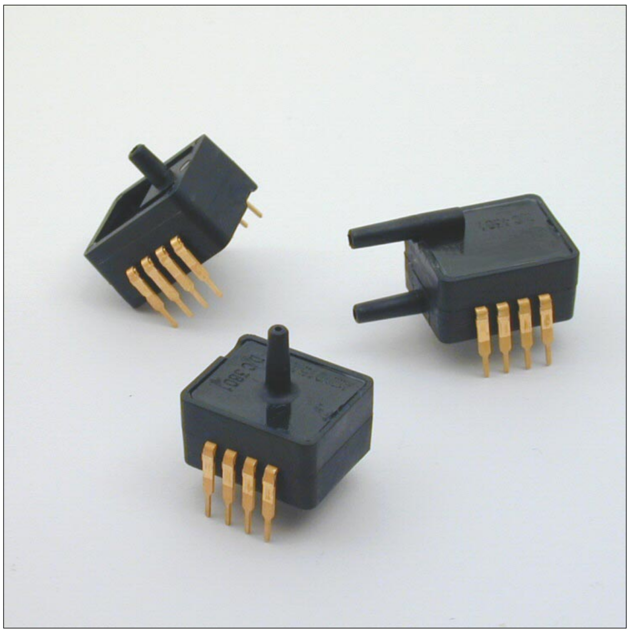
CSDX Series
Digital pressure transducers

FEATURES

- **0...25 mbar to 0...5 bar, 0...±10 mbar to 0...±1 bar, barometric range 800...1100 mbar**
- **Absolute, gage or differential pressure**
- **Digital readout via I²C-bus**
- **Precision ASIC conditioning**
- **Temperature compensated**
- **Non-ratiometric output**
- **Total accuracy ±0.5 to ±1.0 %FSS**



SPECIFICATIONS

Maximum ratings

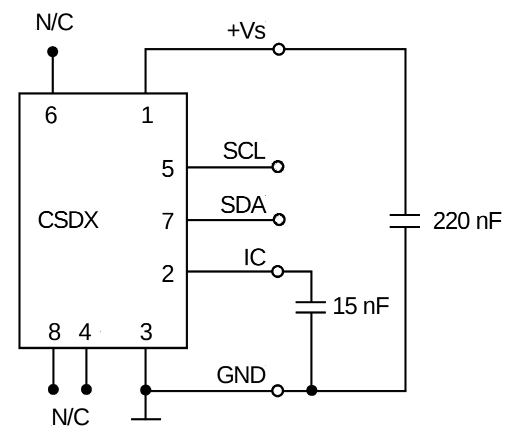
Supply voltage V_S	4.75 V to 5.25 V_{DC} max. 6.50 V_{DC}
Lead temperature (2 - 4 sec.)	250°C
Temperature ranges	
Compensated	0 to +85°C
Operating	-20 to +105°C
Storage	-40 to +125°C
Vibration	10 g at 20 - 2000 Hz
Shock	100 g for 11 ms

Caution! The sensor is not reverse polarity protected.

Incorrect applications of excitation voltage or ground to the wrong pin can cause electrical failure.

Application of supply voltage above the maximum can cause electrical failure.

ELECTRICAL CONNECTION



<u>Note</u>: **A capacitor of 220 nF is required between +Vs and GND.**

Pin 2 is an internal device connection and should be connected to ground with a 15 nF capacitor.

It is important to place the capacitors as close to the pins as possible!

Pins 4, 6 and 8 are internal device connections and should not be connected for any reason!

PRESSURE RANGES SPECIFICATIONS

(V_S = 5.0 V_{DC}, T_A = 25°C)

<table>
<tr><th>Part number</th><th colspan="2">Pressure range</th><th colspan="2">Burst pressure[1]</th><th colspan="2">Sensitivity (typ.)</th></tr>
<tr><td>CSDX0811BARO</td><td>800 to 1100</td><td>mbar(a)</td><td>2</td><td rowspan="4">bar
(a)</td><td>10.7</td><td rowspan="19">counts/
mbar</td></tr>
<tr><td>CSDX1000A2R</td><td>0 to 1</td><td rowspan="3">bar
(a)</td><td>2</td><td>3.2</td></tr>
<tr><td>CSDX2000A2R</td><td>0 to 2</td><td>4</td><td>1.6</td></tr>
<tr><td>CSDX5000A2R</td><td>0 to 5</td><td>10</td><td>0.6</td></tr>
<tr><td>CSDX0025D4R</td><td>0 to 25</td><td rowspan="5">mbar
(g,d)</td><td>0.2</td><td rowspan="8">bar
(g,d)</td><td>128</td></tr>
<tr><td>CSDX0050G2R / D4R</td><td>0 to 50</td><td>0.35</td><td>64</td></tr>
<tr><td>CSDX0100G2R / D4R</td><td>0 to 100</td><td>0.35</td><td>32</td></tr>
<tr><td>CSDX0250G2R / D4R</td><td>0 to 250</td><td>1</td><td>12.8</td></tr>
<tr><td>CSDX0500G2R / D4R</td><td>0 to 500</td><td>1</td><td>6.4</td></tr>
<tr><td>CSDX1000G2R / D4R</td><td>0 to 1</td><td rowspan="3">bar
(g,d)</td><td>2</td><td>3.2</td></tr>
<tr><td>CSDX2000G2R / D4R</td><td>0 to 2</td><td>4</td><td>1.6</td></tr>
<tr><td>CSDX5000G2R / D4R</td><td>0 to 5</td><td>10</td><td>0.6</td></tr>
<tr><td>CSDX0010D4D</td><td>0 to ±10</td><td rowspan="6">mbar
(d)</td><td>0.2</td><td rowspan="7">bar
(d)</td><td>160</td></tr>
<tr><td>CSDX0025D4D</td><td>0 to ±25</td><td>0.2</td><td>64</td></tr>
<tr><td>CSDX0050D4D</td><td>0 to ±50</td><td>0.35</td><td>32</td></tr>
<tr><td>CSDX0100D4D</td><td>0 to ±100</td><td>0.35</td><td>16</td></tr>
<tr><td>CSDX0250D4D</td><td>0 to ±250</td><td>1</td><td>6.4</td></tr>
<tr><td>CSDX0500D4D</td><td>0 to ±500</td><td>1</td><td>3.2</td></tr>
<tr><td>CSDX1000D4D</td><td>0 to ±1</td><td>bar(d)</td><td>2</td><td>1.6</td></tr>
</table>

Specification notes:

1. If maximum burst pressure is exceeded, even momentarily, the package may leak or burst, or the pressure sensing die may fracture.
2. Span is the algebraic difference between the output signal for the highest and lowest specified pressure.
3. 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.
4. Delay time between sampling and signal change at the output.
5. The smallest change in the output voltage, given any change in pressure.

PERFORMANCE CHARACTERISTICS

The output signal is not ratiometric to the supply voltage (V_S = 5.0 V_{DC}, T_A = 25°C)

All CSDX...R and CSDX0811BARO

Characteristics		Min.	Typ.	Max.	Units
Offset at lowest specified pressure	CSDX0025... CSDX0050... CSDX0811BARO	368	400	432	counts
	all others	384	400	416	counts
Full scale span (FSS)[2]			3200		counts
Full scale output	CSDX0025... CSDX0050... CSDX0811BARO	3568	3600	3632	counts
	all others	3584	3600	3616	counts
Total accuracy (0 to 85°C)[3]	CSDX0025... CSDX0050... CSDX0811BARO			±1.0	%FSS
	all others			±0.5	%FSS
Sample rate		100			Hz
Response delay[4]		2.73		14.11	ms
Startup time (power up to 1st result)				40	ms
Quantization step[5]	CSDX0811BARO		4		counts
	all others		2		counts
Current consumption			6		mA

All CSDX...D

Characteristics			Min.	Typ.	Max.	Units
Zero pressure offset		CSDX0010... CSDX0025... CSDX0050...	1968	2000	2032	counts
		all others	1984	2000	2016	counts
Full scale span (FSS)[2]				3200		counts
Output	at max. specified pressure	CSDX0010... CSDX0025... CSDX0050...	3568	3600	3632	counts
		all others	3584	3600	3616	counts
	at min. specified pressure	CSDX0010... CSDX0025... CSDX0050...	368	400	432	counts
		all others	384	400	416	counts
Total accuracy (0 to 85°C)[3]		CSDX0010... CSDX0025... CSDX0050...			±1.0	%FSS
		all others			±0.5	%FSS
Sample rate			100			Hz
Response delay[4]			2.73		14.11	ms
Startup time (power up to 1st result)					40	ms
Quantization step[5]				2		counts
Current consumption				6		mA

INTRODUCTION

The CSDX is capable to generate a digital output signal. It runs a cyclic program, which will store a corrected 12-bit sensor value about every 10 ms within the output registers of the internal ASIC. In order to use the pressure transducer for digital signal readout, the device should be connected to a bidirectional I²C-bus.

According to the I²C-bus communication 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 CSDX is designed to work as a slave, hence it will only respond to requests from a master device.

The I²C-bus master-slave concept requires a unique address for each device. The CSDX has a hard coded slave address (1111000xb), therefore it is **not** possible to access more than one CSDX on the same I²C-bus line.

DIGITAL I²C INTERFACE

The CSDX complies with the following protocol (FIGURE I):

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 request for the current pressure value must be initiated with a START.

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: Each device connected to the bus has a unique slave address. After generating a START condition, the master has to transmit the slave address for the CSDX with a READ command: $F1. The CSDX must not be accessed with a WRITE command ($F0) as the correct function of the device can not be guaranteed in this case (note: a power-down power-up change will force the sensor to use factory data again).

DATA operation: The CSDX starts to send 2 data bytes containing the current pressure value placed in the output registers.

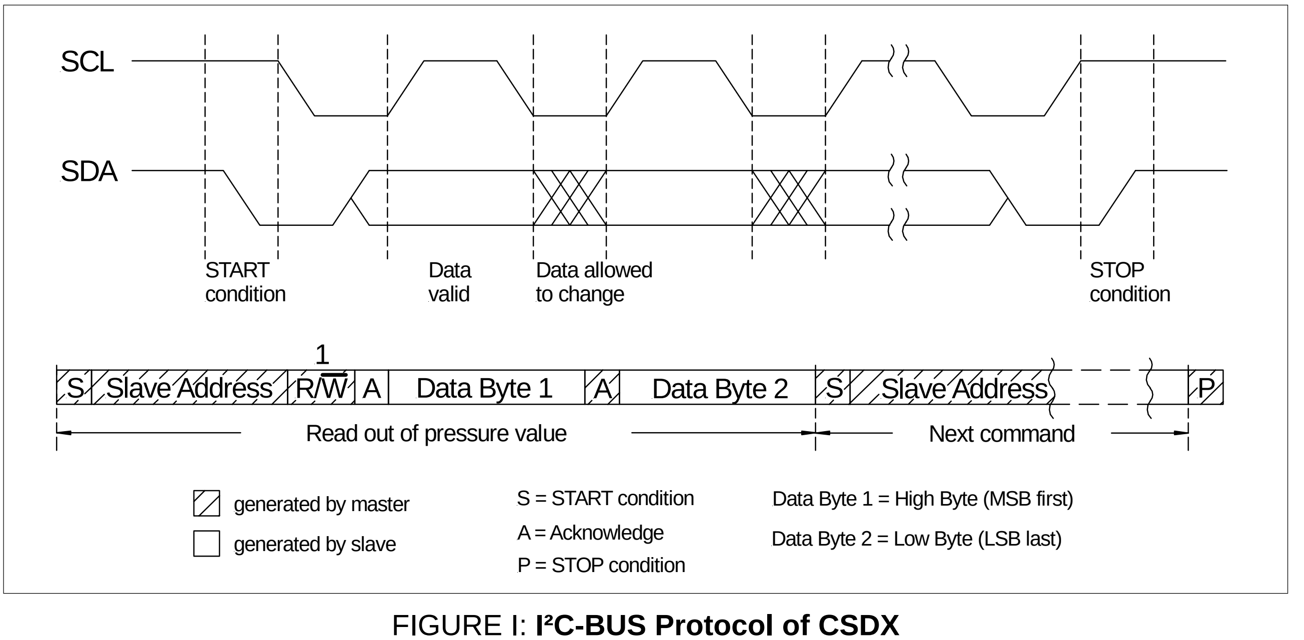


FIGURE I: **I²C-BUS Protocol of CSDX**

I²C INTERFACE PARAMETERS

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Input high level			90		100	% of Vs
Input low level			0		10	
Output low level		(open drain, IOL = -4 mA)			10	
Pull up current		(pins SCL and SDA)	5		20	µA
Load capacitance SDA					400	pF
SCL clock frequency	F_{SCL}		---		100	kHz
Bus free time between STOP and START condition	t_{BUF}		4.7			µs
Hold time (repeated) START condition	$t_{HD;STA}$	to first clock pulse	4.0			µs
LOW period of SCL	t_{LOW}		4.7			µs
HIGH period of SCL	t_{HIGH}		4.0			µs
Setup time repeated START condition	$t_{SU;STA}$		4.7			µs
Data hold time	$t_{HD;DAT}$		0			ns
Data setup time	$t_{SU;DAT}$		250			ns
Rise time of both SDA and SCL	t_R		---		300	ns
Fall time of both SDA and SCL	t_F		---		300	ns
Setup time for STOP condition	$t_{SU;STO}$		4			µs
Input filter spike suppression	t_{SP}	spikes on SDA or SCL of that length are suppressed			50	ns

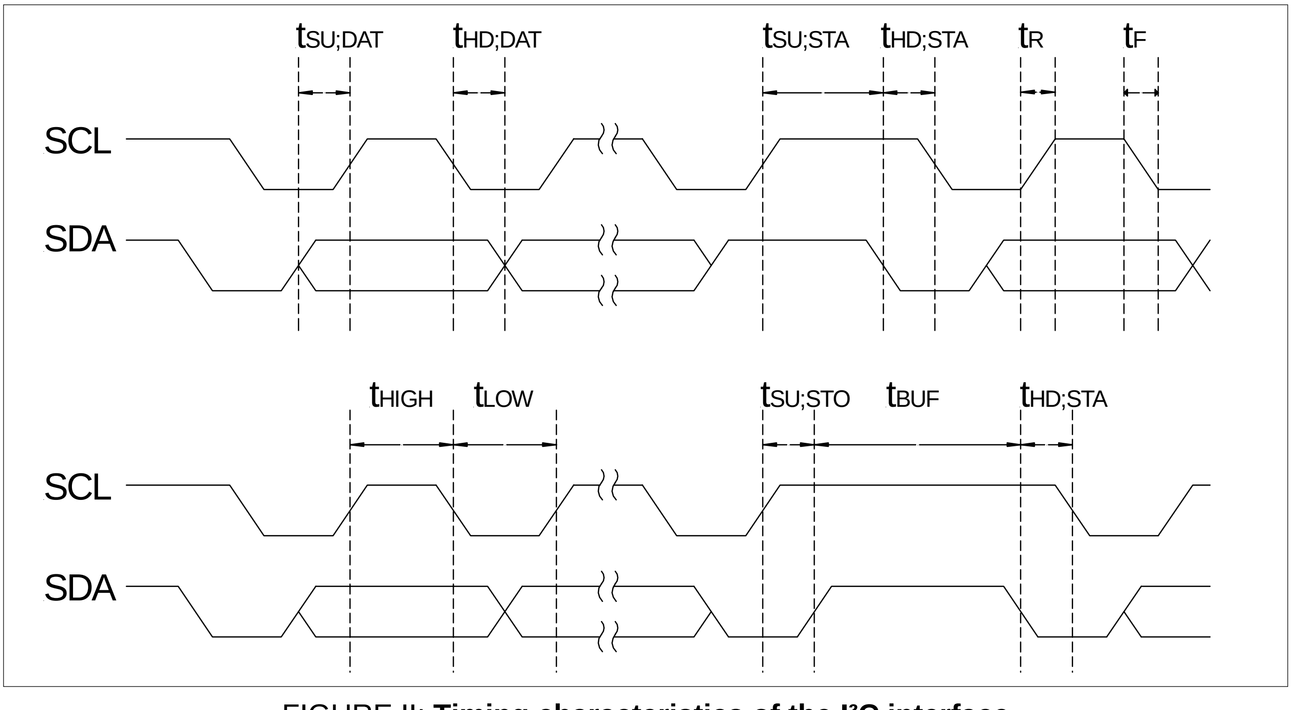
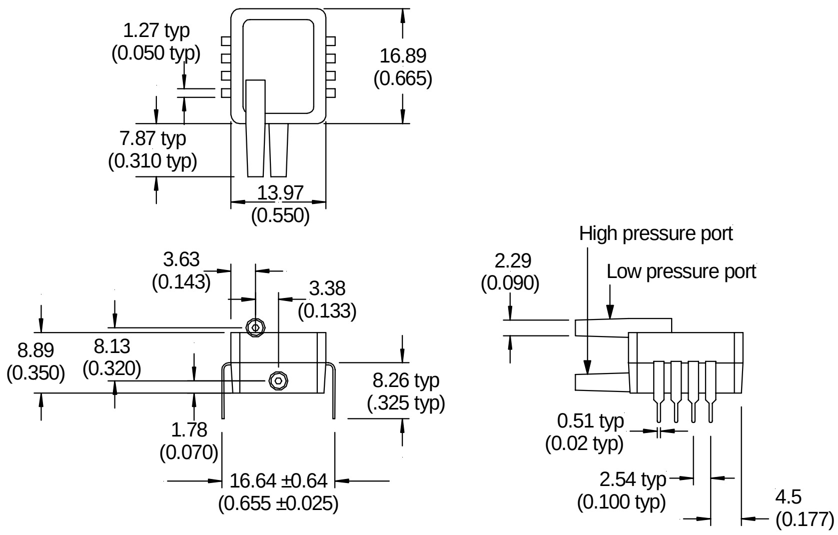


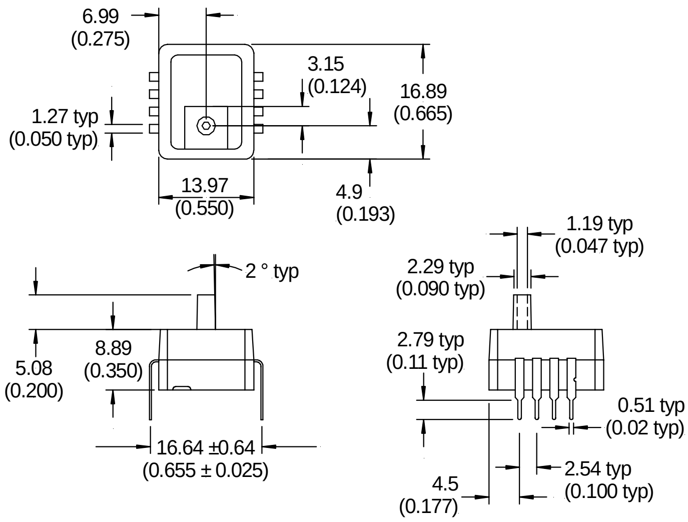
FIGURE II: **Timing characteristics of the I²C interface**

PHYSICAL DIMENSIONS

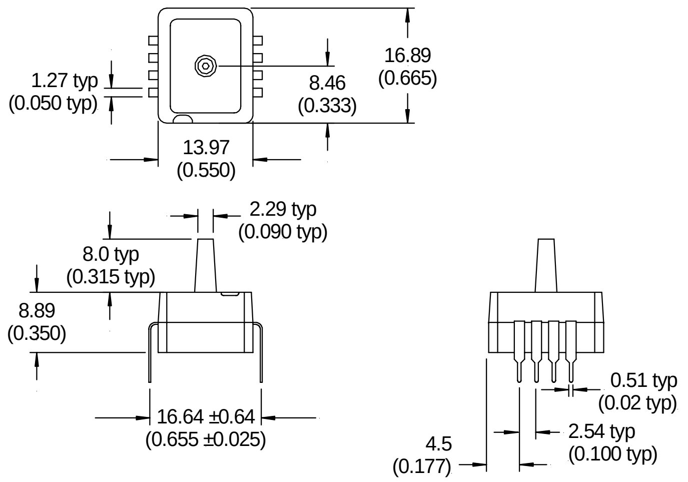
D4 package

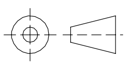


G2 package



A2 package



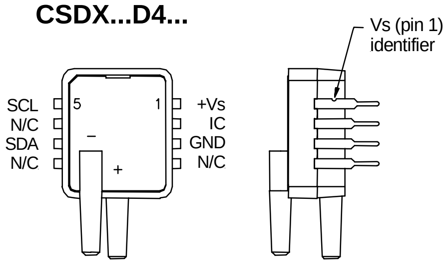


third angle projection

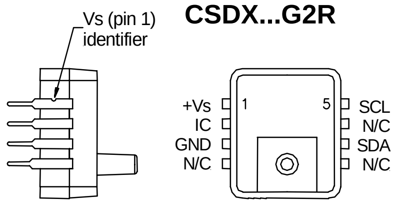
dimensions in mm (inches)

ELECTRICAL CONNECTIONS

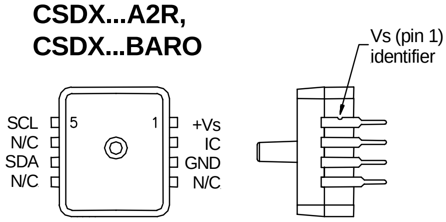
CSDX...D4...



CSDX...G2R



CSDX...A2R,
CSDX...BARO



Note: Pins 4, 6 and 8 are internal device connections and should not be connected for any reason.

Pin 2 is an internal device connection and should be connected to ground with a 15 nF capacitor.

ORDERING INFORMATION

Pressure range	Absolute	Gage	Differential/Gage
0 to 25 mbar		-	CSDX0025D4R
0 to 50 mbar		CSDX0050G2R	CSDX0050D4R
0 to 100 mbar		CSDX0100G2R	CSDX0100D4R
0 to 250 mbar		CSDX0250G2R	CSDX0250D4R
0 to 500 mbar		CSDX0500G2R	CSDX0500D4R
800 to 1100 mbar	CSDX0811BARO	-	-
0 to 1 bar	CSDX1000A2R	CSDX1000G2R	CSDX1000D4R
0 to 2 bar	CSDX2000A2R	CSDX2000G2R	CSDX2000D4R
0 to 5 bar	CSDX5000A2R	CSDX5000G2R	CSDX5000D4R
0 to ±10 mbar			CSDX0010D4D
0 to ±25 mbar			CSDX0025D4D
0 to ±50 mbar			CSDX0050D4D
0 to ±100 mbar			CSDX0100D4D
0 to ±250 mbar			CSDX0250D4D
0 to ±500 mbar			CSDX0500D4D
0 to ±1 bar			CSDX1000D4D

Other pressure ranges or calibrations are available on request