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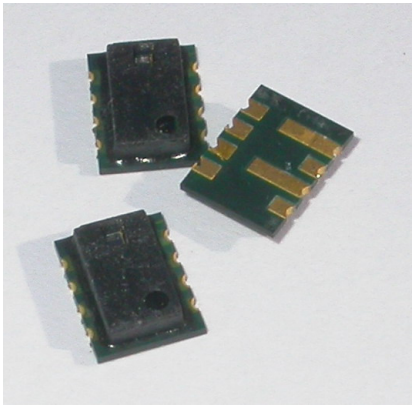
Preliminary and CONFIDENTIAL

Features

- On-chip Humidity & Temperature sensor
- Fully calibrated
- Excellent long-term stability
- Low power consumption (<1 µA idle)
- I^2C compatible output
- Available in 8-pins SOP



Applications

- Hvac,
- Consumer
- Test & measurement
- Medical
- Battery operated equipment

SMTH08I Product summary

The SMTH08I is a combined Humidity and Temperature sensor and has a calibrated output. For easy interfacing the digital output is I^2C compatible. The temperature as well as the humidity has resp. a 14 and 12 bits digital output. The on-chip I^2C interface circuit make the device easy for interfacing with almost any kind of microcontroller.

Each SMTH08I is individually calibrated in a precision environment. The calibration coefficients are stored into an OTP memory and are used for internal correction and calibration.

The two-wire digital I^2C output allows fast system integration.

Due to the very low idle state power(< 1 µA) , this device is of interest for any kind of battery operation.

The completely automatic production method makes it possible to offer the temperature/humidity module SMTH08I for a very competitive price.

SMTH08I

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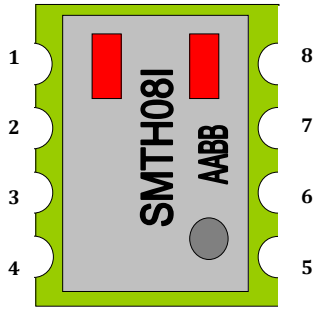
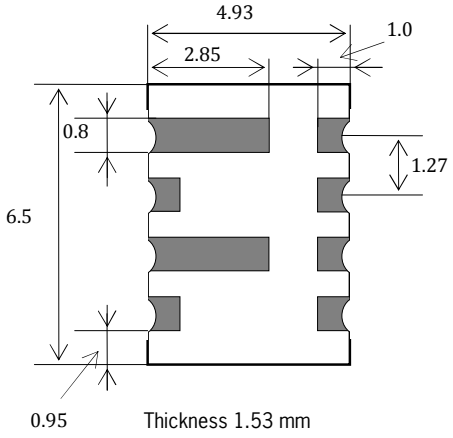
Preliminary and CONFIDENTIAL

Specifications

Specifications @25 °C unless otherwise mentioned.

Parameter	Min	Typ	Max	Units.
General				
Supply Voltage	2,4	3,3	3,6	V
Supply Current(idle)			1	µA
Supply current (operation)		500	600	µA
Operating Temp range	-40		125	°C
Operating humidity range	0		100	% RH
Humidity				
range	0		100	% RH
accuracy (20 - 80%RH)			3	% RH
response time			5	s
output (resolution)		12		bits
Temperature				
range	-40		125	°C
accuracy (-10 - 80 C)			3	°C
output (resolution)			14	bits
In/Outputs				
Level low/high input	<0,3		>0,7	x Vcc
Level low/high output	<0,2		>0,8	x Vcc
Sclk frequency			1	Mhz(Vcc>3,0V)
Sclk hi/low time	200			ns
Sclk rise / fall time		10		ns
Sdat Fall time	3	10	20	ns
Sdat setup time	100			ns
Sdat valid time		250		ns





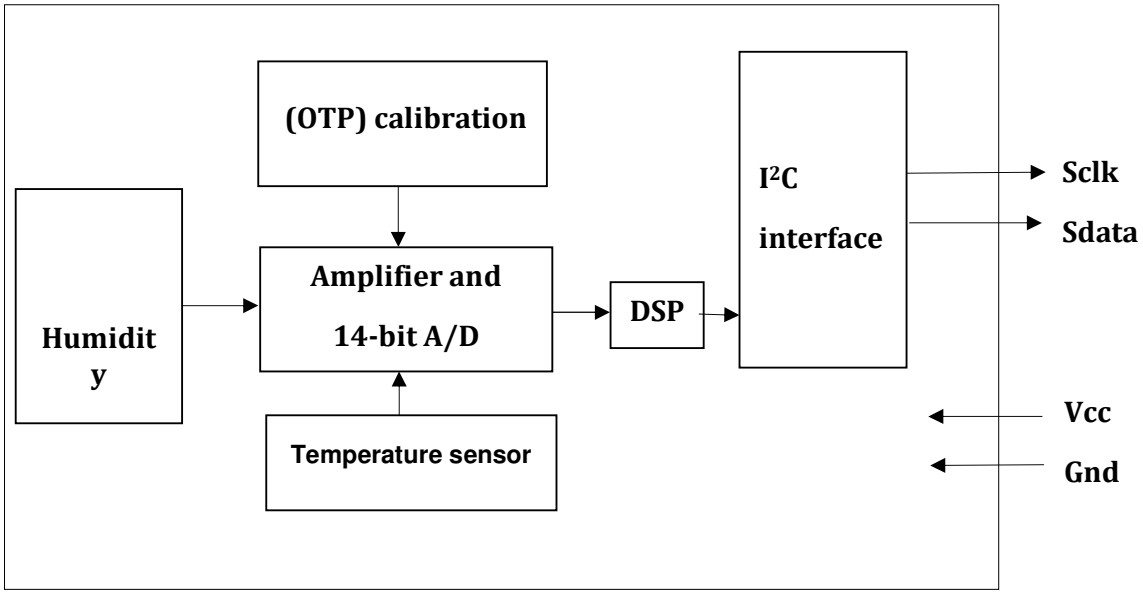
Pinout:

1. Gnd
2. Sda
3. Sclk
4. Vcc

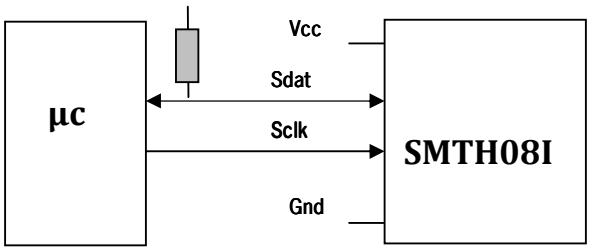
5-8 N.C.

All N.C. pins must be left open

STILL UNDER CONSTRUCTION
Preliminary and CONFIDENTIAL



Block diagram of SMTH08I



Hardware connection to 2-wire I²C bus

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About specifications and interfacing

Power

The SMTh08I needs a power voltage between 2.4 and 3.6 V. After power up the device needs about 10 ms to come into the "stand-by" state. This means that the first command should not be sent before 10 ms after start-up. It is advised to decouple the Vcc from spurious with a 0.1 µF capacitor.

General conventions of I²C sensor reading

- Before a communication, the I²C -bus must be free or not busy. It means that the SCL and SDA lines must both be released by all devices on the bus, and they become HIGH by the bus pull-up resistors.
- The host must provide SCL clock pulses necessary for the communication. Data is transferred in a sequence of 9 SCL clock pulses for every 8-bit data byte followed by 1-bit status of the acknowledgement.
- During data transfer, except the START and STOP signals, the SDA signal must be stable while the SCL signal is HIGH. It means that the SDA signal can be changed only during the LOW duration of the SCL line.
- S: START signal, initiated by the host to start a communication, the SDA goes from HIGH to LOW while the SCL is HIGH.
- P: STOP signal, generated by the host to stop a communication, the SDA goes from LOW to HIGH while the SCL is HIGH. The bus becomes free thereafter.
- W: write bit, when the write/read bit = LOW in a write command.
- R: read bit, when the write/read bit = HIGH in a read command.
- A: device acknowledge bit, returned by the SMTIRMOD. It is LOW if the device works properly and HIGH if not. The host must release the SDA line during this period in order to give the device the control on the SDA line.
- A': master acknowledge bit, not returned by the device, but set by the master or host in reading 2-byte data. During this clock period, the host must set the SDA line to LOW in order to notify the device that the first byte has been read for the device to provide the second byte onto the bus.
- NA: Not Acknowledge bit. During this clock period, both the device and host release the SDA line at the end of a data transfer, the host is then enabled to generate the STOP signal.
- In a write protocol, data are sent from the host to the device and the host controls the SDA line, except during the clock period when the device sends the device acknowledgement signal to the bus.
- In a read protocol, data are sent to the bus by the device and the host must release the SDA line during the time that the device is providing data onto the bus and controlling the SDA line, except during the clock period when the master sends the master acknowledgement signal to the bus.

The serial interface is not fully compatible with the standards; the device is optimized for low power consumption. In general similar commands are used to address and readout Humidity value and Temperature.

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Preliminary and CONFIDENTIAL

Serial Clock input (Sclk).

The serial clock input is used to synchronise the communication between the SMTH08I and the microcontroller. Internal static logic is used which means there is no minimum Sclk frequency defined. Maximum is about 1 MHz @ Vcc = 3V.

Serial data (Sdat).

Synchronised by the clock signal the tri-state serial data line is used to transfer the data from the SMTH08I to the microcontroller. The serial data line specifications are in accordance with the I^2C definitions concerning transmission and synchronisation with the Serial clock line.

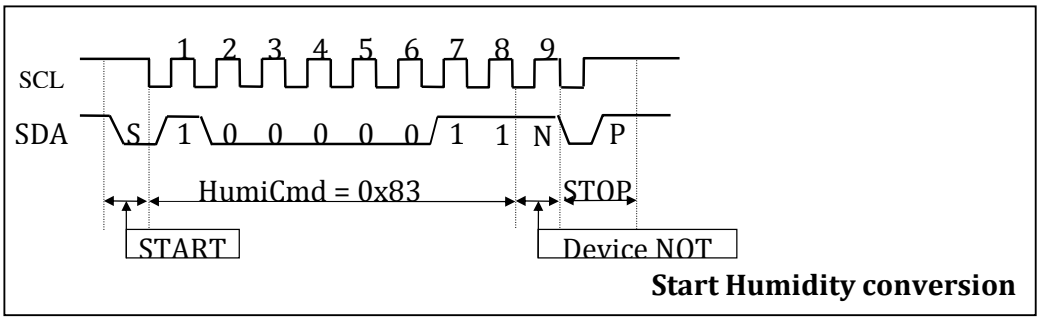
The SMTH08I communication protocol

The SMTH08I is a sophisticated combination of a Temperature and a Humidity sensor. It iss available in a small 8-pins SOP 5 x 6.5 mm housing. The power supply voltage is 3 V so suitable for all kind of battery operated equipment. For further information about this sensor please read the SMTH08I specification sheet. Below only the communication with the SMTAS02I2C is depicted.

Humidity conversion procedure

Start	**83hex(HumiCmd)**	*NACK*	**Stop**				
Wait 220 ms							
Start	**80hex(WriteCmd)**	*ACK*	**10hex (Addr)**	*ACK*			
Start	**81hex(ReadCmd)**	*ACK*	*Data0(R16)*	**ACK**	*Data1(R17)*	**NACK**	**Stop**

(Master controls the SDA line *Slave controls the SDA line)*



Start Humidity conversion

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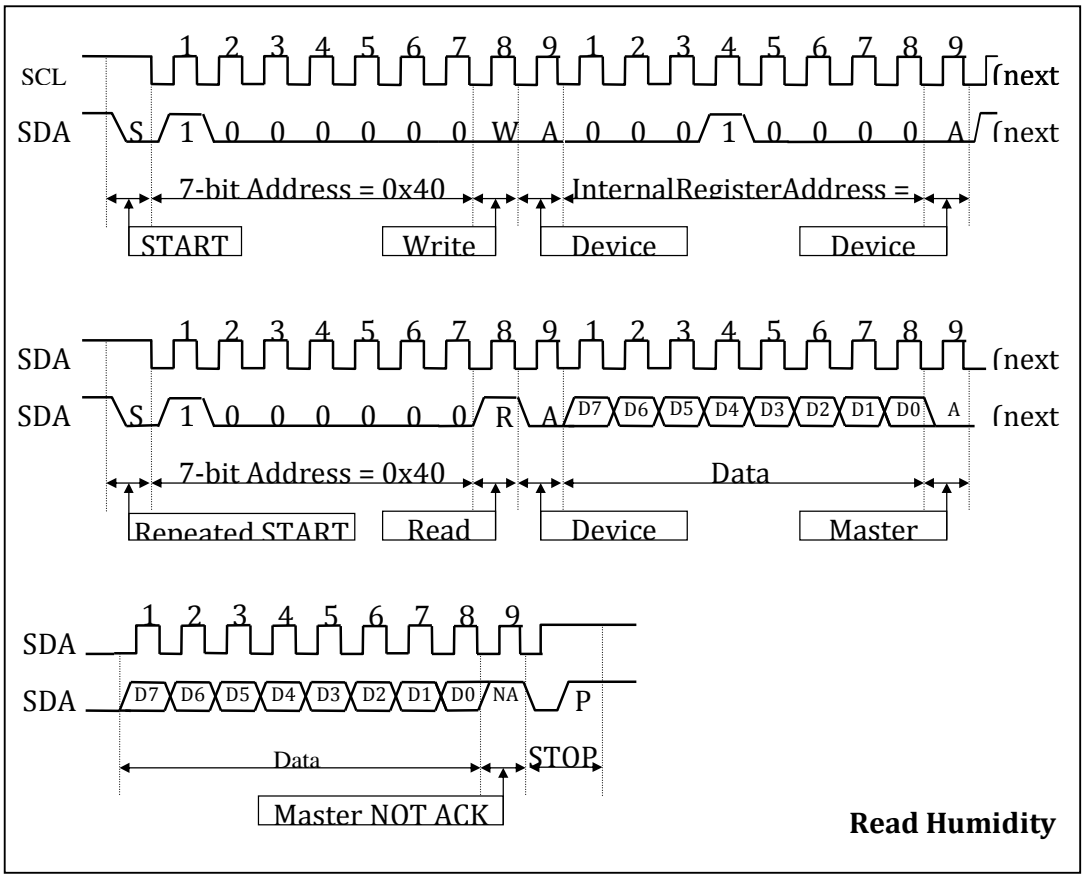
Preliminary and CONFIDENTIAL



Temperature conversion procedure

Start	**82hex(HumiCmd)**	*NACK*	**Stop**				
Wait 110 ms							
Start	**80hex(WriteCmd)**	*ACK*	**12hex (Addr)**	*ACK*			
Start	**81hex(ReadCmd)**	*ACK*	*Data0(R17)*	**ACK**	*Data1(R18)*	**NACK**	**Stop**

(Master controls the SDA line *Slave controls the SDA line)*

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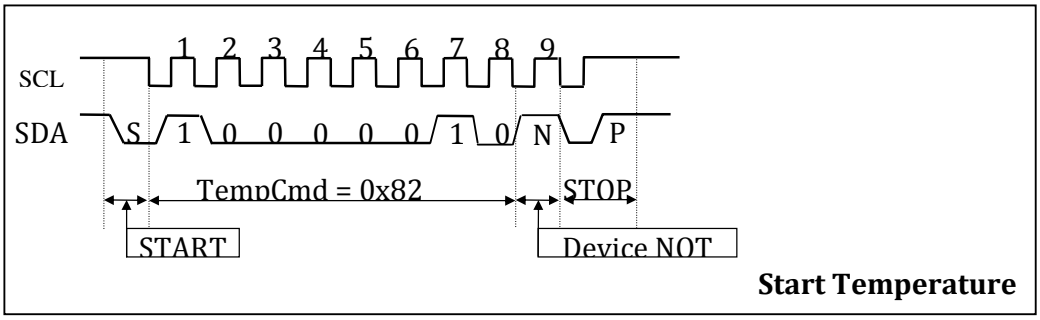
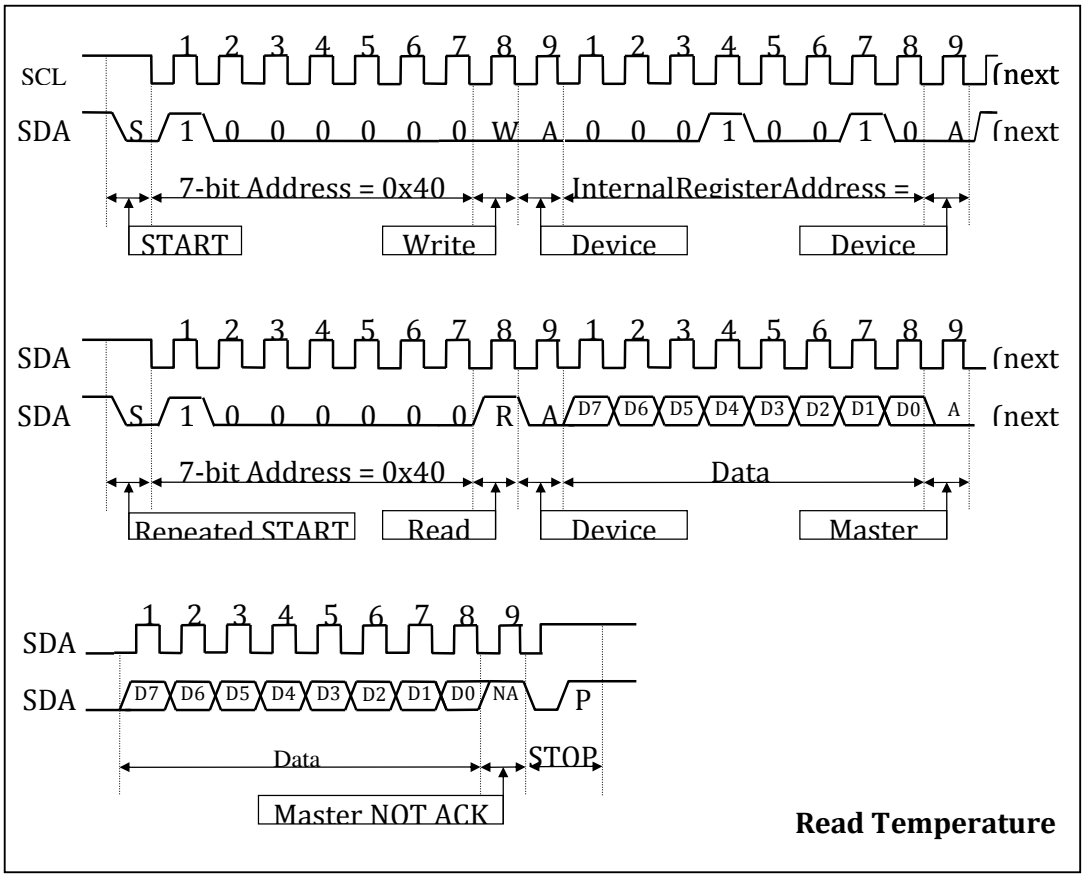
Preliminary and CONFIDENTIAL



Start Temperature



Read Temperature

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Humidity & Temperature conversion procedure

Start	**83hex(HumiCmd)**	*NACK*	**Stop**	**Start**	**83hex(HumiCmd)**	*NACK*	**Stop**
Wait 330 ms							
Start	**80hex(WriteCmd)**	*ACK*	**10hex (Addr)**	*ACK*			
Start	**81hex(ReadCmd)**	*ACK*	*Data0(R16)*	**ACK**	*Data1(R17)*	**ACK**	
Data2(R18)	**ACK**	*Data1(R19)*	**NACK**	**Stop**			

(Master controls the SDA line *Slave controls the SDA line)*

From bites to temperature and humidity.

Humidity

The humidity is read out in two bytes. Converting these bytes to decimal will give a value between 23350 and 26350. To calculate the RH out off the decimal value apply the formula below:

$$\mathbf{RH\% = (Value_{(dec)} - 23{,}350)/30}$$

Calculation example

Suppose measured value: 24650(dec) substituted in RH =(24650-23350)/30 = 43.3 %

Temperature

The temperature is read out in 16 bytes.

The temperature in Celsius can be calculated by means of the formula below:

$$\mathbf{t(°C) = (value_{(dec)} - 27{,}650) / 190 - 40}$$

Calculation example:

Value is suppose 29,630

Temperature= (29,630 – 27,650)/190 – 40 = -29.6 °C

Ordering code

SMTH08I **Smartec Temperature and Humidity sensor with I²C output.**