Innovative Sensor Technology
physical. chemical. biological.

400 °C Series

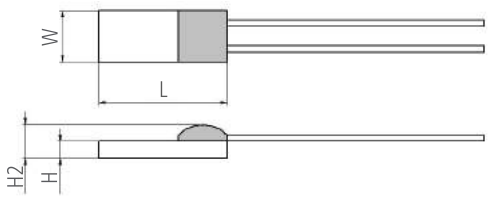
Platinum sensor with wires

For medium temperatures

Benefits & Characteristics

- Outstanding long-term stability
- Excellent solderability
- Low self-heating
- Vibration and temperature shock resistant
- Paired and grouped sensors available
- 1/5 DIN and 1/10 DIN
- Customer-specific sensor available upon request

Illustration[1)]



Dimension tolerances:	W ±0.2 mm, L ±0.2 mm, H ±0.1 mm, H2 ±0.3 mm, L_W (up to 30 mm) ±1 mm

1) For actual size, see dimensions

Technical Data

Operating temperature range:	-200 °C to +400 °C	
Nominal resistance:*	100 Ω at 0 °C	
	500 Ω at 0 °C	
	1000 Ω at 0 °C	
Characteristics curve:*	3850 ppm/K	
Long-term stability:	< 0.04 % at 1000 h at maximal operating temperature	
Tolerance class (dependent on temperature range):*		IST AG reference
	IEC 60751 F0.15	A
	IEC 60751 F0.3	B
	IEC 60751 F0.6	C
	IEC 60751 F0.1	Y
	1/5 IEC 60751 F0.3	K*
	1/10 IEC 60751 F0.3	K*
Connection:*	Ag-wire, Ø 0.25 mm (solderable, weldable)	
Alternative wire construction:*	Perpendicular wires	
	Inverted wires	
Recommended applied current:[1)]	1 mA at 100 Ω	
[1)] Self-heating must be considered	0.5 mA at 500 Ω	
	0.3 mA at 1000 Ω	

Other alternatives:*	Housed in round ceramics (for dry environments only) - see data sheet DTP_Round_Housing_E
	Grouped and paired
	Substrate thickness

* Customer-specific alternatives available

Order Information - 4W (Ag-wire, Ø 0.25 mm)

Size	Dimensions (L x W x H / H2; L_W in mm)	F0.1 (class Y)	F0.15 (class A)	F0.3 (class B)
Nominal resistance: 100 Ω at 0 °C				
161	1.6 x 1.2 x 0.25 / 0.6; 10.0	P0K1.161.4W.Y.010	P0K1.161.4W.A.010	P0K1.161.4W.B.010
Order code		010.00048	010.00045	010.00042
202	2.0 x 2.0 x 0.65 / 1.3; 7.0	Upon request	Upon request	P0K1.202.4W.B.007
Order code				010.03050
216	2.5 x 1.6 x 0.65 / 1.3; 7.0	Upon request	Upon request	P0K1.216.4W.B.007
Order code				010.03223
216	2.5 x 1.6 x 0.65 / 1.3; 15.0	Upon request	P0K1.216.4W.A.015	P0K1.216.4W.B.015
Order code			010.02699	010.02698
232	2.3 x 2.0 x 0.65 / 1.3; 7.0	Upon request	P0K1.232.4W.A.007	P0K1.232.4W.B.007
Order code			010.00008	010.00007
232	2.3 x 2.0 x 0.65 / 1.3; 10.0	P0K1.232.4W.Y.010	P0K1.232.4W.A.010	P0K1.232.4W.B.010
Order code		010.00006	010.00004	010.00002
505	5.0 x 5.0 x 0.65 / 1.3; 10.0	Upon request	P0K1.505.4W.A.010	P0K1.505.4W.B.010
Order code			010.00141	010.00139
516	5.0 x 1.6 x 0.65 / 1.3; 10.0	P0K1.516.4W.Y.010	P0K1.516.4W.A.010	P0K1.516.4W.B.010
Order code		010.00075	010.00073	010.00071
520	5.0 x 2.0 x 0.65 / 1.3; 10.0	P0K1.520.4W.Y.010	P0K1.520.4W.A.010	P0K1.520.4W.B.010
Order code		010.00096	010.00094	010.00092
538	5.0 x 3.8 x 0.65 / 1.3; 10.0	Upon request	P0K1.538.4W.A.010	P0K1.538.4W.B.010
Order code			010.00123	010.00121
102	10.0 x 2.0 x 0.65 / 1.3; 10.0	P0K1.102.4W.Y.010	P0K1.102.4W.A.010	P0K1.102.4W.B.010
Order code		010.00150	010.00148	010.00146
Nominal resistance: 150 Ω at 0 °C				
202	2.0 x 2.0 x 0.65 / 1.3; 10.0	Upon request	Upon request	P150.202.4W.B.010
Order code				010.03166
Nominal resistance: 350 Ω at 0 °C				
202	2.0 x 2.0 x 0.65 / 1.3; 10.0	Upon request	Upon request	P350.202.4W.B.010
Order code				010.03167

Size	Dimensions (L x W x H / H2; L_w in mm)	F0.1 (class Y)	F0.15 (class A)	F0.3 (class B)
Nominal resistance: 500 Ω at 0 °C				
161	1.6 x 1.2 x 0.25 / 0.6; 10.0	P0K5.161.4W.Y.010	P0K5.161.4W.A.010	P0K5.161.4W.B.010
Order code		010.00179	010.00177	010.00175
232	2.3 x 2.0 x 0.65 / 1.3; 10.0	Upon request	P0K5.232.4W.A.010	P0K5.232.4W.B.010
Order code			010.00667	010.00664
516	5.0 x 1.6 x 0.65 / 1.3; 15.0	P0K5.516.4W.Y.015	P0K5.516.4W.A.015	P0K5.516.4W.B.015
Order code		010.00190	010.00189	010.00188
520	5.0 x 2.0 x 0.65 / 1.3; 10.0	Upon request	P0K5.520.4W.A.010	P0K5.520.4W.B.010
Order code			010.00946	010.00663
520	5.0 x 2.0 x 0.65 / 1.3; 15.0	P0K5.520.4W.Y.015	P0K5.520.4W.A.015	P0K5.520.4W.B.015
Order code		010.00196	010.00195	010.00194
102	10.0 x 2.0 x 0.65 / 1.3; 10.0	Upon request	P0K5.102.4W.A.010	P0K5.102.4W.B.010
Order code			010.02332	010.02341
Nominal resistance: 1000 Ω at 0 °C				
161	1.6 x 1.2 x 0.25 / 0.6; 10.0	P1K0.161.4W.Y.010	P1K0.161.4W.A.010	P1K0.161.4W.B.010
Order code		010.00217	010.00214	010.00211
232	2.3 x 2.0 x 0.65 / 1.3; 7.0	Upon request	P1K0.232.4W.A.007	P1K0.232.4W.B.007
Order code			010.01938	010.01939
232	2.3 x 2.0 x 0.65 / 1.3; 10.0	P1K0.232.4W.Y.010	P1K0.232.4W.A.010	P1K0.232.4W.B.010
Order code		010.00228	010.03200	010.03201
505	5.0 x 5.0 x 0.65 / 1.3; 10.0	Upon request	P1K0.505.4W.A.010	P1K0.505.4W.B.010
Order code			010.00295	010.00294
516	5.0 x 1.6 x 0.65 / 1.3; 10.0	P1K0.516.4W.Y.010	P1K0.516.4W.A.010	P1K0.516.4W.B.010
Order code		010.00254	010.00252	010.00250
520	5.0 x 2.0 x 0.65 / 1.3; 10.0	P1K0.520.4W.Y.010	P1K0.520.4W.A.010	P1K0.520.4W.B.010
Order code		010.00266	010.00264	010.00262
520	5.0 x 2.0 x 0.65 / 1.3; 40.0	Upon request	Upon request	P1K0.520.4W.B.040
Order code				010.03155
520	5.0 x 2.0 x 0.65 / 1.3; 1000.0	Upon request	P1K0.520.4W.A.1000	P1K0.520.4W.B.1000
Order code			010.03074	010.03075
538	5.0 x 3.8 x 0.65 / 1.3; 10.0	Upon request	P1K0.538.4W.A.010	P1K0.538.4W.B.010
Order code			010.00390	010.00389
102	10.0 x 2.0 x 0.65 / 1.3; 10.0	P1K0.102.4W.Y.010	P1K0.102.4W.A.010	P1K0.102.4W.B.010
Order code		010.00305	010.00301	010.00299

Order Information - 4SW (Ag-wire, Ø 0.25 mm, perpendicular wire)

Size	Dimensions (L x W x H / H2; L_w in mm)	F0.1 (class Y)	F0.15 (class A)	F0.3 (class B)
Nominal resistance: 100 Ω at 0 °C				
161	1.6 x 1.2 x 0.25 / 0.6; 10.0	Upon request	P0K1.161.4SW.A.010	P0K1.161.4SW.B.010
Order code			010.01108	010.00616
232	2.3 x 2.0 x 0.65 / 1.3; 10.0	P0K1.232.4SW.Y.010	P0K1.232.4SW.A.010	P0K1.232.4SW.B.010
Order code		010.02159	010.01179	010.01695
538	5.0 x 3.8 x 0.65 / 1.3; 15.0	Upon request	Upon request	P0K1.538.4SW.B.015
Order code				010.02497
Nominal resistance: 500 Ω at 0 °C				
232	2.3 x 2.0 x 0.65 / 1.3; 10.0	Upon request	Upon request	P0K5.232.4SW.B.010
Order code				010.00578
Nominal resistance: 1000 Ω at 0 °C				
161	1.6 x 1.2 x 0.25 / 0.6; 10.0	Upon request	P1K0.161.4SW.A.010	P1K0.161.4SW.B.010
Order code			010.00599	010.00361
232	2.3 x 2.0 x 0.65 / 1.3; 15.0	Upon request	P1K0.232.4SW.A.015	P1K0.232.4SW.B.015
Order code			010.00586	010.00235

Order Information - 308 (with Ag-wire, Ø 0.15 mm)

Size	Dimensions (L x W x H / H2; L_w in mm)	F0.1 (class Y)	F0.15 (class A)	F0.3 (class B)
Nominal resistance: 100 Ω at 0 °C				
308	3.0 x 0.8 x 0.25 / 0.6; 10.0	Upon request	P0K1.308.4W.A.010	P0K1.308.4W.B.010
Order code			010.03150	010.03149
308	3.0 x 0.8 x 0.25 / 0.6; 18.0	Upon request	P0K1.308.4W.A.018	P0K1.308.4W.B.018
Order code			010.03157	010.03151
Nominal resistance: 1000 Ω at 0 °C				
308	3.0 x 0.8 x 0.25 / 0.6; 10.0	Upon request	P1K0.308.4W.A.010	P1K0.308.4W.B.010
Order code			010.03146	010.03145
308	3.0 x 0.8 x 0.25 / 0.6; 60.0	Upon request	P1K0.308.4W.A.060	P1K0.308.4W.B.060
Order code			010.03148	010.03147

Order Information - 308 (with FKS-wire, Ø 0.15 mm, suitable for Ø 1.0 mm)

Size	Dimensions (L x W x H / H2; L_W in mm)	F0.1 (class Y)	F0.15 (class A)	F0.3 (class B)
Nominal resistance: 100 Ω at 0 °C				
308	3.0 x 0.8 x 0.25 / 0.6; 10.0	P0K1.308.4W.Y.010.S	Upon request	P0K1.308.4W.B.010.S
Order code		010.03165		310.01025

Additional Documents

	Document name:
Application Note:	ATP_E

Order Information

Platinum Sensor

Secondary reference

Material

P	=	Platinum

TCR

	=	Pt 3850 ppm/K	G	=	Pt 3911 ppm/K
U	=	Pt 3750 ppm/K	W	=	Pt 3850 ppm/K (extended operating temperature range in class A)

Resistance in Ω at 0 °C

Size in mm

Operating temperature range

1	=	-50 °C to +150 °C	6	=	-200 °C to +600 °C
2	=	-50 °C to +200 °C	7	=	-200 °C to +750 °C
3	=	-200 °C to +300 °C	8	=	-200 °C to +850 °C
4	=	-200 °C to +400 °C	10	=	-70 °C to +1000 °C

Connections

S	=	SIL	FK	=	flat wire customer-specific
I	=	insulated wire	SW	=	perpendicular wire
K	=	customer-specific	L	=	insulate stranded wire
W	=	wire	E	=	enameled Cu-wire
FW	=	flat wire			

Tolerance class

A	=	IEC 60751 F0.15	K	=	customer-specific
B	=	IEC 60751 F0.3	P	=	pair
C	=	IEC 60751 F0.6	G	=	group
Y	=	IEC 60751 F0.1			

Wire length in mm

Special

T	=	substrate thickness 0.25 mm	M	=	metallized backside
D	=	substrate thickness 0.38 mm	U	=	inverted welding
R	=	round housing	S	=	special
W	=	sintered powder			

P	0K1.	308.	4	W.	B.	010.	S

Innovative Sensor Technology IST AG, Stegrütistrasse 14, 9642 Ebnat-Kappel, Switzerland
Phone: +41 71 992 01 00 | Fax: +41 71 992 01 99 | Email: info@ist-ag.com | www.ist-ag.com

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Application Note
RTD Platinum Sensor

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Application Note
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Content

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Application Note
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1. General Information

In many sectors, temperature is one of the most important physically defined parameters to determine product quality, security and reliability. Temperature sensors are produced with different technologies to fit specific application requirements. IST AG has concentrated on the development and manufacturing of high-quality thin-film temperature sensors. This know-how, partially derived from the semiconductor industry, allows IST AG to manufacture sensors in very small dimensions. Thin-film temperature sensors exhibit a very short response time due to their low thermal mass. The technologies and processes of IST AG thin-film sensors combine the positive attributes of traditional sensors - accuracy, long-term stability, repeatability and interchangeability within a wide temperature range. The advantages of thin-film mass-production create an optimal price/performance-ratio.

2. Construction

The temperature sensor consists of a high-purity platinum meander, structured on a ceramic substrate by the use of photolithography. The resistivity is laser-trimmed and precisely adjusted to the final value. The resistive structure is covered with a glass passivation layer protecting the sensor against mechanical and chemical damages. The welded lead wires are covered with an additional fixation layer.

3. Nominal Value and Temperature Coefficent

The nominal value of the sensor is the defined value of the sensor resistance at 0 °C. The temperature coefficient α (TCR) is defined as:

$$\alpha = \frac{R_{100} - R_0}{100 \times R_0}$$ [K^{-1}] according to the IEC60751, 2008-07 numerical value of 0.00385 K^{-1}.

Generally, the value is defined in ppm/K.

This example defines 3850 ppm/K[1)].

R_0 = resistance value in Ω at 0 °C
R_{100} = resistance value in Ω at +100 °C

1) Other TCRs available upon request

4. Long-term Stability

For all sensor types up to 7W (+750 °C), the change in ohmic value after 1000 hrs is less than 0.04 % at maximum operating temperatures.

5. Temperature Characteristic Curve

The curve determines the relationship between the electrical resistance and the temperature.

$R(T) = R_0 (1 + A \times T + B \times T^2)$	0 °C to +850 °C
$R(T) = R_0 (1 + A \times T + B \times T^2 + C \times [T-100] \times T^3)$	-200 °C to 0 °C

Platinum (3850 ppm/K)	Platinum (3911 ppm/K)	Platinum (3750 ppm/K)	Platinum (3770 ppm/K)
$A = 3.9083 \times 10^{-3}$ [°C^{-1}]	$A = 3.9692 \times 10^{-3}$ [°C^{-1}]	$A = 3.8102 \times 10^{-3}$ [°C^{-1}]	$A = 3.8285 \times 10^{-3}$ [°C^{-1}]
$B = -5.775 \times 10^{-7}$ [°C^{-2}]	$B = -5.829 \times 10^{-7}$ [°C^{-2}]	$B = -6.01888 \times 10^{-7}$ [°C^{-2}]	$B = -5.85 \times 10^{-7}$ [°C^{-2}]
$C = -4.183 \times 10^{-12}$ [°C^{-4}]	$C = -4.3303 \times 10^{-12}$ [°C^{-4}]	$C = -6 \times 10^{-12}$ [°C^{-4}]	

R_0 = resistance value in Ω at 0 °C
T = temperature in accordance with ITS 90

6. Tolerance Classes IEC60751 Norm

Temperature sensors are classified according to IEC60751, 2008-07.

Class	± deviations in °C	Temperature range of validity in °C*	IST AG reference
IEC60751 F 0.1	0.10 + 0.0017 x |T|	0 to +150	Y
IEC60751 F 0.15	0.15 + 0.002 x |T|	-30 to +300	A
IEC60751 F 0.3	0.30 + 0.005 x |T|	-50 to +500	B
IEC60751 F 0.6	0.60 + 0.01 x |T|	-50 to +600	C
1/5 IEC60751 F 0.3	0.06 + 0.001 x |T|	upon request	K
1/10 IEC60751 F 0.3	0.03 + 0.0005 x |T|	upon request	K

* Customer-specific temperature range available on request

|T| is the numerical value of the temperature in °C without taking leading signs into account.

The temperature curves refer to IEC60751 standards. The values in the table are for informative purposes only. Based on the assembly method and the different measurement conditions, accuracy, self-heating and response time may vary.

The measurement point is 5 mm from the wire end. For long wires (> 20 mm) the resistance is compensated (measured at room temperature) to ensure the correct resistance at the chip edge.

The resistance compensation of long wires (direct soldered or extended wires) has always to be taken into consideration for the end application. Exceptions are 3 or 4 wire solutions.

For 1/3 IEC60751, 1/5 IEC60751, 1/10 IEC60751 and 3- or 4-wire sensors please contact us.

7. Applied Current

The influence of the applied current is highly dependent on how the sensor is used in the application and can lead to significant self-heating effects. In general, the applied current should be as low as possible in order to reduce self-heating effects. The following values are typically used as measurement current:

100 Ω	500 Ω	1000 Ω	2000 Ω	10000 Ω
1 mA	0.5 mA	0.3 mA	0.2 mA	0.1 mA

Higher measurement currents can be applied as long as self-heating does not change the measurement value more than the needed measurement accuracy. The maximum current for sensors between 750°C and 1000°C should not exceed 1mA.

8. Self-heating

The electric current generates self-heating resulting in errors of measurement. To minimize the error, the testing current should be kept as low as possible. The measurement error caused by self-heating is dependent on temperature error $\Delta T = R \times I^2 / E$.

E = self-heating coefficient in mW/K, R = resistance in kΩ, I = measuring current in mA

9. Response Time

The response time is defined as the time in seconds the sensor needs to detect the change in temperature. $t_{0.63}$ describes the time in seconds the sensor needs to measure 63 % of the temperature change. The response time depends on the sensor dimensions, the thermal contact resistance and the surrounding medium.

Dimensions number	Response time in seconds						Self-heating			
	Water (v = 0.4 m/s)			Air (v = 1 m/s)			Water (v = 0 m/s)		Air (v = 0 m/s)	
	$t_{0.5}$	$t_{0.63}$	$t_{0.9}$	$t_{0.5}$	$t_{0.63}$	$t_{0.9}$	E in mW/K	ΔT in [mK][1)]	E in mW/K	ΔT in [mK][1)]
161	0.05	0.08	0.18	1	1.2	2.5	12	8.3	1.8	56
308	0.08	0.1	0.25	1.2	1.5	3.5	15	6.7	2.2	46
232 (thin substrate)	0.09	0.12	0.33	2.7	3.6	7.5	40	2.5	4	25
202	0.11	0.16	0.38	3.6	4.9	10.2	32	3.1	3.2	31
216	0.12	0.18	0.42	4	5.4	11	36	2.8	3.6	28
232	0.15	0.2	0.55	4.5	6	12	40	2.5	4	25
325	0.25	0.3	0.7	5.5	7.5	16	90	1.1	8	13
516	0.25	0.3	0.7	5.5	7.5	16	80	1.3	7	14
520	0.25	0.3	0.75	6	8.5	18	80	1.3	7	14
525	0.33	0.4	0.85	6.5	9	19	90	1.1	8	13
538	0.35	0.4	0.90	7.5	10	20	140	0.7	10	10
505	0.4	0.5	1.1	8	11	21	150	0.7	11	9
102	0.33	0.4	0.85	7.5	10.5	20	140	0.7	10	10
281	2.5	4.5	8	10	15	28	60	1.7	5.5	18
281*	2	2.5	5.5	10	12	22	45	2.2	4	25
451	8	10	22	12	22	40	85	1.2	8	13
451*	5	6	14	16	18	37	60	1.7	6.5	15
SMD 1206	0.15	0.25	0.45	3.5	4.2	10	55	1.8	7	14
SMD 0805	0.1	0.12	0.33	2.5	3	8	38	2.6	4	25
FC 0603	0.08	0.1	0.25	1.8	2.2	5.5	25	4	2.5	40

1) Self-heating ΔT[mK] measured with Pt100 at 1 mA applied current at 0 °C

* Two sensing elements in the same round ceramic housing

L: Sensor length (without connections)
W: Sensor width
H: Sensor height (without connections)
H2: Sensor height (incl. connections and strain relief)

10. Dimensions Tolerances

Sensor width (W) ±0.2 mm
Sensor length (L) ±0.2 mm
Sensor height (H2) ±0.3 mm
Sensor height (H) ±0.1 mm

Wire length ±1 mm (up to 30 mm)
Wire length > 30 mm, tolerances according ISO 2768-1, tolerance class V (very coarse): see table below

Wire length in mm	31-120	121-400	401-1000	1001-2000	2001-4000
ISO 2768-1, tolerance class V (very coarse):	±1.5 mm	±2.5 mm	±4 mm	±6 mm	±8 mm

11. Operating Conditions

Platinum temperature sensors are built on the basis of very robust materials: a high temperature glass protects the meander, the substrate is mainly based on densely sintered high-purity alumina and the wire fixations enable a reliable strain relief of the welding points.

Unfortunately it is not possible to test the sensor behavior in all application and installation conditions. Therefore the customer needs to test the compatibility of the sensor element with the application and/or the installation conditions. With certain ceramic casting compounds for instance there can occur chemical reactions between the passivation glass and the fixation glass. Potential problems can also arise due to strong creeping polymers (e.g. uncured silicones) or because of the reaction between plastic-based casting compounds with the plastic-based wire fixations, used for directly welded wires. The use of bare sensors in long-term humid environment as well as in aggressive atmospheres has to be avoided; the same applies to the direct dipping of the sensor into liquids. Furthermore mechanical pressure on the sensors, e.g. caused by hard or strong post-curing casting compounds should be avoided. Some epoxy-based casting compounds might become conductive above Tg and therefore cause a bypass via the sensor wires, which can lead to a lower resistance reading.

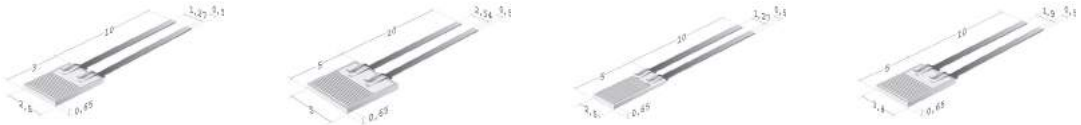
For sensors at higher temperatures (> +600 °C) oxygen access should be guaranteed in order to counter post-oxidation-effects in stainless steel housings. Alternatively the construction should be chosen in a way that no significant decrease of the oxygen partial pressure might occur in the installation. In principle, stainless steel parts should be carefully cleaned and pre-oxidized.

IST AG also offers special (customer-specific) sensors for various applications. Please don't hesitate to contact us and ask for your suitable sensor solution.

12. Sensor Construction Examples

Wire

SIL



FlipChip and SMD

Minisens and Slimsens

Long wire, insulated wire and insulated stranded wire

Inverted wire and perpendicular wire

Round ceramic housing

13. Additional Documents

	Document name:	
	English:	German:
Data Sheets:	DTP150_E	DTP150_D
	DTP200_E	DTP200_D
	DTP300_E	DTP300_D
	DTP400_E	DTP400_D
	DTP600_E	DTP600_D
	DTP750_E	DTP750_D
	DTP850_E	DTP850_D
	DTP1000_E	DTP1000_D
	DTPPW_E	DTPPW_D
	DTPPW_4-Wire_E	DTPPW_4-Leiter_E
	DTPPG_E	DTPPG_D
	DTPSMD_E	DTPSMD_D
	DTPFC_E	DTPFC_D
	DTPBondSens_E	DTPBondSens_D
	DTPRPT_E	DTPRPT_D
	DTP_Round_Housing_E	DTP_Rundes_Gehaeuse_D

Innovative Sensor Technology IST AG, Stegrütistrasse 14, 9642 Ebnat-Kappel, Switzerland
Phone: +41 71 992 01 00 | Fax: +41 71 992 01 99 | Email: info@ist-ag.com | www.ist-ag.com