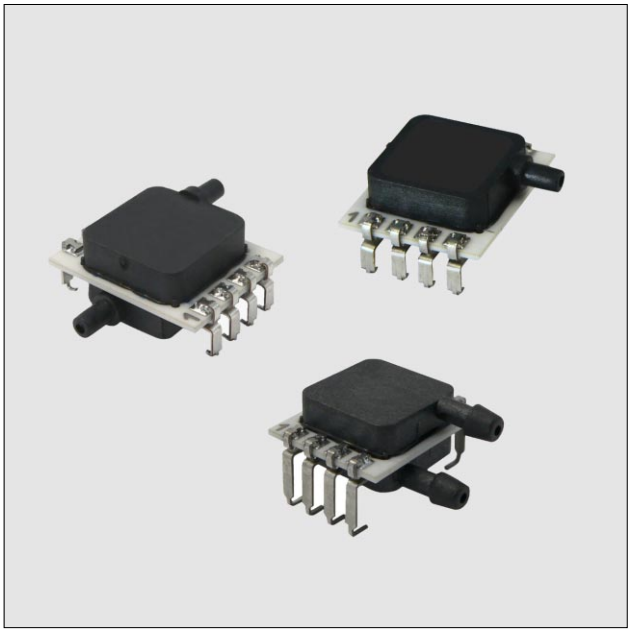
HCE Series

Miniature amplified pressure sensors

FEATURES

- **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**
- **Matched pressure port volumes**
- **Miniature SMD housings**
- **RoHS compliant**
- **Sensortechnics PRO services**

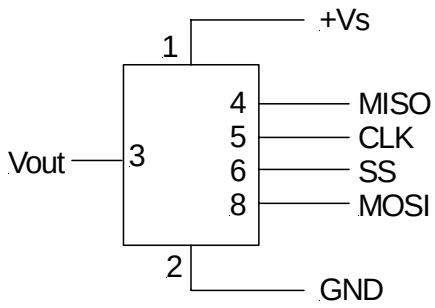


SPECIFICATIONS

Maximum ratings

Supply voltage V_S	
HCE...3	2.7 ... 3.3 V_{DC}
HCE...5	4.5 V ... 5.5 V_{DC}
	max. 6.50 V_{DC}
Output current	
Sink	1 mA
Source	1 mA
Lead specifications	
Average preheating temperature gradient	2.5 K/s
Soak time	ca. 3 min
Time above 217°C	50 s
Time above 230°C	40 s
Time above 250°C	15 s
Peak temperature	260°C
Cooling temperature gradient	-3.5 K/s
Temperature ranges[6]	
Compensated	0 ... 85°C
Operating	-25 ... 85°C
Storage	-40 ... 125°C
Humidity limits (non-condensing)	0 ... 95 %RH

ELECTRICAL CONNECTION



Note: **Connections for digital SPI bus (pins 4 to 6) are only available for SMD package styles (E, H and Q housings).**

PRESSURE SENSOR CHARACTERISTICS

(T_A = 25 °C)

Part no.	Operating pressure	Proof pressure[3,5]	Burst pressure[4,5]
HCEM010...B...	0...±10 mbar	250 mbar	500 mbar
HCEM020...B...	0...±20 mbar	500 mbar	750 mbar
HCEM050...B...	0...±50 mbar	750 mbar	1.2 bar
HCEM100...B...	0...±100 mbar	1.2 bar	2 bar
HCEM200...B...	0...±200 mbar	2 bar	2 bar
HCEM500...B...	0...±500 mbar	2 bar	2 bar
HCEB001...B...	0...±1 bar	3 bar	5 bar
HCEM010...U...	0...10 mbar	250 mbar	500 mbar
HCEM020...U...	0...20 mbar	500 mbar	750 mbar
HCEM050...U...	0...50 mbar	750 mbar	1.2 bar
HCEM100...U...	0...100 mbar	1.2 bar	2 bar
HCEM200...U...	0...200 mbar	2 bar	2 bar
HCEM500...U...	0...500 mbar	2 bar	2 bar
HCEB001...U...	0...1 bar	3 bar	5 bar
HCEB002...U...	0...2 bar	6 bar	7 bar
HCEB005...U...	0...5 bar	7 bar	7 bar
HCE0611AR...	600...1100 mbar(a)	3 bar	5 bar
HCE0811AR...	800...1100 mbar(a)	3 bar	5 bar

Other pressure ranges are available on request. Please contact Sensortechnics.

Specification notes:

1. 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.
2. Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.
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. The HCE common mode pressure is 2 bar for all devices up to 500 mbar and 7 bar for all other devices. Common mode pressure is the maximum pressure that can be applied to both ports of a differential pressure sensor simultaneously without damaging the sensor housing.
6. Extended temperature ranges on request. Please contact Sensortechnics.
7. Max. delay time between pressure change at the pressure die and signal change at the output.
8. The response time depends on the adjusted internal A/D resolution of the sensor. For 14 bit it is typ. 1 ms. Other A/D resolutions and reponse times are available on request. Please contact Sensortechnics for further information.
9. Sensors with lower current consumption are available on request. Please contact Sensortechnics for further information.

PERFORMANCE CHARACTERISTICS

(V_s = 5.0 V, T_A = 25 °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 HCE...5 devices (V_S = 5.0)

Characteristics		Min.	Typ.	Max.	Units
Total accuracy (0...85 °C)[1]	HCE0611..., HCE0811...			±1.0	%FSS
	all other devices			±0.5	
Response delay[7, 8]			1		ms
A/D resolution[8]			14		bit
D/A resolution				11	
Current consumption (no load)[9]			5		mA

HCE...R...5 (barometric devices)

Characteristics	Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS				
Output at min. specified pressure	0560	0666	076C	Count Hex
Full scale span (FSS)[2]		6666		
Full scale output	6BC6	6CCC	6DD2	
ANALOGUE PERFORMANCE CHARACTERISTICS				
Output at min. specified pressure	0.21	0.25	0.29	V
Full scale span (FSS)[2]		4.00		
Full scale output	4.21	4.25	4.29	

HCE...U...5 (unidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS				
Zero pressure offset	05E3	0666	06E9	Count Hex
Full scale span (FSS)[2]		6666		
Full scale output	6C49	6CCC	6D4F	
ANALOGUE PERFORMANCE CHARACTERISTICS				
Zero pressure offset	0.23	0.25	0.27	V
Full scale span (FSS)[2]		4.00		
Full scale output	4.23	4.25	4.27	

HCE...B...5 (bidirectional devices)

Characteristics		Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTIC					
Zero pressure offset		3916	3999	3A1C	Count Hex
Full scale span (FSS)[2]			6666		
Output	at max. specified pressure	6C49	6CCC	6D4F	
	at min. specified pressure	05E3	0666	06E9	
ANALOGUE PERFORMANCE CHARACTERISTICS					
Zero pressure offset		2.23	2.25	2.27	V
Full scale span (FSS)[2]			4.00		
Output	at max. specified pressure	4.23	4.25	4.27	
	at min. specified pressure	0.23	0.25	0.27	

PERFORMANCE CHARACTERISTICS

(V_s = 3.0 V, T_A = 25 °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 HCE...3 devices (V_s = 3.0)

Characteristics		Min.	Typ.	Max.	Units
Total accuracy (0...85 °C)[1]	HCE0611..., HCE0811...			±1.0	%FSS
	all other devices			±0.5	
Response delay[7, 8]			1		ms
A/D resolution[8]			14		bit
D/A resolution				11	
Current consumption (no load)[9]			3		mA

HCE...R...3 (barometric devices)

Characteristics	Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS				
Output at min. specified pressure	09D0	0AAA	0B85	Count Hex
Full scale span (FSS)[2]		5555		
Full scale output	5F25	5FFF	60D9	
ANALOGUE PERFORMANCE CHARACTERISTICS				
Output at min. specified pressure	0.23	0.25	0.27	V
Full scale span (FSS)[2]		2.00		
Full scale output	2.23	2.25	2.27	

HCE...U...3 (unidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS				
Zero pressure offset	0A3D	0AAA	0B17	Count Hex
Full scale span (FSS)[2]		5555		
Full scale output	5F92	5FFF	606C	
ANALOGUE PERFORMANCE CHARACTERISTICS				
Zero pressure offset	0.24	0.25	0.26	V
Full scale span (FSS)[2]		2.00		
Full scale output	2.24	2.25	2.26	

HCE...B...3 (bidirectional devices)

Characteristics		Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTIC					
Zero pressure offset		34E8	3555	35C2	Count Hex
Full scale span (FSS)[2]			5555		
Output	at max. specified pressure	5F92	5FFF	606C	
	at min. specified pressure	0A3D	0AAA	0B17	
ANALOGUE PERFORMANCE CHARACTERISTICS					
Zero pressure offset		1.24	1.25	1.26	V
Full scale span (FSS)[2]			2.00		
Output	at max. specified pressure	2.24	2.25	2.26	
	at min. specified pressure	0.24	0.25	0.26	

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 sensor 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 select line (SS) allows 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 are 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 three 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).

For further information please refer to Sensortechnics SPI bus application note

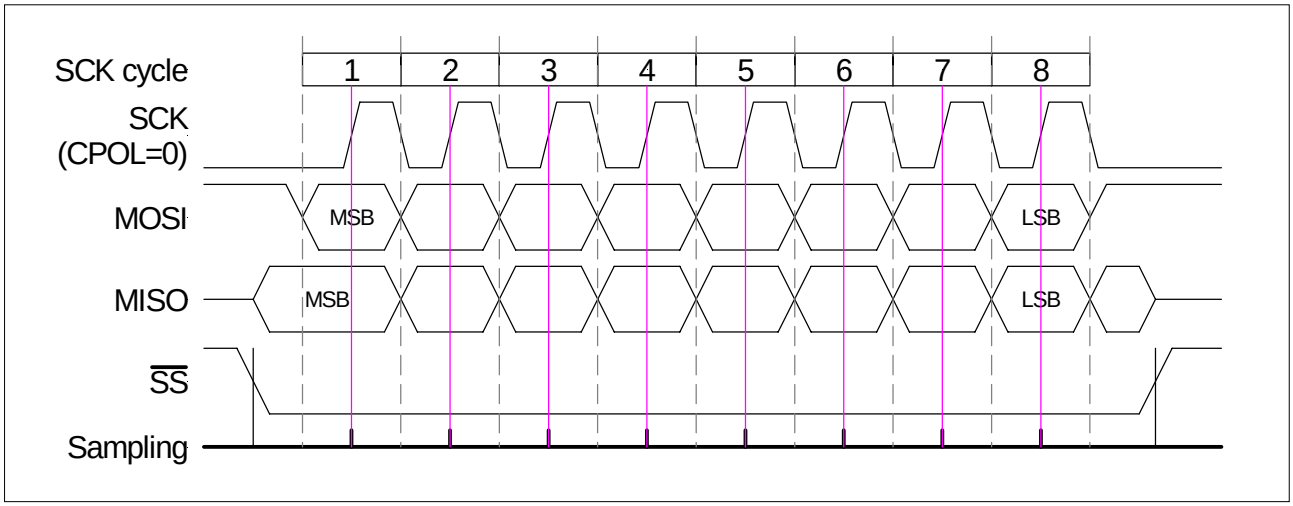


Fig. 1: Example of a standard 1 byte SPI data transfer for CPHA=0 and CPOL=0

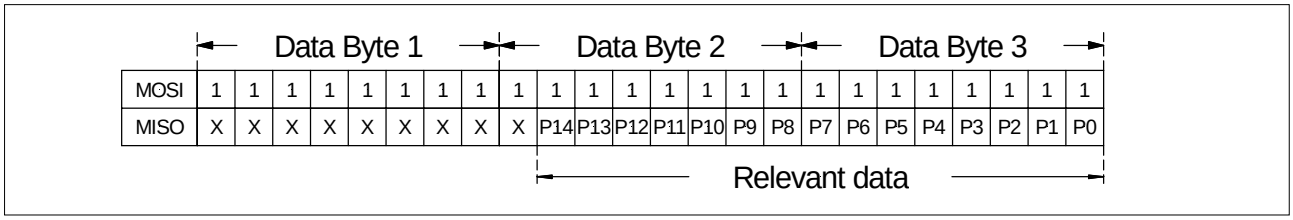


Fig. 2: 3 byte data stream between HCE sensor and master containing the pressure value as a 15 bit information

SPI - SERIAL PERIPHERAL INTERFACE (cont.)

Interface parameters

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			ns
/SS hold time after SCK sample slope	$t_{SPI_HD_SS}$	$1/f_{CLK}$			

* recommended

Note: **Sensortechnics recommends communication speeds of at least 100 kHz (max. 640 kHz). Please contact your nearest Sensortechnics sales office for further information.**

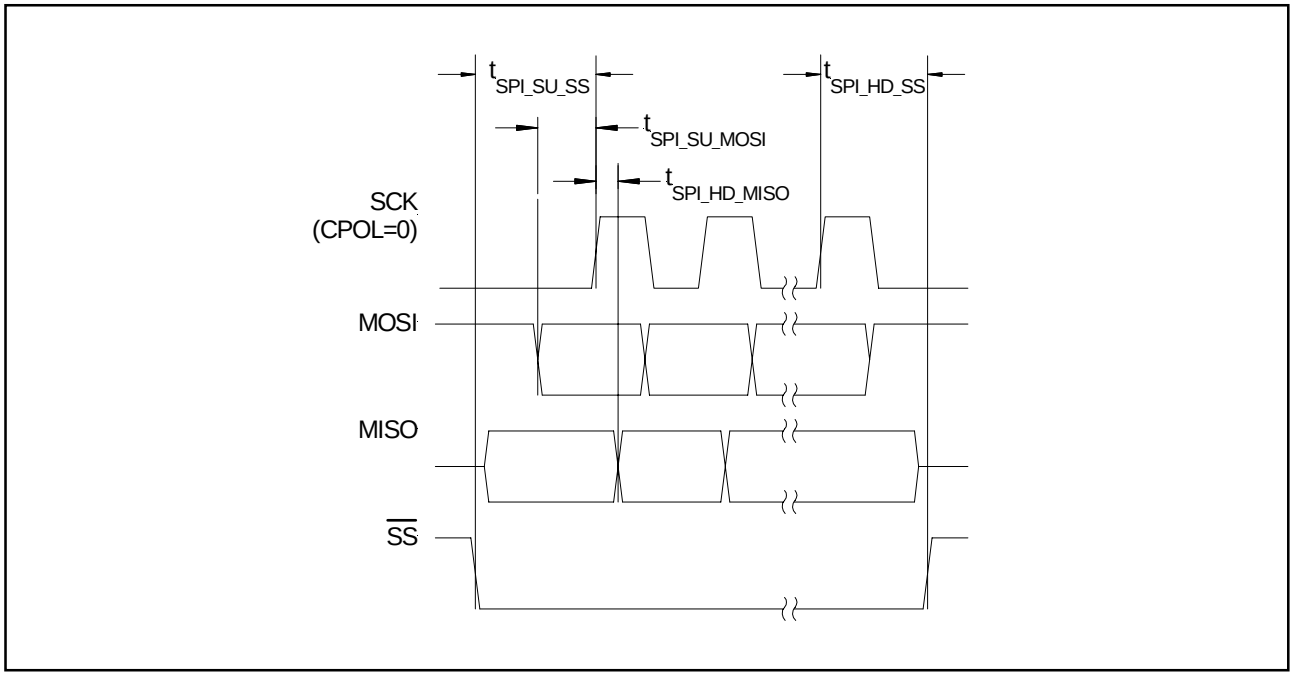
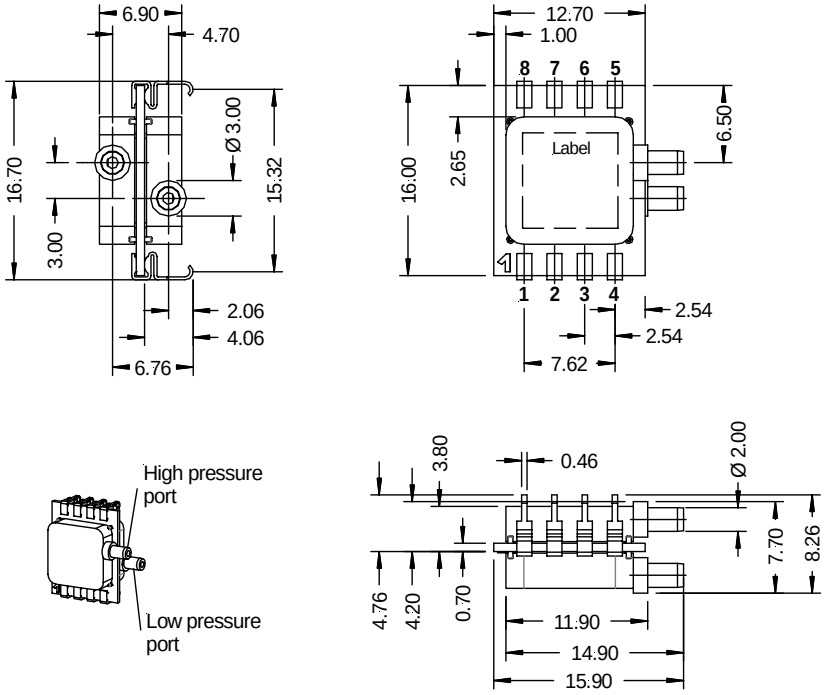


Fig. 3: Timing characteristics

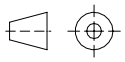
PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTIONS

HCE...E8...
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

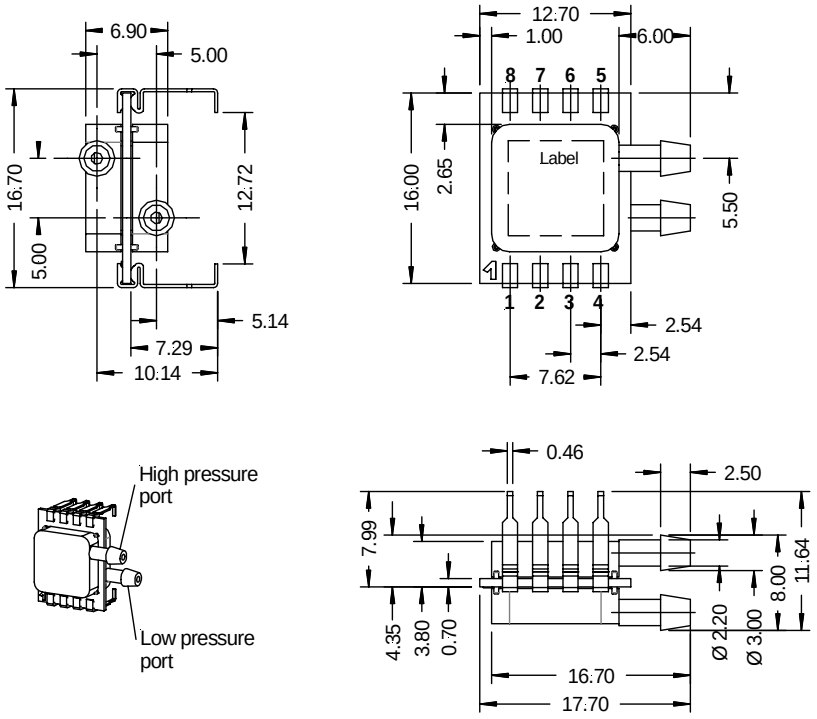
* Internal connection.
Do not connect
for any reason



first angle projection

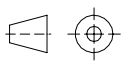
dimensions in mm

HCE...E9...
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

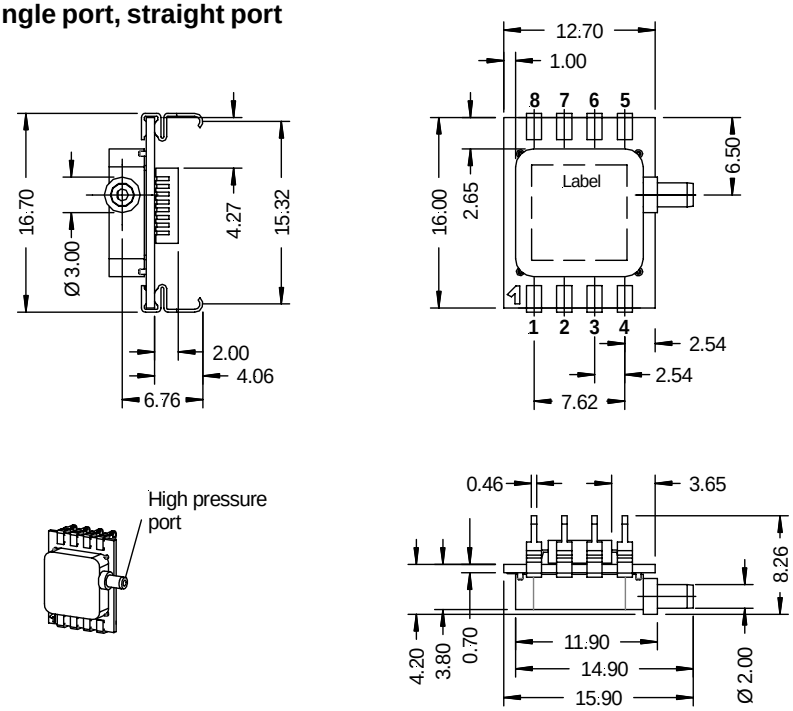


first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTIONS (cont.)

HCE...H8...
SMD single port, straight port



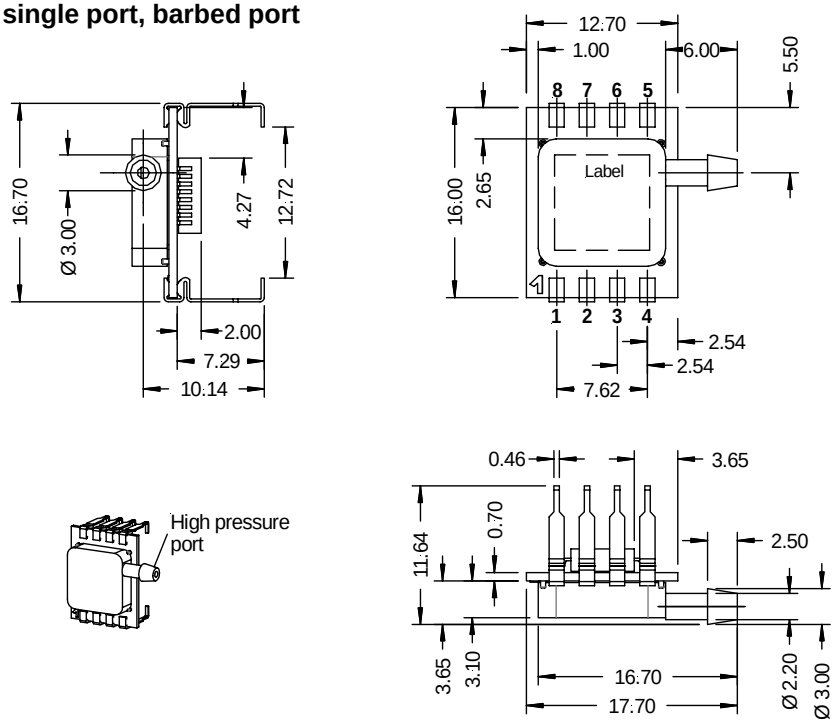
Pin	Connection
1	+Vs
2	GND
3	Vout
4	MISO
5	CLK
6	SS
7	I / C *
8	MOSI

* Internal connection.
Do not connect
for any reason

first angle projection

dimensions in mm

HCE...H9...
SMD single port, barbed port



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

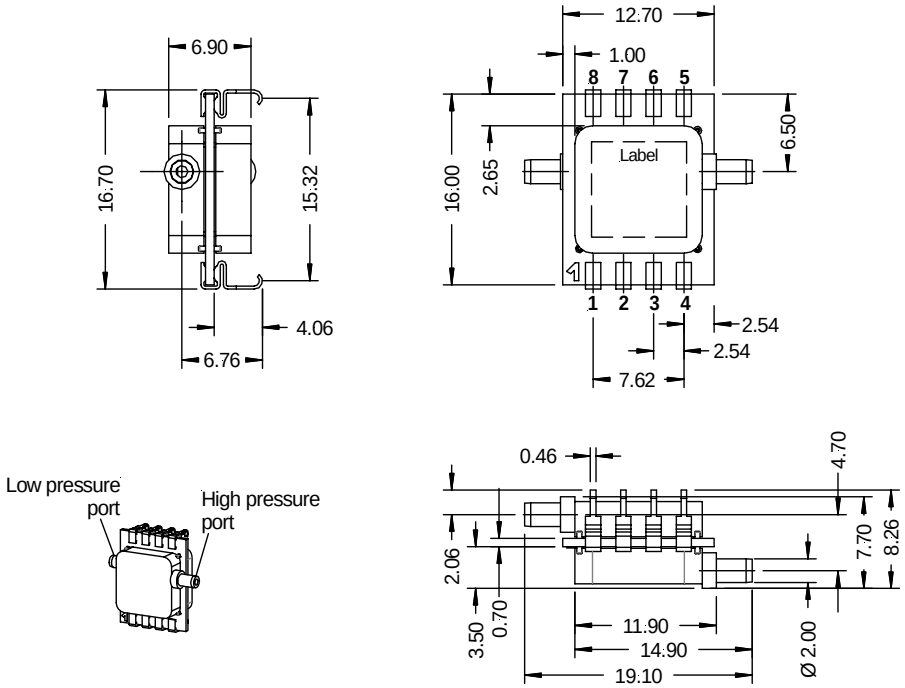
* Internal connection.
Do not connect
for any reason

first angle projection

dimensions in mm

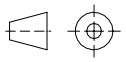
PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTIONS (cont.)

HCE...Q8...
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

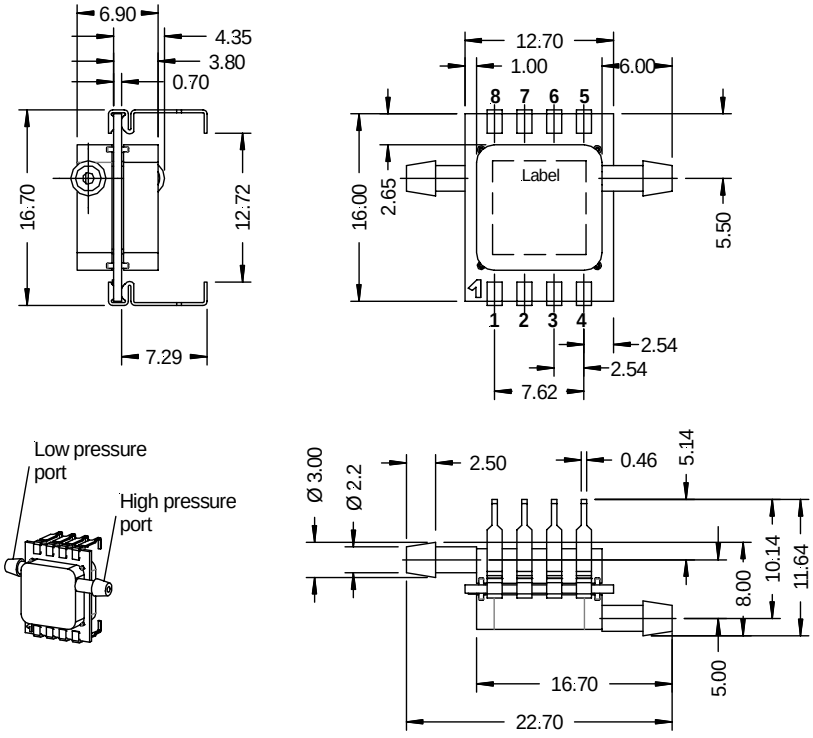
* Internal connection.
Do not connect
for any reason



first angle projection

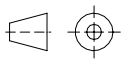
dimensions in mm

HCE...Q9...
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

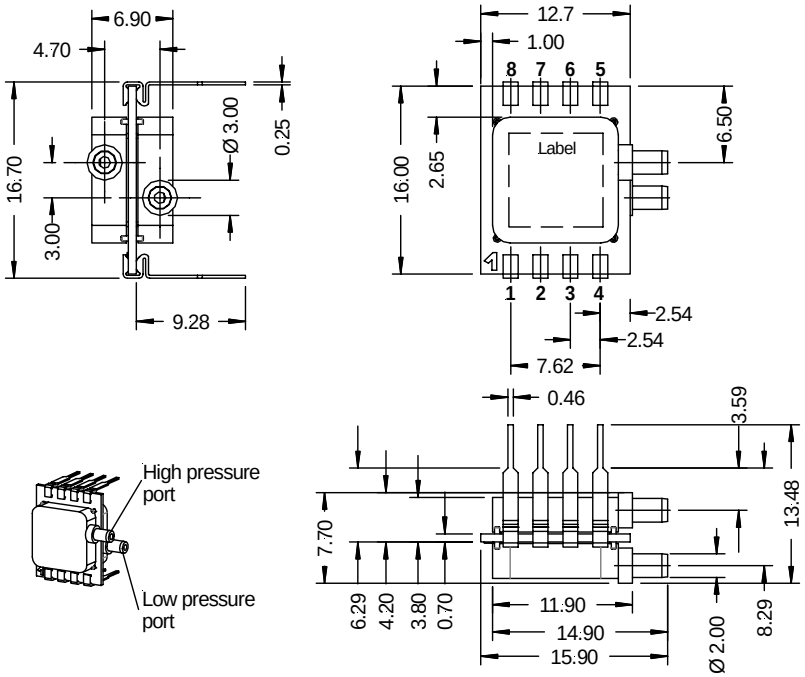
dimensions in mm

HOUSING OPTIONS

Different housing options are available on request. Please contact Sensortechnics.

Dual Inline Packages (DIP)

(Sample package shown: DIP dual port, same side)

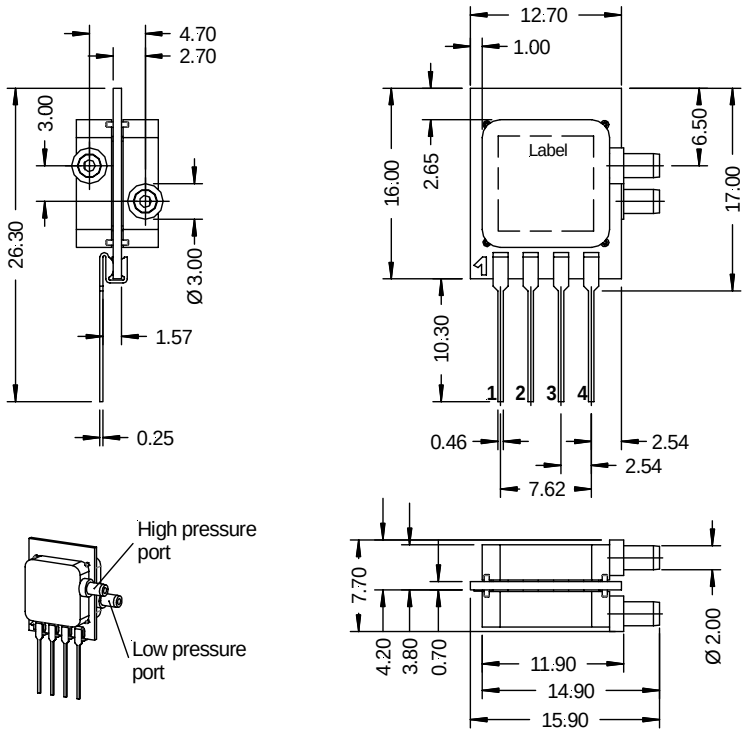


first angle projection

dimensions in mm

Single Inline Packages (SIL)

(Sample package shown: SIL dual port, same side)



first angle projection

dimensions in mm

HCE Series
Miniature amplified pressure sensors

ORDERING INFORMATION

	Series	Pressure range		Pressure mode		Calibration		Housing		Porting		Grade		Voltage	
Options	HCE	0611	600...1100 mbar	A*	Absolute	B	Bidirectional	E*	SMD, 2 ports, same side	8*	Straight	P	Prime	3	3 V
		0811	800...1100 mbar	D	Differential	U	Unidirectional			9**	Barbed			5	5 V
		M010	10 mbar	G	Gage	R*	Barometric	H**	SMD, 1 port						
		M020	20 mbar												
		M050	50 mbar					Q*	SMD, 2 ports, opposite side						
		M100	100 mbar												
		M200	200 mbar												
		M500	500 mbar												
		B001	1 bar												
		(B001A)	1 bara												
		B002	2 bar												
		B005	5 bar												
				* only available for pressure ranges 0611, 0811, B001, B002		* for pressure ranges 0611, 0811		Housings Q only available up to 1 bar. Please contact Sensortechnics. * standard for differential devices, "D" ** standard for absolute and gage devices, "A" and "G"		* standard for devices up to 500 mbar and barometric ranges ** standard for devices from 1 bar					
Example:	HCE	M050		D		B		E		8		P		5	

Note:	Devices highlighted in grey are preferred stock items

Custom specific pressure ranges and mechanical or electronic sensor modifications are widely available:

- I^2C, switching and custom specific outputs
- Dual inline packages (DIP)
- Single inline packages (SIL)

... etc.

Please contact your nearest Sensortechnics sales office for further information.

Sensortechnics PRO services:

- Extended warranty period of 2 years
- Custom product modifications and adaptations even for small quantities
- Advanced logistics models for supply inventory and short delivery times
- Technical support through application engineers on the phone or at your site
- Traceability of each sensor through serial numbers on request
- No product specification changes without customer notification
- No product obsolescence without very early prior notice
- Fastest possible technical response for design and QA engineers
- Long term product availability for your spares and service needs

... plus other services on request

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