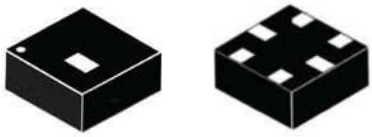
HTS221

Capacitive digital sensor for relative humidity and temperature

Datasheet - production data



HLGA-6L
(2 x 2 x 0.9 mm)

Features

- 0 to 100% relative humidity range
- Supply voltage: 1.7 to 3.6 V
- Low power consumption: 2 µA @ 1 Hz ODR
- Selectable ODR from 1 Hz to 12.5 Hz
- High rH sensitivity: 0.004% rH/LSB
- Humidity accuracy: ± 4.5% rH, 20 to +80% rH
- Temperature accuracy: ± 0.5 °C,15 to +40 °C
- Embedded 16-bit ADC
- 16-bit humidity and temperature output data
- SPI and I²C interfaces
- Factory calibrated
- Tiny 2 x 2 x 0.9 mm package
- ECOPACK® compliant

Applications

- Air conditioning, heating and ventilation
- Air humidifiers
- Refrigerators
- Wearable devices
- Smart home automation
- Industrial automation
- Respiratory equipments
- Asset and goods tracking

Description

The HTS221 is an ultra compact sensor for relative humidity and temperature. It includes a sensing element and a mixed signal ASIC to provide the measurement information through digital serial interfaces.

The sensing element consists of a polymer dielectric planar capacitor structure capable of detecting relative humidity variations and is manufactured using a dedicated ST process.

The HTS221 is available in a small top-holed cap land grid array (HLGA) package guaranteed to operate over a temperature range from -40 °C to +120 °C.

Table 1. Device summary

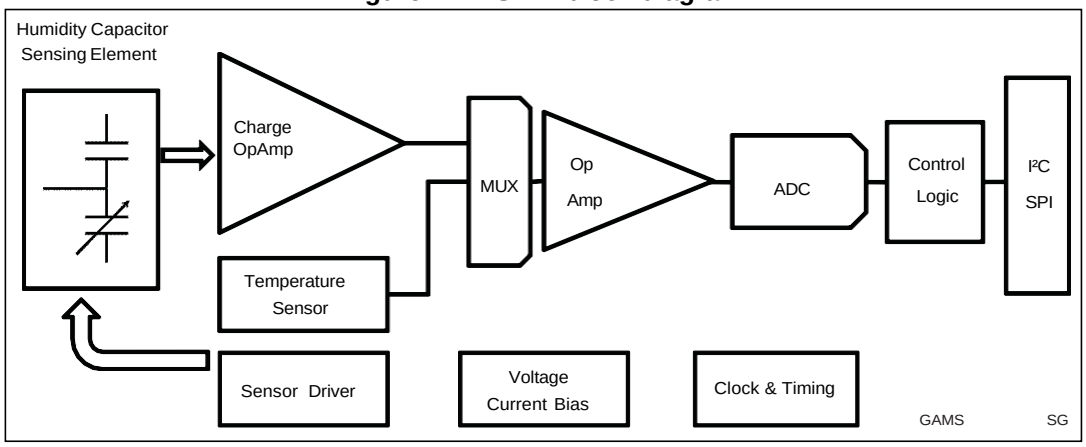
Order code	Temperature range [°C]	Package	Packing
HTS221TR	-40 to +120	HLGA-6L	Tape and reel

This is information on a product in full production.

Contents

1 HTS221 block diagram

Figure 1. HTS221 block diagram



1.1 Pin information

Figure 2. Pin configuration (bottom view)

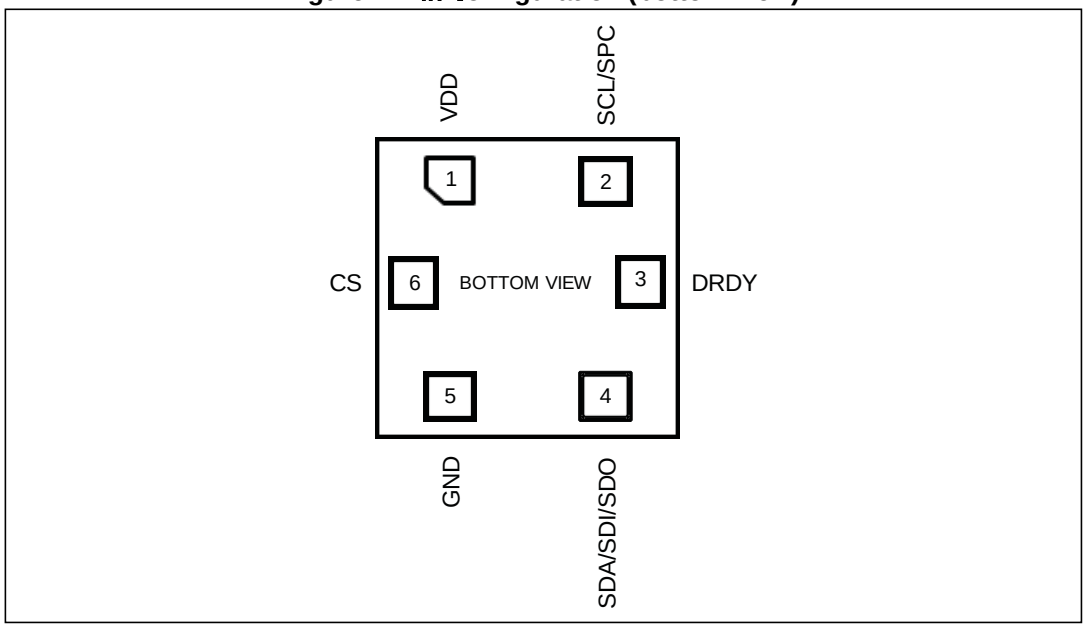


Table 2. Pin description

Pin n°	Name	Function
1	V_{DD}	Power supply
2	SCL/SPC	I²C serial clock (SCL) SPI serial port clock (SPC)
3	DRDY	Data Ready output signal

Table 2. Pin description (continued)

Pin n°	Name	Function
4	SDA/SDI/SDO	I²C serial data (SDA) 3-wire SPI serial data input /output (SDI/SDO)
5	GND	Ground
6	SPI enable	I²C/SPI mode selection (1: SPI idle mode / I2C communication enabled; 0: SPI communication mode / I2C disabled)”

2 Sensor parameters and electrical specifications

Conditions at V_{DD} = 2.5 V, T = 25 °C, unless otherwise noted.

Table 3. Humidity and temperature parameter specifications

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
Hop	Operating humidity range		0	–	100	% rH
Hbit	Humidity output data			16	–	bit
Hs	Humidity sensitivity			0.004		%rH/LSB
				256		LSB/%rH
Hacc	Humidity accuracy(2)	20 to 80 % rH		±4.5		% rH
		0 to 100 % rH		±6		
Hnoise	Humidity noise(3)			0.03		RMS
Hhys	Humidity hysteresis			±1		% rH
Hstep	Humidity response time(4)	t @ 63%		10		s
Hdrift	Humidity long term drift	20 to 80 % rH		0.5		%rH/yr
Top	Operating temperature range		-40	–	120	°C
Tbit	Temperature output data		–	16	–	bit
Ts	Temperature sensitivity			0.016		°C/LSB
				64		LSB/°C
Tacc	Temperature accuracy	15 to 40 °C		±0.5		°C
		0 to 60 °C		±1		
Tnoise	Temperature noise(5)			0.007		RMS
Tstep	Temperature response time	t @ 63%		15		s
Tdrift	Temperature long term drift	T= 0 to 80 °C			0.05	°C/yr
ODR	Humidity and temperature digital output data rate			1/7/12.5		Hz

1. Typical specifications are not guaranteed
2. Accuracy in non condensing environment including hysteresis
3. Default value; noise value can be modified by AV_CONF register (10h)
4. Valid at 25 °C and 1 m/s airflow
5. Default value; noise value can be modified by AV_CONF register (10h)

Table 4. Electrical characteristics

Symbol	Parameter	Test condition	Min.	Typ.(1)	Max.	Unit
V_{DD}	Supply voltage		1.7	–	3.6	V
I_{DD}	Supply current (2)	1 Hz, 25 °C, 2.5 V		2		µA
$I_{DD}P_{DN}$	Supply current in power-down mode T = 25 °C	25 °C, 2.5 V	–	0.5	–	µA

1. Typical specifications are not guaranteed
2. Refer to *Table 16*.

2.1 Communication interface characteristics

2.1.1 SPI - serial peripheral interface

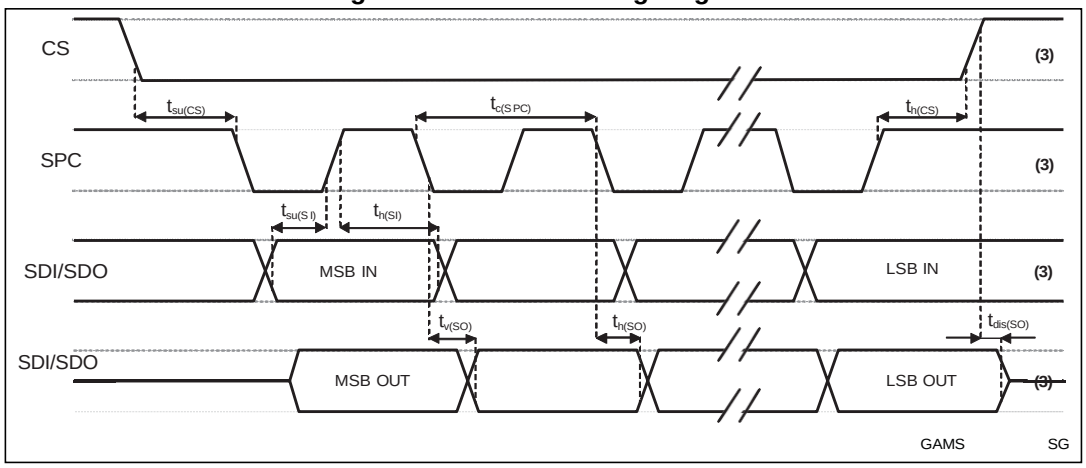
Subject to general operating conditions for V_{DD} and T_{OP}

Table 5. SPI slave timing values

Symbol	Parameter	Value (1)		Unit
		Min.	Max.	
$t_{c(SPC)}$	SPI clock cycle	100		ns
$f_{c(SPC)}$	SPI clock frequency		10	MHz
$t_{su(CS)}$	CS setup time	6		
$t_{h(CS)}$	CS hold time	8		
$t_{su(SI)}$	SDI input setup time	5		
$t_{h(SI)}$	SDI input hold time	15		ns
$t_{v(SO)}$	SDO valid output time		50	
$t_{h(SO)}$	SDO output hold time	9		
$t_{dis(SO)}$	SDO output disable time		50	

1. Values are guaranteed at 10 MHz clock frequency for SPI, based on characterization results, not tested in production.

Figure 3. SPI slave timing diagram



Note: Measurement points are done at 0.2·V_{DD} and 0.8·V_{DD}, for both ports.

2.1.2 I²C - control interface

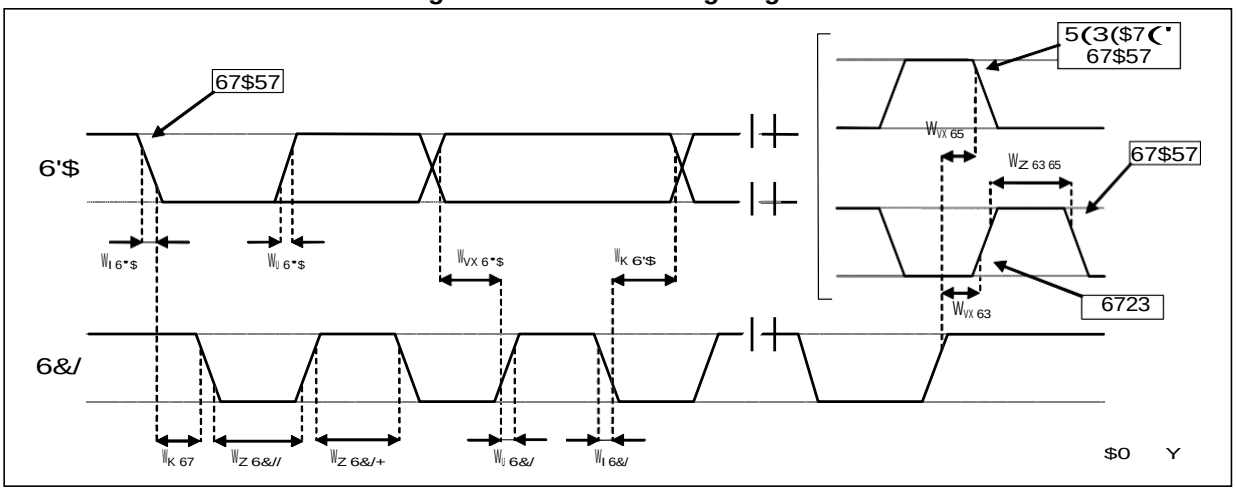
Subject to general operating conditions for V_{DD} and T_{OP}.

Table 6. I²C slave timing values

Symbol	Parameter (1)	I²C standard mode (1)		I²C fast mode (1)		Unit
		Min.	Max.	Min.	Max.	
$f_{(SCL)}$	SCL clock frequency	0	100	0	400	kHz
$t_{w(SCLL)}$	SCL clock low time	4.7		1.3		µs
$t_{w(SCLH)}$	SCL clock high time	4.0		0.6		
$t_{su(SDA)}$	SDA setup time	250		100		ns
$t_{h(SDA)}$	SDA data hold time	0.01	3.45	0	0.9	µs
$t_{r(SDA)}$ $t_{r(SCL)}$	SDA and SCL rise time		1000	20 + 0.1C_b (2)	300	ns
$t_{f(SDA)}$ $t_{f(SCL)}$	SDA and SCL fall time		300	20 + 0.1C_b (2)	300	
$t_{h(ST)}$	START condition hold time	4		0.6		µs
$t_{su(SR)}$	Repeated START condition setup time	4.7		0.6		
$t_{su(SP)}$	STOP condition setup time	4		0.6		
$t_{w(SP:SR)}$	Bus free time between STOP and START condition	4.7		1.3		

1. Data based on standard I²C protocol requirement, not tested in production.
2. Cb = total capacitance of one bus line, in pF.

Figure 4. I²C slave timing diagram



Measurement points are done at $0.2 \cdot V_{DD}$ and $0.8 \cdot V_{DD}$, for both ports.

2.2 Absolute maximum ratings

Stress above those listed as “Absolute maximum ratings” may cause permanent damage to the device. This is a stress rating only and functional operation of the device under these conditions is not implied. Exposure to maximum rating conditions for extended periods may affect device reliability.

Table 7. Absolute maximum ratings

Symbol	Ratings	Maximum value	Unit
V_{DD}	Supply voltage	-0.3 to 4.8	V
V_{IN}	Input voltage on any control pin	-0.3 to V_{DD} +0.3	V
T_{STG}	Storage temperature range	-40 to +125	°C
ESD	Electrostatic discharge protection	2 (HBM)	kV

Note: Supply voltage on any pin should never exceed 4.8 V.

This is a mechanical shock sensitive device, improper handling can cause permanent damage to the part.

This is an ESD sensitive device, improper handling can cause permanent damage to the part.