

## Thermoset Polymer-based Capacitive Sensors

## Application Sheet

### THERMOSET POLYMER-BASED CAPACITIVE SENSORS

Thermoset polymer-based capacitive RH sensors directly detect changes in “relative saturation” as a change in sensor capacitance with fast response, high linearity, low hysteresis and excellent long term stability. Relative saturation is the same as ambient relative humidity when the sensor is at ambient temperature. Because this is almost always the case, sensor capacitance change is then a measure of RH change.

### CAPACITIVE RH

Capacitive RH sensors dominate both atmospheric and process measurements and are the only types of full-range RH measuring devices capable of operating accurately down to 0% RH. Because of their low temperature effect, they are often used over wide temperature ranges without active temperature compensation.

### THERMOSET POLYMER

Thermoset polymer-based capacitive sensors, as opposed to thermoplastic-based capacitive sensors, allow higher operating temperatures and provide better resistivity against chemical liquids and vapors such as isopropyl, benzene, toluene, formaldehydes, oils, common cleaning agents, and ammonia vapor in concentrations common to chicken coops and pig barns. In addition, thermoset polymer RH sensors provide the longest operating life in ethylene oxide-based (ETO) sterilization processes.

### RELATIVE SATURATION VS RELATIVE HUMIDITY

Thermoset thin film polymer capacitive sensors have been shown to have an almost ideal response to RH, as opposed to absolute moisture, (i.e., water vapor pressure). This response is due to the driving force-free energy for absorption, G:

$$G = R T \ln(P/P_0)$$

where:

G = driving force

R = gas constant

P = partial water vapor pressure

P<sub>0</sub> = saturation water vapor pressure

P/P<sub>0</sub> is the same as ambient RH when the sensor is at ambient temperature. The relative saturation level driving sensor response is 100% at the sensor temperature T.

Research has also demonstrated that the RH sensor calibration in air applies to relative saturation measurement in oil to within 0.3% (a result which can be extended to other chemically compatible liquids)

### HUMIDITY SENSOR COMPARISON CHART

Active Material	Thermoset Polymer <sup>1</sup>	Thermoplastic Polymer	Thermoplastic Polymer	Bulk Thermoplastic	Bulk AlO <sub>3</sub>	Lithium Chloride Film	Evaporative Saturation
Substrate	ceramic or silicon	ceramic, silicon or glass	polyester or mylar film	N/A	N/A	ceramic	N/A
Changing Parameter	capacitance	capacitance	capacitance	resistance	resistance	conductivity	temperature
Measured Parameter	%RH	%RH	%RH	%RH	%RH	%RH	wet and dry bulb temp.
RH Range	0% to 100%	0% to 100%	0% to 100%	20% to 100%	2% to 90%	15% to <100%	20% to 100%
RH Accuracy	±1% to ±5%	±3% to ±5%	±3% to ±5%	±3% to ±10%	±1% to ±5%	±5%	±3% to ±4%
Interchangeability <sup>2</sup>	±2% to ±10% RH	±3% to ±20% RH	±3% to ±20% RH	±5% to ±25% RH	poor	±3% to ±10% RH	excellent
Hysteresis	<1% to 3% RH	2% to 5% RH	2% to 5% RH	3% to 6% RH	<2% RH	very poor	poor
Linearity	±1% RH	±1% RH	±2% RH	poor	poor	very poor	poor
Risetime	15 s to 60 s	15 s to 90 s	15 s to 90 s	2 min to 5 min	3 min to 5 min	3 min to 5 min	2 min to 5 min
Temperature Range	-40 °C to 185 °C	-30 °C to 190 °C	-25°C to 100 °C	10 °C to 40 °C	-10 °C to 75 °C	3 min to 5 min	0 °C to <100 °C

# Thermoset Polymer-based Capacitive Sensors

**HUMIDITY SENSOR COMPARISON CHART (Continued)**

Active Material	Thermoset Polymer <sup>1</sup>	Thermoplastic Polymer	Thermoplastic Polymer	Bulk Thermoplastic	Bulk AIO <sub>3</sub>	Lithium Chloride Film	Evaporative Saturation
Temperature Effect <sup>3</sup>	-0.0022% RH/%RH/°C	0.3% RH/°C	<0.3% RH/°C	>1% RH/°C	>1% RH/°C	>1% RH/°C	<0.5 % RH/°C
Long Term Stability	±1%RH/5 yr	±1%RH/yr	±1%RH/yr	±3%RH/yr	±3% RH/yr	>1% RH/°C	±0.1% RH/yr
Contamination Resistance	excellent	fair to good	fair	fair	fair	±1% RH/yr	fair
Condensation Resistance	excellent	very good	fair to good	fair	fair	fair	very good

**Notes:**

1. Sensing and Control exclusive.
2. Value depends on sensor model.
3. Values quoted are for 0 C° to 50 °C [32 F° to 122 °F].

**⚠ WARNING**  
**PERSONAL INJURY**  
 DO NOT USE these products as safety or emergency stop devices or in any other application where failure of the product could result in personal injury.  
**Failure to comply with these instructions could result in death or serious injury.**

**WARRANTY/REMEDY**

Honeywell warrants goods of its manufacture as being free of defective materials and faulty workmanship. Honeywell's standard product warranty applies unless agreed to otherwise by Honeywell in writing; please refer to your order acknowledgement or consult your local sales office for specific warranty details. If warranted goods are returned to Honeywell during the period of coverage, Honeywell will repair or replace, at its option, without charge those items it finds defective. **The foregoing is buyer's sole remedy and is in lieu of all other warranties, expressed or implied, including those of merchantability and fitness for a particular purpose. In no event shall Honeywell be liable for consequential, special, or indirect damages.**

While we provide application assistance personally, through our literature and the Honeywell web site, it is up to the customer to determine the suitability of the product in the application.

Specifications may change without notice. The information we supply is believed to be accurate and reliable as of this printing. However, we assume no responsibility for its use.

**Automation and Control Solutions**

Sensing and Control  
 Honeywell  
 1985 Douglas Drive North  
 Minneapolis, MN 55422  
[www.honeywell.com/sensing](http://www.honeywell.com/sensing)

**⚠ WARNING**  
**MISUSE OF DOCUMENTATION**

- The information presented in this product sheet is for reference only. Do not use this document as a product installation guide.
- Complete installation, operation, and maintenance information is provided in the instructions supplied with each product.

**Failure to comply with these instructions could result in death or serious injury.**

**SALES AND SERVICE**

Honeywell serves its customers through a worldwide network of sales offices, representatives and distributors. For application assistance, current specifications, pricing or name of the nearest Authorized Distributor, contact your local sales office or:

**E-mail:** [info.sc@honeywell.com](mailto:info.sc@honeywell.com)

**Internet:** [www.honeywell.com/sensing](http://www.honeywell.com/sensing)

**Phone and Fax:**

Asia Pacific +65 6355-2828  
 +65 6445-3033 Fax  
 Europe +44 (0) 1698 481481  
 +44 (0) 1698 481676 Fax  
 Latin America +1-305-805-8188  
 +1-305-883-8257 Fax  
 USA/Canada +1-800-537-6945  
 +1-815-235-6847  
 +1-815-235-6545 Fax

