



TSic™ 506F/503F/501F

High precision, longterm stable temperature sensor IC



Product

The TSic™ series of temperature sensor ICs are specifically designed as a low-power solution for temperature measurement in building automation, medical/pharma technologies, industrial and mobile applications. The TSic™ provides a simple temperature measurement and achieves outstanding accuracy combined with long term stability.

The TSic™ has a high precision bandgap reference with a PTAT (proportional-to-absolute-temperature) output, a low-power and high-precision ADC and an on-chip DSP core with an EEPROM for the precisely calibrated output signal. The TSic™ temperature sensor is fully calibrated, meaning no further calibration effort is required by the customer. With an accuracy of ±0.1K in a range of 40K (e.g. 5°C to 45°C), the sensor is more accurate than a class F0.1 (DIN EN 60751) platinum sensor. Extended long wires (> 10m) will not influence the accuracy.

The TSic™ is available with digital (ZacWire, TSic™ 506F), analog (0-1V, TSic™ 501F) or ratiometric (10% - 90% V⁺, TSic™ 503F) output signal. The low power consumption of about 35µA makes it suitable for many applications.

Features

- **Accuracy:** ±0.1K in the range of 5°C to 45°C (other ranges available)
- **Resolution:** 0.034K
- **Measurement Range:** -10°C to 60°C
- **Sampling Rate:** 10Hz
- **Supply Voltage:** V⁺ = 3.0V to 5.5V, high precision operation in range V⁺ = 4.5V to 5.5V
- **Package:** SOP-8, TO92 (other packages on request)
- **Supply Current:** typ. 30µA at 25°C and V⁺ = 3.3V for minimal self-heating.

Custom Specific Calibrations

The accuracy range of 40K (default: 5°C – 45°C) can be shifted, e.g. the accuracy in the temperature range of -5 °C to +35 °C can be ensured.

Key Benefits

- **No calibration necessary**
- **Outstanding accuracy of ±0.1K**
- **Very low power consumption**
- **Excellent long term stability**
- **Custom calibration and assembly possible**



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TEMPERATURE



FLOW



HUMIDITY



CONDUCTIVITY

TSic™ 506F/503F/501F

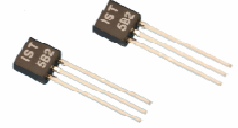
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Packages

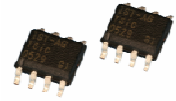
TO92

The TO92 package is suitable for assemblies, e.g. in stainless steel tubes or various sensing probes. The TO92 package is recommended for high precision applications, due to lower thermal and mechanical stress during a reflow assembly process.



SOP-8

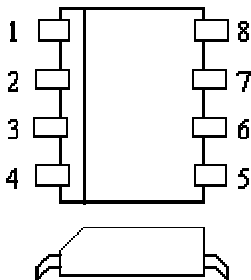
The SOP-8 package is highly suitable for automatic assembly on a PCB. Generally all TSics™ are available in a SOP-8 package. However for high-precision devices, such as the TSic50xF, the ensured accuracy cannot be guaranteed after the reflow soldering process (the process brings thermal stress to the chip). To ensure a high accuracy with SOP-8 package, IST provides calibration of the TSic™ after a PCB assembly. Please contact us for further information.



⇒ see package datasheet for exact dimensions

Pin assignment

SOP-8:



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

TO92:



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



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Accuracy

The tolerances of the TSic™ and DIN class F0.15 and F0.1 platinum sensors are compared in Figure 1.

With a standard calibration, the TSic™ is more accurate than a DIN F0.1 platinum sensor in the range of 5°C to 45°C.

The outstanding long-term stability ensures that the accuracy of the TSic™ remains within tolerance.

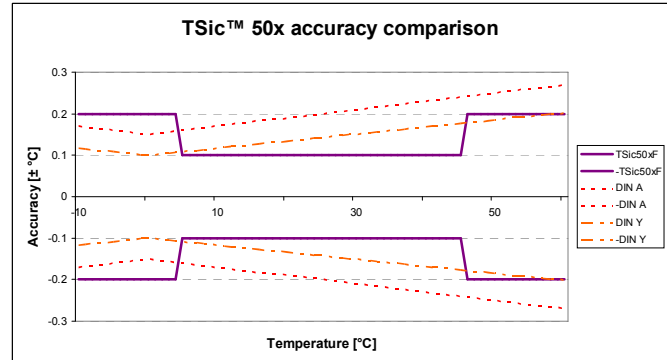


Figure 1: Comparison of TSic™ <--> platinum sensor accuracy

Signal output

Formulas for the output signal [°C]:

Analog output (0-1V):

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

Ratiometric output (10%-90%):

$$T = \left[\frac{\frac{\text{Sig}[V]}{V^+ [V]} - 0.1}{0.8} * (HT - LT) + LT \right] \text{ [}^\circ\text{C]}$$

Digital output:

$$T = \frac{\text{DigitalSignal}}{2047} * (HT - LT) + LT \text{ [}^\circ\text{C]}$$

For a programming example see TSic™ ZACwire Documentation

Output examples:

Temperature Range: -10°C to 60°C			
Temp (°C)	Digital Values	Analog 0-1V	Analog Ratiometric 10%~90% (V+ = 5.0V)
<-10 - -10 ¹	0x000	0.000	10.0% of V ⁺ (e.g. 0.5V)
0	0x124	0.143	21.4% of V ⁺ (e.g. 1.07V)
25	0x3FF	0.500	50.0% of V ⁺ (e.g. 2.5V)
+60 ² - >+60	0x7FF	1.000	90.0% of V ⁺ (e.g. 4.5V)

¹ LT = -10, ² HT = 60 as standard value for the temperature-calculation.

LT: Lower temperature limit [°C]
 HT: Higher temperature limit [°C]
 V+: Supply voltage [V]
 Sig[V]: Analog/ratiometric output signal [V]



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Absolute Maximum Ratings

PARAMETER	MIN	MAX	UNITS
Supply Voltage (V ⁺)	-0.3	6.0	V
Voltages to analog I/O – Pins (V _{INA} , V _{OUTA})	-0.3	V _{DDA} +0.3	V
Storage Temperature Range (T _{stor})	-20	80	°C

Operating Conditions

PARAMETER	MIN	TYP	MAX	UNITS
Supply Voltage to GND (V ⁺)	2.97	5.0	5.5	V
Supply Current (I _{v+}) @ V ⁺ = 3.3V, RT	25	30	60	μA
Operating Temperature Range (T _{amb})	-10		60	°C
Output Load Capacitance (C _L)			15	nF
External Capacitance between V ⁺ and GND ¹ (C _{V+})	80	100	470	nF
Output Load Resistance between signal and GND (or V ⁺)	47			kΩ

¹Recommended as close to TSic V⁺ and GND-Pins as possible.

Temperature Accuracies²

PARAMETER	Tol.	UNITS
T1: 5°C to 45°C	±0.1	K
T2: -10°C to 5°C	+0.2	K

Tolerance out of the measurement range:

Below -10°C / above +60°C: ±3K

² The sensor is calibrated at 5V. The provided accuracy is applicable for a supply voltage between 4.5V and 5.5V. The accuracy is smaller with a supply voltage between 2.97V and 4.5V. For applications where the best accuracy at 3V is requested, ask for a custom specific 3V calibrated device.

Other TSic™ products with custom specific calibrations are available on request e.g. other temperature range for high accuracy.

Accuracy at delivery; the assembly method can influence the accuracy!

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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