

# HTG3500 Series – Relative Humidity and Temperature Module



- Suitable for small bulk assembly
- Product free from Lead, Cr (6+), Cd and Hg. Compliant with RoHS
- Full interchangeability. Better than +/-3%RH and +/-0.25 °C
- Humidity calibrated within +/- 3% RH @ 55% RH
- Temperature measurement through NTC direct output



## DESCRIPTION

Based on the rugged MEAS-FRANCE/HUMIREL humidity sensor, the HTG3500 Series are dedicated humidity and temperature plug and play transducers designed for OEM applications where reliable and accurate measurements are needed. Direct interface with a micro-controller is made possible with the modules humidity linear voltage and direct NTC outputs. The HTG3500 Series are designed for high volume and demanding applications where power consumption is critical.

## FEATURES

- Reliability not affected by repeated condensation
- Demonstrated reliability and long term stability
- Ratiometric to voltage supply within the specified range
- HTG3500 Series are also available with a Humidity Linear Frequency Output: HTG3400 Series (HPC124)

## APPLICATIONS

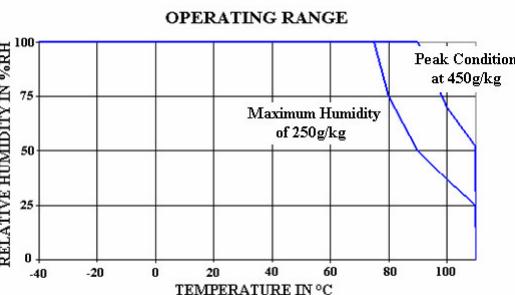
- Automotive
- Home Appliance
- Printers
- ...

## PERFORMANCE SPECS

### MAXIMUM RATINGS

Ratings	Symbol	Value	Unit
Storage Temperature	$T_{stg}$	- 40 to +125	°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	°C
Maximum Output Current (Peak)	$I_{peak}$	3	mA
Maximum Power	$P_d$	10	mW

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



# HTG3500 Series - Relative Humidity and Temperature Module

## ELECTRICAL CHARACTERISTICS

(@T=23°C,  $R_L > 1M\Omega$  unless otherwise noted)

Humidity Characteristics	Symbol	Min	Typ	Max	Unit
Humidity Measuring Range	RH	0		100	%RH
Relative Humidity Accuracy (10% to 95%RH)			±3	±5	%RH
Temperature coefficient (10°C to 50°C)	$T_{cc}$		-0.05	-0.1	%RH/°C
Recovery time after 150 hours of condensation	t		10		s
Humidity hysteresis			+/-1		%RH
Output impedance	Z			50	Ω
Sink current capability ( $R_L$ _Min = 8 kOhms) <sup>(1)</sup>	I			1	mA
Warm up time	$t_w$		150		ms
Time Constant (at 63% of signal) 33%RH to 75%RH <sup>(2)</sup>	$\tau$		5	10	s

(1) Conditions of sink current:  $V_{out} + 0.054V$  (3%RH) at  $V_{out} = 0.600$  V ( $V_{out}$  min)

(2) At 1m/s air flow

Temperature 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	$T_a$	-40		85	°C
Nominal Resistance Tolerance at 25°C	$R_n$		1		%
B value tolerance	B		1		%
Time Constant	T		10		s

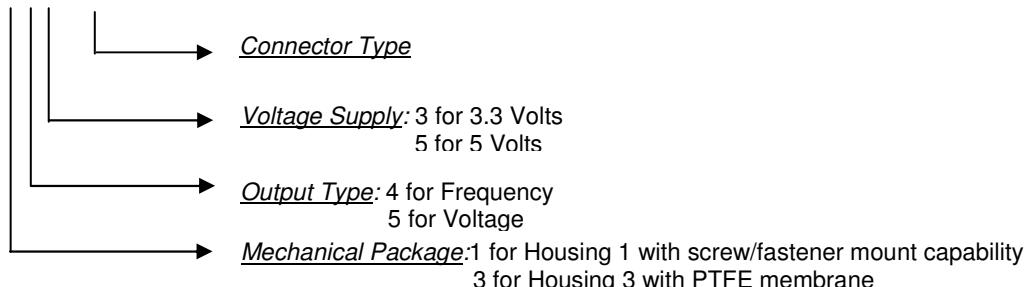
\* Except for low temperatures

## POWER SUPPLY OPTION OF HTG3500 SERIES AT 3.3V<sub>DC</sub> OR AT 5V<sub>DC</sub>

At 3.3V<sub>DC</sub> or at 5V<sub>DC</sub> power supply, there is no measurable impact of type of powering on temperature and RH accuracy.

## NOMENCLATURE

**HTG3XYZ yyy**



# HTG3500 Series - Relative Humidity and Temperature Module

## SPECIFIC ELECTRICAL AND METROLOGICAL CHARACTERISTICS

- HTG35Y3

Characteristics	Symbol	Min	Typ	Max	Unit
Voltage Supply <sup>(1) (2)</sup>	V <sub>cc</sub>	3	3.3	3.46	V <sub>dc</sub>
Nominal Output @55%RH	V <sub>out</sub>	1.581	1.635	1.689	V
Humidity Average Sensitivity	ΔmV/RH	-	+18	-	mV/%RH
Current consumption	I <sub>cc</sub>	-	1.0	1.2	mA dc

(1) Module is ratiometric to voltage supply  
 (2) Maximum power supply ramp up time to VCC should be less than 20ms

- HTG35Y5

Characteristics	Symbol	Min	Typ	Max	Unit
Voltage Supply <sup>(1) (2)</sup>	V <sub>cc</sub>	4.75	5	5.25	V <sub>dc</sub>
Nominal Output @55%RH	V <sub>out</sub>	2.420	2.480	2.540	V
Humidity Average Sensitivity	ΔmV/RH	-	+26	-	mV/%RH
Current consumption	I <sub>cc</sub>	-	1.2	1.5	mA dc

(1) Module is ratiometric to voltage supply  
 (2) Maximum power supply ramp up time to VCC should be less than 20ms

## TYPICAL PERFORMANCE CURVES

### HUMIDITY SENSOR

- Humidity Look-up Tables

HTG35Y5 Modeled Voltage Output		HTG35Y3 Modeled Voltage Output	
Reference Output Values (Vcc = 5V) In any power mode		Reference Output Values (Vcc = 3.3V) In any power mode	
RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	1235	55	2480
15	1390	60	2605
20	1540	70	2730
25	1685	75	2860
30	1825	80	2990
35	1960	85	3125
40	2090	90	3260
45	2220	95	3400
50	2350	100	3530

### POLYNOMIAL EQUATIONS

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

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

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

### LINEAR EQUATIONS

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

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

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

### POLYNOMIAL EQUATIONS

$$V_{out} = 4.0E^{-5} RH^3 - 2.34E^{-2} RH^2 + 20.34 RH + 582.6$$

$$RH = -3E^{-11} V_{out}^3 + 3E^{-6} V_{out}^2 + 4.55E^{-2} V_{out} - 27.5$$

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

### LINEAR EQUATIONS

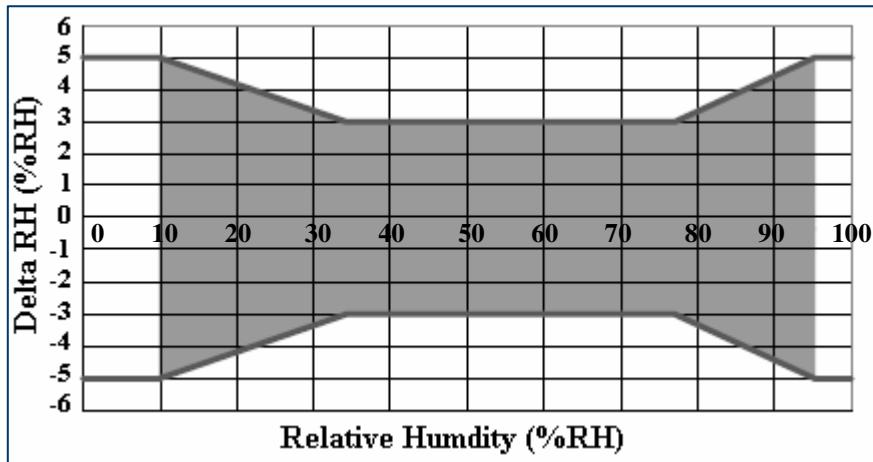
$$V_{out} = 18.19 RH + 636.8$$

$$RH = 0.055 V_{out} - 35.0$$

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

## HTG3500 Series - Relative Humidity and Temperature Module

- Humidity error budget conditions at 23°C



HTG3500 series modules are 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 HTG3500 series characteristics.

### 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 $\Omega$ 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/Humirel Application Note HPC106 "Low power NTC measurement".

## HTG3500 Series - Relative Humidity and Temperature Module

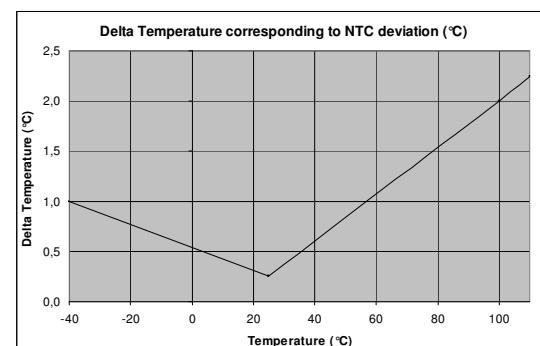
- Temperature Look-up Table

Temp (°C)	Resistance (Ω)
-40	195652
-39	184917
-38	174845
-37	165391
-36	156513
-35	148171
-34	140330
-33	132958
-32	126022
-31	119494
-30	113347
-29	107565
-28	102116
-27	96978
-26	92132
-25	87559
-24	83242
-23	79166
-22	75316
-21	71677
-20	68237
-19	64991
-18	61919
-17	59011
-16	56258
-15	53650
-14	51178
-13	48835
-12	46613
-11	44506
-10	42506
-9	40600
-8	38791
-7	37073
-6	35442
-5	33892
-4	32420
-3	31020
-2	29689
-1	28423

Temp (°C)	Resistance (Ω)
0	27219
1	26076
2	24988
3	23951
4	22963
5	22021
6	21123
7	20267
8	19450
9	18670
10	17926
11	17214
12	16534
13	15886
14	15266
15	14674
16	14108
17	13566
18	13049
19	12554
20	12081
21	11628
22	11195
23	10780
24	10382
25	10000
26	9634
27	9284
28	8947
29	8624
30	8315
31	8018
32	7734
33	7461
34	7199
35	6948
36	6707
37	6475
38	6253
39	6039

Temp (°C)	Resistance (Ω)
40	5834
41	5636
42	5445
43	5262
44	5086
45	4917
46	4754
47	4597
48	4446
49	4301
50	4161
51	4026
52	3896
53	3771
54	3651
55	3535
56	3423
57	3315
58	3211
59	3111
60	3014
61	2922
62	2834
63	2748
64	2666
65	2586
66	2509
67	2435
68	2364
69	2294
70	2228
71	2163
72	2100
73	2040
74	1981
75	1925
76	1870
77	1817
78	1766
79	1716

Temp (°C)	Resistance (Ω)
80	1669
81	1622
82	1578
83	1535
84	1493
85	1452
86	1413
87	1375
88	1338
89	1303
90	1268
91	1234
92	1202
93	1170
94	1139
95	1110
96	1081
97	1053
98	1026
99	999
100	974
101	949
102	925
103	902
104	880
105	858
106	837
107	816
108	796
109	777
110	758



0.1 °C tolerance on Resistance Measurement

# HTG3500 Series - Relative Humidity and Temperature Module

## CONNECTING AND MECHANICAL CHARACTERISTICS

### CONNECTING CHARACTERISTICS

Connector Type	Symbol	Overview	Housing	Connector Pitch	Connector Footprint	Mating Connector*
Side Connector	CH		1 & 3	-		JST ZHR-4
Short Male Connector <sup>(1) (3)</sup> (1.65 mm – 0.065 in long)	PVBS		3			Samtec CLT 104 Series
Long Male Connector <sup>(2) (3)</sup> (4.27 mm – 0.198 in long)	PVBL		3			Direct Soldering (through hole)
Female Connector <sup>(1) (3)</sup>	CFB		3		-	Samtec TMM 104-05-D

\* For alternate connector type, please contact factory.

<sup>(1)</sup> Connector should undergo vibration test before validation.  
A second fixing point add double-sided adhesive tape (ref: 3M – 5925F).

<sup>(2)</sup> For board-to-board mounting, we suggest wave soldering.

<sup>(3)</sup> Pins are connected by twos.

### Pin Out Assignment (with any connector)

N°	Function
1	Ground
2	Vcc – Voltage Supply
3	NTC – Temperature
4	Vout – Humidity

### WIRING CHARACTERISTICS

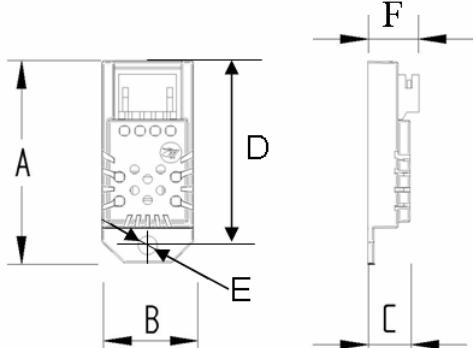
	Overview	Housing	More information
With wires		1	<p>Wiring cable length*: TBD</p> <p>Wiring cable type*: AWG 30</p>
		3	<p>Wiring cable length*: TBD</p> <p>Wiring cable type*: AWG 30</p>

### Pin Out Assignment (with wires)

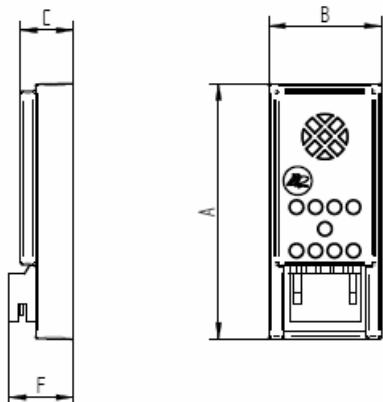
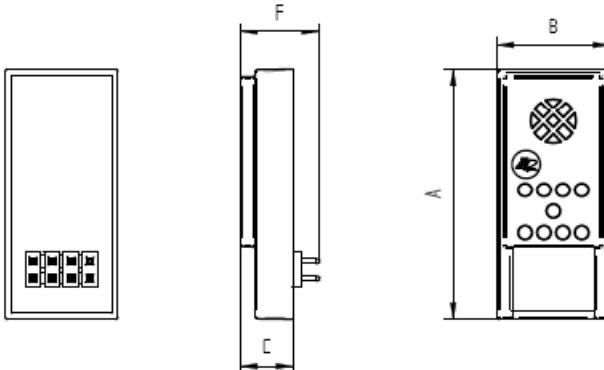
Colour	Function
Black	Ground
Red	Vcc – Voltage Supply
Green	NTC – Temperature
Yellow	Vout – Humidity

## HTG3500 Series - Relative Humidity and Temperature Module

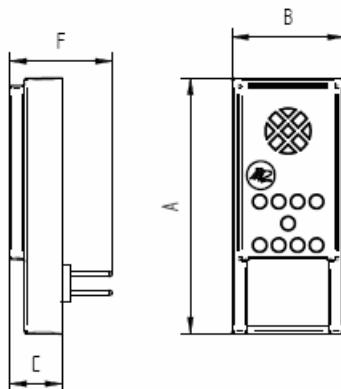
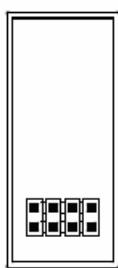
### MECHANICAL CHARACTERISTICS: HTG3500 SERIES PACKAGE OUTLINE

Housing 1 : HTG3X1Z ( <i>with screw/fastener capability</i> )		Package Outline With CH connector														
		<table border="1"> <thead> <tr> <th>Dim</th><th>Typ (mm)</th></tr> </thead> <tbody> <tr> <td>A</td><td>27 ± 0.25</td></tr> <tr> <td>B</td><td>11.9 ± 0.2</td></tr> <tr> <td>C</td><td>5.5 ± 0.2</td></tr> <tr> <td>D</td><td>24.65 ± 0.25</td></tr> <tr> <td>E</td><td>Ø2.5 ± 0.2</td></tr> <tr> <td>F</td><td>6.7 ± 0.3</td></tr> </tbody> </table> <p>Color : Black Weight : 1.5g</p>	Dim	Typ (mm)	A	27 ± 0.25	B	11.9 ± 0.2	C	5.5 ± 0.2	D	24.65 ± 0.25	E	Ø2.5 ± 0.2	F	6.7 ± 0.3
Dim	Typ (mm)															
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C	5.5 ± 0.2															
D	24.65 ± 0.25															
E	Ø2.5 ± 0.2															
F	6.7 ± 0.3															

Housing 1 can be fixed with a M2 screw.

Housing 3 : HTG3X3Z ( <i>with PTFE membrane</i> )		Package Outline with CH connector										
		<table border="1"> <thead> <tr> <th>Dim</th><th>Typ (mm)</th></tr> </thead> <tbody> <tr> <td>A</td><td>27 ± 0.25</td></tr> <tr> <td>B</td><td>11.9 ± 0.2</td></tr> <tr> <td>C</td><td>5.5 ± 0.2</td></tr> <tr> <td>F</td><td>6.7 ± 0.3</td></tr> </tbody> </table> <p>Color : Black Weight : 1.8g</p>	Dim	Typ (mm)	A	27 ± 0.25	B	11.9 ± 0.2	C	5.5 ± 0.2	F	6.7 ± 0.3
Dim	Typ (mm)											
A	27 ± 0.25											
B	11.9 ± 0.2											
C	5.5 ± 0.2											
F	6.7 ± 0.3											
		Package Outline with PVBS connector (1.65 mm – 0.065 in long)										
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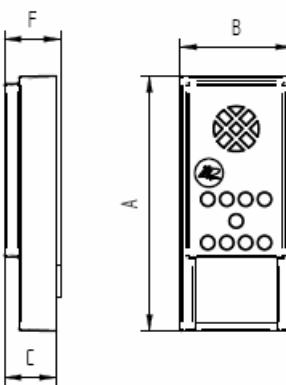
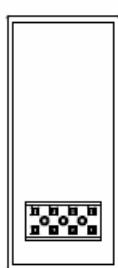
## HTG3500 Series - Relative Humidity and Temperature Module



Package Outline  
with PVBL connector  
(4.27 mm – 0.198 in long)

Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.5 ± 0.2
F	10.8 ± 0.5

Color : Black  
Weight : 1.8g



Package Outline  
with CFB connector

Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.5 ± 0.2
F	5.96 ± 0.5

Color : Black  
Weight : 1.8g

Double coated adhesive tape could be used on potted area for housings 1 and 3 (ref: 3M – 5925F) to fix parts.

### RESISTANCE TO PHYSICAL AND CHEMICAL STRESSES

HTG3500 Series contain circuits to protect its inputs and outputs against Electrostatic discharges (ESD) up to ±15kV, air discharge.

HTG3500 Series are protected against EMC interferences.

HTG3500 Series are protected against reverse polarity.

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, a non-exhaustive list.

HTG3500 Series are not light sensitive.

# HTG3500 Series - Relative Humidity and Temperature Module

## ORDERING INFORMATION

### HTG3XYZ yyy

X		Y		Z		yyy			
Output Voltage		Housing		Voltage Supply		Connector Type			
4	5	1	3	3	5	CH	PVBS	PVBL	CFB
Frequency	Voltage	with screw/fastener capability	with PTFE membrane	3.3V	5V				

#### 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
<b>0</b>	Creation document	D. LE GALL	August 07
<b>A</b>	Paragraph concerning wiring characteristics added	D. LE GALL	September 07
<b>B</b>	NTC LUT updated	D. LE GALL	November 07
<b>C</b>	Information relative to the influence of power supply on modules outputs removed and Standardized datasheet format	D. LE GALL	April 08
<b>D</b>	RH Nominal output for HTG35Y3 updated	D. LE GALL	May 08

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