



## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

The HCE pressure sensors perform precision digital signal conditioning and provide analog and digital output at the same time. The sensors are calibrated, temperature compensated and linearized and achieve very high total accuracies. They are intended to be used with dry and non-corrosive gases. Miniature SMT housings allow for space-saving PCB-mounting and maximum OEM design flexibility. All HCE pressure sensors can be modified according to customer specific requirements.

### Features

- Pressure ranges from 10 mbar to 5 bar, absolute, gage or differential pressure
- Barometric pressure ranges
- Digital SPI bus and analog output
- Precision ASIC signal conditioning
- Calibrated and temperature compensated
- Miniature SMD housings

### Applications

- Medical devices
- Instrumentation
- HVAC
- Industrial controls
- Pneumatic controls
- Environmental controls

### Certificates

- RoHS and REACH compliant

### Media compatibility

- To be used with non-corrosive, non-ionic working fluids such as clean dry air, dry gases and the like.

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## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

### Maximum ratings

Parameter		Min.	Typ.	Max.	Unit
Supply voltage $V_S$ <sup>(1)</sup>	HCExxx3	2.7	3	3.3	$V_{DC}$
	HCExxx5	4.5	5	5.5	
Output current	Sink		1		mA
	Source		1		
Lead specifications	Average preheating temperature gradient			2.5	K/s
	Soak time			approx. 3	min.
	Time above 217 °C			50	s
	Time above 230 °C			40	
	Time above 250 °C			15	
	Peak temperature			260	°C
	Cooling temperature gradient			-3.5	K/s
Temperature ranges <sup>(2)</sup>	Compensated	0		+85	°C
	Operating	-25		+85	
	Storage	-40		+125	
Humidity limits (non-condensing)		0		95	%RH

### Pressure sensor characteristics

Part no.	Operating pressure	Proof pressure <sup>(3)</sup>	Burst pressure <sup>(4)</sup>
HCEM010xxxBxxx	0 to ±10 mbar	250 mbar	500 mbar
HCEM020xxxBxxx	0 to ±20 mbar	500 mbar	750 mbar
HCEM050xxxBxxx	0 to ±50 mbar	750 mbar	1.2 bar
HCEM100xxxBxxx	0 to ±100 mbar	1.2 bar	2 bar
HCEM200xxxBxxx	0 to ±200 mbar	2 bar	
HCEM500xxxBxxx	0 to ±500 mbar		
HCEB001xxxBxxx	0 to ±1 bar	3 bar	5 bar
HCEM010xxxUxxx	0 to 10 mbar	250 mbar	500 mbar
HCEM020xxxUxxx	0 to 20 mbar	500 mbar	750 mbar
HCEM050xxxUxxx	0 to 50 mbar	750 mbar	1.2 bar
HCEM100xxxUxxx	0 to 100 mbar	1.2 bar	2 bar
HCEM200xxxUxxx	0 to 200 mbar	2 bar	
HCEM500xxxUxxx	0 to 500 mbar		
HCEB001xxxUxxx	0 to 1 bar	3 bar	5 bar
HCEB002xxxUxxx	0 to 2 bar	6 bar	7 bar
HCEB005xxxUxxx	0 to 5 bar	7 bar	
HCE0611ARxxx	600 to 1100 mbar(a)	3 bar	5 bar
HCE0811ARxxx	800 to 1100 mbar(a)		

Other pressure ranges are available on request. Please contact your local sensors representative.

## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

### Performance characteristics

( $V_S=5.0 V_{DC}$ ,  $T_A=25\text{ }^\circ\text{C}$ , analog output signal is ratiometric to  $V_S$ , digital output signal is not ratiometric to  $V_S$ , pressure applied to high pressure port)

#### All HCExxx5 devices ( $V_S= 5.0 V$ )

Characteristics		Min.	Typ.	Max.	Unit
Total accuracy (0 to 85°C) <sup>(5)</sup>	all barometric devices			±1.0	%FSS
	all other devices			±0.5	
Response delay <sup>(6, 7)</sup>			1		ms
A/D resolution <sup>(7)</sup>			14		bit
D/A resolution				11	
Current consumption <sup>(8)</sup>			5		mA

#### All HCExxxRxxx5 (barometric devices)

Characteristics	Min.	Typ.	Max.	Unit
<b>ANALOG</b>				
Output at min. specified pressure	0.21	0.25	0.29	V
Full scale span (FSS) <sup>(9)</sup>		4.00		
Full scale output	4.21	4.25	4.29	
<b>DIGITAL</b>				
Output at min. specified pressure	0560	0666	076C	Count Hex
Full scale span (FSS) <sup>(9)</sup>		6666		
Full scale output	6BC6	6CCC	6DD2	

#### All HCExxxUxxx5 (Unidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
<b>ANALOG</b>				
Zero pressure offset	0.23	0.25	0.27	V
Full scale span (FSS) <sup>(9)</sup>		4.00		
Full scale output	4.23	4.25	4.27	
<b>DIGITAL</b>				
Zero pressure offset	05E3	0666	06E9	Count Hex
Full scale span (FSS) <sup>(9)</sup>		6666		
Full scale output	6C49	6CCC	6D4F	

## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

### Performance characteristics (cont.)

( $V_S=5.0 V_{DC}$ ,  $T_A=25\text{ }^\circ\text{C}$ , analog output signal is ratiometric to  $V_S$ , digital output signal is not ratiometric to  $V_S$ , pressure applied to high pressure port)

#### All HCExxxBxxx5 (Bidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
<b>ANALOG</b>				
Zero pressure offset	2.23	2.25	2.27	V
Full scale span (FSS) <sup>(9)</sup>		4.00		
Output	at max. specified pressure	4.23	4.25	
	at min. specified pressure	0.23	0.25	0.27
<b>DIGITAL</b>				
Zero pressure offset	3916	3999	3A1C	Count Hex
Full scale span (FSS) <sup>(9)</sup>		6666		
Output	at max. specified pressure	6C49	6CCC	
	at min. specified pressure	05E3	0666	06E9

### Performance characteristics

( $V_S=3.0 V_{DC}$ ,  $T_A=25\text{ }^\circ\text{C}$ , analog output signal is ratiometric to  $V_S$ , digital output signal is not ratiometric to  $V_S$ , pressure applied to high pressure port)

#### All HCExxx3 devices ( $V_S= 3.0\text{ V}$ )

Characteristics	Min.	Typ.	Max.	Unit
Total accuracy <sup>(5)</sup> (0 to 85°C)	all barometric devices		±1.0	%FSS
	all other devices		±0.5	
Response delay <sup>(6, 7)</sup>		1		ms
A/D resolution <sup>(7)</sup>		14		bit
D/A resolution			11	
Current consumption <sup>(6)</sup>		3		mA

#### All HCExxxRxxx3 (barometric devices)

Characteristics	Min.	Typ.	Max.	Unit
<b>ANALOG</b>				
Zero pressure offset	0.23	0.25	0.27	V
Full scale span (FSS) <sup>(9)</sup>		2.00		
Full scale output	2.23	2.25	2.27	
<b>DIGITAL</b>				
Zero pressure offset	09D0	0AAA	0B85	Count Hex
Full scale span (FSS) <sup>(9)</sup>		5555		
Full scale output	5F25	5FFF	60D9	

## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

### Performance characteristics (cont.)

( $V_S=3.0 V_{DC}$ ,  $T_A=25\text{ }^\circ\text{C}$ , analog output signal is ratiometric to  $V_S$ , digital output signal is not ratiometric to  $V_S$ , pressure applied to high pressure port)

#### All HCExxxUxxx3 (Unidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
<b>ANALOG</b>				
Output at min. specified pressure	0.24	0.25	0.26	V
Full scale span (FSS) <sup>(9)</sup>		2.00		
Full scale output	2.24	2.25	2.26	
<b>DIGITAL</b>				
Output at min. specified pressure	0A3D	0AAA	0B17	Count Hex
Full scale span (FSS) <sup>(9)</sup>		5555		
Full scale output	5F92	5FFF	606C	

#### All HCExxxBxxx3 (Bidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit	
<b>ANALOG</b>					
Zero pressure offset	1.24	1.25	1.26	V	
Full scale span (FSS) <sup>(9)</sup>		2.00			
Output	at max. specified pressure	2.24	2.25		2.26
	at min. specified pressure	0.24	0.25		0.26
<b>DIGITAL</b>					
Zero pressure offset	34E8	3555	35C2	Count Hex	
Full scale span (FSS) <sup>(9)</sup>		5555			
Output	at max. specified pressure	5F92	5FFF		606C
	at min. specified pressure	0A3D	0AAA		0B17

### SPI - Serial peripheral interface

#### Introduction

The HCE is capable to generate a digital output signal. The device runs a cyclic program, which will store a corrected pressure value with 14 bit resolution about every 500 μs within the output registers of the internal ASIC. This cyclic program runs independent from the bus communication. In order to use the pressure sensor for digital signal readout, it should be connected to a SPI Master device.

SPI specifies four signals: The clock (CLK) is generated by the master and input to all slaves. MOSI carries data from master to slave. MISO carries data from slave back to master. A slave selects line (SS) allow a individual selection of a slave device.

#### SPI Modes

A pair of parameters called clock polarity (CPOL) and clock phase (CPHA) determine the edges of the clock signal on which the data are driven and sampled. Each of the two parameters has two possible states, which allows for four possible combinations, all of which incompatible with one another.

In general, the HCE series supports all combinations of clock phase (CPHA) and polarity (CPOL). By default, it is programmed to CPHA 0 and CPOL=0, which means that data transmission starts with the rising first clock edge (see Fig. 1).

**Slave select:** The falling edge of the SS line indicates the beginning of the transfer. Additionally, the SS line must not be negated and reasserted between the tree bytes to be transmitted.

**DATA operation:** The MOSI line should always be set to high level. So there is no data transmission from master to slave. Because of internal configuration the slave will answer the first byte with an FFxh. The second and third byte contain the 15 bit pressure information (see Fig. 2).

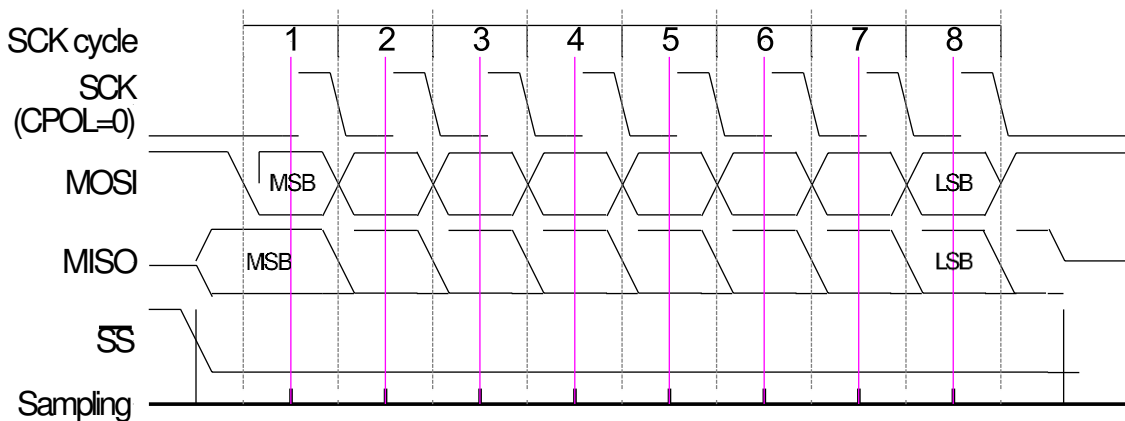


Fig. 1: Example of a standard 1 byte SPI data transfer for CPHA=0 and CPOL=0

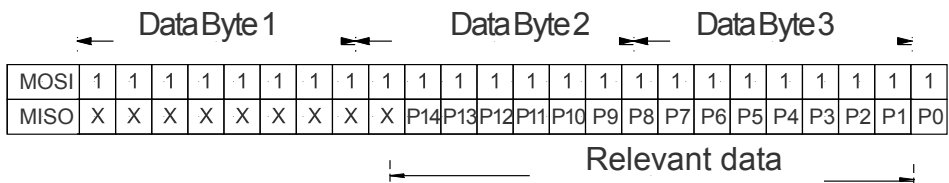


Fig. 2: 3 byte data stream between HCE sensor and master containing the pressure value as a 15 bit information

**SPI - serial peripheral interface (cont.)**

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input high level		90		100	% of Vs
Input low level		0		10	
Output low level				10	
Pull-up resistor		500			Ω
Load capacitance @ MISO	$C_{MISO}$			400	pF
Input capacitance @ each pin	$C_{SPI\_IN}$			10	
Signal clock frequency	$f_{SCK}$	100*		640	kHz
MISO hold time after SCK sample slope	$t_{SPI\_HD\_MISO}$	200			ns
MOSI setup time before SCK sample slope	$t_{SPI\_SU\_MOSI}$	$2/f_{CLK}$			
/SS setup time before SCK sample slope	$t_{SPI\_SU\_SS}$	10			
/SS hold time after SCK sample slope	$t_{SPI\_HD\_SS}$	$1/f_{CLK}$			

\*recommended

**Note:** TE Connectivity recommends communication speeds of at least 100 kHz (max. 400 kHz). Please contact us for further information.

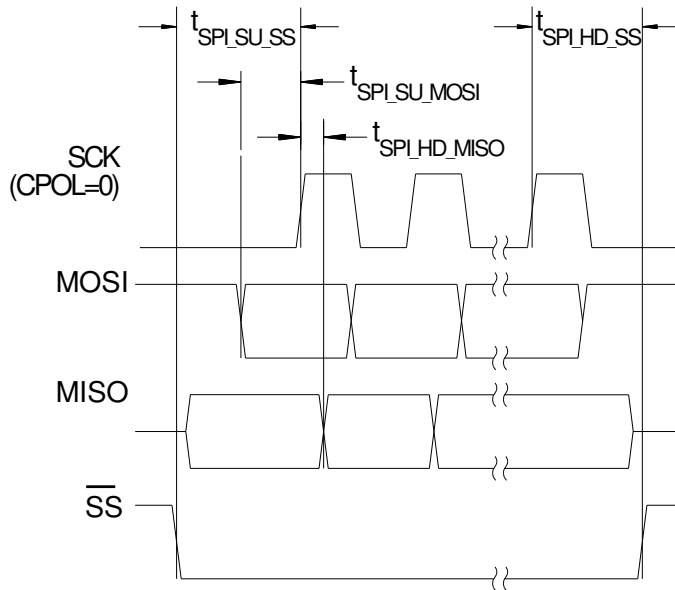
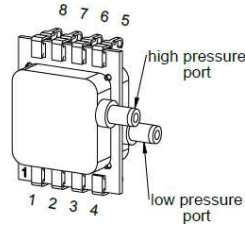
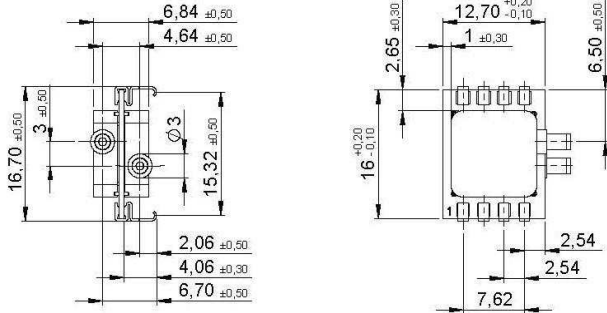


Fig. 3: Timing characteristics

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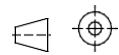
## Dimensional drawing <sup>(10)</sup>

HCExxxE8xxx (SMD dual port, same side, straight ports)

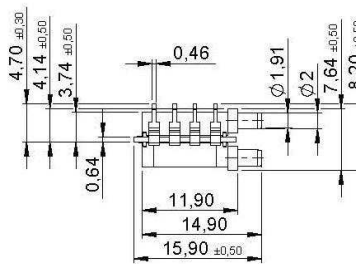


Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

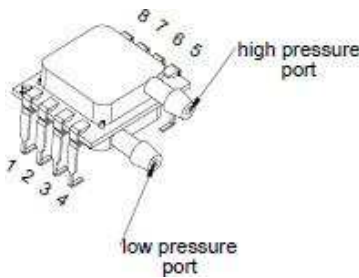
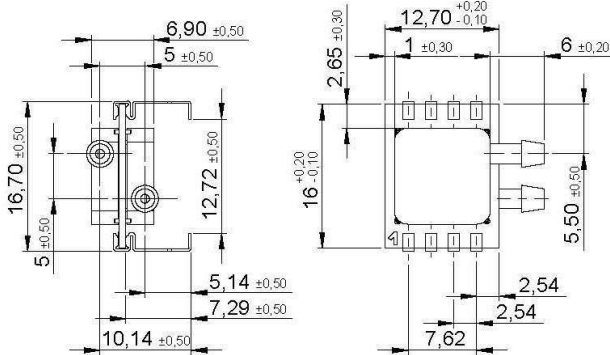
\* internal connection.  
Do not connect for any reason



first angle projection  
dimensions in mm

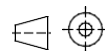
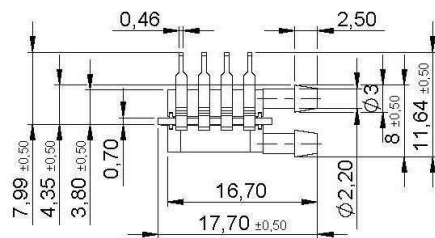


HCExxxE9xxx (SMD dual port, same side, barbed ports)



Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

\* internal connection.  
Do not connect for any reason



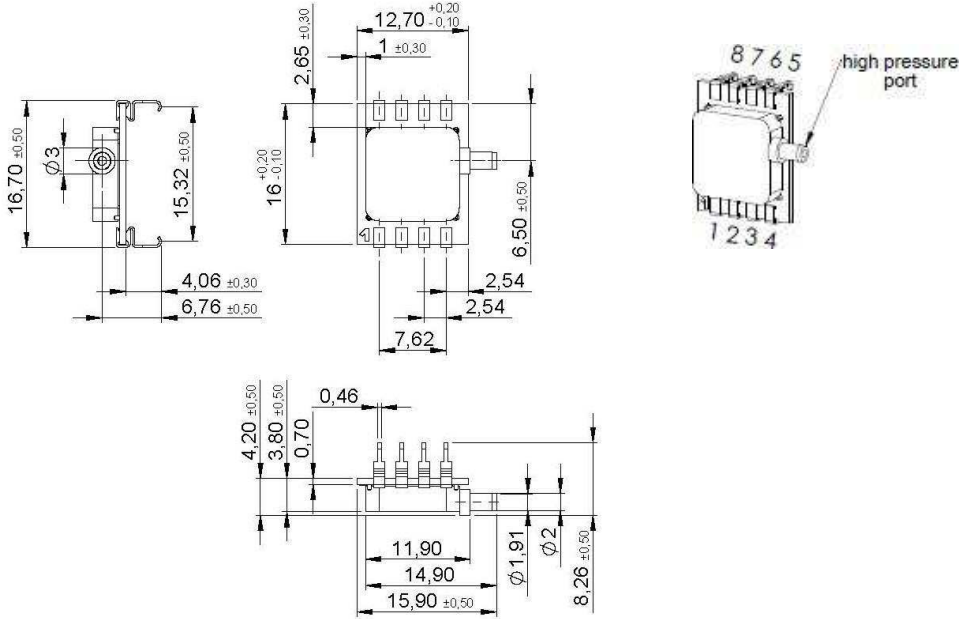
first angle projection  
dimensions in mm



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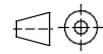
## Dimensional drawing <sup>(10)</sup>

HCExxxH8xxx (SMD single port, straight port)



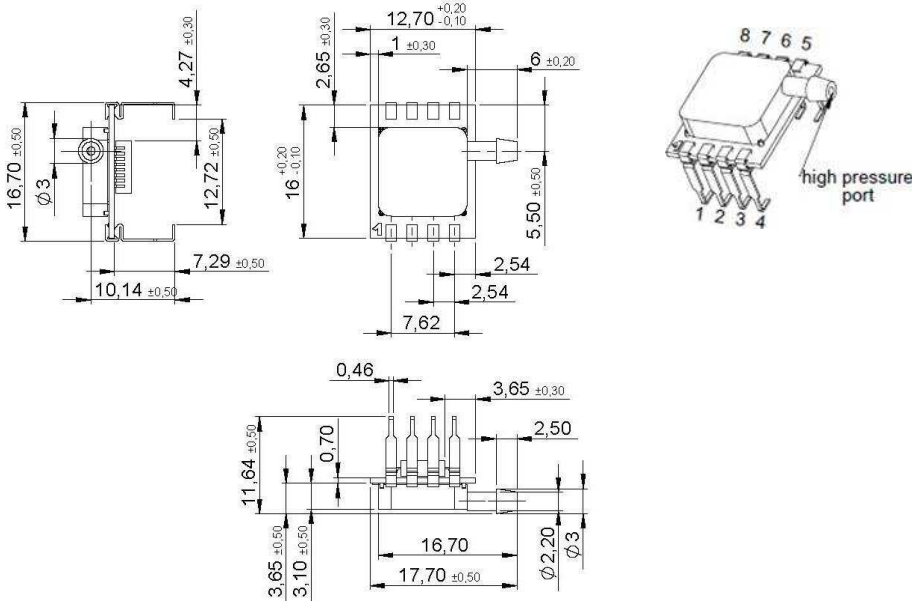
Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

\* internal connection.  
Do not connect for any reason



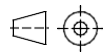
first angle projection  
dimensions in mm

HCExxxH9xxx (SMD single port, barbed port)



Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

\* internal connection.  
Do not connect for any reason

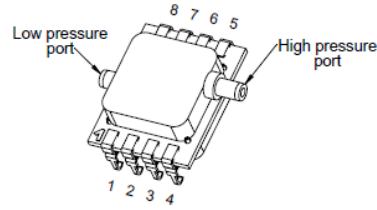
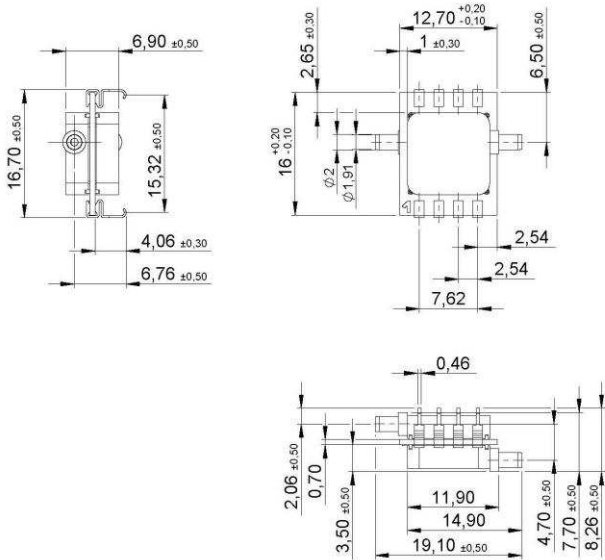


first angle projection  
dimensions in mm

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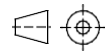
## Dimensional drawing <sup>(10)</sup>

HCExxxQ8xxx (SMD dual port, opposite side, straight ports)



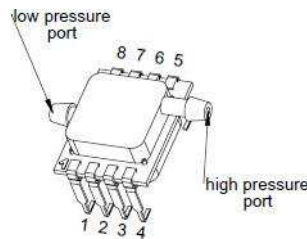
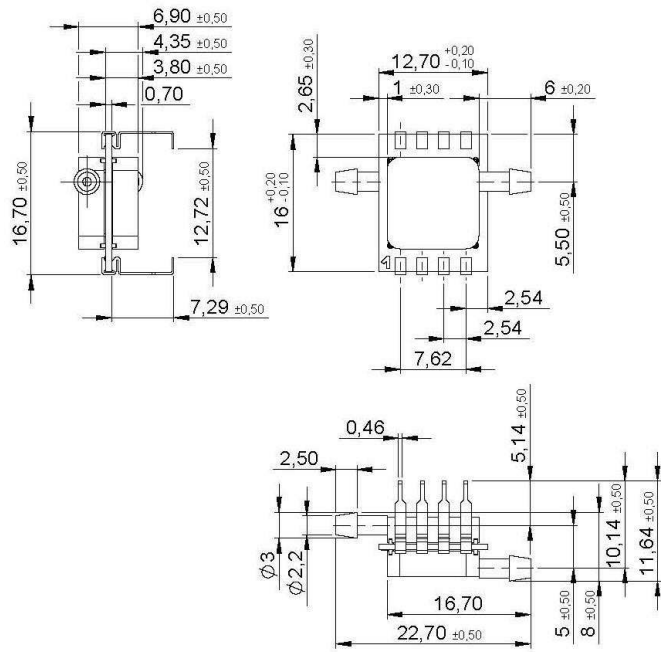
Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

\* internal connection.  
Do not connect for any reason



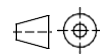
first angle projection  
dimensions in mm

HCExxxQ9xxx (SMD dual port, opposite side, barbed ports)



Pin	connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I/C*
8	MOSI

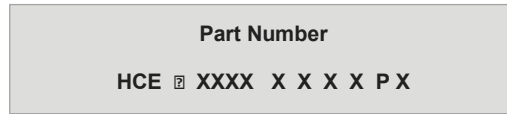
\* internal connection.  
Do not connect for any reason



first angle projection  
dimensions in mm

# HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

## Part numbering key



### Pressure range

<b>0611</b>	600 to 1100 mbar
<b>0811</b>	800 to 1100 mbar
<b>M010</b>	10 mbar
<b>M020</b>	20 mbar
<b>M050</b>	50 mbar
<b>M100</b>	100 mbar
<b>M200</b>	200 mbar
<b>M500</b>	500 mbar
<b>B001</b>	1 bar
<b>B002</b>	2 bar
<b>B005</b>	5 bar

### Pressure mode

<b>A*</b>	Absolute
<b>D</b>	Differential
<b>G</b>	Gage

\*only for pressure ranges 0611,0811, B001, B002

### Calibration

<b>B</b>	Bidirectional
<b>U</b>	Unidirectional
<b>R*</b>	Barometric

\*only for pressure ranges 0611,0811

### Voltage

<b>5</b>	5V
<b>3</b>	3V

### Grade

<b>P</b>	Prime
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### Porting

<b>8*</b>	Straight
<b>9**</b>	Barbed

\* standard for devices up to 500 mbar and barometric ranges

\*\*standard for devices from 1 bar

### Housing

<b>E*</b>	[SMD, 2 ports same side]
<b>H**</b>	[SMD, 1 port]
<b>Q*</b>	[SMD, 2 ports opposite side]

Housings Q only available up to 1 bar. Please contact TE Connectivity.

\* standard for differential devices, "D"

\*\*standard for absolute and gage devices, "A" and "G"

**Order code example: HCEM050DBE8P5**

**Note: Not all possible sensor configurations are active products. MOQ may apply.**

Custom specific pressure ranges and mechanical or electronic sensor modifications are widely available. Please contact your local sensors representative to learn more.

## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

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### Ordering information (standard configurations)

Description	TE Part Number	Pressure Range	Pressure mode	Calibration	Housing	Porting	Grade	Voltage
HCEM100DUE9P5	2003204	100 mbar	Differential	Unidirectional	[SMD, 2 ports same side]	Barbed	Prime	5 V
HCEM200GUH9P3	2003243	200 mbar	Gage	Unidirectional	[SMD, 1 port]	Barbed	Prime	3 V
HCEM500DBE8P3	2003895	500 mbar	Differential	Bidirectional	[SMD, 2 ports same side]	Straight	Prime	3 V
HCEB005DUE9P5	2003483	5 bar	Differential	Unidirectional	[SMD, 2 ports same side]	Barbed	Prime	5 V
HCE0611ARH8P3	2003443	600 to 1100 mbar	Absolute	Barometric	[SMD, 1 port]	Straight	Prime	3 V

#### Note:

The above product listings are examples of possible product configurations. More standard product configurations are available on request.

In addition, custom specific pressure and temperature ranges as well as mechanical or electronic sensor modifications are widely available.

Please note, not all possible sensor configurations are active products. MOQ may apply. Please contact your local sensors representative to learn more.

### Specification notes

- (1) The sensor might not function or be operable above an absolute maximum rating of  $V_S = 6.5V$ .
- (2) Extended temperature ranges on request. Please contact TE Connectivity.
- (3) Proof pressure is the maximum pressure which may be applied without causing durable shifts of the electrical parameters of the sensing element.
- (4) Burst pressure is the maximum pressure which may be applied without causing damage to the sensing element or leaks to the housing.
- (5) Total accuracy is the combined error from offset and span calibration, linearity, pressure hysteresis, and temperature effects. Linearity is the measured deviation based on a straight line. Hysteresis is the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure. Calibration errors include the deviation of offset and full scale from nominal values.
- (6) The response time depends on the adjusted internal A/D resolution of the sensor. For 12 bit it is typ. 0.5 ms. Other A/D resolutions and response time are available on request. Please contact TE Connectivity for further information.
- (7) Max. delay time between pressure change at the pressure die and signal change at the output.
- (8) Sensors with lower current consumption are available on request. Please contact TE Connectivity for further information.
- (9) Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.
- (10) Unless otherwise noted, all tolerances acc. to: DIN ISO 2768, tolerance class m (medium) for general tolerances, DIN 16742 for plastics molded parts.

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