SENSYLINK Microelectronics

(CHT8305C)

Digital Humidity &Temperature Sensor

CHT8305C is a Digital Humidity and Temperature Sensor with ±3.0%RH Accuracy for humidity and ±0.5°C Accuracy for temperature. It is compatible with I^2C and 2-wire Interface. It is ideally used in HVAC, environment monitor etc.

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Description

CHT8305C is a digital humidity and temperature sensor with ±3.0%RH(Max.) accuracy for humidity and ±0.5°C(Max.) accuracy for temperature. Humidity and Temperature data can be read out directly via I^2C digital interface by MCU, Bluetooth Chip or SoC chip.

CHT8305C supports I^2C communication with speed up to 400kHz.

Each chip is specially calibrated for temperature and humidity accuracy in factory before shipment to customers. There is no need for re-calibration anymore.

It includes a high precision band-gap circuit, a 14-bit analog to digital converter, a calibration unit with non-volatile memory, and a digital interface block.

It has ALERT logic output pin with open drain structure, which is active low.

The chip supports up to 4 devices in one I^2C bus by setting different slave address via AD0 pin.

Available Package: DFN3x3-6 package

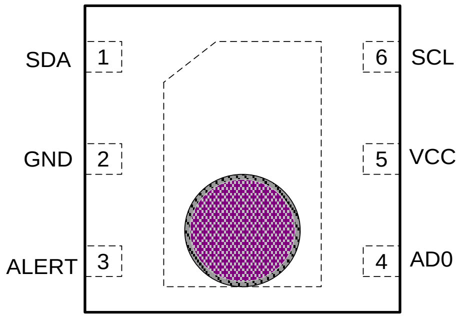
Features

- Operation Voltage: 2.5V to 5.5V
- Average Operating Current: 1.5uA (Typ.), at 1.0con/sec, Vcc=3.3V (Both T&RH conversion). 3.0uA(Max.)
- Standby Current: 0.05uA(Typ.), 0.3uA (Max.)
- Temperature Accuracy without calibration: Maximum: ±0.5°C from 0°C to 50°C
- Humidity Accuracy without calibration: Maximum: ±3.0%RH at 50%RH
- 14 bit ADC for Temperature and Humidity
- Compatible with 2-wire and I^2C interface
- Programmable Alert response of Over Temperature and/or Humidity
- Generate 4 different slave address by settingAD0 pin
- Temperature Range: -40°C to 125°C
- Humidity Range: 0%RH to 100%RH
- Protection Cover is available

Applications

- Smart HVAC System
- Environment Monitor
- Portable/Wearable Weather Monitor

PIN Configurations (Top View)



DFN3x3-6(Package Code DN)

Typical Application

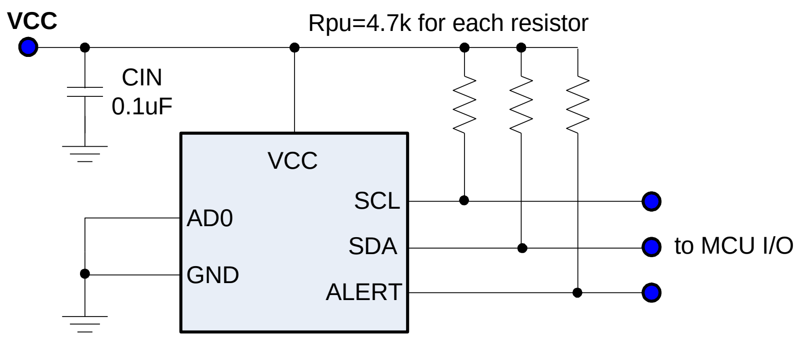


Figure 1. Typical Application of CHT8305C

Pin Description

PIN No.	PIN Name	Description
1	SDA	Digital interface data input or output pin, need a pull-up resistor to VCC.
2	GND	Ground pin.
3	ALERT	To Indicate alert status of over Humidity and/or Temperature limitation programmed by setting H_{LIMIT}/T_{LIMIT} register. Need a pull-up resistor to VCC in application. active low with open drain output.
4	AD0	Slave Address selection pins, the chip can be defined total 4 different slave addresses by connecting this pin to GND, VCC, SCL or SDA pin respectively. If leave this pin open, address is 0x80. See Slave Address for detail.
5	VCC	Power supply input pin, using 0.1uF low ESR ceramic capacitor to ground
6	SCL	Digital interface clock input pin, need a pull-up resistor to VCC.

Function Block

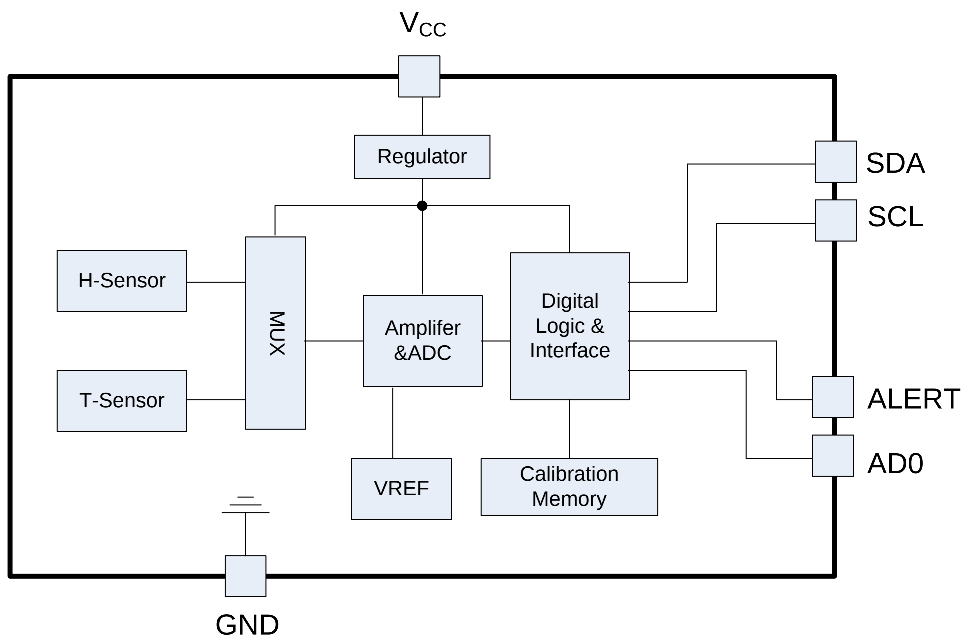


Figure 2. CHT8305C function block

Ordering Information

CHT8305C X X - X

Package Type
DN : DFN3x3-6

Packing
R: Tape & Reel

Protection
C : with Cover
Blank : without Cover

Order PN	Accuracy	Green[1]	Package	Marking ID[2]	Packing	MPQ	Operation Temperature	Protection Cover
CHT8305CDNR	±0.5℃ ±3%RH	Halogen free	DFN3x3-6	8305 YWWAXX	Tape & Reel	3,000	-40^{o}C~+125^{o}C	No
CHT8305CDNR-C	±0.5℃ ±3%RH	Halogen free	DFN3x3-6	8305 YWWAXX	Tape & Reel	3,000	-40^{o}C~+125^{o}C	Yes

Notes

1. Based on ROHS Y2012 spec, Halogen free covers lead free. So most package types Sensylink offers only states halogen free, instead of lead free.

2. Marking ID includes 2 rows of characters. In general, the 1st row of characters are part number, and the 2nd row of characters are date code plus production information.

1) *Generally, date code is represented by 3 numbers. The number stands for year and work week information. e.g. 501stands for the first work week of year 2015; 621 stands for the 21st work week of year 2016.*
2) *Right after the date code information, the next 2-3 numbers or letters are specified to stands for supplier or production location information.*
3) *For very small outline package, there's 4 digits to stands for product information and date code, first 2 digits represent product code, and the other 2 digits stands for work week*

Absolute Maximum Ratings (Note3)

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC} to GND	-0.3 to 5.5	V
SDA, SCL, AD0 Voltage	$V_{SDA}/V_{SCL}/V_{AD0}$ to GND	-0.3 to 5.5	V
ALERT Voltage	V_{ALERT} to GND	-0.3 to 5.5	V
Operation junction temperature	T_J	-50 to 150	ºC
Storage temperature Range	T_{STG}	-65 to 150	ºC
Lead Temperature (Soldering, 10 Seconds)	T_{LEAD}	260	ºC
ESD MM	ESD_{MM}	400	V
ESD HBM	ESD_{HBM}	4000	V
ESD CDM	ESD_{CDM}	1000	V

Note3

1. *Stresses greater than those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only. Functional operation of the device at the "Absolute Maximum Ratings" conditions or any other conditions beyond those indicated under "Recommended Operating Conditions" is not recommended. Exposure to "Absolute Maximum Ratings" for extended periods may affect device reliability.*
2. *Using 2oz dual layer (Top, Bottom) FR4 PCB with 2.5x1.4 mm^2 cooper as thermal PAD*

Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	2.5 ~ 5.5	V
Ambient Operation Temperature Range	T_{AT}	-40~+125	°C
Ambient Operation Temperature Range for Humidity	T_{ATH}	0~ +85	°C
Ambient Operation Humidity Range	T_{AH}	0~100	%RH

Electrical Characteristics (Note4)

Test Conditions: C_{IN} = 0.1uF, V_{CC} =3.3V, T_A=25°C unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	V_{CC}		2.5		5.5	V
Shutdown Current	$I_{SHUTDOWN}$	Idle, no iteration on SDA/SCL		0.05	0.3	uA
Open Drain Output Voltage	V_{OL}	ALERT pin, sink 5mA	0		0.4	V
Open Drain Leakage	I_{ODL}	ALERT pin	-1.0		1.0	uA
Heater Current	I_{HEATER}	Peak Current during Heater Enable		7.0		mA
Temperature Sensor						
Temperature Accuracy	T_{AC}	T_A = 0 to 50°C	-0.5	±0.3	0.5	°C
		T_A = -20 to 85°C	-1.0	±0.5	1.0	°C
		T_A = -40 to 125°C	-2.0	±1.0	2.0	°C
Temperature Resolution		14-bit		0.02		°C
Conversion time	t_{CON}	14-bit for Temperature		5.0		ms
Conversion Current	I_{CON}	14-bit		150		uA
Humidity Sensor						
Humidity Accuracy	H_{AC}	H_A = 50%RH		±2	±3	%RH
		H_A = 20%RH to 80%RH		±3	±5	%RH
		H_A = 5%RH to 95%RH		±5		%RH
Humidity Resolution		14-bit		0.02		%RH
Humidity Hysteresis	H_{HYS}			±1.0		%RH
Humidity Response time	$t_{63\%}$			8		s
Conversion time	t_{CON}	14-bit for Temperature		5.0		ms
Conversion Current	I_{CON}	14-bit		175		uA
Digital Interface						
Logic Input Capacitance	C_{IL}	SDA, SCL pin		3.0		pF
Logic Input High Voltage	V_{IH}	SDA, SCL pin	0.7*VCC		VCC+0.3	V
Logic Input High Voltage	V_{IL}	SDA, SCL pin	-0.3		0.3*VCC	V
Logic Input Current	I_{INL}	SDA, SCL pin	-1.0		1.0	uA
Logic Output Sink Current	I_{OLS}	SDA, SCL pin, forced 0.2V		4.0		mA
SCL frequency	f_{CLK}	Fast Speed Mode	1		400	kHz
Clock low period time	t_{LOW}	Fast Speed Mode	1300			ns
Clock high period time	t_{HIGH}	Fast Speed Mode	600			ns
Bus free time	t_{BUF}	Between Stop and Start condition	1200			ns
Hold time after Start condition	$t_{HD:STA}$		600			ns
Repeated Start condition setup time	$t_{SU:STA}$		600			ns
Stop condition setup time	$t_{SU:STO}$		600			ns
Data Hold time	$t_{HD:DAT}$		100			ns
Data Setup time	$t_{SU:DAT}$		100			ns
Clock/Data fall time	t_F				300	ns
Clock/Data rise time	t_{SR}				1000	ns

Note 4:

1. *All devices are 100% production tested at TA = +25°C; All specifications over the automotive temperature range is guaranteed by design, not production tested.*
2. *Time for the RH output to change by 63% of the total RH change after a step change in environmental humidity.*
3. *For humidity accuracy, it excludes hysteresis, high temperature bake, hydration drift, long-term drift.*

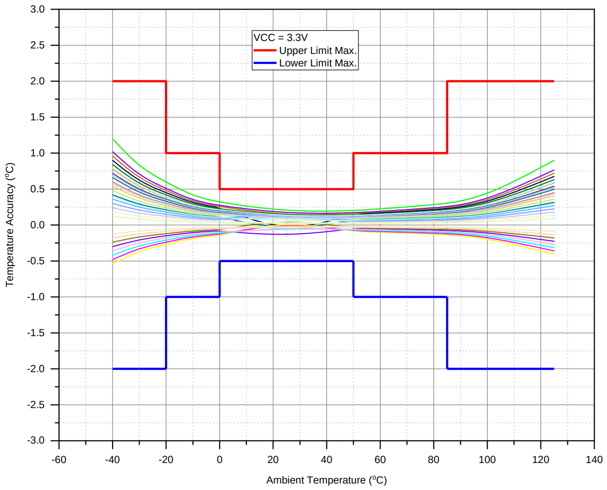


Figure 3. Temperature Accuracy

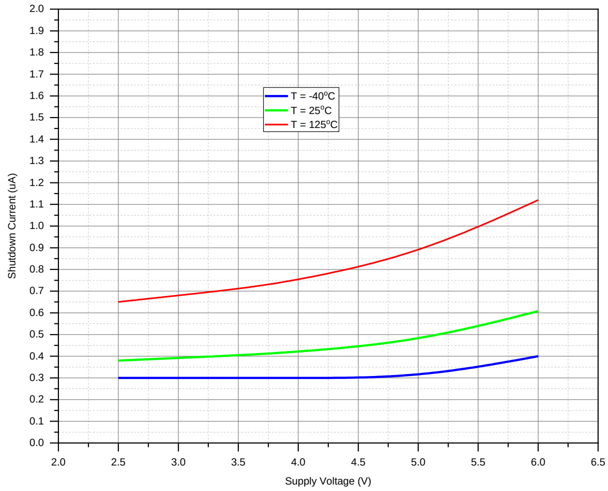


Figure 5. Shutdown Current

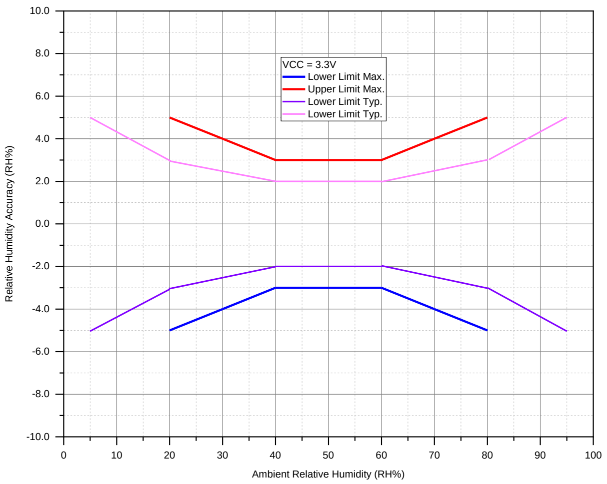


Figure 4. Relative Humidity Accuracy

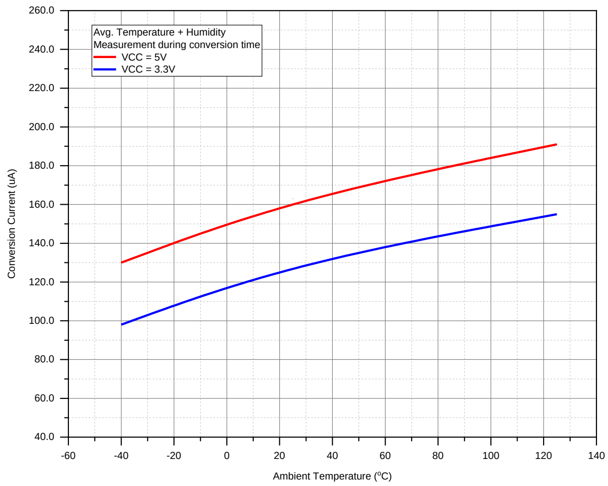


Figure 6. Conversion Current

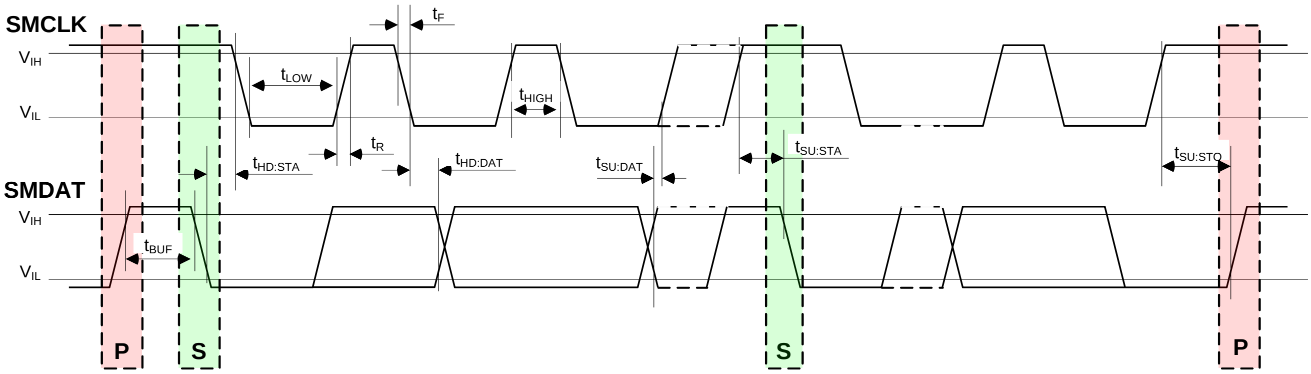


Figure 7. I^{2}C Timing Diagram

1 Function Descriptions

The chip can sense both temperature and humidity.It has integrated temperature and humidity sensor transducers, an analog-to-digital converter, signal processing, calibration, polynomial fit correction, and an I^2C interface in a single chip. The chip is individually calibrated for both temperature and humidity before shipment using on-chip non-volatile memory. It is permitted to connect 4 devices at the same I^2C bus by setting AD0 PIN. The SDA and SCL pins integrate spike-suppression filters and Schmitt triggers to minimize the effects of input spikes and bus noise. After power-up, the sensor enters standby mode until a communication or humidity and/or temperature measurement is performed. All output data bytes are transmitted MSB first. Also the chip supports programmable high-limit of temperature and humidity settings. If the measured temperature and/or humidity exceeds the high-limit threshold (T_{TH}, H_{TH}), ALERT pin will be asserted low. Once the measured temperature goes below the high-limit threshold, ALERT pin will be released.

1.1 Register Map

The sensor has 6 registers that user can access. The detail information is shown as below.

Table 1. Register Maps Definition

Register Address	Name	Default	Attribution*	Description
0x00	Temperature	0x0000	R/O	Temperature measurement data.
0x01	Humidity	0x0000	R/O	Relative humidity measurement data.
0x02	Config	0x1000	R/W	Sensor for configuration and status.
0x03	Alert Setup	0xCD36	R/W	High-limit setup for Temperature and Humidity
0xFE	Manufacture ID	0x5959	R/O	Manufacture ID
0xFF	Version ID	0x8305	R/O	Sensor Version ID

*Note: R/O, means ready only; R/W means readable/writable.

1.1.1 Temperature Measurement Data [Add:0x00]

The temperature measurement data is stored in Read Only temperature register. The temperature register is in 16-bit binary format with 2-Bytes. Actually only 14 bits (bit15 to bit2) are valid, bit1 and bit 0 are always '0'. This 2-Bytes Temperature data must be read at the same time in each reading cycle, 1^{st}-Byte is MSB followed by 2^{nd}-Byte, the LSB. The relationship between temperature data in Celsius degree and binary data is shown as below formula (1).

Table 2. 16-bit Temperature Data

Bit	Attribution	Temperature Data
Bit15 to bit2	Read only	Valid data, 0 or 1
Bit1 to bit0	Read only	Always 0

$$\text{Temperature}(^\circ\text{C}) = 165 * \frac{\text{Temperature[bit15:0]}}{2^{16}-1} - 40 \ldots\ldots(1)$$

1.1.2 Relative Humidity Measurement Data [Add:0x01]

The relative humidity measurement data is stored in Read Only humidity register. The humidity register is in 16-bit binary format with 2-Bytes. Actually only 14 bits (bit15 to bit2) are valid, bit1 and bit 0 are always '0'. This 2-Bytes data must be read at the same time in each reading cycle, 1^{st}-Byte is MSB followed by 2^{nd}-Byte, the LSB. The relationship between humidity data in %RH and binary data is shown as below formula.

Table 3. 16-bit humidity Data

Humidity Data	Attribution	Humidity Data
Bit15 to bit2	Read only	Valid data, 0 or 1
Bit1 to bit0	Read only	Always 0

$$\text{Relative Humidity}(\%RH) = 100\% * \frac{\text{Humidity}[bit15{:}0]}{2^{16}-1} \ldots\ldots(2)$$

1.1.3 Config Register [Add: 0x02]

The chip has a 16-bit (2-Bytes) configuration register, which is readable/writable attribution for user. User can change related bit to setup features, like Alert trigger, clock stretching, heater ON/OFF etc. Also user can read out register data to check the chip working status. And the register will reset to default data after power-up. 16 bits definition is shown as below table.

Table 4. Status Register Definition

BIT	15	14	13	12	11	10	9	8
definition	SRST	CLKSTR	Heater	MODE	VCCS	T_RES	H_RES	
default	0	0	0	1	0	0	00	
BIT	7	6	5	4	3	2	1	0
definition	ALTM		APS	HALT	TALT	Reserved	Reserved	
default	00		0	0	0	0	00	

bit2 is reserved for internal test with R/W attribution, DO NOT write ‘1’b into this bit during application.

SRST, Software Reset bit

‘1’ -- means soft reset.

‘0’ -- means normal operation.

default: 0

CLKSTR, clock stretching

‘1’ -- means clock stretching enable.

‘0’ -- means clock stretching disable.

default: 0

Heater

‘1’ -- means Heater ON.

‘0’-- means Heater OFF.

default: 0

MODE, measurement mode selection

'1' -- means both T and RH are measured in sequence, T in first.

'0' -- means only T or RH or voltage is measured

default: 1

VCCS, Supply Voltage Status bit

‘0’ -- means >2.8V.

‘1’ -- means <2.8V.

default: 0

T_RES, Temperature resolution bit

‘1’ -- means 11-bit.

‘0’ -- means 14-bit.

default: 0

H_RES, Humidity resolution bit

‘10’ -- means 8-bit.

‘01’ -- means 11-bit.

‘00’ -- means 14-bit.

default: 00

ALTM, Alert trigger mode selection bit

‘00’ -- either T or RH happens, ALT pin is active.

‘01’ -- only T happens, ALT pin is active.

‘10’ -- only RH happens, ALT pin is active.

‘11’ -- Both T&RH happen, ALT pin is active.

default: 00

APS, Alert Pending Status bit

'1' -- means at least one pending alert.

'0' -- means no pending alert.

default: 0

HALT, Humidity Alert Status bit

'1' -- means alter.

'0' -- means no alter.

default: 0

TALT, Temperature Alert Status bit

'1' -- means alter.

'0' -- means no alter.

default: 0

1.1.4 Alert High Limit Setup [Add: 0x03]

The chip features high-limit of temperature and humidity at ALERT pin. When temperature and/or humidity of measured achieves or exceeds threshold temperature and humidity setup by user, ALERT pin will be active. Once both temperature and humidity measured fall below threshold value, ALERT pin will be released from active status. ALERT pin is open drain output with active low. It is necessary to use external pull-up resistor of 4.7k to 10k in application. The default status of ALERT pin is NOT active after power on or soft reset the chip. ALERT pin trigger happens after each measurement cycle. In each measurement cycle, the chip will compare data of temperature and humidity register to that of threshold register. Comparing result will be performed at both ALERT pin and related bit of configuration register (bit4, bit3).

For threshold temperature and humidity data, the format is shown as below.

Table 5. Threshold Bit definition

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Default:0xCD36 RH=80%,T=60°C	1	1	0	0	1	1	0	1	0	0	1	1	0	1	1	0
	Humidity							Temperature								

The 1st 7bits are used for humidity threshold and the last 9bits are used for temperature threshold data.

The relationship between binary data and threshold data is shown as below sample.

Step 1, using zero '0' as LSB to complete 16 bits format data.

for Humidity, **1100 1100 0000 0000**

for Temperature, **1001 1011 0000 0000**

Step 2, using above formula to calculate temperature and humidity respectively.

$$\text{Relative Humidity}(\%RH) = 100\% * \frac{\text{Humidity}[\text{bit}15:0]}{2^{16}-1} = 100\% * \frac{52224}{65535} = 79.7\%RH \approx 80\%RH$$

$$\text{Temperature}(℃) = 165 * \frac{\text{Temperature}[\text{bit}15:0]}{2^{16}-1} - 40 = 165 * \frac{39680}{65535} - 40 = 59.9℃ \approx 60℃$$

Conversely, it is easy to convert threshold data into binary format for 7-bits humidity and 9-bits temperature.

For example, set threshold for humidity as 90%RH, 80℃ for temperature.

Step 1, convert threshold data into binary according to above formula.

Humidity, **1110 011**~~0 0110 0101~~, only keep the fist 7-bits[1110 011], remove all rest bits.

Temperature, **1011 1010 0**~~010 1101~~, only keep the fist 9-bits[1011 1010 0], remove all rest bits.

Step 2, then combine Humidity and Temperature binary data to compose full 16 bit format

Table 6. Combination for humidity and temperature high-limit

BIT	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	1	1	1	0	0	1	1	1	0	1	1	1	0	1	0	0
	Humidity							Temperature								

Based on above example, the threshold resolution for humidity is 512/65535 =0.78%RH, for temperature is 128/65535 *165=0.32^{o}C. The binary threshold data can be read & write by reading and writing command shown as below.

S	Slave Address	W	A	Register Add [0x03]	A	P	Sr	Slave Address	R	A

Register Data [MSB]	A	Register Data [LSB]	NA	P

Read High-limit Register [Reg Add:0x03] Procedure

S	Slave Address	W	A	Register Add [0x03]	A	Register Data [MSB]	A	Register Data [LSB]	A	P

Write High-limit Register [Reg Add:0x03] Procedure

1.1.5 Manufacture ID [Add: 0xFE]

Manufacture ID is the ready only register, for this sensor, the data is 0x5959.

1.1.6 Version ID [0xFF]

Version ID is another ready only register, which stands for released version or part no.

1.2 Soft Reset

Generally the chip will reset itself internally during power up every time. Also the chip supports reset without power off by, using soft reset command. When bit15 of config register is set to '1', the sensor will perform reset. After finishing reset, all registers will become the default data and the chip will reload calibration data from the memory. And bit15 will be read as '0'.

1.3 Heater

The chip integrated a resistive heater device that could be used to raise the temperature of the sensor. The heater can be switched on and off by setting bit13 as '1' or '0'of config register. After a reset the heater is disabled (as default). This can be used to drive off condensation, or to implement dew-point measurement. Turning on the heater will reduce the tendency of the humidity sensor to accumulate an offset especially at high humidity conditions. The heater current is slightly changed by VCC voltage.

1.4 Do Measurement Procedure

The sensor can be easily used to read out temperature and humidity data by following steps blew:

1.4.1 Step 1, Setup The Sensor

It is necessary to setup the sensor by writing proper data into config register [Reg Add:0x02], .like acquisition mode (bit12, MODE), temperature resolution (bit10, T_RES) and humidity resolution (bit9, bit8, RH_RES). Of course it is ok to use the default setup, just ignore this step.

1.4.2 Step 2, Trigger Temperature and/or Humidity Measurement

Trigger temperature measurement by writing register address, 0x00 into the sensor via I^2C bus.

Trigger humidity measurement by writing register address, 0x01 into the sensor via I^2C bus.

1.4.3 Step 3, Waiting for Conversion Time

The typical conversion time of temperature/humidity is 5.50ms with 14-bit, during the conversion, the sensor will NOT ACK reading action at I2C bus until one-time conversion is finished. Also the clock will be stretching if user set CLKSTR '1' (bit12 of config).

1.4.4 Step 4, Read Out Temperature and/or Humidity Measurement Data

Once conversion is finished, temperature and humidity raw data can be obtained by reading register 0x00, 0x01 respectively via I^2C bus.

1.4.5 Example C++ Code for Reading Out Temperature and Humidity Data

Here is the C++ code as example, to show 2 methods of reading out temperature and humidity register data.

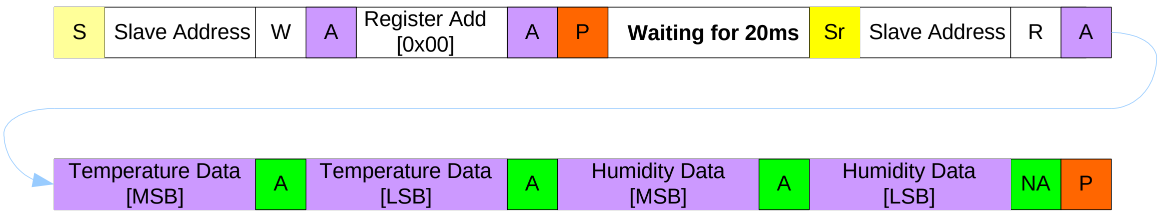
Method 1, reading 2-bytes from Reg 0x00 and Reg 0x01 to get temperature and humidity data respectively.

```
DWORD wLength;
BYTE* pReadBuf_CHT8305_Temp_Reg = new BYTE[wLength];
BYTE com_CHT8305_T_Reg[4];  com_CHT8305_T_Reg[0]=0x00;
BYTE com_CHT8305_H_Reg[4];  com_CHT8305_H_Reg[0]=0x01;
//get Temperature Data
DoWrite(0x80,com_CHT8305_T_Reg,1);      //writeReg add, 0x00, 0x80 is I2C slave add.
Sleep(20);                              //waiting 20ms for temperature conversion.
DoRead(0x80,pReadBuf_CHT8305_Temp_Reg,2,0,com_CHT8305_T_Reg);       //reading 2-bytes, and put them into
pReadBuf_CHT8305_Temp_Regvariable.
```

```
//get Relative Humidity Data
DoWrite(0x80,com_CHT8305_H_Reg,1);      //writeReg add, 0x01, 0x80 is I2C slave add.
Sleep(20);                               //waiting 20ms for humidity conversion.
DoRead(0x80,pReadBuf_CHT8305_Temp_Reg,2,0,com_CHT8305_H_Reg);      //reading 2-bytes, and put them into
pReadBuf_CHT8305_Temp_Reg variable.
```

Method 2, reading 4-bytes from Reg 0x00 to get temperature and humidity data at once reading operation.

```
//get both Temperature & Humidity Data at once reading cycle
DoWrite(0x80,com_CHT8305_T_Reg,1);      //writeReg add, 0x01, 0x80 is I2C slave add.
Sleep(20);                               //waiting 20ms for both temperature and humidity conversion.
DoRead(0x80,pReadBuf_CHT8305_Temp_Reg,4,0,com_CHT8305_T_Reg);      //reading 4-bytes, and put them into
pReadBuf_CHT8305_Temp_Reg variable.
```



1.5 Digital Interface

1.5.1 Slave Address

The chip is compatible with industry standard I^2C protocol as slave device communication with host via SDA and SCL pin. Both SDA and SCL pin are open drain structure.So it is necessary to use 2 pull-up resistors of 4.7k to 10k.The communication speed supports up to 400 kHz. The I^2C slave address of this device can be configured with 4 different addresses by setting AD0 pin. See below table for details. This permits connecting total of 4 devices in one same bus. Keeping AD0 pin float is the same as connecting AD0 pin to GND.

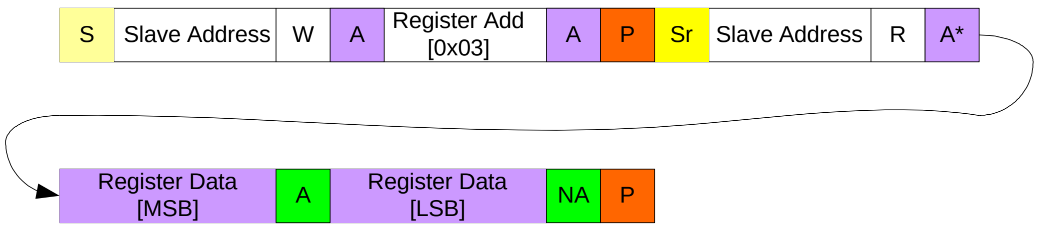
Table 7. Slave address vs. AD0 pin connection

No.	AD0	Slave Address in Bin
1	GND	7'b1000000
2	VCC	7'b1000100
3	SDA	7'b1001000
4	SCL	7'b1001100

1.5.2 Read/Write Operation

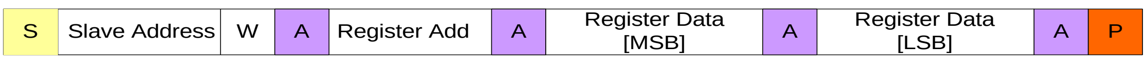
The chip supports basic standard protocols of Read, Write operation, shown as below figures. For CHT8305C, all register data is 16bit, 2-Bytes format.

Read Operation, Host generates start 'S' signal at first, then sends out slave address (R/W bit=0) of the chip set by user; the chip will ACK the slave address by pulling SDA low, then the host sends out register address, and the chip will acknowledge, ending with stop 'P'. The host will generate re-start 'Sr', then send out slave address again (R/W bit=1); the chip will ACK again with the output 16-bit (2-Bytes) data with MSB first, then LSB, the host has to ACK the MSB byte. Then the host send out ACK or NACK with stop 'P' at last.



Read (2-Bytes) Operation Figures

Write Operation:host generates start 'S' signal at first, then sends out slave address (R/W bit=0) of the chip set by user; the chip will acknowledge the slave address by pulling SDA low, then the host sends out register address. The chip will acknowledge. The host will send out 16-bit (2-Bytes) data to be written with MSB first, then LSB, the sensor will ACK byte by byte. Then host sends out stop 'P' at last.



Write (2-Bytes) Operation Figures

*Note: the chip will NOT ACK the salve address byte until conversion is finished if read 0x00 or 0x01 register.

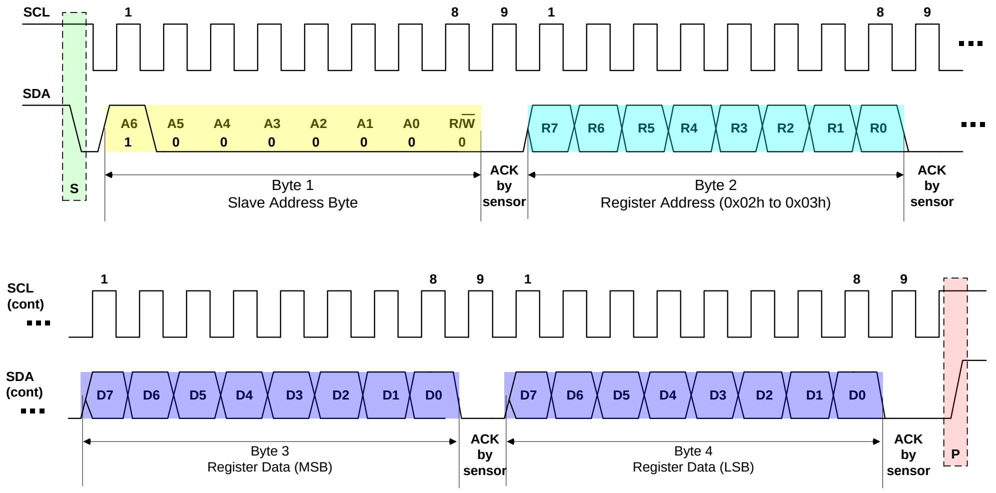


Figure 8. I2C Write Word (2-Bytes) Timing Diagram

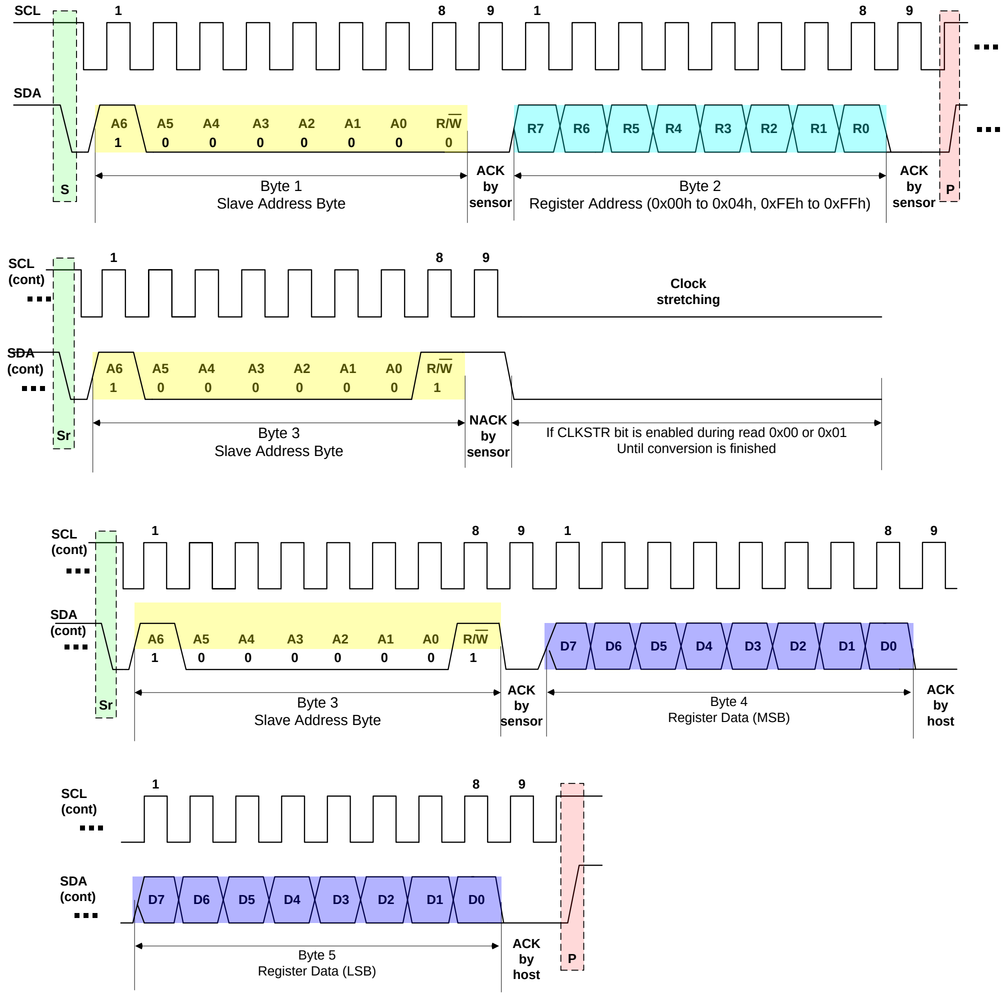


Figure 9. I2C Read Word (2-Bytes, for temperature or humidity) Timing Diagram

1.6 ALERT Output

ALERT pin is open drain output with active low. And it is triggered when the measured temperature and/or humidity equals or exceeds the high-limit threshold temperature and humidity setup by user. The ALERT pin can be used to connect to the interrupt pin of a microcontroller. It should be connected to a pull-up resistor in application shown in Figure 1. The logic status of ALERT pin is shown as in Figure 10.

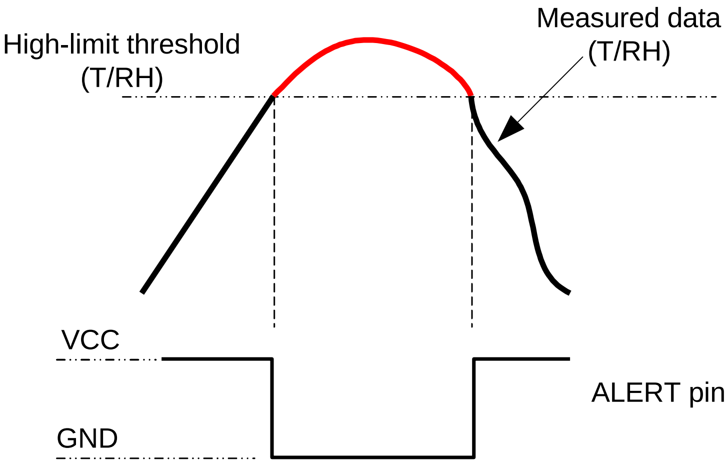


Figure 10. ALERT pin logic status

2 Application Information

In order to correctly and accurately sense the ambient temperature and humidity, the chip should be kept away from heat sources, RF module and big size components on the PCB. Also to minimize the error caused by self-heating it is recommended to measure at a maximum sample rate of 1mps (1 time measurement per second) (H + T). In general application, 0.5mps or even lower monitoring frequency of humidity and temperature is good enough.

2.1 Typical Application in Hardware

For the sensor, voltage range (VCC) can be applied by 2.5V to 5.5V. The formula is shown as below. It is necessary to use 4.7k pull-up resistors for I^2C Bus (SDA, SCL pin). If I^2C bus is available in system, which means pull-up resistors have been placed, just connect SDA, SCL pin of the sensor to the bus respectively. It need another pull-up resistor (4.7k) for ALERT pin, due to open drain structure. For AD0 pin, it is ok to connect to GND, or VCC or SDA, or SCL pin directly.

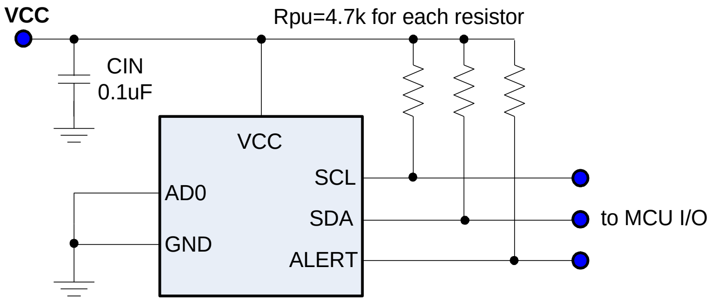


Figure 11. Sensor typical application

2.2 PCB Layout

Cautions below are important to improve temperature and humidity measurement accuracy in PCB layout design.

2.2.1 Device Placement

The sensor has to be placed on the top side of the PCB. It is recommended to isolate the sensor from the rest components of the PCB by eliminating copper layers below the device (GND, V_{DD}) and creating a slot into the PCB around the sensor to enhance thermal isolation. It is recommended to place the sensor away from any thermal source (e.g. power device in board), high speed digital bus (e.g. memory bus), coil device (e.g. inductors or transformers) and wireless antenna (e.g. Bluetooth, WiFi or RF). It is also recommened to place the sensor to be perpendicular to the ground to prevent dust drop into the cavity. Another important thing is to keep the sensor at good air circulation in the environment to be measured.

Figure 12. sensor placement example at PCB

2.2.2 Cin, Pull-up Resistor

It is better to place Cin as close as possible to VCC and GND pins of the chip. The recommended Cin value is 0.1uF with low ESR ceramic cap although using multi caps, such as 1.0uF plus 0.1uF or 0.01uF, is ok, which can suppress digital noise with different frequency range. User has to put a pull-up resistor with 4.7k to 10k for SDA,SCLand ALERT pins respectively. For AD0 pin, it can be connected to GND, VCC , SDA or SCL pin directly to assign different slave address, see above table.

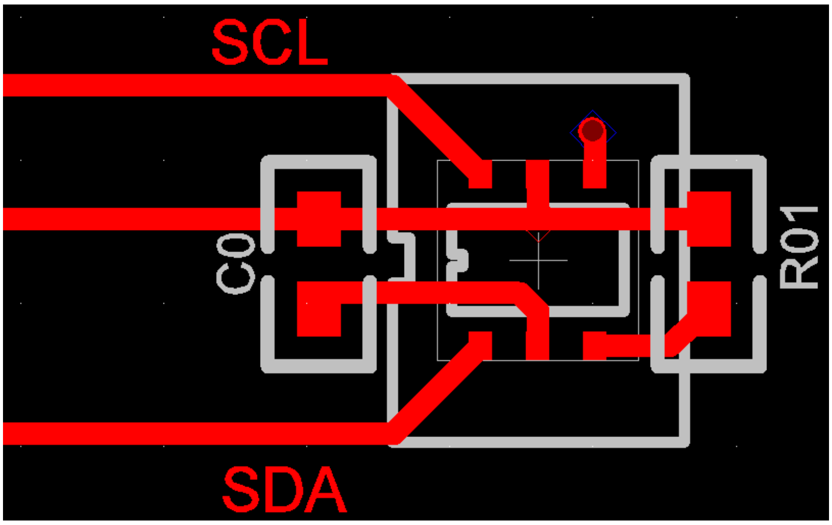


Figure 13. Sensor PCB layout example

2.3 Humidity Hysteresis

The measured humidity data of the sensor when environment changes from low to high, like from 10% to 80% could be slightly different from that when environment changes from 80% to 10%,,which is called humidity sensor hysteresis. The root cause is the difference of moisture absorption and moisture desorption of sensor transducer material. Figures below show the hysteresis.

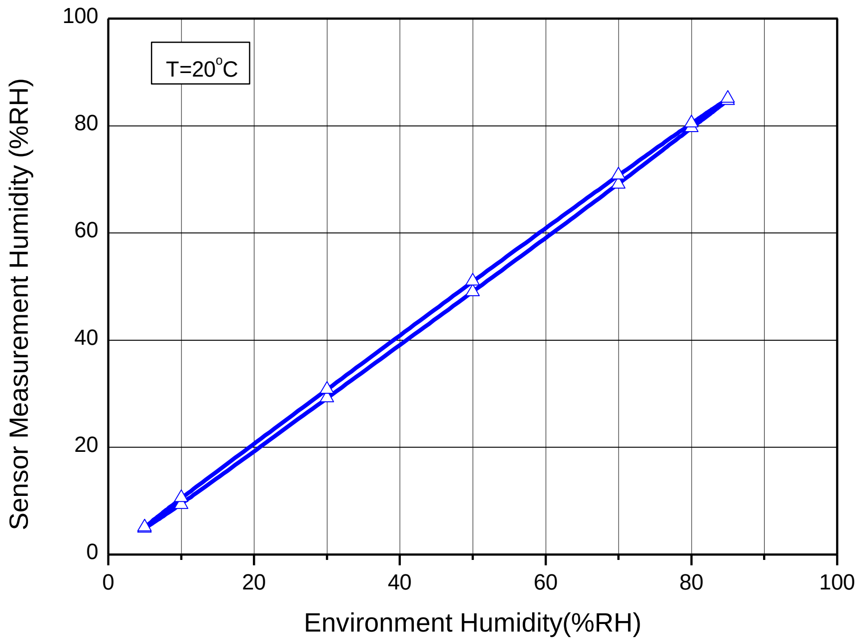


Figure 14. Humidity sensor data vs. environment humidity

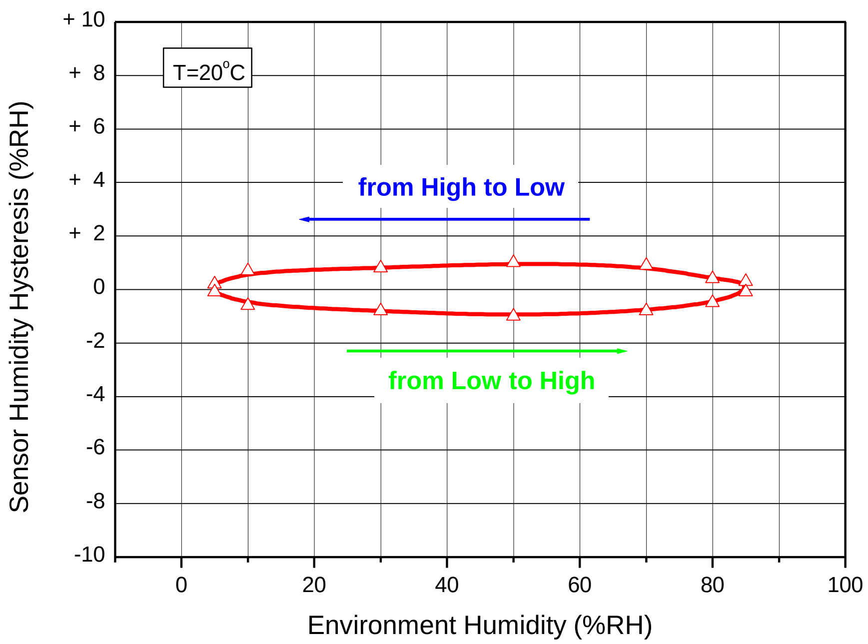


Figure 15. Sensor Humidity Hysteresis vs. environment humidity

2.4 Important Notices

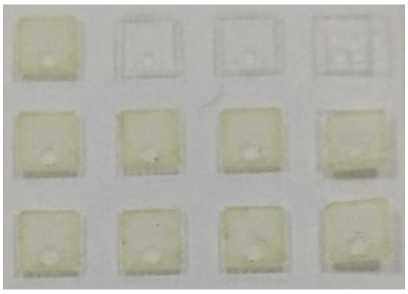
It is important to avoid the probability of contaminants coming into contact with the sensor through the open cavity. Dust and other particles as well as liquids could affect the humidity reading data. Also it is recommended to be far away from VOC, which could cause data drift of humidity reading. However the sensor could recover after a few minutes once it is moved to a normal environment. **DO NOT touch the surface of sensor area by inserting hard solid needle into cavity, like tweezers, which could permanently damage the sensor.**

2.4.1 Soldering

The CHT8305C chips shipped from the factory is vacuum-packed to avoid humidity accuracy offset during storage and to prevent moisture issues during solder reflow. The following procedure is recommended during PCB assembly: This sensor chip is compatible with standard board reflow assembly process. It is recommended to use 'No Clean' solder reflow process to reduce water or solvent rinsing impact. If cleaning is needed after reflow, it is recommended to order the chip with cavity protection cover.See ordering information for details. The humidity data of the sensor could be lower if reading immediately after reflow. However it will recover to normal after a few days hydration in normal environment. Do not exceed 300^{o}C over 10s during reflow or manual handling, which could damage the sensor permanently. For details about baking conditions, please contact Sensylink sales.

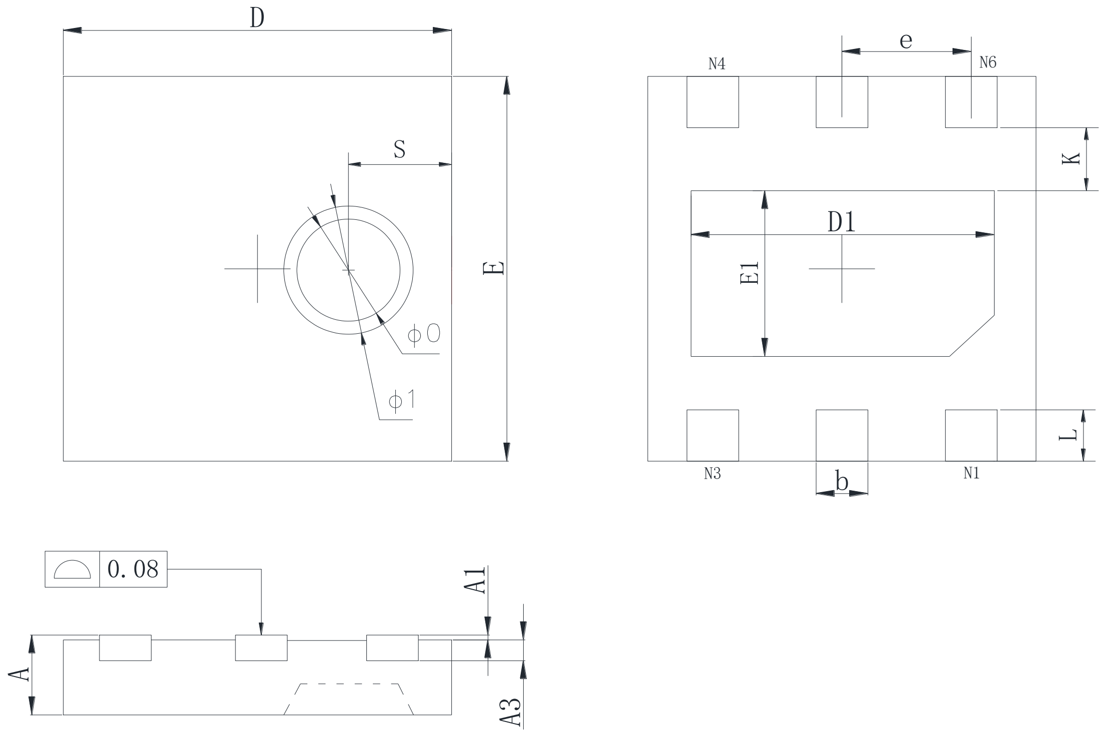
2.4.2 Cavity Protection Cover

The cavity protection cover for CHT8305C is available for order with postfix 'C'.The protection cover sticks to the chip surface and cover the cavity totally. It is NOT necessary to remove this cover after reflow process. It is very effective to block dust and liquid down to 0.40 microns in size. Below is cover sample with 3 rows by 4 columns.



Package Outline Dimensions (DFN3x3-6)

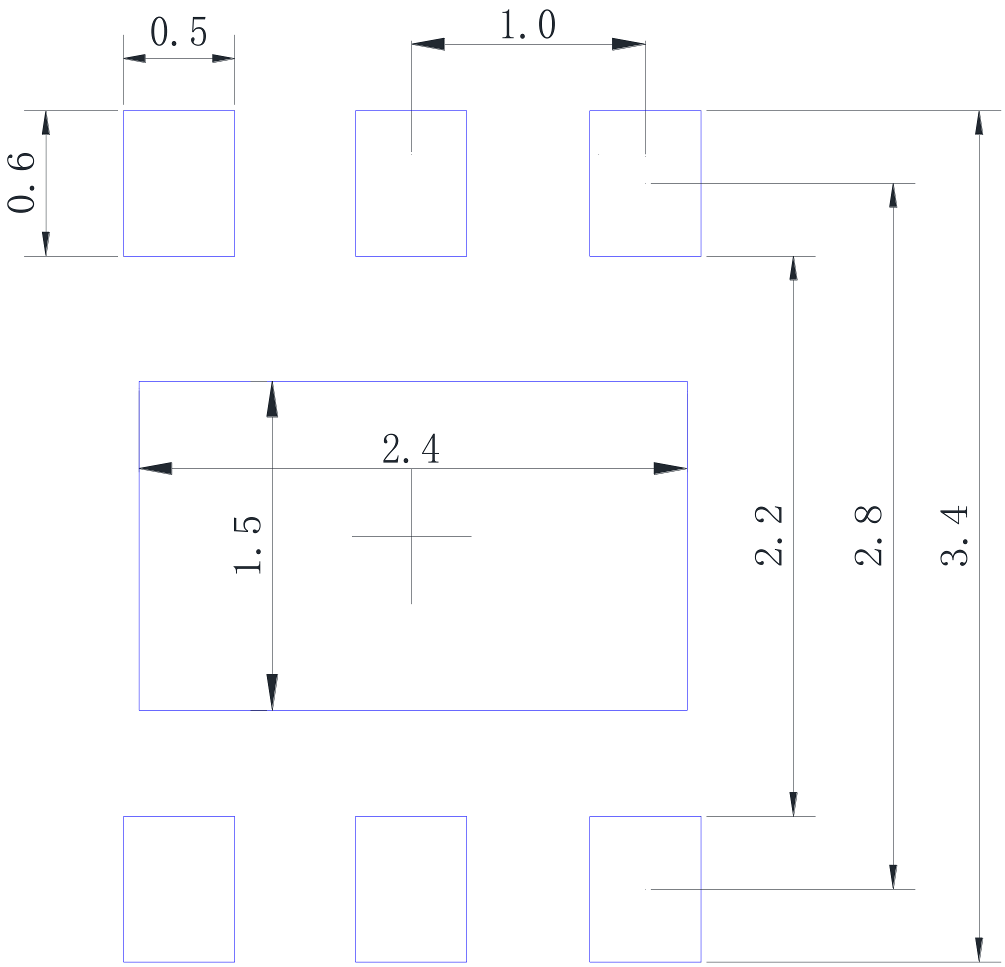
DFN3x3-6 **Unit (mm)**



Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	0.900	1.100	0.035	0.043
A1	0.010	0.050	0.000	0.002
A3	0.203REF.		0.008REF	
D	2.900	3.100	0.114	0.122
E	2.900	3.100	0.114	0.122
D1	2.300	2.500	0.091	0.098
E1	1.400	1.600	0.055	0.063
k	0.350MIN.		0.014MIN	
b	0.350	0.450	0.014	0.018
e	1.000TYP.		0.040TYP	
L	0.350	0.450	0.014	0.018
S	0.740	0.840	0.029	0.033
φ0	0.800TYP		0.036TYP	
φ1	1.000TYP		0.040TYP	

Recommend Land Pattern Layout (DFN3x3-6)

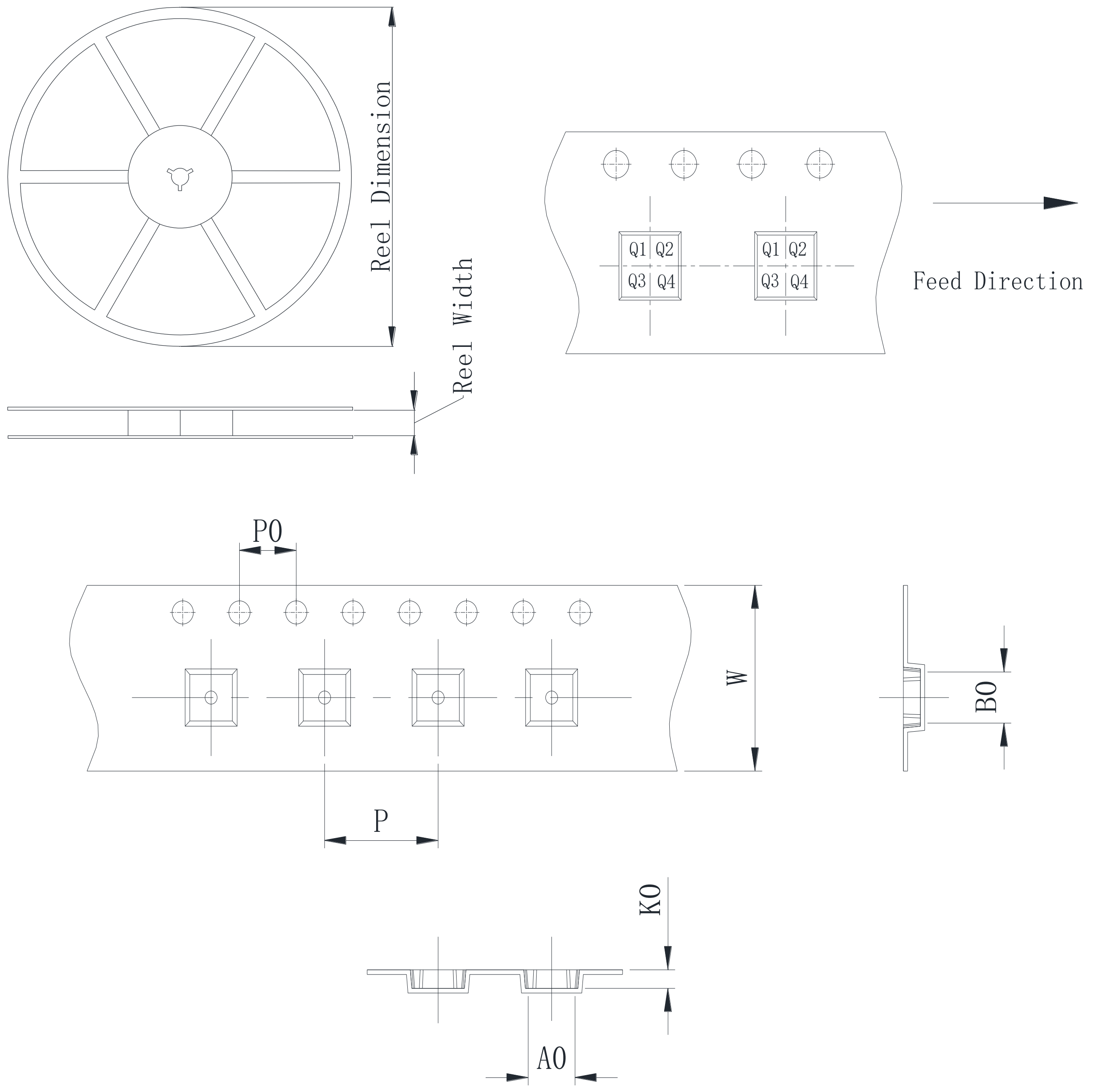
DFN3x3-6 **Unit (mm)**



Note:

1. All dimensions are in millimeter
2. Recommend tolerance is within ±0.1mm
3. If the thermal pad is not necessary, designer can leave the land pattern area blank
4. Change without notice

Packing information



Package type	Reel size	Reel dimension (±3.0mm)	Reel width (±1.0mm)	A0 (±0.1mm)	B0 (±0.1mm)	K0 (±0.1mm)	P (±0.1mm)	P0 (±0.1mm)	W (±0.3mm)	Pin1
DFN3x3-6	13'	330	12.8	3.5	3.5	1.2	8.0	4.0	12.0	Q4

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IMPORTANT NOTICE