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

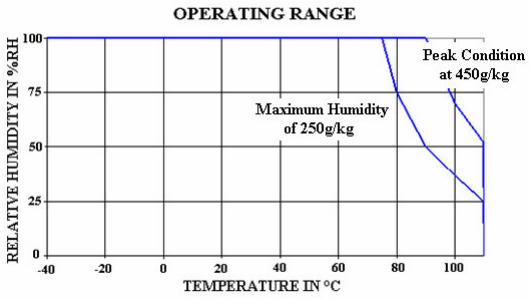
…

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	Pd	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>1MΩ 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) (1)	I			1	mA
Warm up time	t_w		150		ms
Time Constant (at 63% of signal) 33%RH to 75%RH (2)	τ		5	10	s

(1) Conditions of sink current: Vout + 0.054V (3%RH) at Vout = 0.600 V (Vout 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	τ		10		s

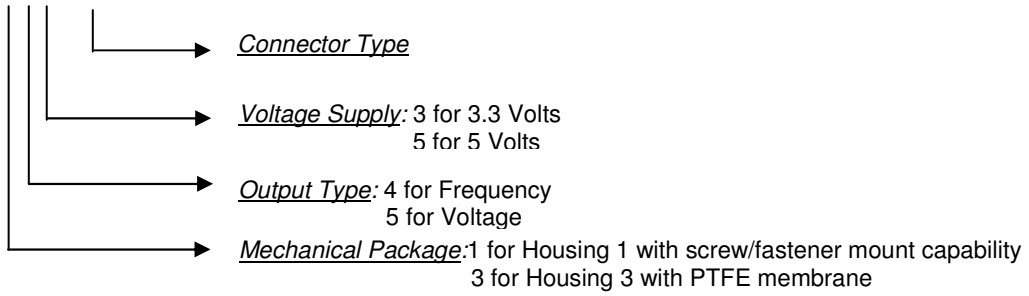
** Except for low temperatures*

POWER SUPPLY OPTION OF HTG3500 SERIES AT 3.3V_{DC} OR AT 5V_{DC}

At 3.3V_{DC} or at 5V_{DC} power supply, there is no measurable impact of type of powering on temperature and RH accuracy.

NOMENCLATURE

HTG3XYZ yyy



SPECIFIC ELECTRICAL AND METROLOGICALCHARACTERISTICS

- **HTG35Y3**

Characteristics	Symbol	Min	Typ	Max	Unit
Voltage Supply (1) (2)	V_{cc}	3	3.3	3.46	V_{dc}
Nominal Output @55%RH	V_{out}	1.581	1.635	1.689	V
Humidity Average Sensitivity	ΔmV/RH	-	+18	-	mV/%RH
Current consumption	I_{cc}	-	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 (1) (2)	V_{cc}	4.75	5	5.25	V_{dc}
Nominal Output @55%RH	V_{out}	2.420	2.480	2.540	V
Humidity Average Sensitivity	ΔmV/RH	-	+26	-	mV/%RH
Current consumption	I_{cc}	-	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

Reference Output Values (Vcc = 5V)
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 %

HTG35Y3 Modeled Voltage Output

Reference Output Values (Vcc = 3.3V)
In any power mode

RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	785	55	1635
15	885	60	1725
20	980	70	1815
25	1080	75	1905
30	1175	80	1995
35	1270	85	2080
40	1360	90	2165
45	1455	95	2255
50	1545	100	2340

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 %

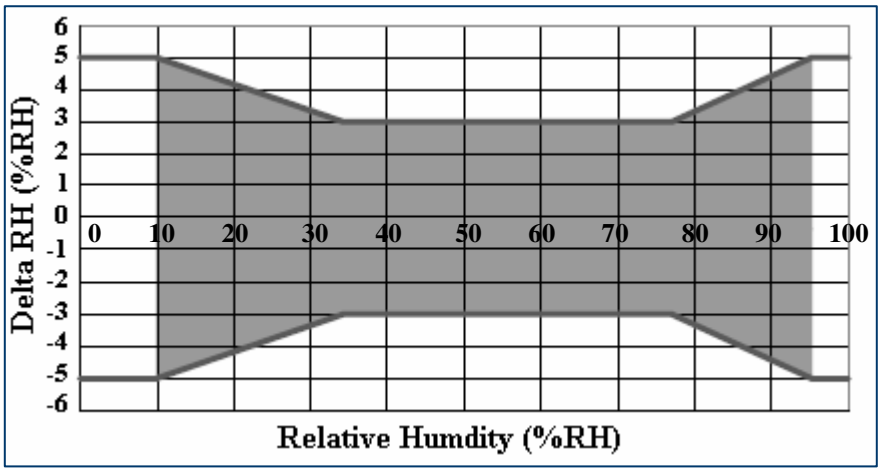
LINEAR EQUATIONS

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

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

with V_{out} in mV and RH in %

- **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 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.

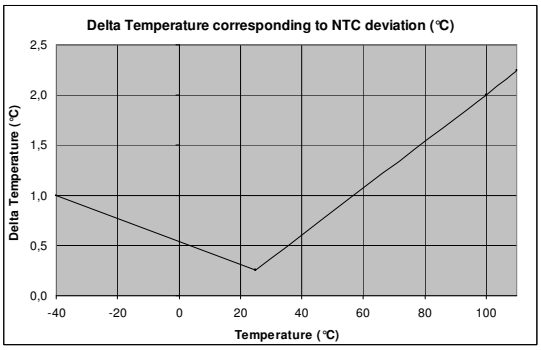
② For practical applications, a more precise description of the real R/T curve may be required. Either more complicated approaches (e.g. the Steinhart-Hart equation) are used or the resistance/temperature relation as given in tabulation form. The below table has been experimentally determined with utmost 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”.

HTG3500 Series - Relative Humidity and Temperature Module

- **Temperature Look-up Table**

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-40	195652	0	27219	40	5834	80	1669
-39	184917	1	26076	41	5636	81	1622
-38	174845	2	24988	42	5445	82	1578
-37	165391	3	23951	43	5262	83	1535
-36	156513	4	22963	44	5086	84	1493
-35	148171	5	22021	45	4917	85	1452
-34	140330	6	21123	46	4754	86	1413
-33	132958	7	20267	47	4597	87	1375
-32	126022	8	19450	48	4446	88	1338
-31	119494	9	18670	49	4301	89	1303
-30	113347	10	17926	50	4161	90	1268
-29	107565	11	17214	51	4026	91	1234
-28	102116	12	16534	52	3896	92	1202
-27	96978	13	15886	53	3771	93	1170
-26	92132	14	15266	54	3651	94	1139
-25	87559	15	14674	55	3535	95	1110
-24	83242	16	14108	56	3423	96	1081
-23	79166	17	13566	57	3315	97	1053
-22	75316	18	13049	58	3211	98	1026
-21	71677	19	12554	59	3111	99	999
-20	68237	20	12081	60	3014	100	974
-19	64991	21	11628	61	2922	101	949
-18	61919	22	11195	62	2834	102	925
-17	59011	23	10780	63	2748	103	902
-16	56258	24	10382	64	2666	104	880
-15	53650	25	10000	65	2586	105	858
-14	51178	26	9634	66	2509	106	837
-13	48835	27	9284	67	2435	107	816
-12	46613	28	8947	68	2364	108	796
-11	44506	29	8624	69	2294	109	777
-10	42506	30	8315	70	2228	110	758
-9	40600	31	8018	71	2163		
-8	38791	32	7734	72	2100		
-7	37073	33	7461	73	2040		
-6	35442	34	7199	74	1981		
-5	33892	35	6948	75	1925		
-4	32420	36	6707	76	1870		
-3	31020	37	6475	77	1817		
-2	29689	38	6253	78	1766		
-1	28423	39	6039	79	1716		

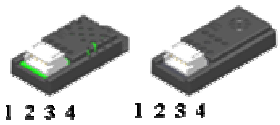
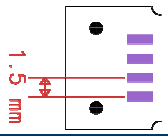
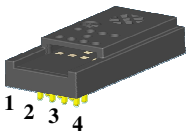
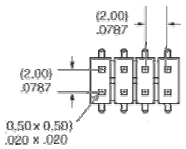
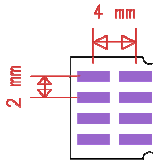
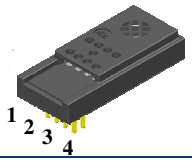
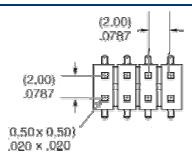
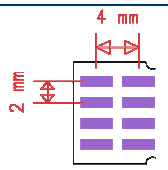
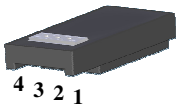
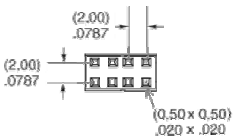


0.1°C tolerance on Resistance Measurement

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 (1) (3) (1.65 mm – 0.065 in long)	PVBS		3			Samtec CLT 104 Series
Long Male Connector (2) (3) (4.27 mm – 0.198 in long)	PVBL		3			Direct Soldering (through hole)
Female Connector (1) (3)	CFB		3		-	Samtec TMM 104-05-D

** For alternate connector type, please contact factory.*

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

(2) For board-to-board mounting, we suggest wave soldering.

(3) 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	Wiring cable length*: TBD Wiring cable type*: AWG 30
		3	Wiring cable length*: TBD Wiring cable type*: AWG 30

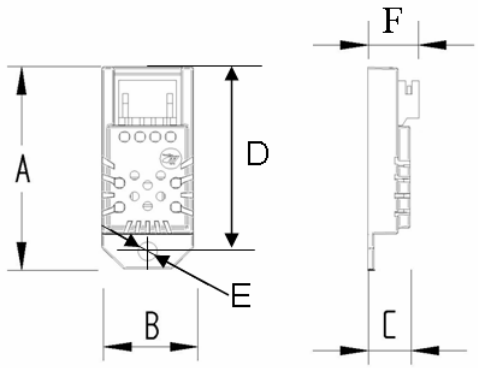
Pin Out Assignment (with wires)

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 *(with screw/fastener capability)*



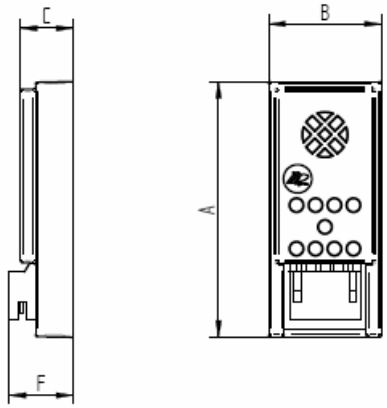
Package Outline
With CH connector

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

Color : Black
Weight : 1.5g

Housing 1 can be fixed with a M2 screw.

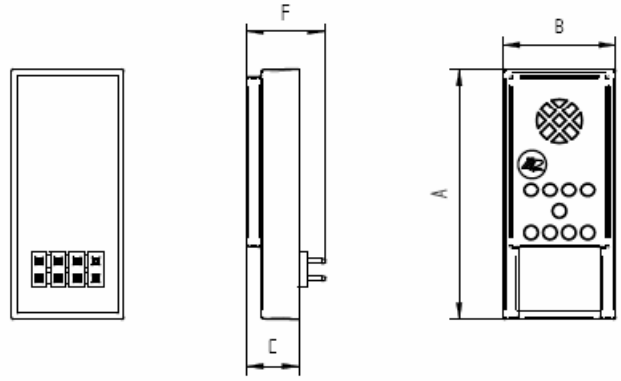
Housing 3 : HTG3X3Z *(with PTFE membrane)*



Package Outline
with CH connector

Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.5 ± 0.2
F	6.7 ± 0.3

Color : Black
Weight : 1.8g

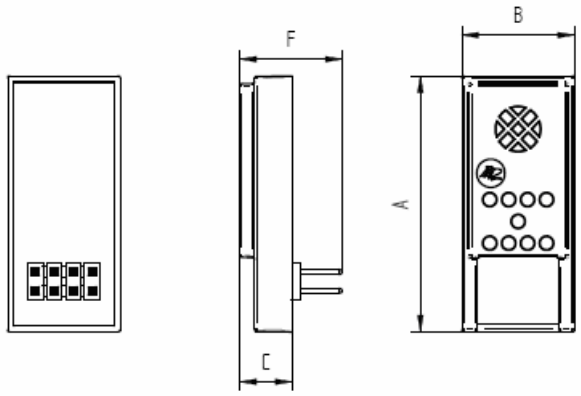


Package Outline
with PVBS connector
(1.65 mm – 0.065 in long)

Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.5 ± 0.2
F	8.2 ± 0.5

Color : Black
Weight : 1.8g

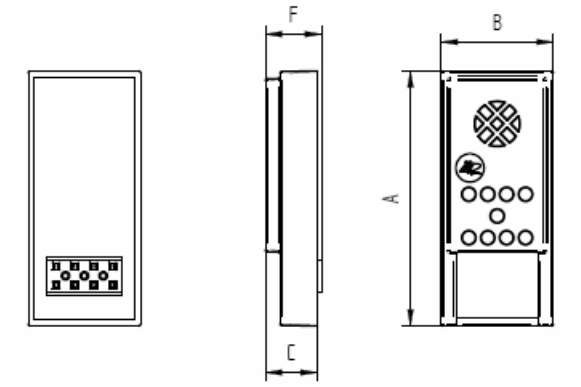
HTG3500 Series - Relative Humidity and Temperature Module



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 CHEMINAL 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_2 (0.5%), H_2S (0.5%), O_3, NO_x, NO, CO, CO_2, Softener, Soap, Toluene, acids (H_2SO_4, HNO_3, 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

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

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