HTS2030SMD – Temperature and Relative Humidity Sensor

- **Miniature Surface mount SMD package**
- **Lead free component**
- **Patented solid polymer structure**
- **Suitable for linear voltage or frequency output circuitry**
- **Fast response time and very low temperature coefficient**

DESCRIPTION

Based on a unique **capacitive cell for humidity** measurement and a **Negative Temperature Coefficient (NTC)** thermistor for temperature measurement, this dual-purpose relative humidity / temperature miniaturized sensor is designed for high volume, **cost sensitive applications with tight space constraints**. It is useful in all applications where **dew point, absolute humidity measurements** or humidity compensation are required.

FEATURES

- Fulll interchangeability with no calibration required in standard conditions
- Instantaneous desaturation after long periods in saturation phase
- Compatible with automatized assembly processes, including Pb free wave soldering and reflow processes (1)
- Individual marking for compliance to stringent traceability requirements
- Part may be washed with distilled water

APPLICATIONS

- Automotive
- Home Appliance
- Printers
- Meteorology

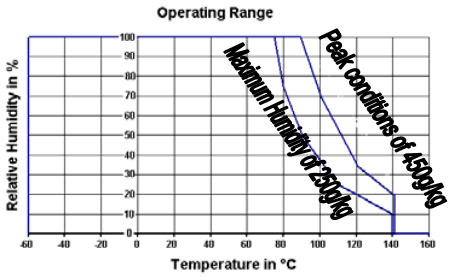
(1) Soldering temperature profiles available on request / contact us at humidity.application@meas-spec.com

PERFORMANCE SPECS

MAXIMUM RATINGS

Ratings	Symbol	Value	Unit
Operating Temperature	Ta	-60 to 140	°C
Storage Temperature	Tstg	-60 to 140	°C
Supply Voltage (Peak)	Vs	10	Vac
Humidity Operating Range	RH	0 to 100	% RH

Peak conditions: less than 10% of the operating time.



ELECTRICAL CHARACTERISTICS

(Ta=25°C, measurement frequency @10kHz unless otherwise noted)

Humidity Characteristics	Symbol	Min	Typ	Max	Unit
Humidity Measuring Range	RH	1		99	%RH
Supply Voltage	Vs			10	V
Nominal Capacitance @55%RH (1)	C	177	180	183	pF
Temperature coefficient	T_{cc}			0.01	pF/°C
Average Sensitivity from 33% to 75%RH	ΔC/%RH		0.31		pF/%RH
Leakage Current (Vcc=5V)	I			1	nA
Recovery time after 150 hours of condensation	tr		10		s
Humidity Hysteresis				+/-1	%RH
Long Term Stability	T		+/-0.5		%RH/yr
Time Constant (at 63% of signal, still air) 33%RH to 80%RH	τ		3	5	s
Deviation to typical response curve (10% RH to 90%RH)			+/-2		%RH

(1) Tighter specification available on request

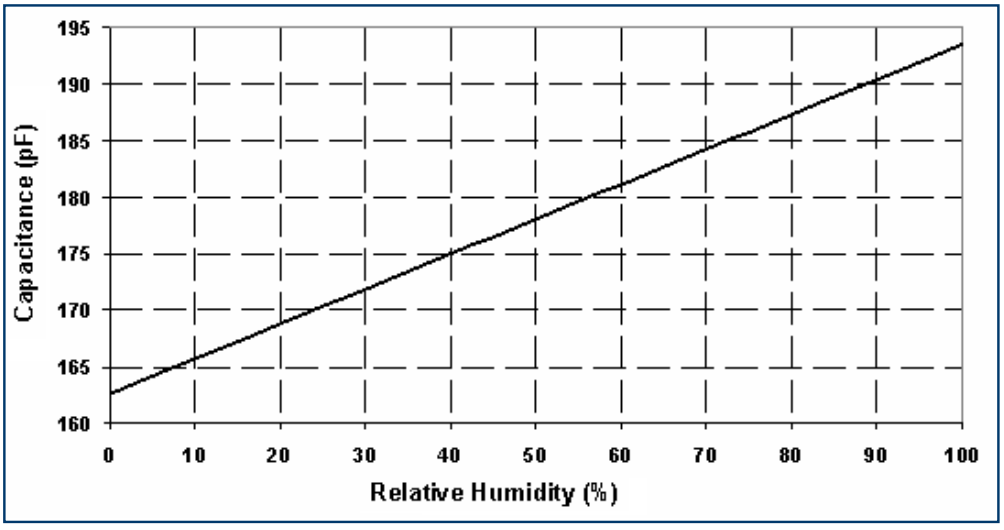
Temperature Characteristics	Symbol	Min	Typ	Max	Unit
Nominal Resistance @25°C	R		10		kΩ
Beta value: B25/100	β	3600	3730	3800	
Temperature Measuring Range	Ta	-60		140	°C
Nominal Resistance Tolerance @25°C	R_N		2	3	%
Beta Value Tolerance	β		3		%
Response Time	τ		10		s

TYPICAL PERFORMANCE CURVES

HUMIDITY SENSOR

- **Polynomial Response**

C (pF)=C@55 %*(3.903 10^{-8} *RH^3-8.294 10^{-6} *RH^2+2.188 10^{-3} *RH+0.898)



- **Typical Response Look-Up Table (polynomial reference curve) @10kHz/1V**

RH (%)	0	5	10	15	20	25	30	35	40	45	50
Cp (pF)	161.6	163.6	165.4	167.2	169.0	170.7	172.3	173.9	175.5	177.0	178.5
RH (%)	55	60	65	70	75	80	85	90	95	100	
Cp (pF)	180	181.4	182.9	184.3	185.7	187.2	188.6	190.1	191.6	193.1	

- **Reverse Polynomial Response**

RH (%) = -3.4656 10^{+3}*X^3+1.0732 10^{+4}*X^2-1.0457 10^{+4}*X+3.2459 10^{+3}
With X = C(read) / C@55%RH

TEMPERATURE SENSOR

- **Typical Temperature Output**

Depending on the needed temperature measurement range and associated accuracy, we suggest two methods to access to the NTC resistance values.

$$R_T = R_N \times e^{\beta\left(\frac{1}{T}-\frac{1}{T_N}\right)}$$

R_T	NTC resistance in Ω at temperature T in K
R_N	NTC resistance in Ω at rated temperature T in K
T, T_N	Temperature in K
β	Beta value, material specific constant of NTC
e	Base of natural logarithm (e=2.71828)

① The exponential relation only roughly describes the actual characteristic of an NTC thermistor can, however, as the material parameter β in reality also depend on temperature. So this approach is suitable for describing a restricted range around the rated temperature or resistance with sufficient accuracy.

② For practical applications, a more precise description of the real R/T curve may be required. Either more complicated approaches (e.g. the Steinhart-Hart equation) are used or the resistance/temperature relation as given in tabulation form. The below table has been experimentally determined with utmost accuracy for temperature increments of 1 degree.

Actual values may also be influenced by inherent self-heating properties of NTCs. Please refer to MEAS-France Application Note HPC106 “Low power NTC measurement”.

- **Temperature look-up table**

Temp (°C)	Resistance (Ω)	Max Deviation (Ω)
-40	262960	35403
-39	247217	32777
-38	232539	30358
-37	218845	28130
-36	206064	26075
-35	194110	24178
-34	182852	22416
-33	172332	20791
-32	162498	19290
-31	153299	17905
-30	144790	16636
-29	136664	15444
-28	129054	14343
-27	121925	13325
-26	115243	12383
-25	109030	11516
-24	103115	10705
-23	97565	9953
-22	92354	9257
-21	87460	8612
-20	82923	8020
-19	78581	7463
-18	74497	6947
-17	70655	6468
-16	67039	6023
-15	63591	5606
-14	60381	5222
-13	57356	4865
-12	54503	4533
-11	51813	4225
-10	49204	3932
-9	46767	3662
-8	44467	3411
-7	42296	3177
-6	40247	2960
-5	38279	2756
-4	36455	2568
-3	34731	2393
-2	33100	2230
-1	31557	2078
0	30029	1932
1	28627	1799
2	27299	1675
3	26042	1560
4	24852	1452
5	23773	1355
6	22708	1261
7	21698	1174
8	20739	1093
9	19829	1017
10	18959	946
11	18128	879
12	17338	817
13	16588	759
14	15876	705
15	15207	654
16	14569	607
17	13962	563
18	13384	522
19	12834	484
20	12280	447
21	11777	413
22	11297	382
23	10840	353
24	10404	325
25	10000	300
26	9600	300
27	9218	300
28	8853	299
29	8506	297
30	8178	296
31	7866	294
32	7568	292
33	7283	290
34	7011	287
35	6734	284
36	6484	281
37	6244	278
38	6015	275
39	5796	271
40	5575	267
41	5373	264
42	5180	260
43	4995	257
44	4817	253
45	4636	248
46	4473	245
47	4316	241
48	4166	237
49	4021	233
50	3874	229
51	3737	225
52	3606	221
53	3481	217
54	3360	213
55	3237	208
56	3126	204
57	3019	200
58	2917	197
59	2819	193
60	2720	189
61	2629	185
62	2542	182
63	2458	178
64	2378	175
65	2304	171
66	2229	168
67	2158	165
68	2089	161
69	2022	158
70	1960	155
71	1898	152
72	1839	149
73	1782	146
74	1727	143
75	1673	140
76	1622	138
77	1573	135
78	1526	132
79	1480	130
80	1432	127
81	1390	124
82	1349	122
83	1310	119
84	1272	117
85	1235	115
86	1199	112
87	1163	110
88	1130	108
89	1097	106
90	1067	104
91	1038	102
92	1009	100
93	982	98
94	955	96
95	927	94
96	901	92
97	877	90
98	853	89
99	830	87

- **Steinhart-Hart coefficients**

According to the equation below, the Steinhart-Hart coefficients for the operating temperature range for HTS2030SMD thermistor are:

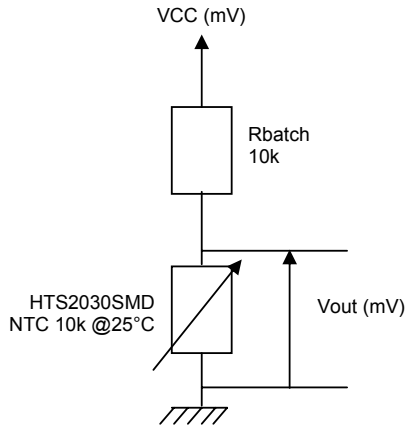
$$\frac{1}{T} = a + b * \ln(R) + C * \ln(R) * \ln(R) * \ln(R)$$

R	NTC resistance in Ω at temperature T in K
T	Temperature in K
a	Constant value (a= 9.94805E-04)
b	Constant value (b= 2.46791E-04)
c	Constant value (c= 1.10298E-07)

- **Temperature Interface circuit**

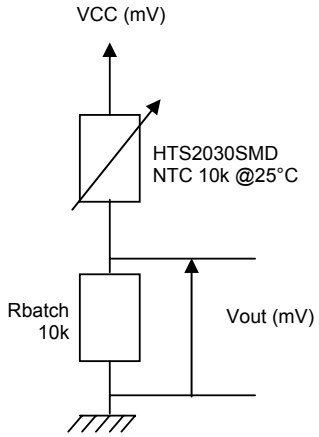
Concerning the temperature sensor of the HTS2030SMD, the following measuring method described below is based on a voltage bridge divider circuit. It uses only one resistor component (Rbatch) at 1% to design HTS2230 temperature sensor interfacing circuit. Rbatch is chosen to be equal to NTC @25°C to get: Vout = Vcc/2 @25°C. There are two proposal configurations: If Rbatch is connected to Vcc and NTC to Ground, it leads to a negative slope characteristic (Pull-Down Configuration). For a positive slope, Rbatch and NTC resistors have to be switched (Pull-Up Configuration).

Pull-Up Configuration



$$V_{OUT}(mV) = \frac{Vcc(mV) * NTC_{HTS\,2030\,SMD}(\Omega)}{R_{batch}(\Omega) + NTC_{HTS\,2030\,SMD}(\Omega)}$$

Pull-Down Configuration



$$V_{OUT}(mV) = \frac{Vcc(mV) * R_{batch}(\Omega)}{R_{batch}(\Omega) + NTC_{HTS\,2030\,SMD}(\Omega)}$$

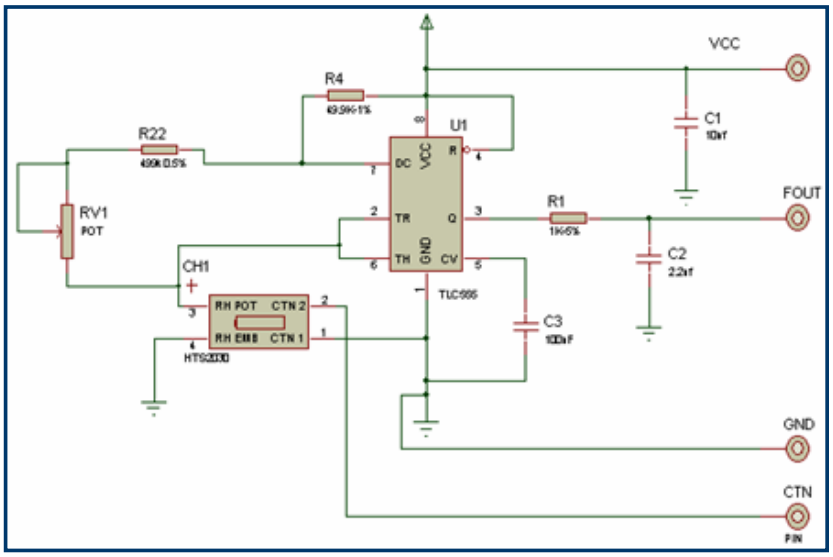
Temperature conversion: look-up table (Vcc=5Vdc)

Temperature (°C)	Resistance (Ω)	Pull-Up Configuration Vout (mV)	Pull-Down Configuration Vout (mV)
-40	262960	4817	183
-30	144790	4677	323
-20	82923	4462	538
-10	49204	4155	845
0	30029	3751	1249
10	18959	3273	1727
20	12280	2756	2244
25	10000	2500	2500
30	8178	2249	2751
40	5575	1790	3210
50	3874	1396	3604
60	2720	1069	3931
70	1960	819	4181
80	1432	626	4374
90	1067	482	4518
99	830	383	4617

SUGGESTED FREQUENCY OUTPUT CIRCUITS

CIRCUIT

Note: R22=499kΩ/
R4=49.9kΩ/R1=1kΩ/
RV1=50kΩ potentiometer/
C1=10nF/C2=2.2nF/C3=100nF



TYPICAL RESPONSE LOOK-UP TABLE (HUMIDITY OUTPUT)

RH (%)	0	5	10	15	20	25	30	35	40	45	50
Fout (Hz)			7155	7080	7010	6945	6880	6820	6760	6705	6650
RH (%)	**55**	**60**	**65**	**70**	**75**	**80**	**85**	**90**	**95**	**100**	
Fout (Hz)	6600	6550	6500	6450	6400	6355	6305	6260	6210		

QUALIFICATION PROCESS

HTS2030SMD sensors have been qualified through a complete qualification process taking in account many of the requirements of the JEDEC standard including:

- Solder heat and solderability including lead free process
- Pb free wave soldering and reflow soldering process(260°C) + DI water clean at 45°C
- Mechanical shock JESD-22-B104-A
- Vibration - Variable frequency (20 to 2000Hz) JESD-22-B103-A
- Marking permanency
- ESD - Electrostatic Discharge – Air Gun +-15kV(IEC 1000)
- Salt Atmosphere JESD22-A107-A
- Temperature Cycling - 40°C / +125°C
- High Temperature / Humidity Operating Life - 93%RH / 60°C for 1000 hours
- Low Humidity storage life - RH < 10%/23°C for 1000 hours
- Resistance to immersion in water at ambient temperature and 80°C
- High temperature storage 140°C for 168 hours
- Resistance to many chemicals linked to home appliances/automotive or consumer applications

ENVIRONMENTAL AND RECYCLING

HTS2030SMD sensors are lead free components and are compatible with Pb Free soldering processes.
HTS2030SMD sensors are free from Cr (6+), Cd and Hg.

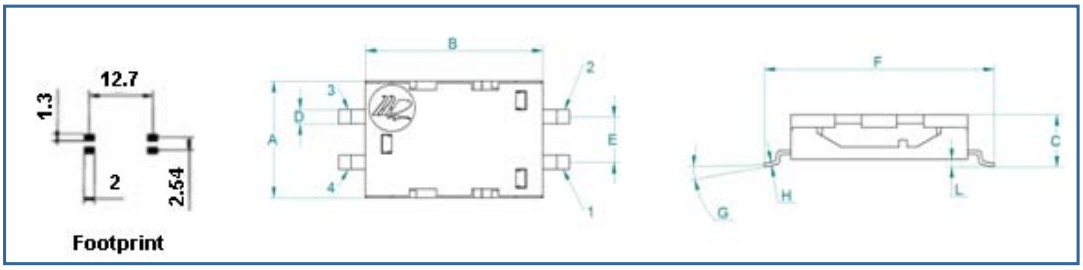
SOLDERING INSTRUCTIONS

We recommend taking specific attention to soldering conditions to get the best performance of MEAS-France sensors. See Application Note. To get it, please contact: humidity.application@meas-spec.com

PACKAGE OUTLINE

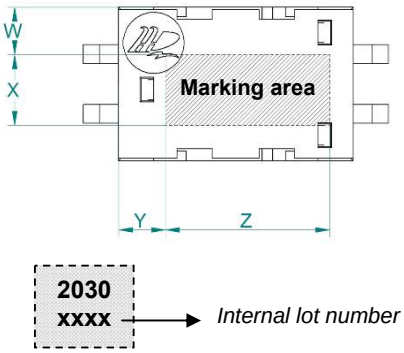
HTS2030SMD GULL WING

(JLEAD OPTION ALSO AVAILABLE)

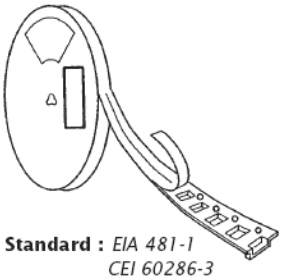


Pin Out Assignment

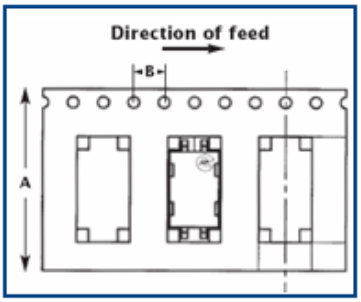
N°	Function
1	CTN1
2	CTN2
3	RH POT
4	RH EMB

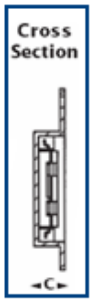


Dimension	mm
A	6 ± 0.25
B	10 ± 0.25
C	2.7 ± 0.2
D	0.8 ± 0.1
E	2.54 ± 0.1
F	13.6 ± 0.1
G	0-10°
H	0.2 ± 0.05
L	0.15 ± 0.1
W	2± 0.25
X	3± 0.25
Y	2± 0.25
Z	6 ± 0.25



		A	B	C
Reel Diameter	Reel Width	Carrier Tape	Carrier Tape Pitch	Carrier Tape Depth
360 mm	30.4 mm	24 mm	4 mm	4mm





ORDERING INFORMATION

- **HPP804B130: TUBE M.P.Q OF 78 PIECES**
- **HPP804B131: TAPE AND REEL M.P.Q OF 1500 PIECES**

HTS2030SMD - TEMPERATURE AND RELATIVE HUMIDITY SENSOR

Customer Service contact details

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Revision	Comments	Who	Date
B	RoHS logo added, Measurement Specialties logo updated, mechanical dimensions updated	D. LE GALL	December 07
C	Pinout added on package outline schematic	D. LE GALL	January 08
D	Standardized datasheet format	D. LE GALL	April 08
E	Humidity sensor characteristic drawing updated	D. LE GALL	November 08
F	Package outline paragraph updated	D. LE GALL	June 09
G	Steinhart-Hart equation and temperature interface circuit added, Pinout added	D. LE GALL	July 09