



## ▶ SECTION 7: MINIATURE SENSORS

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

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# Embedment RTDs

Element	TCR $\Omega/\Omega/^{\circ}\text{C}$	Case style A		Case style B		Case style C		Case style D	
		Single	Dual	Single	Dual	Single	Dual	Single	Dual
Platinum, 100 $\Omega$ $\pm 0.36\%$ 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're 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).

**Leadwire size (AWG):**

Case style	Number of leads			
	2	3	4	6
A	24	24	24	24
B	24	24	28	28
C	24	26	30	30
D	30	30	34	

**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.

## Specification and order options

S325PA	Model number from table
3	Number of leads per sensing element (2, 3, or 4): CA or PD elements not available with 2 leads. 4 leads available on single elements and S24405 only.
S	Covering over leadwires: T = PTFE only K = Polyimide; available only on S331, S340, S101913, S11636, S13282 and S14455 S = Stainless steel overbraid
36	Lead length in inches
(Stop here for case style C or D; no babbitt option)	
B0	Optional babbitt tip: B0 = No babbitt metal B1 = Babbitt metal applied
S325PA3S36B0 = Sample part number	

Specifications subject to change

# Embedment Thermocouples

Leadwire	Case style A		Case style B		Case style C		Case style D	
	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 the previous page.

## 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 J = Iron-Constantan K = Chromel-Alumel T = Copper-Constantan
U	Junction grounding: G = Grounded U = Ungrounded
24	Lead length in inches
T	Covering over leadwires: T = PTFE only S = Stainless steel overbraid
(Stop here for case style C or D; no babbitt option)	
B0	Optional babbitt tip: B0 = No babbitt metal B1 = Babbitt metal applied
TC311EU24TB0 = Sample part number	

MINIATURE SENSORS

## 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 4-11 for details.

**Leadwire and cable seal** models FG1015 and FG3015 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 4-12 for details.

**Elastomer rubber-filled cable** 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. The outside of the cable can be sealed with an FG1015 or FG3015 fitting. See page 4-13 for details.

Minco Application Aid #27 provides more information on the problems of oil seepage and various solutions. Download AA#27 at [www.minco.com/sensoraid/](http://www.minco.com/sensoraid/)

Specifications subject to change

# Non-sparking Embedment Sensors

 **ATEX II 3G EEx nA IIC u**



## Overview

- Non-sparking embedment sensors for monitoring the temperature of thrust bearings
- Four case styles offer a variety of installation options
- Certified for use in Zone 2, Group IIC hazardous areas

## Specifications

**Temperature range:** -50 to 200°C (-58 to 392°F), reducing to 125°C (257°F) when elastomer filled cable is ordered.

**Case:** Tin plated copper alloy.

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

### Leads:

RTD: stranded copper with PTFE insulation.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

Thermocouple: stranded, PTFE insulated, twisted pairs.

Stainless steel braid, FEP over PTFE and FEP over stainless steel braid with elastomer fill are optional.

### Leadwire size (AWG):

RTD					
Case style	Number of leads				
	2	3	4	6	8
A	24	24	24	24	
B	24	24	28	28	28
C	24	26	30	30	
Short B	24	26	28	30	
Thermocouple					
All cases	24		24		

**Time constant:** 3.0 seconds (case style A), typical in moving water.

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

## Specification and order options:

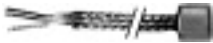



### RTD non-sparking embedment sensors





S102617PD	Model number from next page
3	Number of leads per sensing element (2, 3 or 4): CA or PD require 3 or 4 leads per element 4 leads available on all single elements and dual S102618 only
F	Covering over leadwires: T = PTFE only S = SS braid over PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over SS braid with elastomer fill (max. fill length 144")
48	Lead length in inches
(Stop here for case style C; no babbitt option)	
B0	Optional babbitt tip: B0 = No babbitt metal B1 = Babbitt metal applied
S102617PD3F48B0 = Sample part number	

### Thermocouple non-sparking embedment sensors

TC102621E	Model number from next page
U	Junction grounding: G = Grounded U = Ungrounded
48	Lead length in inches
F	Covering over leadwires: T = PTFE only S = SS braid over PTFE insulated leads F = FEP over PTFE insulated leads E = FEP over SS braid with elastomer fill (max. fill length 44")
(Stop here for case style C; no babbitt option)	
B0	Optional babbitt tip: B0 = No babbitt metal B1 = Babbitt metal applied
TC102621EU48FB0 = Sample part number	

Specifications subject to change

RTD Element	TCR $\Omega/\Omega/^{\circ}\text{C}$	Case style A		Case style B		Case style C		Short case style B	
		Case L: 0.250" (6.4 mm) Case $\varnothing$ : 0.275" (7.0 mm)		Case L: 0.250" (6.4 mm) Case $\varnothing$ : 0.188" (4.8 mm) Flange $\varnothing$ : 0.250" (6.4 mm)		Case L: 0.300" (7.6 mm) Case $\varnothing$ : 0.125" (3.2 mm)		Case L: .188" (4.8 mm) Case $\varnothing$ : .188" (4.8 mm) Flange $\varnothing$ : 0.250" (6.4 mm)	
									
		Single	Dual	Single	Dual	Single	Dual	Single	Dual
Platinum, 100 $\Omega$ $\pm$ 0.36% at 0°C	.00392	S102617PA	S102617PAPA	S102618PA	S102618PAPA	S102619PA	S102619PAPA	S102662PA	S102662PAPA
Platinum, 100 $\Omega$ $\pm$ 0.12% at 0°C (Meets EN60751, Class B)	.00385	S102617PD	S102617PDPD	S102618PD	S102618PDPD	S102619PD	S102619PDPD	S102662PD	S102662PDPD
Platinum, 100 $\Omega$ $\pm$ 0.36% at 0°C	.00385	S102617PE	S102617PEPE	S102618PE	S102618PEPE	S102619PE	S102619PEPE	S102662PE	S102662PEPE
Platinum, 1000 $\Omega$ $\pm$ 0.12% at 0°C	.00385	S102617PF	S102617PFPF	S102618PF	S102618PFPF	S102619PF	S102619PFPF	S102662PF	S102662PFPF
Copper, 10 $\Omega$ $\pm$ 0.2% at 25°C	.00427	S102617CA	S102617CACA	S102618CA		S102619CA		S102662CA	
Nickel, 120 $\Omega$ $\pm$ 0.5% at 0°C	.00672	S102617NA	S102617NANA	S102618NA	S102618NANA	S102619NA		S102662NA	S102662NANA

Thermocouple Junction Type	Case style A		Case style B		Case style C		Short case style B	
	Case L: 0.250" (6.4 mm) Case $\varnothing$ : 0.275" (7.0 mm)		Case L: 0.250" (6.4 mm) Case $\varnothing$ : 0.188" (4.8 mm) Flange $\varnothing$ : 0.250" (6.4 mm)		Case L: 0.300" (7.6 mm) Case $\varnothing$ : 0.125" (3.2 mm)		Case L: .188" (4.8 mm) Case $\varnothing$ : .188" (4.8 mm) Flange $\varnothing$ : 0.250" (6.4 mm)	
								
	Single	Dual	Single	Dual	Single	Dual	Single	Dual
E = Chromel-Constantan	TC102620E	TC102620EE	TC102621E	TC102621EE	TC102622E	TC102622EE	TC102663E	TC102663EE
J = Iron-Constantan	TC102620J	TC102620JJ	TC102621J	TC102621JJ	TC102622J	TC102622JJ	TC102663J	TC102663JJ
K = Chromel-Alumel	TC102620K	TC102620KK	TC102621K	TC102621KK	TC102622K	TC102622KK	TC102663K	TC102663KK
T = Copper-Constantan	TC102620T	TC102620TT	TC102621T	TC102621TT	TC102622T	TC102622TT	TC102663T	TC102663TT

### Stop Oil Seepage!

**Feedthroughs** provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar.) See page 4-11 for details.







**Leadwire and cable seal** models FG1015 and FG3015 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 4-12 for details.

**Elastomer rubber-filled cable** 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. The outside of the cable can be sealed with an FG1015 or FG3015 fitting. See page 4-13 for details.

Minco Application Aid #27 provides more information on the problems of oil seepage and various solutions. Download AA#27 at [www.minco.com/sensoraid/](http://www.minco.com/sensoraid/)

Specifications subject to change

# Bolt-on Temperature Sensors

	Dimensions W x L x T (max.)	Temperature range	Element options	Case material	Leadwire	Model
	0.50 x 1.00 x 0.188" (12.7 x 25.4 x 4.8 mm) with 0.161" (4.1 mm) diameter hole	-70 to 500°C (-94 to 932°F)	PD, PF, PW	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, PW	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, PE, PF, NB	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, PE, PF, NB	Stainless steel	2 lead: AWG 24, 3 lead: AWG 26, PTFE insulated	S101733
	1/4 - 20 x 3/8" long thread with 7/16" hex head	-50 to 260°C (-58 to 500°F)	PD, PE, PF, NB	Stainless steel	with SS braid cover	S101734
	M6 x 1 thread, 10 mm long, with 10 mm hex					S101797
	0.51 x 1.97 x 0.079" (13 x 50 x 2 mm) with Ø 0.130" (3.3 mm) holes spaced 1.47" (37.3 mm) apart	-50 to 180°C (-58 to 356°F)	PD, PF, PW, PS, NB, NA, NJ	High temperature epoxy glass	AWG 22, PTFE insulated, SS braid option	S100722

## 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) (EN60751, Class B)	100 Ω ±0.12% at 0°C	PD
Platinum (0.00385 TCR)	100 Ω ±0.36% at 0°C	PE
Platinum (0.00385 TCR)	1000 Ω ±0.12% at 0°C	PF
Platinum (0.00375 TCR)	1000 Ω ±0.12% at 0°C	PW
Platinum (0.00385 TCR)	10000 Ω ±0.12% at 0°C	PS
Nickel 0.00618 TCR) (DIN43760 NI100, Class B)	100 Ω ±0.22% at 0°C	NB
Nickel (0.00672 TCR)	120 Ω ±0.50% at 0°C	NA
Nickel (0.00618 TCR)	1000 Ω ±0.22% at 0°C	NJ

\*See descriptions for element options on each model.

## 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	<b>Leadwire covering:</b> 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 in inches: 40" (1000 mm) standard
S101732PD3S40 = Sample part number	

# Economy Sensors

	Dimensions	Temperature range	Element options	Case material	Leadwire	Model
	2 leads: .050" x .065" x .035" thick (1.3 x 1.7 x .9 mm) Thin-Film with insulated leads 3 leads: .063" x .079" x .035" thick (1.6 x 2 x .9 mm) Thin-Film with insulated leads	-50 to 150°C a (-58 to 302°F)	PD, PF	Ceramic	2 leads: AWG 32 solid enamel insulated	S102404
	3 leads: AWG 34, solid enamel insulated					
	Ø .125" x .90" (Ø 3.2 x 22.9 mm)	-50 to 260°C (-58 to 500°F)	PD, PF, PW	Stainless steel	AWG 24, 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, PW	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, PW	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, PW	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, PW, NA	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, PW	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) (EN60751, Class B)	100 Ω ±0.12% at 0°C	PD
Platinum (0.00385 TCR)	1000 Ω ±0.12% at 0°C	PF
Platinum (0.00375 TCR)	1000 Ω ±0.12% at 0°C	PW
Nickel (0.00672 TCR)	120 Ω ±0.50% at 0°C	NA

\* See descriptions for element options on each model.

## Specification and order options

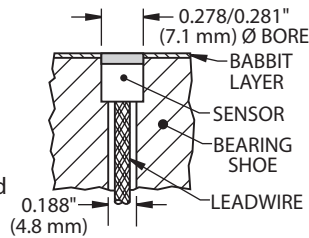
S102408	Model number from table
PD	Element code from table
3	Number of leads: 2 leads (not recommended for PD models) or 3 leads (only option for S102410PD)
G	Leadwire covering: E = Enamel (S102404) G = Glass (S102408 and S102410) R = Silicone rubber (S102406) T = PTFE (S102405, S102407, S102409, S102737)
40	Leadwire length in inches: 40" (1000 mm) standard
S102408PD3G40 = Sample part number	

Specifications subject to change

# Installation and Accessories

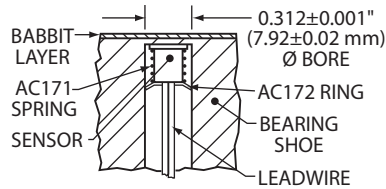
## Case style A

Install case style A sensor just below the babbitt layer, then puddle the babbitt metal over the sensor tip and smooth. Read [Engineering Instruction #164](#) and [Engineering Instruction #167](#) for complete details.



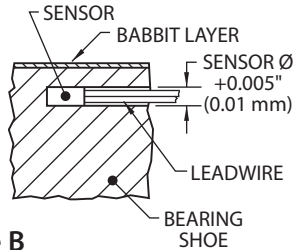
## Case style B

The "top hat" flange shape allows spring loading with the AC171 spring and AC172 or AC915 retaining ring (order separately). Choose the economical AC172 style for lowest cost. The AC915 style allows removal and reinstallation. Slide the spring and ring over the leads, insert the sensor tip into a milled hole, and push down on the retaining ring to compress the spring and secure the sensor. Read [Engineering Instruction #180](#) and [Engineering Instruction #181](#).



## Case styles C and D

Pot with epoxy inside small bearing shoes. Locate near the babbitt face for best readings. Read [Engineering Instruction #184](#).



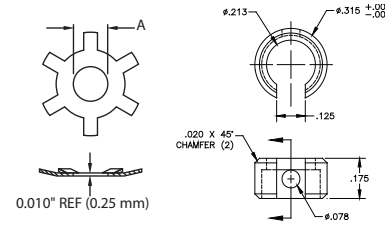
## AC171 spring for case style B

Stainless steel. Outside diameter 0.240" (6.1 mm). Compressed length 0.22" (5.6 mm). To be used in conjunction with AC172 or AC915 for spring loading case style B

## Feedthroughs

Feedthroughs provide an oil tight seal where a cable exits a machine housing. The stainless steel tube is epoxy filled and each wire is sealed to the individual conductor. This prevents wicking of oil inside the wires as well as leakage around the wire insulation. Pressure rating to 25 psi (1.7 bar). See page 4-12 for more information.

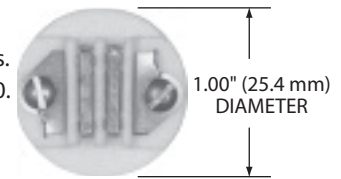
## AC172 and AC915 retaining ring for case style B



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](#).



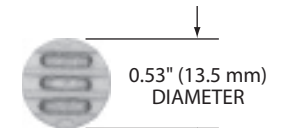
## AC191 terminal block

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 10<sup>9</sup> 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 10<sup>9</sup> rads.

Embedment sensor engineering instructions are available at [www.minco.com/sensorei/](http://www.minco.com/sensorei/)

Specifications subject to change