

## ► 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™

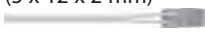

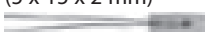



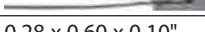
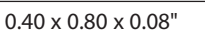

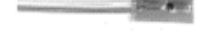

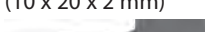
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# Thermal Tab™ Sensors

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. Time constant in moving water at 1m/sec is <1.0 sec for polyimide products and 1.5 sec for silicone rubber products.

- Fast response surface sensing in aerospace, medical and industrial devices
- Rugged lamination construction except S665 and S667
- Polyimide, silicone rubber or Mylar™ insulation
- All models are RoHS compliant

## Thermal-Tab Specifications

Dimensions W x L x T <sub>max</sub>	Element options	Insulation	Temperature range	Leadwires	Leadwire Configuration	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	2, 3 enter	Standard options stocked for immediate shipment	▼ S665
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	2, 3 enter	Waterproof; suitable for continuous immersion	S667
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	2 enter, 3,4 outside	Standard options stocked for immediate shipment	▼ S17624
0.28 x 0.60 x 0.08" (7 x 15 x 2mm) 	▼: PD, PF, PW, PS	Polyimide	-50 to 200°C -58 to 392°F	AWG 26, PTFE or polyimide insulated	2, 3, 4 enter	All leadwires laminated into body for rugged applications	S239558
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	2 enter, 3,4 outside	Highest temperature capability	S100820
0.28 x 0.60 x 0.08" (7 x 15 x 2mm) 	▼: PD, PF	Polyimide film	-50 to 260°C -58 to 500°F	AWG 26, PTFE or polyimide insulated	2, 3, 4 enter	Highest temperature capability; all leadwires laminated into body for rugged applications	S239559
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	2 enter, 3,4 outside	Thinnest profile	S100725
0.28 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	2 enter, 3,4 outside	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	2 enter, 3,4 outside	Larger surface area for easier handling and maximum adhesive bond	S100723
0.40 x 0.80 x .08" (10 x 20 x 2mm) 	▼: PD, PF	Polyimide film	-50 to 200°C -58 to 392°F	AWG 26, PTFE or polyimide insulated	2, 3, 4 enter	Larger surface area for easier handling and maximum adhesive bond; all leadwires laminated into body for rugged applications	S239560
0.40 x 0.80 x 0.08" (10 x 20 x 2mm) 	▼: PD, PF	Polyimide film	-50 to 260°C 58 to 500°F	AWG 26, PTFE or polyimide insulated	2, 3, 4 enter	Larger surface area for easier handling and maximum adhesive bond; Highest temperature capability; all leadwires laminated into body for rugged applications	S239561
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	2 enter, 3,4 outside	High temperature rating, available with wide range of element options	S100721

# Thermal Tab™ Sensors

## Specifications, continued

Leadwire insulation codes	
S665, S667	Leave blank
S17624, S100721, S100723, S100724, S100725, S100820, S239558, S239559, S239560, S239561	▼ T = PTFE insulated wires K = Polyimide insulated wires

## Sensing elements

Sensing element specifications*		Code
Platinum (0.00385 TCR) (EN60751, Class B)	100 Ω ±0.12% at 0°C	PD
Platinum (0.00385 TCR)	100 Ω ±0.22% 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)	10,000 Ω ±0.12% at 0°C	PS
Nickel-iron (0.00518 TCR)	604 Ω ±0.26% at 0°C	FA
Nickel (0.00618 TCR) (DIN43760 Ni100, Class B)	100 Ω ±0.22% at 0°C	NB

\* See table on previous page for element options on each model.

## 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 to 177°C (350°F) and adds 0.002" (0.05 mm) to thickness for all models except S665, S667, and S100721.

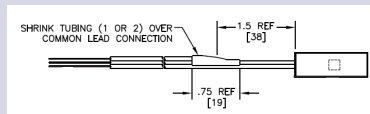
### ▼ = STANDARD OPTIONS

Specifications subject to change

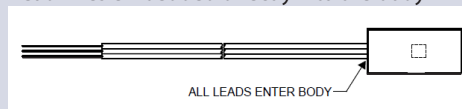
## Embedded lead wires

Models S239558, S239559, S239560, and S239561 feature all leadwires embedded directly into the body of the sensor. Laminating the leadwires into the sensor body creates an even more robust connection that can withstand mechanical stress, vibration, and harsh environmental conditions.

### Common lead connection outside body



### Leadwires embedded directly into the body



## 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.






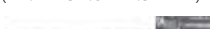
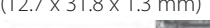
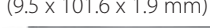
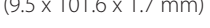


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# Thermal Ribbon™ Sensors

Thermal ribbon sensing elements are crucial components utilized in various industrial and commercial applications for temperature monitoring and control. These sensing elements are designed with high precision and sensitivity, ensuring accurate measurement of temperature changes. Their thin and flexible construction enables easy integration into different systems and environments, allowing for versatile usage. One of the key features of thermal ribbon sensing elements is their rapid response time, providing real-time data on temperature fluctuations. Additionally, they exhibit excellent durability and reliability, ensuring consistent performance even in harsh operating conditions. Their non-invasive nature makes them ideal for applications where direct contact with the object being measured is impractical or undesirable. Overall, thermal ribbon sensing elements offer enhanced efficiency, cost-effectiveness, and reliability, making them indispensable tools in temperature monitoring and control systems across various industries.

## Thermal-Ribbon Specifications

Dimensions W x L x T <sub>max</sub>	Element options	Insulation	Temperature range	Leadwires	Time constant*	Features	Model
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
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 ▼PD12 PE22	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 ▼S385
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 insul- ated	0.17 sec.	Easy motor installations	▼S3238
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		0.17 sec.	IECEX and ATEX (Ex) certified	S217496
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<sub>max</sub> is measured over the lead bulge.

\*Time constant is in water at 1 m/sec.

# Thermal Ribbons™ Sensors

## Specifications, continued

Leadwire insulation codes	
S25, S38, S651, S32, S385, S17422	Leave blank
S34, S386, S35	▼ T = PTFE insulated wires K = Polyimide insulated wires

## 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 (S17422)
Platinum (0.00385 TCR) 100 Ω ±0.5% at 0°C	PE (S3238)
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.

### 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.



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## 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)
T	Leadwire insulation code from left
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 to 177°C (350°F) and adds 0.002" (0.05 mm) to thickness.

## Model S3238/S217496

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. Model S217496 is the same as the S3238, but includes certifications for hazardous areas, with both IECEx and ATEX (Ex) approvals.

## 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	

# 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 <sub>max</sub>	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<sub>max</sub> 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 = no adhesive
C	Compliance: C = RoHS compliant
TS665TFY40AC = Sample part number	

Note: PSA adds 0.002" (0.05 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 <sub>max</sub>	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<sub>max</sub> 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 to 177°C (350°F) and adds 0.002" (0.05 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 8-4 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](http://www.minco.com)

*Specifications subject to change*