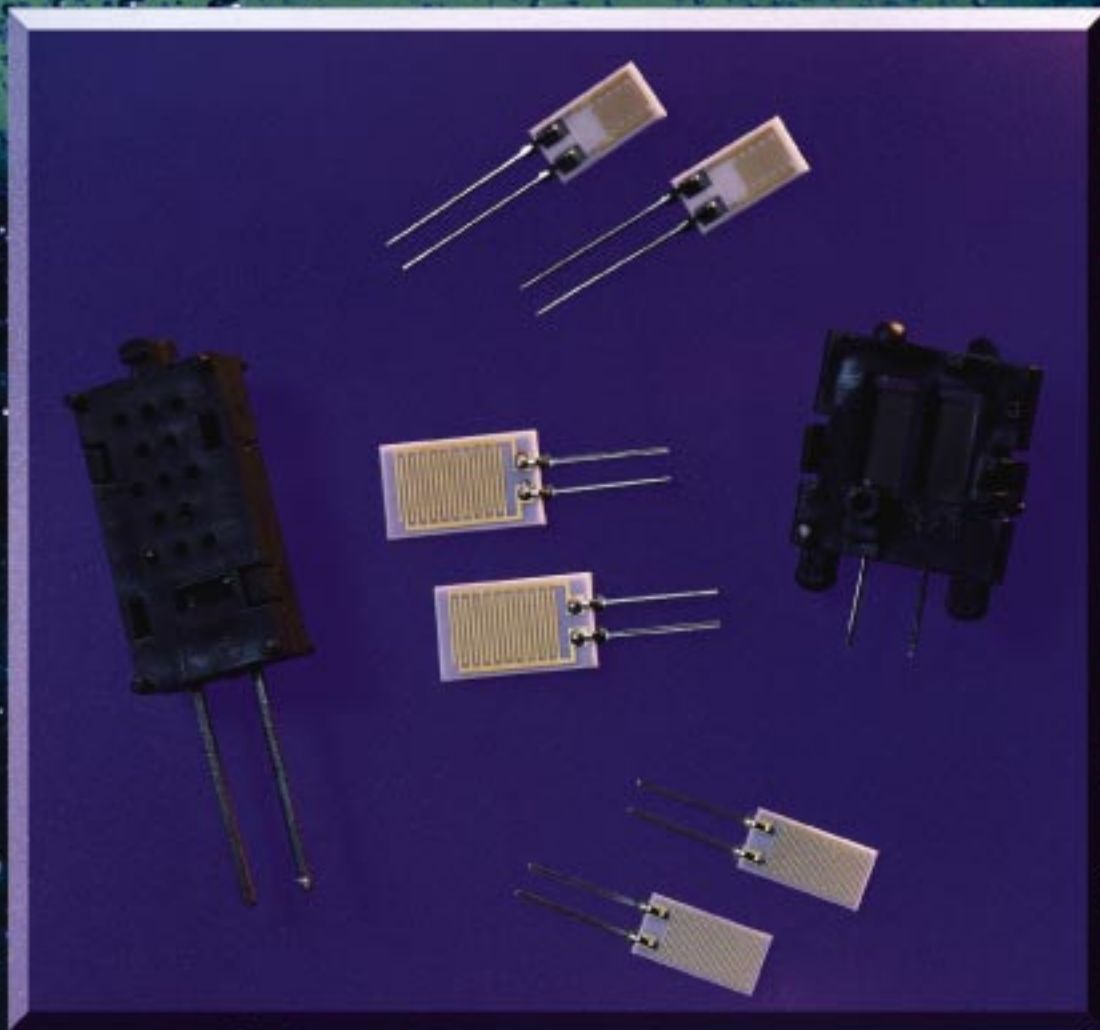


# SENSING SOLUTIONS



## Relative Humidity Sensors



**GENERAL EASTERN**

*The Humidity Experts*

# More Than Sensors... Sensible Solutions

When you need the perfect relative humidity sensor for your product, you're interested in the results: Will it work accurately? Will the sensor last in your particular application? Is it cost-effective? Is it available in the quantities you need? You don't want to hear why a single sensor is the ONLY one for your application. In fact, no single relative humidity sensor is ideal for every application.

General Eastern Instruments offers the greatest diversity of humidity sensing technologies available. Choose from two capacitive relative humidity sensors and three resistive relative humidity sensors. With no stake in promoting a particular sensor or humidity sensing technology, you'll get the correct solution, and the right sensor, for your particular need.

General Eastern can help you integrate these components into your circuits. We can also provide calibrated electronics to shorten your development cycles or we can help you develop your own calibration process to assure your product's quality.

## Resistive Sensors — Proven Technology for Tough, Condensing Environments

Resistive humidity sensors work by using a moisture-sensitive material on an interdigitated electrode substrate. The device's resistance varies exponentially with variations in relative humidity. The main advantage of resistive technology for humidity sensors is that it is suited for use in varying, difficult, condensing environments.



## Capacitive Sensors — The Solution for Aggressive Environments

Capacitive humidity sensors utilize conductive plates formed on a dielectric film. This forms a capacitor that is sensitive to the amount of water vapor in the air. The active portion of the sensor changes its dielectric constant as it absorbs atmospheric humidity, which varies the sensor's capacitance in proportion to changes in relative humidity. One benefit of capacitive sensor technology is that it's suited for use in chemically aggressive environments like the chlorinated air around swimming pools and the ammonia present in the air of many livestock facilities.



# A Summary of Sensors...

## Which Is Right for You?

### HUMIDITY SENSOR SELECTION SUMMARY

Principle	Capacitive G-CAP 2	Capacitive APS - 200	Resistive RH - 8	Resistive EMD - 2000	Resistive EMD - 3000
Best RH Range	3 to 95%	3 to 95%	20 to 100%	20 to 100%	20 to 100%
Linearity	±2%	±2%	Logarithmic	Logarithmic	Logarithmic
Response Speed (63% Step)	45 Sec Max	90 Sec Max	120 Sec Max	15 Sec Max	15 Sec Max
Hysteresis	< 2%	< 2%	< 3%	< 5%	< 1%
Water Immersion	No Drift	< 2% Drift	< 5% Drift	Not Acceptable	< 3% Drift
Condensation Effect	No Drift	< 2% Drift	< 3% Drift	< 3% Drift	< 3% Drift
Temperature Effect	0.1% RH/°C	0.2% RH/°C	0.3% RH/°C	0.3% RH/°C	0.3% RH/°C
Stability	0.5% RH/Year	0.5% RH/Year	< 1% RH/Year	< 1% RH/Year	< 1% RH/Year
Sensor Accuracy	±3% RH	Uncalibrated	±5% RH	±1,2,3,5% RH	±1,2,3,5% RH
Chemical Resistance	Good	Excellent	Good	Excellent	Excellent

-  = Highly Suited
-  = Works in this Situation
-  = Not Optimal Properties

# The Phys-Chem EMD Series

## Resistive Relative Humidity Sensors

General Eastern purchased Phys-Chem Scientific Corp. for their high quality resistive sensor. Now General Eastern manufactures those same high quality sensors in our own facility. First, there was the EMD-2000 sensor, known for its tight accuracy and strong resistance to chemicals. Now, the EMD-2000 is joined by the EMD-3000, which offers not only high accuracy but also improved hysteresis and a compact size. Both sensors are bulk polymer RH sensors that change resistance as the relative humidity changes.



EMD-2000 and 3000 Relative Humidity Sensors are ideal for humidity measurement applications that require a high degree of accuracy without calibration. The EMD-3000 offers low hysteresis (<1% RH) and accuracy as close as  $\pm 1\%$  RH. The EMD-2000 sensor includes an HDPE filter cover that protects the sensor during handling and helps keep contaminants from affecting performance.

The EMD-3000 can be utilized in many existing probe configurations. The sensor's design employs a reliable, inexpensive approach, which enhances its interchangeability and permits a lower cost. The small size means it can fit into most existing designs, where space is at a premium.



### EMD-2000 Characteristics

The EMD-2000 sensor has exceptional chemical resistance. The table below is a partial list of chemicals the sensor has been tested in.

### EMD-3000 Characteristics

The EMD-3000 has remarkable hysteresis qualities. Hysteresis with this sensor is better than 1%. The compact size makes it ideal for many applications.

### EMD-2000 Chemical Resistance

Chemical	Ammonia	Methanol	Oil	Acetone	Hexane	Formalin
Condition	100%	15000 PPM	Immersion	1000 PPM	1000 PPM	1000 PPM
%RH Drift	0% RH	1% RH	<1% RH	0% RH	<1% RH	@ 25°C <1% RH

### Phys-Chem EMD-2000/3000 Series Properties

<b>Operating Range/Humidity</b>	0% to 100% RH
<b>/Temperature</b>	40°F to 212°F (-40° to 100°C)
<b>Accuracy</b>	$\pm 1\%$ , 2%, 3%, 5% RH
<b>Frequency Range</b>	100 Hz to 10 kHz, 40% to 80% RH
<b>Typical Resistance Range</b>	@ 20 to 90% RH, resistance is 5MW to 2.9 kW
<b>Average Temperature Coefficient</b>	-0.3% RH/°C (-0.2% RH/°F)
<b>Hysteresis</b>	$\pm 1\%$ RH @ 25°C (EMD-2000) < $\pm 1\%$ RH @ 25°C (EMD-3000)
<b>Time Response</b>	15 seconds for a step change from 11% RH to 93% to reach 90% or better of equilibrium value
<b>Dimensions/EMD-2000</b>	0.30" x 0.50" x 0.025" SIP package, 0.10" mounting centers
<b>EMD-3000</b>	0.20" x 0.40" x 0.02" SIP package, 0.10" mounting centers
<b>POWER</b>	
<b>Suggested Drive Voltage</b>	1 VAC, peak to peak, sine or square wave recommended at 5,000 to 10,000 Hz

### Phys-Chem Series Accelerated Aging Tests

TEST	CONDITION	SENSOR CALIBRATION SHIFT AT 50% RH
Cyclic Aging (Room Temp.)	100 cycles 25°C 0 to 100% RH and back	1% RH
High Temperature Test	160°C for 20 hrs.	1% RH
Saturated Condition (Room Temperature)	7 weeks @ 100% RH, 25°C	2% RH
Saturated Temperature (Elevated Temperature)	24 hrs @ 100% RH, 60°C	2% RH
Saturated Condition (Low Temperature)	5 days @ 100% RH, 5°C	1% RH
Saturated Condition (Below Freezing)	5 days @ 100% RH, -7°C	1% RH
Methanol Vapor	15,000 ppm @ 22.5°C	1% RH
Carbon Tetrachloride Vapor	15,000 ppm @ 22.5°C	0% RH
Corn Oil	Immersion 2 min. @ 25°C	1% RH
Water	Immersion 2 min. @ 25°C	4% RH
Long Term Aging (Room Conditions)	3 years (and continuing)	2% RH
Ammonia	100% @ 25°C	1% RH

# The G-CAP2™

## Capacitive Relative Humidity Sensor

With a polymer capacitive sensor that varies as little as 3% RH, the G-CAP2 offers exceptional interchangeability, so you spend less time on assembly and production calibration. By contrast, some competing capacitive sensors vary by as much as 40% or more. Such wide variances require time-consuming calibration that affects manufacturing costs and cycle time.

For customers with calibration capabilities, an economical, uncalibrated version of the G-CAP2 is offered in various capacitance ranges. Otherwise, the G-CAP2 comes factory-calibrated to within  $\pm 1$  picofarad (pf), for relative humidity measurement accuracy of  $\pm 3\%$  RH. Drift is under 1% per year and declines logarithmically, compared to the industry average of 3% per year for some capacitive sensors.

The G-CAP2 can function in 100% humidity and its wide measurement range can handle most applications. It is ideally suited for high volume applications, where it reduces the time required for final assembly and calibration. The simple, low-cost circuitry required for the G-CAP2 sensor can also produce cost savings.

General Eastern's Sensor Evaluation Kit is available with the G-CAP2 sensor. The kit includes five G-CAP2 sensors and a PC board with a 0-5 volt output. The PC board features plug-in connectors that allow engineers to evaluate each G-CAP2 sensor without the need to design special test circuits. The Evaluation Kit includes full documentation, along with instructions on how to devise some simple tests.



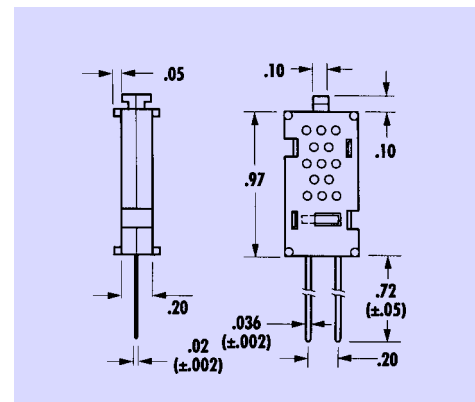
**Evaluation Kit**

### Typical Sensor Characteristics (Calibrated version only)

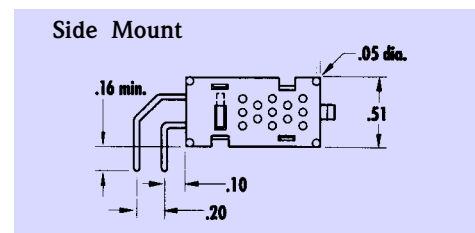
% RH	Capacitance (pf)
0	148.0
20	156.5
30	159.6
40	162.8
50	165.7
60	168.7
70	171.7
80	174.7
90	178.0

### G-CAP2 Properties

<b>Operating Range/Humidity /Temperature</b>	0% to 100% RH (condensing) -40°F to +185°F (-40° to +85°C)
<b>Capacitance Range</b> 1VRMS (calibrated version only)	148pf $\pm$ 1pf @ 77°F (25°C), 0% RH, 10 KHz,
<b>Frequency Range</b>	D.C. to 1MHz
<b>Temperature Effect</b>	Less than 0.05% RH/°F
<b>Hysteresis</b>	Less than 2% RH @ 25°C (25% to 80% RH)
<b>Long Term Stability</b>	Less than 0.5% drift per year typical
<b>Sensor Interchangeability</b>	Better than $\pm 3\%$ RH (calibrated version only)
<b>Time Response</b>	30 sec. typical, 45 sec. max., 63% change for 25-75% step change, 150 LFM air flow
<b>MECHANICAL</b>	
<b>Assembly</b>	Sensor can be soldered onto PCB
<b>Lead Strength</b>	2 lb. pull test with no damage
<b>MATERIAL</b>	
<b>Case</b>	PBT plastic, 15% glass fill
<b>Pins</b>	Copper with .00001" min. tin plate
<b>POWER</b>	
<b>Maximum Voltage</b>	5 Volts (across sensor leads), 1 VRMS recommended



\*Lead reforming by the user may cause sensor failure.



\*Dimensions are in inches.

# The APS-200

## Capacitive Relative Humidity Sensor



The APS-200 Sensor is unique among polymer sensors. Virtually every other capacitive sensor is composed of a humidity sensitive dielectric material with metal electrodes. The APS-200 is manufactured from a unique, humidity sensing polymer film and the conductor plates of the capacitor are composed of a conductive, humidity-permeable polymeric film. No metal electrodes are used in the APS-200. The APS-200's unique design makes it especially resistant to aggressive chemical environments, including chlorine and ammonia. Swimming pool areas, in particular, feature chlorine-laden air that normally attacks sensors with metal electrodes. The APS-200 is ideal for use in such environments. An additional advantage of the APS-200 sensor is that it is virtually free of drift. Even after one week's exposure to temperatures of 85°C and 85% RH, the tested sensor drifted only 6%. In a test in which it was exposed to 110°C temperatures and 5% RH, it drifted a mere 3%. In both of these cases, the sensor also returned to nominal values after exposure to room temperature air and humidity.

The APS-200 sensor also offers a very wide operating range of -20°F to +140°F (-29°C to +60°C) and 0-100% RH. Like the G-CAP2 sensor, the APS-200 sensor is available in an uncalibrated version for customers with calibration capabilities.

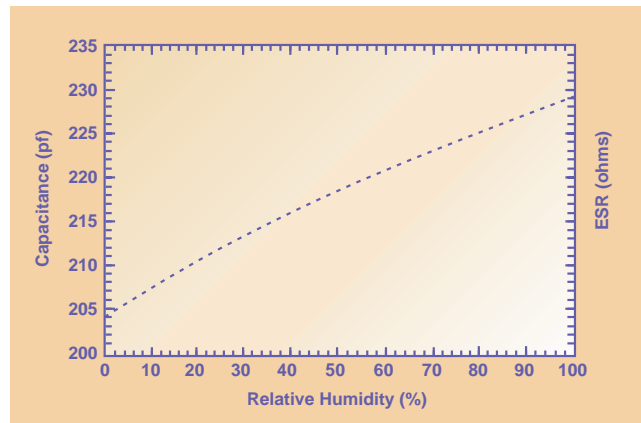
### Chemical Testing Data @ 50% RH and 25°C

Chemicals	Swimming Pool Environments	TSQ Germicide	Ammonia 100%	Formaldehyde	*Mixed Solvents
%RH Change	< 1%	< 2%	< 5%	< 0.5%	< 1.5%

\* Solvent Mix = acetone, pentane, xylene

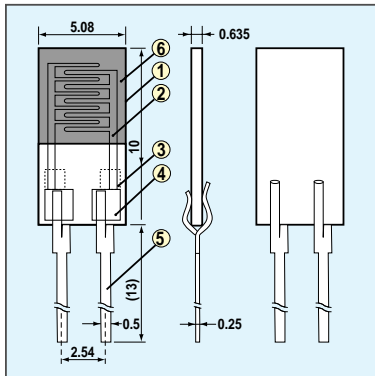
### APS-200 Properties

<b>Operating Range/Humidity</b>	0% to 100% RH
<b>/Temperature</b>	-20°F to +140°F (-29° to +60°C)
<b>Nominal Capacitance Range</b>	218pf ± 22pf @ 50% RH 77°F (25°C) and 10 kHz
<b>Frequency Range</b>	D.C. to 1MHz
<b>Typical Resistance Range</b>	@ 20 to 90% RH, resistance is 5MW to 2.9 kW
<b>Temperature Coefficient</b>	0.12% RH/°F or .22% RH/°C
<b>Hysteresis</b>	Less than 3% RH @ 25°C (40% to 80%RH)
<b>Long Term Stability</b>	Less than 0.5% drift per year typical
<b>Time Response</b>	90 seconds typical - 63% change for 20-80% RH
<b>POWER</b>	
<b>Maximum Voltage</b>	5 Volts (1 Volt, 10KHz recommended)



# The RH-8 Bulk Polymer Resistive Relative Humidity Sensor

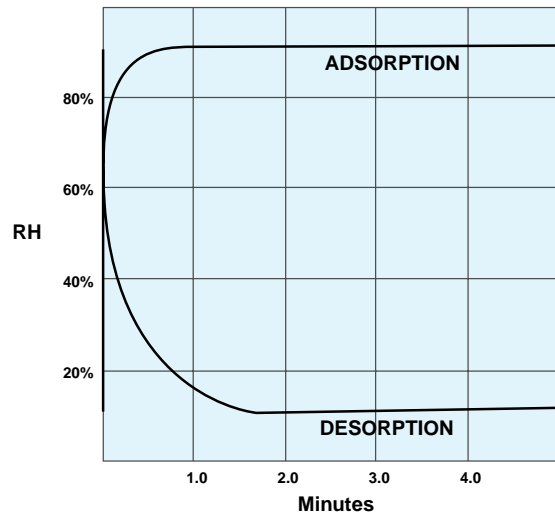
The RH-8 sensor was developed specifically to meet the growing needs of HVAC and other high volume OEM applications. The RH-8 sensor is also frequently used in protected outside environments. The sensor works by using an element composed of an electrode base-plate coated with a humidity sensitive macro-polymer. Changes in relative humidity affect the resistance of the electrode. Small and lightweight, the RH-8 offers a response of less than two minutes at room temperature. Hysteresis is low, at <3% RH. The RH-8 sensor is used in many of General Eastern's own RH transmitters. The RH-8 sensor can be easily integrated into room air conditioners, humidifiers, test chambers, and many other systems.



- ① Substrate
- ② Gold electrode
- ③ Overcoating
- ④ Ag-Pd electrode
- ⑤ Lead frame
- ⑥ Humidity sensitive material

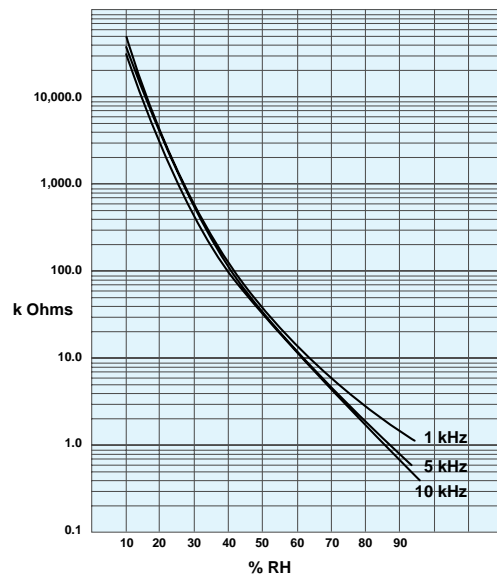
Dimensions in mm

## Speed Of Response for 11-93% RH Step Change



## RH-8 Properties

<b>Operating Range/Humidity</b>	0% to 100% RH
<b>/Temperature</b>	32°F to 140°F (0° to 60°C)
<b>Accuracy</b>	±5% RH
<b>Frequency Range</b>	100 Hz to 10 kHz, 40% to 80% RH
<b>Typical Resistance Range</b>	@ 20 to 90% RH, resistance is 5MW to 2.9 kW
<b>Temperature Coefficient</b>	0.3% RH/°C (0.2% RH/°F)
<b>Hysteresis</b>	Less than 3% RH @ 25°C (40% to 80%RH)
<b>Long Term Stability</b>	Less than 2% drift per year typical
<b>Time Response</b>	120 seconds for a change from @ an air flow velocity of 8ft/s
<b>POWER</b>	
<b>Rated Voltage</b>	1.4 VAC, 100Hz - 10kHz, 0.2mW AC power



Resistance vs. Relative Humidity

## The Right Solution for Your Application

General Eastern has over a quarter century of experience in the design, development, and production of global humidity sensing technologies, relative humidity sensors, transmitters, generators, and calibration equipment. The company provides standard and custom-designed humidity measurement solutions for countless applications over a wide range of industries. Whether your humidity-sensing needs entail choosing the correct sensing technology, the right sensor, or accurate advice, trust the humidity experts.

### The General Eastern Family of Humidity Measurement Products

- Sensors
- Humidity Transmitters
- Industrial Humidity Transmitters
- Process Humidity Transmitters
- Humidity Transfer Standards
- Humidity Generators

**Call Today: 800/225-3208.**



**GENERAL EASTERN**

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