

HTF3000LF – Temperature and Relative Humidity Module



- Small size product
- Compliant with RoHS recommendations and most of Lead Free Soldering Process
- Humidity calibrated within +/-3% @55%RH at 5Vdc
- Stable, proportional frequency output from 0 to 100% RH
- High quality thermistor

DESCRIPTION

Based on the rugged HS1101LF humidity sensor, HTF3000LF is a dedicated humidity and temperature transducer designed for OEM applications where a reliable and accurate measurement is needed. It features a very small size for easy, cost-effective mechanical mounting. Direct interface with a micro-controller is made possible with the module's linear frequency output.

FEATURES

- | | |
|---|---|
| <ul style="list-style-type: none"> • One of the smallest humidity/temperature modules on the market • High reliability and long term stability • Not affected by water immersion • Stable characteristics with temperature • Part could be washed with distilled water | <p>Humidity Sensor Specific Features</p> <ul style="list-style-type: none"> • Instantaneous de-saturation after long periods in saturation phase • Fast response time • High resistance to chemicals • Patented solid polymer structure <p>Temperature Sensor Specific Features</p> <ul style="list-style-type: none"> • 10kΩ +/-1% NTC temperature sensor • Stable • High sensitivity |
|---|---|

APPLICATIONS

- Printers
- HVAC controller
- ...

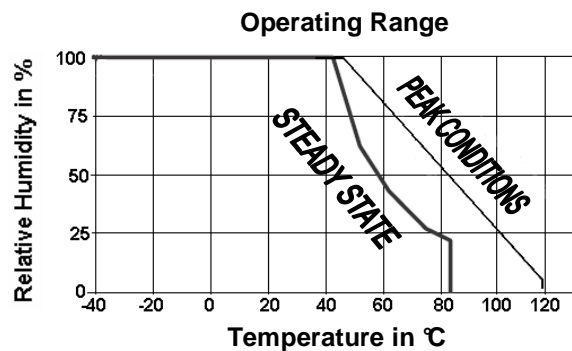
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PERFORMANCE SPECS

MAXIMUM RATINGS

| Ratings | Symbol | Value | Unit |
|-----------------------------|--------|------------|------|
| Storage Temperature | Tstg | -40 to 105 | °C |
| Storage Humidity | RHstg | 0 to 100 | % RH |
| Supply Voltage (Peak) | Vs | 16 | 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%, RL>1MΩ unless otherwise stated)

| Humidity Characteristics | Symbol | Min | Typ | Max | Unit |
|---|----------------------------|----------------------------|--------|------|--------|
| Humidity Measuring Range | RH | 0 | | 100 | %RH |
| Relative Humidity Accuracy (0 to 100% RH) | RH | Refer to Chart 2 on page 3 | | | %RH |
| Supply Voltage | Vs | 3 | 5 | 8 | Vdc |
| Nominal Output @55%RH (at 5Vdc) | Fout | 6560 | 6600 | 6640 | Hz |
| Current consumption (Max at 16Vdc) | Ic | | 0.18 | 1 | mA |
| Supply Voltage Influence (3 to 7Vdc) | RH | | +/-1 | | % RH |
| Average Sensitivity from 10% to 95%RH | $\Delta F_{out}/\Delta RH$ | -10 | -12 | -14 | Hz/%RH |
| Humidity Hysteresis | | | | +/-1 | %RH |
| Long Term Stability | T | | +/-0.5 | | %RH/yr |
| Time Constant (at 63% of signal, static) 40% to 95%RH, 2m/s | τ | | | 10 | s |

(Ta=25°C)

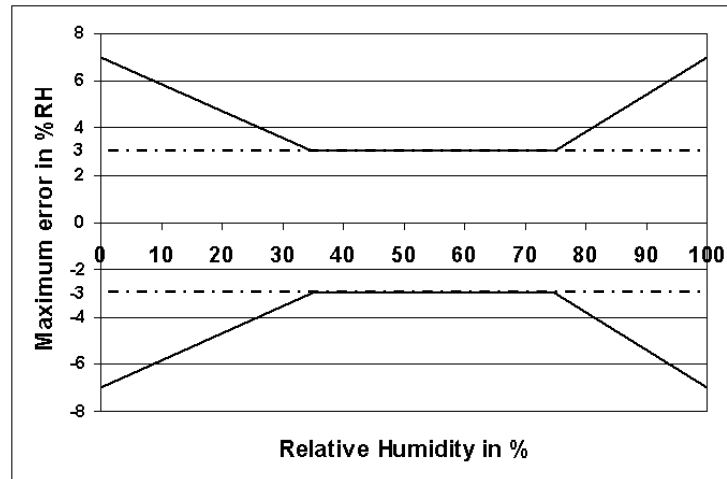
| Temperature Characteristics | Symbol | Min | Typ | Max | Unit |
|------------------------------------|----------------|------|------|------|------|
| Nominal Resistance @25°C | R | | 10 | | kΩ |
| Beta value: B25/100 | β | 3346 | 3380 | 3413 | |
| Temperature Measuring Range | Ta | -40 | | 85 | °C |
| Nominal Resistance Tolerance @25°C | R _N | | 1 | | % |
| Beta Value Tolerance | β | | 1 | | % |
| Response Time | τ | | 10 | | s |

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TYPICAL PERFORMANCE CURVES

HUMIDITY SENSOR

- Relative Humidity Accuracy of HTF3000LF @23°C



- Modeled Signal Output Equations

$$F_{out} = 7314 - 16.79 \cdot RH + 0.0886 \cdot RH^2 - 0.000358 \cdot RH^3$$

F_{out} in Hz and RH in %

- Modeled Reversed Output Equations

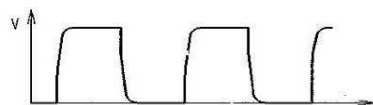
$$RH = 89.8 \cdot 10^{-10} \cdot F_{out}^3 - 15.7486 \cdot 10^{-5} \cdot F_{out}^2 + 0.80945 \cdot F_{out} - 1009$$

F_{out} in Hz and RH in %

- Typical response look-up table

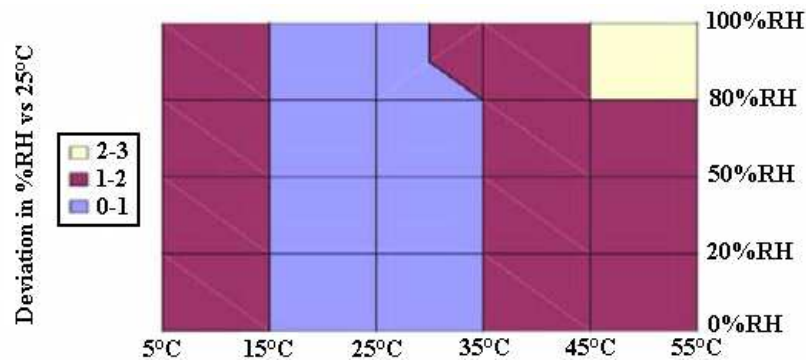
| | | | | | | | | | | | |
|-----------------------|------|------|------|------|------|------|------|------|------|------|------|
| RH (%) | 1 | 5 | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 |
| F _{out} (Hz) | 7295 | 7230 | 7155 | 7080 | 7010 | 6945 | 6880 | 6820 | 6760 | 6705 | 6650 |
| RH (%) | 55 | 60 | 65 | 70 | 75 | 80 | 85 | 90 | 95 | 99 | |
| F _{out} (Hz) | 6600 | 6550 | 6500 | 6450 | 6400 | 6355 | 6305 | 6260 | 6210 | 6170 | |

Output Voltage wave form



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- Temperature influence on HTF3000LF humidity measurement



Calibration data are traceable to NIST standards through CETIAT laboratory.

For demanding application, temperature coefficient could be compensated over operating temperature range using following formula:

$$RH_{corr} = RH + 0.08 * (T - 25)$$

$$Fout_{corr} = Fout - 0.88 * (T - 25)$$

T in °C, RH in %, Fout in Hz

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.

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

| | |
|----------|--|
| 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 HPC106-0 "Low power NTC measurement".

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• Temperature Look-up Table

| Temp (°C) | Rout (Ω) | Max Dev (Ω) |
|--------------|-------------|----------------|
| -40 | 195652 | 7921 |
| -39 | 184917 | 7378 |
| -38 | 174845 | 6874 |
| -37 | 165391 | 6407 |
| -36 | 156513 | 5974 |
| -35 | 148171 | 5571 |
| -34 | 140330 | 5197 |
| -33 | 132958 | 4849 |
| -32 | 126022 | 4527 |
| -31 | 119494 | 4226 |
| -30 | 113347 | 3947 |
| -29 | 107565 | 3687 |
| -28 | 102116 | 3446 |
| -27 | 96978 | 3221 |
| -26 | 92132 | 3011 |
| -25 | 87559 | 2815 |
| -24 | 83242 | 2633 |
| -23 | 79166 | 2463 |
| -22 | 75316 | 2305 |
| -21 | 71677 | 2157 |
| -20 | 68237 | 2019 |
| -19 | 64991 | 1890 |
| -18 | 61919 | 1770 |
| -17 | 59011 | 1658 |
| -16 | 56258 | 1553 |
| -15 | 53650 | 1454 |
| -14 | 51178 | 1363 |
| -13 | 48835 | 1277 |
| -12 | 46613 | 1197 |
| -11 | 44506 | 1121 |
| -10 | 42506 | 1051 |
| -9 | 40600 | 985 |
| -8 | 38791 | 923 |
| -7 | 37073 | 865 |
| -6 | 35442 | 810 |
| -5 | 33892 | 759 |
| -4 | 32420 | 712 |
| -3 | 31020 | 667 |
| -2 | 29689 | 625 |
| -1 | 28423 | 586 |
| 0 | 27219 | 549 |
| 1 | 26076 | 514 |

| Temp (°C) | Rout (Ω) | Max Dev (Ω) |
|--------------|-------------|----------------|
| 2 | 24988 | 482 |
| 3 | 23951 | 452 |
| 4 | 22963 | 423 |
| 5 | 22021 | 396 |
| 6 | 21123 | 371 |
| 7 | 20267 | 348 |
| 8 | 19450 | 326 |
| 9 | 18670 | 305 |
| 10 | 17926 | 285 |
| 11 | 17214 | 267 |
| 12 | 16534 | 250 |
| 13 | 15886 | 233 |
| 14 | 15266 | 218 |
| 15 | 14674 | 204 |
| 16 | 14108 | 190 |
| 17 | 13566 | 178 |
| 18 | 13049 | 166 |
| 19 | 12554 | 154 |
| 20 | 12081 | 144 |
| 21 | 11628 | 134 |
| 22 | 11195 | 125 |
| 23 | 10780 | 116 |
| 24 | 10382 | 108 |
| 25 | 10000 | 100 |
| 26 | 9634 | 100 |
| 27 | 9284 | 100 |
| 28 | 8947 | 100 |
| 29 | 8624 | 99 |
| 30 | 8315 | 99 |
| 31 | 8018 | 98 |
| 32 | 7734 | 98 |
| 33 | 7461 | 97 |
| 34 | 7199 | 96 |
| 35 | 6948 | 95 |
| 36 | 6707 | 94 |
| 37 | 6475 | 93 |
| 38 | 6253 | 92 |
| 39 | 6039 | 91 |
| 40 | 5834 | 90 |
| 41 | 5636 | 89 |
| 42 | 5445 | 88 |
| 43 | 5262 | 87 |

| Temp (°C) | Rout (Ω) | Max Dev (Ω) |
|--------------|-------------|----------------|
| 44 | 5086 | 86 |
| 45 | 4917 | 85 |
| 46 | 4754 | 83 |
| 47 | 4597 | 82 |
| 48 | 4446 | 81 |
| 49 | 4301 | 80 |
| 50 | 4161 | 79 |
| 51 | 4026 | 77 |
| 52 | 3896 | 76 |
| 53 | 3771 | 75 |
| 54 | 3651 | 74 |
| 55 | 3535 | 73 |
| 56 | 3423 | 72 |
| 57 | 3315 | 70 |
| 58 | 3211 | 69 |
| 59 | 3111 | 68 |
| 60 | 3014 | 67 |
| 61 | 2922 | 66 |
| 62 | 2834 | 65 |
| 63 | 2748 | 64 |
| 64 | 2666 | 63 |
| 65 | 2586 | 62 |
| 66 | 2509 | 60 |
| 67 | 2435 | 59 |
| 68 | 2364 | 58 |
| 69 | 2294 | 57 |
| 70 | 2228 | 56 |
| 71 | 2163 | 55 |
| 72 | 2100 | 54 |
| 73 | 2040 | 53 |
| 74 | 1981 | 52 |
| 75 | 1925 | 52 |
| 76 | 1870 | 51 |
| 77 | 1817 | 50 |
| 78 | 1766 | 49 |
| 79 | 1716 | 48 |
| 80 | 1669 | 47 |
| 81 | 1622 | 46 |
| 82 | 1578 | 46 |
| 83 | 1535 | 45 |
| 84 | 1493 | 44 |
| 85 | 1452 | 43 |

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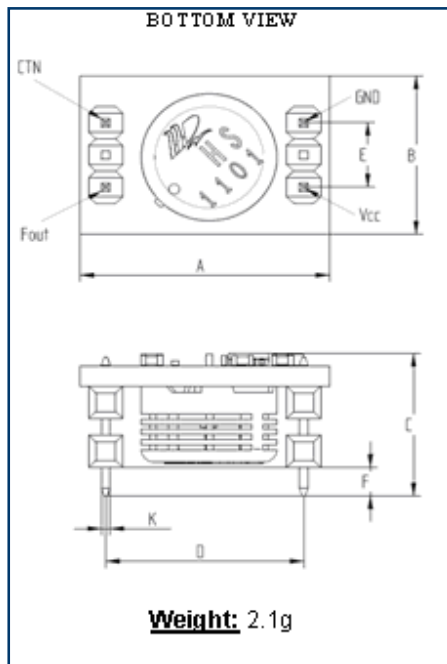
QUALIFICATION PROCESS

RESISTANCE TO PHYSICAL AND CHEMICAL STRESSES

- HTF3000LF has passed through qualification processes of MEAS-France including vibration, shock, storage, high temperature and humidity.
- Additional tests under harsh chemical conditions demonstrate good operation in presence of salt atmosphere, SO₂ (0.5%), H₂S (0.5%), O₃, NO_x, NO, CO, CO₂, Softener, Soap, Toluene, acids (H₂SO₄, HNO₃, HCl), HMDS, Insecticide, Cigarette smoke, this is not an exhaustive list.
- ESD: HTF3000LF is able to sustain a minimum of +/-8kV (contact discharge).

PACKAGE OUTLINE

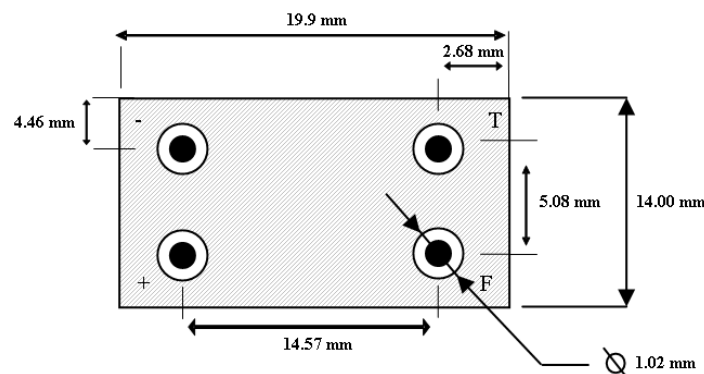
HTF3000LF PVH



| Dim | A | B | C | D | E | F | K |
|-----|------|------|------|-------|------|------|------|
| Min | 17.9 | 12.0 | 10.7 | 14.25 | 4.80 | 1.76 | 0.54 |
| Max | 18.9 | 13.0 | 11.7 | 14.95 | 5.40 | 3.76 | 0.74 |

Dimensions in millimeters

RECOMMENDED THROUGH HOLE FOOTPRINT



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SOLDERING INFORMATION

HTF3000LF PVH: Hand soldering or wave soldering

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