User's Guide

HDC3 Silicon

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ABSTRACT

This document is to familiarize the user with the HDC3 family of devices by providing storage and handling guidelines, software configuration examples, and pseudo code. The HDC devices are integrated humidity and temperature sensors that provides a typical RH Accuracy of ±1.5% RH, a typical temperature accuracy of ±0.1 °C and consumes an average measurement current of a few nA. The devices measures humidity through a capacitive polymer dielectric that has the capability to calibrate and restore humidity accuracy to meet product specifications. The HDC3 features a 2.5-mm × 2.5-mm WSON open-cavity package where the sensor is exposed directly to ambient air.

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Trademarks

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1 HDC3020 Devices

HDC3020 in WSON

The HDC3020 is the standard WSON device in the HDC3020 family. It does not have additional protection over the RH sensor window and the sensor is centered. It is available in a 2.5-mm × 2.5-mm WSON package. When using the HDC3020, care should be taken to ensure all the requirements are followed. For more information on the HDC3020, see the HDC3020 data sheet.

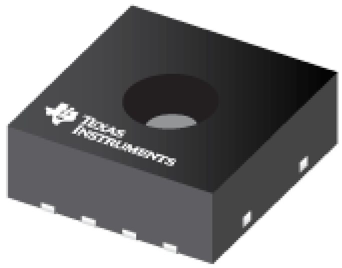

Figure 1-1. HDC3020 in WSON Package

2 Storage and Handling Guidelines

2.1 Exposure to Contaminants

Humidity sensors are not standard ICs and therefore must not be exposed to articles or volatile chemicals such as solvents or other inorganic compounds. The opening in the package exposes the sensing polymer to the environment and makes it susceptible to pollutants. Typical ambient conditions do not present a significant risk for chemical exposure but manufacturing and storage environments are a known source of volatile contamination. During assembly, a Kapton tape can be placed over the sensor opening to ensure that the device is not exposed to harmful chemicals. The tape can be removed after this process, but the device is still susceptible to contamination.

Exposure to a range of chemicals must be avoided or minimized. Exposure of the following chemicals is known to cause drift of the humidity output readings which may be irreversible:

- Solvents such as:
  - Toluene: C_7H_8
  - Acetone: $(CH_3)_2CO$
  - Ethanol: C_2H_6O
  - Methanol: CH_3OH
  - Isopropyl Alcohol: C_3H_8O
  - Di-isopropyl Ether: $C_6H_{14}O$
  - Ethylene Glycol: $(CH_2OH)_2$
  - Ethyl Acetate: $C_4H_8O_2$
  - Butyl Acetate: $C_6H_{12}O_2$
  - Methyl Ethyl Ketone: $CH_3C(O)CH_2CH_{3\backslash}$
- Acids such as:
  - Hydrochloric Acid: HCl
  - Sulfuric Acid: H_2SO_4
  - Nitric Acid: HNO_3
- Other chemicals, including:
  - Ketenes
  - Ammonia: NH_3
  - Hydrogen Peroxide: H_2O_2
  - Ozone: O_3
  - Formaldehyde: CH_2O

Such chemicals are an integral part of epoxies, glues, adhesives, or reaction by-products that outgas during baking and curing processes.

The sense layer must not have direct contact with cleaning agents such as printed circuit board (PCB) wash after soldering. Applying cleaning agents to the sense layer may lead to drift of the RH output or even complete breakdown of the sensor. Avoid strong blasts from aerosol dusters and use only low-pressure, oil-free air dusting.

If it is necessary to expose the HDC to contaminants, concentration and exposure time must be reduced as much as feasible. Good ventilation (fresh air supply) aids in lowering the concentration of volatile chemicals, particularly solvents.

2.2 Packaging and Storing

TI's Humidity sensors are shipping in sealed anti-static tape and reel cavities. The sensors can be stored in a humidity and temperature-controlled environment after being removed from the tape and reel cavity prior to assembly. Storage temperature and humidity limitations are defined by the MSL level of the sensor. Refer to the application note *MSL Ratings and Reflow Profiles* for details.

Do not store the humidity sensors within Anti-static polyethylene bags or packing materials (pink foam/wrap), as these materials emit gases that can affect the sensor. Metallized, anti-static seal-able bags are recommended for storage. Do not use adhesives or tape inside the storage container.

2.2.1 Assembly

The HDC must be added in the last assembly step. In case the PCB passes through multiple solder cycles (as is the case for PCBs that have components on the top and bottom side), adding the HDC last reduces the risk of damage to the sensing polymer from contaminants or excessive heat. Contaminants such as those listed in *Exposure to Contaminants* must be avoided or minimized. Maximum assembly temperatures and exposure times must not be exceeded.

Note

It is important that no-clean solder paste is used and no board wash is applied once the sensor is assembled onto the PCB. To ensure proper device performance, these instructions should be communicated to board manufacturers before assembly.

2.2.2 Application in Extreme Environment

Some applications require the usage of the HDC in harsh environments. Ensure that the exposure of the sensor to the maximum limit of temperature and humidity operating conditions meets the data sheet guidelines. Limiting exposure to volatile organic compounds at high concentration and long exposure time is critical. Usage in harsh environments must be carefully tested and qualified.

Exposure to any aqueous solutions is highly discouraged. In the event some aqueous exposure cannot be avoided, the following guidelines should be followed:

- Exposure to acids or bases may affect humidity output accuracy readings
- Bases are less damaging than acidic solutions. All acids must be considered damaging to the sensor. Etching substances such as H_2O_2 or NH_3 at high concentrations can be damaging to the sensor.
- Corrosive solutions at very low concentrations are not damaging to the sensor itself. However, take care to ensure that the solder contacts are not damaged.

3 Programming the HDC3020

The Functional Modes

The HDC3 has two modes of operation: sleep and measurement mode. After power up, the HDC3 enters sleep mode. In this mode, the device waits for I^2C instruction to set the programmable low power mode, trigger a measurement/conversion, or read/write valid data. When a measurement is triggered, the device wakes from sleep mode to enter measurement mode. In measurement mode, the HDC3 coverts temperature or humidity values from integrated sensors through an internal ADC.

Two different types of ADC conversions (measurement modes) are available in the HDC devices: Trigger-on Demand and Auto Measurement mode.

3.1 Trigger-On Demand

In this mode, I^2C commands triggers each measurement conversion. After device power up, the device is placed in sleep mode waiting for an input.

To configure the device to collect both the humidity and temperature data in a single acquisition mode, select TRIGGER ON DEMAND (MSB HEX CODE 24) in the command table along with the appropriate low power mode selection. The device will exit from sleep mode and perform a single measurement. Figure 3-1 shows the Trigger-on Demand mode.

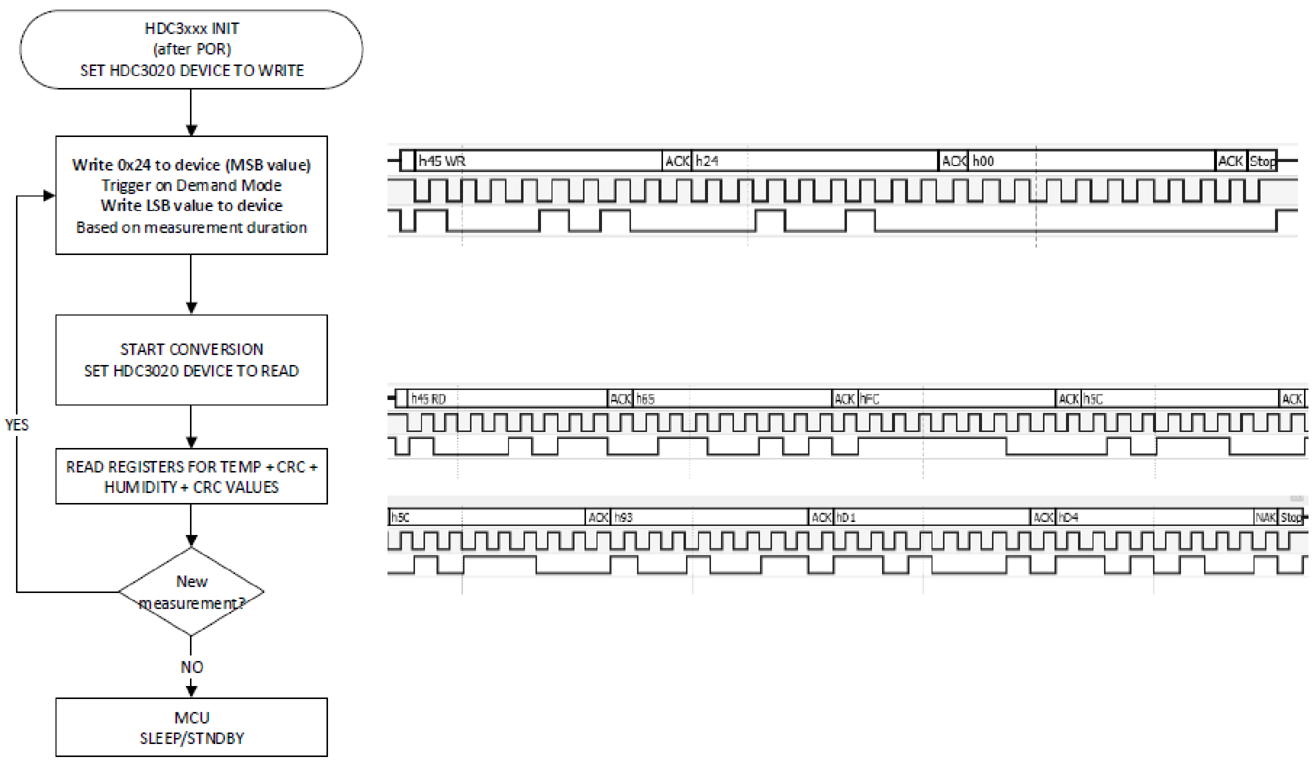

Figure 3-1. Flowchart for Trigger-On Demand Mode

3.2 Auto Measurement

Auto mode is a continuous operation mode. The user can select the measurement frequency between 10 samples a second to 1 sample every 2 seconds.

To configure the device to collect both the humidity and temperature data in continuous mode, select the desired Auto Measurement mode and low power mode duration from the command table. To obtain the temperature and humidity values, the user can issue commands 0x0E & 0x00. After each measurement, the device will update register 0x0E and re-enters sleep mode. Figure 3-2 shows this transaction.

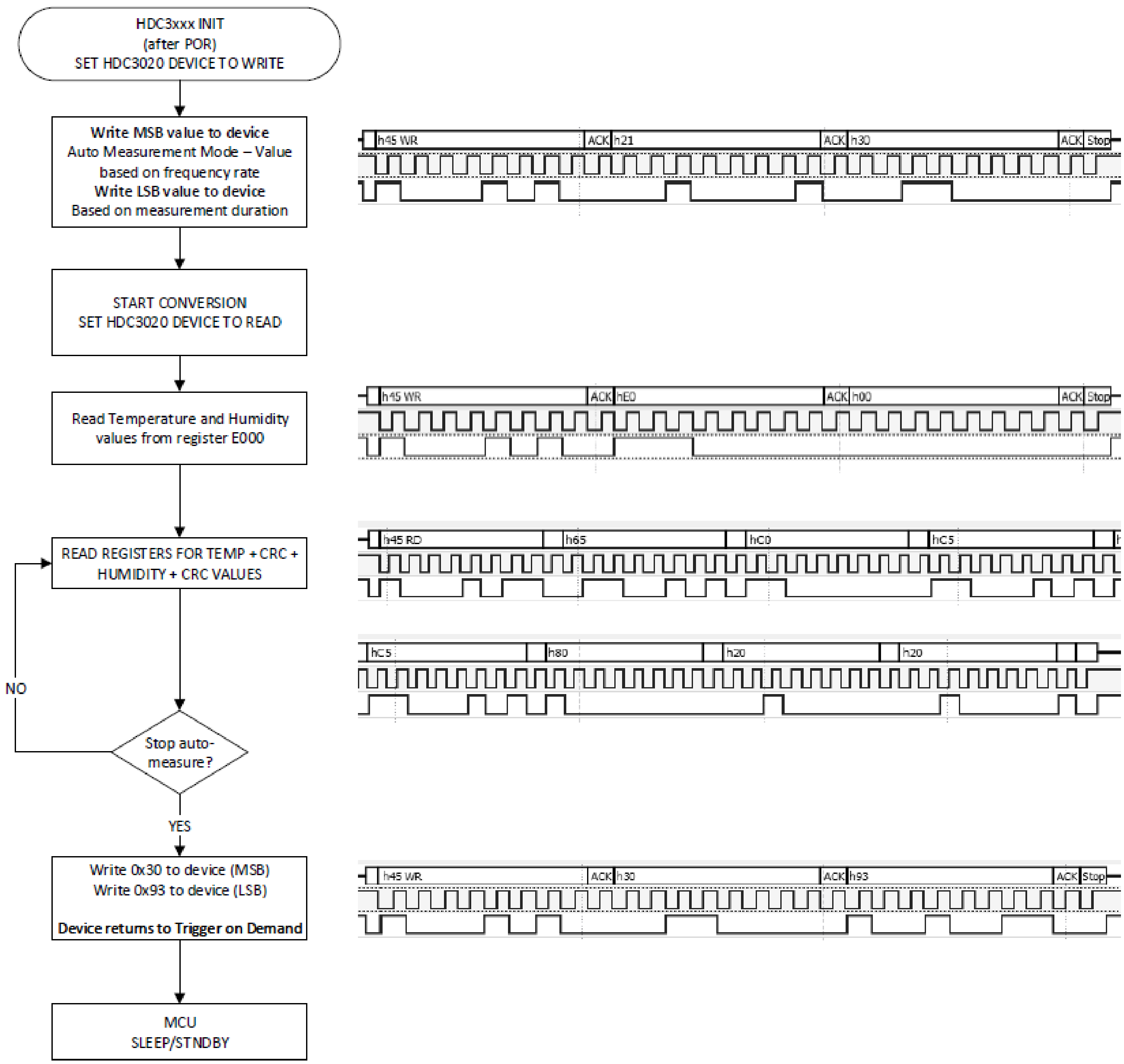

Figure 3-2. Flowchart for Auto-Measurement Mode

4 References

For related documentation, see the following:

1. Texas Instruments, *HDC302x High-Accuracy, Low-Power, Digital Humidity and Temperature Sensor With Ultra-Low Drift* data sheet
2. Texas Instruments, *MSL Ratings and Reflow Profiles* application report
3. Texas Instruments, *Optimizing Placement and Routing for Humidity Sensors* application report