Temperature and Humidity Sensor

1 Features

- Wide supply voltage range, from 2.0V to 5.5V
- Typical accuracy of GD30TSHT3A is ±3%RH and ±0.3°C
- Temperature range: −45°C to 130°C
- Linear analog voltage output within the 10% to 90% range
- Simultaneously measure temperature and humidity in parallel (T and RH)
- High reliability and long-term stability
- DFN8 Package

2 Applications

- Smart home
- Air quality/dehumidifier
- Washer & dryer
- Consumer electronics
- Cold chain transportation
- Wireless sensor

3 Description

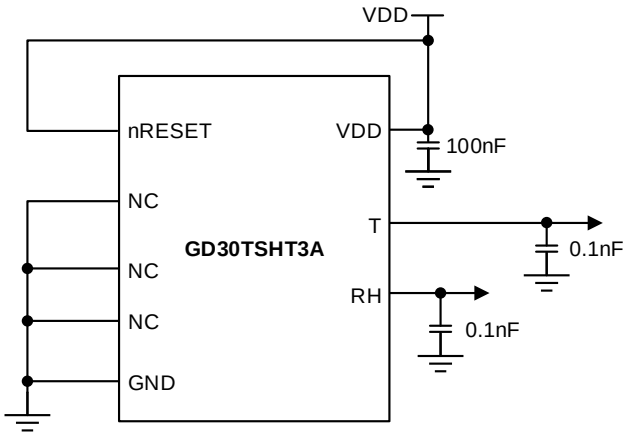
GD30TSHT3A is the next generation of single-chip integrated temperature and humidity sensor developed by GD. It was developed based on the extremely weak signal detection design platform and MEMS process design platform of GD. Integrating high-sensitivity MEMS moisture-sensitive components on silicon-based CMOS wafers can reduce the interference of multi-chip signal transmission, reduce chip area, and improve packaging reliability. The chip is packaged in a miniaturized DFN package with an outline size of 2.5mm x 2.5mm and a height of 0.9 mm. This enables the GD30TSHT3A to be integrated in various applications. In addition, the wide power supply voltage range of 2.0V to 5.5V makes it adaptable to various power supply environments.

Device Information[1]

PART NUMBER	PACKAGE	BODY SIZE (NOM)
GD30TSHT3A	DFN-8	2.50mm x 2.50mm

1. For packaging details, see *Package Information* section.

Simplified Application Schematic



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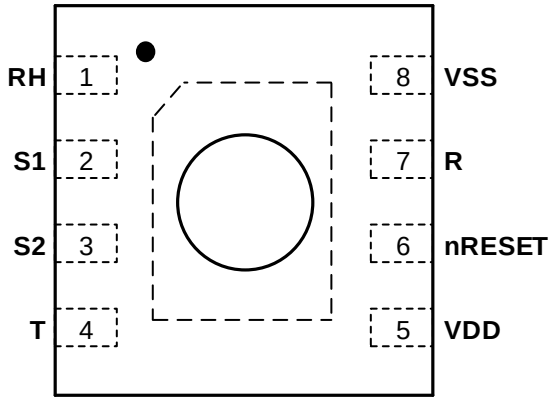
DFN Package
8-Pin Top View



4.2 Pin Description

PINS		PIN TYPE[1]	FUNCTION
NAME	NUM		
RH	1	O	Analog voltage output, humidity.
S1	2		No electrical function; to be connected to VSS.
S2	3		No electrical function; to be connected to VSS.
T	4	O	Analog voltage output, temperature.
VDD	5	P	Input Supply voltage
nRESET	6	I	Reset pin active low; input; if not used, it is recommended to be left floating.
R	7		No electrical function; to be connected to VSS.
VSS	8	G	Ground.

1. P = power, G = Ground, I = input, O = Output.

5 Parameter Information

5.1 Absolute Minimum and Maximum Ratings

Exceeding the operating temperature range (unless otherwise noted)[1]

SYMBOL	PARAMETER	MIN	MAX	UNIT
V_{DD}	Power supply	−0.3	6	V
V_{IO}	Voltage at SCL, SDA, ADDR, ALERT and nRESET	−0.3	VDD+0.3	V
I_{IN}	Input current on any range	−100	100	mA
T_A	Operating temperature range	−40	130	°C
T_{stg}	Storage temperature	−40	150	°C

1. The maximum ratings are the limits to which the device can be subjected without permanently damaging the device. Note that the device is not guaranteed to operate properly at the maximum ratings. Exposure to the absolute maximum rating conditions for extended periods may affect device reliability.

5.2 Recommended Operation Conditions

SYMBOL[1]	PARAMETER	MIN	TYP	MAX	UNIT
V_{DD}	Supply voltage	2.0	3.3	5.5	V
T_A	Operating Temperature range	−40		130	°C

5.3 Electrical Sensitivity

SYMBOL[1]	CONDITIONS	VALUE	UNIT
$V_{ESD(HBM)}$	Human-body model (HBM), ANSI/ESDA/JEDEC JS-001-2017[1]	±6000	V
$V_{ESD(CDM)}$	Charge-device model (CDM), ANSI/ESDA/JEDEC JS-002-2022[2]	±850	V

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.

5.4 Electrical Characteristics

Typical values correspond to temperatures of 25°C, while maximum and minimum values correspond to temperatures of −45°C and 130°C, respectively.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Power supply						
V_{DD}	Power Supply Voltage		2.0	3.3	5.5	V
V_{POR}	Power-up/down level		1.8	2.1	2.15	V
$V_{DD,slew}$	Slew rate change of the supply voltage				20	V/ms
I_{DD}	Supply current	Average		1.7		µA
AO_{IOUT}	Output current		−100		100	µA
C_L	Capacitive load				5	nF
Timing Specification for the Sensor System (−40 °C to 125 °C and 2.4 V to 5.5 V)						
t_{PU}	Power-up time	After hard reset, $V_{DD} \geq V_{POR}$		0.5	1	ms
AO_{settle}	Analog output setting time	Step to VDD/2		0.3		ms
t_{RESETN}	Reset pulse width		1			µs

5.5 Humidity Sensor Characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Accuracy			±3	Figure 1	%RH
Repeatability Error		0.10			%RH
Resolution			0.01		%RH
Hysteresis	at 25°C		±1		%RH
Specified Range	Measurement Range	0		100	%RH
Response Time	τ63%		8		Second
Long Term Drift	Typ		<0.25		%RH/year
Sensitivity	VDD = 2.4V		19.2		mV/%RH
	VDD = 3.3V		26.4		
	VDD = 5.5V		44.0		

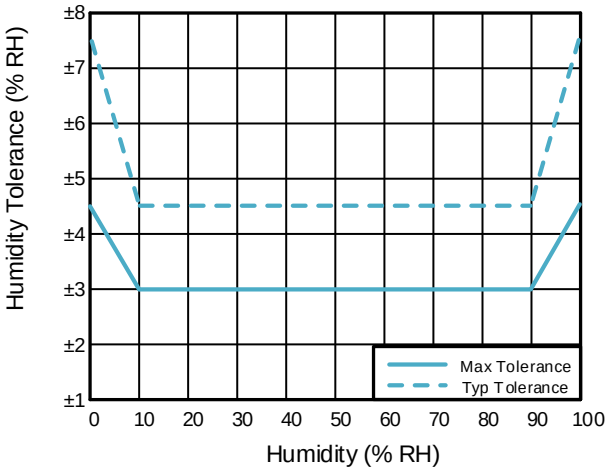


Figure 1. Tolerance of RH for GD30TSHT3A

5.6 Temperature Sensor Characteristics

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNIT
Accuracy	Typical values from −40°C to 90°C		±0.3		°C
Repeatability Error		0.24			°C
Resolution			0.015		°C
Specified Range	Measurement Range	−45		130	°C
Response Time	τ63%		>2		second
Long Term Drift				<0.03	°C/year
Sensitivity	VDD = 2.4V		19.2		mV/°C
	VDD = 3.3V		26.4		
	VDD = 5.5V		44.0		

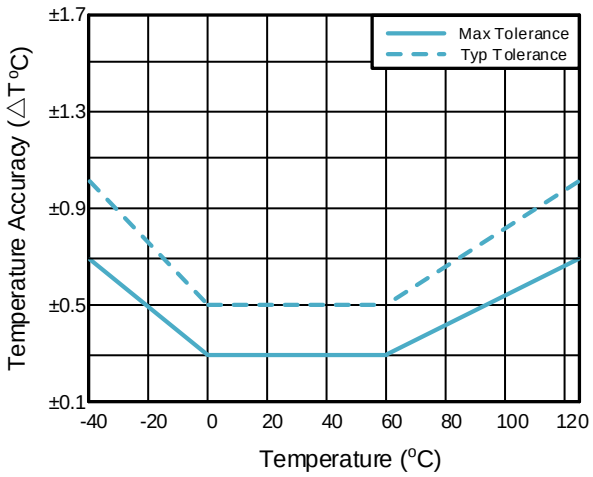


Figure 2. Tolerance of Temperature for GD30TSHT3A

When operating within the recommended normal temperature and humidity range (5°C to 60°C and 20%RH to 80%RH respectively), the sensor exhibits optimal performance. Long-term exposure to conditions outside the normal range, especially under high humidity for extended periods, may temporarily offset the relative humidity signal. Once back within the normal temperature and humidity range, the sensor will slowly return to its calibrated state on its own.

6 Functional Description

6.1 Block Diagram

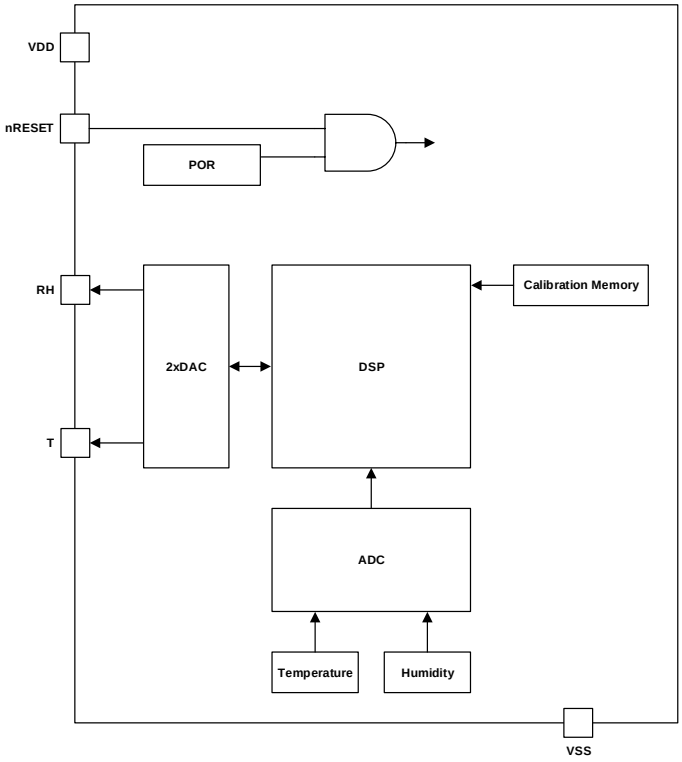


Figure 3. GD30TSHT3A Block Diagram

6.2 Operation

6.2.1 Pin Assignment

6.2.1.1 Power Pin (VDD、VSS)

The power supply pins must be decoupled with a 100nF capacitor that shall be placed as closed to the sensor as possible.

6.2.1.2 Temperature and Humidity Output Pin(T and RH)

Refer to the *Pin Assignment*. The outputs for temperature and humidity are read on different pins. The data is output linearly, and the specific analog voltage signals and corresponding physical values are provided in the documentation.

6.2.1.3 Thermal Pad

The center pad (thermal pad) is in the middle of the backside of the chip and is internally connected to ground within the sensor chip so there is no need to consider the electrical connection of the center pad. However, based on mechanical stress considerations, the center pad should still be soldered on the PCB.

6.2.1.4 nRESET pin

A reset signal can be given to the sensor through the nRESET pin. The reset signal is active low with a minimum pulse width of 1μs. Its function will be explained in detail in the fourth section. If not used, it is recommended to leave this pin floating or use a resistor greater than 2kΩ to pull this pin up to VDD. In fact, this pin has been pulled up to VDD by a 50kΩ resistor inside the chip.

6.2.2 Power-Up and Communication Start

When the power supply voltage exceeds V_{POR}, the sensor starts powering-up. After reaching this threshold voltage the sensor needs the time t_{PU} to enter idle state. Once in the idle state, the chip is ready to receive commands and data from the microcontroller.

6.2.3 Temperature and Humidity Measurement

The humidity range of 10%-90% is linearly mapped to an analog voltage output by the sensor. Before conversion to analog voltage output, the sensor’s output undergoes temperature compensation and linearization, and each sensor is calibrated accordingly. Therefore, the temperature and humidity output accuracy of each sensor meets the design specifications.

Equations (1), (2), and (3) provide the relationships between the physical values of temperature and humidity and the output voltage. Figure 4 and Figure 5 are the corresponding curve graphs.

$$RH = -12.5+125 \times \frac{V_{RH}}{V_{DD}} - \frac{10}{0.8} + \frac{100}{0.8} \times \frac{V_{RH}}{V_{DD}} \quad (1)$$

$$T[°C] = -66.875 + 218.75 \times \frac{V_T}{V_{DD}} = -45 - \frac{17.5}{0.8} - \frac{175}{0.8} \times \frac{V_T}{V_{DD}} \quad (2)$$

$$T[°F] = -88.375 + 393.75 \times \frac{V_T}{V_{DD}} = -49 - \frac{31.5}{0.8} - \frac{315}{0.8} \times \frac{V_T}{V_{DD}} \quad (3)$$

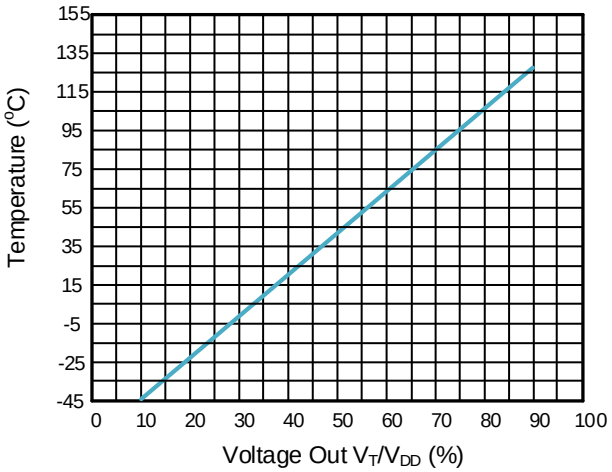


Figure 4. Relative Temperature vs. Output Analog Voltage

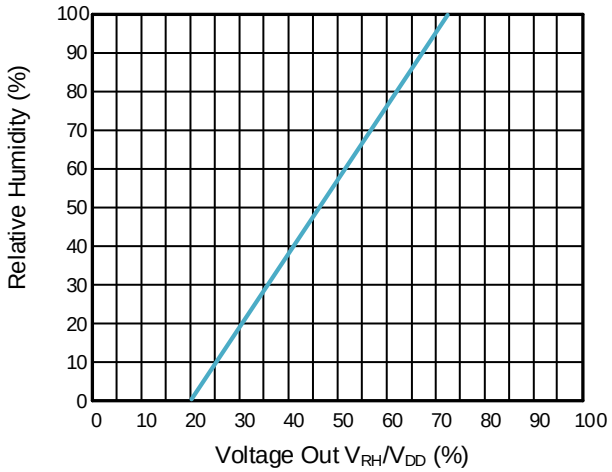


Figure 5. Relative Humidity vs. Output Analog Voltage

7 Application Information

The GD30TSHT3A is a single-chip integrated temperature and humidity sensor with a wide supply voltage range, with signal output pins for temperature and humidity. The typical application circuit is as follows.

7.1 Typical Application Circuit

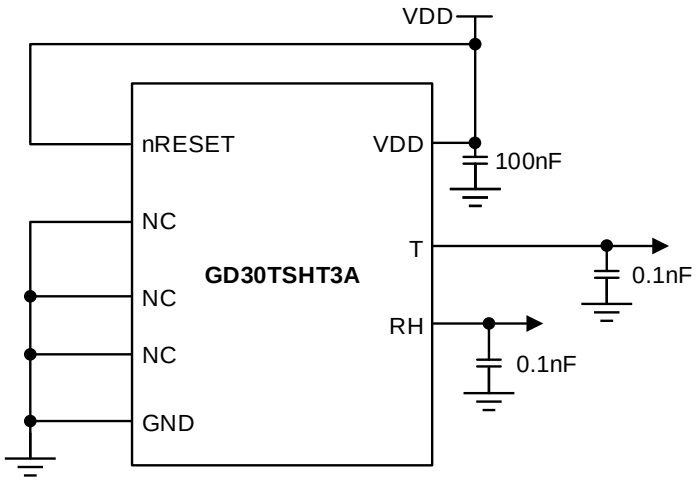
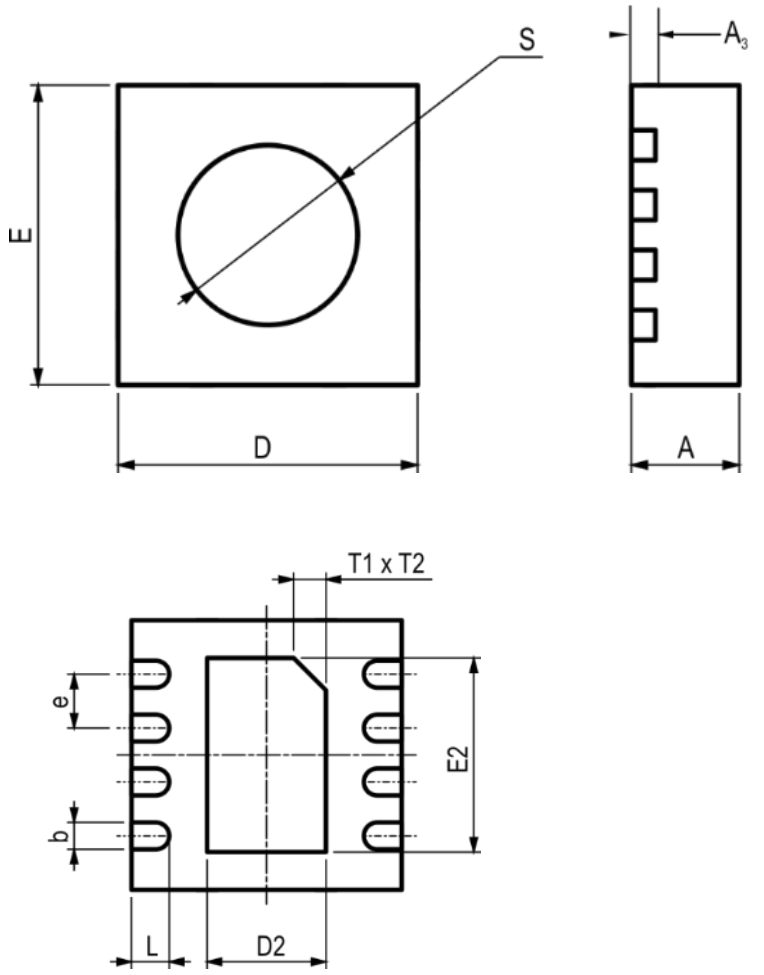


Figure 6. GD30TSHT3A Typical Application Circuit

8 Package Information

8.1 Outline Dimension

DFN-8 Package Outline



NOTES:

1. All dimensions are in millimeters.
2. Package dimensions does not include mold flash, protrusions, or gate burrs.
3. Refer to the *Table 1. DFN-8 dimensions(mm)*.

Table 1. DFN-8 dimensions(mm)

SYMBOL	MIN	NOM	MAX
A	0.8	0.9	1
A3		0.2	
b	0.2	0.25	0.3
D	2.4	2.5	2.6
D2	1	1.1	1.2
E	2.4	2.5	2.6
E2	1.7	1.8	1.9
e		0.5	
L	0.25	0.35	0.45
S		1	1.5
T1xT2		0.3x0.45°	

9 Ordering Information

Ordering Code	Package Type	ECO Plan	Packing Type	MOQ	OP Temp(°C)
GD30TSHT3AWETR-I	DFN-8	Green	Tape & Reel	2000	−40°C to +130°C
GD30TSHT3AWETC-I	DFN-8	Green	Tape & Reel	2000	−40°C to +130°C

1. GD30TSHT3AWETR-I tape and reel packaging.
2. GD30TSHT3AWETC-I with dustproof and breathable membrane, tape and reel packaging.

10 Revision History

REVISION NUMBER	DESCRIPTION	DATE
1.0	Initial release and device details	2024
1.1	Version upgrade	2025

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