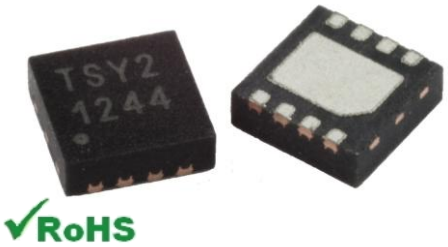
TSYS02D Digital Temperature Sensor



RoHS

- **High Accuracy Temperature Sensor**
- **16 bit Resolution**
- **High Speed, low Response Time**
- **Low Power Consumption**
- **I²C Interface**
- **Small TDFN8 Package**

DESCRIPTION

The TSYS02D is a single chip, temperature sensor.
It provides factory calibrated data corresponding to the measured temperature.
The data is provided via **I²C interface**.
The temperature range is -40°C ... +125°C while the resolution is 0.01°C.
The TSYS02D can be interfaced to any microcontroller by an I²C interface.
The TDFN8 package provides smallest size and very fast time response.

FEATURES

High Accuracy ±0.2°C @ Temp.: -5°C … +50°C

Adjustment of high accuracy temperature range on request

Low Supply Current < 420µA (standby < 0.14µA)

I²C Interface up to 400kHz

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

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) pin to pin incl. VDD & GND	-2		+2	kV
Humidity	Hum		Non condensing			

OPERATING CONDITIONS

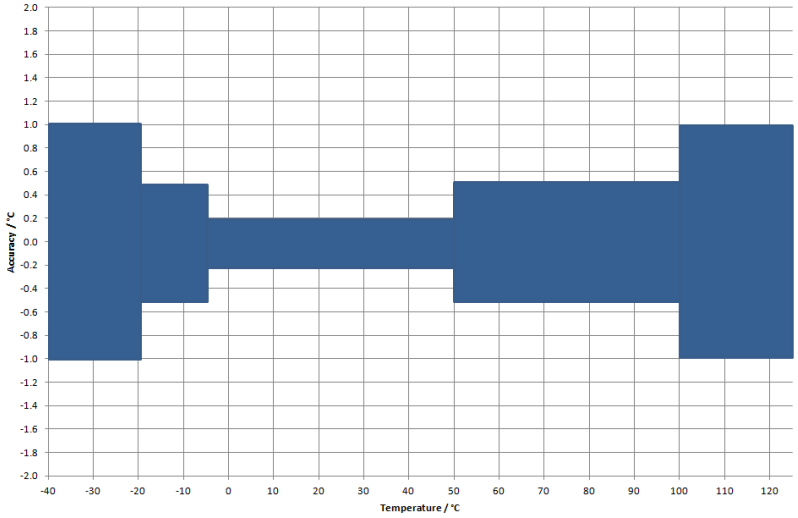
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Operating Supply Voltage	V_{DD}	stabilized	1.5		3.6	V
Supply Current	I_{DD}	1 sample per second		18		µA
Standby current	IS	No conversion, VDD = 3V T = 25°C T = 85°C		0.02 0.70	0.14 1.40	µA µA
Peak Supply Current	I_{DD}	During conversion		420		µA
Conversion time	T_{CONV}			43		ms
Serial Data Clock I^2C	F_{SCL}				400	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}				0.01	°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 INPUTS (SCLK, SDA)

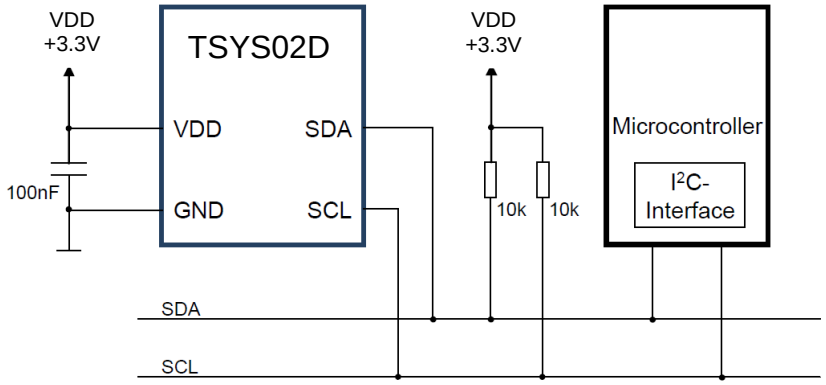
Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Input High Voltage	V_{IH}	V_{DD} = 1.5…3.6V	0.7 V_{DD}		V_{DD}	V
Input Low Voltage	V_{IL}	V_{DD} = 1.5…3.6V	0.0 V_{DD}		0.3 V_{DD}	V
Input leakage Current	I_{leak_25} I_{leak_85}	T = 25°C T = 85°C		0.01 0.25	0.14 1.40	µA
Input Capacitance	C_{IN}				6	pF

DIGITAL OUTPUTS (SDA)

Parameter	Symbol	Conditions	Min	Typ	Max	Unit
Output High Voltage	V_{OH}	I_{Source} = 1mA	0.8 V_{DD}		V_{DD}	V
Output Low Voltage	V_{OL}	I_{Sink} = 1mA	0.0 V_{DD}		0.2 V_{DD}	V

TSYS02D Digital Temperature Sensor

CONNECTION DIAGRAM



PIN FUNCTION TABLE

Pin	Name	Type	Function
1	VDD	Power	Supply Voltage
2	SCL	Digital Input	I^2C: Serial Data Clock
3	SDA	Digital Input/Output	I^2C Data Input / Output
4	VSS	Power	Ground
5 – 8	NC	---	Not connected / Do not connect

INTERFACE DESCRIPTION

I^2C INTERFACE

An I^2C communication message starts with a start condition and it is ended by a stop condition. Each command consists of two bytes: the address byte and command byte.

I^2C ADDRESS

The I^2C address is 0b1000000x.

COMMANDS

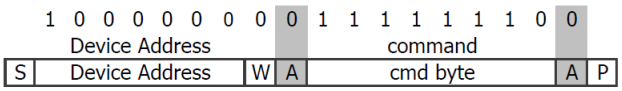
There are four commands:

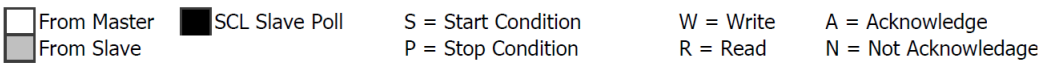
- Reset
- Read PROM (serial number)
- Read ADC16 Temperature Data (with SCL hold)
- Read ADC16 Temperature Data (without SCL hold)

Command	Hex Value
Reset	0x7E
Read ADC16 Temperature Data (with SCL hold)	0x E3
Read ADC16 Temperature Data (without SCL hold)	0x F3
Read first 8 bytes of Serial Number	0x FA0F
Read last 6 bytes of Serial Number	0x FCC9

RESET SEQUENCE

The reset of TSYS02D can be sent at any time. When SDA line is blocked by an undefined state the only way to get the TSYS02D to work is to send a power on reset or several SCL cycles. This is not needed when the last command was not a conversion.

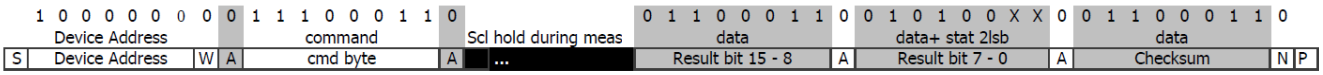


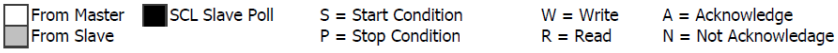


CONVERSION AND ADC READ

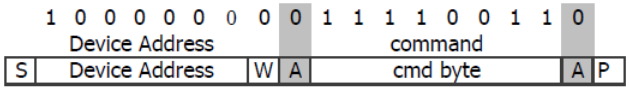
A conversion can be started by sending this command to TSYS02D. When the command is sent to the sensor it stays busy until conversion is done. All other commands except the reset command will not be executed during this time. When conversion is finished the data can be accessed by sending a Read command. If an acknowledge appears from the TSYS02D, you may then send 24 SCLK cycles to get all result bits. Every 9th bit the system waits for acknowledge. If the acknowledge is not sent the data clocking out of the chip stops. Two types of conversion commands for temperature reading are possible. If the “hold” command is issued, the SCL is held low during conversion, indicating when the conversion is finished. If the “no hold” is issued, the SCL line is not controlled by the TSYS02D.

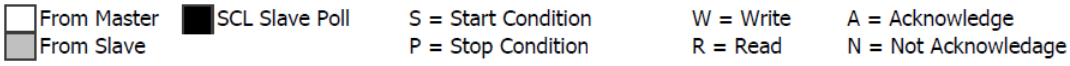
WITH HOLD



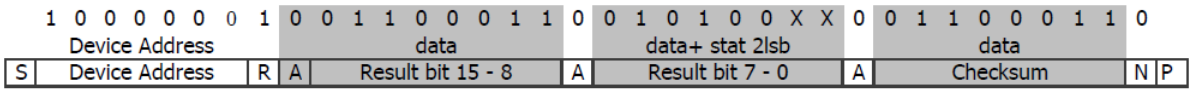


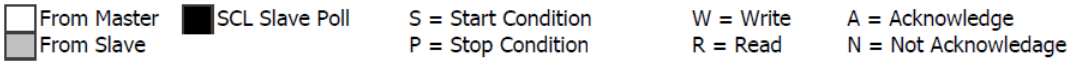
WITHOUT HOLD



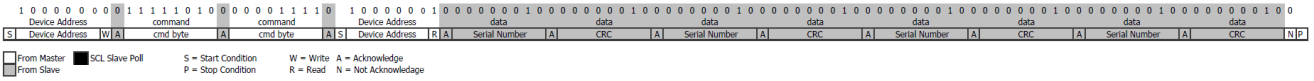


Poll if the conversion is finished by sending the address and check for acknowledge

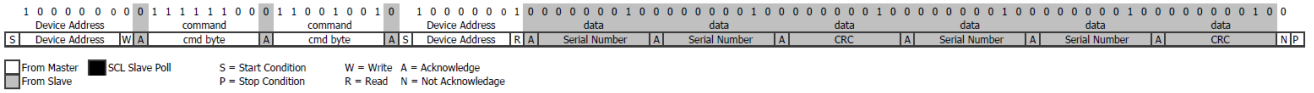




READ SERIAL NUMBER FIRST 8 BYTES



READ SERIAL NUMBER LAST 6 BYTES



TEMPERATURE CALCULATION

TEMPERATURE POLYNOMAL

ADC16: ADC Result 16 bits

$T / °C = ADC16 / 2^{16} \times 175.72 - 46.85$

EXAMPLE

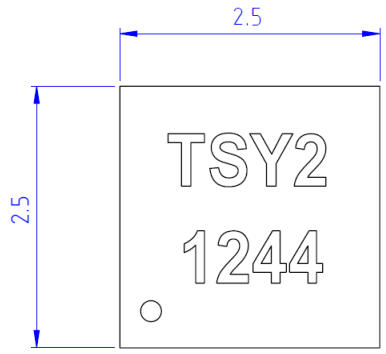
ADC16: 36636

$T / °C = 36636 / 2^{16} \times 175.72 - 46.85$

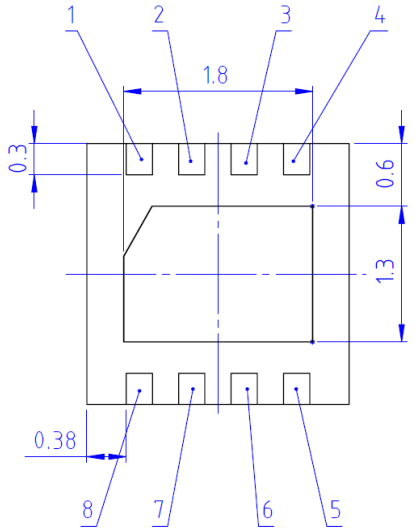
$T / °C = 51.38°C$

DIMENSIONS

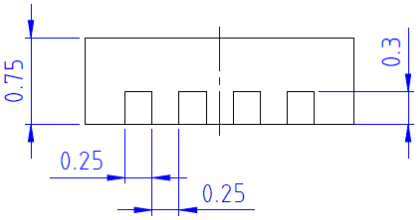
TOP VIEW



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 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**
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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