EVM User's Guide: HDC3120EVM

HDC3120EVM Evaluation Module

Description

The HDC3120EVM is an analog evaluation module (EVM) designed for users to evaluate the performance of the HDC3120: a versatile, high accuracy ratiometric analog humidity and temperature sensor. This EVM provides users the flexibility and customizability required for implementing the sensor in the user systems. This EVM also includes two TLV9030 comparators, enabling the user the ability to evaluate the humidity and temperature outputs of the HDC3120 with a switch-like function.

Get Started

1. Order the HDC3120EVM on ti.com
2. See Setup and Interface section for instructions on connecting the evaluation module
3. Refer to the HDC3120 data sheet for sensor details
4. Visit our E2E forums for support or questions

Features

- Straightforward application to verify temperature and humidity functionality of HDC3120
- Included TLV9030 comparators enable switch-like function for further evaluation of sensor in end equipment design process
- Wide range of connection and test points for the convenience of the user

Applications

- Major Appliances:
  - Dishwasher
  - Washer & Dryer
  - Refrigerator & Freezer
- Energy Infrastructure:
  - Battery Energy Storage Systems
  - Remote Power Distribution Automation
- Data Center
- Telecom power systems
- Automotive
  - EPS (Electronic Power Steering)
  - BMS (Battery Management System)
  - HVAC
  - Inverter

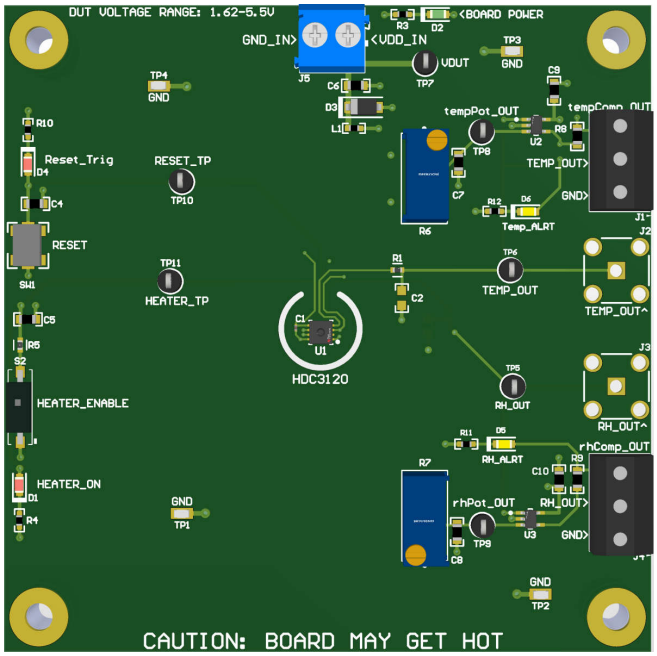

Figure 1-1. HDC3120EVM

1 Evaluation Module Overview

1.1 Introduction

This User's Guide describes the characteristics, operation, and use of the HDC3120 Evaluation Module (EVM). A full schematic, printed-circuit board layouts, and bill of materials (BOM) are included in this document. This User's Guide provides detailed steps to set up and operate the HDC3120EVM.

1.2 Kit Contents

Table 1-1 details the contents of the EVM kit. Contact the nearest Texas Instruments Product Information Center for missing components. TI highly recommends checking the TI website for the latest revision.

Table 1-1. Kit Contents

Item	Quantity
HDC3120EVM	1

1.3 Specification

Table 1-2 defines the absolute maximum thermal conditions of the EVM. The following limits must be considered when evaluating the performance of the device at extreme temperatures.

Table 1-2. HDC3120EVM Temperature Limits

Board Section	Conditions	Temperature Range
EVM Board	Recommended operating free-air temperature, T_A	-20° to 80°C
	Absolute maximum junction temperature, $T_{J(MAX)}$	-55°C to 150°C

1.4 Device Information

The HDC3120 is an integrated, capacitive based relative humidity (RH) and temperature sensor where the relative humidity and temperature sensor results are represented as ratiometric analog outputs. Conversion of signals to the analog domain provides a robust design in applications requiring signal transmission over wire or other distance based use cases. The analog focused design of the HDC3120EVM provides designers more flexibility to test the EVM in the system without the need to be tethered to a computer or I2C bus to read temperature and humidity. This also gives users the ability to place the EVM further than the digital counterpart. For more information of the IC, please refer to the device data sheet. Table 1-3 includes some of the parameters of interest of the HDC3120 and Table 1-4 includes parameters of the included TLV9030 comparators to consider when using this EVM.

Table 1-3. HDC3120 Device Specifications

Device Specifications	Values
Operating temperature range (Temperature)	-40°C to 125°C
Operating temperature range (RH)	-20°C to 80°C
Operating supply range	1.62V - 5.5V

Table 1-4. TLV9030 Device Specifications

Device Specifications	Values
Operating temperature range	-40°C to 125°C
Operating supply range	1.65V to 5.5V

2 Hardware

The HDC3120EVM is an analog EVM and requires no software. This EVM is designed to provide the user with the flexibility to implement a temperature and humidity sensing design in any part of a system. The device also includes footprints for a coaxial SMA connector for TEMP and RH output signals. The figure below highlights the various peripherals and some of the functions of the EVM which are explained in further detail in the following sections.

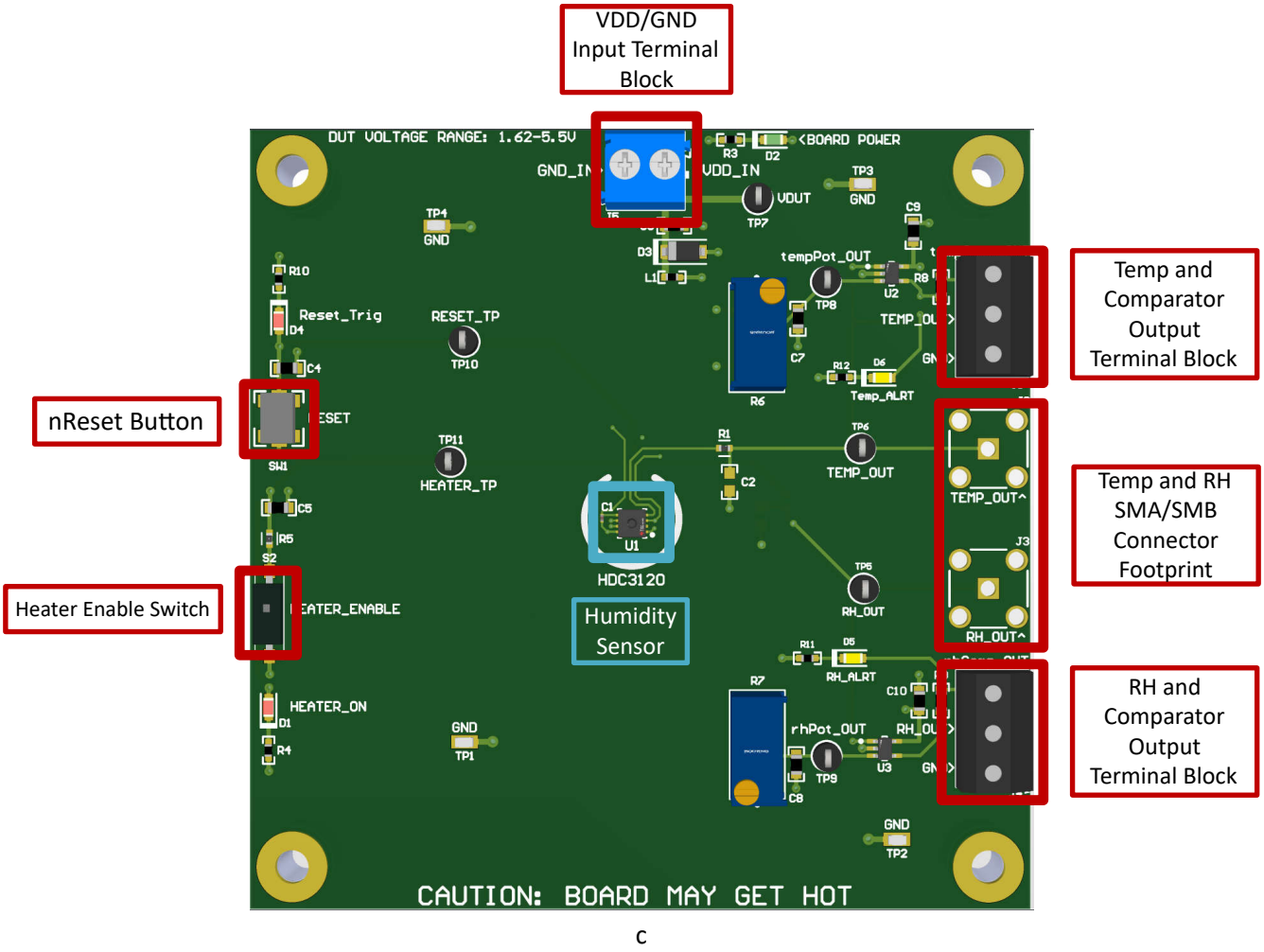

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Figure 2-1. HDC3120EVM Board Sections

2.1 Setup and Interface

2.1.1 Setup Overview

The HDC3120EVM is powered through the 2-position terminal block at the center-top of the board and a green LED (D2) has been included to indicate the board is receiving power. The device can be supplied power from 1.62V to 5.5V as defined by the sensor data sheet. There are also switches available on the left side of the board to enable the heater and reset functions. These switches also have LEDs (red for heater and yellow for reset) for user feedback upon activating either switch.

To access the temperature and humidity outputs of the HDC3120 device, there is a choice of the two 3-position terminal blocks or adding SMA connectors to the available footprints on the board. The terminal blocks also include a test point for ground as well as the outputs for the TLV9030 comparators.

2.1.2 Connecting Board Power and Ground

The HDC3120EVM uses a 2-position terminal block at the center-top of the board. A user can unscrew the locking screws and carefully, fully insert the exposed copper tip of each jumper cable into each opening and carefully tighten the screw just enough to secure the cable in place. The HDC3120EVM has an input voltage range of 1.62V to 5.5V and must not be exceeded to avoid damaging the module.

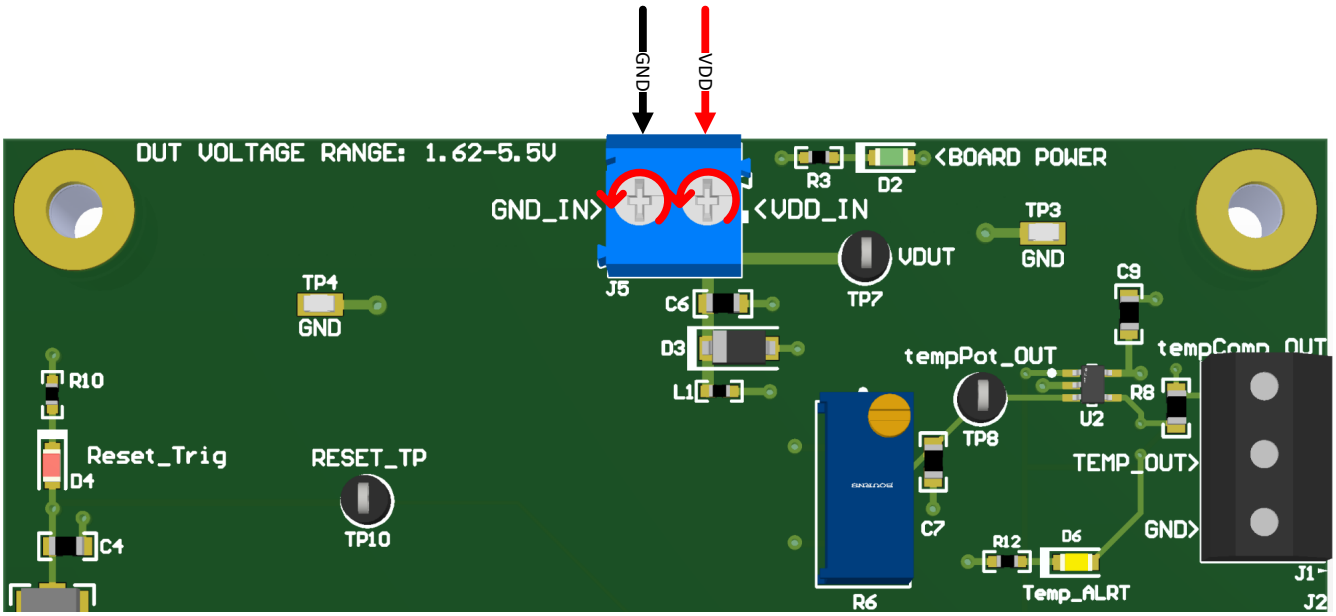

Figure 2-2. Input VDD and GND Insert

2.1.3 Connecting to HDC3120 and Comparator Outputs

To access the temperature and humidity outputs of the HDC3120 device, there is a choice of the two 3-position terminal blocks or adding SMA connectors to the available footprints on the board. The terminal blocks also include a test point for ground as well as the outputs for the TLV9030 comparators.

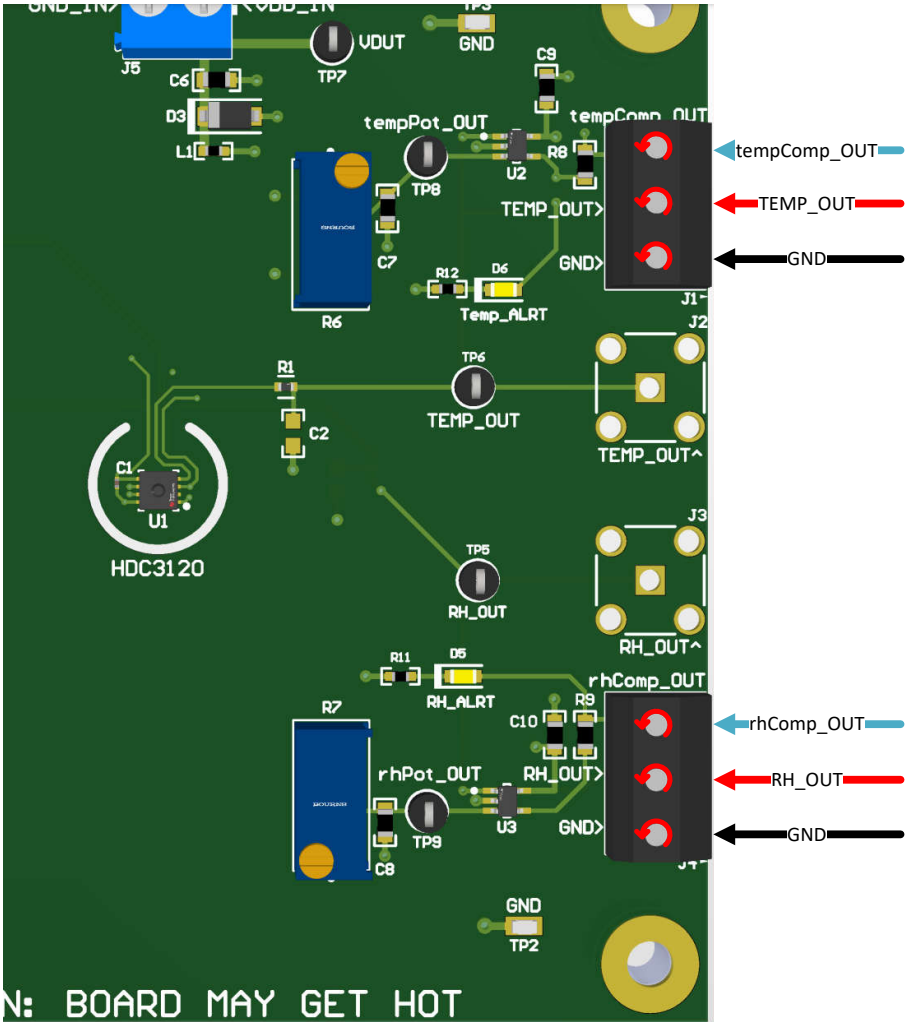

Figure 2-3. HDC3120EVM Outputs

The Temperature and RH values can be determined using the equations in the following sections derived from the HDC3120 data sheet.

2.1.3.1 Temperature

$$T(℃) = 218.75 \times \frac{V_{OUT}}{V_{DD}} - 66.875 \quad (1)$$

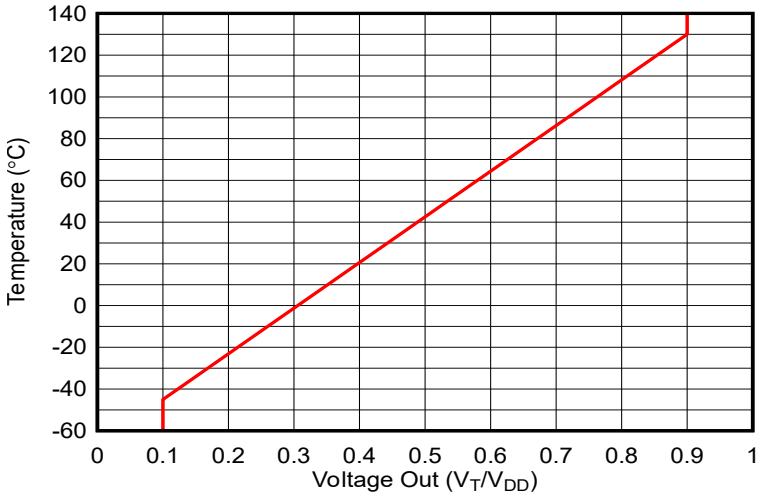

Figure 2-4. HDC3120 Temperature Output Profile

2.1.3.2 Relative Humidity (RH)

$$\%RH = 125 \times \frac{V_{OUT}}{V_{DD}} - 12.3 \quad (2)$$

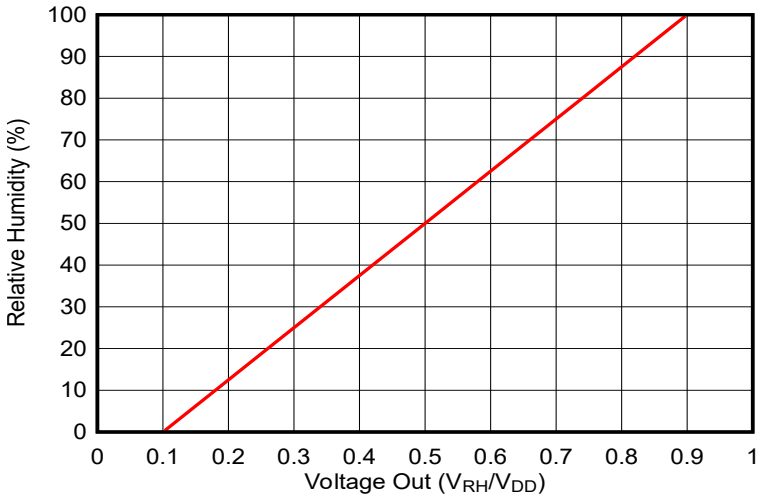

Figure 2-5. HDC3120 %RH Output Profile

2.1.4 HDC3120EVM Buttons

The HDC3120EVM includes two buttons for utilizing the reset and heater functions of the HDC3120. The reset button (SW1) is a single push-button mechanism. When the button is held down, the red LED (D4) illuminates, indicating to the user the reset button is pushed and the user must observe the temperature and humidity output values drop to zero momentarily.

The heater enable switch (S2) is a sliding switch mechanism which enables the heater for a user-determined amount of time. When not in use and by default, the switch is in the "OFF" position. This is further reinforced since the switch is labeled with "OFF" on one side of the switch to designate which direction to slide the switch to disable the switch. The heater circuit also employs a red LED (D1) which illuminates when the heater is enabled (switch is moved to the "ON" position).

During heater operation, avoid contact with the HDC3120 as the temperature can exceed 55°C. After the heater has finished running, resetting the device using SW1 is recommended before continuing to read temperature and humidity measurements.

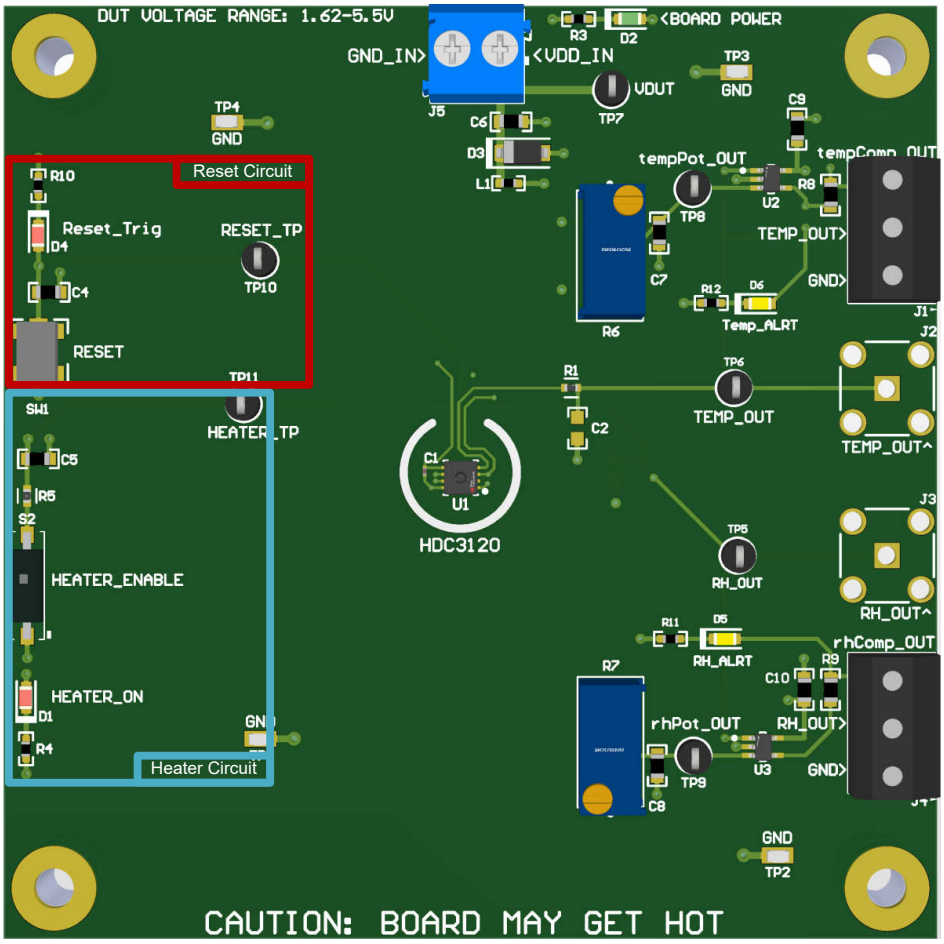

Figure 2-6. Heater and Reset Buttons

2.2 Comparator Function

The HDC3120EVM features two TLV9030 comparators enabling the ability for designers to evaluate the EVM with a switch-like function for both temperature and humidity outputs. The comparators output high if the preset temperature or humidity is exceeded. Potentiometers rated at 10kΩ are also included to allow for fine tuning of the comparator sensitivity and can be adjusted using any tool with a flathead. The TLV9030 comparators output through the 3-position terminal blocks on the right side of the board illustrated in Figure 2-8

Before tuning the potentiometers, testing the outputs is recommend for comprehending the starting resistance values with a multimeter. The value of resistance displayed on the multimeter corresponds with the remaining resistance available out of the maximum 10kΩ. For example, if a multimeter reads 2.4kΩ from the test points, the potentiometer is applying 7.6kΩ to the circuit. When tuning the potentiometer, turning the potentiometer screw clockwise increases the resistance by a value of ≅0.2kΩ per full 360° rotation. To decrease the resistance, simply rotate the screw in the counter-clockwise direction (-0.2kΩ is deducted each 360° rotation).

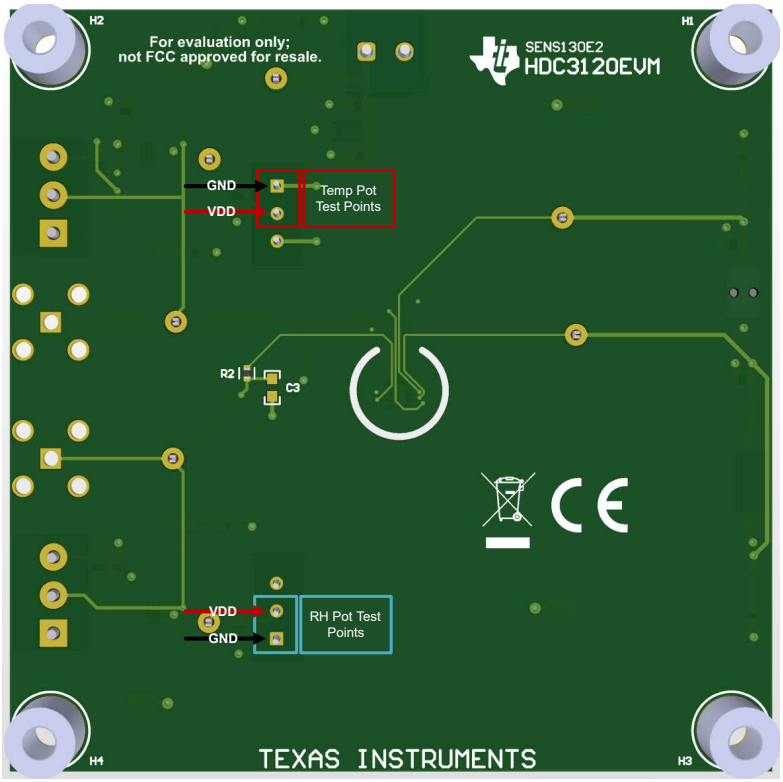

Figure 2-7. Potentiometer Multimeter Test Points

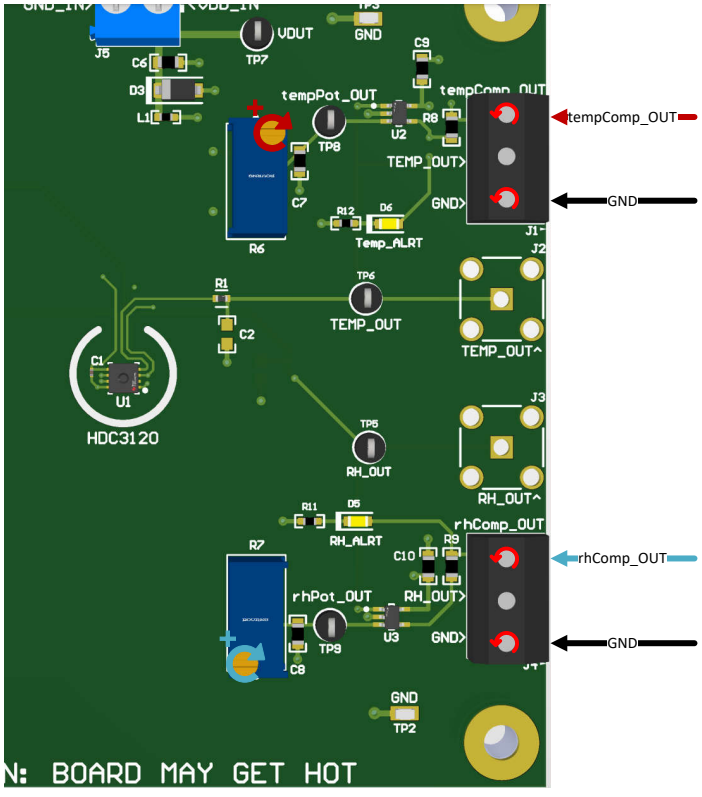

Figure 2-8. HDC3120EVM Comparator and Potentiometer Interface Points

2.2.1 Comparator Usage Examples

Note: The values explained below only apply to an HDC3120EVM running at 3.3V input voltage.

Provided below are some examples on utilizing the comparators and potentiometers to simulate a switch for evaluation purposes:

As mentioned above, the resistance values mentioned below represent the **remaining** resistance out of 10kΩ (2.45kΩ mulitimeter readout = 7.55kΩ applied to circuit).

Scenario 1: 45% RH at Ambient (25°C)

To adjust the relative humidity comparator output of the EVM to assert high when 45% RH is achieved at ambient temperature, the user needs to adjust the voltage ceiling of the potentiometer. In this case, the potentiometer needs to be set to approximately 2.45kΩ (when reading the output of the potentiometer with a multimeter).

Scenario 2: 75% RH at Ambient (25°C)

To adjust the relative humidity comparator output of the EVM to assert high when 75% RH is achieved at ambient temperature, the user needs to adjust the voltage ceiling of the potentiometer. In this case the potentiometer needs to be set to approximately 2kΩ (when reading the output of the potentiometer with a multimeter).

Note

Due to the nature of real world components, potentiometers can have a slight variance in resistance.

3 Hardware Design Files

3.1 Schematics

Figure 3-1 illustrates the EVM schematic.

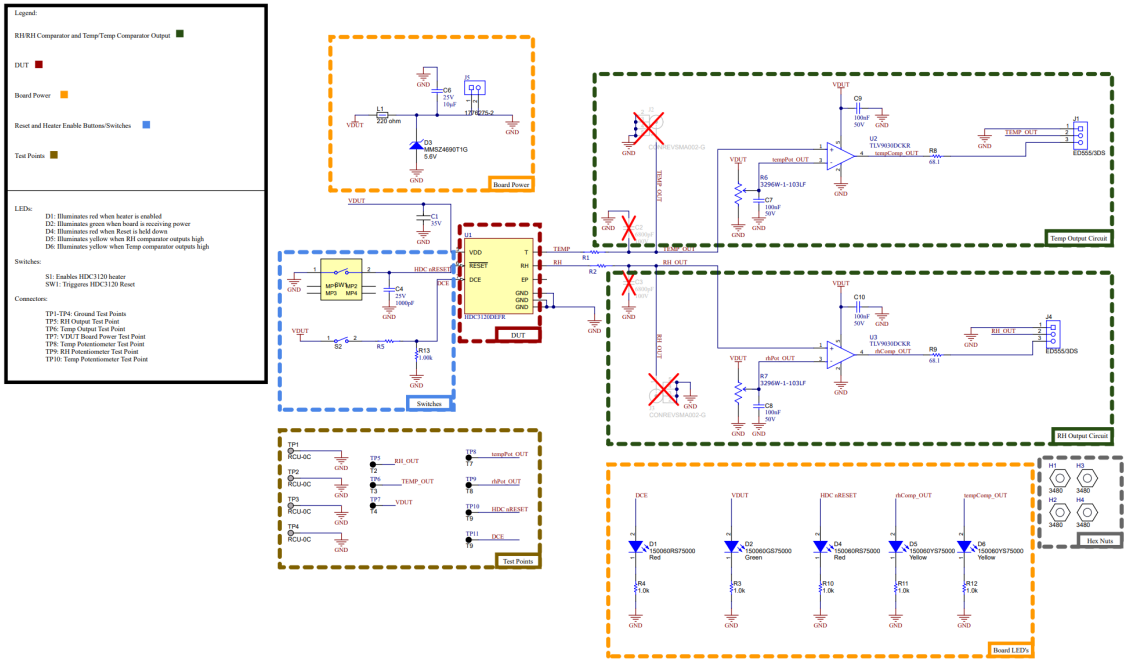

Figure 3-1. HDC3120EVM Schematic

3.2 PCB Layout and Recommendations

The HDC3120EVM is a four-layer PCB design with a cutout for the HDC3120 for better thermal isolation. The first (top) layer consists of analog signal path traces, and is poured with a solid copper plane. The second internal layer is a dedicated solid GND plane. The third internal layer is a dedicated solid VDD plane for all power connections. The fourth (bottom) layer contains additional analog signal path traces to allow for more efficient and cleaner signal traces.

To minimize second and other even-harmonic content, route traces as symmetrically as possible for both positive and negative feedback pathways. Place feedback components in close proximity to the output and input pins of the device. Position decoupling capacitors on the top layer as close as possible to the power-supply pins. Lastly, place independent vias at the ground connection of every component to provide a low-impedance path to ground.

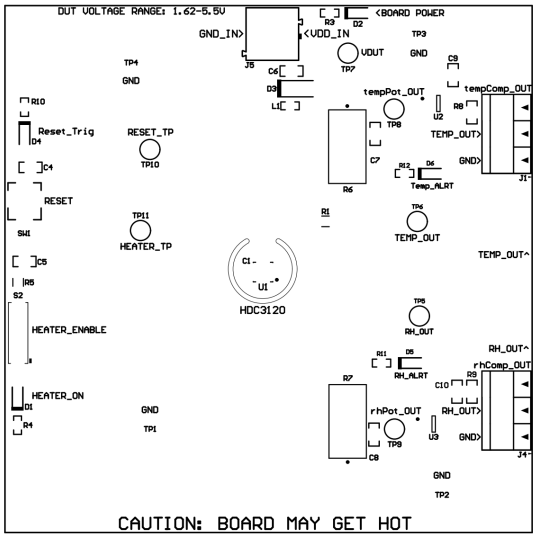

Figure 3-2. Top Layer PCB Layout (1)

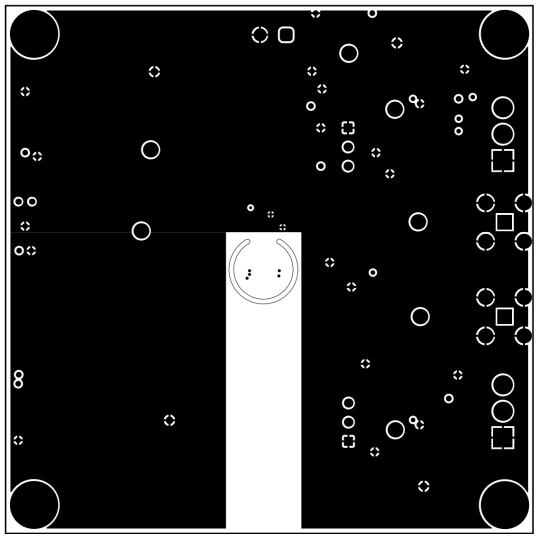

Figure 3-3. Ground Layer (2)

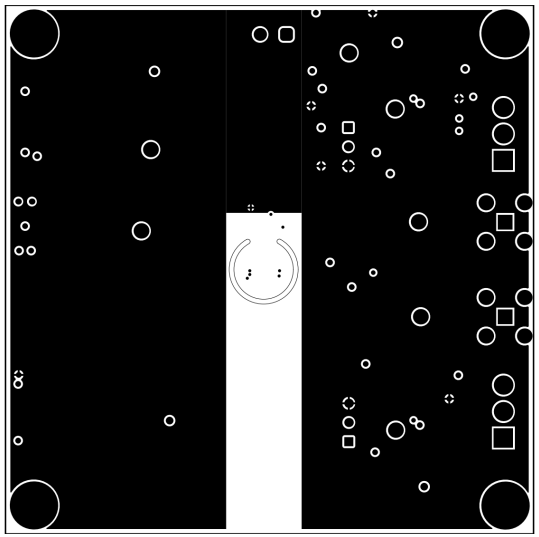

Figure 3-4. VDD Layer (3)

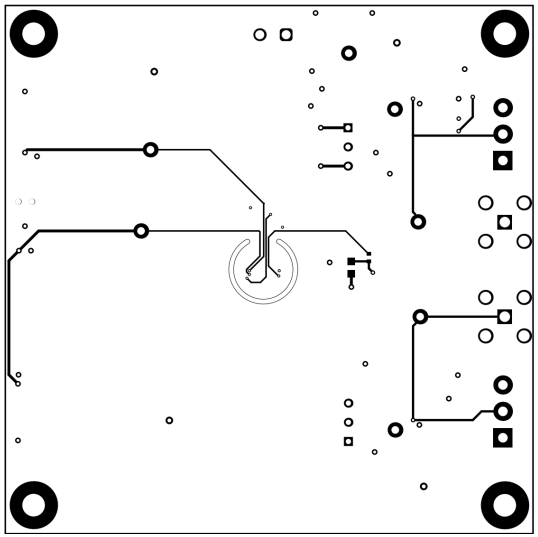

Figure 3-5. Bottom Layer (4)

3.3 Bill of Materials (BOM)

Table 3-1 lists the HDC3120EVM bill of materials (BOM).

Table 3-1. HDC3120EVM Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer(1)
C1	1		Cap Ceramic 0.1uF 35V X5R 10% Pad SMD 0201 85C T/R	0201 (0603 Metric)	GRM033R6YA104KE14D	Murata Electronics North America
C4	1	1000pF	CAP, CERM, 1000 pF, 25 V,+/- 1%, C0G/NP0, 0603	0603	C0603C102F3GACTU	Kemet
C5	1	0.01uF	CAP, CERM, 0.01 uF, 200 V, +/- 10%, X7R, 0603	0603	C0603C103K2RACTU	Kemet
C6	1	10uF	CAP, CERM, 10 µF, 25 V,+/- 10%, X5R, 0603	0603	GRM188R61E106KA73D	MuRata
C7, C8, C9, C10	4	0.1uF	CAP, CERM, 0.1 uF, 50 V, +/- 10%, X7R, 0603	0603	8.85012E+11	Wurth Elektronik
D1, D4	2	Red	LED, Red, SMD	LED_0603	150060RS75000	Wurth Elektronik
D2	1	Green	LED, Green, SMD	LED_0603	150060GS75000	Wurth Elektronik
D3	1	5.6V	Diode, Zener, 5.6 V, 500 mW, SOD-123	SOD-123	MMSZ4690T1G	ON Semiconductor
D5, D6	2	Yellow	LED, Yellow, SMD	LED_0603	150060YS75000	Wurth Elektronik
H1, H2, H3, H4	4		1/4 Round Female Standoff, Alum	3480, 1/4 Round Female Standoff	3480	Keystone
J1, J4	2		Terminal Block, 3.5mm Pitch, 3x1, TH	10.5x8.2x6.5mm	ED555/3DS	On-Shore Technology
J5	1		Terminal Block, 3.5mm, 2x1, Tin, TH	Terminal Block, 3.5mm, 2x1, TH	1776275-2	TE Connectivity
L1	1	220 ohm	Ferrite Bead, 220 ohm @ 100 MHz, 0.45 A, 0402	0402	BLM15AG221SN1D	MuRata
R1, R2	2	100	Res Thin Film 0402 100 Ohm 0.1% 0.063W(1/16W) ±25ppm/C Pad SMD T/R	0402	RT0402BRD07100RL	Yageo
R3, R4, R10, R11, R12	5	1.0k	RES, 1.0 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GEJ102X	Panasonic
R5	1	50k	RES Thick Film, 50kΩ, 1%, 0.063W, 100ppm/°C, 0402	0402	CRCW040250K0FKED	Vishay
R6, R7	2	10kΩ	10 kOhms 0.5W, 1/2W PC Pins Through Hole Trimmer Potentiometer Cermet 25.0 Turn Top Adjustment	PTH3_9MM53_4MM83	3296W-1-103LF	Bourns
R8, R9	2	68.1	RES, 68.1, 0.1%, 0.1 W, 0603	0603	RT0603BRD0768R1L	Yageo America
S2	1		Switch, Slide, SPST, Top Slide, SMT	Switch, Single Top Slide, 2.5x8x2.5mm	CHS-01TB	Copal Electronics
SW1	1		Switch, SPST-NO, Off-Mom, 0.05A, 12VDC, SMD	3.9x2.9mm	PTS820 J20M SMTR LFS	C&K Components
TP1, TP2, TP3, TP4	4		PC Test Point, SMT	1.6x0.8mm	RCU-0C	TE Connectivity
TP5, TP6, TP7, TP8, TP9, TP10, TP11	7		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics

Table 3-1. HDC3120EVM Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer(1)
U1	1		Integrated Humidity and Temperature Sensor With Analog Outputs	WSON8	HDC3120DEFR	Texas Instruments
U2, U3	2		Single low-voltage comparator with push-pull output 5-SC70 -40 to 125	SC70-5	TLV9030DCKR	Texas Instruments
C2, C3	0	6800pF	CAP, CERM, 6800 pF, 100 V,+/- 5%, C0G/NP0, AEC-Q200 Grade 0, 0603	0603	CGA3EANP02A682J080AC	TDK
J2, J3	0		CONN SMA JACK R/A 50 OHM PCB	SMA Jack	5-1814400-2	TE Connectivity AMP Connectors

(1) Unless otherwise noted all parts can be substituted with equivalents.

4 Additional Information

4.1 Trademarks

All trademarks are the property of their respective owners.

5 Related Documentation

The following document provides information regarding Texas Instruments integrated circuits used in the assembly of the HDC3120EVM. This user's guide is available from the TI website under literature number SBOU319. Any letter appended to the literature number corresponds to the document revision that is current at the time of the writing of this document. Newer revisions can be available from the TI website at http://www.ti.com/, or call the Texas Instruments Literature Response Center at (800) 477-8924 or the Product Information Center at (972) 644-5580. When ordering, identify the document by both title and literature number.

Table 5-1. Related Documentation

Document	Literature Number
HDC3120 Data sheet	SNAS758
HDC302x Silicon Users Guide	SNAU265

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