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 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

- Demonstrated reliability and long term stability
- Reliability not affected by repeated condensation

APPLICATIONS

- Automotive
- Home Appliance
- Printers

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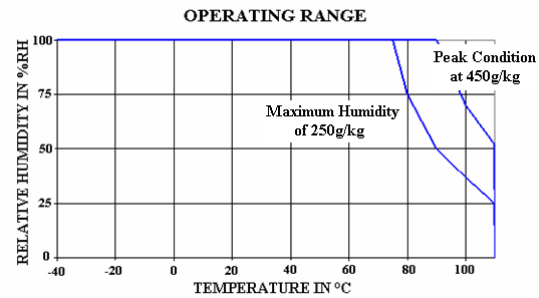
PERFORMANCE SPECS

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.



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 (90% of signal)	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

HTG35YZ CH

- *Connector Type*
- *Voltage Supply:* 3 for 3,3 Volts; 5 for 5 Volts
- *Mechanical Package:* 1 for Housing with screw/fastener mount capability; 3 for Housing with PTFE membrane
- *5 : Voltage*

HTG3500 Series - Relative Humidity and Temperature Module

Specific electrical and metrological characteristics

- **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}	1.462	1.515	1.568	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}	2.401	2.480	2.559	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	**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 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	690	**55**	1515
15	795	**60**	1595
20	895	**65**	1680
25	990	**70**	1765
30	1080	**75**	1850
35	1170	**80**	1940
40	1255	**85**	2030
45	1345	**90**	2120
50	1430	**95**	2205

POLYNOMIAL EQUATIONS

$V_{out} = 5.57E^{-4}\ RH^3 – 9.81E^{-2}\ RH^2 + 22.55\ RH + 477.2$

$RH = -5.38E^{-9}\ V_{out}^3 + 2.55E^{-5}\ V_{out}^2 + 1.9E^{-2}\ V_{out} - 13.5$

with V_{out} in mV and RH in %

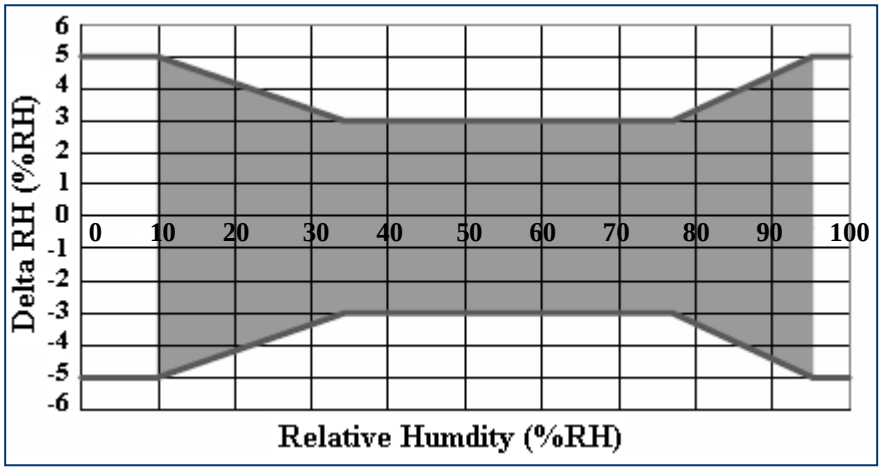
LINEAR EQUATIONS

$V_{out} = 17.52\ RH + 544.1$

$RH = 0.057\ V_{out} – 31.0$

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.

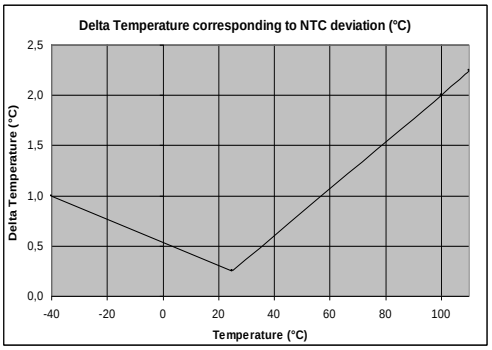
② For practical applications, a more precise description of the real R/T curve may be required. Either more complicated approaches (e.g. the Steinhart-Hart equation) are used or the resistance/temperature relation as given in tabulation form. The below table has been experimentally determined with utmost 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 Application Note HPC106 “Low power NTC measurement”.

HTG3500 Series - Relative Humidity and Temperature Module

- **Temperature Look-up Table**

Temp (°C)	R (Ω)	Temp (°C)	R (Ω)	Temp (°C)	R (Ω)	Temp (°C)	R (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

- **Steinhart-Hart coefficients**

According to the equation below, the Steinhart-Hart coefficients for the operating temperature range for HTG3500 products thermistor are:

$$\frac{1}{T} = a + b * \ln(R) + C * \ln(R) * \ln(R) * \ln(R)$$

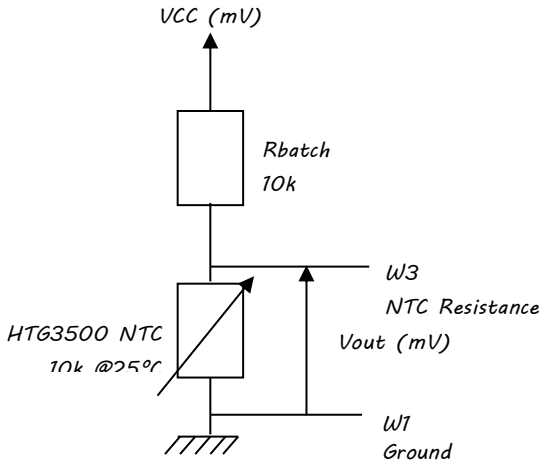
R	NTC resistance in Ω at temperature T in K
T	Temperature in K
a	Constant value (a= 8.61393E-04)
b	Constant value (b= 2.56377E-04)
c	Constant value (c= 1.68055E-07)

- **Temperature Interface circuit**

Concerning the temperature sensor of the HTG3500 Series products, the following measuring method described below is based on a voltage bridge divider circuit. It uses only one resistor component (Rbatch) at 1% to design HTM2500 temperature sensor interfacing circuit.

Rbatch is chosen to be equal to NTC @25°C to get: Vout = Vcc/2 @25°C.

The proposal method connects Rbatch to Vcc (5Vdc) and NTC to Ground. It leads to a negative slope characteristic (Pull-Up Configuration).

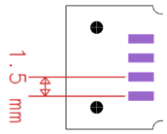


$$V_{OUT}(mV) = \frac{Vcc(mV) * NTC_{HTG3500}(\Omega)}{R_{batch}(\Omega) + NTC_{HTG3500}(\Omega)}$$

Temperature (°C)	Resistance (Ω)	Pull-Up Configuration Vout (mV)
-40	195652	4757
-30	113347	4595
-20	68237	4361
-10	42506	4048
0	27219	3657
10	17926	3210
20	12081	2736
25	10000	2500
30	8315	2270
40	5834	1842
50	4161	1469
60	3014	1158
70	2228	911
80	1669	665
90	1268	563
100	974	444
110	758	352

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

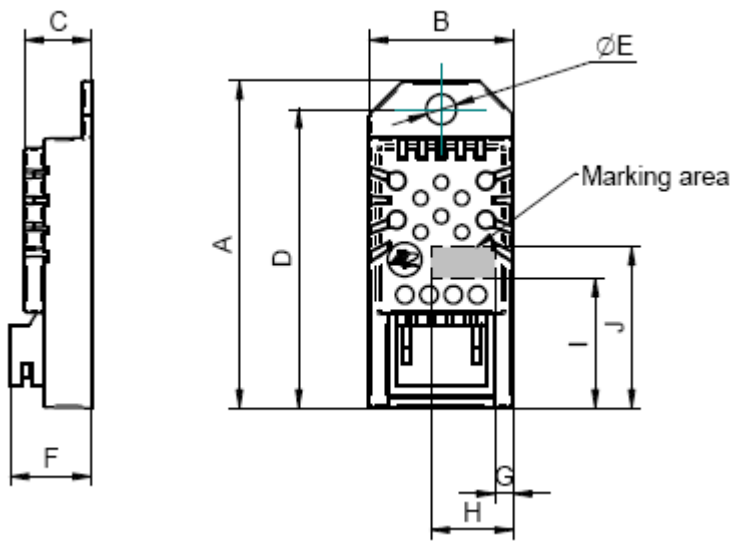
***** *For alternate connector type, please contact factory.*

Pin Out Assignment

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

MECHANICAL CHARACTERISTICS: HTG3500 SERIES PACKAGE OUTLINE

Housing 1 : HTG351ZCH *(with screw/fastener capability)*



Package Outline
With CH connector

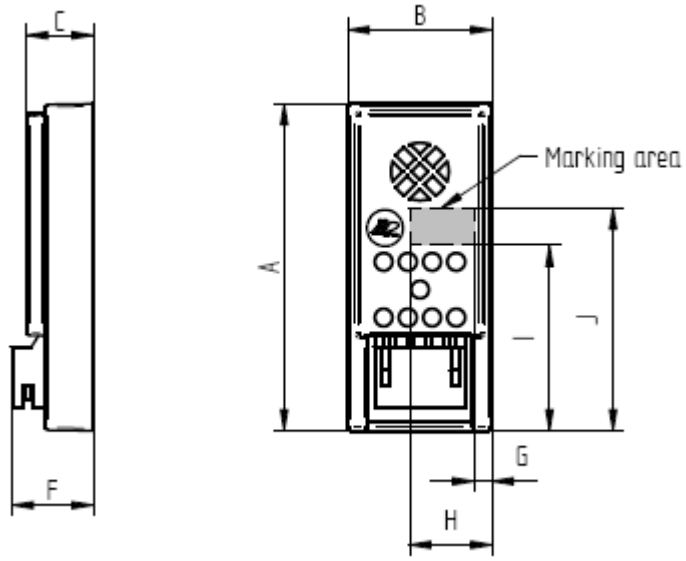
Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.7 ± 0.5
D	24.65 ± 0.25
E	Ø2.5 ± 0.2
F	6.7 ± 0.3
G	1.5 ± 0.5
H	6.8 ± 0.5
I	10.7 ± 0.5
J	13.3 ± 0.5

Color : Black

Weight : 1.5g

Housing 1 can be fixed with a M2 screw. The recommended maximum mounting torque is 0.22 Nm.

Housing 3 : HTG3535CH *(with PTFE membrane)*



Package Outline
with CH connector

Dim	Typ (mm)
A	27 ± 0.25
B	11.9 ± 0.2
C	5.7 ± 0.5
F	6.7 ± 0.3
I	1.5 ± 0.5
J	6.8 ± 0.5
K	15.3 ± 0.5
L	18.4 ± 0.5

Color : Black

Weight : 1.8g

RESISTANCE TO PHYSICAL AND CHEMINAL STRESSES

HTG3500 Series have passed through qualification processes of MEAS-France including vibration, shock, storage, high temperature and humidity, ESD.

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.

ORDERING INFORMATION

HTG35YZ CH

X	Y		Z		CH
Output voltage	Housing		Voltage supply		Connector Type
5	1	3	3	5	CH
Voltage	With screw/fastener	With PTFE membrane	3,3V	5	

Product	Order Reference
HTG3513CH	HPP815A533
HTG3515CH	HPP815A535
HTG3535CH	HPP815F535

Samples are available through MEASUREMENT SPECIALTIES web site:
http://www.meas-spec.com/humidity-sensors.aspx

Customer Service contact details
Measurement Specialties, Inc - MEAS France
Impasse Jeanne Benozzi
CS 83 163
31027 Toulouse Cedex 3
FRANCE
Tel:+33 (0)5 820.822.02
Fax:+33 (0)5.820.821.51
Sales: humidity.sales@meas-spec.com

HTG3500 Series - Relative Humidity and Temperature Module

Revision	Comments	Who	Date
F	RH LUT @3.3V updated, Steinhart-Hart equation and temperature interface circuit added, max torque for housing 1 added, marking location area and dimensions updated, resistance to physical and chemical stresses paragraph updated	D. LE GALL	June 09
G	Wiring characteristics updated and dimension C rectified	D. LE GALL	January 10
H	Package outline updated for PVBL and PVBS modules, dimensions C and D rectified for housing 3, HPP references added	D. LE GALL	December 10
I	New MEAS Template applied, updated PVBS/PVBL/CFB connector dimension definition in Mechanical Characteristics paragraph	D. LE GALL	January 12
J	MEAS-France contact details updated	D. LE GALL-ZIRILLI	October 12
K	References updated	M. BITARD	November 14

Mouser Electronics

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TE Connectivity:

HTG3535PVBL HPP815A535 HTG353XCH / PVBL