



HUMIDITY MEASUREMENT

Capacitive Sensor

G-US.120

Ultra fast response time - low temperature

RoHS compliant

DESCRIPTION

The technology of these capacitive humidity sensors, protected by international patents, enable the implementation of an active or passive family of humidity and temperature sensing micro-modules.

This UPSICAP MSS Bi-Face technology is distinguished by a passive or active substrate on which the humidity cell is created in situ, without any connection wires, in opposition to a sensitive « chip » connected to a receiver by miniature electrical links.

This original design allows a high reliability and faithful features, because no uncertainties due to connection elements will modify accuracy and response time.

Features shared by all versions

- Utterly interchangeable without recalibration
- Defined accuracy from 1 % RH to 99 % RH
- Instant desaturation after long time condensation
- Suitable to automatic assembling
- No package, allowing a very short response time and a reduction of surface pollution problems
- External electrode connected to electrical ground, banishing any influence of leakage currents in comparison with electrical 0 (electrical and mechanical screening)
- Operating range of temperatures from -90°C to +120°C

Peculiar features

- Miniature SMD sensor
- Connected by conductive glue
- **Ultra fast response time (0.1 s)**
- Low cost version
- Dimensions 8 x 9 x 1 mm³



TECHNICAL SPECIFICATIONS

Main characteristics	Value				Rival markets	Unit
	UPSI					
Qualified measurement range					5 to 95	% Hr
	Reactivity code	R	R1	R2	R3	
Time constant at	+40°C	0.21	0.1	0.044	0.024	s
	+20°C	0.62	0.3	0.13	0.066	0.5 to 10
	0°C	2.17	1.0	0.45	0.24	s
	-20°C	9.7	4.5	2.0	1.1	s
	-40°C	58	27	12	6.4	20 to 60
Hysteresis	± 1				± 1	% RH
Non-linearity error from 20 % RH to 80 % RH*	± 1.6				± 2.5	% RH
Conformity error	1					% RH
Temperature coefficient	0.25				0.3	%RH/°C
Interchangeability-accuracy	3 - 5				± 10 to ± 20	% RH
Operating temperature range	- 90 to +140				- 60 to +140	°C
Electrical supply	1 to 10				1 to 10	V
Rated capacitance at 55 % RH	270 ± 3				100 to 300	Pf
Sensitivity from 33 % RH to 75 % RH	0.002				0.0015 to 0.0022	%FS/RH
Recovery time after 150h condensation	2				10 to 200	s
Long-term stability	0.5				0.5	%RH/year

* With oscillator. Please see diagram page 4.

ORIGINAL TECHNOLOGY UPSICAP – MSS BI-FACE

UPSICAP product range are based on two fundamental concepts **UPSICAP** and **MSS Bi-Face**.

The **MSS Bi-Face** concept incorporates on the same substrate both, the humidity sensor on the main face and electronic device, including connections, on the opposite side.

The humidity cell is not added on the substrate but carried out directly *in situ*.

Accuracy, stability and reliability are improved, connecting the sensor to the acquisition electronic circuit with continuum solid vias excluding link wires or printed circuit.

The surface electrode in contact with water vapor is connected to 0V (ground) provides shielding against surrounding electrical field and its thickness provide high robustness atmospheric filter.

The absence of electrical connections on the sensitive face does away with a barrier irregularity reducing the airborne dust on this side and enhancing reliability in the event mechanical action affecting the cell.

For harsh environment, a complementary filter could be placed on the sensing side.

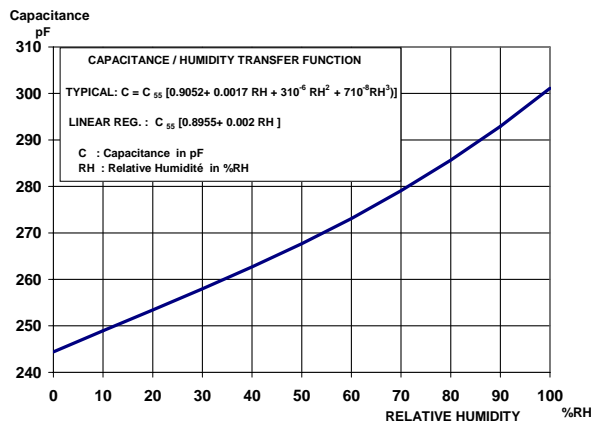
The additional function (transmitter) component quantity is divided by 2 using some multifunction device increasing the reliability and decreasing area and cost (original electronic concept).

This technology allow to supply an analogical or digital sensor transmitter with 100 μW - 20 μA.

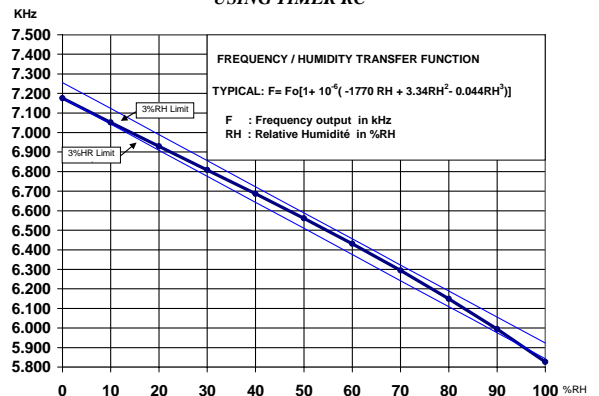
The operating range until 100% RH is insured by a specific treatment (substrate and components impregnation).

TRANSFER FUNCTIONS

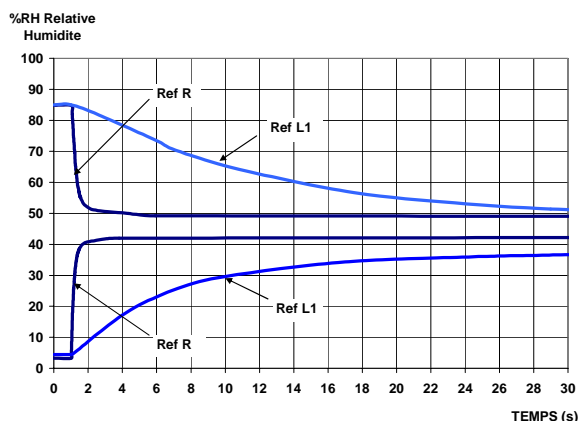
CAPACITANCE VERSUS RELATIVE HUMIDITY



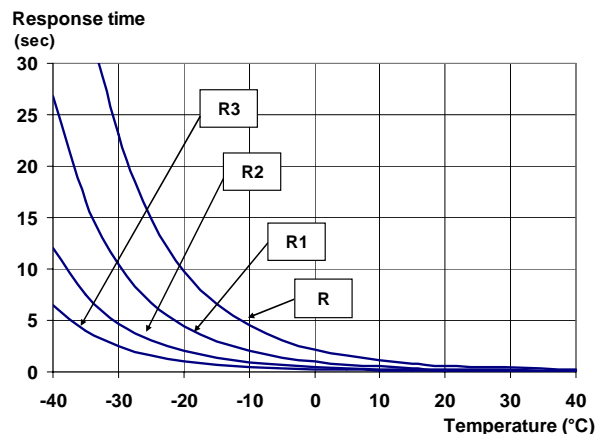
OUTPUT FREQUENCY VERSUS RELATIVE HUMIDITY USING TIMER RC



RESPONSE TIME RELATIVE HUMIDITY



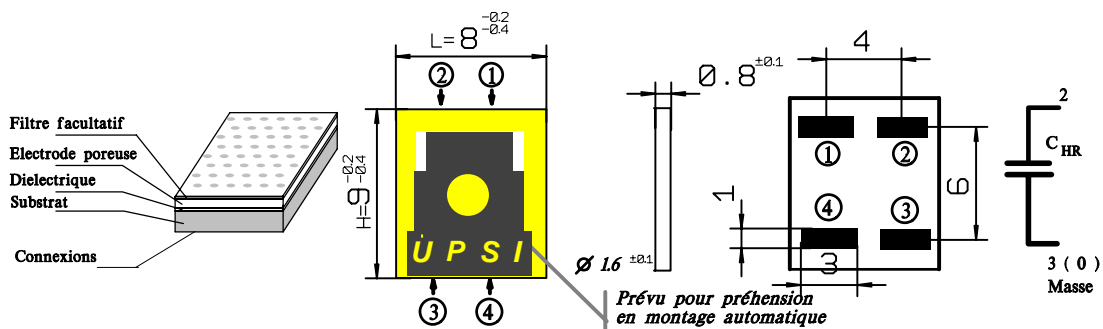
RESPONSE TIME VERSUS TEMPERATURE



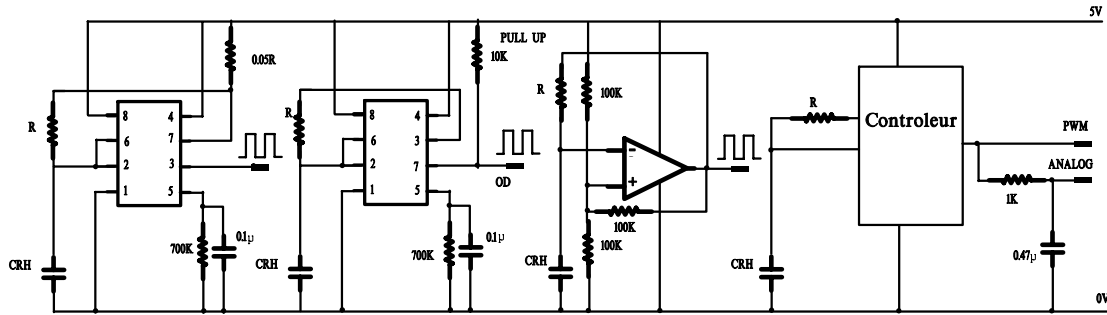
ELECTRICAL AND MEASURING SPECIFICATIONS

Measured or influencing values	Définition	Values			Unit
		Min.	Nom.	Max.	
Relative humidity RH	RH operating range	0	→	100	% RH
	RH measurement range	2	→	98	% RH
	Hysteresis		< 1,5		% RH
	Accuracy to reference conditions	3	5		% RH
	Conformity error (2 % RH to 98 % RH)			1.5	% RH
	Time constant at 25°C (R2)		0.1		sec.
	Recovery time (100 % RH 150 hours)		2 (R2)		sec.
	Absolute humidity Specified metrology		0.12		Kg/Kg
Maximum Metrology outside tolerance		0.35		Kg/Kg	
Degraded metrology		0.5		Kg/Kg	
<i>Output signal</i>	Capacitive variation as a function of RH	244	→	301	pF
	Nominal capacitor at 55 % RH		270		pF
<i>Transfer</i>	$C = C_{55} (0.9052 + 0.0017 RH - 3.10^{-6} RH^2 + 7.10^{-8} RH^3)$				
	Standard calibration 12 % RH	246	250	254	pF
	$C_{55} = 270$ pF 55 % RH	267	270	273	pF
	97.5 % RH	295	300	305	pF
	Sensitivity (33 % RH à 76 % RH)	0.53	0.55	0.57	pF / %RH
	In association with oscillator G-UCN.32 : $F = F_{55} (1.1045 - 0.002 RH + 4.10^{-6} RH^2 - 5.10^{-8} RH^3)$	0.995	1	1.005	F / F ₅₅
Operating frequency	3	6.5	100	KHz	
<i>Electrical power supply</i>	Operating voltage	1	5	10	V
<i>Stability</i>	Instantaneous modulation (noise)	0.005	0.01	0.05	% RH
	Thermal sensitivity		700		ppm
	Thermal stability from 5° C to 60° C		± 5		% RH
Temperature	Long term storage	- 50	+ 25	+ 85	°C
	Specified operating range	- 90		+ 85	°C

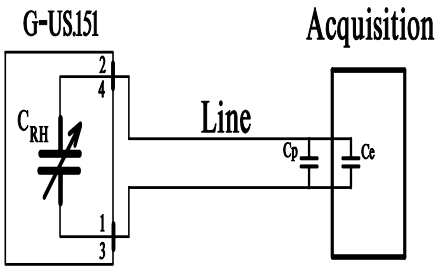
MECHANICAL SPECIFICATIONS - ELECTRICAL CONNECTION



APPLICATIONS

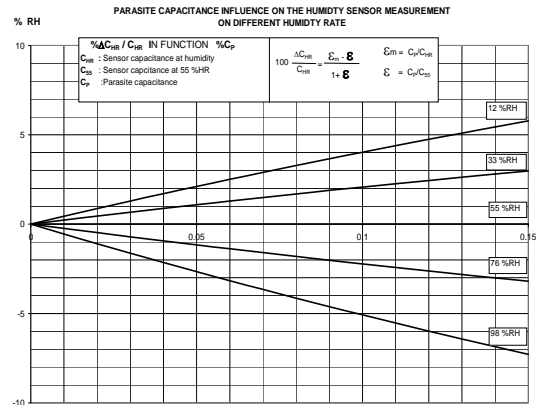


PARASITE CAPACITANCE INFLUENCE :



$CT = CRH + Cp + Ce$

CT Total Capacitance
 CRH Humidity Capacitance
 Cp Line parasite Capacitance
 Ce Electronic parasite Capacitance



Sensitivity : The sensor had to be connected to a electronic circuit to convert the capacitive variation. This connections could created a parasite capacitance in parallel with the sensor.
 The electronic circuit input measure the sensor and the parasite capacitance. This parasite capacitance had to be the smallest and the more stable as possible.

the capacitive relative variation corresponding to 100%RH represent 22% of the nominal capacitance. All parasite relative variation of capacitance create a relative humidity error equal at 5 time (1/20) of this parasite variation.

Stability: The stability of the parasite capacitance influence act on the sensor value. This parasite capacitance mustn't vary with the humidity

Electric field : The lines connecting the sensor had to be protected to avoid electric field perturbation.

Transfer function : Depending on parasite capacitance, the electronic circuit transfer function could change. A new transfer function had to be measured.

RESPONSE TIME INFLUENCE ON ACCURACY

The measuring systems announced accuracy corresponds with physical magnitude during more than 5 times the sensor time constant (Asymptote).

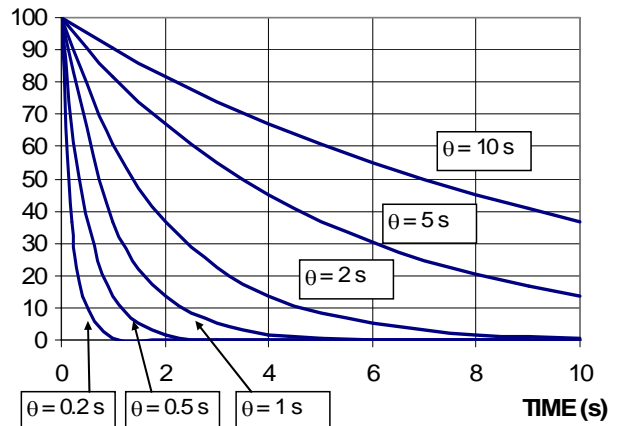
The curve in the margin shows physical magnitude events duration versus the real accuracy.

This graph is all the more important when the measuring duration magnitude is less than five times the constant time.

The sensor accuracy changes in function of sensor RH or At constant time.

For example, a sensor with a 1 seconds time constant and a variation during 0,4 secondes cause 35% RH error for 50% humidity.

ERROR (%)



RELATIVE HUMIDITY LEVEL

This parameter is the ratio of the amount of moisture in the air to the maximum amount of moisture the air could have at a given temperature.

This maximum quantity depends on temperature and corresponds to 100% RH.

ABSOLUTE HUMIDITY

This parameter is the ratio of the mass of water vapor within a gaz mixture to the mass of its total volume.

The absolute humidity can be calculated if the RH is known at a given temperature.

UNITE DE PRODUCTION DE SYSTEMES INDUSTRIELS

S.A.R.L au capital de 250 000 € RCS Créteil B 433 547 643 Siret 433 547 643 00018 Code NAF 321 C

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