

## HTM25X0LF – Temperature and Relative Humidity Module



- Hermetic Housing
- Humidity calibrated within +/-2% @55%RH
- Temperature measurement through NTC 10kOhms +/-1% direct output
- Small size product
- Typical 1 to 4 Volt DC output for 0 to 100%RH at 5Vdc

### DESCRIPTION

Based on the rugged HTS2230 humidity / temperature sensor, HTM25X0LF is a dedicated humidity and temperature transducer designed for OEM applications where a reliable and accurate measurement is needed. Direct interface with a micro-controller is made possible with the module's humidity linear voltage output.

### FEATURES

- Full interchangeability
  - High reliability and long term stability
  - Not affected by water immersion
  - Ratiometric to voltage supply
  - Suitable for 3 to 10 Vdc supply voltage
- Humidity Sensor Specific Features**
- Instantaneous de-saturation after long periods in saturation phase
  - Fast response time
  - High resistance to chemicals
  - Patented solid polymer structure
- Temperature Sensor Specific Features**
- Stable
  - High sensitivity

### APPLICATIONS

- Industrial
- Process control
- Hygrostat
- Data logger

...

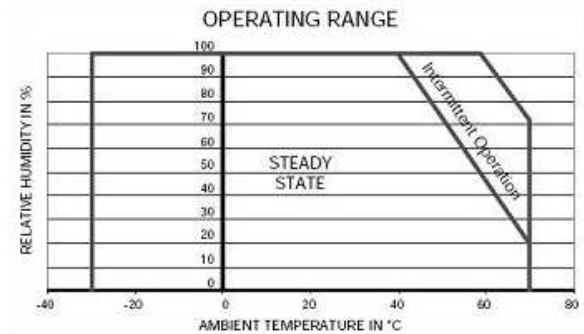
## HTM25X0LF – Temperature and Relative Humidity Module

### PERFORMANCE SPECS

#### MAXIMUM RATINGS

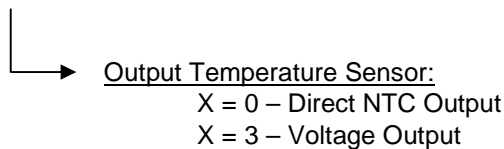
Ratings	Symbol	Value	Unit
Storage Temperature	Tstg	-40 to 85	°C
Storage Humidity	RHstg	0 to 100	% RH
Supply Voltage (Peak)	Vs	12	Vdc
Humidity Operating Range	RH	0 to 100	% RH
Temperature Operating Range	Ta	-40 to 85	°C

Peak conditions: less than 10% of the operating time



#### NOMENCLATURE

##### HTM25X0LF



#### ELECTRICAL CHARACTERISTICS

(Ta=23°C, Vs=5Vdc +/-5%, RL>1MΩ unless otherwise stated)

Humidity Characteristics	Symbol	Min	Typ	Max	Unit
Humidity Measuring Range	RH	1		99	%RH
Relative Humidity Accuracy (10 to 95% RH)	RH		+/-3	+/-5	%RH
Supply Voltage	Vs	4.75	5.00	5.25	Vdc
Nominal Output @55%RH (at 5Vdc)	Vout	2.42	2.48	2.54	V
Current consumption (HTM2500LF)	Ic		1.0	1.2	mA
Current consumption (HTM2530LF)	Ic		3.4	3.6	mA
Temperature Coefficient (10 to 50°C)	Tcc		+0.1		%RH/°C
Average Sensitivity from 33% to 75%RH	$\Delta V_{out}/\Delta RH$		+26		mV/%RH
Sink Current Capability (RL=15kΩ)	Is			300	μA
Recovery time after 150 hours of condensation	tr		10		s
Humidity Hysteresis			+/-1.5		%RH
Long term stability	T		+/-0.5		%RH/yr
Time Constant (at 63% of signal, static) 33% to 76%RH <sup>(1)</sup>	$\tau$		5		s
Output Impedance	Z		70		Ω

(1) At 1m/s air flow

(Ta=25°C)

Temperature Characteristics	Symbol	Min	Typ	Max	Unit
Nominal Resistance @25°C	R		10		kΩ
Beta value: B25/50	$\beta$	3347	3380	3413	K
Temperature Measuring Range*	Ta	-40		85	°C
Nominal Resistance Tolerance @25°C	R <sub>N</sub>			1	%
Beta Value Tolerance	$\beta$		1		%
Response Time	$\tau$		10		s
Output Impedance (HTM2530LF)	Z		70		Ω

\* For temperature upper than 60°C, specific high temperature cable is required: HTM25X0LFL products

## HTM25X0LF – Temperature and Relative Humidity Module

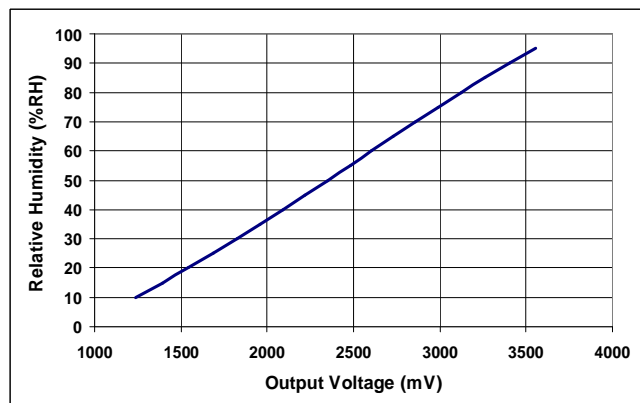
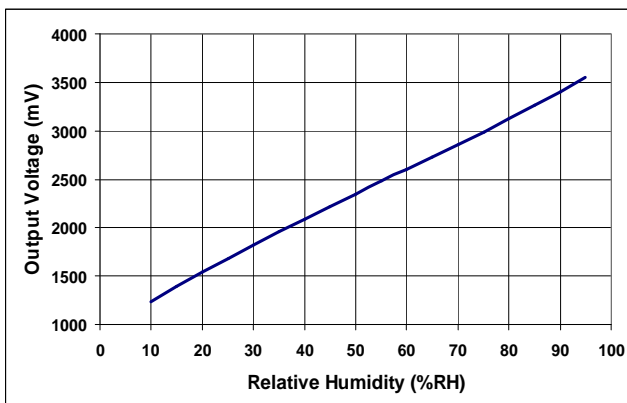
### TYPICAL PERFORMANCE CURVES

#### HUMIDITY SENSOR

- Typical response look-up table ( $V_s = 5V$ )

RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	1235	55	2480
15	1390	60	2605
20	1540	65	2730
25	1685	70	2860
30	1825	75	2990
35	1960	80	3125
40	2090	85	3260
45	2220	90	3405
50	2350	95	3555

- Modeled linear voltage output ( $V_s = 5V$ )



- Linear Equations

$$V_{out} = 26.65 * RH + 1006$$

$$RH = 0.0375 * V_{out} - 37.7$$

with  $V_{out}$  in mV and RH in %

- Polynomial Equations

$$V_{out} = 1.05E^{-3} * RH^3 - 1.76E^{-1} * RH^2 + 35.2 * RH + 898.6$$

$$RH = -1.92E^{-9} * V_{out}^3 + 1.44E^{-5} * V_{out}^2 + 3.4E^{-3} * V_{out} - 12.4$$

with  $V_{out}$  in mV and RH in %

- Measurement Conditions

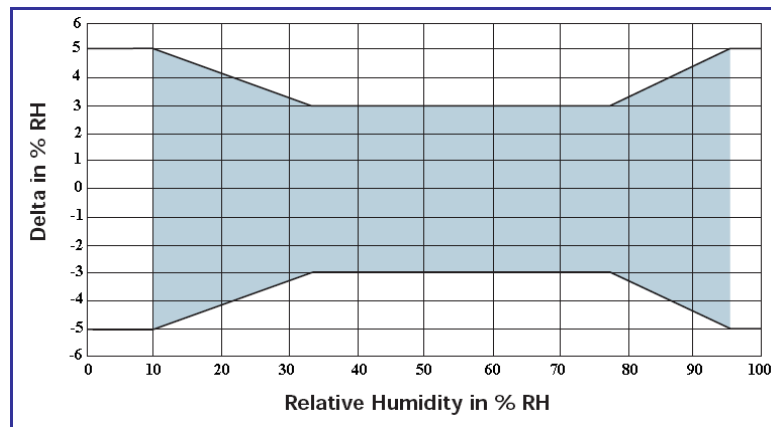
HTM25X0LF is specified for accurate measurements within 10 to 95% RH.

Excursion out of this range (<10% or >95% RH, including condensation) does not affect the reliability of HTM25X0LF characteristics.

## HTM25X0LF – Temperature and Relative Humidity Module

- Error Budget at 23°C

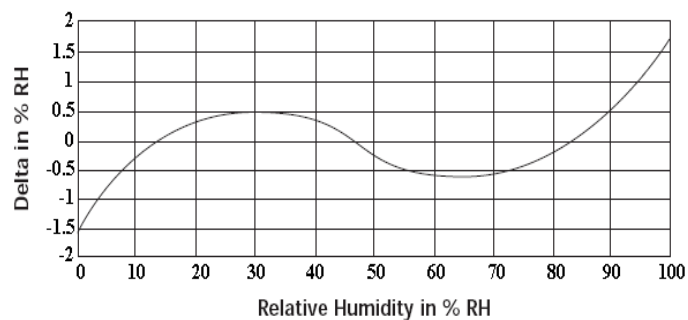
HTM25X0LF Error Limits:



Temperature coefficient compensation:

$$RH_{Cor} \% = RH_{read} \% \times \left(1 - (T_a - 23) \times 2.4 E^{-3}\right)$$

HTM25X0LF Linearity Error:



Non-linearity and temperature compensation:

$$RH \% = \frac{-1.9206 E^{-9} V_{out}^3 + 1.437 E^{-5} V_{out}^2 + 3.421 E^{-3} V_{out} - 12.4}{1 + (T_a - 23) \times 2.4 E^{-3}}$$

with Vout in mV, RH in % and Ta in °C

## HTM25X0LF – Temperature and Relative Humidity Module

### HTM2500LF TEMPERATURE SENSOR: DIRECT NTC OUTPUT

- **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  $\Omega$  at temperature T in K
- $R_N$  NTC resistance in  $\Omega$  at rated temperature T in K
- T,  $T_N$  Temperature in K
- $\beta$  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  $\beta$  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)	R ( $\Omega$ )	Temp (°C)	R ( $\Omega$ )
-40	195652	25	10000
-35	148171	30	8315
-30	113347	35	6948
-25	87559	40	5834
-20	68237	45	4917
-15	53650	50	4161
-10	42506	55	3535
-5	33892	60	3014
0	27219	65	2586
5	22021	70	2228
10	17926	75	1925
15	14674	80	1669
20	12081	85	1452

## HTM25X0LF – Temperature and Relative Humidity Module

- Steinhart-Hart coefficients

According to the equation below, the Steinhart-Hart coefficients for the operating temperature range for HTM2500LF thermistor are:

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

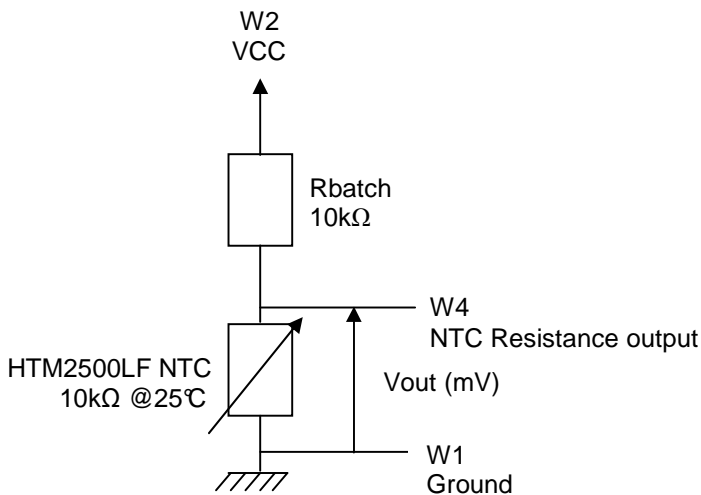
R	NTC resistance in $\Omega$ at temperature T in K
T	Temperature in K
a	Constant value (a = 8.54942E-04)
b	Constant value (b = 2.57305E-04)
c	Constant value (c = 1.65368E-07)

- Temperature Interface Circuit

Concerning the temperature sensor of the HTM2500LF, 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 HTM2500LF temperature sensor interfacing circuit.

Rbatch is chosen to be equal to NTC @25°C to get:  $V_{out} = V_{cc}/2$  @25°C.

The proposal method connects Rbatch to Vcc (5Vdc) and NTC to Ground. It leads to a negative slope characteristic (Pull-Up Configuration).



$$V_{OUT} (mV) = \frac{V_{cc}(mV) * NTC_{HTM2500LF} (\Omega)}{R_{batch} (\Omega) + NTC_{HTM2500LF} (\Omega)}$$

Temp (°C)	R ( $\Omega$ )	Pull-up Configuration Vout (mV)
-40	195652	4757
-30	113347	4595
-20	68237	4361
-10	42506	4048
0	27219	3657
10	17926	3210
20	12081	2736
25	10000	2500
30	8315	2270
40	5834	1842
50	4161	1469
60	3014	1158
70	2228	911
80	1669	715

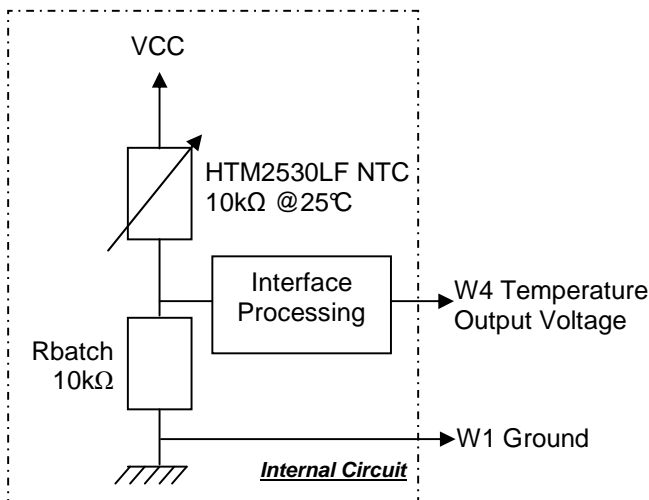
## HTM25X0LF – Temperature and Relative Humidity Module

### HTM2530LF TEMPERATURE SENSOR: VOLTAGE OUTPUT

Concerning the temperature sensor of the HTM2530LF, it is built as the HTM2500LF temperature sensor interface circuit. The voltage bridge divider circuit is internal. It uses only one resistor component (Rbatch) at 1% to design HTM2530LF temperature sensor interfacing circuit.

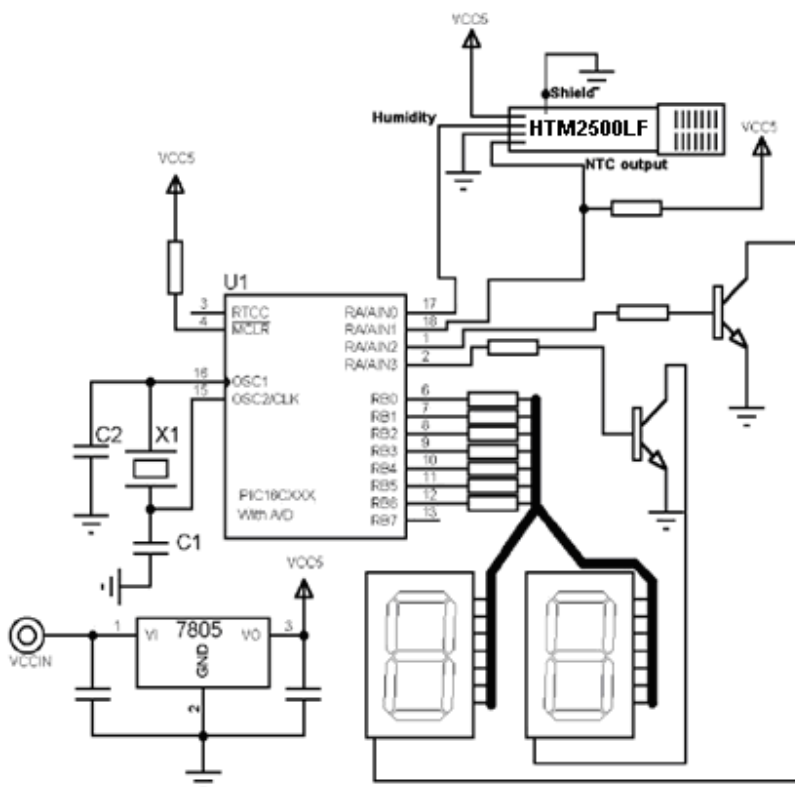
Rbatch is chosen to be equal to NTC @25°C to get:  $V_{out} = V_{cc}/2 @25^{\circ}\text{C}$ .

The difference is based on internal connections: Rbatch connected to Ground and NTC to Vcc (5Vdc). It leads to a positive slope characteristic (Pull-Down Configuration).



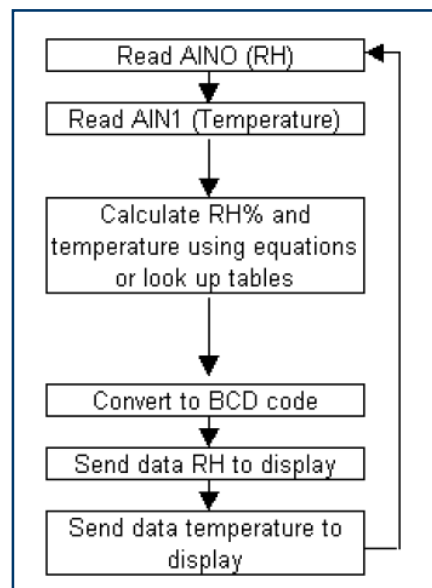
Temp (°C)	R (Ω)	Pull-Down Configuration Vout (mV)
-20	68237	1280
-10	42506	1515
0	27219	1775
10	17926	2050
20	12081	2330
25	10000	2470
30	8315	2600
40	5834	2850
50	4161	3070
60	3014	3240
70	2228	3360

### SUGGESTED APPLICATION



Steps of 1% RH are achievable by using 8-bit A/D.

If more resolution is required, a 10-bit A/D needs to be used and a third display will be added, giving steps of 0.2% RH.



## HTM25X0LF – Temperature and Relative Humidity Module

### QUALIFICATION PROCESS

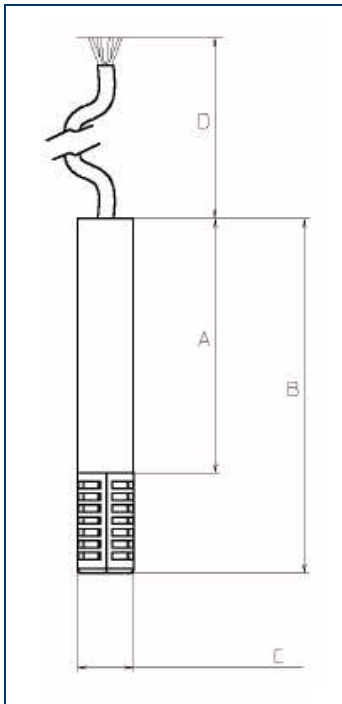
#### RESISTANCE TO PHYSICAL AND CHEMICAL STRESSES

- HTM25X0LF has passed through qualification processes of MEAS-France including vibration, shock, storage, high temperature and humidity, ESD.
- Additional tests under harsh chemical conditions demonstrate good operation in presence of salt atmosphere, SO<sub>2</sub> (0.5%), H<sub>2</sub>S (0.5%), O<sub>3</sub>, NO<sub>x</sub>, NO, CO, CO<sub>2</sub>, Softener, Soap, Toluene, acids (H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub>, HCl), HMDS, Insecticide, Cigarette smoke, this is not an exhaustive list.
- HTM25X0LF is not light sensitive.

#### SPECIFIC PRECAUTIONS

- HTM25X0LF is not protected against reversed polarity - Check carefully when connecting the device.
- If you wish to use HTM25X0LF in a chemical atmosphere not listed above, consult us.

### PACKAGE OUTLINE



Dim	Min (mm)	Max (mm)
A	53	55
B	74.3	76.3
C	11.2	11.6
D* (HTM25X0LF)	200	250
D* (HTM25X0LFL)	1450	1550

*\*Specific length available on request*

*For operating temperature upper than 60°C, specific high temperature cable is required (1500mm long)*

Wire	Cable Color HTM25X0LF	Cable Color HTM25X0LFL	Function
W1	Brown	Black	Ground
W2	White	Orange	Supply Voltage
W3	Yellow	Yellow	Humidity Voltage Output
W4	Green	Purple	Temperature Output (NTC Direct or Voltage)
W5	Black (thick)	Black (thick)	Shield

HTM25X0LF weight: 17.5g

HTM25X0LFL weight: 50g

HTM25X0LF wire characteristics: AWG 24 for W1, W2, W3 and W4 / AWG 16 for W5

HTM25X0LFL wire characteristics: AWG 24 for W1, W2, W3 and W4 / AWG 16 for W5



## HTM25X0LF – Temperature and Relative Humidity Module

### ORDERING INFORMATION

HPP809A031 : HTM2500LF

HUMIDITY VOLTAGE OUTPUT + NTC (TEMPERATURE DIRECT OUTPUT)

HPP809A032 : HTM2530LF

VOLTAGE OUTPUT FOR HUMIDITY AND TEMPERATURE

HPP809A033 : HTM2500LFL

HUMIDITY VOLTAGE OUTPUT + NTC (TEMPERATURE DIRECT OUTPUT) WITH LONG CABLE

HPP809A034 : HTM2530LFL

VOLTAGE OUTPUT FOR HUMIDITY AND TEMPERATURE WITH LONG CABLE

(MULTIPLE PACKAGE QUANTITY OF 10 PIECES)

#### Customer Service contact details

Measurement Specialties, Inc.  
105 av. du Général Eisenhower  
BP 23705 31037 TOULOUSE CEDEX 1  
FRANCE  
Tél: +33 (0) 561 194 848  
Fax: +33 (0) 561 194 553  
Sales: [humidity.sales@meas-spec.com](mailto:humidity.sales@meas-spec.com)

Revision	Comments	Who	Date
0	Document creation	D. LE GALL	July 09
A	Temperature operating range updated, HTM25X0LFL references added	D. LE GALL	December 09
B	New MEAS template, Temperature operating range updated, RH polynomial equation modified, package outline paragraph updated	D. LE GALL	January 12

The information in this sheet has been carefully reviewed and is believed to be accurate; however, no responsibility is assumed for inaccuracies. Furthermore, this information does not convey to the purchaser of such devices any license under the patent rights to the manufacturer. Measurement Specialties, Inc. reserves the right to make changes without further notice to any product herein. Measurement Specialties, Inc. makes no warranty, representation or guarantee regarding the suitability of its product for any particular purpose, nor does Measurement Specialties, Inc. assume any liability arising out of the application or use of any product or circuit and specifically disclaims any and all liability, including without limitation consequential or incidental damages. Typical parameters can and do vary in different applications. All operating parameters must be validated for each customer application by customer's technical experts. Measurement Specialties, Inc. does not convey any license under its patent rights nor the rights of others.