

## HDC1010 具有温度传感器的低功耗、高精度数字湿度传感器

### 1 特性

- 相对湿度精度为  $\pm 2\%$  (典型值)
- 温度精度为  $\pm 0.2^\circ\text{C}$  (典型值)
- 高湿度下具有出色的稳定性
- 14 位测量分辨率
- 睡眠模式的电流为 100nA
- 平均电源电流:
  - 1 sps、11 位相对湿度 (RH) 测量时为 710nA
  - 1 sps、11 位 RH 与温度测量时为 1.3 $\mu\text{A}$
- 电源电压为 2.7V 至 5.5V
- 微型 2mm x 1.6mm 器件封装
- I<sup>2</sup>C 接口

### 2 应用

- 制热、通风与空调控制 (HVAC)
- 物联网 (IoT) 智能温度调节装置和室温监视器
- 冰箱
- 打印机
- 白色家电
- 医疗设备
- 无线传感器 (TIDA: [00374](#)、[00484](#)、[00524](#))

### 4 典型应用

### 3 说明

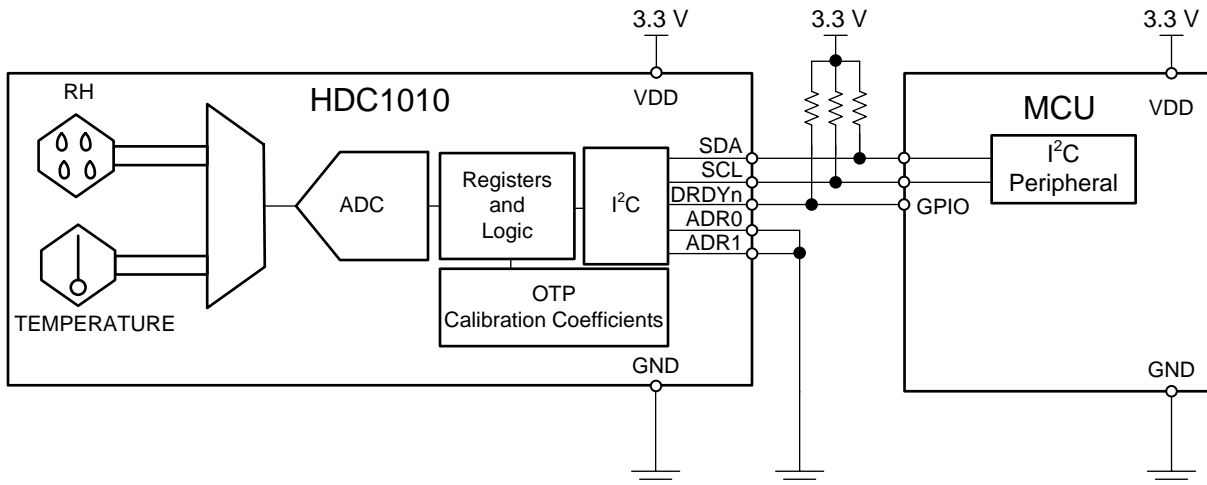
HDC1010 是一款具有集成温度传感器的数字湿度传感器，其能够以超低功耗提供出色的测量精度。

HDC1010 支持较宽的工作电源电压范围，并且相比竞争解决方案，该器件可为各类常见应用提供低成本和低功耗优势。创新型 WLCSP (晶圆级芯片规模封装) 凭借超紧凑型封装简化了电路板设计。HDC1010 的传感元件位于器件底部，这样可使 HDC1010 免受灰尘、粉尘以及其他环境污染物的影响，从而提高耐用性。湿度和温度传感器均经过出厂校准，校准数据存储在片上非易失性存储器中。

器件信息 (1)

部件号	封装	封装尺寸 (标称值)
HDC1010	DSBGA (8 凸点)	2.04mm x 1.59mm

(1) 要了解所有可用封装，请见数据表末尾的可订购产品附录。



Copyright © 2016, Texas Instruments Incorporated



## 目录

<b>1</b>	特性 .....	<b>1</b>	8.4	Device Functional Modes .....	<b>9</b>
<b>2</b>	应用 .....	<b>1</b>	8.5	Programming .....	<b>10</b>
<b>3</b>	说明 .....	<b>1</b>	8.6	Register Map .....	<b>14</b>
<b>4</b>	典型应用 .....	<b>1</b>	<b>9</b>	<b>Application and Implementation</b> .....	<b>17</b>
<b>5</b>	修订历史记录 .....	<b>2</b>	9.1	Application Information .....	<b>17</b>
<b>6</b>	<b>Pin Configuration and Functions</b> .....	<b>3</b>	9.2	Typical Application .....	<b>17</b>
<b>7</b>	<b>Specifications</b> .....	<b>4</b>	9.3	Do's and Don'ts .....	<b>18</b>
7.1	Absolute Maximum Ratings .....	<b>4</b>	<b>10</b>	<b>Power Supply Recommendations</b> .....	<b>19</b>
7.2	ESD Ratings .....	<b>4</b>	<b>11</b>	<b>Layout</b> .....	<b>19</b>
7.3	Recommended Operating Conditions .....	<b>4</b>	11.1	Layout Guidelines .....	<b>19</b>
7.4	Thermal Information .....	<b>4</b>	11.2	Layout Example .....	<b>21</b>
7.5	Electrical Characteristics .....	<b>5</b>	<b>12</b>	<b>器件和文档支持</b> .....	<b>22</b>
7.6	I2C Interface Electrical Characteristics .....	<b>6</b>	12.1	文档支持 .....	<b>22</b>
7.7	I2C Interface Timing Requirements .....	<b>6</b>	12.2	接收文档更新通知 .....	<b>22</b>
7.8	Typical Characteristics .....	<b>7</b>	12.3	社区资源 .....	<b>22</b>
<b>8</b>	<b>Detailed Description</b> .....	<b>9</b>	12.4	商标 .....	<b>22</b>
8.1	Overview .....	<b>9</b>	12.5	静电放电警告 .....	<b>22</b>
8.2	Functional Block Diagram .....	<b>9</b>	12.6	Glossary .....	<b>22</b>
8.3	Feature Description .....	<b>9</b>	<b>13</b>	<b>机械、封装和可订购信息</b> .....	<b>22</b>

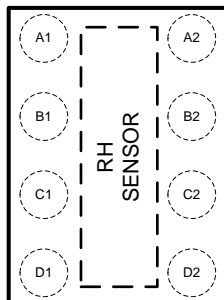
## 5 修订历史记录

注：之前版本的页码可能与当前版本有所不同。

<b>Changes from Original (May 2016) to Revision A</b>	<b>Page</b>
• 已更改“产品预览”至“量产数据” .....	<b>1</b>

## 6 Pin Configuration and Functions

**WLCSP (DSBGA)  
8 Pin YPA  
Top View**



**Pin Functions**

PIN		I/O TYPE <sup>(1)</sup>	DESCRIPTION
NAME	NO.		
SCL	A1	I	Serial clock line for I2C, open-drain; requires a pull-up resistor to VDD
VDD	B1	P	Supply Voltage
ADR0	C1	I	Address select pin – hardwired to GND or VDD
ADR1	D1	I	Address select pin – hardwired to GND or VDD
SDA	A2	I/O	Serial data line for I2C, open-drain; requires a pull-up resistor to VDD
GND	B2	G	Ground
DNC	C2	-	Do not connect, or, may be connected to GND.
DRDY <sub>n</sub>	D2	O	Data ready, active low, open-drain. Requires a pull-up resistor to VDD. If not used tie to GND.

(1) P=Power, G=Ground, I=Input, O=Output

## 7 Specifications

### 7.1 Absolute Maximum Ratings<sup>(1)</sup>

		MIN	MAX	UNIT
Input Voltage	VDD	-0.3	6	V
	SCL	-0.3	6	
	SDA	-0.3	6	
	DRDYn	-0.3	6	
	ADR0	-0.3	VDD+0.3	
	ADR1	-0.3	VDD+0.3	
Storage Temperature	T <sub>STG</sub>	-65	150	°C

(1) Stresses beyond those listed under *Absolute Maximum Ratings* may cause permanent damage to the device. These are stress ratings only, which do not imply functional operation of the device at these or any other conditions beyond those indicated under *Recommended Operating Conditions*. Exposure to absolute-maximum-rated conditions for extended periods may affect device reliability.

### 7.2 ESD Ratings

			VALUE	UNIT
V <sub>(ESD)</sub>	Electrostatic discharge	Human body model (HBM), per ANSI/ESDA/JEDEC JS-001, all pins <sup>(1)</sup>	±1000	V
		Charged device model (CDM), per JEDEC specification –500 500 JESD22-C101, all pins <sup>(2)</sup>	±250	

(1) JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

(2) JEDEC document JEP157 states that 250-V CDM allows safe manufacturing with a standard ESD control process.

### 7.3 Recommended Operating Conditions

over operating range (unless otherwise noted)

		MIN	NOM	MAX	UNIT
V <sub>DD</sub>	Supply Voltage	2.7	3	5.5	V
T <sub>A</sub> , Temperature Sensor	Ambient Operating Temperature	-40		125	°C
T <sub>A</sub> , Humidity Sensor <sup>(1)</sup>	Ambient Operating Temperature	-20		70	°C
T <sub>A</sub> , Humidity sensor <sup>(1)</sup>	Functional Operating Temperature	-20		85	°C

(1) See [Figure 2](#)

### 7.4 Thermal Information

THERMAL METRIC <sup>(1)</sup>		HDC1010	UNIT
		DSBGA -YPA	
		8 PINS	
R <sub>θJA</sub>	Junction-to-ambient thermal resistance	98.0	°C/W
R <sub>θJC(top)</sub>	Junction-to-case (top) thermal resistance	0.8	°C/W
R <sub>θJB</sub>	Junction-to-board thermal resistance	17.8	°C/W
ψ <sub>JT</sub>	Junction-to-top characterization parameter	3.7	°C/W
ψ <sub>JB</sub>	Junction-to-board characterization parameter	17.8	°C/W

(1) For more information about traditional and new thermal metrics, see the [Semiconductor and IC Package Thermal Metrics](#) application report.

## 7.5 Electrical Characteristics<sup>(1)</sup>

The electrical ratings specified in this section apply to all specifications in this document, unless otherwise noted.  $T_A = 30^\circ\text{C}$ ,  $V_{DD} = 3\text{V}$ , and  $\text{RH} = 40\%$ .

PARAMETER		TEST CONDITION <sup>(2)</sup>	MIN <sup>(3)</sup>	TYP <sup>(4)</sup>	MAX <sup>(3)</sup>	UNIT
<b>POWER CONSUMPTION</b>						
$I_{DD}$	Supply Current	RH measurement, bit 12 of 0x02 register = 0 <sup>(5)</sup>		190	220	$\mu\text{A}$
		Temperature measurement, bit 12 of 0x02 register = 0 <sup>(5)</sup>		160	185	$\mu\text{A}$
		Sleep Mode		100	200	nA
		Average @ 1 measurement/second, RH (11 bit), bit 12 of 0x02 register = 0 <sup>(5)(6)</sup>		710		nA
		Average @ 1 measurement/second, Temp (11 bit), bit 12 of 0x02 register = 0 <sup>(5)(6)</sup>		590		nA
		Average @ 1 measurement/second, RH (11bit) +temperature (11 bit), bit 12 of 0x02 register = 1 <sup>(5)(6)</sup>		1.3		$\mu\text{A}$
		Startup (average on Start-up time)		300		$\mu\text{A}$
$I_{HEAT}$	Heater Current <sup>(7)</sup>	Peak current		7.2		mA
		Average @ 1 measurement/second, RH (11bit) +temperature (11 bit), bit 12 of 0x02 register = 1 <sup>(5)(6)</sup>		50		$\mu\text{A}$
<b>RELATIVE HUMIDITY SENSOR</b>						
$\text{RH}_{ACC}$	Accuracy	Refer to <a href="#">Figure 2</a> in Typical Characteristics section.		$\pm 2$		%RH
$\text{RH}_{REP}$	Repeatability <sup>(7)</sup>	14 bit resolution.		$\pm 0.1$		%RH
$\text{RH}_{HYS}$	Hysteresis <sup>(8)</sup>	$10\% \leq \text{RH} \leq 70\%$		$\pm 1$		%RH
$\text{RH}_{RT}$	Response Time <sup>(9)</sup>	$t_{63\%}$ <sup>(10)</sup>		15		s
$\text{RH}_{CT}$	Conversion Time <sup>(7)</sup>	8 bit resolution		2.50		ms
		11 bit resolution		3.85		ms
		14 bit resolution		6.50		ms
$\text{RH}_{HOR}$	Operating Range <sup>(11)</sup>	Non-condensing	0		100	%RH
$\text{RH}_{LTD}$	Long Term Drift <sup>(12)</sup>			$\pm 0.25$		%RH/yr
<b>TEMPERATURE SENSOR</b>						
$\text{TEMP}_{ACC}$	Accuracy <sup>(7)</sup>	$5^\circ\text{C} < T_A < 60^\circ\text{C}$		$\pm 0.2$	$\pm 0.4$	$^\circ\text{C}$
$\text{TEMP}_{REP}$	Repeatability <sup>(7)</sup>	14 bit accuracy		$\pm 0.1$		$^\circ\text{C}$
$\text{TEMP}_{CT}$	Conversion Time <sup>(7)</sup>	11 bit accuracy		3.65		ms
		14 bit accuracy		6.35		ms

- (1) Electrical Characteristics Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ . Absolute Maximum Ratings indicate junction temperature limits beyond which the device may be permanently degraded, either mechanically or electrically.
- (2) Register values are represented as either binary (b is the prefix to the digits), or hexadecimal (0x is the prefix to the digits). Decimal values have no prefix.
- (3) Limits are ensured by testing, design, or statistical analysis at  $30^\circ\text{C}$ . Limits over the operating temperature range are ensured through correlations using statistical quality control (SQC) method.
- (4) Typical values represent the most likely parametric norm as determined at the time of characterization. Actual typical values may vary over time and will also depend on the application and configuration. The typical values are not tested and are not guaranteed on shipped production material.
- (5) I<sup>2</sup>C read/write communication and pull-up resistors current through SCL and SDA not included.
- (6) Average current consumption while conversion is in progress.
- (7) This parameter is specified by design and/or characterization and it is not tested in production.
- (8) The hysteresis value is the difference between an RH measurement in a rising and falling RH environment, at a specific RH point.
- (9) Actual response times will vary dependent on system thermal mass and air-flow.
- (10) Time for the RH output to change by 63% of the total RH change after a step change in environmental humidity.
- (11) Recommended humidity operating range is 10% to 70% RH. Prolonged operation outside this range may result in a measurement offset. The measurement offset will decrease after operating the sensor in this recommended operating range.
- (12) Drift due to aging effects at typical conditions ( $30^\circ\text{C}$  and 20% to 50% RH). This value may be impacted by dust, vaporized solvents, out-gassing tapes, adhesives, packaging materials, etc.

### Electrical Characteristics<sup>(1)</sup> (continued)

The electrical ratings specified in this section apply to all specifications in this document, unless otherwise noted.  $T_A = 30^\circ\text{C}$ ,  $V_{DD} = 3\text{V}$ , and  $\text{RH} = 40\%$ .

PARAMETER	TEST CONDITION <sup>(2)</sup>	MIN <sup>(3)</sup>	TYP <sup>(4)</sup>	MAX <sup>(3)</sup>	UNIT
TEMP <sub>OR</sub> Operating Range		-40		125	°C

### 7.6 I2C Interface Electrical Characteristics

At  $T_A=30^\circ\text{C}$ ,  $V_{DD}=3\text{V}$  (unless otherwise noted)

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>I2C INTERFACE VOLTAGE LEVEL</b>					
V <sub>IH</sub>	Input High Voltage	0.7xV <sub>DD</sub>			V
V <sub>IL</sub>	Input Low Voltage			0.3xV <sub>DD</sub>	V
V <sub>OL</sub>	Output Low Voltage	Sink current 3mA		0.4	V
HYS	Hysteresis <sup>(1)</sup>	0.1xV <sub>DD</sub>			V
CIN	Input Capacitance on all digital pins		0.5		pF

(1) This parameter is specified by design and/or characterization and it is not tested in production.

### 7.7 I2C Interface Timing Requirements

PARAMETER	TEST CONDITION	MIN	TYP	MAX	UNIT
<b>I2C INTERFACE VOLTAGE LEVEL</b>					
f <sub>SCL</sub>	Clock Frequency	10		400	kHz
t <sub>LOW</sub>	Clock Low Time	1.3			µs
t <sub>HIGH</sub>	Clock High Time	0.6			µs
t <sub>SP</sub>	Pulse width of spikes that must be suppressed by the input filter <sup>(1)</sup>			50	ns
t <sub>START</sub>	Device Start-up time	From V <sub>DD</sub> ≥ 2.7 V to ready for a conversion <sup>(1)(2)</sup>	10	15	ms

(1) This parameter is specified by design and/or characterization and it is not tested in production.

(2) Within this interval it is not possible to communicate to the device.

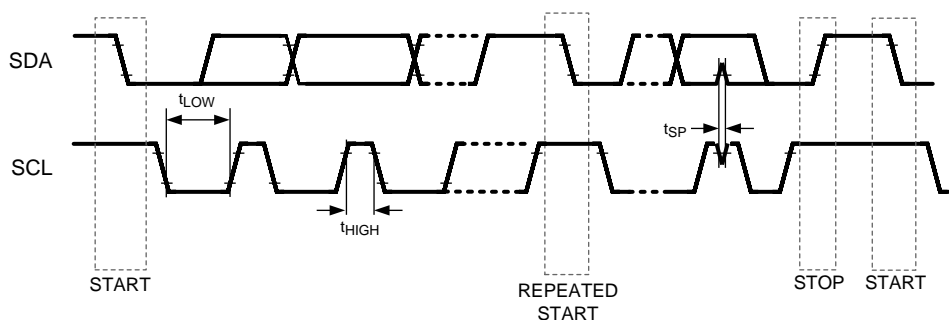


Figure 1. I2C Timing

## 7.8 Typical Characteristics

Unless otherwise noted.  $T_A = 30^\circ\text{C}$ ,  $V_{DD} = 3\text{V}$ .

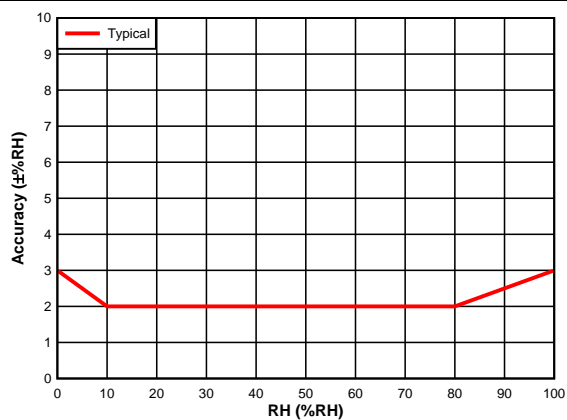


Figure 2. RH Accuracy vs. RH

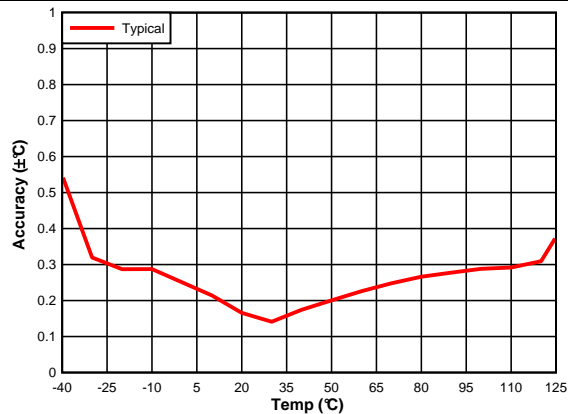


Figure 3. Temperature Accuracy vs. Temperature

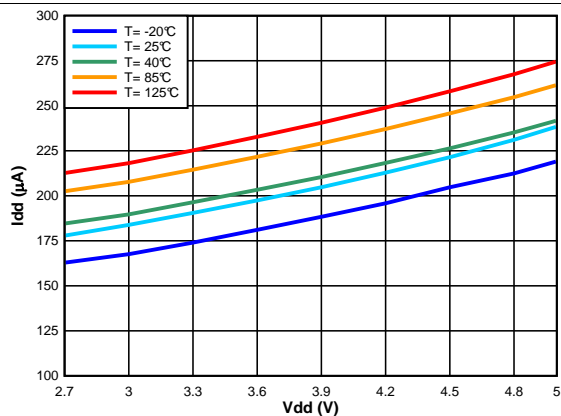


Figure 4. Supply Current vs. Supply Voltage, RH Measurement

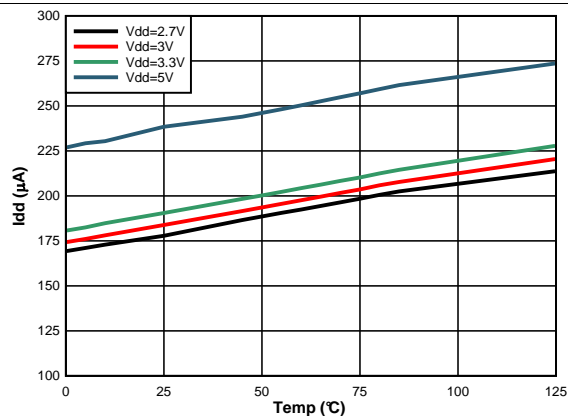


Figure 5. Supply Current vs. Temperature, RH Measurement

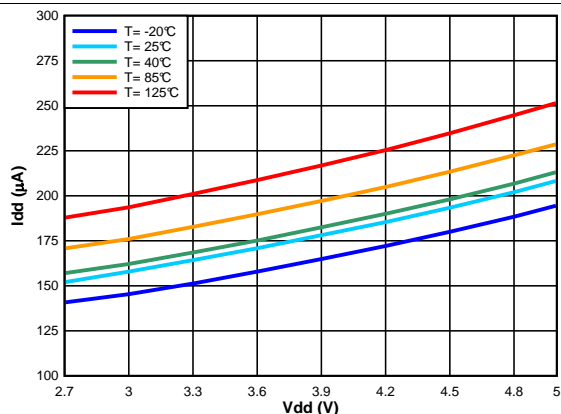


Figure 6. Supply Current vs. Supply Voltage, Temp Measurement

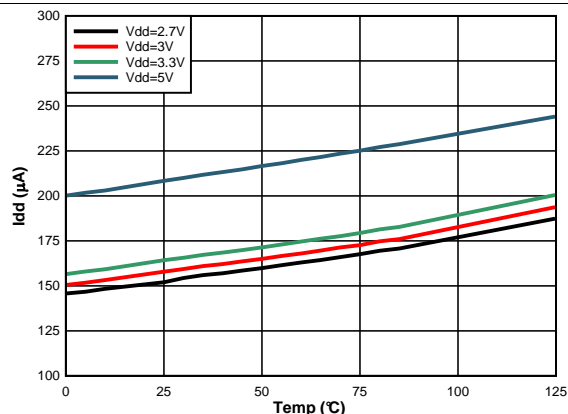
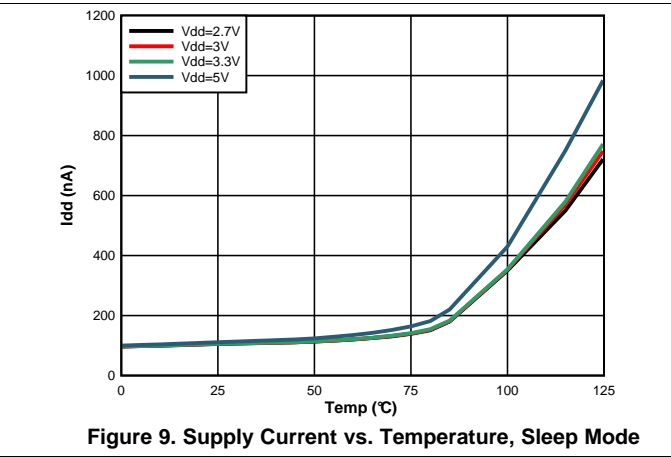
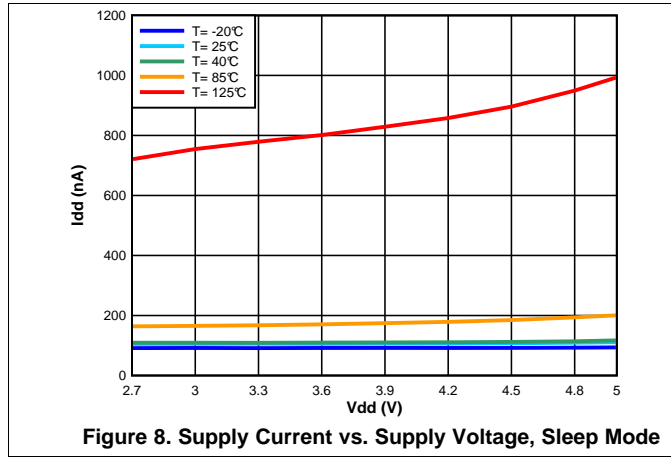


Figure 7. Supply Current vs. Temperature, Temp Measurement

### Typical Characteristics (continued)

Unless otherwise noted.  $T_A = 30^\circ\text{C}$ ,  $V_{DD} = 3\text{V}$ .



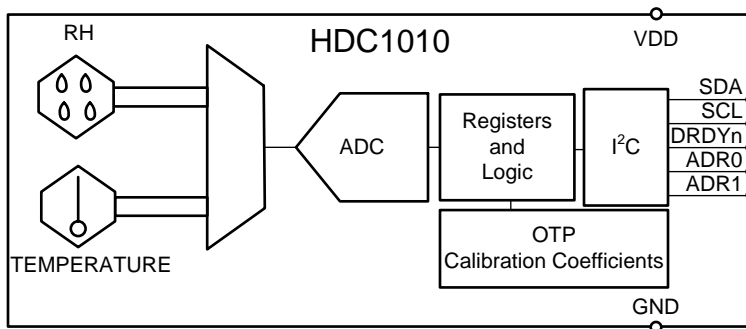


## 8 Detailed Description

### 8.1 Overview

The HDC1010 is a digital humidity sensor with integrated temperature sensor that provides excellent measurement accuracy at very low power. The sensing element of the HDC1010 is placed on the bottom part of the device, which makes the HDC1010 more robust against dirt, dust, and other environmental contaminants. Measurement results can be read out through the I2C compatible interface. Resolution is based on the measurement time and can be 8, 11, or 14 bits for humidity; 11 or 14 bits for temperature.

### 8.2 Functional Block Diagram



Copyright © 2016, Texas Instruments Incorporated

### 8.3 Feature Description

#### 8.3.1 Power Consumption

One of the key features of the HDC1010 is its low power consumption, which makes the device suitable in battery or power harvesting applications. In these applications the HDC1010 spends most of the time in sleep mode: with a typical 100nA of current consumption in sleep mode, the averaged current consumption is minimal. Its low consumption in measurement mode minimizes any self-heating.

#### 8.3.2 Voltage Supply Monitoring

The HDC1010 monitors the supply voltage level and indicates when the voltage supply of the HDC1010 is less than 2.8V. This information is useful in battery-powered systems in order to inform the user to replace the battery. This is reported in the BTST field (register address 0x02:bit[11]) which is updated after power-on reset (POR) and after each measurement request.

#### 8.3.3 Heater

The heater is an integrated resistive element that can be used to test the sensor or to drive condensation off the sensor. The heater can be activated using HEAT, bit 13 in Configuration Register. The heater helps in reducing the accumulated offset after long exposure at high humidity conditions.

Once enabled the heater is turned on only in the measurement mode. To have a reasonable increase of the temperature it is suggested to increase the measurement data rate.

### 8.4 Device Functional Modes

The HDC1010 has two modes of operation: sleep mode and measurement mode. After power up, the HDC1010 is in sleep mode. In this mode, the HDC1010 waits for I2C input including commands to configure the conversion times, read the status of the battery, trigger a measurement, and read measurements. Once it receives a command to trigger a measurement, the HDC1010 moves from sleep mode to measurement mode. In measurement mode, the HDC1010 acquires the configured measurements and sets the DRDYn line low when the measurement is complete. After completing the measurement and setting DRDYn low, the HDC1010 returns to sleep mode.

## 8.5 Programming

### 8.5.1 I2C Serial Bus Address Configuration

To communicate with the HDC1010, the master must first address slave devices via a slave address byte. The slave address byte consists of seven address bits and a direction bit that indicates the intent to execute a read or write operation. The HDC1010 features two address pins to allow up to 4 devices to be addressed on a single bus. [Table 1](#) describes the pin logic levels used to properly connect up to 4 devices. The state of the ADR0 and ADR1 pins is sampled on every bus communication and should be set before any activity on the interface occurs. The address pin is read at the start of each communication event.

**Table 1. HDC1010 ADDRESS**

ADR1	ADR0	ADDRESS (7-bit address)
0	0	1000000
0	1	1000001
1	0	1000010
1	1	1000011

### 8.5.2 I2C Interface

The HDC1010 operates only as a slave device on the I2C bus interface. It is not allowed to have on the I2C bus multiple devices with the same address. Connection to the bus is made via the open-drain I/O lines, SDA, and SCL. The SDA and SCL pins feature integrated spike-suppression filters and Schmitt triggers to minimize the effects of input spikes and bus noise. After power-up, the sensor needs at most 15 ms, to be ready to start RH and temperature measurement. During this power-up time the HDC1010 is only able to provide the content of the serial number registers (0xFB to 0xFF) if requested. After the power-up the sensor is in the sleep mode until a communication or measurement is performed. All data bytes are transmitted MSB first.

#### 8.5.2.1 Serial Bus Address

To communicate with the HDC1010, the master must first address slave devices via a slave address byte. The slave address byte consists of seven address bits, and a direction bit that indicates the intent to execute a read or write operation.

#### 8.5.2.2 Read and Write Operations

To access a particular register on the HDC1010, write the desired register address value to the Pointer Register. The pointer value is the first byte transferred after the slave address byte with the R/W bit low. Every write operation to the HDC1010 requires a value for the pointer register (refer to [Figure 10](#)).

When reading from the HDC1010, the last value stored in the pointer by a write operation is used to determine which register is read by a read operation. To change the pointer register for a read operation, a new value must be written to the pointer. This transaction is accomplished by issuing the slave address byte with the R/W bit low, followed by the pointer byte. No additional data is required (refer to [Figure 11](#)).

The master can then generate a START condition and send the slave address byte with the R/W bit high to initiate the read command. Note that register bytes are sent MSB first, followed by the LSB. A write operation in a read-only register such as (DEVICE ID, MANUFACTURER ID, SERIAL ID) returns a NACK after each data byte; read/write operation to unused address returns a NACK after the pointer; a read/write operation with incorrect I2C address returns a NACK after the I2C address.

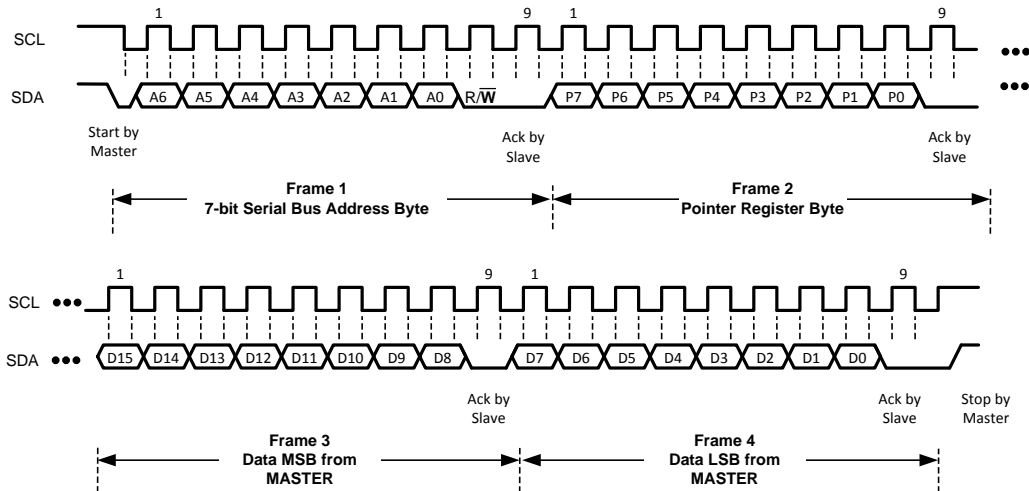


Figure 10. Writing Frame (Configuration Register)

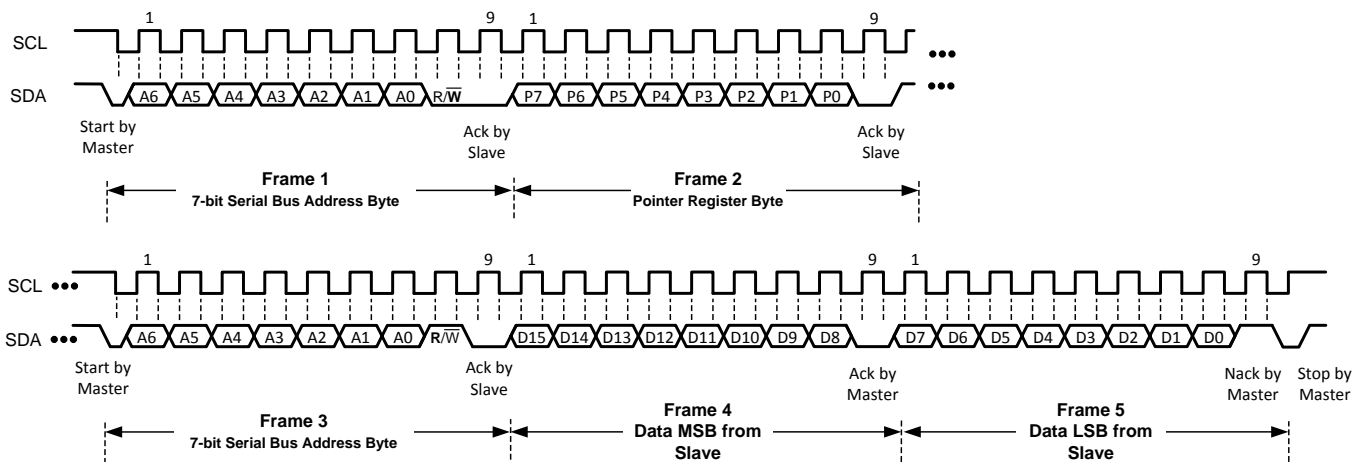


Figure 11. Reading Frame (Configuration Register)

### 8.5.2.3 Device Measurement Configuration

By default the HDC1010 will first perform a temperature measurement followed by a humidity measurement. On power-up, the HDC1010 enters a low power sleep mode and is not actively measuring. Use the following steps to perform a measurement of both temperature and humidity and then retrieve the results:

1. Configure the acquisition parameters in register address 0x02:
  - (a) Set the acquisition mode to measure both temperature and humidity by setting Bit[12] to 1.
  - (b) Set the desired temperature measurement resolution:
    - Set Bit[10] to 0 for 14 bit resolution.
    - Set Bit[10] to 1 for 11 bit resolution.
  - (c) Set the desired humidity measurement resolution:
    - Set Bit[9:8] to 00 for 14 bit resolution.
    - Set Bit[9:8] to 01 for 11 bit resolution.
    - Set Bit[9:8] to 10 for 8 bit resolution.
2. Trigger the measurements by executing a pointer write transaction with the address pointer set to 0x00. Refer to [Figure 12](#).

3. Wait for the measurements to complete, based on the conversion time (refer to [Electrical Characteristics<sup>\(1\)</sup>](#) for the conversion time). Alternatively, wait for the assertion of DRDYn.
4. Read the output data:

Read the temperature data from register address 0x00, followed by the humidity data from register address 0x01 in a single transaction as shown in [Figure 14](#). A read operation will return a NACK if the contents of the registers have not been updated as shown in [Figure 13](#).

To perform another acquisition with the same measurement configuration simply repeat steps 2 through 4.

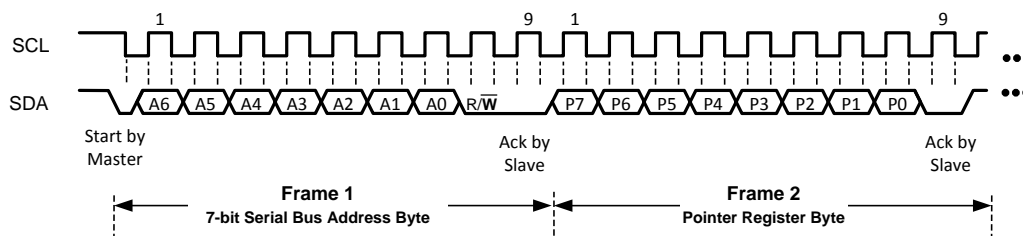
If only a humidity or temperature measurement is desired, the following steps will perform a measurement and retrieve the result:

1. Configure the acquisition parameters in register address 0x02:
  - (a) Set the acquisition mode to independently measure temperature or humidity by setting Bit[12] to 0.
  - (b) For a temperature measurement, set the desired temperature measurement resolution:
    - Set Bit[10] to 0 for 14 bit resolution.
    - Set Bit[10] to 1 for 11 bit resolution.
  - (c) For a humidity measurement, set the desired humidity measurement resolution:
    - Set Bit[9:8] to 00 for 14 bit resolution.
    - Set Bit[9:8] to 01 for 11 bit resolution.
    - Set Bit[9:8] to 10 for 8 bit resolution.
2. Trigger the measurement by executing a pointer write transaction. Refer to [Figure 12](#)
  - Set the address pointer to 0x00 for a temperature measurement.
  - Set the address pointer to 0x01 for a humidity measurement.
3. Wait for the measurement to complete, based on the conversion time (refer to [Electrical Characteristics<sup>\(1\)</sup>](#) for the conversion time). Alternatively, wait for the assertion of DRDYn.
4. Read the output data:

Retrieve the completed measurement result from register address 0x00 or 0x01, as appropriate, as shown in [Figure 10](#). A read operation will return a NACK if the measurement result is not yet available, as shown in [Figure 13](#).

To perform another acquisition with the same measurement configuration repeat steps 2 through 4.

It is possible to read the output registers (addresses 0x00 and 0x01) during an Temperature or Relative Humidity measurement without affecting any ongoing measurement. Note that a write to address 0x00 or 0x01 while a measurement is ongoing will abort the ongoing measurement. If the newest acquired measurement is not read, DRDYn stays low until the next measurement is triggered.



**Figure 12. Trigger Humidity/Temperature Measurement**

(1) Electrical Characteristics Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ . Absolute Maximum Ratings indicate junction temperature limits beyond which the device may be permanently degraded, either mechanically or electrically.

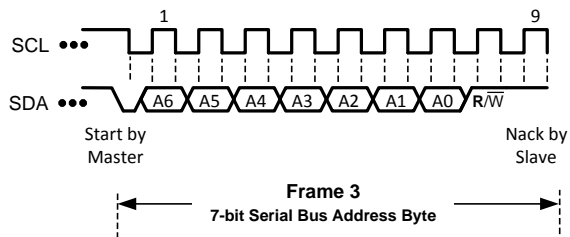


Figure 13. Read Humidity/Temperature Measurement (Data Not Ready)

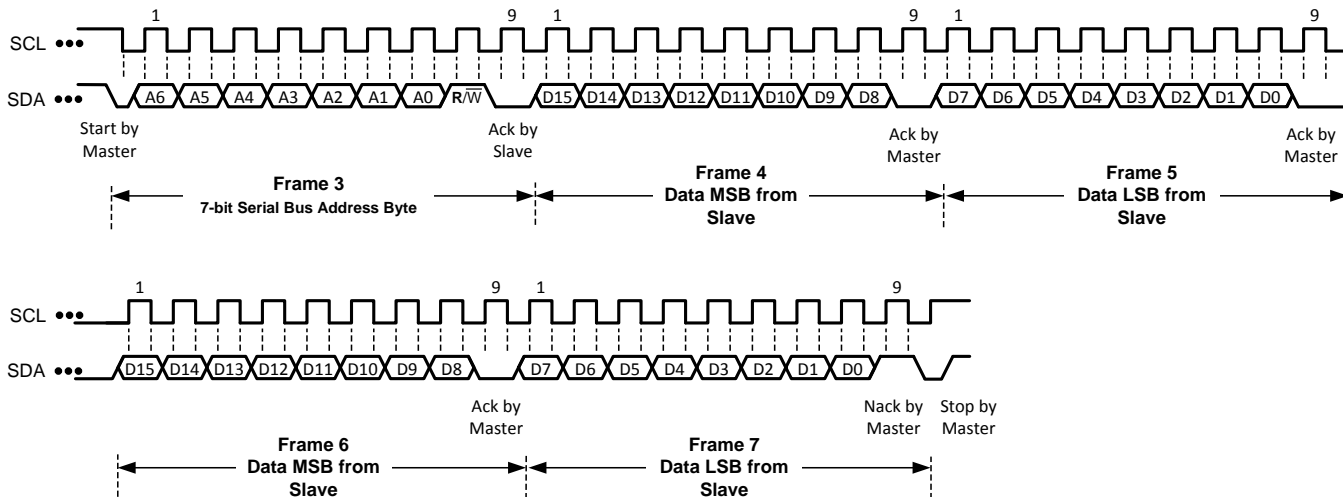


Figure 14. Read Humidity and Temperature Measurement (Data Ready)

## 8.6 Register Map

The HDC1010 contains data registers that hold configuration information, temperature and humidity measurement results, and status information.

**Table 2. Register Map**

Pointer	Name	Reset value	Description
0x00	Temperature	0x0000	Temperature measurement output
0x01	Humidity	0x0000	Relative Humidity measurement output
0x02	Configuration	0x1000	HDC1010 configuration and status
0xFB	Serial ID	device dependent	First 2 bytes of the serial ID of the part
0xFC	Serial ID	device dependent	Mid 2 bytes of the serial ID of the part
0xFD	Serial ID	device dependent	Last byte bit of the serial ID of the part
0xFE	Manufacturer ID	0x5449	ID of Texas Instruments
0xFF	Device ID	0x1000	ID of HDC1010 device

Registers from 0x03 to 0xFA are reserved and should not be written.

The HDC1010 has an 8-bit pointer used to address a given data register. The pointer identifies which of the data registers should respond to a read or write command on the two-wire bus. This register is set with every write command. A write command must be issued to set the proper value in the pointer before executing a read command. The power-on reset (POR) value of the pointer is 0x00, which selects a temperature measurement.

### 8.6.1 Temperature Register

The temperature register is a 16-bit result register in binary format (the 2 LSBs D1 and D0 are always 0). The result of the acquisition is always a 14 bit value. The accuracy of the result is related to the selected conversion time (refer to [Electrical Characteristics<sup>\(1\)</sup>](#)). The temperature can be calculated from the output data with:

$$\text{Temperature}(^{\circ}\text{C}) = \left( \frac{\text{TEMPERATURE}[15:00]}{2^{16}} \right) * 165^{\circ}\text{C} - 40^{\circ}\text{C}$$

**Table 3. Temperature Register Description (0x00)**

Name	Registers	Description
TEMPERATURE	[15:02]	Temperature Temperature measurement (read only)
	[01:00]	Reserved Reserved, always 0 (read only)

- (1) Electrical Characteristics Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ . Absolute Maximum Ratings indicate junction temperature limits beyond which the device may be permanently degraded, either mechanically or electrically.

### 8.6.2 Humidity Register

The humidity register is a 16-bit result register in binary format (the 2 LSBs D1 and D0 are always 0). The result of the acquisition is always a 14 bit value, while the accuracy is related to the selected conversion time (refer to [Electrical Characteristics<sup>\(1\)</sup>](#)). The humidity can be calculated from the output data with:

$$\text{Relative Humidity}(\% \text{ RH}) = \left( \frac{\text{HUMIDITY}[15:00]}{2^{16}} \right) * 100\% \text{ RH}$$

**Table 4. Humidity Register Description (0x01)**

Name	Registers	Description
HUMIDITY	[15:02]	Relative Humidity Relative Humidity measurement (read only)
	[01:00]	Reserved Reserved, always 0 (read only)

- (1) Electrical Characteristics Table values apply only for factory testing conditions at the temperature indicated. Factory testing conditions result in very limited self-heating of the device such that  $T_J = T_A$ . No guarantee of parametric performance is indicated in the electrical tables under conditions of internal self-heating where  $T_J > T_A$ . Absolute Maximum Ratings indicate junction temperature limits beyond which the device may be permanently degraded, either mechanically or electrically.

### 8.6.3 Configuration Register

This register configures device functionality and returns status.

**Table 5. Configuration Register Description (0x02)**

NAME	REGISTERS	DESCRIPTION		
RST	[15]	Software reset bit	0	Normal Operation, this bit self clears
			1	Software Reset
Reserved	[14]	Reserved	0	Reserved, must be 0
HEAT	[13]	Heater	0	Heater Disabled
			1	Heater Enabled
MODE	[12]	Mode of acquisition	0	Temperature or Humidity is acquired.
			1	Temperature and Humidity are acquired in sequence, Temperature first.
BTST	[11]	Battery Status	0	Battery voltage > 2.8V (read only)
			1	Battery voltage < 2.8V (read only)
TRES	[10]	Temperature Measurement Resolution	0	14 bit
			1	11 bit
HRES	[9:8]	Humidity Measurement Resolution	00	14 bit
			01	11 bit
			10	8 bit
Reserved	[7:0]	Reserved	0	Reserved, must be 0

### 8.6.4 Serial Number Registers

These registers contain a 40bit unique serial number for each individual HDC1010.

**Table 6. Serial Number Register Description (0xFB)**

Name	Registers	Description	
SERIAL ID[40:25]	[15:0]	Serial Id bits	Device Serial Number bits from 40 to 25 (read only)

**Table 7. Serial Number Register Description (0xFC)**

Name	Registers	Description	
SERIAL ID[24:9]	[15:0]	Serial Id bits	Device Serial Number bits from 24 to 9 (read only)

**Table 8. Serial Number Register Description (0xFD)**

Name	Registers	Description	
SERIAL ID[8:0]	[15:7]	Serial Id bits	Device Serial Number bits from 8 to 0 (read only)
	[6:0]	Reserved	Reserved, always 0 (read only)

### 8.6.5 Manufacturer ID Register

This register contains a factory-programmable identification value that identifies this device as being manufactured by Texas Instruments. This register distinguishes this device from other devices that are on the same I2C bus. The manufacturer ID reads 0x5449.

**Table 9. Manufacturer ID Register Description (0xFE)**

Name	Registers	Description		
MANUFACTURER ID	[15:0]	Manufacturer ID	0x5449	Texas instruments ID (read only)

**HDC1010**

ZHCSFF0A – MAY 2016 – REVISED AUGUST 2016

[www.ti.com.cn](http://www.ti.com.cn)
**8.6.6 Device Register ID**

This register contains a factory-programmable identification value that identifies this device as a HDC1010. This register distinguishes this device from other devices that are on the same I2C bus. The Device ID for the HDC1010 is 0x1000.

**Table 10. Device ID Register Description (0xFF)**

Name	Registers			Description
DEVICE ID	[15:0]	Device ID	0x1000	HDC1010 Device ID (read only)



## 9 Application and Implementation

### NOTE

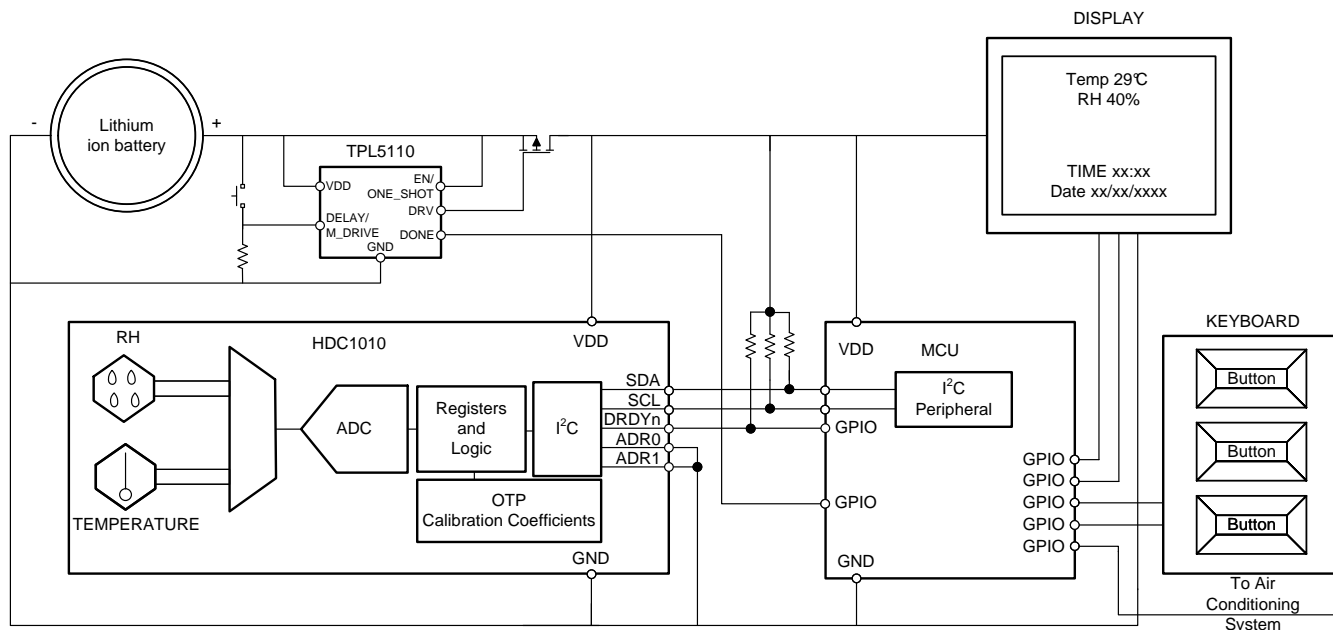
Information in the following applications sections is not part of the TI component specification, and TI does not warrant its accuracy or completeness. TI's customers are responsible for determining suitability of components for their purposes. Customers should validate and test their design implementation to confirm system functionality.

### 9.1 Application Information

An HVAC system thermostat control is based on environmental sensors and a micro-controller. The micro-controller acquires data from humidity sensors and temperature sensors and controls the heating/cooling system. The collected data are then showed on a display that can be easily controlled by the micro controller. Based on data from the humidity and temperature sensor, the heating/cooling system then maintains the environment at customer-defined preferred conditions.

### 9.2 Typical Application

In a battery-powered HVAC system thermostat, one of the key parameters in the selection of components is the power consumption. The HDC1010, with its 1.3 $\mu$ A of current consumption (average consumption over 1s for RH and Temperature measurements) in conjunction with an MSP430 represents an excellent choice for the low power consumption, which extends the battery life. A system block diagram of a battery powered HVAC or Thermostat is shown in [Figure 15](#).



Copyright © 2016, Texas Instruments Incorporated

Figure 15. Typical Application Schematic HVAC

#### 9.2.1 Design Requirements

In order to correctly sense the ambient temperature and humidity, the HDC1010 should be positioned away from heat sources on the PCB. Generally, it should not be close to the LCD and battery. Moreover, to minimize any self-heating of the HDC1010 it is recommended to acquire at a maximum sample rate of 1sps (RH + Temp). In home systems, humidity and the temperature monitoring rates of less than 1sps (even 0.5sps or 0.2sps) can be still effective.

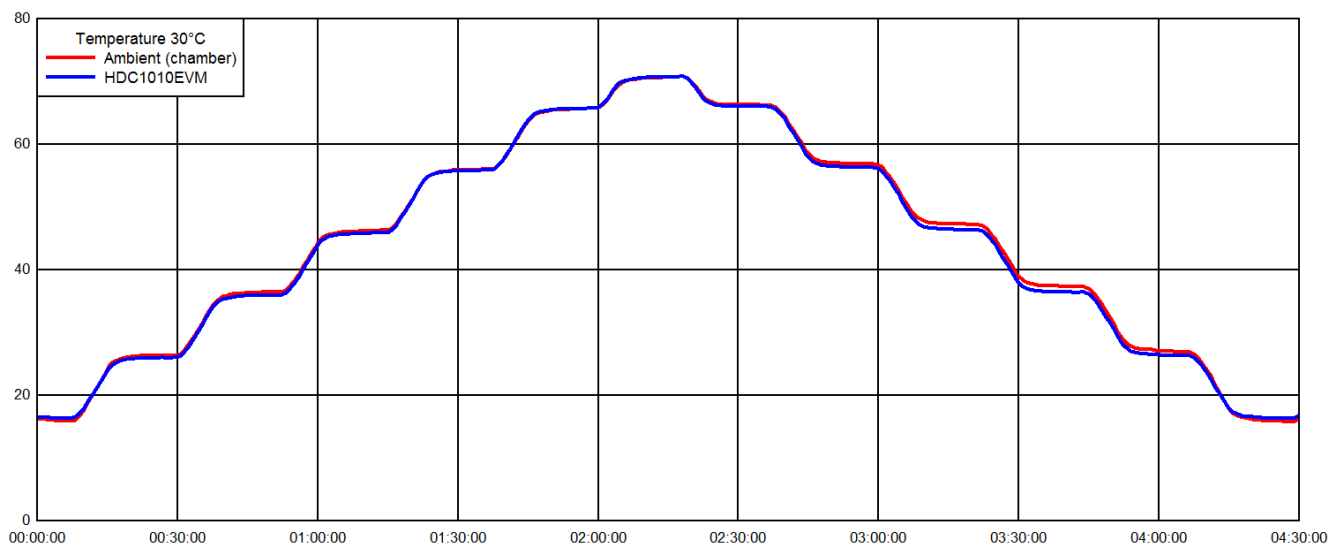
## Typical Application (continued)

### 9.2.2 Detailed Design Procedure

When a circuit board layout is created from the schematic shown in [Figure 15](#) a small circuit board is possible. The accuracy of a RH and temperature measurement depends on the sensor accuracy and the setup of the sensing system. The HDC1010 samples relative humidity and temperature in its immediate environment, it is therefore important that the local conditions at the sensor match the monitored environment. Use one or more openings in the physical cover of the thermostat to obtain a good airflow even in static conditions. Refer to the layout below ([Figure 20](#)) for a PCB layout which minimizes the thermal mass of the PCB in the region of the HDC1010, which can improve measurement response time and accuracy.

### 9.2.3 Application Curve

The data showed below have been acquired with the HDC1010EVM. A humidity chamber was used to control the environment.



**Figure 16. RH vs. Time**

## 9.3 Do's and Don'ts

### 9.3.1 Soldering

For soldering HDC1010 use the standard soldering profile IPC/JEDEC J-STD-020 with peak temperatures at 260 °C. Refer to the document [SNVA009](#) for more details on the DSBGA package. In the document refer to DSBGA package with bump size 0.5mm pitch and 0.32mm diameter.

When soldering the HDC1010 it is mandatory to use no-clean solder paste and no board wash shall be applied. The HDC1010 should be limited to a single IR reflow and no rework is recommended.

### 9.3.2 Chemical Exposure and Sensor Protection

The humidity sensor is not a standard IC and therefore should not be exposed to particulates or volatile chemicals such as solvents or other organic compounds. If any type of protective coating must be applied to the circuit board, the sensor must be protected during the coating process.

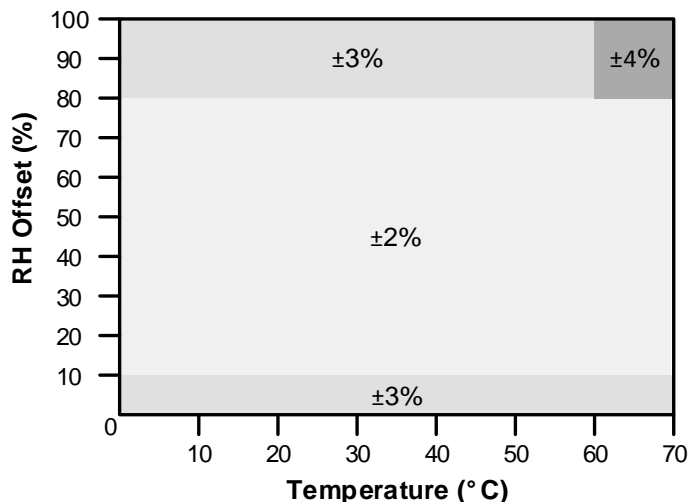
### 9.3.3 High Temperature and Humidity Exposure

Long exposure outside the recommended operating conditions may temporarily offset the RH output. [Table 11](#) shows the RH offset values that can be expected for exposure to 85°C and 85% RH for duration between 12 and 500 hours (continuos).

**Table 11. Induced RH Offset Due to Extended Exposure to High Humidity and High Temperature (85°C/85% RH)**

85°C/85% RH Duration (hours)	12	24	168	500
RH Offset (%)	3	6	12	15

When the sensor is exposed to less severe conditions, [Figure 17](#) shows the typical RH offset at other combinations of temperature and RH.



**Figure 17. Relative Humidity Accuracy vs Temperature**

## 10 Power Supply Recommendations

The HDC1010 require a voltage supply within 2.7V and 5.5V. A multilayer ceramic bypass X7R capacitor of 0.1µF between VDD and GND pin is recommended.

## 11 Layout

### 11.1 Layout Guidelines

The Relative Humidity sensor element is located on the bottom side of the package. It is positioned between the two rows of bumps

It is recommended to not route any traces below the sensor element. Moreover the external components, such as pull-up resistors and bypass capacitors need to be placed next to the 2 rows of bumps or on the bottom side of the PCB in order to guarantee a good air flow.

It is recommended to isolate the sensor from the rest of the PCB by eliminating copper layers below the device (GND, V<sub>DD</sub>) and creating a slot into the PCB around the sensor to enhance thermal isolation.

#### 11.1.1 Surface Mount

Two types of PCB land patterns are used for surface mount packages:

1. Non-solder mask defined (NSMD)
2. Solder mask defined (SMD)

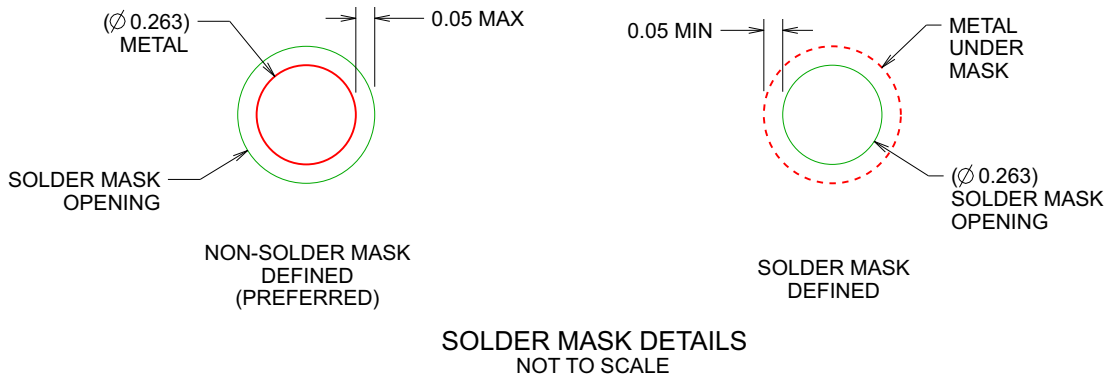
Pros and cons of NSMD and SMD:

1. The NSMD configuration is preferred due to its tighter control of the copper etch process and a reduction in the stress concentration points on the PCB side compared to SMD configuration.
2. A copper layer thickness of less than 1 oz. is recommended to achieve higher solder joint stand-off. A 1 oz. (30 micron) or greater copper thickness causes a lower effective solder joint stand-off, which may

**Layout Guidelines (continued)**

compromise solder joint reliability.

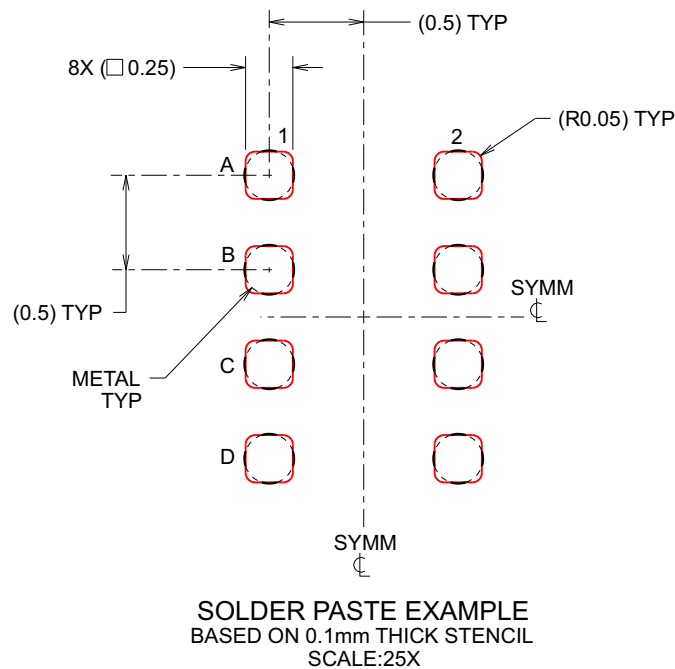
- For the NSMD pad geometry, the trace width at the connection to the land pad should not exceed 2/3 of the pad diameter.



**Figure 18. Solder Mask**

**11.1.2 Stencil Printing Process**

- Use laser cutting followed by electro-polishing for stencil fabrication
- If possible, offset apertures from land pads to maximize separation and minimize possibility of bridging for DSBGA packages
- Use Type 3 (25 to 45 micron particle size range) or finer solder paste for printing



**Figure 19. Solder Paste**

## 11.2 Layout Example

The only component next to the device is the supply bypass capacitor. Since the relative humidity is dependent on the temperature, the HDC1010 should be positioned away from hot points present on the board such as battery, display or micro-controller. Slots around the device can be used to reduce the thermal mass, for a quicker response to environmental changes.

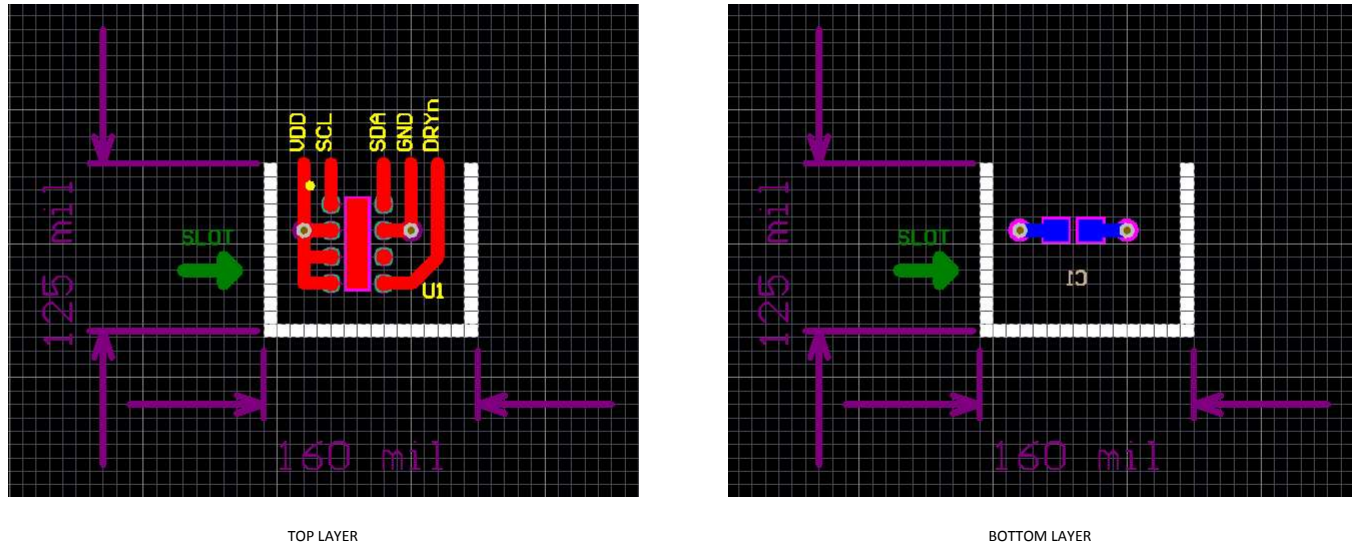


Figure 20. Layout

## 12 器件和文档支持

### 12.1 文档支持

#### 12.1.1 相关文档

《适用于星型网络的无线湿度和温度传感器节点参考设计，可实现 10 年以上的纽扣电池使用寿命》 [TIDA-00374](#)

《适用于低于 1GHz 的星型网络的湿度和温度传感器节点，可实现 10 年以上的纽扣电池使用寿命》 [TIDA-00484](#)

《具有 NFC 接口的超低功耗多传感器数据记录器参考设计》 [TIDA-00524](#)

《HDC1010 德州仪器 (TI) 湿度传感器》， [SNAA216](#)

### 12.2 接收文档更新通知

如需接收文档更新通知，请访问 [www.ti.com.cn](http://www.ti.com.cn) 网站上的器件产品文件夹。点击右上角的提醒我 (Alert me) 注册后，即可每周定期收到已更改的产品信息。有关更改的详细信息，请查阅已修订文档中包含的修订历史记录。

### 12.3 社区资源

The following links connect to TI community resources. Linked contents are provided "AS IS" by the respective contributors. They do not constitute TI specifications and do not necessarily reflect TI's views; see TI's [Terms of Use](#).

**TI E2E™ Online Community** *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [e2e.ti.com](http://e2e.ti.com), you can ask questions, share knowledge, explore ideas and help solve problems with fellow engineers.

**Design Support** *TI's Design Support* Quickly find helpful E2E forums along with design support tools and contact information for technical support.

### 12.4 商标

E2E is a trademark of Texas Instruments.

All other trademarks are the property of their respective owners.

### 12.5 静电放电警告



这些装置包含有限的内置 ESD 保护。存储或装卸时，应将导线一起截短或将装置放置于导电泡棉中，以防止 MOS 门极遭受静电损伤。

### 12.6 Glossary

[SLYZ022](#) — *TI Glossary*.

This glossary lists and explains terms, acronyms, and definitions.

## 13 机械、封装和可订购信息

以下页中包括机械、封装和可订购信息。这些信息是针对指定器件可提供的最新数据。这些数据会在无通知且不对本文档进行修订的情况下发生改变。欲获得该数据表的浏览器版本，请查阅左侧的导航栏

## 重要声明

德州仪器(TI)及其下属子公司有权根据 JESD46 最新标准,对所提供的产品和服务进行更正、修改、增强、改进或其它更改,并有权根据 JESD48 最新标准中止提供任何产品和服务。客户在下订单前应获取最新的相关信息,并验证这些信息是否完整且是最新的。所有产品的销售都遵循在订单确认时所提供的TI 销售条款与条件。

TI 保证其所销售的组件的性能符合产品销售时 TI 半导体产品销售条件与条款的适用规范。仅在 TI 保证的范围内,且 TI 认为有必要时才会使用测试或其它质量控制技术。除非适用法律做出了硬性规定,否则没有必要对每种组件的所有参数进行测试。

TI 对应用帮助或客户产品设计不承担任何义务。客户应对其使用 TI 组件的产品和应用自行负责。为尽量减小与客户产品和应用相关的风险,客户应提供充分的设计与操作安全措施。

TI 不对任何 TI 专利权、版权、屏蔽作品权或其它与使用了 TI 组件或服务的组合设备、机器或流程相关的 TI 知识产权中授予的直接或隐含权限作出任何保证或解释。TI 所发布的与第三方产品或服务有关的信息,不能构成从 TI 获得使用这些产品或服务的许可、授权、或认可。使用此类信息可能需要获得第三方的专利权或其它知识产权方面的许可,或是 TI 的专利权或其它知识产权方面的许可。

对于 TI 的产品手册或数据表中 TI 信息的重要部分,仅在没有对内容进行任何篡改且带有相关授权、条件、限制和声明的情况下才允许进行复制。TI 对此类篡改过的文件不承担任何责任或义务。复制第三方的信息可能需要服从额外的限制条件。

在转售 TI 组件或服务时,如果对该组件或服务参数的陈述与 TI 标明的参数相比存在差异或虚假成分,则会失去相关 TI 组件或服务的所有明示或暗示授权,且这是不正当的、欺诈性商业行为。TI 对任何此类虚假陈述均不承担任何责任或义务。

客户认可并同意,尽管任何应用相关信息或支持仍可能由 TI 提供,但他们将独立负责满足与其产品及其在应用中使用的 TI 产品相关的所有法律、法规和安全相关要求。客户声明并同意,他们具备制定与实施安全措施所需的全部专业技术和知识,可预见故障的危险后果、监测故障及其后果、降低有可能造成人身伤害的故障的发生机率并采取适当的补救措施。客户将全额赔偿因在此类安全关键应用中使用任何 TI 组件而对 TI 及其代理造成的任何损失。

在某些场合中,为了推进安全相关应用有可能对 TI 组件进行特别的促销。TI 的目标是利用此类组件帮助客户设计和创立其特有的可满足适用的功能安全性标准和要求的终端产品解决方案。尽管如此,此类组件仍然服从这些条款。

TI 组件未获得用于 FDA Class III (或类似的生命攸关医疗设备)的授权许可,除非各方授权官员已经达成了专门管控此类使用的特别协议。

只有那些 TI 特别注明属于军用等级或“增强型塑料”的 TI 组件才是设计或专门用于军事/航空应用或环境的。购买者认可并同意,对并非指定面向军事或航空航天用途的 TI 组件进行军事或航空航天方面的应用,其风险由客户单独承担,并且由客户独立负责满足与此类使用相关的所有法律和法规要求。

TI 已明确指定符合 ISO/TS16949 要求的产品,这些产品主要用于汽车。在任何情况下,因使用非指定产品而无法达到 ISO/TS16949 要求, TI 不承担任何责任。

	产品		应用
数字音频	<a href="http://www.ti.com.cn/audio">www.ti.com.cn/audio</a>	通信与电信	<a href="http://www.ti.com.cn/telecom">www.ti.com.cn/telecom</a>
放大器和线性器件	<a href="http://www.ti.com.cn/amplifiers">www.ti.com.cn/amplifiers</a>	计算机及周边	<a href="http://www.ti.com.cn/computer">www.ti.com.cn/computer</a>
数据转换器	<a href="http://www.ti.com.cn/dataconverters">www.ti.com.cn/dataconverters</a>	消费电子	<a href="http://www.ti.com.cn/consumer-apps">www.ti.com.cn/consumer-apps</a>
DLP® 产品	<a href="http://www.dlp.com">www.dlp.com</a>	能源	<a href="http://www.ti.com.cn/energy">www.ti.com.cn/energy</a>
DSP - 数字信号处理器	<a href="http://www.ti.com.cn/dsp">www.ti.com.cn/dsp</a>	工业应用	<a href="http://www.ti.com.cn/industrial">www.ti.com.cn/industrial</a>
时钟和计时器	<a href="http://www.ti.com.cn/clockandtimers">www.ti.com.cn/clockandtimers</a>	医疗电子	<a href="http://www.ti.com.cn/medical">www.ti.com.cn/medical</a>
接口	<a href="http://www.ti.com.cn/interface">www.ti.com.cn/interface</a>	安防应用	<a href="http://www.ti.com.cn/security">www.ti.com.cn/security</a>
逻辑	<a href="http://www.ti.com.cn/logic">www.ti.com.cn/logic</a>	汽车电子	<a href="http://www.ti.com.cn/automotive">www.ti.com.cn/automotive</a>
电源管理	<a href="http://www.ti.com.cn/power">www.ti.com.cn/power</a>	视频和影像	<a href="http://www.ti.com.cn/video">www.ti.com.cn/video</a>
微控制器 (MCU)	<a href="http://www.ti.com.cn/microcontrollers">www.ti.com.cn/microcontrollers</a>		
RFID 系统	<a href="http://www.ti.com.cn/rfidsys">www.ti.com.cn/rfidsys</a>		
OMAP应用处理器	<a href="http://www.ti.com.cn/omap">www.ti.com.cn/omap</a>		
无线连通性	<a href="http://www.ti.com.cn/wirelessconnectivity">www.ti.com.cn/wirelessconnectivity</a>	德州仪器在线技术支持社区	<a href="http://www.deyisupport.com">www.deyisupport.com</a>

邮寄地址: 上海市浦东新区世纪大道1568号, 中建大厦32楼邮政编码: 200122  
Copyright © 2016, 德州仪器半导体技术(上海)有限公司

**PACKAGING INFORMATION**

Orderable Device	Status (1)	Package Type	Package Drawing	Pins	Package Qty	Eco Plan (2)	Lead finish/ Ball material (6)	MSL Peak Temp (3)	Op Temp (°C)	Device Marking (4/5)	Samples
HDC1010YPAR	ACTIVE	DSBGA	YPA	8	3000	RoHS & Green	SAC405 SNAGCU	Level-1-260C-UNLIM	-40 to 85	3N	<b>Samples</b>
HDC1010YPAT	ACTIVE	DSBGA	YPA	8	250	RoHS & Green	SAC405 SNAGCU	Level-1-260C-UNLIM	-40 to 85	3N	<b>Samples</b>

(1) The marketing status values are defined as follows:

**ACTIVE:** Product device recommended for new designs.

**LIFEBUY:** TI has announced that the device will be discontinued, and a lifetime-buy period is in effect.

**NRND:** Not recommended for new designs. Device is in production to support existing customers, but TI does not recommend using this part in a new design.

**PREVIEW:** Device has been announced but is not in production. Samples may or may not be available.

**OBSOLETE:** TI has discontinued the production of the device.

(2) **RoHS:** TI defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials. Where designed to be soldered at high temperatures, "RoHS" products are suitable for use in specified lead-free processes. TI may reference these types of products as "Pb-Free".

**RoHS Exempt:** TI defines "RoHS Exempt" to mean products that contain lead but are compliant with EU RoHS pursuant to a specific EU RoHS exemption.

**Green:** TI defines "Green" to mean the content of Chlorine (Cl) and Bromine (Br) based flame retardants meet JS709B low halogen requirements of <=1000ppm threshold. Antimony trioxide based flame retardants must also meet the <=1000ppm threshold requirement.

(3) MSL, Peak Temp. - The Moisture Sensitivity Level rating according to the JEDEC industry standard classifications, and peak solder temperature.

(4) There may be additional marking, which relates to the logo, the lot trace code information, or the environmental category on the device.

(5) Multiple Device Markings will be inside parentheses. Only one Device Marking contained in parentheses and separated by a "~" will appear on a device. If a line is indented then it is a continuation of the previous line and the two combined represent the entire Device Marking for that device.

(6) Lead finish/Ball material - Orderable Devices may have multiple material finish options. Finish options are separated by a vertical ruled line. Lead finish/Ball material values may wrap to two lines if the finish value exceeds the maximum column width.

**Important Information and Disclaimer:**The information provided on this page represents TI's knowledge and belief as of the date that it is provided. TI bases its knowledge and belief on information provided by third parties, and makes no representation or warranty as to the accuracy of such information. Efforts are underway to better integrate information from third parties. TI has taken and continues to take reasonable steps to provide representative and accurate information but may not have conducted destructive testing or chemical analysis on incoming materials and chemicals. TI and TI suppliers consider certain information to be proprietary, and thus CAS numbers and other limited information may not be available for release.

In no event shall TI's liability arising out of such information exceed the total purchase price of the TI part(s) at issue in this document sold by TI to Customer on an annual basis.





## TAPE AND REEL INFORMATION



### QUADRANT ASSIGNMENTS FOR PIN 1 ORIENTATION IN TAPE



\*All dimensions are nominal

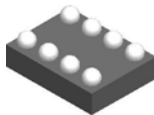
Device	Package Type	Package Drawing	Pins	SPQ	Reel Diameter (mm)	Reel Width W1 (mm)	A0 (mm)	B0 (mm)	K0 (mm)	P1 (mm)	W (mm)	Pin1 Quadrant
HDC1010YPAR	DSBGA	YPA	8	3000	178.0	8.4	1.68	2.13	0.76	4.0	8.0	Q1
HDC1010YPAT	DSBGA	YPA	8	250	178.0	8.4	1.68	2.13	0.76	4.0	8.0	Q1

**TAPE AND REEL BOX DIMENSIONS**


\*All dimensions are nominal

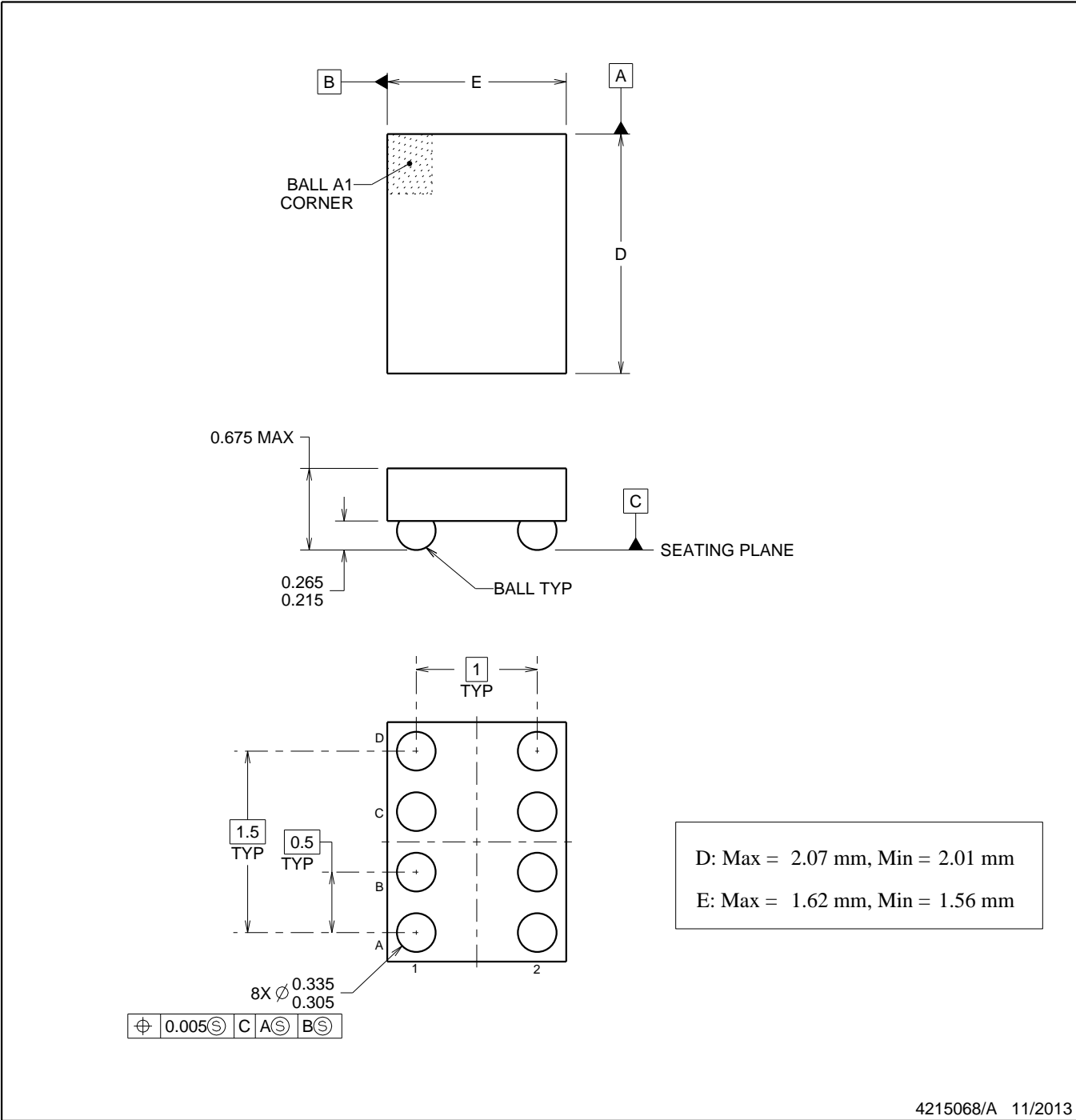
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
HDC1010YPAR	DSBGA	YPA	8	3000	210.0	185.0	35.0
HDC1010YPAT	DSBGA	YPA	8	250	210.0	185.0	35.0

YPA0008



DSBGA - 0.675 mm max height

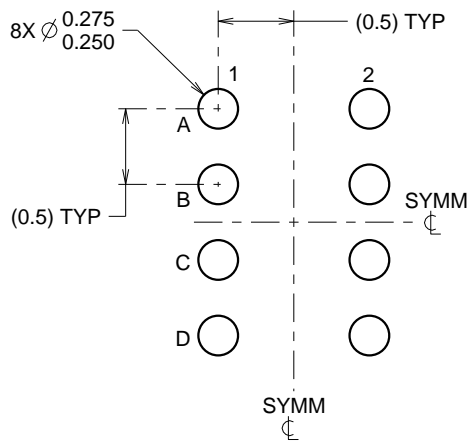
DIE SIZE BALL GRID ARRAY



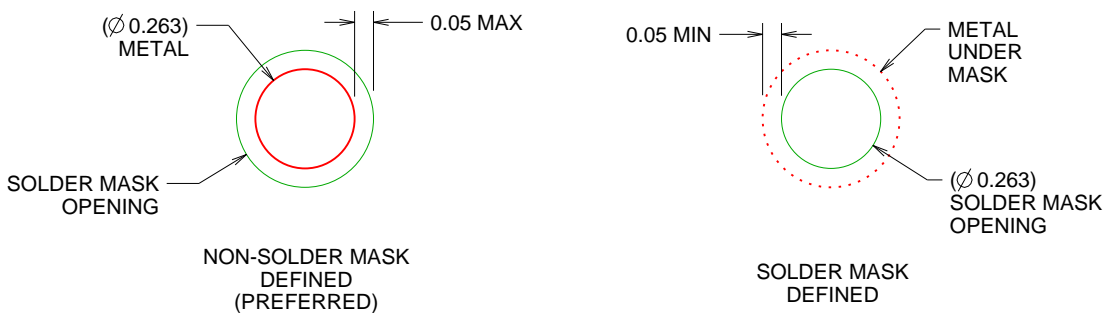
4215068/A 11/2013

NOTES:

1. All linear dimensions are in millimeters. Dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.



LAND PATTERN EXAMPLE  
SCALE:20X

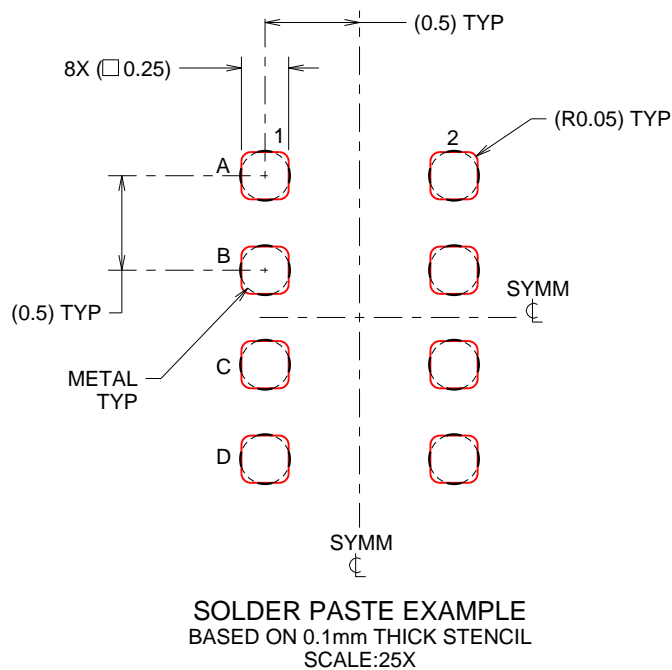


SOLDER MASK DETAILS  
NOT TO SCALE

4215068/A 11/2013

NOTES: (continued)

- 3. Final dimensions may vary due to manufacturing tolerance considerations and also routing constraints. See Texas Instruments Literature No. SBVA017 ([www.ti.com/lit/sbva017](http://www.ti.com/lit/sbva017)).



4215068/A 11/2013

NOTES: (continued)

4. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release.

## 重要声明和免责声明

TI 均以“原样”提供技术性及其可靠性数据（包括数据表）、设计资源（包括参考设计）、应用或其他设计建议、网络工具、安全信息和其他资源，不保证其中不含任何瑕疵，且不做任何明示或暗示的担保，包括但不限于对适销性、适合某特定用途或不侵犯任何第三方知识产权的暗示担保。

所述资源可供专业开发人员应用TI 产品进行设计使用。您将对以下行为独自承担全部责任：(1) 针对您的应用选择合适的TI 产品；(2) 设计、验证并测试您的应用；(3) 确保您的应用满足相应标准以及任何其他安全、安保或其他要求。所述资源如有变更，恕不另行通知。TI 对您使用所述资源的授权仅限于开发资源所涉及TI 产品的相关应用。除此之外不得复制或展示所述资源，也不提供其它TI 或任何第三方的知识产权授权许可。如因使用所述资源而产生任何索赔、赔偿、成本、损失及债务等，TI 对此概不负责，并且您须赔偿由此对TI 及其代表造成的损害。

TI 所提供产品均受TI 的销售条款 (<http://www.ti.com.cn/zh-cn/legal/termsofsale.html>) 以及ti.com.cn 上或随附TI 产品提供的其他可适用条款的约束。TI 提供所述资源并不扩展或以其他方式更改TI 针对TI 产品所发布的可适用的担保范围或担保免责声明。

邮寄地址：上海市浦东新区世纪大道 1568 号中建大厦 32 楼，邮政编码：200122

Copyright © 2020 德州仪器半导体技术（上海）有限公司