



# TSic™-101

## Fast Response and Low-cost Temperature Sensor IC Analog 0-1 Volt

### Product

Accuracy  $\pm 0.5^\circ\text{C}$  at room temperature

Measurement range  $-50^\circ\text{C}.. +150^\circ\text{C}$

Analog 0-1 Volt signal output

Resolution  $0.1^\circ\text{C}$

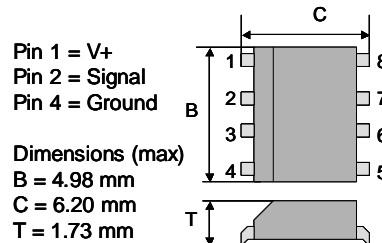
The temperature sensor family TSic™ from IST are fully tested and calibrated sensors to allow absolute measurement accuracy at delivery and eliminates further calibration efforts. The temperature measurement with the TSic™ is very simple, can achieve outstanding accuracy combined with a long term stability.

### Advantages

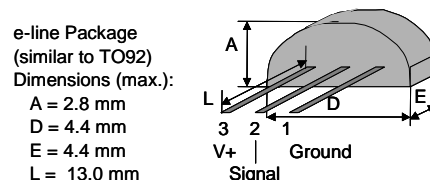
- Different accuracy classes with 100% upward compatibility
- No calibration by customer necessary any more, absolute calibration specified
- Simple to integrate, reducing cost and time for application-development
- Robust and elementary signal transmission requires only one signal line
- Optimum solution for temperature control, thanks to fast data measurement
- Packages for standard SMD, THT or application specific assembly
- Miniaturised solutions with Bare-chip (COB, COF, CSP) or e-line package
- Very fast response time with Bare-chip (COF – Chip on Flex)
- Very small power consumption – ideal for mobile and standard applications
- Field (re-)configuration or (re-)calibration available (option for high volume customers only)
- Outstanding long term stability

### Packages

- SOP8 Package (150mil, Standard SMT Technology, SOIC-8) based on IEC 191-2Q: Type 076E35 B



- e-line (small THT package, TO-92 like)



### Specification

See next pages "TSic™101 Temperature Sensor Device, Specification"



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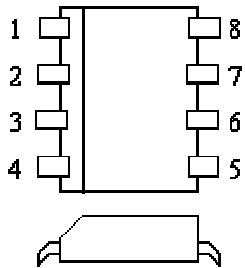
# Temperature Sensor IC Specification

## Features

- **Analog 0-1 Volt signal output**
- **Accuracy:  $\pm 0.5^{\circ}\text{C}$  at room temperature  $\pm 1.0^{\circ}\text{C}$  over span of  $40^{\circ}\text{C}$**
- **Resolution:  $0.1^{\circ}\text{C}$**
- **Wide range measurement:  $-50^{\circ}$  to  $+150^{\circ}\text{C}$**
- Signal update every 0.1 second (other update frequencies on request)
- Supply Voltage  $V+ = 3.0\text{V}$  to  $5.5\text{V}$ , high accuracy operation in range  $V+ = 4.5\text{V}$  to  $5.5\text{V}$
- Precision temperature sensor at low cost
- Package: 8-pin SOIC or 3-pin e-line
- Low quiescent current of less than  $80\mu\text{A}$  at  $25^{\circ}\text{C}$  and  $3.3\text{V}$  to minimize self-heating and power consumption
- System-on-a-chip based on advanced mixed signal technology incorporating:
  - precision temperature sensing bandgap reference with PTAT output
  - digital signal processor (DSP) core
  - electrically erasable (EE) memory
  - digital serial interface using single wire for signal output

## Package Information

- TSic™ 101 SOP8: 150mil, Standard SMT Package, SOIC, Based on IEC 191-2Q: Type 076E35 B



Pin No.	Name	Description
1	V+	supply voltage (3.0-5.5V)
2	Signal	Temperature output signal
4	Gnd	Ground
3, 5-8	TP/NC	Test Pin / NC Do not connect

- Other packages on customer's demand: TSic™ 101 e-line: 3 Pin THT package

## Description TSic™ Series

The TSic™ series of temperature sensor ICs were specifically designed as a high-performance, cost-effective solution for temperature sensing in building automation, automotive, industrial, office automation, white goods and low power / mobile applications.

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

TSic™ series of temperature sensor ICs offers devices with two linear analog signal output options such as standard  $0\sim 1V_{\text{out}}$  signal ( $V+ = 3.0\text{V}$  to  $5.5\text{V}$ ) or ratiometric ( $10\sim 90\% V+$  i.e.  $0.5\sim 4.5V_{\text{out}}$  @  $V+=5\text{V}$ ) or the digital serial output signal to interface with  $\mu\text{P}$  controllers.

## Output Example of TSic™ devices

		Temperature Measurement Range $-50^{\circ}\text{C}$ to $150^{\circ}\text{C}$ or $-58^{\circ}\text{F}$ to $302^{\circ}\text{F}$ (wide range device)		
		TSic-101	TSic-103	TSic-106
Temp ( $^{\circ}\text{C}$ )	Temp ( $^{\circ}\text{F}$ )	Analog 0~1V	Analog ratiometric 10~90%	Digital
$-50^1$	-58	0.000	10% of V+	<b>0x000</b>
-10	14	0.200	26% of V+	<b>0x199</b>
0	32	0.250	30% of V+	<b>0x200</b>
25	77	0.375	40% of V+	<b>0x2FF</b>
60	140	0.550	54% of V+	<b>0x465</b>
125	257	0.875	80% of V+	<b>0x6FE</b>
$150^2$	302	1.000	90% of V+	<b>0x7FF</b>

<sup>1</sup> LT =  $-50$ , <sup>2</sup> HT =  $150$  as default values for the temperature calculation set points.

### Formula for Temperature Signal [ $^{\circ}\text{C}$ ]:

- Analog output 0-1V:  
 $T = (\text{Sig[Volt]} * (\text{HT} - \text{LT}) + \text{LT}) [^{\circ}\text{C}]$
- Ratiometric 10%-90% output:  
 $T = ((\text{Sig[V]}/\text{VDD[V]}) - 0.1) / 0.8 * (\text{HT} - \text{LT}) + \text{LT}$
- Digital output:  
 $T = (\text{Digital\_signal} / 2047 * (\text{HT} - \text{LT}) + \text{LT}) [^{\circ}\text{C}]$



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# Temperature Sensor Device Specification

## Absolute Maximum Ratings

PARAMETER	MIN	MAX	UNITS
Supply Voltage (V <sub>+</sub> )	-0.3	6.0	V
Voltage at analog I/O – Pin (V <sub>INA</sub> , V <sub>OUTA</sub> )	-0.3	V <sub>DDA</sub> +0.3	V
Storage Temperature Range (T <sub>stor</sub> )	-50	150	°C

## Operating Conditions

PARAMETER	MIN	TYP	MAX	UNITS
Supply <sup>1</sup> Voltage to Gnd (V <sub>+</sub> )	3.0	5.0	5.5	V
Supply Current (I <sub>V+</sub> ) <sup>2</sup> @ V <sub>+</sub> = 3.3V, RT			200	μA
Ambient Temperature <sup>3</sup> Range (T <sub>amb</sub> )	-50		150	°C
External Capacitance between V <sub>+</sub> and Gnd <sup>4</sup> (C <sub>V+</sub> )	80	100	470	nF
Output Load Resistance between signal and Gnd (or V <sub>+</sub> )	47	100		kΩ

<sup>1</sup>Best accuracy with supply voltage 4.5V – 5.5V. With supply voltage 3.5V – 4.5V accuracy reduced.

<sup>2</sup> Without load; typ. with load: I<sub>V+</sub> = 95+375/R<sub>load</sub> [μA]

<sup>3</sup>Output signal is limited to this ambient temperature ±3°C (with regard to calibration, offset and gain)

<sup>4</sup>Recommended as close to TSic V<sub>+</sub> and Gnd-Pins as possible.

## Temperature Accuracies<sup>5</sup>

PARAMETER	MIN	TYP	MAX	UNITS
<i>Wide Range Device for -50° to 150°C</i>				
At room temperature	-0.5	±0.3	0.5	°C
+0°C to +40°C <sup>4</sup>	-1.0		+1.0	°C
-50 to 0, +40 to 150°C		+1.5		°C

<sup>5</sup> 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<sub>+</sub> = 4.5V to 5.5V, 2σ value.

Other TSic products with customer specific calibration available on request: i.e. with special calibration where the 80°C span (bandgap) with the high precision temperature range of ±0.3 °C is shifted to another (lower or higher) temperature range.

Temperature range limits T1, T2: ±0.1°C; T3: ±3°C



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