

## 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.:  $-5^{\circ}\text{C}$  ...  $+50^{\circ}\text{C}$
- 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:  $-40^{\circ}\text{C}$  ...  $+125^{\circ}\text{C}$

#### 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	$V_{DD}$	---	-0.3	---	+3.6	V
Operating Temperature	$T_{OP}$	---	-40	---	+125	°C
Storage temperature	$T_{stor}$	---	-55	---	+150	°C
ESD rating	ESD	Human Body Model (HBM) pin to pin incl. $V_{DD}$ & GND	-2	---	+2	kV
Humidity	Hum	---	Non condensing			---

### Operating Conditions

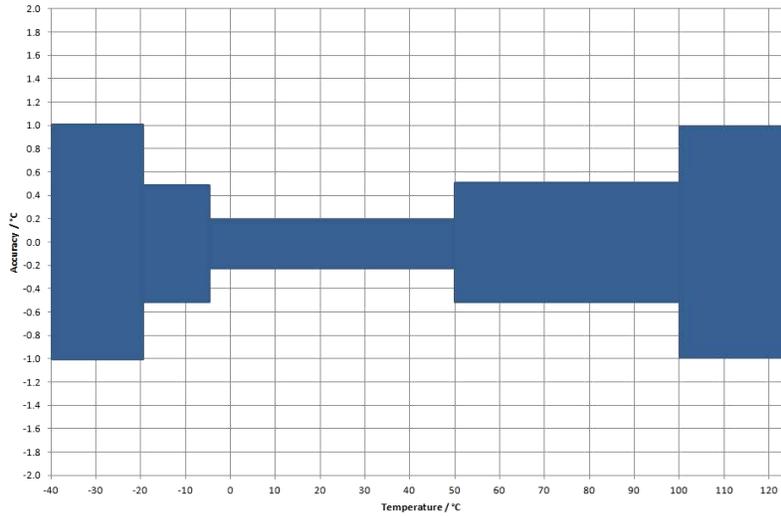
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating Supply Voltage	$V_{DD}$	stabilized	1.5	---	3.6	V
Supply Current	$I_{DD}$	2 sample per second	---	36	---	μA
Peak Supply Current	$I_{DD}$	During conversion	---	420	---	μA
Conversion Time	$T_{CONV}$	---	---	43	---	ms
Measurement Frequency	$F_{MEAS}$	---	---	2	---	Hz
PWM Period	$T_{PERIOD}$	---	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	Condition	Min	Typ	Max	Unit
Temp. Measurement Range	$T_{RANG}$	---	-40	---	+125	°C
Accuracy 1	$T_{ACC1}$	-5°C < T < +50°C $V_{DD} = 3.2V - 3.4V$	-0.2	---	+0.2	°C
Accuracy 2	$T_{ACC2}$	-20°C < T < +100°C $V_{DD} = 3.2V - 3.4V$	-0.5	---	+0.5	°C
Accuracy 3	$T_{ACC3}$	-40°C < T < +125°C $V_{DD} = 3.2V - 3.4V$	-1.0	---	+1.0	°C
PSRR Power Supply Reject Ratio	---	$V_{DD} = 2.7 - 3.6, T = 25°C, C = 100nF$	---	---	0.1	°C
Temperature Resolution	$T_{RES}$	---	---	---	0.01	°C
Self Heating	$SH_1$	10 samples/s, 60s, still air	---	---	0.1	°C

Accuracy



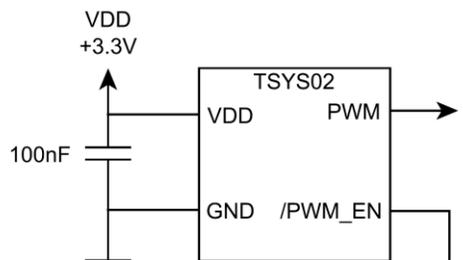
Analogue to Digital Converter

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Resolution	---	---		16		bit
Conversion Time	$t_c$	---	---	43	---	ms

Digital Outputs (PWM)

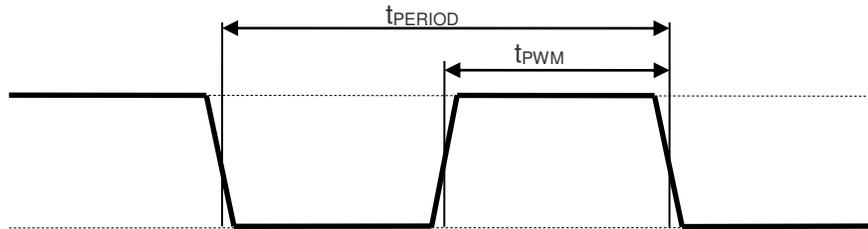
Parameter	Symbol	Condition	Min	Typ	Max	Unit
Output High Voltage	$V_{OH}$	---	---	VDD	---	V
Output Low Voltage	$V_{OL}$	---	---	0	---	V
Output Sink Current	$I_{OL}$	---	---	---	40	$\mu A$

Connection Diagram



**Pin Function Table**

Pin	Name	Type	Function
1	V <sub>DD</sub>	Power	Supply Voltage
2	/PWM_EN	Digital Input	Enable PWM Output (0 = ON)
3	PWM	Digital Output	PWM Output
4	V <sub>SS</sub>	Power	Ground
5 ... 8	NC	---	Not connected / Do not connect

**PWM Output****Start Up**

After power-up (V<sub>DD</sub> 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**

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

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

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

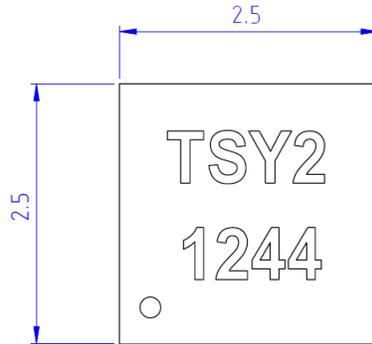
$$T / ^\circ\text{C} = \underline{41.01^\circ\text{C}}$$

# TSYS02P

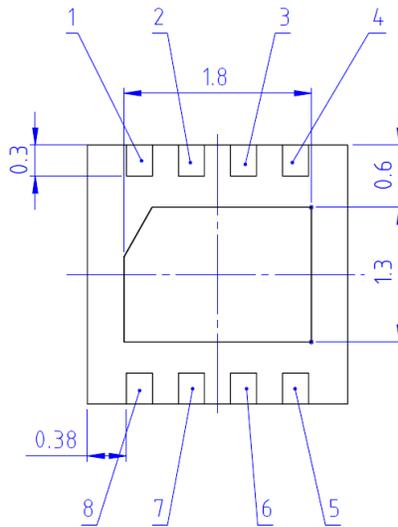
Digital Temperature Sensor

## DIMENSIONS

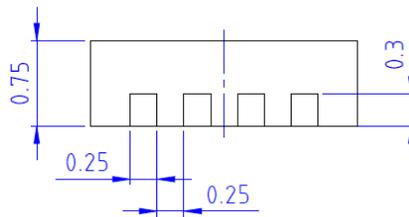
### TOP VIEW



### BOTTOM VIEW



### SIDE VIEW



## MARKING

Line	Description	Text
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 Number	Part 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.

### Definitions and Disclaimers

- Application information – Applications that are described herein for any of these products are for illustrative purpose only. MEAS Deutschland GmbH makes no representation or warranty that such applications will be suitable for the specified use without further testing or modification.
- Life support applications – These products are not designed for use in life support appliances, devices, or systems where malfunctions of these products can reasonably be expected to result in personal injury. MEAS Deutschland GmbH customers using or selling this product for use in such applications do so at their own risk and agree to fully indemnify MEAS Deutschland GmbH for any damages resulting from such improper use or sale.

#### **NORTH AMERICA**

Measurement Specialties, Inc.,  
a TE Connectivity Company  
Phone: +1-800-522-6752  
[customercare.hmpt@te.com](mailto:customercare.hmpt@te.com)

#### **EUROPE**

MEAS France(Europe)  
a TE Connectivity Company  
Phone: +31 73 624 6999  
[customercare.dtmd@te.com](mailto:customercare.dtmd@te.com)

#### **ASIA**

Measurement Specialties (China), Ltd.,  
a TE Connectivity Company  
Phone: +86-400-820-6015  
[customercare.shzn@te.com](mailto:customercare.shzn@te.com)

### TE.com/sensorsolutions

Measurement Specialties, Inc., a TE Connectivity company.

Measurement Specialties (MEAS), American Sensor Technologies (AST), TE Connectivity, TE Connectivity (logo) and EVERY CONNECTION COUNTS are trademarks. All other logos, products and/or company names referred to herein might be trademarks of their respective owners.

The information given herein, including drawings, illustrations and schematics which are intended for illustration purposes only, is believed to be reliable. However, TE Connectivity makes no warranties as to its accuracy or completeness and disclaims any liability in connection with its use. TE Connectivity's obligations shall only be as set forth in TE Connectivity's Standard Terms and Conditions of Sale for this product and in no case will TE Connectivity be liable for any incidental, indirect or consequential damages arising out of the sale, resale, use or misuse of the product. Users of TE Connectivity products should make their own evaluation to determine the suitability of each such product for the specific application.

© 2017 TE Connectivity Ltd. family of companies All Rights Reserved.