HTM2500LF

Temperature and Relative Humidity Module

SPECIFICATIONS

- **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**

Based on the rugged HTS2035SMD humidity / temperature sensor, HTM2500LF 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

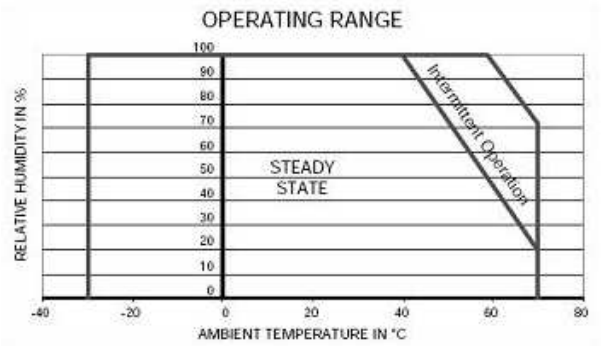
- Industrial
- Process control
- Hygrostat
- Data logger

APPLICATIONSPERFORMANCE 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



ELECTRICAL CHARACTERISTICS

(Ta=23°C, Vs=5Vdc +/-5%, R_L>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	Ic		1.0	1.2	mA
Temperature Coefficient (10 to 50°C)	Tcc		+0.1		%RH/°C
Average Sensitivity from 33% to 75%RH	ΔVout/ΔRH		+26		mV/%RH
Sink Current Capability (R_L=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 (1)	τ		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	β	3347	3380	3413	K
Temperature Measuring Range*	Ta	-40		85	°C
Nominal Resistance Tolerance @25°C	R_N			1	%
Beta Value Tolerance	β		1		%
Response Time	τ		10		s

** For temperature upper than 60°C, specific high temperature cable is required: HTM2500LFL products*

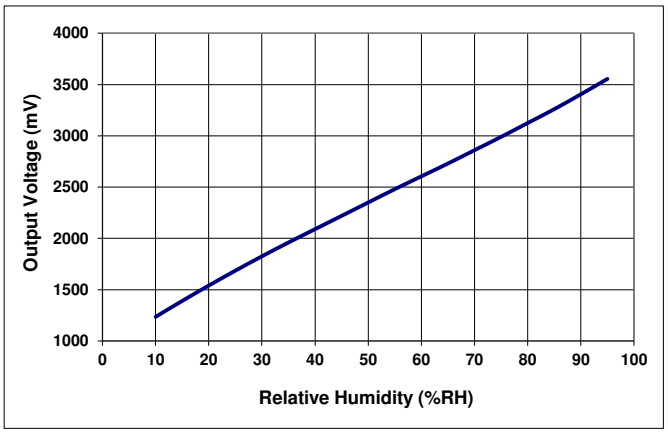
TYPICAL PERFORMANCE CURVES

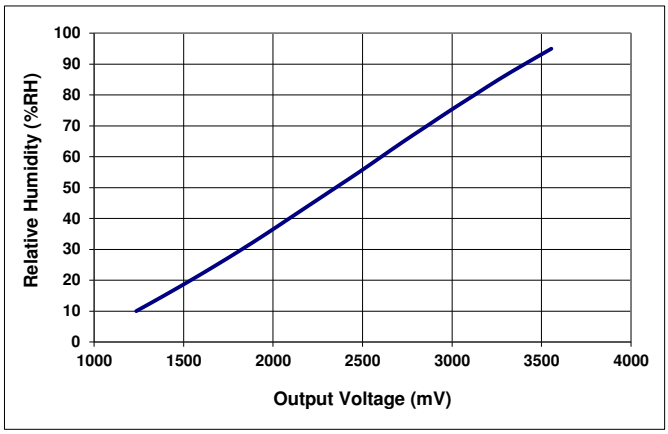
HUMIDITY SENSOR

Typical response look-up table (Vs = 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 (Vs = 5V)





Linear Equations

Vout = 26.65 * RH + 1006
RH = 0.0375 * Vout – 37.7
with Vout in mV and RH in %

Polynomial Equations

$Vout = 1.05E^{-3} * RH^3 - 1.76E^{-1} * RH^2 + 35.2 * RH + 898.6$
$RH = -1.92E^{-9} * Vout^3 + 1.44E^{-5} * Vout^2 + 3.4E^{-3} * Vout – 12.4$
with Vout in mV and RH in %

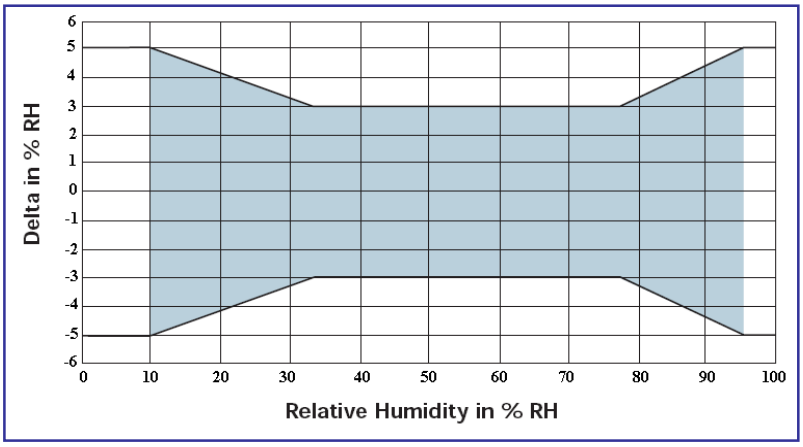
Measurement Conditions

HTM2500LF 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 HTM2500LF characteristics.

Error Budget at 23°C

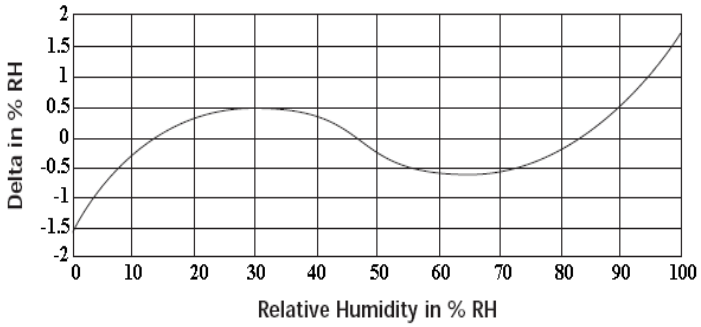
HTM2500LF Error Limits:



Temperature coefficient compensation:

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

HTM2500LF Linearity Error:



Non-linearity and temperature compensation:

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

with Vout in mV, RH in % and Ta in °C

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 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)	R (Ω)	Temp (°C)	R (Ω)
-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

- **Steinhart-Hart coefficients**

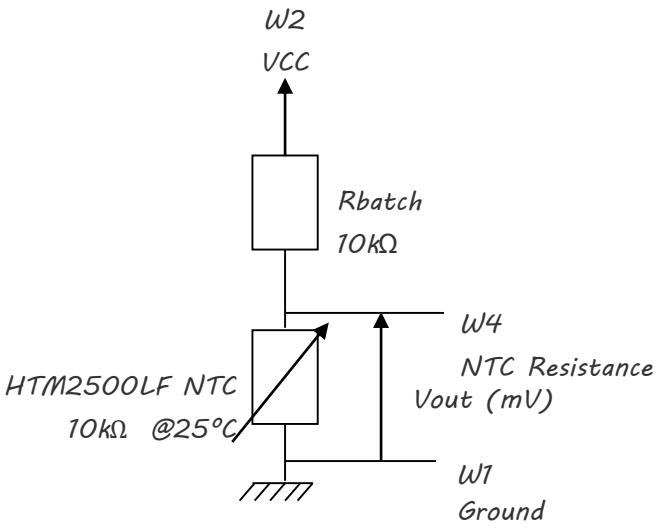
According to the equation below, the Steinhart-Hart coefficients for the operating temperature range for HTM2500LF thermistor are:

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

R	NTC resistance in Ω 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**

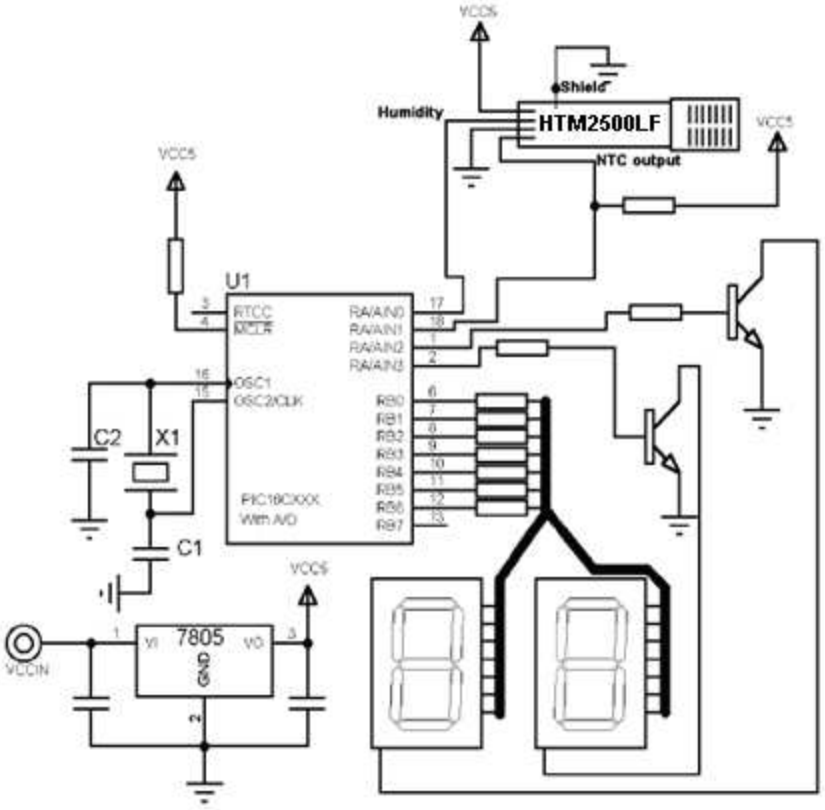
Concerning the temperature sensor of the HTM2500LF, the following measuring method described below is based on a voltage bridge divider circuit. It uses only one resistor component (Rbatch) at 1% to design HTM2500LF temperature sensor interfacing circuit.
Rbatch is chosen to be equal to NTC @25°C to get: Vout = Vcc/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).



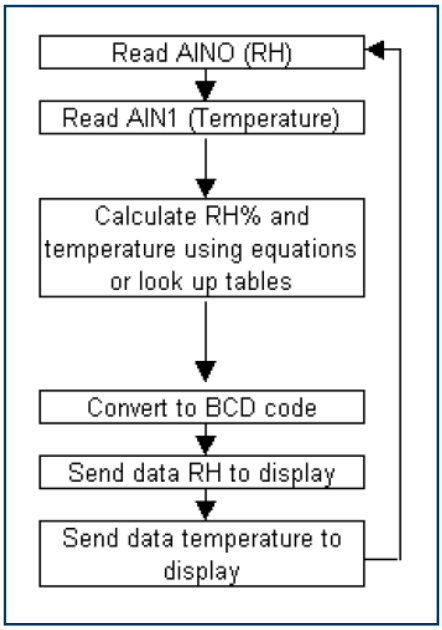
$$V_{OUT}(mV) = \frac{Vcc(mV) * NTC_{HTM\,2500LF}(\Omega)}{R_{batch}(\Omega) + NTC_{HTM\,2500LF}(\Omega)}$$

Temp (°C)	R (Ω)	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

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.



QUALIFICATION PROCESS

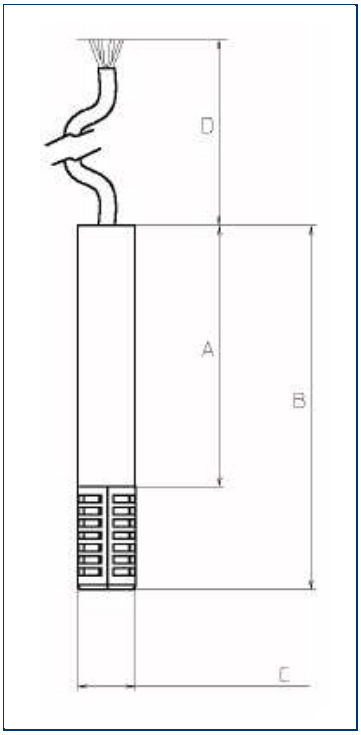
RESISTANCE TO PHYSICAL AND CHEMICAL STRESSES

- HTM2500LF 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, SO2 (0.5%, H2S (0.5%), 03, NOx, NO, CO, CO2, Softener, Soap, Toluene, acids (H2SO4, HNO3, HCI), HMDS, Insecticide, Cigarette smoke, this is not an exhaustive list.
- HTM2500LF is not light sensitive.

SPECIFIC PRECAUTIONS

- HTM2500LF is not protected against reversed polarity - Check carefully when connecting the device.
- If you wish to use HTM2500LF 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* (HTM2500LF)	200	250
D* (HTM2500LFL)	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 HTM2500LF	Cable Color HTM2500LFL	Function
W1	Brown	Black	Ground
W2	White	Orange	Supply Voltage
W3	Yellow	Yellow	Humidity Voltage Output
W4	Green	Purple	Temperature Output (NTC Direct)
W5	Black (thick)	Black (thick)	Shield

HTM2500LF weight: 17.5g
HTM2500LFL weight: 50g

HTM2500LF wire characteristics: AWG 24 for W1, W2, W3 and W4 / AWG 16 for W5
HTM2500LFL wire characteristics: AWG 24 for W1, W2, W3 and W4 / AWG 16 for W5

ORDERING INFORMATION

HPP809A031 : HTM2500LF

HUMIDITY VOLTAGE OUTPUT + NTC (TEMPERATURE DIRECT OUTPUT)

HPP809A033 : HTM2500LFL

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

(MULTIPLE PACKAGE QUANTITY OF 10 PIECES)

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