

TSYS02S

Digital Temperature Sensor

SPECIFICATIONS

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

The TSYS02S is a single chip, temperature sensor. It provides factory calibrated data corresponding to the measured temperature.

The data is provided via **SDM output**.

SDM signal is a pulse sequence that may be converted into analogue voltage by an discrete low pass filter.

The temperature range is -40°C ... +125°C while the resolution is < 0.1°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 $< 0.14\mu\text{A}$)
- SDM 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

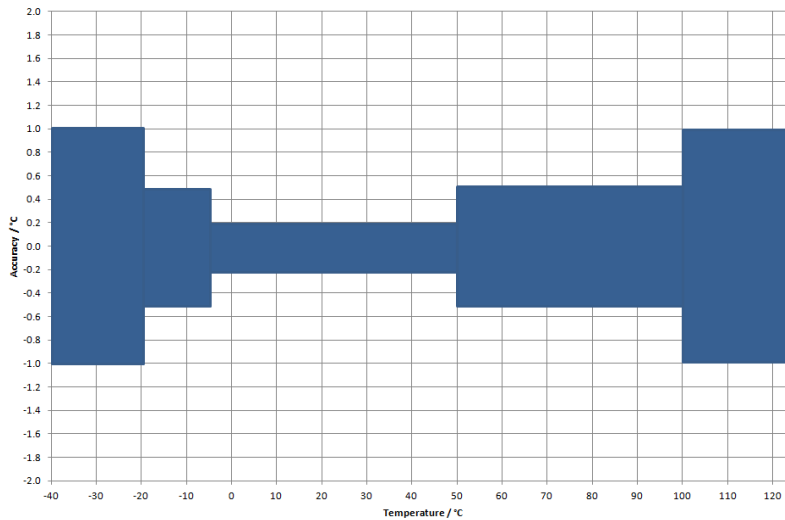
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating Supply Voltage	VDD	stabilized	1.5		3.6	V
Supply Current	IDD	2 sample per second		36		μA
Peak Supply Current	IDD	During conversion		420		μA
Conversion Time	T _{CONV}			43		ms
Measurement Frequency	F _{MEAS}			2		Hz
SDM Frequency	F _{SDM}		4		65	kHz
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 _{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 _{ACC2}	-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}				0.1	°C
Self Heating	SH ₁	10 samples/s, 60s, still air			0.1	°C

ACCURACY



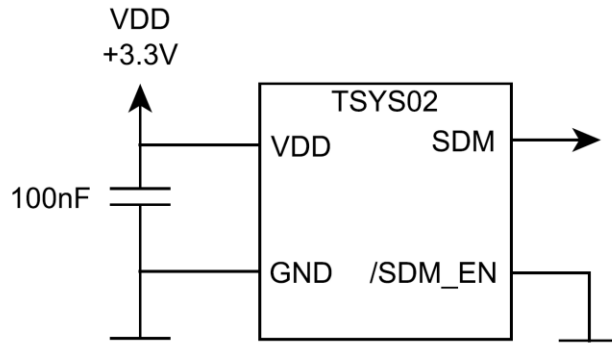
ANALOGUE TO DIGITAL CONVERTER

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Resolution				16		bit
Conversion Time	t _c			43		ms

DIGITAL OUTPUTS (SDM)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output High Voltage	V _{OH}			V _{DD}		V
Output Low Voltage	V _{OL}			0		V
Output Sink Current	I _{OL}				40	µA

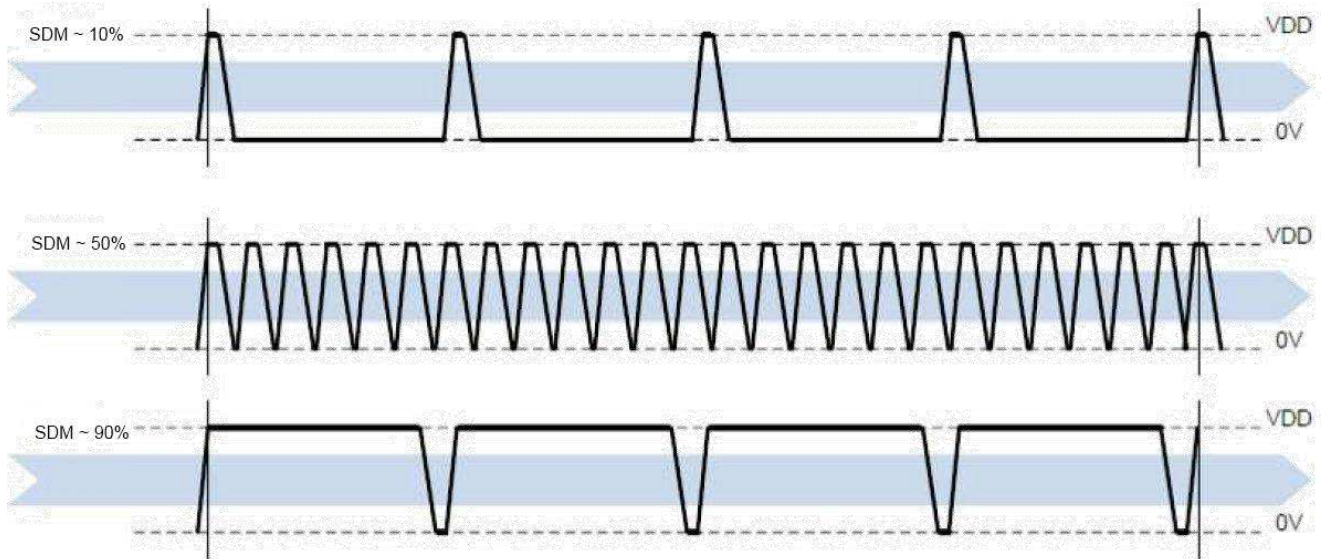
CONNECTION DIAGRAM



PIN FUNCTION TABLE

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

SDM OUTPUT



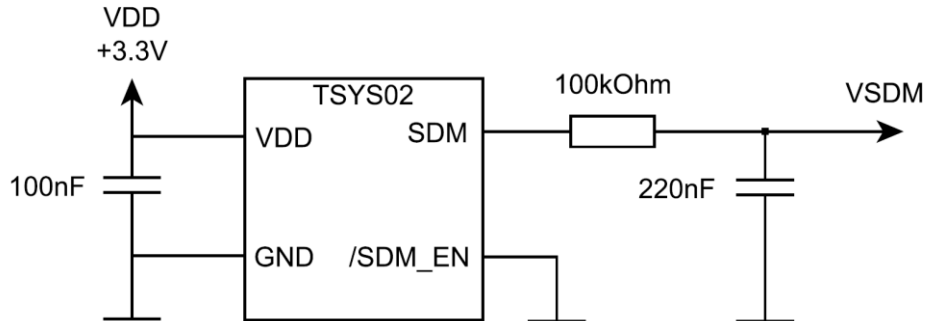
Sigma Delta Modulation output (SDM) is a bit-stream of pulses. The higher the pulse density is, the higher the measured temperature. The fundamental frequency of SDM is in the range of roughly 4 kHz and 65 kHz

START UP

After power-up (VDD between 1.8V and 3.6V) TSYS02S needs at most 150ms for reaching idle state. During that time SDM output is in undefined state. Afterwards, TSYS02S starts measuring and provides data on SDM output.

CONVERTING SMD TO ANALOG SIGNAL

An SDM signal normally is converted to an analog voltage signal by the addition of a low-pass filter.



Recommended component values for a RC low pass are $R = 100\text{k}\Omega$ and $C = 220\text{nF}$. The resulting output voltage V_{SDM} represents the measured temperature with respect to V_{DD} .

TEMPERATURE CALCULATION

TEMPERATURE POLYNOMIAL

$$T / ^\circ\text{C} = V_{\text{SDM}} / V_{\text{DD}} \times 175.72 - 46.85$$

EXAMPLE

$$V_{\text{SDM}}: \quad 1.5\text{V}$$

$$V_{\text{DD}}: \quad 3.3\text{V}$$

$$T / ^\circ\text{C} = 1.5\text{V} / 3.3\text{V} \times 175.72 - 46.85$$

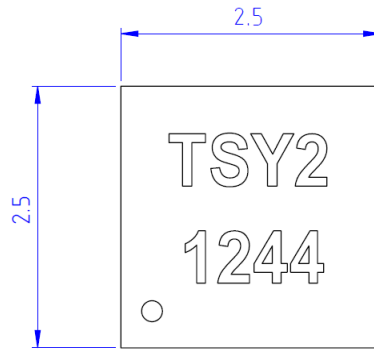
$$T / ^\circ\text{C} = \underline{\underline{33.02^\circ\text{C}}}$$

TSYS02S

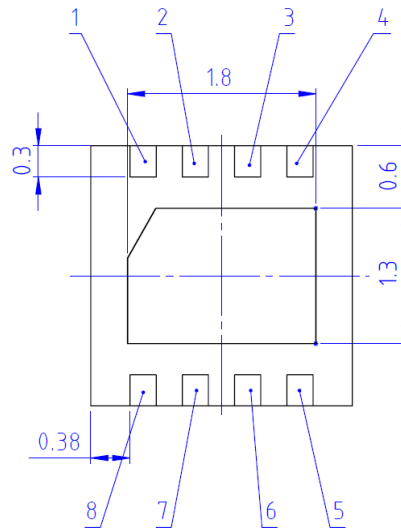
Digital Temperature Sensor

DIMENSIONS

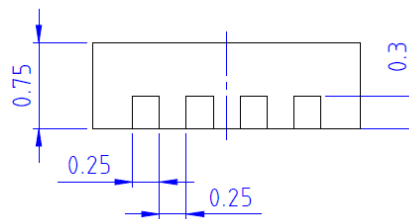
TOP VIEW



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
TSYS02P	Digital Temperature Sensor, TDFN8, PWM Interface	G-NIMO-004
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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