HTG3500 Series

Compliant with RoHS regulations

RELATIVE HUMIDITY AND TEMPERATURE MODULE

Based on the rugged 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.

• HTG3500 SERIES GENERAL CHARACTERISTICS

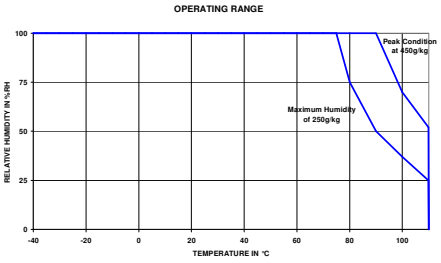
Main Features

- **Suitable for small bulk assembly**
- **Product free from Lead, Cr (6+), Cd and Hg. Compliant with RoHS**
- Reliability not affected by repeated condensation
- **Full interchangeability. Better than +/-3% RH and +/-0.25°C**
- Demonstrated reliability and long term stability
- **Humidity calibrated within +/- 3% RH @ 55% RH**
- **Temperature measurement through NTC direct output**
- Ratiometric to voltage supply within the specified range
- HTG3500 Series are also available with a Humidity Linear Frequency Output: HTG3400 Series (HPC124_0)

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	t_w		150		ms
Time Constant (at 63% of signal) 33%RH to 75%RH (2)	τ		5	10	s

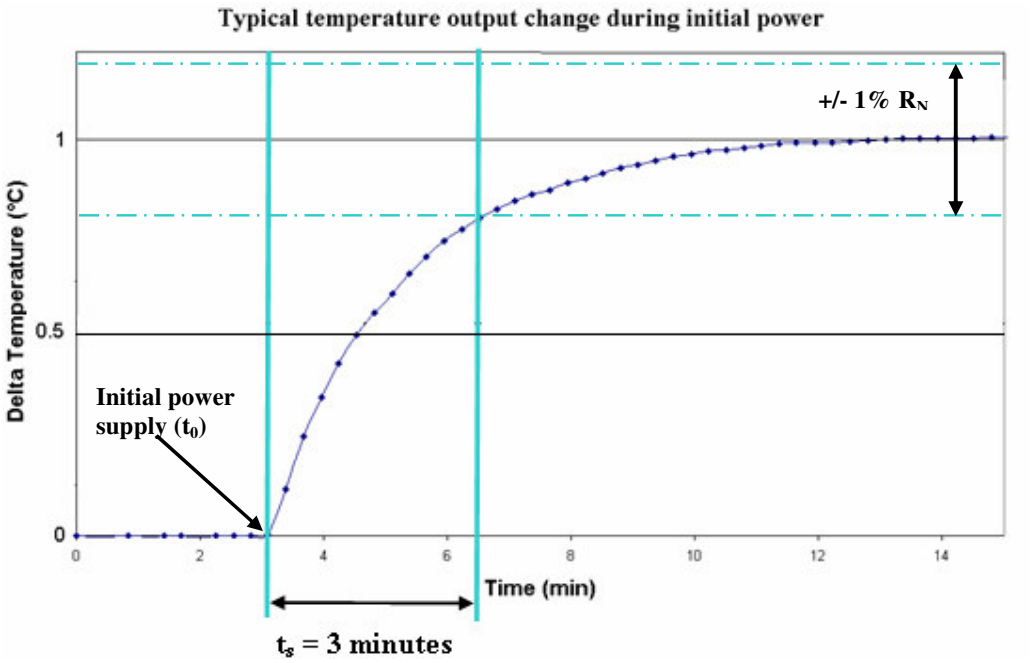
(1) Conditions of sink current: Vout + 0.054V (3%RH) at Vout = 0.600 V (Vout min)
(2) At 1m/s air flow

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

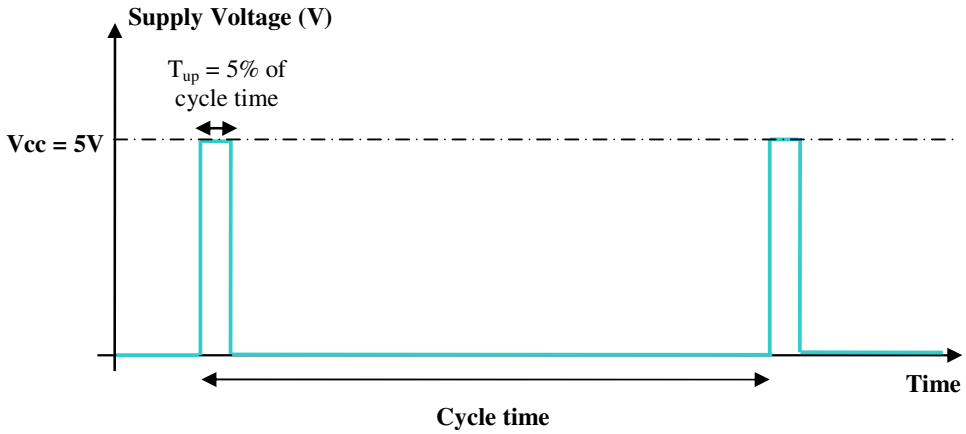
* *Except for low temperatures*

Power Supply option of HTG3500 Series at $5V_{DC}$

Continuous Mode:
When powering HTG3500 series modules at $5V_{DC}$ in continuous mode, an initial 3-minute stabilization time (t_s) is necessary to reach the temperature and the RH outputs with an optimum accuracy.



Pulsed Mode:
When powering HTG3500 series modules in pulsed mode, accurate temperature and RH measurement is reached instantaneously. Time up (T_{up}) must be of 5% of the cycle time. Minimum time up (T_{up}) is 150 ms. Thus minimum cycle time is 3s.

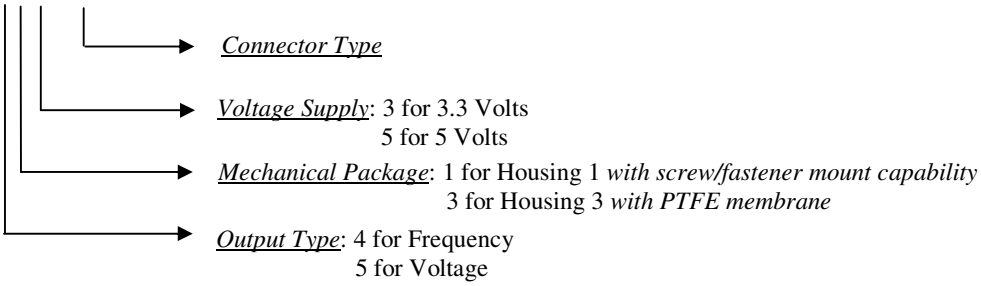


Power Supply option of HTG3500 Series at $3.3V_{DC}$

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

Nomenclature

HTG3XYZ yyy



• SPECIFIC ELECTRICAL AND METROLOGICAL CHARACTERISTICS

Electrical 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}	1.640	1.695	1.750	V
Humidity Average Sensitivity (in continuous and pulsed mode)	ΔmV/RH	-	+18	-	mV/%RH
Current consumption (in continuous and pulsed mode)	I_{cc}	-	1.5	3.0	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 in pulsed mode	V_{out}	2.510	2.570	2.630	V
Nominal Output @55%RH in continuous mode	V_{out}	2.420	2.480	2.540	V
Humidity Average Sensitivity in pulsed mode	ΔmV/RH	-	+26	-	mV/%RH
Humidity Average Sensitivity in continuous mode	ΔmV/RH	-	+25	-	mV/%RH
Current consumption (in continuous and pulsed mode)	I_{cc}	-	3.2		mA dc

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

Humidity Sensor

HTG35Y5 Modeled Voltage Output

Reference Output Values (Vcc = 5V)
In Pulsed Mode (5%)

RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	1325	**55**	2570
15	1480	**60**	2695
20	1630	**65**	2820
25	1775	**70**	2950
30	1915	**75**	3080
35	2050	**80**	3215
40	2180	**85**	3350
45	2310	**90**	3490
50	2440	**95**	3620

POLYNOMIAL EQUATIONS

$V_{out} = 8.44E^{-4}\ RH^3 - 0.1486\ RH^2 + 34.16\ RH + 999$

$RH = -1.57E^{-9}\ V_{out}^3 + 1.25E^{-5}\ V_{out}^2 + 5.88E^{-3}\ V_{out} - 16.1$

with V_{out} in mV and RH in %

LINEAR EQUATIONS

$V_{out} = 26.55\ RH + 1100$

$RH = 0.0376\ V_{out} - 41.40$

with V_{out} in mV and RH in %

Reference Output Values (Vcc = 5V)
In Continuous Mode

RH (%)	Vout (mV)	RH (%)	Vout (mV)
10	1310	**55**	2480
15	1455	**60**	2600
20	1595	**65**	2715
25	1735	**70**	2840
30	1865	**75**	2960
35	1995	**80**	3085
40	2120	**85**	3215
45	2240	**90**	3345
50	2360	**95**	3465

POLYNOMIAL EQUATIONS

$V_{out} = 8{,}24E^{-4}\ RH^3 - 0.1467\ RH^2 + 32.5\ RH + 998$

$RH = -1.96E^{-9}\ V_{out}^3 + 1.52E^{-5}\ V_{out}^2 + 2.72E^{-3}\ V_{out} - 15.1$

with V_{out} in mV and RH in %

LINEAR EQUATIONS

$V_{out} = 24.94\ RH + 1101$

$RH = 0.0401\ V_{out} - 44.1$

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	845	**55**	1695
15	945	**60**	1785
20	1040	**65**	1875
25	1140	**70**	1965
30	1235	**75**	2055
35	1330	**80**	2140
40	1420	**85**	2225
45	1515	**90**	2315
50	1605	**95**	2400

POLYNOMIAL EQUATIONS

$V_{out} = 8{,}83E^{-5}\ RH^3 - 2{,}95E^{-2}\ RH^2 + 20.5\ RH + 643$

$RH = -5.57E^{-10}\ V_{out}^3 + 5.3E^{-6}\ V_{out}^2 + 4.23E^{-2}\ V_{out} - 29.1$

with V_{out} in mV and RH in %

LINEAR EQUATIONS

$V_{out} = 18.24\ RH + 683$

$RH = 0{,}0549\ V_{out} - 37.4$

with V_{out} in mV and RH in %

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)

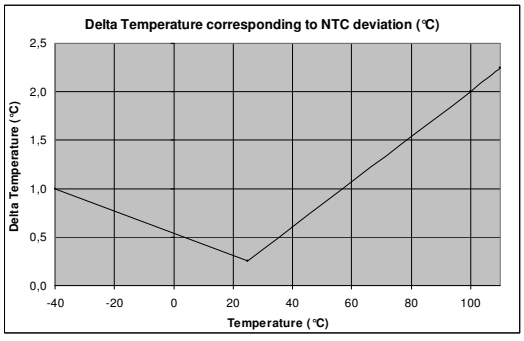
① The exponential relation only roughly describes the actual characteristic of an NTC thermistor can, however, as the material parameter β in reality also depend on temperature. So this approach is suitable for describing a restricted range around the rated temperature or resistance with sufficient accuracy.

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 Humirel Application Note HPC106-0 "Low power NTC measurement".

Temperature Look-Up Table in pulsed mode or for a 3.3 voltage supply

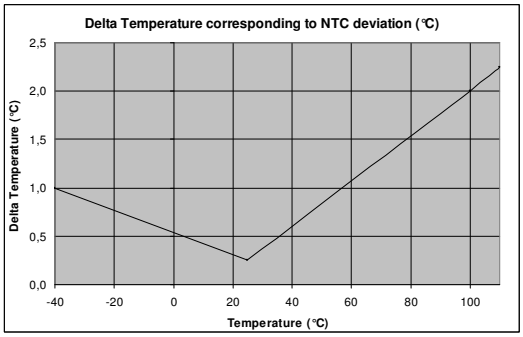
Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-40	195652	0	27219	40	5834	80	1669
-39	184917	1	26076	41	5636	81	1622
-38	174845	2	24988	42	5445	82	1578
-37	165391	3	23951	43	5262	83	1535
-36	156513	4	22963	44	5086	84	1493
-35	148171	5	22021	45	4917	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

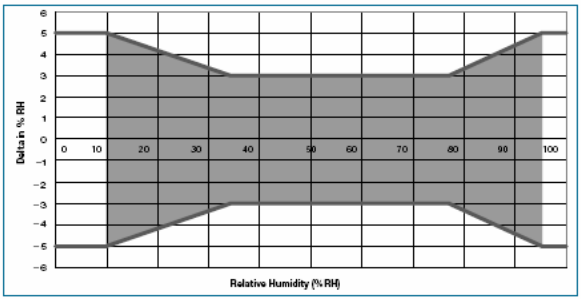
Temperature Look-Up Table for a 5V continuous voltage supply

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-40	176844	0	26018	40	5618	80	1555
-39	168835	1	24980	41	5432	81	1515
-38	161153	2	23982	42	5254	82	1473
-37	153786	3	23024	43	5082	83	1431
-36	146725	4	22103	44	4916	84	1391
-35	139958	5	21219	45	4757	85	1352
-34	133477	6	20371	46	4603	86	1314
-33	127271	7	19557	47	4454	87	1277
-32	121331	8	18777	48	4311	88	1241
-31	115648	9	18028	49	4172	89	1206
-30	110213	10	17311	50	4038	90	1173
-29	105017	11	16623	51	3908	91	1140
-28	100052	12	15965	52	3783	92	1108
-27	95309	13	15334	53	3661	93	1076
-26	90780	14	14730	54	3543	94	1046
-25	86457	15	14152	55	3429	95	1017
-24	82332	16	13598	56	3319	96	988
-23	78398	17	13069	57	3212	97	960
-22	74648	18	12562	58	3108	98	934
-21	71074	19	12078	59	3008	99	907
-20	67670	20	11615	60	2911	100	882
-19	64428	21	11172	61	2817	101	857
-18	61342	22	10748	62	2727	102	833
-17	58405	23	10343	63	2640	103	810
-16	55612	24	9956	64	2557	104	787
-15	52956	25	9586	65	2477	105	765
-14	50432	26	9233	66	2401	106	743
-13	48034	27	8895	67	2329	107	722
-12	45755	28	8571	68	2261	108	702
-11	43592	29	8262	69	2197	109	682
-10	41539	30	7966	70	2137	110	663
-9	39590	31	7684	71	2081		
-8	37741	32	7413	72	2031		
-7	35988	33	7154	73	1985		
-6	34325	34	6906	74	1945		
-5	32748	35	6668	75	1910		
-4	31254	36	6440	76	1707		
-3	29837	37	6222	77	1654		
-2	28495	38	6012	78	1604		
-1	27223	39	5811	79	1559		



0.1°C tolerance on Resistance Measurement

Humidity Error Budget Conditions at 23°C

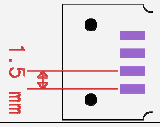
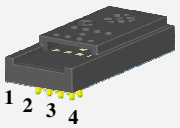
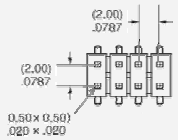
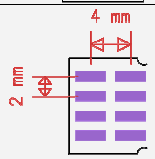
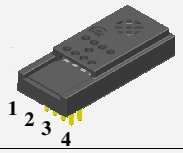
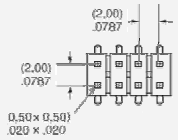
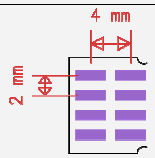
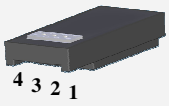
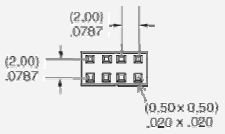


- HTG3500 series modules are specified for maximum accuracy measurements within 10 to 95 %RH.

- Excursion out of this range (< 10% or > 95% RH, including condensation) does not affect the reliability of HTG3500 series characteristics.

• 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

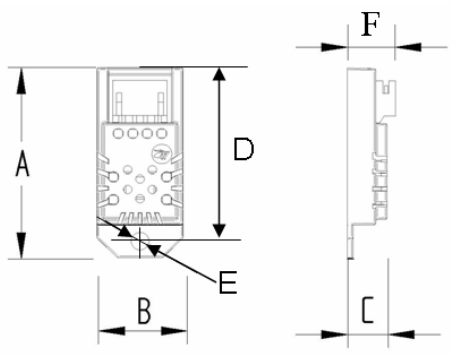
Pin Out Assignment (with wires)

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

Mechanical Characteristics

HTG3500 Series Package Outline

Housing 1 : HTG3X1Z *(with screw/fastener capability)*



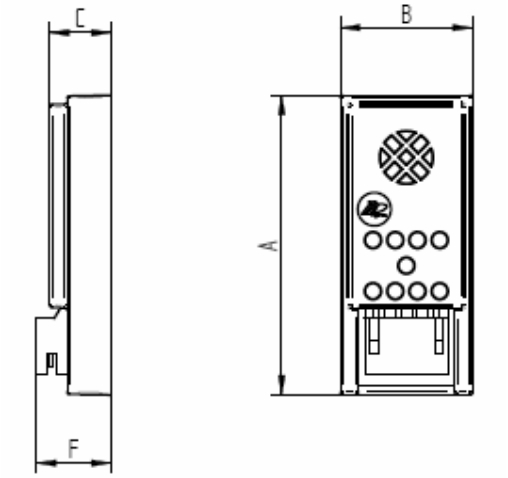
Package Outline
With CH connector

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.

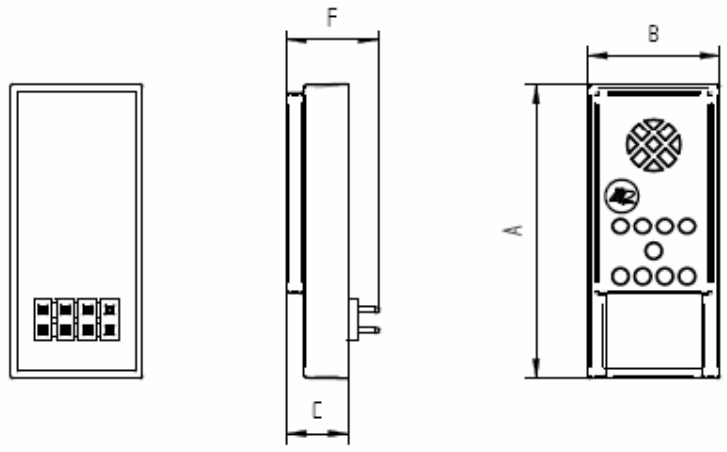
Housing 3 : HTG3X3Z *(with PTFE membrane)*



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

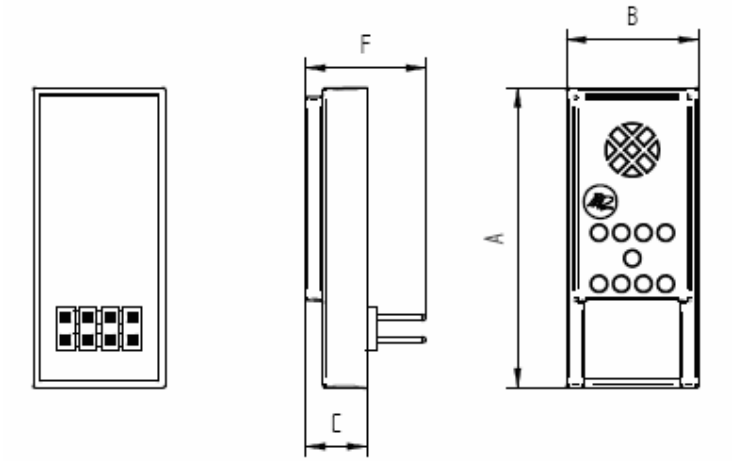
Color : Black
Weight : 1.8g



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

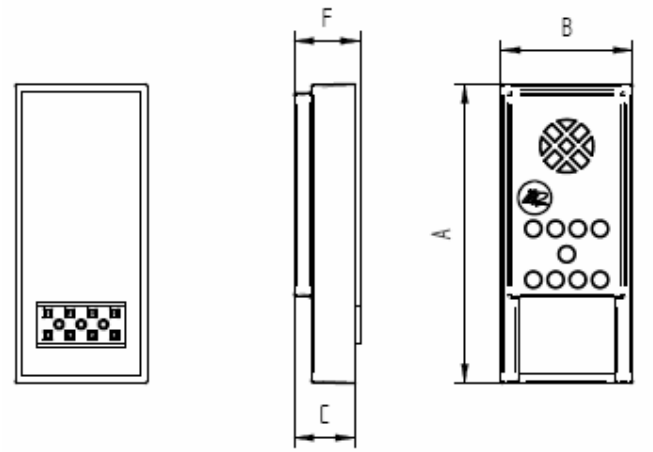
Color : Black
Weight : 1.8g



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_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

HTG3XYZ yyy

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

email: sales@humirel.com

Revision	Who	Date	Comments
0	Issue Originale	D. LE GALL	August 07
A	Paragraph concerning wiring characterisctics added	D. LE GALL	September 07
B	CTN LUT updated	D. LE GALL	November 07

• DISCLAIMER