

HDI SERIES – AMPLIFIED PRESSURE SENSORS

The HDI 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 and DIP housings allow for space-saving PCB-mounting and maximum OEM design flexibility. All HDI pressure sensors can be modified according to customer specific requirements.

Features

- Pressure ranges from 10 mbar to 5 bar, absolute, gage or differential pressure
- Digital I²C bus and analog output
- Precision ASIC signal conditioning
- Calibrated and temperature compensated
- SMT and DIP 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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HDI SERIES – AMPLIFIED PRESSURE SENSORS

Maximum ratings

| Parameter | | Min. | Typ. | Max. | Unit |
|-----------------------------------|---|------|------|-----------|----------|
| Supply voltage V_S | HDIxxx3 | 2.7 | 3 | 3.3 | V_{DC} |
| | HDIxxx5 | 4.5 | 5 | 5.5 | |
| Output current | Sink | | 1 | | mA |
| | Source | | 1 | | mA |
| 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 ⁽¹⁾ | Compensated | 0 | | +85 | °C |
| | Operating | -20 | | +85 | |
| | Storage | -40 | | +125 | |

Pressure sensor characteristics

| Part no. | Operating pressure | Proof pressure ⁽²⁾ | Burst pressure ⁽³⁾ |
|----------------|---------------------|-------------------------------|-------------------------------|
| HDIM010xxxBxxx | 0 to ±10 mbar | 150 mbar | 200 mbar |
| HDIM020xxxBxxx | 0 to ±20 mbar | | |
| HDIM050xxxBxxx | 0 to ±50 mbar | 550 mbar | 800 mbar |
| HDIM100xxxBxxx | 0 to ±100 mbar | 1 bar | 1.5 bar |
| HDIM200xxxBxxx | 0 to ±200 mbar | | |
| HDIM500xxxBxxx | 0 to ±500 mbar | | |
| HDIB001xxxBxxx | 0 to ±1 bar | 2 bar | 3 bar |
| HDIM010xxxUxxx | 0 to 10 mbar | 150 mbar | 200 mbar |
| HDIM020xxxUxxx | 0 to 20 mbar | | |
| HDIM050xxxUxxx | 0 to 50 mbar | 550 mbar | 800 mbar |
| HDIM100xxxUxxx | 0 to 100 mbar | 1 bar | 1.5 bar |
| HDIM200xxxUxxx | 0 to 200 mbar | | |
| HDIM500xxxUxxx | 0 to 500 mbar | | |
| HDIB001xxxUxxx | 0 to 1 bar | 2 bar | 5 bar |
| HDIB002xxxUxxx | 0 to 2 bar | 4 bar | 6 bar |
| HDIB005xxxUxxx | 0 to 5 bar | 7 bar | 7 bar |
| HDI0611ARxxx | 600 to 1100 mbar(a) | 2 bara | 3 bara |
| HDI0811ARxxx | 800 to 1100 mbar(a) | | |

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

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Performance characteristics

(V_S=5.0 V_{DC}, T_A=25 °C, RH=50 %, analog output signal is ratiometric to V_S, digital output signal is not ratiometric to V_S)

All HDIxxxP5 devices (V_S= 5.0)

| Characteristics | | Min. | Typ. | Max. | Unit |
|---|------------------------|------|------|------|------|
| Total accuracy (0 to 85°C) ⁽⁴⁾ | all barometric devices | | | ±1.0 | %FSS |
| | all other devices | | | ±0.5 | |
| Response delay ^(5,6) | | | 0.5 | | ms |
| A/D resolution ⁽⁶⁾ | | | 12 | | bit |
| D/A resolution | | | | 11 | |
| Current consumption ⁽⁷⁾ | | | 5 | | mA |

All HDIxxxRxxxP5 (barometric devices)

| Characteristics | Min. | Typ. | Max. | Unit |
|--------------------------------------|-------|-------|-------|--------|
| ANALOG | | | | |
| Output at min. specified pressure | 0.46 | 0.50 | 0.54 | V |
| Full scale span (FSS) ⁽⁸⁾ | | 4.00 | | |
| Full scale output | 4.46 | 4.50 | 4.52 | |
| DIGITAL | | | | |
| Output at min. specified pressure | 3015 | 3277 | 3539 | counts |
| Full scale span (FSS) ⁽⁸⁾ | | 26214 | | |
| Full scale output | 29228 | 29490 | 29752 | |

All HDIxxxUxxxP5 (Unidirectional devices)

| Characteristics | Min. | Typ. | Max. | Unit |
|--------------------------------------|-------|-------|-------|--------|
| ANALOG | | | | |
| Zero pressure offset | 0.48 | 0.50 | 0.52 | V |
| Full scale span (FSS) ⁽⁸⁾ | | 4.00 | | |
| Full scale output | 4.48 | 4.50 | 4.52 | |
| DIGITAL | | | | |
| Zero pressure offset | 3146 | 3277 | 3480 | counts |
| Full scale span (FSS) ⁽⁸⁾ | | 26214 | | |
| Full scale output | 29359 | 29490 | 29621 | |

ALL HDIxxxBxxxP5 (Bidirectional device)

| Characteristics | Min. | Typ. | Max. | Unit | |
|--------------------------------------|---------------------------|-------|-------|--------|-------|
| ANALOG | | | | | |
| Zero pressure offset | 2.48 | 2.50 | 2.52 | V | |
| Full scale span (FSS) ⁽⁸⁾ | | 4.00 | | | |
| Output | @ max. specified pressure | 4.48 | 4.50 | | 4.52 |
| | @ min. specified pressure | 0.48 | 0.50 | | 0.52 |
| DIGITAL | | | | | |
| Zero pressure offset | 16252 | 16384 | 16515 | counts | |
| Full scale span (FSS) ⁽⁸⁾ | | 26214 | | | |
| Output | @ max. specified pressure | 29359 | 29490 | | 29621 |
| | @ min. specified pressure | 3146 | 3277 | | 3408 |

HDI SERIES – AMPLIFIED PRESSURE SENSORS

Performance characteristics

($V_S = 3.0 V_{DC}$, $T_A = 25^\circ C$, $RH = 50\%$, analog output signal is ratiometric to V_S , digital output signal is not ratiometric to V_S)

All HDIxxxP3 devices ($V_S = 3.0$)

| Characteristics | | Min. | Typ. | Max. | Unit |
|---|------------------------|------|------|------|------|
| Total accuracy (0 to 85°C) ⁽⁴⁾ | all barometric devices | | | ±1.0 | %FSS |
| | all other devices | | | ±0.5 | |
| Response delay ^(5,6) | | | 0.5 | | ms |
| A/D resolution ⁽⁶⁾ | | | 12 | | bit |
| D/A resolution | | | | 11 | |
| Current consumption ⁽⁷⁾ | | | 3 | | mA |

All HDIxxxRxxxP3 (barometric devices)

| Characteristics | Min. | Typ. | Max. | Unit |
|--------------------------------------|-------|-------|-------|--------|
| ANALOG | | | | |
| Output at min. specified pressure | 0.23 | 0.25 | 0.27 | V |
| Full scale span (FSS) ⁽⁸⁾ | | 2.00 | | |
| Full scale output | 2.23 | 2.25 | 2.27 | |
| DIGITAL | | | | |
| Output at min. specified pressure | 2512 | 2731 | 2949 | counts |
| Full scale span (FSS) ⁽⁸⁾ | | 21845 | | |
| Full scale output | 24357 | 24575 | 24794 | |

ALL HDIxxxUxxxP3 (Bidirectional device)

| Characteristics | Min. | Typ. | Max. | Unit |
|--------------------------------------|-------|-------|-------|--------|
| ANALOG | | | | |
| Zero pressure offset | 0.24 | 0.25 | 0.26 | V |
| Full scale span (FSS) ⁽⁸⁾ | | 2.00 | | |
| Full scale output | 2.24 | 2.25 | 2.26 | |
| DIGITAL | | | | |
| Zero pressure offset | 2621 | 2731 | 2840 | counts |
| Full scale span (FSS) ⁽⁸⁾ | | 21845 | | |
| Full scale output | 24466 | 24575 | 24684 | |

All HDIxxxBxxxP3 (Unidirectional devices)

| Characteristics | Min. | Typ. | Max. | Unit | |
|--------------------------------------|---------------------------|-------|-------|--------|-------|
| ANALOG | | | | | |
| Zero pressure offset | 1.24 | 1.25 | 1.26 | V | |
| Full scale span (FSS) ⁽⁸⁾ | | 2.00 | | | |
| Output | @ max. specified pressure | 2.24 | 2.25 | | 2.26 |
| | @ min. specified pressure | 0.24 | 0.25 | | 0.26 |
| DIGITAL | | | | | |
| Zero pressure offset | 13545 | 13653 | 13762 | counts | |
| Full scale span (FSS) ⁽⁸⁾ | | 21845 | | | |
| Output | @ max. specified pressure | 24466 | 24575 | | 24684 |
| | @ min. specified pressure | 2621 | 2731 | | 2840 |

I²C Bus

Introduction

The HDI is capable to generate a digital output signal. The device runs a cyclic program, which will store a corrected pressure value with 12 bit resolution about every 250 μs within the output registers of the internal ASIC. In order to use the sensor for digital signal readout, it should be connected to a bidirectional I²C-bus.

According to the I²C-bus specification, the bus is controlled by a master device, which generates the clock signal, controls the bus access and generates START and STOP conditions. The HDI is designed to work as a slave, hence it will only respond to requests from a master device.

Digital I²C interface

The HDI complies with the following protocol (Fig. 1):

Bus not busy: During idle periods both data line (SDA) and clock line (SCL) remain HIGH.

START condition (S): HIGH to LOW transition of SDA line while clock (SCL) is HIGH is interpreted as START condition. START conditions are always generated by the master. Each initial request for a pressure value has to begin with a START condition.

STOP condition (P): LOW to HIGH transition of SDA line while clock (SCL) is HIGH determines STOP condition. STOP conditions are always generated by the master. More than one request for the current pressure value can be transmitted without generation of intermediate STOP condition.

DATA valid (D): State of data line represents valid data when, after START condition, data line is stable for duration of HIGH period of clock signal. Data on line must be changed during LOW period of clock signal. There is one clock pulse per bit of data.

Acknowledge (A): Data is transferred in pieces of 8 bits (1 byte) on serial bus, MSB first. After each byte receiving device whether master or slave – is obliged to pull data line LOW as acknowledge for reception of data. Master must generate an extra clock pulse for this purpose. When acknowledge is missed, slave transmitter becomes inactive. It is on master either to send last command again or to generate STOP condition in that case.

Slave address: The I²C-bus master-slave concept requires a unique address for each device. The HDI has a preconfigured slave address (1111000xb). By factory programming it is possible to define a secondary slave address additional to the general one. According to I²C specification 127 different addresses are available. The sensor will then listen to both slave addresses. After generating a START condition the master sends the address byte containing a 7 bit address followed by a data direction bit (R/W). A "0" indicates a transmission from master to slave (WRITE), a "1" indicates a data request (READ).

DATA operation: The sensor starts to send 2 data bytes containing the current pressure value as a 15 bit information placed in the output registers.



Fig. 1: I²C bus protocol

I²C Interface parameters

| Parameter | Symbol | Min. | Typ. | Max. | Unit |
|--|---------------------|------|------|------|---------|
| Input high level | | 90 | | 100 | |
| Input low level | | 0 | | 10 | % of Vs |
| Output low level | | | | 10 | |
| Pull-up resistor | | 500 | | | Ω |
| Load capacitance @ SDA | C _{SDA} | | | 400 | pF |
| Input capacitance @ SDA/SCL | C _{I2C_IN} | | | 10 | |
| SCL clock frequency | F _{SCL} | 100* | | 400 | kHz |
| Bus free time between STOP and START condition | t _{BUF} | 1.3 | | | μs |
| Hold time (repeated) START condition, to first clock pulse | t _{HD,STA} | 0.8 | | | |
| LOW period of SCL | t _{LOW} | 1.3 | | | |
| HIGH period of SCL | t _{HIGH} | 0.6 | | | |
| Setup time repeated START condition | t _{SU,STA} | 1 | | | |
| Data hold time | t _{HD,DAT} | 0 | | | |
| Data setup time | t _{SU,DAT} | 0.2 | | | |
| Rise time of both SDA and SCL | t _R | | | 0.3 | |
| Fall time of both SDA and SCL | t _F | | | 0.3 | |
| Setup time for STOP condition | t _{SU,STO} | 0.6 | | | |

*recommended

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



Fig. 2: Timing characteristics

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Dimensional drawing

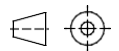
HDIxxxFxxx (DIP, 2 ports same side)



first angle projection
dimensions in mm

Dimensional drawing

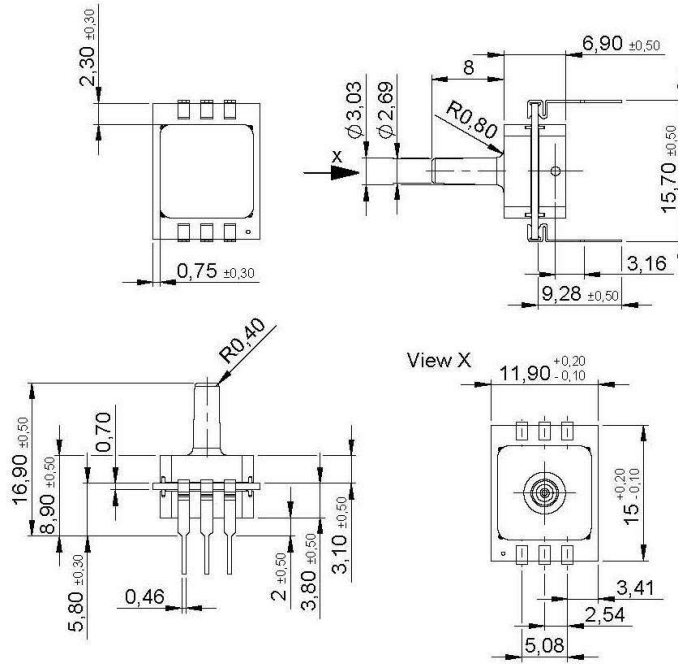
HDIxxxExxx (SMD, 2 ports same side)



first angle projection
dimensions in mm

HDI SERIES – AMPLIFIED PRESSURE SENSORS

HDIxxxZxxx (DIP, 1 port axial)



first angle projection
dimensions in mm

HDIxxxYxxx (SMD, 1 port axial)



first angle projection
dimensions in mm

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Electrical connection

HDI...A...
(absolute)



HDI...G...
(gage)



HDI...D...
(differential)

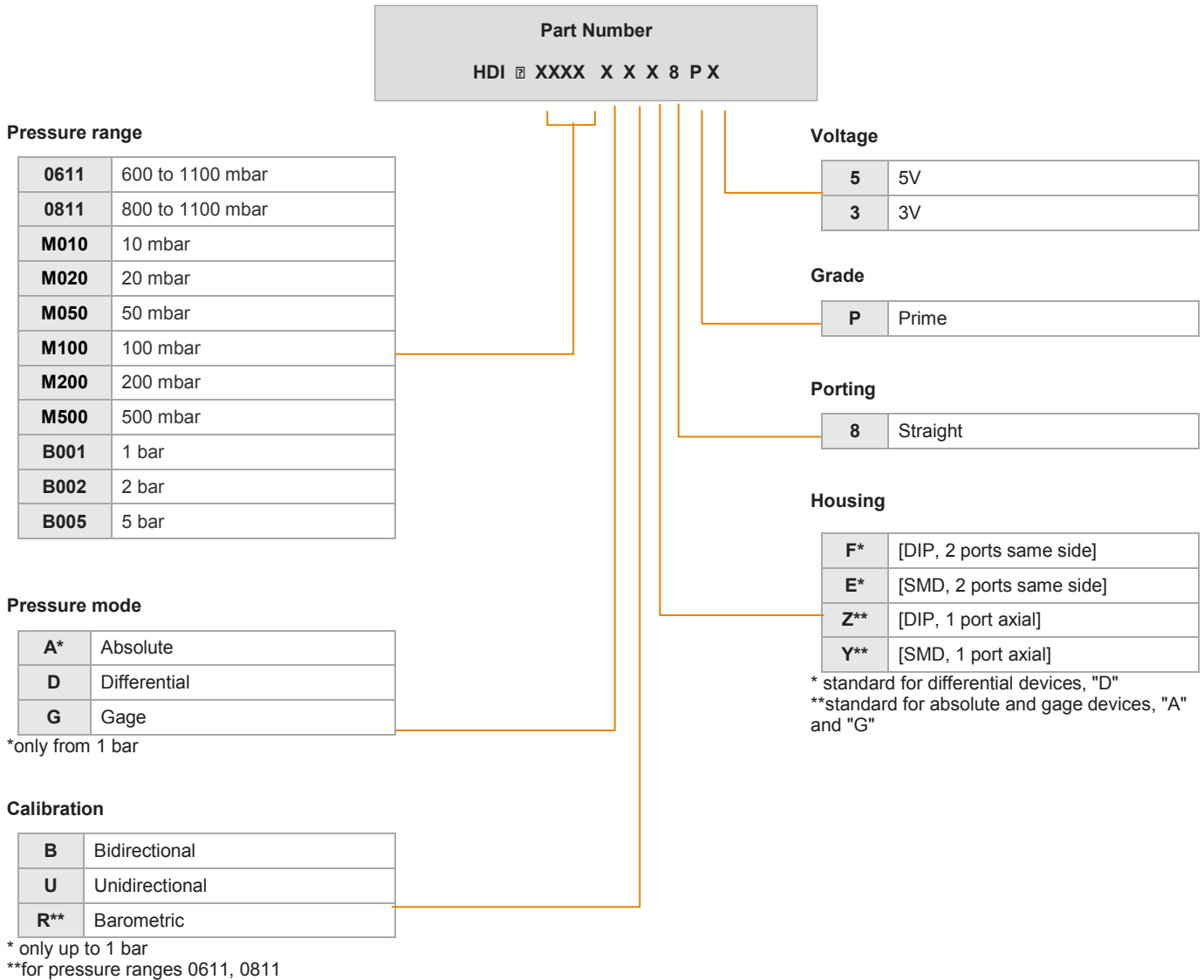


| Pin | connection |
|-----|------------|
| 1 | +Vs |
| 2 | +Vout |
| 3 | GND |
| 4 | SDA |
| 5 | I/C* |
| 6 | SCL |

* internal connection.
Do not connect for any reason

HDI SERIES – AMPLIFIED PRESSURE SENSORS

Part numbering key



Order code example: HDIM050GUZ8P5

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.

HDI SERIES – AMPLIFIED PRESSURE SENSORS

Ordering information (standard configurations)

| Description | TE Part Number | Pressure Range | Pressure mode | Calibration | Housing | Porting | Grade | Voltage |
|---------------|----------------|----------------|---------------|----------------|------------------------|----------|-------|---------|
| HDIM010GBZ8P5 | 2003438 | 10 mbar | Gage | Bidirectional | DIP, 1 port axial | Straight | Prime | 5 V |
| HDIM100DUE8P5 | 2003098 | 100 mbar | Differential | Unidirectional | SMD, 2 ports same side | Straight | Prime | 5 V |
| HDIM500GUY8P5 | 2003101 | 500 mbar | Gage | Unidirectional | SMD, 1 port axial | Straight | Prime | 5 V |
| HDIB001GUZ8P3 | 2003188 | 1 bar | Gage | Unidirectional | DIP, 1 port axial | Straight | Prime | 3 V |
| HDIB002AUY8P3 | 2003164 | 2 bar | Absolute | Unidirectional | SMD, 1 port axial | 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.