Innovative Sensor Technology

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Application Note

Humidity Module

HYT.R411

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Application Note
Humidity Modules
Content

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1. General benefits

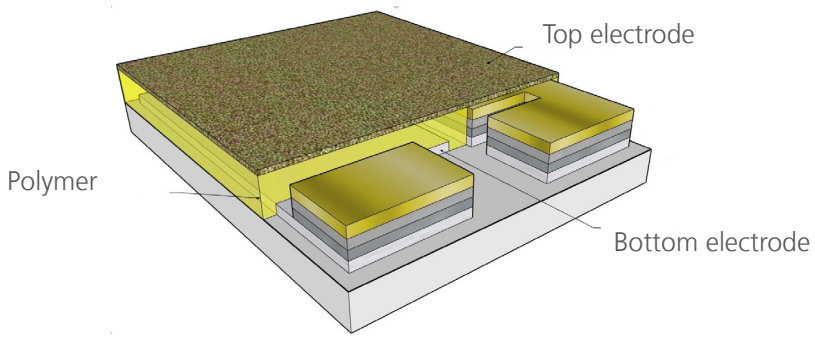
- Fast response time
- Precise measurement at low temperatures
- Digital I²C interface
- Excellent stability
- Fully factory-calibrated exchangeable module
- Real stratospheric to mesospheric temperature measurement
- High humidity/temperature accuracy
- Customer specific versions available

IST AG's fully calibrated and temperature-compensated humidity modules are the best solution for the most demanding humidity applications.

The heart of any type of module is its capacitive polymer-based sensor element, which is fabricated with IST AG's cutting-edge thin film techniques. Its proprietary polymer and porous humidity-permeable cover layer enables excellent stability while maintaining the advantages of fast response times.

The use of only first-class materials and the robust sensor design make the elements very stable in harsh conditions, such as high humidity and dew formation. With the SIL or pin-contacts, the modules can easily be integrated into various assemblies. The signal processing integrated in the sensor completely processes the measured data and directly delivers the physical parameters of relative humidity and temperature over the I²C compatible interface as digital values. The precise calibration of every module against dewpoint ensures the outstanding accuracy of our humidity modules.

1.1 Sensor construction

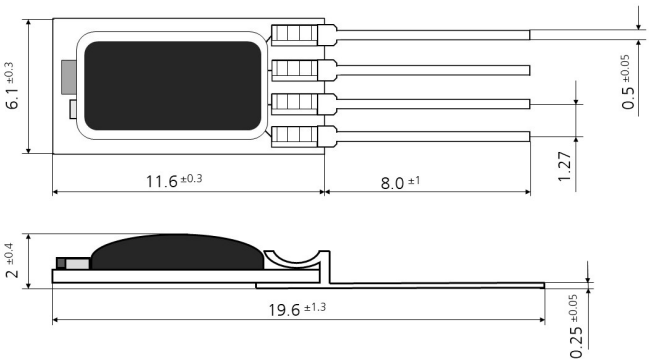


Application range:
0 to 90 % RH & -80 °C to 50 °C

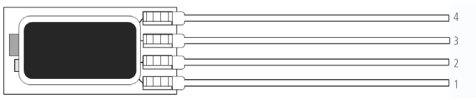
Accuracy humidity:
±2 %RH (0-90 %RH)

Accuracy temperature:
±0.5°C (-80°C to 0°C)
±0.2°C (0°C to 50°C)

1.2 Mechanical Dimensions



1.3 Pin Assignment



Pin	Function
4	SCL
3	VDD
2	GND
1	SDA

2. Sensor Handling

2.1 Sensor pollution

Gaseous chemicals such as volatile organic compounds (VOCs) are known to pollute the sensitive layer of the humidity sensor element. If such pollutants are present in the surrounding atmosphere of the sensor, they diffuse into the polymer where they occupy spaces reserved for water molecules. This process often results in lower humidity readings. Sources of pollution can be materials that release chemicals such as:

- Plastics or other packaging materials, such as ESD Bags, cardboard boxes, foams etc.
- Potting compounds
- Adhesives
- Coatings
- Glues etc.

High concentrations of pollutants are known to occur in storage rooms and manufacturing floors especially where castings, glues, epoxies etc. are cured. To avoid false readings please:

- Store the modules in the original sealed packaging material
- Only use tested or recommended packaging material
- The ESD bag must be hermetically sealed
- Eliminate VOCs during storage and manufacturing
- Ensure a clean surrounding atmosphere by fresh air supply and good ventilation.
- Keep the sensor in the recommended/tested packaging materials during longer storage times
- Use only tested materials in the sensor assembly

2.2 Reconditioning procedure

Once the modules already read wrong humidity signals, the pollutants can be removed by evaporation in many cases. For reconditioning

- bake the sensors for 2-24 hours at 120°C. It is possible that the modules read slightly too high values after reconditioning, then
- store the modules for 4-8 weeks in eurostat ESD bags (without desiccant) at 55 °C

2.3. Packaging

Due to the polluting effect of many plastics (see 2.1), only use tested or recommended packaging materials. Recommendations:

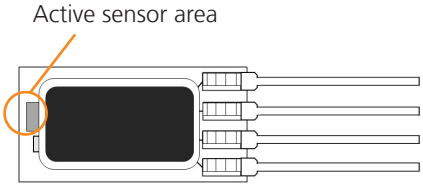
ESD Bag
- ESD bag (eurostat 20-87x-xxxx, 20-771-xxxx) or
- W-Tech France MBB Aluminium bag: Total thickness 150µm ±10% Structure: ESD+PET (12µm) / PA (15µm) / AL (7µm) / ESD+LDPE (110µm)

Desiccant bag
- Desiccant bag DESI PAK (Clariant 25085627656)
  Never use the ESD bags without desiccant bag (except reconditioning procedure)!

The bag with the desiccant and the modules must be sealed. Fix the modules in the packaging to avoid damages on the active sensor area or on the dark grey glob top

2.4 Handling

- Do not use metal tweezers to handle the modules
- Never handle the modules by hand without gloves
- Avoid mechanical stress, e.g. bending or touching the module with sharp objects
- Hold the module with plastic tweezers on the wires and side edges only



Do not touch the active sensor area or the dark grey glob top on the module. Scratches and contaminations can damage the sensitive layers and therefore degrade the sensor performance (for more details see AHHYTM_E). Mechanical stress on the dark grey glob top can damage the electronics

3. I²C Protocol Description

S	Start
R	Read
W	Write
D	Data
A	Acknowledge
NA	Not Acknowledge
P	Stop
	Signal generated by master
	Signal generated by Slave

The HYT R411 Module has a standard address of 0x28. The module supports clock frequencies up to 100kHz.

3.1 Commands

Reset
In order to reset the module a "Reset" command is available. As data values are only updated after the last data element has been read, a reset command will update the result registers.

A reset of the module is triggered by sending command 0x8A (Hex) / 0b10001010 (Bin).

S	6	5	4	3	2	1	0	W	A	7	6	5	4	3	2	1	0	A	P
S	0	1	0	1	0	0	0	0	A	1	0	0	0	1	0	1	0	A	P
	Slave Address (0 x 28)									Reset (0 x 8 A)									

Read result
To read a result from the module the "Read Result" command must be sent to the module. After the Read Result command the module prepares the results and they can be read from the module, either only humidity, only temperature or one after the other.

Result Register	Command	
Humidity	0x40 (Hex) / 0b01000000 (Bin)	Read 4 Bytes
Temperature	0x44 (Hex) / 0b01000100 (Bin)	Read 4 Bytes
Humidity and Temperature	0x40 (Hex) / 0b01000000 (Bin)	Read 8 Bytes

The recommended way to read out a HYT R411 Module is to send a reset command, wait 100ms until a conversion is done before sending a read result command and read the corresponding number of bytes as shown below.

Read Humidity Signal

S	6	5	4	3	2	1	0	W	A	7	6	5	4	3	2	1	0	A	P
S	0	1	0	1	0	0	0	0	A	0	1	0	0	0	0	0	0	A	P
	Slave Address (0 x 28)									Read Humidity (0 x 40)									

S	6	5	4	3	2	1	0	R	A	7	6	5	4	3	2	1	0	A	15	14	13	12	11	10	9	8	A	
S	0	1	0	1	0	0	0	1	A	D	D	D	D	D	D	D	D	A	D	D	D	D	D	D	D	D	A	…
	Slave Address (0 x 28)									Humidity LSB									Humidity MidLSB									

	23	22	21	20	19	18	17	16	A	31	30	29	28	27	26	25	24	NA	P
…	D	D	D	D	D	D	D	D	A	D	D	D	D	D	D	D	D	NA	P
	Humidity Mid MSB									Humidity MSB									

Read Humidity and Temperature Signal

S	6	5	4	3	2	1	0	W	A	7	6	5	4	3	2	1	0	A	P
S	0	1	0	1	0	0	0	0	A	0	1	0	0	0	0	0	0	A	P
	Slave Address (0 x 28)									Read Humidity (0 x 40)									

S	6	5	4	3	2	1	0	R	
S	0	1	0	1	0	0	0	1	…
	Slave Address (0 x 28)								

7	6	5	4	3	2	1	0	A	15	14	13	12	11	10	9	8	A	
D	D	D	D	D	D	D	D	A	A	D	D	D	D	D	D	D	D	…
	Humidity LSB									Humidity MidLSB								

	23	22	21	20	19	18	17	16	A	31	30	29	28	27	26	25	24	A	P
…	D	D	D	D	D	D	D	D	A	D	D	D	D	D	D	D	D	A	P
	Humidity Mid MSB									Humidity MSB									

7	6	5	4	3	2	1	0	A	15	14	13	12	11	10	9	8	A	
D	D	D	D	D	D	D	D	A	A	D	D	D	D	D	D	D	D	…
	Temperature LSB									Temperature MidLSB								

	23	22	21	20	19	18	17	16	A	31	30	29	28	27	26	25	24	NA	P
…	D	D	D	D	D	D	D	D	A	D	D	D	D	D	D	D	D	NA	P
	Temperature Mid MSB									Temperature MSB									

4. Scaling of measurement values

Each of the result values must be interpreted as a signed 32-bit wide integer. The data is stored as a fixed-point integer with a fractional part of 8bit

Example Temperature:
If the values received are 0x20, 0x15, 0x00, 0x00, the corresponding signed integer is therefore 0x00001520 which equals to 5408. The corresponding Humidity is:

$$RH[\%] = \frac{Received\ Value}{256} = \frac{5408}{256} = 21.125\%RH$$

Example Temperature:
If the values received are 0x69, 0x1F, 0x00, 0x00, the corresponding signed integer is therefore 0x00001F69 which equals to 8041. The corresponding Temperature is:

$$T[°C] = \frac{Received\ Value}{256} = \frac{8041}{256} \approx 31.41°C$$

If the values received are 0xE6, 0xF3, 0xFF, 0xFF, the corresponding signed integer is therefore 0xFFFFF3E6. As the result is a signed integer and the most significant bit equals 1, the value is negative. As result must be interpreted as a two's complement, the value received is (-1) x 3098. The corresponding Temperature equals to:

$$T[°C] = \frac{Received\ Value}{256} = \frac{(-1) \cdot 3098}{256} \approx -12.102°C$$

5. Additional Documents

	Document name
Application note HYT Modules	AHHYTM_E
Data sheet HYT.R411 Humidity and Temperature Module	DHHYTR411Humidity and Temperature Module_E

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