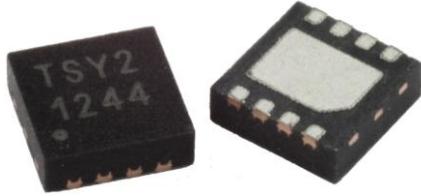


# TSYS02P Digital Temperature Sensor



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

## DESCRIPTION

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°C ... +125°C while the resolution is 0.01°C.

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

## FEATURES

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

## APPLICATIONS

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

# TSYS02P Digital Temperature Sensor

## 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 | °C   |
| Storage temperature   | Tstor  |  | -55            |     | +150 | °C   |
| ESD rating            | ESD    | Human Body Model (HBM)<br>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  |     | µA   |
| Peak Supply Current       | I <sub>DD</sub>     | During conversion       |       | 420 |     | µA   |
| 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   |
| V <sub>DD</sub> Capacitor |                     | Place close to the chip | 100nF |     |     |      |

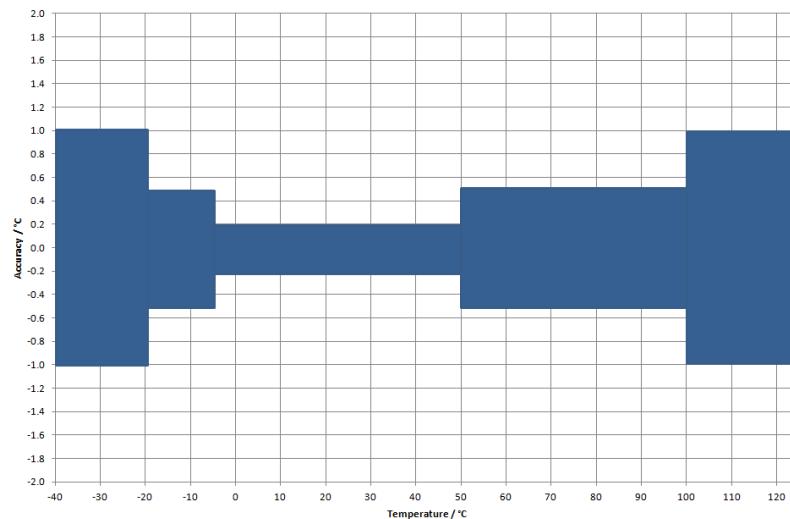
## OPERATIONAL CHARACTERISTICS

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<br>V <sub>DD</sub> = 3.2V – 3.4V   | -0.2 |     | +0.2 | °C   |
| Accuracy 2                        | T <sub>ACC2</sub> | -20°C < T < +100°C<br>V <sub>DD</sub> = 3.2V – 3.4V | -0.5 |     | +0.5 | °C   |
| Accuracy 3                        | T <sub>ACC2</sub> | -40°C < T < +125°C<br>V <sub>DD</sub> = 3.2V – 3.4V | -1.0 |     | +1.0 | °C   |
| PSRR<br>Power Supply Reject Ratio |                   | V <sub>DD</sub> = 2.7 – 3.6<br>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   |

# TSYS02P Digital Temperature Sensor

## ACCURACY



## ANALOGUE TO DIGITAL CONVERTER

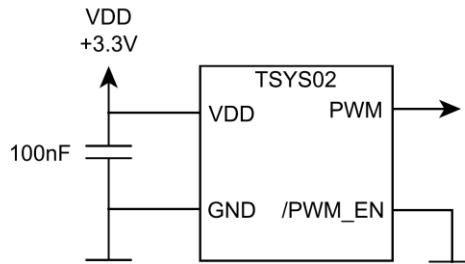
| Parameter       | Symbol | Conditions | Min | Typ | Max | Unit |
|-----------------|--------|------------|-----|-----|-----|------|
| Resolution      |        |            |     | 16  |     | bit  |
| Conversion Time | $t_c$  |            |     | 43  |     | ms   |

## DIGITAL OUTPUTS (PWM)

| Parameter           | Symbol | Conditions | Min | Typ | Max | Unit |
|---------------------|--------|------------|-----|-----|-----|------|
| Output High Voltage | VOH    |            |     | VDD |     | V    |
| Output Low Voltage  | VOL    |            |     | 0   |     | V    |
| Output Sink Current | IOL    |            |     |     | 40  | µA   |

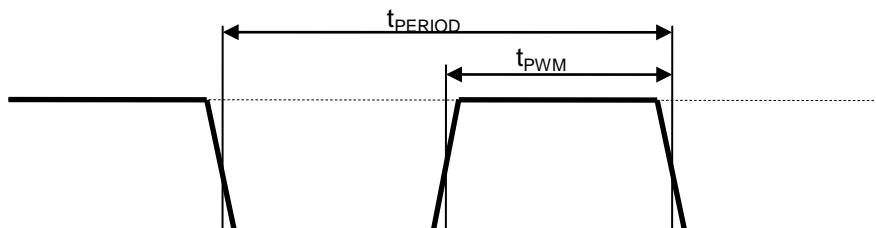
# TSYS02P Digital Temperature Sensor

## 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 POLYNOMAL

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

### EXAMPLE

$$\begin{aligned} t_{\text{PWM}}: & 4.15\text{ms} \\ t_{\text{PERIOD}}: & 8.30\text{ms} \end{aligned}$$

## TSYS02P Digital Temperature Sensor

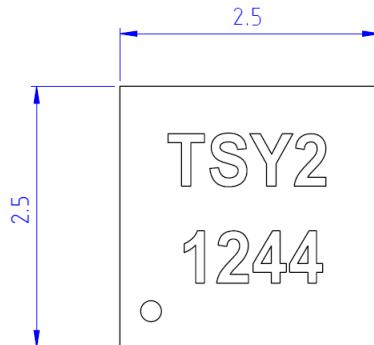
T / °C = 4.15ms / 8.30ms x 175.72 - 46.85

T / °C = 41.01°C

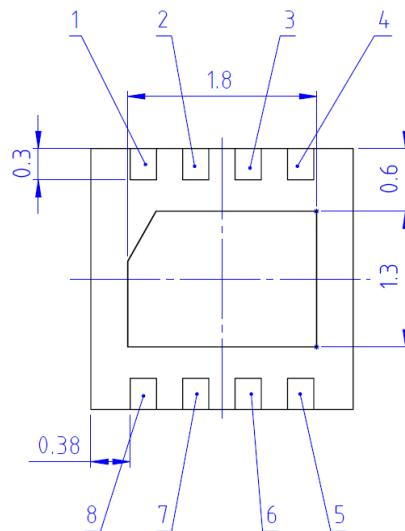
# TSYS02P Digital Temperature Sensor

## DIMENSIONS

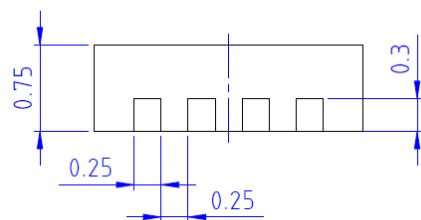
### TOP VIEW



### BOTTOM VIEW



### SIDE VIEW



## MARKING

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

# TSYS02P Digital Temperature Sensor

## ORDER INFORMATION

The TSYS02 temperature sensor family compromises 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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- 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.

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