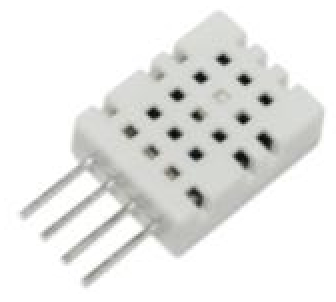
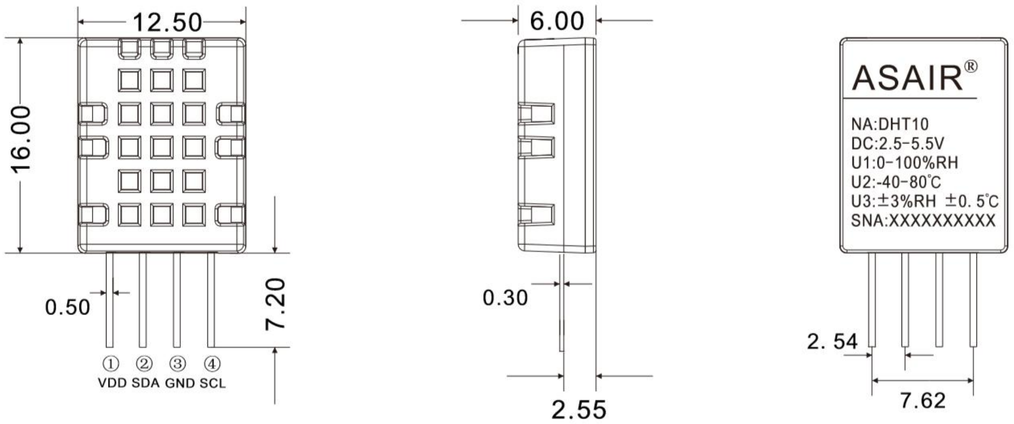
DHT10 technological manual

Temperature and humidity sensor

• Full calibration • strong anti-interference ability • Digital output, I2C interface • Excellent long-term stability • Quick response and strong anti-jamming capability • Wide voltage support 2.5-5.5v DC	

Application

HVAC system,dehumidifier,test and inspection equipment,consumer goods,automobiles, automatic control, data recorder,weather station,household appliances,humidity regulati on,medical and other related temperature and humidity detection and control.



Unit: mm tolerance: 0.1mm

Performance of sensor

Relative humidity

parameter	condition	minimum	typical	maximum	unit
accuracy	standard		0.024		%RH
Error range	standard		+/-3		%RH
	maximum	Figure 2			%RH
repeatability			+/-0.1		%RH
delaying			+/-1		%RH
nonlinearity			<0.1		%RH
response time	T63%		8		%RH
working range		0		100	%RH
drifting	normal		<0.5		%RH/yr

Table 1

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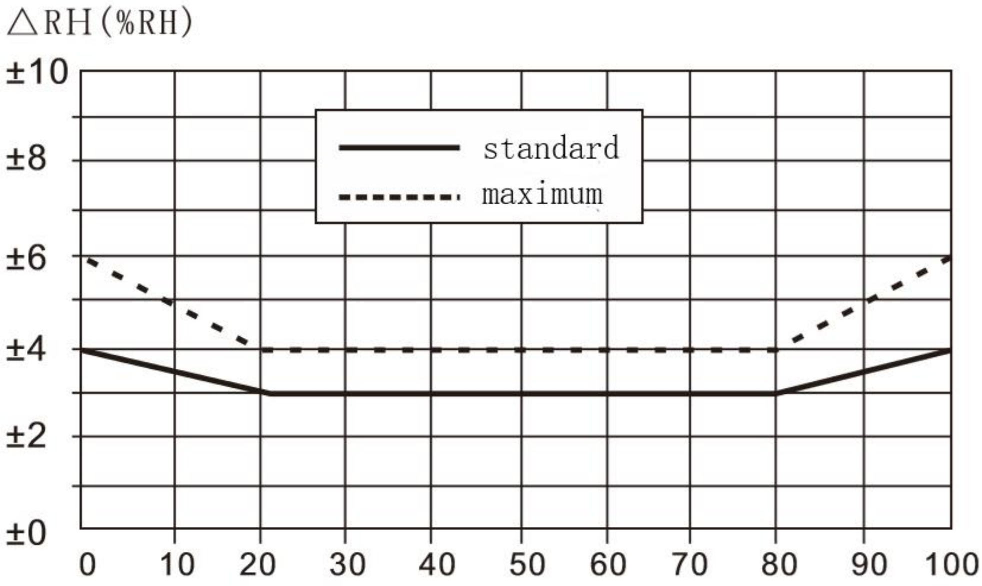

Figure 2 relative humidity (%RH)

temperature

parameter	condition	minimum	typical	maximum	unit
accuracy	standard		0.01		%RH
Error range	standard		+/-0.5		%RH
	maximum	Figure 3			%RH
repeatability			+/-0.1		%RH
delaying			+/-1		%RH
response time	T63%	5		30	%RH
working range		-40		80	%RH
drifting			<0.04		℃/yr

Table 3

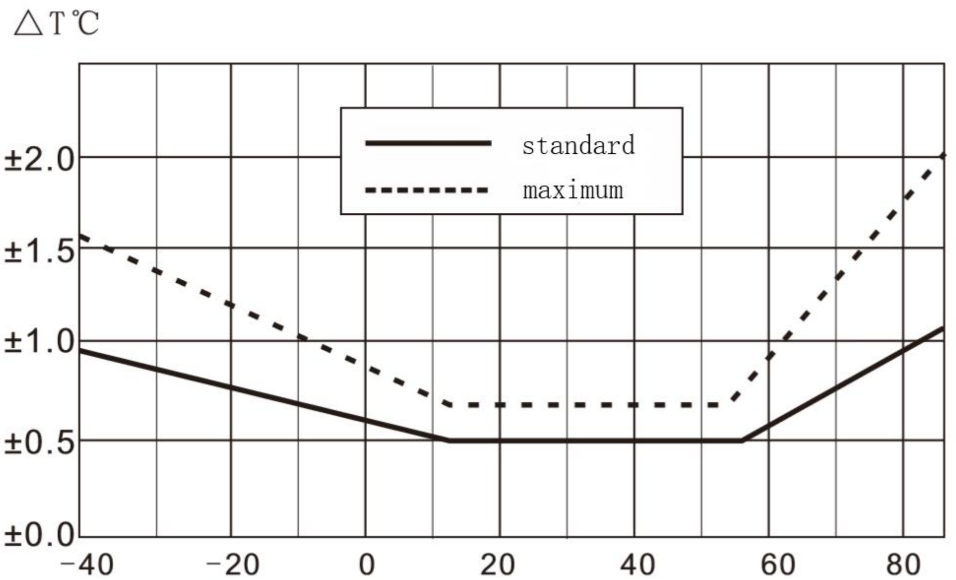

Figure 3 temperature (℃)

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electrical specification

parameter	condition	minimum	standard	maximum	unit
Operating voltage	standard	2.5	3.3	5.5	V
Operating current	dormancy	-		7.2	uA
	measure		4.3		uA
power dissipation	dormancy	-		39.6	uW
	measure		143		uW
	average	-	29.1	-	uW
interface	Standard I2C interface				

Table 2

DHT10 operational guideline

1 expansion performance

1.1 operating conditions

The performance of the sensor is stable within the recommended operating range, as shown in figure 4.Prolonged exposure to conditions outside the normal range, especially at humidity of > 80%, may result in temporary drift of the signal (drift +3%RH after 60 hours).After returning to normal operating conditions, the sensor will slowly self-restore to the normal state.See "recovery processing" in section 2.3 to speed up the recovery process.Prolonged use under abnormal conditions will accelerate the aging of the product.

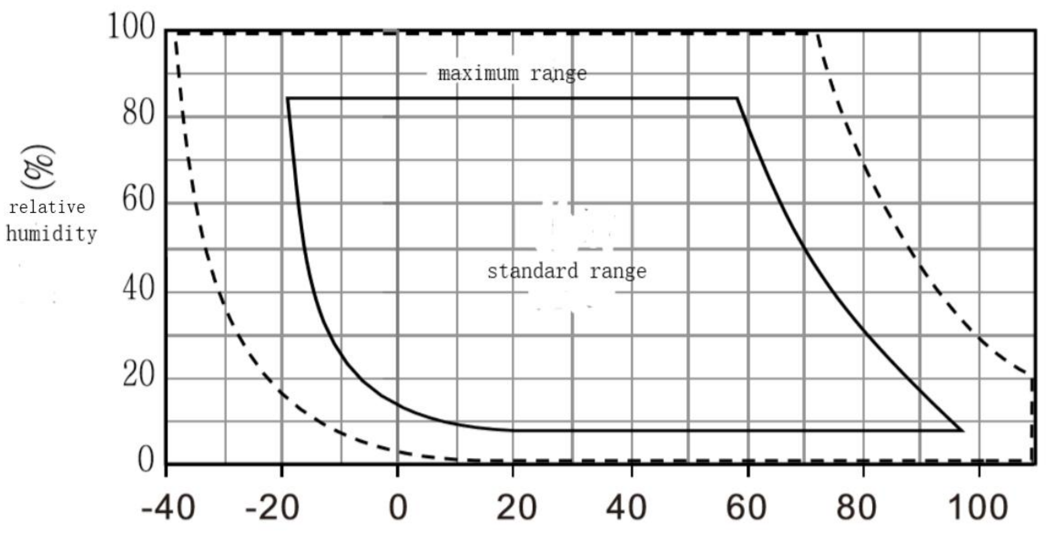


figure 4 operating condition

1.2 RH accuracy at different temperatures

The RH precision at 25 hours is defined in FIG. 2, and the maximum humidity error at other temperature segments of ℃ is shown in FIG. 5.

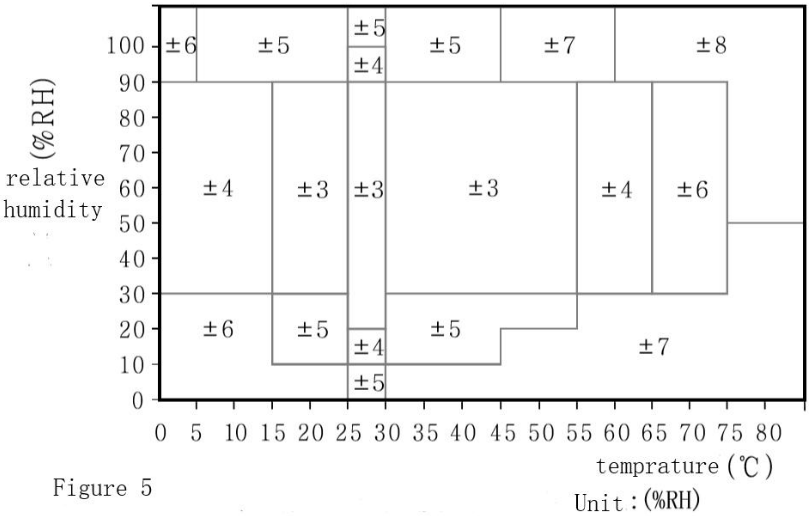


Figure 5

1.3 electrical characteristics

The power consumption given in table 2 is related to temperature and supply voltage VDD.See figures 6 and 7 for an estimate of power consumption.Note that the curves in figures 6 and 7 are typical natural features and may be biased.

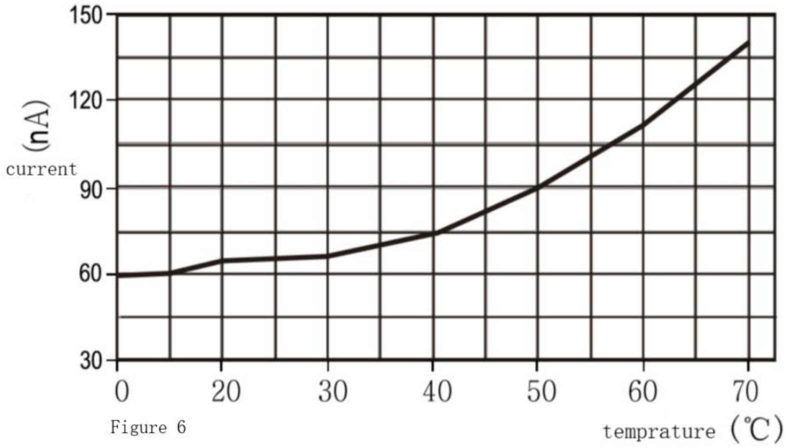


Figure 6

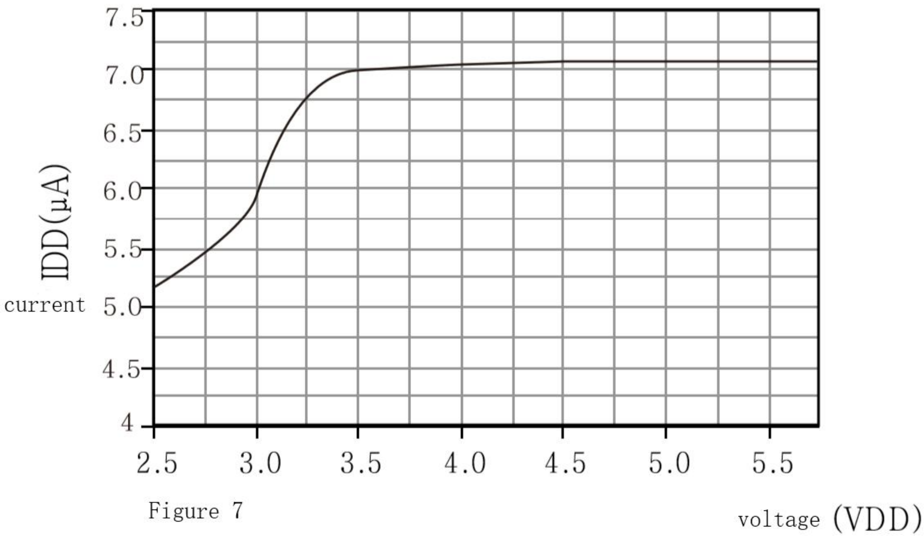


Figure 7

2 application information

2.1 welding instructions

Products are not allowed to use reflow or wave soldering welding.Manual welding at the highest temperature of 350℃ contact must be less than 5 seconds.

Note: after welding, the sensor should be stored in a >75%RH environment for at least 12 hours to ensure the polymer rehydration.Otherwise the sensor reading will drift.The sensor can also be placed in the natural environment (>40%RH) for more than 5 days to rehydrate it.Use low temperature solder (e.g., 180℃) to reduce hydration time.
If the sensor is applied in a corrosive gas or is produced by condensed water (such as in a high humidity environment), both the pin solder pad and the PCB shall be sealed (such as with a form coating) to avoid poor contact or short circuit.

2.2 storage conditions and operation instructions

Humidity sensitivity level (MSL) is 1, according to IPC/JEDEC j-std-020 standard.Therefore, it is recommended to use within one year after shipment.
Temperature and humidity sensor is not an ordinary electronic components, need careful protection, this user must pay attention to.Prolonged exposure to high concentrations of chemical vapor will cause the sensor read Numbers to drift.Therefore, it is recommended to store the sensor in the original package including the sealed ESD pocket, and meet the following conditions: temperature range of 10℃-50℃ (0-85℃ in limited time);Humidity 20-60%RH (sensor without ESD seal).For those sensors that have been removed from their original packaging, we recommend that they be stored in an anti-static bag containing a metal PET/AL/CPE material.
During production and transportation, the sensors should avoid contact with high concentrations of chemical solvents and prolonged exposure.Avoid contact with volatile glues, tapes, stickers or volatile packaging materials, such as foils and foams.The production area should be well ventilated.

2.3 recovery treatment

As mentioned above, readings can drift if the sensor is exposed to extreme working bars or chemical vapors.It can be restored to the calibration state by the following treatment.Drying: keep for 10 hours at 80-85℃ and humidity <5%RH;Rehydration: maintain for 12 hours at 20-30℃ and 7 pieces of >75%RH humidity bar.

2.4 temperature influence

The relative humidity of a gas depends largely on its temperature.Therefore, in the measurement of humidity, should be as far as possible to ensure that the measurement of the same humidity sensor at the same temperature.When doing a test, make sure that the sensor being tested and the reference sensor are at the same temperature, and then compare humidity readings.

In addition, when the measurement frequency is too high, the temperature of the sensor will increase and affect the measurement accuracy.If its own temperature rise is to be kept below 0.1℃, the activation time of DHT10 should not exceed 10% of the measured time -- it is recommended to measure the data every 2 seconds.

2.5 materials for sealing and encapsulation

Many materials absorb moisture and will act as buffers, increasing response time and hysteresis.Therefore, the material around the sensor should be carefully selected.Recommended materials are: metal materials, LCP, POM (Delrin), PTFE (Teflon), PE, PEEK, PP, PB, PPS, PSU, PVDF,PVF.Materials used for sealing and bonding (conservatively recommended) : epoxy filled methods are recommended for sealing electronic components, or silicone.Gases released from these materials may also contaminate DHT10(see 2.2).Therefore, the sensor should be finally assembled and placed in a well-ventilated place or dried in a >50℃ environment for 24 hours so that the contaminated gas can be released before packaging.

2.6 wiring rules and signal integrity

If the SCL and SDA signal lines are parallel and very close together, it is possible to cause signal crosstalk and communication failure.The solution is to place VDD and/or GND between the two signal lines, separate the signal lines, and use shielded cables.In addition, reducing the SCL frequency may also improve signal integrity.A 100nF debunking capacitor must be added between the power pin (VDD, GND) for filtering.The capacitance should be as close to the sensor as possible.See the next chapter.

3 interface definition

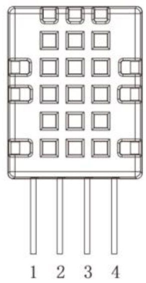
pin	name	explain	
1	VDD	Power(2.5-5.5V)	
2	SDA	Serial data, bidirectional	
3	GND	ground	
4	SCL	Serial clock, bidirectional	

Table 5

3.1 power pin(VDD\GND)

The power supply range of DHT10 is 2.5-5.5v, and the recommended voltage is 3.3v.A 100nF decoupling capacitor shall be connected between the power supply (VDD) and ground (GND), and the capacitance shall be positioned as close to the sensor as possible - refer to figure 8.

3.2 serial clock(SCK)

SCL is used for communication between the microprocessor and DHT10.Since the interface contains completely static logic, there is no minimum SCL frequency.

3.3 serial data(SDA)

SDA pins are used for data input and output of the sensor.SDA is effective at the rising edge of the serial clock (SCL) when sending a command to the sensor, and must remain stable when the SCL is high.The SDA value can be changed after the SCL drop edge.To ensure communication security, the effective time of SDA should be extended to TSU and tho-reference figure 9 before and after the SCL rising edge and after the falling edge, respectively.When the data is read from the sensor, the SDA is effective (TV) after the SCL is low and is maintained to the next SCL drop edge.

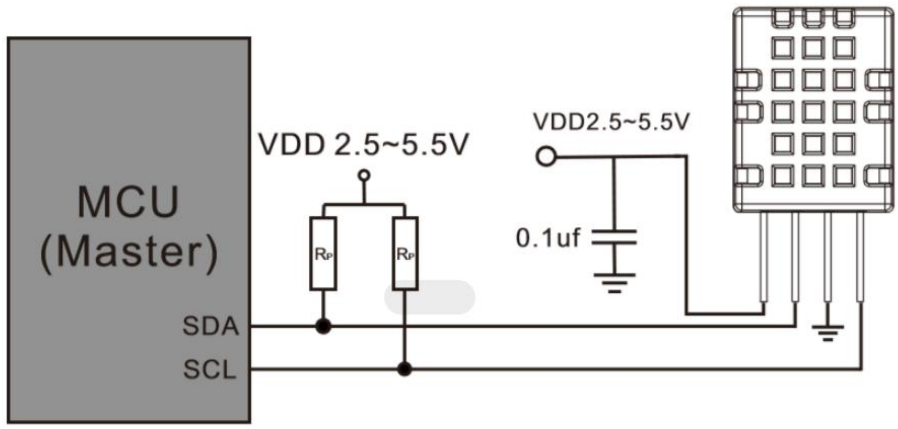


Figure 8

To avoid signal collisions, the microprocessor (MCU) must be able to drive SDA and SCL only at low levels.Need a outside of the department of pull-up resistor (for example: 10 k Ω) will lift the signals to high level.Pull-up resistors may normally be included in the microprocessor's I/O circuit.Refer to tables 7 and 8 for detailed information on sensor input/output characteristics.

4 electrical characteristics

4.1 absolute maximum rating

The electrical characteristics of DHT10 are defined in table 1.The absolute maximum ratings given in table 6 are for stress ratings only and provide more information.Under such conditions, the installation is not desirable for functional operation.Prolonged exposure to absolute maximum rating conditions may affect the reliability of the sensor.

parameter	minimum	maximum	unit
VDD to GND	-0.3	5.5	V
SDA and SCL to GND	-0.3	VDD+0.3	V
current of pin	-20	20	mA

Table 6

ESD electrostatic discharge conforms to JEDEC jesd22-a114 standard (human mode ±4kV), JEDEC jesd22-a115 (machine mode ±200V).If the test condition exceeds the nominal limit, the sensor needs to be equipped with an additional protective circuit.

4.2 input/output characteristics

Electrical characteristics, such as power consumption, input and output of high and low level voltage, etc., depend on the power supply voltage.In order for the sensor to communicate smoothly, it is important to ensure that the signal design is strictly limited to the range given in table 7, 8 and figure 9.

parameter	condition	minimum	standard	maximum	unit
Low voltage output	VDD=3.3V,-4mA<IOL <0mA	0	-	0.4	V
High voltage output		70% VDD	-	VDD	V
IOL		-	-	-4	mA
Low voltage input		0	-	30% VDD	V
High voltage input		70% VDD	-	VDD	V
Input current	VDD=5.5V, VIN=0V to 5.5VDD	-	-	+\-1	uA

Table 7

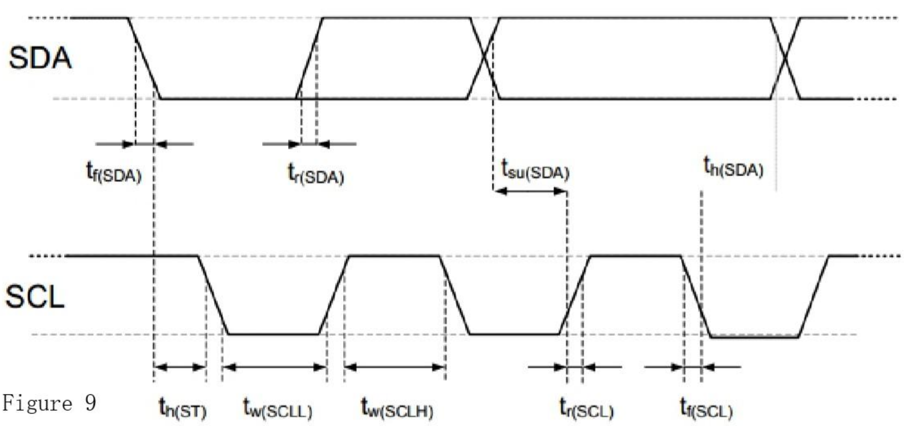


Figure 9

parameter	mark	Standard I2C		High speed I2C		Unit
		MIN	MAX	MIN	MAX	
Clock frequency	fSCL	0	100	0	400	KHz
Initial signal time	tHDSTA					uS
SCL clock high level width	tHIGH	4.7		1.3		uS
SCL clock low level width	tLOW	4.0		0.6		uS
Data retention time (relative to the edge of SCL SDA)	tHDDAT	0.09	3.45	0.02	0.9	uS
Data set time (relative to the edge of SCL SDA)	tSUDAT	250		100		uS

Table 8

5 sensor communication

DHT10 USES standard I2C protocol for communication.

5.1 start sensor

The first step is to electrify the sensor at the selected VDD supply voltage (between 2.5v and 5.5v).After powering up, it takes up to 20 milliseconds for the sensor (where the SCL is high) to reach the idle state, ready to receive commands sent by the host (MCU).

5.2 start/stop timing

Each transmission sequence starts with the Start state and ends with the Stop state, as shown in figures 10 and 11

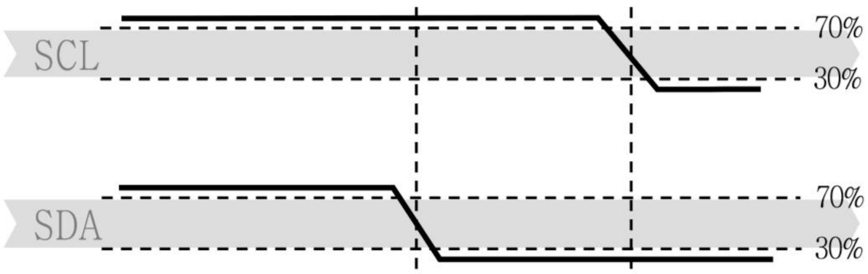


FIG. 10 startup transfer state (S) - when SCL is high, SDA is converted from high to low.The Start state is a special master line state controlled by the host, indicating the beginning of transmission from the slave (after Start, the BUS is generally considered to be busy).

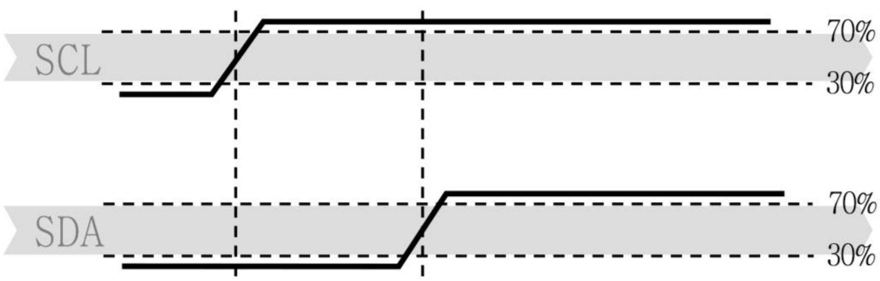


FIG. 11 stop transmission state (P) - when SCL is high, SDA line is converted from low level to high level.Stop state is a special BUS state controlled by the host, indicating the end of transmission from the slave (after Stop, the BUS is generally considered to be idle).

5.3 send command

After the transfer is initiated, the I2C first byte subsequently transmitted consists of the 7 bit I2C device address 0x38 and an SDA directional bit (read R: '1', write W: '0').After the 8th SCL clock drop edge, the SDA pin (ACK bit) is pulled down to indicate that the sensor data receives normally.After issuing the initialization command (' 1110 '0001' for initialization and '1010' 1100 'for temperature and humidity measurement), the MCU must wait for the measurement to complete.The basic commands are summarized in table 9.Table 10 shows the status bits returned from the machine.

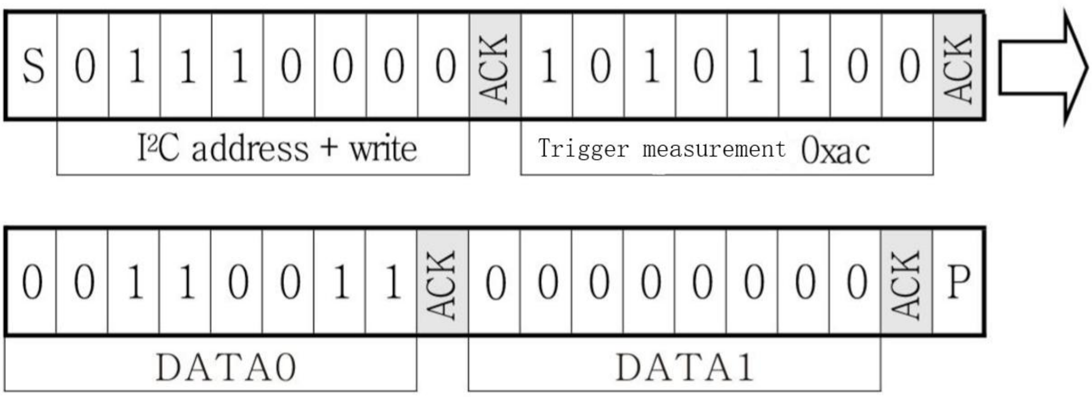
command	number
Initialization command	11100001
Trigger measurement	10101100
Soft reset	10111010

Table 9 Basic command set

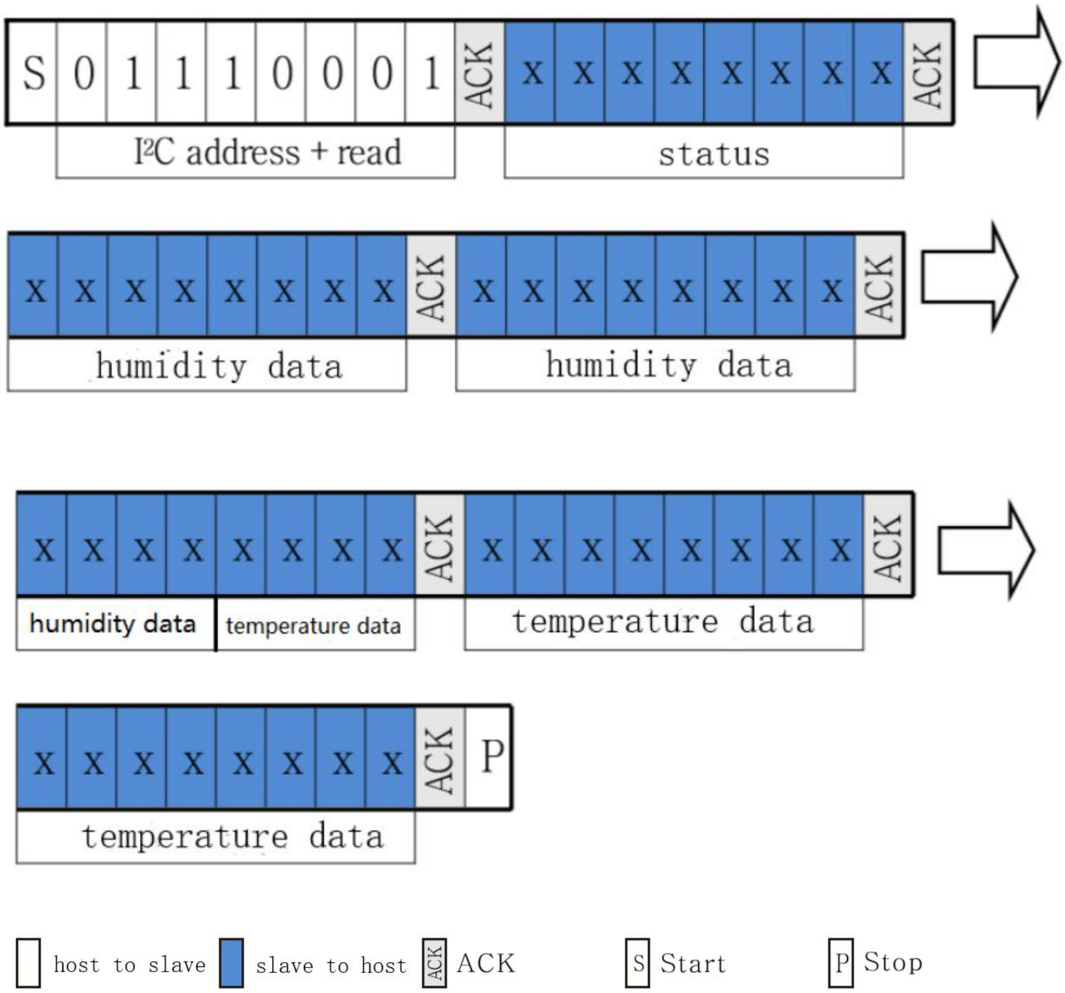
bit	meaning	describe
Bit[7]	Busy indication	1:device busy,under measurement 0:device idle,dormant
Bit[6:5]	Mode status	00:NOR mode 01:CYC mode 1x:CMD mode
Bit[4]	reserve	reserve
Bit[3]	CAL enable	1:Has the calibration 0:No calibration
Bit[2:0]	reserve	reserve

Table 10 Status bit explain

Trigger measurement



Read data of temperature and humidity



Note: it takes time for the sensor to be collected. After the host sends out the measurement instruction (0xAC), it reads the converted data after a delay of more than 75 milliseconds and determines whether the returned configuration is normal or not.If the status bit [Bit7] is 0, the data can be read normally; if it is 1, the sensor is in a busy state, and the host needs to wait for the completion of data processing.

5.4 soft reset

This command (see table 9) is used to restart the sensor system without having to turn off and off the power again.Upon receipt of this command, the sensor system begins to reinitialize and revert to the default Settings, with the soft reset taking no more than 20 milliseconds.

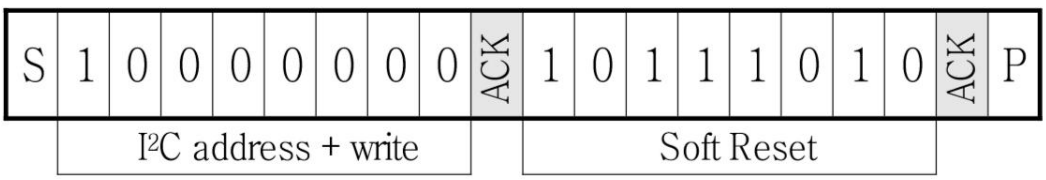


Figure 12 soft reset -- the gray section is controlled by AHT15

6 signal conversion

6.1 relative humidity conversion

Relative humidity RH can be calculated according to the relative humidity signal SRH output by SDA by the following formula (the result is expressed as %RH).

$$RH[\%]=\left(\frac{S_{RH}}{2^{20}}\right)*100\%$$

6.2 temperature conversion

Temperature T can be calculated by substituting the temperature output signal ST into the following formula (the result is expressed as temperature °C) :

$$T(℃)=\left(\frac{S_{T}}{2^{20}}\right)*200-50$$