



TSic™ 206/203/201/306/303/301

Low power, easy to integrate Temperature Sensor IC

Product

The TSic™ series of temperature sensor ICs were specifically designed as a low power solution for temperature sensing in building automation, measurement devices, industrial, medical/pharma technology and mobile applications.

The TSic™ employs high precision bandgap reference with proportional-to-absolute-temperature (PTAT); low-power, precision ADC; and on-chip DSP core with electrically erasable (EE) memory to precisely calibrate the output temperature signal.

The temperature sensor family TSic™ from IST are fully tested and calibrated sensors to allow absolute measurement accuracy at delivery and eliminates further calibration efforts. The temperature measurement with the TSic™ is very simple, it can achieve outstanding accuracy combined with a long term stability.

With an accuracy of **up to $\pm 0.3^{\circ}\text{C}$** in a range of 80°C the sensor is more accurate than a common DIN B platinum sensor. Even long wires ($> 10\text{m}$) do not influence the accuracy!

The TSic™ is available with digital (ZacWire, TSic™ x06), analogue (0-1V, TSic™ x01), or ratiometric ($10\% - 90\% V^+$, TSic™ x03) output signal.

The low power consumption of the TSic™ makes it ideal for mobile applications.

Features

- **Accuracy:** up to $\pm 0.3^{\circ}\text{C}$ ¹⁾ (TSic 30x) in the range of 10°C to 90°C (other ranges on request)
- **Resolution:** 0.1°C

- **Measurement range:** -50°C to 150°C
- Signal-Output every 0.1s (digital)
- **Supply Voltage:** $V^+ = 3.0\text{V}$ to 5.5V , high precision operation in range $V^+ = 4.5\text{V}$ to 5.5V
- **Package:** 8-pin SOP-8, 3-pin TO92 (further packages and assemblies on request)
- **Supply Current** of typ. $30\mu\text{A}$ @ 25°C and $V^+ = 3.3\text{V}$ Supply Current for minimal self heating.

¹⁾ Accuracy on delivery; the kind of assembly can influence the accuracy!

Customer specific calibrations

The accuracy range of 80°C (default: $10^{\circ}\text{C} - 90^{\circ}\text{C}$) can be shifted up or down, e.g. to a range of -30°C to $+50^{\circ}\text{C}$ for refrigerated transports (TSic 30x).

Key benefits

- **No calibration necessary!**
- **Low power consumption** – appropriate for mobile applications
- **More accurate than a DIN B platinum sensor** (10°C to 110°C , TSic 30x)
- **Easy to integrate** – low development costs
- **Digital and analogue output signal in the same package available**
- **Robust and elementary signal transmission requires only one signal line**
- **Optimum solution for temperature control, thanks to fast data measurement**
- **Packages for standard SMD, THT or application specific assembly**
- **Outstanding long term stability!**



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Packages

SOP-8 Package (150mil, Standard SMT Technology, SOIC-8) based on IEC 191-2Q: Type 076E35 B

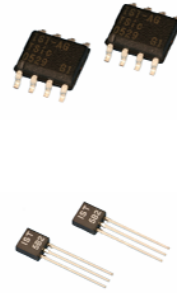
The SOP-8 package is qualified for automatic assembly on PCB.

Principally all TSic™ types are available in this package. However it is to notice that the reflow soldering process influences the calibrated accuracy and can generate a spreading loss of accuracy through thermal and mechanical stress in the package.

In order to achieve the high accuracy with this package we also provide calibration after assembly. Please contact us for further discussions.

TO92 (small THT package)

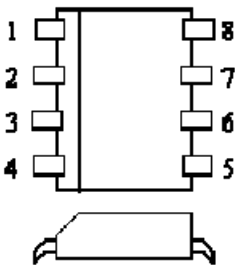
The TO92 package is intended for temperature probes e.g. in stainless steel tubes and other assemblies. This package has a better thermal decoupling through the pins than the SOP-8 package.



For exact dimensions of the packages refer the package datasheet.

Pin assignment

SOP-8:



- 1 V+, Supply voltage (3.0-5.5V)
- 2 Signal
- 4 GND, Ground
- 3 3, 5-8 not used

TO92:



- 1 GND, Ground
- 2 Signal
- 3 V+, Supply voltage (3.0-5.5V)

Note: The e-line package (discontinued) has swapped pins 1 and 3!



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Accuracy

In Figure 1 is illustrated the tolerances of the TSic™ and DIN B and DIN A platinum sensors.

In the standard calibration the TSic™ 30x is in the range between 10°C and 110°C more accurate than the DIN B platinum sensor.

An outstanding long term stability makes sure that the accuracy will remain in the described tolerances.

The accurate range of the TSic™ can be shifted. Please contact us for custom calibrations.

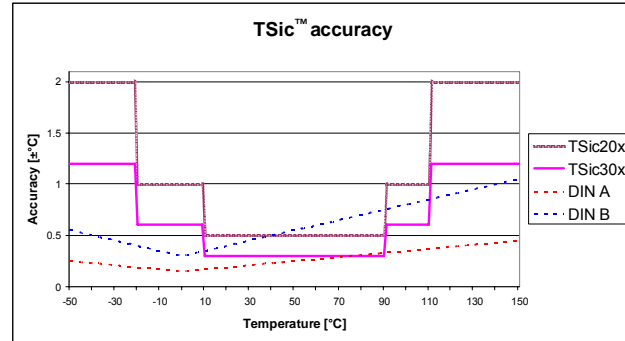


Figure 1: Comparison of TSic™ <-> platinum sensor accuracy

Signal output

Formulas for the output signal:

Digital Output:

$$T = (\text{Digital_signal}/2047 \cdot (HT-LT) + LT) [^{\circ}\text{C}]$$

Programming -Example: refer TSic ZACwire Documentation.

Analogue output signal (0-1V):

$$T = (\text{Sig[Volt]} \cdot (HT-LT) + LT) [^{\circ}\text{C}]$$

Ratiometric output signal (10%-90%):

$$T = ((\text{Sig[V]}/VDD[V] - 0.1) / 0.8 \cdot (HT-LT) + LT) [^{\circ}\text{C}]$$

Output examples:

Measurement range: -50°C to 150°C (-58°F to 302°F)				
Temp (°C)	Temp (°F)	digital value (TSic x06)	analogue 0-1V [V] (TSic x01)	analogue ratiometric 10%-90% (V* = 5.0V) (TSic x03)
-50 ¹	-58	0x000	0.000	10% V+ (0.5V)
-10	14	0x199	0.200	26% V+ (1.3V)
0	32	0x200	0.250	30% V+ (1.5V)
25	77	0x2FF	0.375	40% V+ (2.0V)
60	140	0x465	0.550	54% V+ (2.7V)
125	257	0x6FE	0.875	80% V+ (4.0V)
150 ²	302	0x7FF	1.000	90% V+ (4.5V)

¹ LT = -50, ² HT = 150 as standard value for the temperature-calculation.



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Absolute Maximum Ratings

PARAMETER	MIN	MAX	Units
Supply Voltage (V^+)	-0.3	6.0	V
Voltages at analog I/O – Pins (V_{INA} , V_{OUTA})	-0.3	$V_{DDA}+0.3$	V
Storage Temperature Range (T_{stor})	-50	150	°C

Operating Conditions

PARAMETER	MIN	TYP	MAX	Units
Supply ¹ Voltage to Gnd (V^+)	3.0	5.0	5.5	V
Supply Current (I_{V+}) @ $V^+ = 3.3V$, RT	25	30	60	μA
Operating Temperature ² Range (T_{amb})	-50		150	°C
Output Load Capacitance (C_L)			15	nF
External Capacitance between V^+ and Gnd ³ (C_{V+})	80	100	470	nF
Output Load Resistance between signal and Gnd (or V^+)	47			KΩ

¹Best accuracy with supply voltage 4.5V – 5.5V. With supply voltage 3.0V – 4.5V accuracy reduced. Other supply voltages on request.

²Output signal is limited to this ambient temperature

³Recommended as close to TSic V^+ and Gnd-Pins as possible.

Temperature Accuracies⁴

TSic 30x	MIN	TYP	MAX	Units
T1: +10°C to 90°C	-0.3	±0.3	0.3	°C
T2: -20°C to +110°C	-0.6	±0.3	0.6	°C
T3: -50°C to +150°C	-1.2	±0.5	1.2	°C
TSic 20x	MIN	TYP	MAX	Units
T1: +10°C to 90°C	-0.5	±0.3	0.5	°C
T2: -20°C to 110°C	-1.0	±0.4	1.0	°C
T3: -50°C to 150°C	-2.0	±0.9	2.0	°C
Measurement range: -50°C to +150°C (±3°C)				

Accuracy on delivery; the kind of mounting can influence the accuracy!

⁴ Accuracy = specification plus quantization error of 1 bit (0.1°C). This device gets calibrated at 5V. For applications where best accuracy at 3V is requested: ask for a customer specific 3V calibrated device. Accuracy for supply voltage within $V^+ = 4.5V$ to 5.5V, 2K (95%) value.

Other TSic products with customer specific calibration available on request: i.e. other temperature range for high accuracy etc.



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All mechanical dimensions are valid at 25°C ambient temperature, if not differently indicated. ■ All data except the mechanical dimensions only have information purposes and are not to be understood as assured characteristics. ■ Technical changes without previous announcement as well as mistakes reserve. ■ The information on this data sheet was examined carefully and will be accepted as correct. No liability in case of mistakes. ■ Load with extreme values during a longer period can affect the reliability. All rights reserved. The material contained herein may not be reproduced, adapted, merged, translated, stored, or used without the prior written consent of the copyright owner. Typing errors and mistakes reserved. Product specifications are subject to change without notice. All rights reserved.

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