HTG3800 Series W/O TC – Relative Humidity and Temperature Module

- **Compact plug and play module with no external component required**
- **Can operate under 5VDC or 3.3VDC**
- **SPI Digital interface**
- **Compliant with RoHS**
- **Full interchangeability. No calibration required.**
- **Low power consumption**

DESCRIPTION

Based on the rugged MEAS-FRANCE humidity sensor, the HTG3800 Series W/O TC are dedicated humidity and temperature plug and play transducer designed for OEM applications where reliable and accurate measurements are needed. Direct interface with a micro-controller is made possible with the module humidity and temperature digital outputs. The HTG3800 Series are designed for high volume and demanding applications where power consumption is critical.

FEATURES

- Digital output serial
- Linear response for Humidity and Temperature
- Full interchangeability with no calibration required in standard conditions
- Demonstrated reliability and long term stability
- Reliability not affected by repeated condensation
- Instantaneous desaturation after long periods in saturation phase

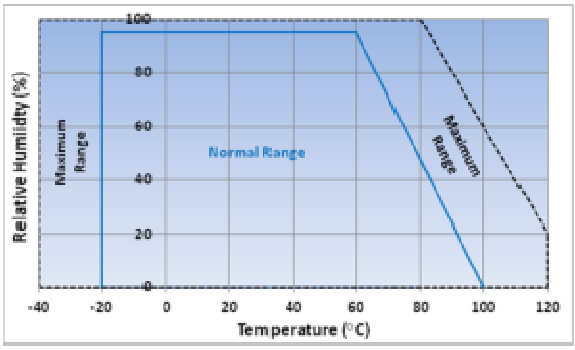
APPLICATIONS

- Automotive
- Home appliance
- Medical
- Humidifier
- Printer

PERFORMANCE SPECS

MAXIMUM RATINGS

Ratings	Symbol	Value	Unit
Storage Temperature	T_{stg}	-40 to +125	℃
Supply Voltage (Peak)	V_{cc}	20	V_{dc}
Humidity Operating Range	RH	0 to 100	%RH
Temperature Operating Range	T_a	10 to 40	℃
Maximum Power	Pd	4	mW



HTG3800 Series W/O TC – Relative Humidity and Temperature Module

ELECTRICAL AND GENERAL ITEMS

Characteristics		Symbol	Min	Typ	Max	Unit
Voltage Supply	HTG3833 products	VDD	3.2	3.3	3.4	V
	HTG3835 products		4.75	5	5.25	V
Current consumption (1)	HTG3833 products	idd		0.6	1.2	mA
	HTG3835 products			1	2	mA
Communication		Digital (2-wire interface)				
Storage		10-50℃ (0℃ / 125℃ peak), 20 -60%RH				

(1) Conditions: SCK= 1 MHz at 25℃

NOMENCLATURE

HTG383X yyy Series W/O TC Modules

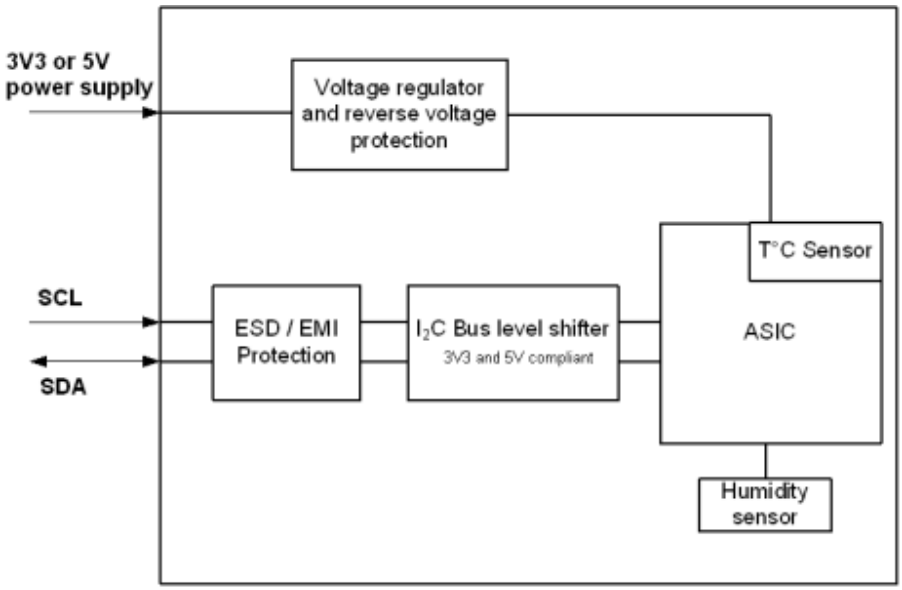
Connector type: **yyy = CH or PVBL**

Voltage supply: **X=3 : Vcc=3.3V**
X=5 : Vcc=5V

HTG383XCH W/O TC Modules

HTG383XPVBL W/O TC Modules

BLOCK DIAGRAM



HTG3800 Series W/O TC – Relative Humidity and Temperature Module

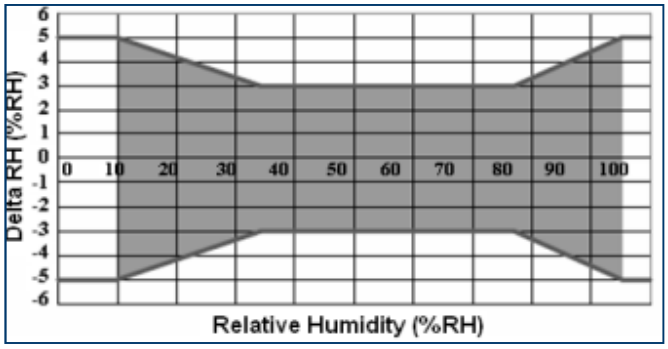
SENSOR PERFORMANCES

(@T = 25℃, @Vdd = 3.3V or 5V)

Characteristics	Symbol	Min	Typ	Max	Unit
Resolution			12		bits
			0.05		%RH
Humidity Measuring Range	RH	0		100	%RH
Relative Humidity Accuracy (10% to 95%RH)			±3	±5	%RH
Replacement	fully interchangeable				
Temperature Coefficient (10℃ to 50℃)	T_{cc}		-0.1		%RH/℃
Humidity Hysteresis				±1	%RH
Measuring Time (12 bits)			110		ms
Recovery time after 150 hours of condensation	t		10		s
Long term drift			-0.5		%RH/yr
Response Time (at 63% of signal) from 33 to 75%RH (1)	τ_{RH}		5	10	s

(1) At 1m/s air flow

HUMIDITY ERROR BUDGET CONDITIONS AT 25℃



HTG3800 Series W/O TC 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 HTG3800 Series W/O TC characteristics.

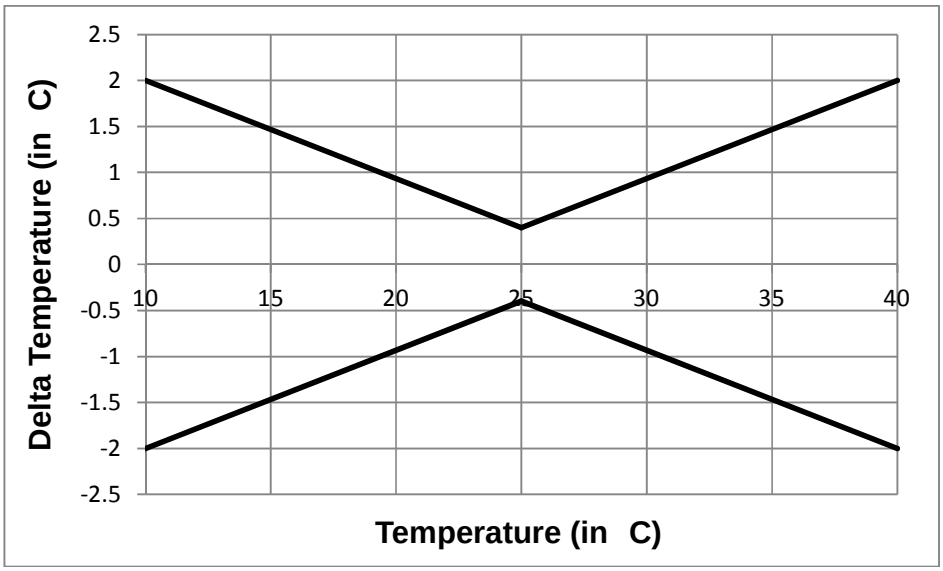
TEMPERATURE

Characteristics	Symbol	Min	Typ	Max	Unit
Resolution			14		bits
			0.01		℃
Temperature Measuring Range	T	10		40	℃
Accuracy @25℃ (calibration point)			+/-0.4		℃
Accuracy (10℃ to 40℃)			+/-2		℃
Replacement		fully interchangeable			
Measuring time (14 bits)			210		ms
Response Time (at 63% of signal) from 15℃ to 45℃ (1)	τ_T		10		s

(1) At 1m/s air flow

HTG3800 Series W/O TC – Relative Humidity and Temperature Module

TEMPERATURE ERROR BUDGET



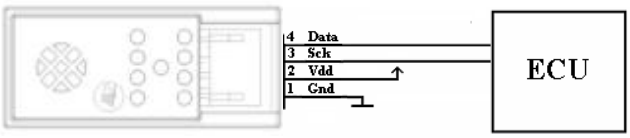
APPLICATION INFORMATION

- **Wiring Considerations and Signal Integrity**

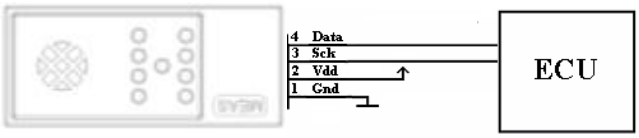
Carrying the SCK and DATA signal parallel and in close proximity (e.g. in wires) for more than 10cm may result in cross talk and loss of communication.
This may be resolved by routing VDD and/or GND between the two data signals and/or using shielded cables. Furthermore, slowing down SCK frequency will possibly improve signal integrity.

Power supply pins (VDD, GND) must be decoupled with a 100nF capacitor if wires are used. Capacitor should be placed as close as possible to the sensor.

- **Typical application circuit**



For HTG383XCH W/O TC Products



For HTG383XPVBL W/O TC Products

- **Power Pins (VDD, GND)**

The supply voltage of HTG3833 W/O TC products must be in the range of 3.2VDC - 3.4VDC, recommended supply voltage is 3.3VDC (regulated).

The supply voltage of HTG3835 W/O TC products must be in the range of 4.75VDC – 5.25VDC, recommended supply voltage is 5VDC (regulated).

However the typical application circuit includes a 100nF decoupling capacitor between VDD and GND.

- **Serial clock input (SCK)**

SCK is used to synchronize the communication between microcontroller and HTG3800 Series W/O TC modules. Since the interface consists of fully static logic there is no minimum SCK frequency.

- **Serial data (DATA)**

The DATA tri-state pin is used to transfer data in and out of the device. Data changes after the falling edge and is valid on the rising edge of the serial clock SCK. During transmission the DATA line must remain stable while SCK is high.

ELECTRICAL CHARACTERISTICS

(Temperature=25℃ unless otherwise noted)

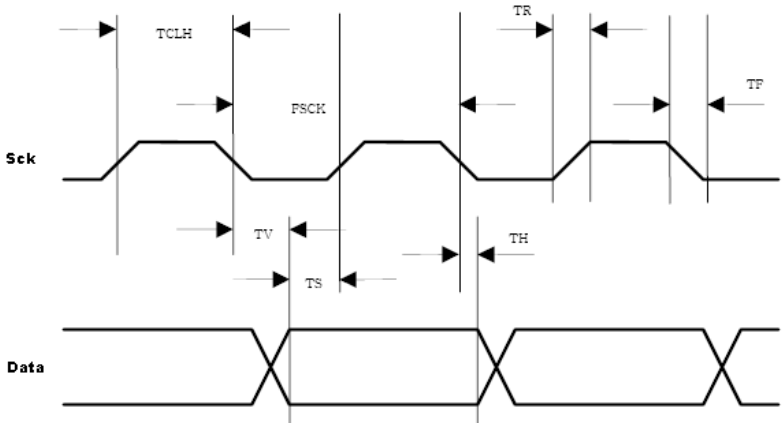
Characteristics		Symbol	Min	Typ	Max	Unit	Condition
Voltage Supply	HTG3833 products	VDD	3.2	3.3	3.4	V	
	HTG3835 products		4.75	5	5.25	V	
Current consumption (1)	HTG3833 products	idd		0.6	1.2*	mA	*Measuring
	HTG3835 products	idd		1	2*	mA	*Measuring
High level input voltage		VIH	70%			VDD	
Low level input voltage		VIL			30%	VDD	
High level output voltage		VOH	80%			VDD	
Low level output voltage		VOL			20%	VDD	
Leakage current		IL			1	μA	
Sink Current Capability		I_{sink}		1		mA	
Source Current Capability		I_{source}		1		mA	

(1) Conditions: SCK= 1 MHz.

DC CHARACTERISTICS

Characteristics	Symbol	Min	Typ	Max	Unit	Condition
SCK Frequency	FSCK			1	MHz	VCC>3.0V
DATA Fall time	TRFO	3	10	20	ns	Output Load 5pF
SCK Hi/Low time	TCLx	200			ns	
DATA valid time	TV		250		ns	
DATA setup time	TS	100			ns	
DATA hold time	TH	0	10			
SCK rise/fall time	TR/TF		10		ns	

HTG3800 Series W/O TC – Relative Humidity and Temperature Module



COMMUNICATION PROTOCOL WITH PRODUCT

- **Power pins**

The HTG3833 Series W/O TC modules require a voltage supply between 3.2VDC and 3.4VDC. After power up, the device needs 10ms to reach its “stand-by” state. No commands should be sent before that time.

The HTG3835 Series W/O TC modules require a voltage supply between 4.75VDC and 5.25VDC. After power up, the device needs 10ms to reach its “stand-by” state. No commands should be sent before that time.

- **Start symbol**

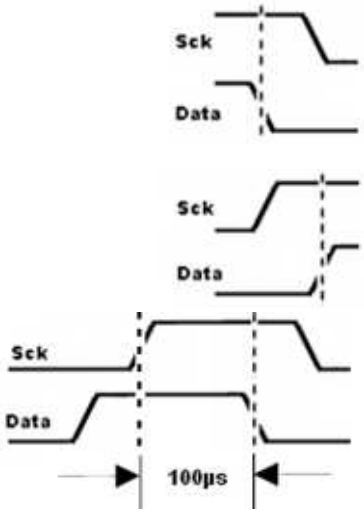
To initiate transmission, a start bit has to be issued. It consists of a lowering of the DATA line while SCK is high followed by lowering SCK.

- **Stop symbol**

To stop transmission, a stop bit has to be issued. It consists of a heightening of the DATA line while SCK is high preceded by a heightening of the SCK.

- **Restart symbol**

To restart transmission, a restart bit has to be issued between write and read commands including a start symbol.



- **Interface**

The serial interface of the HTG3800 Series W/O TC modules is optimized for sensor readout and power consumption. HTG3800 W/O TC Series modules communication bus is very close to I2C bus for wiring and voltage levels. Start and stop signals are I2C compliant but:
The sensor (slave) has no address. To avoid any communication conflict with other slaves on a standard I2C bus, you need to check is none of the other slave addresses is 0x80, 0x81, 0x82, 0x83.
The sensor answers only to specific commands (requests).

It is a 2 wires bus (1 clock and 1 data). The clock signal is unidirectional signal from master (MCU) to slave (sensor). This signal is managed by the master. The slave is only listening. The data signal is bidirectional.
The idle level is Vcc.

Two suggested options are:

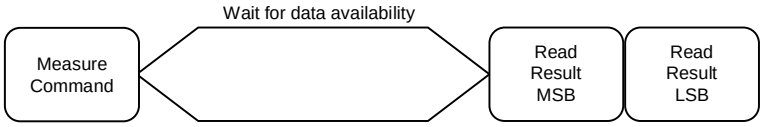
- To use another port dedicated for communication with our sensor (recommended option).
- To rename other slave addresses different from 0x80, 0x81, 0x82, 0x83 values as they are parametrable to avoid any potential communication conflict.

HTG3800 SERIES W/O TC MODULES LIST OF COMMANDS AND REGISTER ADRESSES

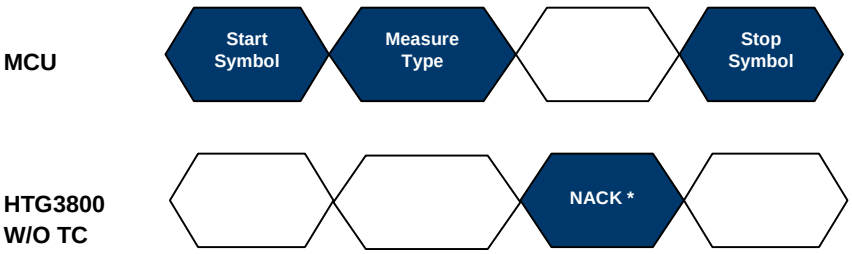
Command	Code
Write Command	0x80
Read Command	0x81
Measure Temperature	0x82
Measure Humidity	0x83

Register	Address
Humidity MSB	0x10
Humidity LSB	0x11
Temperature MSB	0x12
Temperature LSB	0x13

MEASUREMENT SEQUENCE OVERVIEW

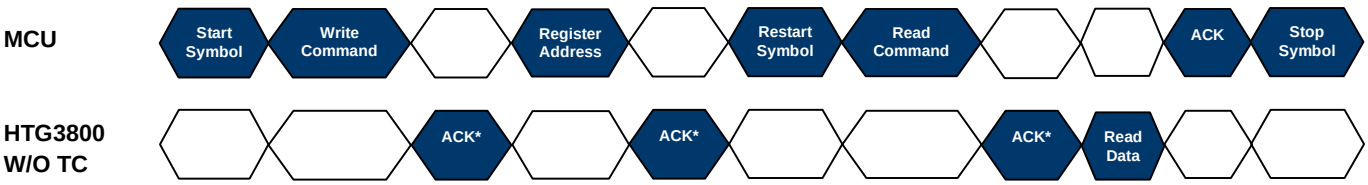


MEASURE COMMAND: RH OR TEMP



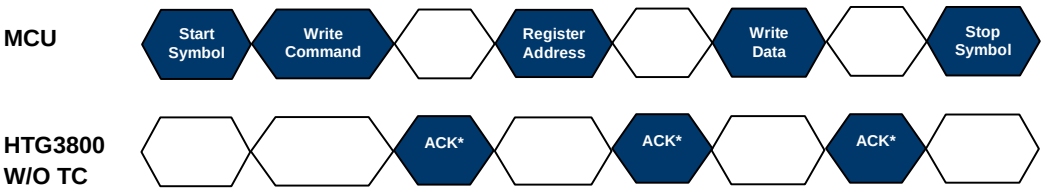
**: Measure commands will be NACKed. Read and Write commands will be ACKed.*

READ SEQUENCE



**: in case of Nack, read sequence must be restarted.*

WRITE SEQUENCE



MEASUREMENT OF RH AND TEMPERATURE

After issuing a measurement command (‘0x83’ for Humidity, ‘0x82’ for Temperature) the controller has to wait for the measurement to complete. This takes approximately 110/210 ms for 12/14bit-measurement. The exact time varies by up to ±15% with the speed of the internal oscillator.

To signal the completion of a measurement, the HTG3800 Series W/O TC modules pull up the data line and enter idle mode. The controller must wait for this “data ready” signal before restarting SCK to readout the data. Measurement data is stored HTG3800 Series W/O TC modules internal register (‘0x10’, ‘0x11’ for Humidity, ‘0x12’, ‘0x13’ for Temperature), therefore the controller can continue with other tasks and readout as convenient. Two bytes register value of measurement data will then be readout. The MCU must acknowledge each byte by pulling the DATA line low for measurement data readout.

14-bit Temp & 12-bit RH Configuration – Valid data

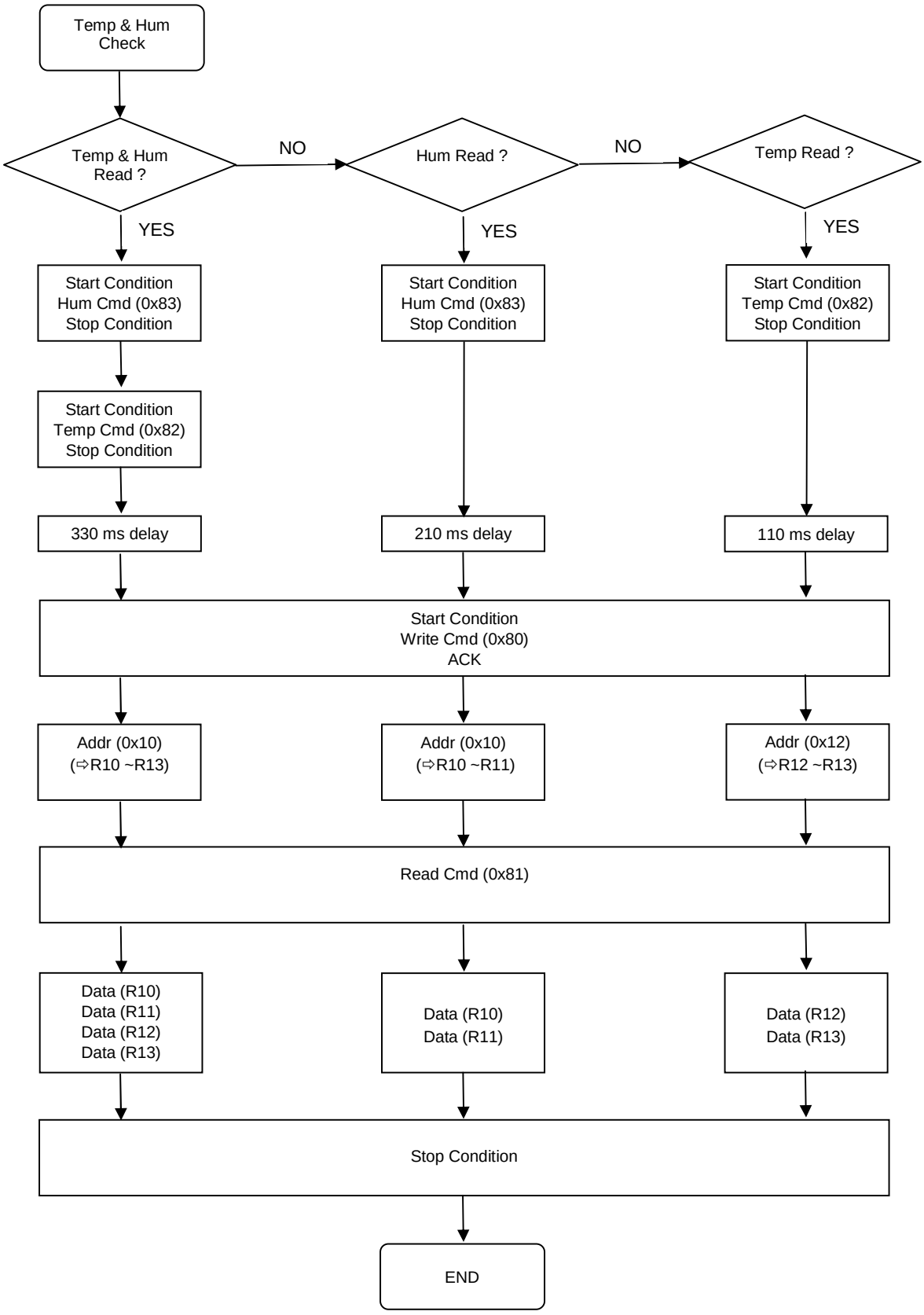
Temperature

0x12 register (MSB)								0x13 register (LSB)							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
T13	T12	T11	T10	T9	T8	T7	T6	T5	T4	T3	T2	T1	T0	X	X

Relative Humidity

0x10 register (MSB)								0x11 register (LSB)							
b15	b14	b13	b12	b11	b10	b9	b8	b7	b6	b5	b4	b3	b2	b1	b0
X	X	X	X	H11	H10	H9	H8	H7	H6	H5	H4	H3	H2	H1	H0

MEASUREMENT DIAGRAM



HTG3800 Series W/O TC – Relative Humidity and Temperature Module

TYPICAL PERFORMANCE CURVES

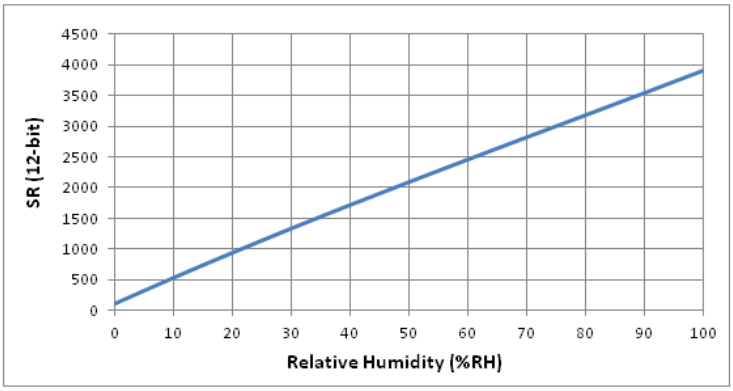
HUMIDITY SENSOR

(Temperature=25℃ unless otherwise noted)

- **Humidity Look-up Table (for HTG3833 at Vcc=3.3VDC and HTG3835 at Vcc=5VDC)**

%RH	SR 12bits	%RH	SR 12bits
5	108	**55**	**2276**
10	322	**60**	2459
15	532	**65**	2641
20	738	**70**	2822
25	941	**75**	3003
30	1139	**80**	3183
35	1335	**85**	3364
40	1528	**90**	3545
45	1718	**95**	3727
50	1906	**100**	3909

- **Humidity Curve**



- **Humidity Polynomial Equations (for HTG3833 at Vcc=3.3VDC and HTG3835 at Vcc=5VDC)**

RH in %RH

$SR = a*RH^3 + b*RH^2 + c*RH + d$

SR	a	b	c	d
12-bit	$3.988x10^{-4}$	$-9.3x10^{-2}$	43.327	107.99

$RH = a*SR^3 + b*SR^2 + c*SR + d$

SR	a	b	c	d
12-bit	$-1.197x10^{-11}$	$6.073x10^{-7}$	$2.405x10^{-2}$	-2.749

HTG3800 Series W/O TC – Relative Humidity and Temperature Module

- **Humidity Linear Equations (for HTG3833 at Vcc=3.3VDC and HTG3835 at Vcc=5VDC)**

RH in %RH

SR = a*RH + b

SR	a	b
12-bit	37.674	177.58

RH = a*SR + b

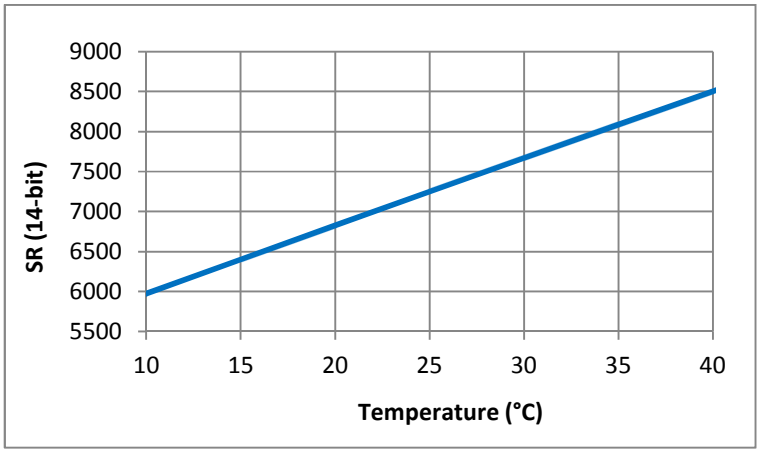
SR	a	b
12-bit	$2.63x10^{-2}$	-4.28

TEMPERATURE SENSOR

- **Temperature Look-up Table (for HTG3833 at Vcc=3.3VDC and HTG3835 at Vcc=5VDC)**

T (℃)	SR 14bits
10	5974
15	6402
20	6827
25	**7250**
30	7671
35	8089
40	8506

- **Temperature Curve**



HTG3800 Series W/O TC – Relative Humidity and Temperature Module

- **Temperature Linear Equation (without temperature coefficient TC compensation)**

Temp in °C

$SR = a*Temp^3 + b*Temp^2 + c*Temp + d$

$Temp = a*SR^3 + b*SR^2 + c*SR + d$

SR	a	b	c	d
14-bit	$9.904x10^{-5}$	$-5.156x10^{-2}$	86.746	5112

SR	a	b	c	d
14-bit	$-1.043x10^{-12}$	$9.613.x10^{-8}$	$1.063X10^{-2}$	-56.69

- **Temperature Polynomial Equation (without temperature coefficient TC compensation)**

Temp in °C

$SR = a*Temp + b$

$Temp = a*SR + b$

SR	a	b
14-bit	84.042	5070.4

SR	a	b
14-bit	$1.19x10^{-2}$	-60.296

RESISTANCE TO PHYSICAL AND CHEMICAL STRESSES

HTG3800 Series W/O TC modules have been tested through a complete sequence process taking in account many of the requirements of the JEDEC standard including:

- Solder heat and solderability including lead free process
- Pb free wave soldering and reflow soldering processes (260°C) + DI water clean at 45°C
- Salt Atmosphere JESD22-A107-A
- Temperature Cycling - 40°C / +125°C for 168 hours
- High Temperature / Humidity Operating Life - 93%RH / 60°C for 168 hours
- Low Humidity storage life - RH < 10%/23°C for 168 hours
- Resistance to immersion in water at ambient temperature and 80°C
- High temperature storage 120°C for 168 hours
- Resistance to many chemicals linked to home appliances/automotive or consumer applications

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.

HTG3800 Series W/O TC modules contain circuits to protect its inputs and outputs against Electrostatic discharges (ESD) up to ±15kV, air discharge.

HTG3800 Series W/O TC modules are protected against EMC interferences.

HTG3800 Series W/O TC modules are protected against reverse polarity.
HTG3800 Series W/O TC modules are not light sensitive.

ENVIRONMENTAL AND RECYCLING

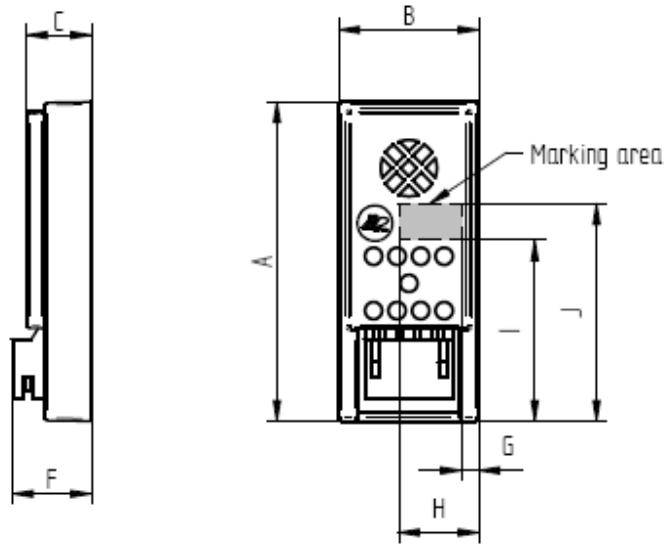
HTG3800 Series W/O TC modules are lead free components and are compatible with Pb Free soldering processes.

HTG3800 Series W/O TC modules are free from Cr (6+), Cd and Hg.

HTG3800 Series W/O TC – Relative Humidity and Temperature Module

PACKAGE OUTLINE

HTG383XCH W/O TC Products

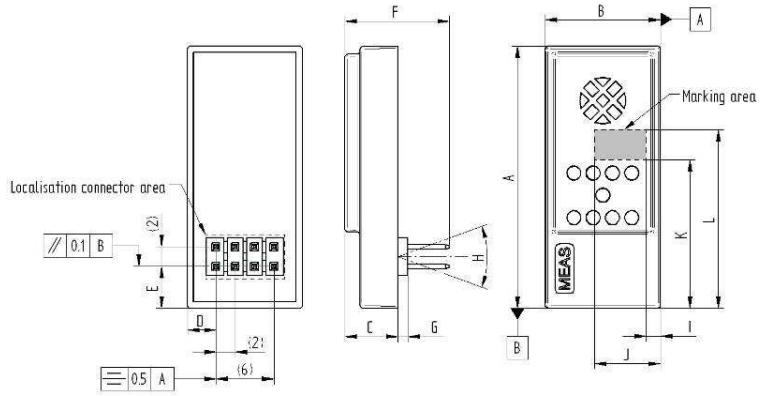


Package Outline with CH connector

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

HTG383XPVBL W/O TC Products



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

Dim	Typ (mm)	Dim	Typ (mm)
A	27 ± 0.25	G	1 ± 0.25
B	11.9 ± 0.2	H	3° ± 1°
C	5.7 ± 0.5	I	1.5 ± 0.5
D	2.95 ± 0.3	J	6.8 ± 0.5
E	4.32 ± 0.3	K	15.3 ± 0.5
F	10.8 ± 0.5	L	18.4 ± 0.5

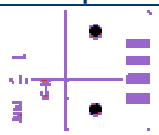
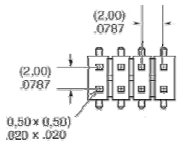
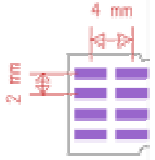
Color: Black
Weight: 1.8g

Double coated adhesive tape could be used on potted area (ref: 3M – 5925F) to fix HTG383XCH W/O TC parts.

HTG3800 Series W/O TC – Relative Humidity and Temperature Module

CONNECTING AND MECHANICAL CHARACTERISTICS

CONNECTING CHARACTERISTICS

Connector Type	Symbol	Overview	Connector Pitch	Connector Footprint	Mating Connector*
Side Connector	CH		-		JST ZHR-4
Long Male Connector (2) (3) (4.27 mm – 0.198 in long)	PVBL				Direct Soldering (through hole)

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

(2) Pins are connected by twos.

Pin Out Assignment

N°	Function
1/8	Ground
2/7	Vdd – Voltage Supply
3/6	Serial Clock Input
4/5	Serial Data bidirectional

ORDERING INFORMATION

HTG383X yyy W/O TC

X Voltage Supply		yyy Connector Type	
3	5	CH	PVBL
3.3V	5V		

Product	Order Reference
HTG8333PVBL W/O TC	HPP815K637
HTG3835CH W/O TC	HPP815K635
HTG3835PVBL W/O TC	HPP815K636

HTG3800 Series W/O TC – Relative Humidity and Temperature Module

Revision	Comments	Who	Date
0	Creation	D. LE GALL	January 12
A	Temperature Linear Equation update	D. LE GALL-ZIRILLI	October 12

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