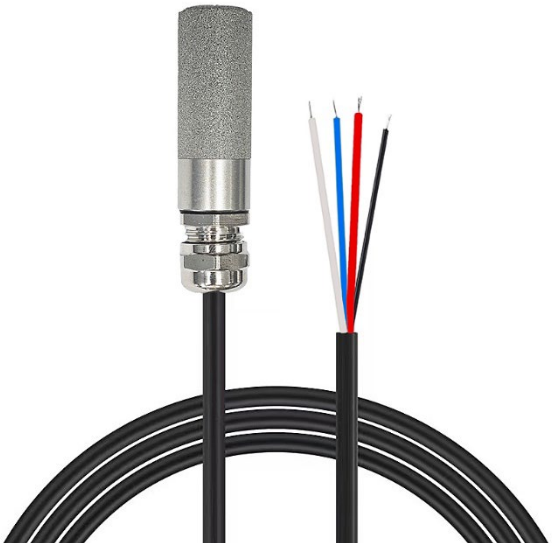
产品规格书

产品名称	温湿度模块
产品型号	MHTCI01-YK-L300
版本	V1.1
制定人	GW.H
审核人	CY



修改记录表：

版本	更改内容	更改人	更改日期
V1.0	新建	GW.H	2024-03-28
V1.1	更新实物图片、尺寸图	GW.H	2024-04-16

一、产品概述

本产品是以进口的温湿度芯片为核心，输出信号是 I^2C 信号，本产品具有较高的可靠性与卓越的长期稳定性。

二、产品特点

耐高温、防水、长期稳定。

三、结构尺寸图

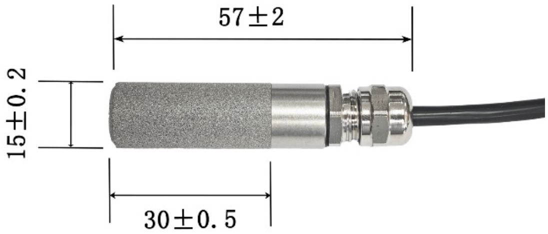


图 1.结构尺寸图（单位:mm）

四、产品接线定义

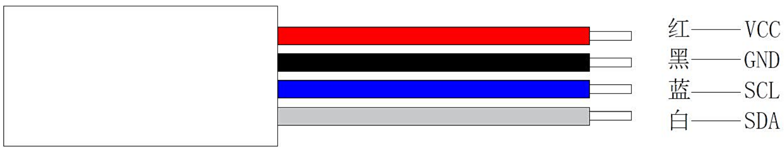


图 2. 产品接线定义图

编号	线材颜色	名称	功能
1	红色	VCC	电源正
2	黑色	GND	电源地
3	蓝色	SCL	时钟线
4	白色	SDA	数据线

五、应用范围

用于除湿设备、农业、冷链仓储、家用电器、湿度调节器、医疗等其他需要检测和控制温度、湿度的领域。

六、技术参数

项目	符号	参数	单位
工作温度范围	T	-40～110	℃
工作湿度范围	RH	0～100	%RH
工作电压范围	VCC	1.08～3.60	VDC

平均工作电流	I	0.4	uA
湿度检测范围	/	0～100	%RH
相对湿度精度	/	±3.0 (检测点：25℃/55%RH)	%RH
温度检测精度	/	±0.4(检测点：0～60℃)	℃
传感器芯片	/	I^2C 信号输出 (通讯地址：0x44)	/
I^2C 通讯协议	/	详见九、I^2C 通讯协议	/
线材长度	/	耐高温硅胶线，300mm	mm
防水等级	/	IP65	/

七、温度与湿度的典型误差、最大误差曲线图

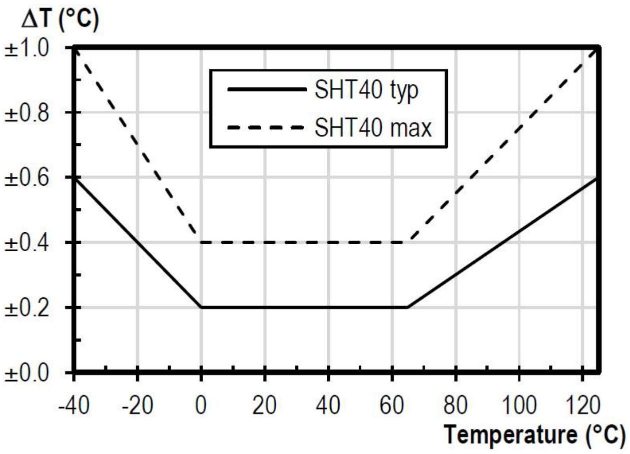


图 3. 温度精度与温度间的关系

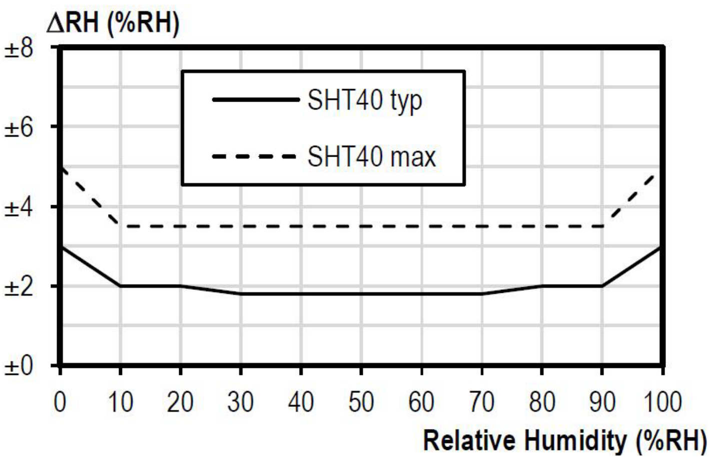


图 4. 湿度精度与湿度间的关系

八、注意事项

1、产品存储温湿度范围要求：温度 0℃～50℃，湿度 0%～90%RH；

2、产品在装卸及运输过程中，应小心轻放，外加包装保存，避免强烈 碰撞与踩踏，不要与酸碱等腐蚀性物质混储；

3、安装过程中应尽量避免机械外力作用于传感器部分；

4、传感器不能和清洁剂接触(比如：洗板水)，不能用含有油气的强风吹；

5、传感器不应该近距离接触挥发性的化学物品，特别是高浓度和长时间接触会更危险，例如

乙烯酮、丙酮、异丙酮、乙醇、甲苯等已经被证明可以导致湿度读数偏移，大部分情况下是不可逆的；

6、对于传感器的安装操作应避免静电影响。

九、I²C 通讯协议

4 Sensor Operation

4.1 I2C communication

I2C communication is based on NXP's I2C-bus specification and user manual UM10204, Rev.6, 4 April 2014. Supported I2C modes are standard, fast mode, and fast mode plus. Data is transferred in multiples of 16-bit words and 8-bit checksum (cyclic redundancy check = CRC). All transfers must begin with a start condition (S) and terminate with a stop condition (P). To finish a read transfer, send not acknowledge (NACK) and stop condition (P). Addressing a specific slave device is done by sending its 7-bit I2C address followed by an eighth bit, denoting the communication direction: "zero" indicates transmission to the slave, i.e. "write", a "one" indicates a "read" request. Schematics of the I2C transfer types are sketched in **Figure 8**. The sensor does not support clock-stretching. In case the sensor receives a read header and is still busy with e.g. measurement or

[11] The recommended storage temperature range is 10-50°C. Please consult the document "SHTxx Handling Instructions" for more information.

heating, it will return a NACK. Measurement data can only be received once and will be deleted from the sensor's register after the first acknowledged I2C read header.

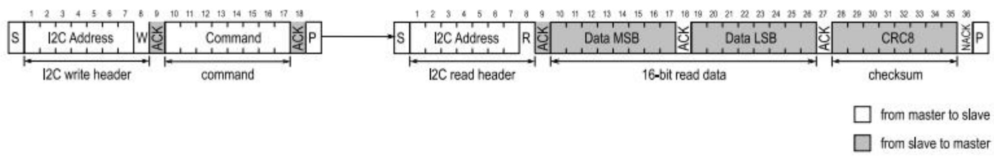


Figure 8: I2C transfer types: First a write header is sent to the I2C slave, followed by a command, for example "measure RH&T with highest precision". After the measurement is finished the read request directed to this I2C slave will be acknowledged and transmission of data will be started by the slave.

4.2 Data type & length

I2C bus operates with 8-bit data packages. Information from the sensor to the master has a checksum after every second 8-bit data package.

Humidity and temperature data will always be transmitted in the following way: The first value is the temperature signal (2 * 8-bit data + 8-bit CRC), the second is the humidity signal (2 * 8-bit data + 8-bit CRC).

4.3 Checksum Calculation

For read transfers each 16-bit data is followed by a checksum with the following properties

Property	Value
Name	CRC-8
Message Length	16-bit
Polynomial	0x31 ($x^8 + x^5 + x^4 + 1$)
Initialization	0xFF
Reflect Input/Output	false/false
Final XOR	0x00
Examples	CRC(0xBEEF) = 0x92

Table 6 Data checksum properties.

The master may abort a read transfer after the 16-bit data, if it does not require a checksum.

4.4 Command Overview

Command (hex)	Response length incl. CRC (bytes)	Description [return values]
0xFD	6	measure T & RH with high precision (high repeatability) [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0xF6	6	measure T & RH with medium precision (medium repeatability) [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0xE0	6	measure T & RH with lowest precision (low repeatability) [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x89	6	read serial number [2 * 8-bit data; 8-bit CRC; 2 * 8-bit data; 8-bit CRC]
0x94	-	soft reset [ACK]
0x39	6	activate heater with 200mW for 1s, including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x32	6	activate heater with 200mW for 0.1s including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x2F	6	activate heater with 110mW for 1s including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x24	6	activate heater with 110mW for 0.1s including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x1E	6	activate heater with 20mW for 1s including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]
0x15	6	activate heater with 20mW for 0.1s including a high precision measurement just before deactivation [2 * 8-bit T-data; 8-bit CRC; 2 * 8-bit RH-data; 8-bit CRC]

Table 7 Overview of I2C commands. If the sensor is not ready to process a command, e.g. because it is still measuring, it will response with NACK to the I2C read header. Given heater power values are typical and valid for VDD=3.3V.

4.5 Conversion of Signal Output

The digital sensor signals correspond to following humidity and temperature values:

$$RH = \left(-6 + 125 \cdot \frac{S_{RH}}{2^{16} - 1}\right) \%\mathrm{RH} \quad (1)$$

$$T = \left(-45 + 175 \cdot \frac{S_T}{2^{16} - 1}\right) {}^{\circ}\mathrm{C} \quad (2)$$

$$T = \left(-49 + 315 \cdot \frac{S_T}{2^{16} - 1}\right) {}^{\circ}\mathrm{F} \quad (3)$$

N.B.: The RH conversion formula (1) allows values to be reported which are outside of the range of 0 %RH … 100 %RH. Relative humidity values which are smaller than 0 %RH and larger than 100 %RH are non-physical, however these “uncropped” values might be found beneficial in some cases (e.g. when the distribution of the sensors at the measurement boundaries are of interest). For all users who do not want to engage in evaluation of these non-physical values, cropping of the RH signal to the range of 0 %RH … 100 %RH is advised.

4.6 Serial number

Each sensor has a unique serial number, that is assigned by Sensirion during production. It is stored in the one-time-programmable memory and cannot be manipulated after production. The serial number is accessible via I2C command 0x89 and is transmitted as two 16-bit words, each followed by an 8-bit CRC.

4.7 Reset & Abort

A reset of the sensor can be achieved in three ways:

- Soft reset: send the reset command described in **Table 7**.
- I2C general call reset: all devices on I2C bus are reset by sending the command 0x06 to the I2C address 0x00.
- Power down (incl. pulling SCL and SDA low)

Any command that triggers an action at the sensor can be aborted via I2C general call reset or soft reset.

4.8 Heater Operation

The sensor incorporates an integrated on-chip heater which can be switched on by the set of commands given in **Table 7**. Three heating powers and two heating durations are selectable. After reception of a heater-on command, the sensor executes the following procedure:

1. The heater is enabled and the timer starts its count-down
2. On timer expiration a temperature and humidity measurement with the highest repeatability is started, the heater remains enabled
3. After the measurement is finished the heater is turned off
4. Temperature and humidity values are now available

The maximum on-time of the heater commands is 1 second, in order to prevent overheating of the sensor by unintended usage of the heater. Thus, there is no dedicated command to turn off the heater. For extended heating periods it is required to send periodic heater-on commands, keeping in mind that the heater is designed for a maximal duty cycle of less than 5%. To obtain a fast increase in temperature the idle time between consecutive heating pulses shall be kept minimal.

Possible Heater Use Cases

There will be dedicated Sensirion application notes elaborating on various use cases of the heater. In general, the applications of the on-chip heater range around:

1. Removal of condensed / spray water on the sensor surface. Although condensed water is not a reliability / quality problem to the sensor, it will however make the sensor non-responsive to RH changes in the air as long as there is liquid water on the surface.
2. Creep-free operation in high humid environments. Periodic heating pulses allow for creep-free high-humidity measurements for extended times.

Important notes for operating the heater:

1. The heater is designed for a maximum duty cycle of 5%, meaning the total heater-on-time should not be longer than 5% of the sensor's lifetime.
2. During operation of the heater, sensor specifications are not valid.
3. The temperature sensor can additionally be affected by the thermally induced mechanical stress, offsetting the temperature reading from the actual temperature.
4. The sensor's temperature (base temperature + temperature increase from heater) must not exceed T_{max} = 125 °C in order to have proper electrical functionality of the chip.
5. The heater draws a large amount of current once enabled (up to ~75mA in the highest power setting). Although a dedicated circuitry draws this current smoothly, the power

supply has to be strong enough to avoid large voltage drops that could provoke a sensor reset.

If higher heating temperatures are desired, consecutive heating commands have to be sent to the sensor. The heater shall only be operated in ambient temperatures below 65°C else it could drive the sensor outside of its maximal operating temperature.