SENSYLINK Microelectronics

(CHT8320)

Digital Humidity &Temperature Sensor

CHT8320 is a Digital Humidity and Temperature Sensor with ± 2.0%RH accuracy for humidity and ±0.1°C accuracy for temperature . It is compatible with SMBus, I2C Interface. It is ideally used in HVAC, Refrigerator, environment monitor etc.

Table of Contents

1 DESCRIPTION 4
2 FEATURES 4
3 APPLICATIONS 4
4 PIN CONFIGURATIONS (TOP VIEW) 4
5 TYPICAL APPLICATION 4
6 PIN DESCRIPTION 5
7 FUNCTION BLOCK 5
8 ORDERING INFORMATION 6
9 ABSOLUTE MAXIMUM RATINGS (NOTE1) 7
9.1. ABSOLUTE MAXIMUM RATINGS 7
9.2. RECOMMENDED OPERATING CONDITIONS 7
9.3. ELECTRICAL CHARACTERISTICS 8
9.4. TIMING CHARACTERISTICS 9
9.5. PARAMETER MEASUREMENT INFORMATION 10
9.6. HUMIDITY SENSOR ERROR GRAPHS 11
10 FUNCTION DESCRIPTIONS 12
10.1. COMMAND TABLE 12
10.2. OPERATION MODE 13
10.2.1 Power-Up and Communication Start 13
10.2.2 Measurement Commands for One-Shot Data Acquisition Mode 13
10.2.3 Measurement Commands for Continuous mode 13
10.2.4 ART Command 13
10.2.5 Break command / Stop Periodic Data Acquisition Mode 15
10.3. CONVERSION OF SIGNAL OUTPUT 15
10.4. HEATER 15
10.4.1 Heater Enable and Disable 15
10.4.2 Configure Level of Heater Current 15
10.5. STATUS REGISTERS 16
10.6. RESET 17
10.6.1 Software Reset 17
10.6.2 I2C General Call Reset 17
10.7. READ NIST ID/SERIAL NUMBER 17
10.8. READ MANUFACTURER ID 17
10.9. DIGITAL INTERFACE 17
10.9.1 I2C Interface 17
10.9.2 Timeout 17
10.9.3 I2C Write - Send Device Command 18
10.9.4 I2C Read 18
10.9.5 I2C Repeated START - Send Command and Retrieve Data Results 18
10.9.6 Checksum Calculation 19
11 APPLICATION INFORMATION 19
11.1. TYPICAL APPLICATION IN HARDWARE 19
11.2. PCB LAYOUT 19
11.2.1 Device placement 19
11.2.2 Cin, Pull-up resistor 20
11.3. IMPORTANT NOTICES 20
11.3.1 Soldering 20
11.3.2 Cavity Protection Cover 20
11.3.3 Cavity process Cover 20
12 PACKAGE OUTLINE DIMENSIONS (DFN2X2-4) 21

13 RECOMMENDED PCB LAYOUT PATTERN (DFN2X2-4)........22
14 PACKING INFORMATION........23
15 REVISION HISTORY........24

Figures and Tables

Figure 1 Typical Application of CHT8320........4
Figure 2 CHT8320 function block........5
Figure 3 I2C Timing Diagram........9
Figure 4 I2C Write Command Timing Diagram........9
Figure 5 I2C 2-Byte Read Timing Diagram........9
Figure 6 Shutdown Current vs Vcc........10
Figure 7 Average Current vs Vcc........10
Figure 8 Temperature Error vs. Ambient Temperature........10
Figure 9 Temperature Error vs. Vcc(RH=50%)........10
Figure 10 Humidity Error vs Vcc(T=25℃)........10
Figure 11 CHT8320 Humidity Error vs Ambient Humidity........11
Figure 12 Measurement commands in One-shot mode........14
Figure 13 Readout of Measurement Results for continuous mode........14
Figure 14 Break command........15
Figure 15 Enable Heater & Disable Heater Command........15
Figure 16 Configure Heater Current Full Power........16
Figure 17 Read Status &Clear Status Sequence........16
Figure 18 Software Reset Sequence........17
Figure 19 Read NIST ID Command Sequence........17
Figure 20 Read Manufacture ID Command Sequence........17
Figure 21 I2C Write Command........18
Figure 22 I2C Read Command........18
Figure 23 I2C Send Command and Retrieve Data Results........18
Figure 24 Sensor typical application........19
Figure 25 Sensor placement example at PCB........20

Table 1 CHT8320 Command Table........12
Table 2 Configurations of HEATER_CONFIG........16
Table 3 Status Register Table........16
Table 4 CHT8320 CRC Properties........19

1 Description

CHT8320 is a digital humidity and temperature sensor with ±2.0%RH(Typ.) accuracy for humidity and ±0.1 ℃ (Typ.) accuracy for temperature. It provides high accuracy measurements over a wide supply range (1.8 V – 5.5 V), along with ultra-low power consumption. Humidity and Temperature data can be read out directly via digital interface by MCU, Bluetooth Chip or Soc chip.

The digital interface is compatible with SMBus and I2C protocol. Also, it supports communication with high speed (up to 1.0MHz) for I2C protocol.

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, an analog to digital converter, a calibration unit with non-volatile memory, and a digital interface block.

Available Package: DFN2x2-4 package

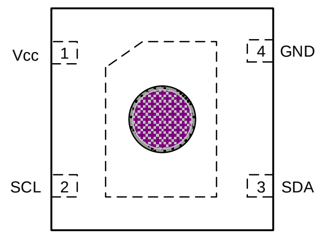
2 Features

- Operation Voltage: 1.8V to 5.5V
- Average Operating Current: 5.5uA (Typ.)@ 3.3V, 1Con/s for Both temperature and humidity Conversion
- Standby Current: 0.36uA(Typ.)
- Temperature Accuracy with calibration:
  ±0.1℃(Typ.), ±0.3℃(Max.)from 10℃ to 50℃
  ±0.2℃(Typ.), ±0.6℃(Max.)from 0℃ to 85℃
  ±0.5℃(Typ.), ±1.0℃(Max.) from -40℃ to 125℃
- Humidity Accuracy with calibration:
  ±2.0%RH(Typ.),±4.0%RH(Max.) from 20%RH to 80%RH
- Digital Interface compatible with SMBus and I2C, support:
  Packet Error Checking feature to improve communication reliability and robustness
  Speed up to 1.0MHz
  SMBus General Call
- Supports One shot or continuous measurement
- NIST traceability
- Temperature Range: -40℃ to 125 ℃
- Humidity Range: 0%RH to 100%RH

3 Applications

- Smart HVAC System
- Washer & dryer
- Refrigerator & freezer
- Cold Chain asset tracking & data logger
- Environment Monitor
- Portable/Wearable Weather Monitor
- IP Camera

4 PIN Configurations (Top View)



DFN2x2-4(Package Code DN)

5 Typical Application

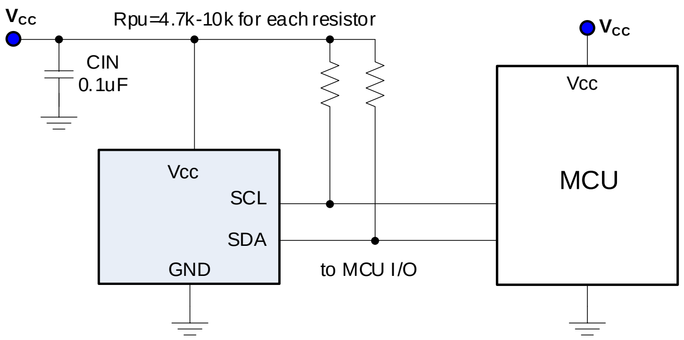


Figure 1 Typical Application of CHT8320

6 Pin Description

PIN No.	PIN Name	Description
1	Vcc	Power supply input pin, using 0.1uF low ESR ceramic capacitor to ground
2	SCL	Digital interface clock input pin, need a pull-up resistor to Vcc.
3	SDA	Digital interface data input or output pin, need a pull-up resistor to Vcc.
4	GND	Ground pin.
	Exposed Thermal PAD	Exposed thermal pad (bottom side).

7 Function Block

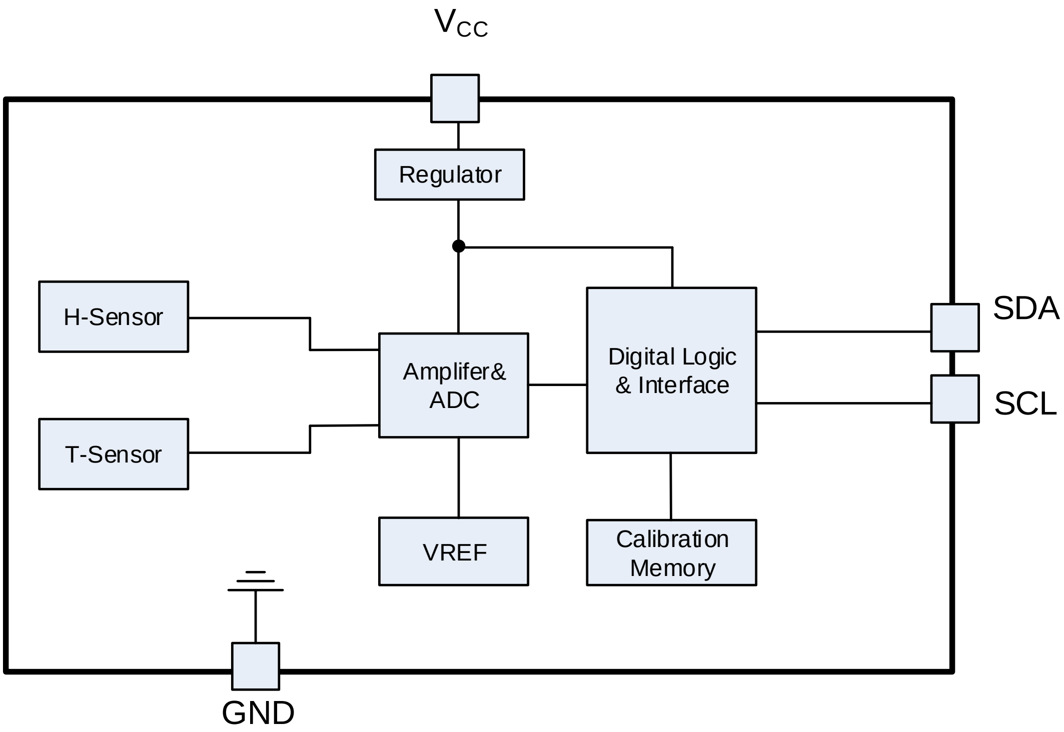


Figure 2 CHT8320 function block

8 Ordering Information

CHT8320 X X X - X

Address
A :0x88

Package Type
DN :DFN2x2-4

Packing
R: Tape & Reel

Protection
Blank: No Cover
C:Protect Cover
V:Process Cover

Order PN	Address	Accuracy	Green[1]	Package	Marking ID[2]	Packing	MPQ	Operation Temperature
CHT8320ADNR	0x88	±0.1℃ ±1.5%RH	Halogen free	DFN2X2-4	ML YWXA	Tape & Reel	3,000	-40℃~+125℃
CHT8320ADNR-C	0x88	±0.1℃ ±1.5%RH	Halogen free	DFN2X2-4	ML YWXA	Tape & Reel	3,000	-40℃~+125℃
CHT8320ADNR-V	0x88	±0.1℃ ±1.5%RH	Halogen free	DFN2X2-4	ML YWXA	Tape & Reel	3,000	-40℃~+125℃

Notes

1. Sensylink can meet RoHS 2.0/REACH requirement. 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.

9 Absolute Maximum Ratings (Note1)

9.1. Absolute Maximum Ratings

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC} to GND	-0.3 to 7.0	V
SDA, SCL Voltage	V_{SDA}/V_{SCL} to GND	-0.3 to 7.0	V
Operation junction temperature	T_J	-50 to 150	ºC
Storage temperature Range	T_{STG}	-65 to 150	ºC
ESD HBM	ESD_{HBM}	±4000	V
ESD CDM	ESD_{CDM}	±1000	V

Note1

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.*

9.2. Recommended Operating Conditions

Parameter	Symbol	Value	Unit
Supply Voltage	V_{CC}	1.8~ 5.5	V
Ambient Operation Temperature Range	T_{AT}	-40~+125	°C
Ambient Operation Temperature Range for Humidity measurement	T_{ATH}	0~ +80	°C
Ambient Operation Humidity Range	T_{AH}	0~100	%RH

9.3. Electrical Characteristics

Test Conditions: CIN = 0.1uF, Vcc =3.3V, TA=25℃ unless otherwise specified.

Parameter	Symbol	Test Conditions	Min	Typ	Max	Unit
Supply Voltage	Vcc		1.8		5.5	V
Active Current	I_{ACTIVE}	Both 1 Humidity and 1 Temperature measurement		90	125	uA
Sleep Current	$I_{SHUTDOWN}$	No Active Measurement		0.36	1	µA
		No Active Measurement, auto measurement mode		0.45	1	µA
Averaged Current(1) (2)	I_{CC}	Auto measurement mode, Averaged at 1 sample per second		5.5	8	uA
Heater Current (Condensation Removal)	I_{HEATER}	Quarter Power , Vcc = 3.3V		5	8	mA
		Half Power , Vcc = 3.3V		9	12	mA
		Full Power, Vcc = 3.3V		11	15	mA
Sensor Timing						
Measurement Duration (3)	t_{MEAS}	Both 1 Humidity and 1 Temperature measurement		60		ms
Power-up time	t_{PU}	Power-up time, Vcc⩾ V_{POR}		0.5	1	ms
Soft reset time	tSR	Time between ACK of soft reset command and sensor entering idle state		0.5	1	ms
Relative Humidity Sensor						
Humidity Accuracy(4)	H_{AC}	HA = 20%RH to 80%RH		±2.0	±4.0	%RH
		HA = 5%RH to 95%RH		±2.5	±6.0	%RH
Repeatability	RH_{REP}	TA = 25°C, 10% to 90% RH		±0.06		%RH
Hysteresis (5)	RH_{HYS}	TA = 25°C, 10% to 90% RH		±0.8		%RH
Resolution	R_{RES}			0.01		%RH
Response Time(6) (7)	RH_{RT}	TA = 25°C, 10% to 90% RH t63% step.		4		s
Long-term Drift (8)	RH_{LTD}			0.21		%RH/yr
Temperature Sensor						
Temperature Accuracy	T_{AC}	TA = 10 to 50℃		±0.1	±0.3	°C
		TA = 0 to 85℃		±0.2	±0.6	
		TA = -40 to 125℃		±0.5	±1.0	°C
Repeatability	T_{REP}			±0.02	±0.04	°C
Resolution	T_{RES}			0.01		°C
Response Time (in air) (9)	T_{RT}	25C <TA< 75C t63% step		2		s
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 Low 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
Low level Output Voltage	V_{OL}	SDA pin ,sin current 3mA			0.4	V
Logic Output Sink Current	I_{OLS}	SDA, SCL pin, forced 0.2V		4.0		mA
SCL frequency	f_{CLK}	High Speed Mode	0.001		1.0	MHz
Timeout of detecting clock low period time	t_{TOUT}	SMBus Communication		27	30	ms
Clock low period time	t_{LOW}		530			ns
Clock high period time	t_{HIGH}		260			ns
Bus free time	t_{BUF}	Between Stop and Start condition	1200			ns
Hold time after Start condition	$t_{HD:STA}$		260			ns
Repeated Start condition setup time	$t_{SU:STA}$		260			ns
Stop condition setup time	$t_{SU:STO}$		260			ns
Data Hold time	$t_{HD:DAT}$		0			ns
Data Setup time	$t_{SU:DAT}$		100			ns
Clock/Data fall time	t_F				300	ns
Clock/Data rise time	t_{SR}				300	ns

Note :

1. *Does not include I2C read/write communication or pullup resistor current through SCL and SDA*
2. *Average current consumption while conversion is in progress, Icc = measurement freq x I_{active} x tmeas+ Ishutdown x (1- (measurement freq x tmeas))*
3. *Measurement duration includes the time to measure RH plus Temp*
4. *For humidity accuracy, it excludes hysteresis, high temperature baker, hydration drift, long-term drift.*
5. *The hysteresis value is the difference between the RH measurement in a rising and falling RH environment, at a specific RH point*
6. *Actual response times will vary dependent on system thermal mass and air-flow*
7. *Time for the RH output to change by 63% of the total RH change after a step change in environmental humidity.*
8. *Based on THB (temperature humidity bias) testing. Excludes the impact of dust, gas phase solvents and other contaminants such as vapors from packaging materials, adhesives, or tapes, etc.*
9. *Time for the T output to change by 63% of the total T change after a step change in environmental temperature*

9.4. Timing Characteristics

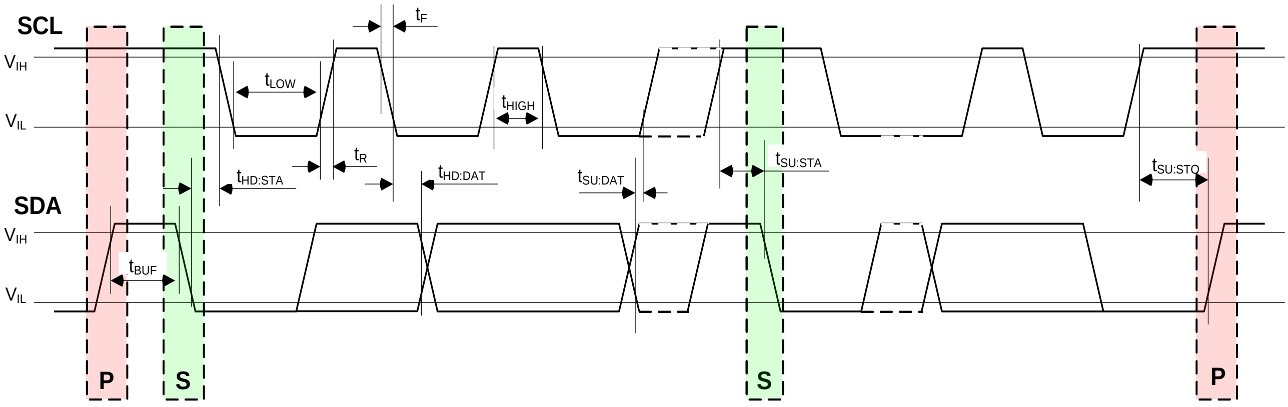


Figure 3 I2C Timing Diagram

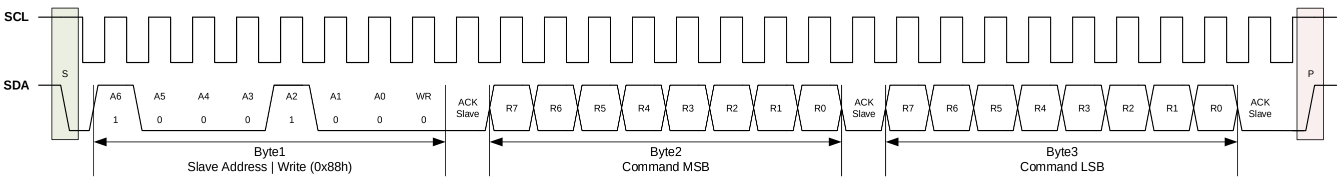


Figure 4 I2C Write Command Timing Diagram

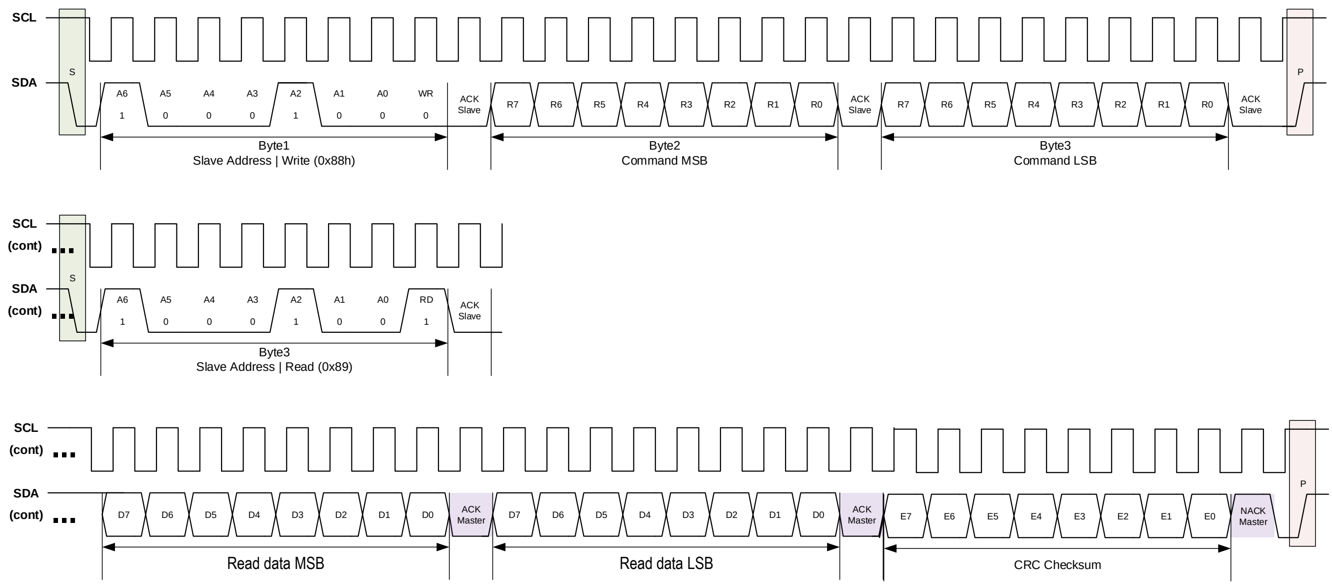


Figure 5 I2C 2-Byte Read Timing Diagram

9.5. Parameter Measurement Information

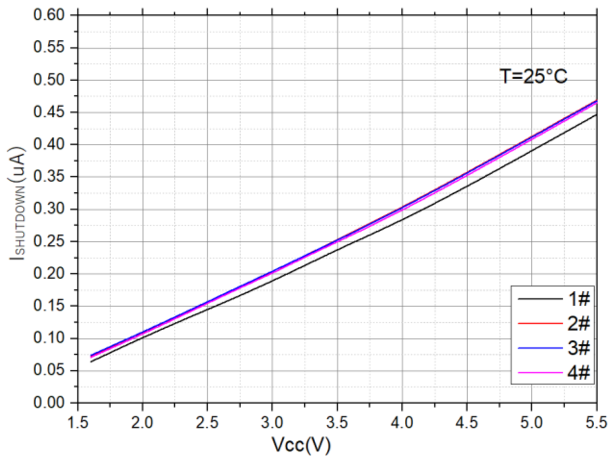


Figure 6 Shutdown Current vs Vcc

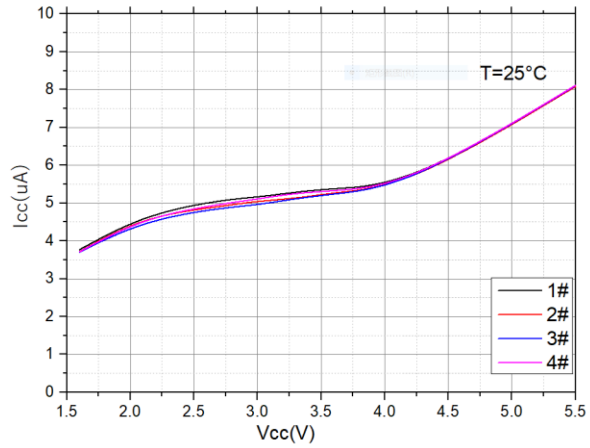


Figure 7 Average Current vs Vcc

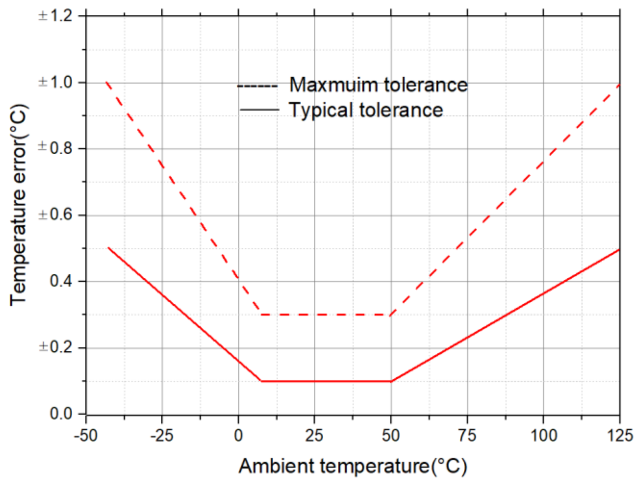


Figure 8 Temperature Error vs. Ambient Temperature

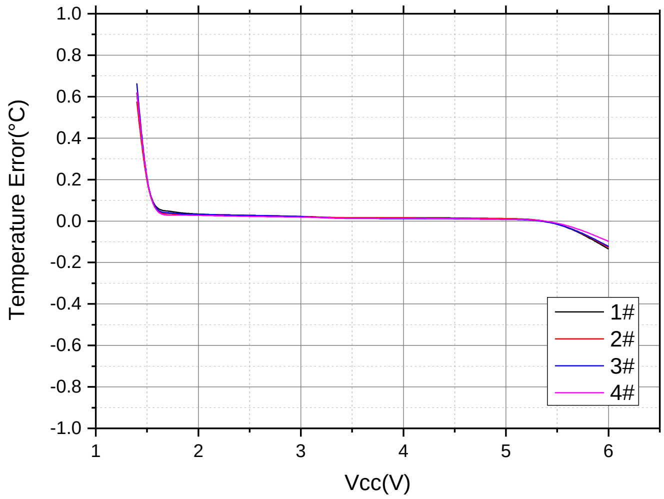


Figure 9 Temperature Error vs. Vcc(RH=50%)

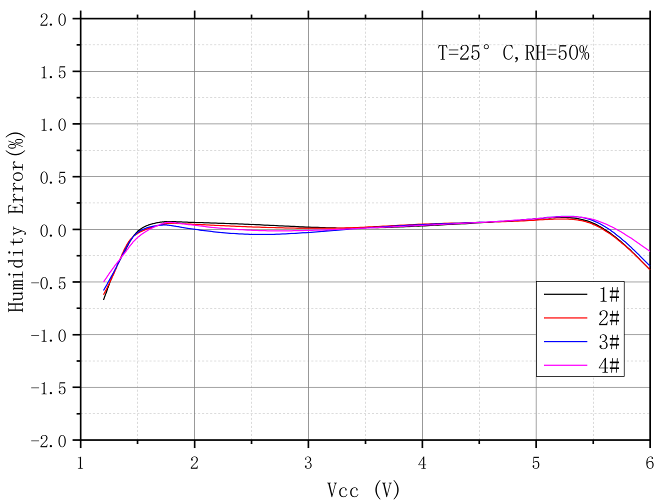


Figure 10 Humidity Error vs Vcc(T=25℃)

9.6. Humidity Sensor Error Graphs

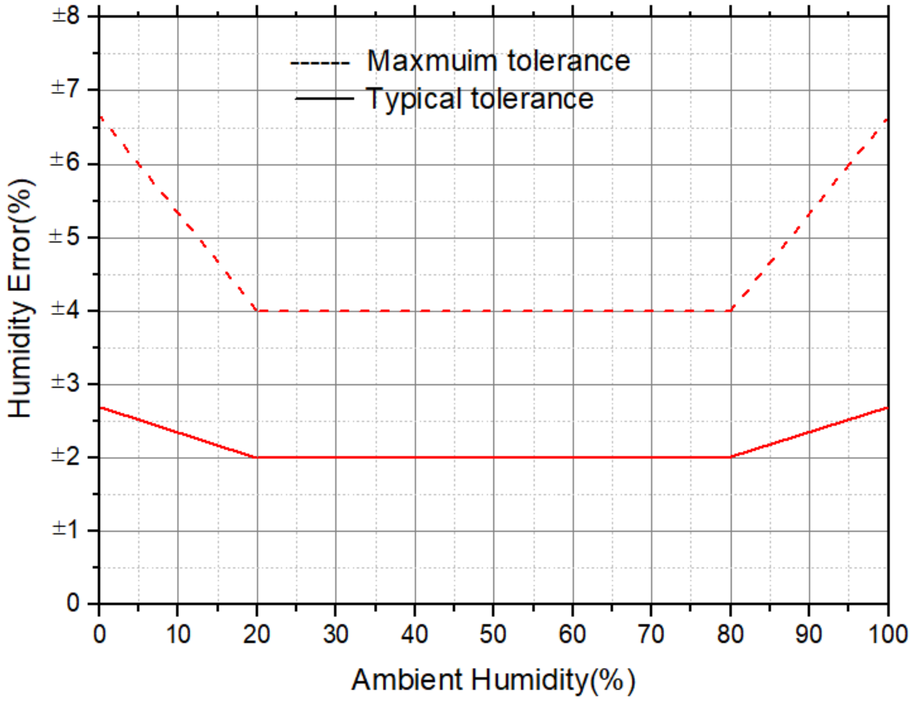


Figure 11 CHT8320 Humidity Error vs Ambient Humidity

10 Function Descriptions

10.1. Command Table

The CHT8320 command structure is documented below in Table 1.

Table 1 CHT8320 Command Table

HEX CODE (MSB)	HEX CODE (LSB)	COMMAND	COMMAND DETAIL
24	00	One-shot Mode Single Temperature (T) Measurement Single Relative Humidity (RH) Measurement Clock stretching disable	
24	0B		
24	16		
24	FF		
20	32	Auto Measurement Mode 1 measurement per 2 seconds.	
20	24		
20	2F		
20	FF		
21	30	Auto Measurement Mode 1 measurement per second.	
21	26		
21	2D		
21	FF		
22	36	Auto Measurement Mode 2 measurements per second.	
22	20		
22	2B		
22	FF		
23	34	Auto Measurement Mode 4 measurements per second.	
23	22		
23	29		
23	FF		
27	37	Auto Measurement Mode 10 measurements per second.	
27	21		
27	2A		
27	FF		
2c	06	One-shot Mode Single Temperature (T) Measurement Single Relative Humidity (RH) Measurement Clock stretching enable	
2c	0D		
2c	10		
30	93	Auto Measurement Mode	Exit, then return to sleep mode.
E0	00		Measurement Readout of T and RH.
2B	32		ART Command
30	6D	Integrated Heater	Enable
30	66		Disable
30	6e		Configure
F3	2D	Status Register	Read Content
30	41		Clear Content
30	A2	Soft Reset	
36	83	Read NIST ID (Serial Number) Bytes 5 and 4	
36	84	Read NIST ID (Serial Number) Bytes 3 and 2	
36	85	Read NIST ID (Serial Number) Bytes 1 and 0	
37	81	Read Manufacturer ID	5959

10.2. Operation Mode

The chip can sense both temperature and humidity that integrates temperature and humidity sensor transducers, an analog-to-digital converter, signal processing, calibration and SMBus/I2C interface in a single chip. The chip is individually calibrated for both temperature and humidity before shipment using on-chip non-volatile memory.

The CHT8320 has two modes of operation: Sleep Mode and Measurement Mode. Sleep mode is the default mode of the CHT8320 upon Power Up and Soft Reset. The chip will wait for an I2C instruction to trigger a measurement, or to read and write valid data. A measurement request will trigger the chip to switch to measurement mode, where measurements from the integrated sensors are passed through an internal ADC, and go through linearization using calibration data from within the device to produce accurate calculations of temperature and relative humidity. The results are stored in their respective data registers. After completing the conversion, the chip returns to sleep mode.

10.2.1 Power-Up and Communication Start

The sensor starts powering-up after reaching the power-up threshold voltage VPOR. After reaching this threshold voltage the sensor enter idle state. Once the idle state is entered it is ready to receive commands from the master (microcontroller). Each transmission sequence begins with a START condition (S) and ends with a STOP condition (P) as described in the I2C-bus specification. Whenever the sensor is powered up, but not performing a measurement or communicating, it automatically enters idle state for energy saving.

10.2.2 Measurement Commands for One-Shot Data Acquisition Mode

One-shot mode is a single measurement reading of temperature and relative humidity that is triggered through an I2C command on an as-needed basis. After the measurement is converted, the device remains in sleep mode until another I2C command is received.

In this mode one issued measurement command triggers the acquisition of one data pair. Each data pair consists of one 16 bit temperature and one 16 bit humidity value (in this order). During transmission each data value is always followed by a CRC checksum, see Figure 13. In one-shot mode different measurement commands can be selected. The 16 bit commands are shown in Table 1. They differ with respect to clock stretching (enabled or disabled).

After the sensor has completed the measurement, the master can read the measurement results (pair of RH& T) by sending a START condition followed by an I2C read header. The sensor will acknowledge the reception of the read header and send two bytes of data(temperature) followed by one byte CRC checksum and another two bytes of data (relative humidity) followed by one byte CRC checksum. Each byte must be acknowledged by the microcontroller with an ACK condition for the sensor to continue sending data. If the sensor does not receive an ACK from the master after any byte of data, it will not continue sending data.

The sensor will send the temperature value first and then the relative humidity value. After having received the checksum for the humidity value a NACK and stop condition should be sent. The I2C master can abort the read transfer with a NACK condition after any data byte if it is not interested in subsequent data, e.g. the CRC byte or the second measurement result, in order to save time. In case the user needs humidity and temperature data but does not want to process CRC data, it is recommended to read the two temperature bytes of data with the CRC byte (without processing the CRC data); after having read the two humidity bytes, the read transfer can be aborted with a with a NACK.

When a command without clock stretching has been issued, the sensor responds to a read header with a not acknowledge (NACK), if no data is present. When a command with clock stretching has been issued, the sensor responds to a read header with an ACK and subsequently pulls down the SCL line. The SCL line is pulled down until the measurement is complete. As soon as the measurement is complete, the sensor releases the SCL line and sends the measurement results.

10.2.3 Measurement Commands for Continuous mode

In the continuous mode one issued measurement command yields a stream of data pairs. Each data pair consists of one 16 bit temperature and one 16 bit humidity value. In this mode, the data acquisition frequency (0.5, 1, 2, 4, and 10 measurements per second mps) can be selected for different measurement commands. Clock stretching cannot be selected in this mode. The data acquisition frequency influences the measurement duration and the current consumption of the sensor.

If a measurement command is issued, while the sensor is busy with a measurement (measurement durations), it is recommended to issue a break command first. Upon reception of the break command the sensor abort the ongoing measurement and enter the sleep mode.

Transmission of the measurement data can be initiated through the fetch data command 0xE000 shown in Figure 14. If the ADC conversion is not completed, the last measurement data will be output after issuing the command to read the data.

10.2.4 ART Command

The ART (accelerated response time) feature can be activated by issuing the command 0x2B32. After issuing the ART command the sensor will start acquiring data with a frequency of 4Hz.The ART command is structurally similar to any other continuous mode command. Readout of measurement results through the fetch data command. Stop the periodic data acquisition through break command 0x3093.

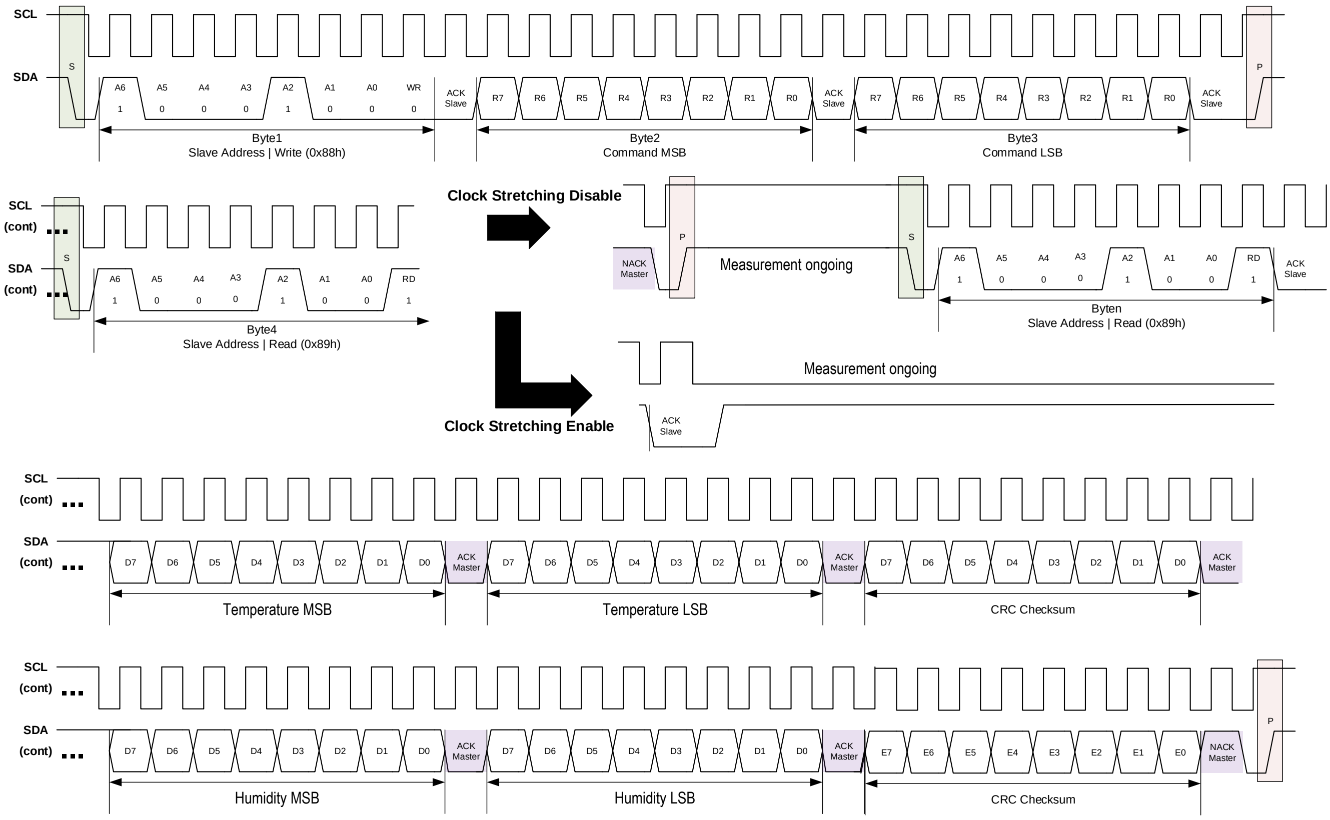


Figure 12 Measurement commands in One-shot mode

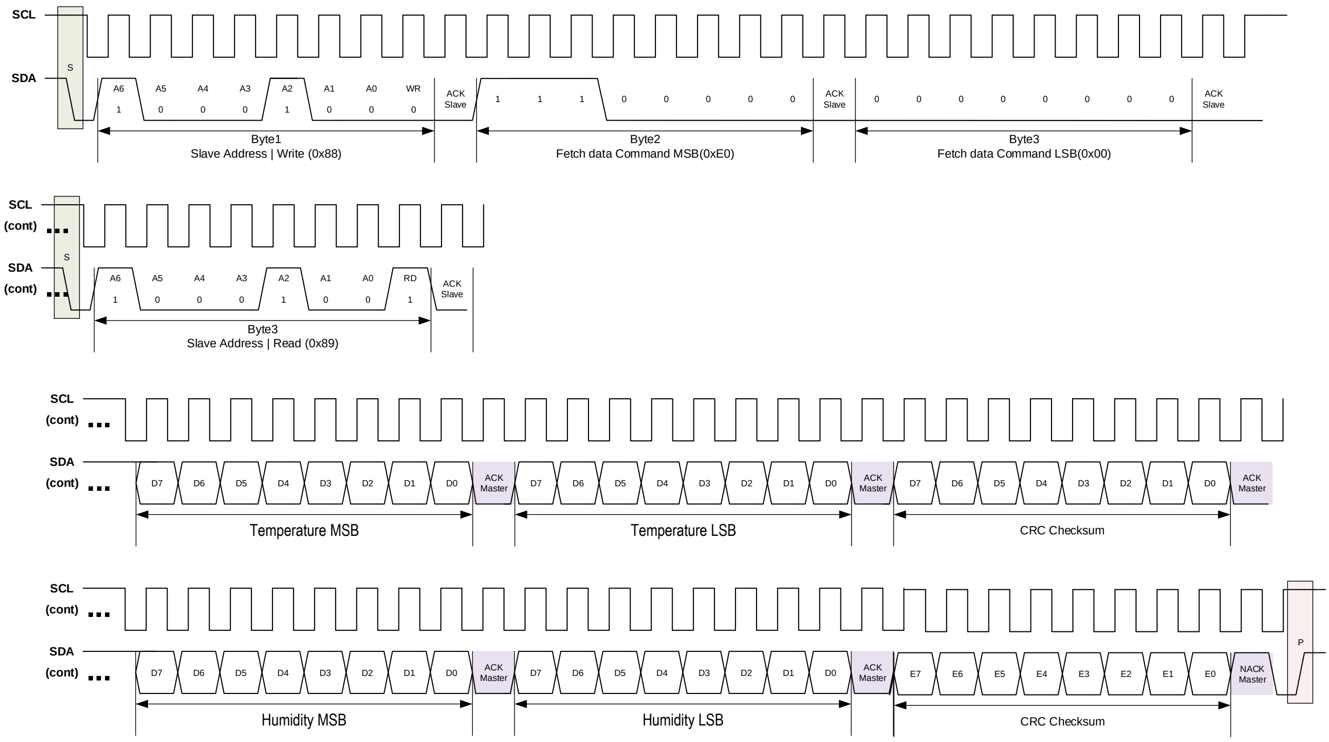


Figure 13 Readout of Measurement Results for continuous mode

10.2.5 Break command / Stop Periodic Data Acquisition Mode

The periodic data acquisition mode can be stopped using the break command 0x3093. It is recommended to stop the periodic data acquisition prior to sending another command (except Fetch Data command) using the break command. Upon reception of the break command the sensor will abort the ongoing measurement and enter the single shot mode.

S	I2C Address(W)	A	0x30	A	0x93	A	P

Figure 14 Break command

10.3. Conversion of Signal Output

Measurement data is always transferred as 16-bit values (unsigned integer). The relationship between humidity data in %RH unit and binary data is shown as below formula. Also humidity data can be considered as combination by each bit with 0.01%RH resolution.

Relative humidity conversion formula (result in %RH):

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

Temperature conversion formula (result in °C & °F):

$$\text{Temperature(°C)} = -45 + 175 * \frac{\text{Temperature[bit15:0]}}{2^{16}-1}$$

$$\text{Temperature(°F)} = -49 + 315 * \frac{\text{Temperature[bit15:0]}}{2^{16}-1}$$

10.4. Heater

10.4.1 Heater Enable and Disable

The CHT8320 includes an integrated heater with enough current draw to enable operation in condensing environments. The heater protects the humidity sensor area by preventing condensation as well as removing condensate. Enabling heater through command 0x306D and disable heater using command 0x3066.

Enable Heater:	S	I2C Address(W)	A	0x30	A	0x6D	A	P
Disable Heater:	S	I2C Address(W)	A	0x30	A	0x66	A	P

Figure 15 Enable Heater & Disable Heater Command

The heater is expected to impact the temperature measurement result and the relative humidity measurement result. An IC-based humidity sensor uses the die temperature as an estimate for the ambient temperature. Use of the heater will increase the die temperature up to 50°C above ambient temperature. Therefore, accurate measurement results of ambient temperature and relative humidity are not possible when the heater is in operation.

It is important to recognize that the integrated heater will evaporate condensate that forms on top of the humidity sensor, but does not remove any dissolved contaminants. This contaminant residue, if present, may impact the accuracy of the humidity sensor.

10.4.2 Configure Level of Heater Current

The CHT8320 heater architecture is comprised of 14 resistors in parallel, allowing support of several different power levels. The intent of this resistor array is to configure the appropriate heater current for offset error correction or condensation prevention/removal based on the ambient temperature and supply voltage. Table 2 below provides a partial list of heater configuration options. Figure 17 provides the sequence of setting the heating mode to full power.

Table 2 Configurations of HEATER_CONFIG

DESIRED HEATER CONFIGURATION	REQUIRED HEATER_CONFIG	CRC
ENABLE HEATER full power	3F FF	06
ENABLE HEATER half power	03 FF	00
ENABLE HEATER quarter power	00 9F	96

S	I2C Address(W)	A	0x30	A	0x6E	A	0x3F	A	0xFF	A	0x06	A	P

Figure 16 Configure Heater Current Full Power

10.5. Status Registers

The Status Register contains real-time information about the operating state of the CHT8320, as documented in Table 3. There are two commands associated with the Status Register: Read Content and Clear Content, as illustrated in Figure18.

Table 3 Status Register Table

BIT	DEFAULT	DESCRIPTION
15	1	Reserved
14	0	Reserved
13	0	Heater Status 0 : Heater Disabled 1 : Heater Enabled
12:5	0	Reserved
4	1	Device Reset Detected 0: No reset detected since last clearing of Status Register 1 :Device reset detected (via hard reset, soft reset command or supply fail)
3		Reserved
2		Reserved
1	0	Command status 0: last command executed successfully 1: last command not processed. It was either invalid, failed the integrated command checksum
0	0	Checksum verification of last data write 0: Pass (correct checksum received) 1 :Fail (incorrect checksum received)

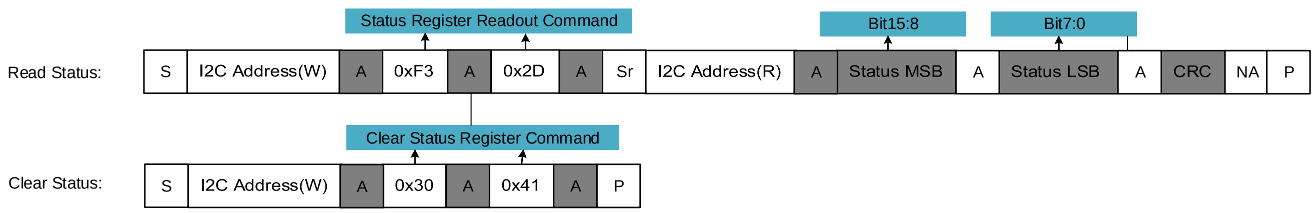


Figure 17 Read Status &Clear Status Sequence

10.6. Reset

10.6.1 Software Reset

The CHT8320 provides a soft reset mechanism that forces the system into a well-defined state without removing the power supply. When executed, the chip will reset its status register and reload the calibration data from memory. Software reset command illustrated in Figure 19.

Software Reset Command

Software Reset:	S	I2C Address(W)	A	0x30	A	0xA2	A	P

Figure 18 Software Reset Sequence

10.6.2 I2C General Call Reset

The chip supports reset via General Call Address (0000 000) on the bus. The chip acknowledges the general-call address and responds to commands in the second byte. If the second byte is 0000 0110, the chip all internal registers are reset to default values.

10.7. Read NIST ID/Serial Number

Each CHT8320 is configured with a unique 48-bit value that is used to support NIST traceability of the temperature and relative humidity sensor. It can also be used to represent the unique serial number for that device. Three commands are required to read the full 48-bit value as illustrated in Figure 20. Each command will return two bytes of NIST ID followed by a CRC byte. From MSB to LSB, the full device NIST ID is read as NIST_ID_5, NIST_ID_4, NIST_ID_3, NIST_ID_2, NIST_ID_1, and NIST_ID_0.

Read NIST_ID Byte5 & 4

Read NIST ID(NIST_ID Byte 5& Byte 4)	S	I2C Address(W)	A	0x36	A	0x83	A	Sr	I2C Address(R)	A	NIST_ID_5	A	NIST_ID_4	A	CRC	NA	P

Read NIST_ID Byte3 & 2

Read NIST ID(NIST_ID Byte 3& Byte 2)	S	I2C Address(W)	A	0x36	A	0x84	A	Sr	I2C Address(R)	A	NIST_ID_3	A	NIST_ID_2	A	CRC	NA	P

Read NIST_ID Byte1 & 0

Read NIST ID(NIST_ID Byte 1& Byte 0)	S	I2C Address(W)	A	0x36	A	0x85	A	Sr	I2C Address(R)	A	NIST_ID_1	A	NIST_ID_0	A	CRC	NA	P

Figure 19 Read NIST ID Command Sequence

10.8. Read Manufacturer ID

The Manufacture ID is a fixed value, for CHT8320, this data is 0x5959.Read the manufacture ID command sequence as illustrated in Figure 21.

Read Manufacture ID

S	I2C Address(W)	A	0x37	A	0x81	A	Sr	I2C Address(R)	A	0x59	A	0x59	A	0x53	NA	P

Figure 20 Read Manufacture ID Command Sequence

10.9. Digital Interface

10.9.1 I2C Interface

The CHT8320 operates only as a target device on the I2C bus. Multiple devices on the same I2C bus with the same address are not allowed. Connection to the bus is made through the open-drain I/O lines, SCL and SDA. After power-up, the sensor needs at most 3 ms to be ready to begin acquisition of temperature and relative humidity measurements. All data bytes are transmitted MSB first.

An I2C controller will communicate to a desired target device through a target address byte. The target address please refer to the product Ordering Information

10.9.2 Timeout

The chip supports SMBus timeout. If the data (SDA PIN) is held low for longer than 27ms (Typ.), the chip will reset its SMBus protocol and be ready for a new transmission when timeout feature is enabled.

10.9.3 I2C Write - Send Device Command

Communication to the CHT8320 is based upon a command list, which is documented in Table 1. Commands other than those documented are undefined and should not be sent to the device. An unsupported command returns a NACK after the pointer, and a read or write operation with incorrect I2C address returns a NACK after the I2C address.

An I2C write sequence is performed to send a command to the CHT8320. Some of these commands also require configuration data from the I2C controller. In those instances, a CRC byte must accompany the configuration data to permit error checking by the CHT8320. Both of these I2C write scenarios are illustrated in Figure 22.

I2C Write Command, No Configuration Data Required:

S	I2C Address(W)	A	Command MSB	A	Command LSB	A	P

I2C Write Command, Configuration Data and CRC Byte Required:

S	I2C Address (W)	A	Command MSB	A	Command LSB	A	Data MSB	A	Data LSB	A	CRC	A	P

Figure 21 I2C Write Command

10.9.4 I2C Read

An I2C read sequence is performed to retrieve data from the CHT8320. The I2C read sequence must follow the I2C write sequence that was used to initiate the data acquisition. A CRC byte always accompanies data that is transmitted by the CHT8320. If the I2C controller does not use the CRC byte to perform a data integrity check, then an I2C NACK can be issued to discard CRC transmission and save time. Both of these I2C read scenarios are illustrated in Figure 23. The CHT8320 will stop transmission of a data byte if the I2C controller fails to ACK after any byte of data. When an I2C read sequence is performed to retrieve multiple data results and the I2C controller does not use the CRC byte to perform a data integrity check, then an I2C NACK can be issued to only discard CRC transmission from the final transmitted data result.

I2C Read Single Data Result, CRC Discarded

S	I2C Address (R)	A	Data MSB	A	Data LSB	NA	P

I2C Read Single Data Result, CRC Retained

S	I2C Address (R)	A	Data MSB	A	Data LSB	A	CRC	NA	P

I2C Read Multi Data Result, Final CRC Discarded

S	I2C Address (R)	A	Data1 MSB	A	Data1 LSB	A	CRC	A	Data2 MSB	A	Data2 LSB	NA	P

I2C Read Multi Data Result, Final CRC Retained

S	I2C Address (R)	A	Data1 MSB	A	Data1 LSB	A	CRC	A	Data2 MSB	A	Data2 LSB	A	CRC	NA	P

Figure 22 I2C Read Command

10.9.5 I2C Repeated START - Send Command and Retrieve Data Results

CHT8320 supports I2C repeated START, which enables the issue of a command and retrieval of data without releasing the I2C bus. With all other data retrieval requests, reception of the CRC byte corresponding to the last data result may be discarded or retained. Both of these examples are illustrated in Figure 24.

I2C Repeated START Sequence, Single Data Result, CRC Discarded

S	I2C Address (W)	A	Command MSB	A	Command LSB	A	Sr	I2C Address (R)	A	Data MSB	A	Data LSB	NA	P

I2C Repeated START Sequence, Single Data Result, CRC Retained

S	I2C Address (W)	A	Command MSB	A	Command LSB	A	Sr	I2C Address (R)	A	Data MSB	A	Data LSB	A	CRC	NA	P

I2C Repeated START Sequence, Multi Data Result, Final CRC Discarded

S	I2C Address (W)	A	Command MSB	A	Command LSB	A	Sr	I2C Address (R)	A	Data1 MSB	A	Data1 LSB	A	CRC	A	Data2 MSB	A	Data2 LSB	NA	P

I2C Repeated START Sequence, Multi Data Result, Final CRC Retained

S	I2C Address (W)	A	Command MSB	A	Command LSB	A	Sr	I2C Address (R)	A	Data1 MSB	A	Data1 LSB	A	CRC	A	Data2 MSB	A	Data2 LSB	A	CRC	NA	P

Figure 23 I2C Send Command and Retrieve Data Results

10.9.6 Checksum Calculation

The 8-bit CRC checksum transmitted after each data word is generated by a CRC algorithm. Its properties are displayed in Table 4. The CRC covers the contents of the two previously transmitted data bytes. To calculate the checksum only these two previously transmitted data bytes are used.

Table 4 CHT8320 CRC Properties

PROPERTY	VALUE
Name	CRC-8
Width	8 bit
Protected Data	Read and/or Write Data
Polynomial	0x31 ($x^8 + x^5 + x^4 + 1$)
Initialization	0xFF
Reflect Input	False
Reflect Output	False
Final XOR	0x00
Examples	CRC of 0xABCD = 0x6F

11 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 still enough.

11.1. Typical application in hardware

For the sensor, voltage range (Vcc) can be applied by 1.8V to 5.5V. The typical application circuit is shown as below. It is necessary to use 4.7k pull-up resistors for I2C Bus (SDA, SCL pin). If I2C bus is available is system, which means pull-up resistors have been placed, just connect SDA, SCL pin of the sensor to the bus respectively.

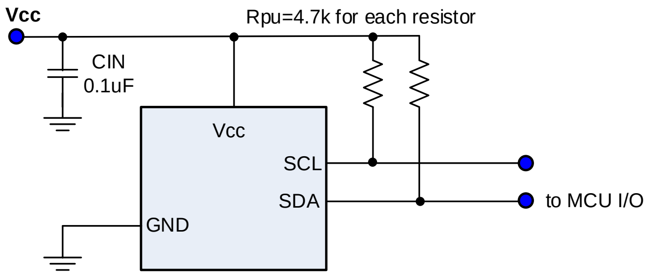


Figure 24 Sensor typical application

11.2. PCB Layout

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

11.2.1 Device placement

The sensor has to be located 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, Vcc) and creating a slot into the PCB around the sensor to enhance thermal isolation. It is better 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 better to keep the sensor be perpendicular to the ground to prevent dust drop into the cavity. Another important thing is to keep the sensor be good air circulation with environment to be measured.

Figure 25 Sensor placement example at PCB

11.2.2 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 ,SCL pins respectively.

11.3. Important Notices

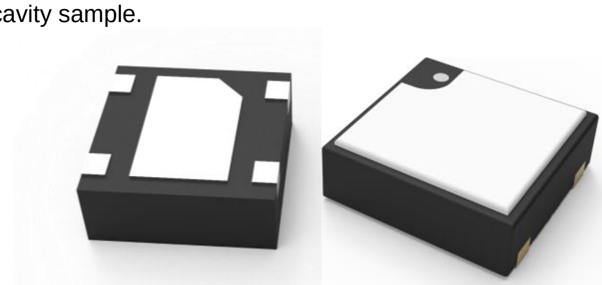
It is important to avoid the probability of contaminants coming into contact with the sensor through the open cavity. Dust and other particles as well as liquids could affect the humidity reading data. Also it is recommended to be far away from Voc, which could cause data drift of humidity reading. However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

11.3.1 Soldering

The CHT8320 chips shipped from the factory is vacuum-packed with an enclosed desiccant 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 have to do after reflow, it is better to order the chip with cavity protection cover, see ordering information for detail. The humidity data of the sensor could be lower if reading immediately after reflow. However it will come back to normal after hydration. Do not exceed 300℃ over 10s during reflow or manual handling, which could damage the sensor permanently. For detail about baker conditions, please contact Sensylink sales.

11.3.2 Cavity Protection Cover

The cavity protection cover for CHT8320 is available for order with postfix 'C'. it stick 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 cavity sample.

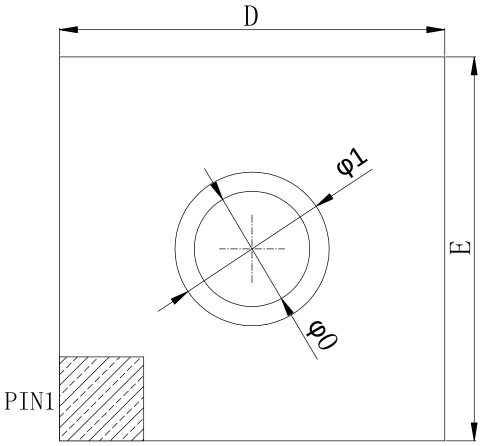


11.3.3 Cavity process Cover

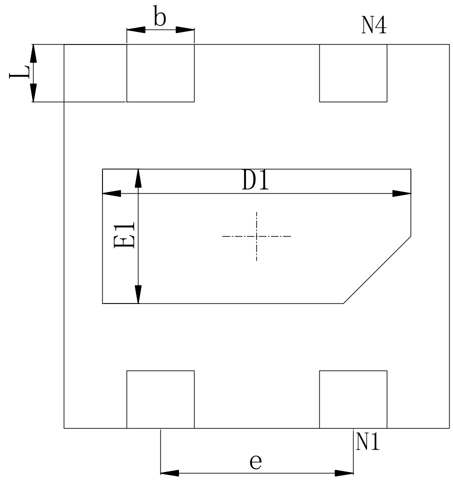
This cavity process cover for CHT8320 is available for order with postfix 'V'， it is a polyimide foil, dedicated to protect the sensor opening from pollution. The sensor is delivered with the process cover attached such that the sensor opening is completely covered and sealed. This enables cost-effective brush-over and spray-over application procedures of conformal coating material. The process cover can be easily removed with tweezers at the end of the assembly process to allow for proper sensor operation.

12 Package Outline Dimensions (DFN2X2-4)

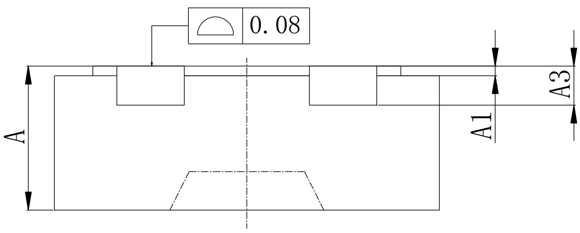
DFN2X2-4 Unit (mm)



Top View



Bottom View



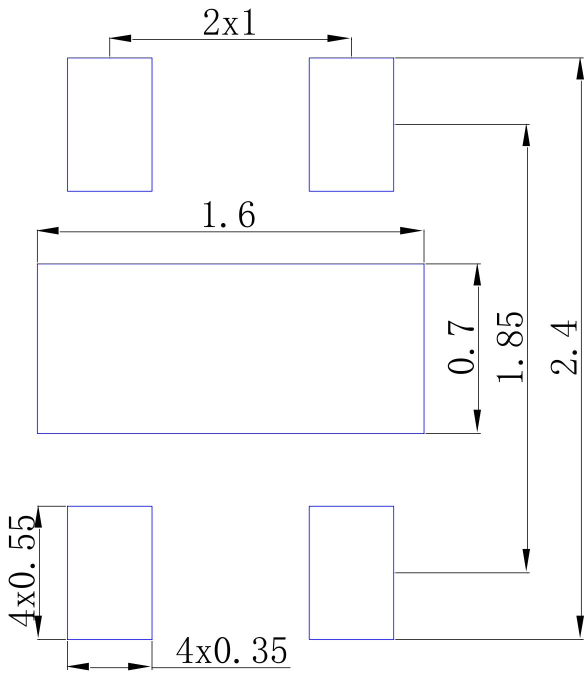
Side View

Symbol	Dimensions in Millimeters		Dimensions in Inches	
	Min.	Max.	Min.	Max.
A	0.700	0.800	0.028	0.031
A1	0.000	0.050	0.000	0.002
A3	0.203REF.		0.008REF	
D	1.900	2.100	0.075	0.083
E	1.900	2.100	0.075	0.083
D1	1.500	1.700	0.059	0.067
E1	0.600	0.800	0.024	0.031
b	0.300	0.400	0.012	0.016
e	1.000TYP.		0.039TYP	
L	0.250	0.350	0.010	0.014
φ0	0.600REF		0.024REF	
φ1	0.800REF		0.031REF	

Note：pin1 shape for thermal pad on backside is not limited to bevel, it can be a notch or arch

13 Recommended PCB Layout Pattern (DFN2X2-4)

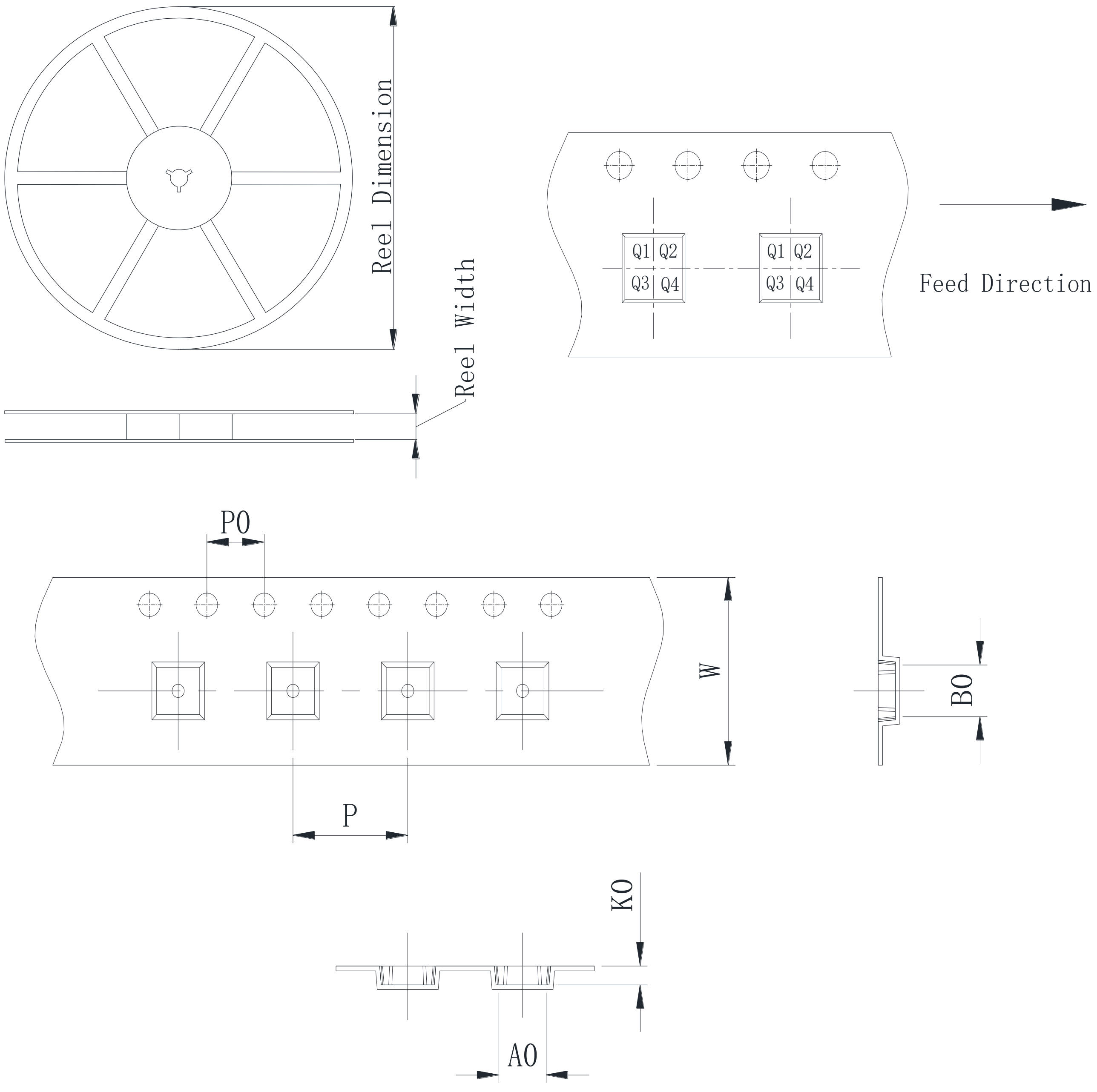
DFN2X2-4 Unit (mm)



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

14Packing 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
DFN2X2-4	7'	180	8.4	2.2	2.2	1.1	4.0	4.0	8.0	Q2
DFN2x2-V	13‘	330	12.5	2.15	3.2	1.15	8.0	4.0	12.0	Q1

15 Revision History

Version	Date	Change Content
Ver1.0	2024/12	Initial Version

SENSYLINK

SENSYLINK Microelectronics Inc.

www.sensylink.com

IMPORTANT NOTICE