

for resistance thermometers
and thermocouples

■ Structure of electrical thermometers

- Exchangeability during operation based on modular design
- Less effort for recovery with maximum flexibility and system uptime

■ Functionality of the modular system

- Protection against mechanical and chemical stress based on thermowells of various designs
- Exchangeable measuring inset generates measuring signal
- Transmitter provides interface to latest process management systems

■ Areas of application

- Offshore and coastal areas
- Petroleum and natural gas production and transport
- Petrochemical, chemical and energy industry
- Manufacturing systems and plant engineering
- General process engineering
- Tank and pipeline construction
- Food and drink industry

■ Made up of mineral-insulated cable

- High vibration resistance, ductility, temperature capacity and electrical insulation

■ Spring-loaded attachment to base plate

- This ensures the measuring inset tip is pressed against the bottom of the thermowell. This results in:
 - short response times
 - Reduce natural oscillation

■ Approvals

- For mounting on approved TSP temperature sensors:
- Intrinsically safe, hermetically sealed, dust ignition proof
- GOST Russia, Kazakhstan, Ukraina

■ Wide selection of sensors and interfaces

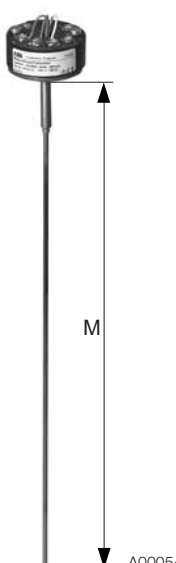

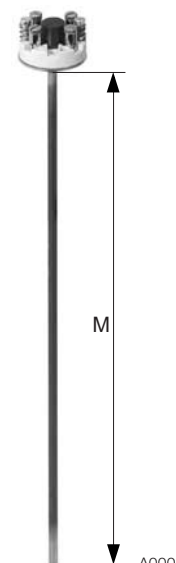


Easy to replace
Multi-purpose
With integrated transmitter

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1 Overview of measuring insets

Type	Sheathed thermocouples and sheathed resistance thermometers		
			
Electrical connection	Installed ABB transmitter	Flying leads	Terminal block
Design	Mineral insulated cable: flexible, bendable, vibration resistant		
Standard	DIN 43 735 – Updated 04/2005		
Sensor types	Resistance thermometers, thermocouples		
Measuring inset diameter	Ø = 1 mm less than inside diameter of the thermowell		
Standard measuring elements	Resistance thermometers: Pt100 basic application (-50 ... 400 °C), single/dual, 3-/4-wire connection (EN 60751) Pt100 extended measuring range (-200 ... 600 °C), single/dual, 3-/4-wire connection Thermocouples: Type K, J and N, single/dual (EN 60584)		
Standard sheath material	Resistance thermometers: 1.4571 (SS 316Ti) Thermocouples: 2.4816 (Inconel 600)		
Design of measuring point	Standard: Insulated, optional with thermocouples: grounded		
Spring travel	Approx. 10 mm		
Explosion protection class	Intrinsically safe ATEX II 1 G EEx ia IIC T6 ... T1; for installation in ABB temperature sensors TSP1X1, TSP3X1 Dust ignition proof ATEX II 1 D T135 ... T450; for installation in ABB temperature sensors TSP1X1, TSP3X1 Hermetically sealed ATEX II 1/2 G EEx d IIC T6 ... T4; for installation in ABB temperature sensors TSP3X1 Note: Requirements for NAMUR NE24 recommendation are fulfilled by ATEX EEx i.		
Temperature	Resistance thermometers: Basic application: -50 ... 400 °C Extended vibration resistance: -50 ... 400 °C Extended measuring range: -200 ... 600 °C Thermocouples Type K, J and N: Approx. -40 ... 1000 °C		
Application	Installation in TSP temperature sensors		



Note

For higher resistance to vibrations, resistance measuring insets with higher resistance to vibrations or thermocouples are recommended.

For information on additional sensor models, sheath materials and diameters, contact your ABB sales representative.

2 Design

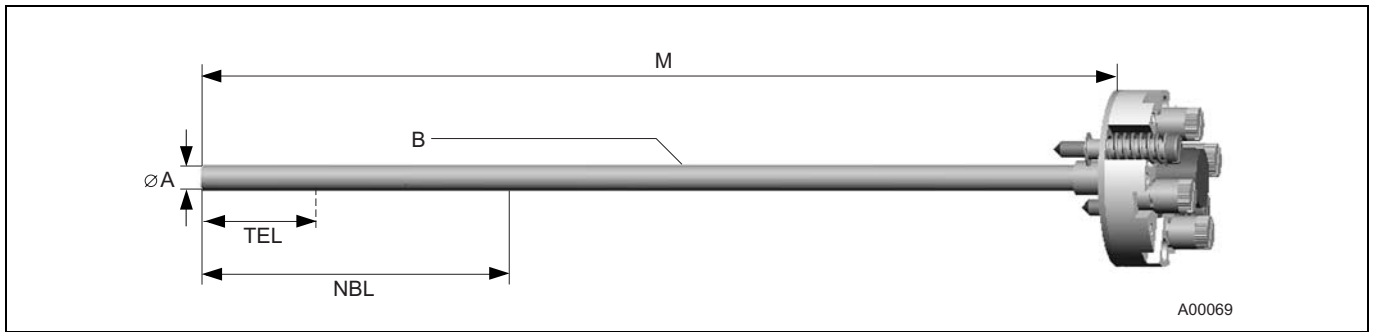


Fig. 1

- A Measuring inset diameter
- B Mineral-insulated, plastic-sheathed cable, with compact wires embedded in MgO
- M Measuring inset length
- TEL Temperature-sensitive length
- NBL Non-bendable length

Connector base

- Base: \varnothing 42 mm
- Distance between screws: \varnothing 33 mm
- Screw size: M4 x 1.5
- Spring travel: > 10 mm

3 General information

3.1 Measurement accuracy of mounted transmitter

For information on transmitter accuracy, refer to the documentation on transmitters.

3.2 Vibration resistance of measuring inset

Use of plastic-sheathed cables and special measuring elements, including their installation, results in a very high vibration resistance for all measuring insets of the TSP temperature sensor.

The acceleration values of 3 g, defined in accordance with EN 60751 (IEC 751) for additional requirements, are exceeded by all measuring inset models in TSP temperature sensors.

The following table provides an overview of the vibration resistance in accordance with EN 60751 for the measuring inset models (on hot side), as well as the temperature-sensitive sections and the non-bendable sections at the tip of the measuring inset.

Measuring inset-design	Vibration resistance EN 60751 (tip-tip)	temperature-sensitive section	non-bendable section
Pt100, Basic application (-50 ... 400 °C)	10 g	7 mm	30 mm
Pt100, Extended vibration resistance (-50 ... 400 °C)	60 g	10 mm	40 mm
Pt100, Extended measuring range (-200 ... 600 °C)	10 g	50 mm	60 mm
Thermocouple	60 g	3 mm	20 mm

3.3 Insulation resistance of measuring inset

The insulation resistance is measured between outside sheath and measuring circuit. In case of two measuring circuits, the insulation resistance between both measuring circuits is also measured.

The following applies for all measuring inset models:

$R_{iso} > 500 \text{ M}\Omega$ at 500 V DC, $15 \text{ }^\circ\text{C} < T_u < 35 \text{ }^\circ\text{C}$, relative humidity < 80%

As a result of a special process during manufacturing, ABB measuring insets also have outstanding insulation values at high temperatures.

3.4 Measuring range of measuring inset

Resistance thermometers	
Basic application	-50 ... 400 °C
Extended vibration resistance	-50 ... 400 °C
Extended measuring range	-200 ... 600 °C
Thermocouple	
Type K	-40 ... 1000 °C
Type J	-40 ... 750 °C
Type N	-40 ... 1000 °C



Note

The resistance of the copper inner conductor for the measuring inset affects the measurement value of 2-wire connections and must be taken into consideration. The diameter and length of the measuring inset are determining factors.

If the error cannot be compensated mechanically, the following values apply:

- Ø measuring inset 3 mm: (0.281 Ω/m ⇒ +0.7 °C/m)
- Ø measuring inset 6 mm: (0.1 Ω/m ⇒ +0.25 °C/m)

ABB provides standard 3- or 4-wire circuits. This eliminates the error.

3.5 Accuracy of measuring element

Resistance thermometer (EN 60751)

Basic application	
Class B: $\Delta t = \pm (0.30 + 0.0050 t)$	-50 ... 400 °C
Class A: $\Delta t = \pm (0.15 + 0.0020 t)$	-30 ... 350 °C
$\Delta t = \pm (0.30 + 0.0050 t)$	-50 ... -30 / 350 ... 400 °C
1/3 Class B: $\Delta t = \pm (0.10 + 0.0017 t)$	0 ... 100 °C
$\Delta t = \pm (0.15 + 0.0020 t)$	-30 ... 0 / 100 ... 350 °C
$\Delta t = \pm (0.30 + 0.0050 t)$	-50 ... -30 / 350 ... 400 °C
Extended vibration resistance	
Class B: $\Delta t = \pm (0.30 + 0.0050 t)$	-50 ... 400 °C
Class A: $\Delta t = \pm (0.15 + 0.0020 t)$	-30 ... 350 °C
$\Delta t = \pm (0.30 + 0.0050 t)$	-50 ... -30 / 350 ... 400 °C
Extended measuring range	
Class B: $\Delta t = \pm (0.30 + 0.0050 t)$	-200 ... 600 °C
Class A: $\Delta t = \pm (0.15 + 0.0020 t)$	-200 ... 600 °C

Measurement resistances: Tolerances in accordance with EN 60751 (IEC 60751)

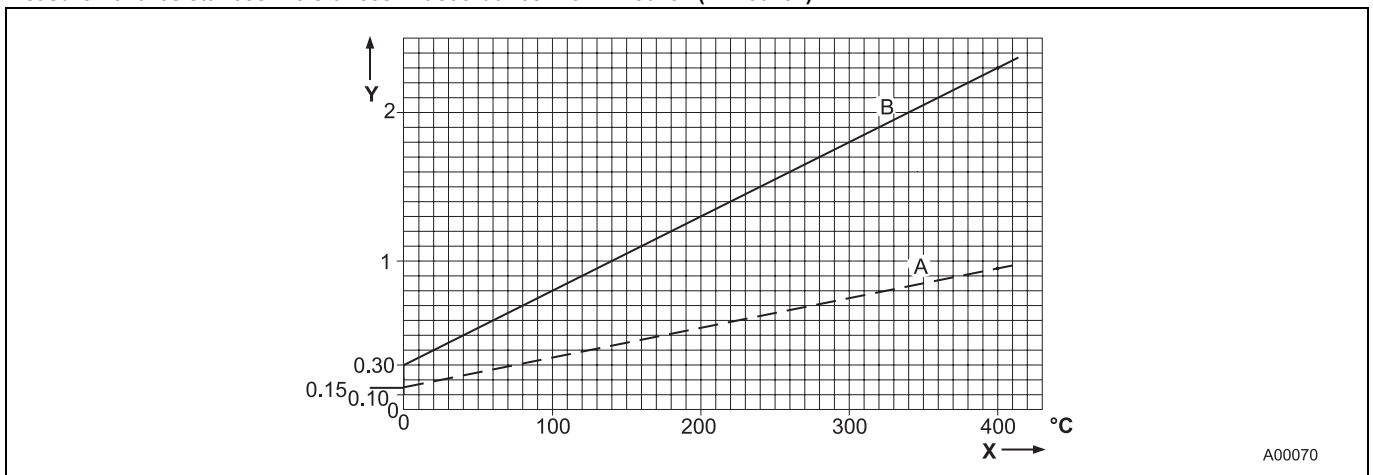


Fig. 2

X Temperature
Y Upper/lower deviation (+/-) / Kelvin

A Tolerance class A
B Tolerance class B

Thermocouple

The measurement accuracy of the ABB standard thermocouples complies with international standard IEC 584 / EN 60584. Thermocouples compliant with ANSI MC96.1 are also available upon request. Since the values of both standards vary only marginally in the lower temperature range (up to approx. 300 °C), we recommend the use of thermocouples compliant with international standard IEC 584. The tolerance information must be defined in the table "Tolerance classes".

Tolerance classes

Standard	TE type	Class	Temperature range	Maximum deviation
EN 60584 / IEC 584	K (NiCr-Ni)	2	-40 ... 333 °C	±2.5 °C
			333 ... 1200 °C	±0.0075 x [t]
		1	-40 ... 375 °C	±1.5 °C
			375 ... 1000 °C	±0.0040 x [t]
	J (Fe-CuNi)	2	-40 ... 333 °C	±2.5 °C
			333 ... 750 °C	±0.0075 x [t]
		1	-40 ... 375 °C	±1.5 °C
			375 ... 750 °C	±0.0040 x [t]
	N (NiCrSiNiSi)	2	-40 ... 333 °C	±2.5 °C
			333 ... 1200 °C	±0.0075 x [t]
		1	-40 ... 375 °C	±1.5 °C
			375 ... 1000 °C	±0.0040 x [t]
Standard	TE type	Class	Temperature range	Maximum deviation
ANSI MC96.1	K (NiCr-Ni)	Standard	-0 ... 293 °C	±2.2 °C
			293 ... 1250 °C	±0.0075 x [t]
		Special	-0 ... 275 °C	±1.1 °C
			275 ... 1250 °C	±0.0040 x [t]
	J (Fe-CuNi)	Standard	-0 ... 293 °C	±2.2 °C
			293 ... 750 °C	±0.0075 x [t]
		Special	-0 ... 275 °C	±1.1 °C
			275 ... 750 °C	±0.0040 x [t]
	N (NiCrSiNiSi)	Standard	-0 ... 293 °C	±2.2 °C
			293 ... 1250 °C	±0.0075 x [t]
		Special	-0 ... 275 °C	±1.1 °C
			275 ... 1250 °C	±0.0040 x [t]

Thermocouple: Tolerances in accordance with EN 60584 (IEC 60584)

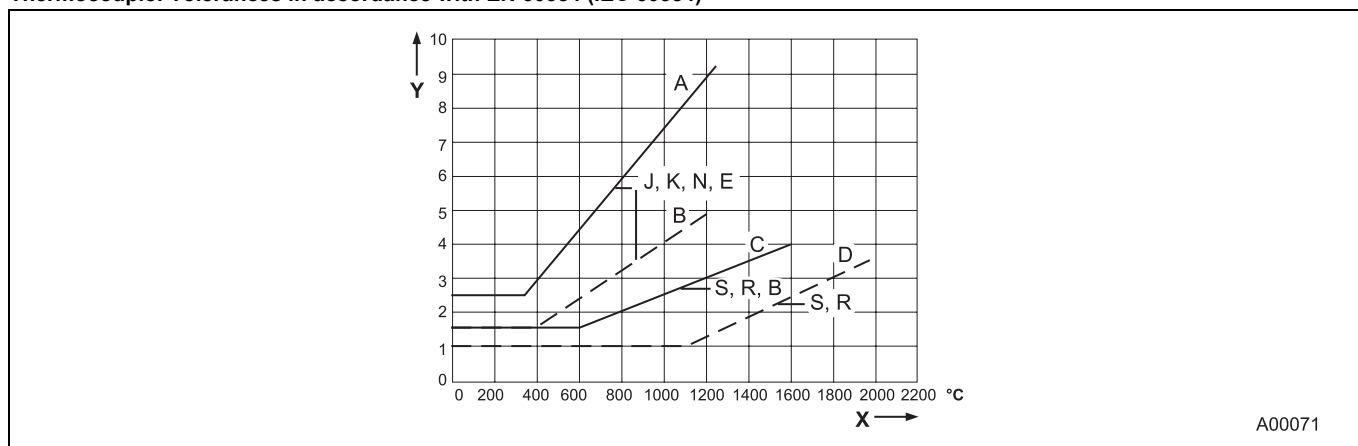


Fig. 3

X Temperature
Y Upper/lower deviation (+/-) / Kelvin

A, C Tolerance class 2
B, D Tolerance class 1

3.6 Measuring inset designs

3.6.1 Resistance thermometers, basic application

	Single			Dual		
	2-wire connection	3-wire connection	4-wire connection	2-wire connection	3-wire connection	4-wire connection
3 mm, class B	●	●	●	-	-	-
3 mm, class A	-	●	●	-	-	-
6 mm, class B	●	●	●	●	●	●
6 mm, class A	-	●	●	-	●	●
6 mm, 1/3 Cl. B	-	●	●	-	●	●

3.6.2 Resistance thermometers, extended vibration resistance

	Single			Dual		
	2-wire connection	3-wire connection	4-wire connection	2-wire connection	3-wire connection	4-wire connection
3 mm, class B	-	-	-	-	-	-
3 mm, class A	-	-	-	-	-	-
6 mm, class B	●	●	●	●	●	●
6 mm, class A	-	●	●	-	●	●

3.6.3 Resistance thermometer, extended measuring range

	Single			Dual		
	2-wire connection	3-wire connection	4-wire connection	2-wire connection	3-wire connection	4-wire connection
3 mm, class B	●	●	●	●	●	-
3 mm, class A	-	●	●	-	-	-
6 mm, class B	●	●	●	●	●	●
6 mm, class A	-	●	●	-	-	-

3.6.4 Thermocouple

	1 x type K	2 x type K	1 x type J	2 x type J	1 x type N	2 x type N
3 mm, class 2	●	●	●	●	-	-
3 mm, class 1	●	●	●	●	-	-
6 mm, class 2	●	●	●	●	●	●
6 mm, class 1	●	●	●	●	●	●

3.7 Recalibration recommendations

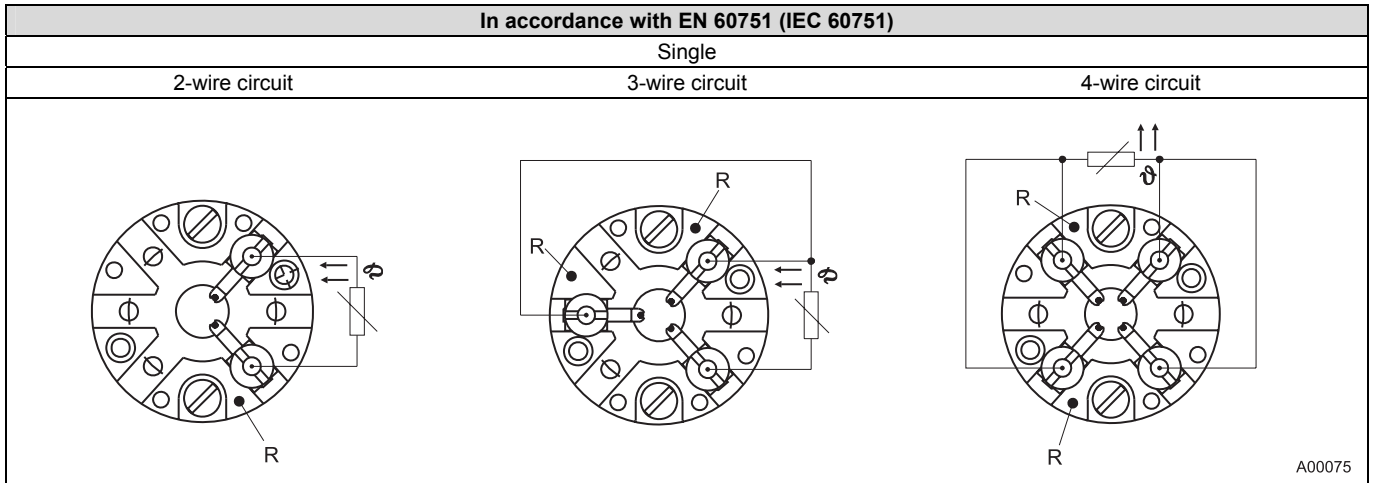
Recommended values for a maximum uniform operating temperature:

- 400 °C recalibration at the latest after two years
- 200 °C recalibration at the latest after five years

Depending on process requirements (e.g., increased accuracy, system availability, safety) and with above-average stress (strong vibrations, frequent and rapid temperature fluctuations, etc.), the time periods might have to be significantly shortened.

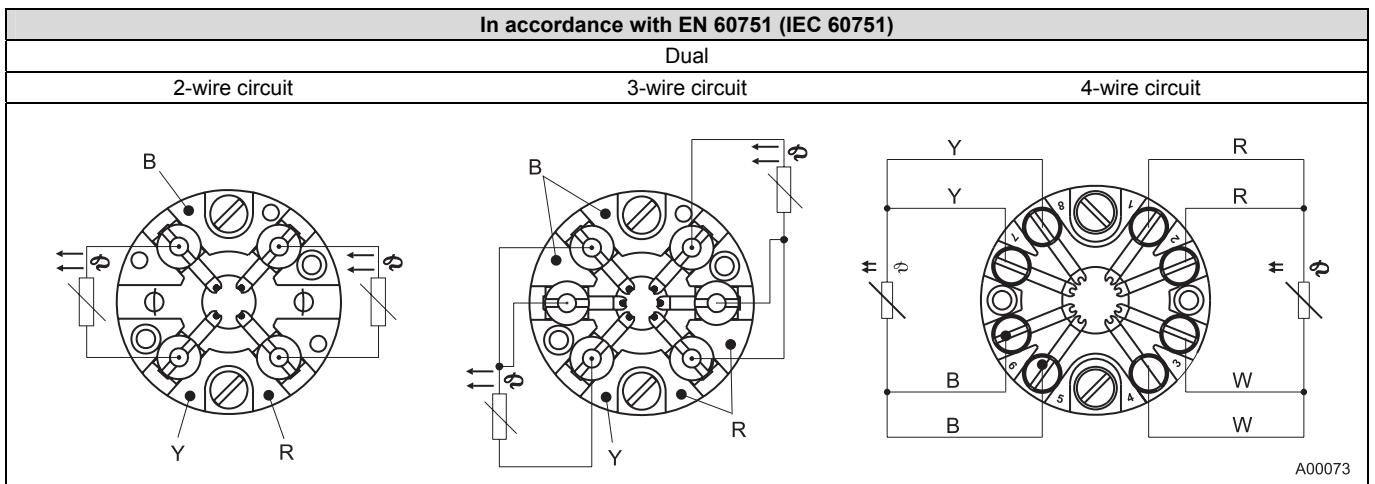
4 Terminal connection diagrams

4.1 Resistance thermometers



A00075

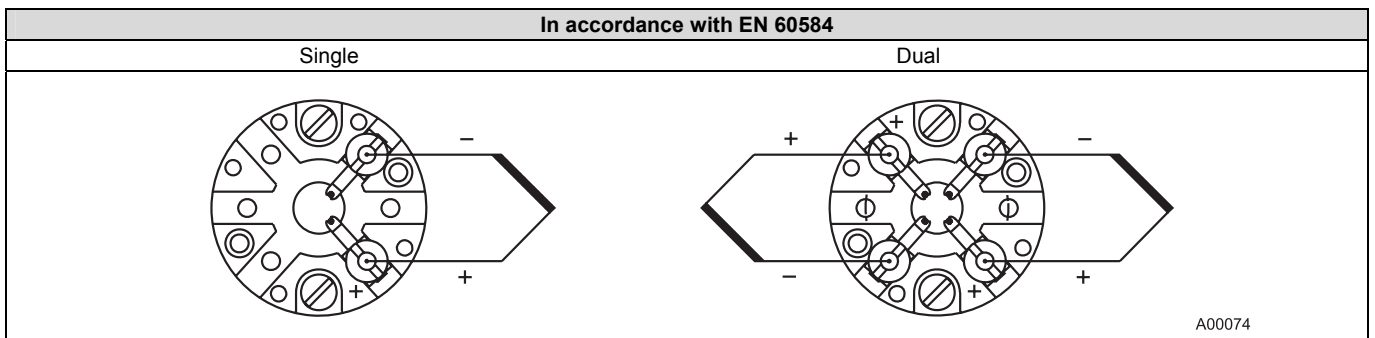
Fig. 4
R red



A00073

Fig. 5
Y yellow
B black
R red
W white

4.2 Thermoelements



A00074

Fig. 6

5 Additional information

5.1 Delivery times

Typical delivery times for small (≤ 10 units) to medium (≤ 50 units) quantities and standard models are 3 to 10 days, depending on configuration.

5.2 Supplementary documents

Device	Data sheet
Temperature transmitter for sensor head mounting	
TR04-Eco, 4 ... 20 mA, TR04-Ex; permanent	10/11-8.14
TH01, TH01-Ex 4 ... 20 mA, configurable	3KDE115080R1003
TH02, TH02-Ex HART	10/11-8.19
TF12, TF12-Ex PA	10/11-8.26
TF02, TF02-Ex FF	10/11-8.25
TTH300 HART, Sensor redundancy	DS/TTH300
Temperature sensors for use in the process industry	
SensyTemp TSP100	DS/TSP1X1
SensyTemp TSP300	DS/TSP3X1

5.3 Information about ordering information:

The order codes cannot be combined in any order with each other.
For questions regarding installation feasibility, contact your ABB partner.

6 Ordering information

Exchangeable measuring inset SensyTemp TSA101	Variant digit No.	1 - 7	8	9	10	11	12	13	14	15	Code			
	Catalog No.	TSA101-												
Explosion protection / approval														
Without														
Intrinsic Safety: ATEX II 1 G EEx ia IIC T6 ... T1 - Zone 0, 1, 2														
Dust ignition proof: ATEX II 1 D IP6X T133 ... T400 - Zone 20, 21, 22														
Dust ignition proof and intrinsic safety: ATEX II 1 D IP6X T133 ... T400 and ATEX II 1 G EEx ia IIC T6 ... T1 - Zone 0, 1, 2, 20, 21, 22														
Flameproof Enclosure: ATEX II 1/2 G EEx d IIC T6 ... T4 - Zone 1														
ATEX II 3 G EEx nA II T6 ... T1														
and ATEX II 3 D IP6X T133 ... T400 - Zone 2 and 22														
Others														
Measuring inset type														
Resistance thermometer, basic application, measuring range -50 ... 400 °C														
Resistance thermometer, extended vibration resistance, measuring range -50 ... 400 °C														
Resistance thermometer, extended measuring range -200 ... 600 °C														
Thermocouple														
Others														
Measuring inset diameter														
3 mm														
6 mm														
6 mm, tip with additional sleeve 8 mm														
6 mm, tip with additional sleeve 10 mm														
Others														
Sensor type and wiring														
1 x Pt100, 2-wire														
1 x Pt100, 3-wire														
1 x Pt100, 4-wire														
2 x Pt100, 2-wire														
Measuring inset type S1, S2														
Measuring inset type D1														
2 x Pt100, 3-wire														
Measuring inset type S1, S2														
Measuring inset type D1														
2 x Pt100, 4-wire														
Measuring inset type S1, S2														
Measuring inset type D1														
1 x Type K (NiCr-Ni)														
2 x Type K (NiCr-Ni)														
1 x Type J (Fe-CuNi)														
2 x Type J (Fe-CuNi)														
1 x Type N (NiCrSi-NiSi)														
2 x Type N (NiCrSi-NiSi)														
Others														

Continued on next page

Exchangeable measuring inset		Variant digit No.	1 - 7	12	13	14	15	16	17	18	19	Code				
SensyTemp TSA101		Catalog No.	TSA101-													
Sensor accuracy																
Standard accuracy EN 60751 class B										B	2					
Extended accuracy EN 60751 class A from -30 ... 350 °C										S	1					
Extended accuracy EN 60751 class A from -200 ... 600 °C										D	1					
Standard accuracy EN 60584 class 2										T	2					
Extended accuracy EN 60584 class 1										T	1					
High accuracy EN 60751 1/3 class B from 0 ... 100 °C										S	3					
Others										Z	9					
Inset length M																
M = 255 mm										M	1					
M = 270 mm										H	1					
M = 285 mm										D	1					
M = 300 mm										D	2					
M = 315 mm										M	2					
M = 330 mm										H	2					
M = 355 mm										H	3					
M = 375 mm										D	3					
M = 390 mm										D	4					
M = 405 mm										M	3					
M = 420 mm										H	4					
M = 435 mm										D	5					
M = 450 mm										D	6					
M = 455 mm										H	5					
M = 505 mm										H	6					
M = 555 mm										M	4					
M = 570 mm										H	7					
M = 585 mm										D	7					
M = 600 mm										D	8					
M = 605 mm										H	8					
M = 1025 mm										M	5					
Acc. to customer specification (price per each commencing 100 mm)										Z	9					

Continued on next page

Exchangeable measuring inset SensyTemp TSA101	Variant digit No.											Code			
	1	2	3	4	5	6	7	8	9	10	11				
	Catalog No. TSA101-														
Transmitter															
Without transmitter, measuring inset with ceramic terminal block												Y 1			
Without transmitter, measuring inset with flying leads												Y 2			
TR04, fixed range, output signal 4 ... 20 mA															
2/3-wire circuit												R 1			
4-wire circuit												R 1			
TR04-Ex, fixed range, output signal 4 ... 20 mA															
2/3-wire circuit												R 2			
4-wire circuit												R 2			
TH01, programmable, output signal 4 ... 20 mA												P 1			
TH01-Ex, programmable, output signal 4 ... 20 mA												P 2			
TH02, programmable, output signal 4 ... 20 mA, HART												H 1			
TH02-Ex, programmable, output signal 4 ... 20 mA, HART												H 2			
TTH300, programmable, output signal 4 ... 20 mA, HART												H 4			
TTH300 (Ex-version), programmable, output signal 4 ... 20 mA, HART												H 5			
TF12, programmable, output PROFIBUS PA												F 1			
TF12-Ex, programmable, output PROFIBUS PA												F 2			
TF02, programmable, output FOUNDATION Fieldbus												F 3			
TF02-Ex, programmable, output FOUNDATION Fieldbus												F 4			
Others												Z 9			

Additional ordering information											Code			
Transmitter measuring range														
-30 ... 60 °C											A1			
-20 ... 40 °C											A2			
0 ... 40 °C											A3			
0 ... 60 °C											A4			
0 ... 100 °C											A5			
0 ... 120 °C											A6			
0 ... 150 °C											A7			
0 ... 200 °C											A8			
0 ... 250 °C											AF			
0 ... 300 °C											AG			
0 ... 400 °C											AH			
0 ... 600 °C											AJ			
0 ... 800 °C											AK			
0 ... 1000 °C											AL			
0 ... 1200 °C											AM			
0 ... 1400 °C											AN			
0 ... 1600 °C											AP			
Others											AZ			

Additional ordering information

Exchangeable measuring inset SensyTemp TSA101	Code			
Name plate Stainless steel plate with TAG no.	T1			
Certificates Inspection certificate 3.1 acc. to EN 10204 for sensor calibration 1 x Pt100 Inspection certificate 3.1 acc. to EN 10204 for sensor calibration 2 x Pt100 Inspection certificate 3.1 acc. to EN 10204 for sensor calibration 1 x thermocouple Inspection certificate 3.1 acc. to EN 10204 for sensor calibration 2 x thermocouple DKD sensor calibration 1 x Pt100, separate calibration certificate for each thermometer DKD sensor calibration 2 x Pt100, separate calibration certificate for each thermometer DKD sensor calibration 1 x thermocouple, separate calibration certificate for each thermometer DKD sensor calibration 2 x thermocouple, separate calibration certificate for each thermometer Others	CD CE CF CG CH CJ CK CL CZ			
Temperatures for sensor calibration 0 °C / 32 °F 100 °C / 212 °F 400 °C / 752 °F 0 °C and 100 °C / 32 °F and 212 °F 0 °C and 400 °C / 32 °F and 752 °F 0 °C, 100 °C and 200 °C / 32 °F, 212 °F and 392 °F 0 °C, 200 °C and 400 °C / 32 °F, 392 °F and 752 °F As specified by customer (price per calibration point)	V1 V2 V3 V4 V5 V7 V8 V6			
Temperatures for DKD calibration 0 °C / 32 °F 100 °C / 212 °F 400 °C / 752 °F 0 °C and 100 °C / 32 °F and 212 °F 0 °C and 400 °C / 32 °F and 752 °F 0 °C, 100 °C and 200 °C / 32 °F, 212 °F and 392 °F 0 °C, 200 °C and 400 °C / 32 °F, 392 °F and 752 °F As specified by customer (price per calibration point)	D1 D2 D3 D4 D5 D7 D8 D6			

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Printed in the Fed. Rep. of Germany (06.2007)

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3KXT111001R1001



ABB Limited
Salterbeck Trading Estate
Workington, Cumbria
CA14 5DS
UK
Tel: +44 (0)1946 830 611
Fax: +44 (0)1946 832 661

ABB Inc.
125 E. County Line Road
Warminster, PA 18974
USA
Tel: +1 215 674 6000
Fax: +1 215 674 7183

ABB Automation Products GmbH
Borsigstr. 2
63755 Alzenau
Germany
Tel: +49 551 905-534
Fax: +49 551 905-555
CCC-support.deapr@de.abb.com

DS/TSA101-EN Rev. A