

HDC1050 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 $\pm 3\%$ (典型值)
- 温度精度为 $\pm 0.2^{\circ}\text{C}$ (典型值)
- 14 位测量分辨率
- 休眠模式的电流为 100nA
- 平均电源电流:
 - 1sps、11 位相对湿度 (RH) 测量时为 710nA
 - 1sps、11 位 RH 与温度测量时为 1.3 μA
- 电源电压范围: 2.7V 至 5.5V
- 3mm x 3mm 小型器件封装
- I²C 接口

2 应用

- 制热、通风与空调控制 (HVAC)
- 智能温度调节装置和室温监视器
- 大型家用电器
- 打印机
- 手持式计量表
- 医疗设备
- 无线传感器 ([TIDA-00374](#))

3 说明

HDC1050 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。

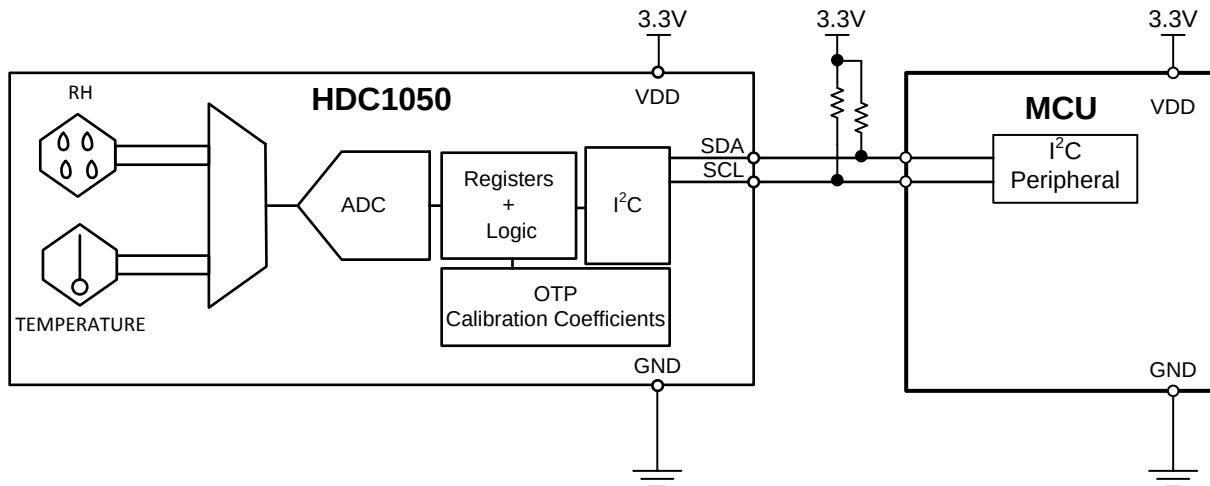
HDC1050 支持较宽的工作电源电压范围，并且相比竞争解决方案，该器件可为各类常见应用提供低成本和低功耗优势。湿度和温度传感器均经过出厂校准。

器件信息 (1)

部件号	封装	封装尺寸 (标称值)
HDC1050	PWSON (6 引脚) DMB	3.00mm x 3.00mm

(1) 如需了解所有可用封装，请见数据表末尾的可订购产品附录。

4 典型应用



目录

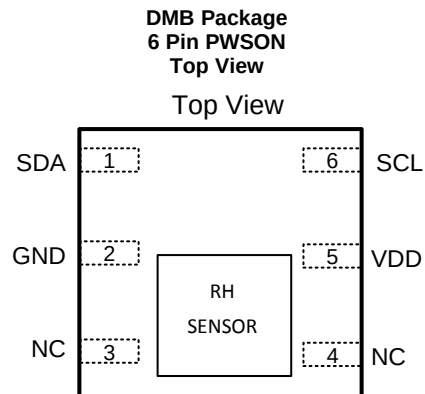
1	特性	1	8.4	Device Functional Modes	9
2	应用	1	8.5	Programming	10
3	说明	1	8.6	Register Map	14
4	典型应用	1	9	Application and Implementation	17
5	修订历史记录	2	9.1	Application Information	17
6	Pin Configuration and Functions	3	9.2	Typical Application	17
7	Specifications	4	9.3	Do's and Don'ts	18
7.1	Absolute Maximum Ratings	4	10	Power Supply Recommendations	19
7.2	ESD Ratings	4	11	Layout	19
7.3	Recommended Operating Conditions	4	11.1	Layout Guidelines	19
7.4	Thermal Information	4	11.2	Layout Example	19
7.5	Electrical Characteristics	5	12	器件和文档支持	20
7.6	I2C Interface Electrical Characteristics	6	12.1	文档支持	20
7.7	I2C Interface Timing Requirements	6	12.2	社区资源	20
7.8	Typical Characteristics	7	12.3	商标	20
8	Detailed Description	9	12.4	静电放电警告	20
8.1	Overview	9	12.5	Glossary	20
8.2	Functional Block Diagram	9	13	机械、封装和可订购信息	20
8.3	Feature Description	9			

5 修订历史记录

Changes from Revision A (July 2015) to Revision B	Page
• Added range for Temp sensor only	4
• Added operating range for RH sensor	4
• Added RH condition	5
• Added RH range condition	5
• Added long term drift spec	5
• Changed recommended operating range.	5
• Changed Figure 2	7
• Changed soldering recovery temperature	18

Changes from Original (July 2015) to Revision A	Page
• 已添加 产品预览至完整数据表	1

6 Pin Configuration and Functions



Pin Functions

PIN		I/O TYPE ⁽¹⁾	DESCRIPTION
NAME	NO.		
SDA	1	I/O	Serial data line for I2C, open-drain; requires a pull-up resistor to VDD
GND	2	G	Ground
NC	3,4	-	These pins may be left floating, or connected to GND
VDD	5	P	Supply Voltage
SCL	6	I	Serial clock line for I2C, open-drain; requires a pull-up resistor to VDD
DAP	DAP	G	Die Attach Pad. Should be left floating. (On bottom of the device, not shown in the figure)

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

7 Specifications

7.1 Absolute Maximum Ratings⁽¹⁾

		MIN	MAX	UNIT
Input Voltage	VDD	-0.3	6	V
	SCL	-0.3	6	
	SDA	-0.3	6	
Storage Temperature	T _{STG}	-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 _(ESD) Electrostatic discharge	Human-body model (HBM), per ANSI/ESDA/JEDEC JS-001 ⁽¹⁾	±2000	V
	Charged-device model (CDM), per JEDEC specification JESD22-C101 ⁽²⁾	±500	

- (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 _{DD}	Supply Voltage	2.7	3	5.5	V
T _A , Temperature sensor	Ambient Operating Temperature	-40		125	°C
T _A , Humidity sensor	Ambient Operating Temperature	-20		60	°C

7.4 Thermal Information

THERMAL METRIC ⁽¹⁾		HDC1050	UNIT
		PWSON	
		DMB 6 PINS	
R _{θJA}	Junction-to-Ambient Thermal Resistance	49.4	°C/W

- (1) For more information about traditional and new thermal metrics, see the: *IC Package Thermal Metrics* application report, [SPRA953](#).

7.5 Electrical Characteristics⁽¹⁾

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

PARAMETER		TEST CONDITION ⁽²⁾	MIN ⁽³⁾	TYP ⁽⁴⁾	MAX ⁽³⁾	UNIT
POWER CONSUMPTION						
I _{DD}	Supply Current	RH measurement, bit 12 of 0x02 register = 0 ⁽⁵⁾		190	220	μA
		Temperature measurement, bit 12 of 0x02 register = 0 ⁽⁵⁾		160	185	μA
		Sleep Mode		100	200	nA
		Average @ 1 measurement/second, RH (11 bit), bit 12 of 0x02 register = 0 ⁽⁵⁾⁽⁶⁾		710		nA
		Average @ 1 measurement/second, Temp (11 bit), bit 12 of 0x02 register = 0 ⁽⁵⁾⁽⁶⁾		590		nA
		Average @ 1 measurement/second, RH (11bit) +temperature (11 bit), bit 12 of 0x02 register = 1 ⁽⁵⁾⁽⁶⁾		1.3		μA
		Startup (average on Start-up time)		300		μA
I _{HEAT}	Heater Current ⁽⁷⁾	Peak current		7.2		mA
		Average @ 1 measurement/second, RH (11bit) +temperature (11 bit), bit 12 of 0x02 register = 1 ⁽⁵⁾⁽⁶⁾		50		μA
RELATIVE HUMIDITY SENSOR						
RH _{ACC}	Accuracy	Refer to Figure 2 in Typical Characteristics section.		±3		%RH
RH _{REP}	Repeatability ⁽⁷⁾	14 bit resolution		±0.1		%RH
RH _{HYS}	Hysteresis ⁽⁸⁾	20% ≤ RH ≤ 60%		±1		%RH
RH _{RT}	Response Time ⁽⁹⁾	t _{63%} ⁽¹⁰⁾		30		s
RH _{CT}	Conversion Time ⁽⁷⁾	8 bit resolution		2.50		ms
		11 bit resolution		3.85		ms
		14 bit resolution		6.50		ms
RH _{OR}	Operating Range ⁽¹¹⁾	Non-condensing	0		100	%RH
RH _{LTD}	Long Term Drift			±0.5		%RH/yr
TEMPERATURE SENSOR						
TEMP _{ACC}	Accuracy ⁽⁷⁾	5°C < T _A < 60°C		±0.2	±0.4	°C
TEMP _{REP}	Repeatability ⁽⁷⁾	14 bit resolution		±0.1		°C
TEMP _{CT}	Conversion Time ⁽⁷⁾	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°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^2C 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 20% to 60% 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.

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
I2C INTERFACE VOLTAGE LEVEL					
V_{IH}	Input High Voltage	$0.7 \times V_{DD}$			V
V_{IL}	Input Low Voltage			$0.3 \times V_{DD}$	V
V_{OL}	Output Low Voltage	Sink current 3mA		0.4	V
HYS	Hysteresis ⁽¹⁾	$0.1 \times V_{DD}$			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	NOM	MAX	UNIT
I2C INTERFACE VOLTAGE LEVEL					
f_{SCL}	Clock Frequency	10		400	kHz
t_{LOW}	Clock Low Time	1.3			μs
t_{HIGH}	Clock High Time	0.6			μs
t_{SP}	Pulse width of spikes that must be suppressed by the input filter ⁽¹⁾			50	ns
t_{START}	Device Start-up time	From $V_{DD} \geq 2.7\text{V}$ to ready for a conversion ⁽¹⁾⁽²⁾	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.

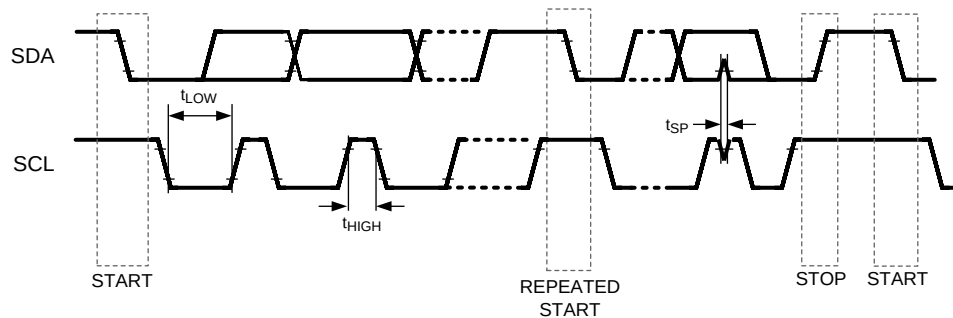


Figure 1. I2C Timing

7.8 Typical Characteristics

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

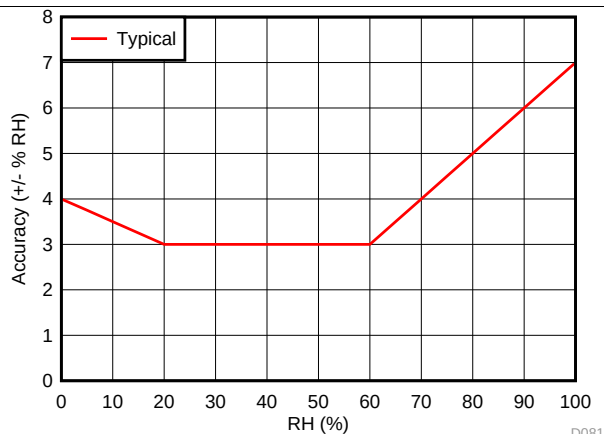


Figure 2. RH Accuracy vs. RH

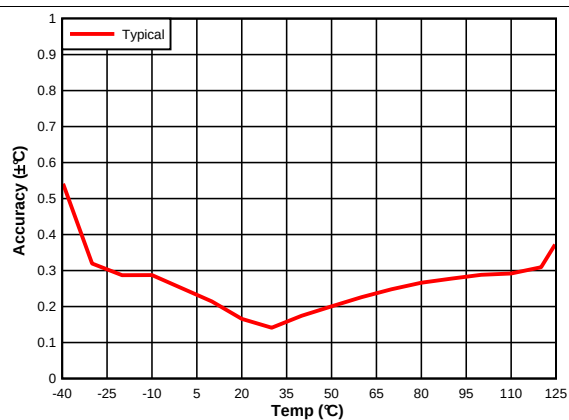


Figure 3. Temperature Accuracy vs. Temperature

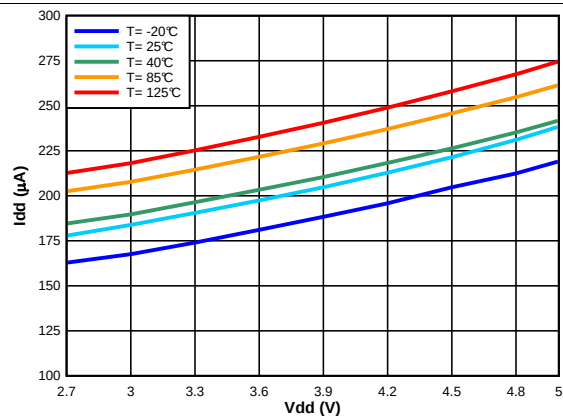


Figure 4. Supply Current vs. Supply Voltage, RH Measurement Active

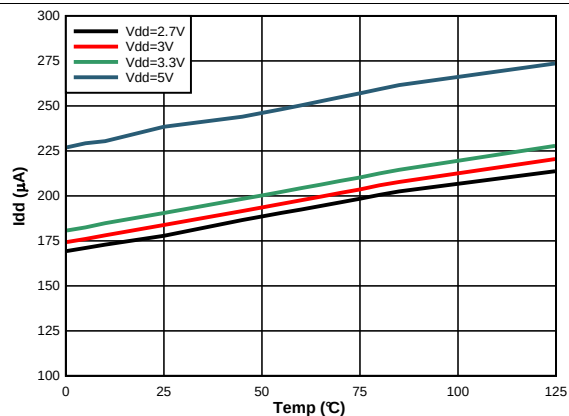


Figure 5. Supply Current vs. Temperature, RH Measurement Active

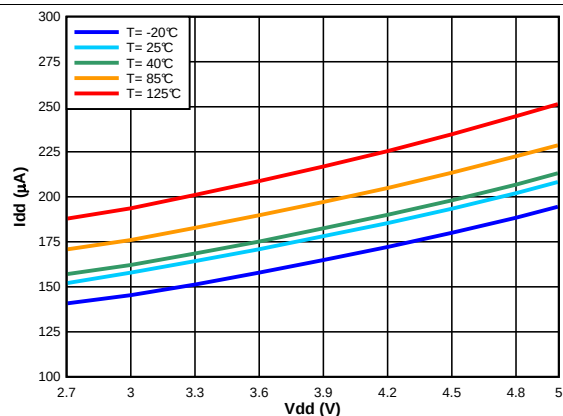


Figure 6. Supply Current vs. Supply Voltage, Temp Measurement Active

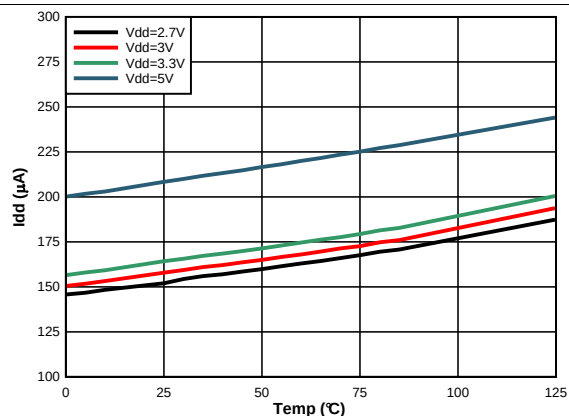


Figure 7. Supply Current vs. Temperature, Temp Measurement Active

Typical Characteristics (continued)

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

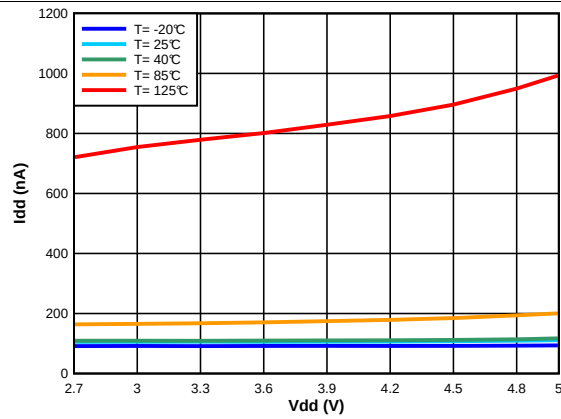


Figure 8. Supply Current vs. Supply Voltage, Sleep Mode

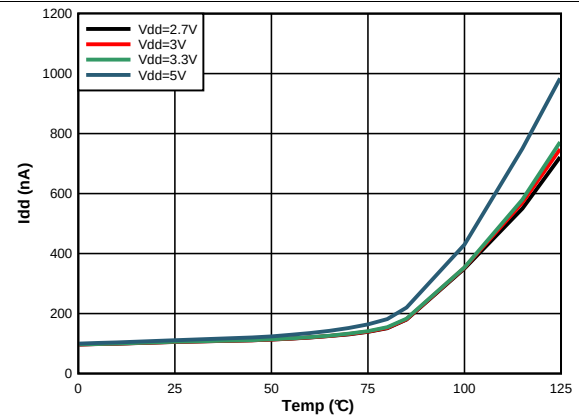


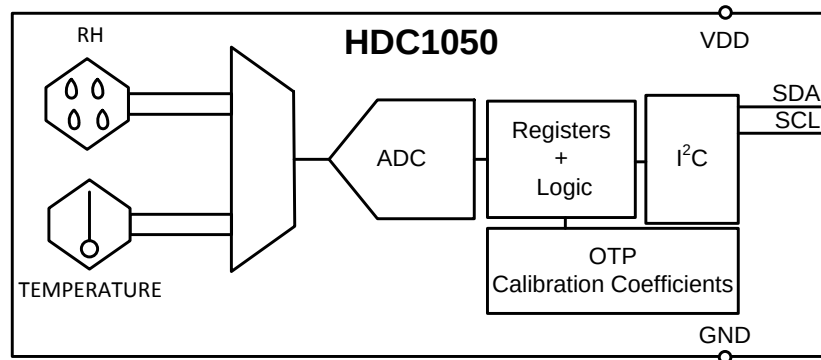
Figure 9. Supply Current vs. Temperature, Sleep Mode

8 Detailed Description

8.1 Overview

The HDC1050 is a digital humidity sensor with integrated temperature sensor that provides excellent measurement accuracy at very low power. The sensing element of the HDC1050 is placed on the top part of the device. 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



8.3 Feature Description

8.3.1 Power Consumption

One of the key features of the HDC1050 is its low power consumption, which makes the device suitable in battery or power harvesting applications. In these applications the HDC1050 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 HDC1050 monitors the supply voltage level and indicates when the voltage supply of the HDC1050 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 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 the 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 accelerate the temperature increase it is suggested to increase the measurement data rate.

8.4 Device Functional Modes

The HDC1050 has two modes of operation: sleep mode and measurement mode. After power up, the HDC1050 is in sleep mode. In this mode, the HDC1050 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 HDC1050 moves from sleep mode to measurement mode. After completing the measurement the HDC1050 returns to sleep mode.

8.5 Programming

8.5.1 I2C Interface

The HDC1050 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 HDC1050 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.

8.5.1.1 Serial Bus Address

To communicate with the HDC1050, 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 I2C address of the HDC1050 is 1000000 (7-bit address).

8.5.1.2 Read and Write Operations

To access a particular register on the HDC1050, 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 HDC1050 requires a value for the pointer register (refer to [Figure 10](#)).

When reading from the HDC1050, the last value stored in the pointer by a write operation is used to determine which register is accessed by a read operation. To change the pointer register for a read operation, a new value must be written to the pointer register. 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.

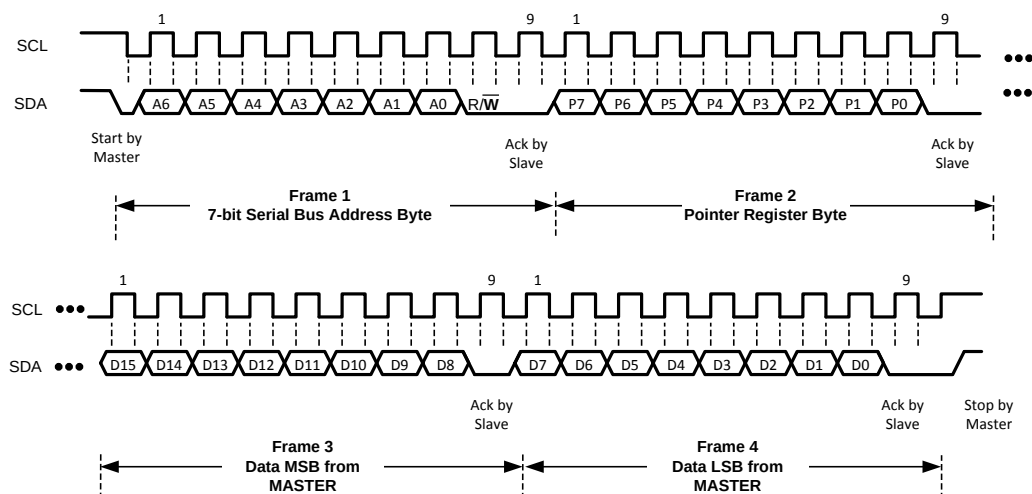


Figure 10. Writing Frame (Configuration Register)

Programming (continued)

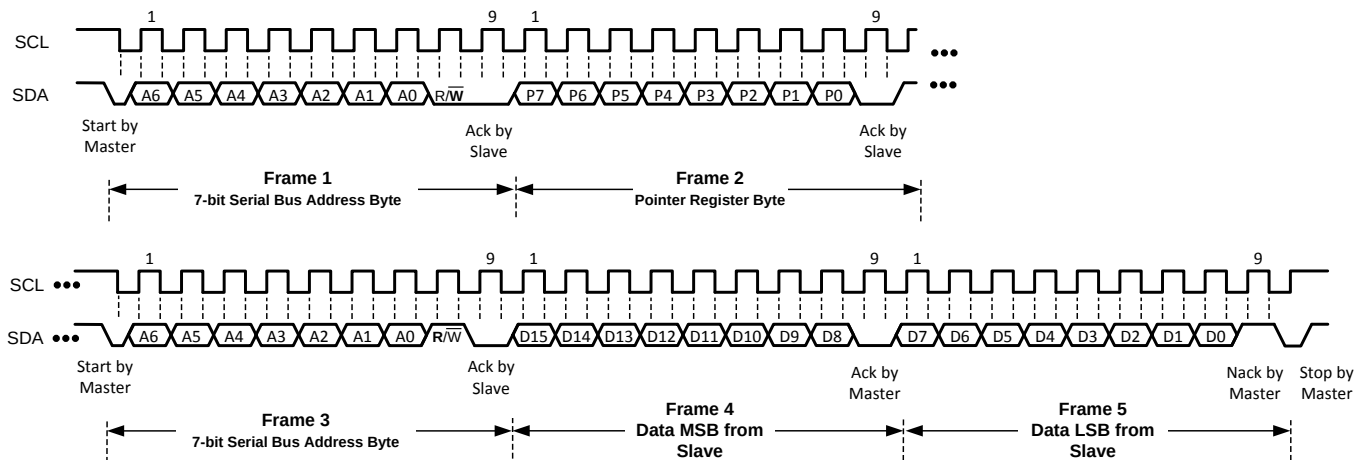


Figure 11. Reading Frame (Configuration Register)

8.5.1.3 Device Measurement Configuration

By default the HDC1050 will first perform a temperature measurement followed by a humidity measurement. On power-up, the HDC1050 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](#)⁽¹⁾ for the conversion time).
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.

(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.

Programming (continued)

- 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^{\(1\)}](#) for the conversion time).
- 4. Read the output data:

Retrieve the completed measurement result from register address 0x00 or 0x01, as appropriate, as shown in [Figure 11](#). 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 a 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.

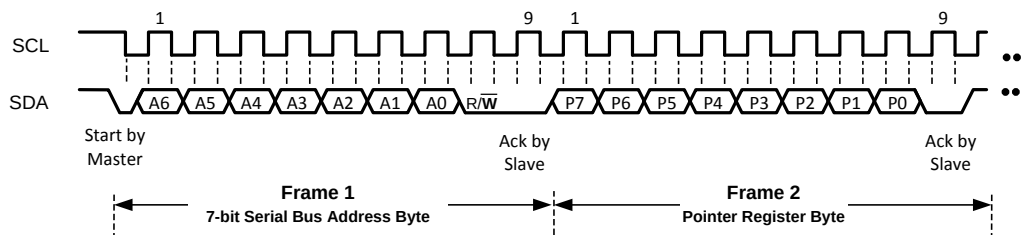


Figure 12. Trigger Humidity/Temperature Measurement

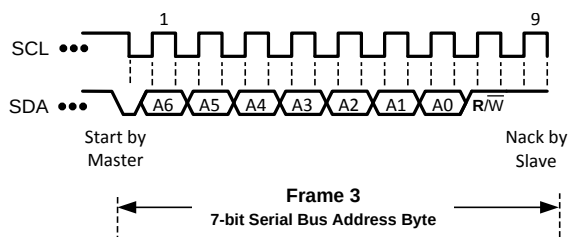


Figure 13. Read Humidity/Temperature Measurement (Data Not Ready)

Programming (continued)

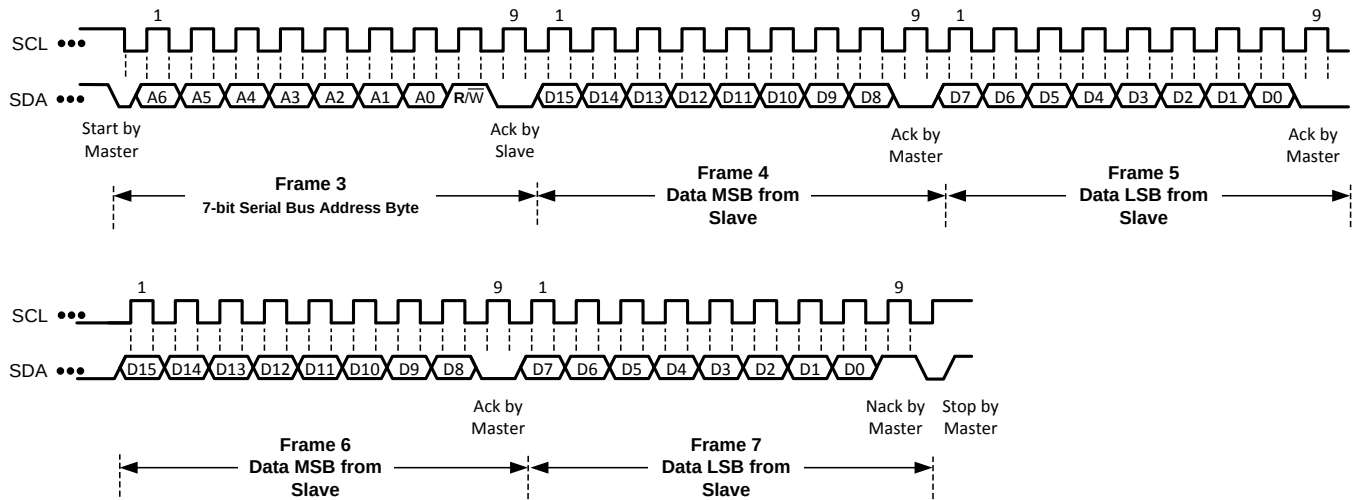


Figure 14. Read Humidity and Temperature Measurement (Data Ready)

8.6 Register Map

The HDC1050 contains data registers that hold configuration information, temperature and humidity measurement results, and status information.

Table 1. Register Map

Pointer	Name	Reset value	Description
0x00	Temperature	0x0000	Temperature measurement output
0x01	Humidity	0x0000	Relative Humidity measurement output
0x02	Configuration	0x1000	HDC1050 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	0x1050	ID of HDC1050 device

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

The HDC1050 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^{\(1\)}](#)). 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 2. Temperature Register Description (0x00)

Name	Bits	Description
TEMPERATURE	[15:02]	Temperature measurement (read only)
	[01:00]	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^{\(1\)}](#)). 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 3. Humidity Register Description (0x01)

Name	Bits	Description
HUMIDITY	[15:02]	Relative Humidity measurement (read only)
	[01:00]	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 4. Configuration Register Description (0x02)

NAME	Bits	DESCRIPTION
RST	[15]	Software reset bit
		0 Normal Operation, this bit self clears 1 Software Reset
Reserved	[14]	Reserved
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

8.6.4 Serial Number Registers

These registers contain a 40bit unique serial number for each individual HDC1050.

Table 5. Serial Number Register Description (0xFB)

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

Table 6. Serial Number Register Description (0xFC)

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

Table 7. Serial Number Register Description (0xFD)

Name	Bits	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 8. Manufacturer ID Register Description (0xFE)

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

HDC1050

ZHCSDX0B –MAY 2015–REVISED JULY 2015

www.ti.com.cn**8.6.6 Device Register ID**

This register contains a factory-programmable identification value that identifies this device as a HDC1050. This register distinguishes this device from other devices that are on the same I2C bus. The Device ID for the HDC1050 is 0x1050.

Table 9. Device ID Register Description (0xFF)

Name	Bits	Description
DEVICE ID	[15:0] Device ID 0x1050	HDC1050 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 microcontroller acquires data from humidity sensors and temperature sensors and controls the heating/cooling system. The collected data are then shown 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 HDC1050, with 1.3µA of current consumption (average consumption over 1s for RH and Temperature measurements), in conjunction with an MSP430, represents an excellent choice for low power consumption, which extends the battery life. A system block diagram of a battery powered thermostat is shown in [Figure 15](#).

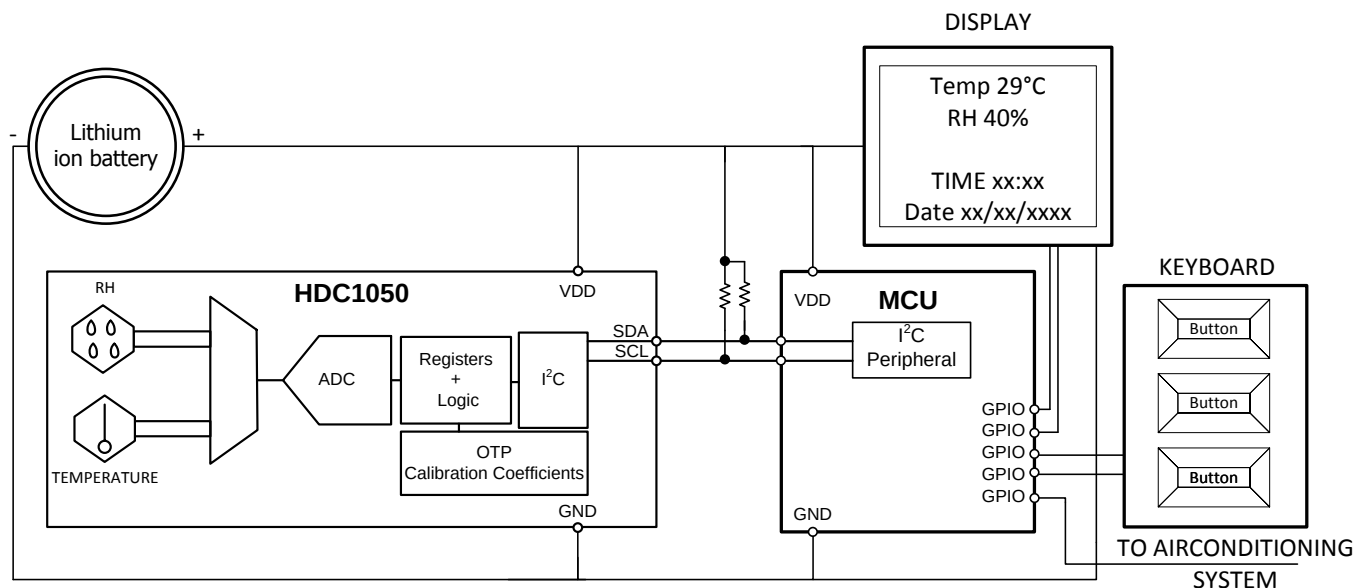


Figure 15. Typical Application Schematic HVAC

9.2.1 Design Requirements

In order to correctly sense the ambient temperature and humidity, the HDC1050 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 HDC1050 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 HDC1050 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 17](#)) for a PCB layout which minimizes the thermal mass of the PCB in the region of the HDC1050, which can improve measurement response time and accuracy.

9.2.3 Application Curve

The data shown below was acquired with the HDC1050EVM. A humidity chamber was used to control the environment.

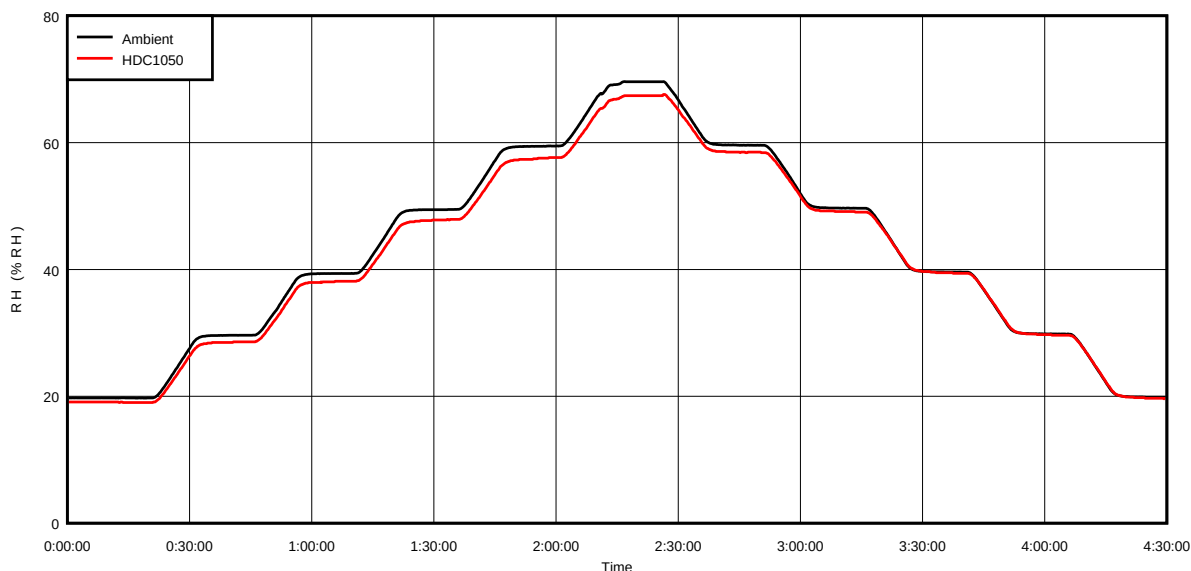


Figure 16. RH vs. Time

9.3 Do's and Don'ts

9.3.1 Soldering

For soldering HDC1050, standard reflow soldering ovens may be used. The sensor is qualified to withstand soldering profile according to IPC/JEDEC J-STD-020 with peak temperatures at 260 °C.

When soldering the HDC1050 it is mandatory to use no-clean solder paste and no board wash shall be applied. The HDC1050 should be limited to a single IR reflow and no rework is recommended.

9.3.2 Recovery From Soldering

Due to the thermal stress of soldering, the HDC1050 may exhibit an RH offset error immediately after soldering and will slowly recover when the humidity sensor is exposed to ambient conditions. If a faster recovery is desired, the following re-hydration process can be used:

- Store the PCB containing the HDC1050 at 45% RH, 50 degrees C, for 12 hours.

9.3.3 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.

The HDC1050 requires a voltage supply within 2.7V and 5.5V. A multilayer ceramic bypass X7R capacitor of 0.1μF between the VDD and GND pins is recommended.

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

The only component next to the device is the supply bypass capacitor. Since the relative humidity is dependent on the temperature, the HDC1050 should be positioned away from hot spots present on the board, such as a battery, display or micro-controller. Slots around the device can be used to reduce the thermal mass, for a quicker response to environmental changes. The DAP may be soldered to a floating pad on the board, but the board pad should NOT be connected to GND.

Figure 17. Layout

12 器件和文档支持

12.1 文档支持

12.1.1 相关文档

《德州仪器 (TI) 湿度传感器》， [SNAA216](#)，提供湿度感测的一般性说明和重要设计指南。

12.2 社区资源

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TI E2E™ Online Community *TI's Engineer-to-Engineer (E2E) Community*. Created to foster collaboration among engineers. At [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.

12.3 商标

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12.4 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。

12.5 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。

PACKAGING INFORMATION

Orderable part number	Status (1)	Material type (2)	Package Pins	Package qty Carrier	RoHS (3)	Lead finish/ Ball material (4)	MSL rating/ Peak reflow (5)	Op temp (°C)	Part marking (6)
HDC1050DMBR	NRND	Production	WSO (DMB) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	FE
HDC1050DMBR.A	NRND	Production	WSO (DMB) 6	3000 LARGE T&R	Yes	NIPDAU	Level-1-260C-UNLIM	-40 to 125	FE

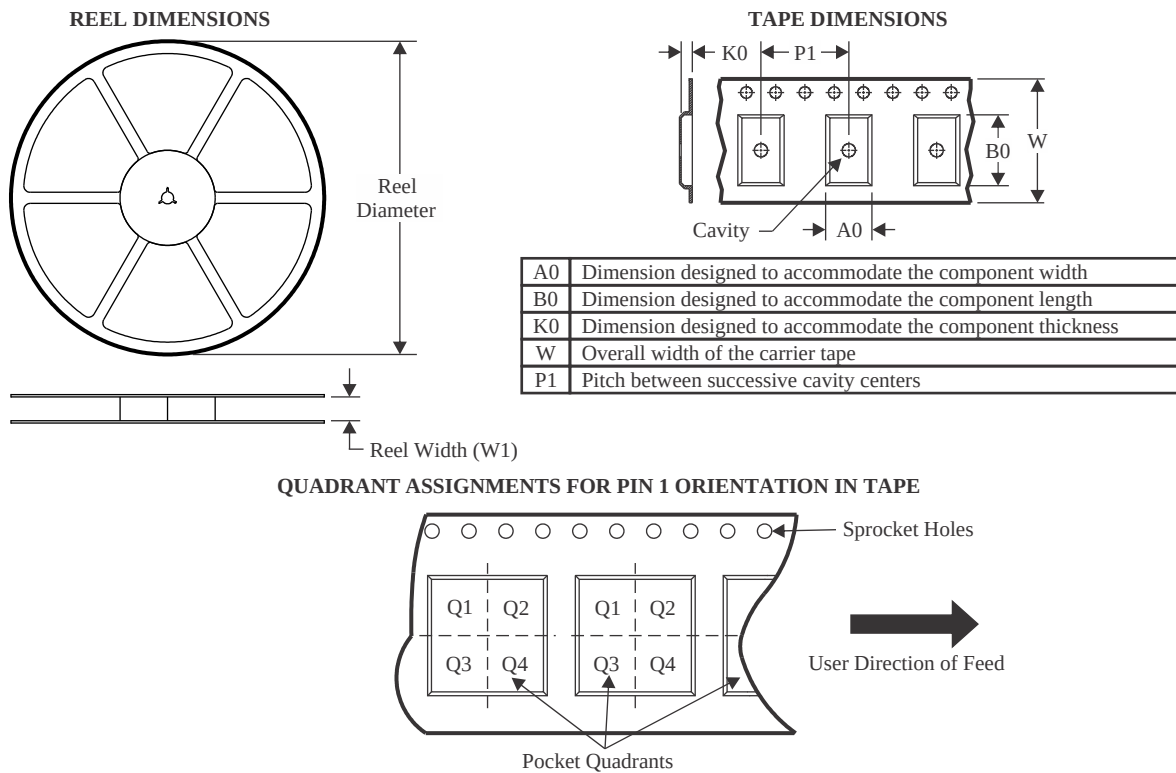
- (1) **Status:** For more details on status, see our [product life cycle](#).
- (2) **Material type:** When designated, preproduction parts are prototypes/experimental devices, and are not yet approved or released for full production. Testing and final process, including without limitation quality assurance, reliability performance testing, and/or process qualification, may not yet be complete, and this item is subject to further changes or possible discontinuation. If available for ordering, purchases will be subject to an additional waiver at checkout, and are intended for early internal evaluation purposes only. These items are sold without warranties of any kind.
- (3) **RoHS values:** Yes, No, RoHS Exempt. See the [TI RoHS Statement](#) for additional information and value definition.
- (4) **Lead finish/Ball material:** Parts 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.
- (5) **MSL rating/Peak reflow:** The moisture sensitivity level ratings and peak solder (reflow) temperatures. In the event that a part has multiple moisture sensitivity ratings, only the lowest level per JEDEC standards is shown. Refer to the shipping label for the actual reflow temperature that will be used to mount the part to the printed circuit board.
- (6) **Part marking:** There may be an additional marking, which relates to the logo, the lot trace code information, or the environmental category of the part.

Multiple part markings will be inside parentheses. Only one part marking contained in parentheses and separated by a "~" will appear on a part. If a line is indented then it is a continuation of the previous line and the two combined represent the entire part marking for that device.

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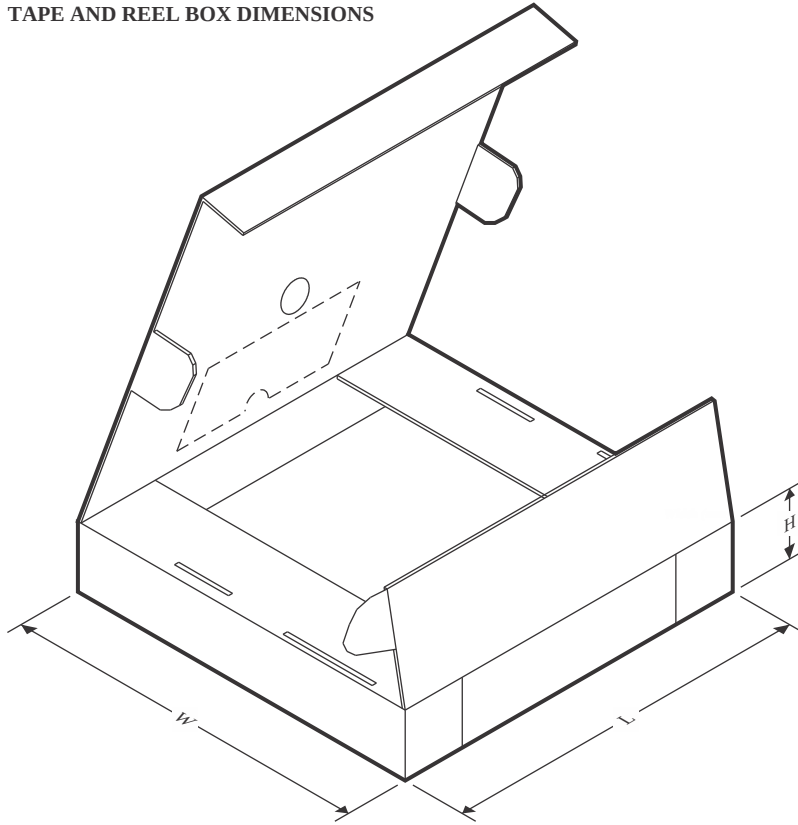
TAPE AND REEL INFORMATION



*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
HDC1050DMBR	WSO	DMB	6	3000	330.0	15.4	3.3	3.3	1.1	8.0	12.0	Q2

TAPE AND REEL BOX DIMENSIONS



*All dimensions are nominal

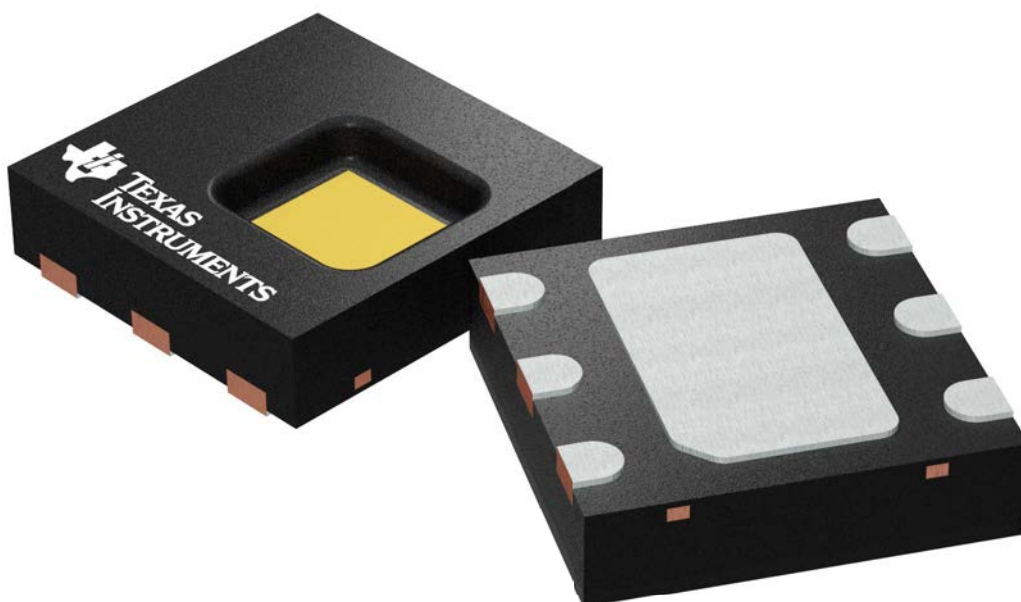
Device	Package Type	Package Drawing	Pins	SPQ	Length (mm)	Width (mm)	Height (mm)
HDC1050DMBR	WSON	DMB	6	3000	335.0	335.0	32.0

DMB 6

GENERIC PACKAGE VIEW

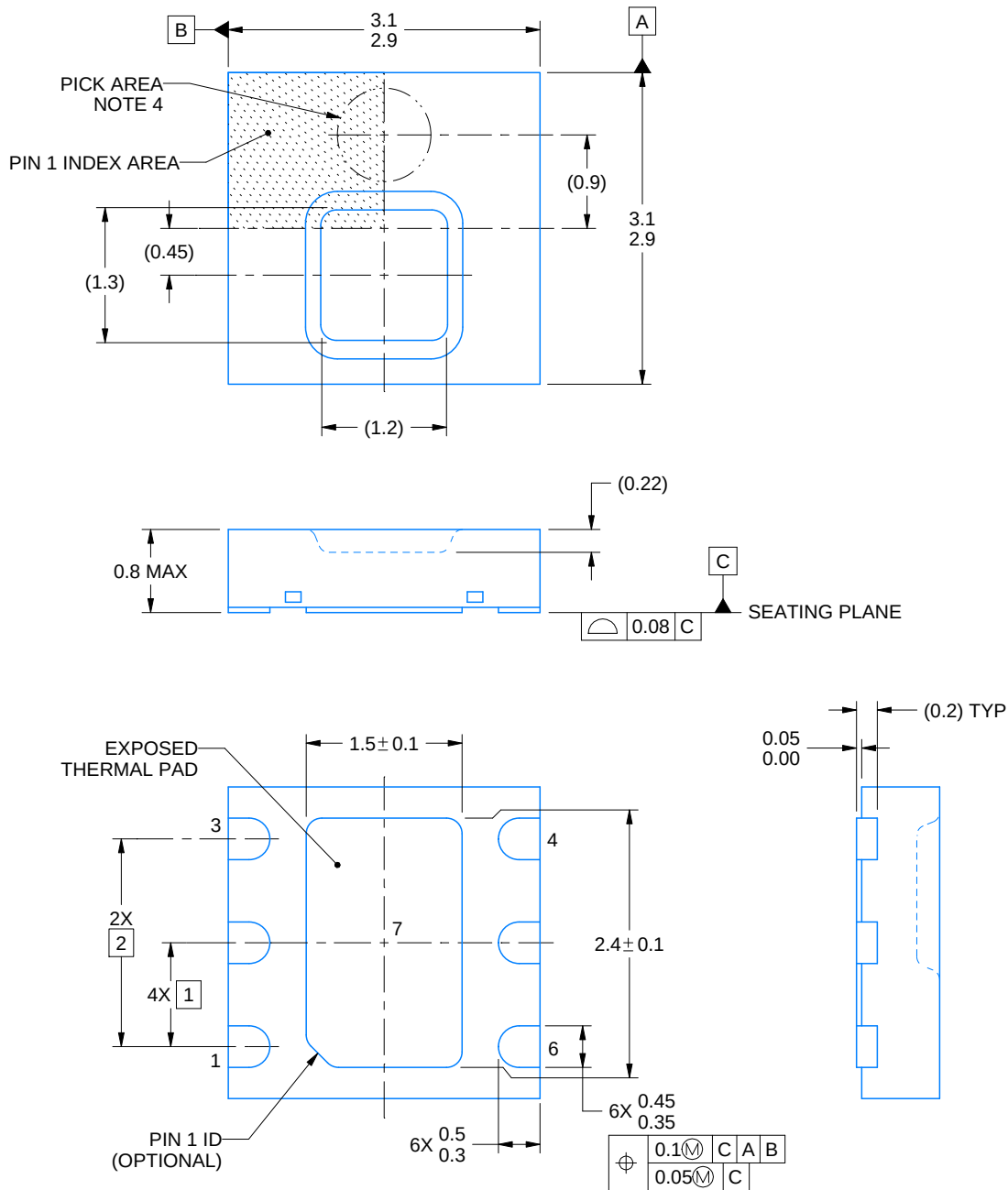
WSON - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



Images above are just a representation of the package family, actual package may vary.
Refer to the product data sheet for package details.

4212623/D



4221225/C 12/2018

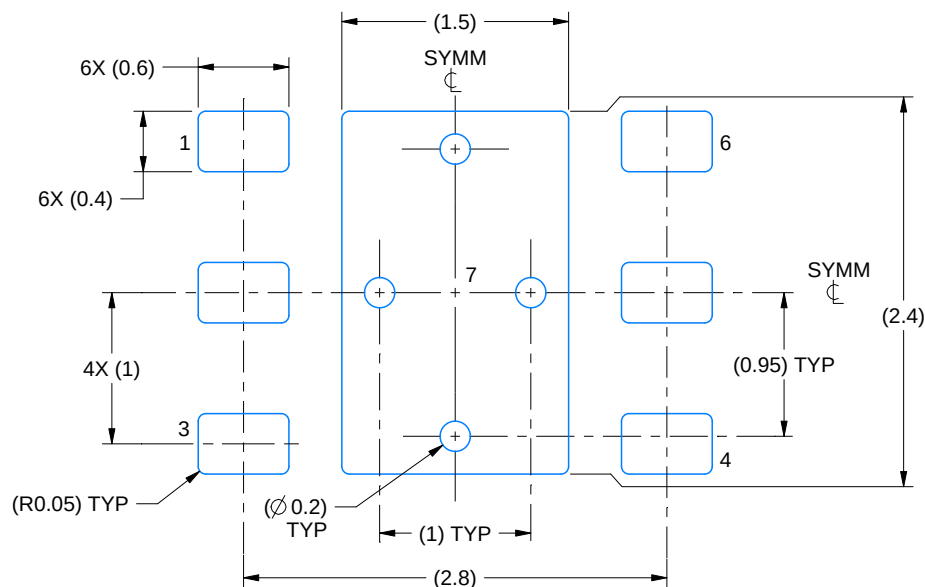
NOTES:

1. All linear dimensions are in millimeters. Any dimensions in parenthesis are for reference only. Dimensioning and tolerancing per ASME Y14.5M.
2. This drawing is subject to change without notice.
3. The package thermal pad must be soldered to the printed circuit board for thermal and mechanical performance.
4. Pick and place nozzle $\varnothing$ 0.9 mm or smaller recommended.

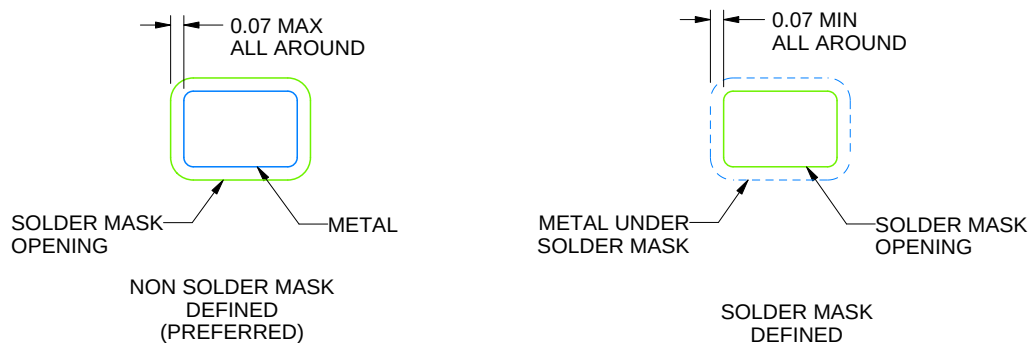
DMB0006A

WSN - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



LAND PATTERN EXAMPLE
SCALE:20X



SOLDER MASK DETAILS

4221225/C 12/2018

NOTES: (continued)

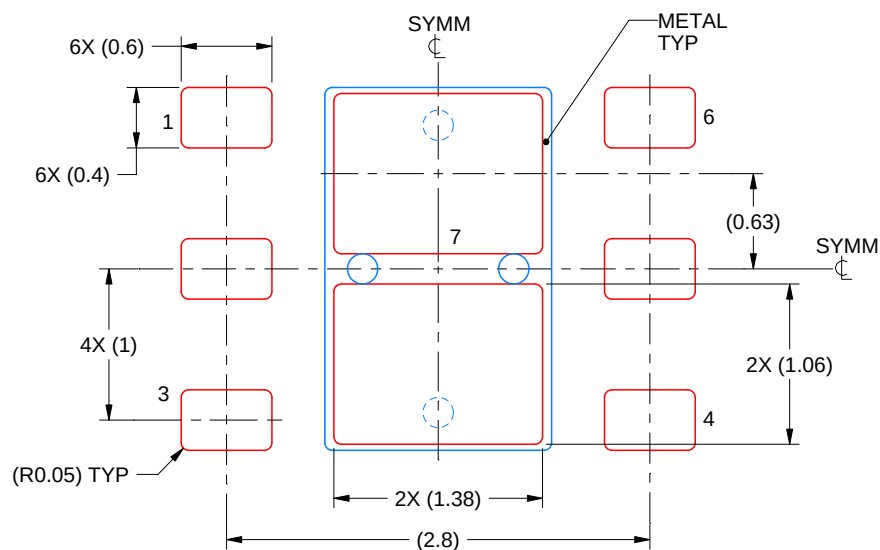
5. This package is designed to be soldered to a thermal pad on the board. For more information, see Texas Instruments literature number SLUA271 (www.ti.com/lit/sluea271).
6. Vias are optional depending on application, refer to device data sheet. If any vias are implemented, refer to their locations shown on this view. It is recommended that vias under paste be filled, plugged or tented.

EXAMPLE STENCIL DESIGN

DMB0006A

WSN - 0.8 mm max height

PLASTIC SMALL OUTLINE - NO LEAD



SOLDER PASTE EXAMPLE
BASED ON 0.125 mm THICK STENCIL

EXPOSED PAD 7:
81% PRINTED SOLDER COVERAGE BY AREA UNDER PACKAGE
SCALE:20X

4221225/C 12/2018

NOTES: (continued)

7. Laser cutting apertures with trapezoidal walls and rounded corners may offer better paste release. IPC-7525 may have alternate design recommendations.

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