acal bfi European leader in advanced technology solutions

Selecting the right humidity sensor for your application

Humidity is the presence of water in the air. The amount of vapour can affect human comfort as well as many manufacturing processes. Monitoring and controlling humidity is desirable in many industrial, medical, agricultural and domestic situations.

Choosing the best type of humidity sensing can be a complicated process and this guide aims to help you select the best solution for your application.

Acal BFi provide solutions from world-leading humidity sensor manufacturers Honeywell, Amphenol, Sangshin and Shinyei, which are all featured in this guide.

What is relative humidty?

Relative humidity is defined as the ratio of the current amount of water vapour in the air to the maximum amount to be contained at the current air temperature.

The capacity of air to hold water vapour is heavily dependent on its temperature. The warmer the air, the more moisture it can contain.

The ratio of water vapour in the air to the maximum amount of water vapour the air can hold at a particular temperature is expressed as relative humidity (RH). For example, an RH of 30% means that the air contains 30% of the moisture it can possibly hold at that particular temperature.

When air can hold no more moisture at a given temperature (ie the RH is 100%), the air is said to be saturated. Electronic sensors are designed to react to these moisture levels.

This guide includes:

- types of sensors
- key terms
- manufacturers
- sensor factors,
- typical applications, and a
- range overview.

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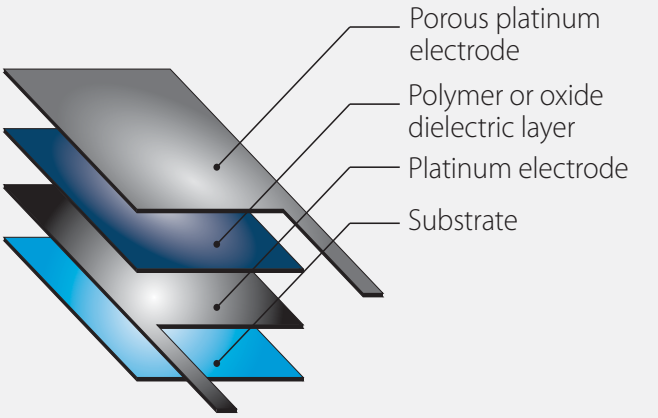
Types of electronic humidity sensors

Electronic sensors are designed to react to moisture levels and two basic types exist.

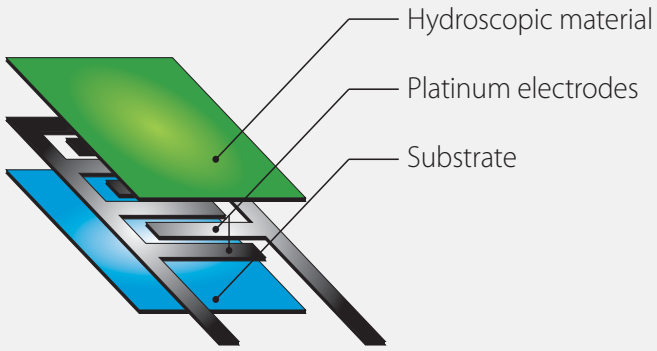
Capacitive sensing

Consists of a hygroscopic dielectric material sandwiched between a pair of electrodes forming a small capacitor that is sensitive to moisture. Capacitive type sensors are very linear and hence can measure RH from 0% to 100%. Capacitive RH sensors dominate both atmospheric and process measurements.



Resistive sensing

Resistance of a sensing element changes in response to the change in the humidity. Resistive-type sensors have a weakness in measuring low values (below 5% RH) but are lower cost and ideal where precision is less important.



Key humidity terms

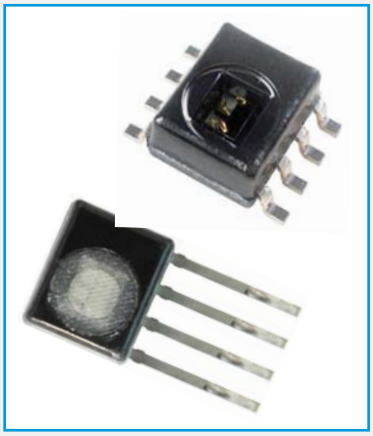
To discuss humidity it is essential that key terms are understood. These are the most commonly used.

Term	Definition	Unit
Relative humidity (RH)	Ratio of mass (vapour) to mass (saturated vapour) or ratio of actual vapour pressure to saturation pressure. RH is a function of temperature and is hence a relative measurement.	%
Dew point	Temperature at which the water vapour in gas condenses to water. Is a function of pressure but independent of temperature and hence an absolute humidity measurement.	°C
Frost point	Temperature at which the water vapour in gas condenses to ice. As above, an absolute humidity measurement.	°C
ppm (volume)	Ratio of volume (vapour) x 10^6 to volume of dry gas.	ppm
Saturated air	When air cannot absorb any more water vapour, its RH is 100% or fully saturated.	

Honeywell humidity sensors

With a 75-year legacy and more than 50,000 products in their sensing and control range, Honeywell have one of the broadest portfolios available.

Honeywell HumidIcon™ digital humidity/temperature sensors



These sensors feature digital output-type RH capacitive and temperature sensors combined in the same package. Configured with on-chip signal conditioning they provide wide operating temperature ranges and low hysteresis.

It is available in the following accuracies:

- ± 1.7% RH – HIH9000 series
- ± 2.0% RH – HIH 8000 series
- ± 3.0% RH – HIH 7000 series
- ± 4.0% RH – HIH 6100 series
- ± 4.5% RH – HIH 6000 series

The Humidicon™ series is offered with several packaging variations, offering a choice in housing style (SIP 4-pin or SOIC-8 SMD), filter (hydrophobic filter or no filter), output (I2C or SPI) and packaging (tape and boxed, tape and reel, or samples on tape).

Advantages

- Combined humidity and temperature sensor – one sensor does the work of two.
- Industry-leading, long-term stability – 1.2% RH over five years.
- Industry-leading reliability – MTTF 9,312,507 hr.
- True, temperature-compensated digital I2C or SPI output – remove components associated with sensor signal conditioning.
- Energy efficient – low supply voltage (2.3 Vdc) and low power consumption (1µA in sleep mode).
- Ultra-small package footprint saves board space – ultra-small SOIC-8 SMD or SIP 4-pin.

Other Honeywell humidity sensors (not HumidIcon™) available

• HIH 5030/5031	– analogue voltage output	– SMD
• HIH 4000	– analogue voltage output	– SIP
• HIH 4010/4020/4021	– analogue voltage output	– SIP
• HIH 4602	– analogue voltage RH	– TO-5 can
• HCH 1000	– capacitance value output	– SIP

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TELAIRE®

Amphenol
Advanced Sensors

Telaire T9602 humidity and temperature sensor

The Telaire T9602 offers the most advanced and cost-effective humidity and temperature sensing solution for virtually any type of application. Comprising a capacitive polymer sensor and CMOS IC with EEPROM integrated into one easy mount OEM package.

Individually calibrated and tested, the T9602 sensor chip performs at ±2% from 20% to 80% RH (±3% over entire range) and is simply ready to use without further calibration or temperature compensation.

Features

- Fully calibrated and temperature compensated
- Water resistant (IP65)
- I2C digital or PDM analogue output
- Low current consumption
- Optional wire length
- Various mounting options
- Accuracy ±2% RH, ±0.3°C, 14 bit

Typical applications include:

- **HVAC control** – energy saving, air conditioning, refrigeration, air qulity, vent fans, home appliances, humidifiers and dehumidifiers, and
- **process control and instrumentation** – medical instruments, handheld devices, weather stations, food processing, printers and RFIDs.

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Sangshin

The KSH range of 20 resistive humidity sensors combines exceptional accuracy and high quality with excellent value. They ar intended for use in a wide variety of applications including HVAC, medical, industrial, building and clean room uses.

Features

- Operating range of 20% to 95% RH
- Rapid response <1.5 minutes
- Low hysteresis ±2%
- Small and light
- Robust construction

Typical applications

- Humidifiers/dehumidifiers
- Air conditioners
- Automotive
- Printers/copiers
- Food processing

Shinyei RHI-112, 120 and 150 series

The SHINYEI RHI series module consists of a reliable and proven resistive humidity sensor and a custom IC designed exclusively for the sensor, which provides a simple but highly accurate, cost-effective solution. Available in three forms, it is ideal for airconditioning, HVAC, printers/copiers and other OEM applications.

Features

- High accuracy: ±3%rh (at 25°C 50% RH)
- Input voltage: 3.15~5.5V
- Low voltage dependency (includes regulator in IC)
- Linear output voltage: 0-3V (at 90%RH:3V)
- Low temperature dependency
- Analogue or digital output versions (I2C)
- Wide humidity range
- Low power consumption

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Key factors in selecting humidity sensors

When considering an RH sensor application, the selection process involves a series of choices to meet requirements. Common to most industry applications is the need to support automated manufacturing processes, good sensor interchangability (to minimise calibration), compact profile, and stable accuracy over the application life.

Key considerations

- **Accuracy** – linearity, hysteresis, operational temperature range and repeatability all impact accuracy and need to be considered.
- **Interchangability** – low part-to-part variation reduces or eliminates production calibration costs.
- **Package type** – combined humidity and temperature sensors means one sensor instead of two. SMD to support cost savings in production.
- **Environmental** – if condensation is present hydrophobic (condensate resistant) filters may be needed.
- **On-chip signal conditioning** – require limited or zero support electronics and typically offer direct input to other devices.
- **Power consumption** – low current draws for battery powered applications.

Acal BFi have the experience and knowledge to help you make the informed choice.

Typical humidity sensor applications

Applications are limitless as humidity sensing is increasingly important for many environmental and industrial control applications.

Industrial

- Commercial refrigeration
- Cargo storage
- Contract services
- Handheld instrumentation
- Industrial equipment manufacturers
- Consumer electronics
- White goods
- Weather stations
- Humidors
- Greenhouse control

HVACR

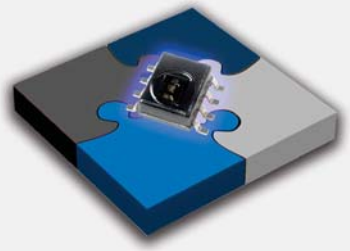
- Commercial BAS peripheral devices
- Museums and institutions
- Humidifiers
- Dehumidifiers
- Residential equipment

Transportation

- In-cabin climate control
- Under hood
- On engine

Healthcare

- Incubators
- Sterilisation
- Patient monitoring
- Clean rooms
- Respiratory
- Ventilators



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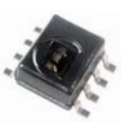
Range overview

	Honeywell HumidIcon	Honeywell					Amphenol	Sangshin	Shinyei
									
Type	**HIH 6000 HIH 6100 HIH 7000 HIH 8000 HIH 9000**	**HIH 5030 HIH 5031**	**HIH 4000 HIH 4010 HIH 4020 HIH 4021 HIH 4030 HIH 4031**	**HIH 4602-a,c**	**HIH 4602-L, L-CP**	**HCH 1000**	**Telaire T9602**	**KSH-01 KSH-02 KSH-03 KSH-04**	**RHI-112A RHI -112C RHI -112D RHI-120A RHI-120D RHI-150D**
Capacitive or resistive sensor	C	C	C	C	C	C	C	R	R
Combined RH and temperature	Y	–	–	Y	–	–	Y	N	4
RH only	–	Y	Y	N	Y	Y	–	Y	2
Items in range	24	2	20	2	2	2	8	20	6
Digital output	I2C or SPI	–	–	–	–	–	I2C	N	I2C
Analogue output	–	Voltage	Voltage	RH voltage T resistance	Voltage	Capacitive	PDM	Resistive	Voltage
Package size									
Package	SIP 4-pin SOIC 8 SMD	SOIC 8 SMD	SOIC 8 SMD SIP 2.54mm (0.10in) SIP 1.27mm (0.05in)	TO 5 can	TO 5 can (Slotted)	SIP 2.54mm (0.10in)	Ø11mm mount	SIP 2.54mm (0.10in)	Encased OEM module
Typical specification									
Moisture/dust filter	Some listings	Some	Some	Some	No	No	IP 65	Some	Some
Cover/case	N	Y	Some	Y	Y	some	Y	Some	Some
Cable length							1.8m or 1m		
Humidity accuracy	±1.7% to ±4.5 %			±3.5% RH			±2.0% to ±3.5% RH	±3 or ±5%	±3%
Operating humidity range	0% to 100% RH			0% to 100% RH			0% to 100% RH	30-90% RH	10-90% RH
Temperature accuracy	±1°C						±0.5°C		
Operating temperature range	-40°C to 100°C			-40°C to 120°c			0°C to 50°C	0°C to 60°C	0°C to 60°C
Hysteresis	±1.0% RH						±2.0%	±2%	±3%
Standard resistance	N/A			N/A			N/A	23k or 31k Ω	
Response time	6s in 20l/min airflow			5s in slow moving air			5s	<1min	
Long term stability	±1.2% RH over 5 years			±1.2% RH over 5 years			<0.5% RH/yr		
Rated power	N/A			N/A			750µA	0.3mW	0.75mA
Supply/operating voltage	3.3Vdc			2.7 Vdc to 5.8Vdc			3Vdc or 5Vdc	1Vac	+3.15-5.5v

See our website – www.acalbfi.com – for further information.

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