# HTM2500 – Temperature and Relative Humidity Module


- **Hermetic Housing**
- **Humidity calibrated within +/-2% @55%RH**
- **Temperature measurement through NTC 10kOohms +/-3% direct output**
- **Small size product**
- **Typical 1 to 4 Volt DC output for 0 to 100%RH at 5Vdc**

## DESCRIPTION

Based on the rugged HTS2010 humidity / temperature sensor, HTM2500 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

…

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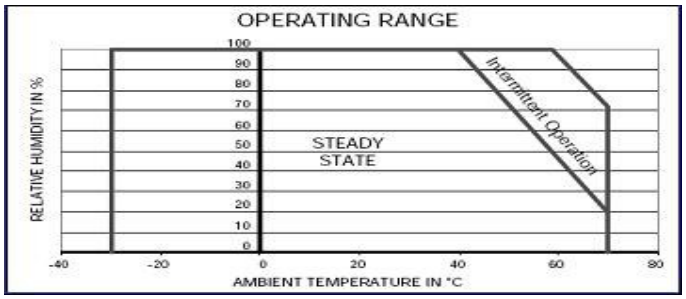
## PERFORMANCE SPECS

### MAXIMUM RATINGS

| Ratings | Symbol | Value | Unit |
|---|---|---|---|
| Storage Temperature | Tstg | -40 to 85 | ℃ |
| Storage Humidity | RHstg | 0 to 100 | % RH |
| Supply Voltage (Peak) | Vs | 12 | Vdc |
| Humidity Operating Range | RH | 0 to 100 | % RH |
| Temperature Operating | Ta | -30 to 70 | ℃ |

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




### ELECTRICAL CHARACTERISTICS

(Ta=23℃, 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 | | 0.4 | 08 | mA |
| Temperature Coefficient (10 to 50℃) | Tcc | | +0.1 | | %RH/℃ |
| Average Sensitivity from 33% to 75%RH | ΔVout/ΔRH | | +25 | | 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 | τ | | 5 | | s |
| Output Impedance | Z | | 70 | | Ω |

(Ta=25℃)

| Temperature Characteristics | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Nominal Resistance @25℃ | R | | 10 | | kΩ |
| Beta value: B25/100 | β | 3600 | 3730 | 3800 | |
| Temperature Measuring Range | Ta | -40 | | 85 | ℃ |
| Nominal Resistance Tolerance @25℃ | $R_N$ | | 2 | 3 | % |
| Beta Value Tolerance | β | | 3 | | % |
| Response Time | τ | | 10 | | s |

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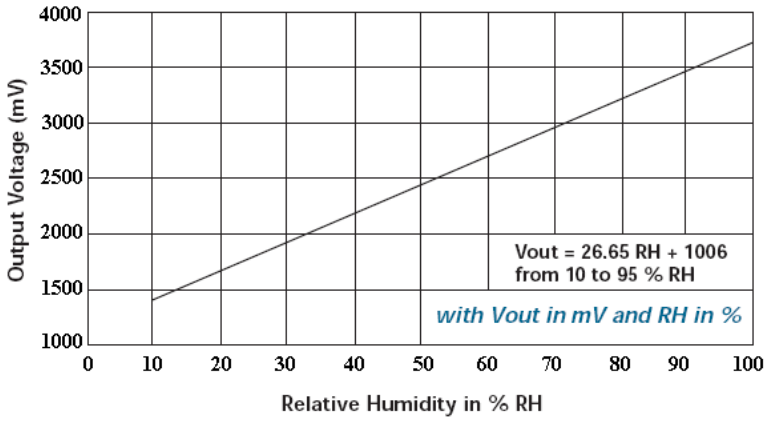
## TYPICAL PERFORMANCE CURVES

### HUMIDITY SENSOR

- **Modeled linear voltage output (Vs = 5V)**




- **Polynomial Equation**

$$Vout = 1.05E^{-3}RH^3 - 1.76E^{-1}RH^2 + 35.2RH + 898.6$$ with Vout in mV and RH in %

- **Typical response look-up table**

| 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 |

- **Measurement Conditions**

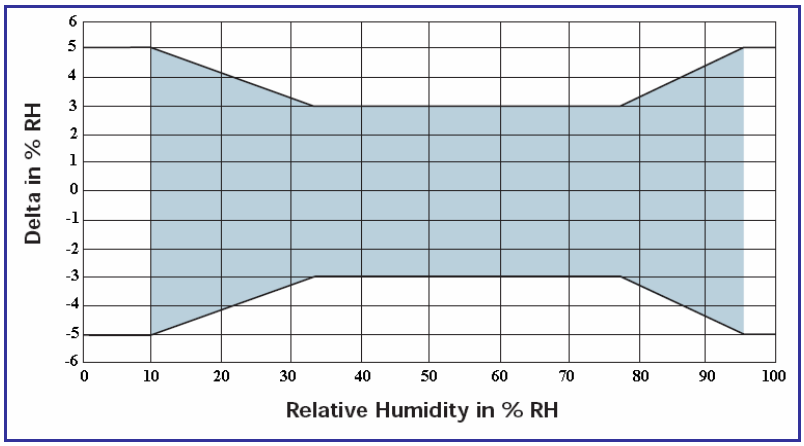
HTM2500 is specified for accurate measurements within 10 to 95% RH.

Excursion out of this range (<10% or >95% RH, including condensation) does not affect the reliability of HTM2500 characteristics.

# HTM2500 – Temperature and Relative Humidity Module

- **Error Budget at 23°C**

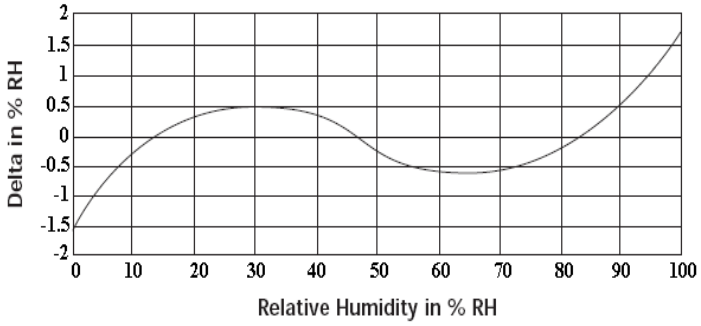
### HTM2500 Error Limits:




### Temperature coefficient compensation:

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

### HTM2500 Linearity Error:



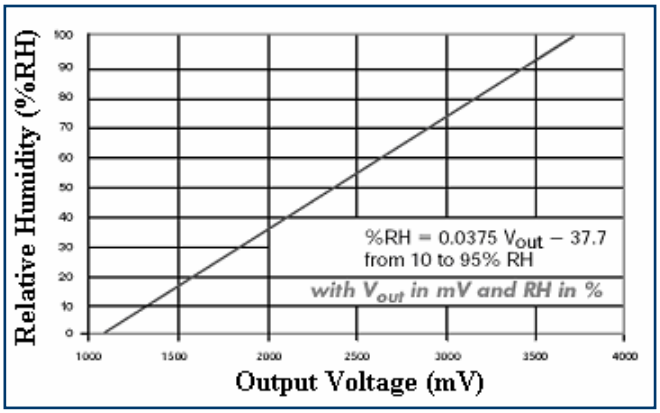

### Non-linearity and temperature compensation:

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

All equations Vout in mV, RH in % and Ta in °C

# HTM2500 – Temperature and Relative Humidity Module

- **Humidity Measurement using HTM2500**




## 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/Humirel Application Note HPC106 “Low power NTC measurement”.

- **Temperature look-up table**

| Temp (℃) | R (Ω) | Temp (℃) | R (Ω) |
|---|---|---|---|
| -30 | 169149 | 20 | 12474 |
| -25 | 125546 | 25 | 10000 |
| -20 | 94143 | 30 | 8080 |
| -15 | 71172 | 35 | 6569 |
| -10 | 54308 | 40 | 5372 |
| -5 | 41505 | 45 | 4424 |
| 0 | 32014 | 50 | 3661 |
| 5 | 25011 | 55 | 3039 |
| 10 | 19691 | 60 | 2536 |
| 15 | 15618 | 65 | 2128 |

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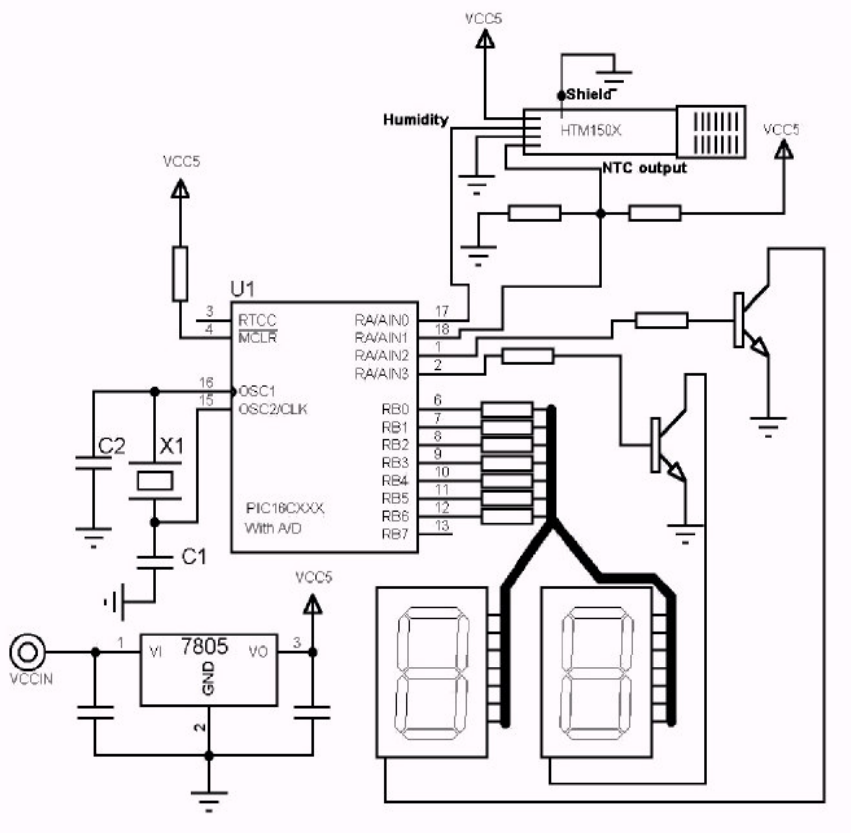
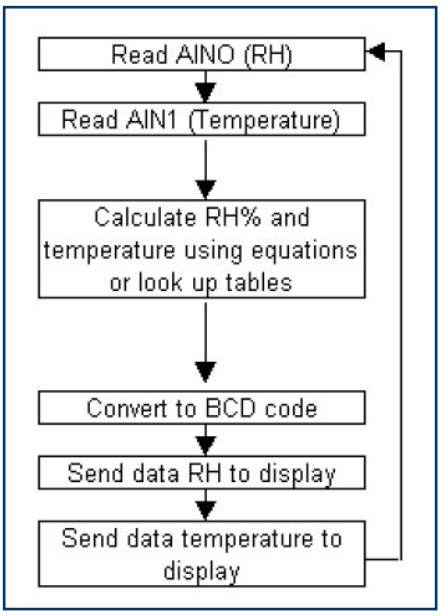
## SUGGESTED APPLICATION




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

- HTM2500 has passed through qualification processes of MEAS-FRANCE/HUMIREL 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.
- HTM2500 is not light sensitive.

### SPECIFIC PRECAUTIONS

- HTM2500 is not protected against reversed polarity - Check carefully when connecting the device.
- If you wish to use HTM2500 in a chemical atmosphere not listed above, consult us.

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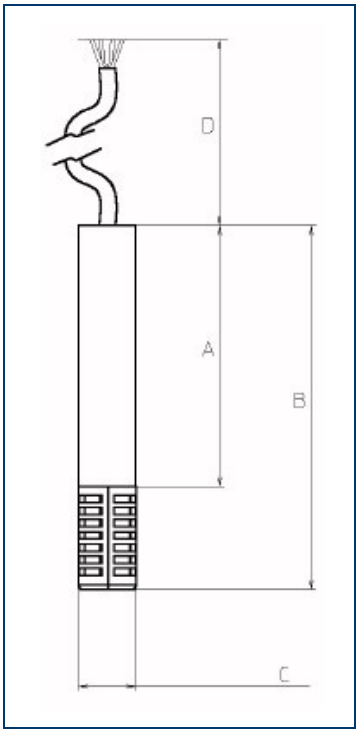
## PACKAGE OUTLINE




| Dim | Min (mm) | Max (mm) |
|---|---|---|
| A | 53 | 55 |
| B | 74.3 | 76.3 |
| C | 11.2 | 11.6 |
| D* | 200 | 250 |

** Specific lenght available on request*

| Wire | Color | Function |
|---|---|---|
| W1 | Brown | Ground |
| W2 | White | Supply Voltage |
| W3 | Yellow | Humidity Voltage Output |
| W4 | Green | NTC Resistance Output |
| W5 | Black | Shield |

## ORDERING INFORMATION

**HPP809A001 (MULTIPLE PACKAGE QUANTITY OF 10 PIECES)**

**HTM2500 – HUMIDITY VOLTAGE OUTPUT + NTC (TEMPERATURE DIRECT OUTPUT)**

| Revision | Comments | Who | Date |
|---|---|---|---|
| C | Standardized datasheet format | D. LE GALL | April 08 |