Product Technical Information
IT-0105-TTC 59B-04-2010EN

Temperature Probe AMBItemp TTC 59B

Thermocouple with Transmission Cable
Non Intrusive

TTC 59B

Features and Areas of Application

The model TTC 59B is manufactured with thermocouple elements and signal transmission cable. The hot junction is located in the process connection, being available different process connections as pipe clamp, magnet and fork and ring terminals, allowing the probe mounting from the outsider of the process.

Are also available a wide range of thermocouple cables and connectors, allowing the integration of the thermocouple TTC 59B to any temperature acquisition systems. The thermocouple robustness increases by using a protective stainless steel spring or thermal sleeve.

High reliability and attending customized construction, the AMBItemp TTC 59B has high quality/price ratio.
For laboratory applications in quality control, molds manufacturing processes or generally in applications where not becomes viable the insertion of a sheath in the process.

Thermocouples General Information

A thermocouple is based on junction between two different metals, called hot junction, generating electromotive force when the hot junction and the cold junction, on the other side, are submitted at different temperatures. This is effect is called *Seeback effect*. The hot junction is the part of the thermocouple, which is immersed on the process. The cold or reference junction is normally at a lower temperature (room temperature) e will compensate the hot junction. The electromotive force generated by thermocouple will vary according the junction metals. Usually the thermocouple elements end on temperature head. From there, the signal can be transmitted to other system components, like displays or controllers by a temperature transmitter or by compensation cable. This type of transducers can be used in temperature measurements in the range of –270ºC up to +2200ºC.
The mineral isolated thermocouple was developed for the nuclear industry, extended after the application to other industry branches. The main reasons for that development were the demand of a high response thermocouple (higher than the conventional thermocouple with metallic thermowell) and granting that elements should not be in contact with the medium.
The mineral insulated thermocouple manufacturing starts from a conventional thermocouple, being all parts assembled. In this process the thermo-elements are insulated by magnesium oxide dust and protected by a metallic or ceramic sheath. Therefore a thermocouple is intended to work on a temperature range, is necessary to pay attention to temperature limits and medium resistance of metallic and ceramic materials and if those materials are suitable for the medium. A correct component material selection will allow a higher reliability, a bigger lifetime, reducing the plant area exploration costs.
All thermocouples with mineral insulation cable can be manufactured with hot junction isolated, grounded or exposed. In lack of order information all thermocouples will be manufactured with isolated hot junction. If a temperature transmitter is used, then the hot junction must be isolated.

As example purpose, consider a conventional thermocouple with a metallic sheath. Can also be proved the thermocouple is submitted a temperature difference as one side is in contact with process, in opposite side is at environmental temperature. Is inevitable a thermal flux from the higher temperature point to the colder point. The balance happens when the hot flux received in the sensor is the same that was lost and in this case the temperature measured is not necessarily the process temperature. Since the scope of measurement is the process temperature is it necessary to take some precautions in the sensor, accessories and the assembly installation on process choice, to avoid additional measurement errors:

- ✓ The complete assembly must have the smallest mass possible comparing with process. This should be followed because there is a thermal resistance associated to assembly and the bigger the assembly the greater the resistance. Also when exists the possibility to have quick changes on the process temperature, due to the thermal inertia, these changes is attenuated or simply not detected.

- ✓ Other important factor is the sensor immersion length. The biggest the immersion length, less will be the temperature gradient of wanted measured temperature. As a consequence is the temperature on hot junction is close to measured temperature. As rule of sump, the immersion length should be 6 times diameter length in liquids and at least 20 times for air, gases or steam.

- ✓ When the assembly/extension cable will be installed near electromagnetic fields, are probable inductions, leading to measurement errors. In this case is it recommendable to use isolated hot junction thermocouples, with thermowell or protection well earth connected. The compensation cable should be screened and also connected to earth.

- ✓ Keep in mind the thermocouples suffers degradation with time, and that is particularly noted on high temperature processes or in aggressive atmospheres. It's important, according to each process, to establish appropriate maintenance and calibration routines.

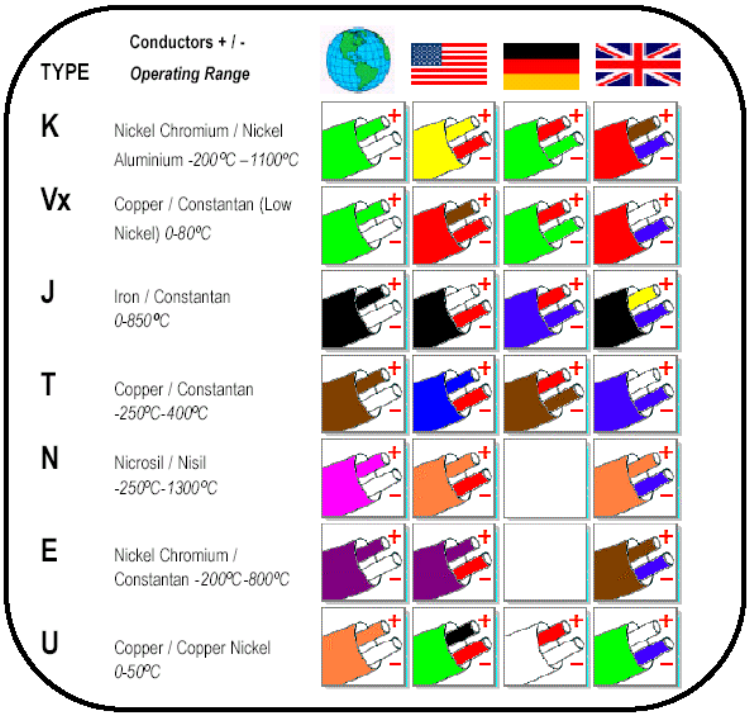
Thermocouples Types

The most common thermocouples used in industrial applications are types, K, J, T, R, S and less common types E and N. Bellow is shown the main features for those thermocouples. The model AMBItemp TTC 59B features as standard thermocouple elements J, K and T.

Deviation Classes for Thermocouples According IEC60584

Type		R and S	B	J	T	E	K e N
Class 1	Temperature Range ºC	0 to 1100 1100 to 1600	-	-40 to 375 375 to 750	-40 to 125 125 to 350	-40 to 375 375 to 800	-40 to 375 375 to 1000
	Deviation ºC	+/- 1 +-(1 + 0,003(t - 1100)	-	+/- 1,5 +/- 0,004 (t)	+/- 0,5 +/- 0,004 (t)	+/- 1,5 +/- 0,004 (t)	+/- 1,5 +/- 0,004 (t)
Class 2	Temperature Range ºC	0 to 600 600 to 1600	600 to 800 800 to 1700	-40 to 333 333 to 750	-40 to 133 133 a 350	-40 to 333 333 to 900	-40 to 333 333 to 1200
	Deviation ºC	+/- 1,5 +/- 0,0025 (t)	+/- 0,0025 (t) +/- 0,005 (t)	+/- 2,5 +/- 0,0075 (t)	+/- 1,0 +/- 0,0075 (t)	+/- 2,5 +/- 0,0075 (t)	+/- 2,5 +/- 0,0075 (t)

Color Codes for Thermocouples



Thermocouple Type K (NICKEL CHROMIUM - NICKEL)

Positive Element (KP):	Ni90%Cr10%
Negative Element (KN):	Ni95%Mn2%Si1%A12%
Measuring Range:	-270°C to 1200°C
Voltage Produced:	-6,458 mV to 48,838 mV
Features:	Can be used on oxidant and inertial atmospheres. Due to its oxidation resistance is used at high temperatures above 600ºC and low temperatures bellow 0ºC. It should not be used on reducing or sulphuric atmospheres. At high temperatures and with low oxygen content, chromium diffusion happens, leading to a thermocouple response curve gap.

Thermocouple Type J (IRON - CONSTANTAN)

Positive Element (JP):	Fe99,5%
Negative Element (JN):	Cu55%Ni45%
Measuring Range:	-210°C to 760°C
Voltage Produced:	-8,096 mV to 42,919 mV
Features:	Can be used in neutral, oxidant or reducer atmospheres. Is not recommendable to be used at relative humidity (RH) atmospheres and at low temperatures (the thermo element JP becomes fragile). Above 540°C, iron suffers oxidation very quickly. Also not recommendable to be used on sulphur atmospheres above 500°C.

Thermocouple Type T (COPPER - CONSTANTAN)

Positive Element (TP):	Cu100%
Negative Element (TN):	Cu55%Ni45%
Measuring Range:	-270°C to 400°C
Voltage Produced:	-6,258 mV to 20,872 mV
Features:	Can be used in neutral, oxidant or reducer atmospheres. It shows very good accuracy, due to copper properties. Above 300°C, the copper oxidation becomes very intense, reducing the thermocouple lifetime and causing deviation on the thermocouple original response curve.

Measurement Range

The practical upper limit of the application range is:

Thermocouple Type	Wires / Sheath Material	Wire Colours (EN 60584)	Maximum Temperature [1] (ºC)
J	Fe-CuNi / SS 321	(+)black / (-)white	700
K	Ni-CrNi / Inconel 600	(+)green / (-)white	900
T	Cu-CuNi / SS316	(+)brown / (-)white	200

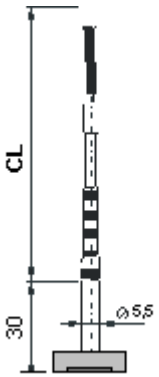
[1] The maximum temperature might be strongly reduced according the process connection type and materials. Please contact us to know the operating range for not standard process connections.

Technical Data

Thermocouple Types	Thermocouples types T, J or K, IEC 60584 class 1, simplex configuration, grounded junction.
Standard Temperature Range	Type T: -75ºC a 200ºC. Type J: -40ºC a 400ºC. Type K: -75ºC a 400ºC. The maximum temperature might be reduced according the process connection type and materials.
Process Connection	By piping clamp for tubes DN25 to DN50. By magnet with diameter 25mm and 7mm high. By fork and ring terminals M4.
Materials	Signal transmission cable with outer sheath in PVC, PTFE or SS. Optional cable protection by thermal sleeve or SS304 spring with 50mm. PBT thermocouple connectors for types J and K and thermoplastic connectors for type T.
Dimensions	Cable maximum length of 100m. Standard adaptation length of 30mm and 5.5mm of diameter.
Connectors	Thermocouple IEC plugs and sockets connectors, standard round pin or miniature flat pin.

Technical Drawings

The drawing shown below features an assembly with magnet as process connection. Fork or ring terminals are also available as standard process connections, being valid stated dimensions for adaptation length and diameter.



Additional information

Maintenance	The AMBItemp thermocouple assemblies do not require any specific maintenance. Is therefore recommended to check periodically thermocouple integrity.
Calibration Certificate	If required, can be issued a calibration certificate, ordered in a separate position and conducted by an independent and accredited entity.
Delivery Time	For small quantities (less than 10 pieces) with standard options, the delivery time is from 5 up to 9 working days, or express manufacturing (72h) with feasibility according configuration and required quantities.

How to Order

Order code	Description
TTC 59B-	**Temperature Probe AMBItemp Model TTC 59B**
010	**Thermocouple Type**
T	Thermocouple type T simplex
J	Thermocouple type J simplex
K	Thermocouple type K simplex
020	**Process Connection**
G0	Pipe Clamp DN 25-50
G1	Magnet d 25mm, h 7mm (max. temperature of 200ºC)
G2	Fork terminal M4
G3	Ring terminal M4
Y9	Customized version
030	**Cable Protection**
B	SS Spring
A	Thermal Sleeve
C	Without protection. Crimped and sealed cable
Y	Customized version
040	**Transmission Cable Length LC (500mm – 100m)**
0	Cable length with 1000mm
1	Cable length with 1500mm
2	Cable length with 2000mm
3	Cable length with 2500mm
4	Cable length with 3000mm
5	Cable length with 5000mm
X	Cable length according specification
9	Customized version
050	**Transmission Cable (Price by 500mm)**
T0	For thermocouple type T, in PVC/PVC, max. 105ºC
T1	For thermocouple type T, in PVC/metallic screen/PVC, max. 105ºC
T3	For thermocouple type T, in Teflon/Polyurethane, max 110ºC, curly leads
T4	For thermocouple type T, in PTFE/PTFE, temp. -75ºC to 250ºC, 2 wires 7/0.2mm
T5	For thermocouple type T, -75ºC to 240ºC, standard PTFE cable
J0	For thermocouple type J, in PVC/PVC, max. 105ºC
J1	For thermocouple type J, in PVC/metallic screen/PVC, max. 105ºC
J2	For thermocouple type J, in fiber glass/fiber glass-SS over braided silicone varnished, max. 400ºC
J3	For thermocouple type J, in Teflon/Polyurethane, max 110ºC, curly leads
J4	For thermocouple type J, in PTFE/PTFE, temp. -75ºC to 250ºC, 2 wires 7/0.2mm 2
J5	For thermocouple type J, -40ºC to 240ºC, standard PTFE cable
K0	For thermocouple type K, in PVC/PVC, max. 105ºC
K1	For thermocouple type K, in PVC/metallic screen/PVC, max. 105ºC
K2	For thermocouple type K, in fiber glass/fiber glass-SS over braided silicone varnished, max. 400ºC
K3	For thermocouple type K, in Teflon/Polyurethane, max 110ºC, curly leads
K4	For thermocouple type K, in PTFE/PTFE, temp. -75ºC to 250ºC, 2 wires 7/0.2mm
K5	For thermocouple type K, -75ºC to 240ºC, standard PTFE cable
Y9	Customized version

Order Code	Description
060	**End Cable Thermocouple Connector**
AB	Not selected; free end wires without terminals
FT	Miniature plug type T
BT	Standard plug type T
AT	Standard socket type T
TT	Miniature socket type T
FJ	Miniature plug type J
BJ	Standard plug type J
AJ	Standard socket type J
TJ	Miniature socket type J
FK	Miniature plug type K
BK	Standard plug type K
AK	Standard socket type K
TK	Miniature socket type K
YY	Customized version

Selection Example:

Thermocouple type K to use in range of 0 to 60ºC, very fast response required, process connection by magnet and extension cable with 5000mm with PVC outer sheath. A miniature flat plug IEC color code is necessary for proper connection with temperature reader. Reinforced mechanical protection by thermal sleeve.

Order Code: TTC 59B-KG1A5K0FK

Subject to modifications. All rights reserved to Delta Sensor, Lda

Delta Sensor

Produção e Comercialização
de Sistemas Industriais, Lda

Address: Parque Industrial do Barreiro
Rua 48 Nº11 Apartado 5056
2831-904 Barreiro, Portugal
Commercial Department:
Tel: +351 21207 0802
Fax: +351 21207 0804
Email: commercial@deltasensor.pt