

## Advanced Information

## TECHNICAL DATA



## HTG3515CH

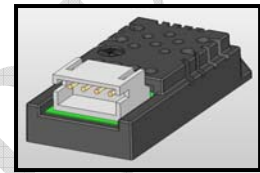
Compliant with RoHS regulations

## ANALOG VOLTAGE RELATIVE HUMIDITY AND TEMPERATURE MODULE

Based on the rugged HUMIREL humidity sensor, HTG3515CH is a dedicated humidity and temperature plug and play 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 and direct NTC outputs. HTG3515CH is designed for high volume and demanding applications.

## Main features

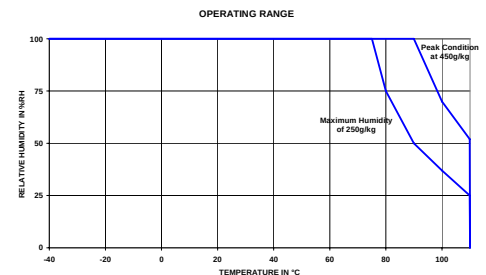
- Suitable for small bulk assembly
- Product free from Lead, Cr (6+), Cd and Hg. Compliant with RoHS
- Reliability not affected by repeated condensations
- Full interchangeability. Better than  $\pm 3\%RH$  and  $\pm 0.15^\circ C$
- Demonstrated reliability and long term stability
- Typical 1 to 3.6 Volt DC output for 0 to 100% RH at 5 V DC supply
- Humidity calibrated within  $\pm 3\% RH$  @ 55% RH
- Temperature measurement through NTC 10 k $\Omega$   $\pm 1\%$  direct output
- Ratiometric to voltage supply within the specified range



HTG3515CH : 5V Supply

## Maximum ratings

| Ratings                       | Symbol     | Value        | Unit       |
|-------------------------------|------------|--------------|------------|
| Storage Temperature           | $T_{stg}$  | - 40 to +125 | $^\circ C$ |
| Supply Voltage (Peak)         | $V_{cc}$   | 20           | $V_{dc}$   |
| Humidity Operating Range      | RH         | 0 to 100     | %RH        |
| Temperature Operating Range   | $T_a$      | -40 to +110  | $^\circ C$ |
| Maximum Output Current (Peak) | $I_{peak}$ | 5            | mA         |
| Maximum Power                 | $P_d$      | 25           | mW         |



## Electrical characteristics

(@ $T=23^\circ C$ , @ $V_{cc}=5V$ ,  $R_L > 1M\Omega$  unless otherwise noted)

| Characteristics                                                            | Symbol         | Min  | Typ     | Max     | Unit            |
|----------------------------------------------------------------------------|----------------|------|---------|---------|-----------------|
| Humidity Measuring Range                                                   | RH             | 0    |         | 100     | %RH             |
| Relative Humidity Accuracy (10% to 95%RH)                                  |                |      | $\pm 3$ | $\pm 5$ | %RH             |
| Voltage Supply <sup>(1) (4)</sup>                                          | $V_{cc}$       | 4.75 | 5       | 5.25    | $V_{dc}$        |
| Nominal Output @55%RH                                                      | $V_{out}$      | 2.42 | 2.48    | 2.54    | V               |
| Current Consumption                                                        | $I_{cc}$       |      | 3.2     |         | mAdc            |
| Temperature coefficient (10 $^\circ C$ to 50 $^\circ C$ )                  | $T_{cc}$       |      | -0.05   | -0.1    | %RH/ $^\circ C$ |
| Humidity Average Sensitivity                                               | $\Delta mV/RH$ |      | +26     |         | mV/%RH          |
| Recovery time after 150 hours of condensation                              | t              |      | 10      |         | s               |
| Humidity hysteresis                                                        |                |      | $\pm 1$ |         | %RH             |
| Output impedance                                                           | Z              |      |         | 50      | $\Omega$        |
| Sink current capability ( $R_{L\_Min} = 8\text{ k}\Omega$ ) <sup>(2)</sup> | I              |      |         | 1       | mA              |
| Warm up time                                                               | $t_w$          |      | 150     |         | ms              |
| Response Time (at 63% of signal) 33%RH to 75%RH <sup>(3)</sup>             | $\tau$         |      | 5       | 10      | s               |

(1) Module is ratiometric to voltage supply.

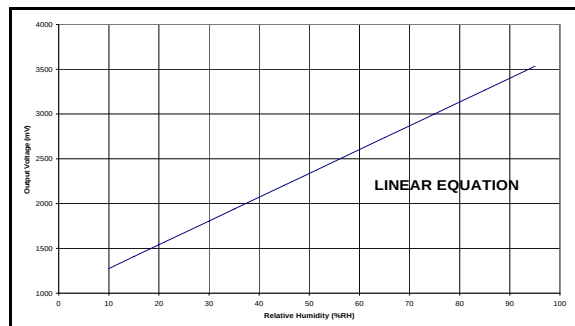
(2) Conditions of sink current :  $V_{out} + 0.078V$  (3%RH) at  $V_{out} = 1.000V$  ( $V_{out}$  min).

(3) At 1m/s air flow.

(4) Maximum power supply ramp up time to VCC should be less than 20 ms.

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HTG3515CH Modeled Voltage Output (V<sub>cc</sub>=5V)**LINEAR EQUATION**

$$V_{out} = 26.23RH + 1032$$

$$RH = 0.03812 V_{out} - 39.36$$

with V<sub>out</sub> in mV and RH in %

## Reference Output Values

| 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     | 3400      |
| 50     | 2350      | 95     | 3530      |

**POLYNOMIAL EQUATION**

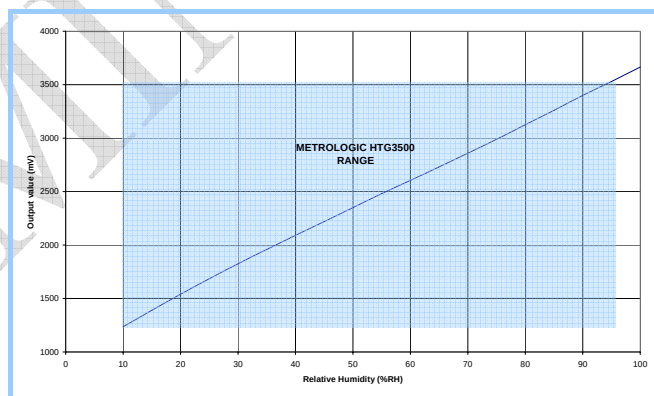
$$V_{out} = 8.43E^{-4}RH^3 - 0.1485RH^2 + 34.16RH + 909$$

$$RH = -1.564E^{-9}V_{out}^3 + 1.205E^{-5}V_{out}^2 + 8.22E^{-3}V_{out} - 15.6$$

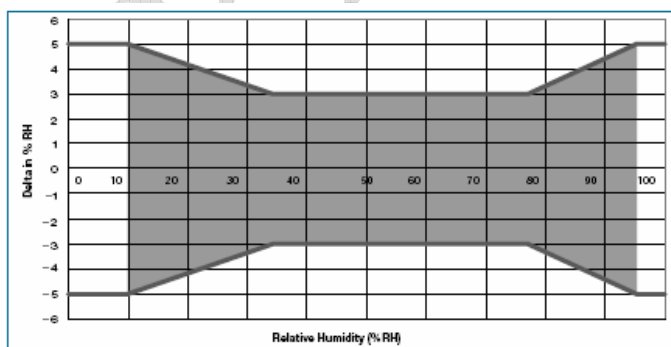
with V<sub>out</sub> in mV and RH in %

## Measurement Conditions

- HTG3515CH is specified for maximum accuracy measurements within 10 to 95 %RH.
- Excursion out of this range (< 10% or > 95% RH, including condensation) does not affect the reliability of HTG3515CH characteristics



## Error Budget Conditions at 23°C



## HTG3515CH ERROR LIMITS

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## TECHNICAL DATA

## CHARACTERISTICS

## Temperature sensor

| Characteristics                      | Symbol         | Min. | Typ  | Max. | Unit. |
|--------------------------------------|----------------|------|------|------|-------|
| Nominal resistance @ 25°C            | R              | 9.9  | 10   | 10.1 | kΩ    |
| Beta value : B25/50                  | B              | 3346 | 3380 | 3414 | K     |
| Temperature measuring range          | T <sub>a</sub> | -40  |      | 110  | °C    |
| Nominal Resistance Tolerance at 25°C | R <sub>n</sub> |      | 1    |      | %     |
| B value tolerance                    | B              |      | 1    |      | %     |
| Response Time                        | τ              |      | 10   |      | s     |

## Typical temperature output

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

①

$$R_T = R_n * e^{B \left( \frac{1}{T} - \frac{1}{T_n} \right)}$$

R<sub>T</sub> NTC resistance in Ω at temperature T in K

R<sub>n</sub> NTC resistance in Ω at rated temperature in K

T, T<sub>n</sub> Temperature in K

B B value, material-specific constant of the NTC thermistor

e Base of natural logarithm (e = 2.71828)

The actual characteristic of an NTC thermistor can, however, only be roughly described by the exponential relation, as the material parameter B in reality also depends on temperature. So this approach is only 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 tabulated form. The below table has been experimentally determined with utmost accuracy for temperature increments of 1 degree.

| Temp (°C) | Resistance (Ohms) | Max Deviation (Ohms) |
|-----------|-------------------|----------------------|
| -40       | 195652            | 7776                 |
| -39       | 184917            | 7245                 |
| -38       | 174845            | 6753                 |
| -37       | 166391            | 6296                 |
| -36       | 158513            | 5871                 |
| -35       | 148171            | 5477                 |
| -34       | 140330            | 5111                 |
| -33       | 132958            | 4771                 |
| -32       | 126022            | 4454                 |
| -31       | 119494            | 4160                 |
| -30       | 113347            | 3886                 |
| -29       | 107565            | 3631                 |
| -28       | 102116            | 3394                 |
| -27       | 96978             | 3173                 |
| -26       | 92132             | 2968                 |
| -25       | 87559             | 2776                 |
| -24       | 83242             | 2597                 |
| -23       | 79166             | 2430                 |
| -22       | 75316             | 2274                 |
| -21       | 71677             | 2129                 |
| -20       | 68237             | 1993                 |
| -19       | 64991             | 1867                 |
| -18       | 61919             | 1748                 |
| -17       | 59011             | 1638                 |
| -16       | 56258             | 1535                 |
| -15       | 53650             | 1438                 |
| -14       | 51178             | 1348                 |
| -13       | 48835             | 1263                 |
| -12       | 46613             | 1184                 |
| -11       | 44506             | 1110                 |
| -10       | 42506             | 1040                 |
| -9        | 40600             | 975                  |
| -8        | 38791             | 914                  |
| -7        | 37073             | 856                  |
| -6        | 35442             | 803                  |
| -5        | 33892             | 753                  |
| -4        | 32420             | 706                  |
| -3        | 31020             | 661                  |
| -2        | 29689             | 620                  |
| -1        | 28423             | 581                  |

| Temp (°C) | Resistance (Ohms) | Max Deviation (Ohms) |
|-----------|-------------------|----------------------|
| 0         | 27219             | 545                  |
| 1         | 26076             | 511                  |
| 2         | 24988             | 479                  |
| 3         | 23951             | 449                  |
| 4         | 22963             | 421                  |
| 5         | 22021             | 394                  |
| 6         | 21123             | 369                  |
| 7         | 20267             | 346                  |
| 8         | 19450             | 324                  |
| 9         | 18670             | 303                  |
| 10        | 17926             | 284                  |
| 11        | 17214             | 266                  |
| 12        | 16534             | 249                  |
| 13        | 15886             | 232                  |
| 14        | 15266             | 217                  |
| 15        | 14674             | 203                  |
| 16        | 14108             | 190                  |
| 17        | 13566             | 177                  |
| 18        | 13049             | 165                  |
| 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              | 99                   |
| 29        | 8624              | 99                   |
| 30        | 8315              | 98                   |
| 31        | 8018              | 98                   |
| 32        | 7734              | 97                   |
| 33        | 7461              | 96                   |
| 34        | 7199              | 96                   |
| 35        | 6948              | 95                   |
| 36        | 6707              | 94                   |
| 37        | 6475              | 93                   |
| 38        | 6253              | 92                   |
| 39        | 6039              | 91                   |

| Temp (°C) | Resistance (Ohms) | Max Deviation (Ohms) |
|-----------|-------------------|----------------------|
| 40        | 5834              | 90                   |
| 41        | 5636              | 89                   |
| 42        | 5445              | 88                   |
| 43        | 5262              | 86                   |
| 44        | 5086              | 85                   |
| 45        | 4917              | 84                   |
| 46        | 4754              | 83                   |
| 47        | 4597              | 82                   |
| 48        | 4446              | 81                   |
| 49        | 4301              | 79                   |
| 50        | 4161              | 78                   |
| 51        | 4026              | 77                   |
| 52        | 3896              | 76                   |
| 53        | 3771              | 75                   |
| 54        | 3651              | 73                   |
| 55        | 3535              | 72                   |
| 56        | 3423              | 71                   |
| 57        | 3315              | 70                   |
| 58        | 3211              | 69                   |
| 59        | 3111              | 67                   |
| 60        | 3014              | 66                   |
| 61        | 2922              | 65                   |
| 62        | 2834              | 64                   |
| 63        | 2748              | 63                   |
| 64        | 2666              | 62                   |
| 65        | 2586              | 61                   |
| 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              | 51                   |
| 76        | 1870              | 50                   |
| 77        | 1817              | 49                   |
| 78        | 1766              | 48                   |
| 79        | 1716              | 47                   |

| Temp (°C) | Resistance (Ohms) | Max Deviation (Ohms) |
|-----------|-------------------|----------------------|
| 80        | 1669              | 47                   |
| 81        | 1622              | 46                   |
| 82        | 1578              | 45                   |
| 83        | 1535              | 44                   |
| 84        | 1493              | 43                   |
| 85        | 1452              | 43                   |
| 86        | 1413              | 42                   |
| 87        | 1375              | 41                   |
| 88        | 1338              | 40                   |
| 89        | 1303              | 40                   |
| 90        | 1268              | 39                   |
| 91        | 1234              | 38                   |
| 92        | 1202              | 37                   |
| 93        | 1170              | 37                   |
| 94        | 1139              | 36                   |
| 95        | 1110              | 36                   |
| 96        | 1081              | 35                   |
| 97        | 1053              | 34                   |
| 98        | 1026              | 34                   |
| 99        | 999               | 33                   |
| 100       | 974               | 32                   |
| 101       | 949               | 32                   |
| 102       | 925               | 31                   |
| 103       | 902               | 31                   |
| 104       | 880               | 30                   |
| 105       | 858               | 30                   |
| 106       | 837               | 29                   |
| 107       | 816               | 29                   |
| 108       | 796               | 28                   |
| 109       | 777               | 28                   |
| 110       | 758               | 27                   |

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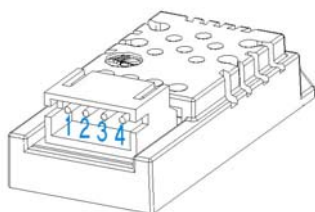
## TECHNICAL DATA

### Resistance to physical and chemical stresses

- HTG3515CH contains circuits to protect its inputs and outputs against Electrostatic discharges (ESD) up to  $\pm 15\text{kV}$ , air discharge.
- HTG3515CH is protected against EMC interferences.
- HTG3515CH is protected against reverse polarity.
- Additional tests under harsh chemical conditions demonstrate good operation in presence of salt atmosphere,  $\text{SO}_2$  (0.5%),  $\text{H}_2\text{S}$  (0.5%),  $\text{O}_3$ ,  $\text{NO}_x$ ,  $\text{NO}$ ,  $\text{CO}$ ,  $\text{CO}_2$ , Softener, Soap, Toluene, acids ( $\text{H}_2\text{SO}_4$ ,  $\text{HNO}_3$ ,  $\text{HCl}$ ), HMDS, Insecticide, Cigarette smoke, a non exhaustive list.
- HTG3515CH is not light sensitive.

### Pin Out Assignment and Package Outline

#### HTG3515CH 3D VIEW

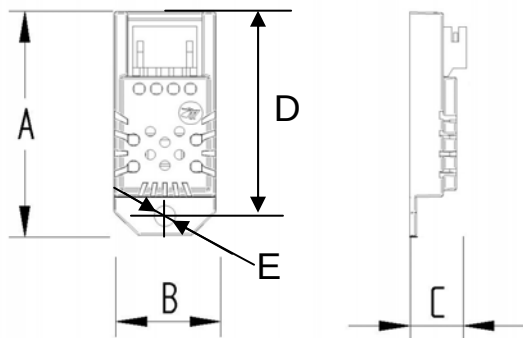


#### Pin Out Assignment

| Pin | Function             |
|-----|----------------------|
| 1   | Ground               |
| 2   | Vcc – Voltage supply |
| 3   | NTC - Temperature    |
| 4   | Vout - Humidity      |

Mating Connector: JST ZHR-4

#### HTG3515CH Package Outline



#### Package Outline

| Dim | Typ (mm)          |
|-----|-------------------|
| A   | 27                |
| B   | 11.9              |
| C   | 6.7               |
| D   | 25                |
| E   | $\varnothing 2.5$ |

Color: Black

Weight: 1.5g