to 75°C (-40 to 167°F) |
| Pressure | 50 psi (3.4 bar) at 20°C |
| Ingress protection rating* | IP65/IP66 |
| ATEX and IECEx certification* | ATEX II 2 G Ex d e IIc Gb IECEx Ex d e IIc Gb |

*FG4014 and FG4015 only

▼ = **STANDARD OPTIONS**
Specifications subject to change

Ordering Information

FG products can be ordered as complete assemblies or as piece parts (fitting body and grommet kit separately).

Cable Seal Assemblies

To configure your assembly, select from the options listed below to determine the complete assembly part number. Use the code shown in **bold** for each selection. Assemblies include fitting body, grommet and compression plugs, and washer (1015).

| | | | | | | |
|--------------------------------------|--|----------------------|------------------|----------------|---------------------|-------------------------|
| FG1015 | Model number: ▼ FG1015 : Cable seal assembly (feed-through grommet) ▼ FG3015 : Cable seal assembly (split grommet) ▼ FG4015 : Cable seal assembly (feed-through grommet, certified) ▼ FG4015 : Cable seal assembly (feed-through grommet, certified - add S to end of part number for certified version) | | | | | |
| P1 | Pipe thread code: | | | | | |
| | Code | Connection thread | Process thread | Overall length | Connection hex size | |
| | ▼ P1 | 1/2" 14 NPT | 3/4" 14 NPT | 3.25" | 1-1/8" | |
| | ▼ P2 | 3/4" 14 NPT | | | | |
| | ▼ P3 | 1/2" 14 NPT | 1/2" 14 NPT | | | |
| | ▼ P4 | 3/4" 14 NPT | | | | |
| | P5 | NONE | 1/2" 14 NPT | 2.50" | | |
| | P6 | | 3/4" 14 NPT | | | |
| | P7 | 1/2" 14 NPT (FEMALE) | 1/2" 14 NPT | 3.25" | | |
| | P8 | | 3/4" 14 NPT | | | |
| P9 | 3/4" 14 NPT (FEMALE) | 3/4" 14 NPT | 3.35" | 1-3/8" | | |
| SS | Fitting material: ▼ SS = Stainless steel, type 303 ST = Stainless steel, type 316 | | | | | |
| 1V130 | Grommet hole quantity, material and size: | | | | | |
| | Hole qty. | Material | | | Grommet hole Ø | Cable/conductor Ø range |
| | | Neo-prene | Fluoro-elastomer | | | |
| | | 1015, 4015 | 1015, 4015 | 3015 | | |
| | 1 | | ▼ 1V130 | | 0.130" | 0.100" to 0.130" |
| | | | ▼ 1V160 | 1V160 | 0.160" | 0.130" to 0.160" |
| | | | ▼ 1V220 | 1V220 | 0.220" | 0.190" to 0.220" |
| | 2 | 2N130 | ▼ 2V130 | | 0.130" | 0.100" to 0.130" |
| | | 2N160 | ▼ 2V160 | | 0.160" | 0.130" to 0.160" |
| | | 2N190 | 2V190 | | 0.190" | 0.160" to 0.190" |
| 2N220 | | 2V220 | 2V220 | 0.220" | 0.190" to 0.220" | |
| 3 | 3N130 | 3V130 | | 0.130" | 0.100" to 0.130" | |
| | | 3V160 | | 0.160" | 0.130" to 0.160" | |
| | 3N190 | 3V190 | ▼ 3V190 | 0.190" | 0.160" to 0.190" | |
| 4 | | | ▼ 4V100 | 0.100" | 0.080" to 0.100" | |
| | | ▼ 4V130 | ▼ 4V130 | 0.130" | 0.100" to 0.130" | |
| | | ▼ 4V160 | ▼ 4V160 | 0.160" | 0.130" to 0.160" | |
| 6 | 6N050 | ▼ 6V050 | ▼ 6V050 | 0.050" | 0.030" to 0.050" | |
| FG1015P1SS1V130 = Sample part number | | | | | | |

Fitting Body/Cap Only

To configure your fitting body/cap, select from the options listed below to determine the complete part number. Use the code shown in **bold** for each selection. Fitting bodies do not include grommet and compression plugs, and washer.

| | | | | | |
|---------------------------------|--|----------------------|----------------|----------------|---------------------|
| FG1014 | Model number: FG1014: Cable seal fitting body only FG4014: Cable seal fitting body only (ATEX) | | | | |
| P1 | Pipe thread code: | | | | |
| | Code | Connection thread | Process thread | Overall length | Connection hex size |
| | P1 | 1/2" 14 NPT | 3/4" 14 NPT | 3.25" | 1-1/8" |
| | P2 | 3/4" 14 NPT | | | |
| | P3 | 1/2" 14 NPT | 1/2" 14 NPT | | |
| | P4 | 3/4" 14 NPT | | | |
| | P5 | NONE | 1/2" 14 NPT | 2.50" | |
| | P6 | | 3/4" 14 NPT | | |
| | P7 | 1/2" 14 NPT (FEMALE) | 1/2" 14 NPT | 3.25" | |
| | P8 | | 3/4" 14 NPT | | |
| P9 | 3/4" 14 NPT (FEMALE) | 3/4" 14 NPT | 3.35" | 1-3/8" | |
| SS | Fitting material: SS = Stainless steel, type 303 ST = Stainless steel, type 316 | | | | |
| FG1014P1SS = Sample part number | | | | | |

Grommet Kits

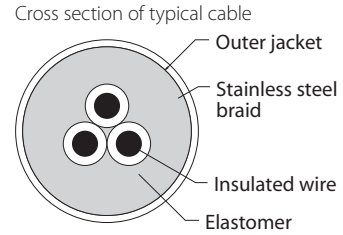
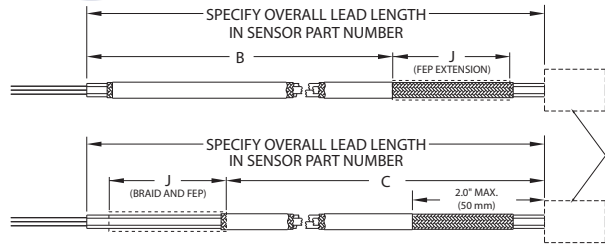
To configure your grommet kit, select from the options listed below to determine the complete part number. Use the code shown in **bold** for each selection. Kits include grommet and compression plugs, and washer (1015).

| | | | | | | |
|-----------------------------------|--|--------------|------------------|--------------|------------------|-------------------------|
| AC1015 | Kit type: AC1015 = Feed-through grommet AC3015 = Split grommet design AC4015 = Feed-through grommet, certified AC4015 = Split grommet design, certified (add S to end of part number to receive split grommet version) | | | | | |
| H1V130 | Grommet hole quantity, material and size: | | | | | |
| | Hole qty. | Material | | | Grommet hole Ø | Cable/conductor Ø range |
| | | Neo-prene | Fluoro-elastomer | | | |
| | | 1015, 4015 | 1015, 4015 | 3015 | | |
| | H1 | | 1V130 | | 0.130" | 0.100" to 0.130" |
| | | | 1V160 | 1V160 | 0.160" | 0.130" to 0.160" |
| | | | 1V220 | 1V220 | 0.220" | 0.190" to 0.220" |
| | H2 | 2N130 | 2V130 | | 0.130" | 0.100" to 0.130" |
| | | 2N160 | 2V160 | | 0.160" | 0.130" to 0.160" |
| | | 2N190 | 2V190 | | 0.190" | 0.160" to 0.190" |
| H3 | 2N220 | 2V220 | 2V220 | 0.220" | 0.190" to 0.220" | |
| | 3N130 | 3V130 | | 0.130" | 0.100" to 0.130" | |
| | | 3V160 | | 0.160" | 0.130" to 0.160" | |
| H4 | 3N190 | 3V190 | 3V190 | 0.190" | 0.160" to 0.190" | |
| | | | 4V100 | 0.100" | 0.080" to 0.100" | |
| | | 4V130 | 4V130 | 0.130" | 0.100" to 0.130" | |
| H6 | | 4V160 | 4V160 | 0.160" | 0.130" to 0.160" | |
| | | 4V130 | 4V130 | 0.130" | 0.100" to 0.130" | |
| | 6N050 | 6V050 | 6V050 | 0.050" | 0.030" to 0.050" | |
| AC1015H1V130 = Sample part number | | | | | | |

Specifications subject to change

Note: Order the 6-hole version to seal around PTFE-insulated wires.

Sealed Elastomer Rubber-filled Cable - Prevent Oil Seepage



| Lead size AWG | Number of leads | Grommet hole Ø |
|---------------|-----------------|----------------|
| 20 | 2 | 0.160 |
| 24 | 2 | 0.130 |
| 24 | 3 and 4 | 0.160 |
| 24 | 6 | 0.190 |
| 26 - 28 | 2, 3, 4, and 6 | 0.130 |
| 30 | 2, 3, and 4 | 0.100 |
| 30 | 6 | 0.130 |

Overview

Model AC100324 is a sensor cable with elastomer fill between the wires, stainless steel braid, and outer jacket. This fill can extend along the entire length of the cable, or a specified portion. Seal the outside of the cable with an FG1015, FG3015 or FG4015 leadwire and cable seal fitting. See page 3-12 for more information.

While the AC100324 provides a good seal, a minuscule amount of oil may escape inside the individual wires.

Specifications

Temperature range: -50° C to 125°C (-58°F to 257°F).

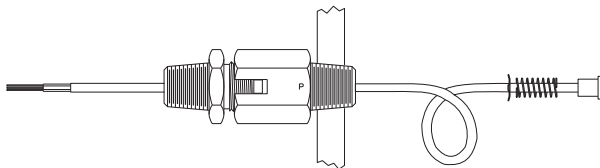
Tolerance on lead length: +1/-0" (+25/-0mm) for lead lengths 24" or less; +5/-0% for lead length greater than 24".

B length: Cable is filled starting at leadwire end of cable. Tubing ends at B length; stainless steel braid extends to case.

C length: Cable is filled starting 2" from case. If J length is specified, stainless steel braid extends to lead end.

J length: Unfilled FEP extension length.

Using the AC100324 with FG1015/FG3015/FG4015 oil seal fittings



When selecting the FG1015, FG3015 or FG4015 for use with silicone filled cable use the grommet hole size from the tables.

| Number of sensing elements | Case style | Grommet hole Ø | |
|----------------------------|------------|----------------|------|
| | | Leads/RTD | |
| | | 2 | 3 |
| 1 | A | .130 | .160 |
| | B | .130 | .160 |
| | C | .130 | .130 |
| | D | .100 | .100 |
| 2 | A | .160 | .190 |
| | B | .130 | .130 |
| | C | .100 | .130 |

Learn more about FG1015, FG3015 or FG4015 leadwire and cable seal fittings on page 3-12.

Specify elastomer filled cables directly in miniature sensor part numbers on pages 6-2 to 6-9 or add to any sensor as part of an assembly.

Specification and order options

| | |
|--|---|
| AC100324 | Model number |
| B24 | Elastomer filled length B or C in inches (if not specified, entire length will be filled) B = Lead end C = Sensor end (Max fill length = 240") |
| To order standard filled cable, stop here. To order an optional jacket extension add: | |
| J | Jacket extension |
| AC100324B24J = Sample part number | |

Note: The sensor model number dictates all specifications other than the elastomer filled length B or C and optional extension J. You must specify sensor model including SS braid covering over the leadwires when ordering. Some sensor models do not include the option for SS braid lead covering; contact Minco for assistance with these sensors.

Specifications subject to change

Extension Wire

Overview

Use extension wire and cable to connect sensor leadwires to remote instrumentation. Unless informed otherwise, wire and cable will be supplied in continuous lengths. Ends are not stripped.



ACCESSORIES

Wire for RTDs

Choose single conductor copper wire or cable.

| Description | Temperature Limit | Color | Model number for AWG | |
|--|-------------------|------------------------------------|----------------------|--------|
| | | | 22 | 26 |
| Single conductor wire, stranded PTFE insulation | 260°C (500°F) | White | WS122W | WS126W |
| | | Red | WS122R | WS126R |
| | | Blue | WS122B | WS126B |
| | | Yellow | WS122Y | WS126Y |
| Single conductor wire, stranded, mica/glass insulation | 550°C (1022°F) | White | WS222W | |
| | | Red tracer | WS222R | |
| 3 conductor cable, PTFE insulation, stainless steel braid over all | 260°C (500°F) | Red/White/White | WS322S | WS326S |
| 6 conductor cable, PTFE insulation, stainless steel braid over all | 260°C (500°F) | Red/White/White/Blue/Yellow/Yellow | | WS426S |
| 3 conductor cable, PTFE insulation, copper shield and PTFE jacket over all | 260°C (500°F) | Red/White/White | WS522T | |

Specification and order options

| | |
|-------------------------------|-------------------------|
| WS122R | Model number from table |
| 10 | Length in feet |
| WS122R10 = Sample part number | |

Single Pair Thermocouple Cable

All thermocouple wire meets standard limits of error per NBS (NIST) Monograph 175, based on ITS-90.

| Description | Temperature Limit | Model number for AWG | |
|--|-------------------|----------------------|--------|
| | | 20 | 24 |
| Single pair thermocouple cable, glass braid insulation | 482°C (900°F) | WT120G | WT124G |
| Single pair thermocouple cable, PTFE insulation | 260°C (500°F) | WT120T | WT124T |
| Single pair thermocouple cable, glass braid insulation with stainless steel braid over all | 482°C (900°F) | WT120S | WT124S |

Specification and order options

| | |
|--------------------------------|---------------------------------|
| WT120S | Model number from table |
| J | Junction type: E, J, K, or T |
| 25 | Length in feet |
| WT120SJ25 = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change





► SECTION 4: INSTRUMENTS

- RTD and thermocouple Temptran™ transmitters provide accurate signals over thousands of feet.
 - Fixed range, dip switch field rangeable or programmable
 - 4-20mA output or HART® protocol
 - Miniature, hockey puck, DIN rail and isolated versions
 - High-accuracy calibration available matched to individual RTDs
 - Controllers, indicators and alarms for precise monitoring and control

| | | | |
|-----------------------------------|---------------------------|--|--------------|
| RTD transmitters..... | 4-2 to 4-5, 4-8 to 4-9, | CT24 12-channel monitor | 4-25 to 4-26 |
| | 4-12 to 4-13 | CT424 alarm/monitor | 4-27 to 4-28 |
| Thermocouple transmitters | 4-6 to 4-7, 4-10 to 4-11, | CT325 miniature DC temperature controller..... | 4-29 to 4-30 |
| | 4-14 to 4-15 | CT335 PC board mount temperature controller..... | 4-31 to 4-32 |
| Programmable transmitters..... | 4-8 to 4-11 | CT435 PC board mount temperature controller..... | 4-33 to 4-34 |
| Field rangeable transmitters..... | 4-12 to 4-15 | CT15 controller/alarm..... | 4-35 to 4-36 |
| Programmable transmitters..... | 4-16 to 4-17 | CT16A temperature controller | 4-37 to 4-38 |
| HART® transmitters | 4-18 to 4-19 | CT15/CT16A accessories | 4-39 |
| Temperature range table..... | 4-20 to 4-21 | CT425 Temperature Controller..... | 4-40 to 4-41 |
| High accuracy calibration | 4-22 | | |
| Mounting accessories..... | 4-22 | | |
| Loop-powered indicators..... | 4-23 to 4-24 | | |

Miniature Temptran™ RTD Transmitters



Overview

- Two models:
 - TT111: UL-recognized component for Canada and United States.
 - TT211: Wider ambient rating; Factory Mutual (FM) approved intrinsically safe and nonincendive.
- Optional high-accuracy calibration to Minco RTDs for improved accuracy; see next page and page 4-22 for more information.

Specifications

Output: 4 to 20 mA over specified range, linear with temperature.

Calibration accuracy: ±0.1% of span.

Linearity: Referenced to actual sensor temperature.

Platinum RTD input: ±0.1% of span.

Nickel and nickel-iron RTD input:

±0.25% of span for spans less than 100°C.

±0.25% of span per 100°C of span for spans greater than 100°C.

Adjustments: Zero and span, ±5% of span. Factory set.

Ambient temperature:

TT111: 0 to 50°C (32 to 122°F).

TT211: -25 to 85°C (-13 to 185°F).

Storage: -55 to 100°C (-67 to 212°F).

Ambient temperature effects:

±0.013% of span per °C.

±0.025% of span per °C for spans less than 55°C.

Warmup drift: ±0.1% of span max., with

$V_{supply} = 24$ VDC and $R_{loop} = 250 \Omega$.

Stable within 30 minutes.

Supply voltage: 8.5 to 35 VDC. Voltage effect ±0.001% of span per volt. Reverse polarity protected.

Maximum load resistance: The maximum allowable resistance of the signal carrying loop is:

$$R_{loop\ max} = \frac{V_{supply} - 8.5}{0.020\ \text{amps}}$$

Example: With supply voltage 24 VDC, maximum loop resistance is 775 Ω .

Minimum span: 27.8°C (50°F).

Hazardous atmospheres: All models may be used with Minco flameproof/explosionproof connection heads. Models TT211 is Factory Mutual approved nonincendive for use in Class I, Division 2 areas and intrinsically safe for Class I, Division 1 areas (requires approved barrier). Transmitter entity parameters:

$V_{max} = 35$ volts; $I_{max} = 150$ mA; $C_i = 0 \mu\text{F}$ and $L_i = 0$ mH.

Connections:

Terminal block for wires AWG 22 to AWG 14.

Physical: Polycarbonate case, epoxy potted for moisture resistance.

Weight: 1.1 oz. (30 g).

Hazardous area requirements

For more information on how to classify a hazardous area, methods of protection, and the various standards and agencies (including FM, CSA, CENELEC, IECEx and ATEX), visit www.minco.com.

▼ = STANDARD OPTIONS
Specifications subject to change

Miniature RTD Transmitters

RTD input types

2-wire resistance thermometer:

| Element | | Code |
|---------------------------|-----------------------|--------|
| Platinum (0.00392 TCR) | 100 Ω at 0°C | PA |
| Platinum (0.00391 TCR) | 100 Ω at 0°C | PB |
| Platinum (0.00385 TCR) | 100 Ω at 0°C | PD, PE |
| Platinum (0.00385 TCR) | 1000 Ω at 0°C | PF |
| Platinum (0.00375 TCR) | 1000 Ω at 0°C | PW |
| Nickel-iron (0.00518 TCR) | 604 Ω at 0°C | FA |
| Nickel-iron (0.00527 TCR) | 1000 Ω at 70°F | FB |
| Nickel-iron (0.00527 TCR) | 2000 Ω at 70°F | FC |
| Nickel (0.00672 TCR) | 120 Ω at 0°C | NA |

Special high-accuracy calibration

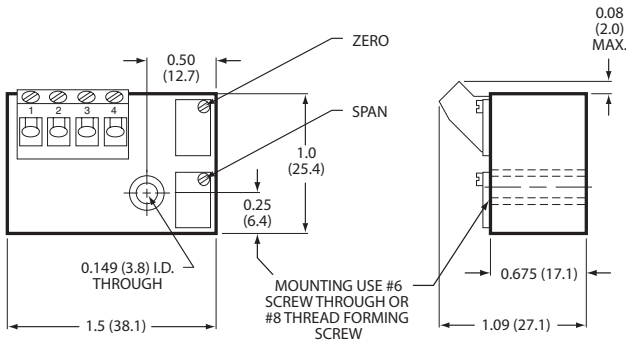
For high system accuracy, specify transmitters with matched calibration. Temptrans match calibrated to a sensor are always ordered as assemblies. Common examples are shown in Section 1.

Specification and order options:

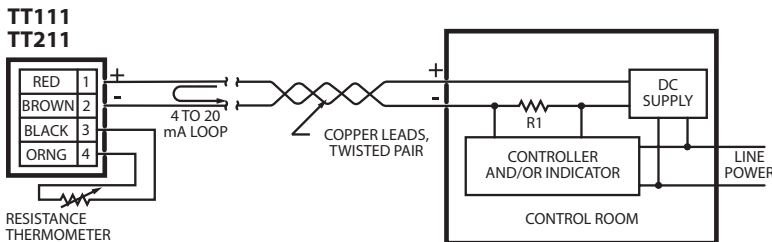
| | |
|--------------------------------|--|
| TT111 | Model number: TT111 or TT211 |
| PD | RTD element code from table |
| 1 | Output: 4 to 20 mA DC |
| C | Temperature range code starting on page 4-20 [Ex: C = 0 to 100°C (32 to 212°F)] |
| TT111PD1C = Sample part number | |

INSTRUMENTS

Dimensions in inches (mm)



Wiring Diagram



▼ = **STANDARD OPTIONS**
Specifications subject to change

TT246 RTD Transmitters



TT246 RTD Transmitter,
voltage output

Overview

Specify this rugged, accurate transmitter for process control and other industrial applications.

Model TT246 outputs 1 to 5 VDC proportional to temperature. It draws only 3 mA of quiescent current, making it ideal for solar or battery powered systems.

- 2 or 3-wire RTD input
- Ambient rated to 85°C (185°F)
- Fits DIN "B" style connection heads
- Optional high-accuracy calibration to Minco RTDs for improved accuracy; see next page and page 4-22 for more information.

Specifications

Output: Linear with temperature over specified range.
TT246: 1 to 5 VDC

Calibration Accuracy: ±0.1% of span (0.2% of span for spans less than 10 Ω)

Linearity: 0.1% of span, referenced to actual sensor temperature

Adjustments Zero and span, ±5% of span, non-interacting. Factory set.

Ambient temperature:

Operating: -40 to 85°C (-40 to 185°F)

Storage: -55 to 100°C (-67 to 212°F)

Ambient temperature effects:

±0.009% of span per °C

±0.014% of span per °C for spans less than 10 Ω

Warmup drift:

±0.1% of span max., with $V_{supply} = 24$ VDC and $R_{loop} = 250$ Ω.
Stable within 15 minutes.

Supply voltage:

TT246: 7.5 to 35 VDC

Voltage effect ±0.001% of span per volt.

Reverse polarity protected.

Supply current: 3mA max. with no load.

Maximum load resistance: The maximum allowable resistance of the signal carrying loop is:

$$R_{loop\ max} = \frac{V_{supply} - 10}{0.020\ \text{amps}}$$

Example: With supply voltage 24 VDC, maximum loop resistance is 700 Ω.

Minimum span: 10°C (18°F).

Minimum output current: 2.2 mA.

Maximum output current: 28 mA.

Leadwire compensation: (3-wire RTD) ±0.05% of span per Ω up to 25 Ω in each leg.

Hazardous atmospheres: May be used with Minco explosion-proof connection heads.

Connections: Terminal block for wires AWG 22 to AWG 14.

Physical: Polycarbonate case, epoxy potted for moisture resistance.

Weight: 2.0 oz. (57 g).

▼ = STANDARD OPTIONS

Specifications subject to change

RTD input types

2 or 3-wire resistance thermometer:

| Element | | Code |
|---------------------------|-----------------------|--------|
| Platinum (0.00392 TCR) | 100 Ω at 0°C | PA |
| Platinum (0.00391 TCR) | 100 Ω at 0°C | PB |
| Platinum (0.00385 TCR) | 100 Ω at 0°C | PD, PE |
| Platinum (0.00385 TCR) | 1000 Ω at 0°C | PF |
| Platinum (0.00375 TCR) | 1000 Ω at 0°C | PW |
| Copper (0.00427 TCR) | 10 Ω at 25°C | CA |
| Nickel-iron (0.00518 TCR) | 604 Ω at 0°C | FA |
| Nickel-iron (0.00527 TCR) | 1000 Ω at 70°F | FB |
| Nickel-iron (0.00527 TCR) | 2000 Ω at 70°F | FC |
| Nickel (0.00672 TCR) | 120 Ω at 0°C | NA |

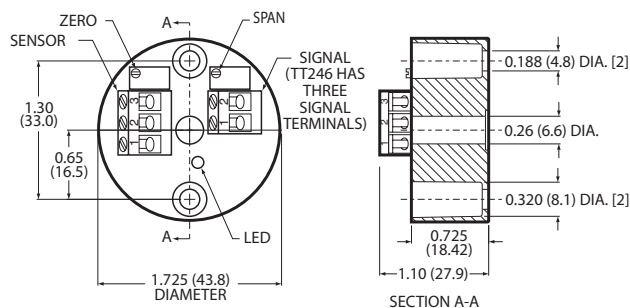
Special high-accuracy calibration

For high system accuracy, specify transmitters with matched calibration. Temptrans match calibrated to a sensor are always ordered as assemblies.

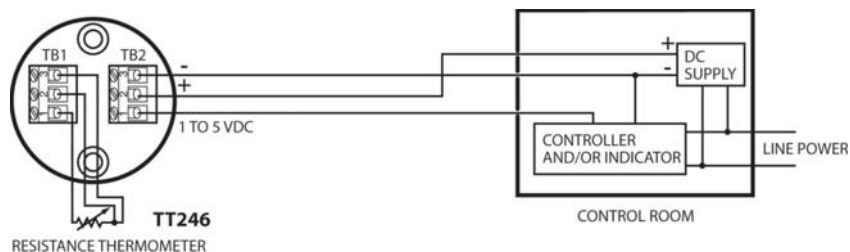
Specification and order options:

| | |
|--------------------------------|--|
| TT246 | Model Number: |
| PB | RTD element code from table |
| 1 | |
| K | Temperature range code starting on page 4-20 [Ex: K = 0 to 200°C (32 to 392°F)] |
| TT246PB1K = Sample part number | |

Dimensions in inches (mm)



Wiring Diagram



▼ = **STANDARD OPTIONS**
Specifications subject to change

TT205 Thermocouple Transmitters



TT205
Thermocouple Transmitter

Overview

Model TT205 interfaces with thermocouples for use in process control and other industrial applications.

Model TT205 offers superior performance in an economical and small package.

- Thermocouple input
- Fits DIN "B" style connection heads

Specifications

Output: 4 to 20 mA over specified range.

Accuracy: ±0.2% of span.

Linearity: Voltage linear.

The output signal is voltage linear (not temperature linear) and is intended for use with instruments which compensate for the nonlinear signal output of the thermocouples sensor.

Adjustments: Zero and span, ±5% of span, non-interacting. Factory set.

Warmup drift: ±0.2% of span max., with $V_{supply} = 24$ VDC and $R_{loop} = 250 \Omega$.
Stable within 15 minutes.

Supply voltage: 8.5 to 35 VDC
Voltage effect ±0.001% of span per volt.
Reverse polarity protected.

Maximum load resistance: The maximum allowable resistance of the signal carrying loop is:

$$R_{loop\ max} = \frac{V_{supply} - 10}{0.020\ amps}$$

Example: With supply voltage 24 VDC, maximum loop resistance is 700 Ω .

Minimum output current: 1.5 mA.

Maximum output current: 28 mA.

Burnout: Downscale burnout standard; upscale optional.

Connections: Terminal block for wires AWG 22 to AWG 14.

Physical: Polycarbonate case, epoxy potted for moisture resistance.

Weight: 1.8 oz. (52 g).

▼ = STANDARD OPTIONS
Specifications subject to change

TT205

Ambient temperature:

Operating: -10 to 60°C (14 to 140°F).

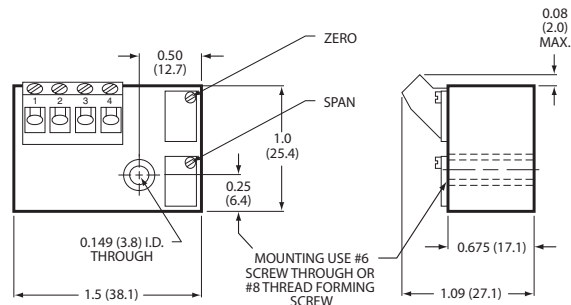
Storage: -55 to 100°C (-67 to 212°F).

Ambient temperature effects: ±0.036% of span per °C.

Cold junction compensation drift: ±0.05°C per °C.

Minimum span: 150°C (270°F).

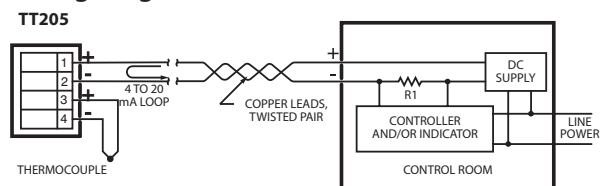
TT205 Dimensions in inches (mm)



Specification and order options

| | |
|---------------------------------|---|
| TT205 | Model Number: TT190: Round TT205: Rectangular |
| J | TC junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan |
| U | U = Ungrounded junction (required) |
| 1 | Output: 4 to 20 mA DC |
| AN | Temperature range code starting on page 4-20 [Ex: AN = -17.8 to 148.9°C (0 to 300°F)] |
| TT205JU1AN = Sample part number | |

Wiring Diagram



▼ = STANDARD OPTIONS
Specifications subject to change

TT508/TT518 Programmable Temperature Transmitter

Overview

This transmitter amplifies a signal from a RTD or linear resistance, and it turns the signal into a current which increases from 4 to 20 milliamperes as the temperature or input signal increases. This industry-standard 4-20mA signal travels thousands of feet over a pair of wires, ignoring electrical interference and bringing the temperature, accurately, into your computer or controller. Drawing power directly from the signal line, only 2 wires are needed for power and signal.

- RTD or Ohm input
- Accurate, Stable 4–20mA Output
- PC and field-programmable
- FM Approved Intrinsically Safe

Converts multiple inputs

Temperature measurement can be done with one of several RTD's: 100 Ω , 1000 Ω platinum, 100 Ω Nickel and 1000 Ω Nickel.

Because amplification and conversion of the input signal is performed within a few feet of the sensor, electrical interference in noisy environments is eliminated. The transmitter can be mounted at the field location in a standard DIN form B head or on a DIN rail inside a local box.

Applications

- Single temperature measurement

Configuration

The TT508/TT518 is delivered configured to the customer's specifications, including the transmitter's measurement range and RTD type.

PC Programming

The TT508/TT518 transmitter can be configured via a standard PC using a programming kit. It can be configured before installation or while installed in the process - even in hazardous areas. Communication is 2-way, so set-up and serial/tag numbers can be retrieved from the transmitter.



Specifications

Ambient temperature range: -40°C to +85°C

Supply voltage: 8 -30 VDC

Warm-up time: 5 min.

Communication interface: PC Interface/Loop Link

Signal/noise ratio: Min. 60 dB

Response time (programmable): 0.33 sec. to 60 sec.

Update time: 135 msec.

Calibration temperature: 20 to 28°C

Effect of supply voltage change: < 0.005% of span/ VDC

EMC-Immunity influence: < \pm 0.5% of span

Vibration: IEC 600 68-2-6 Test FC

Lloyd's specification no. 1: 4 g / 2 - 100 Hz

Max. wire size: AWG14 (1.5 mm²)

Air humidity: 0 - 95% RH

Dimensions: \varnothing 1.73 x 0.84 in (\varnothing 44 x 20.2mm)

Tightness (enclosure/terminal): IP 68 / IP00

Weight: 50g

▼ = **STANDARD OPTIONS**
Specifications subject to change

Inputs (common specifications)

Max. offset: 50% of selected max. value

Cable resistance per wire (max.): 10Ω

Sensor current: >0.2mA, <0.4mA

Effect of sensor cable resistance:
(3-wire): < 0.002 Ω/Ω

Input:

| Type | Minimum Value | Maximum Value | Minimum Span |
|-------------|---------------|---------------|--------------|
| PD (Pt100) | -200°C | +850°C | 25°C |
| PF (Pt1000) | -200°C | +850°C | 25°C |
| Linear Res. | 0 Ω | 10000 Ω | 30 Ω |

Basic accuracy:

PD/PF (Pt100/1000): <±0.3°C
Linear Resistance: <±0.2Ω

Temperature coefficient:

PD/PF (Pt100/1000): <±0.01°C/°C
Linear Resistance: <±20mΩ/°C

Current output:

Signal range: 4 - 20 mA
Min. signal range: 16 mA
Load resistance : < (Vsup. - 8) / 0.023 [Ω]
Load stability: ± 0.01% of span / 100 Ω

Sensor error detection:

Programmable: 3.5 - 23 mA, or no action
Namur NE43 Downscale/Upscale: 3.5 mA/ 23 mA

Approvals:

EMC: EN 61326-1
ATEX.: KEMA 03ATEX1535
FM: 2D5A7
CSA: 1125003
GOST R: Yes
GOST Ex: Yes
DNV Marine: Stand. F. Certification No. 2.4

Input

The input type is selected to be one of these types:

- RTD (2 or 3-wire): PT100, PT1000

Output

The 4-20 mA output follows the TT518 input configuration, reflecting the temperature and/or resistance. The unit is protected against polarity reversal. The output signal action can be reversed with respect to the input signal. Sensor and/or cable errors can be programmed to cause the output to go to a fixed value.

Specification and order options:

| | |
|--|--|
| TT518 | Model Number: TT518 Approvals, fits .236" Probe Max TT508 No Approvals, fits .250" Probe Max |
| PD | Sensor Type: PD = 100 Ω Platinum RTD (0.00385) PF = 1000 Ω Platinum RTD (0.00385) |
| (-25/200) | Ranging: Specify temperature range in either °C or °F. For example, -25° to +200°C = 4 to 20 mA. |
| C | Display Units: C = Celsius F = Fahrenheit |
| 1 | Calibration: 1 = Nominal 2 = Matched to sensor ±0.75% of span For other calibration options, contact Minco |
| Z | Sensor Leads: (3 Lead Recommended) Y = 2-lead RTD (Supplied with jumper wire to connect terminals 3 and 4) Z = 3-lead RTD |
| TT518PD(-25/200)C1Z : Sample part number | |

Note: TT508 does not carry any external approvals, but does allow a .250" probe to pass through its center hole

▼ = **STANDARD OPTIONS**
Specifications subject to change

TT509/TT519 Programmable Temperature Transmitter

Overview

This transmitter amplifies a signal from a thermocouple, and it turns the signal into a current which increases from 4 to 20 milliamperes as the temperature or input signal increases. This industry-standard 4-20mA signal travels thousands of feet over a pair of wires, ignoring electrical interference and bringing the temperature, accurately, into your computer or controller. Drawing power directly from the signal line, only 2 wires are needed for power and signal.

- Thermocouple or Voltage Input
- Accurate, Stable 4–20mA Output
- PC and field-programmable
- Galvanically Isolated

Converts multiple inputs

Temperature measurement can be done with multiple thermocouple types, which boast high operating temperature ranges.

Because amplification and conversion of the input signal is performed within a few feet of the sensor, electrical interference in noisy environments is eliminated. The transmitter can be mounted at the field location in a standard DIN form B head or on a DIN rail inside a local box.

Applications

- Single temperature measurement

Configuration

The TT509/TT519 is delivered configured to the customer's specifications, including the transmitter's measurement range and thermocouple type.

PC programming

The TT509/TT519 transmitter can be configured via a standard PC using a programming kit. It can be configured before installation or while installed in the process - even in hazardous areas. Communication is 2-way, so set-up and serial/tag numbers can be retrieved from the transmitter.



Specifications

Ambient temperature range: -40°C to +85°C

Supply voltage: 7.2 -30 VDC

Warm-up time: 5 min.

Communication interface: PC Interface/Loop Link

Signal/noise ratio: Min. 60 dB

Response time (programmable): 1 sec. to 60 sec.

Update time: 440 msec.

Calibration temperature: 20 to 28°C

Effect of supply voltage change: < 0.005% of span/ VDC

EMC-Immunity influence: < ±0.5% of span

Electrical Isolation, test/operation: 1.5kVAC/50VAC

Vibration: IEC 600 68-2-6 Test FC

Lloyd's specification no. 1: 4 g / 2 - 100 Hz

Max. wire size: AWG14 (1.5 mm²)

Air humidity: 0 - 95% RH

Dimensions: ∅1.73 x 0.84 in (∅44 x 20.2mm)

Tightness (enclosure/terminal): IP 68 / IP00

Weight: 50g

▼ = **STANDARD OPTIONS**
Specifications subject to change

Inputs (common specifications)

Max. offset: 50% of selected max. value

Input:

| Type | Minimum Value | Maximum Value | Minimum Span |
|------|---------------|---------------|--------------|
| E | -100°C | +1000°C | 50°C |
| J | -100°C | +1200°C | 50°C |
| K | -180°C | +1372°C | 50°C |
| T | -200°C | +400°C | 50°C |
| B | +400°C | +1820°C | 100°C |
| N | -180°C | +1300°C | 50°C |
| R | -50°C | +1760°C | 100°C |
| S | -50°C | +1760°C | 100°C |

Basic accuracy:

TC type E, J, K, L, N, T: $<\pm 1^{\circ}\text{C}$

TC type B, R, S: $<\pm 2^{\circ}\text{C}$

Voltage: $\leq \pm 10\mu\text{V}$

Temperature coefficient:

TC type E, J, K, T: $<\pm 0.05^{\circ}\text{C}/^{\circ}\text{C}$

TC type B, N, R, S: $<\pm 0.2^{\circ}\text{C}/^{\circ}\text{C}$

Voltage: $<\pm 1\mu\text{V}/^{\circ}\text{C}$

Cold Junction Compensation: $<\pm 1^{\circ}\text{C}$

Current output:

Signal range: 4 - 20 mA

Min. signal range: 16 mA

Load resistance : $< (V_{\text{sup}} - 7.2) / 0.023 [\Omega]$

Load stability: $\pm 0.01\%$ of span / 100 Ω

Sensor error detection:

Programmable: 3.5 - 23 mA, or no action

Namur NE43 Downscale/Upscale: 3.5 mA/ 23 mA

Approvals:

EMC: EN 61326-1

ATEX.: KEMA 06ATEX0062

GOST R: Yes

GOST Ex: Yes

DNV Marine: Stand. F. Certification No. 2.4

Input

The input type is selected to be one of these types:

- Type E, J, K, T, B, N, R, S Thermocouple
- Voltage Input

Output

The 4-20 mA output follows the TT519 input configuration, reflecting the temperature. The unit is protected against polarity reversal. The output signal action can be reversed with respect to the input signal. Sensor and/or cable errors can be programmed to cause the output to go to a fixed value.

Specification and order options:

| | |
|--|---|
| TT519 | Model Number: TT519 Approvals, fits .236" Probe Max TT509 No Approvals, fits .250" Probe Max |
| K | Sensor Type: E=Type E Thermocouple J=Type J Thermocouple K=Type K Thermocouple T=Type T Thermocouple B=Type B Thermocouple N=Type N Thermocouple R=Type R Thermocouple S=Type S Thermocouple V = Voltage Input |
| (-25/200) | Ranging: Specify temperature range in either °C or °F. For example, -25° to +200°C = 4 to 20 mA. |
| C | Display Units: C = Celsius F = Fahrenheit MV = Millivolts |
| 1 | Calibration: 1 = Nominal |
| Y | Sensor Leads: Y = 2-lead |
| TT519K(-25/200)C1Y: Sample part number | |

Note: TT509 does not carry any external approvals, but does allow a .250" probe to pass through its center hole

▼ = STANDARD OPTIONS

Specifications subject to change

TT273 Field Rangeable RTD Temperature Transmitter



TT273 RTD
Temperature Transmitter

Overview

Model TT273 is a 2-wire temperature transmitter for 2 or 3-lead 100 Ω platinum RTDs. The transmitter converts the RTD temperature into a linearized 4 to 20 mA DC current signal. Because this current signal is immune to leadwire and electrical noise, the TT273 lets you obtain accurate temperature readings from RTDs thousands of feet away. An ordinary twisted pair of wires carries both the temperature signal and power for the transmitter's electronics.

An LED conveniently indicates the status of the control loop. The brightness is directly proportional to the loop current. A very bright LED indicates an open RTD; a dark LED signals a shorted RTD or loss of current loop power.

- 4 to 20 mA current signal
- Fits standard 35 mm DIN rail
- Field-calibrate to your temperature range
- Optional high-accuracy calibration to Minco RTDs for improved accuracy; see next page and page 5-22 for more information
- Optional Input/Output isolation to 600 VRMS

Specifications

Output: 4 to 20 mA DC over specified range.

Calibration accuracy: $\pm 0.2\%$ of span.

Linearity: $\pm 0.2\%$ of span, reference to actual sensor temperature.

Adjustments:

Zero: -50 to 150°C (-58 to 302°F).

Span: 50 to 600°C (90 to 1080°F).

Ambient temperature:

Operating: -40 to 85°C (-40 to 185°F).

Storage: -55 to 100°C (-67 to 212°F).

Ambient temperature effects:

$\pm 0.018\%$ of span/ $^{\circ}\text{C}$ ($\pm 0.01\%$ of span/ $^{\circ}\text{F}$).

Warmup drift:

 $\pm 0.1\%$ of span max., assuming

$V_{\text{supply}} = 24$ VDC and $R_{\text{loop}} = 250 \Omega$.

Stable within 15 minutes.

Input/output isolation (optional): 600 VRMS, 1 minute.

Supply voltage:

Non-Isolated: 10 to 45 volts DC with no load.

Isolated: 13 to 45 volts DC with no load.

Reverse polarity protected.

Voltage effect: $\pm 0.001\%$ of span per volt.

Lead wire compensation: (3-wire RTD)

$\pm 0.05\%$ of span per Ω , up to 25Ω in each leg.

Maximum load resistance: The maximum allowable resistance of the signal-carrying loop is given by this formula:

$$\text{Non-Isolated: } R_{\text{loop max}} = \frac{V_{\text{supply}} - 10}{0.020 \text{ amps}}$$

$$\text{Isolated: } R_{\text{loop max}} = \frac{V_{\text{supply}} - 13}{0.020 \text{ amps}}$$

Maximum output current: 28 mA.

Connections: Terminal block accepts wires from AWG 22 to AWG 14.

Physical: Polycarbonate, DIN rail enclosure.

Weight: 4.2 oz. (119 g).

▼ = **STANDARD OPTIONS**
Specifications subject to change

RTD input types

2 or 3-wire 100 Ω platinum RTD.

| Element | | Code |
|------------------------|---------------------|--------|
| Platinum (0.00392 TCR) | 100 Ω at 0°C | PA |
| Platinum (0.00391 TCR) | 100 Ω at 0°C | PB |
| Platinum (0.00385 TCR) | 100 Ω at 0°C | PD, PE |

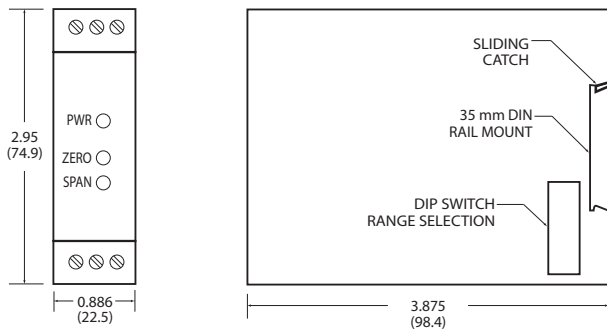
Special high-accuracy calibration

For high system accuracy, specify transmitters with matched calibration. Temprans match calibrated to a sensor are always ordered as assemblies. Common examples are shown in Section 1.

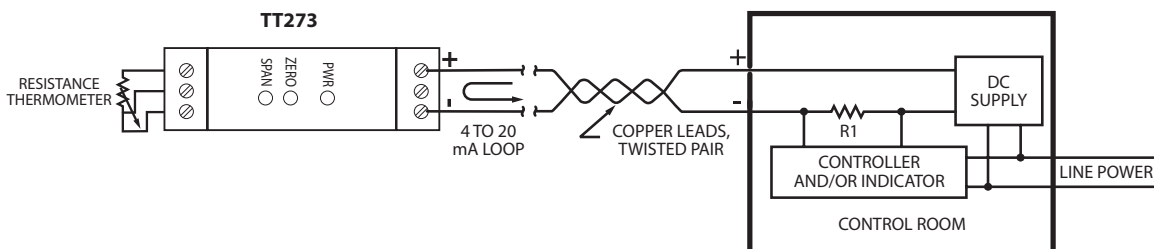
Specification and order options

| | |
|---|--|
| TT273 | Model number |
| PD | RTD element code from table |
| 1 | Output: 4 to 20 mA DC |
| N | Input/Output: N = Non-isolated I = Isolated |
| (-25/50) | Factory preset temp. range: (4 mA/20 mA temperature) Range is user adjustable. Refer to the Zero and Span specifications. |
| C | Temperature scale: F = Fahrenheit C = Celsius |
| TT273PD1N(-25/50)C = Sample part number | |

Dimensions in inches (mm)



Wiring diagram



▼ = **STANDARD OPTIONS**
Specifications subject to change

TT274 Field Rangeable Thermocouple Temperature Transmitter

Overview

Model TT274 is a 2-wire temperature transmitter for types J and K thermocouples. The transmitter converts the thermocouple's millivolt signal to a 4 to 20 mA DC current signal. Because this current signal is immune to leadwire and electrical noise, the TT274 lets you obtain accurate temperature readings from thermocouples thousands of feet away. An ordinary twisted pair of wires carries both the temperature signal and power for the transmitter's electronics.

With the isolation option, the mV input signal from the thermocouple is electrically isolated from the 4 to 20 mA output, allowing use of grounded thermocouples with multiple TT274s operating from the same power supply.

An LED conveniently indicates the status of the control loop. The brightness is directly proportional to the loop current. A dark LED signals an open sensor or loss of current loop power.

- 4 to 20 mA current signal
- Fits standard 35 mm DIN rail
- Field-calibrate to your thermocouple type and temperature range
- Optional Input/Output isolation to 600 VRMS

Specifications

Input: Type J or K thermocouple (field selectable).

Output: 4 to 20 mA DC over specified range.

Accuracy: $\pm 0.2\%$ of span.

Linearity: Voltage linear.

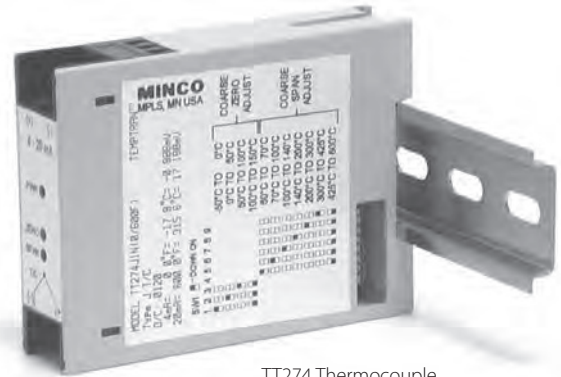
The output signal of the TT274 is voltage linear (not temperature linear) and is intended for use with instruments which compensate for the nonlinear signal output of the thermocouple sensor.

Adjustments:

Zero: -50°C to 150°C (-58°F to 302°F).

Span: Type J: 125 to 850°C (225 to 1530°F).

Type K: 150 to 1200°C (270 to 2160°F).



TT274 Thermocouple Temperature Transmitter

Ambient temperature:

Operating: -40 to 85°C (-40 to 185°F).

Storage: -55 to 100°C (-67 to 212°F).

Ambient temperature effects: $\pm 0.036\%$ of span/ $^{\circ}\text{C}$ ($\pm 0.02\%$ of span/ $^{\circ}\text{F}$).

Cold junction compensation drift: $\pm 0.03^{\circ}\text{C}/^{\circ}\text{C}$ for -25 to 70°C ambients. $\pm 0.06^{\circ}\text{C}/^{\circ}\text{C}$ for -40 to -25°C and 70 to 85°C ambients.

Warmup drift: $\pm 0.1\%$ of span max., assuming

$V_{\text{supply}} = 24$ VDC and $R_{\text{loop}} = 250 \Omega$.

Stable within 15 minutes.

Input/output isolation (optional): 600 VRMS, 1 minute.

Supply voltage:

Non-Isolated: 10 to 45 volts DC with no load.

Isolated: 13 to 45 volts DC with no load.

Reverse polarity protected.

Voltage effect: $\pm 0.001\%$ of span per volt.

Maximum load resistance: The maximum allowable resistance of the signal-carrying loop is given by this formula:

$$\text{Non-Isolated: } R_{\text{loop max}} = \frac{V_{\text{supply}} - 10}{0.020 \text{ amps}}$$

$$\text{Isolated: } R_{\text{loop max}} = \frac{V_{\text{supply}} - 13}{0.020 \text{ amps}}$$

Maximum output current: 28 mA.

Connections: Terminal block accepts wires from AWG 22 to AWG 14.

Physical: Polycarbonate, DIN rail enclosure.

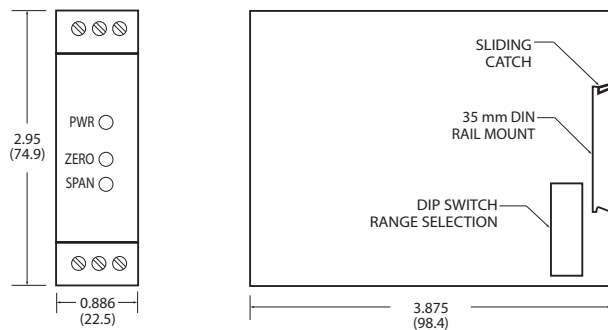
Weight: 4.2 oz. (119 g).

▼ = **STANDARD OPTIONS**
Specifications subject to change

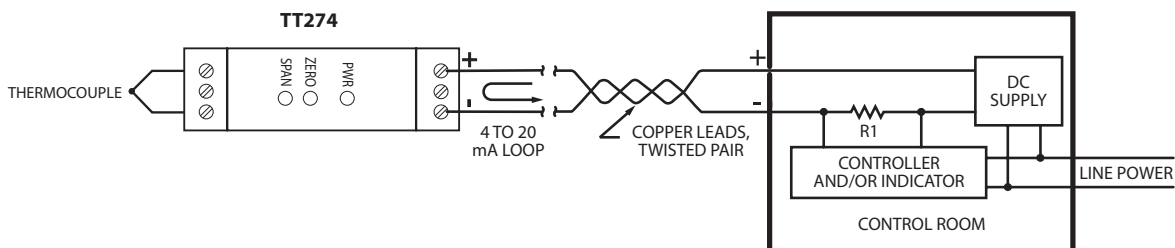
Specification and order options

| | |
|---|--|
| TT274 | Model number |
| K | T/C element code J = Type J thermocouple K = Type K thermocouple |
| 1 | Output: 4 to 20 mA DC |
| N | Input/Output: N = Non-isolated I = Isolated |
| (-25/200) | Factory preset temp. range: (4 mA/20 mA temperature) Range is user adjustable. Refer to the Zero and Span specifications. |
| C | Temperature scale: F = Fahrenheit C = Celsius |
| TT274K1N(-25/200)C = Sample part number | |

Dimensions in inches (mm)



Wiring diagram



Specifications subject to change

Programmable Transmitters

Overview

Models TT520 and TT530 are programmable transmitters designed for process control and other applications. Both transmitters use a 4-20mA current loop output and are PC programmable to accept a signal from a thermocouple, a Resistance Temperature Detector (RTD), or a millivolt signal. Model TT520 can be mounted at the field location in a standard DIN form B head or on a DIN rail inside a local box (with an AC807 Minco DIN rail adapter), whereas model TT530 can be mounted vertically or horizontally on a DIN rail.

- T/C, RTD, or mV input
- Accurate, Stable 4-20mA Output
- PC and field-programmable
- Galvanically isolated
- FM Approved Intrinsically Safe
- Single temperature measurement

Specifications

Common Specifications:

Supply voltage: 7.2 - 30 VDC

Temperature coefficient: $\pm 0.01\%$ of span/ °C

Effect of supply voltage change: $< 0.005\%$ of span/ VDC

Max. wire size: AWG14 (1.5 mm²)

Air humidity: 0 - 95% RH

Dimensions:

TT520: Ø1.73 x 0.84 in (Ø44 x 20.2mm)

TT530: 4.29 x .093 x 4.09 in (109 x 23.5 x 104mm)

AC205817 USB Loop Link Programmer:

TT520 and TT530 transmitters are preconfigured for ease of use. The AC205817 USB Loop Link Programmer allows the user to reconfigure the transmitter using free, Windows-based software.

Tightness (enclosure/terminal):

TT520: IP 68 / IP00

TT530: IP50 / IP20

Weight:

TT520: 50 g

TT530: 145 g



TT520



TT530

TC Input:

Minimum measurement range:

Type E, J, K, T: 50°C

Max. offset: 50% of selected max. value

Basic accuracy:

Type E, J, K, T: $\leq 1^\circ\text{C}$

Cold junction compensation (CJC): $\leq 1.0^\circ\text{C}$

Temperature coefficient:

Type E, J, K, T: $\leq \pm 0.05^\circ\text{C} / ^\circ\text{C}_{\text{amb}}$

Sensor error detection: yes

| RTD type | Minimum value | Maximum value | Minimum span. |
|-------------|---------------|---------------|---------------|
| PD (Pt100) | -200°C | +850°C | 25°C |
| PF (Pt1000) | -200°C | +850°C | 25°C |

RTD-input:

Basic accuracy PD/PF (Pt100/1000): $\leq \pm 0.2^\circ\text{C}$

Temperature coefficient: $\leq \pm 0.01^\circ\text{C} / ^\circ\text{C}$

Current output:

Signal range: 4 - 20 mA

Load resistance: $< (V_{\text{sup.}} - 7.2) / 0.023 [\Omega]$

Intrinsic Safety data: FM Approved Intrinsically Safe for Class 1, Div. 1, Groups A-D, Entity Approval (pending)

V_{max} : 30.0 VDC

C_i : 1 nF

I_{max} : 120 mA DC

L_i : 10 μH

P_{max} : 0.84 W

Europe: ATEX II 1 G

Meets these European requirements:

EMC 2004/108/EC: Standard EN 61326

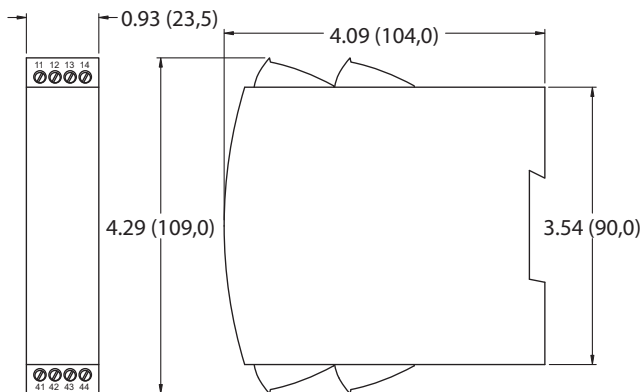
▼ = STANDARD OPTIONS

Specifications subject to change

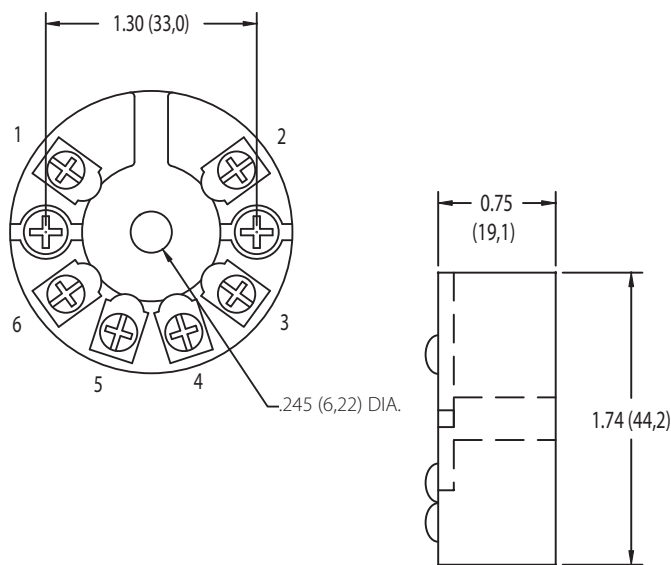
Specifications and order options

| | |
|--|--|
| TT520 | Model Number: TT520 Temperature Transmitter TT530 DIN Rail Temperature Transmitter |
| PD | Sensor Type: PD = 100Ω Platinum RTD (0.00385) PF = 1000Ω Platinum RTD (0.00385) E = Type E Thermocouple J = Type J Thermocouple K = Type K Thermocouple T = Type T Thermocouple |
| (-25/200) | Temperature Range: Specify temperature range in either °C or °F. For example, -25° to +200°C = 4 to 20 mA. |
| C | Temperature Units: C = Celsius F = Fahrenheit |
| 1 | Calibration: 1 = Nominal 2 = Matched to sensor ±0.75% span For other calibration options, contact Minco |
| Y | Sensor Leads: Y = 2-lead RTD (or thermocouple) Z = 3-lead RTD X = 4-lead RTD |
| TT520PD(-25/200)C1Y = Sample part number | |

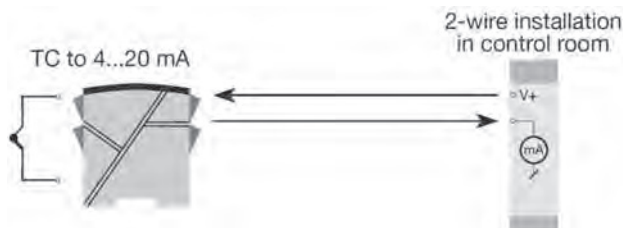
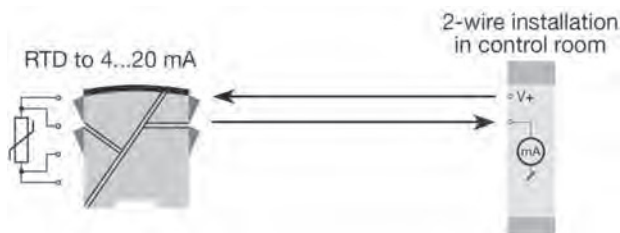
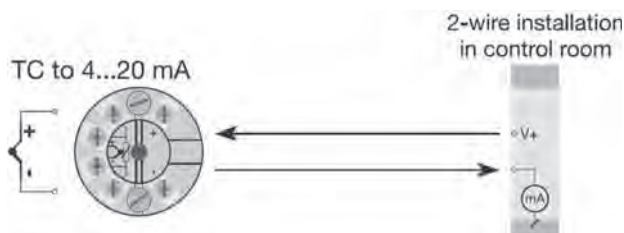
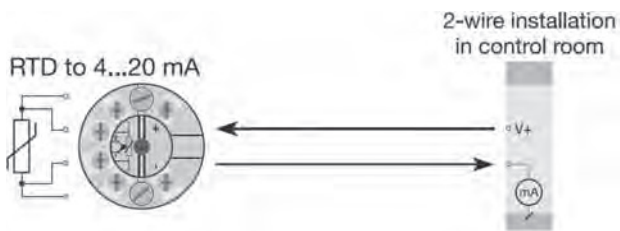
Dimensions in inches (mm)



Dimensions in inches (mm)



Wiring Diagrams



Specifications subject to change

Programmable Transmitters w/ HART® Protocol



TT511/TT521

TT531

Overview

Models TT511, TT521 and TT531 are programmable transmitters designed for process control and other applications. All three models use HART® communication protocol and are PC programmable to accept a signal from a thermocouple, a Resistance Temperature Detector (RTD), or a millivolt signal. Model TT511/TT521 transmitter can be mounted at the field location in a standard DIN form B head or on a DIN rail inside a local box (with an AC807 Minco DIN rail adapter). Model TT531 can be mounted vertically or horizontally on a DIN rail.

- T/C, RTD, or mV input
- HART® 7/5 Communication Protocol
- PC and field-programmable
- Galvanically isolated
- FM Approved Intrinsically Safe
- Single temperature measurement
- Difference temperature measurement
- Average temperature measurement

HART® Communication

By way of 2-wire HART® communication between the process computer and the TT511, TT521 or TT531, the transmitter is programmable, readable, and controllable.

- Up to 63 transmitters can be controlled in a multidrop system. (Parallel connection of all transmitters on 2 wires).
- Set-up, configuration and control can be done from a central monitoring room.

When each transmitter is connected to a 2-wire cable, a standard 4-20 mA signal can be used at the same time as the HART® communication.

Specifications

Common Specifications:

Supply voltage: 8.0 - 30 VDC

Specifications subject to change

Communication interface: HART® 7/5 and PC interface

Temperature coefficient: $< \pm 0.005\%$ of span/ °C

Effect of supply voltage change: $< 0.005\%$ of span/ VDC

Max. wire size: AWG14 (1.5 mm²)

Air humidity: 0 - 95% RH

Dimensions:

TT511/TT521: Ø1.73 x 0.84 in (Ø44 x 20.2mm)

TT531: 4.29 x .0.93 x 4.09 in (109 x 23.5 x 104mm)

Tightness (enclosure/terminal):

TT511/TT521: IP 68 / IP00 TT531: IP50 / IP20

Weight:

TT511/TT521: 50 g

TT531: 145 g

AC205817 USB Loop Link Programmer:

TT511/TT521 and TT531 transmitters are preconfigured for ease of use. The AC205817 USB Loop Link Programmer allows the user to reconfigure the transmitter using free, Windows-based software.

TC Input:

Minimum measurement range:

Type E, J, K, T : 50°C

Max. offset: 50% of selected max. value

Basic accuracy:

Type E, J, K, T : $\pm 0.5^\circ\text{C}$

Cold junction compensation (CJC): $\pm 1.0^\circ\text{C}$

Temperature coefficient:

Type E, J, K, T : $\pm 0.025^\circ\text{C} / ^\circ\text{C}_{\text{amb}}$

Sensor error detection: yes

RTD-input:

| RTD type | Minimum value | Maximum value | Minimum span. |
|-------------|---------------|---------------|---------------|
| PD (Pt100) | -200°C | +850°C | 25°C |
| PF (Pt1000) | -200°C | +850°C | 25°C |

Basic accuracy PD/PF (Pt100/1000): $\leq \pm 0.1^\circ\text{C}$

Temperature coefficient: $\leq \pm 0.005^\circ\text{C} / ^\circ\text{C}$

Current output:

Signal range: 4 - 20 mA

Load resistance: $< (V_{\text{sup.}} - 8) / 0.023 [\Omega]$

Intrinsic Safety data: FM Approved Intrinsically Safe for Class 1, Div. 1, Groups A-D, Entity Approval (pending)

V_{max} : 30.0 VDC C_i : 1 nF

I_{max} : 120 mA DC L_i : 10 μH

P_{max} : 0.84 W

Europe: ATEX II 1 G

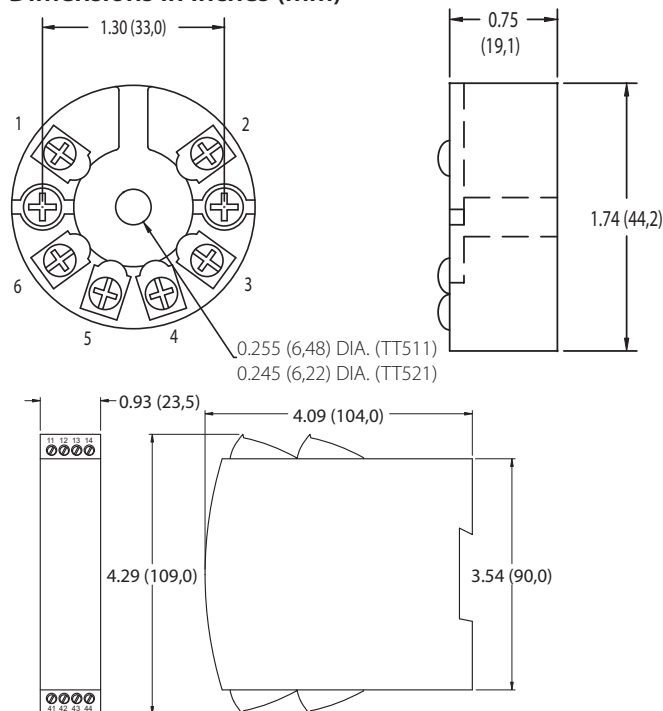
Meets these European requirements:

EMC 2004/108/EC: Standard EN 61326-1

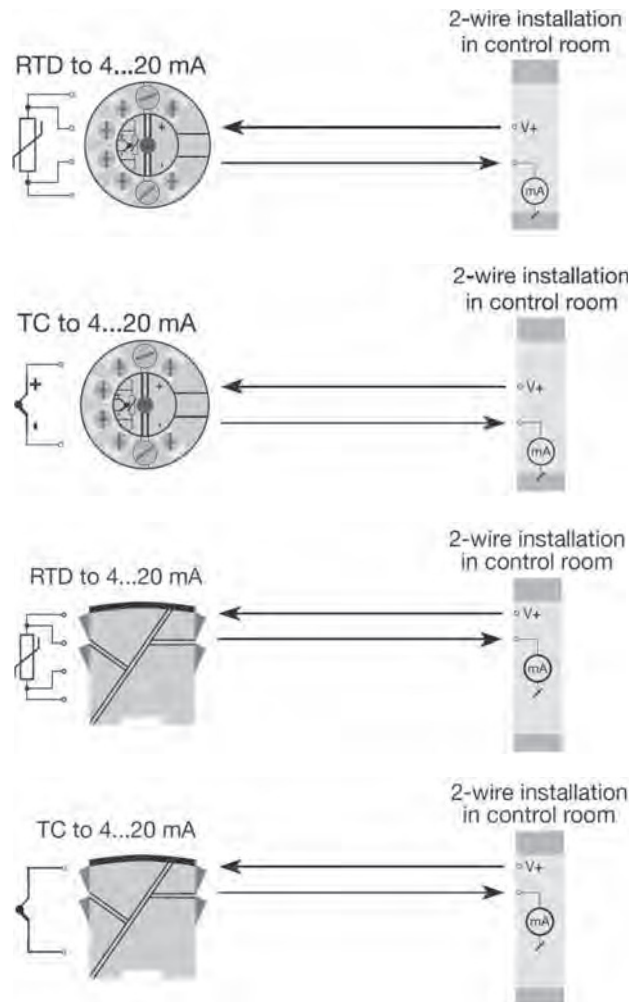
Specifications and order options

| | |
|--|--|
| TT521 | Model Number: TT511 No Approvals, Temperature Transmitter with HART® protocol, fits .250" Probe Max TT521 Temperature Transmitter with HART® Protocol, fits .236" Probe Max TT531 DIN Rail Temperature Transmitter with HART® Protocol |
| PD | Sensor Type: PD = 100Ω Platinum RTD (0.00385) PF = 1000Ω Platinum RTD (0.00385) E = Type E Thermocouple J = Type J Thermocouple K = Type K Thermocouple T = Type T Thermocouple |
| (-25/200) | Temperature Range: Specify temperature range in either °C or °F. For example, -25° to +200°C = 4 to 20 mA. |
| C | Temperature Units: C = Celsius F = Fahrenheit |
| 1 | Calibration: 1 = Nominal 2 = Matched to sensor ±0.75% span For other calibration options, contact Minco |
| Y | Sensor Leads: Y = 2-lead RTD (or thermocouple) Z = 3-lead RTD X = 4-lead RTD |
| TT521PD(-25/200)C1Y = Sample part number | |

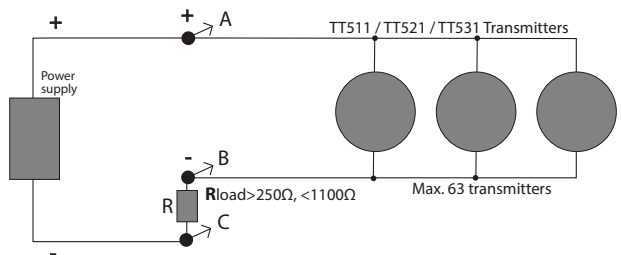
Dimensions in inches (mm)



Wiring Diagrams



HART® Multidrop Wiring Diagram



▼ = STANDARD OPTIONS
 Specifications subject to change

Temptran™ Temperature Ranges

Below is a list of commonly selected Temptran temperature ranges. The endpoints of the temperature range correspond to the Temptran's 4 and 20 mA signals. Choose the smallest possible span for best accuracy. Be sure to check the temperature limits of the sensor you specify.

If you do not find the temperature range required by your application, go to www.minco.com for a complete list of temperature ranges. Custom ranges are also available for a small setup charge. Contact Minco Sales and Customer Service for more information.

For more temperature ranges (over 400 options) go to www.minco.com

| Range code | Temperature Range | | | | RTD Temptrons | | | Thermocouple Temptrons | |
|------------|-------------------|---------|---------|---------|----------------------------|----------------|-------------------|------------------------|-----------|
| | Zero °F | Span °F | Zero °C | Span °C | TT111, TT115, TT211, TT829 | | TT246, TT220 | TT221 | TT205 |
| | | | | | Platinum elements* | Other elements | Elements | T/C types | T/C types |
| MH | -328 | -148 | -200.0 | -100.0 | PA PB PD PE | | | | |
| HG | -325 | 100 | -198.3 | 37.8 | PA PB PD PE PF PW | | | JT | |
| QS | -300 | 150 | -184.4 | 65.6 | | | PA PB PD PE | | |
| EZ | -148 | 32 | -100.0 | 0.0 | PA PB PD PE PF PW | | PA PB PD PE | | |
| LN | -148 | 212 | -100.0 | 100.0 | PA PB PD PE | | | | |
| SA | -140 | 100 | -95.6 | 37.8 | | | PA PB PD PE | | |
| UL | -103 | 752 | -75.0 | 400.0 | | | | K | |
| M | -58 | 122 | -50.0 | 50.0 | PA PB PD PE PF PW | | PA PB PD PE | | |
| EO | -58 | 212 | -50.0 | 100.0 | PA PB PD PE | NA | PA PB PD PE | T | ET |
| JD | -58 | 302 | -50.0 | 150.0 | PA PB PD PE | | PA PB PD PE | J | |
| MR | -58 | 500 | -50.0 | 260.0 | | | PA PB PD PE CA NA | | |
| SD | -50 | 100 | -45.6 | 37.8 | PA PB PD PE | | | | |
| MI | -50 | 150 | -45.6 | 65.6 | PA PB PD PE | | PA PB PD PE | T | |
| AI | -50 | 275 | -45.6 | 135.0 | PA PB PD PE PF PW | FB FC FL NA | PA PB PD PE | | |
| MS | -50 | 650 | -45.6 | 343.3 | PA PB PD PE | | PA PB PD PE | | |
| AD | -40 | 120 | -40.0 | 48.9 | PA PB PD PE | FB FC | PA PB PD PE | | |
| AK | -40 | 140 | -40.0 | 60.0 | PA PB PD PE PU | | PA PB PD PE | | |
| BE | -40 | 160 | -40.0 | 71.1 | PA PB PD PE | FB | PA PB PD PE | | |
| GH | -40 | 212 | -40.0 | 100.0 | PA PB PD PE | | PA PB PD PE | | |
| UE | -40 | 302 | -40.0 | 150.0 | PA PB PD PE | | PA PB PD PE | | |
| L | -30 | 120 | -34.4 | 48.9 | PA PB PD PE PF PW | FB FC | | | |
| AS | -30 | 130 | -34.4 | 54.4 | PA PB PD PE PF PW | FB | PA PB PD PE | | |
| R | -30 | 150 | -34.4 | 65.6 | PA PB PD PE | FB FC | PA PB PD PE | | |
| DN | -22 | 122 | -30.0 | 50.0 | PA PB PD PE | | PA PB PD PE | | |
| EE | -22 | 302 | -30.0 | 150.0 | PA PB PD PE | | PA PB PD PE | | |
| DO | -20 | 120 | -28.9 | 48.9 | PA PB PD PE PF PW | ND | PA PB PD PE | | |
| EN | -20 | 140 | -28.9 | 60.0 | PA PB PD PE PF PW | FB | PA PB PD PE | | |
| B | -20 | 180 | -28.9 | 82.2 | PA PB PD PE | FB FC NA | PA PB PD PE CA | | |
| BP | -4 | 104 | -20.0 | 40.0 | PA PB PD PE | FC | PA PB PD PE | | |
| SH | -4 | 122 | -20.0 | 50.0 | PA PB PD PE | | | | |
| DB | -4 | 212 | -20.0 | 100.0 | PA PB PD PE | | PA PB PD PE | | |
| JZ | 0 | 65 | -17.8 | 18.3 | PA PB PD PE | | PA PB PD PE | | |
| S | 0 | 100 | -17.8 | 37.8 | PA PB PD PE PF PG PW | FB | PA PB PD PE PW | | |
| JH | 0 | 120 | -17.8 | 48.9 | PA PB PD PE PF PW | FC | PA PB PD PE | | |
| HD | 0 | 130 | -17.8 | 54.4 | PA PB PD PE PF PW | | PA PB PD PE | | |
| DV | 0 | 150 | -17.8 | 65.6 | PA PB PD PE | FB | PA PB PD PE | | |
| EI | 0 | 160 | -17.8 | 71.1 | PA PB PD PE | | | | |
| AC | 0 | 200 | -17.8 | 93.3 | PA PB PD PE PF PW | FB NA | PA PB PD PE CA | EJKT | T |
| EY | 0 | 250 | -17.8 | 121.1 | PA PB PD PE PF PW | NA | PA PB PD PE | JK | JKT |
| AN | 0 | 300 | -17.8 | 148.9 | PA PB PD PE PF PW | FB FC NA | PA PB PD PE CA NA | EJKT | K |
| JA | 0 | 350 | -17.8 | 176.7 | PA PB PD PE | | PA PB PD PE | KJ | |
| DS | 0 | 400 | -17.8 | 204.4 | PA PB PD PE | NA | PA PB PD PE CA NA | JK | |
| AG | 0 | 500 | -17.8 | 260.0 | PA PB PD PE PF PW | NA | PA PB PD PE CA | EJT | JKT |
| QN | 0 | 550 | -17.8 | 287.8 | PA PB PD PE | | PA PB PD PE | | |
| AB | 0 | 600 | -17.8 | 315.6 | PA PB PD PE PF PW | NA | PA PB PD PE | EJK | J |
| AA | 0 | 800 | -17.8 | 426.7 | PA PB PD PE PF PW | | PA PB PD PE | J | JK |
| BZ | 0 | 1000 | -17.8 | 537.8 | PA PB PD PE | | PA PB PD PE | JK | EJ |

* Element codes (PA, PB, PD, PE, etc.) are defined in the Resistance/Temperature Tables on page 11-11

Specifications subject to change



For more temperature ranges (over 400 options) go to www.minco.com

| Range code | Temperature Range | | | | RTD Temptrans | | | | Thermocouple Temptrans | |
|------------|-------------------|---------|---------|---------|----------------------------|----------------|-------------------|-----------|------------------------|-------|
| | Zero °F | Span °F | Zero °C | Span °C | TT111, TT115, TT211, TT829 | | TT246, TT220 | | TT221 | TT205 |
| | | | | | Platinum elements* | Other elements | Elements | T/C types | T/C types | |
| HU | 0 | 1300 | -17.8 | 704.4 | | | | | K | |
| BY | 14 | 104 | -10.0 | 40.0 | PA PB PD PE | | PA PB PD PE | | | |
| AJ | 14 | 122 | -10.0 | 50.0 | PA PB PD PE | | PA PB PD PE | | | |
| AP | 20 | 70 | -6.7 | 21.1 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| GV | 20 | 100 | -6.7 | 37.8 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| A | 20 | 120 | -6.7 | 48.9 | PA PB PD PE PF PW | FA FB FC NA | PA PB PD PE PF | | | |
| HE | 20 | 240 | -6.7 | 115.6 | PA PB PD PE | | | | | |
| AF | 20 | 320 | -6.7 | 160.0 | PA PB PD PE | FA FB | | | | |
| QE | 22 | 122 | -5.6 | 50.0 | PA PB PD PE | | | | | |
| GW | 23 | 131 | -5.0 | 55.0 | PA PB PD PE | | | | | |
| U | 30 | 80 | -1.1 | 26.7 | PA PB PD PE PF PW | FB FC | PA PB PD PE | | | |
| DA | 30 | 90 | -1.1 | 32.2 | PA PB PD PE PF PW | FC | PA PB PD PE | | | |
| DP | 30 | 100 | -1.1 | 37.8 | PA PB PD PE PF PW | | | | | |
| BI | 30 | 130 | -1.1 | 54.4 | PA PB PD PE PF PW | | PA PB PD PE PF PW | | | |
| DQ | 30 | 150 | -1.1 | 65.6 | PA PB PD PE | FB | PA PB PD PE | | | |
| KK | 30 | 180 | -1.1 | 82.2 | PA PB PD PE | | | | | |
| EV | 30 | 230 | -1.1 | 110.0 | PA PB PD PE | | PA PB PD PE | | | |
| BN | 30 | 240 | -1.1 | 115.6 | PA PB PD PE PF PW | FB | PA PB PD PE | | | |
| BJ | 30 | 250 | -1.1 | 121.1 | PA PB PD PE PF PW | NA | PA PB PD PE FA | | | |
| GQ | 32 | 100 | 0.0 | 37.8 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| EG | 32 | 104 | 0.0 | 40.0 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| N | 32 | 122 | 0.0 | 50.0 | PA PB PD PE PF PW | FB FC | PA PB PD PE | | | |
| HL | 32 | 167 | 0.0 | 75.0 | PA PB PD PE | | PA PB PD PE | | | |
| C | 32 | 212 | 0.0 | 100.0 | PA PB PD PE PF PW | FB FC NA | PA PB PD PE CA NA | JT | | |
| QR | 32 | 257 | 0.0 | 125.0 | PA PB PD PE | | | | | |
| DL | 32 | 280 | 0.0 | 137.8 | PA PB PD PE | | PA PB PD PE | | | |
| J | 32 | 302 | 0.0 | 150.0 | PA PB PD PE PF PU PW | FC NA | PA PB PD PE CA | J | | J |
| K | 32 | 392 | 0.0 | 200.0 | PA PB PD PE PU | NA | PA PB PD PE CA | JK | | J |
| LX | 32 | 400 | 0.0 | 204.4 | PA PB PD PE | | | | | |
| BW | 32 | 482 | 0.0 | 250.0 | PA PB PD PE | NA | PA PB PD PE | EJKT | | J |
| LF | 32 | 572 | 0.0 | 300.0 | PA PB PD PE | | PA PB PD PE | JT | | |
| JW | 32 | 932 | 0.0 | 500.0 | PA PB PD PE | | PA PB PD PE | JK | | K |
| HA | 32 | 1112 | 0.0 | 600.0 | PA PB PD PE PF PW | | | K | | |
| GF | 32 | 1472 | 0.0 | 800.0 | PA PB PD PE | | PA PB PD PE | K | | K |
| SG | 33.8 | 123.8 | 1.0 | 51.0 | PA PB PD PE | | | | | |
| H | 40 | 90 | 4.4 | 32.2 | PA PB PD PE PF PW | FB | PA PB PD PE | | | |
| BU | 40 | 100 | 4.4 | 37.8 | PA PB PD PE PF PW | | | | | |
| QL | 40 | 120 | 4.4 | 48.9 | PF PW | FC | | | | |
| BK | 40 | 140 | 4.4 | 60.0 | PA PB PD PE PF PW | FB | PA PB PD PE | | | |
| KH | 40 | 240 | 4.4 | 115.6 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| KP | 42 | 92 | 5.6 | 33.3 | PA PB PD PE | | | | | |
| DU | 45 | 95 | 7.2 | 35.0 | PA PB PD PE | | PA PB PD PE | | | |
| DX | 50 | 100 | 10.0 | 37.8 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| AH | 50 | 110 | 10.0 | 43.3 | PA PB PD PE | FB | PA PB PD PE | | | |
| ED | 50 | 120 | 10.0 | 48.9 | PA PB PD PE PF PW | FB | | | | |
| V | 50 | 150 | 10.0 | 65.6 | PA PB PD PE PF PW | FA FB NA | PA PB PD PE | | | |
| AV | 50 | 230 | 10.0 | 110.0 | PA PB PD PE PF PW | | PA PB PD PE | J | | |
| BF | 50 | 250 | 10.0 | 121.1 | PA PB PD PE PF PW | | PA PB PD PE PF PW | ET | | |
| AO | 50 | 300 | 10.0 | 148.9 | PA PB PD PE | | PA PB PD PE CA FA | | | |
| KF | 50 | 400 | 10.0 | 204.4 | PA PB PD PE | | PA PB PD PE | | | |
| D | 70 | 220 | 21.1 | 104.4 | PA PB PD PE PF PW | FB FC | PA PB PD PE | | | |
| E | 100 | 500 | 37.8 | 260.0 | PA PB PD PE PF PW | | PA PB PD PE | | | |
| BH | 122 | 302 | 50.0 | 150.0 | PA PB PD PE | | PA PB PD PE | T | | |
| BL | 200 | 500 | 93.3 | 260.0 | PA PB PD PE PF PW | | | K | | |

* Element codes (PA, PB, PD, PE, etc.) are defined in the Resistance/Temperature Tables on page 11-11

Specifications subject to change



Temptran™ Calibration & Accessories

Special high-accuracy calibration

Standard transmitters can be calibrated to the nominal resistance values of the RTD at the zero and span points. Total system error includes the tolerance of both the transmitter and the RTD sensor. If you order Minco Temptrons calibrated to the actual resistance of the RTD (traceable to NIST), this effectively eliminates the sensor tolerance from the system accuracy specifications.

Temptrons match calibrated to a sensor are always ordered as assemblies. Common examples are shown in Section 1.

Free NIST traceability

With each matched sensor/transmitter set, Minco sends you calibration data traceable to the National Institute of Standards & Technology. This helps your process comply with ISO 9001 and other quality standards.

Recalibration

Minco prints RTD resistance values right on the Temptran label to simplify recalibration. You simply connect a resistance decade box or "RTD simulator" in place of the RTD, dial in the correct values, and adjust zero and span.

Because Minco platinum RTDs are extremely stable in typical installations (0.1°C or better), you can trust the printed values for many years.

| | | | |
|------------------------|------------------------|-----------|--|
| MINCO MPS, MIN, USA | MODEL | TEMPTRAN™ | |
| | D/C: 9614 | | |
| | 100 OHM PLATINUM RTD | | |
| | 4mA= 20.0°F= -6.7°C= | 97.932Ω | |
| | 20mA= 120.0°F= 48.9°C= | 118.969Ω | |

RTD resistances are printed on Temptran labels for easy recalibration of zero and span. A standard Temptran shows nominal values.

| | | | |
|------------------------|------------------------|-----------|--|
| MINCO MPS, MIN, USA | MODEL | TEMPTRAN™ | |
| | D/C: 9614 S/N: 103 | | |
| | 100 OHM PLATINUM RTD | | |
| | 4mA= 20.0°F= -6.7°C= | 97.427Ω | |
| | 20mA= 120.0°F= 48.9°C= | 118.988Ω | |

A specially calibrated Temptran shows actual resistance of the serialized, connected RTD.

Temptran Accessories

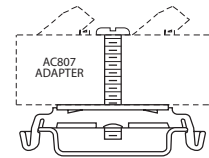
DIN rail mounting

For easy installation in instrument cabinets. Adapters fit all Temptran models. Specify length when ordering rails.

| Model | Description |
|-------|---------------------|
| AC805 | DIN EN50022 Rail |
| AC807 | Adapter for EN50022 |



Temptrons mounted to DIN rail



AC807 adapter for EN50022

Dual mounting kits

The AC103528 mounting kit fits connection head models CH105, CH107, CH328, CH330, CH342, CH343, CH357, CH358, CH405 and CH407. It holds two miniature Temptrons in a single head for use with dual RTDs.

Use AC103133 for connection head models CH104, CH106 and CH306, and CH356. CH106, CH306 and CH356 also require AC103625 connection head modification.



AC103528 mounting kit

AC103133 mounting kit

▼ = STANDARD OPTIONS
Specifications subject to change

Loop-powered Indicators



TI196 Head-mounted Indicator



AC102765 Pipe Mounting Hardware Kit



TI350 Indicator

Overview

The display range is field programmable via coarse dip switches and two fine adjustment potentiometers. Wiring is easy. Simply connect the indicator in series with the 4 to 20 mA loop. Forward voltage drop is only 2.8 VDC.

- Local indication of process variable for convenient visual verification
- Enclosures are sealed from harsh environments to enhance product reliability and longevity
- Variety of mounting options allows for flexible and easy installation
- Compatible with 4 to 20 mA temperature transmitters for easy sensor interchangeability
- IP66 NEMA 4X/7 rated (only for TI196)

TI196 head-mounted indicator

The TI196 includes an explosionproof connection head and digital indicator for local indication of temperature. Sensors and transmitters are specified separately. Optional Temptran models TT111, TT211 or TT205 will fit inside the connection head along with the meter.

TI196 Hazardous Area Certification (explosionproof/flameproof):

Class I, Div I, Groups B,C and D
Class II, Div I, Groups E,F and G
Class III
Ex d IIC

TI350 indicator

The TI350 features a washdown compatible digital readout for local indication of temperature. Sensors and transmitters are specified separately. Optional Temptran model TT321 will fit inside the case along with the meter. Other 4 to 20 mA transmitters may be mounted outside the case and used with this device.

- NEMA 4X enclosure
- Cable glands are installed for 0.118" to 0.256" (3mm to 6.5mm) cable

AC102765 pipe mounting hardware kit

Use AC102765 for mounting TI196 or TI350 to vertical or horizontal pipe. Kit includes plate, stainless U-bolts, nuts and washers for 2" schedule 40 pipe [Ø 2.375" (60mm)].

Order model number AC102765

▼ = STANDARD OPTIONS

Specifications subject to change

TI196 head-mounted indicator

Specifications

Input: 4 to 20 mA DC series connection

Range: User adjustable.
Zero: -500 to +1000 counts.
Span: 10 to 2000 counts.

Accuracy: ± (0.1% reading + 1 count).

Temperature Coefficient:
Zero: ± 0.075 counts/°C typ.
Span: ± 0.005% of span/°C typ.

Linearity: ± (0.1% of span + 1 count).

Forward Voltage Drop: 2.8 volts DC maximum.

Display: 0.59" (15mm) high, 3-1/2 digit LCD, with °C/°F descriptor.

Display Update: 3 times per second.

Underrange Indication: -1 in MSD (Most Significant Digit).

Overrange Indication: 1 in MSD.

Connections: Terminal Block, Pluggable

Decimal: User programmable to 1 position or absent (i.e. 1XX.X or 1XXX).

Ambient Temperature Range:
Operating: 32 to 122°F (0 to 50°C).
Storage: -4 to 149°F (-20 to 65°C).

Weight: 50 oz. (1420 g).

Enclosure: Aluminum, polyester-coated

Enclosure Rating: NEMA 4X, IP66

Dimensions (connection head): 4.5" W x 4.5" H x 3.4" D (144 mm W x 114 mm H x 87 mm D).

TI196 specification and order options

| | |
|--------------------------------------|---|
| TI196 | Model number TI196 |
| P3 | Pipe thread size: P2 = 3/4 - 14 NPT (sensor and conduit) P3 = 1/2 - 14 NPT (sensor and conduit) |
| (0/100) | Temperature range: (4 mA temp./20 mA temp.), user adjustable |
| C | Display: C = Celsius F = Fahrenheit |
| TI196P3(0/100)C = Sample part number | |

Note: Sensors and transmitters are specified separately.

TI350 indicator

Specifications

Input: 4 to 20 mA DC series connection

Range: User adjustable.
Zero: -500 to +1000 counts.
Span: 10 to 2000 counts.

Accuracy: ± (0.1% reading + 1 count).

Temperature Coefficient:
Zero: ± 0.075 counts/°C typ.
Span: ± 0.005% of span/°C typ.

Linearity: ± (0.1% of span + 1 count).

Forward Voltage Drop: 2.8 volts DC maximum.

Display: 0.59" (15mm) high, 3-1/2 digit LCD, with °C/°F descriptor.

Display Update: 3 times per second.

Underrange Indication: -1 in MSD (Most Significant Digit).

Overrange Indication: 1 in MSD.

Connections: Terminal Block, Pluggable

Decimal: User programmable to 1 position or absent (i.e. 1XX.X or 1XXX).

Ambient Temperature Range:
Operating: 32 to 122°F (0 to 50°C).
Storage: -4 to 149°F (-20 to 65°C).

Weight: 7 oz. (200 g).

Enclosure: Polycarbonate, NEMA 4X.

Dimensions (box only): 2.6" W x 4.5" L x 2.2" D (65 mm W x 115 mm H x 56 mm D).

TI350 specification and order options

| | |
|------------------------------------|---|
| TI350 | Model number TI350 |
| (0/100) | Temperature range: (4 mA temp./20 mA temp.), user adjustable |
| C | Display: C = Celsius F = Fahrenheit |
| TI350(0/100)C = Sample part number | |

Note: Sensors and transmitters are specified separately.

▼ = STANDARD OPTIONS
Specifications subject to change

CT224 12-Channel Temperature Alarm/Monitor



Overview

The CT224 consists of a 12-Channel temperature monitor/over-temperature alarm and MincoSoft™ CT224 Software. It is the next generation in temperature monitoring equipment from Minco designed to meet the needs of electric machinery protection. The 12-channel scanning capability, standard RS485/RS232 interface and Windows-compatible software utility for system configuration and data logging provide over-temperature and under-temperature protection and critical feedback to safeguard expensive machinery.

- UL and cUL recognized to help meet regulatory compliance
- PC programmable with Windows compatible software makes monitoring easy and efficient, allowing quick reprogramming and extensive data logging
- Mix and match sensor input types for freedom to adapt to pre-installed bearing and apparatus sensors
- Ability to monitor 12 inputs allows you to monitor stator sensors from two motors
- Five outputs, relays or logic offers either internal relay trips or flexibility of external control
- Logic outputs can be used with external SSRs
- Prevent costly damage to motors, generators, transformers, and other equipment
- Power loss protection
- 24 independent trip points (2 per channel)
- Programmable deadband (hysteresis)
- Rugged steel enclosure
- Can be used as a 4-channel on/off controller
- Display High, Low, or Any valid zones
- Self-calibrating

Software

MincoSoft™ CT224 software features:

- Compatibility with Microsoft® Windows® operating system
- User-friendly configuration program
- Save unlimited set-up configurations
- Commission mode to test configurations before implementation
- Continuously displayed measurement and relay status of all 12 channels
- Data-logging

Applications

- Generators
- Motors
- Turbines
- Compressors
- Pumps

▼ = **STANDARD OPTIONS**
Specifications subject to change

Specifications

Input: 1 to 12 RTDs (2 or 3-wire), thermocouples, or 4 to 20 mA current loops. Accepts any combination of input types.

Standard Input types:

RTD:

- 200 to 700°C: PA (Platinum / 100 Ω / 0.00392 Ω/Ω/°C)
- 200 to 700°C: PB (Platinum / 100 Ω / 0.00391 Ω/Ω/°C)
- 200 to 850°C: PD/PE (Platinum / 100 Ω / 0.00385 Ω/Ω/°C)
- 200 to 600°C: PF (Platinum / 1000 Ω / 0.00385 Ω/Ω/°C)
- 80 to 260°C: NA (Nickel / 120 Ω / 0.00672 Ω/Ω/°C)
- 100 to 260°C: CA (Copper / 10 Ω / 0.00427 Ω/Ω/°C)

Thermocouple:

- 270 to 1000°C: Type E -270 to 1150°C: Type K
- 200 to 1200°C: Type J -270 to 400°C: Type T

4 to 20 mA current loop: Pressure (PSI, Bar), Humidity (%), Temperature (°F, °C), Vibration (G), and process variable (mA, VDC)
Note: 4 to 20 mA inputs must be linear with respect to the measured variable.

Input scan rate: 1.5 seconds maximum to scan all 12 channels.

Input fault detection: Options for ignoring, sounding alarm, or tripping relays associated with the failed sensor. Other zones are unaffected.

Output: 24 independent trip points (2 per channel): 5 relays, one relay is intended for use as an alarm function (but can be configured as a trip point), and one internal audible alarm. Alarm may be programmed to sound when selected relays trip. Logic output option is available for controlling external SSRs or sending a signal to another device.

Relays: Form C, SPDT 10 A @ 250 VAC/24 VDC resistive load; 10 A make current; 2500 VA breaking capacity, ¼ HP at 120 VAC motor load.

Trip point hysteresis (deadband): Programmable from 0 to 20 (°C or °F).

Display: 20 x 4 line backlit LCD. 0.1°C or 0.1°F resolution. Front panel LEDs indicate relay and alarm status.

Accuracy: 2°C (3°F) in 0 to 60°C (32 to 140°F) ambient, over entire range of the input.

Supply power: 85 to 240 VAC @ 50/60 Hz. or 110 to 250 VDC, 5 watts max.; or 18 to 36 VDC, 6 watts max.

Keyboard: 4 membrane type keys with audible feedback.

Serial interface: RS485 or RS232 (Modbus protocol).

Power loss protection: Trip points and program parameters stored in non-volatile memory. Normal operation resumes when power is restored.

Programming: Programmable from front panel or via RS485 or RS232 interface using Modbus protocol. PC software is included for data logging, commissioning, and configuration. Program settings may be password protected.

Firmware fault protection: Watchdog resets microprocessor if it fails to perform program sequence.

Enclosure: Steel case; NEMA 4 front panel.

Ambient temperature rating: 0 to 60°C (32 to 140°F).

Connections: Terminal blocks at rear accept wires to AWG 12.

Leadwire resistance compensation: Up to 30 Ω per leadwire for RTDs with no effect on reading.

Dimensions: 7.5 x 11.5 x 2" (191 x 292 x 51 mm).

Mounting: Panel mount enclosure. Cutout size of 6.8" x 10.6" (173 x 269 mm).

Weight: 3.8 lbs. (1.72 kg.).

Approvals: UL 508, CSA C22.2 No. 14-M91.

Accessories

AC102734: Communication package. Includes isolated RS232 to RS485 converter and power supply.

Specification and order options

| | |
|-------------------------------|--|
| CT224 | Model number |
| A | Power supply A: 85-240 VAC @ 50/60 Hz / 110-250 VDC B: 18-36 VDC |
| 1 | Output 1: Relays 2: Logic (5 VDC) |
| A | Interface A: RS232 B: RS485 |
| CT224A1A = Sample part number | |



STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**
Specifications subject to change

CT424 Temperature Alarm/Monitor

User-programmable three input temperature monitor system

Overview

Minco's CT424 consists of a 3-channel temperature monitor and alarm system that controls three relay outputs based on user-programmable set points to help safeguard expensive machinery.

Features

The CT424 offers users a completely programmable monitor and alarm with improved measurement range and universal inputs. The microprocessor-based design maintains accuracy over a wide range of temperatures and conducts regular self-checks to ensure correct operation. Additionally, one of the relay outputs is specifically designed for control of a cooling fan, and the user-configurable fan exercise option extends the fan life and reduces bearing lock-up. Other key features include:

- Universal inputs of 100 and 1000 Ω platinum RTDs and Types E and K thermocouples
- Configurable through the front-panel interface, MODBUS over USB or the isolated RS-485, PC software included for data logging and configuration
- User-configurable measurement range to Celsius or Fahrenheit scale
- Large, dimmable 7-digit LED display allows easy programming and visibility at various distances and lighting conditions
- Dual password design allows certain users to have full configuration access and others, set points only
- Non-volatile memory storage of per-channel min/max temperatures for recall in the event of power-loss
- Electrically isolated 4-20mA output signal allows for connection to PLCs or remote displays
- UL/cUL recognition (CT424A and CT424B) and CE certification (CT424A)



INSTRUMENTS

Applications

Minco's CT424 temperature monitor and alarm is designed with the specifications for dry-type transformer monitoring and protection. Additional applications include use in pumps, compressors and motors.

Specification and order options

| | |
|--------|---|
| CT424 | Model number |
| CT424A | AC power, 120-240VAC 50-60Hz, 120-240VDC |
| CT424B | DC power: 21-36VDC |

▼ = **STANDARD OPTIONS**
Specifications subject to change



Technical Specifications

| | | |
|-------------|---|--|
| Performance | Measurement Range | -50°C to 300°C (-58°F to 572°F), 1°C resolution, 2°C full-range accuracy |
| | Relay Contact Ratings | Voltage: 240V AC Fan Relay: 30A or 1.5HP @ 55°C, derates to 22A or 1.5HP @ 72°C Trip/Alarm Relays: 10A |
| | Current Loop Outputs <i>Isolated, industry-standard 4-20mA current-loop output for forwarding of reading to PLC or remote indicator.</i> | Configuration: high value, low value, specific channel selection. Scaling: Offset from -50°C to 250°C, span from 50°C to 350°C Error signaling: 3.5mA or 23mA output during sensor failure. Power: isolated loop power –or– non-isolated self-power |
| | Communications | MODBUS over USB or isolated RS-485, RTU, 300-38400bps |
| | Certifications | UL/cUL recognized (CT424A and CT424B) and CE certification (CT424A) |
| Environment | Sensor Inputs <i>Note: "Universal" inputs are standard and are electrically isolated from control logic and communications.</i> | RTD: 100Ω or 1000Ω Platinum, 0.00385Ω/Ω/°C TCR, 2- or 3-wire connection, Open and shorted sensor detection Thermocouple: Type K or Type E thermocouple, open detection. |
| | Temperature Range | -30°C to 72°C (-22°F to 162°F), 95% humidity, non-condensing |
| | Output Relays | Connection: terminal block, 30 AWG to 10 AWG wire |
| Mechanical | User Interface | Display: LED, 7-segment, red, 0.56" height, dimmable Indicators: LED, red: Fan, Trip, Alarm, Peak, Manual Fan, Test |
| | Dimensions | Front-panel: 6.3" x 9.9" Cut-out: 5.67" x 9.17" Depth: 1.9" |
| | Enclosure | Metal, corrosion-resistant |

▼ = STANDARD OPTIONS
Specifications subject to change

CT325 Miniature DC Temperature Controller



CT325 DC Controller

Overview

The CT325 Miniature DC Temperature Controller is designed for use with Minco Thermofoil™ heaters and RTD or thermistor sensors. It offers inexpensive on/off temperature control of your process or equipment with accuracy many times better than bimetal thermostats. Easily read and adjust the set point temperature using a voltmeter, then monitor the actual signal temperature at the other end. Operating from your 4.75 to 60 volt DC power supply, the controller can switch up to 4 amps power to the heater. A bright LED indicates when power is applied to the heater.

The entire unit is epoxy filled for moisture resistance, with a through-hole for a mounting bolt. A terminal block provides the power input, sensor input and heater output connections.

- Tight control in a small package means that enclosures or panel spaces are not required which allows successful portable device implementation
- Simple control without complicated programming can reduce set-up time
- Three-wire RTD connection cancels lead resistance for highly accurate temperature readings
- Solid state on-off control with adjustable set point improves durability compared to electro-mechanical devices
- Flexible heating control compliments all Minco Thermofoil™ Heaters for convenient off the shelf operation
- Uses standard 100 Ω or 1000 Ω platinum RTD or 50 kΩ thermistor sensor input
- Single DC power source provides power to the controller and heater up to 240 watts

Applications

- IV solutions for medical/surgical applications
- Military batteries
- Enclosures to maintain the temperature of electronics
- Ruggedized laptop LCDs and hardrives

Custom design options

Minco can customize the design of the CT325 for special applications. Specific temperature ranges, other sensor options, and special packaging are possible for volume OEM applications.

Specifications

Input: 100 Ω or 1000 Ω platinum RTD, 0.00385 Ω/Ω/°C, 2 or 3-leads, or 50 k Ω NTC thermistor, 2-lead.

Setpoint range: 2 to 200°C (36 to 392°F) for platinum RTD input. 25 to 75°C (77 to 167°F) for thermistor input. Consult factory for other ranges.

Setpoint stability: ±0.02% of span/°C.

V_{temp} signal: 0.010 V/°C over specified range.

| Platinum RTD sensor | | Thermistor sensor | |
|---------------------|---------------|-------------------|-------------|
| 2°C | 0.02 V | 25°C | 0.25 V |
| 50°C | 0.50 V | 50°C | 0.50 V |
| 100°C | 1.00 V | 75°C | 0.75 V |
| 200°C | 2.00 V | | |
| Accuracy: | ±1% of span | Accuracy: | ±2% of span |
| Linearity: | ±0.1% of span | Linearity: | ±2% of span |

Deadband: ±0.1°C (0.2°F).

Input power: 4.75 to 60 VDC.

Output: Open drain, 4 amps max. DC.

Leadwire compensation: (3-wire RTD) ±0.06°C/Ω for 100 Ω or 1000 Ω platinum up to 25 Ω per leg.

Fault protection: Heater disabled on RTD short or thermistor open. No heater protection; external fuse is recommended.

Operating ambient temperature range: -40 to 70°C (-40 to 158°F).

Relative humidity: 0 to 95% non-condensing.

Physical: Polycarbonate case, epoxy sealed for moisture resistance.

Weight: 1 oz. (28g).

Connections: Terminal block for wires AWG 22 to AWG 14.

Mounting: Mounting hole for #6 screw through or #8 thread forming screw.

▼ = **STANDARD OPTIONS**
Specifications subject to change

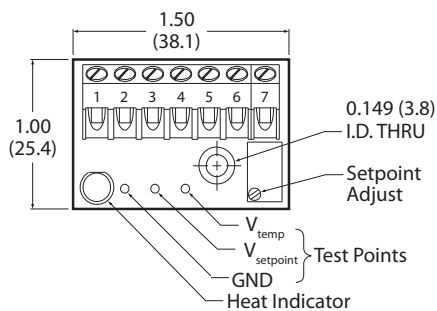
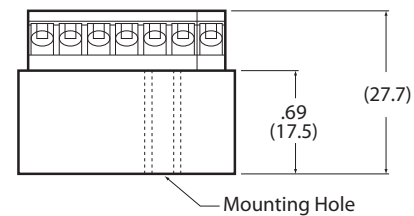
| Sensor type | Code |
|----------------------------------|------|
| 100Ω platinum RTD (0.00385 TCR) | PD |
| 1000Ω platinum RTD (0.00385 TCR) | PF |
| 50 kΩ thermistor R25/R125 = 31.2 | TF |

Note: 50kW thermistor sensor TS665TF is available on page 9-6

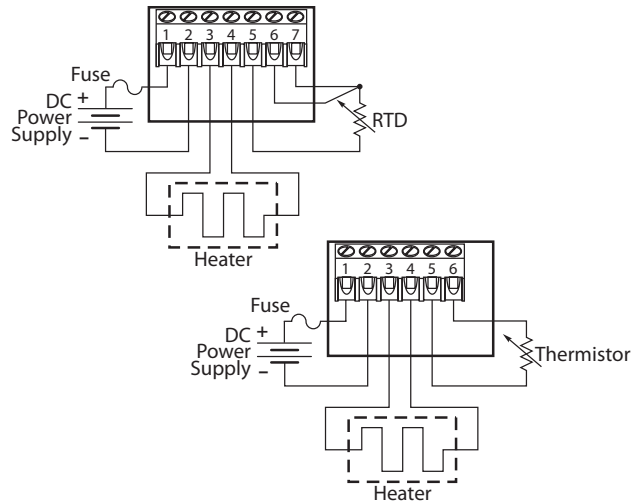
Specification and order options

| | |
|---------------------------------|---|
| CT325 | Model number |
| PD | Sensor type from table |
| 1 | Power supply: 1 = 4.75 to 10 VDC 2 = 7.5 to 60 VDC |
| C | Temperature range: A = 25 to 75°C (thermistor only) C = 2 to 200°C (RTD only) |
| 1 | Dead band: 1 = 0.1°C |
| CT325PD1C1 = Sample part number | |

Dimensions in inches (mm)

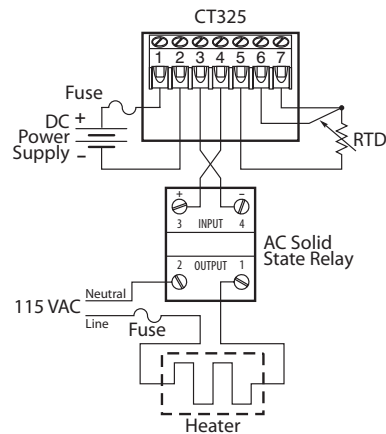


Wiring diagrams



AC powered heaters

The CT325 can provide the control signal to an external solid state relay to switch AC power. Use a DC supply voltage suitable for both the CT325 and SSR.



STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**

Specifications subject to change

CT335 PC Board Mount Temperature Controller

Overview

The CT335 is an OEM micro-processor based temperature controller that offers two sensor inputs, and two outputs. This low cost, PCB mount style proportional controller is great for system integration.

The CT335 multiple output options make it more versatile than other temperature controllers. Option 1) one output capable of handling up to 6 Amps. Option 2) Two open drain outputs with 3 Amps each. Option 3) one open drain output that can handle up to 3 Amps and a logic output option to work with an external SSR for higher power.

- Proportional and On/Off control
- Two inputs and two outputs (solid state)
- Small package designed for PCB mounting
- Able to handle up to 6 Amps
- Operates on 7.5-60 volts DC
- Low cost

Specifications

Sensor Inputs:

100Ω at 0°C Pt RTD, 2-leads (0.00385 TCR)

1000 Ω at 0°C Pt RTD, 2-leads (0.00385 TCR)

Output Options:

One output of 6A

Two outputs of 3A each

One 3A output and one logic output (0-5V)

Controlling Parameters:

Dead-band for On/Off Control: 0.1 to 10°C

Proportional band for Proportional Control: 0.1 to 10°C

Ambient:

Operating temperature: -40 to 70°C (-40 to 158°F)

Storage temperature: -55 to 85°C (-67 to 185°F)

Relative humidity: 90%, non-condensing

Accuracy: ±1° C

System stability determined by overall system.

Power supply: 7.5 to 60VDC

Physical: ABS case, epoxy potted for moisture resistance

Case Dimensions: 1.49x1.03x0.36"

Mounting: Pins on 0.1" center for mounting on PCB



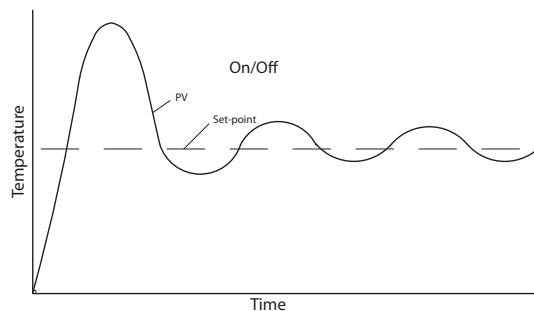
AC207473 USB to SPI Converter Kit:

The AC207473 allows the user to configure the CT335 from a PC. It is ideal for prototyping and early-stage development. It consists of a CT335 USB to SPI converter, power supply, USB cable, and software CD for easy user interface.

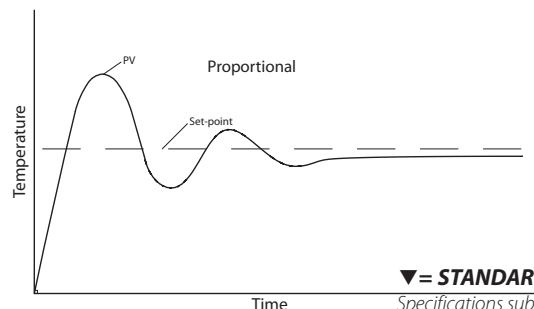
Operation

The CT335 controller can be configured to On/Off or Proportional control. On/Off control offers faster reaction time and better accuracy over thermostats. The CT335 Proportional control minimizes temperature overshoot and gives steadier temperature control by reducing the time the heater/load stays on as the process temperature approaches the set-point. Note that actual outputs depend on the system's configuration and controlling parameters. See below.

On/Off Control



Proportional Control

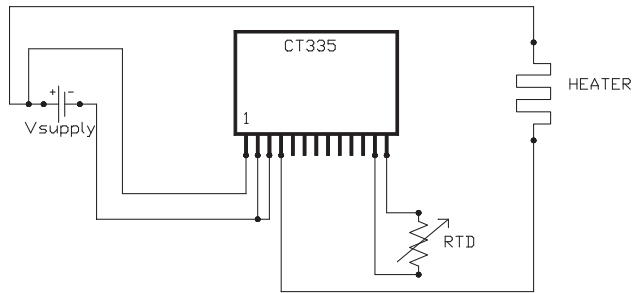


▼ = STANDARD OPTIONS
Specifications subject to change

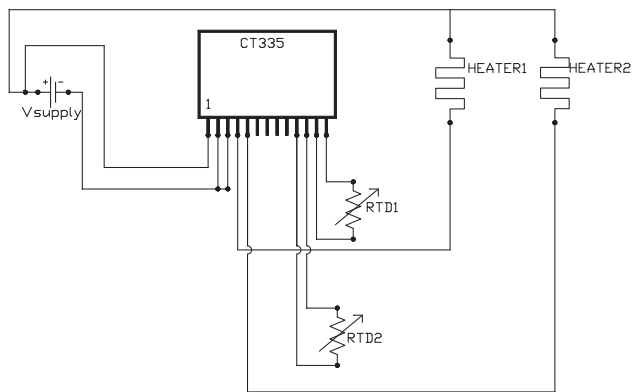
Specifications subject to change

Wiring with Different Output Options:

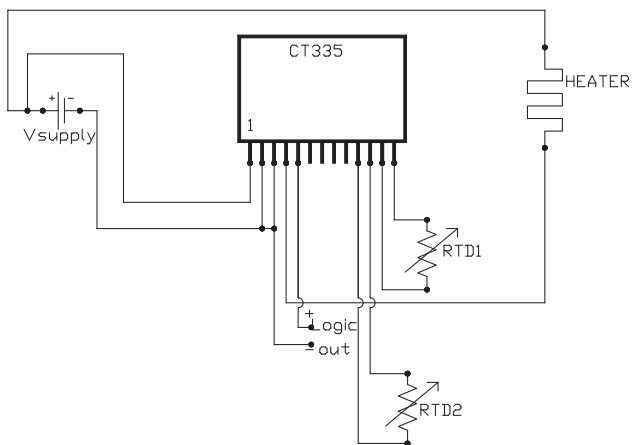
Option 1: One output of 6A



Option 2: Two outputs of 3A each



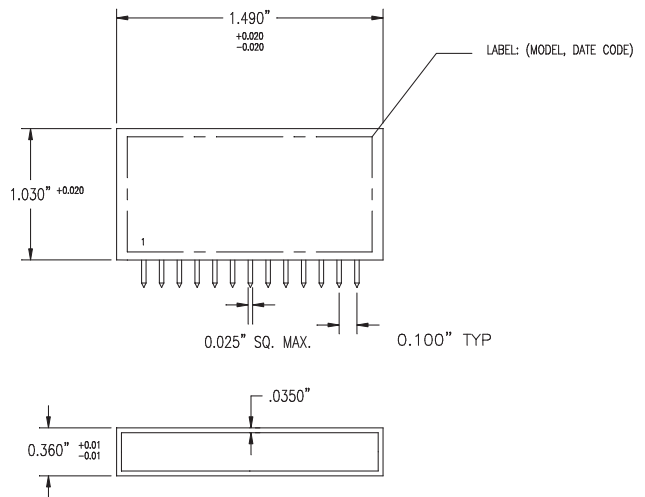
Option 3: One 3A output and one logic output (0-5V)



Specifications and order options

| | |
|-----------------------------------|---|
| CT335 | Model Number: CT335 |
| PD | Sensor Types: PD = 100Ω Platinum RTD (-40 to 200°C) PF = 1000Ω Platinum RTD |
| 1 | Output Options: 1. one output of 6A 2. two outputs of 3A 3. one 3A output and 1 logic output |
| P | Control Method: O = On/Off P = Proportional |
| 10 | Dead-band or Proportional Band 1 = 0.1° C 10 = 1.0° C 100 = 10.0° C |
| T100 | Setpoint Temperature (Min = -40°C, Max = 200°C): XXXX = Setpoint in 0.1°C increments Example: 100 = 10.0°C 103 = 10.3°C -200 = -20.0°C |
| CT335PD1T100 = Sample part number | |

Dimensions



▼ = STANDARD OPTIONS
Specifications subject to change

CT435 PC Board Mount Temperature Controller

Programmable Multi-input/output Controller

Overview

The CT435 is an OEM micro-processor based PID temperature controller that offers two independent sensor inputs and two outputs. This low cost, PCB mount style PID controller is very flexible through its many configuration options. Using the UART Modbus interface, system parameters, sensor temperatures, and output status may be read and/or written, allowing for complete system integration with existing micro-processors.

- Two RTD temperature sensor inputs – Pt100 or Pt1000
- Wide temperature sensing range
- All controller features are configurable through the UART Modbus interface
- Two independent solid state open drain outputs – 3A each
- Each output individually configurable for any variation of PID, On/Off, or Alarm control
- Auto-tune feature estimates PID coefficients for several control types
- 32-bit microprocessor executes both PID loops simultaneously at individually configurable rates up to 25 times/second
- Addressable Modbus protocol allows for multiple units connected on one set of UART lines
- No additional heat sinking required
- Small package designed for PCB mounting
- Operates from a 5V supply
- Low cost

Specifications

Sensor Inputs:

100 Ω at 0°C Pt RTD, 2-leads (0.00385 TCR)
 1000 Ω at 0°C Pt RTD, 2-leads (0.00385 TCR)
 2-wire connection
 Open and shorted sensor detection

Measurement Range:

-70°C to 650°C (-94°C to 1202°F), 0.25°C full-range accuracy at 25°C ambient

Accuracy:

25°C ambient: $\pm 0.25^\circ\text{C}$ or $\pm 0.25\%$ of range
 Full range ambient: $\pm 1.5^\circ\text{C}$ or $\pm 1\%$ of range
 System stability determined by overall system.



Electrical:

Input power: 5 to 24VDC, 20mA typical, 40mA max

Outputs: 2 open drain outputs, 60V max switching voltage

| Number of Outputs in Use | Controller Supply Voltage | Ambient Temperature | Current Rating |
|--------------------------|---------------------------|---------------------|----------------|
| 1 Output | 5-12 VDC | 25°C | 7 A |
| | | 70°C | 4 A |
| | 12-24 VDC | 25°C | 6 A |
| | | 70°C | 3 A |
| 2 Outputs | 5-12 VDC | 25°C | 5 A |
| | | 70°C | 3 A |
| | 12-24 VDC | 25°C | 5 A |
| | | 70°C | 2.5 A |

Environmental:

Operating temperature: -40 to 70°C (-40 to 158°F)

Storage temperature: -55 to 85°C (-67 to 185°F)

Relative humidity: 90%, non-condensing

Communication:

Modbus over UART – 19.2kbps, no flow control

Package:

Enclosure: ABS case, epoxy potted

Dimensions: 1.49x1.03x0.36"

Mounting: Pins on 0.1" center for mounting on PCB

▼ = **STANDARD OPTIONS**

Specifications subject to change

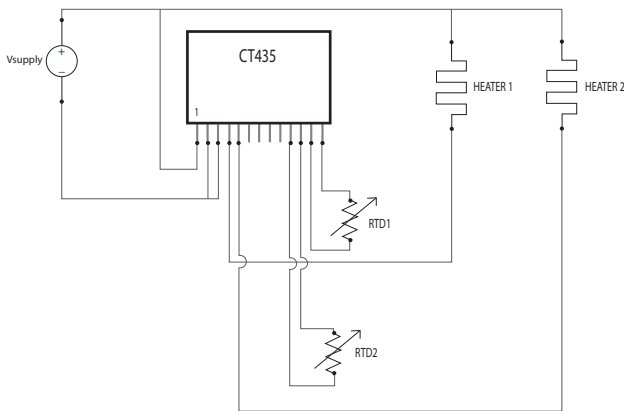
Operation:

The CT435 controller can be configured to PID (and any variation) or On/Off control. On/Off control offers faster reaction time and better accuracy over thermostats. PID control minimizes temperature overshoot and gives steadier temperature control by utilizing proportional, integral, and derivative control factors. The inputs and outputs may be configured in any fashion, and all parameters are read/write through the addressable UART Modbus interface. The controller and heaters may be powered from the same supply or separate supplies, as long as they share a common ground.

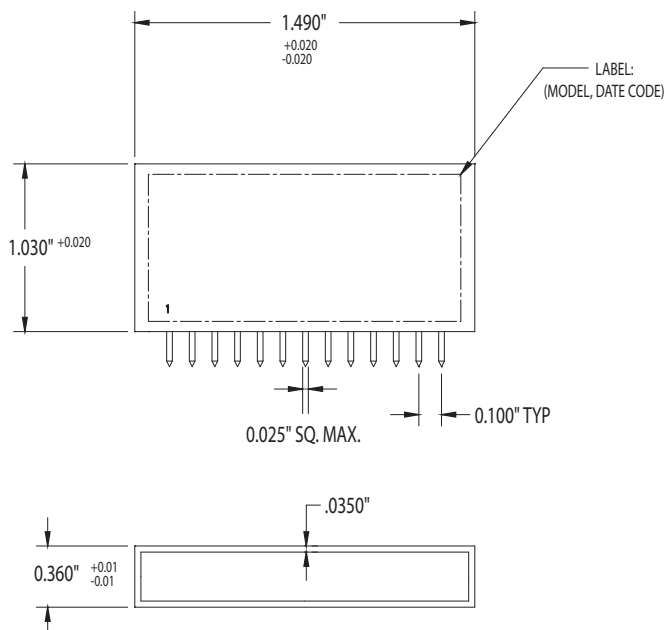
How to Order:

| | |
|------------------------------|--|
| CT435 | Model number |
| PD | Sensor Types: PD = 100 Ω Platinum RTD PF = 1000 Ω Platinum RTD |
| CT435PD = Sample part number | |

Common Wiring Diagram:



Dimensions:



▼ = STANDARD OPTIONS
Specifications subject to change

CT15 Temperature Controller & Alarm



CT15 Controller

Overview

The CT15 is an easy-to-use controller with sophisticated PID control. It can also be a single or 2-stage alarm (using alarm feature plus control relay) to monitor motors and generators for overheating.

- RTD or thermocouple input
- Control modes: Self-Tune, pre-set or programmable PID, or On/Off
- Bright red LED display
- Ramp to setpoint
- Digital sensor input correction
- Digital input filter adjustable for noisy or jittery processes
- Four security levels
- Setpoint limits
- Non-volatile memory needs no battery backup
- Input fault timer
- Alarms at one or two temperatures
- Alarm Relay option is programmable for high, low, absolute, or deviation, can be reset manually or automatically, and controls a single electromechanical relay with voltage-free contacts

Specifications

Selectable inputs:

RTD: 2 or 3-wire, Minco types PD or PE (100 Ω EN60751 platinum).
Thermocouple: Type J (factory default), K, T (selectable).

Input impedance:

Thermocouple: 3 megohms minimum.
RTD current: 200 μ A maximum.

Sensor break or short protection: De-energizes control outputs to protect system.

Loop break protection: Error message is initiated and output is turned off in case of shorted sensor or open heater circuit. Break time adjustable from OFF to 99 minutes.

Cycle rate: 1 to 80 seconds.

Setpoint range: Selectable from -212 to 1371°C (-350 to 2500°F), input dependent.

Display: One 4 digit, 7 segment, 0.3" high LED. Display shows the measured temperature unless a control key is pressed, then it will display the item value.

Control action: Reverse (usually heating) or Direct (usually cooling), selectable.

Ramp/Soak: One ramp, 0 to 100 hours.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Specifications continued

Accuracy: $\pm 0.25\%$ of span ± 1 count.

Resolution: 1° or 0.1° , selectable.

Line voltage stability: $\pm 0.05\%$ over supply voltage range.

Temperature stability: $4 \mu V/^\circ C$ ($2.3 \mu V/^\circ F$) typical, $8 \mu V/^\circ C$ ($4.5 \mu V/^\circ F$) max. ($100 \text{ ppm}/^\circ C$ typical, $200 \text{ ppm}/^\circ C$ max.).

Isolation: Relay and SSR outputs are isolated. Pulsed voltage output must not share a common ground with the input.

Supply voltage: 100 to 240 VAC nom., $+10/-15\%$, 50 to 400 Hz, single phase; 132 to 240 VDC, nom., $+10/-20\%$. 5 VA maximum.
Note: Do not confuse controller power with heater power. The controller does not supply power to the heater, but only acts as a switch. For example, the controller could be powered by 115 VAC, but controlling 12 VDC to the heater.

Operating temperature range: -10 to $55^\circ C$ (14 to $131^\circ F$).

Memory backup: Non-volatile memory (no batteries required).

Control output ratings:

AC SSR (SPST): 3.5 A @ 250 VAC @ $25^\circ C$ ($77^\circ F$); derates to 1.25 A @ $55^\circ C$ ($131^\circ F$).

Minimum 48 VAC and 100mA required.

An SSR is recommended for longer life than a mechanical relay.

Switched voltage (non-isolated):

5 VDC @ 25 mA.

Mechanical relay, SPST Form A (Normally Open):

3 A resistive, 1.5 A inductive @ 250 VAC;
 pilot duty: 250 VA; 2 A @ 125 VAC or
 1 A @ 250 VAC.

Alarm relay, SPST Form A (Normally Open):

3 A resistive, 1.5 A inductive @ 250 VAC;
 pilot duty: 250 VA; 2 A @ 125 VAC or
 1 A @ 250 VAC.

Weight: 227g (8 oz.).

Agency approvals: UL & CSA.

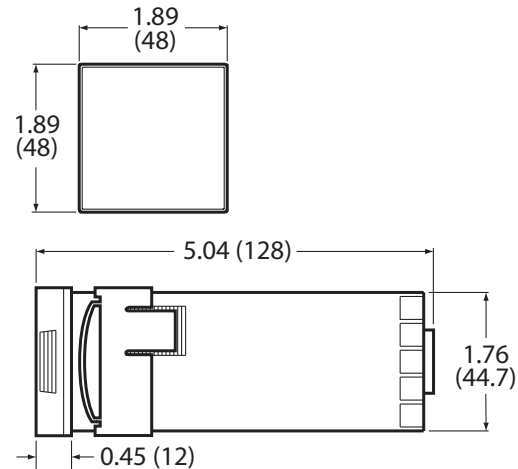
Front panel rating: Type 4X (IP66).

Specification and order options

| CT15 | Model number |
|------------------------------|---|
| 1 | Alarm: 0 = No 1 = Yes |
| 2 | Input: 1 = J, K, or T thermocouple 2 = 100Ω platinum RTD, type PD or PE |
| 1 | Output: 1 = Built-in AC SSR 2 = Pulsed voltage (5 VDC) 3 = Mechanical relay |
| CT15121 = Sample part number | |

Note: See page 4-37 for controller accessories.

Dimensions shown in inches (mm)



PANEL CUTOUT: 1.775" \times 1.775" (45 mm \times 45 mm)
 MAXIMUM PANEL THICKNESS: 0.25" (6.35 mm)
 DIMENSIONS IN INCHES (mm)



STOCKED PARTS AVAILABLE

Specifications subject to change

CT16A Temperature Controller



CT16A Controller

Overview

This economical controller packs sophisticated PID control into a compact $\frac{1}{16}$ DIN enclosure. A wide range of control modes, sensor input types, and relay or SSR outputs give versatile control of Thermofoil™ heaters and lets you easily connect to other electronics.

- Dual displays continuously show the set point and the actual temperature reading in resolutions of 1°, 0.1°, or engineering units
- Universal Input fits any sensor: Select from 10 thermocouple types, 4 RTD types, voltage, and current signals
- Isolated Outputs for safe, easy wiring
- Loop Break protection handles sensor or heater failure
- Peak / Valley records the maximum and minimum temperatures
- Front panel is waterproof and corrosion-resistant, making it ideal for sanitary applications. Illuminated keypad for easy operation
- Limit the temperatures which the operator can set via four password-protected Security Levels
- Controller can Self-Tune for best PID control
- Control modes: Self-Tune, pre-set or adjustable PID values, simple On/Off control, and open loop
- Fuzzy Logic provides better response time and reduces overshoot in processes with unpredictable inputs
- Alarms at one or two temperatures
- Alarm Relay option is programmable for high, low, absolute, or deviation, can be reset manually or automatically, and controls a single electromechanical relay with voltage-free contacts

- Ramp & Soak option handles complex heating profiles of 16 segments with front-panel activation and a selectable time base (CT16A3)
- Auto / Manual option easily switches to manual control for set up or experiments (CT16A3)
- RS-232 or RS-485 Serial Communications access the temperature readings and all control parameters (optional)
- Retransmit either the sensed temperature or the set point as a voltage or current signal to a computer or recorder (optional)
- 4-Stage Set Point to quickly switch from one temperature to the next (optional)

Specifications

Selectable inputs:

RTD: 2 or 3-wire, Minco types
PD or PE (100 Ω EN60751 platinum),
PA (100 Ω NIST platinum),
PF (1000 Ω EN60751 platinum), or
NA (120 Ω Nickel).

Thermocouple: Type J (factory default), K, T, L, E, R, S, B, C, or N.
DC current: 0-20 mA or 4-20 mA (use with Temptran™ transmitters).
DC voltage: 0-10 or 2-10 VDC, -10 to 10 mVDC, scalable.

Input impedance:

Voltage: 5000 Ω .
Thermocouple: 3 megohms minimum.
Current: 10 Ω .
RTD current: 200 μ A.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Specifications continued

Sensor break or short protection:

Selectable output: disabled, average output before fault, or preprogrammed output.

Adjustable delay: 0.0 to 540.0 minutes.

Loop break protection: Error message is initiated and output is turned off in case of shorted sensor or open heater circuit.

Break time adjustable from OFF to 9999 seconds.

Cycle rate: 1 to 80 seconds.

Setpoint range: Selectable from -212 to 2320°C (-350 to 4208°F), input dependent.

Displays: Two, 4 digit, 7 segment, 0.3" high LEDs. Process Value red, Setpoint Value green. °C or °F.

Control action: Reverse (usually heating) or Direct (usually cooling), selectable.

Ramp/soak: (CT16A3 only) 16 separate ramp and soak times are adjustable in minutes or seconds from 0 to 9999. When the program has ended, you may choose to repeat, hold, revert to local setpoint, or turn the outputs off.

Accuracy: ±0.25% of span ±1 count.

Resolution: 1° or 0.1°, selectable.

Line voltage stability: ±0.05% over supply voltage range.

Temperature stability: 4 $\mu\text{V}/^\circ\text{C}$ (2.3 $\mu\text{V}/^\circ\text{F}$) typical, 8 $\mu\text{V}/^\circ\text{C}$ (4.5 $\mu\text{V}/^\circ\text{F}$) max. (100 ppm/°C typical, 200 ppm/°C max.).

Isolation:

Relay and SSR: 1500 VAC to all other inputs and outputs.

SP1 and SP2 current and voltage: 500 VAC to all other inputs and outputs, but not isolated from each other.

Process output (options 934, 936): 500 VAC to all other inputs and outputs.

Supply voltage: 100 to 240 VAC nom., +10/-15%, 50 to 400 Hz, single phase; 132 to 240 VDC, nom., +10/-20%. 5 VA maximum.

Note: Do not confuse controller power with heater power. The controller does not supply power to the heater, but only acts as a switch. For example, the controller could be powered by 115 VAC, but controlling 12 VDC to the heater.

Operating temperature range:

-10 to 55°C (14 to 131°F).

Memory backup: Non-volatile memory (no batteries required).

Control output ratings:

AC SSR (SPST): 2.0 A combined outputs

A & B @ 240 VAC @ 25°C (77°F);

derates to 1.0 A @ 55°C (131°F).

An SSR is recommended for longer life than a mechanical relay.

Mechanical relay, SPST Form A (Normally Open) or Form B (Normally Closed):

3 A resistive, 1.5 A inductive @ 240 VAC;

pilot duty: 240 VA; 2 A @ 120 VAC or 1 A @ 240 VAC.

Switched voltage (isolated): 15 VDC @ 20 mA.

Current (isolated): 0 to 20 mA, 600 Ω max.

DC SSR: 1.75 A @ 32 VDC max.

Alarm relay, SPST Form A (Normally Open):

3 A @ 240 VAC resistive;

1/10 HP @ 120 VAC.

Specifications and order options

| CT16A | Model number |
|------------------------------------|---|
| 2 | Feature set: 2 = Standard 3 = Enhanced (ramp & soak, Auto/manual) |
| 1 | Alarm relay: 0 = No 1 = Yes |
| 1 | Output A: 1 = Built-in AC SSR 2 = Pulsed voltage (15 VDC) for external SSR 3 = Mechanical relay, SPST (normally open) 4 = Mechanical relay, SPST (normally closed) 5 = Current 8 = DC SSR |
| 0 | Output B: 0 = None 1 = Built-in AC SSR 2 = Pulsed voltage (15 VDC) for external SSR 3 = Mechanical relay, SPST (normally open) 4 = Mechanical relay, SPST (normally closed) 5 = Current |
| -948 | Options on next page (leave blank for none) |
| CT16A2110-948 = Sample part number | |

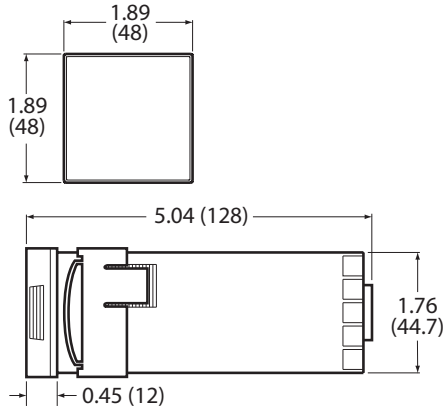
See page 4-37 for Accessories.

▼ = STANDARD OPTIONS

Specifications subject to change

CT16A - Options and Accessories

Dimensions shown in inches (mm)



PANEL CUTOUT: 1.775" x 1.775" (45 mm x 45 mm)
 MAXIMUM PANEL THICKNESS: 0.25" (6.35 mm)

Additional options for CT16A (board level)

934: Analog retransmission of Process Variable or Set Variable: (4 to 20 mA DC) For use as recorder, transmitter or computer A/D input. Linearized 4 to 20 mA DC signal follows the Process or Set variable. Scalable.

936: Analog retransmission of Process Variable or Set Variable: (0 to 10 VDC) Similar to option 934, but output signal is linearized 0 to 10 VDC.

948: 4-Stage setpoint: Four preset setpoints may be selected by external contacts. Each set point has its own set of PID values giving controller 4 distinct "recipes" for different process situations.

992: RS-485 Computer communication link: Allows remote computer to read and write all control parameters.

993: RS-232 Computer communication link: Allows remote computer to read and write all control parameters.

Accessories for CT15 and CT16A

AC744: 1-10 A, 24 to 280 VAC SSR

AC745: 1-25 A, 24 to 280 VAC SSR

AC746: 1-50 A, 24 to 280 VAC SSR

AC1009: 1-20 A, 0 to 100 VDC SSR

AC743: SSR heat sink for high current or ambient temperature

AC996 R/C Snubber: Highly recommended to prolong relay contact life if using the mechanical relay or SSR output to drive a relay or solenoid. Also, for the CT16A AC SSR output, make sure that the coil HOLDING current is greater than 100 mA and voltage is minimum 48 VDC.

AC1001: Steel 1/16 to ¼ DIN adapter plate. 127 x 127 mm gray steel with 45 x 45 mm centered hole.



▼ = **STANDARD OPTIONS**
 Specifications subject to change

CT425 Temperature Controller

Versatile, configurable controller with Bluetooth option

Overview

Minco's CT425 Temperature Controller provides simple, yet quick customization for most controller applications. The CT425 Temperature Controller features three user-configurable outputs, two programmable inputs, and communication via USB.

Minco's CT425 Temperature Controller is a PID temperature controller capable of reading two independent temperature sensors (RTDs). By utilizing an internal solid state relay, logic voltage output, and internal mechanical relay, the controller is fully configurable. Simply connect the CT425 to a laptop or PC to configure.

Features

Flexible configuration for:

Inputs:

- Utilize one or two Platinum RTDs
- Choose 100 or 1000 ohm RTDs (independently programmable)

Outputs:

- Utilize up to three outputs
 - Solid state relay
 - Logic voltage
 - Mechanical relay
- Choose control type
 - PID
 - On/Off (mechanical relay only)
 - Alarm
- USB and a user-friendly software package allow for easy setup and use
- 32-bit microprocessor executes both PID loops simultaneously at individually configurable rates up to 25 times/second
- High current capacity internal switching
- Electrically isolated switching outputs increase high voltage safety
- AC powered models perform zero-cross detection to reduce switching noise
- LED indicators provide a quick confirmation of correct sensors input operation



Applications

The CT425 is designed for a variety of applications that include heating and cooling of equipment or processes. The CT425's versatility makes it ideal to use as an off-the-shelf prototyping tool or as an economical controller for small to medium volume applications. Moreover, the CT425's modular design provides the platform for fast and cost-effective custom designs for medium to high volume applications.

Bluetooth option

The controller may be ordered with Bluetooth communication (Bluetooth Low Energy, Class 2). The Bluetooth may be used to view real-time data and make basic setting changes.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Specifications

| CT425 Temperature Controller | | | | | |
|------------------------------|---|---|---------------|---------------|---------------|
| Performance | Measurement Range | -70°C to 650°C (-94°C to 1202°F), 0.25°C full-range accuracy at 25°C | | | |
| | Input Power | Model CT425A: 120VAC, 50-60Hz Model CT425B: 10.5-60VDC Model CT425C: 240VAC, 50-60Hz | | | |
| | Sensor Inputs (RTD) | 100Ω or 1000Ω Platinum, 0.00385Ω/Ω/°C TCR, 2-wire connection, Open and shorted sensor detection | | | |
| | Connections | 5mm spacing terminal block | | | |
| Environment | Output Ratings | Output | Max Voltage | Current (25C) | Current (55C) |
| | | 120VAC Solid State (CT425A) | 120VAC | 6A | 5A |
| | | DC Solid State (CT425B) | 60VDC | 15A | 11A |
| | | 240VAC Solid State (CT425C) | 240VAC | 3A | 2.5A |
| | | Mechanical Relay | 250VAC/30VDC | 10A resistive | |
| | Logic Voltage | 4.4V, +/- 0.1V output | 26mA, +/- 3mA | | |
| Temperature Range | -20°C to 55°C, 90% humidity, non-condensing | | | | |
| Mechanical | Dimensions | 5.46" x 3.34" x 1.22" | | | |
| | Weight | 350 grams (12.3 ounces) | | | |
| | Enclosure | UL 94V-0 ABS plastic with epoxy potting | | | |

Ordering Information

To configure your temperature controller, select from the options listed below to determine the complete part number.

| | |
|---|---|
| CT425 | Power Supply |
| CT425A | 120VAC power, 120 VAC solid state relay |
| CT425B | 10.5–60VDC power, DC solid state relay |
| CT425C | 240VAC power, 240 VAC solid state relay |
| Additional Option: -BT Blank for none | Bluetooth Communication |
| CT425A, CT425A-BT = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change



▶ SECTION 6: MINIATURE SENSORS

- Embedment sensors install in bearings for over-temperature protection
- Small, rugged RTDs and thermocouples withstand rough handling and harsh environments
- Certified non-sparking sensors for hazardous areas
- Bolt-on designs for easy installation

| | |
|--|------------|
| Embedment RTDs..... | 6-2 |
| Embedment Thermocouples..... | 6-3 |
| Increased Safety and Intrinsically Safe Embedment Sensors | 6-4 to 6-5 |
| Non-sparking Embedment Sensors | 6-6 to 6-9 |
| Bolt-on sensors | 6-10 |
| Economy sensors..... | 6-11 |
| Installation and accessories | 6-12 |

Embedment RTDs

| Element | TCR $\Omega/\Omega/^{\circ}\text{C}$ | Case style A | | Case style B | | Case style C | | Case style D | |
|--|---|----------------------|-----------|--------------|-----------|--------------|-----------|--------------|------|
| | | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| Platinum, 100 Ω $\pm 0.36\%$ at 0°C | .00392 | S325PA, S11636PA* | S4026PA | S331PA | S7792PA | S341PA | S14320PA | S12414PA | |
| Platinum, 100 Ω $\pm 0.12\%$ at 0°C (Meets EN60751, Class B) | .00385 | S304PD | S309PD | S306PD | S14405PD | S308PD | S14455PD | ▼ S13282PD | |
| Platinum, 100 Ω $\pm 0.36\%$ at 0°C | .00385 | S7304PE | S305PE | S7746PE | S307PE | S7908PE | S14456PE | S13282PE | |
| Platinum, 1000 Ω $\pm 0.12\%$ at 0°C | .00385 | S101907PF | S101911PF | S101908PF | S101912PF | S101909PF | S101913PF | S101910PF | |
| Copper, 10 Ω $\pm 0.2\%$ at 25°C | .00427 | S324CA | S4026CA | S332CA | | S342CA | | | |
| Nickel, 120 Ω $\pm 0.5\%$ at 0°C | .00672 | S326NA, S11636NA* | S4026NA | S330NA | S7792NA | S340NA | | | |

*MIL-T-24388C qualified models

Overview

Install miniature sensors in or beneath the babbitt layer of bearing shoes. They monitor metal temperature — the most reliable indicator of bearing condition — to give early warning of oil film breakdown. Machines can then be shut down and the problem corrected before catastrophic failure occurs.

While no larger than many bare ceramic elements, these RTDs have metal cases and insulated leads to withstand rough handling and harsh environments. They are easy to install in drilled holes for general purpose sensing.

Specifications

Temperature range: -50 to 260°C (-58 to 500°F).

Case: Tin plated copper alloy. Models S12414, S13282 and S101910: Stainless steel.

Babbitt tip: Factory applied babbitt tip, available on case style A or B, reduces the danger of overheating the sensor when installed in babbitt layer.

Leads: Stranded copper with PTFE insulation; stainless steel overbraid optional (one sleeve covers all leads). Polyimide insulation available on selected models (See specification and order options).

Time constant: 3.0 seconds (case style A) to 1.5 seconds (case style D), typical value in moving water.

Insulation resistance: 10 megohms min. at 100 VDC, leads to case.

*MIL-T-24388C qualified models:
PRT-EM-E2: Order S11636PA3K36B1.
NRT-EM-E1: Order S11636NA3K36B1.

▼ = **STANDARD OPTIONS**

Specifications subject to change

Leadwire size (AWG):

| Case style | Number of leads | | | |
|------------|-----------------|----|----|----|
| | 2 | 3 | 4 | 6 |
| A | 24 | 24 | 24 | 24 |
| B | 24 | 24 | 28 | 28 |
| C | 24 | 26 | 30 | 30 |
| D | 30 | 30 | 34 | |



STOP OIL SEEPAGE!



STOCKED PARTS AVAILABLE

Specification and order options

| | |
|---|--|
| S331PA | Model number from table |
| 3 | Number of leads per sensing element (2, ▼3, or 4): ▼:3 CA or PD elements not available with 2 leads. 4 leads available on single elements and S14405 only. |
| S | Covering over leadwires: ▼ T = PTFE insulated leads only ▼ S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads R = FEP over stainless steel braid and PTFE insulated leads. E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads. (max fill length 240") S11636 Covering options only: K = Polyimide insulated leads. S = Stainless steel overbraid with polyimide insulated leads. |
| 120 | Lead length in inches: ▼120 |
| (Stop here for case style C or D; no installation variable) | |
| AC1 | Optional Installation/Accessory option: B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| S331PA3S120AC1 = Sample part number | |

Embedment Thermocouples

| Leadwire | Case style A Case L: 0.250" (6.4 mm) Case Ø: 0.275" (7.0 mm) | | Case style B Case L: 0.250" (6.4 mm) Case Ø: 0.188" (4.8 mm) Flange Ø: 0.250" (6.4 mm) | | Case style C Case L: 0.300" (7.6 mm) Case Ø: 0.125" (3.2 mm) | | Case style D Case L: 0.300" (7.6 mm) Case Ø: 0.080" (2.0 mm) | |
|---|--|--------|---|--------|--|--------|--|------|
| | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| AWG 20 stranded | TC311 | TC312 | TC333 | | | | | |
| AWG 24 stranded | TC2162 | TC2303 | TC2084 | TC2096 | TC344 | TC2623 | | |
| AWG 24 stranded with single SS braid over both wire pairs | | TC2698 | | TC2520 | | TC2837 | | |
| AWG 30 solid | | | | | | | ▼TC2741 | |

Overview

These thermocouples are mechanically interchangeable with the RTDs on pages 6-2 and 6-3.

Specifications

Temperature range: -184 to 260°C (-300 to 500°F).

Copper-Constantan (Type T):

AWG 24: 200°C (392°F) maximum,

AWG 30: 150°C (302°F) maximum.

Time constant: Typical value in moving water:

Grounded junction: 0.3 seconds.

Ungrounded junction: 6 seconds (case style A) to 1 second (case style C).

Insulation resistance: 10 megohms min. at 100 VDC, leads to case, ungrounded junctions only.

Case: Tin plated copper alloy.

Babbitt tip: Factory applied babbitt tip, available on case styles A and B, reduces the danger of overheating the sensor when installed in babbitt layer.

Leads: See table for sizes and options. Dual element models with AWG 24 stranded leadwires are available with a single stainless steel braid over all four wires. This option is recommended for use with integral feedthroughs. See below for more information.

Specification and order options

| | |
|---|--|
| TC311 | Model number from table |
| E | Junction type: ▼ E = Chromel-Constantan ▼ K = Chromel-Alumel ▼ J = Iron-Constantan ▼ T = Copper-Constantan |
| U | Junction grounding: ▼ G = Grounded ▼ U = Ungrounded |
| 36 | Lead length in inches ▼: 48, 144 |
| S | Covering over leadwires: T = PTFE insulated leads only ▼ S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads R = FEP over stainless steel braid and PTFE insulated leads E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads (max fill length 240") |
| (Stop here for case style C or D; no installation variable) | |
| B0 | Optional Installation/Accessory option: B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| TC311EU36SB0 = Sample part number | |

STOP OIL SEEPAGE!

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar.) See page 3-11 for details.

Leadwire and cable seal models FG1015, FG3015 and FG4015 seal RTD or thermocouple leadwires where they exit oil-filled bearing housings of rotating equipment. Both versions include a grommet that provides the seal and allows adjustment of the wire or cable position. See page 3-12 for details.

Elastomer rubber-filled cable has elastomer fill between the wires, stainless steel braid, and outer jacket. This fill can extend along the entire length of the cable, or a specified portion. The outside of the cable can be sealed with an FG1015, FG3015 and FG4015 fitting. See Leadwire Covering Options on Miniature Sensors on pages 6-2 to 6-10.

For more information on the problems of oil seepage and various solutions, visit www.minco.com



▼ = STANDARD OPTIONS
Specifications subject to change

Increased Safety & Intrinsically Safe Embedment Sensors

ATEX  **II 2 G Ex e IIC**

ATEX  **II 1 G Ex ia IIC**

IECEx Ex eb IIC

IECEx Ex ia IIC

EAC



Overview

- Increased safety and intrinsically safe embedment sensors for monitoring the temperature of thrust bearings
- Three case styles offer a variety of installation options
- Certified for use in Zone 0 and Zone 1, Group IIC hazardous areas, defined by IEC 60079-0 and IEC 60079-7

Specifications

Temperature range: -50 to 200°C (-58 to 392°F), reducing to 125°C (257°F) when elastomer filled cable is ordered.

Case: Tin plated copper alloy.

Babbitt tip: Factory applied babbitt tip, available on case style A and B reduces the danger of overheating the sensor when installed in babbitt layer.

Leads:

RTD: stranded copper with PTFE insulation.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Thermocouple: stranded, PTFE insulated, twisted pairs.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Leadwire size (AWG):

| RTD | | | | | |
|--------------|-----------------|----|----|----|----|
| Case style | Number of leads | | | | |
| | 2 | 3 | 4 | 6 | 8 |
| A | 24 | 24 | 24 | 24 | |
| B | 24 | 24 | 28 | 28 | 28 |
| C | 24 | 26 | 30 | 30 | |
| D | 30 | 30 | 34 | | |
| Thermocouple | | | | | |
| A, B, C | 24 | | 24 | | |
| D | 30 | | | | |

Time constant: 3.0 seconds (case style A), typical in moving water.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

▼ = **STANDARD OPTIONS**

Specifications subject to change

Specification and order options: RTD

| | |
|---|--|
| S102951PD | Model number from next page |
| 3 | Number of leads per sensing element (2, 3 or 4): ▼:3 CA or PD elements not available with 2 leads 4 leads available on all single elements and dual S207596 + S207598 only |
| E | Covering over leadwires: T = PTFE insulated leads only ▼ S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads ▼ E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads (max. fill length 240") |
| 36 | Lead length in inches ▼:36, 120 |
| (Stop here for case style C; no installation variable) | |
| AC1 | Optional Installation/Accessory option ▼ B0 = No babbitt metal or accessories ▼ B1 = Babbitt metal applied ▼ AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| S102951PD3E36AC1 = Sample part number | |

Specification and order options: Thermocouple

| | |
|---|--|
| TC102960K | Model number from next page |
| U | Junction grounding: ▼ G = Grounded ▼ U = Ungrounded |
| 48 | Lead length in inches ▼:48, 144 |
| S | Covering over leadwires: T = PTFE insulated leads only ▼ S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads ▼ E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads (max fill length 240") |
| (Stop here for case style C; no installation variable) | |
| B0 | Optional Installation/Accessory option ▼ B0 = No babbitt metal or accessories ▼ B1 = Babbitt metal applied ▼ AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| TC102960KU48SB0 = Sample part number | |

| RTD Element | TCR $\Omega/\Omega/^{\circ}\text{C}$ | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm) | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm) | | Case style D Case L: 0.300" (7.6 mm) Case \varnothing : 0.080" (2.0 mm) |
|---|---|---|---------|---|---------|---|---------|---|
| | | Single | Dual | Single | Dual | Single | Dual | Single |
| ▼ Platinum, 100 Ω \pm 0.36% at 0°C | .00392 | S102950 | S102950 | S102951 | S102951 | S102952 | S102952 | S102954 * Zone 0 only |
| ▼ Platinum, 100 Ω \pm 0.12% at 0°C (Meets EN60751, Class B) | .00385 | | | | | | | |
| ▼ Platinum, 100 Ω \pm 0.067% at 0°C (Meets EN60751, Class A) | .00385 | | | | | | | |
| ▼ Platinum, 100 Ω \pm 0.36% at 0°C | .00385 | | | | | | | |
| ▼ Platinum, 1000 Ω \pm 0.12% at 0°C | .00385 | | | | | | | |
| ▼ Copper, 10 Ω \pm 0.2% at 25°C | .00427 | | | | | | | |
| ▼ Nickel, 120 Ω \pm 0.5% at 0°C | .00672 | | | | | | | Not Available |

| Thermocouple Junction Type | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm) | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm) | | Case style D Case L: 0.300" (7.6 mm) Case \varnothing : 0.080" (2.0 mm) |
|-------------------------------|---|------------|---|------------|---|----------|---|
| | Single | Dual | Single | Dual | Single | Dual | Single |
| E = Chromel-Constantan | ▼ TC102960 | ▼ TC102960 | ▼ TC102961 | ▼ TC102961 | TC102962 | TC102962 | TC102964 *Zone 0 only |
| J = Iron-Constantan | | | | | | | |
| K = Chromel-Alumel | | | | | | | |
| T = Copper-Constantan | | | | | | | |

STOP OIL SEEPAGE!

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar.) See page 3-11 for details.

Leadwire and cable seal models FG1015, FG3015 and FG4015 seal RTD or thermocouple leadwires where they exit oil-filled bearing housings of rotating equipment. Both versions include a grommet that provides the seal and allows adjustment of the wire or cable position. See page 3-12 for details.

Elastomer rubber-filled cable has elastomer fill between the wires, stainless steel braid, and outer jacket. This fill can extend along the entire length of the cable, or a specified portion. The outside of the cable can be sealed with an FG1015, FG3015 and FG4015 fitting. See Leadwire Covering Options on Miniature Sensors on pages 6-2 to 6-10.



Minco Application Aid #27 provides more information on the problems of oil seepage and various solutions. Download AA#27 at www.minco.com

▼ = STANDARD OPTIONS
Specifications subject to change

Non-sparking Embedment Sensors - Self Certified



ATEX
II 3 G Ex nA IIC u



Overview

- Non-sparking embedment sensors for monitoring the temperature of thrust bearings
- Four case styles offer a variety of installation options
- Certified for use in Zone 2, Group IIC hazardous areas

Specifications

Temperature range: -50 to 200°C (-58 to 392°F), reducing to 125°C (257°F) when elastomer filled cable is ordered.

Case: Tin plated copper alloy.

Babbitt tip: Factory applied babbitt tip, available on case style A, B, and short style B, reduces the danger of overheating the sensor when installed in babbitt layer.

Leads:

RTD: stranded copper with PTFE insulation.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Thermocouple: stranded, PTFE insulated, twisted pairs.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Leadwire size (AWG):

| RTD | | | | | |
|--------------|-----------------|----|----|----|----|
| Case style | Number of leads | | | | |
| | 2 | 3 | 4 | 6 | 8 |
| A | 24 | 24 | 24 | 24 | |
| B | 24 | 24 | 28 | 28 | 28 |
| C | 24 | 26 | 30 | 30 | |
| Short B | 24 | 26 | 28 | 30 | |
| Thermocouple | | | | | |
| All cases | 24 | | 24 | | |

Time constant: 3.0 seconds (case style A), typical in moving water.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

▼ = **STANDARD OPTIONS**

Specifications subject to change





Specification and order options:


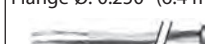

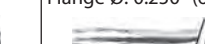
RTD

| | |
|---|---|
| S102617PD | Model number from next page |
| 3 | Number of leads per sensing element (2, 3 or 4): CA or PD elements not available with 2 leads 4 leads available on all single elements and dual S102618 and S102662 only |
| F | Covering over leadwires: T = PTFE insulated leads only S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over stainless steel braid with elastomer fill and PTFE Insulated leads (max. fill length 240") |
| 48 | Lead length in inches |
| (Stop here for case style C or D; no installation variable) | |
| B0 | Optional Installation/Accessory option: B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| S102617PD3F48B0 = Sample part number | |

Thermocouple

| | |
|---|---|
| TC102621E | Model number from next page |
| U | Junction grounding: G = Grounded U = Ungrounded |
| 48 | Lead length in inches |
| F | Covering over leadwires: T = PTFE insulated leads only S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over stainless steel braid with elastomer fill and PTFE Insulated leads (max. fill length 240") |
| (Stop here for case style C or D; no installation variable) | |
| B0 | Optional Installation/Accessory option: B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| TC102621EU48FB0 = Sample part number | |

| RTD Element | TCR $\Omega/\Omega/^{\circ}\text{C}$ | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm)  | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm)  | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm)  | | Short case style B Case L: .188" (4.8 mm) Case \varnothing : .188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm)  | |
|--|---|--|-------------|--|-------------|---|-------------|--|-------------|
| | | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| Platinum, 100 Ω \pm 0.36% at 0°C | .00392 | S102617PA | S102617PAPA | S102618PA | S102618PAPA | S102619PA | S102619PAPA | S102662PA | S102662PAPA |
| Platinum, 100 Ω \pm 0.12% at 0°C (Meets EN60751, Class B) | .00385 | S102617PD | S102617PDPD | S102618PD | S102618PDPD | S102619PD | S102619PDPD | S102662PD | S102662PDPD |
| Platinum, 100 Ω \pm 0.36% at 0°C | .00385 | S102617PE | S102617PEPE | S102618PE | S102618PEPE | S102619PE | S102619PEPE | S102662PE | S102662PEPE |
| Platinum, 1000 Ω \pm 0.12% at 0°C | .00385 | S102617PF | S102617PFPF | S102618PF | S102618PFPF | S102619PF | S102619PFPF | S102662PF | S102662PFPF |
| Copper, 10 Ω \pm 0.2% at 25°C | .00427 | S102617CA | S102617CACA | S102618CA | | S102619CA | | S102662CA | |
| Nickel, 120 Ω \pm 0.5% at 0°C | .00672 | S102617NA | S102617NANA | S102618NA | S102618NANA | S102619NA | | S102662NA | S102662NANA |

| Thermocouple Junction Type | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm)  | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm)  | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm)  | | Short case style B Case L: .188" (4.8 mm) Case \varnothing : .188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm)  | |
|-------------------------------|--|------------|--|------------|---|------------|--|------------|
| | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| E = Chromel-Constantan | TC102620E | TC102620EE | TC102621E | TC102621EE | TC102622E | TC102622EE | TC102663E | TC102663EE |
| J = Iron-Constantan | TC102620J | TC102620JJ | TC102621J | TC102621JJ | TC102622J | TC102622JJ | TC102663J | TC102663JJ |
| K = Chromel-Alumel | TC102620K | TC102620KK | TC102621K | TC102621KK | TC102622K | TC102622KK | TC102663K | TC102663KK |
| T = Copper-Constantan | TC102620T | TC102620TT | TC102621T | TC102621TT | TC102622T | TC102622TT | TC102663T | TC102663TT |

STOP OIL SEEPAGE!

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar.) See page 3-11 for details.

Leadwire and cable seal models FG1015, FG3015 and FG4015 seal RTD or thermocouple leadwires where they exit oil-filled bearing housings of rotating equipment. Both versions include a grommet that provides the seal and allows adjustment of the wire or cable position. See page 3-12 for details.

Elastomer rubber-filled cable has elastomer fill between the wires, stainless steel braid, and outer jacket. This fill can extend along the entire length of the cable, or a specified portion. The outside of the cable can be sealed with an FG1015, FG3015 and FG4015 fitting. See Leadwire Covering Options on Miniature Sensors on pages 6-2 to 6-10.

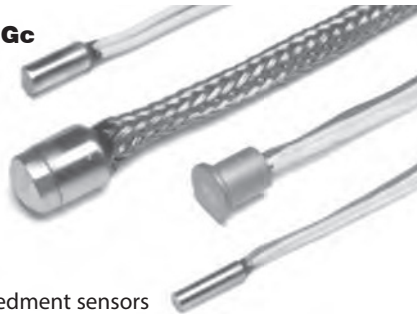
Minco Application Aid #27 provides more information on the problems of oil seepage and various solutions. Download AA#27 at www.minco.com



▼ = STANDARD OPTIONS
Specifications subject to change

Non-sparking Embedment Sensors

ATEX  **II 3 G Ex nA IIC Gc**
IECEx Ex nA IIC Gc



Overview

- Non-sparking embedment sensors for monitoring the temperature of thrust bearings
- Four case styles offer a variety of installation options
- Certified for use in Zone 2, Group IIC hazardous areas, defined by EN/IEC 60079-0 and EN/IEC 60079-15

Specifications

Temperature range: -50 to 200°C (-58 to 392°F), reducing to 125°C (257°F) when elastomer filled cable is ordered.

Case: Tin plated copper alloy.

Babbitt tip: Factory applied babbitt tip, available on case style A, B, and short style B, reduces the danger of overheating the sensor when installed in babbitt layer.

Leads:

RTD: stranded copper with PTFE insulation.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Thermocouple: stranded, PTFE insulated, twisted pairs.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Leadwire size (AWG):

| RTD | | | | | |
|--------------|-----------------|----|----|----|----|
| Case style | Number of leads | | | | |
| | 2 | 3 | 4 | 6 | 8 |
| A | 24 | 24 | 24 | 24 | |
| B | 24 | 24 | 28 | 28 | 28 |
| C | 24 | 26 | 30 | 30 | |
| Short B | 24 | 24 | 28 | 28 | |
| Thermocouple | | | | | |
| All cases | 24 | | 24 | | |

Time constant: 3.0 seconds (case style A), typical in moving water.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

▼ = **STANDARD OPTIONS**
 Specifications subject to change

Specification and order options:

RTD

| | |
|--|---|
| S207596PD | Model number from next page |
| 3 | Number of leads per sensing element (2, 3 or 4): CA or PD elements not available with 2 leads 4 leads available on all single elements and dual S207596 + S207598 only |
| E | Covering over leadwires: T = PTFE insulated leads only S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads (max. fill length 240") |
| 40 | Lead length in inches ▼:40, 120 |
| (Stop here for case style C; no installation variable) | |
| AC1 | Optional Installation/Accessory option B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| S207596PD3E40AC1 = Sample part number | |

Thermocouple

| | |
|--|---|
| TC207600K | Model number from next page |
| U | Junction grounding: G = Grounded U = Ungrounded |
| 40 | Lead length in inches ▼:40, 120 |
| S | Covering over leadwires: T = PTFE insulated leads only S = Stainless steel overbraid with PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over stainless steel braid, with elastomer fill and PTFE insulated leads (max fill length 240") |
| (Stop here for case style C; no installation variable) | |
| B0 | Optional Installation/Accessory option B0 = No babbitt metal or accessories B1 = Babbitt metal applied AC1 = Supplied with AC171 spring and AC172 series ring (case style B only) AC2 = Supplied with AC171 spring and AC1038 ring (case style B only) AC3 = Supplied with AC171 spring and AC915-1 ring (case style B only) |
| TC207600KU40SB0 = Sample part number | |

| RTD Element | TCR $\Omega/\Omega/^{\circ}\text{C}$ | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm) | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm) | | Short case style B Case L: .188" (4.8 mm) Case \varnothing : .188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | |
|---|---|---|-------------|---|-------------|---|-------------|---|-------------|
| | | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| Platinum, 100 Ω \pm 0.36% at 0°C | .00392 | S207595PA | S207595PAPA | S207596PA | S207596PAPA | S207597PA | S207597PAPA | S207598PA | S207598PAPA |
| Platinum, 100 Ω \pm 0.12% at 0°C (Meets EN60751, Class B) | .00385 | S207595PD | S207595PDPD | S207596PD | S207596PDPD | S207597PD | S207597PDPD | S207598PD | S207598PDPD |
| Platinum, 100 Ω \pm 0.067% at 0°C (Meets EN60751, Class A) | .00385 | S207595PM | S207595PMPM | S207596PM | S207596PMPM | S207597PM | S207597PMPM | S207598PM | S207598PMPM |
| Platinum, 100 Ω \pm 0.36% at 0°C | .00385 | S207595PE | S207595PEPE | S207596PE | S207596PEPE | S207597PE | S207597PEPE | S207598PE | S207598PEPE |
| Platinum, 1000 Ω \pm 0.12% at 0°C | .00385 | S207595PF | S207595PFPF | S207596PF | S207596PFPF | S207597PF | S207597PFPF | S207598PF | S207598PFPF |
| Copper, 10 Ω \pm 0.2% at 25°C | .00427 | S207595CA | S207595CACA | S207596CA | | S207597CA | | S207598CA | |
| Nickel, 120 Ω \pm 0.5% at 0°C | .00672 | S207595NA | S207595NANA | S207596NA | S207596NANA | S207597NA | | S207598NA | S207598NANA |

| Thermocouple Junction Type | Case style A Case L: 0.250" (6.4 mm) Case \varnothing : 0.275" (7.0 mm) | | Case style B Case L: 0.250" (6.4 mm) Case \varnothing : 0.188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | | Case style C Case L: 0.300" (7.6 mm) Case \varnothing : 0.125" (3.2 mm) | | Short case style B Case L: .188" (4.8 mm) Case \varnothing : .188" (4.8 mm) Flange \varnothing : 0.250" (6.4 mm) | |
|-------------------------------|---|------------|---|------------|---|------------|---|------------|
| | Single | Dual | Single | Dual | Single | Dual | Single | Dual |
| E = Chromel-Constantan | TC207600E | TC207600EE | TC207601E | TC207601EE | TC207602E | TC207602EE | TC207603E | TC207603EE |
| J = Iron-Constantan | TC207600J | TC207600JJ | TC207601J | TC207601JJ | TC207602J | TC207602JJ | TC207603J | TC207603JJ |
| K = Chromel-Alumel | TC207600K | TC207600KK | TC207601K | TC207601KK | TC207602K | TC207602KK | TC207603K | TC207603KK |
| T = Copper-Constantan | TC207600T | TC207600TT | TC207601T | TC207601TT | TC207602T | TC207602TT | TC207603T | TC207603TT |

STOP OIL SEEPAGE!

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar.) See page 3-11 for details.

Leadwire and cable seal models FG1015, FG3015 and FG4015 seal RTD or thermocouple leadwires where they exit oil-filled bearing housings of rotating equipment. Both versions include a grommet that provides the seal and allows adjustment of the wire or cable position. See page 3-12 for details.






Elastomer rubber-filled cable has elastomer fill between the wires, stainless steel braid, and outer jacket. This fill can extend along the entire length of the cable, or a specified portion. The outside of the cable can be sealed with an FG1015, FG3015 and FG4015 fitting. See Leadwire Covering Options on Miniature Sensors on pages 6-2 to 6-10.

Minco Application Aid #27 provides more information on the problems of oil seepage and various solutions. Download AA#27 at www.minco.com



▼ = STANDARD OPTIONS
Specifications subject to change

Bolt-on Temperature Sensors

| | Dimensions W x L x T (max.) | Temp. range | Element options | Case material | Leadwire | Model |
|---|--|--------------------------------|--------------------|----------------------|--|-----------|
|  | 0.50 x 1.00 x 0.188" (12.7 x 25.4 x 4.8 mm) w/ 0.161" (4.1 mm) diameter hole | -70 to 500°C (-94 to 932°F) | PD, PF | Stainless steel | AWG 22, Mica-glass insulated | ▼ S101730 |
|  | 0.29 x 1.25 x 0.188" (7.4 x 31.8 x 4.8 mm) with 0.161" (4.1 mm) hole | -70 to 500°C (-94 to 932°F) | PD, PF | Stainless steel | AWG 22, Mica-glass insulated | ▼ S101731 |
|  | 0.265" (6.7 mm) ID ring lug | -50 to 260°C (-58 to 500°F) | PD, PF | Nickel plated copper | 2 lead: AWG 24, 3 lead: AWG 26, PTFE insulated | ▼ S101732 |
|  | 0.50 x 0.375 x 0.188" (12.7 x 9.5 x 4.8 mm) with 0.166" (4.2 mm) hole | -50 to 260°C (-58 to 500°F) | PD, PF | Stainless steel | 2 lead: AWG 24, 3 lead: AWG 26, PTFE insulated with SS braid cover | ▼ S101733 |
|  | 1/4" - 20 x 3/8" long thread with 7/16" hex head | -50 to 260°C (-58 to 500°F) | PD, PF | Stainless steel | 2 lead: AWG 24, 3 lead: AWG 26, PTFE insulated with SS braid cover | ▼ S101734 |
| | M6 x 1 thread, 10 mm long, with 10 mm hex | | | | | ▼ S101797 |

Overview

Bolt-on temperature sensors are designed for easy installation in industrial and commercial environments. The sensors can be mounted on machines, against process pipes, or embedded directly into a machined part. Threaded fasteners install in seconds and can be easily removed for installation at another location.

These sensors are ideal for process control measurements, test and verification of existing systems, and retrofitting existing machines. Standard designs allow prototyping without high setup costs, while significant discounts are available for large quantities.

Standard platinum and nickel RTD elements provide stable and reliable output compatible with most control and monitoring systems. Physically interchangeable designs allow you to easily customize your installation to different instrumentation. Minco can also provide custom RTD, thermistor or thermocouple elements in these packages, or specialized case designs to meet your application needs.

- Removable and reusable
- Wide temperature range
- Configurations to fit most applications
- Standard 100 Ω platinum, 1000 Ω platinum and 100 Ω nickel elements

Specification and order options:

| | |
|------------------------------------|---|
| S101732 | Model number from table |
| PD | Element code from table |
| 3 | Number of leads: ▼: 2 or 3 2 leads not recommended for PD models |
| S | Leadwire covering: ▼ G = Mica-glass (S101730 and S101731) ▼ T = PTFE (S100722, S101732, S101733, S101734, and S101797) ▼ S = Stainless steel braid over PTFE insulated leads (S100722, S101732, S101733, S101734, and S101797) |
| 40 | Leadwire length (inches): 40" (1000 mm) standard ▼: 40, 120 |
| S101732PD3S40 = Sample part number | |

Specifications

Time constant: Less than 10 seconds in moving water.

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202. Method 204, test condition D.

| Element specifications* | | Code |
|--|----------------------|------|
| Platinum (0.00385 TCR) (EN60751, Class B) | 100 Ω ±0.12% at 0°C | ▼ PD |
| Platinum (0.00385 TCR) | 1000 Ω ±0.12% at 0°C | ▼ PF |
| Nickel 0.00618 TCR) | 100 Ω ±0.22% at 0°C | NB |









*See descriptions for element options on each model.



STOCKED PARTS AVAILABLE

▼ = STANDARD OPTIONS
Specifications subject to change

Economy Sensors

| | Dimensions | Temperature range | Element options | Case material | Leadwire | Model |
|--|--|------------------------------|-----------------|-----------------|--------------------------------------|-----------|
|  | 2 leads: .050" x .065" x .035" thick (1.3 x 1.7 x .9 mm) Thin-Film with insulated leads 3 leads: .063" x .098" x .035" thick (1.6 x 2.5 x .9 mm) Thin-Film with insulated leads | -50 to 150°C (-58 to 302°F) | PD, PF | Ceramic | AWG 32 solid enamel insulated | ▼ S102404 |
|  | Ø .125" x .90" (Ø 3.2 x 22.9 mm) | -50 to 260°C (-58 to 500°F) | PD, PF | Stainless steel | AWG 26, PTFE insulated | ▼ S102409 |
|  | Ø .125" x .90" (Ø 3.2 x 22.9 mm) | -50 to 155°C (-58 to 311°F) | PD, PF | Stainless steel | AWG 30, PTFE insulated | ▼ S102737 |
|  | Ø .140" x .40" (Ø 3.6 x 10.2 mm) | -70 to 500°C (-94 to 932°F) | PD, PF | Ceramic | AWG 27, solid glass insulated nickel | ▼ S102410 |
|  | Ø .188" x .90" (Ø 4.8 x 22.9 mm) | -50 to 150°C (-58 to 302°F) | PD, PF | Silicone rubber | AWG 24, silicone rubber insulated | ▼ S102406 |
|  | Ø .188" x 1.25" (Ø 4.8 x 31.8 mm) | -50 to 230°C (-58 to 446°F) | PD, PF | PTFE | AWG 24, PTFE with PTFE jacket | ▼ S102405 |
|  | Ø .188" x 1.25" (Ø 4.8 x 31.8 mm) | -50 to 260°C (-58 to 500°F) | PD, PF | Aluminum | AWG 22, PTFE insulated | ▼ S102407 |
|  | Ø .188" x 2.38" (Ø 4.8 x 60.5 mm) | -70 to 550°C (-94 to 1022°F) | PD, PF | Stainless steel | AWG 22, glass braid insulated | ▼ S102408 |

MINIATURE SENSORS

Overview

Economy sensors are designed to be a component of your final assembly. With insulated leads preattached and strain relieved, final construction is easy and reliable.

- Insulated leads of variable length, installed and strain relieved
- Wide temperature range
- Configurations to fit most applications
- Standard 100 Ω platinum, 1000 Ω platinum and 120 Ω nickel elements

Specifications

Insulation resistance: 10 megohms minimum at 100 VDC, leads to case.

Vibration: Withstands 10 to 2000 Hz at 20 G's minimum per MIL-STD-202. Method 204, test condition D.

| Element specifications* | Code |
|---|------|
| Platinum (0.00385 TCR) 100 Ω ±0.12% at 0°C (EN60751, Class B) | ▼ PD |
| Platinum (0.00385 TCR) 1000 Ω ±0.12% at 0°C | ▼ PF |

* See descriptions for element options on each model.

Specification and order options

| | |
|------------------------------------|--|
| S102408 | Model number from table |
| PD | Element code from table |
| 3 | Number of leads: ▼ 2 leads (not recommended for PD models) or ▼ 3 leads (only option for S102410PD) |
| G | Leadwire covering: ▼ E = Enamel (S102404) ▼ G = Glass (S102408 and S102410) ▼ R = Silicone rubber (S102406) ▼ T = PTFE (S102405, S102407, S102409, S102737) |
| 40 | Leadwire length in inches: 40" (1000 mm) standard ▼ : 40, 120 |
| S102408PD3G40 = Sample part number | |



STOCKED PARTS AVAILABLE

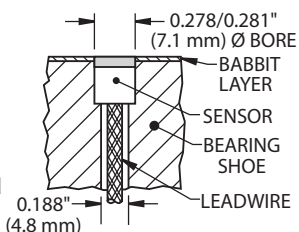
▼ = STANDARD OPTIONS
Specifications subject to change



Installation and Accessories

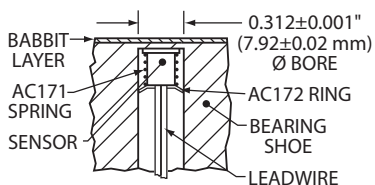
Case style A

Install case style A sensor just below the babbitt layer, then puddle the babbitt metal over the sensor tip and smooth. Read [Engineering Instruction #164](#) and [Engineering Instruction #167](#) for complete details.



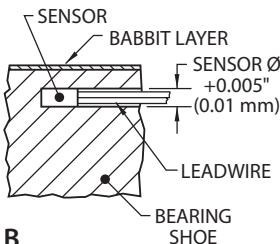
Case style B

The “top hat” flange shape allows spring loading with the AC171 spring and AC172 or AC915 retaining ring (order separately). Choose the economical AC172 style for lowest cost. The AC915 style allows removal and reinstallation. Slide the spring and ring over the leads, insert the sensor tip into a milled hole, and push down on the retaining ring to compress the spring and secure the sensor. Read [Engineering Instruction #180](#) and [Engineering Instruction #181](#).



Case styles C and D

Pot with epoxy inside small bearing shoes. Locate near the babbitt face for best readings. Read [Engineering Instruction #184](#).



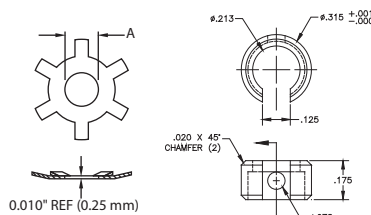
AC171 spring for case style B

Stainless steel. Outside diameter 0.240" (6.1 mm). Compressed length 0.22" (5.6 mm). To be used in conjunction with AC172 or AC915 for spring loading case style B

Feedthroughs

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar). See page 3-12 for more information.

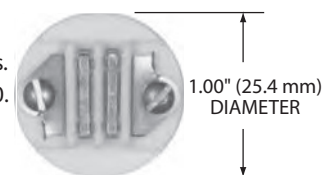
AC172 and AC915 retaining ring for case style B



| Model | "A" diameter | Hole I.D. |
|---------|------------------------|------------------|
| AC172 | sized to fit leadwires | 0.312" (7.92 mm) |
| AC172-3 | 0.175" (4.45 mm) | 0.375" (9.53 mm) |
| AC915-1 | 0.213" (5.4 mm) | 0.312" (7.92 mm) |

AC190 terminal block

Two tin-plated brass terminals. PTFE body. Meets MIL-T-17600. For instructions, read [Installation Instruction #107](#).



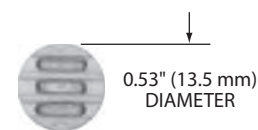
AC191 terminal block

Two tin-plated brass terminals. PTFE body. Meets MIL-T-17600. Read [Installation Instruction #121](#) for instructions.



AC192 terminal block

Three tin-plated brass terminals. Glass-filled PTFE body.



AC195 terminal block

Same as AC192 except polyamide-imide body for radiation resistance to 10⁹ rads.

AC197 terminal block

Three tin-plated brass terminals. Glass-filled PTFE body.



AC196 terminal block

Same as AC197 except polyamide-imide body for radiation resistance to 10⁹ rads.

▼ = STANDARD OPTIONS
Specifications subject to change



▶ SECTION 7: STATOR WINDING SENSORS

- Install between stator windings for continuous protection of motors and generators
- Increased safety sensors for use in hazardous areas
- Single and dual elements offer high reliability
- Sensor dimensions to fit any machine
- Class F or Class H

| | |
|-------------------------------------|------------|
| Increased safety RTDs | 7-2 to 7-3 |
| Single element RTDs | 7-4 to 7-5 |
| Dual element RTDs..... | 7-6 |
| Corona resistant RTD..... | 7-7 |
| Machinery protection products | 7-8 |

Increased Safety Stator Winding Temp. Sensors

ATEX  II 2 G Ex e IIC Gb

ATEX  II 1 G Ex ia IIC Ga

IECEX Ex e IIC Gb

IECEX Ex ia IIC Ga

CSA Ex e IIC Gb



Overview

Insert these thin, laminated RTDs in winding slots to detect high temperatures before insulation damage occurs. RTD temperature sensors continuously monitor conditions and provide the long term trend data that is necessary for making adjustments before unexpected alarms occur. These models are designed for use in hazardous areas, where there may be a presence of flammable gas under normal operating conditions. Strict construction guidelines prevent arcing. These RTDs are certified as “increased safety” and “intrinsic safety” devices.

- Pt100, Ni100, or U.S. curves
- EC-Type Examination Certificate KEMA 03ATEX2240 U
- Complies with European standards for electrical apparatus for potentially explosive atmospheres: ATEX Directive 94/9/EC and International IEC certification schemes for explosive atmospheres.

Specifications

Temperature limit: -50 to 180°C (-58 to 356°F), class H

Body material: High temperature epoxy glass.

Leadwires: 2, 3, or 4 leads, stranded copper, AWG #22 (0.35 mm², with TFE or polyimide insulation).

Dielectric strength: 3,200 VRMS at 60 Hz, 1 mA maximum leakage current, tested momentarily (1–5 seconds), between the leads and external flat body surface.

Specification and order options

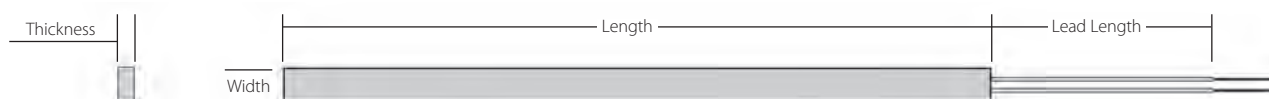
| S100050 PD | Model number from table on next page |
|--|---|
| 60 | RTD length in .1" increments: Example: 79 = 7.9" (200 mm) Minimum length = 20 (2.0" [51 mm]) Maximum length = 232 (23.2" [590 mm]) ▼: 60, 110, 200 |
| T | Lead insulation: ▼ T = TFE |
| 236 | RTD width in .001" increments: Example: 394 = .394" (10 mm) Minimum width = .219" (5.6 mm) for 2 or 3 leads; = .285" (7.25 mm) for 4 leads Maximum width = .956" (25.4 mm) ▼: 236, 315 |
| Z | Number of leads: Y = 2 leads ▼ Z = 3 leads ▼ X = 4 leads |
| 118 | Lead length in inches ▼: 118, 237 |
| F | Lead configuration: ▼ T = Twisted leads ▼ F = Flat leads |
| N | Lead covering: ▼ N = No jacket ▼ S = FEP jacket overall (available only with twisted lead configuration option "T") |
| S100050PD60T236Z118FN = Sample part number | |

▼ = **STANDARD OPTIONS**
 Specifications subject to change

Wire-wound or thin-film RTD element

Wire-wound RTDs, embedded in stator slots, are the most common method for measuring winding temperature in large motors. The wire-wound element extends through most of the body length and measures the average temperature of the winding.

Thin-film RTDs are identical, except for the size of the sensing element. Because the thin-film element is small, approximately 0.08" x 0.09" (2.0 mm x 2.3 mm), it senses the temperature in only one small spot of the winding. Thin-film elements are best suited for shorter length stator sensors.



Wire-wound RTD elements

| Thickness | Platinum (0.00385 TCR) 100Ω ±0.12 at 0°C Meets IEC 751, Class B | Platinum (0.00385 TCR) 100Ω ±0.5 at 0°C | Nickel (0.00618 TCR) 100Ω ±0.2 at 0 C Meets DIN 43760 | Platinum (0.00392 TCR) 100Ω ±0.5 at 0°C |
|-----------------|---|--|---|--|
| 0.079" [2.0 mm] | ▼ S100050PD | S100050PE | S100050NB | ▼ S100050PA |
| 0.098" [2.5 mm] | S100051PD | S100051PE | S100051NB | S100051PA |
| 0.118" [3.0 mm] | S100052PD | S100052PE | S100052NB | S100052PA |
| 0.138" [3.5 mm] | S100053PD | S100053PE | S100053NB | S100053PA |
| 0.157" [4.0 mm] | S100054PD | S100054PE | S100054NB | S100054PA |

Thin-film RTD elements

| Thickness | Platinum (0.00385 TCR) 100Ω ±0.12 at 0°C Meets IEC 751, Class B | Platinum (0.00385 TCR) 100Ω ±0.5 at 0°C | Nickel (0.00618 TCR) 100Ω ±0.2 at 0 C Meets DIN 43760 | Platinum (0.00392 TCR) 100Ω ±0.5 at 0°C |
|-----------------|---|--|---|--|
| 0.079" [2.0 mm] | S200050PD | S200050PE | S200050NB | S200050PA |
| 0.098" [2.5 mm] | S200051PD | S200051PE | S200051NB | S200051PA |
| 0.118" [3.0 mm] | S200052PD | S200052PE | S200052NB | S200052PA |
| 0.138" [3.5 mm] | S200053PD | S200053PE | S200053NB | S200053PA |
| 0.157" [4.0 mm] | S200054PD | S200054PE | S200054NB | S200054PA |

▼ = **STANDARD OPTIONS**
Specifications subject to change

Single Element Stator Winding RTDs



Overview

Flat, laminated “stick” RTDs fit in slots between stator windings to monitor temperature rise and prevent overheating. The National Electrical Manufacturers Association (NEMA) recognizes embedded detectors as a standard protection for motor and generator insulation. Unlike on-off devices, RTDs provide continuous sensing for earlier warning without unnecessary tripouts.

The sensing elements of stator RTDs extend through most of the body length to provide an average temperature reading. This eliminates the danger of a point-type sensor missing a localized hot spot. Six sensors are recommended for each motor, two per phase. Locate sensors near the hottest point of the windings for best performance.

Minco stator RTDs meet the specifications of ANSI C50.10-1990, general requirements for synchronous motors.

Custom designs

Minco designs and builds custom models for many applications. We offer unmatched capabilities because we control all steps of the production from element to finished product. Examples of special options include:

- Thermocouple elements
- Thermistor elements (PTC or NTC)
- Dual sensors with different elements (for example, one copper and one platinum element)
- Ex rated sensors for equipment in hazardous areas. See page 7-2 for more information.
- Electrically conductive coating
- Special leadwire or cable

Specifications

Temperature limit:

Class F: 155°C (311°F)
Class H: 180°C (356°F).

Body material:

Class F: Epoxy glass
Class H: High temperature epoxy glass.

Standard sizes (others available):

| | | | | |
|---------------------------------------|--|---|---|---|
| Thickness inches (mm) | 0.030 (.76) | 0.050 (1.3) | 0.078 (2.0) | 0.125 (3.2) |
| Length inches (mm) | 6.0 (152) | 10.0 (254) | 11.0 (279) | 12.0 (305) |
| Standard body width inches (mm) | 0.219 (5.6) 0.344 (8.7) 0.563 (14) 1.000 (25) | 0.260 (6.6) 0.406 (10) 0.656 (17) | 0.305 (7.7) 0.455 (12) 0.750 (19) | 0.315 (8.0) 0.500 (13) 0.875 (22) |

Note: Order any width from 0.219" (5.6mm) to 2.500" (64mm)

Leadwires: 2, 3, or 4, stranded copper with PTFE or polyimide insulation. Other leadwire coverings available.

- 0.125" thick: AWG 18.
- 0.078" thick: AWG 22.
- 0.050" thick: AWG 26.
- 0.030" thick: AWG 30 (no lead bulge);
AWG 18 (0.110" lead bulge);
Cable (0.110" lead bulge).

Dielectric strength: 3200 VRMS at 60 Hz, tested between the leads and external flat body surface for 1 to 5 seconds.

▼ = STANDARD OPTIONS
Specifications subject to change

Class H (180°C) RTDs

| Element | Model thickness: | | | |
|---|--|-------------------|-------------------|-------------------|
| | 0.030" (.76mm) | 0.050" (1.3mm) | 0.078" (2.0mm) | 0.125" (3.2mm) |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | ▼ S1420PA ¹ | ▼ S7401PA | ▼ S13PA | S8016PA |
| Platinum (0.00385 TCR) 100 Ω ±0.12% at 0°C (Meets EN60751, Class B) | ▼ S8010PD ¹ ▼ S100305PD ² S100415PD ³ | ▼ S8014PD | ▼ S11016PD | S8016PD |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | S8010PE ¹ | S8014PE | S8012PE | S8016PE |
| Copper (0.00427 TCR) 10 Ω ±0.2% at 25°C | ▼ S1220CA ¹ | ▼ S7401CA | ▼ S18CA | S8016CA |
| Nickel (0.00672 TCR) 120 Ω ±0.5% at 0°C | ▼ S1240NA ¹ | ▼ S7401NA | ▼ S15NA | S8016NA |

Notes:

¹ Leadwires: AWG 30; lead bulge: 0.045" thick, extending into the body a maximum of 0.62".

² Leadwires: AWG 18; lead bulge: 0.110" thick, extending into the body a maximum of 1.75".

³ Leadwires: AWG 30 with PTFE jacket overall; lead bulge: 0.110" thick, extending into the body a maximum of 1.75".

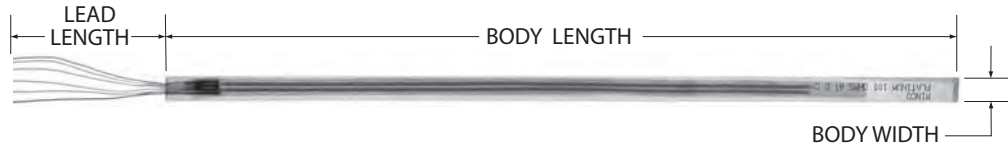
Specification and order options

| | |
|--------------------------------------|---|
| S13PA | Model number from table |
| 110 | Body length: Specify in 0.1" increments (Example: 110 = 11.0 inches) ▼ : 20, 60, 110 |
| T | Leadwire insulation: ▼ T = PTFE |
| 344 | Body width: Specify in 0.001" increments (Example: 344 = 0.344 inches) Minimum body widths: S8015, 2 or 3-lead: 320 S8015, 4-lead: 420 S8016, 2 or 3-lead: 320 S8016, 4-lead: 420 S100305: 310 S100415: 310 All other 2 or 3-lead models: 219 All other 4-lead models: 320 ▼ : 219, 260, 305, 344 |
| Z | Number of leads: Y = 2 leads (PA, PE, NA only) ▼ Z = 3 leads X = 4 leads |
| 36 | Lead length in inches ▼ : 36, 120, 240 |
| S13PA110T344Z36 = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change



Dual Element Stator Winding RTDs



Overview

Dual element stator winding RTDs provide extra protection for motors and generators. The second element can be a back up in case of damage, or use one element for input to a temperature display at the machine and the other for control room monitoring.

Standard models are available with thickness options of 0.030" to 0.125", with sensing elements to match most instrumentation.

Custom designs

Minco designs and builds custom models for many applications. We offer unmatched capabilities because we control all steps of the production from element to finished product. Examples of special options include:

- Thermocouple elements
- Thermistor elements (PTC or NTC)
- Dual sensors with different elements (for example, one copper and one platinum element)
- Ex rated sensors for equipment in hazardous areas. See page 7-2 for more information.
- Electrically conductive coating
- Special leadwire or cable

Specifications

Temperature limit: 180°C (356°F), class H.

Body material: High temperature epoxy glass.

Standard sizes:

| Thickness inches (mm) | 0.030 (.76mm) | 0.050 (1.3mm) | 0.078 (2.0mm) | 0.125 (3.2mm) |
|------------------------|----------------------------------|---------------|----------------------------------|---------------|
| Length inches (mm) | 2.0 to 35.0" (51 to 899 mm) | | 2.0 to 48.0" (51 to 1219.2 mm) | |
| Body width inches (mm) | 0.425 to 1.065 (10.8 to 27.0 mm) | | 0.425 to 2.500 (10.8 to 63.5 mm) | |

Leadwires: 2 or 3 (per element) stranded copper with PTFE or polyimide insulation. Other leadwire coverings available.

- 0.125" thick: AWG 18.
- 0.078" thick: AWG 22.
- 0.050" thick: AWG 26.
- 0.030" thick: AWG 30.

Dielectric strength: 3200 VRMS at 60 Hz, tested between the leads and external flat body surface for 1 to 5 seconds.

Class H (180°C) RTDs

| Element | Model for thickness: | | | |
|--|----------------------|------------|------------|-----------|
| | 0.030" * | 0.050" | 0.078" | 0.125" |
| Platinum (0.00392 TCR) 100 Ω ±0.5% at 0°C | ▼S9030PAPA | ▼S9050PAPA | ▼S9078PAPA | S9125PAPA |
| Platinum (0.00385 TCR) 100 Ω ±0.12% at 0°C (Meets EN60751, Class B) | ▼S9030PDPD | ▼S9050PDPD | ▼S9078PDPD | S9125PDPD |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | S9030PEPE | S9050PEPE | S9078PEPE | S9125PEPE |
| Copper (0.00427 TCR) 10 Ω ±0.2% at 25°C | S9030CACA | S9050CACA | S9078CACA | S9125CACA |
| Nickel (0.00672 TCR) 120 Ω ±0.5% at 0°C | S9030NANA | S9050NANA | S9078NANA | S9125NANA |

*Model has a lead bulge 0.045" (0.11mm) thick, extending into the body a maximum of 0.62" (1.6mm).

Specification and order options

| | |
|--|--|
| S9078PAPA | Model number from table |
| 110 | Body length: Specify in 0.1" increments (Ex: 110 = 11.0") ▼: 60, 110 |
| T | Leadwire insulation: ▼T = PTFE |
| 425 | Body width: ▼425 Specify in 0.001" increments (Ex: 425= 0.425") |
| Z | Number of leads per element: Y = 2 leads (PA, PE, NA only) ▼Z = 3 leads |
| 36 | Lead length in inches ▼: 36, 240 |
| S9078PAPA110T425Z36 = Sample part number | |

▼ = STANDARD OPTIONS
Specifications subject to change

Machinery Protection Products

CT224 12-channel temperature alarm/monitor

The CT224 consists of a 12-Channel Temperature Monitor and MincoSoft™ CT224 Software. It is the next generation in temperature monitoring equipment from Minco designed to meet the needs of electric machinery protection. The 12-channel scanning capability, standard RS485/RS232 interface and Windows-compatible software utility for system configuration and data logging provide overtemperature and undertemperature protection and critical feedback to safeguard expensive machinery.

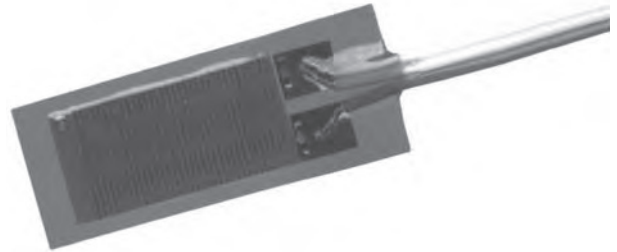
- UL and cUL recognized to help meet regulatory compliance
- Mix and match sensor input types for freedom to adapt to pre-installed bearing and apparatus sensors
- Ability to monitor 12 inputs allows you to monitor stator sensors from two motors

See page 4-25 for details.



End turn RTD

Model S3238 Thermal-Ribbon is designed to sense stator temperatures in motors and generators. With an alternative installation method to the “stick-type” sensors in this section, S3238 is used on the end turns of stator windings and provides an easy way to add overtemperature protection when the stator is not being rewound.



See page 9-5 for details.

CT15 temperature alarm

- Alarm shuts down motor on over-temperature to prevent catastrophic failure
- Monitors single 100 Ω platinum RTD (PD or PE)
- 1 or 2 relays with independent trip points for warning and shutdown
- Microprocessor-based
- Front panel programmable with four security levels
- 100 to 240 VAC supply power
- Compact DIN case with water resistant front panel



See pages 4-33 for details.

Anti-condensation space heaters

- Flexible silicone rubber insulation
- Mount on windings or housings to prevent moisture buildup
- 2.5 to 10 watts per square inch at 120 or 240 volts
- Variety of sizes to 60" (1.5 m)
- UL component recognition
- Available from stock



Go to www.minco.com for more information.

Specifications subject to change



► SECTION 8: HVAC SENSORS

- Complete range of sensors/transmitter assemblies made for easy installation, high reliability, and compatibility with almost any Building Automation System
- Accurate and stable sensing ensures maximum energy efficiency
- Optional matched system calibration of transmitters and sensors offer increased accuracy
- RTDs, thermistors and humidity sensing for a variety of applications in critical environments

| | |
|--|--------------|
| Chill-Out™ combination sensor..... | 8-2 to 8-3 |
| Averaging temperature sensors..... | 8-4 |
| Duct and outside air temperature sensors..... | 8-5 |
| Room air temperature sensors..... | 8-6 |
| Flexible Thermal-Ribbon™ pipe sensors..... | 8-7 |
| Humidity sensor/transmitter assembly..... | 8-8 to 8-9 |
| Hazardous area humidity assembly | 8-10 to 8-11 |
| Intrinsically safe humidity assembly..... | 8-12 to 8-13 |
| Thermal Vial™ temperature sensing system..... | 8-14 to 8-15 |
| Refrigeration and freezer temperature system | 8-16 |
| Fluid immersion temperature sensors | 8-17 |
| Elements and probes | 8-18 |
| Temptran 4 to 20 mA transmitters | 8-19 |

Chill-Out™ Combination Sensor

Overview

- Two sensors in one easily installed package: a solid state low temperature cut-out ("Freeze Stat") and an averaging resistance temperature sensor.
- Digital alarm signal to RTU, PLC or an electronic control; 24VAC-powered.
- Solid state design and rugged 3/8" diameter tubing eliminate concerns of gas leaks or kinking the capillary during installation.
- Mount in any direction — horizontal installation is not required.
- Easily formed aluminum or ultra flexible plenum-rated PVC coated galvanized steel armor sensor case.
- Relay and control circuitry self contained in rugged housing. Mounts on either side of enclosure with a locknut (included).
- Failure detection feature — relay changes state if power is lost
- 4 to 20 mA temperature loop output available with optional Temptran™ (ordered separately — see Section 4 for more information)

Specifications

Switching temperature: 38°F factory pre-set, user adjustable from 30°F to 44°F.

Accuracy: ±0.9°F (±0.5°C) typical.

Power requirement: 24V AC or DC.

Relay contact: User specified

Standard relay, SPDT (2" x 4" utility box)
 0.3 A at 125 VAC, Max. Voltage 125 VAC, or
 1A at 30 VDC, Max. Voltage 110 VDC

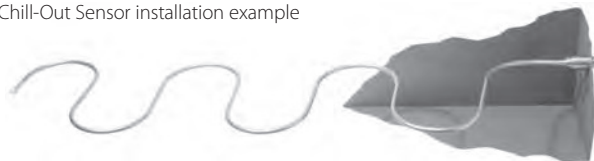
Optional power relay, DPST (4" x 4" utility box)

25 A at 277 VAC
 25 A at 120 VAC
 1 HP at 120 VAC
 2 HP at 277 VAC

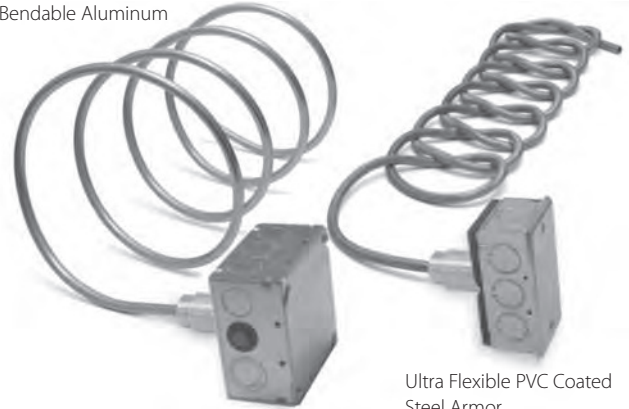
Sensor case length: 10 feet standard, lengths up to 50 feet available by special order.

Connection: AWG 18 leadwires.

Chill-Out Sensor installation example



Bendable Aluminum



Ultra Flexible PVC Coated Steel Armor

Specification and order options

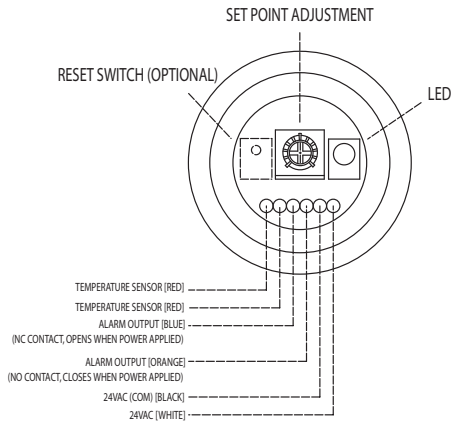
| | |
|---|--|
| ▼AS103759 | Model number |
| PF | Element Type: PF = 1000 Ω RTD (0.00385 Platinum) |
| 38 | Switching Temperature: ▼38°F Specify 30 to 44°F |
| E | Relay reset option: N = Non-latching (auto reset) ▼L = Latching (manual reset) ▼E = Latching (panel mounted reset) Note: option 'E' requires enclosure 'L' |
| 10 | Case length: 10 feet ▼: 10, 24, 50 |
| A | Case type: ▼A = Aluminum ▼B = PVC |
| 1 | Relay Rating: ▼1 = 0.3A ▼2 = 25A, VAC powered controller/coil 3 = 25A, VDC powered controller/coil Note: option 2 or 3 requires enclosure 'L' |
| L | Enclosure: N = No enclosure S = Standard utility box (2" x 4") ▼L = Large utility box (4" x 4") W = Weatherproof utility box (2" x 4") |
| AS103759PF38E10A1L = Sample part number | |

Order Replacement Relays

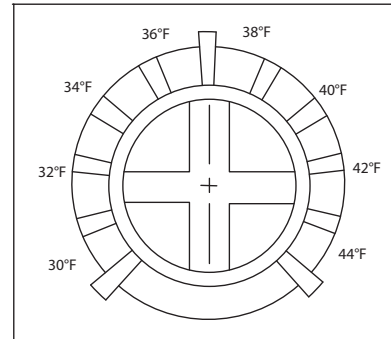
| Model number | External Relay |
|--------------|-------------------|
| AC103779 | 25A 24VAC Coil |
| AC103780 | 25A 24VDC Coil |

▼ = **STANDARD OPTIONS**
 Specifications subject to change

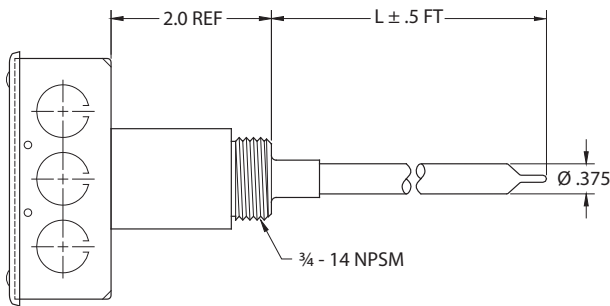
Chill-Out Sensor Interface



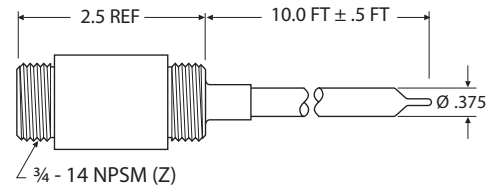
Setpoint Adjustment



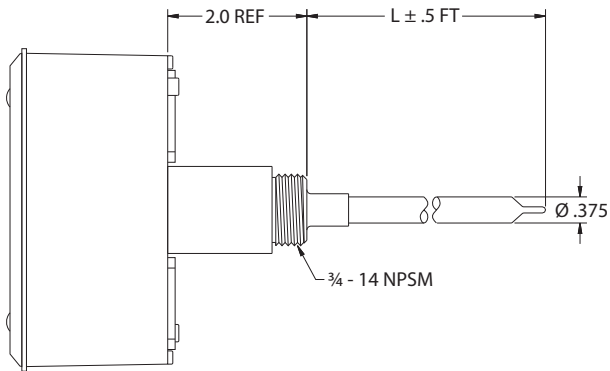
Standard and Large Utility Boxes



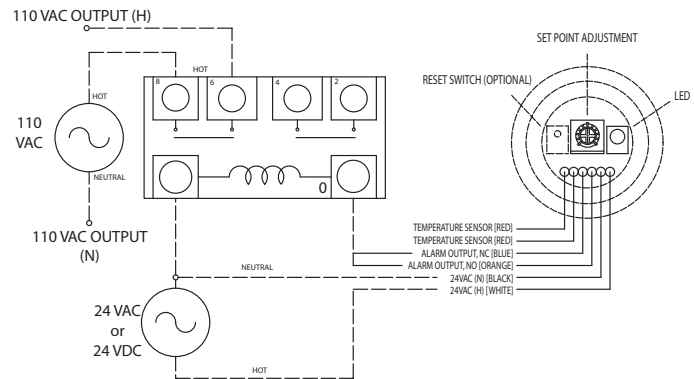
No Enclosure



Weatherproof Utility Box



Typical Installation with Relay



▼ = STANDARD OPTIONS
Specifications subject to change

Averaging Temperature Sensors

Overview

Sense temperature of air streams in ducts and plenums. Sensors include a junction box with gasket to prevent leakage and vibration noise.

These sensors have a continuous element to sense true average temperature along their entire length. They provide accurate composite readings in locations where air may be stratified into hot and cold layers.

Rigid averaging sensors have a brass case. Bendable models have aluminum sheaths (copper on special order), formable to a radius of 4". Bendable sensors can criss-cross ducts to average temperatures in two dimensions.

See page 4-2 for optional 4 to 20 mA temperature transmitters.

Specifications

Temperature range:

Probe: -45.5 to 135°C (-50 to 275°F).

Gasket: 100°C (212°F) max.

Leadwires: AWG 22, PTFE insulated, 8" (200 mm) long.

Moisture resistance: Meet MIL-STD-202, Method 104, Test Condition B.

Special options:

- Lengths to 100 feet(30 m)
- Weatherproof connection box
- Sensor only, no box
- Thermistor averaging sensors

Model numbers

| RTDs (Tolerance: ±0.25% at 70°F) | TCR Ω/Ω/°C | Rigid averaging sensors | Bendable averaging sensors |
|-------------------------------------|---------------|-------------------------------|----------------------------------|
| *Platinum 100 Ω at 0°C | 0.00391 | S423PB | S447PB |
| *Platinum 100 Ω at 0°C | 0.00385 | ▼ S456PE | ▼ S457PE |
| *Platinum 1000 Ω at 0°C | 0.00385 | ▼ S493PF | ▼ S475PF |
| *Platinum 1000 Ω at 0°C | 0.00375 | S492PW | ▼ S488PW |
| Nickel-iron 1000 Ω at 70°F | 0.00527 | S421FB | S445FB |
| Nickel-iron 2000 Ω at 70°F | 0.00527 | S422FC | S446FC |
| *HW 3000 Ω at -30.2°C | 0.00262 | S20080PX | ▼ S15215PX |

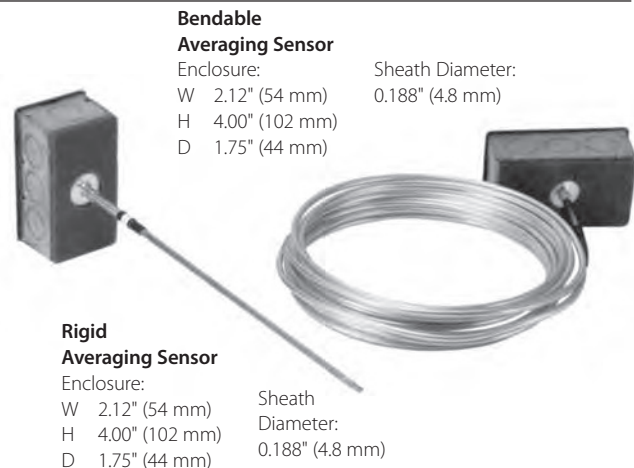
*These averaging sensors use a proprietary sensing element that closely matches the platinum curve over the specified range.



STOCKED PARTS AVAILABLE

▼ = **STANDARD OPTIONS**

Specifications subject to change



Bendable Averaging Sensor

Enclosure:
W 2.12" (54 mm)
H 4.00" (102 mm)
D 1.75" (44 mm)

Sheath Diameter:
0.188" (4.8 mm)

Rigid Averaging Sensor

Enclosure:
W 2.12" (54 mm)
H 4.00" (102 mm)
D 1.75" (44 mm)

Sheath Diameter:
0.188" (4.8 mm)

Specification and order options:

Rigid averaging sensors

| S456PE | Model number from table |
|--------------------------------|--|
| Y | Number of leads: ▼ Y = 2 leads Z = 3 leads |
| 12 | Insertion depth in inches: 1 inch = 25.4 mm ▼ : 12, 24, 48 |
| S456PEY12 = Sample part number | |

Bendable averaging sensors

| S457PE | Model number from table |
|--------------------------------|--|
| Z | Number of leads: ▼ Y = 2 leads ▼ Z = 3 leads |
| 24 | Insertion length in feet: 1 foot = 0.3 m ▼ : 12, 24, 50, 100 |
| S457PEZ24 = Sample part number | |

To order with transmitter, add

| | |
|---------------------------------------|---|
| TT111 | Transmitter Models TT111: Fixed Range (2 leads) TT211: Fixed Range (2 leads) TT321: Fixed Range (3 leads) <i>Contact for other transmitter options.</i> |
| A | Temperature Range Code: A = 20°F to 120°F (-6.7°C to 48.9°C) <i>Contact for complete list of available temp. codes.</i> |
| 1 | Calibration: 1 = Nominal Calibration 2 = Match Calibrated, 0.75% Total System Accuracy <i>Contact for other calibration options.</i> |
| TT111A1 = Sample part number addition | |

Duct and Outside Air Temperature Sensors

Overview

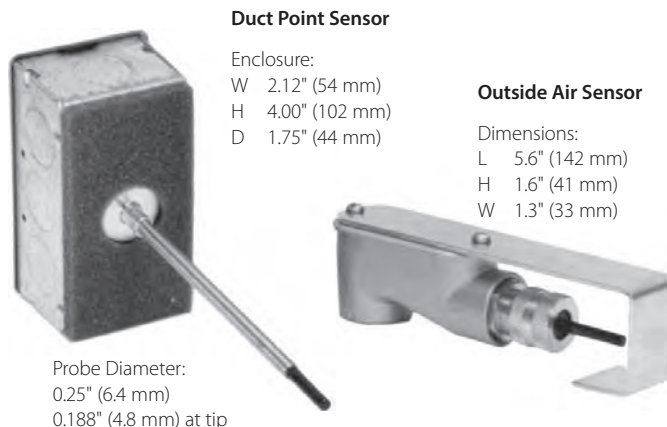
Sense temperature of air streams in ducts and plenums. Sensors include a junction box with gasket to prevent leakage and vibration noise.

These point-sensing thermometers feature a fast-responding aluminum sensing tip.

Custom options include a weatherproof connection box and an all stainless steel probe.

Outside air sensors are designed to mount on conduit outside your building. They include an elbow type enclosure and sun shield.

See page 4-2 for optional 4 to 20 mA temperature transmitters.



Specifications

Temperature range:

Probe: -45.5 to 135°C (-50 to 275°F).

Gasket: 100°C (212°F) max.

Leadwires:

AWG 22, PTFE insulated,
4" (100 mm) long.

Moisture resistance:

Point sensors meet MIL-STD-202, Method 104, Test Condition B

Special options

- Weatherproof connection box
- All stainless steel probe



STOCKED PARTS AVAILABLE

Model numbers

| Element | TCR $\Omega / \Omega / ^\circ\text{C}$ | Duct point sensors | Outside air sensors |
|--|---|-----------------------|------------------------|
| RTDs | | | |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C | 0.00391 | ▼S408PB | ▼S414PB |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C (Meets EN60751, Class B) | 0.00385 | ▼S450PD | ▼S454PD |
| Platinum 1000 $\Omega \pm 0.1\%$ at 0°C | 0.00385 | ▼S451PF | S455PF |
| Platinum 1000 $\Omega \pm 0.1\%$ at 0°C | 0.00375 | ▼S484PW | S486PW |
| Nickel-iron 1000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S406FB | S412FB |
| Nickel-iron 2000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S407FC | S413FC |
| HW 3000 Ω at -30.2°C | 0.00262 | S100060PX | S100062PX |
| Thermistors <small>R251/4R125</small> | | | |
| Thermistor 2,252 $\Omega \pm 1\%$ at 25°C | 29.2 | TS430TA | TS428TA |
| Thermistor 10,000 $\Omega \pm 1\%$ at 25°C | 23.5 | TS431TB | TS429TB |

Specifications subject to change

Specification and order options:

Duct point sensors

| S450PD | Model number from table |
|--------------------------------|---|
| Y | Number of leads: ▼ Y = 2 leads Z = 3 leads (RTD only) |
| 12 | Insertion depth in inches: 1 inch = 25.4 mm ▼ : 6, 12, 18" Minimum: 3" |
| S450PDY12 = Sample part number | |

Outside air sensors

| S414PB | Model number from table |
|------------------------------|---|
| Z | Number of leads: ▼ Y = 2 leads ▼ Z = 3 leads (RTD only) |
| S414PBZ = Sample part number | |

To order with transmitter, add

| | |
|---------------------------------------|---|
| TT111 | Transmitter Models TT111: Fixed Range (2 leads) TT211: Fixed Range (2 leads) TT321: Fixed Range (3 leads) <i>Contact for other transmitter options.</i> |
| A | Temperature Range Code: A = 20°F to 120°F (-6.7°C to 48.9°C) <i>Contact for complete list of available temp. codes.</i> |
| 1 | Calibration: 1 = Nominal Calibration 2 = Match Calibrated, 0.75% Total System Accuracy 3 = Match Calibrated, 0.5% Total System Accuracy 4 = Match Calibrated, 0.2% or 1°C Total System Accuracy <i>Contact for other calibration options.</i> |
| TT111A1 = Sample part number addition | |

Room Air Temperature Sensors

Compact Wall-mount

Dimensions:

W 3.12" (79 mm)
H 2.09" (54 mm)
D 1.80" (46 mm)



Full Size Wall-mount

Dimensions:

W 2.75" (70 mm)
H 4.50" (114 mm)
D 1.56" (40 mm)



Explosionproof Wall-mount

Dimensions:

W 1.60" (41 mm)
H 5.55" (141 mm)
D 2.05" (52 mm)



Flush Wall-mount

Dimensions:

W 2.75" (70 mm)
H 4.50" (114 mm)
D 0.18" (5 mm)



Overview

Minco's room air sensors are available with a variety of enclosures that meet most standard and explosionproof HVAC/R installations. The sensors can be match calibrated with a Minco Tempran™ (temperature transmitter) for increased accuracy and reliability.

Room air sensors are designed for wall mounting. Choose from two plastic enclosure styles with brushed aluminum faceplates or a flushmount stainless steel model.

The full-size enclosure and flushmount fit over standard junction boxes. The full size enclosure has optional knockouts for Wiremold raceway surface wiring. Just remove knockouts with pliers. This enclosure may also include a 4-20 mA temperature transmitter; specify model AS200655.

The compact room air sensor mounts directly on drywall.

The explosionproof sensor housing is UL listed and CSA approved for Class I, Groups C and D; Class II, Groups E, F, and G; and Class III. Download Application Aid #19 for more hazardous area information and the various standards and agencies (including FM, CSA, CENELEC and ATEX) at www.minco.com.

Specifications

Temperature range:

-45.5 to 100°C (-50 to 212°F)

Temperature range (with TT115 transmitter):

Zero: -40 to 10°C (-40 to 50°F)

Span: 25 to 100°C (45 to 180°F)

Max upper temperature: 85°C (185°F)

Leadwires:

Full size and compact: AWG 22,

PTFE insulated, 4" (100 mm) long.

Explosionproof and flush mount: AWG 26,

PTFE insulated, 6" (150 mm)

inside cover.

Moisture resistance: Meets MIL-STD-202, Method 104, Test Condition B.

Transmitters: Full size sensors with 2 leads can use Tempran™ transmitter model TT115 installed within the sensor enclosure. A variety of transmitters are available for all other sensor models. Transmitters must be installed in a separate enclosure from the sensor.

Specification and order options:

Compact and full size

| | |
|---------------------------------|---|
| S472PB | Model number from table |
| Y | Number of leads: ▼ Y = 2 leads Z = 3 leads |
| 4 | Lead length in inches: ▼: 4 |
| K0 | Knockouts (full size only): ▼ K0= No knockouts K1= Knockouts for wiremold raceway |
| S472PBY4K0 = Sample part number | |

Note: For replacement cover only, order part AC692KO or AC692K1 for full size, AC551 for compact.

Explosionproof and flush-mount

| | |
|---------------------------------|--|
| S100147PD | Model number from table |
| Y | Number of leads: Y = 2 leads Z = 3 leads |
| S100147PDY = Sample part number | |



STOCKED PARTS AVAILABLE

| Element | TCR Ω /Ω/°C | Compact room air sensors | Full size room air sensors | Explosion- proof wall-mount sensors | Flush mount room air sensors |
|--|----------------|--------------------------------|----------------------------------|--|---------------------------------------|
| RTDs | | | | | |
| Platinum 100 Ω ±0.1% at 0°C | 0.00391 | S405PB | S472PB | | |
| Platinum 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | 0.00385 | ▼ S448PD | ▼ S473PD | S100147PD | S101456PD |
| Platinum 1000 Ω ±0.1% at 0°C | 0.00385 | ▼ S449PF | ▼ S474PF | S100148PF | S101456PF |
| Platinum 1000 Ω ±0.1% at 0°C | 0.00375 | S483PW | S489PW | S101608PW | S101456PW |
| Nickel-iron 1000 Ω ±0.12% at 70°F | 0.00527 | S403FB | S470FB | | |
| Nickel-iron 2000 Ω ±0.12% at 70°F | 0.00527 | S404FC | S471FC | | |
| HW 3000 Ω at -30.2°C | 0.00262 | S1000064PX | S1000063PX | | |
| Thermistors ^{R251} / _{R125} | | | | | |
| Thermistor 2,252 Ω ±1% at 25°C | 29.2 | TS426TA | TS424TA | TS100149TA | TS101769TA |
| Thermistor 10,000 Ω ±1% at 25°C | 23.5 | TS427TB | TS425TB | TS100150TB | TS101769TB |

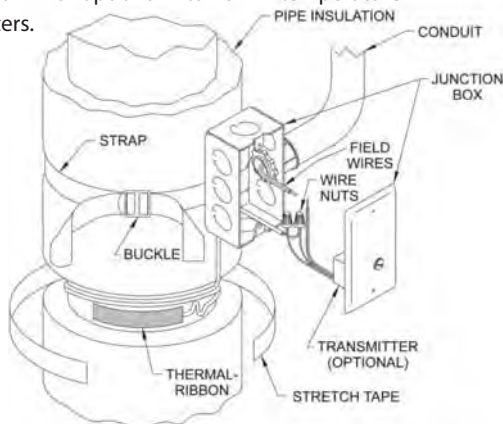
Flexible Thermal-Ribbon™ Pipe Sensors

Overview

Flexible Thermal-Ribbon™ sensors mount on the pipe surface so there's no expense of a pipefitter to drain, drill, and tap the pipe for a thermowell because there is no thermowell! When properly installed and insulated, the accuracy and response of a Thermal-Ribbon equals an immersed thermowell assembly.

Options include stainless steel braid over leadwires to prevent abrasion damage and pressure-sensitive adhesive for easier mounting (smooth surfaces only).

See Section 4 for optional 4 to 20 mA temperature transmitters.



Note: Tape the Thermal-Ribbon in place beneath a layer of insulation.

Mounting accessories:

AC766 mounting kit

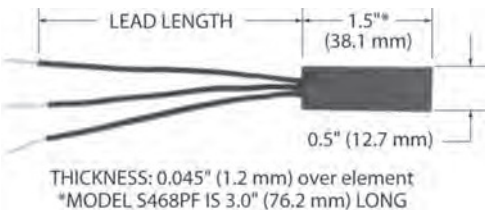
Provides a pipe-mounted enclosure for transmitters and connections. Kit includes junction box, 5 ft. nylon strap, buckle, 4 wire nuts, and 6 ft. of #20 stretch tape.

#20 stretch tape

High temperature self-fusing silicone rubber tape for mounting Thermal-Ribbons to pipes. 1" wide rolls, 6 or 36 foot lengths.

#6 RTV adhesive

Room temperature vulcanizing adhesive for attaching Thermal-Ribbons to surfaces. 3 oz. (89 ml) tube.



Specifications

Body material: Silicone rubber with polyimide backing.

Temperature range:

RTD: -62 to 200°C (-80 to 392°F).

Thermistor: -45.5 to 135°C (-50 to 275°F).

Leadwires: AWG 24, silicone rubber.

Moisture resistance: Meets MIL-STD-202, Method 104, Test Condition B.

Model numbers

| Element | TCR $\Omega / \Omega / ^\circ\text{C}$ | Model |
|--|--|-----------|
| RTDs | | |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C | 0.00391 | S464PB |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C (Meets EN60751, Class B) | 0.00385 | S467PD |
| Platinum 1000 $\Omega \pm 0.1\%$ at 0°C | 0.00385 | S468PF |
| Nickel-iron 1000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S462FB |
| Nickel-iron 2000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S463FC |
| HW 3000 Ω at -30.2°C | 0.00262 | S100001PX |
| Thermistors | | |
| Thermistor 2,252 $\Omega \pm 1\%$ at 25°C | 29.2 | TS436TA |
| Thermistor 10,000 $\Omega \pm 1\%$ at 25°C | 23.5 | TS437TB |

Specification and order options

| S467PD | Model number from table |
|---------------------------------|--|
| Z | Number of leads: Y = 2 leads Z = 3 leads (RTD only) YS = 2 leads, stainless steel braid ZS = 3 leads, stainless steel braid (RTD only) |
| 36 | Lead length in inches |
| A | Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive |
| S467PDZ36A = Sample part number | |

HVAC SENSORS



STOCKED PARTS AVAILABLE

▼ = STANDARD OPTIONS
Specifications subject to change



Humidity Sensor/Transmitter Assembly



Overview

Minco humidity and humidity/temperature transmitters are designed using an advanced microprocessor. Digital signal processing allows these transmitters to precisely match the characteristics of the humidity sensor to a wide range of RH and temperature values found in the many applications the product serves.

The humidity sensor is composed of an integrated circuit (IC) with a stable polymer element and platinum RTD that is used for temperature compensation. This sensor offers outstanding resistance to airborne contaminant and chemicals, and is protected by a sintered stainless steel filter which resists condensation.

- Wall/Duct/OSA mounting configurations
- Accuracies of $\pm 1\%$ or $\pm 2\%$ RH
- Temperature compensated
- Temperature output option
- Two-point field calibration
- NIST traceable calibrations

Applications

Building environmental control systems (HVAC), hospitals, food storage, warehouses, clean rooms, pharmaceutical, freezers, drying equipment, and emissions monitoring.

Specifications

Ambient Temperature:

Operating:

Room: -10 to 150°F (-23 to 65°C), non-condensing.

Wall/Duct/OSA: -10 to 185°F (-23 to 85°C), non-condensing.

Storage:

Room: -58 to 150°F (-50 to 65°C), non-condensing.

Wall/Duct/OSA: -58 to 185°F (-50 to 85°C), non-condensing.

Supply voltage: 9.5 to 35 VDC, non-polarized.

Voltage effect: $\pm 0.001\%$ of span/volt from 9.5 to 35 VDC.

Loop resistance: The maximum allowable resistance of the signal-carrying loop, including extension wires and load resistors, is given by this formula: $R_{\text{loopmax}} = (V_{\text{supply}} - 9.5)/0.02 \text{ AMPS}$. For example, if supply voltage is 24 VDC, the loop resistance must be less than 725Ω .

Adjustments: Zero and span field adjustments, non-interacting.

Time Constant: 50 seconds in slow moving air.

Connections: Screw terminals (22-14 AWG wire).

Weight:

Room: 0.19 lb (.084 kg).

Wall/Duct/OSA: 1.20 lb (0.55 kg).

Minimum output current: 3.5 mA

Maximum output current: 23 mA.

▼ = **STANDARD OPTIONS**
Specifications subject to change

Humidity Transmitter AH429 and AH439

Output: 4-20 mA DC = 0% to 100% RH.

Sensing Element: Capacitive monolithic IC.

Accuracy: Includes temperature, linearity, hysteresis, and repeatability.

- ±1% from 10% to 80% RH @ 25 to 35°C or
- ±2% from 0% to 90% RH @ 25°C
(±3% from 0% to 90% RH @ 15 to 50°C)
(±5% from 0% to 90% RH @ 0 to 82°C)

Temperature Transmitter (AH439 only)

Output: 4-20 mA DC over the specified temperature range.

Sensing element: 1000 Ω platinum; 2 lead resistance thermometer, 0.00385 TCR.

Accuracy: Includes resistance thermometer tolerance, calibration accuracy, linearity, and ambient temperature effects.

- ±.75% of Temptran™ span for 32 to 122°F ambient.
- ±1.50% of Temptran™ span for -13 to 185°F ambient.

AH429 Specification and order options

| | |
|--|---|
| ▼AH429 | Model number: |
| R | Enclosure ▼D: Duct mount, 8" probe length ▼O: Outside Air/Wall mount, 4" probe length with shield, weather resistant enclosure ▼S: Space mount ▼W: Wall mount, 4" probe length, weather resistant enclosure R: Remote probe, 4" probe length |
| 1 | Output: 4 to 20 mA DC |
| N10 | Calibration accuracy (humidity transmitter) ▼N10: ±1% from 10% to 80% (25 to 35°C) with NIST certificate N20: ±2% from 0% to 90% (25 to 35°C) with NIST certificate ▼S20: ±2% from 0% to 90% (25 to 35°C) |
| T1 | Sensing element cover (omitted on "S" space mount models) T0= Sintered stainless steel; pressed on cover ▼T1= Sintered stainless steel; screw on cover T2= Slotted stainless steel; screw on cover (NA on "O" outside air models) |
| To order enclosure D, O, S or W, stop here. To order enclosure R (remote probe), add: | |
| A | Probe mounting location A = Side mounting B = Bottom mounting |
| 48 | Remote probe cable length (in inches) 48" and 96" are standard lengths |
| AH429R1N10T1A48 = Sample part number | |

AH429 = Humidity Transmitter

AH439 = Humidity/Temperature Transmitter

AH439 Specification and order options

| | |
|--|---|
| ▼AH439 | Model number: |
| D | Enclosure ▼D: Duct mount, 8" probe length ▼O: Outside Air/Wall mount, 4" probe length with shield, weather resistant enclosure ▼S: Space mount W: Wall mount, 4" probe length, weather resistant enclosure R: Remote probe, 4" probe length |
| 1 | Outputs: 4 to 20 mA DC |
| N10 | Calibration accuracy (humidity transmitter) ▼N10: ±1% from 10% to 80% (25 to 35°C) with NIST certificate N20: ±2% from 0% to 90% (25 to 35°C) with NIST certificate ▼S20: ±2% from 0% to 90% (25 to 35°C) |
| A | Temperature transmitter range ▼EN: -20°F to 140°F S: 0°F to 100°F ▼A: 20°F to 120°F B: 30°F to 130°F KK: 30°F to 180°F ▼N: 32°F to 122°F H: 40°F to 90°F More temperature range codes starting on page 4-20 or www.minco.com |
| T1 | Sensing element cover (omitted on "S" space mount models) T0= Sintered stainless steel; pressed on cover ▼T1= Sintered stainless steel; screw on cover T2= Slotted stainless steel; screw on cover (NA on "O" outside air models) |
| To order enclosure D, O, S or W, stop here. To order enclosure R (remote probe), add: | |
| A | Probe mounting location A = Side mounting B = Bottom mounting |
| 48 | Remote probe cable length (in inches) 48" and 96" are standard lengths |
| AH439D1N10AT1A48 = Sample part number | |

▼= STANDARD OPTIONS
Specifications subject to change

Hazardous Area Humidity Assembly



Overview

Models AH71_, AH72_, and AH73_ series are 2-wire temperature compensated humidity transmitters that are FM and CFM approved for use in hazardous locations. Intrinsically safe models are available with an optional temperature transmitter output. The AH73 is also available with an optional digital display for remote indication of relative humidity and temperature.

The transmitters utilize a thin film capacitive humidity sensor which provides outstanding sensitivity and chemical robustness. The transmitter converts the humidity sensor's signal into a 4 to 20 mA DC current, which changes proportionally from 4 mA at 0% RH to 20 mA at 100% RH. The optional temperature loop produces a second 4 to 20 mA DC output where the current changes from 4 mA at the lowest temperature of the range, to 20 mA at the top of the temperature range. The leads that supply power also carry the current signal.

- Accuracy of $\pm 2.5\%$ RH
- Temperature compensated
- Temperature output option
- Two-point field calibration
- NIST traceable calibrations

Applications

Building automation systems (HVAC), hospitals, food storage, warehouses, clean rooms, pharmaceutical, drying equipment, and emissions monitoring.

Specifications

Output(s):

Humidity: 4 to 20 mA DC = 0% to 100% RH.
Temperature: 4 to 20 mA DC over specified range (optional)

Humidity Range: 0 – 100% RH

Sensing Element:

Humidity: Thin film capacitive element.
Temperature: 1000 ohm platinum RTD, 0.00385 TCR

Temperature Effect: $\pm 0.03\%$ RH/ $^{\circ}\text{C}$ $\pm 1\%$ from 10°C to 85°C

Operating Temperature:

Transmitter:

- 40 to 176°F (-40 to 80°C), non-condensing.
- 4 to 176°F (-20 to 80°C), non-condensing, model AH73.

Sensor:

- 40 to 302°F (-40 to 150°C).

Storage Temperature:

-58 to 185°F (-50 to 85°C), non-condensing.

Supply voltage:

9.5 to 28 VDC for intrinsically safe (IS) models.
16.5 to 28 VDC for explosionproof (XP) models.

Voltage effect: $\pm 0.001\%$ of span/volt from 9.5 to 28 VDC.

Loop resistance: The maximum allowable resistance of the signal-carrying loop, including extension wires and load resistors, is given by this formula:

IS: $R_{\text{loopmax}} = (V_{\text{supply}} - 9.5)/0.02 \text{ AMPS}$. For example, if supply voltage is 24 VDC, the loop resistance must be less than 725 Ω .

XP: $R_{\text{loopmax}} = (V_{\text{supply}} - 16.5)/0.02 \text{ AMPS}$. For example, if supply voltage is 24 VDC, the loop resistance must be less than 375 Ω .

▼ = STANDARD OPTIONS
Specifications subject to change

Accuracy: Includes linearity, hysteresis, repeatability, and voltage effects.
 Humidity: $\pm 2.5\%$ from 10% to 80% RH @ 25°C, $\pm 3.5\%$ from 80% to 90% RH @ 25°C.
 Temperature: $\pm 0.5^\circ\text{F}$ (0.27°C) @ 77°F (25°C) or $\pm 0.75\%$ of span, whichever is greater.

Adjustments: Zero and Span field adjustments, non-interacting.

Time Constant: 50 seconds in slow moving air.

Connections: Screw terminals (22-14 AWG wire).

Weight:

AH71_ 2.84 lbs (1.29 kg).
 AH72_, AH73_ 4.46 lbs (2.02 kg).

Min. output current: 3.8 mA.

Max. output current: 22 mA.

Filter: 60 micron stainless-steel sintered filter (replacement P/N : AC103512)

Factory Mutual Approvals:

Explosionproof with intrinsically safe sensor:
 Suitable for the following hazardous area locations:
 Class I, Division 1, 2, Groups B, C, D
 Class II, Division 1, 2, Groups E, F, G
 Class III, Division 1, 2

Intrinsically safe installation:
 Suitable for the following hazardous area locations:
 Class I, Division 1, 2, Groups A, B, C, D
 Class II, Division 1, 2, Groups E, F, G
 Class III, Division 1, 2
 Class I, Zone 0, AEx ia IIC T4

Non-Incendive:
 Suitable for the following hazardous area locations:
 Class I, Division 2, Groups A, B, C, D
 Class II, Division 2, Groups F, G
 Class III, Division 2

Transmitter entity parameters:

$V_{max} = 28$ volts; $I_{max} = 100$ mA; $C_i = 0.037$ μF and $L_i = 0$ mH.

Transmitter ranges:

| Code | Transmitter range |
|------|----------------------------|
| ▼NT | No temperature transmitter |
| ▼EN | -20°F to 140°F |
| S | 0°F to 100°F |
| ▼A | 20°F to 120°F |
| BI | 30°F to 130°F |
| KK | 30°F to 180°F |
| ▼N | 32°F to 122°F |
| H | 40°F to 90°F |

Accessories:

| | |
|---------------------------------|-----------------------|
| Sintered Filter Replacement | Part Number: AC103512 |
| Slotted Filter Replacement | Part Number: AC103513 |
| Pipe Mounting Kit for AH72/AH73 | Part Number: AC102765 |
| Wall Mounting Kit for AH71 | Part Number: AC103168 |
| Duct Mounting Kit for AH71 | Part Number: AC103253 |

Specification and order options

| | | | |
|--|---|----------------|----------------|
| AH73 | Model number ▼ AH71 Industrial grade humidity transmitter with optional temperature transmitter, CH106 connection head, display NA AH72 Industrial grade humidity transmitter with optional temperature transmitter, connection head, display NA ▼ AH73 Industrial grade humidity transmitter with optional temperature transmitter, connection head, display available | | |
| 1 | Probe diameter ▼ 1 = 0.375" | | |
| P3 | Pipe Thread Code | Process | Conduit |
| | ▼ P3 | 1/2 - 14NPT | 1/2 - 14NPT |
| | P4 | 1/2 - 14NPT | 3/4 - 14NPT |
| | P5 | G1/2A | 1/2 - 14NPT |
| | P6 | G1/2A | 3/4 - 14NPT |
| L120 | Probe length ▼ L60 = 6" ▼ L120 = 12" | | |
| T1 | Filter type ▼ T1 = Sintered stainless steel T2 = Slotted stainless steel | | |
| HT490 | Transmitter model number ▼ HT480 = Explosionproof with intrinsically safe sensor (transmitter code NT only) ▼ HT490 = Intrinsically safe | | |
| F | Display C = Display, metric units (AH73_series only) ▼ F = Display, English units (AH73_series only) ▼ N = No display (AH71_ and AH72_ series only) | | |
| 1 | Signal output ▼ 1 = 4 to 20mA | | |
| N25 | Calibration accuracy (humidity transmitter) ▼ N25 $\pm 2.5\%$ from 10% to 80% (25°C) with NIST certificate S25: $\pm 2.5\%$ from 10% to 80% (25°C) | | |
| EN | Temperature transmitter range from table | | |
| AH731P3L120T1HT490F1N25EN = Sample part number | | | |

HVAC SENSORS

▼ = STANDARD OPTIONS
 Specifications subject to change



Intrinsically Safe Humidity Assembly



Overview

Models AH74 and AH75 are 2-wire temperature compensated humidity transmitters that are FM and CFM approved as intrinsically safe for use in hazardous locations. Both models are available with an optional temperature transmitter output. AH75 incorporates a digital display for remote indication of relative humidity and temperature.

The transmitters utilize a thin film capacitive humidity sensor which provides outstanding sensitivity and chemical robustness. The transmitter converts the humidity sensor's signal into a 4 to 20 mA DC current, which changes proportionally from 4 mA at 0% RH to 20 mA at 100% RH. The optional temperature loop produces a second 4 to 20 mA DC output where the current changes from 4 mA at the lowest temperature of the range, to 20 mA at the top of the temperature range. The leads that supply power also carry the current signal.

- Accuracy of $\pm 2.5\%$ RH
- Temperature compensated
- Temperature output option
- Two-point field calibration
- NIST traceable calibrations

Applications

Building automation systems (HVAC), hospitals, food storage, warehouses, clean rooms, pharmaceutical, drying equipment, and emissions monitoring.

Specifications

Output(s):

Humidity: 4 to 20 mA DC = 0% to 100% RH.

Temperature: 4 to 20 mA DC over specified range (optional).

Humidity Range: 0 – 100% RH

Sensing Element:

Humidity: Thin film capacitive element.

Temperature: 1000 ohm platinum RTD.

Temperature Effect: $\pm 0.03\%$ RH/ $^{\circ}\text{C}$ $\pm 1\%$ from 10°C to 85°C

Operating Temperature:

Transmitter:

-40 to 176°F (-40 to 80°C), non-condensing.

-4 to 176°F (-20 to 80°C), non-condensing, model AH75.

Sensor:

-40 to 176°F (-40 to 80°C),

Storage Temperature:

-58 to 185°F (-50 to 85°C), non-condensing.

Supply voltage: 9.5 to 28 VDC .

Voltage effect: $\pm 0.001\%$ of span/volt from 9.5 to 28 VDC.

Loop resistance: The maximum allowable resistance of the signal-carrying loop, including extension wires and load resistors, is given by this formula: $R_{\text{loopmax}} = (V_{\text{supply}} - 9.5)/0.02 \text{ AMPS}$.

Accuracy: Includes linearity, hysteresis, repeatability, and voltage effects.

Humidity: $\pm 2.5\%$ from 10% to 80% RH @ 25°C , $\pm 3.5\%$ from 80% to 90% RH @ 25°C .

Temperature: $\pm 0.5^{\circ}\text{F}$ (0.27°C) @ 77°F (25°C) or $\pm 0.75\%$ of span, whichever is greater.

Adjustments: Zero and Span field adjustments, non-interacting.

Time Constant: 50 seconds in slow moving air.

Connections: Screw terminals (22-14 AWG wire).

Weight:

AH74 0.54 lbs (245 g).

AH75 0.61 lbs (276 g).

Min. output current: 3.8 mA.

Max. output current: 22 mA.

Filter: 60 micron stainless-steel sintered filter (replacement P/N : AC103512)

Factory Mutual Approvals:

Intrinsically safe:

Suitable for the following hazardous area locations:

Class I, Division 1, Groups A, B, C, D

Class I, Zone 0, AEx ia IIC T4

Non-Incendive:

Suitable for the following hazardous area locations:

Class I, Division 2, Groups A, B, C, D

Transmitter entity parameters:

$V_{\text{max}} = 28 \text{ volts}$; $I_{\text{max}} = 100 \text{ mA}$; $C_i = 0.037 \mu\text{F}$ and $L_i = 0 \text{ mH}$.

▼ = STANDARD OPTIONS
Specifications subject to change

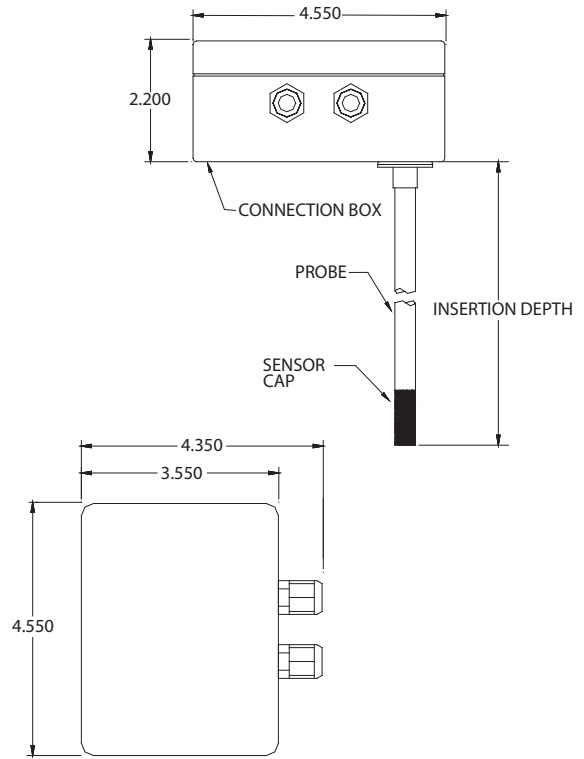
Transmitter ranges:

| Code | Transmitter range |
|------|----------------------------|
| ▼NT | No temperature transmitter |
| EN | -20°F to 140°F |
| S | 0°F to 100°F |
| ▼A | 20°F to 120°F |
| BI | 30°F to 130°F |
| KK | 30°F to 180°F |
| N | 32°F to 122°F |
| H | 40°F to 90°F |

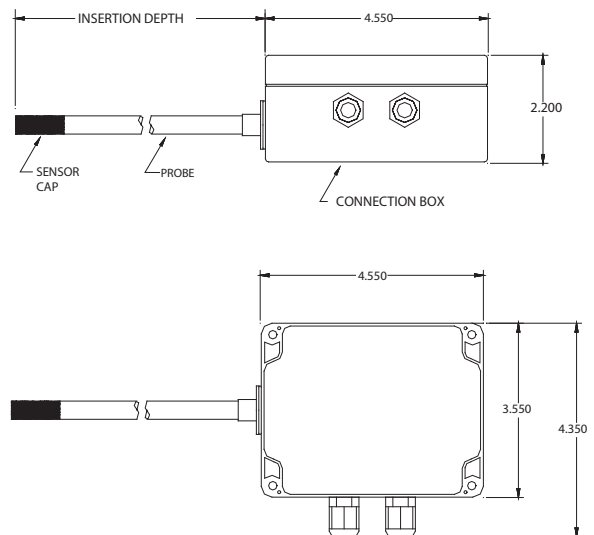
Specification and order options

| | |
|--|--|
| AH75 | <p>Model Number:</p> <ul style="list-style-type: none"> ▼AH74 - Humidity Transmitter with Optional Temperature Transmitter, No Display ▼AH75 - Humidity Transmitter with Optional Temperature Transmitter, with Display |
| 1 | <p>Probe Diameter: 1 = 0.375"</p> |
| C3 | <p>Probe Location / Cable Bushings Option: Please refer to dimensional drawings for probe Location.</p> <ul style="list-style-type: none"> C1 = Probe Location A (Rear) / Single Cable Gland C2 = Probe Location A (Rear) / Dual Cable Glands ▼C3 = Probe Location A (Rear) / Single Conduit Fitting, 1/2" NPT ▼C4 = Probe Location A (Rear) / Dual Conduit Fittings, 1/2" NPT ▼C5 = Probe Location B (Bottom) / Single Cable Gland ▼C6 = Probe Location B (Bottom) / Dual Cable Glands ▼C7 = Probe Location B (Bottom) / Single Conduit Fitting, 1/2" NPT ▼C8 = Probe Location B (Bottom) / Dual Conduit Fittings, 1/2" NPT <p><i>Note: If a temperature loop is desired, dual cable glands or dual conduit fittings must be selected unless special cable is used during installation. Please refer to National Electrical Code ANSI/NFPA 70 for installation in accordance with US requirements, or Canadian Electrical Code, C22.1 for installation in accordance with Canadian requirements.</i></p> |
| L40 | <p>Probe Length: ▼L40 = 4"</p> |
| T1 | <p>Filter Type:</p> <ul style="list-style-type: none"> ▼ T1 = Sintered Stainless Steel T2 = Slotted Stainless Steel |
| HT490 | <p>Transmitter Model Number:</p> <ul style="list-style-type: none"> ▼ HT490 = Intrinsically Safe Transmitter |
| F | <p>Display:</p> <ul style="list-style-type: none"> C = Display, Metric Units (AH75_ Series Only) ▼ F = Display, English Units (AH75_ Series Only) ▼ N = No Display |
| 1 | <p>Signal Output: ▼1 = 4-20mA</p> |
| N25 | <p>Calibration Accuracy:</p> <ul style="list-style-type: none"> ▼ N25 = ±2.5% from 10% to 80% (25°C) with NIST Certificate S25 = ±2.5% from 10% to 80% (25°C) |
| NT | <p>Temperature Transmitter Range from table: ▼A, NT</p> |
| <p>AH751C3L40T1HT490F1N25NT = Sample part number</p> | |

**Dimensions:
Probe Location A**



Probe Location B



HVAC SENSORS

▼ = STANDARD OPTIONS
Specifications subject to change

Thermal Vial™ Temperature Sensing System



Overview

- Ideal for ultralow freezers, laboratories, blood banks, walk-in freezers and refrigerators, even incubators—anywhere accurate sensing of the contents instead of the air is a vital concern.
- Sealed Polyethylene Thermal Vial™ eliminates spillage and contamination. Simply fill with fluid such as ethylene glycol, alcohol, water, or a cryopreservative to accurately emulate the material being stored or processed.
- Large (50 mm x 50 mm) footprint of the single well vial provides stability on a shelf or rack. Holds 175 ml (6 oz) of fluid. Other vial configurations are available. See next page.
- Platinum RTD probe is constructed of 316 Stainless Steel and operates to -200°C (-328°F).
- Metal shielded cable is rugged and washdown proof.
- 4 to 20 mA transmitter is match calibrated to the RTD for improved system accuracy.
- System accuracy is a variable
- NIST certificate and calibration data supplied at no additional cost.
- Additional accessories available.
- Customizable for validation requirements.
- Connection box and indicator are polycarbonate and NEMA 4X sealed to be washdown proof.

Specifications

Probe case: Stainless steel.

Element: Platinum.

Resistance (excluding leadwire resistance):

PM platinum: 100.00 Ω ±.06% at 0°C (32°F) (Class A).

PD platinum: 100.00 Ω ±.12% at 0°C (32°F) (Class B).

PF platinum: 1000.00 Ω ±.12% at 0°C (32°F).

TCR: .00385 Ω/Ω/°C nominal from 0°C to 100°C.

Operating temperature range:

Probe and vial: -200 to 120°C (-328 to 248°F).

Transmitter: -25 to 85°C (-13 to 185°F).

Insulation resistance: 1000 megohms minimum at 500 VDC, leads to probe case.

Leads: AWG #22, stranded, TFE insulated, with TFE jacket overall.

Thermal vial: Polyethylene bottle with cap.

Thermowell: Delrin material.

Transmitter: 4-20 mA output; 8.5 to 35 VDC loop powered.

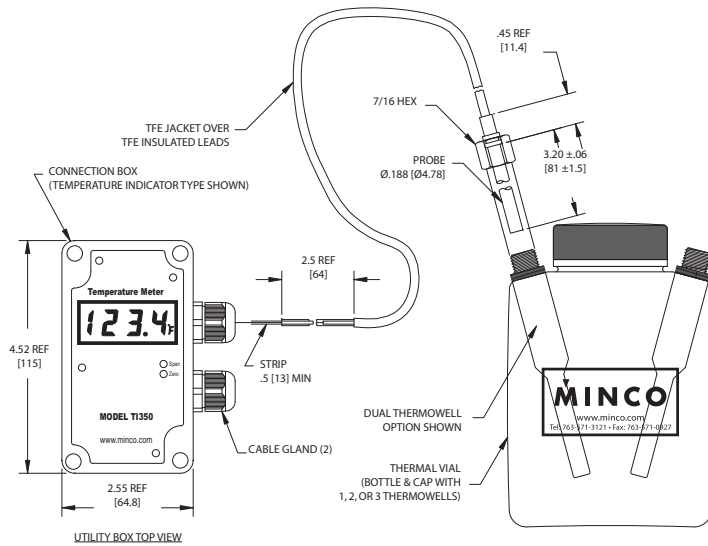
Connection box: Polycarbonate enclosure, NEMA 4X.

Specification and order options

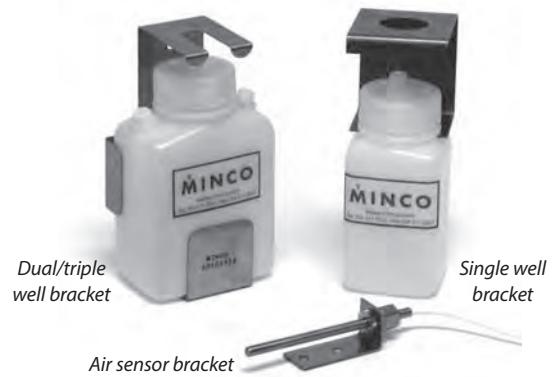
| | |
|---|---|
| AS103282 | Model number |
| PM | Sensing element, .00385 TCR: ▼ PM = 100 Ω Platinum ±.06%, Class A PD = 100 Ω Platinum ±.12%, Class B PF = 1000 Ω Platinum ±.12% |
| 60 | Cable length in inches ▼: 60, 120 |
| D | Vial configuration: ▼ S = Single thermowell, standard vial ▼ D = Dual thermowell T = Triple thermowell ▼ M = Single thermowell, miniature vial L = Single thermowell, large vial |
| C | Connection box type: ▼ C = Indicating °C ▼ F = Indicating °F ▼ B = Non-indicating |
| 20 | System accuracy: 75 = .75% of span 50 = .50% of span ▼ 20 = .20% of span or .1°C, whichever is greater |
| EZ | Temptran temperature range code: ▼ EZ = -100/0°C (-148/32°F) ▼ M = -50/50°C (-58/122°F) C = 0/100°C (32/212°F) More ranges starting on page 4-20. |
| AS103282PM60DC20EZ = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change

Thermal Vial™ Accessories



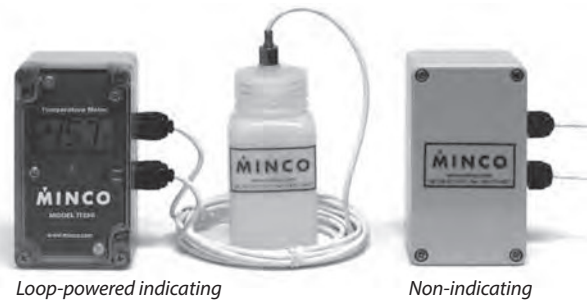
Available Accessories



| Description | Model |
|--------------------------|----------|
| Single well bracket | AC101540 |
| Dual/triple well bracket | AC102732 |
| Air sensor bracket | AC102074 |



| Description | Capacity | | Model |
|-------------|----------|---------|----------|
| Single | 6 oz. | 175 ml | AC101394 |
| Dual | 8 oz. | 250 ml | AC102026 |
| Triple | 8 oz. | 250 ml | AC102647 |
| Mini | 2 oz. | 60 ml | AC103316 |
| Large | 32 oz. | 1000 ml | AC102551 |



| Description | Model |
|-------------------------|----------|
| Loop-powered indicating | TI350 |
| Non-indicating | CH102777 |

▼ = STANDARD OPTIONS
Specifications subject to change

Refrigeration & Freezer Temperature System

Overview

- Ideal for refrigerated rooms, freezers, cold storage facilities and laboratories — anywhere an accurate, rugged, and weatherproof temperature sensor is needed.
- 100 Ω platinum RTD probe is constructed of 316 stainless steel to be resistant to most chemicals, including ammonia. Operates to -452°F (-269°C).
- 4 to 20 mA transmitter is epoxy potted to protect circuitry from condensation and ice. Operates in ambient temperatures down to -13°F (-25°C).
- Transmitter is match calibrated to RTD for 0.75% system accuracy. Free NIST certificate.
- Enclosure is gasketed and moisture resistant.
- RTD probe is available in lengths ranging from 2 inches to 48 inches, and the probe can be center-mounted for through-the-wall installation, or end-mounted for flush-to-the-wall mounting.

Specifications

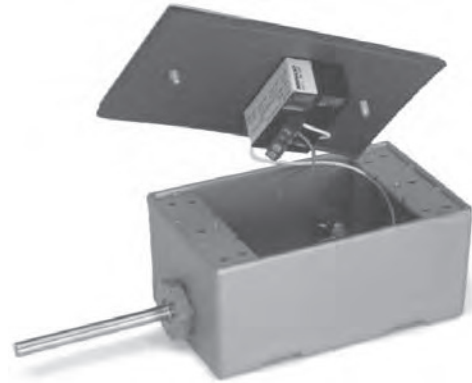
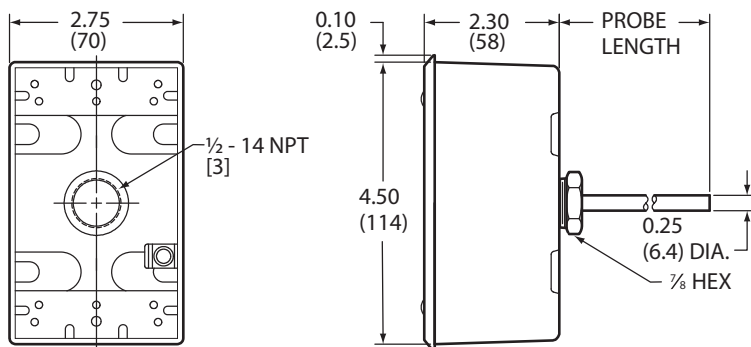
Temperature range:

Probe: -269 to 260°C (-452 to 500°F).

Transmitter: -25 to 85°C (-13 to 185°F).

RTD probe: 100 Ω platinum, 0.00385 TCR.

Transmitter: 4-20 mA output, 8.5 to 35 VDC loop powered.

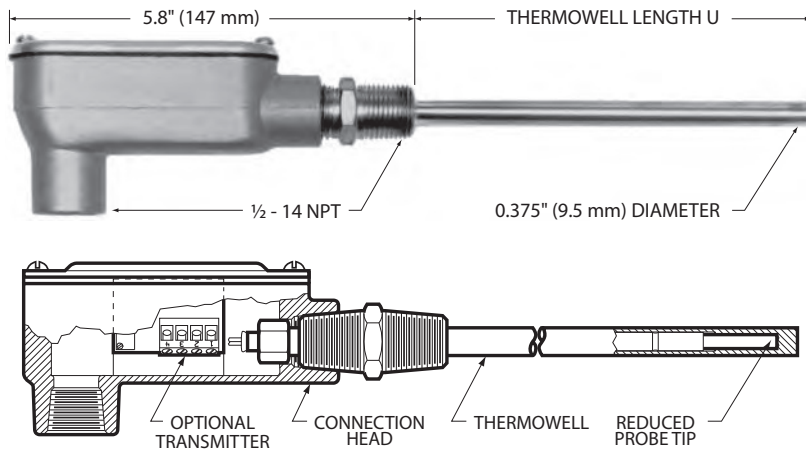


Specification and order options

| | |
|------------------------------------|---|
| AS100279 | Assembly number |
| PD | 100 Ω platinum RTD |
| 67 | Probe length: Specify in 0.1" increments (Ex: 67 = 6.7 inches) |
| M | Temperature range for 4-20 mA output: M = -50 to 50°C (-58 to 122°F) AD = -40 to 48.9°C (-40 to 120°F) DN = -30 to 50°C (-22 to 122°F) S = -18 to 37.8°C (0 to 100°F) BY = -10 to 40°C (14 to 104°F) Other ranges are available starting on page 5-20. |
| AS100279PD67M = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change

Fluid Immersion Temperature Sensors



Overview

Immersion sensors include stainless steel thermowells for insertion directly into fluid streams. The sensing probe may be removed without breaking the fluid seal. Brass thermowells are also available.

See page 4-2 for optional 4 to 20 mA temperature transmitters.

Specifications

Temperature range: -45.5 to 260°C (-50 to 500°F).

Leadwires: AWG 22, PTFE insulated, 4" (100 mm) long.

Thermowell pressure rating: 1880 psi (130 bar).

Moisture resistance: Meets MIL-STD-202, Method 104, Test Condition B.



STOCKED PARTS AVAILABLE

Model numbers

| Element | TCR Ω/Ω/°C | Model number |
|---|---------------|--------------|
| Platinum 100 Ω ±0.1% at 0°C | 0.00391 | ▼ S478PB |
| Platinum 100 Ω ±0.1% at 0°C (Meets EN60751, Class B) | 0.00385 | ▼ S479PD |
| Platinum 1000 Ω ±0.1% at 0°C | 0.00385 | ▼ S480PF |
| Platinum 1000 Ω ±0.1% at 0°C | 0.00375 | ▼ S490PW* |
| Nickel-iron 1000 Ω ±0.12% at 70°F | 0.00527 | ▼ S476FB* |
| Nickel-iron 2000 Ω ±0.12% at 70°F | 0.00527 | S477FC* |
| HW 3000 Ω at -30.2°C | 0.00262 | S100061PX* |

* Maximum temperature is 130°C (266°F).

Note: These sensors are intended for use in slow-moving fluid streams. For applications where fluid velocity exceeds 3 ft/s, you may need to use a thermowell assembly as an alternative. Contact Minco Sales and Customer Service for additional information.

Specification and order options:

Fluid immersion temperature sensors

| | |
|--------------------------------|--|
| S479P | D Model number from table |
| Y | Number of leads: ▼ Y = 2 leads Z = 3 leads |
| 60 | Thermowell length U: Specify in 0.1" increments (Ex: 60 = 6.0 inches) ▼ : 20, 30, 60 Contact factory for other lengths |
| S479PDY60 = Sample part number | |

Replacement stainless steel thermowells

| | |
|-------------------------------|---|
| TW488 | Model number |
| U | |
| 60 | Thermowell length U: Specify in 0.1" increments (Ex: 60 = 6.0 inches) Standard thermowell lengths are 3" and 6", contact factory for other lengths |
| TW488U60 = Sample part number | |

To order with transmitter, add

| | |
|---------------------------------------|---|
| TT111 | Transmitter Models TT111: Fixed Range (2 leads) TT211: Fixed Range (2 leads) TT321: Fixed Range (3 leads) <i>Contact for other transmitter options.</i> |
| A | Temperature Range Code: A = 20°F to 120°F (-6.7°C to 48.9°C) <i>Contact for complete list of available temp. codes.</i> |
| 1 | Calibration: 1 = Nominal Calibration 2 = Match Calibrated, 0.75% Total System Accuracy 3 = Match Calibrated, 0.5% Total System Accuracy 4 = Match Calibrated, 0.2% or 1°C Total System Accuracy <i>Contact for other calibration options.</i> |
| TT111A1 = Sample part number addition | |

Specifications subject to change



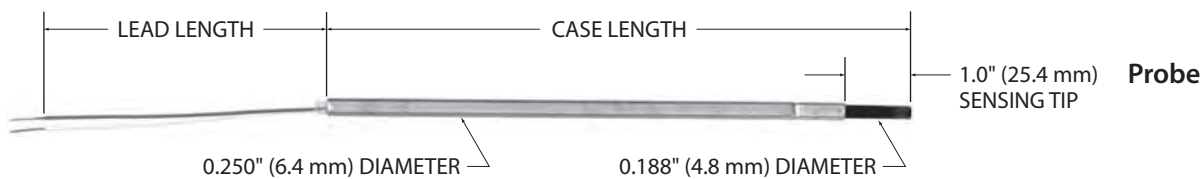
Elements & Probes

Overview

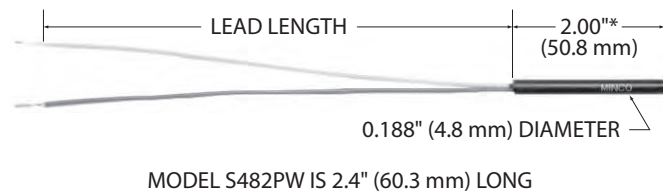
These models feature fast-responding RTD or thermistor elements in aluminum cases (except stainless steel on S482PW) with PTFE insulated leadwires. They can be assembled into probes or used separately as all-purpose sensors.

Probes consist of elements assembled into stainless steel extension tubes. They are not suitable for direct fluid immersion but may be used with thermowells. See Section 3 for thermowell options.

See Section 4 for optional 4 to 20 mA temperature transmitters.



Element



Specifications

Temperature range: -45.5 to 135°C (-50 to 275°F).

Leadwires: AWG 22, PTFE insulated. Standard lengths are 4", 12" and 18".

Moisture resistance: Meets MIL-STD-202, Method 104, Test Condition B.

Insulation resistance: 1000 megohms min. at 500 VDC, leads to case.

Model numbers

| Element | TCR $\Omega / \Omega / ^\circ\text{C}$ | Elements | Probes |
|--|---|-----------|-----------|
| RTDs | | | |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C | 0.00391 | S402PB | 411PB |
| Platinum 100 $\Omega \pm 0.1\%$ at 0°C (Meets EN60751, Class B) | 0.00385 | S458PD | S460PD |
| Platinum 1000 $\Omega \pm 0.1\%$ at 0°C | 0.00385 | S459PF | S461PF |
| Platinum 1000 $\Omega \pm 0.1\%$ at 0°C | 0.00375 | S482PW | S485PW |
| Nickel-iron 1000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S400FB | S409FB |
| Nickel-iron 2000 $\Omega \pm 0.12\%$ at 70°F | 0.00527 | S401FC | S410FC |
| HW 3000 Ω at -30.2°C | 0.00262 | S100057PX | S100837PX |
| Thermistors | R_{25}/R_{125} | | |
| Thermistor 2,252 $\Omega \pm 1\%$ at 25°C | 29.2 | TS438TA | TS440TA |
| Thermistor 10,000 $\Omega \pm 1\%$ at 25°C | 23.5 | TS439TB | TS441TB |

Specification and order options:

Probes

| | |
|---------------------------------|---|
| S411PB | Model number from table |
| 60 | Case length: Specify in 0.1" increments (Ex: 60 = 6.0 inches) Minimum length is 3" |
| Z | Number of leads: Y = 2 leads Z = 3 leads (platinum only) |
| 4 | Lead length in inches |
| S411PB60Z4 = Sample part number | |

Elements

| | |
|-------------------------------|--|
| S458PD | Model number from table |
| Z | Number of leads: Y = 2 leads Z = 3 leads (platinum only) |
| 4 | Lead length in inches |
| S458PDZ4 = Sample part number | |

To order with transmitter, add

| | |
|---------------------------------------|---|
| TT111 | Transmitter Models TT111: Fixed Range (2 leads) TT211: Fixed Range (2 leads) TT321: Fixed Range (3 leads) <i>Contact for other transmitter options.</i> |
| A | Temperature Range Code: A = 20°F to 120°F (-6.7°C to 48.9°C) <i>Contact for complete list of available temp. codes.</i> |
| 1 | Calibration: 1 = Nominal Calibration 2 = Match Calibrated, 0.75% Total System Accuracy 3 = Match Calibrated, 0.5% Total System Accuracy 4 = Match Calibrated, 0.2% or 1°C Total System Accuracy <i>Contact for other calibration options.</i> |
| TT111A1 = Sample part number addition | |



STOCKED PARTS AVAILABLE

Specifications subject to change

Temptran™ 4 to 20 mA Transmitters

Most HVAC sensors are available with companion 4 to 20 mA transmitters. See page 4-2 for suitable models. (Room air thermometers use model TT115, which has the same specifications as TT111). Temptran™ temperature transmitters convert low-level RTD output to a standard current signal that is immune to lead resistance and electrical noise. You can get accurate readings from points thousands of feet away.

How to order transmitters

To order HVAC/R sensors with integral transmitters, specify both the RTD and the Temptran part numbers.

High-accuracy calibration

Standard transmitters are calibrated to the nominal resistance values of the RTD at the zero and span points. Total system error includes the tolerance of both the transmitter and the RTD sensor.

If you order Minco Temptrans calibrated to the actual resistance of the RTD (as measured in Minco's metrology lab), this effectively subtracts the sensor tolerance from system accuracy specifications.

For example, consider a transmitter with a range of 0 to 500°C. The transmitter itself is accurate to $\pm 1.0^\circ\text{C}$ ($\pm 0.2\%$ of span, including calibration accuracy and linearity). The RTD interchangeability contributes an additional error of $\pm 0.3^\circ\text{C}$ at 0°C and $\pm 2.8^\circ\text{C}$ at 500°C . Total system error would be $\pm 1.3^\circ\text{C}$ at 0°C and $\pm 3.8^\circ\text{C}$ at 500°C . When you calibrate the sensor and transmitter as a set, the sensor error disappears, reducing system error to $\pm 1.0^\circ\text{C}$ over the full range — all for a nominal extra cost.

0.75% guaranteed accuracy

Minco guarantees a system accuracy (current signal vs temperature) of 0.75% of span when you order specially calibrated Temptrans with any RTD in the HVAC/R Sensors Section. (An RTD with standard transmitter will deviate about 1-2% of span.) Tighter accuracies are available on special order.



Transmitters are mounted in the junction box on duct sensors, or in the connection head of fluid immersion sensors.

Outside air thermometers and Thermal-Ribbons: Transmitters are furnished separately. Install in an enclosure near the sensor, but away from excessive ambient temperatures.

Full size wall mount thermometers use the TT115 circuit-board style Temptran. The enclosure is thermally designed to minimize heating of the sensor by transmitter electronics.

Free NIST traceability

With each matched sensor/transmitter set, Minco sends you calibration data traceable to the National Institute of Standards & Technology. This helps you comply with ISO 9001 and other quality standards.

Recalibration

Minco prints RTD resistance values right on the Temptran label to simplify recalibration. You simply connect a resistance decade box or "RTD simulator" in place of the RTD, dial in the correct values, and adjust zero and span. Because Minco RTDs shift less than 0.05°F per year in a typical HVAC installation, the printed values remain valid for many years.

| | | | | |
|--------------------------|----------------------|-----------|---------|----------|
| MINCO MINCO, INC. USA | MODEL | TEMPTRAN™ | | |
| | D/C: 9614 | | | |
| | 100 OHM PLATINUM RTD | | | |
| | 4mA= | 20.0°F= | -6.7°C= | 97.932Ω |
| | 20mA= | 120.0°F= | 48.9°C= | 118.969Ω |

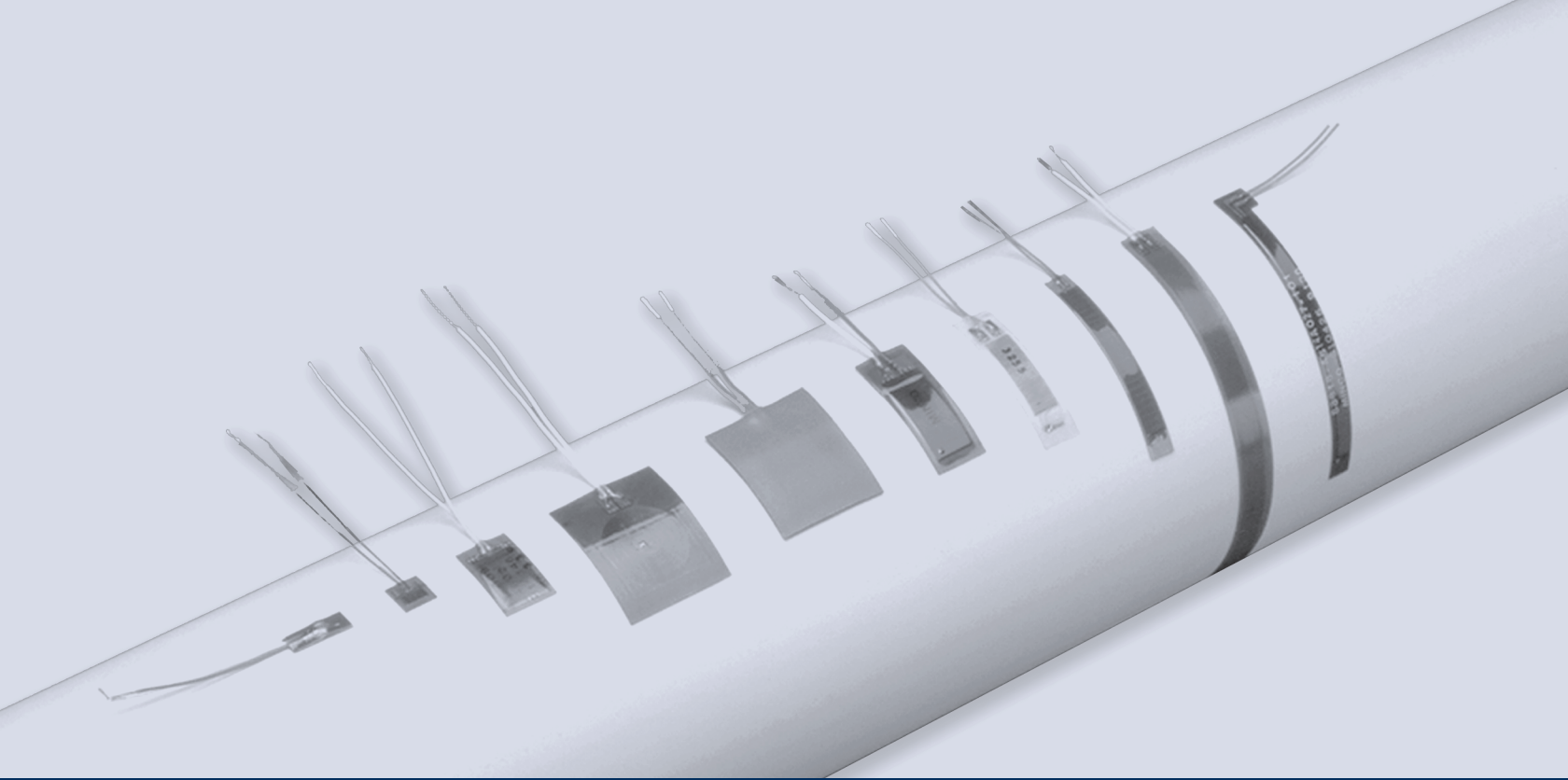
RTD resistances are printed on Temptran labels for easy recalibration of zero and span. A standard Temptran shows nominal values.

| | | | | |
|--------------------------|----------------------|-----------|---------|----------|
| MINCO MINCO, INC. USA | MODEL | TEMPTRAN™ | | |
| | D/C: 9614 S/N: 103 | | | |
| | 100 OHM PLATINUM RTD | | | |
| | 4mA= | 20.0°F= | -6.7°C= | 97.427Ω |
| | 20mA= | 120.0°F= | 48.9°C= | 118.988Ω |

A specially calibrated Temptran shows actual resistance of the serialized, connected RTD.

See Section 4 for complete details and ordering information.

▼ = STANDARD OPTIONS
Specifications subject to change



► SECTION 9: THERMAL-RIBBONS™

- Fast response surface sensing in aerospace, medical, and industrial devices
- Thin, flexible RTDs and thermocouples offer easy, non-invasive installation
- Rugged laminated construction for use in extreme environments
- Polyimide, silicone rubber, Mylar™ insulation





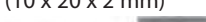

| | |
|-------------------------------------|------------|
| Thermal-Ribbons™ | 9-2 to 9-3 |
| Thermal-Tabs™ | 9-2 to 9-3 |
| Discoil™ Thermal-Ribbons | 9-4 |
| Strip sensing Thermal-Ribbons | 9-5 |
| Thermistor Thermal-Ribbons | 9-6 |
| Thermocouple Thermal-Ribbons | 9-6 |
| Installation and accessories | 9-7 |

Thermal-Tab™ and Thermal-Ribbon™ Sensors


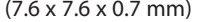
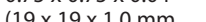
Install these compact sensors anywhere for accurate point sensing and fast response. All Thermal-Tab modules use a thin-film RTD element. All Thermal-Ribbon models conform to EN60751 Class B tolerance when ordered with a PD platinum element.

- Fast response surface sensing in aerospace, medical and industrial devices
- Rugged lamination construction
- Polyimide, silicone rubber or Mylar™ insulation
- All models are RoHS compliant

Thermal-Tab Specifications

| Dimensions W x L x T _{max} | Element options | Insulation | Temperature range | Leadwires | Time constant* | Features | Model |
|---|-------------------|---|------------------------------|-------------------------------------|----------------|---|---------|
| 0.20 x 0.50 x 0.08" (5 x 12 x 2 mm)  | ▼: PD, PF | Polyimide with elastomer cover coat | -50 to 155°C -58 to 311°F | AWG 26, PTFE insulated | 0.8 sec. | Stocked for immediate shipment | ▼S665 |
| 0.20 x 0.60 x 0.08" (5 x 15 x 2 mm)  | ▼: PD, PF, PW, PS | Polyimide | -50 to 200°C -58 to 392°F | AWG 26, PTFE or polyimide insulated | 1.0 sec. | Platinum models in stock | ▼S17624 |
| 0.20 x 0.60 x 0.08" (5 x 15 x 2 mm)  | ▼: PD, PF | Polyimide film | -50 to 260°C -58 to 500°F | AWG 26, PTFE or polyimide insulated | 0.4 sec. | Highest temperature capability | S100820 |
| 0.20 x 0.60 x 0.12" (5 x 15 x 3 mm)  | ▼: PD, PF | Silicone rubber with elastomer cover and foil backing | -50 to 155°C -58 to 311°F | AWG 24, Silicone insulated | 1.3 sec. | Waterproof; suitable for continuous immersion | S667 |
| 0.20 x 0.60 x 0.045" (5 x 15 x 1.15 mm)  | ▼: PD, PF | Polyimide film | -50 to 200°C -58 to 392°F | AWG 26, PTFE or polyimide insulated | 0.6 sec. | Thinnest profile | S100725 |
| 0.30 x 0.60 x 0.10" (7 x 15 x 2.5 mm)  | ▼: PD, PF | Polyimide film | -50 to 200°C -58 to 392°F | AWG 22, PTFE or polyimide insulated | 1.2 sec. | Heavier leadwire for applications requiring ruggedized design | S100724 |
| 0.40 x 0.80 x 0.08" (10 x 20 x 2 mm)  | ▼: PD, PF | Polyimide film | -50 to 200°C -58 to 392°F | AWG 26, PTFE or polyimide insulated | 0.9 sec. | Larger surface area for easier handling and maximum adhesive bond | S100723 |
| 0.40 x 0.80 x 0.08" (10 x 20 x 2 mm)  | ▼: PD, PF | Silicone rubber | -50 to 220°C -58 to 428°F | AWG 26, PTFE or polyimide insulated | 1.5 sec. | High temperature rating, available with wide range of element options | S100721 |

Thermal-Ribbon Specifications

| | | | | | | | |
|--|-----------|-----------------------------|--------------------------------|------------------------|-----------|---|-------|
| 0.20 x 1.50 x 0.030" (5.1 x 38.1 x 0.8 mm)  | ▼FA | Polyimide | -200 to 200°C -328 to 392°F | AWG 34, PTFE insulated | 0.15 sec. | Wire-wound nickel-iron for high resistance in small package | ▼S38 |
| 0.30 x 0.30 x 0.025" (7.6 x 7.6 x 0.7 mm)  | ▼PD PE | Polyimide with foil backing | -200 to 200°C -328 to 392°F | AWG 28, PTFE insulated | 0.15 sec. | Wire-wound element | ▼S651 |
| 0.75 x 0.75 x 0.04" (19 x 19 x 1.0 mm)  | ▼FA | Mylar | -200 to 150°C -328 to 302°F | AWG 30, PTFE insulated | 0.3 sec. | Wire-wound nickel-iron flat element for high resistance | ▼S25 |

Notes: T_{max} is measured over the lead bulge. *Time constant is in water at 1 m/sec.

Specifications, continued

| Leadwire insulation codes | |
|---|---------------------------|
| S25, S38, S651, S665, S667 | Leave blank |
| S17624, S100721, S100723, S100724, S100725, S100820 | ▼T = PTFE insulated wires |

▼ = STANDARD OPTIONS
Specifications subject to change

Sensing elements

| Sensing element specifications** | | Code |
|---|------------------------------------|------|
| Platinum (0.00385 TCR) (EN60751, Class B) | 100 Ω \pm 0.12% at 0°C | PD |
| Platinum (0.00385 TCR) | 100 Ω \pm 0.22% at 0°C | PE |
| Platinum (0.00385 TCR) | 1000 Ω \pm 0.12% at 0°C | PF |
| Platinum (0.00375 TCR) | 1000 Ω \pm 0.12% at 0°C | PW |
| Platinum (0.00385 TCR) | 10,000 Ω \pm 0.12% at 0°C | PS |
| Nickel-iron (0.00518 TCR) | 604 Ω \pm 0.26% at 0°C | FA |
| Nickel (0.00618 TCR) (DIN43760 Ni100, Class B) | 100 Ω \pm 0.22% at 0°C | NB |

** See table on previous page for element options on each model.

Waterproof model

Model S667 is waterproof and suitable for continuous immersion. Use it to monitor the temperature of water in a tank or container, or on equipment that must withstand wash-down or immersion.

Check with Minco for suitability in other liquids.



Specification and order options

| | |
|---|---|
| S17624 | Model number from table |
| PD | Sensing element from table |
| Z | Number of leads: ▼ Y = 2 leads ▼ Z = 3 leads (N/A on S25, S38) X = 4 leads (N/A on S25, S38 or S665/S667) |
| T | Leadwire insulation code from table at left |
| 12 | Lead length in inches: S665/S667: 60" max. ▼: 12, 36, 120 |
| A | Adhesive backing: ▼ A = No adhesive ▼ B = Pressure-sensitive adhesive (PSA) |
| Stop here for all models except S665 or S667. For models S665 and S667, add: | |
| C | Compliance: C = RoHS Compliance |
| S665PDZT12AC = Sample part number | |

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Custom Thermal-Ribbon designs

Minco can custom-wind Thermal-Ribbon elements in virtually any shape and size. We can profile sensing elements to provide increased sensitivity in selected zones, and provide packaging to perfectly fit your applications.

Contact Minco Sales and Customer Service today to discuss your application.



STOCKED PARTS AVAILABLE

THERMAL-
RIBBONS

▼ = STANDARD OPTIONS

Specifications subject to change

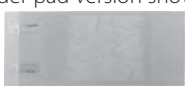



Discoil™ Thermal-Ribbons

Overview

Install these compact sensors anywhere for accurate point sensing. Discoil™ RTD elements are wound on a single plane for faster time response.

Specifications

| Dimensions W x L x T _{max} | Element options | Insulation | Temperature range | Leadwires | Time constant* | Features | Model |
|---|--------------------|--|-------------------------------|-----------------------------------|-------------------|--|----------|
| 0.79 x 1.87 x 0.055" (20 x 47.5 x 1.4 mm) solder pad version shown  | ▼ PD PE | Polyimide (clear polyester available) | -73 to 200°C -100 to 392°F | (Optional) AWG 24, PTFE insulated | 0.10 sec. | Only 0.010" thick over element, fast time response, platinum PD accuracy available | ▼ S17422 |
| 1.00 x 1.25 x 0.090" (25.4 x 31.8 x 2.3 mm)  | ▼ PB11 PB22 | Silicone rubber with polyimide backing | -62 to 220°C -80 to 428°F | AWG 24, silicone rubber insulated | 0.2 sec. | High temperature rating, platinum PD accuracy available | ▼ S32 |
| | ▼ PD12 PE22 | | | | | | ▼ S385 |

Notes: T_{max} is measured over the lead bulge.

*Time constant is in water at 1 m/sec.

Sensing elements

| Sensing element specifications** | Code |
|---|--------------------|
| Platinum (0.00391 TCR) 100 Ω ±0.5% at 0°C | PA |
| Platinum (0.00391 TCR) 100 Ω ±0.11% at 0°C | PB11 |
| Platinum (0.00391 TCR) 100 Ω ±0.22% at 0°C | PB22 |
| Platinum (0.00385 TCR) 100 Ω ±0.12% at 0°C (EN60751, Class B) | PD, PD12 |
| Platinum (0.00385 TCR) 100 Ω ±0.36% at 0°C | PE (Discoil) |
| Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C | PE (Strip sensing) |
| Platinum (0.00385 TCR) 100 Ω ±0.22% at 0°C | PE22 |
| Nickel-iron (0.00518 TCR) 604 Ω ±0.26% at 0°C | FA |
| Copper 427 10 Ω ±0.20% at 25°C | CA |
| Nickel 672 120 Ω ±0.3% at 0°C | NA |

** See table above for element options on each model.

Specification and order options

| | |
|----------------------------------|--|
| S32 | Model number from table |
| PB22 | Sensing element from table |
| Z | Number of leads: ▼ Y = 2 leads ▼ Z = 3 leads X = 4 leads ▼ W = Solder pads (S17422 only) |
| 36 | Lead length in inches ▼: 0, 12, 36, 144 (Specify 0 for solder pads, option on S17422 only) |
| A | Adhesive backing: ▼ A = No adhesive ▼ B = Pressure-sensitive adhesive (PSA) |
| S32PB22Z36A = Sample part number | |

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.




▼ = STANDARD OPTIONS
Specifications subject to change

Strip Sensing Thermal-Ribbons™

Overview

These models average temperatures along their length to eliminate point measurement errors. Wrap them around cylinders or adhere them to flat surfaces.

Specifications

| Dimensions W x L x T _{max} | Element options | Insulation | Temperature range | Lead-wires | Time constant* | Features | Model |
|---|--------------------------|--------------------------------------|--------------------------------|---------------------------|----------------|--|---------------|
|  0.50 x 1.25 x 0.050" (12.7 x 31.8 x 1.3 mm) | ▼PA ▼PE ▼CA ▼NA | Polyimide | -73 to 200°C -100 to 392°F | AWG 26, PTFE insulated | 0.17 sec. | Easy motor installations | ▼S3238 |
|  0.375 x 4.00 x 0.075" (9.5 x 101.6 x 1.9 mm) | ▼PB22 ▼PD12 PE22 | Silicone rubber w/ polyimide backing | -62 to 220°C -80 to 428°F | | 0.6 sec. | Platinum PD accuracy | ▼S34 ▼S386 |
|  0.375 x 4.00 x 0.065" (9.5 x 101.6 x 1.7 mm) | ▼FA | Polyimide | -200 to 200°C -328 to 392°F | | 0.2 sec. | Wire-wound nickel-iron for high resistance, thin element | ▼S35 |

Notes: T_{max} is measured over the lead bulge.

*Time constant is in water at 1 m/sec.

Refer to Sensing Elements Table on Page 9-4

Specification and order options

| | |
|----------------------------------|--|
| S34 | Model number from table (except S3238) |
| PB22 | Sensing element from table |
| Y | Number of leads: Y = 2 leads Z = 3 leads (required on CA) X = 4 leads (PD only) |
| 36 | Lead length in inches: 36" stocked |
| A | Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA) |
| S34PB22Y36A = Sample part number | |

Notes: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

Model S3238

Model S3238 is specially designed to sense **stator** temperatures in motors and generators. An alternative to the "stick" sensors, the S3238 mounts on the end turns of stator windings and provides an easy way to add overtemperature protection when the stator is not being rewound.

S3238 specification and order options

| | |
|------------------------------------|---|
| S3238 | Model number S3238 |
| PA | Sensing element from table |
| Y | Number of leads: ▼Y = 2 leads (not available on CA) ▼Z = 3 leads X = 4 leads |
| T | Lead insulation: ▼T = PTFE ▼TS = SS braid over PTFE |
| 36 | Lead length in inches: ▼: 36, 240 |
| U | Lead configuration: ▼T = Twisted ▼U = Untwisted |
| A | Adhesive backing: ▼A = No adhesive ▼B = Pressure-sensitive adhesive (PSA) |
| S3238PAYT36UA = Sample part number | |



STOCKED PARTS AVAILABLE

THERMAL-
RIBBONS

Note: Available up to 10 pieces or contact Minco Customer Service

▼ = STANDARD OPTIONS

Specifications subject to change



Thermistor Thermal-Tab™

Overview

Model TS665 and TS667 offer extremely sensitive NTC thermistors for applications with small temperature changes. Model TS667 also features waterproof construction, making it suitable for continuous immersion.

Specifications

| Dimensions W x L x T _{max} | Element options | Insulation | Temp. range | Leadwires | Time constant | Feature | Model |
|---|-----------------|---|--------------------------------|----------------------------|---------------|---|--------|
| 0.20 x 0.47 x 0.079" (5.0 x 12.0 x 2.0 mm) | TF, TK | Polyimide with elastomer cover coat | -50 to 125°C (-58 to 257°F) | AWG 26, PTFE insulated | 0.8 sec. | Small, low-cost | ▼TS665 |
| 0.20 x 0.60 x 0.118" (5.0 x 15.2 x 3.0 mm) | | Silicone rubber with elastomer cover and foil backing | | AWG 24, Silicone insulated | 1.3 sec. | Waterproof, suitable for continuous immersion | ▼TS667 |

Notes: T_{max} is measured over the lead bulge. TS665 is suitable for the CT325 temperature controller (page 4-20). *Time constant is in water at 1 m/sec.

Sensing elements

| Sensing element specifications** | Code |
|----------------------------------|------|
| NTC thermistor 50k Ω ±1% at 25°C | ▼TF |
| NTC thermistor 10k Ω ±1% at 25°C | ▼TK |

** See table above for element options on each model.

Specification and order options

| | |
|-----------------------------------|---|
| TS665 | Model number from table |
| TF | Sensing element from table |
| Y | Number of leads: Y = 2 leads |
| 40 | Lead length in inches: ▼40" (60" max.) |
| A | Adhesive backing: ▼A = No adhesive B = Pressure-sensitive adhesive (PSA) |
| C | Compliance: C = RoHS compliant |
| TS665TFY40AC = Sample part number | |

Note: PSA reduces temp. range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.



STOCKED PARTS AVAILABLE

Thermocouple Thermal-Ribbon™

Overview

TC40 is a patch-style thermocouple that adheres to all types of surfaces for quick and easy mounting.

Specifications

| | |
|--|--|
| Dimensions W x L x T _{max} | 0.75 x 0.75 x 0.065" (19.1 x 19.1 x 1.7 mm) |
| Junction type | E, J, K, or T |
| Insulation | Polyimide |
| Temp. range | -200 to 200°C (-328 to 392°F) |
| Leadwires | AWG 24, solid PTFE insulated |
| Time constant | 0.6 sec. |
| Features | Surface mounting |
| Model | TC40 |

Notes: T_{max} is measured over the lead bulge.

*Time constant is in water at 1 m/sec.

Specification and order options

| | |
|--------------------------------|--|
| TC40 | Model number |
| J | Junction type: E, ▼J, ▼K, or ▼T |
| T | Covering over leadwires: ▼T = PTFE only S = Stainless steel braid |
| 40 | Lead length in inches: ▼: 40, 240 |
| A | Adhesive backing: A = No adhesive B = Pressure-sensitive adhesive (PSA) |
| TC40JT36A = Sample part number | |

Note: PSA reduces temperature range to -20 to 177°C (-4 to 350°F) and adds 0.005" (0.1 mm) to thickness.

▼ = STANDARD OPTIONS
Specifications subject to change

Thermal-Ribbon Installation and Accessories

Thermal-Ribbons lend themselves to a variety of installation methods. You should avoid repeated bending during the installation process, and Thermal-Ribbons should not flex in use unless they are specifically designed to do so. Take care to secure leadwires so they do not pull against sensor bodies. Leadwires should be routed along the sensed surface a short distance so that they do not sink heat away from the sensing element. Listed below are some standard installation methods.

Pressure sensitive adhesive

PSA (option B in part number) is the simplest mounting method, but it is restricted to flat surfaces and temperatures below 177°C (350°F). PSA is usually factory applied to the mounting surface of the Thermal-Ribbon. To install, just remove the backing paper and press in place.

#20 stretch tape

High temperature silicone rubber tape for mounting Thermal-Ribbons to pipes or other cylinders as shown above. It comes in 1" wide rolls, 6 or 36 feet long.



Thermal Ribbons for pipe sensing

Thermal Ribbons make a practical, economical alternative to traditional immersed sensors for sensing fluid temperatures in pipes or tanks. They mount directly on pipe surfaces, so there is no need to tap and drain systems to install thermowells. If the Thermal-Ribbon is installed correctly, tests show that the thermal response is as quick and accurate as traditional invasive sensors. See page 8-7 for Thermal-Ribbons specially designed for pipe sensing.

#6 RTV cement

Room temperature vulcanizing cement for mounting silicone rubber Thermal-Ribbons to flat or curved surfaces. It is available in 3 oz. (89 ml) tubes. Contact Minco for other adhesives usable with Kapton™ or Mylar™ Thermal-Ribbons.

Shrink bands

Minco shrink bands are pre-stretched plastic strips with adhesive at both ends. Use them to mount Thermal-Ribbons to cylinders. Simply wrap the band around the sensor and cylinder, secure the ends, and heat to shrink in place. To order, specify band width and cylinder diameter.

#21 Polyimide tape

High temperature tape with silicone-based adhesive. Useful for quick mounting of Thermal-Ribbon or Thermal-Tab sensors to flat surfaces. Makes a strong but removable bond to most smooth and clean surfaces. Maximum operating temperature is 150°C. 0.5 inch wide x 108 ft. long roll.



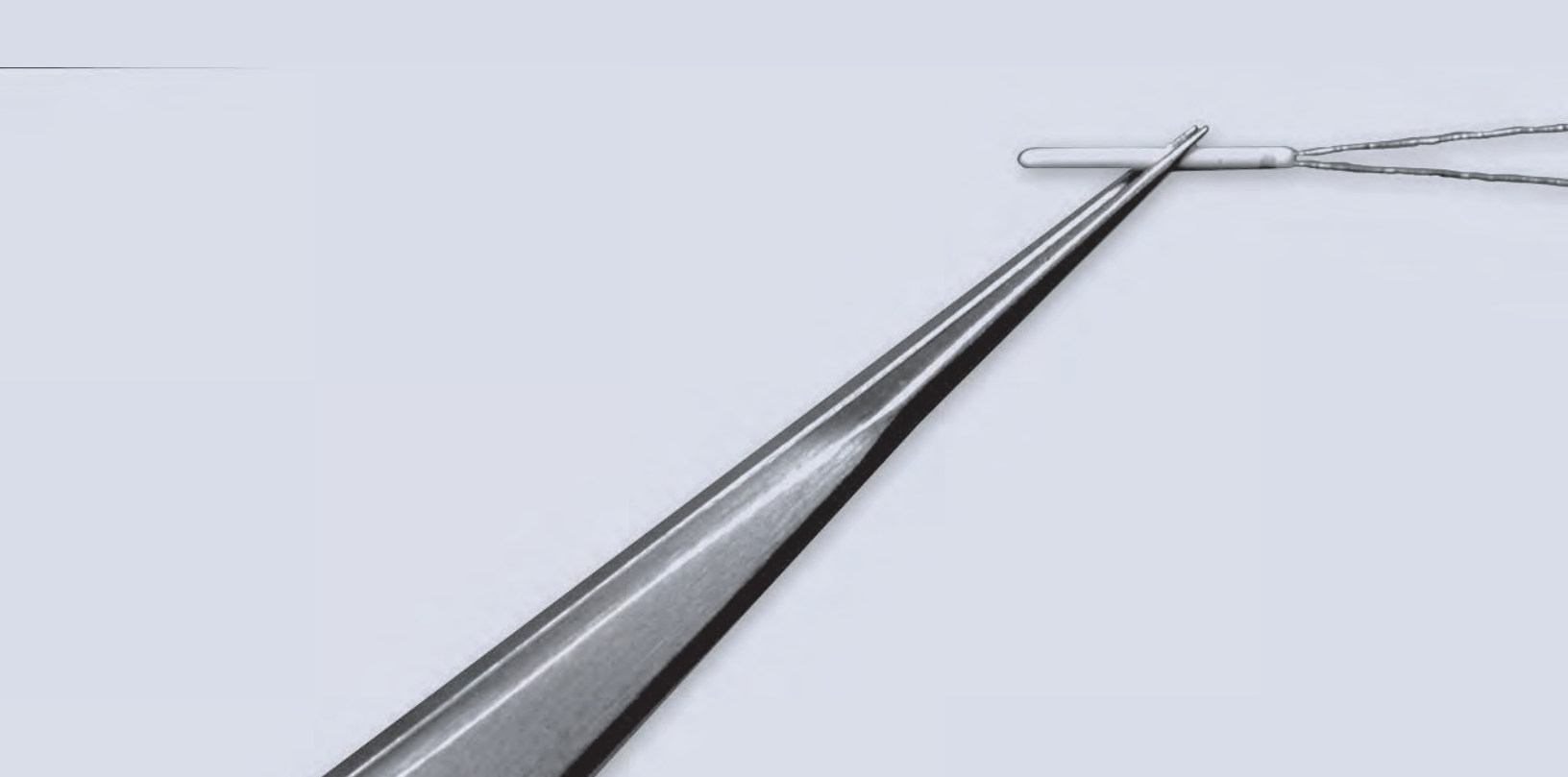
Minco manufactures flexible Thermofoil™ etched-foil heaters for precision temperature control of critical applications. We can integrate heaters with Thermal-Ribbons and other sensors and controllers to provide complete turnkey thermal solutions.

Learn more about Thermofoil heater solutions at www.minco.com

Thermal-Ribbons

Specifications subject to change





▶ SECTION 10: ELEMENTS

- Accurate sensing from -200 to 600°C (-328 to 1112°F)
- Wide choice of sizes and styles for application versatility
- Low cost thin-film elements
- Wire wound elements

| | |
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Wire-wound & Thin-film Elements

Overview: Wire-wound Elements

Use these elements for general purpose sensing in probes or equipment. PD models meet EN60751, Class B.

Specifications

Temperature range: See table below. Some elements may be used down to -269°C in certain applications. Contact factory for advice on cryogenic use.

Element Body: Glass-coated ceramic

Resistance Tolerance: ± 0.1% at 0°C

Lead Length Tolerance: ± 0.4" (10.2mm)

TCR: 0.00385 Ω/Ω/°C

Element Diameter tolerance: ±0.005" (0.13 mm)

Element Length tolerance: ±0.06 (1.5 mm)

Repeatability: ±0.1°C or better

Stability: Drift less than 0.1°C/year (normal use)

Vibration: Withstands 20 G's minimum at 10 to 2,000 Hz.

Shock: Withstands 100G's minimum sine wave shock of 8 milliseconds duration

Overview: Thin-film Elements

Thin film elements offer low cost and resistances to 10k Ω.

Specifications

Tolerance: ±0.12% (EN60751 Class B) To order optional ±0.06% tolerance (EN60751 Class A), change 12 to 06 for ±0.06% (EN60751 Class A). Not available with S101162PD, S101163PF, or S19827PS.

Material: Aluminum oxide substrate with fused glass cover.

Dimensional tolerance:

400, 600°C elements: ±0.02" (0.5 mm).

SMT models: Length x Width ±0.008 (0.2 mm),

Thickness ±0.004 (0.1 mm).

TCR: 0.00385 Ω/Ω/°C.






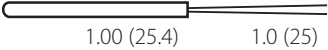
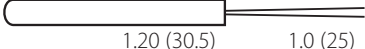
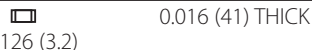
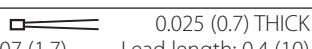


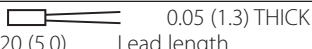
Repeatability: ±0.1°C or better.

Stability: Drift less than 0.1°C/year in normal use.

Vibration: Withstands 20 G's minimum at 10 to 2,000 Hz.

Shock: Withstands 100 G's minimum sine wave shock of 8 milliseconds duration.

Order options: order part number from table.

| Dimensions in inches (mm) | R (0°C) | Temp. range | Leads | Model |
|--|---------|--|--|---------------|
| 550°C wire-wound elements | | | | |
| 0.040 ø (1.020)  | 100 Ω | -20 to 550°C (-4 to 1022°F) | 0.006" (0.15 mm) ø Platinum | ▼ S200PD |
| 0.058 ø (1.47)  | | | 0.010" (0.25 mm) ø Platinum clad palladium | ▼ S201PD |
| 0.077 ø (1.96)  | | | ▼ S202PD | |
| 0.100 ø (2.54)  | | | ▼ S203PD | |
| 0.135 ø (3.43)  | | | S204PD | |
| 0.077 ø (1.96)  | | | ▼ S212PG | |
| 0.135 ø (3.43)  | | | ▼ S214PG | |
| 400°C and 600°C thin-film elements | | | | |
| 0.063 (1.6)  0.016 (41) THICK | 100 Ω | -50 to 150°C (-58 to 302°F) SMT (surface mount technology) | Solder contacts: Tin plated, 0.020" (.51 mm) | ▼ S101162PD |
| | 1000 Ω | | | ▼ S101163PF |
| 0.05 (1.3)  0.025 (0.7) THICK Lead length: 0.4 (10) | 100 Ω | -50 to 400°C (-58 to 752°F) | 0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead | ▼ S100144PD12 |
| | 1000 Ω | | | ▼ S101503PF12 |
| 0.10 (2.5)  0.04 (1.1) THICK Lead length: 0.6 (15) | 10000 Ω | -70 to 400°C (-94 to 752°F) | 0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead | ▼ S19827PS12 |
| | 100 Ω | | | ▼ S245PD12 |
| 0.08 (2.0)  0.05 (1.3) THICK Lead length S245: 0.6 (15) S249: 0.4 (10) | 100 Ω | -70 to 600°C (-94 to 1112°F) | 0.008" (0.20 mm) ø Pt/Ni .003 Ω / mm / lead | ▼ S249PD12 |
| | 1000 Ω | -70 to 400°C (-94 to 752°F) | 0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead | ▼ S247PF12 |
| 0.08 (2.0)  0.05 (1.3) THICK Lead length S247: 0.6 (15) S251: 0.4 (10) | 1000 Ω | -70 to 600°C (-94 to 1112°F) | 0.008" (0.20 mm) ø Pt/Ni .003 Ω / mm / lead | ▼ S251PF12 |

Note: Contact Minco Customer Service for quantities available

Specifications subject to change

Installation & Accessories

Installation

Ceramic elements can be assembled into probes or potted inside holes in heat sinks and platens. Ceramic cement is recommended for high temperature potting. Epoxy is recommended for intermediate temperatures.

Round elements provide the best time response in round sheaths and holes. Flat thin film elements can be bonded to surfaces.

Elements are calibrated at the end of their leads. The leads have resistances ranging from 0.6 to 2.4 Ω per foot, so you should connect extension leads as close as possible to the end of the element leads to maintain tolerance.

Minco can supply elements with extension leadwires welded onto the sensor leads. Use the standard models below or contact us for a quote on your custom design.

One final note: Ceramic elements are fragile and can suffer damage or loss of accuracy from improper installation. In many cases, the best alternative is to buy a complete encased probe assembly from Minco. Take advantage of our expertise and equipment for best overall performance and value.

#8 high temperature cement

#8 comes as a powder in 1 oz. packages. Just add water to form a potting compound rated to 850°C (1562°F).



Extension leads

Extension leads

All elements are available with factory-welded extension leads insulated with PTFE, polyimide, or mica/glass.

Model AC887

Insulation: PTFE, FEP tubing over connections

Maximum temperature: 200°C (392°F).

| Lead AWG | Maximum diameter over lead bundle in inches (mm) | | |
|-------------|--|------------|------------|
| | 2 leads | 3 leads | 4 leads |
| 22 | 0.15 (3.8) | 0.16 (4.0) | 0.18 (4.6) |
| 24 | 0.14 (3.5) | 0.14 (3.5) | 0.17 (4.3) |
| 26 | 0.13 (3.3) | 0.14 (3.5) | 0.14 (3.5) |
| 28 | 0.13 (3.3) | 0.13 (3.3) | 0.13 (3.3) |
| 30 | 0.11 (2.8) | 0.12 (3.0) | 0.12 (3.0) |

Model AC888

Insulation: Mica/glass, glass braid over connections

Maximum temperature: 550°C (1022°F).

| Lead AWG | Maximum diameter over lead bundle in inches (mm) | | |
|-------------|--|------------|------------|
| | 2 leads | 3 leads | 4 leads |
| 22 | 0.16 (4.0) | 0.20 (5.1) | 0.20 (5.1) |

Model AC889

Insulation: Polyimide, FEP tubing over connections

Maximum temperature: 200°C (392°F).

| Lead AWG | Maximum diameter over lead bundle in inches (mm) | | |
|-------------|--|------------|------------|
| | 2 leads | 3 leads | 4 leads |
| 22 | 0.14 (3.5) | 0.16 (4.0) | 0.17 (4.3) |
| 26 | 0.13 (3.3) | 0.15 (3.8) | 0.15 (3.8) |
| 30 | 0.11 (2.8) | 0.12 (3.0) | 0.12 (3.0) |

Model AC101828

Insulation: Glass braid, glass braid over connections

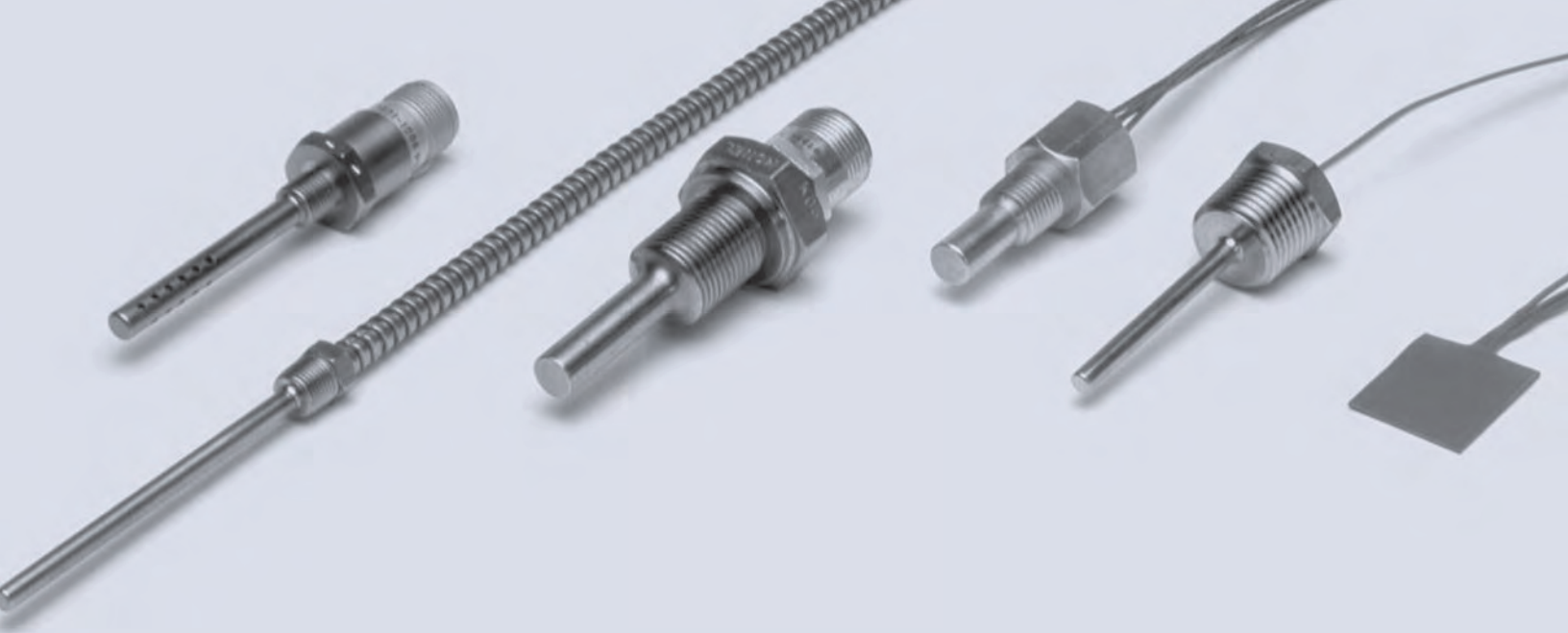
Maximum temperature: 550°C (1022°F).

| Lead AWG | Maximum diameter over lead bundle in inches (mm) | | |
|----------------------|--|------------|------------|
| | 2 leads | 3 leads | 4 leads |
| 27 solid leads | 0.10 (2.5) | 0.12 (3.0) | 0.13 (3.3) |

Extension lead specification and order options

| | |
|----------------------------------|---|
| AC887 | Model number |
| Z | Number of leads: Y = 2 leads Z = 3 leads X = 4 leads |
| 26 | Lead gauge (AWG) |
| L | |
| 48 | Lead length in inches |
| AC887Z26L48 = Sample part number | |

▼ = **STANDARD OPTIONS**
Specifications subject to change



► SECTION 11: TECHNICAL INFORMATION

| | |
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Your Sensors & Instruments Product Guide

How To Get Started

1. Understand and define your application requirements

Many factors should be a part of the sensor system design process. The factors listed below can help you define the sensing requirements for your application.

Define the typical and extremes of these environmental conditions:

- minimum and maximum temperatures
- pressure
- humidity
- shock
- vibration
- flow rate

Also ask:

- What is the sensed medium (a surface or immersed in solid, liquid or gas)?
- Is the medium chemically reactive (corrosive) or hazardous (explosive)?
- Is there high electromagnetic interference potential from power switching, rectification, or radio waves?

Finally, define the significance of these performance specifications in your application?

- sensing accuracy at a calibration point and/or over a temperature span
- repeatability
- stability
- sensor time constant
- insulation resistance

2. Determine which sensing technology options meet your requirements

Several potential sensing technologies may meet the essential environmental and performance specifications of your application. This section of the *Sensors and Instruments Product Guide* will provide you with a basic understanding of Minco's sensing and instrumentation technology. For more information go to www.minco.com.



3. Compare sensor construction alternatives for best fit and ease of use

While a sensing technology may appear to be capable of meeting the requirements of your application, the actual sensor packaging and construction must be evaluated in order to select the optimal cost/performance balance from the available technology options.

Regardless of which sensing technology you consider, the packaging of the sensor introduces some level of specification compromise in terms of cost, performance or durability. Use this guide to compare Minco's various sensor constructions and instrumentation solutions to find the best fit for your application.

4. Obtain parts for testing as prototypes in your application

Minco has a wide selection of standard sensor components that can often be used for prototype testing and production systems. We would appreciate the opportunity to discuss your application with you. We can help ensure that the right sensor construction is selected for your application as well as any accessory components. Often times, we are able to offer recommendations for customization to improve performance and/or lower installed cost.

Order sensors and instruments easily online with our Sensors Configurator at www.minco.com or contact Minco Sales and Customer Service today to talk to an engineer about your application.

Many Industry Applications

Process Control and Building Automation

Minco temperature and humidity sensors and instruments are used in process and HVAC/R applications in the most critical environments. Our sensing solutions achieve the lowest total cost of ownership (TCO) while maintaining accuracy, reliability and ease of installation.



The Thermal-Vial Temperature Sensing System encompasses a wire-wound RTD element capable of -200°C operation to provide accurate measurement and documentation of freezing, process and storage methodology.

Machinery and Motor Protection

Minco RTDs and Thermocouples are used worldwide to safeguard valuable rotating apparatus machinery. Accurate and fast-responding temperature measurement provides overtemperature protection, and our sensors can be manufactured to integrate with any instrumentation package.

Bearing and stator sensors provide accurate sensing in this motor component while Minco's 12-channel temperature monitor (CT224) provides easy and efficient thermal protection.



Defense and Aerospace

Minco temperature sensors are used when ruggedness and reliability are key to an applications success. Our sensors can be manufactured to fit in the smallest spaces or across wide expanses. Fast time response and wide temperature capabilities (from -260°C to 650°C) handle nearly any type of harsh or extreme environment.

RTDs monitor the temperature of a heated windshield.



Flexible Thermal-Ribbons sense wing surface temperatures for wing surface de-icing.

Temperature sensors in hydraulic lines monitor fluid temperatures to prevent overheating.

Industrial and Commercial Equipment

Minco products are manufactured to provide dependability and repeatability in any application. Our sensors and instruments are used in industrial and commercial equipment to ensure accurate process and quality output.

Fast response RTDs monitor oil temperature for perfect cooking results.



Designed for Optimal Performance

Minco offers the perfect fit for any temperature and humidity sensing application. From miniature detectors to 100 foot averaging thermometer and heavy duty probe assemblies, our selection lets you choose the best model for your needs.



Sensing technology options provide flexibility

Minco can supply sensors to work with nearly any type of instrument option.

- Resistance Temperature Detectors (RTDs)
 - Platinum RTDs with wide range of TCRs
 - Range from 0.00375 to 0.003927
 - 0.00385 (Minco element "PD") is most popular
 - Nickel, copper, and nickel-iron RTD elements
 - Non-standard resistance-temperature curves
 - Base resistances up to thousands of ohms
 - Thin film or wire wound constructions
- Thermistor temperature sensors
- Thermocouple temperature sensors
- Integrated Circuit temperature sensors
- High accuracy humidity sensors and transmitters
- Signal conditioning
 - Linearizing transmitters with 4 to 20 mA, 1 to 5 VDC or other voltage/current outputs, and HART® Protocol
- Explosionproof temperature and humidity sensor and transmitter assemblies
- Controllers, monitors and alarms for optimal compatibility with sensors

From simple elements to complex assemblies

Minco can configure a sensor style to best fit your application and capabilities:

- Basic sensing elements for assembly into your own housing or protective sheath
- Addition of leadwires and terminations to elements
- Packaging into protective sheaths, laminates, custom housings, cabling
- Bendable case designs or preformed to your specifications
- Assembly with fittings, connection heads, thermowells, connectors, feedthroughs

- Assembly with signal conditioning electronics, standard or customized
- Certified measurement and test in our metrology lab
- Certified designs for hazardous locations

Machining and materials

A sensor's construction has a large impact on its thermal time response and resistance to corrosive media. Minco has an advanced machine shop with CAD/CAM capability for economic production of cases and fittings.

We have extensive machining capabilities in a variety of materials:

- Stainless steel in various grades
- Copper
- Hastelloy
- Rubber, PTFE, plastics
- Brass
- Monel
- Titanium

We can plate with nickel, gold, and other metals. Additional services include electro-polishing, passivating, and pressure testing.

Leadwires

Sensors may be furnished with many different types of leadwire and cables to meet application parameters:

- PTFE, silicone rubber, polyimide, Tefzel, PVC, mica/glass, and glass braid insulation over silver or nickel plated copper wire are common selections or specify your own leadwire or cable requirements
- Stainless steel overbraid or flexible armor
- Flat ribbon leads or sensor/flex circuit hybrids

Lamination

Minco's winding and lamination technology enables manufacture of flat, flexible sensors in any size or shape. The custom Thermal-Ribbon™ below has a wire element to average temperatures over its entire area.



Testing

Minco has complete in-house testing and metrology equipment to meet stringent quality requirements:

- NIST traceable calibrations
- Hydrostatic testing of thermowells
- Helium leak testing
- Automated resistance measurement
- Humidity testing

Designing for accuracy

How accurate is a temperature sensor? To many, the answer to this question is the sensor's interchangeability specification. For example, 100 Ω platinum RTDs are typically interchangeable within 0.1 Ω (0.3°C) at 0°C.

But interchangeability only tells how closely the electrical characteristics of a sensor conform to its published tables. What you really want to know is how much the temperature seen at your readout or controller deviates from the actual temperature of the material you are sensing. Interchangeability is only one of the potential sources of error in the system, and it is usually not the largest. Following are some other error modes along with suggested solutions.

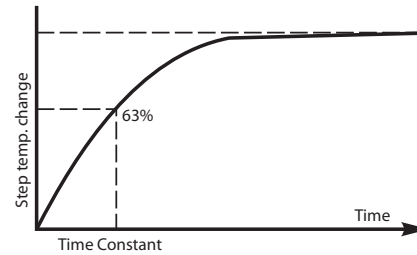
Repeatability/stability: Repeatability tells how well the sensor repeats subsequent readings at the same temperature. Stability is the absence of long term drift. In many cases, the user is less concerned with absolute accuracy than with the ability of a sensor to maintain a process at the same point once properly set.

Solution: Platinum RTDs are the most stable sensor in common use and are used to interpolate over the standard temperature scale from -260 to 962°C. Ordinary industrial models will drift less than 0.1°C per year in normal use.

Time lag: When temperatures change rapidly, sensors may not keep up.

Solution: Minco specializes in fast response RTDs. Most models in this guide have a time constant of 2 seconds or less. Certain custom-designed models are faster yet.

Time constant is defined as the time it takes a sensor to reflect 63% of a step temperature change:



Conduction errors: Heat conducted into sensors from ambient air alters the temperature of the sensing tip.

Solution: Use smaller sensors or tip-sensitive probes, and be sure they are sufficiently immersed or embedded in the sensed medium.

Point sensing errors: In places where temperatures are stratified or gradients are large, the temperature at a single point may be unrepresentative or misleading.

Solution: Use temperature averaging probes or Thermal-Ribbons.

Leadwire resistance: Resistance in the leads between RTDs and control points elevates apparent readings.

Solutions:

- Specify sensors with higher resistances.
- Use 3 or 4-wire compensating circuits (see page 11-9).
- Eliminate leadwire effects with a 4 to 20 mA transmitter.

Self-heating: The measuring current through an RTD can raise its temperature above the true value.

Solution: As a general rule, limit current to 5 mA for industrial applications. Most Minco RTDs, and especially Thermal-Ribbons, have a large surface area to dissipate heat and reduce self-heating effects.

Custom designs

If you have special requirements - or an OEM design - Minco can typically manufacture a custom sensor solution to improve accuracy and reduce cost at the same time. Contact Minco Sales and Customer Service today to discuss your application.

Temptran™ Transmitter Solutions



Why use Temptrans?

Long distance accuracy

Temptran transmitters amplify the low-level signals from RTDs or thermocouples to an industry-standard 4 to 20 mA current signal proportional to temperature or HART® Protocol/output. Unlike resistance or voltage, current signals are immune to resistance in extension wires and stray electrical noise. This lets you receive accurate signals from a sensor located thousands of feet away.

The 4 to 20 mA or HART® output signal and DC power share the same wire pair. You don't need to run power wires to every sensor location. In fact, using HART® transmitters configured in multidrop mode, up to 15 transmitters can be connected in parallel on the same pair of wires.

RTD transmitters also linearize the signal to temperature, making them excellent low cost signal conditioners. Their signal increases from 4mA at the lowest temperature to 20mA at the highest temperatures.

Engineered for reliability

Over 500,000 Minco transmitters are currently giving trouble-free service in installations around the world. Two factors behind Temptran's exceptional stability and longevity are:

- Minco encapsulates all electronics in epoxy to exclude contaminants and protect components.
- Standard fixed-range transmitters feature $\pm 5\%$ adjustability using 20 turn trimpots. Because a complete rotation of the trimpot represents only 0.25% of the adjustment range, slight movements from mechanical shock cause only negligible output change. In contrast, many competitive transmitters have wide ranging zero and span. With zero and span far more sensitive to potentiometer shifts, a minor bump can void the transmitter's calibration.

See Section 4 for complete details and ordering information.

Easy to install

Compact Temptrans fit nearly anywhere. You can install most models in standard electrical utility boxes and elbows. Or Minco offers a complete selection of complementary connection heads in Section 3.

Intrinsic safety

Most Temptrans are rated intrinsically safe by Factory Mutual (FM), a recognized testing authority for safety in hazardous areas. Division 1 installations must include a suitable barrier. Go to www.minco.com for a list of barriers FM approved under the system concept for use with Temptrans.

Special high-accuracy calibration

Standard transmitters can be calibrated to the nominal resistance values of the RTD at the zero and span points. Total system error includes the tolerance of both the transmitter and the RTD sensor. If you order Minco Temptrans match calibrated to the actual resistance of the RTD (traceable to NIST), this effectively eliminates the sensor tolerance from the system accuracy specifications.

Temptrans match calibrated to a sensor are always ordered as assemblies. Common examples are shown in Section 1.

For example, consider a transmitter with a range of 0 to 500°C. The transmitter itself is accurate to $\pm 1.0^\circ\text{C}$ ($\pm 0.2\%$ of span, including calibration accuracy and linearity). The RTD interchangeability contributes an additional error of $\pm 0.3^\circ\text{C}$ at 0°C and $\pm 2.8^\circ\text{C}$ at 500°C. Total system error would be $\pm 1.3^\circ\text{C}$ at 0°C and $\pm 3.8^\circ\text{C}$ at 500°C. Calibration of the sensor and transmitter as a set cancels the sensor error, reducing system error to $\pm 1.0^\circ\text{C}$ over the full range — all for a nominal extra cost. Get more information on page 4-22.

RTD, Thermocouple, or Thermistor?

Resistance temperature detectors (RTDs)

An RTD sensing element consists of a wire coil or deposited film of pure metal. The element's resistance increases with temperature in a known and repeatable manner. RTDs exhibit excellent accuracy over a wide temperature range and represent the fastest growing segment among industrial temperature sensors. Their advantages include:

- **Temperature range:** Minco models cover temperatures from -260 to 650°C (-436 to 1202°F).
- **Repeatability and stability:** The platinum resistance thermometer is the primary interpolation instrument used by the National Institute of Standards and Technology from -260 to 962°C. Ordinary industrial RTDs typically drift less than 0.1°C/year.
- **Sensitivity:** The voltage drop across an RTD provides a much larger output than a thermocouple.
- **Linearity:** Platinum and copper RTDs produce a more linear response than thermocouples or thermistors. RTD non-linearities can be corrected through proper design of resistive bridge networks.
- **Low system cost:** RTDs use ordinary copper extension leads and require no cold junction compensation.
- **Standardization:** Manufacturers offer RTDs to industry standard curves, most commonly 100 Ω platinum to EN60751 (Minco element code PD or PM).

Thermocouples

A thermocouple consists of two wires of dissimilar metals welded together into a junction. At the other end of the signal wires, usually as part of the input instrument, is another junction called the reference junction, which is electronically compensated for its ambient temperature. Heating the sensing junction generates a thermoelectric potential (emf) proportional to the temperature difference between the two junctions. This millivolt-level emf, when compensated for the known temperature of the reference junction, indicates the temperature at the sensing tip.

Thermocouples are simple and familiar. Designing them into systems, however, is complicated by the need for special extension wires and reference junction compensation. Thermocouple advantages include:

- **Extremely high temperature capability:** Thermocouples with precious metal junctions may be rated as high as 1800°C (3272°F).

- **Ruggedness:** The inherent simplicity of thermocouples makes them resistant to shock and vibration.
- **Small size/fast response:** A fine-wire thermocouple junction takes up little space and has low mass, making it suitable for point sensing and fast response. Note, however, that many Minco RTDs have time constants faster than equivalent thermocouples.

Thermistors

A thermistor is a resistive device composed of metal oxides formed into a bead and encapsulated in epoxy or glass. A typical thermistor shows a large negative temperature coefficient. Resistance drops dramatically and non-linearly with temperature. Sensitivity is many times that of RTDs but useful temperature range is limited. Some manufacturers offer thermistors with positive coefficients. Linearized models are also available.

There are wide variations of performance and price between thermistors from different sources. Typical benefits are:

- **Low sensor cost:** Basic thermistors are quite inexpensive. However, models with tighter interchangeability or extended temperature ranges often cost more than RTDs.
- **High sensitivity:** A thermistor may change resistance by tens of ohms per degree temperature change, versus a fraction of an ohm for RTDs.
- **Point sensing:** A thermistor bead can be made the size of a pin head for small area sensing.

| | RTD | Thermocouple | Thermistor |
|--------------|--|--|---|
| Temp. range | -260 to 850°C (-436 to 1562°F) | -270 to 1800°C (-454 to 3272°F) | -80 to 150°C (-112 to 302°F) (typical) |
| Sensor cost | Moderate | Low | Low |
| System cost | Moderate | High | Moderate |
| Stability | Best | Low | Moderate |
| Sensitivity | Moderate | Low | Best |
| Linearity | Best | Moderate | Poor |
| Specify for: | <ul style="list-style-type: none"> • General purpose sensing • Highest accuracy • Temperature averaging | <ul style="list-style-type: none"> • Highest temperatures | <ul style="list-style-type: none"> • Best sensitivity • Narrow ranges (e.g. medical) • Point sensing |

Choosing Sensor Elements

RTD element types

Platinum is the most widely specified RTD element type due to its wide temperature range, stability, and standardization between manufacturers. Copper, nickel, and nickel-iron can offer comparable accuracy at lower cost in many applications.

| Element material | Temperature range | Benefits | Typical base resistance | Sensitivity (Avg. $\Omega/^\circ\text{C}$, 0 to 100 $^\circ\text{C}$) | TCR $\Omega/\Omega/^\circ\text{C}$ |
|------------------|--|--|--|---|------------------------------------|
| Platinum | -260 to 650 $^\circ\text{C}$ (-436 to 1202 $^\circ\text{F}$) | <ul style="list-style-type: none"> Greatest range Best stability Good linearity | 100 Ω at 0 $^\circ\text{C}$ 1000 Ω at 0 $^\circ\text{C}$ | 0.39 3.90 | 0.00375 to 0.003927 |
| Copper | -100 to 260 $^\circ\text{C}$ (-148 to 500 $^\circ\text{F}$) | <ul style="list-style-type: none"> Best linearity | 10 Ω at 25 $^\circ\text{C}$ | 0.04 | 0.00427 |
| Nickel | -100 to 260 $^\circ\text{C}$ (-148 to 500 $^\circ\text{F}$) | <ul style="list-style-type: none"> Low cost High sensitivity | 100 Ω at 0 $^\circ\text{C}$ 120 Ω at 0 $^\circ\text{C}$ | 0.62 0.81 | 0.00618 0.00672 |
| Nickel-iron | -100 to 204 $^\circ\text{C}$ (-148 to 400 $^\circ\text{F}$) | <ul style="list-style-type: none"> Low cost Highest sensitivity | 604 Ω at 0 $^\circ\text{C}$ 1000 Ω at 70 $^\circ\text{F}$ 2000 Ω at 70 $^\circ\text{F}$ | 3.13 4.79 9.58 | 0.00518 to 0.00527 |

RTD and thermistor interchangeability

The tables below show temperature tolerance — the allowable deviation from nominal curves — for RTDs and thermistors in this guide. Minco can supply sensors with tighter overall tolerance, or with the narrowest tolerance at a point other than 0 $^\circ\text{C}$.

| Temperature $^\circ\text{C}$ | Interchangeability | | | | | | |
|------------------------------|--|---|-----------------------------|-----------------------------|----------------------------|-----------------------------|------------------------------|
| | Platinum RTD | | | | | | |
| | 0.06% at 0 $^\circ\text{C}$ (Class A) | 0.1% at 0 $^\circ\text{C}$ (Class B) | 0.22% at 0 $^\circ\text{C}$ | 0.36% at 0 $^\circ\text{C}$ | 0.5% at 0 $^\circ\text{C}$ | 0.1% at 70 $^\circ\text{F}$ | 0.24% at 70 $^\circ\text{F}$ |
| -200 | $\pm 0.55^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | | | $\pm 2.1^\circ\text{C}$ | | |
| -100 | $\pm 0.35^\circ\text{C}$ | $\pm 0.8^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | | $\pm 1.7^\circ\text{C}$ | | |
| 0 | $\pm 0.15^\circ\text{C}$ | $\pm 0.3^\circ\text{C}$ | $\pm 0.5^\circ\text{C}$ | $\pm 0.9^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | $\pm 0.3^\circ\text{C}$ | $\pm 0.7^\circ\text{C}$ |
| 20 | $\pm 0.19^\circ\text{C}$ | $\pm 0.4^\circ\text{C}$ | $\pm 0.7^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | $\pm 1.6^\circ\text{C}$ | $\pm 0.3^\circ\text{C}$ | $\pm 0.6^\circ\text{C}$ |
| 100 | $\pm 0.35^\circ\text{C}$ | $\pm 0.8^\circ\text{C}$ | $\pm 1.8^\circ\text{C}$ | $\pm 2.3^\circ\text{C}$ | $\pm 2.9^\circ\text{C}$ | $\pm 0.7^\circ\text{C}$ | $\pm 1.1^\circ\text{C}$ |
| 200 | $\pm 0.55^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | $\pm 3.1^\circ\text{C}$ | $\pm 3.7^\circ\text{C}$ | $\pm 4.4^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | $\pm 1.8^\circ\text{C}$ |
| 260 | $\pm 0.67^\circ\text{C}$ | $\pm 1.6^\circ\text{C}$ | $\pm 3.7^\circ\text{C}$ | $\pm 4.6^\circ\text{C}$ | $\pm 5.5^\circ\text{C}$ | | |
| 300 | $\pm 0.75^\circ\text{C}$ | $\pm 1.8^\circ\text{C}$ | | | | | |
| 400 | $\pm 0.95^\circ\text{C}$ | $\pm 2.3^\circ\text{C}$ | | | | | |
| 500 | $\pm 1.15^\circ\text{C}$ | $\pm 2.8^\circ\text{C}$ | | | | | |
| 600 | $\pm 1.35^\circ\text{C}$ | $\pm 3.3^\circ\text{C}$ | | | | | |
| 700 | | $\pm 3.8^\circ\text{C}$ | | | | | |
| 800 | | $\pm 4.3^\circ\text{C}$ | | | | | |
| 850 | | $\pm 4.6^\circ\text{C}$ | | | | | |

| Temperature $^\circ\text{C}$ | Interchangeability | | | | | | | | | |
|------------------------------|---------------------------------------|---------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|--------------------------------------|---------------------------------------|--|--|--------------------------------------|
| | Copper RTD | | Nickel RTD | | Nickel-iron RTD | | | | Thermistor | |
| | $\pm 0.2\%$ at 25 $^\circ\text{C}$ | $\pm 0.5\%$ at 25 $^\circ\text{C}$ | $\pm 0.3\%$ at 25 $^\circ\text{C}$ | $\pm 0.5\%$ at 0 $^\circ\text{C}$ | $\pm 0.26\%$ at 0 $^\circ\text{C}$ | $\pm 0.5\%$ at 0 $^\circ\text{C}$ | $\pm 0.5\%$ at 25 $^\circ\text{C}$ | $\pm 0.12\%$ at 70 $^\circ\text{F}$ | $\pm 0.25\%$ at 70 $^\circ\text{F}$ | $\pm 0.1\%$ at 0 $^\circ\text{C}$ |
| -100 | $\pm 1.5^\circ\text{C}$ | $\pm 2.2^\circ\text{C}$ | | | | $\pm 2.5^\circ\text{C}$ | $\pm 2.9^\circ\text{C}$ | | | |
| 0 | $\pm 0.7^\circ\text{C}$ | $\pm 1.5^\circ\text{C}$ | $\pm 0.5^\circ\text{C}$ | $\pm 0.8^\circ\text{C}$ | $\pm 0.6^\circ\text{C}$ | $\pm 1.1^\circ\text{C}$ | $\pm 1.4^\circ\text{C}$ | $\pm 0.5^\circ\text{C}$ | $\pm 1.4^\circ\text{C}$ | $\pm 0.2^\circ\text{C}$ |
| 20 | $\pm 0.5^\circ\text{C}$ | $\pm 1.3^\circ\text{C}$ | $\pm 0.8^\circ\text{C}$ | $\pm 1.2^\circ\text{C}$ | $\pm 0.8^\circ\text{C}$ | $\pm 1.4^\circ\text{C}$ | $\pm 1.2^\circ\text{C}$ | $\pm 0.3^\circ\text{C}$ | $\pm 0.7^\circ\text{C}$ | $\pm 0.2^\circ\text{C}$ |
| 100 | $\pm 1.5^\circ\text{C}$ | $\pm 2.5^\circ\text{C}$ | $\pm 1.8^\circ\text{C}$ | $\pm 2.2^\circ\text{C}$ | $\pm 1.7^\circ\text{C}$ | $\pm 2.4^\circ\text{C}$ | $\pm 2.2^\circ\text{C}$ | $\pm 1.1^\circ\text{C}$ | $\pm 2.0^\circ\text{C}$ | $\pm 0.3^\circ\text{C}$ |
| 150 | $\pm 2.2^\circ\text{C}$ | $\pm 3.3^\circ\text{C}$ | $\pm 2.5^\circ\text{C}$ | $\pm 3.0^\circ\text{C}$ | $\pm 2.3^\circ\text{C}$ | $\pm 3.1^\circ\text{C}$ | $\pm 2.9^\circ\text{C}$ | $\pm 1.6^\circ\text{C}$ | $\pm 2.9^\circ\text{C}$ | $\pm 1.0^\circ\text{C}$ |
| 200 | $\pm 2.8^\circ\text{C}$ | $\pm 4.1^\circ\text{C}$ | $\pm 3.1^\circ\text{C}$ | $\pm 3.7^\circ\text{C}$ | $\pm 2.9^\circ\text{C}$ | $\pm 3.8^\circ\text{C}$ | $\pm 3.6^\circ\text{C}$ | $\pm 2.1^\circ\text{C}$ | $\pm 3.8^\circ\text{C}$ | |
| 260 | $\pm 3.6^\circ\text{C}$ | $\pm 5.1^\circ\text{C}$ | $\pm 3.4^\circ\text{C}$ | $\pm 4.0^\circ\text{C}$ | | | | | | |

Thermocouple limits of error per NBS (NIST) Monograph 175, based on ITS-90

| Junction type: | E (Chromel-Constantan) | J (Iron-Constantan) | K (Chromel-Alumel) | T (Copper-Constantan) |
|------------------|---|--|---|--|
| Limits of error: | $\pm 1.7^\circ\text{C}$ or $\pm 0.5\%$ 0 to 900 $^\circ\text{C}$ | $\pm 2.2^\circ\text{C}$ or $\pm 0.75\%$ 0 to 750 $^\circ\text{C}$ | $\pm 2.2^\circ\text{C}$ or $\pm 0.75\%$ 0 to 1250 $^\circ\text{C}$ | $\pm 1.0^\circ\text{C}$ or $\pm 0.75\%$ 0 to 350 $^\circ\text{C}$ |

RTD Connections: 2-Wire, 3-Wire, 4-Wire?

Because an RTD is a resistance type sensor, resistance introduced by connecting copper extension wires between the RTD and control instrument will add to readings. Furthermore, this additional resistance is not constant but increases with ambient temperature. To estimate leadwire error in 2-wire circuits, multiply the total length of the extension leads times the resistance per foot in the table below. Then divide by the sensitivity of the RTD, given in the next two pages, to obtain an error figure in °C. For example, assume you have connected 100 feet of AWG 22 wires to a 100 Ω platinum RTD (PD element). Lead resistance is:

$$R = (200 \text{ ft.}) \times (0.0165 \text{ } \Omega / \text{ft.}) = 3.3 \text{ } \Omega$$

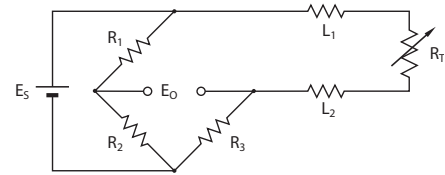
Approximate error is:

$$E = \frac{3.3 \text{ } \Omega}{0.385 \text{ } \Omega / \text{ } ^\circ\text{C}} = 8.6 \text{ } ^\circ\text{C}$$

| Copper Leadwire AWG | Ohms/ft. at 25°C |
|---------------------|------------------|
| 12 | 0.0016 |
| 14 | 0.0026 |
| 16 | 0.0041 |
| 18 | 0.0065 |
| 20 | 0.0103 |
| 22 | 0.0165 |
| 24 | 0.0262 |
| 26 | 0.0418 |
| 28 | 0.0666 |
| 30 | 0.1058 |

You can reduce leadwire error by:

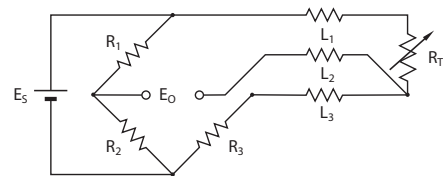
- Using larger gauge extension wires.
- Specifying an RTD with greater sensitivity; 1000 Ω instead of 100 Ω, for example.
- Employing a 3 or 4-wire resistance canceling circuit as shown at right. Common leads, connected to the same end of the sensing element, are the same color.
- Using a 2-wire current transmitter. Its linearized signal is immune to electrical noise as well as resistance and can maintain accuracy over runs of several thousand feet. See Section 4 for more information on temperature transmitters.



2-wire circuit

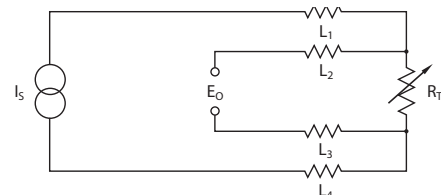
Shown above is a 2-wire RTD connected to a typical Wheatstone bridge circuit. E_5 is the supply voltage; E_0 is the output voltage; R_1 , R_2 , and R_3 are fixed resistors; and R_T is the RTD.

In this uncompensated circuit, lead resistances L_1 and L_2 add directly to R_T .



3-wire circuit

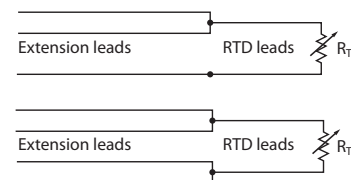
In this circuit there are three leads coming from the RTD instead of two. L_1 and L_3 carry the measuring current while L_2 acts only as a potential lead. No current flows through it while the bridge is in balance. Since L_1 and L_3 are in separate arms of the bridge, resistance is canceled. This circuit assumes high impedance at E_0 and close matching of resistance between wires L_1 and L_3 . Minco matches RTD leads within 5%.



4-wire circuit

4-wire RTD circuits not only cancel leadwires but remove the effects of mismatched resistances such as contact points. A common version is the constant current circuit shown above. I_s drives a precise measuring current through L_1 and L_4 . L_2 and L_3 measure the voltage drop across the RTD element. E_0 must have high impedance to prevent current flow in the potential leads. 4-wire circuits may be usable over longer distances than 3-wire, but you should consider using a transmitter in electrically noisy environments.

If necessary you can connect a 2-wire RTD to a 3-wire circuit or 4-wire circuit, as shown to the right. As long as the junctions are near the RTD, as in a connection head, errors are negligible.



Resistance/Temperature Tables

| Platinum elements | | | | | | | | | | | | |
|----------------------------|-------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|
| Element code | PJ | PA | PB | PD, PE* | PN | PL | PH | PP | PG | PF | PW | PS |
| Resistance at 0°C | 25.5 Ω | 100 Ω | 100 Ω | 100 Ω | 200 Ω | 470 Ω | 500 Ω | 500 Ω | 500 Ω | 1000 Ω | 1000 Ω | 10k Ω |
| TCR (Ω/Ω/°C) | 0.00392 | 0.00392 | 0.00391 | 0.00385 | 0.00385 | 0.00392 | 0.00392 | 0.00391 | 0.00385 | 0.00385 | 0.00375 | 0.00385 |
| Sensitivity (Average Ω/°C) | 0.1 | 0.392 | 0.391 | 0.385 | 0.77 | 1.845 | 1.963 | 1.955 | 1.925 | 3.85 | 3.75 | 38.5 |
| Temperature (°C) | Resistance (ohms) | | | | | | | | | | | |
| -200 | 4.33 | 17.00 | 17.26 | 18.52 | 37.04 | 79.88 | 84.98 | 86.30 | 92.60 | 185.20 | | 1,852 |
| -180 | 6.56 | 25.72 | 25.97 | 27.10 | 54.19 | 120.88 | 128.59 | 129.84 | 135.48 | 270.96 | | 2,710 |
| -160 | 8.75 | 34.31 | 34.54 | 35.54 | 71.09 | 161.28 | 171.57 | 172.72 | 177.72 | 355.43 | | 3,554 |
| -140 | 10.91 | 42.80 | 43.01 | 43.88 | 87.75 | 201.15 | 213.99 | 215.03 | 219.38 | 438.76 | | 4,388 |
| -120 | 13.05 | 51.19 | 51.37 | 52.11 | 104.22 | 240.57 | 255.93 | 256.83 | 260.55 | 521.10 | | 5,211 |
| -100 | 15.17 | 59.49 | 59.64 | 60.26 | 120.51 | 279.58 | 297.43 | 298.19 | 301.28 | 602.56 | | 6,026 |
| -80 | 17.27 | 67.71 | 67.83 | 68.33 | 136.65 | 318.23 | 338.55 | 339.17 | 341.63 | 683.25 | | 6,833 |
| -60 | 19.35 | 75.87 | 75.96 | 76.33 | 152.66 | 356.57 | 379.53 | 379.80 | 381.64 | 763.28 | | 7,633 |
| -40 | 21.41 | 83.96 | 84.03 | 84.27 | 168.54 | 394.63 | 419.82 | 420.13 | 421.35 | 842.71 | 846.57 | 8,427 |
| -20 | 23.46 | 92.01 | 92.04 | 92.16 | 184.32 | 432.43 | 460.03 | 460.19 | 460.80 | 921.60 | 923.55 | 9,216 |
| 0 | 25.50 | 100.00 | 100.00 | 100.00 | 200.00 | 470.00 | 500.00 | 500.00 | 500.00 | 1000.00 | 1000.00 | 10,000 |
| 20 | 27.53 | 107.95 | 107.92 | 107.79 | 215.59 | 507.35 | 539.73 | 539.58 | 538.96 | 1077.94 | 1075.96 | 10,779 |
| 40 | 29.54 | 115.85 | 115.78 | 115.54 | 231.08 | 544.47 | 579.23 | 578.92 | 577.70 | 1155.41 | 1151.44 | 11,554 |
| 60 | 31.54 | 123.70 | 123.60 | 123.24 | 246.48 | 581.38 | 618.49 | 618.02 | 616.21 | 1232.42 | 1226.44 | 12,324 |
| 80 | 33.53 | 131.50 | 131.38 | 130.90 | 261.79 | 618.06 | 657.51 | 656.90 | 654.48 | 1308.97 | 1300.96 | 13,090 |
| 100 | 35.51 | 139.26 | 139.11 | 138.51 | 277.01 | 654.53 | 696.31 | 695.54 | 692.53 | 1385.06 | 1375.00 | 13,851 |
| 120 | 37.48 | 146.97 | 146.79 | 146.07 | 292.14 | 690.77 | 734.86 | 733.94 | 730.34 | 1460.68 | 1448.56 | 14,607 |
| 140 | 39.43 | 154.64 | 154.42 | 153.58 | 307.17 | 726.79 | 773.18 | 772.11 | 767.92 | 1535.84 | 1521.63 | 15,358 |
| 160 | 41.37 | 162.25 | 162.01 | 161.05 | 322.11 | 762.59 | 811.27 | 810.05 | 805.27 | 1610.54 | 1594.22 | 16,105 |
| 180 | 43.31 | 169.82 | 169.55 | 168.48 | 336.96 | 798.18 | 849.12 | 847.75 | 842.39 | 1684.78 | 1666.33 | 16,848 |
| 200 | 45.22 | 177.35 | 177.04 | 175.86 | 351.71 | 833.54 | 886.74 | 885.22 | 879.28 | 1758.56 | 1737.96 | 17,586 |
| 220 | 47.13 | 184.82 | 184.49 | 183.19 | 366.38 | 868.68 | 924.12 | 922.46 | 915.94 | 1831.88 | 1809.11 | 18,319 |
| 240 | 49.02 | 192.25 | 191.89 | 190.47 | 380.95 | 903.59 | 961.27 | 959.46 | 952.36 | 1904.73 | 1879.78 | 19,047 |
| 260 | 50.91 | 199.64 | 199.24 | 197.71 | 395.42 | 938.29 | 998.18 | 996.22 | 988.56 | 1977.12 | 1949.96 | 19,771 |
| 280 | 52.78 | 206.97 | 206.55 | 204.91 | 409.81 | 972.77 | 1034.86 | 1032.76 | 1024.52 | 2049.05 | 2019.67 | 20,490 |
| 300 | 54.64 | 214.26 | 213.81 | 212.05 | 424.10 | 1007.03 | 1071.31 | 1069.06 | 1060.26 | 2120.52 | 2088.89 | 21,205 |
| 320 | 56.48 | 221.50 | 221.02 | 219.15 | 438.30 | 1041.06 | 1107.51 | 1105.12 | 1095.76 | 2191.52 | 2157.63 | 21,915 |
| 340 | 58.32 | 228.70 | 228.19 | 226.21 | 452.41 | 1074.88 | 1143.49 | 1140.95 | 1131.03 | 2262.06 | 2225.89 | 22,621 |
| 360 | 60.14 | 235.85 | 235.31 | 233.21 | 466.43 | 1108.47 | 1179.23 | 1176.55 | 1166.07 | 2332.14 | 2293.67 | 23,321 |
| 380 | 61.95 | 242.95 | 242.38 | 240.18 | 480.35 | 1141.85 | 1214.73 | 1211.91 | 1200.88 | 2401.76 | 2360.96 | 24,018 |
| 400 | 63.75 | 250.00 | 249.41 | 247.09 | 494.18 | 1175.00 | 1250.00 | 1247.04 | 1235.46 | 2470.92 | 2427.78 | 24,709 |
| 420 | 65.54 | 257.01 | 256.39 | 253.96 | 507.92 | 1207.93 | 1285.03 | 1281.94 | 1269.81 | 2539.62 | 2494.11 | 25,396 |
| 440 | 67.31 | 263.97 | 263.32 | 260.79 | 521.57 | 1240.64 | 1319.83 | 1316.60 | 1303.92 | 2607.85 | 2559.96 | 26,078 |
| 460 | 69.07 | 270.88 | 270.21 | 267.56 | 535.12 | 1273.14 | 1354.40 | 1351.03 | 1337.81 | 2674.62 | 2625.33 | 26,756 |
| 480 | 70.83 | 277.75 | 277.04 | 274.29 | 548.59 | 1305.41 | 1388.73 | 1385.22 | 1371.46 | 2742.93 | 2690.22 | 27,429 |
| 500 | 72.56 | 284.57 | 283.84 | 280.98 | 561.96 | 1337.46 | 1422.83 | 1419.18 | 1404.89 | 2808.78 | 2754.63 | 28,098 |
| 520 | 74.29 | 291.34 | 290.58 | 287.62 | 575.23 | 1369.28 | 1456.69 | 1452.91 | 1438.08 | 2876.16 | | 28,762 |
| 540 | 76.01 | 298.06 | 297.28 | 294.21 | 588.42 | 1400.89 | 1490.31 | 1486.40 | 1471.04 | 2942.08 | | 29,421 |
| 560 | 77.71 | 304.74 | 303.93 | 300.75 | 601.51 | 1432.28 | 1523.70 | 1519.66 | 1503.77 | 3007.54 | | 30,075 |
| 580 | 79.40 | 311.37 | 310.54 | 307.25 | 614.51 | 1463.45 | 1556.86 | 1552.68 | 1536.27 | 3072.54 | | 30,725 |
| 600 | 81.08 | 317.96 | 317.09 | 313.71 | 627.42 | 1494.39 | 1589.78 | 1585.47 | 1568.54 | 3137.08 | | 31,371 |
| 620 | 82.75 | 324.49 | 323.60 | 320.12 | 640.23 | 1525.12 | 1622.47 | 1618.02 | 1600.58 | 3201.16 | | |
| 640 | 84.40 | 330.98 | 330.07 | 326.48 | | 1555.62 | 1654.92 | 1650.35 | | | | |
| 660 | 86.04 | 337.43 | 336.49 | 332.79 | | 1585.91 | 1687.14 | 1682.43 | | | | |
| 680 | 87.67 | 343.82 | 342.86 | 339.06 | | 1615.97 | 1719.12 | 1714.29 | | | | |
| 700 | 89.29 | 350.17 | 349.18 | 345.28 | | 1645.81 | 1750.87 | 1745.91 | | | | |
| 720 | | | | 351.46 | | | | | | | | |
| 740 | | | | 357.59 | | | | | | | | |
| 760 | | | | 363.67 | | | | | | | | |
| 780 | | | | 369.71 | | | | | | | | |
| 800 | | | | 375.70 | | | | | | | | |
| 820 | | | | 381.65 | | | | | | | | |
| 840 | | | | 387.55 | | | | | | | | |
| 850 | | | | 390.48 | | | | | | | | |

* PD is the most common platinum sensor element used by industry. PE has a wider manufacturing tolerance than PD.

Note: More element options and complete tables in 1°C or 1°F increments are available from Minco at www.minco.com/

Resistance/Temperature Tables

Most RTD tables follow the modified Callendar-Van Dusen equation:

$$R_t = R_0 [1 + At + Bt^2 + Ct^3]$$

or some variation thereof, where R_t is the modified resistance at temperature t , R_0 is the ice point resistance, and A , B , and C are coefficients describing a given thermometer. Download Minco's white paper entitled *Resistance Thermometry: Principles and Applications of Resistance Thermometers and Thermistors* at www.minco.com for a complete set of equations and coefficients for numerical calculation of resistance vs temperature.

| | Copper | Nickel | Nickel-iron | | | Thermistors | | | |
|----------------------------|-------------------|--------------|--------------|----------------|----------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Element code | CA | NA | FA | FB | FC | TA | TB | TF | TK |
| Base resistance | 10 Ω at 25°C | 120 Ω at 0°C | 604 Ω at 0°C | 1000 Ω at 70°F | 2000 Ω at 70°F | 2252 Ω at 25°C | 10k Ω at 25°C | 50k Ω at 25°C | 10k Ω at 25°C |
| TCR (Ω / Ω /°C) | .00427 | .00672 | .00518 | .00527 | .00527 | $R_{25}/R_{125} = 29.2$ | $R_{25}/R_{125} = 23.5$ | $R_{25}/R_{125} = 31.2$ | $R_{25}/R_{125} = 26.6$ |
| Sensitivity (Average Ω/°C) | 0.039 | 0.806 | 3.133 | 4.788 | 9.576 | -72 | -287 | -1523 | -324 |
| Temperature (°C) | Resistance (ohms) | | | | | | | | |
| -100 | 5.128 | | 372.79 | | | | | | |
| -80 | 5.923 | 66.60 | 410.73 | | | 1660 K | 3558 K | | |
| -60 | 6.712 | 79.62 | 452.82 | | | 316.5 K | 845.9 K | | |
| -40 | 7.490 | 92.76 | 499.06 | | | 75.79 K | 239.8 K | 1380 K | 348.9 K |
| -20 | 8.263 | 106.15 | 549.46 | 826.90 | 1653.81 | 21.87 K | 78.91 K | 431.8 K | 100.2 K |
| 0 | 9.035 | 120.00 | 604.00 | 908.40 | 1816.81 | 7355 | 29.49 K | 155.6 K | 33.15 K |
| 20 | 9.807 | 134.52 | 660.97 | 995.04 | 1990.09 | 2814 | 12.26 K | 62.24 K | 12.52 K |
| 40 | 10.580 | 149.79 | 720.79 | 1086.49 | 2172.99 | 1200 | 5592 | 26.64 K | 5323 |
| 60 | 11.352 | 165.90 | 783.45 | 1182.50 | 2365.01 | 560.3 | 2760 | 12.31 K | 2510 |
| 80 | 12.124 | 182.84 | 848.97 | 1282.83 | 2565.66 | 282.7 | 1458 | 6117 | 1293 |
| 100 | 12.897 | 200.64 | 917.33 | 1387.21 | 2774.44 | 152.8 | 816.8 | 3256 | 718.5 |
| 120 | 13.669 | 219.29 | 988.54 | 1495.42 | 2990.84 | 87.7 | 481.8 | 1836 | 425.0 |
| 140 | 14.442 | 238.85 | 1062.60 | 1607.18 | 3214.37 | 53.0 | 297.2 | | |
| 160 | 15.217 | 259.30 | 1139.50 | 1722.26 | 3444.54 | | | | |
| 180 | 15.996 | 280.77 | 1219.26 | 1840.41 | 3680.84 | | | | |
| 200 | 16.776 | 303.46 | 1301.86 | 1961.38 | 3922.77 | | | | |
| 220 | 17.555 | 327.53 | | | | | | | |
| 240 | 18.335 | 353.14 | | | | | | | |
| 260 | 19.116 | 380.31 | | | | | | | |

Note: More element options and complete tables in 1°C or 1°F increments are available from Minco at www.minco.com

Thermocouple Voltage/Temperature Tables

| Junction type: | E Chromel-Constantan + - Purple Red | J Iron-Constantan + - White Red | K Chromel-Alumel + - Yellow Red | T Copper-Constantan + - Blue Red |
|----------------------|--|--|--|---|
| Sensitivity (mV/°C): | 0.063 | 0.053 | 0.041 | 0.043 |
| Temperature (°C) | Millivolts | | | |
| -200 | -8.824 | -7.890 | -5.891 | -5.603 |
| -150 | -7.279 | -6.499 | -4.912 | -4.648 |
| -100 | -5.237 | -4.632 | -3.553 | -3.378 |
| -50 | -2.787 | -2.431 | -1.889 | -1.819 |
| 0 | 0.000 | 0.000 | 0.000 | 0.000 |
| 50 | 3.047 | 2.585 | 2.022 | 2.035 |
| 100 | 6.317 | 5.268 | 4.095 | 4.277 |
| 150 | 9.787 | 8.008 | 6.137 | 6.702 |
| 200 | 13.419 | 10.777 | 8.137 | 9.286 |
| 250 | 17.178 | 13.553 | 10.151 | 12.011 |
| 300 | 21.033 | 16.325 | 12.207 | 14.860 |
| 350 | 24.961 | 19.089 | 14.292 | 17.816 |
| 400 | 28.943 | 21.846 | 16.395 | 20.869 |
| 450 | 32.960 | 24.607 | 18.513 | |
| 500 | 36.999 | 27.388 | 20.640 | |
| 550 | 41.045 | 30.210 | 22.772 | |

Note: Complete tables in 1°C or 1°F increments are available from Minco at www.minco.com

Temperature Coefficient of Resistance (TCR)

TCR differentiates RTDs by their resistance/temperature curves. Sometimes called alpha (α), it is specified in various ways by different manufacturers.

In this guide TCR is the RTD's resistance change from 0 to 100°C, divided by the resistance at 0°C, divided by 100°C:

$$TCR (\Omega/\Omega/^\circ C) = \frac{R_{100^\circ C} - R_{0^\circ C}}{R_{0^\circ C} \times 100^\circ C}$$

For example, a platinum thermometer measuring 100 Ω at 0°C and 139.11 Ω at 100°C has TCR 0.00391 $\Omega/\Omega/^\circ C$:

$$TCR = \frac{139.11\Omega - 100\Omega}{100\Omega \times 100^\circ C}$$

For a copper RTD, 10 Ω at 25°C, TCR is:

$$TCR = \frac{12.897\Omega - 9.035\Omega}{9.035\Omega \times 100^\circ C} = 0.00427$$

Stated another way, TCR is the average resistance increase per degree of a hypothetical RTD measuring 1 Ω at 0°C.

The most common use of TCR is to distinguish between curves for platinum, which is available with TCRs ranging from 0.00375 to 0.003927. The highest TCR indicates the highest purity platinum, and is mandated by ITS-90 for standard platinum thermometers.

There are no technical advantages of one TCR versus another in practical industrial applications. 0.00385 platinum is the most popular worldwide standard and is available in both wire-wound and thin-film elements.

In most cases, all you need to know about TCR is that it must be properly matched when replacing RTDs or connecting them to instruments.

SensorCalc Program

RTD and thermocouple tables are available online at www.minco.com

You can create and store tables in a variety of formats. You can also enter resistances and coefficients for custom tables, using Callendar-Van Dusen or ITS-90 equations.

Miscellaneous Specifications and Codes

Thread specifications

| Thread | Applicable specifications |
|------------------------------------|--|
| G $\frac{1}{2}$ | <ul style="list-style-type: none"> ISO 228/1 DIN 259 BS 2779 JIS B0202 |
| R $\frac{1}{4}$ R $\frac{1}{8}$ | <ul style="list-style-type: none"> ISO 7/1 DIN 2999 BS 21 JIS B0203 |

Wire gauge conversion

| Wire Gauge Number AWG | Cross Sectional Area mm ² | | Resistance Ω /ft. at 25°C |
|-----------------------|--------------------------------------|-------|----------------------------------|
| | Stranded | Solid | |
| 30 | 0.057 | 0.051 | 0.1058 |
| 28 | 0.089 | 0.080 | 0.0666 |
| 26 | 0.141 | 0.128 | 0.0418 |
| 24 | 0.227 | 0.205 | 0.0262 |
| 22 | 0.355 | 0.324 | 0.0165 |
| 20 | 0.563 | 0.519 | 0.0103 |
| 18 | 0.897 | 0.823 | 0.0065 |

Ingress Protection (IP) Codes

| | First Number Protection against solid bodies | Second Number Protection against liquid |
|---|---|--|
| 0 | No protection | No protection |
| 1 | Objects > 50 mm | Vertically dripping water |
| 2 | Objects > 12 mm | 75° to 90° dripping water |
| 3 | Objects > 2.5 mm | Sprayed water |
| 4 | Objects > 1 mm | Splashed water |
| 5 | Dust-protected | Water jets |
| 6 | Dust-tight | Heavy seas |
| 7 | | Effects of immersion |
| 8 | | Indefinite immersion |

Approximate US Enclosure Type Equivalent to IPXX

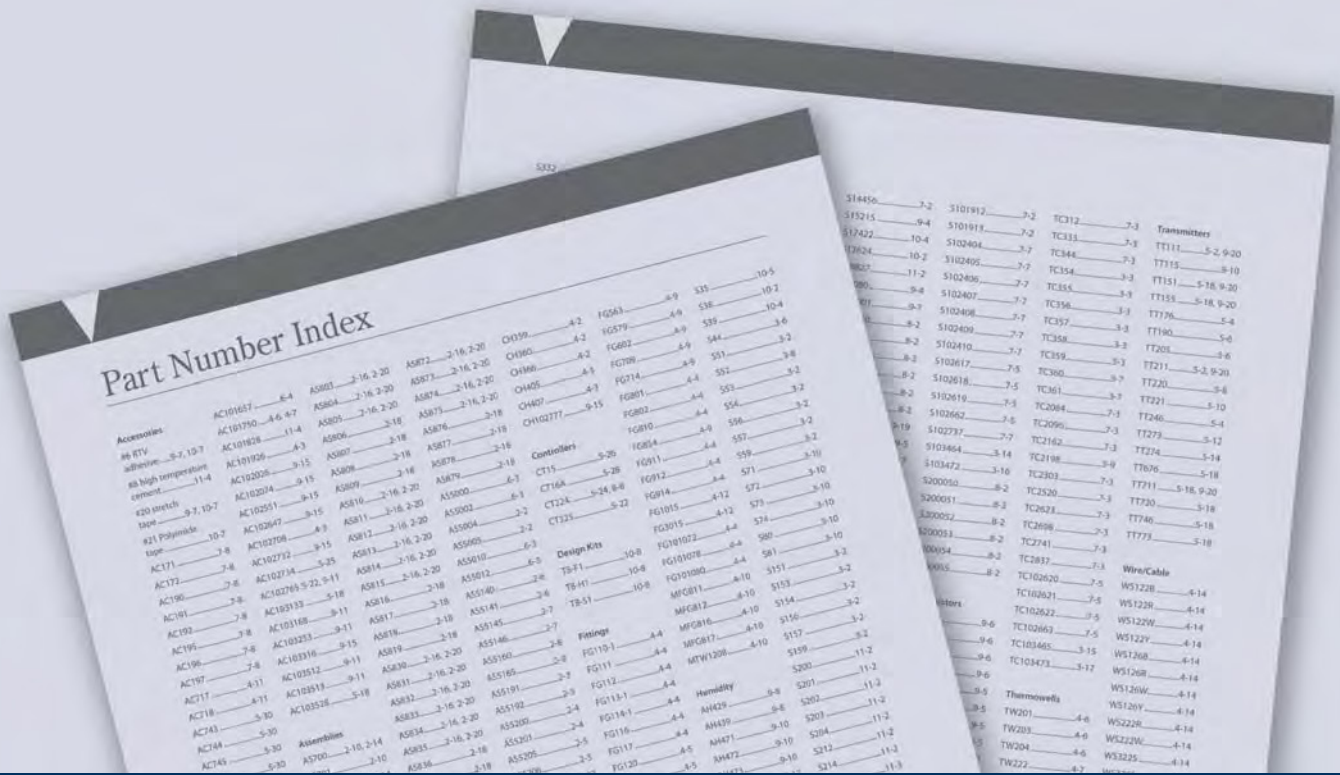
| Type | IP | Type | IP | Type | IP |
|------|----|--------|----|----------|----|
| 1 | 10 | 3S | 54 | 6 & 6P | 67 |
| 2 | 11 | 4 & 4X | 55 | 12 & 12K | 52 |
| 3 | 54 | 5 | 52 | 13 | 54 |
| 3R | 14 | | | | |

Material Selection Guide

This guide lists the least expensive materials compatible with various corrosive media. The user should also consider unusual temperatures or levels of concentration. Contact Minco Sales and Customer Service for assistance.

| Medium | °F (°C) | Material |
|------------------------------------|----------------------|-------------|
| Acetic acid | 212 (100) | Monel |
| Acetic anhydride | 300 (149) | Nickel |
| Acetone | 212 (100) | 304 SS |
| Acetylene | 400 (204) | 304 SS |
| Alcohols | 212 (100) | 304 SS |
| Alum. (Potassium or sodium) | 300 (149) | Hastelloy C |
| Aluminum chloride | 212 (100) | Hastelloy B |
| Aluminum sulfate | 212 (100) | 316 SS |
| Ammonia, dry | 212 (100) | 316 SS |
| Ammonium hydroxide | 212 (100) | 316 SS |
| Ammonium chloride 50% | 300 (149) | Monel |
| Ammonium nitrate | 300 (149) | 304 SS |
| Ammonium sulfate | 212 (100) | 316 SS |
| Amyl acetate | 300 (149) | 304 SS |
| Aniline | 25 (-4) | Monel |
| Asphalt | 250 (121) | 304 SS |
| Atmosphere (industrial and marine) | | 304 SS |
| Barium compounds | See calcium | |
| Beer | 70 (21) | 304 SS |
| Benzene | 212 (100) | Steel |
| Benzoic acid | 212 (100) | 316 SS |
| Bleaching powder 15% | 70 (21) | Monel |
| Borax | 212 (100) | Brass |
| Bordeaux mixture | 200 (93) | 304 SS |
| Boric acid | 400 (204) | 316 SS |
| Bromine, dry | 125 (52) | Monel |
| Butane | 400 (204) | Steel |
| Butyric acid | 212 (100) | Hastelloy C |
| Calcium bisulphite | 75 (24) | Hastelloy C |
| Calcium chloride | 212 (100) | Hastelloy C |
| Calcium hydroxide 20% | 300 (149) | Hastelloy C |
| Calcium hypochlorite | See bleaching powder | |
| Carbolic acid | See phenol | |
| Carbon dioxide, dry | 800 | Brass |
| Carbonated water | 212 (100) | 304 SS |
| Carbonated beverages | 212 (100) | 304 SS |
| Carbon disulfide | 200 (93) | 304 SS |
| Carbon tetrachloride | 125 (52) | Monel |
| Chlorine, dry | 100 (38) | Monel |
| Chlorine, moist | 100 (38) | Monel |
| Chloroacetic acid | 212 (100) | Monel |
| Chloroform, dry | 212 (100) | Monel |
| Chromic acid | 300 (149) | Hastelloy C |
| Cider | 300 (149) | 304 SS |
| Citric acid | 212 (100) | Hastelloy C |
| Copper (10) chloride | 212 (100) | Hastelloy C |
| Copper (10) nitrate | 300 (149) | 316 SS |
| Copper (10) sulfate | 300 (149) | 316 SS |
| Copper plating solution (cyanide) | 180 (82) | 304 SS |
| Copper plating solution (acid) | 75 (24) | 304 SS |
| Corn oil | 200 (93) | 304 SS |
| Creosote | 200 (93) | 304 SS |
| Crude oil | 300 (149) | Monel |
| Ethyl acetate | See lacquer thinner | |
| Ethyl chloride, dry | 500 (260) | Steel |
| Ethylene glycol (uninhibited) | 212 (100) | 304 SS |
| Ethylene oxide | 75 (24) | Steel |
| Fatty acids | 500 (260) | 316 SS |
| Ferric chloride | 75 (24) | Hastelloy C |
| Ferric sulphate | 300 (149) | 304 SS |
| Formaldehyde 40% | 212 (100) | 316 SS |
| Formic acid | 300 (149) | 316 SS |
| Freon | 300 (149) | Steel |
| Fluorine, anhydrous | 100 (38) | 304 SS |
| Furfural | 450 (232) | 316 SS |
| Gasoline | 300 (149) | Steel |
| Glucose | 300 (149) | 304 SS |
| Glue, pH 6-8 | 300 (149) | 304 SS |
| Glycerine | 212 (100) | Brass |
| Hydrobromic acid | 212 (100) | Hastelloy C |
| Hydrochloric acid 37-38% | 225 (107) | Hastelloy B |
| Hydrogen chloride, dry | 500 (260) | 304 SS |
| Hydrocyanic acid | 212 (100) | 304 SS |

| Medium | °F (°C) | Material |
|--------------------------------|----------------------|-------------|
| Hydrofluoric acid 60% | 212 (100) | Monel |
| Hydrogen fluoride, dry | 175 (79) | Steel |
| Hydrofluogilic acid 40% | 212 (100) | Monel |
| Hydrogen peroxide 10-100% | 125 (52) | 304 SS |
| Kerosene | 300 (149) | Steel |
| Lacquers & thinners | 300 (149) | 304 SS |
| Lactic acid | 300 (149) | 316 SS |
| Lime | 212 (100) | 316 SS |
| Linseed oil | 75 (24) | Steel |
| Magnesium chloride 50% | 212 (100) | Nickel |
| Magnesium hydroxide (or oxide) | 75 (24) | 304 SS |
| Magnesium sulphate 40% | 212 (100) | 304 SS |
| Mercuric chloride 10% | 75 (24) | Hastelloy C |
| Mercury 100% | 700 (371) | Steel |
| Methylene chloride | 212 (100) | 304 SS |
| Methyl chloride, dry | 75 (24) | Steel |
| Milk, fresh or sour | 180 (82) | 304 SS |
| Molasses | See glucose | |
| Natural gas | 70 (21) | 304 SS |
| Nitric acid | 75 (24) | 304 SS |
| Nitric acid | 300 (149) | 316 SS |
| Oxygen | 75 (24) | Steel |
| Oleic acid | See fatty acids | |
| Oxalic acid | 212 (100) | Monel |
| Photographic bleaching | 100 (38) | 304 SS |
| Palmitic acid | See fatty acids | |
| Phosphoric acid | 212 (100) | 316 SS |
| Phenol | 212 (100) | 316 SS |
| Potassium compounds | See sodium compounds | |
| Propane | 300 (149) | Steel |
| Rosin 100% | 700 (371) | 316 SS |
| Sea water | 75 (24) | Monel |
| Soap & detergents | 212 (100) | 304 SS |
| Sodium bicarbonate 20% | 212 (100) | 316 SS |
| Sodium bisulphite 20% | 212 (100) | 304 SS |
| Sodium bisulphate 20% | 212 (100) | 304 SS |
| Sodium carbinatate 40% | 212 (100) | 316 SS |
| Sodium chloride 30% | 300 (149) | Monel |
| Sodium chromate | 212 (100) | 316 SS |
| Salt or brine | See sodium chloride | |
| Sodium cyanide | 212 (100) | 304 SS |
| Sodium hydroxide 30% | 212 (100) | 316 SS |
| Sodium hypochlorite 10% | 75 (24) | Hastelloy C |
| Sodium nitrate 40% | 212 (100) | 304 SS |
| Sodium nitrite 20% | 75 (24) | 316 SS |
| Sodium phosphate 10% | 212 (100) | Steel |
| Sodium silicate 10% | 212 (100) | Steel |
| Sodium sulfide 30% | 212 (100) | 316 SS |
| Sodium sulfite 10% | 212 (100) | 316 SS |
| Sodium sulfate 30% | 212 (100) | 304 SS |
| Sodium thiosulfate | 212 (100) | 304 SS |
| Steam | | 304 SS |
| Stearic acid | See fatty acids | |
| Sugar solution | See glucose | |
| Sulfur | 500 (260) | 304 SS |
| Sulfur chloride, dry | 75 (24) | 316 SS |
| Sulfur dioxide, dry | 500 (260) | 316 SS |
| Sulfur trioxide, dry | 500 (260) | 316 SS |
| Sulfuric acid 10% | 212 (100) | 316 SS |
| Sulfuric acid 10-90% | 212 (100) | Hastelloy B |
| Sulfuric acid 90-100% | 212 (100) | 316 SS |
| Sulfuric acid, fuming | 175 (79) | Hastelloy C |
| Sulfurous acid 20% | 75 (24) | 316 SS |
| Titanium tetrachloride | 75 (24) | 316 SS |
| Tannic acid 40% | 75 (24) | Hastelloy B |
| Toluene | 75 (24) | Steel |
| Trichloroacetic acid | 75 (24) | Hastelloy B |
| Trichloroethylene, dry | 300 (149) | Monel |
| Turpentine | 75 (24) | 316 SS |
| Varnish | 150 (66) | Steel |
| Zinc chloride | 212 (100) | Hastelloy B |
| Zinc sulfate | 212 (100) | 316 SS |



► SECTION 12: REFERENCE

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Industry Specifications for Sensors

ISO 9001: 2000 / AS/EN/SJAC9100 (Registrar: TÜV)

Minco's Quality Assurance system has been audited and certified to this internationally recognized standard.

ATEX DIRECTIVE 94/9/EC

Issued by: European Commission
Minco has qualified specific models of sensors and accessories used in potentially hazardous areas to these international requirements.

* Temperature range of individual models may vary.

CENELEC

Issued by: European Committee for Electrotechnical Standardization
Minco has qualified specific models of sensors and accessories used in potentially hazardous areas to these international requirements.

CSA

Issued by: Canadian Standards Assn.
CSA Standards are met through recognized testing labs, such as Underwriters Labs, whose testing covers both the U.S. and Canada (see UL).

DIN 43760

Issued by: Deutsches Institut für Normung (Germany)
Specifies resistance curves and tolerance for nickel RTDs. Platinum curves are now covered under IEC EN60751.

FM

Issued by: Factory Mutual
Selected temperature sensors and Temptran™ transmitter models are certified compliant to FM specifications and requirements for use in hazardous areas, for the purposes of safety and property loss prevention.

IEC EN60751 (IEC 751)

Issued by: International Electrotechnical Commission
IEC 751 has the widest international scope of any RTD standard. It calls for platinum RTDs, 100 Ω at 0°C, TCR 0.00385 $\Omega/\Omega/^\circ\text{C}$, in one of two tolerance classes:

Class A: $\pm 0.06\%$ at 0°C.

Class B: $\pm 0.12\%$ at 0°C.

All Minco RTDs with PD element code meet Class B. Selected models have Class A as an option.

JIS C 1604-1989

Issued by: Japanese Standards Assn.
Specifies 100 Ω 0.00385 platinum thermometers in accordance with EN60751, but also makes provision for 0.003916 TCR. Minco can supply RTDs to either curve.

MIL-T-24388C(SH)

Issued by: U.S. Naval Sea Systems Command
RTDs and thermocouples for shipboard use. Included are platinum RTDs with 0.00392 TCR and nickel models with 0.00672 TCR. See Section 7 for bearing embedment RTDs qualified to this specification. Minco does not currently offer probe or thermowell models to MIL-T-24388.

NBS (NIST) Monograph 175, based on ITS-90

Issued by: National Institute of Standards and Technology
Sets general standards for thermocouples, including millivolt tables, limits of error, and wire color codes. All Minco thermocouples confirm to this specification.

SAMA RC21-4-1966

Issued by: Scientific Apparatus Makers Association
Specifies various curves for platinum, nickel, and copper RTDs. The platinum curve, available from Minco, has a resistance of 98.129 Ω at 0°C and TCR of 0.003923. Placing a fixed resistor of 1.871 Ω in series with this element makes it fit the EN60751 curve.

UL

Issued by: Underwriters Laboratories
Selected Minco temperature controllers and temperature transmitters are UL-Listed, and/or UL Recognized Components (see product listings for details).

Additional Quality system standards

Minco also has the capability of meeting MIL-Q-9858, MIL-I-45208, FDA-GMP, and 10CFR50 and -21.

Global Resources

Minco has an established infrastructure around the world to support the growing needs of our global customer base. Each Minco regional center provides sales, customer service, engineering and technical expertise to help you specify and manufacture a reliable temperature sensing solution. Our key regional centers include:

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