



## 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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## Maximum ratings

| Parameter                         |                                         | Min. | Typ. | Max.      | Unit     |
|-----------------------------------|-----------------------------------------|------|------|-----------|----------|
| Supply voltage $V_S^{(1)}$        | 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.

## Performance characteristics

( $V_S=5.0\text{ V}_{DC}$ ,  $T_A=25\text{ }^{\circ}\text{C}$ , 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 ( $V_S=5.0\text{ V}$ )

| Characteristics                                            |                        | Min. | Typ. | Max.      | Unit |
|------------------------------------------------------------|------------------------|------|------|-----------|------|
| Total accuracy (0 to $85^{\circ}\text{C}$ ) <sup>(5)</sup> | all barometric devices |      |      | $\pm 1.0$ | %FSS |
|                                                            | all other devices      |      |      | $\pm 0.5$ |      |
| 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      |
|--------------------------------------|------|------|------|-----------|
| ANALOG                               |      |      |      |           |
| 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 |           |
| DIGITAL                              |      |      |      |           |
| 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      |
|--------------------------------------|------|------|------|-----------|
| ANALOG                               |      |      |      |           |
| 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 |           |
| DIGITAL                              |      |      |      |           |
| 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.)

( $V_S=5.0\text{ V}_{DC}$ ,  $T_A=25\text{ }^{\circ}\text{C}$ , 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      |
|--------------------------------------|----------------------------|------|------|------|-----------|
| ANALOG                               |                            |      |      |      |           |
| 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 | 4.27 |           |
|                                      | at min. specified pressure | 0.23 | 0.25 | 0.27 |           |
| DIGITAL                              |                            |      |      |      |           |
| Zero pressure offset                 |                            | 3916 | 3999 | 3A1C | Count Hex |
| Full scale span (FSS) <sup>(9)</sup> |                            |      | 6666 |      |           |
| Output                               | at max. specified pressure | 6C49 | 6CCC | 6D4F |           |
|                                      | at min. specified pressure | 05E3 | 0666 | 06E9 |           |

### Performance characteristics

( $V_S=3.0\text{ V}_{DC}$ ,  $T_A=25\text{ }^{\circ}\text{C}$ , 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>(8)</sup>        |                        |      | 3    |      | mA   |

#### All HCExxxRxxx3 (barometric devices)

| Characteristics                      | Min. | Typ. | Max. | Unit      |
|--------------------------------------|------|------|------|-----------|
| ANALOG                               |      |      |      |           |
| 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 |           |
| DIGITAL                              |      |      |      |           |
| Zero pressure offset                 | 09D0 | 0AAA | 0B85 | Count Hex |
| Full scale span (FSS) <sup>(9)</sup> |      | 5555 |      |           |
| Full scale output                    | 5F25 | 5FFF | 60D9 |           |

### Performance characteristics (cont.)

( $V_S=3.0\text{ V}_{DC}$ ,  $T_A=25\text{ }^{\circ}\text{C}$ , 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      |
|--------------------------------------|------|------|------|-----------|
| ANALOG                               |      |      |      |           |
| 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 |           |
| DIGITAL                              |      |      |      |           |
| 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      |
|--------------------------------------|----------------------------|------|------|------|-----------|
| ANALOG                               |                            |      |      |      |           |
| 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 |           |
| DIGITAL                              |                            |      |      |      |           |
| 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  $\mu$ s 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).

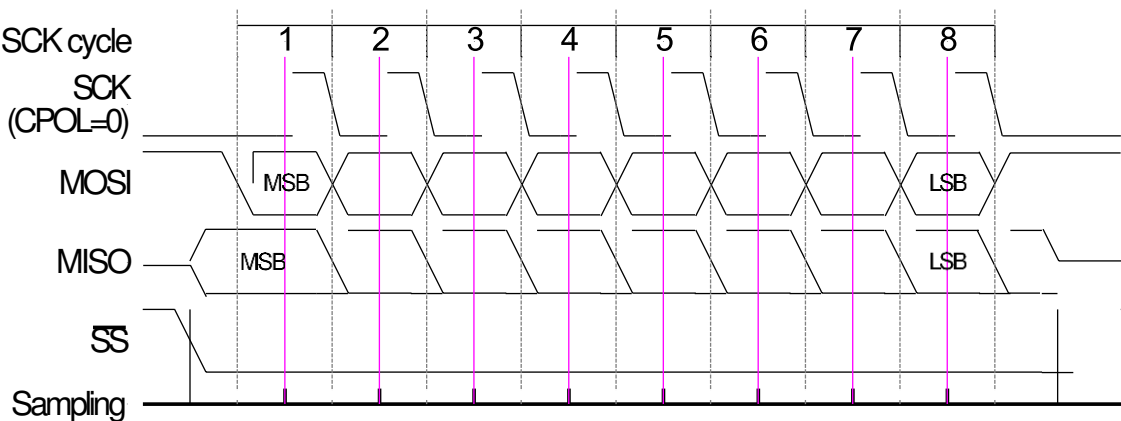


Fig. 1: Example of a standard 1 byte SPI data transfer for CPHA=0 and CPOL=0

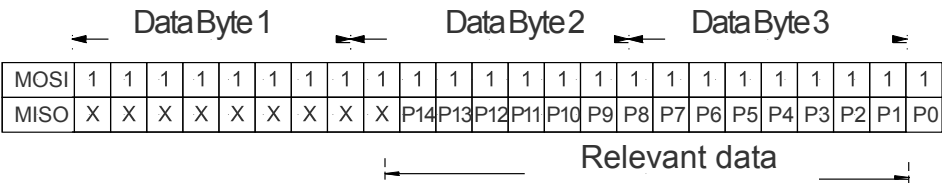


Fig. 2: 3 byte data stream between HCE sensor and master containing the pressure value as a 15 bit information

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 <sub>MISO</sub>        |                    |      | 400  | pF      |
| Input capacitance @ each pin            | C <sub>SPI_IN</sub>      |                    |      | 10   |         |
| Signal clock frequency                  | f <sub>SCK</sub>         | 100*               |      | 640  | kHz     |
| MISO hold time after SCK sample slope   | t <sub>SPI_HD_MISO</sub> | 200                |      |      | ns      |
| MOSI setup time before SCK sample slope | t <sub>SPI_SU_MOSI</sub> | 2/f <sub>CLK</sub> |      |      |         |
| /SS setup time before SCK sample slope  | t <sub>SPI_SU_SS</sub>   | 10                 |      |      |         |
| /SS hold time after SCK sample slope    | t <sub>SPI_HD_SS</sub>   | 1/f <sub>CLK</sub> |      |      |         |

\*recommended

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

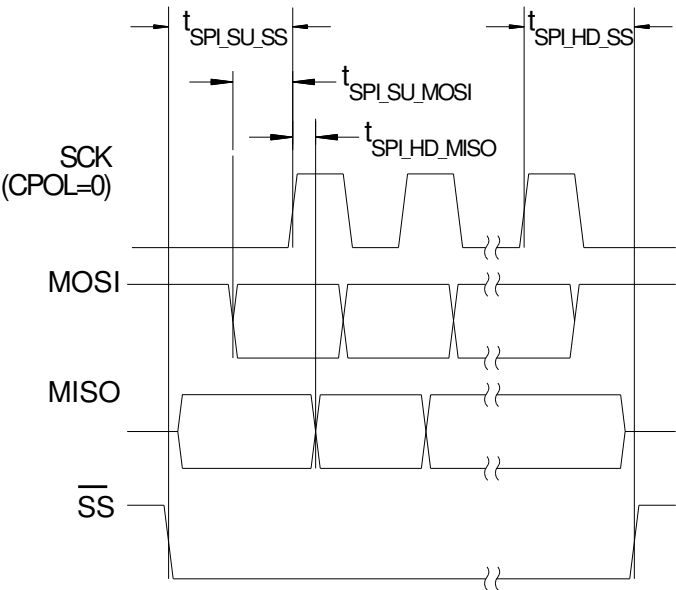
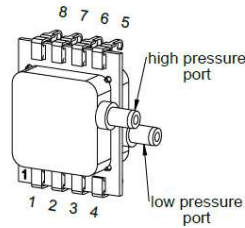
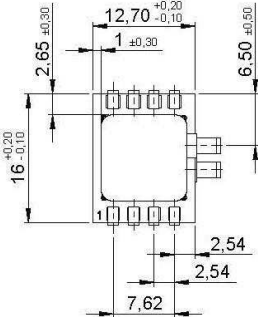
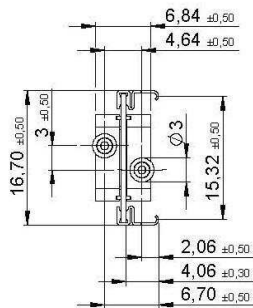


Fig. 3: Timing characteristics

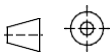
Dimensional drawing <sup>(10)</sup>

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

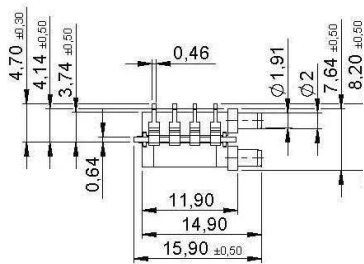


| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

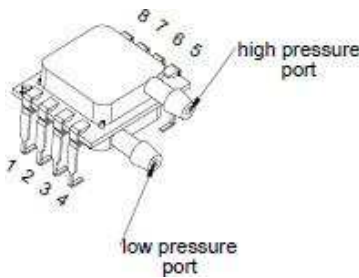
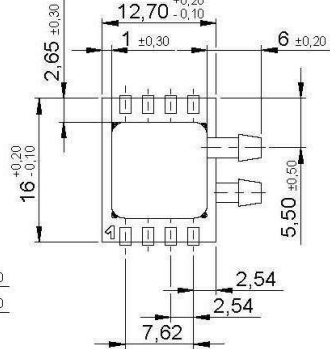
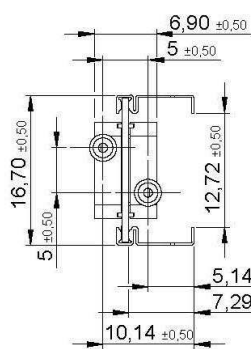
\* internal connection.  
Do not connect for any reason



first angle projection  
dimensions in mm

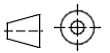


HCExxxE9xxx (SMD dual port, same side, barbed ports)

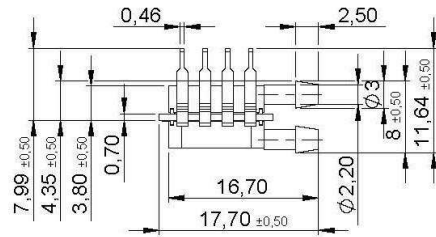


| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

\* internal connection.  
Do not connect for any reason



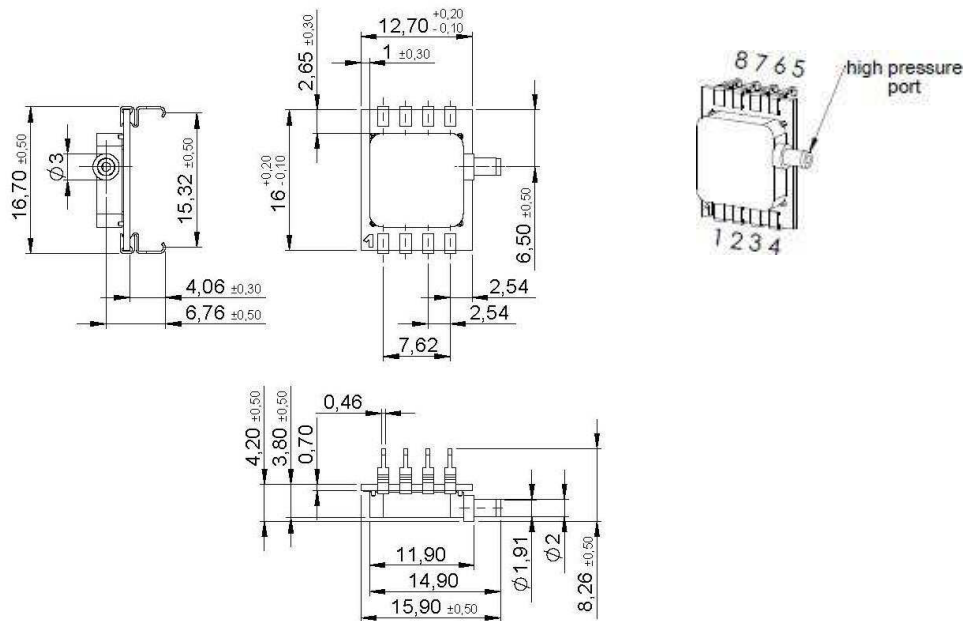
first angle projection  
dimensions in mm





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

HCExxxH8xxx (SMD single port, straight port)

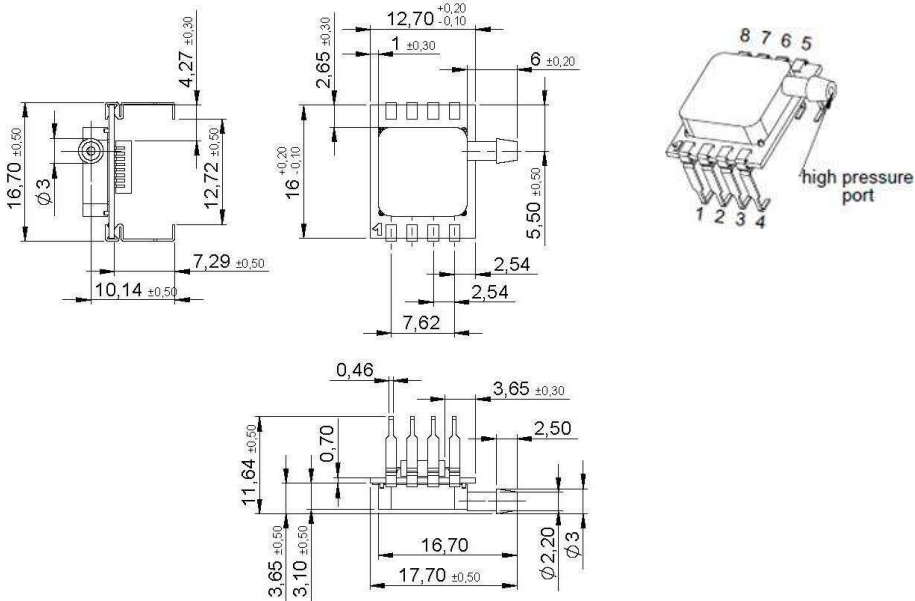


| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

\* internal connection.  
Do not connect for  
any reason

  
first angle projection  
dimensions in mm

HCExxxH9xxx (SMD single port, barbed port)



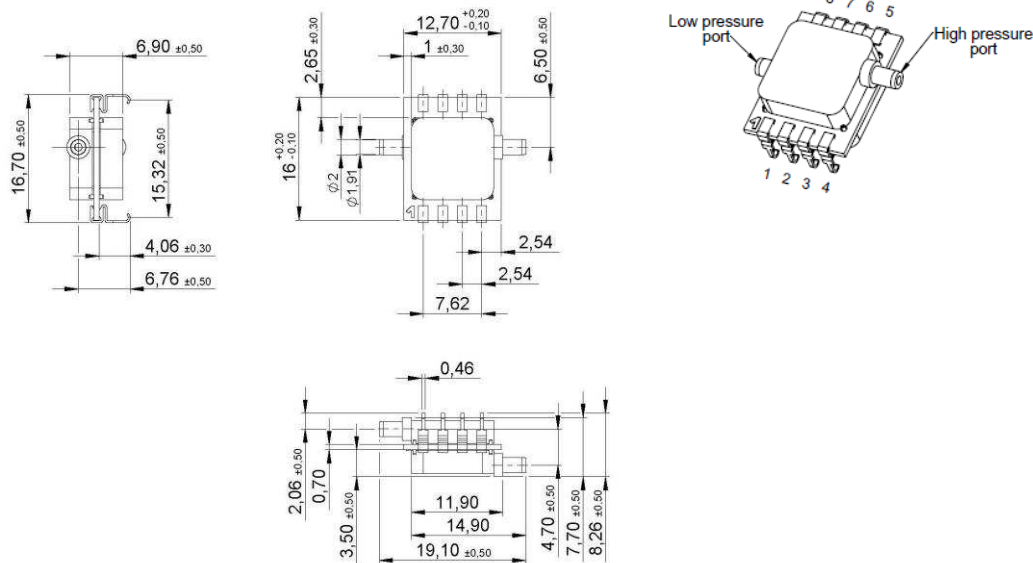
| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

\* internal connection.  
Do not connect for any  
reason

  
first angle projection  
dimensions in mm

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

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

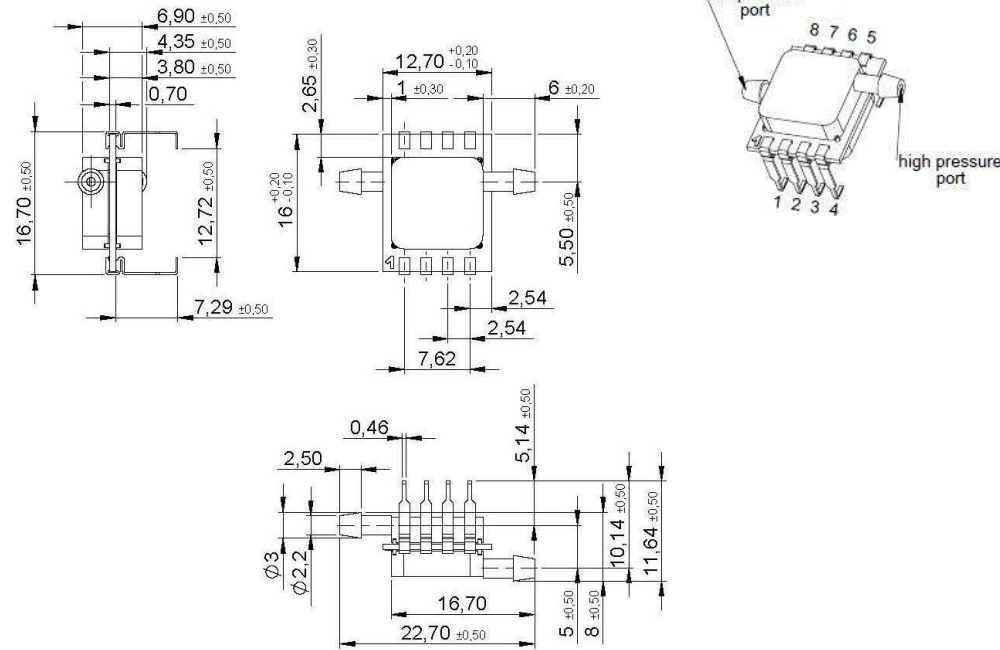


| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

\* internal connection.  
Do not connect for any reason

  
first angle projection  
dimensions in mm

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



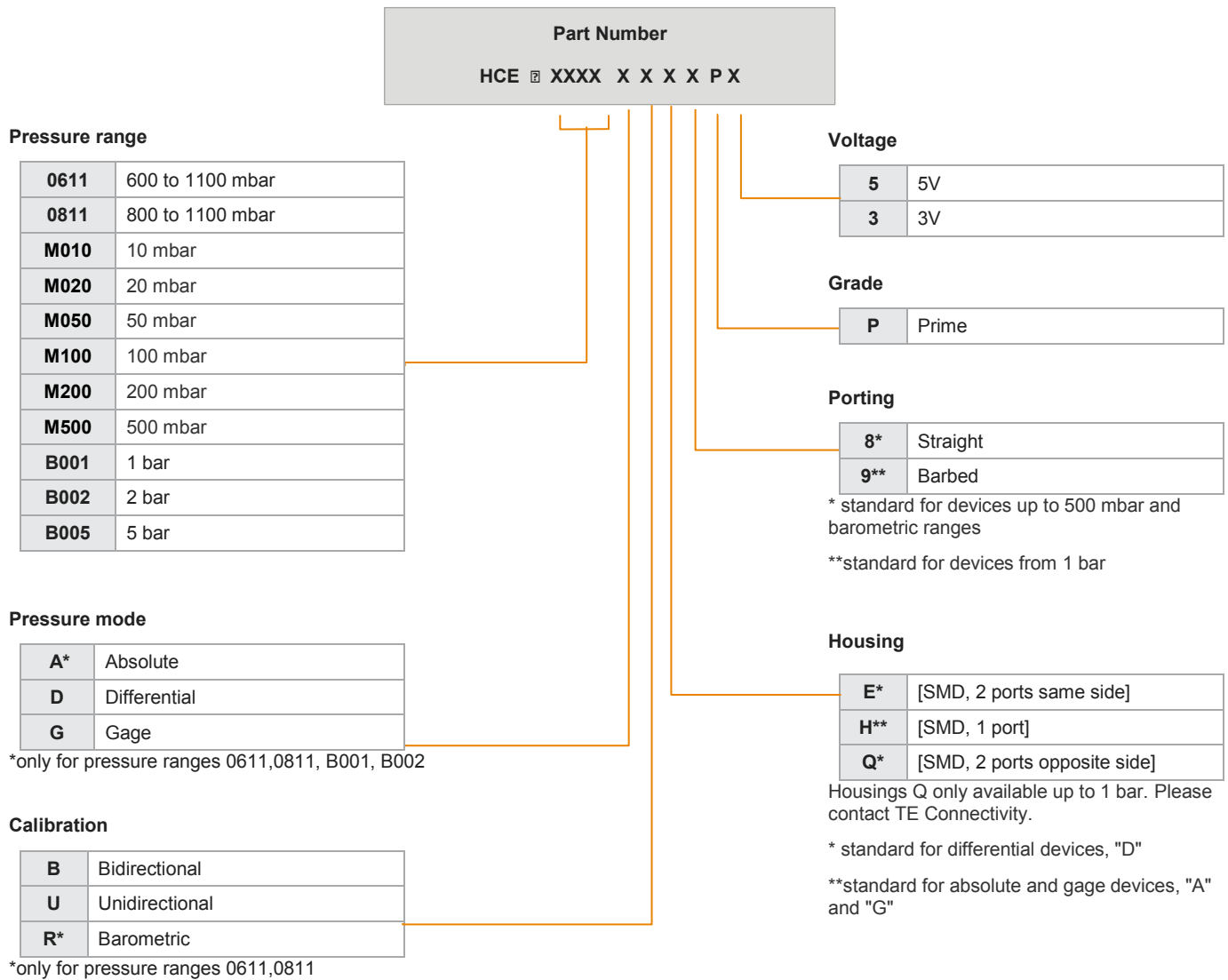
| Pin | connection |
|-----|------------|
| 1   | +Vs        |
| 2   | GND        |
| 3   | Vout       |
| 4   | MISO       |
| 5   | CLK        |
| 6   | SS         |
| 7   | I/C*       |
| 8   | MOSI       |

\* internal connection.  
Do not connect for any reason

  
first angle projection  
dimensions in mm

## HCE SERIES – MINIATURE AMPLIFIED PRESSURE SENSORS

### Part numbering key



**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

### 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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