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Nyfea product specification

PRODUCT SPECIFICATION

Customer: _____

Product Name: Temperature and Humidity Sensor

Part NO: FHT41

Issue Date: _____

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Prepared	Checked	Customer Check
ChenTT	Zelig	

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1 Features

- Relative humidity accuracy: up to ±1.8%RH
- Temperature accuracy: up to ±0.2℃
- Supply voltage: 1.6 V to 5.5 V
- Average current: 0.4 μA (at meas. rate 1 Hz)
- Idle current: 0.1uA
- Resolution: 0.01% RH, 0.01℃
- Operating range: 0-100%RH, -40~125° C
- Communication Interface: I²C, up to 1 MHz, with 2 I²C addresses
- Variable power heater
- NIST traceability
- JEDEC JESD47 qualification

2 Applications

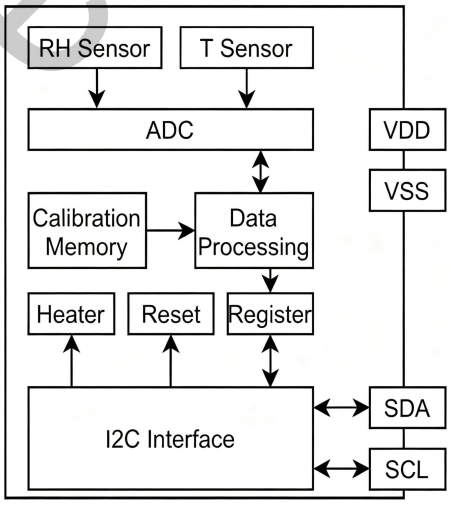
- Automotive cabin
- Industrial control
- Smart home
- Consumer electronics
- Medical devices

Package Information:

PRODUCTS	PACK	DETAILS
FHT41	DFN4	High precision, see Fig, addr:0x44

3 Description

The FHT41 is a next-generation monolithic sensor from NYFEA, combining temperature and humidity measurement in a single chip. It supports user-configurable I²C slave addresses for flexible system integration. An integrated heater is available for use in environments where condensation is a concern, and its output power can be adjusted to suit different application needs.The device comes in a 4-pin dual-flat-no-leads (DFN) package, which is designed to support standard surface-mount technology (SMT) assembly processes.



Functional Block Diagram of FHT41 Family

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4 Pin Configuration and Functions

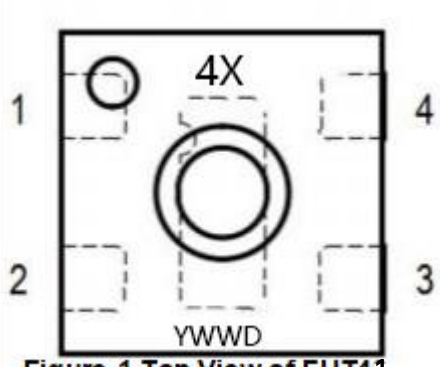


Figure 1 Top View of FHT41

Table 1 Pin Function of FHT41

PIN NUMBER	NAME	DESCRIPTION
1	SDA	I² C Data pin; input / output.
2	SCL	I² C Serial clock; input
3	VDD	Supply voltage
4	VSS	Ground.

5 Specifications

5.1 Absolute Maximum Ratings

Table 2 Absolute Maximum Ratings of FHT41 family

	MIN	MAX	UNIT
ALERT Pin Voltage	- 0.5	6	V
Operating Conditions	- 40	125	℃
Junction Temperature		150	℃
Storage Temperature	- 40	150	℃

All values listed in the table above are valid within the specified ambient temperature range, unless stated otherwise. Exceeding these limits may result in permanent impairment of the device.

5.2 Electrostatic Protection

Table 3 Electrostatic Protection Capability

		VALUE	UNIT
Electrostatic Discharge	Human Body Mode (HBM), per ANSI/ ESDA/JEDEC JS-001	±7000	V
Latch-up effect	Latch-Up, per JESD 78, Class IA	±200	mA

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5.3 Electrical Characteristics

Unless otherwise stated, the characteristic data presented below are obtained under the conditions of an ambient temperature between －40° C and +125° C and a supply voltage from 1.6 V to 5.5 V. Typical values are referenced at +25° C and 3.3 V.

Table 4 Electrical Characteristics of FHT41 family

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Supply voltage	V_{DD}		1.6	3.3	5.5	V
Power up/down level	V_{POR}		0.8		1.0	V
Supply slew rate	$V_{DD,slew}$				20	V/ ms
Supply current	I_{DD}	Idle state	0.08	0.1	0.15	uA
		Measurement		300	500	uA
		Aver. , high repeatability		2		uA
		Aver. , med.repeatability		1.2		uA
		Aver. , low.repeatability		0.4		uA
Low level input voltage	V_{IL}		0		0.3*V_{DD}	V
High level input voltage	V_{IH}		0.7*V_{DD}		V_{DD}	V
Pull up resistors	R_P		390			Ω
Cap bus load	C_b				400	pF

5.4 Timings

Table 5 System Timing Specifications

PARAMETER	SYMBOL	CONDITIONS	MIN	TYP	MAX	UNIT
Power-up time	t_{PU}	After hard reset , V_{DD}>V_{POR}		0.3	1	ms
Soft reset time	t_{SR}	After soft reset			1	ms
Measurement duration	$t_{MEAS,L}$	Low repeatability		1.3	1.6	ms
	$t_{MEAS,M}$	Medium repeatability		3.7	4.5	ms
	$t_{MEAS,H}$	High repeatability		6.9	8.3	ms
Heater-on duration	t_{Heater}	Long pulse	0.9	1	1.1	s
		Short pulse	0.9	1	1.1	s

Note: Max. values are measured at 1.6 V supply voltage.

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5.5 Specifications

5.5.1 Relative Humidity

Table 6 General Relative Humidity Sensor Specifications.

PARAMETER	CONDITIONS	VALUE	UNIT
FHT41 RH accuracy	typ.	±1.8	% RH
	max.	see Fig.2	% RH
Repeatability	high	0.08	% RH
	medium	0.15	% RH
	low	0.25	% RH
Resolution		0.01	% RH
Hysteresis	@25℃	±0.8	% RH
Specified range		0-100	% RH
Response time	t63%	4	s
Long-term drift	typ.	<0.3	%RH/y

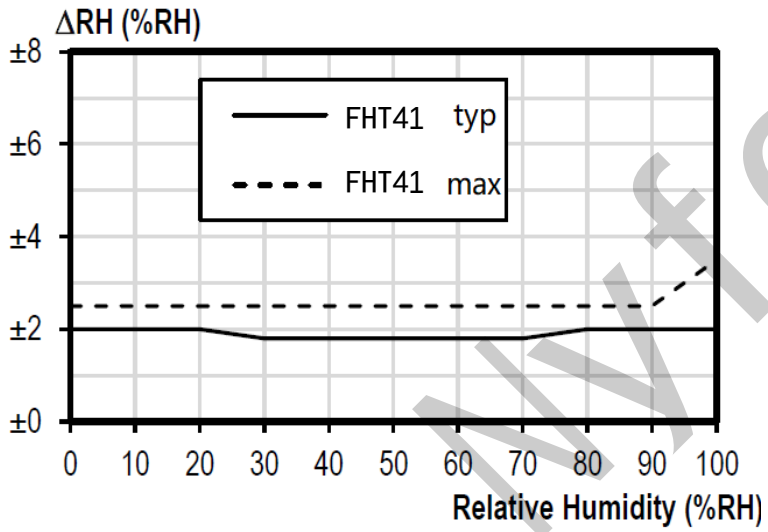


Figure 2 FHT41 RH accuracy @25℃

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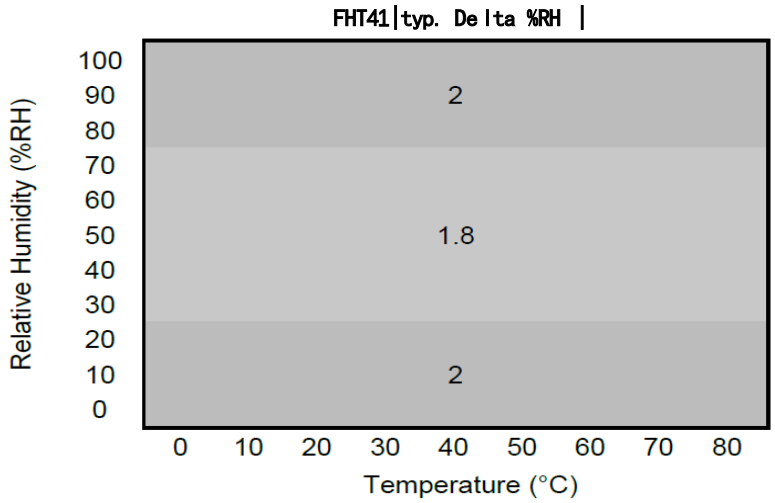


Figure 3 Typical RH accuracy tolerance over humidity and temperature for FHT41.

5.5.2 Temperature

Table 7 General temperature sensor specifications.

PARAMETER	CONDITIONS	VALUE	UNIT
FHT41 T. accuracy	typ.	±0.2	℃
	max.	see Fig.4	℃
Repeatability	high	0.04	℃
	medium	0.07	℃
	low	0.1	℃
Resolution		0.01	℃
Specified range		-40 ~ 125	℃
Response time	t63%	2	s
Long-term drift	typ.	<0.03	℃ / y

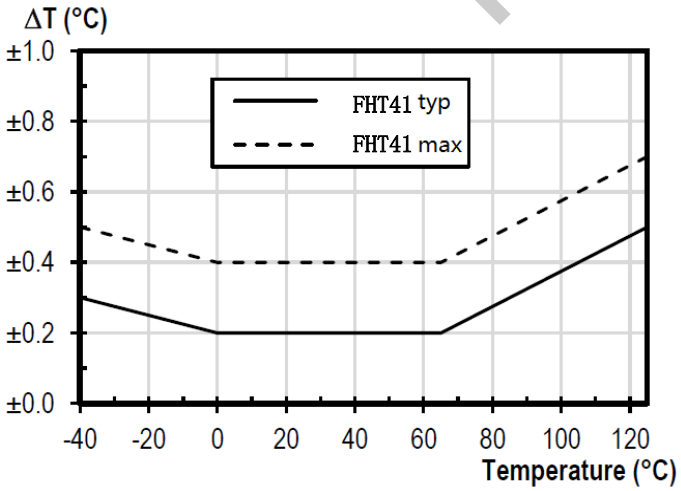


Figure 4 FHT41 temperature accuracy

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6 Sensor Operation

6.1 I²C Communication

This sensor implements an I²C interface compliant with NXP's UM10204 [3], supporting Standard, Fast, and Fast- Mode Plus speeds. Data is exchanged in 16- bit words, and an 8- bit CRC provides protection against bus glitches. All frames start with a START condition and end with a STOP condition; a read transfer is terminated by issuing a NACK and then a STOP. The 7- bit slave address is followed by a direction bit—0 for write, 1 for read. Clock stretching is not supported. Should the sensor receive a read command before completing an ongoing conversion, it will reply with a NACK. The measured data is available for a single readout and is erased from the register file after the first acknowledged read header.

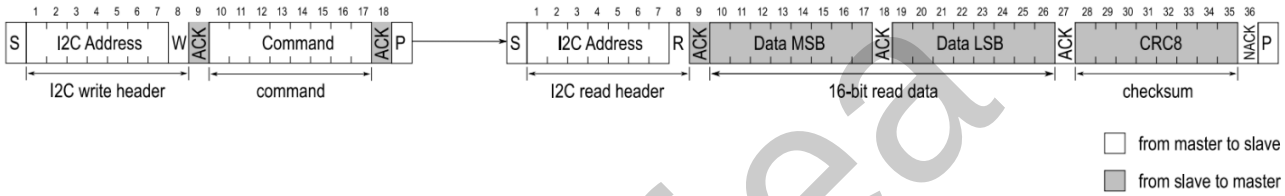


Figure 5 Typical I²C communication timing of FHT41

Figure 5 illustrates the typical I²C communication sequence for the FHT41 series. The master initiates the transaction by sending a write header to the slave device, followed by a command—such as "measure relative humidity and temperature with highest resolution." Once the measurement cycle completes, the slave acknowledges any subsequent read requests directed to it and begins transmitting the measured data.

All timing parameters conform to the I²C-bus interface specifications . Additionally, the external passive components (capacitors andresistors must be selected in accordance with the r equirements listed in Table 4).

6.2 Data type & length

The I²C bus uses 8-bit data packets for all transactions. When the sensor transmits data to the master, a checksum byte is appended after every two 8- bit data packets. Temperature and humidity readings are always sent in a fixed order: the temperature value comes first, consisting of two 8- bit data bytes followed by an 8- bit CRC; the humidity value follows next, also delivered as two 8- bit data bytes with an accompanying 8- bit checksum.

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6.3 Checksum Calculation

For read transfers each 16-bit data is followed by a checksum with the following properties.

Table 8 Data checksum properties

PROPERTY	VALUE
Name	CRC-8
Message Length	16 bit
Polynomial	0x31($X^8+X^5+X^4+1$)
Initialization	0xFF
Reflect Input/Output false/false	false / false
Final XOR	0x00
Examples	CRC(0xBEEF) = 0x92

6.4 Command Overview

Table 9 Instructions for Function Commands of FHT41

COMMAND (HEX)	RETURNED BYTES	DESCRIPTION [return values]
0xFD	6	measure T & RH with high repeatability [2 byte T-data + 1 byte CRC + 2 byte RH-data + 1 byte CRC]
0xF60	6	measure T & RH with medium repeatability [2 byte T-data + 1 byte CRC + 2 byte RH-data + 1 byte CRC]
0xE0	6	measure T & RH with lowest repeatability [2 byte T-data + 1 byte CRC + 2 byte RH-data + 1 byte CRC]
0x89	6	read serial number [2 byte data + 1 byte CRC + 2 byte data + 1 byte CRC]
0x94	-	soft reset [ACK]
0x39	6	activate heater with 200mW for 1s, including a high precision measurement just before deactivation
0x32	6	activate heater with 200mW for 0.1s, including a high precision measurement just before deactivation
0x2F	6	activate heater with 110mW for 1s, including a high precision measurement just before deactivation
0x24	6	activate heater with 110mW for 0.1s including a high precision measurement just before deactivation
0x1E	6	activate heater with 20mW for 1s including a high precision measurement just before deactivation
0x15	6	activate heater with 20mW for 0.1s including a high precision measurement just before deactivation

Note: If the sensor is not ready to process a command e.g. because it is still measuring, it will response with NACK to the I² C read header. Given heater power values are typical and valid for VDD=3.3 V.

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6.5 Conversion of Signal Output

The digital sensor signals correspond to following humidity and temperature values:

$$RH = \left(-6 + 125 \cdot \frac{S_{RH}}{2^{16}-1}\right)\%RH \quad (1)$$

$$T = \left(-45 + 175 \cdot \frac{S_T}{2^{16}-1}\right)℃ \quad (2)$$

$$T = \left(-49 + 315 \cdot \frac{S_T}{2^{16}-1}\right)℉ \quad (3)$$

The relative humidity conversion expressed in equation (1) is capable of generating numerical results that extend beyond the nominal 0% to 100% RH interval. While values less than 0% RH or greater than 100% RH do not correspond to physical reality, leaving the data unclipped may provide valuable insight in certain analytical scenarios — for example, when examining the spread of sensor readings near the operational extremes. For applications where such non- physical values are not desired, applying a saturation (clipping) function to confine the RH output within 0% to 100% RH is strongly advised.

6.6 Serial Number

Each sensor unit is assigned a unique serial identifier during the production process, following a specific internal coding methodology. This identifier resides in the one- time- programmable (OTP) memory array and is rendered immutable subsequent to manufacturing. The serial number may be accessed by sending the I²C command 0x89; the sensor outputs the data as two 16- bit words, with an 8- bit CRC appended to each word for integrity verification.

6.7 Reset & Abort

A reset of the sensor can be achieved in three ways:

1. Soft reset: send the reset command described inTable 9.
2. I² C general call reset: all devices on I² C bus are reset by sending the command 0x06 to the I² C address 0x00.
3. Power down (incl. pulling SCL and SDA low).

Any command that triggers an action at the sensor can be aborted via I²C general call reset or soft reset.

6.8 Heater Operation

The sensor incorporates an integrated on-chip heater which can be switched on by the set of different commands. Three heating powers and two heating durations are selectable. After reception of a heater-on command, the sensor executes the following procedure:

1. The heater is enabled and the timer starts its count-down;
2. On timer expiration a temperature and humidity measurement with the highest repeatability is started, the heater remains enabled;

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3. After the measurement is finished the heater is turned off;
4. Temperature and humidity values are now available for readout.

As a protective measure against unintended thermal overstress, the heater can be activated for no more than one second per command. When periodic heating is necessary for the intended application, the system must ensure that the heater's duty cycle (on- time relative to the total period) remains under 10%..

Possible Heater Use Cases:

1. Removal of condensed / spray water on the sensor surface. Although condensed water is not a reliability / quality problem to the sensor, it will however make the sensor non-responsive to RH changes in the air as long as there is liquid water on the surface.

2. Creep-free operation in high humid environments. Periodic heating pulses allow for creep-free high- humidity measurements for extended times.

Important notes for operating the heater:

1. The maximum allowable duty cycle is 10%, defined as the ratio of total heater activation time to the sensor's overall service life.

2. All published sensor specifications are invalid during periods when the heater is energized.

3. The temperature sensing element may be subject to thermally induced mechanical stress, which can result in an offset between the measured value and the true ambient temperature.

4. To ensure reliable electrical performance, the die temperature—defined as the ambient temperature plus the incremental rise from heater operation—must not exceed the absolute maximum rating of 125° C.

5. The heater draws substantial supply current, up to 70 mA at maximum power. While an integrated slew - rate control circuit mitigates inrush effects, the external power source must be capable of maintaining stable voltage levels to prevent droop- induced resets.

6. Achieving higher heating levels requires sequential execution of heater commands. The heater should not be activated at ambient temperatures above 65° C, as this may cause the chip to exceed its 125° C maximum operating temperature. .

6.9 Typical application circuit

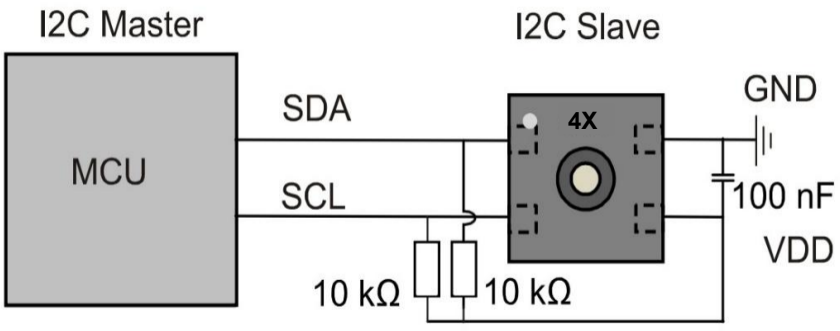
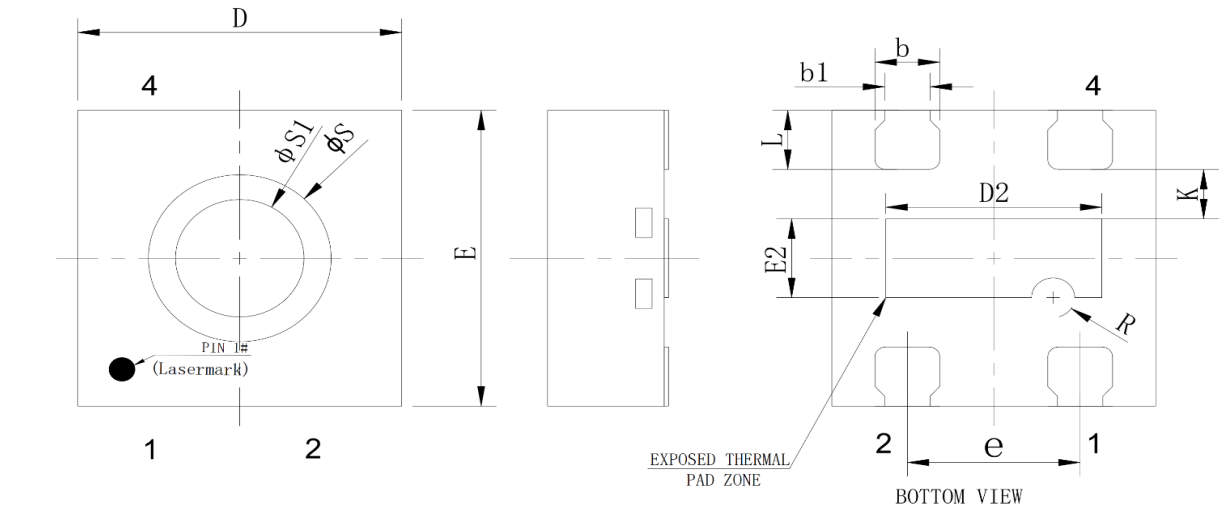


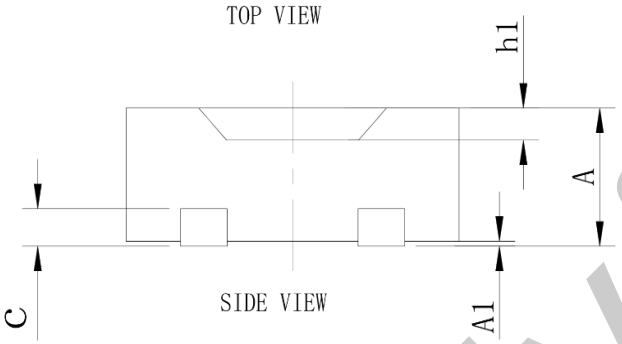
Figure 6 Typical application circuit reference diagram of FHT41

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7 Package Information

7.1 DFN4 package outline (1.5mm×1.5mm)





SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	0.49	0.54	0.59
A1	0	0.02	0.05
b	0.25	0.30	0.35
b1	0.21REF		
c	0.152REF		
D	1.45	1.50	1.55
D2	0.90	1.00	1.10
E	1.45	1.50	1.55
E2	0.30	0.40	0.50
e	0.80BSC		
K	0.25REF		
L	0.25	0.30	0.35
R	0.10REF		
∅S	0.60BSC		
∅S1	0.50BSC		
h1	-	0.13	-

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Figure 7 Dimensional drawing of FHT41 (in mm)

7.2 Land Pattern

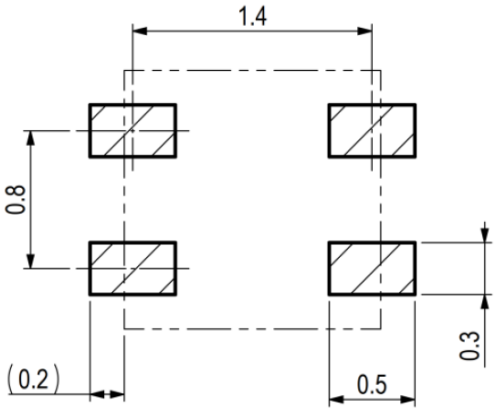
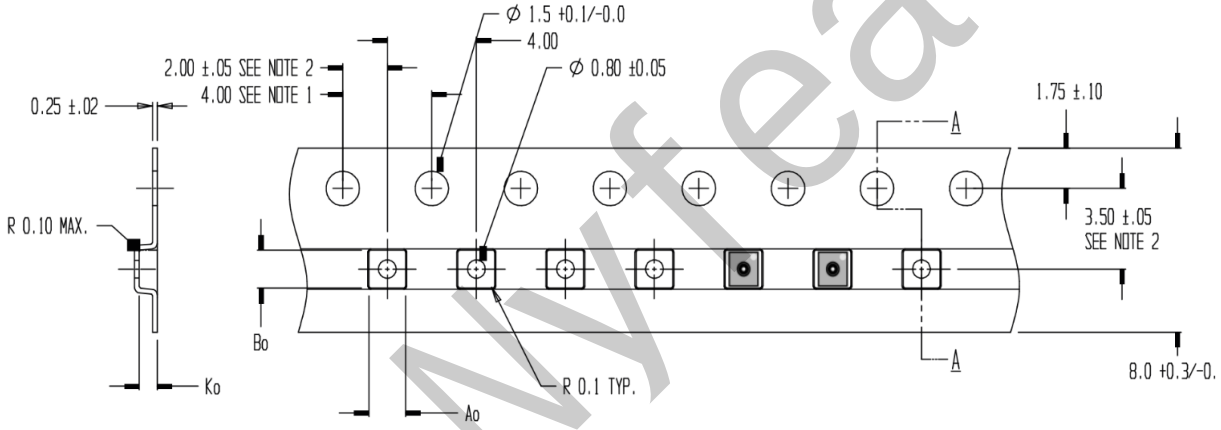


Figure 8 Recommended land pattern (in mm)

7.3 Reel and Tape Information

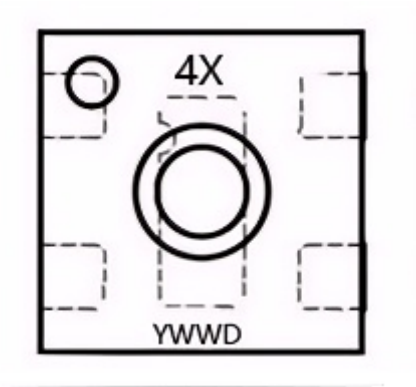


Note: The diameter of the reel for the single-disc 10K is 13 inches, and that for the 2K is 7 inches.

Figure 9 Reel and Tape Information

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7.4 Marking Information





4X: indicates the model FHT4X, where X is a number 0/1/5. For example, 41 indicates the model FHT41.

YWWD: Y is the year, WW is the week, D is the product ID code. For example, 5066 indicates production in the 6th week of 2025, code 6.

8 Ordering Information

ORDER NUMBER	DEVICE	PACKAGE	SPQ	NOTE
FHT41-TR	FHT41	DFN-4	2000	High precision, addr:0x44, Tape &Reel

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9 Important Notices

9.1 ESD Precautions

The semiconductor construction of this component renders it inherently vulnerable to electrostatic discharge (ESD) events. To mitigate the risk of latent or catastrophic damage, the device must be handled solely within an Electrostatic Protected Area (EPA). The following protective protocols are mandatory: all personnel shall be grounded using conductive wrist straps, and any non- insulated or conductive objects present in the vicinity must be maintained at ground potential.

9.2 Exposure to Chemicals

The temperature and humidity sensing elements from NYFEA are highly sensitive environmental transducers and should not be treated as standard electronic components. These sensors must be kept away from volatile chemicals—including but not limited to organic solvents and compounds such as (ethyl)ketene, acetone, isopropanol, ethanol, and toluene. Exposure to these substances, particularly at elevated concentrations or over extended periods, can cause permanent shifts in humidity measurement accuracy that are generally irreversible..

9.3 Applications in Extreme Environments

Certain applications may necessitate exposing the temperature and humidity sensor to aggressive or challenging environmental conditions. In many such cases, the compatibility of the sensor with these environments is often overlooked during system design. The following situations, however, warrant particular care and should be carefully evaluated prior to deployment..

a)When the sensor has been subjected to non- standard operating conditions—particularly relative humidity levels in excess of 90%—it is necessary to allow the device a recovery interval under normal ambient conditions prior to resuming standard measurement operations.

b) Certain operating environments may result in the sensor being exposed to elevated concentrations of volatile organic compounds over extended durations. Such exposure can take place both during the system assembly process and throughout the product's service life. Applications falling into this category necessitate heightened scrutiny and should be subject to thorough compatibility assessment.

c) Certain operating environments may expose the sensor to acidic or alkaline media. It should be noted that damage to the device occurs only when the concentration exceeds a critical threshold. In the case of alkaline solutions, pH values above 9 are considered detrimental. Furthermore, high-concentration exposure to etching agents such as hydrogen peroxide (H_2O_2) and ammonia (NH_3) has also been shown to compromise sensor integrity.

d)Certain application settings may expose the device to corrosive gaseous species. At modest concentration levels, the sensor element itself remains largely unaffected; nevertheless, the long- term

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reliability of solder interconnections may be compromised. When concentrations reach elevated levels, the sensor package and internal structures may also sustain damage.

9.4 Packaging and Storage

Before use, it is strongly recommended to store the sensor in its original packaging in the following environment: temperature 10 ° C ~ 50 ° C (0 ° C - 125 ° C for a limited time), 20% ~ 65% RH.

9.5 Assemblage

The sensor can be stored for 1 year in normal storage environment, and the sensor has a moisture resistance level of 1.

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