

## TSYS02P

### Digital Temperature Sensor

#### SPECIFICATIONS

- **High Accuracy Temperature Sensor**
- **16 bit Resolution**
- **High Speed, low Response Time**
- **Low Power Consumption**
- **PWM Output**
- **Small TDFN8 Package**

The TSYS02P is a single chip, temperature sensor. It provides factory calibrated data corresponding to the measured temperature.

The data is provided via PWM output.

The temperature range is  $-40^{\circ}\text{C}$  ...  $+125^{\circ}\text{C}$  while the resolution is  $0.01^{\circ}\text{C}$ .

The TDFN8 package provides smallest size and very fast time response.

## FEATURES

- High Accuracy  $\pm 0.2^{\circ}\text{C}$  @ Temp.:  $-5^{\circ}\text{C} \dots +50^{\circ}\text{C}$
- Adjustment of high accuracy temperature range on request
- Low Supply Current  $< 420\mu\text{A}$  (standby  $< 0.14\mu\text{A}$ )
- PWM Output
- Small IC-Package TDFN8 2.5mm x 2.5mm
- Operating Temperature Range:  $-40^{\circ}\text{C} \dots +125^{\circ}\text{C}$

## APPLICATIONS

- Industrial Control
- Replacement of Precision RTDs, Thermistors and NTCs
- Heating / Cooling Systems
- HVAC

## ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are limiting values of permitted operation and should never be exceeded under the worst possible conditions either initially or consequently. If exceeded by even the smallest amount, instantaneous catastrophic failure can occur. And even if the device continues to operate satisfactorily, its life may be considerably shortened.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Supply Voltage	VDD		-0.3		+3.6	V
Operating Temperature	Top		-40		+125	$^{\circ}\text{C}$
Storage temperature	Tstor		-55		+150	$^{\circ}\text{C}$
ESD rating	ESD	Human Body Model (HBM) pin to pin incl. VDD & GND	-2		+2	kV
Humidity	Hum		Non condensing			

## OPERATING CONDITIONS

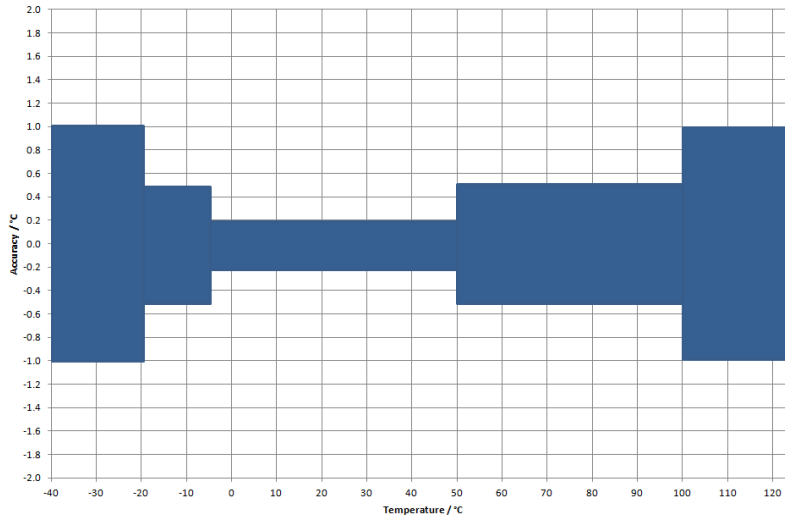
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating Supply Voltage	V <sub>DD</sub>	stabilized	1.5		3.6	V
Supply Current	I <sub>DD</sub>	2 sample per second		36		$\mu\text{A}$
Peak Supply Current	I <sub>DD</sub>	During conversion		420		$\mu\text{A}$
Conversion Time	T <sub>CONV</sub>			43		ms
Measurement Frequency	F <sub>MEAS</sub>			2		Hz
PWM Period	T <sub>PERIOD</sub>		7.5	8.3	9.1	ms
VDD Capacitor		Place close to the chip	100nF			

## OPERATIONAL CHARACTERISTICS

If not otherwise noted, 3.3V supply voltage is applied.

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Temp. Measurement Range	T <sub>RANG</sub>		-40		125	°C
Accuracy 1	T <sub>ACC1</sub>	-5°C < T < +50°C V <sub>DD</sub> = 3.2V – 3.4V	-0.2		+0.2	°C
Accuracy 2	T <sub>ACC2</sub>	-20°C < T < +100°C V <sub>DD</sub> = 3.2V – 3.4V	-0.5		+0.5	°C
Accuracy 3	T <sub>ACC2</sub>	-40°C < T < +125°C V <sub>DD</sub> = 3.2V – 3.4V	-1.0		+1.0	°C
PSRR Power Supply Reject Ratio		V <sub>DD</sub> = 2.7 – 3.6 T = 25°C, C = 100nF			0.1	°C
Temperature Resolution	T <sub>RES</sub>				0.01	°C
Self Heating	SH <sub>1</sub>	10 samples/s, 60s, still air			0.1	°C

## ACCURACY



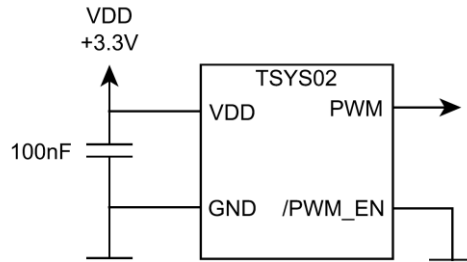
## ANALOGUE TO DIGITAL CONVERTER

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution				16		bit
Conversion Time	t <sub>c</sub>			43		ms

## DIGITAL OUTPUTS (PWM)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output High Voltage	VOH			V <sub>DD</sub>		V
Output Low Voltage	VOL			0		V
Output Sink Current	IOL				40	µA

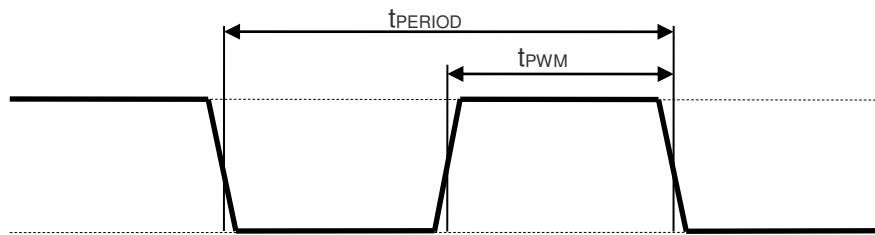
### CONNECTION DIAGRAM



### PIN FUNCTION TABLE

Pin	Name	Type	Function
1	VDD	Power	Supply Voltage
2	/PWM_EN	Digital Input	Enable PWM Output (0 = ON)
3	PWM	Digital Output	PWM Output
4	VSS	Power	Ground
5 – 8	NC	---	Not connected / Do not connect

### PWM OUTPUT



### START UP

After power-up (VDD between 1.8V and 3.6V) TSYS02P needs at most 150ms for reaching idle state. During that time PWM output is in undefined state. Afterwards, TSYS02P starts measuring and provides data on PWM output.

### TEMPERATURE CALCULATION

#### TEMPERATURE POLYNOMIAL

$$T / ^\circ\text{C} = t_{\text{PWM}} / t_{\text{PERIOD}} \times 175.72 - 46.85$$

#### EXAMPLE

$$t_{\text{PWM}}: \quad 4.15\text{ms}$$

$$t_{\text{PERIOD}}: \quad 8.30\text{ms}$$

$$T / ^\circ\text{C} = 4.15\text{ms} / 8.30\text{ms} \times 175.72 - 46.85$$

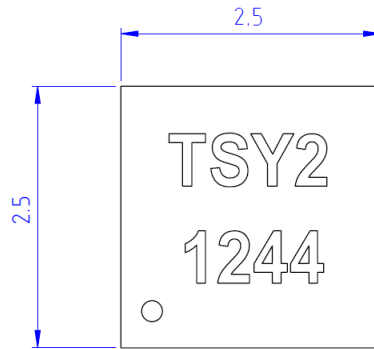
$$T / ^\circ\text{C} = \underline{41.01^\circ\text{C}}$$

# TSYS02P

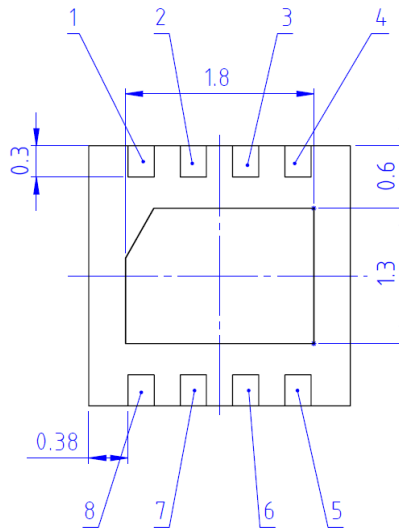
Digital Temperature Sensor

## DIMENSIONS

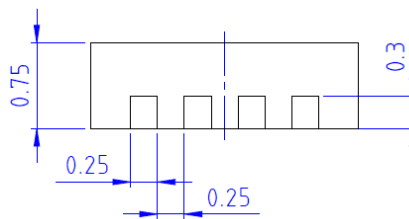
### TOP VIEW



### BOTTOM VIEW



### SIDE VIEW



## MARKING

Line	Description	Example
1	Product Name	TSY2
2	Pin 1 Dot, Date Code YYWW	1244

## ORDER INFORMATION

The TSYS02 temperature sensor family comprises currently three different solutions. Further customer specific adaptations are available on request. Please refer to the table below for part name, description and order information.

Part Name	Description	Order Number
TSYS02D	Digital Temperature Sensor, TDFN8, I2C Interface	G-NIMO-003
<b>TSYS02P</b>	<b>Digital Temperature Sensor, TDFN8, PWM Interface</b>	<b>G-NIMO-004</b>
TSYS02S	Digital Temperature Sensor, TDFN8, SDM Interface	G-NIMO-005

## EMC

Due to the use of these modules for OEM application no CE declaration is done. Especially line coupled disturbances like surge, burst, HF etc. cannot be removed by the module due to the small board area and low price feature. There is no protection circuit against reverse polarity or over voltage implemented. The module will be designed using capacitors for blocking and ground plane areas in order to prevent wireless coupled disturbances as good as possible.

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### NORTH AMERICA

Measurement Specialties, Inc.,  
a TE Connectivity Company  
910 Turnpike Road  
Shrewsbury, MA 01545  
Tel: 1-508-842-0516  
Fax: 1-508-842-0342  
Sales email:  
temperature.sales.amer@meas-spec.com

### EUROPE

Measurement Specialties (Europe), Ltd.,  
a TE Connectivity Company  
Deutschland GmbH  
Hauert 13  
44277 Dortmund  
Tel: +49 (0) 231/9740-0  
Fax: +49 (0) 231/9740-20  
Sales email:  
info.de@meas-spec.com

### ASIA

Measurement Specialties (China), Ltd.,  
a TE Connectivity Company  
No. 26 Langshan Road  
Shenzhen High-Tech Park (North)  
Nanshan District, Shenzhen 518057  
China  
Tel: +86 755 3330 5088  
Fax: +86 755 3330 5099  
Sales temperature.sales.asia@meas-spec.com

### TE.com/sensorsolutions

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