

Sensors & Instruments Product Guide



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

Minco: Providing Temperature Sensing Solutions for Demanding Applications

For nearly 70 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 AS 9100D and ISO 9001:2015 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



Table of Contents



Section 1: Temperature Sensor Assemblies

Tip-sensitive spring loaded	1-2 to 1-3
Tip-sensitive direct immersion	1-4 to 1-5
Tip-sensitive with thermowells	1-6 to 1-7
High temp. with thermowells	1-8 to 1-9
Hazardous area sensor assemblies	1-10 to 1-15
Eurostyle	1-16 to 1-17
Specifying custom assemblies	1-18



Section 2: Probes

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 tubing	2-18



Section 3: Accessories

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



Section 4: Instruments

RTD transmitters	4-2 to 4-5, 4-8 to 4-9, 4-12 to 4-13
Thermocouple transmitters	4-6 to 4-7, 4-10 to 4-11, 4-14 to 4-15
Programmable transmitters	4-8 to 4-11
Field rangeable transmitters	4-12 to 4-15
Programmable transmitters	4-16 to 4-17
HART® transmitters	4-18 to 4-19
Temperature range table	4-20 to 4-21
High accuracy calibration	4-22
Mounting accessories	4-22
Loop-powered indicators	4-23 to 4-24
CT224 12-channel monitor	4-25 to 4-26
CT424 Temperature Alarm/Monitor	4-27 to 4-28
CT325 miniature DC temperature controller	4-29 to 4-30
CT335 PC board mount temperature controller	4-31 to 4-32
CT435 PC board mount temperature controller	4-33 to 4-34
CT15 controller/alarm	4-35 to 4-36
CT16A temperature controller	4-37 to 4-38
CT15/CT16A accessories	4-39
CT425 Temperature Controller	4-40 to 4-41



Section 5: Miniature Sensors

Embedment RTDs	5-2
Embedment thermocouples	5-3
Hazardous area embedment sensors	5-4 to 5-6
Installation and accessories	5-7
Bolt-on RTDs	5-8
Economy RTDs	5-9
Non-metallic case sensors	5-10



Section 6: Stator RTDs

Hazardous Area RTDs	6-2 to 6-3
Single element RTDs	6-4 to 6-5
Dual element RTDs	6-6
Machinery protection products	6-7



Section 7: HVAC Sensors

Chill-Out™ combination sensor	7-2 to 7-3
Averaging temperature sensors	7-4
Duct and outside air temperature sensors	7-5
Room air temperature sensors	7-6
Flexible Thermal-Ribbon™ pipe sensors	7-7
Humidity sensor/transmitter assembly	7-8 to 7-9
Hazardous area humidity assembly	7-10 to 7-11
Intrinsically safe humidity assembly	7-12 to 7-13
Thermal vial™ temperature sensing system	7-14 to 7-15
Refrigeration and freezer temperature system	7-16
Fluid immersion temperature sensors	7-17
Elements and probes	7-18
Tempran 4 to 20 mA transmitters	7-19



Section 8: Thermal-Ribbons™

Thermal Ribbons™	8-2 to 8-3
Thermal Tabs™	8-2 to 8-3
Discoil™ Thermal Ribbons	8-4
Strip sensing Thermal Ribbons	8-5
Thermistor Thermal Ribbons	8-6
Thermocouple Thermal Ribbons	8-6
Installation and accessories	8-7



Section 9: Elements

Wire-wound elements	9-2
Thin film elements	9-2
Installation	9-3
Extension leads	9-3



Section 10: Technical Information

Your product guide	10-2
Industry applications	10-3
Designed for optimal performance	10-4 to 10-5
Tempran™ temperature transmitters	10-6
RTD, thermocouple, or thermistor	10-7
Choosing sensor elements	10-8
RTD connections: 2-wire, 3-wire, 4-wire	10-9
Resistance/temperature tables	10-10 to 10-11
Thermocouple voltage/temperature tables	10-11
Temperature coefficient of resistance (TCR)	10-12
SensorCalc program	10-12
Miscellaneous specifications and codes	10-12
Material selection guide	10-13



Section 11: Reference

Industry specifications	11-2
Global resources	11-3



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





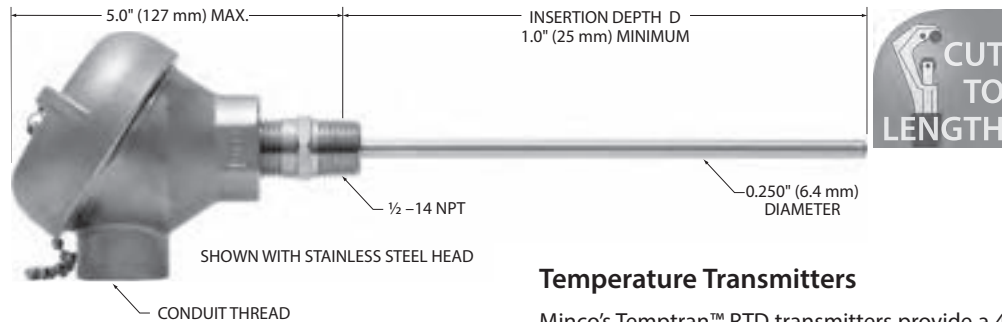
► SECTION 1: ASSEMBLIES

- 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

Section 1: Temperature Sensor Assemblies

Tip-sensitive spring loaded	1-2 to 1-3
Tip-sensitive direct immersion.....	1-4 to 1-5
Tip-sensitive with thermowells.....	1-6 to 1-7
High temp. with thermowells.....	1-8 to 1-9
Hazardous area sensor assemblies.....	1-10 to 1-15
Eurostyle.....	1-16 to 1-17
Specifying custom assemblies.....	1-18

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 \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 (0.00427 TCR)	10 Ω \pm 0.2% at 25°C	CA
(dual)	10 Ω \pm 0.5% at 25°C	CC
Nickel (0.00672 TCR)	120 Ω \pm 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.

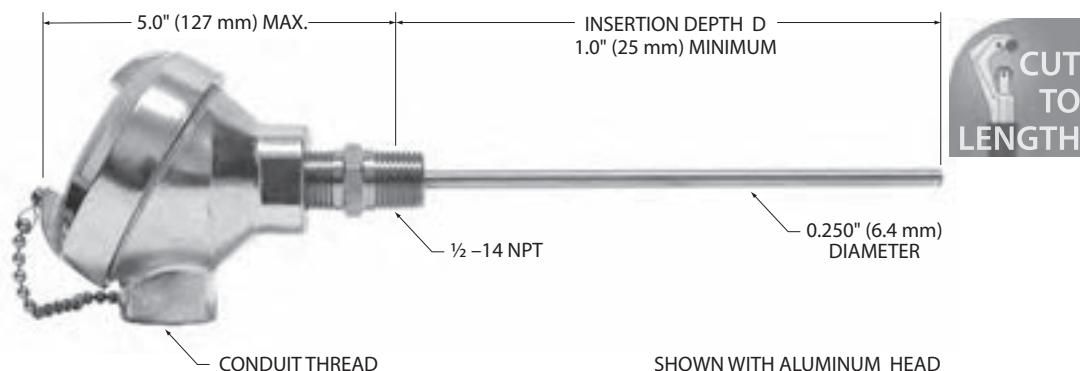
Specification and order options

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

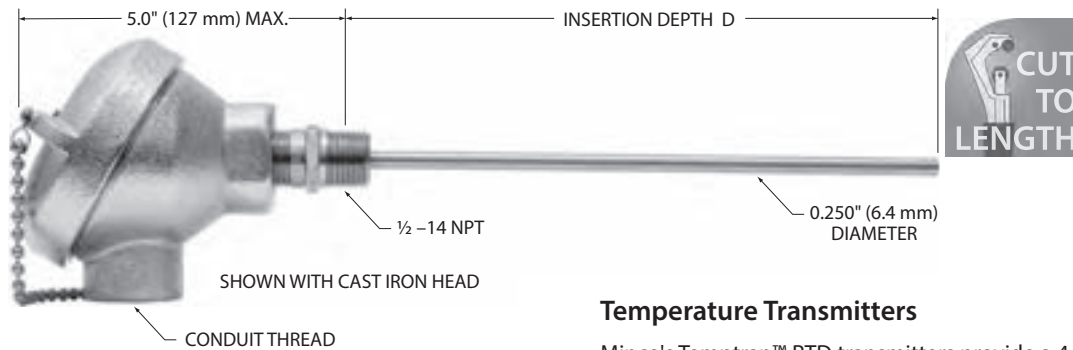
Minco's Temptran™ thermocouple transmitters provide a 4 to 20 mA signal or HART® Protocol that can be sent over long distances with a simple 2-wire system. See Section 4 for complete temperature transmitter specifications.

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 \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 (0.00427 TCR)	10 Ω \pm 0.2% at 25°C	CA
(dual)	10 Ω \pm 0.5% at 25°C	CC
Nickel (0.00672 TCR)	120 Ω \pm 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.

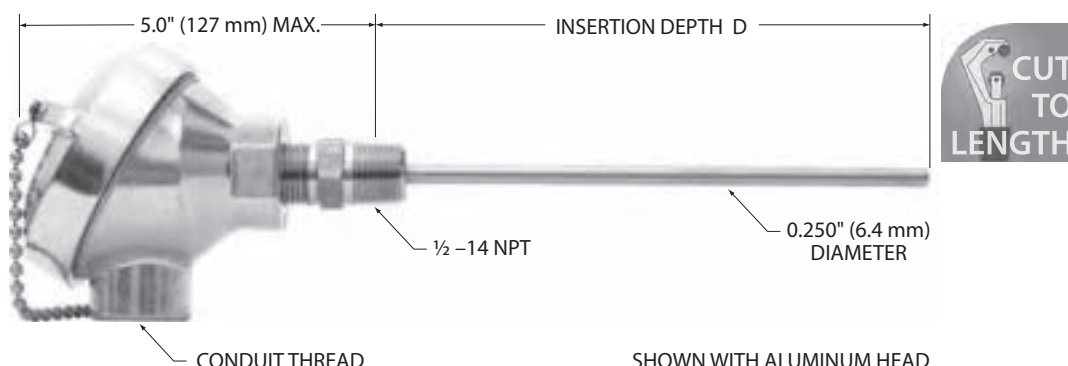
Specification and order options

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	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
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 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

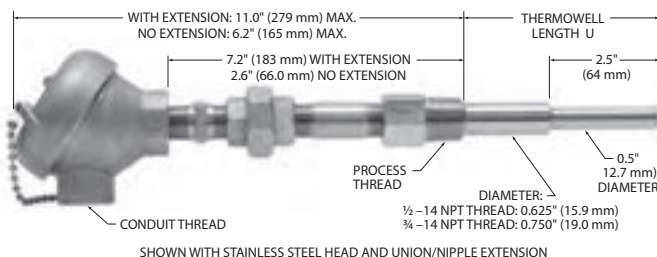
AS5205	Assembly number AS5205: Single junction AS5206: Dual junction
E	Junction type: E = Chromel-Constantan J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan
U	Junction grounding: G = Grounded U = Ungrounded
215	Insertion depth D: Specify in 0.1" increments (Ex: 215 = 21.5 inches)
P	
1	Conduit 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	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
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 \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 (0.00427 TCR)	10 Ω \pm 0.2% at 25°C	CA
(dual)	10 Ω \pm 0.5% at 25°C	CC
Nickel (0.00672 TCR)	120 Ω \pm 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.

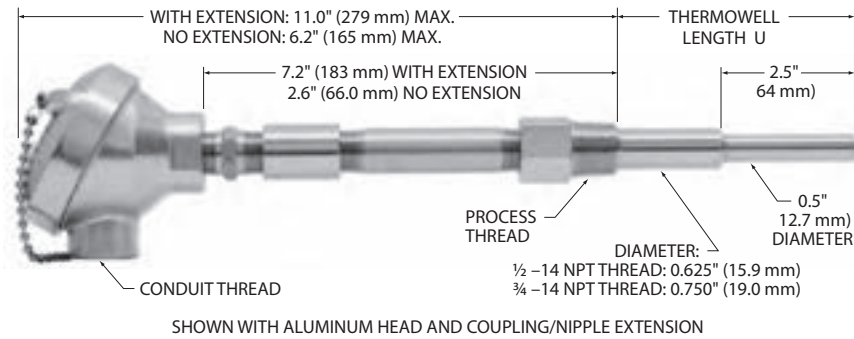
Special high-accuracy calibration: For high system accuracy specify transmitters with matched calibration. Calibration data traceable to NIST will also be provided. Get more information on page 4-22.

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.

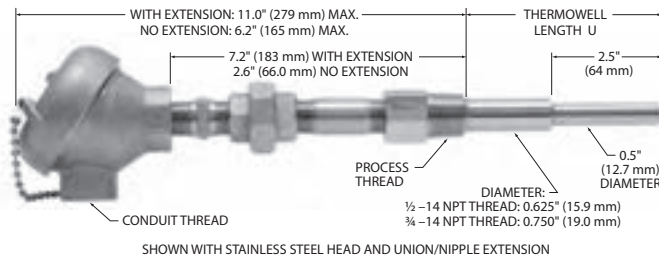
Specification and order options

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 \pm 0.1% at 0°C	PB
Platinum (0.00385 TCR) (Meets EN60751, Class B)	100 Ω \pm 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.

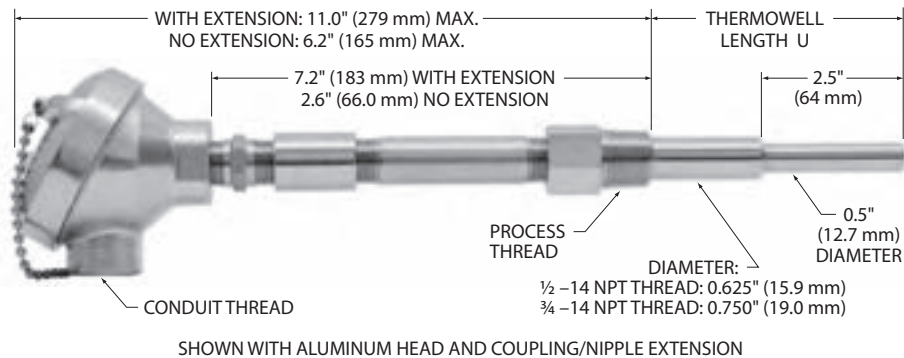
Specification and order options

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.

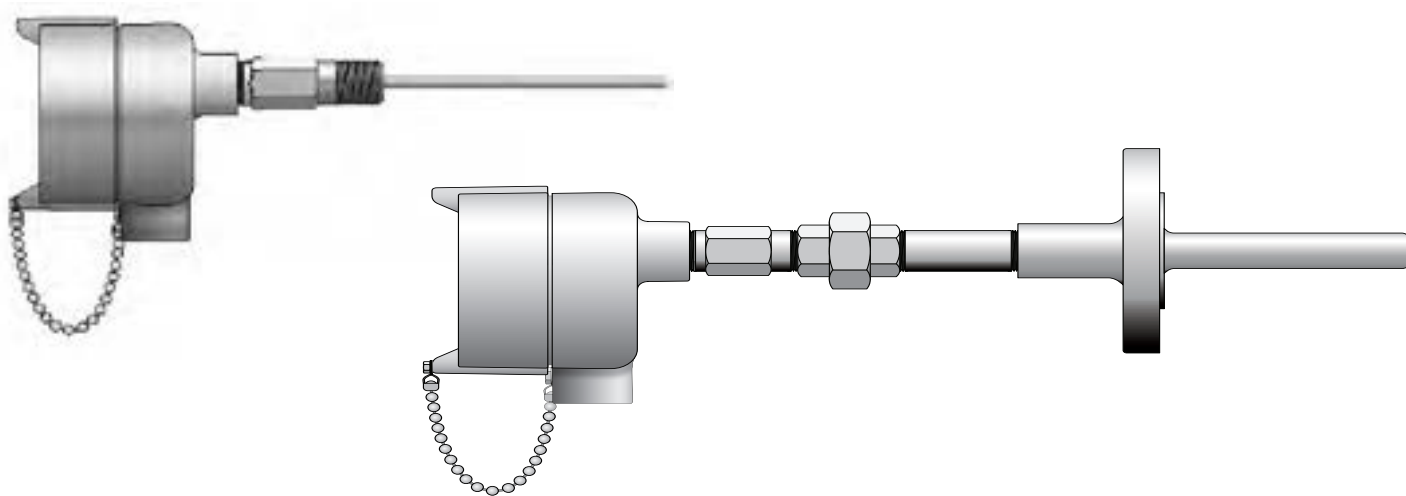
Specification and order options

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

Hazardous Area Sensor Assemblies



Overview

Whether you need to monitor bearing temperature, process temperature, or virtually any temperature in a hazardous area, Minco's AS9 series temperature sensor assembly can be configured to fit your application, and is certified to satisfy your requirements. Minco's AS9 series temperature sensors offers a single product with global certifications simplifying inventory management and reducing the complexities associated with complying with multiple regional standards.

- **Approval agencies:** IECEx, ATEX, CSA-Canada (Canada and United States)
- **Area classifications:** Zone 0, Zone 1, Zone 2, Class I Division 1, Class I Division 2
- **Protection methods:** flameproof (Ex d), increased safety (Ex e), intrinsic safety (Ex i), explosionproof (XP), dustignitionproof (DIP), dust ignition protection by enclosure (Ex tb)
- **Probe options:** tip-sensitive, all stainless steel, mineral insulated
- **Output options:** resistance (RTD), voltage (thermocouple), current (4-20 mA), digital (HART®)
- **Fitting options:** spring-loaded, welded, union/nipple, ½-14 NPT, G ½ (ISO 228-1)
- **Connection head options:** copper-free aluminum (IP66/NEMA 4), epoxy powder coated aluminum (IP66/NEMA 4X), stainless steel (IP66/NEMA 4X), various conduit threads
- **Thermowell options:** threaded, flanged, tapered, reduced tip

Certifications

Minco's AS9 sensors are certified by multiple agencies. Consult the following list to learn more:

IECEx (IEC 60079):

Ex ia IIC T6...T2 Ga IP66
Ex db IIC T6...T2 Gb IP66
Ex tb IIIC T85...T160°C Db

ATEX (EN 60079):

II 1 G Ex ia IIC T6...T2 Ga IP66
II 2 G Ex db IIC T6...T2 Gb IP66
II 2 D Ex tb IIIC T85...T160°C Db

CSA Canada (CSA C22.2):

Class I, Zone 0, Ex ia IIC T6...T2
Class I, Zone 1, Ex db IIC T6...T2
Class II, Zone 21, Ex tb IIIC T85...T160°C
IS/XP Class I, Division 1, Groups B, C, D T6...T2
Class II, Division 1, Groups E, F, G T85...T160°C
Class III, Division 1

CSA USA (NEC 500 & 505):

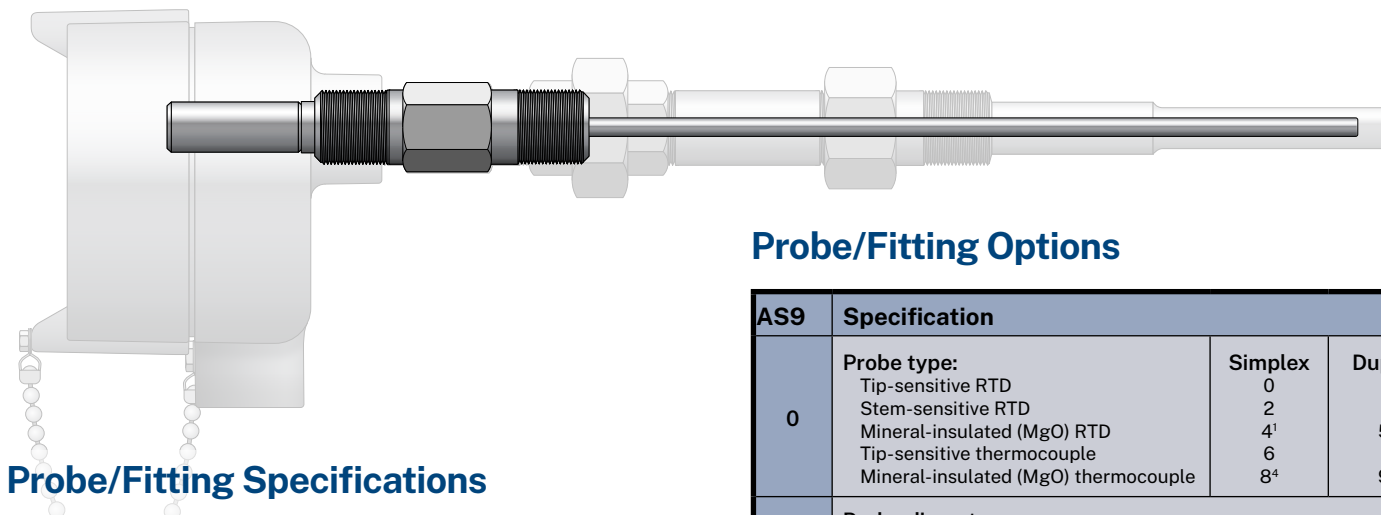
Class I, Zone 0, AEx ia IIC T6...T2
Class I, Zone 1, AEx db IIC T6...T2
Class II, Zone 21, AEx tb IIIC T85...T160°C
IS/XP Class I, Division 1, Groups B,



IECEx

Hazardous Area Sensor Assemblies

Select Probes and Fittings



Probe/Fitting Specifications

Probe Type	Temperature Range Probe/Process
0, 1, 2, 3, 6, 7	-50 to 260°C (-58 to 500°F)
4, 5, 8, 9	-50 to 600°C (-58 to 1112°F)

Fitting Type	Pressure Rating
0, 3, 5, 8	50 psi (3.4 bar)
1, 6	715 psi (49.3 bar)
2, 7	None

Probe Type	Material (probe)
0, 1, 6, 7	Stainless steel with copper alloy tip for faster time response
2, 3, 4, 5, 8, 9	Stainless steel

**Not seeing your ideal configuration?
Contact us for a custom solution!**

Probe/Fitting Options

AS9	Specification		
0	Probe type:	Simplex	Duplex
	Tip-sensitive RTD	0	1
	Stem-sensitive RTD	2	3
	Mineral-insulated (MgO) RTD	4 ¹	5 ²
	Tip-sensitive thermocouple	6	7
	Mineral-insulated (MgO) thermocouple	8 ⁴	9 ⁴
0	Probe diameter:		
	0 = 6.4 mm (.250")		
	1 = 6.0 mm (.236")		
	2 = 5.5 mm (.215")		
	3 = 5.5 mm (.215"); thick wall for bending by hand		
	4 = 4.8 mm (.188")		
0	Process thread \ fitting type:		
	0 = 1/2-14 NPT \ release knob spring-loaded		
	1 ²³ = 1/2-14 NPT \ welded		
	2 ¹ = 1/2-14 NPT \ fixed spring-loaded		
	3 = 1/2-14 NPT \ set screw spring-loaded		
	5 = G 1/2 \ release knob spring-loaded		
	6 ²³ = G 1/2 \ welded		
	7 ¹ = G 1/2 \ fixed spring-loaded		
	8 = G 1/2 \ set screw spring-loaded		
AS9000PD100W3A0X0X1N1 = Sample part number			

1 - Only available for Probe diameter options 0, 1

2 - Only available for Probe diameter option 0

3 - Only available for Probe type options 2, 3, 4, 5, 8, 9

4 - Not available for Probe diameter option 2

Insulation resistance:

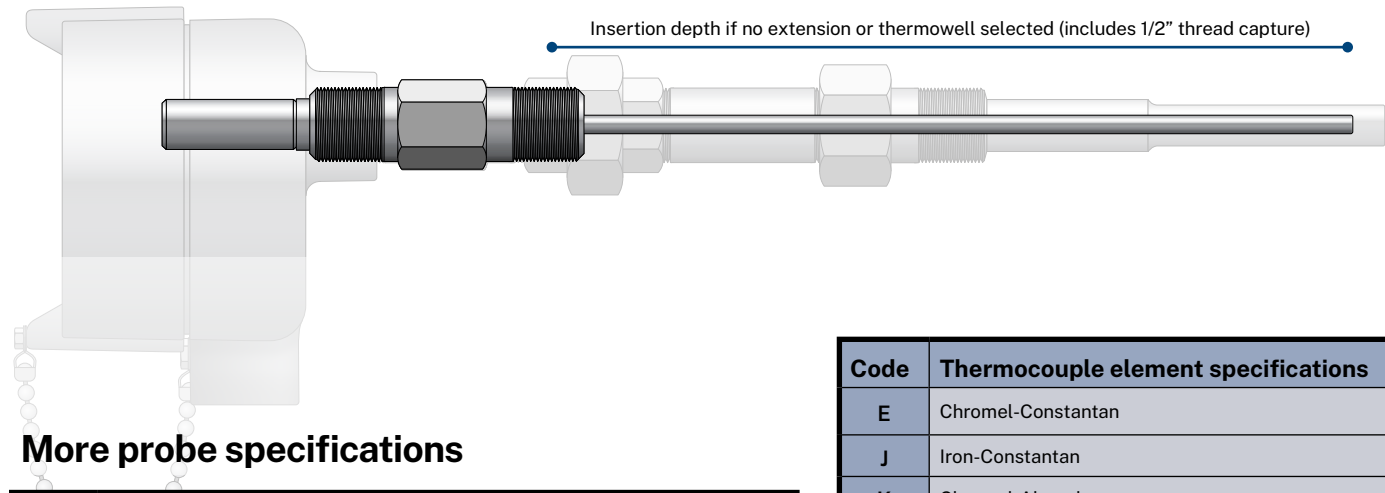
- 1000 megohms min at 100 VDC, leads to case.
- 100 megohms min at 100 VDC, leads to case (ungrounded junction thermocouples).
- 10 megohms min at 100 VDC, leads to case (mineral insulated RTDs and ungrounded mineral insulated thermocouples)

Dielectric strength:

- 600 Vrms at 60 Hz for 2 seconds with 5 mA maximum leakage current (probe leads to connection head).

Hazardous Area Sensor Assemblies

Select Sensing Element, Insertion Depth, and Lead Configuration



More probe specifications

Code	RTD element specifications
PA	Platinum (0.00392 $\Omega/\Omega/^{\circ}\text{C}$); 100 $\Omega \pm 0.5\%$ at 0°C Accuracy: $\pm 1.3^{\circ}\text{C}$ at 0°C
PD	Platinum (0.00385 $\Omega/\Omega/^{\circ}\text{C}$); 100 $\Omega \pm 0.12\%$ at 0°C Accuracy: $\pm 0.3^{\circ}\text{C}$ at 0°C (EN60751 Class B)
PM	Platinum (0.00385 $\Omega/\Omega/^{\circ}\text{C}$); 100 $\Omega \pm 0.06\%$ at 0°C Accuracy: $\pm 0.15^{\circ}\text{C}$ at 0°C (EN60751 Class A)
PF ⁷	Platinum (0.00385 $\Omega/\Omega/^{\circ}\text{C}$); 1000 $\Omega \pm 0.12\%$ at 0°C Accuracy: $\pm 0.3^{\circ}\text{C}$ at 0°C (EN60751 Class B)
PW ⁷	Platinum (0.00375 $\Omega/\Omega/^{\circ}\text{C}$); 1000 $\Omega \pm 0.12\%$ at 0°C Accuracy: $\pm 0.3^{\circ}\text{C}$ at 0°C
CA ⁵⁷	Copper (0.00427 $\Omega/\Omega/^{\circ}\text{C}$); 10 $\Omega \pm 0.2\%$ at 25°C Accuracy: $\pm 0.5^{\circ}\text{C}$ at 25°C
CC ⁶⁷	Copper (0.00427 $\Omega/\Omega/^{\circ}\text{C}$); 10 $\Omega \pm 0.5\%$ at 25°C Accuracy: $\pm 1.3^{\circ}\text{C}$ at 25°C
NA ⁷	Nickel (0.00672 $\Omega/\Omega/^{\circ}\text{C}$); 120 $\Omega \pm 0.5\%$ at 0°C Accuracy: $\pm 0.8^{\circ}\text{C}$ at 0°C
NB ⁶	Nickel (0.00618 $\Omega/\Omega/^{\circ}\text{C}$); 100 $\Omega \pm 0.22\%$ at 0°C Accuracy: $\pm 0.4^{\circ}\text{C}$ at 0°C (DIN 43760 Ni 100)

5 – Simplex only

6 – Duplex only

7 – Not available for Probe type options 4, 5

Note: See interchangeability tables for accuracy over the entire temperature range.

Insertion depth:

- If no thermowell or nipple/union extension, measured from thread engagement on fitting as shown in diagram above. If nipple/union extension but no thermowell, measured from thread engagement on nipple. If threaded thermowell, measured from end of thermowell threads as shown in diagram on page 5. If flanged thermowell, measured from face of flange as shown in diagram on page 5.
- Minimum: 35mm (only applies when no extension and/or no thermowell are specified).
- Maximum: 3048mm probe length. (Maximum insertion depth will vary, depending on selected options.)

Code	Thermocouple element specifications
E	Chromel-Constantan
J	Iron-Constantan
K	Chromel-Alumel
T	Copper-Constantan
_G	Grounded: thermocouple junction internally grounded to case
_U	Ungrounded: thermocouple junction electrically isolated from case

Thermocouple accuracy:

Standard tolerances per ASTM E230/E230M.

Probe/Sensing Element Options

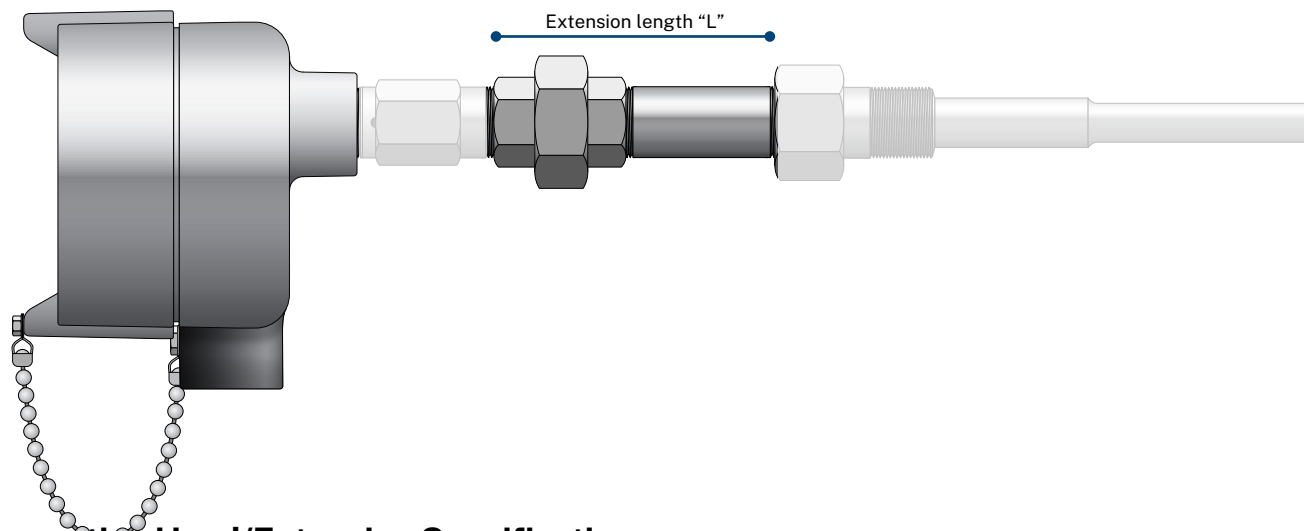
AS9	Specification
PD	Sensing element For RTD enter two letter code from table on left. For Thermocouple, enter E, J, K or T thermocouple type plus U or G for junction type as shown above.
100	Insertion depth (mm)
W	Leads per sensing element (colors shown are first element \ optional second element) Y ⁸ = 2 (1-red/1-white\\1-yellow/1-blue) V ⁸⁹ = 2 (1-white/1-red\\1-yellow/1-black) (EN60751) Z = 3 (1-red/2-white\\1-blue/2-yellow) W = 3 (1-white/2-red\\1-yellow/2-black) (EN60751) X = 4 (2-red/2-white\\2-yellow/2-blue) U ⁹ = 4 (2-white/2-red\\2-yellow/2-black) (EN60751) P = thermocouple (colors per ASTM E230/E230M)
AS900C PD100W3A0X0X1N1 = Sample part number	

8 – Not available for Sensing element options CA, CC

9 – Not available for simplex probe types.

Specifications and Options (continued)

Select Connection Head and Optional Extension



Connection Head/Extension Specifications

Connection head material	Temperature range connection head/ambient
A, E, S	-50 to 121°C (-58 to 250°F)

Connection head material	Ingress protection
E, S	IP66 (Type 4X)
A	IP66 (Type 4)

Connection head material	Material (head)
A	A360.1 aluminum (0.6% copper max.)
E	A360.1 aluminum with powder coating
S	Type 316 stainless steel

Extension type, length	Material (nipple/union)
1,2,3,4,5,6,7,8	Type 316 stainless steel

Connection Head/Extension Options

AS9	Specification
3	Conduit thread: 3 = 1/2" -14 NPT 4 = 3/4" -14 NPT 5 = M20 x 1.5
A	Connection head material: A = Aluminum E = Aluminum powder-coated S = Stainless steel D ¹⁰ = Aluminum with display indicator (coming soon)
0	Extension type, length: 0 = No extension; 1 = 1/2" -14 NPT nipple/union, L = 1.8" (46mm) 2 = 1/2" -14 NPT nipple/union, L = 2.6" (66mm) 3 = 1/2" -14 NPT nipple/union, L = 3.6" (91mm) 4 = 1/2" -14 NPT nipple/union, L = 4.6" (117mm) 5 = 1/2" -14 NPT nipple/union, L = 5.6" (142mm) 6 = 1/2" -14 NPT nipple/union, L = 6.6" (168mm) 7 = 1/2" -14 NPT nipple/union, L = 7.6" (193mm) 8 = 1/2" -14 NPT nipple/union, L = 8.6" (218mm) 9 = Special order - contact Minco for options
AS9000PD100W3A0X0X1N1 = Sample part number	

¹⁰ - Requires Temptran™ code option 7. Not available for Sensing element options CA, CC.

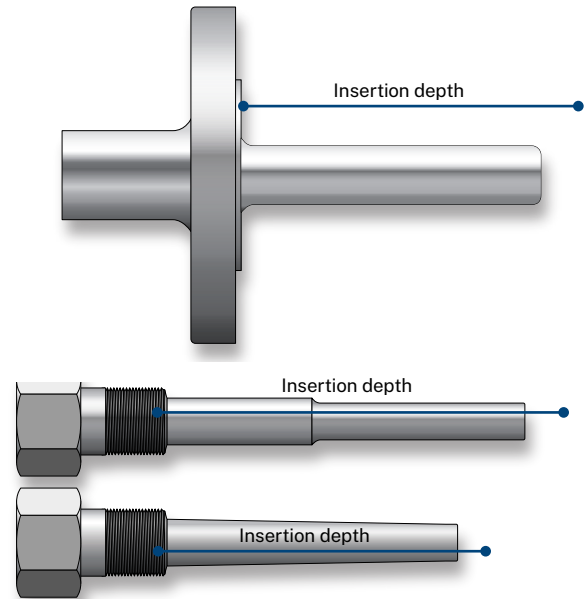
Specifications and Options (continued)

Select Optional Thermowell

Thermowell Specifications

1. Specify thermowell type

Code	Thermowell type
A	1" RF (Raised Face)
B	1.5" RF (Raised Face)
C	2" RF (Raised Face)
D	3" RF (Raised Face)
E	1" RTJ (Ring Type Joint)
F	1.5" RTJ (Ring Type Joint)
G	2" RTJ (Ring Type Joint)
H	3" RTJ (Ring Type Joint)
J	Threaded, reduced tip
K	Threaded, tapered
X0	No thermowell (skip 2a and 2b)



2a. If Flange mount thermowell, specify rating and shaft design

Code	Rating and shaft design
0	150# tapered
1	300# tapered
2	600# tapered
3	900#/1500# tapered
4	2500# tapered
5	150# straight
6	300# straight
7	600# straight
8	900#/1500# straight
9	2500# straight

3. Specify thermowell material

Code	Material
X	No thermowell
A	Type 316/316L SST
B	Type 304 SST
J	Hastelloy C-276
K	Monel 400
N	Carbon Steel C1018

2b. If Thread mount (code J or K) thermowell, specify process thread

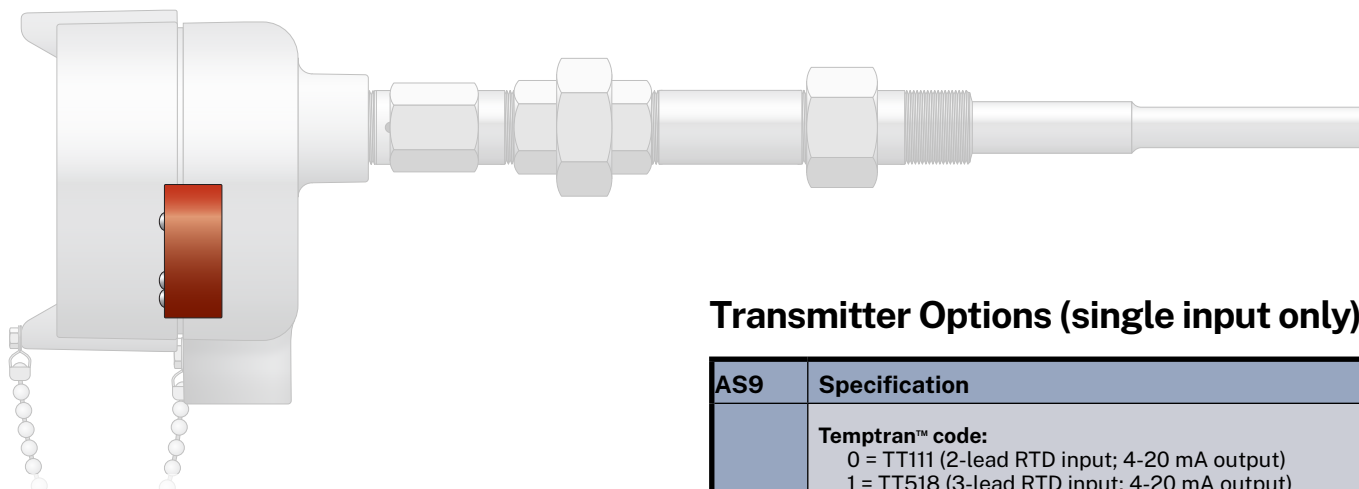
Code	Process thread
0	1/2 - 14 NPT
1	3/4 - 14 NPT
2	1 - 11½ NPT
3	G 1/2

Thermowell Options

Code	Specification
X	Thermowell mounting type: select code from table 1 at left
0	Thermowell rating/shaft or thread: select code from table 2a or 2b at left
X	Thermowell material: select code from table 3 above
AS9000PD100W3A0X0X1N1 = Sample part number	

Hazardous Area Sensor Assemblies

Finish the part number by specifying your transmitter choice



Transmitter Specifications

Note: TT111 series transmitter is certified only for North America use in explosionproof (XP) and flameproof (Ex d) applications

Temptran™ code	Base model number	Agency approvals
1	TT518	ATEX CSA (USA and Canada) IECEX
2	TT519	ATEX IECEX
6	TT520	ATEX CSA (USA and Canada) IECEX
7	TT521	ATEX CSA (USA and Canada) IECEX

Transmitter Options (single input only)

AS9	Specification
1	Temptran™ code: 0 = TT111 (2-lead RTD input; 4-20 mA output) 1 = TT518 (3-lead RTD input; 4-20 mA output) 2 = TT519 (thermocouple input; 4-20 mA output) 5 = TT246 (3-lead RTD input; 1-5 VDC output) 6 = TT520 (any input; 4-20 mA output) 7 = TT521 (any input; 4-20 mA output + HART®)
N	Temperature range code: For a list of Temperature range codes, download a Sensors Design Guide from Minco.com or contact Minco for additional range options.
1	Calibration (options 2, 3, 4 available for Simplex RTD configurations only): 1 = Calibrated to sensing element nominal values 2 = Match calibrated for $\pm 0.75\%$ of span system accuracy 3 = Match calibrated for $\pm 0.50\%$ of span system accuracy 4 ¹¹ = Match calibrated for $\pm 0.20\%$ of span system accuracy
AS9000PD100W3A0X0X1N1 = Sample part number	

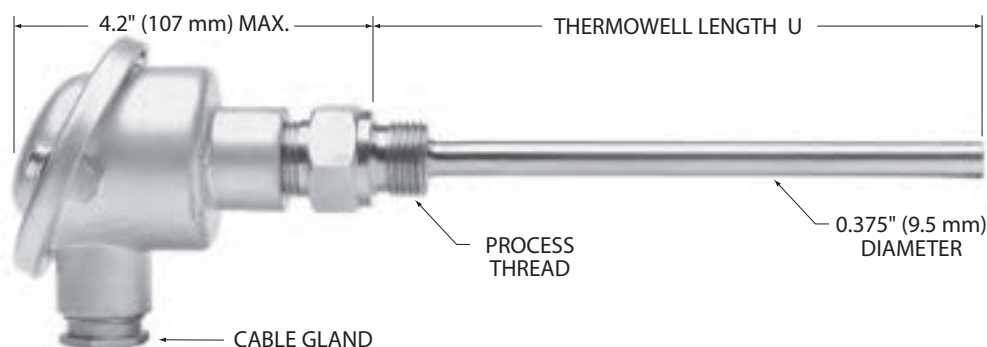
11 – System accuracy = $\pm 0.20\%$ of span or $\pm 0.1^\circ\text{C}$, whichever is greater.

Calibration

Transmitters can be calibrated to nominal resistance values of the RTD (Calibration option 1). Total system error includes the tolerances of both the transmitter and the RTD sensor. Match calibration (Calibration options 2, 3, 4) uses actual resistance of the RTD to calibrate the transmitter. This effectively eliminates the sensor tolerance from system accuracy calculations. A calibration report with traceability to NIST and/or SI is provided with Calibration option 2, 3, or 4.

Calibration options 2, 3, and 4 are not available for thermocouples or duplex RTDs.

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

Eurostyle Sensors

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	10 Ω $\pm 0.2\%$ at 25°C	CA
(dual) (0.00427 TCR)	10 Ω $\pm 0.5\%$ at 25°C	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

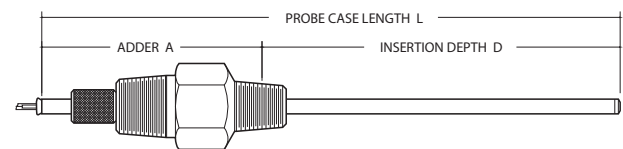
Transmitters convert sensor output to a 4 to 20 mA current signal, immune to leadwire resistance. See Section 4 for RTD and thermocouple transmitters.

Factors to consider are:

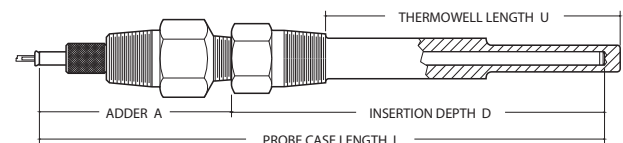
- Transmitter accepts sensor input
- Transmitter fits connection head
- Ambient temperature range acceptable

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



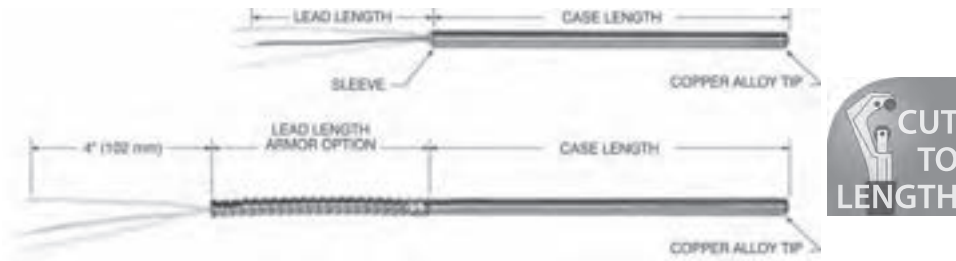
► SECTION 2: PROBES

- 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)

Section 2: Probes

Tip-sensitive RTDs and thermocouples	2-2 to 2-3	Mineral-insulated RTDs	2-13
Fast response RTDs.....	2-4 to 2-5	Compact plug sensor.....	2-14
Bayonet mount tip-sensitive RTDs, thermocouples.....	2-6 to 2-7	Integrated sensor transmitter.....	2-15
Electrically isolated RTDs, thermocouples	2-8 to 2-9	Conductivity level sensor.....	2-16 to 2-17
550°C RTDs, thermocouples.....	2-10 to 2-11	How to shorten cut-to-length probes	2-18
600°C RTDs.....	2-12	PFA, FEP encapsulation tubing.....	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

Tip-sensitive RTDs & Thermocouples

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 \pm 0.5% at 0°C	▼ S54PA	▼ S51PA	▼ S53PA
Platinum (0.00385 TCR) 100 Ω \pm 0.06% at 0°C (Meets EN60751, Class A)	▼ S554PM	▼ S551PM	▼ S553PM
Platinum (0.00385 TCR) 100 Ω \pm 0.1% at 0°C (Meets EN60751, Class B)	▼ S854PD	▼ S851PD	▼ S853PD
Platinum (0.00385 TCR) 100 Ω \pm 0.5% at 0°C	S884PE	S881PE	S883PE
Copper (0.00427 TCR) 10 Ω \pm 0.2% at 25°C	S54CA	S51CA	S53CA
Nickel (0.00672) 120 Ω \pm 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 \pm 0.5% at 0°C	▼ S59PA	▼ S56PA	▼ S57PA
Platinum (0.00385 TCR) 100 Ω \pm 0.06% at 0°C (Meets EN60751, Class A)	S559PM	S856PM	S557PM
Platinum (0.00385 TCR) 100 Ω \pm 0.1% at 0°C (Meets EN60751, Class B)	▼ S859PD	▼ S856PD	▼ S857PD
Platinum (0.00385 TCR) 100 Ω \pm 0.5% at 0°C	S889PE	S886PE	S887PE
Copper (0.00427 TCR) 10 Ω \pm 0.5% at 25°C		S56CC	S57CC
Nickel (0.00672) 120 Ω \pm 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:

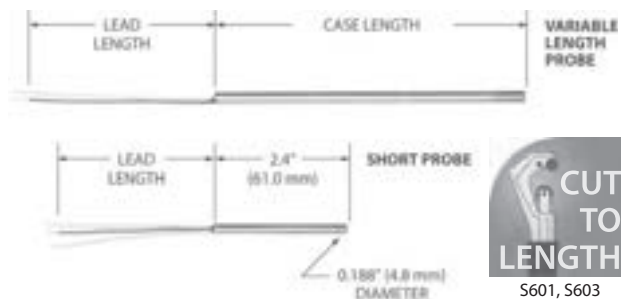
- ATEX Ex ia and EX e (Zones 0 and 1)
- IECEx Ex ia and Ex e (Zones 0 and 1)
- TR CU (EAC) Ex ia and Ex e (Zones 0 and 1)

▼ = **STANDARD OPTIONS**

Specifications subject to change



Fast Response RTDs



Overview

These probes have rugged stainless steel cases for use in high pressures or corrosive fluids. Yet their time constants are comparable to copper-tipped probes at 2 to 4 seconds, compared to 8 to 10 seconds for other all-stainless probes.

- Unique low-mass element reacts quickly to temperature changes
- Non-armor models can be user-shortened
- 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:

S601, S603, S604: 316 stainless steel.

S602, S614: 304/305 stainless steel.

Case length:

Minimum case length:

S602, S604: 2.0" (50.8 mm) with PTFE insulated leads;
3.0" (76.2 mm) with SS braid over leads.

S601, S603: 3.0" (76.2 mm).

Maximum case length:

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

Time constant: Typical in moving water:

S602, S604, S614: 2 seconds.

S601: 3 seconds.

S603: 4 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 (model S602 has AWG 26; add 0.08 Ω per foot for 2-lead).

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:

Fast response probes

Specify 0.125" or 0.188" for fastest response, 0.250" or 0.215" for greater strength and cut-to-length capability (PTFE and SS braid models).

S604	Model number: ▼ S601: Ø 0.215" (5.5 mm) Cut-to-length probe ▼ S602: Ø 0.125" (3.2 mm) ▼ S603: Ø 0.250" (6.4 mm) Cut-to-length probe ▼ S604: Ø 0.188" (4.8 mm)
PD	Sensing element from table ▼: PA, PD, PF
240	Case length: Specify in 0.1" increments (Ex: 240 = 24.0 inches) ▼: 30, 40, 60, 90, 120, 240
X	Number of leadwires: Y = 2 leads ▼ Z = 3 leads (required for copper elements) ▼ X = 4 leads (PD only)
36	Lead length in inches ▼: 36, 120
T	Covering over leadwires: (S, A not available on S602) ▼ T = PTFE only ▼ S = Stainless steel braid A = Stainless steel armor
S604PD240X36T = Sample part number	

Short probes

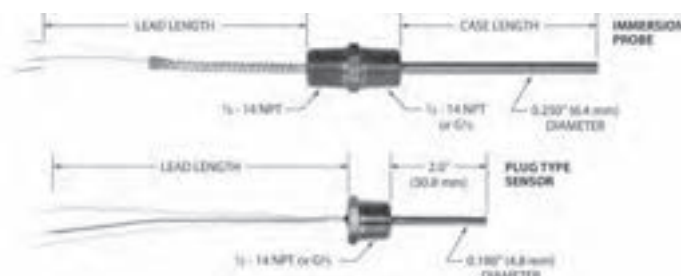
▼ S614	Model number (case with fixed length of 2.4" (61 mm))
PA	Sensing element from table ▼: PA, PD, PF
Z	Number of leadwires: Y = 2 leads ▼ Z = 3 leads (required for copper elements) X = 4 leads (PD only)
36	Lead length in inches ▼ 36
T	Covering over leadwires: ▼ T = PTFE only S = Stainless steel braid
S614PAZ36T = Sample part number	



STOCKED PARTS AVAILABLE

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)	100 Ω ±0.1% at 0°C (Meets EN60751, Class B)	▼PD
Platinum (0.00385 TCR)	100 Ω ±0.5% at 0°C	PE
Platinum (0.00385 TCR)	1000 Ω ±0.1% at 0°C (N/A for model S602)	▼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.

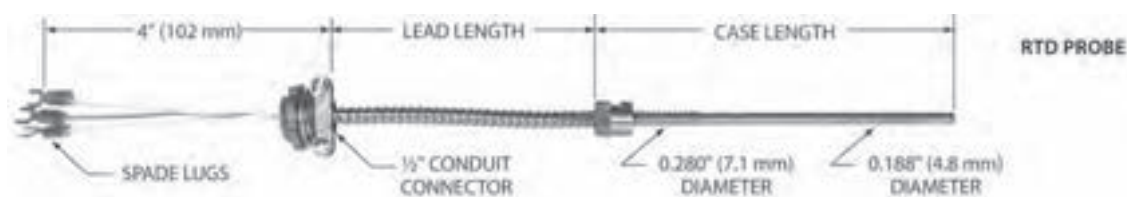
S634	Model number: S634: 1/2 - 14 NPT thread S639: ISO 228/1-G1/2 thread
NA	Sensing element from table
Y	Number of leads: Y = 2 leads X = 4 leads (PD only) Z = 3 leads (required for copper elements)
24	Lead length in inches
T	Covering over leadwires: T = PTFE only S = Stainless steel braid
S634NAY24T = 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 \pm 0.5% at 0°C	▼S44PA
Platinum (0.00385 TCR)	100 Ω \pm 0.1% at 0°C (Meets EN60751, Class B)	▼S844PD
Platinum (0.00385 TCR)	100 Ω \pm 0.5% at 0°C	S874PE
Copper (0.00427 TCR)	10 Ω \pm 0.2% at 25°C	S44CA
Nickel (0.00672 TCR)	120 Ω \pm 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.

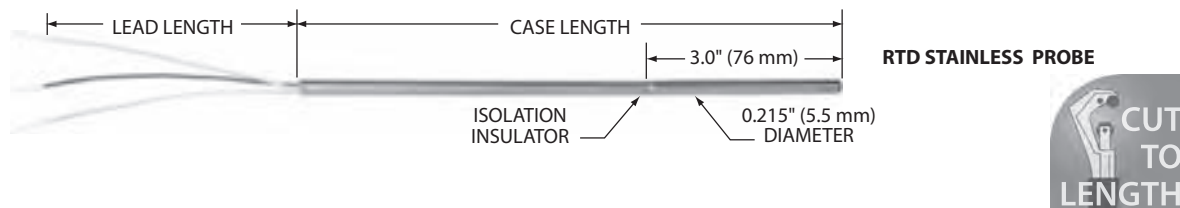
Specification and order options

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.

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

Isolated tip RTDs

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

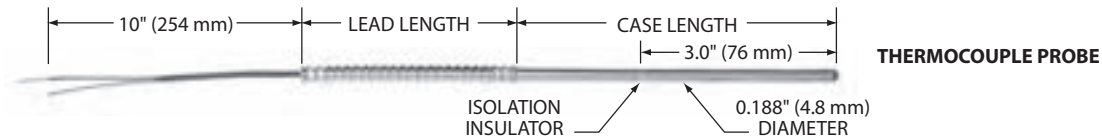
Time constant: 2 seconds typical in moving water.

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

▼ = **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

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.

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.

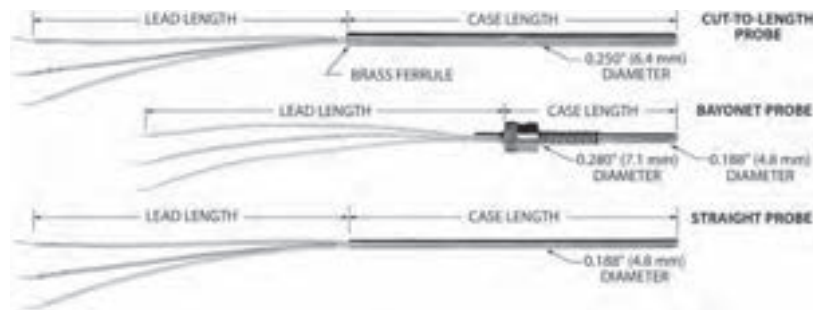
Specification and order options

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: \varnothing 0.188" (4.8 mm)

Element	Model
	▼ S71PB
Platinum (0.00385 TCR)* 100 Ω \pm 0.1% at 0°C	▼ S72PD

Bayonet probe: \varnothing 0.188" (4.8 mm)

Element	Model
	▼ S73PB
Platinum (0.00385 TCR)* 100 Ω \pm 0.1% at 0°C	▼ S74PD

Cut-to-length: \varnothing 0.250" (6.4 mm)

Element	Model
	▼ S80PB
Platinum (0.00385 TCR)* 100 Ω \pm 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	

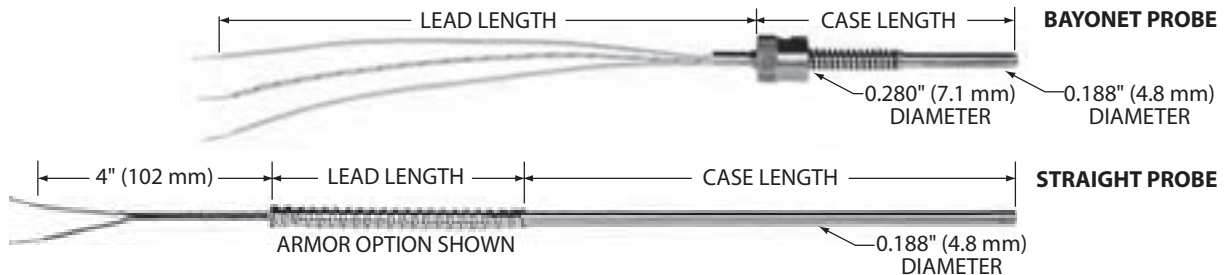


STOCKED PARTS AVAILABLE

▼ = **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.

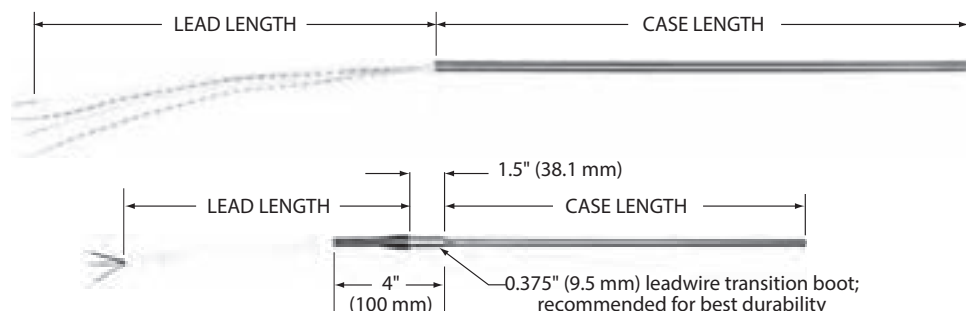
Specification and order options

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.

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.

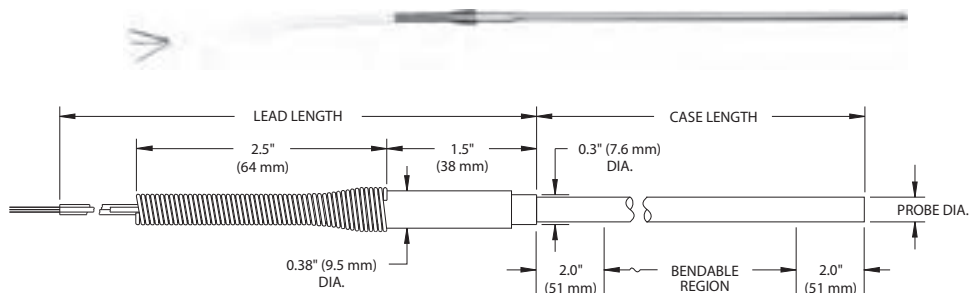
Vibration: Withstands 10 to 5000 Hz at 2 G's per EN60751. Also withstands 50 to 250 Hz at 50 G's at 500°C.

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

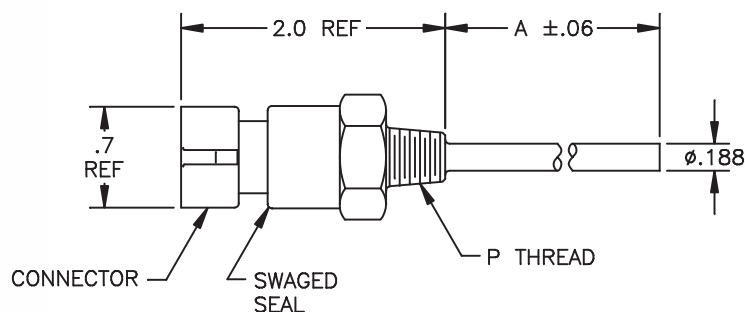
Specification and order options

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

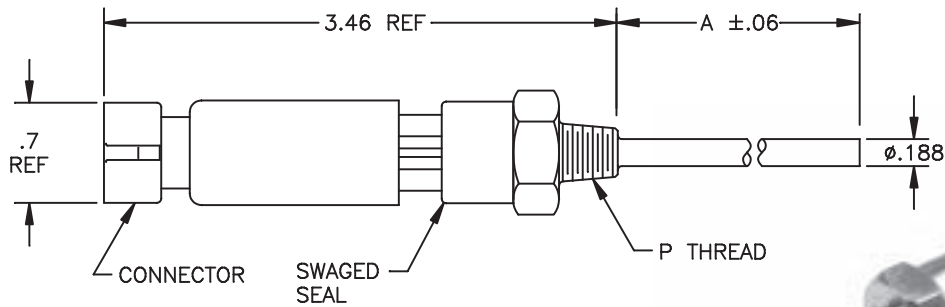
Specification and order options:

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 < ±.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 \pm 1 mA with fluid present and 16 mA \pm 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 $< \pm 0.1$ 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
Variable lengths are available. Contact Minco to learn more about custom design options for your application.	

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

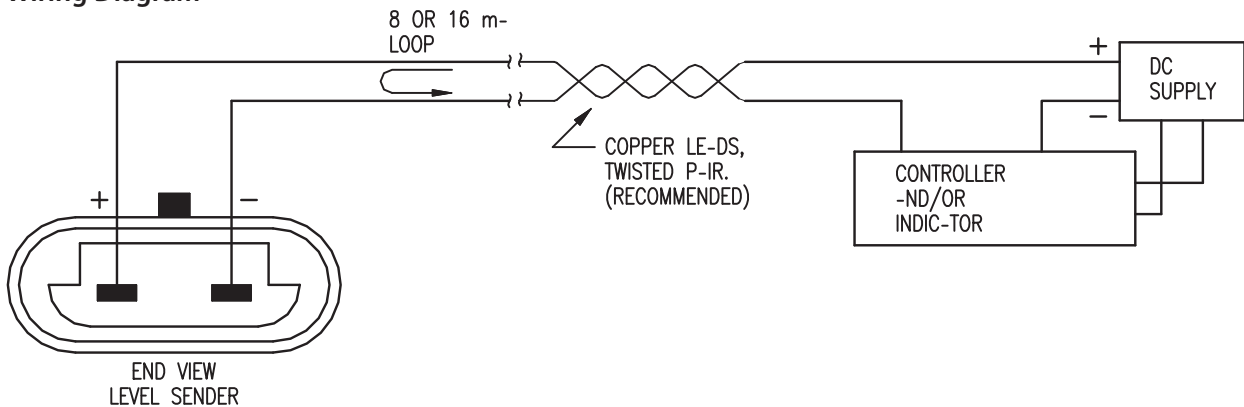
LT364 Mating Cable Assembly

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

▼ = STANDARD OPTIONS
Specifications subject to change

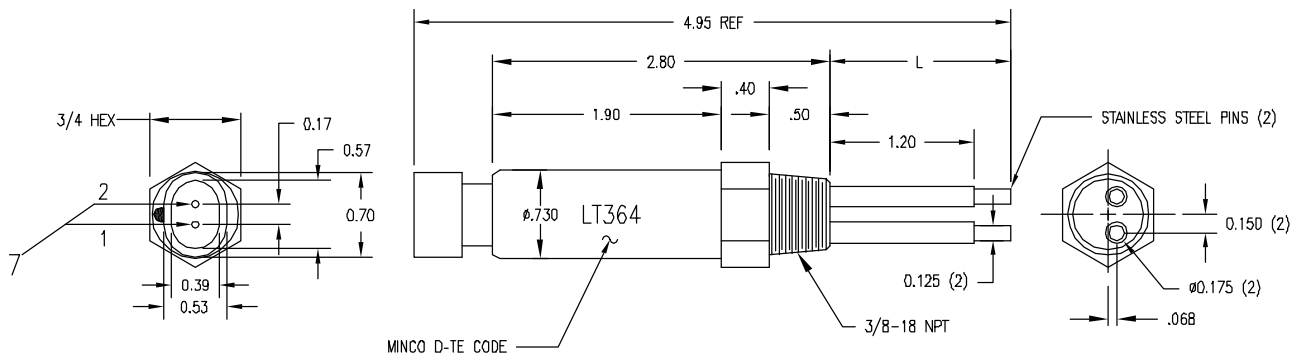
Conductivity Level Sensor

Wiring Diagram

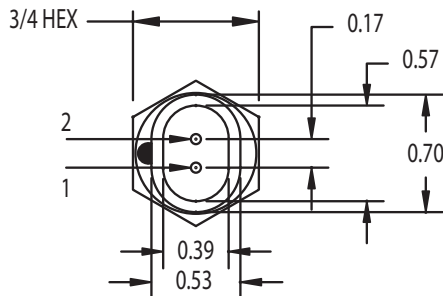


Dimensional Drawings

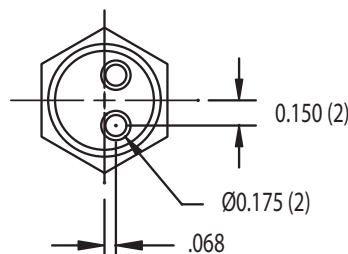
Side View



Connection End



Measurement End



▼ = STANDARD OPTIONS

Specifications subject to change



How to Shorten Cut-to-length Probes



Shorten probes easily with a tubing cutter

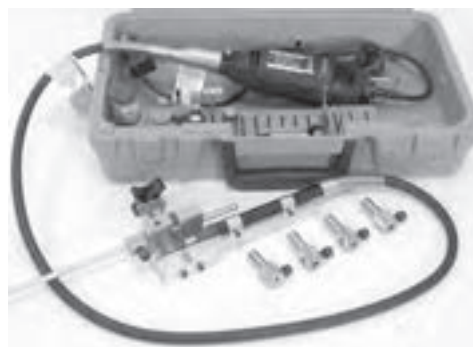
Overview

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

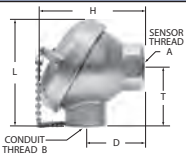

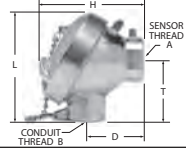
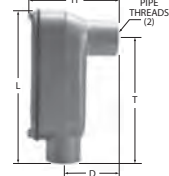
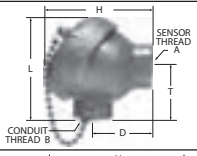

- A wide selection of fittings and accessories adapt sensors to any installation
- Adjustable fittings with cut-to-length probes provide off-the-shelf versatility
- Choose from a variety of materials to meet your critical environment requirements

Section 3: Accessories

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

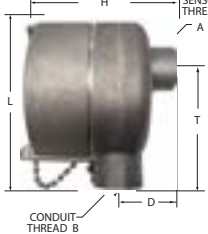
Bayonet fittings	3-9
Extensions	3-9
Metric accessories	3-10
Feedthroughs	3-11
Leadwire and cable seal.....	3-12 to 3-13
Elastomer rubber-filled cable.....	3-14
Extension wire	3-15

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 CH302 2.60 (66.0) H 5.20 (132) L 1.50 (38.1) D 4.25 (108) T		Aluminum/neoprene gasket	IP55 Type 3 and 4	115°C (240°F)	CH301: P3 only CH302: P2 only	Miniature TT111 and TT211 models	0.5 lbs. (0.2 kg.)	▼CH301 ▼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

▼= STANDARD OPTIONS
Specifications subject to change

Connection Heads

Dimensions in inches (mm)	Body/gasket material	Hazardous location rating	IP/NEMA Rating	Max Temp.	Approx. weight	Model
Flameproof/Explosionproof/Dust ignition protected heads - ATEX/IECEx/North American Ex approved						
CH504/CH506: 4.3 (109) L 3.9 (99) H 1.48 (37.6) D 3.09 (78.5) T 	Copper-free aluminum/ Fluorosilicone O-ring,	ATEX/IECEx: Ex II 2G Ex db IIC Gb, Ex II 2D Ex tb IIIC Db; NEC 505/CSA C22.2:	IP66 Type 4	85°C (185°F)	1.4 lbs. (0.6 kg.)	▼ CH504
	Copper-free aluminum, powder coated, Fluorosilicone O-ring	Class I, Zone 1, Ex/AEx db IIC Gb; Zone 21, Ex/AEx tb IIIC Db; NEC 500/CSA C22.2: CI I, Div 1&2, Gp B,C,D CI II, Div 1&2, Gp E,F,G CI III, Div 1&2	IP66 Type 4 and 4X			▼ CH504 _P
	Stainless steel/Fluorosilicone O-ring			85°C (185°F)	3.7 lbs. (1.7 kg.)	▼ CH506

Notes:

- all Temptran™ transmitter models may be used with connection heads on these pages.
- See section 4 for more information

Replacement terminal boards

Model	6-position board	8-position board
CH103	AC103029	AC101926
CH301	AC101377T6	
CH302	AC101377T6	
CH331	AC100427	
CH335	AC100427	AC101926
CH339	AC100427	AC101926
CH359	AC100427	AC101926
CH360	AC100427	AC101926
CH504		AC229180
CH506		AC229180

Specification and order options

CH504	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 (CH504, CH506 only) =	1/2 - 14	M20 x 1.5
	▼P6 (CH504, CH506 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		
8	Number of terminal posts or wire nuts: ▼ 0, 6*, 8 T0: transmitter mounting hardware W0: empty enclosure WO: empty enclosure		
P	Exterior head finish: P = Powder coated finish (available on CH504 heads only)		
CH504P2T8P = Sample part number			

*T6 or W6 not available for CH504 and CH506 Ex heads

Specifications subject to change

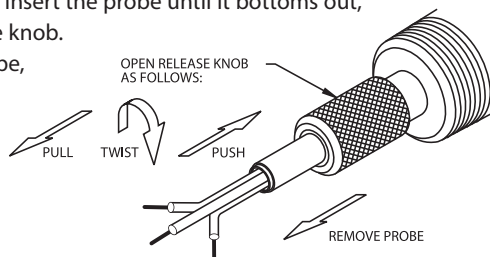


Spring-loaded Holders

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
	300 series stainless steel	-40 to 260°C (-40 to 500°F)	None	1/8 - 27 NPT	5/8" (16 mm)	2.8" (71 mm)	0.125 (3.2)	FG215N
							0.188 (4.8)	FG116
							0.215 (5.5)	FG112
							0.250 (6.4)	FG111
	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)	0.215 (5.5)	FG117
							0.188 (4.8)	FG101072
							0.250 (6.4)	FG101078
								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
	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.



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.

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





ALL PARTS STOCKED

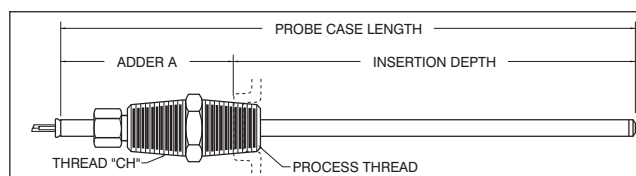
Note: Available up to 10 pieces or contact Minco Customer Service

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

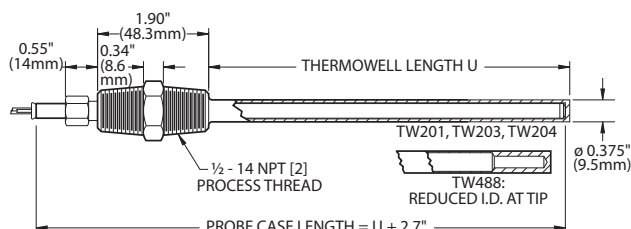


Overview

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) Tip 0.188" (4.8 mm)	1/2-14 NPT	1/2-14 NPT	TW488

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

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.

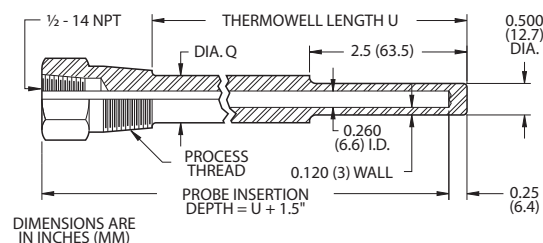
Immerse the thermowell at least 2.5" (65 mm) for accurate readings. The well should extend beyond the center of the fluid stream without touching the opposite wall. Installation in an elbow or tee may be necessary for sufficient immersion in small pipes.

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).

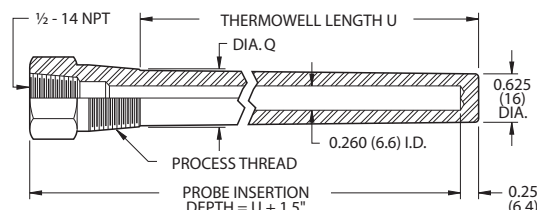
Standard U dimensions: 2.5, 4.5, 6.0, 7.5, 8.0, 10.5, 13.5, 16.5, and 22.5". Other dimensions available.

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

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

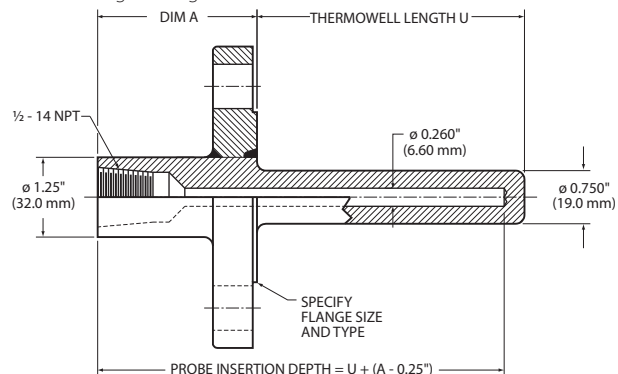
Overview

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.

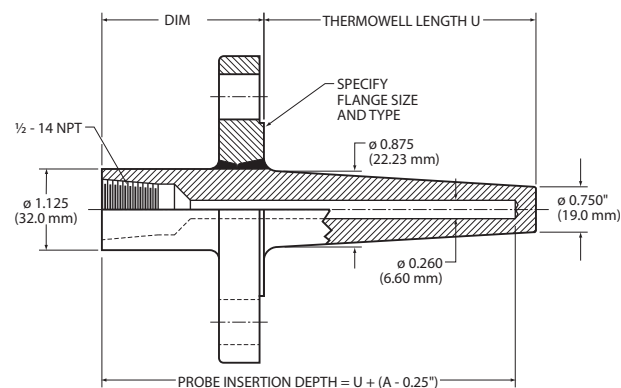
Immerse the thermowell at least 2.5" (65 mm) for accurate readings. The well should extend beyond the center of the fluid stream without touching the opposite wall. Installation in an elbow or tee may be necessary for sufficient immersion in small pipes.



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

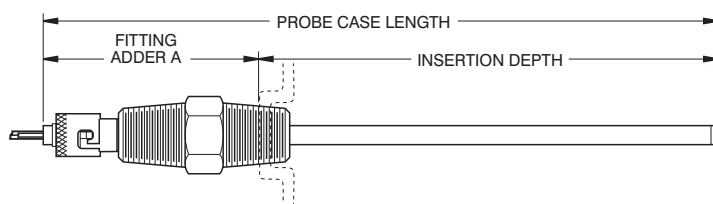
Bayonet adapter style

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)



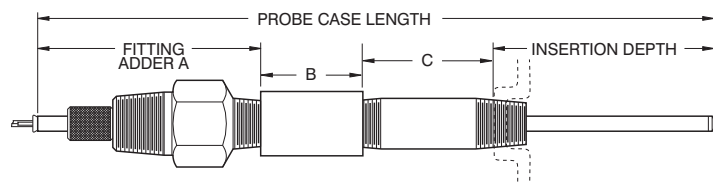
Extension nipples, couplings, unions

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)
 Nipple	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)
 Coupling	Same as Adder B length	▼FG602 Adder B: 1.7" (43mm)	▼FG854 Adder B: 1.4" (36mm)
 Union	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



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.

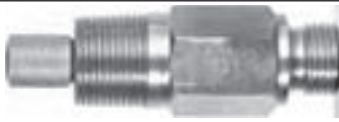



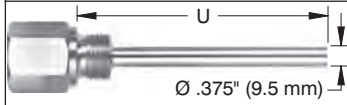
Fluid seal spring-loaded holders: Spring-loaded holders provide fast installation and simple adjustment or removal of probes. Minco's unique designs work with straight probes and provide sealing for the typical oil pressures found in rotating machines.

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 ½ - 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
 Fluid seal spring-loaded holder Probe length adder A: 3.6" (91mm)	303 series stainless steel per DIN 1.4300, AISI 303	260°C (500°F)	3.4 bar (50 psi)	¾ - 14 NPT	G ½ ISO 229/1 parallel	1 ⅛" (27 mm)	0.188" (4.8 mm)	MFG812P477
							0.215" (5.5 mm)	MFG812P546
							0.250" (6.4 mm)	MFG812P635
 Fluid seal fitting Probe length adder A: 1.1" min. (28 mm)	Brass	260°C (500°F)	Silicone rubber O-ring: 17.2 bar (250 psi) Brass compression ring: 34.5 bar (500 psi)	None	R ¼ ISO 7/1 tapered	⅝" (14 mm)	0.250" (6.4 mm)	MFG816
 Bayonet adapter Probe length adder A: 1.2" (31 mm)	303 series stainless steel per DIN 1.4300, AISI 303	871°C (1600°F)	No fluid seal	None	R ⅛ ISO 7/1 tapered	None	0.188" (4.8 mm)	MFG817
 Adapter bushing Probe length adder A: 1.2" (31 mm)	303 series stainless steel per DIN 1.4300, AISI 303	871°C (1600°F)	No fluid seal	½ - 14 NPT (Female)	G ½ ISO 229/1 parallel	1 ⅛" (27 mm)	All	▼ MFG811
 Thermowell Probe length = U + 30 mm + fitting adder A (U= 13 mm min./1200 mm max.)	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	½ - 14 NPT (Female)	G ½ ISO 229/1 parallel	1 ⅛" (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	

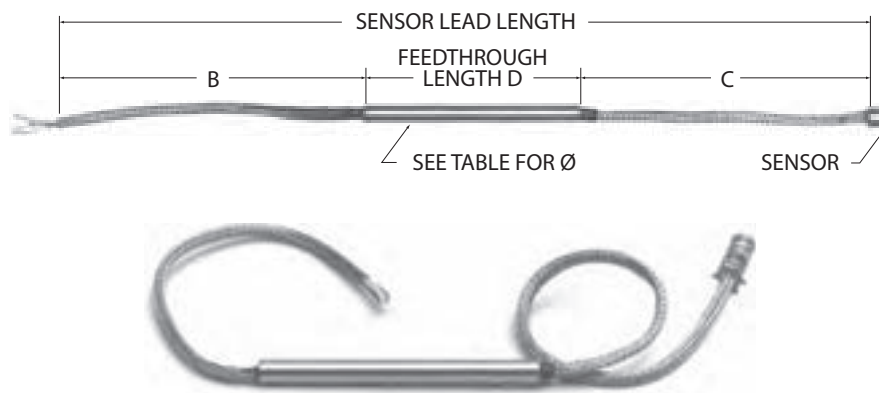
▼ = STANDARD OPTIONS

Specifications subject to change

Feedthroughs - Prevent Oil Seepage



STOP OIL SEEPAGE!



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

FG Series Cable Seals

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"
		2N220	2V220 2V220	0.220"	0.190" to 0.220"
H3		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"
H4			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"
H6	6N050	6V050	6V050	0.050"	0.030" to 0.050"

AC1015H1V130 = Sample part number ▼ = **STANDARD OPTIONS**

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

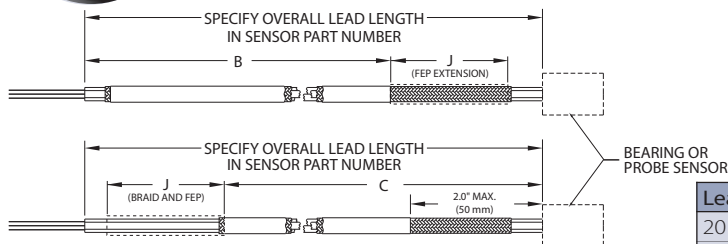
Specifications subject to change



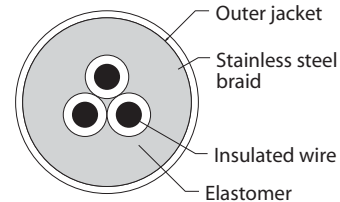
Sealed Elastomer Rubber-filled Cable - Prevent Oil Seepage



STOP OIL SEEPAGE!



Cross section of typical cable



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).

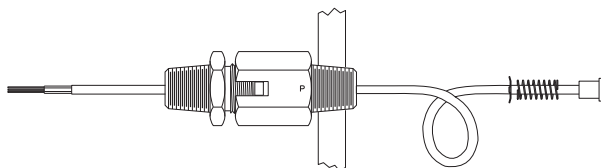
Tolerance on lead length: +1/-0" (+25/-0mm) for lead lengths 24" or less; +5/-0% for lead length greater than 24".

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.

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

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.



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

Section 4: Instruments

RTD transmitters	4-2 to 4-5, 4-8 to 4-9, 4-12 to 4-13
Thermocouple transmitters	4-6 to 4-7, 4-10 to 4-11, 4-14 to 4-15
Programmable transmitters.....	4-8 to 4-11
Field rangeable transmitters	4-12 to 4-15
Programmable transmitters	4-16 to 4-17
HART® transmitters.....	4-18 to 4-19
Temperature range table.....	4-20 to 4-21
High accuracy calibration.....	4-22
Mounting accessories.....	4-22
Loop-powered indicators.....	4-23 to 4-24

CT224 12-channel monitor.....	4-25 to 4-26
CT424 Temperature Alarm/Monitor.....	4-27 to 4-28
CT325 miniature DC temperature controller.....	4-29 to 4-30
CT335 PC board mount temperature controller.....	4-31 to 4-32
CT435 PC board mount temperature controller.....	4-33 to 4-34
CT15 controller/alarm.....	4-35 to 4-36
CT16 temperature controller.....	4-37 to 4-38
CT15/CT16A accessories.....	4-39
CT425 Temperature controller.....	4-40 to 4-41

Miniature Temptran™ RTD Transmitters



TT111 only



TT111, TT211

Overview

- Two models:
 - TT111: UL-recognized component for Canada and United States.
 - TT211: Wider ambient rating; no agency approvals
- 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: $\pm 0.1\%$ of span.

Linearity: Referenced to actual sensor temperature.

Platinum RTD input: $\pm 0.1\%$ of span.

Nickel and nickel-iron RTD input:

$\pm 0.25\%$ of span for spans less than 100°C.

$\pm 0.25\%$ of span per 100°C of span for spans greater than 100°C.

Adjustments: Zero and span, $\pm 5\%$ 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:

$\pm 0.013\%$ of span per °C.

$\pm 0.025\%$ of span per °C for spans less than 55°C.

Warmup drift: $\pm 0.1\%$ 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 $\pm 0.001\%$ 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).

Connections:

Terminal block for wires AWG 22 to AWG 14.

Physical: Polycarbonate case, epoxy potted for moisture resistance.

Weight: 1.1 oz. (30 g).

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

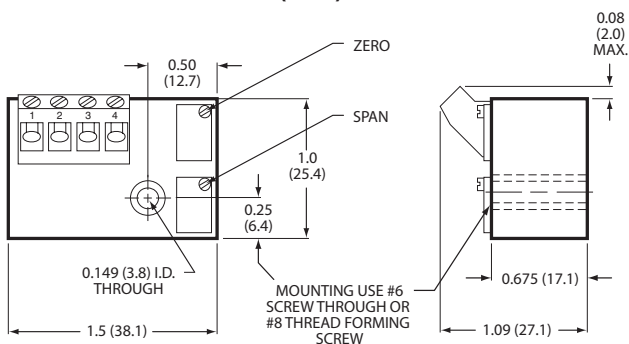
Special high-accuracy calibration

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.

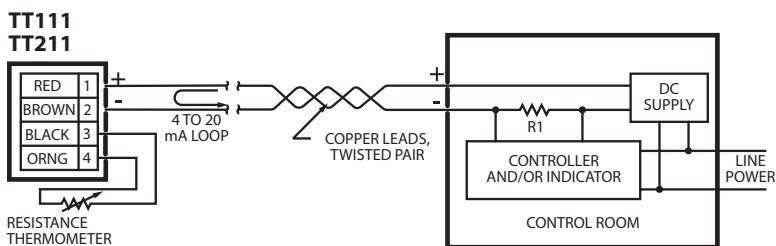
Specification and order options:

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	

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: $\pm 0.1\%$ 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, $\pm 5\%$ 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:

$\pm 0.009\%$ of span per °C

$\pm 0.014\%$ of span per °C for spans less than 10 Ω

Warmup drift:

$\pm 0.1\%$ 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 $\pm 0.001\%$ 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) $\pm 0.05\%$ 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

TT246 RTD Transmitters

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

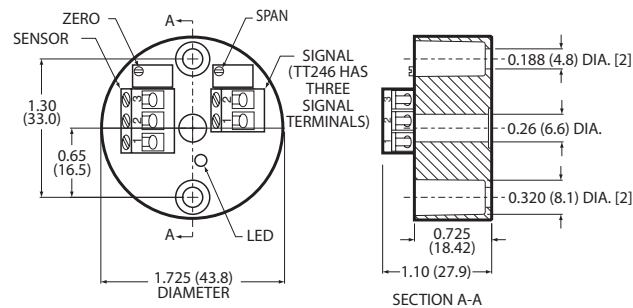
Special high-accuracy calibration

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

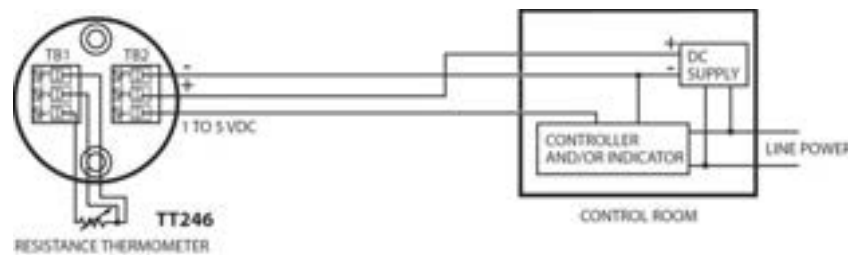
Specification and order options:

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: $\pm 0.2\%$ 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, $\pm 5\%$ of span, non-interacting. Factory set.

Warmup drift: $\pm 0.2\%$ 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 $\pm 0.001\%$ of span per volt.
Reverse polarity protected.

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

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

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

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 Thermocouple Transmitters

TT205

Ambient temperature:

Operating: -10 to 60°C (14 to 140°F).

Storage: -55 to 100°C (-67 to 212°F).

Ambient temperature effects: $\pm 0.036\%$ of span per °C.

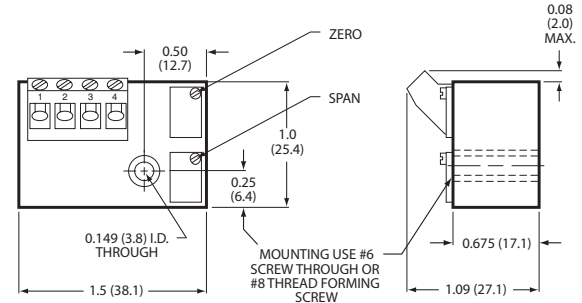
Cold junction compensation drift: $\pm 0.05^\circ\text{C}$ per °C.

Minimum span: 150°C (270°F).

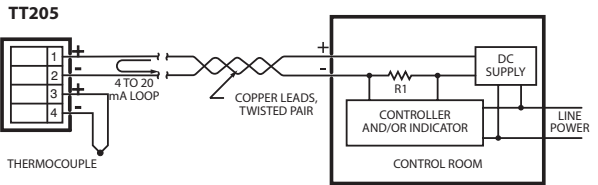
Specification and order options

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	

TT205 Dimensions in inches (mm)



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: $\varnothing 1.73 \times 0.84$ in ($\varnothing 44 \times 20.2$ mm)

Tightness (enclosure/terminal): IP 68 / IP00

Weight: 50g

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

TT508/TT518 Programmable Temperature Transmitter

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: Ø1.73 x 0.84 in (Ø44 x 20.2mm)

Tightness (enclosure/terminal): IP 68 / IP00

Weight: 50g

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

TT509/TT519 Programmable Temperature Transmitter

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

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 $^\circ\text{C}$ or $^\circ\text{F}$. For example, -25° to $+200^\circ\text{C}$ = 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



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

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).

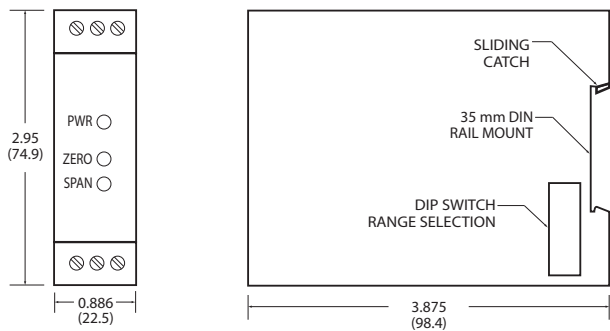
▼ = **STANDARD OPTIONS**
Specifications subject to change

TT274 Field Rangeable Thermocouple Temperature Transmitter

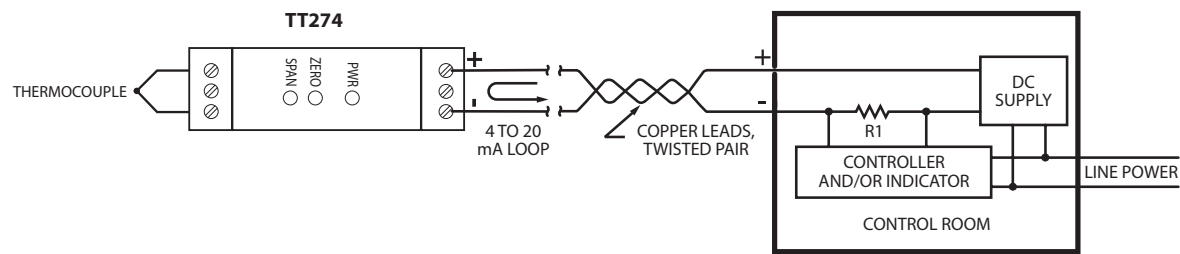
Specification and order options

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

V_{max} : 30.0 VDC

C_i : 1 nF

I_{max} : 120 mADC

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**

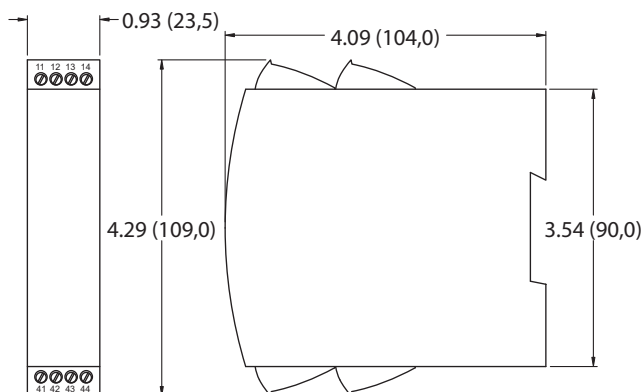
Specifications subject to change

Programmable Transmitters

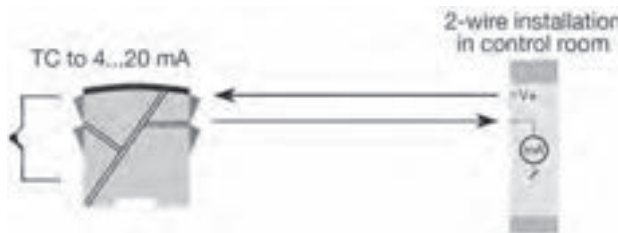
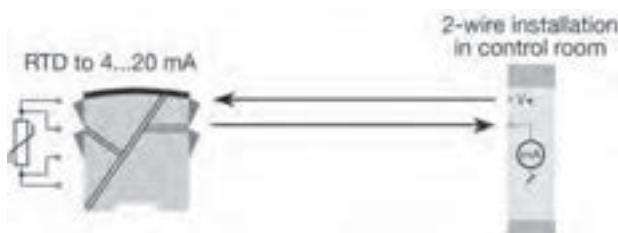
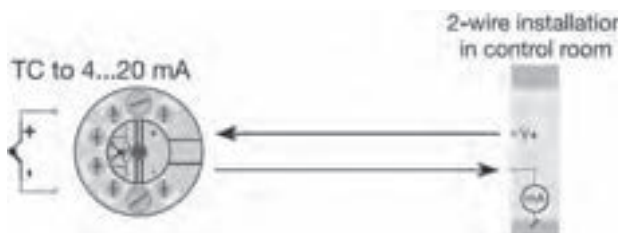
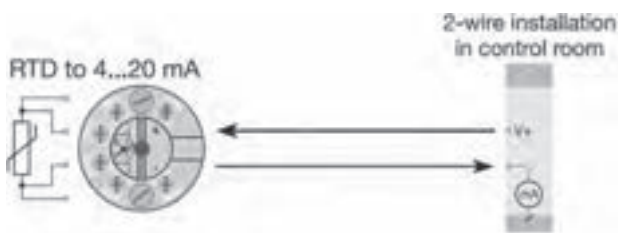
Specifications and order options

TT520	Model Number: TT520 Temperature Transmitter TT530 DIN Rail Temperature Transmitter
PD	Sensor Type: PD = 100 Ω Platinum RTD (0.00385) PF = 1000 Ω 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 $\pm 0.75\%$ 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	

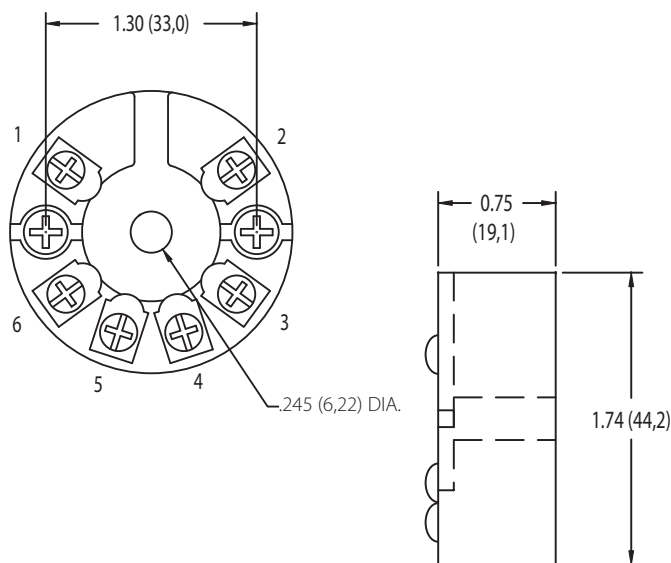
Dimensions in inches (mm)



Wiring Diagrams



Dimensions in inches (mm)



Specifications subject to change

Programmable Transmitters w/ HART® Protocol



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): $\pm 0.1^\circ\text{C}$

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

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

V_{max} : 30.0 VDC C_i : 1 nF

I_{max} : 120 mADC L_i : 10 μH

P_{max} : 0.84 W

Europe: ATEX II 1 G

Meets these European requirements:

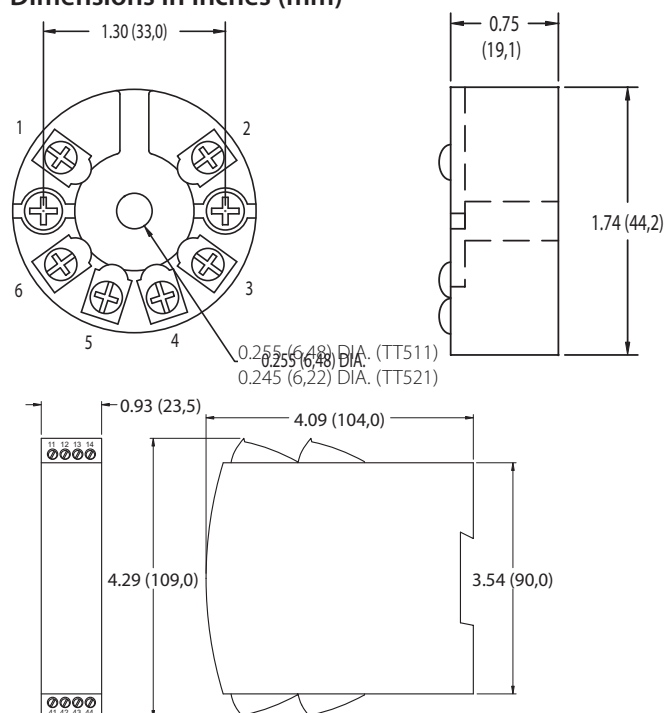
EMC 2004/108/EC: Standard EN 61326-1

Programmable Transmitters w/ HART® Protocol

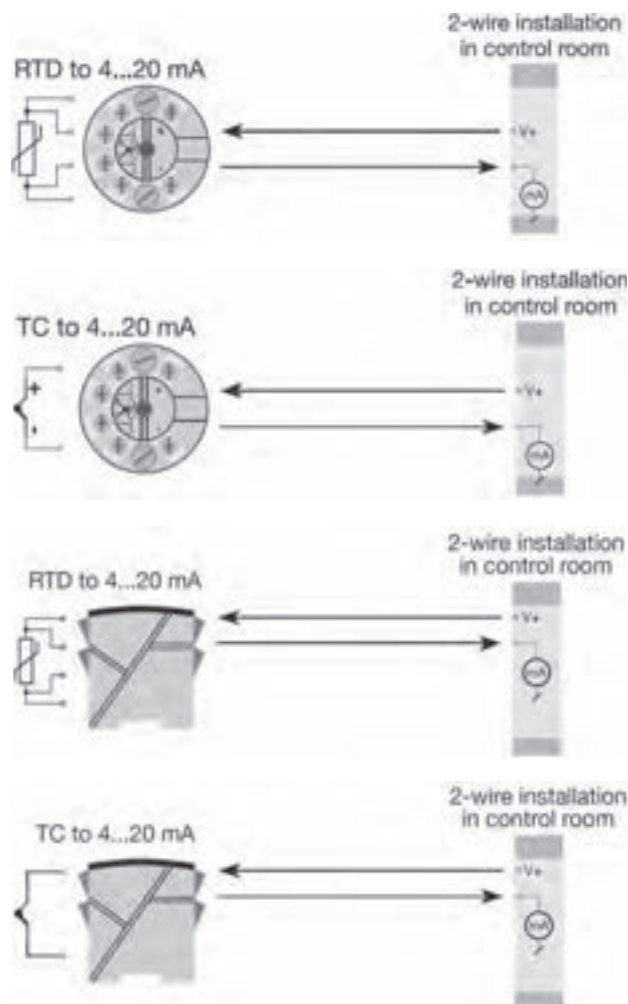
Specifications and order options

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	

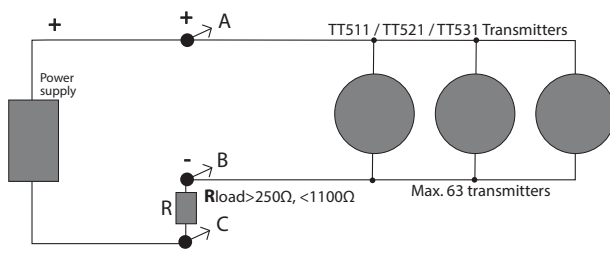
Dimensions in inches (mm)



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) contact Minco Sales and Customer Service

Range code	Temperature Range				RTD Temptrans			Thermocouple Temptrans	
	Zero °F	Span °F	Zero °C	Span °C	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

Temptran™ Temperature Ranges

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	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 Temptrans 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.

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, INC. USA	MODEL	TEMPTRAN™	
	D/C: 9614		
	100 OHM PLATINUM RTD		
	4mA=	20.0°F=	-6.7°C=
	20mA=	120.0°F=	48.9°C=

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

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

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

Temptran Accessories

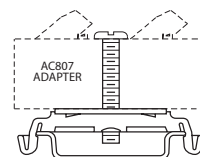
DIN rail mounting

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



Temptrans 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 Temptrans 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

Loop-powered Indicators

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: \pm (0.1% reading + 1 count).

Temperature Coefficient:
Zero: \pm 0.075 counts/ $^{\circ}$ C typ.
Span: \pm 0.005% of span/ $^{\circ}$ C typ.

Linearity: \pm (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 $^{\circ}$ C/ $^{\circ}$ 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 $^{\circ}$ F (0 to 50 $^{\circ}$ C).
Storage: -4 to 149 $^{\circ}$ F (-20 to 65 $^{\circ}$ 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 = $\frac{3}{4}$ - 14 NPT (sensor and conduit) P3 = $\frac{1}{2}$ - 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: \pm (0.1% reading + 1 count).

Temperature Coefficient:
Zero: \pm 0.075 counts/ $^{\circ}$ C typ.
Span: \pm 0.005% of span/ $^{\circ}$ C typ.

Linearity: \pm (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 $^{\circ}$ C/ $^{\circ}$ 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 $^{\circ}$ F (0 to 50 $^{\circ}$ C).
Storage: -4 to 149 $^{\circ}$ F (-20 to 65 $^{\circ}$ 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

Applications

- Generators
- Motors
- Turbines
- Compressors
- Pumps



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

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

CT224 12-Channel Temperature Alarm/Monitor

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 $\Omega/\Omega/^\circ\text{C}$)
- 200 to 700°C: PB (Platinum / 100 Ω / 0.00391 $\Omega/\Omega/^\circ\text{C}$)
- 200 to 850°C: PD/PE (Platinum / 100 Ω / 0.00385 $\Omega/\Omega/^\circ\text{C}$)
- 200 to 600°C: PF (Platinum / 1000 Ω / 0.00385 $\Omega/\Omega/^\circ\text{C}$)
- 80 to 260°C: NA (Nickel / 120 Ω / 0.00672 $\Omega/\Omega/^\circ\text{C}$)
- 100 to 260°C: CA (Copper / 10 Ω / 0.00427 $\Omega/\Omega/^\circ\text{C}$)

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 ($^\circ\text{F}$, $^\circ\text{C}$), 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, 1/4 HP at 120 VAC motor load.

Trip point hysteresis (deadband): Programmable from 0 to 20 ($^\circ\text{C}$ or $^\circ\text{F}$).

Display: 20 x 4 line backlit LCD. 0.1 $^\circ\text{C}$ or 0.1 $^\circ\text{F}$ resolution. Front panel LEDs indicate relay and alarm status.

Accuracy: 2 $^\circ\text{C}$ (3 $^\circ\text{F}$) in 0 to 60 $^\circ\text{C}$ (32 to 140 $^\circ\text{F}$) 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 $^\circ\text{C}$ (32 to 140 $^\circ\text{F}$).

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 $\frac{3}{4}$ 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)



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



CT424 Temperature Alarm/Monitor

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: 100 $\frac{3}{4}$ or 1000 $\frac{3}{4}$ Platinum, 0.00385 $\frac{3}{4}$ / $\frac{3}{4}$ °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

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 k Ω 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.



CT325 DC Controller

Specifications

Input: 100 Ω or 1000 Ω platinum RTD, 0.00385 $\Omega/\Omega/^\circ\text{C}$, 2 or 3-leads, or 50 k Ω NTC thermistor, 2-lead.

Setpoint range: 2 to 200 $^\circ\text{C}$ (36 to 392 $^\circ\text{F}$) for platinum RTD input. 25 to 75 $^\circ\text{C}$ (77 to 167 $^\circ\text{F}$) for thermistor input. Consult factory for other ranges.

Setpoint stability: $\pm 0.02\%$ of span/ $^\circ\text{C}$.

V_{temp} signal: 0.010 V/ $^\circ\text{C}$ over specified range.

Platinum RTD sensor		Thermistor sensor	
2 $^\circ\text{C}$	0.02 V	25 $^\circ\text{C}$	0.25 V
50 $^\circ\text{C}$	0.50 V	50 $^\circ\text{C}$	0.50 V
100 $^\circ\text{C}$	1.00 V	75 $^\circ\text{C}$	0.75 V
200 $^\circ\text{C}$	2.00 V		
Accuracy:	$\pm 1\%$ of span	Accuracy:	$\pm 2\%$ of span
Linearity:	$\pm 0.1\%$ of span	Linearity:	$\pm 2\%$ of span

Deadband: $\pm 0.1^\circ\text{C}$ (0.2 $^\circ\text{F}$).

Input power: 4.75 to 60 VDC.

Output: Open drain, 4 amps max. DC.

Leadwire compensation: (3-wire RTD) $\pm 0.06^\circ\text{C}/\Omega$ 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 $^\circ\text{C}$ (-40 to 158 $^\circ\text{F}$).

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

CT325 Miniature DC Temperature Controller

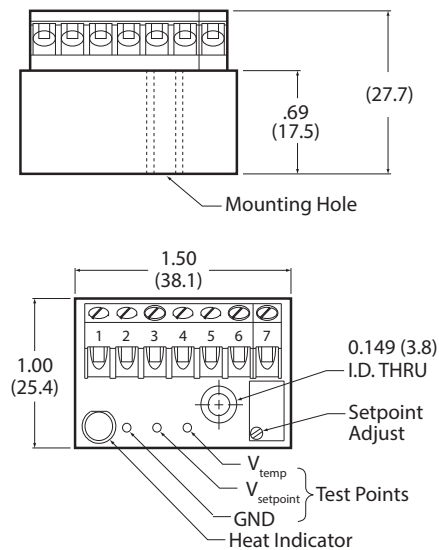
Sensor type	
100 Ω platinum RTD (0.00385 TCR)	PD
1000 Ω platinum RTD (0.00385 TCR)	PF
50 k Ω thermistor R25/R125 = 31.2	TF

Note: 50kW thermistor sensor TS665TF is available on page 9-6

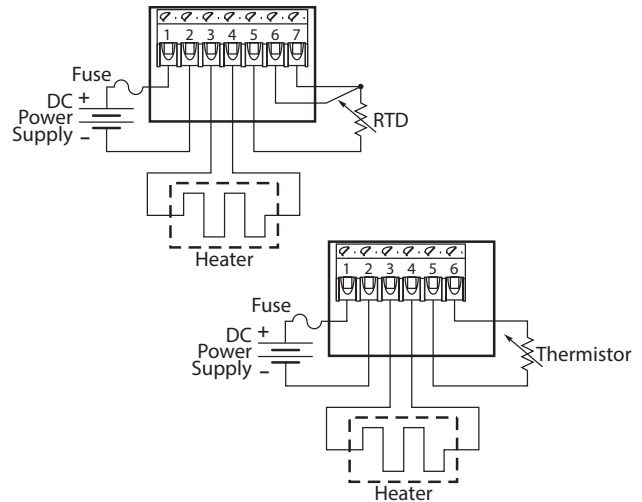
Specification and order options

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)

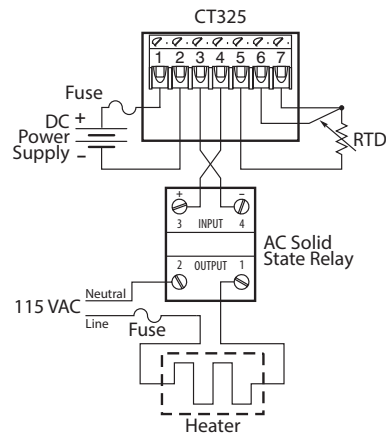


Wiring diagrams



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:

100 Ω 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: $\pm 1^\circ\text{C}$

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



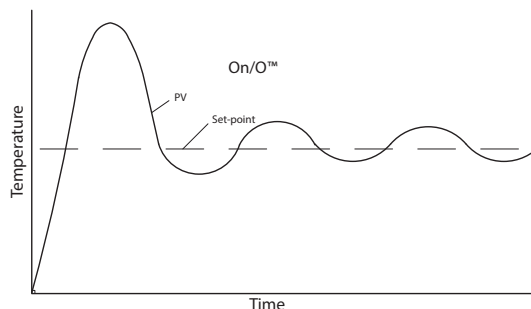
AC207473 USB to SPI Converter Kit:

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.

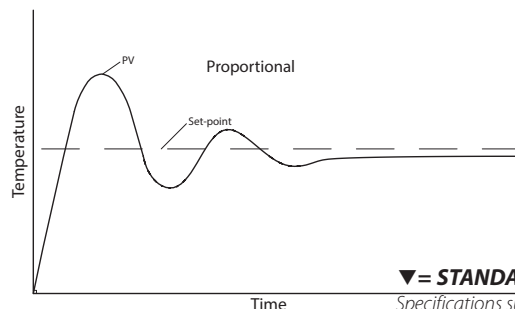
Operation

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

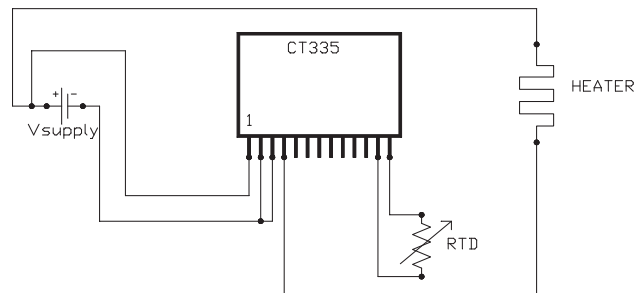
Specifications subject to change



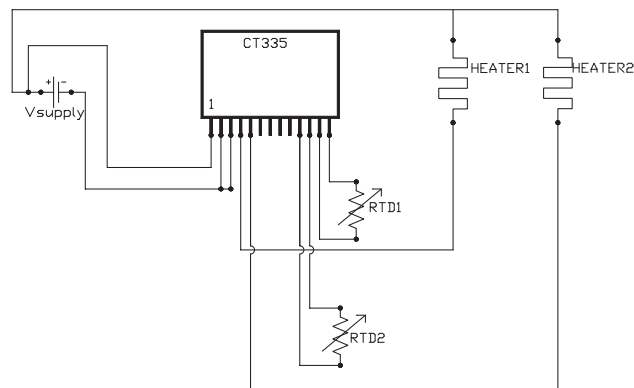
CT335 PC Board Mount Temperature Controller

Wiring with Different Output Options:

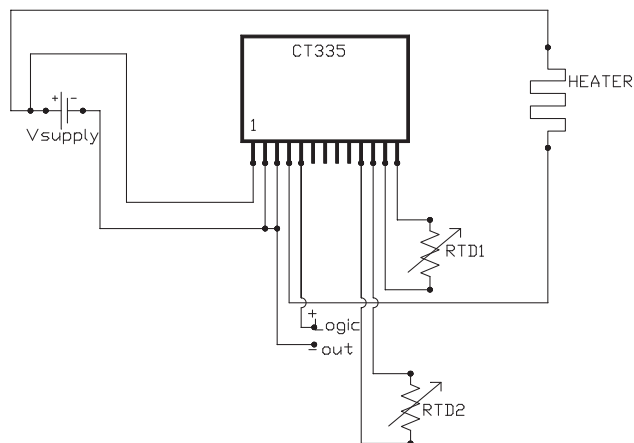
Option 1: One output of 6A



Option 2: Two outputs of 3A each



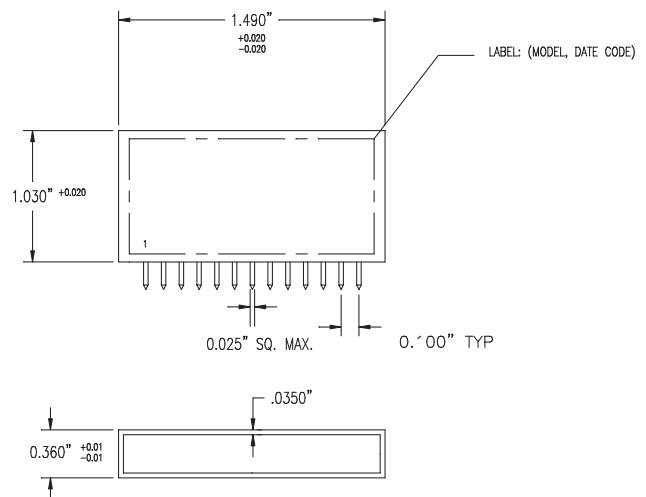
Option 3: One 3A output and one logic output (0-5V)



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°F 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



CT435 PC Board Mount Temperature Controller

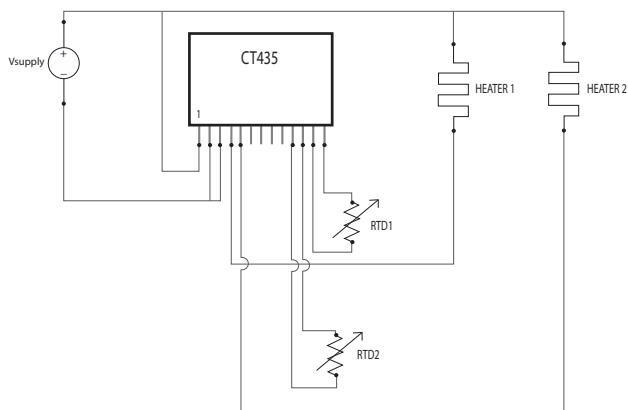
Operation:

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.

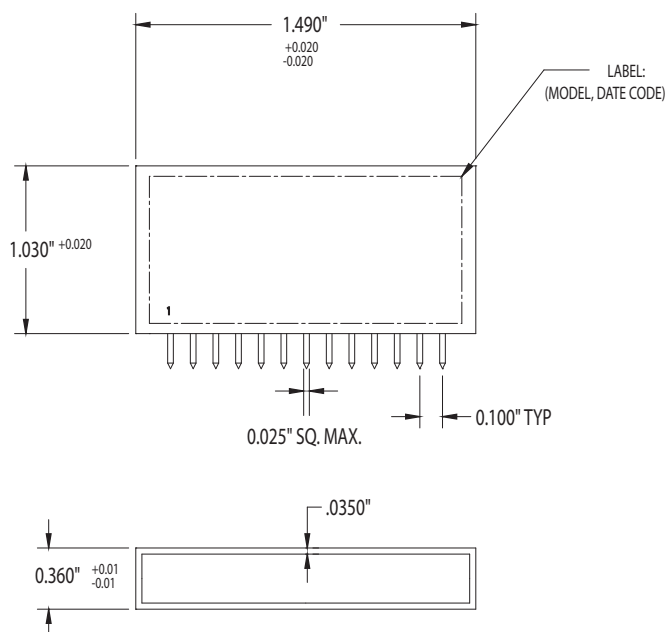
How to Order:

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

CT15 Temperature Controller & Alarm

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., $\pm 10\%$ - 15% , 50 to 400 Hz, single phase; 132 to 240 VDC, nom., $\pm 10\%$ - 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.

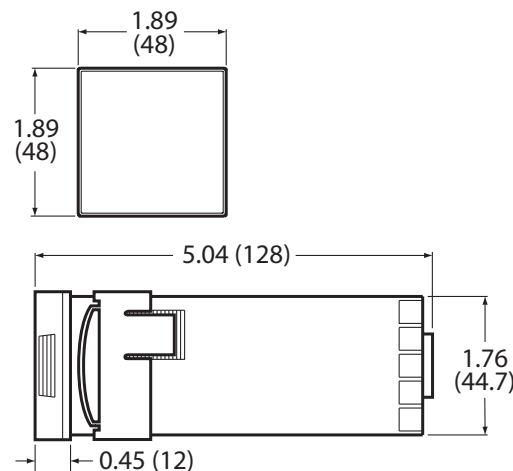
Front panel rating: Type 4X (IP66).

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

CT16A Temperature Controller

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	

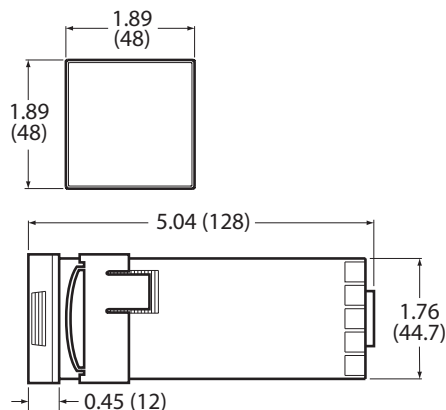
See page 4-37 for Accessories.

▼ = **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 1/4 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

CT425 Temperature Controller

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)	100¾ or 1000¾ Platinum, 0.00385¾/¾°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 5: MINIATURE SENSORS

- Embedment sensors install in bearings for over-temperature protection
- Small, rugged RTDs and thermocouples withstand rough handling and harsh environments
- Agency approved embedment sensors for hazardous areas
- Bolt-on designs for easy installation

Section 5: Miniature Sensors

Embedment RTDs	5-2
Embedment thermocouples.....	5-3
Hazardous area embedment sensors	5-4 to 5-6
Installation and accessories	5-7
Bolt-on sensors	5-8
Economy sensors	5-9
Non-metallic case sensors	5-10

Embedment RTDs

Element	TCR $\Omega/\Omega/^{\circ}\text{C}$	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
Platinum, 100 $\Omega \pm 0.36\%$ at 0°C	.00392	S325PA, S11636PA*	S4026PA	S331PA	S7792PA	S341PA	S14320PA	S12414PA	
Platinum, 100 $\Omega \pm 0.12\%$ at 0°C (Meets EN60751, Class B)	.00385	S304PD	S309PD	S306PD	S14405PD	S308PD	S14455PD	▼ S13282PD	
Platinum, 100 $\Omega \pm 0.36\%$ at 0°C	.00385	S7304PE	S305PE	S7746PE	S307PE	S7908PE	S14456PE	S13282PE	
Platinum, 1000 $\Omega \pm 0.12\%$ at 0°C	.00385	S101907PF	S101911PF	S101908PF	S101912PF	S101909PF	S101913PF	S101910PF	
Copper, 10 $\Omega \pm 0.2\%$ at 25°C	.00427	S324CA	S4026CA	S332CA		S342CA			
Nickel, 120 $\Omega \pm 0.5\%$ 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	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

Hazardous Area Embedment Sensors

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. With predictive maintenance, machines can 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.

Agency Certifications

Tri-certified for use in hazardous areas to IECEx, ATEX and North American (CSA USA and CSA Canada) requirements. These wide-ranging certifications allow users to cover many potential certification requirements with one sensor product, thus increasing flexibility and reducing inventory. For more information see the Certifications box to the right.

Specifications

Temperature range: -60°C to 200°C (-76°F to 392°F),

Reducing to 180°C (356°F) for FEP jacket on cable options;

Reducing to 125°C (257°F) for elastomer filled cable options;

Reducing to -20°C to 149°C (-4°F to 300°F) for feedthrough options.

Babbitt tip: Factory applied babbitt tip, available on case style A, reduces the danger of overheating the sensor when installed in babbitt layer.

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 and to stainless steel braid and feedthrough cases when specified.

Dielectric strength: 600 Volts RMS at 60 Hz for 2 seconds with a maximum leakage of 5mA, leads to case and to stainless steel braid and feedthrough cases when specified.

Lead wire colors can be specified in part number make up per IEC 60751 or Minco standard lead wire conventions.

Special options: Calibration data and tagging options are also available; contact Minco for details.

Case Styles

Case

Specifications



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 B Short

Case L: 0.188" (4.8 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)

Certifications

Minco's S7xx and TC7xx sensors are certified by multiple agencies. Consult the following list to learn more:

IECEx (IEC 60079):

Ex ia IIC Ga

Ex eb IIC Gb

Ex ic ec IIC Gc

ATEX (EN 60079):

II 1 G Ex ia IIC Ga

II 2 G Ex eb IIC Gb

II 3 G Ex ic ec IIC Gc

CSA Canada (CSA C22.2):

Ex ia IIC T6...T2 Ga

Ex eb IIC T6...T2 Gb

Ex ic ec IIC T6...T2 Gc

IS Cl I, Div 1, Grp ABCD T6... T2

Cl I, Div 2, Grp ABCD T6... T2

CSA US (NFPA 70 Art 500 & 505):

Cl I, Zone 0 AEx ia IIC T6... T2 Ga

Cl I, Zone 1, AEx eb IIC T6...T2 Gb

Cl I, Zone 2, AEx ic ec IIC T6...T2 Gc

IS Cl I, Div 1, Grp ABCD T6...T2

Cl I, Div 2, Grp ABCD T6...T2

IECEx



Hazardous Area Embedment Sensors

RTD Sensing Element

Code	Element	TCR $\Omega/\Omega/^{\circ}\text{C}$
CA	Copper, 10 $\Omega \pm 0.2\%$ (10.02/9.98) at 25 $^{\circ}\text{C}$	0.00427
NA	Nickel, 120 $\Omega \pm 0.5\%$ (120.60/119.40) at 0 $^{\circ}\text{C}$	0.00672
NB	Nickel, 100 $\Omega \pm 0.22\%$ (100.22/99.78) at 0 $^{\circ}\text{C}$ (Meets Din 43760)	0.00618
PA	Platinum, 100 $\Omega \pm 0.36\%$ (100.36/99.64) at 0 $^{\circ}\text{C}$	0.00392
PD	Platinum, 100 $\Omega \pm 0.12\%$ (100.12/99.98) at 0 $^{\circ}\text{C}$ (Meets EN60751, Class B)	0.00385
PE	Platinum, 100 $\Omega \pm 0.36\%$ (100.36/99.64) at 0 $^{\circ}\text{C}$	0.00385
PF	Platinum, 1000 $\Omega \pm 0.12\%$ (1001.2/998.8) at 0 $^{\circ}\text{C}$ (Meets EN60751, Class B)	0.00385
PM	Platinum, 100 $\Omega \pm 0.06\%$ (100.06/99.94) at 0 $^{\circ}\text{C}$ (Meets EN60751, Class A)	0.00385

	Feedthrough Options
C	Feedthrough designator
36	Feedthrough distance from sensor case in inches
J	Feedthrough diameter code: H = .188" DIA (same as AC958) J = .215" DIA (same as AC717) M = .250" DIA (same as AC718) N = .375" DIA (same as AC961)
40	Feedthrough length in .1" increments (40 = 4.0") (Standard lengths: 20, 25, 30, 35, 40, 45)
Sample part number: S711PDZS72A1C36J40	

Specifications and Options — RTD

S7	Model number
1	Number of RTD sensing elements: 1 = 1 sensing element (single) 2 = 2 sensing elements (dual) — no duals available in Case Style D, NA and NB duals also not available in Case Style C, CA dual only available in Case Style A
1	Case: 0 = Case Style A, copper alloy, tin plated 1 = Case Style B, copper alloy, tin plated 2 = Case Style C, copper alloy, nickel plated 3 = Case Style Short B, copper alloy, tin plated 4 = Case Style D, type 303 stainless steel
PD	RTD sensing element: CA, NA, NB, PA, PD, PE, PM or PF (from table on this page)
Z	Number of leads and lead color*: <u>Single Element</u> Y = 2 leads, RW Z = 3 leads, RWW (Minco U.S. lead colors) W = 3 leads, WRR (IEC 60751 lead colors) X = 4 leads, RRWW <u>Dual Element</u> Y = 2 leads per element, RW/BIY (Minco U.S. lead colors) V = 2 leads per element, WR/YBk (IEC 60751 lead colors) Z = 3 leads per element, RWW/BIYY (Minco U.S. lead colors) W = 3 leads per element, WRR/YBkY (IEC 60751 lead colors) X = 4 leads per element, RRWW/BIYY (Minco U.S. lead colors) - only Case Style B U = 4 leads per element, WRRR/YBkY (IEC 60751 lead colors) - only Case Style B
S	Leadwire configuration/covering: T = PTFE insulated leads only (no covering) F = FEP jacket over PTFE insulated leads S = Stainless steel braid over PTFE insulated leads R = FEP jacket over stainless steel braid and PTFE insulated leads E = FEP jacket over stainless steel braid and PTFE insulated leads, with elastomer fill
72	Lead length in inches
A1	Optional Installation/Accessories - skip for Case Styles C and D A1 = AC171 spring/AC172 series ring - Case Style B only A2 = AC171 spring/AC1038 rings (Qty of 2) - Case Style B only A3 = AC171 spring/AC915-1 ring - Case Style B only A4 = AC672 spring/AC172 series ring - Case style Short B only A5 = AC672 spring/AC1038 ring (Qty of 2) - Case style Short B only A6 = AC672 spring/AC915-1 ring - Case Style Short B only B0 = No babbitt or no accessory - Case Style A B0 = No accessory or feedthrough - Case Styles B and Short B B1 = Babbitt layer applied to case tip, .100" MIN - Case Style A only
TO ORDER WITHOUT FEEDTHROUGH STOP HERE TO ORDER WITH FEEDTHROUGH CONTINUE IN NEXT COLUMN	

*Lead wire color code: R = red, W - white, Bl = blue, Y = yellow, Bk = black

Hazardous Area Embedment Sensors

Specifications and Options — Thermocouple

	Feedthrough Options
C	Feedthrough designator
36	Feedthrough distance from sensor case in inches
H	Feedthrough diameter code: H = .188" DIA (same as AC958) J = .215" DIA (same as AC717) M = .250" DIA (same as AC718) N = .375" DIA (same as AC961)
40	Feedthrough length in .1" increments (40 = 4.0") (Standard lengths: 20, 25, 30, 35, 40, 45)
Sample part number: TC711KUS120A1C36H40	

Leadwire size (AWG)

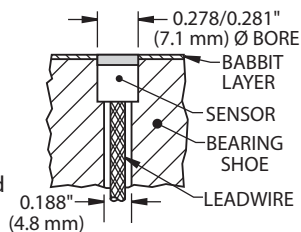
Case style	Number of leadwires				
	2	3	4	6	8
RTD					
A	24	24	24	24	x
B	24	24	28	28	28
Short B	24	26	28	30	x
C	24	26	30	30	x
D	30	30	34	x	x
Thermocouple					
A, B, C	24	x	24	x	x
Short B	24	x	24	x	x
D	30	x	x	x	x

TC7	Specification	
1	Number of sensing elements: 1 = 1 sensing element (single) 2 = 2 sensing elements (dual) in one cable 3 = 2 sensing elements (dual) in two cables	
1	Case: 0 = Case Style A, copper alloy, tin plated 1 = Case Style B, copper alloy, tin plated 2 = Case Style C, copper alloy, nickel plated 3 = Case Style Short B, copper alloy, tin plated 4 = Case Style D, copper alloy, tin plated	
K	Junction type: E = Chromel-Constantan J = Iron-Constantan	K = Chromel-Alumel T = Copper-Constantan
U	Thermocouple junctions: U = Ungrounded (insulated from case) G = Grounded (fused internally to case)	
S	Leadwire covering: T = TFE insulated leads (wrapped and fused) F = FEP jacket over TFE insulated leads S = Stainless steel braid over TFE insulated leads R = FEP jacket over stainless steel braid and TFE insulated leads E = FEP jacket over stainless steel braid and TFE insulated leads, with elastomer fill	
120	Leadwire length	
A1	Optional Installation/Accessories — leave blank for Case Styles C and D: A1 = AC171 spring/AC172 series ring - Case Style B only A2 = AC171 spring/AC1038 rings (Qty of 2) - Case Style B only A3 = AC171 spring/AC915-1 ring - Case Style B only A4 = AC672 spring/AC172 series ring - Case Style Short B only A5 = AC672 spring/AC1038 ring (Qty of 2) - Case Style Short B only A6 = AC672 spring/AC915-1 ring - Case Style Short B only B0 = No babbitt, no accessory - Case Style A only B0 = No accessory or feedthrough - Case Styles B or Short B only B1 = Babbitt layer applied to case tip, .100" MIN - Case Style A only	
TO ORDER WITHOUT FEEDTHROUGH STOP HERE TO ORDER WITH FEEDTHROUGH CONTINUE IN NEXT COLUMN		

Installation and Accessories

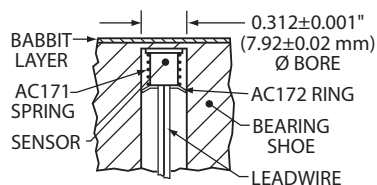
Case style A

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.



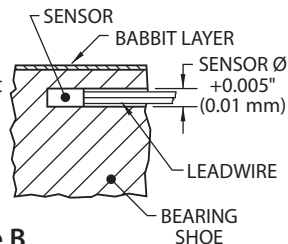
Case style B

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](#).



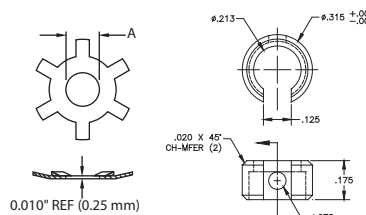
AC171 spring for case style B

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.

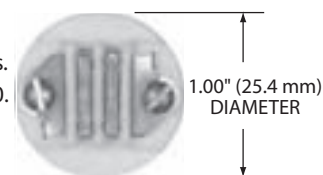
AC172 and AC915 retaining ring for case style B



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](#).



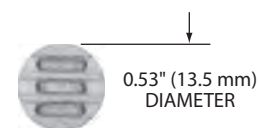
AC191 terminal block

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 10⁵ 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 10⁵ rads.

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

Bolt-on RTDs

	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		▼ 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

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) 100 Ω \pm 0.12% at 0°C (EN60751, Class B)	▼ PD
Platinum (0.00385 TCR) 1000 Ω \pm 0.12% at 0°C	▼ PF
Nickel 0.00618 TCR) 100 Ω \pm 0.22% at 0°C	NB

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	



STOCKED PARTS AVAILABLE

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

Economy RTDs

	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

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

Non-Metallic Case Miniature Sensors

Overview

Non-metallic case miniature sensors are designed for easy installation for industrial and commercial applications. These sensors can be installed directly into drilled holes in components such as bearings or machined parts, as well as onto surfaces of existing equipment. Non-metallic sensors can also be installed into end turn windings of motors and in other equipment. Standard cases are manufactured from DAP (Diallyl Phthalate) and elements are fully encapsulated with high temperature, thermally conductive epoxy.

Due to the electrical insulation properties of the case material, these sensors are ideal for high voltage applications. Standard designs provide low cost options in a variety of sizes and configurations.

Platinum RTD elements provide stable and reliable output compatible with most control and monitoring systems. Alternatively, interchangeable thermocouple designs allow you to easily customize your installation to different instrumentation.

- Wide temperature ranges
- Configurations to fit most applications
- Standard 100 ohms platinum and 1,000 ohm platinum RTD elements, as well as nickel element options.
- Type E, J, K, or T thermocouple options

Case Styles

The illustrations to the right show Minco's standard case styles. Sensors are available in a variety of cylindrical cases for inserting directly into drilled holes, or rectangular cases for mounting on surfaces or embedding into a process. In addition, Minco offers several configuration options, including choices for leadwire lengths and leadwire coverings.

We can also provide custom solutions for your sensor needs, including non-standard elements (such as thermistors) and custom sensor dimensions and materials.

Specifications

Time Constant: Less than 10 seconds in moving water.

Insulation Resistance: 10 megohms minimum at 100 VDC, leads to outer surface of the case.

Dielectric Strength: 1500 Volts RMS at 60 Hz, leads to outer surface of the case.






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

Case Styles



Non-Metallic Case Miniature Sensors

RTD Specification and Options






	Model number	Case dimensions	RTD Element options	Leadwire options	AWG Single 2 lead	AWG Single 3 lead	AWG Single 4 lead	AWG Dual element	Temp range	Lead Covering options
	S239391	.125" diameter, .250" length	PA, PD, PE, PF, PM, NA	V,W,X,Y,Z	24	26	30	30	-50 to 200°C (-58 to 392°F)	T, S, F, R, E
	S239392	.125" diameter, .375" length								
	S239393	.125" diameter, .500" length								
	S239394	.188" diameter, .500" length	PA, PD, PE, PF, PM, NA	U,V,W,X,Y,Z	24	24	28	28	-50 to 200°C (-58 to 392°F)	T, S, F, R, E
	S239395	.188" diameter, .500" length								
	S239396	.188" diameter, .500" length								
	S239397	.250" diameter, .500" length	PA, PD, PE, PF, PM, NA	U,V,W,X,Y,Z	24	24	24	28	-50 to 200°C (-58 to 392°F)	T, S, F, R, E
	S239398	.250" diameter, .500" length								
	S239399	.250" diameter, .500" length								
	S239447	.177" wide X .110" thick X .500 Long	PA, PD, PE, PF, PM, NA	U,V,W,X,Y,Z	24	26	26	NA	-50 to 200°C (-58 to 392°F)	T, S, F, R, E
	S239448	.155" wide X .155" thick X .495 Long	PA, PD, PE, PF, PM, NA	U,V,W,X,Y,Z	24	26	30	30	-50 to 200°C (-58 to 392°F)	T, S, F, R, E

S239394 Model number from table

PD	RTD sensing element PD: Platinum (.00385 TCR), 100Ω ± .12% at 0°C (Meets EN60751, Class B) PF: Platinum (.00385 TCR), 1000 Ω ± .12% at 0°C (Meets EN60751, Class B) PE: Platinum (.00385 TCR) 100 Ω ± .36% at 0°C PM: Platinum (.00385 TCR) 100 Ω ± .06% at 0°C (Meets EN60751, Class A) PA: Platinum (.00392 TCR) 100 Ω ± .36% at 0°C NA: Nickel (.00672 TCR) 120 Ω ± .50% at 0°C *Repeated Element Code (i.e., PDPD) Indicates Dual Sensing Elements
Z	Number of leads, 2, 3 or 4 (4 leads not available on all models). 2 leads not available on PD or PM elements Single element: Y: 2 leads, RW Z: 3 leads, RWW (Minco US lead colors) W: 3 leads, WRR (IEC 60751 lead colors) X: 4 leads, RRWW Dual element: Y: 2 leads/element, RW/BIY V: 2 leads per element, WR/YBk (IEC 60751 lead colors) Z: 3 leads per element, RWW/BIYY (Minco U.S. lead colors) W: 3 leads per element, WRR/YBk (IEC 60751 lead colors) X: 4 leads per element, RRWW/BIYY (Minco U.S. lead colors) U: 4 leads per element, WWRR/YBk (IEC 60751 lead colors)
S	Leadwire Covering: F: FEP Jacket over PTFE Insulated Leads T: PTFE Insulated Leads Only (No Covering) S: Stainless Steel Braid over PTFE Insulated Leads R: FEP Jacket over Stainless Steel Braid and PTFE Insulated Leads E: FEP Jacket over Stainless Steel Braid and PTFE Insulated Leads with Elastomer Fill
36	Length in inches
S239394PDZS36 = Sample Part Number	

Non-Metallic Case Miniature Sensors

Thermocouple Specification and Options

	Model number	Case dimensions	Junction type	Leadwire covering	AWG	Temp range
	TC239391	.125" diameter, .250" length	E,J,K,T (available in single element configurations)	T,S,F,R,E	24	-184 to 200°C (-299 to 392°F)
	TC239392	.125" diameter, .375" length				
	TC239393	.125" diameter, .500" length				
	TC239394	.188" diameter, .250" length	E,J,K,T (available in single element configurations)	T,S,F,R,E	24	-184 to 200°C (-299 to 392°F)
	TC239395	.188" diameter, .375" length				
	TC239396	.188" diameter, .500" length				
	TC239397	.250" diameter, .250" length	E,J,K,T (available in single element configurations)	T,S,F,R,E	24	-184 to 200°C (-299 to 392°F)
	TC239398	.250" diameter, .375" length				
	TC239399	.250" diameter, .500" length				
	TC239447	.177" wide X .110" thick X .500 Long	E,J,K,T (available in single element configurations)	T,S,F,R,E	24	-184 to 200°C (-299 to 392°F)
	TC239448	.155" wide X .155" thick X .495 Long	E,J,K,T (available in single element configurations)	T,S,F,R,E	24	-184 to 200°C (-299 to 392°F)

TC239394 Model number from table

K	Thermocouple Type: E, J, K or T
U	Ungrounded thermocouple junction
S	Leadwire Covering: F: FEP Jacket over PTFE Insulated Leads T: PTFE Insulated Leads Only (No Covering) S: Stainless Steel Braid over PTFE Insulated Leads R: FEP Jacket over Stainless Steel Braid and PTFE Insulated Leads E: FEP Jacket over Stainless Steel Braid and PTFE Insulated Leads with Elastomer Fill
36	Length in inches
TC239394KUS36 = Sample Part Number	



► SECTION 6: STATOR WINDING SENSORS

- Install between stator windings for continuous protection of motors and generators
- Agency approved sensors for use in hazardous areas
- Single and dual elements offer high reliability
- Sensor dimensions to fit any machine
- Class F or Class H

Section 6: Stator RTDs

Hazardous Area RTDs	6-2 to 6-3
Single element RTDs	6-4 to 6-5
Dual element RTDs	6-6
Machinery protection products.....	6-7

Hazardous Area RTDs



IECEEx



SIL

Increased Safety Stator Winding RTDs:

Ex II 2 G Ex eb IIC Gb
IECEEx Ex eb IIC Gb
CSA/US Class I, Zone 1, Ex/AEx eb IIC Gb
CCC/NEPSI Ex e IIC Gb

Intrinsic Safety Stator Winding RTDs:

Ex II 1 G Ex ia IIC Ga
IECEEx Ex ia IIC Ga
CSA/US Class I, Zone 0, Ex/AEx ia IIC Ga
CSA/US Class I, Division 1, Groups A, B, C, D
CCC/NEPSI Ex ia IIC Ga

Overview

Insert these thin, laminated RTDs in stator 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.

Agency Certifications

Tri-certified to satisfy European (EN), International (IEC), and North American (U.S. and Canada) standards for electrical apparatus in potentially explosive atmospheres (Ex):

- ATEX Directive 2014/34/EU
- EN/IEC/UL/CSA 60079-0: Equipment - General requirements
- EN/IEC/UL/CSA 60079-7: Equipment protection by increased safety “e”
- EN/IEC/UL/CSA 60079-11: Equipment protection by intrinsic safety “i”
- National and Canadian Electrical Codes as Class I, Division 1, Groups ABCD intrinsic safety “ia”
- EN 50495: Safety devices required for the safe functioning of equipment with respect to explosion risks, SIL capable up to a safety level of SIL2 or SIL3

Conforms with China standards GB 3836.1-2010 (General requirements), GB 3836.3-2010 (increased safety “e”), and GB 3836.4-2010 (intrinsic safety “ia”).

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.

Two Sensing Options

Choose between wire-wound or thin-film sensing elements:

- Wire-wound elements are the standard for use in stator winding temperature sensors since the temperature sensitive length extends nearly the entire sensor body length. This greatly increases the probability of detecting a localized hot spot within the motor or generator. In addition, Minco's proprietary element winding designs provide protection against electrical noise which can decrease sensor accuracy.
- Thin-film elements are effectively point sensors, with a temperature sensitive length of approximately 0.1". A hot spot located merely inches away from the thin-film element could delay detection, or worse – remain completely undetected. Thin-film elements are generally not recommended for stator sensors longer than 4", but are required for stator sensors under 2" long. These short sensors are also appropriate for installation within the motor/generator winding's end turns. Minco Thermal Ribbons and Thermal Tabs are also used for end turn installation.

Hazardous Area RTDs

Customize the sensor to best fit application needs

RTD Sensing Element

Code	Element	TCR $\Omega/\Omega/^{\circ}\text{C}$
CA	Copper, 10 $\Omega \pm 0.2\%$ (10.02/9.98) at 25°C	0.00427
NA	Nickel, 120 $\Omega \pm 0.5\%$ (120.60/119.40) at 0°C	0.00672
PA	Platinum, 100 $\Omega \pm 0.50\%$ (100.50/99.50) at 0°C	0.00392
PD	Platinum, 100 $\Omega \pm 0.12\%$ (100.12/99.98) at 0°C (Meets EN60751, Class B)	0.00385
PE	Platinum, 100 $\Omega \pm 0.50\%$ (100.50/99.50) at 0°C	0.00385
PF	Platinum, 1000 $\Omega \pm 0.12\%$ (1001.2/998.8) at 0°C (Meets EN60751, Class B)	0.00385
PM	Platinum, 100 $\Omega \pm 0.06\%$ (100.06/99.94) at 0°C (Meets EN60751, Class A)	0.00385

Certifications

Minco's S1xx series sensors are certified by multiple agencies. Consult the following list to learn more:

IECEX (IEC 60079):

Ex ia IIC Ga
Ex eb IIC Gb

ATEX (EN 60079):

II 1 G Ex ia IIC Ga
II 2 G Ex eb IIC Gb

CSA Canada (CSA C22.2):

Ex ia IIC Ga
Ex eb IIC Gb
IS Cl I, Div 1, Grp ABCD

CSA US (NFPA 70 Part 500 & 505):

Cl I, Zone 0 AEx ia IIC Ga
Cl I, Zone 1, AEx eb IIC Gb
IS Cl I, Div 1, Grp ABCD

CCC and NEPSI certified (China GB 3836 standards):

Ex ia IIC Ga
Ex e IIC Gb



SIL IECEx

S1xx Example of Model Number

S1	Base Model Number	
1	Number of sensing elements: 1 = 1 wire-wound element (single) – Not available with PF element. 2 = 2 wire-wound elements (dual) – Not available with PF element. 3 = 1 thin-film elements (single) – Not available with CA or NA element. 4 = 2 thin-film elements (dual) – Not available with CA or NA element.	
0	Thickness T: 0 = .079" 1 = .098" 2 = .118" 3 = .138"	4 = .157" 5 = .050" Note: Thicknesses 0-4 are supplied with AWG 22 leadwires, thickness 5 is supplied with AWG 26 leadwires.
PD	Sensing element (from RTD Sensing Element Table)	
100	Body length L in .1" increments (100 = 10.0") MIN L = 20 (2.0") (S11_ or S12_ models) MIN L = 7 (0.7") (S13_ or S14_ models) MAX L =W 232 (23.2")	
T	Lead insulation: T = PTFE K = Polyimide (only available in N leadwire configuration)	
344	Body width W in .001" increments (344 = .344") MIN W = 219 (.219") (S11_ or S13_ ; 2 or 3 leads) MIN W = 320 (.320") (S11_ or S13_ ; 4 leads) MIN W = 425 (.425") (S12_ or S14_) MAX W = 956 (.956")	
Z	Number of leads and lead color: <u>Single Element</u> Y = 2 leads, RW Z = 3 leads, RWW (Minco U.S. lead colors) W = 3 leads, WRR (IEC 60751 lead colors) X = 4 leads, RRWW	<u>Dual Element</u> Y = 2 leads per element, RW/BIY (Minco U.S. lead colors) V = 2 leads per element, WR/YBk (IEC 60751 lead colors) Z = 3 leads per element, RWW/BIYY (Minco U.S. lead colors) W = 3 leads per element, WRR/YBkBk (IEC 60751 lead colors)
360	Lead length B in inches	
B	Leadwire configuration/covering: N = Straight leads, insulated with no covering T = Twisted leads, insulated with no covering F = FEP jacket over leads	S = Stainless steel braid over leads R = FEP jacket over stainless steel braid B = FEP jacket over silver plated copper braid with drainwire E = FEP jacket over silver plated copper braid and drainwire with elastomer fill
10	Cable jacket and/or braid removal length C in .1" increments (10 = 1.0") (Specify "0" for N and T options) otherwise, MIN C = 5 (.5")	
S110PD100T344Z360B10 = Sample part number		

Calibration data (resistance measurements) may also be ordered. Contact Minco sales team for details.

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

Single Element Stator Winding RTDs

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 \pm 0.5% at 0°C	▼ S1420PA ¹	▼ S7401PA	▼ S13PA	S8016PA
Platinum (0.00385 TCR) 100 Ω \pm 0.12% at 0°C (Meets EN60751, Class B)	▼ S8010PD ¹ ▼ S100305PD ² S100415PD ³	▼ S8014PD	▼ S11016PD	S8016PD
Platinum (0.00385 TCR) 100 Ω \pm 0.5% at 0°C	S8010PE ¹	S8014PE	S8012PE	S8016PE
Copper (0.00427 TCR) 10 Ω \pm 0.2% at 25°C	▼ S1220CA ¹	▼ S7401CA	▼ S18CA	S8016CA
Nickel (0.00672 TCR) 120 Ω \pm 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 7: 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

Section 7: HVAC Sensors

Chill-Out™ combination sensor.....	7-2 to 7-3	Intrinsically safe humidity assembly.....	7-12 to 7-13
Averaging temperature sensors.....	7-4	Thermal vial™ temperature sensing system.....	7-14 to 7-15
Duct and outside air temperature sensors.....	7-5	Refrigeration and freezer temperature system.....	7-16
Room air temperature sensors.....	7-6	Fluid immersion temperature sensors.....	7-17
Flexible Thermal-Ribbon™ pipe sensors.....	7-7	Elements and probes.....	7-18
Humidity sensor/transmitter assembly.....	7-8 to 7-9	Temptran 4 to 20 mA transmitters.....	7-19
Hazardous area humidity assembly.....	7-10 to 7-11		

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 $\frac{3}{8}$ " 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: $\pm 0.9^\circ\text{F}$ ($\pm 0.5^\circ\text{C}$) 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

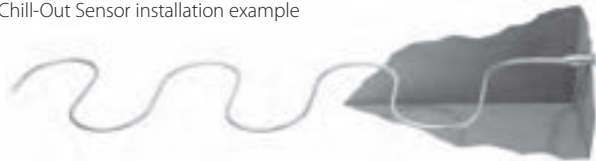
1 HP at 120 VAC

2 HP at 277 VAC

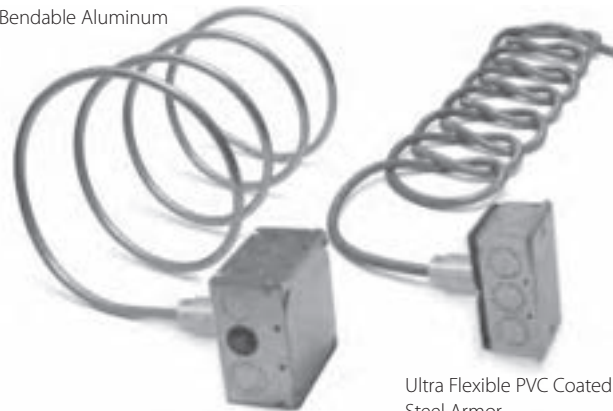
Sensor case length: 10 feet standard, lengths up to 50 feet available by special order.

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	

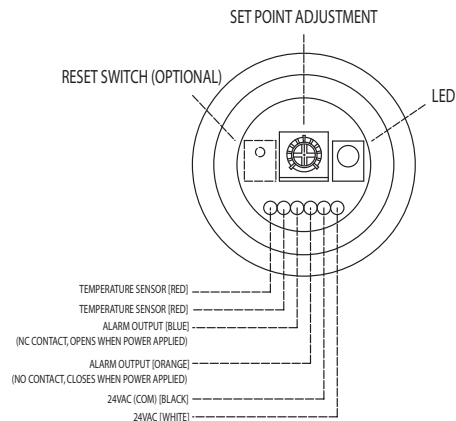
Order Replacement Relays

Model number	External Relay
AC103779	25A 24VAC Coil
AC103780	25A 24VDC Coil

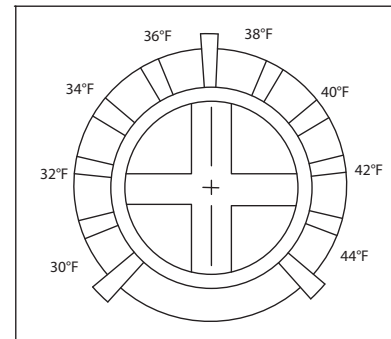
▼ = STANDARD OPTIONS
Specifications subject to change

Chill-Out™ Combination Sensor

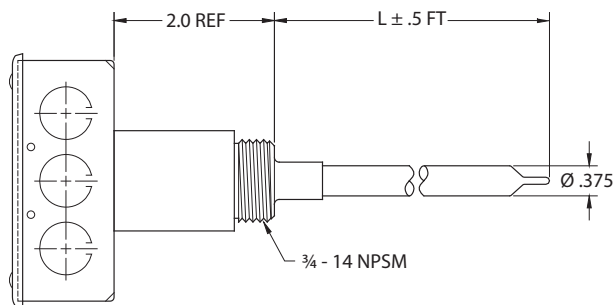
Chill-Out Sensor Interface



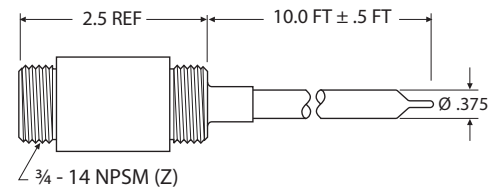
Setpoint Adjustment



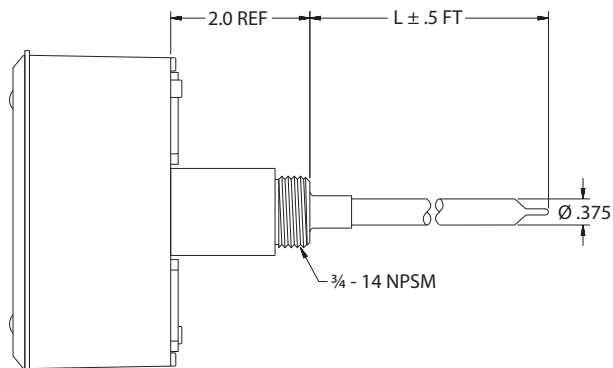
Standard and Large Utility Boxes



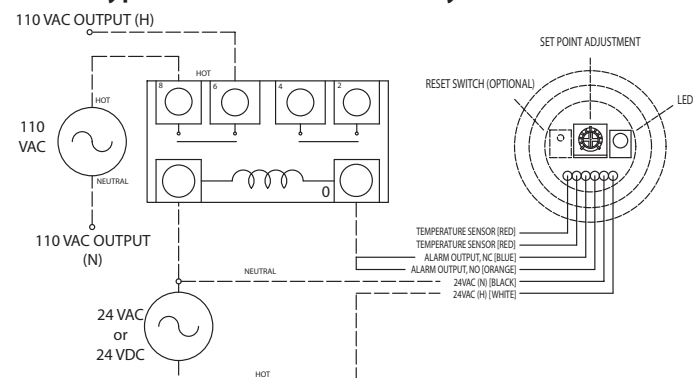
No Enclosure



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: $\pm 0.25\%$ at 70°F)	TCR $\Omega/\Omega/^\circ\text{C}$	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:

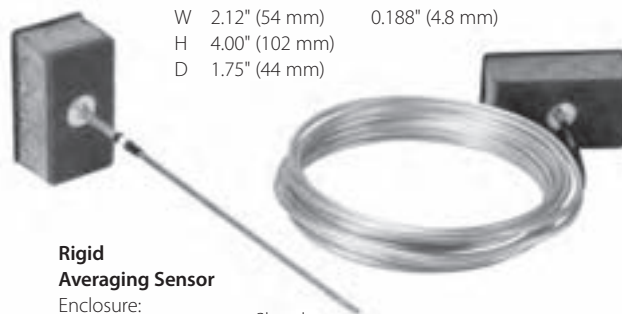
W 2.12" (54 mm)

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) Contact for other transmitter options.
A	Temperature Range Code: A = 20°F to 120°F (-6.7°C to 48.9°C) Contact for complete list of available temp. codes.
1	Calibration: 1 = Nominal Calibration 2 = Match Calibrated, 0.75% Total System Accuracy Contact for other calibration options.
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.

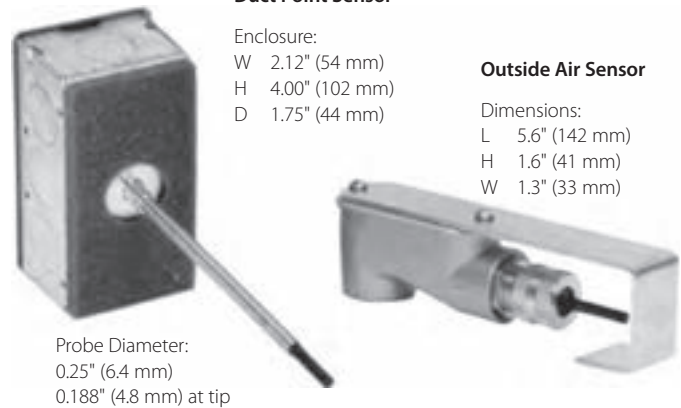
See page 4-2 for optional 4 to 20 mA temperature transmitters.

Duct Point Sensor

Enclosure:
W 2.12" (54 mm)
H 4.00" (102 mm)
D 1.75" (44 mm)

Outside Air Sensor

Dimensions:
L 5.6" (142 mm)
H 1.6" (41 mm)
W 1.3" (33 mm)



Probe Diameter:
0.25" (6.4 mm)
0.188" (4.8 mm) at tip

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	$R_{25} 1/4 R_{125}$		
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 Temptran™ (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 Temptran™ 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 AC692K0 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	R251/4R125				
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

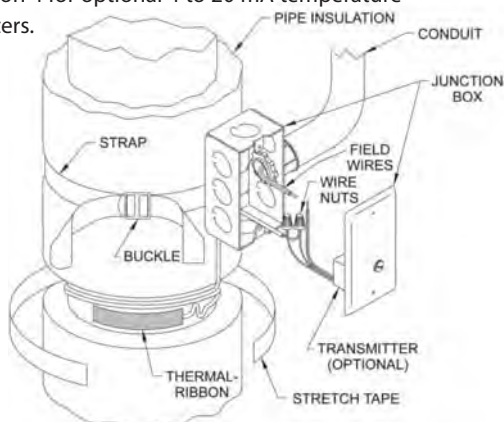
Flexible Thermal-Ribbon™ Pipe Sensors

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

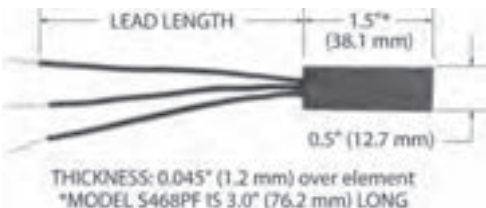
Provides a pipe-mounted enclosure for transmitters and connections. Kit includes junction box, 5 ft. nylon strap, buckle, 4 wire nuts, and 6 ft. of #20 stretch tape.

#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			Model
RTDs			
Platinum	100 Ω \pm 0.1% at 0°C	0.00391	S464PB
Platinum	100 Ω \pm 0.1% at 0°C (Meets EN60751, Class B)	0.00385	S467PD
Platinum	1000 Ω \pm 0.1% at 0°C	0.00385	S468PF
Nickel-iron	1000 Ω \pm 0.12% at 70°F	0.00527	S462FB
Nickel-iron	2000 Ω \pm 0.12% at 70°F	0.00527	S463FC
HW	3000 Ω at -30.2°C	0.00262	S100001PX
Thermistors			
Thermistor	2,252 Ω \pm 1% at 25°C	29.2	TS436TA
Thermistor	10,000 Ω \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	



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 Sensor/Transmitter Assembly

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 <ul style="list-style-type: none">▼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 enclosureR: Remote probe, 4" probe length
1	Output: 4 to 20 mA DC
N10	Calibration accuracy (humidity transmitter) <ul style="list-style-type: none">▼N10: ±1% from 10% to 80% (25 to 35°C) with NIST certificateN20: ±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) <ul style="list-style-type: none">T0= Sintered stainless steel; pressed on cover▼T1= Sintered stainless steel; screw on coverT2= 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 <ul style="list-style-type: none">A = Side mounting B = Bottom mounting
48	Remote probe cable length (in inches) <ul style="list-style-type: none">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 <ul style="list-style-type: none">▼D: Duct mount, 8" probe length▼O: Outside Air/Wall mount, 4" probe length with shield, weather resistant enclosure▼S: Space mountW: Wall mount, 4" probe length, weather resistant enclosureR: Remote probe, 4" probe length
1	Outputs: 4 to 20 mA DC
N10	Calibration accuracy (humidity transmitter) <ul style="list-style-type: none">▼N10: ±1% from 10% to 80% (25 to 35°C) with NIST certificateN20: ±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 <ul style="list-style-type: none">▼EN: -20°F to 140°FS: 0°F to 100°F▼A: 20°F to 120°FBl: 30°F to 130°FKK: 30°F to 180°F▼N: 32°F to 122°FH: 40°F to 90°FMore temperature range codes starting on page 4-20 or www.minco.com
T1	Sensing element cover (omitted on "S" space mount models) <ul style="list-style-type: none">T0= Sintered stainless steel; pressed on cover▼T1= Sintered stainless steel; screw on coverT2= 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 <ul style="list-style-type: none">A = Side mounting B = Bottom mounting
48	Remote probe cable length (in inches) <ul style="list-style-type: none">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 725Ω .

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 375Ω .

▼= STANDARD OPTIONS

Specifications subject to change

Hazardous Area Humidity Assembly

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 ▼ P3 P4 P5 P6	Process 1/2 - 14NPT 1/2 - 14NPT G1/2A G1/2A	Conduit 1/2 - 14NPT 3/4 - 14NPT 1/2 - 14NPT 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 ±2.5% from 10% to 80% (25°C) with NIST certificate S25: ±2.5% from 10% to 80% (25°C)		
EN	Temperature transmitter range from table		
AH731P3L120T1HT490F1N25EN = Sample part number			

▼ = 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

Intrinsically Safe Humidity Assembly

Transmitter ranges:

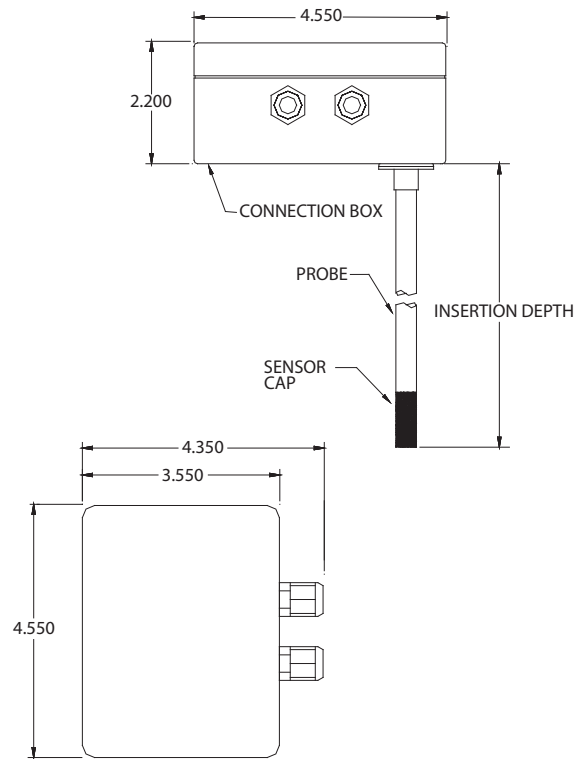
Code	Transmitter range
▼NT	No temperature transmitter
EN	-20°F to 140°F
S	0°F to 100°F
▼A	20°F to 120°F
BI	30°F to 130°F
KK	30°F to 180°F
N	32°F to 122°F
H	40°F to 90°F

Specification and order options

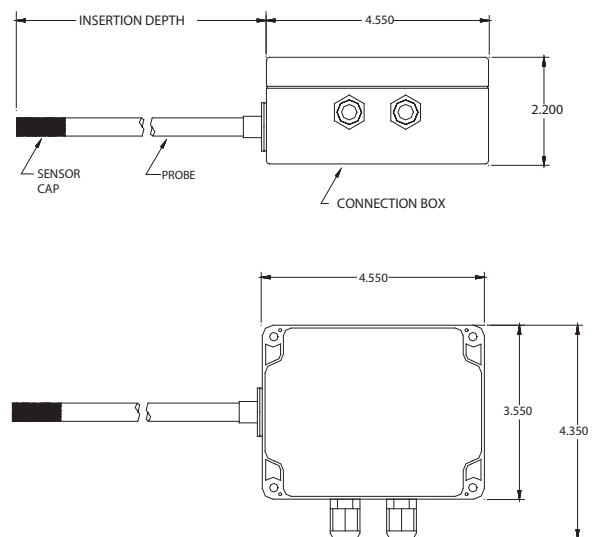
AH75	Model Number: ▼AH74 - Humidity Transmitter with Optional Temperature Transmitter, No Display ▼AH75 - Humidity Transmitter with Optional Temperature Transmitter, with Display
1	Probe Diameter: 1 = 0.375"
C3	Probe Location / Cable Bushings Option: Please refer to dimensional drawings for probe Location. 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 <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>
L40	Probe Length: ▼L40 = 4"
T1	Filter Type: ▼ T1 = Sintered Stainless Steel T2 = Slotted Stainless Steel
HT490	Transmitter Model Number: ▼ HT490 = Intrinsically Safe Transmitter
F	Display: C = Display, Metric Units (AH75_ Series Only) ▼ F = Display, English Units (AH75_ Series Only) ▼ N = No Display
1	Signal Output: ▼1 = 4-20mA
N25	Calibration Accuracy: ▼ N25 = ±2.5% from 10% to 80% (25°C) with NIST Certificate S25 = ±2.5% from 10% to 80% (25°C)
NT	Temperature Transmitter Range from table: ▼A, NT
AH751C3L40T1HT490F1N25NT = Sample part number	

Dimensions:

Probe Location A



Probe Location B



▼ = 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 \pm .06% at 0°C (32°F) (Class A).

PD platinum: 100.00 Ω \pm .12% at 0°C (32°F) (Class B).

PF platinum: 1000.00 Ω \pm .12% at 0°C (32°F).

TCR: .00385 $\Omega/\Omega/^\circ\text{C}$ 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.

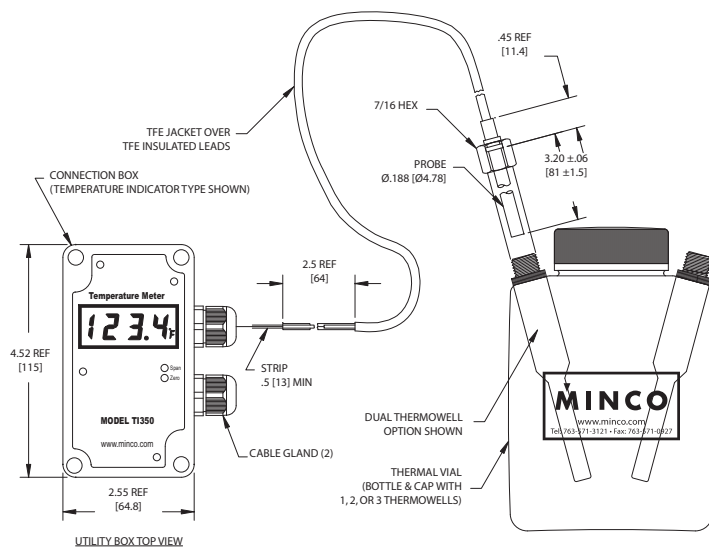
Connection box: Polycarbonate enclosure, NEMA 4X.

Specification and order options

AS103282	Model number
PM	Sensing element, .00385 TCR: ▼ PM = 100 Ω Platinum \pm .06%, Class A PD = 100 Ω Platinum \pm .12%, Class B PF = 1000 Ω Platinum \pm .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 $^\circ\text{C}$ ▼ F = Indicating $^\circ\text{F}$ ▼ 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

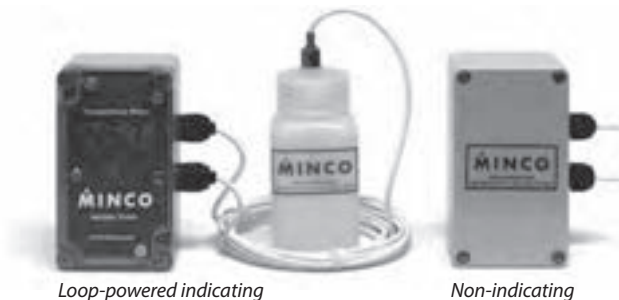


Available Accessories



Description	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
Single well bracket	AC101540
Dual/triple well bracket	AC102732
Air sensor bracket	AC102074



Description	Model
Loop-powered indicating	T1350
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).

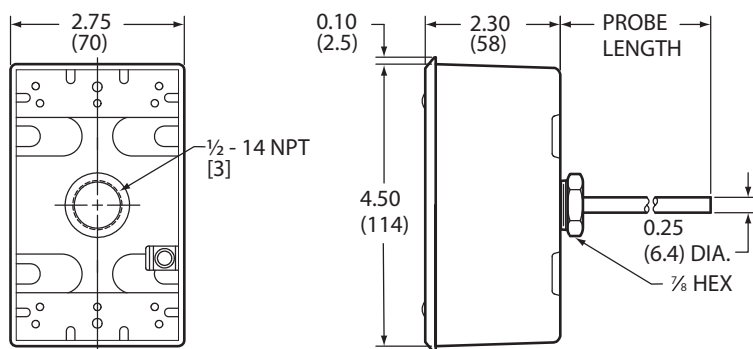
RTD probe: 100 Ω platinum, 0.00385 TCR.

Transmitter: 4-20 mA output, 8.5 to 35 VDC loop powered.



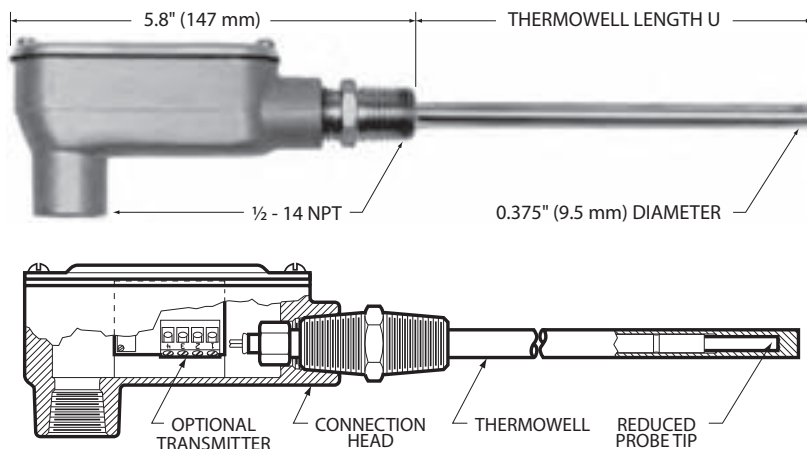
Specification and order options

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 $\Omega/\Omega/^{\circ}\text{C}$	Model number
Platinum 100 Ω $\pm 0.1\%$ at 0°C	0.00391	▼ S478PB
Platinum 100 Ω $\pm 0.1\%$ at 0°C (Meets EN60751, Class B)	0.00385	▼ S479PD
Platinum 1000 Ω $\pm 0.1\%$ at 0°C	0.00385	▼ S480PF
Platinum 1000 Ω $\pm 0.1\%$ at 0°C	0.00375	▼ S490PW*
Nickel-iron 1000 Ω $\pm 0.12\%$ at 70°F	0.00527	▼ S476FB*
Nickel-iron 2000 Ω $\pm 0.12\%$ 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



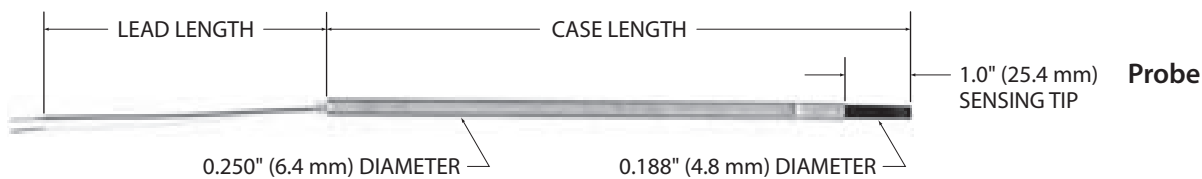
Elements & Probes

Overview

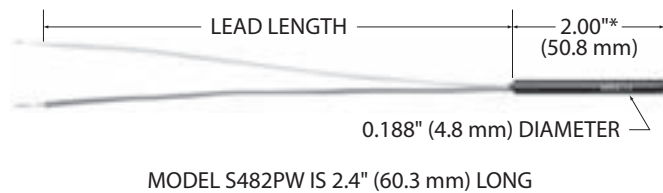
These models feature fast-responding RTD or thermistor elements in aluminum cases (except stainless steel on S482PW) with PTFE insulated leadwires. They can be assembled into probes or used separately as all-purpose sensors.

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



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	

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		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

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>



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.

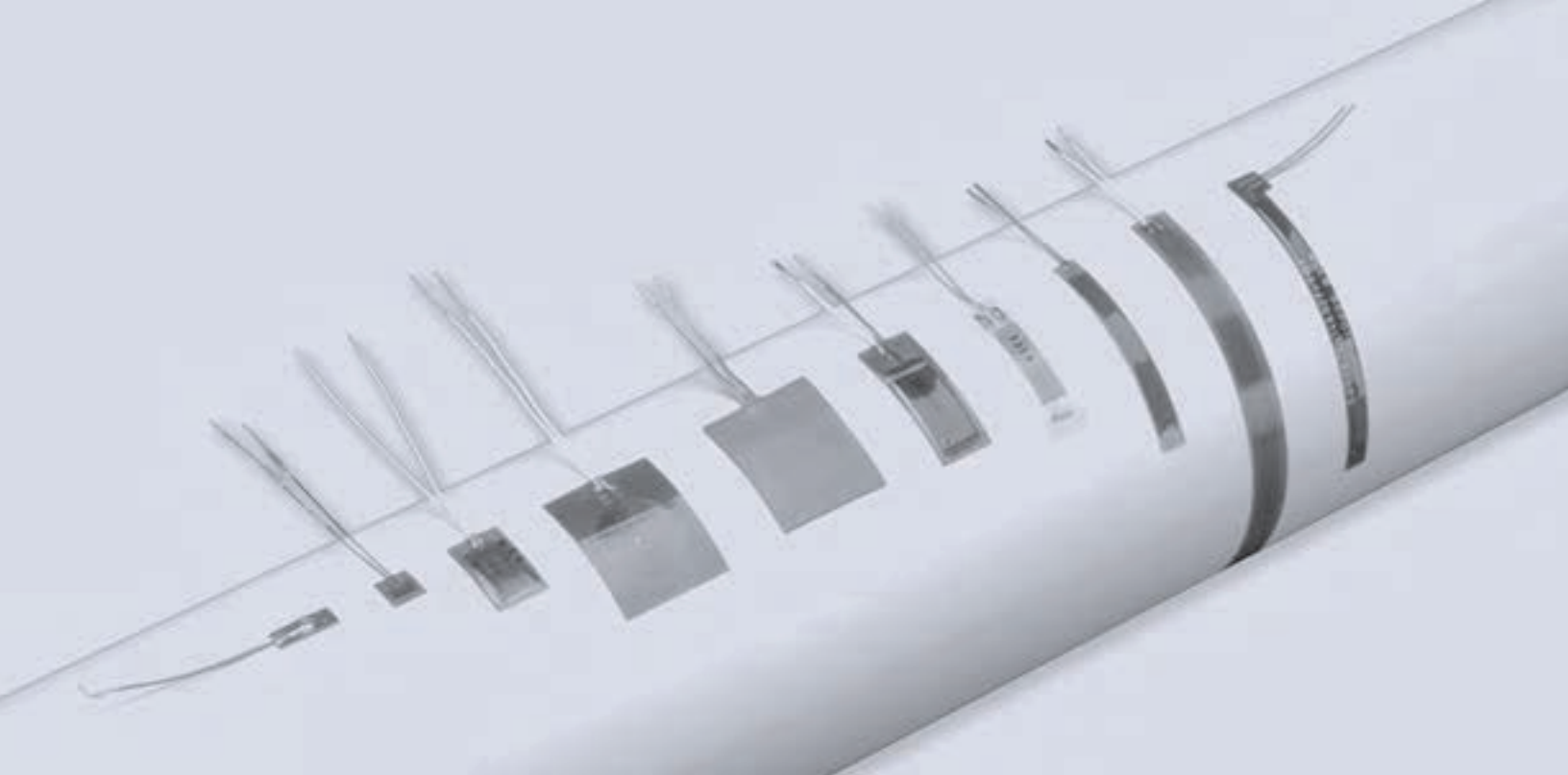
MINCO MINCO, INC. USA	MODEL	TEMPTRAN™	
	D/C: 9614 S/N: 103		
	100 OHM PLATINUM RTD		
	4mA=	20.0°F=	-6.7°C= 97.427Ω
	20mA=	120.0°F=	48.9°C= 118.988Ω

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 8: 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

Section 8: Thermal-Ribbons™






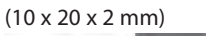
Thermal Ribbons™	8-2 to 8-3
Thermal Tabs™	8-2 to 8-3
Discoil™ Thermal Ribbons	8-4
Strip sensing Thermal Ribbons	8-5
Thermistor Thermal Ribbons	8-6
Thermocouple Thermal Ribbons	8-6
Installation and accessories.....	8-7

Thermal Tab™ and Thermal Ribbon™ Sensors


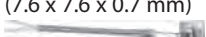
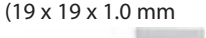
Install these compact sensors anywhere for accurate point sensing and fast response. All Thermal-Tab modules use a thin-film RTD element. All Thermal-Ribbon models conform to EN60751 Class B tolerance when ordered with a PD platinum element.

- 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:	
	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

▼ = STANDARD OPTIONS

Specifications subject to change

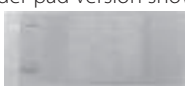



Discoil™ Thermal Ribbons

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 insu- lated	0.17 sec.	Easy motor installations	▼S3238
 0.375 x 4.00 x 0.075" (9.5 x 101.6 x 1.9 mm)	▼PD12 PE22	Silicone rubber w/ poly- imide 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

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

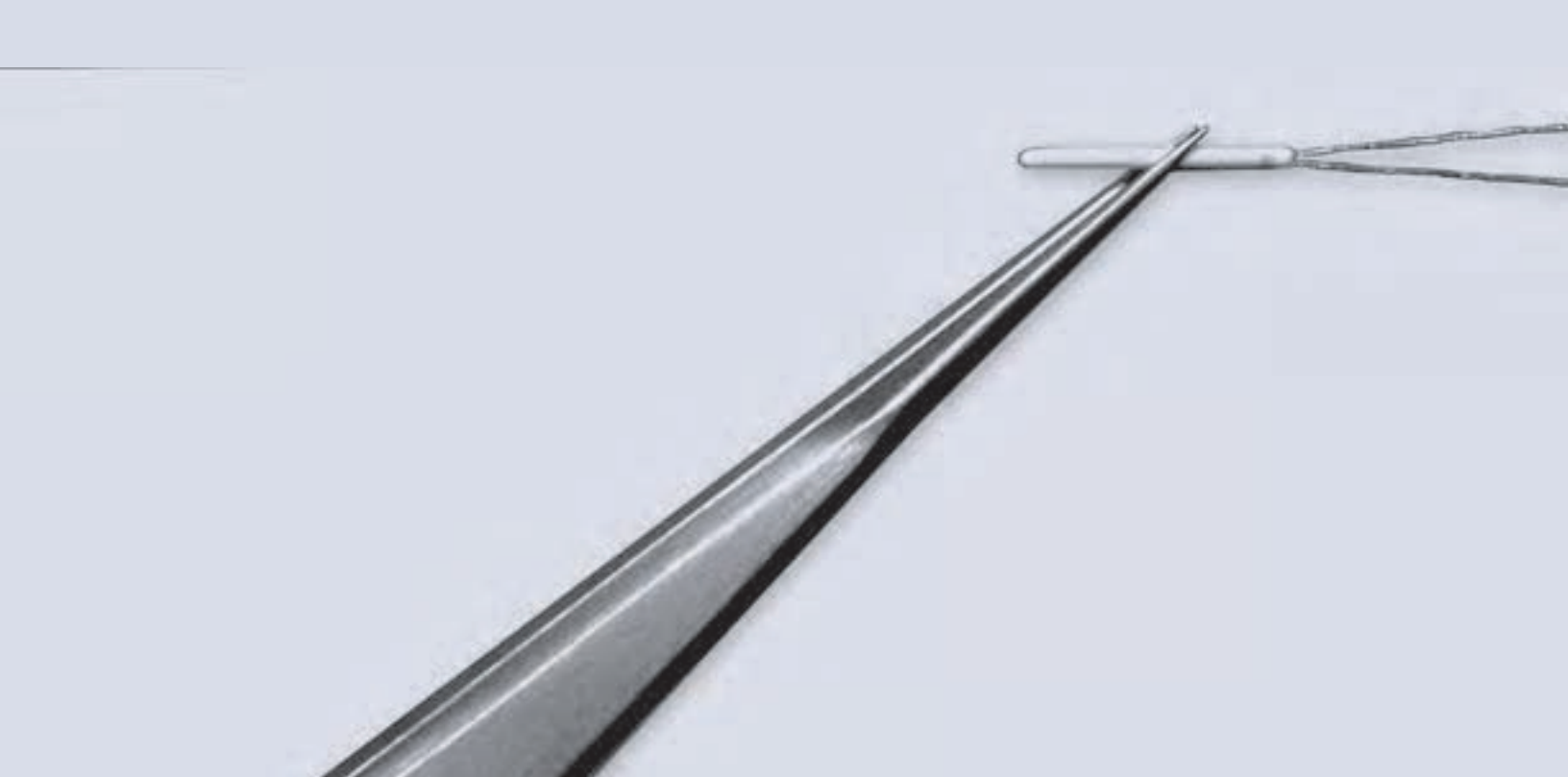
High temperature tape with silicone-based adhesive. Useful for quick mounting of Thermal-Ribbon or Thermal-Tab sensors to flat surfaces. Makes a strong but removable bond to most smooth and clean surfaces. Maximum operating temperature is 150°C. 0.5 inch wide x 108 ft. long roll.



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

Specifications subject to change



► SECTION 9: 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

Section 9: Elements

Wire-wound elements.....	9-2
Thin film elements.....	9-2
Installation.....	9-3
Extension leads.....	9-3



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: $\pm 0.1\%$ at 0°C

Lead Length Tolerance: $\pm 0.4"$ (10.2mm)

TCR: 0.00385 $\Omega/\Omega/^\circ\text{C}$

Element Diameter tolerance: $\pm 0.005"$ (0.13 mm)

Element Length tolerance: $\pm 0.06"$ (1.5 mm)

Repeatability: $\pm 0.1^\circ\text{C}$ or better

Stability: Drift less than $0.1^\circ\text{C}/\text{year}$ (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: $\pm 0.12\%$ (EN60751 Class B) To order optional $\pm 0.06\%$ tolerance (EN60751 Class A), change 12 to 06 for $\pm 0.06\%$ (EN60751 Class A). Not available with S101162PD, S101163PF, or S19827PS.

Material: Aluminum oxide substrate with fused glass cover.

Dimensional tolerance:

400, 600°C elements: $\pm 0.02"$ (0.5 mm).

SMT models: Length x Width ± 0.008 (0.2 mm),

Thickness ± 0.004 (0.1 mm).

TCR: 0.00385 $\Omega/\Omega/^\circ\text{C}$.

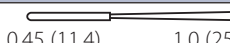


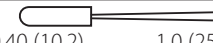
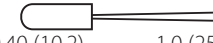
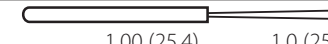
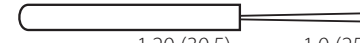





Repeatability: $\pm 0.1^\circ\text{C}$ or better.

Stability: Drift less than $0.1^\circ\text{C}/\text{year}$ 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) 		-100 to 550°C (-148 to 1022°F)	0.010" (0.25 mm) ø Platinum clad palladium	▼ S201PD	
0.077 ø (1.96) 				▼ S202PD	
0.100 ø (2.54) 			0.014" (0.35 mm) ø Platinum clad palladium	▼ S203PD	
0.135 ø (3.43) 			0.014" (0.35 mm) ø Platinum clad palladium	S204PD	
0.077 ø (1.96) 	500 Ω		0.010" (0.25 mm) ø Platinum clad palladium	▼ S212PG	
0.135 ø (3.43) 			0.014" (0.35 mm) ø Platinum clad palladium	▼ S214PG	
400°C and 600°C thin-film elements					
0.063 (1.6)  0.126 (3.2)	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)  0.07 (1.7)	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)  0.20 (5.0)	10000 Ω			0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead	▼ S19827PS12
0.08 (2.0)  0.09 (2.3)	100 Ω	-70 to 400°C (-94 to 752°F)	0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead	▼ S245PD12	
		-70 to 600°C (-94 to 1112°F)	0.008" (0.20 mm) ø Pt/Ni .003 Ω / mm / lead	▼ S249PD12	
0.08 (2.0)  0.20 (5.0)	1000 Ω	-70 to 400°C (-94 to 752°F)	0.010" (0.25 mm) ø Ag .0004 Ω / mm / lead	▼ S247PF12	
		-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 10: TECHNICAL INFORMATION

Section 10: Technical Information

Your product guide.....	10-2
Industry applications.....	10-3
Designed for optimal performance.....	10-4 to 10-5
Temptran™ temperature transmitters.....	10-6
RTD, thermocouple, or thermistor.....	10-7
Choosing sensor elements.....	10-8
RTD connections: 2-wire, 3-wire, 4-wire.....	10-9
Resistance/temperature tables.....	10-10 to 10-11
Thermocouple voltage/temperature tables.....	10-11
Temperature coefficient of resistance (TCR).....	10-12
SensorCalc program.....	10-12
Miscellaneous specifications and codes.....	10-12
Material selection guide.....	10-13

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.



Machinery and Motor Protection

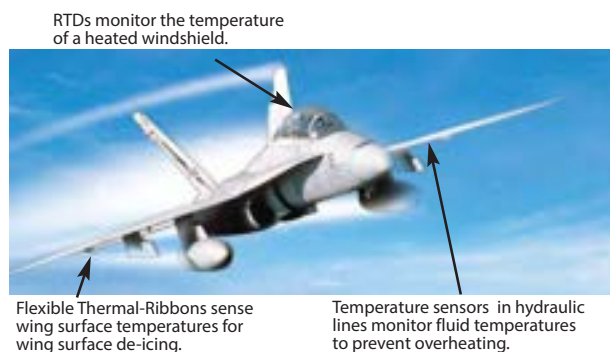
Minco RTDs and Thermocouples are used worldwide to safeguard valuable rotating apparatus machinery. Accurate and fast-responding temperature measurement provides overtemperature protection, and our sensors can be manufactured to integrate with any instrumentation package.

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.



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

- 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.

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

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.

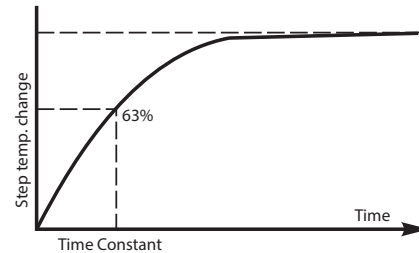
Repeatability/stability: Repeatability tells how well the sensor repeats subsequent readings at the same temperature. Stability is the absence of long term drift. In many cases, the user is less concerned with absolute accuracy than with the ability of a sensor to maintain a process at the same point 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:	• General purpose sensing • Highest accuracy • Temperature averaging	• Highest temperatures	• 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:

$$R = (200 \text{ ft.}) \times (0.0165 \text{ } \Omega / \text{ft.}) = 3.3 \text{ } \Omega$$

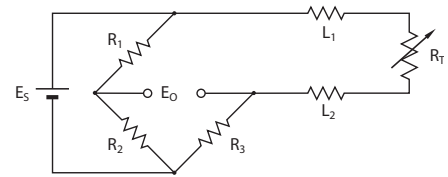
Approximate error is:

$$E = \frac{3.3 \text{ } \Omega}{0.385 \text{ } \Omega / ^\circ\text{C}} = 8.6 ^\circ\text{C}$$

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

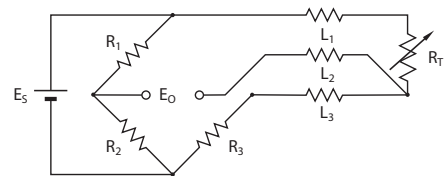
You can reduce leadwire error by:

- 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.



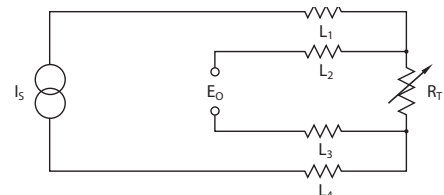
2-wire circuit

Shown above is a 2-wire RTD connected to a typical Wheatstone bridge circuit. E_s is the supply voltage; E_o 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

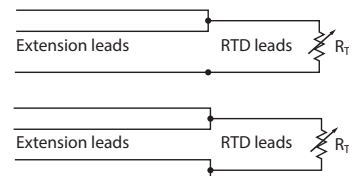
In this circuit there are three leads coming from the RTD instead of two. L_1 and L_3 carry the measuring current while L_2 acts only as a potential lead. No current flows through it while the bridge is in balance. Since L_1 and L_3 are in separate arms of the bridge, resistance is canceled. This circuit assumes high impedance at E_o 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_o 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 ($\Omega / \Omega / ^\circ\text{C}$)	.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 $\Omega / ^\circ\text{C}$)	0.039	0.806	3.133	4.788	9.576	-72	-287	-1523	-324
Temperature ($^\circ\text{C}$)	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/ $^\circ\text{C}$):	0.063	0.053	0.041	0.043
Temperature ($^\circ\text{C}$)	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
Hydrofluogilicic 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 11: REFERENCE

Industry specifications.....	11-2
Global Resources.....	11-3



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:

Minco Global Headquarters

7300 Commerce Lane Northeast
Minneapolis, MN 55432
Tel 763.571.3121 | Fax 763.571.0927
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