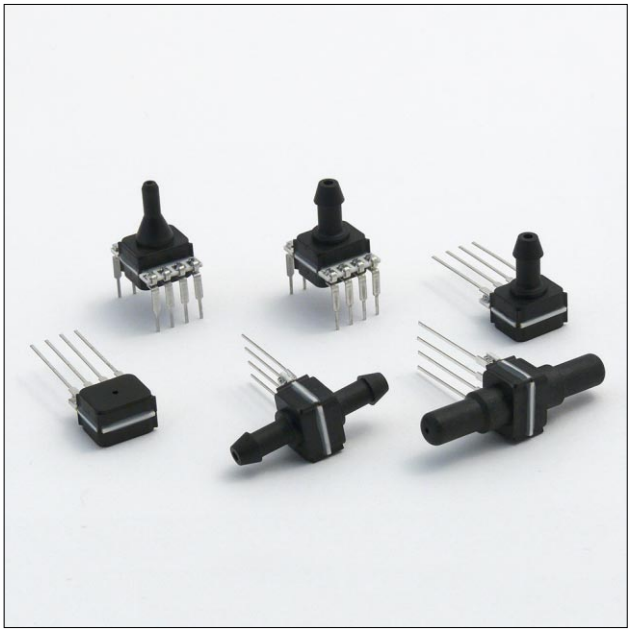
FEATURES

- **100 mbar to 10 bar, 1 to 150 psi gage or differential pressure**
- **Increased media compatibility[1]**
- **Digital I²C bus output**
- **Precision ASIC signal conditioning**
- **Calibrated and temperature compensated[2]**
- **SIL and DIP housings**
- **RoHS compliant**
- **Quality Management System according to ISO 13485:2003 and ISO 9001:2008**



MEDIA COMPATIBILITY[1,2]

High pressure port: To be used with gases and liquids which are compatible with the wetted materials (high temperature polyamide, ceramic AL_2O_3, epoxy, fluorosilicone, glass, silicon).

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

SPECIFICATIONS

Maximum ratings

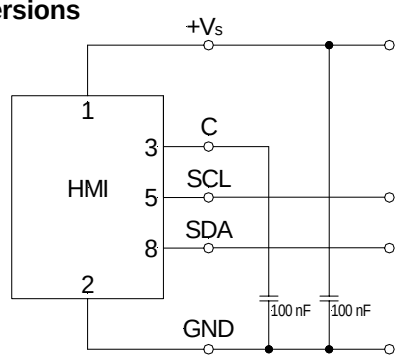
Supply voltage V_S	
HMI...3	2.7 ... 4.2 V_{DC}
HMI...5	4.2 ... 5.5 V_{DC}
	max. 6.5 V_{DC}
Output current	
Sink	1 mA
Source	1 mA

Environmental

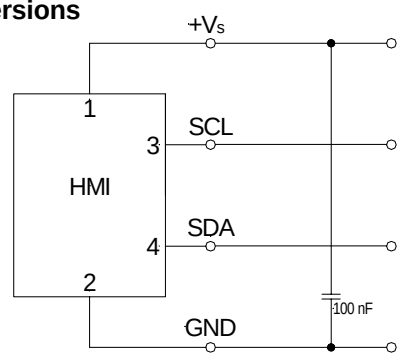
Temperature ranges	
Compensated	-20 ... +85 °C
Operating	-20 ... +85 °C
Storage[3]	-40 ... +125 °C
Humidity limits (non-condensing)	...95 %RH[10]
(100 % condensing or direct liquid media on high pressure port[1])	
Vibration	max. 10 g, 10...2000 Hz, random (EN 60068-2-64)
Mechanical shock	max. 50 g, 11 ms (EN 60068-2-27)
Lead solder temperature	max. 270 °C (JESD22-B106D)

ELECTRICAL CONNECTION

DIP versions



SIL versions



PRESSURE SENSOR CHARACTERISTICS

(T_A=25 °C, RH=50 %)

Part no.	Operating pressure	Proof pressure[4]
HMIM100U...	0...100 mbar	2 bar
HMIM100B...	0...±100 mbar	2 bar
HMIM250U...	0...250 mbar	2 bar
HMIM250B...	0...±250 mbar	2 bar
HMIB001U...	0...1 bar	5 bar
HMIB001B...	0...±1 bar	5 bar
HMIB2x5U...	0...2.5 bar	10 bar
HMIB005U...	0...5 bar	14 bar
HMIB010U...	0...10 bar	14 bar
HMIP001U...	0...1 psi	30 psi
HMIP001B...	0...±1 psi	30 psi
HMIP100U...	0...100 psi	200 psi

Other pressure ranges (e.g. 500 mbar, 5 psi, 150 psi) are available on request. Please contact First Sensor.

PERFORMANCE CHARACTERISTICS[2]

(T_A=25 °C, RH=50 %,
for HMI...3 devices (V_S=3.0 V_{DC}) digital output signal is non-ratiometric to V_S in the range of V_S=2.7...4.2 V,
for HMI...5 devices (V_S=5.0 V_{DC}) digital output signal is non-ratiometric to V_S in the range of V_S=4.2...5.5 V)

Characteristics		Min.	Typ.	Max.	Units
Non-linearity (-20...85 °C)[6]				±0.25	%FSS
Accuracy[7]				±0.25	
Total accuracy (-20...85 °C)[8]				±1.5	
Response delay[9]			0.5		ms
A/D resolution			12		bit
Current consumption	HMI...3		4.5		mA
	HMI...5		5.3		

All HMI...U... (unidirectional devices)

Characteristics	Min.	Typ.	Max.	Units
Zero pressure offset	2595	3000	3405	counts
Full scale span (FSS)[5]		27000		
Full scale output	29595	30000	30405	

All HMI...B... (bidirectional devices)

Characteristics		Min.	Typ.	Max.	Units
Zero pressure offset		16095	16500	16905	counts
Full scale span (FSS)[5]			27000		
Output	at max. specified pressure	29595	30000	30405	
	at min. specified pressure	2595	3000	3405	

I²C BUS

Introduction

The HMI 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 HMI is designed to work as a slave, hence it will only respond to requests from a master device.

Digital I²C interface

The HMI 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 HMI 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.

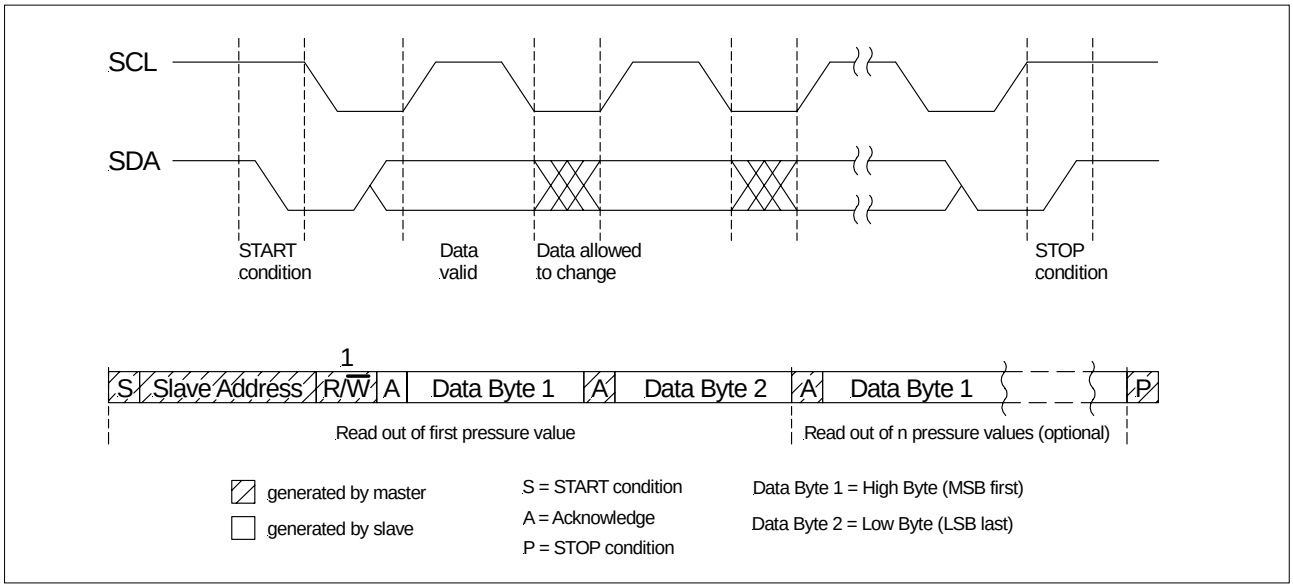


Fig. 1: I²C bus protocol

I²C Interface Parameters

Parameter	Symbol	Min.	Typ.	Max.	Unit
Input high level		90		100	% of Vs
Input low level		0		10	
Output low level				10	
Pull-up resistor		1		5	kΩ
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: **First Sensor recommends communication speeds of at least 100 kHz (max. 400 kHz). Please contact us for further information.**

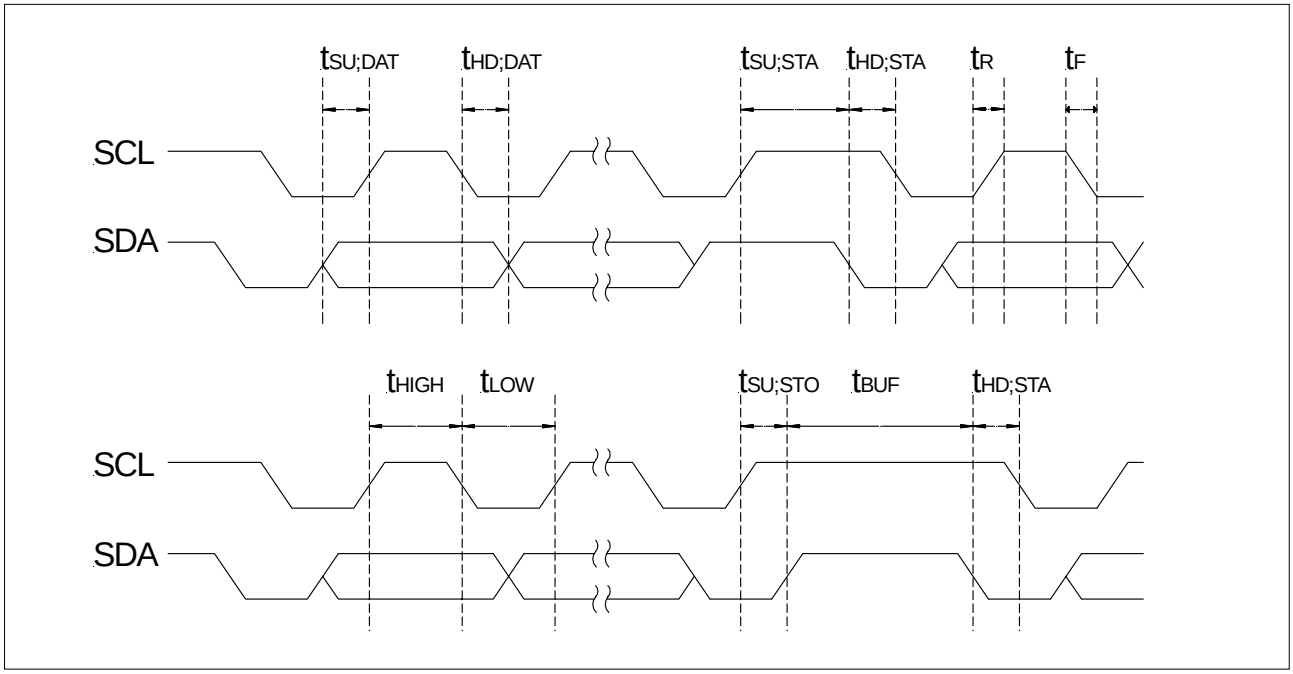
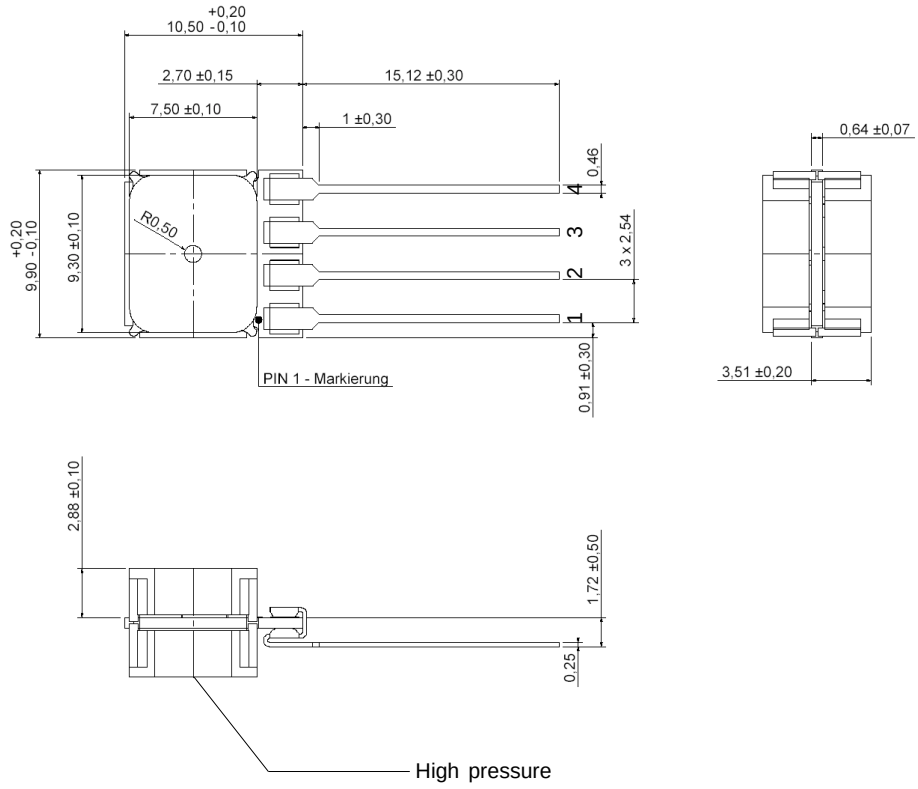


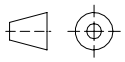
Fig. 2: Timing characteristics

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION

HMI...U1... (SIL, axial no ports)



Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

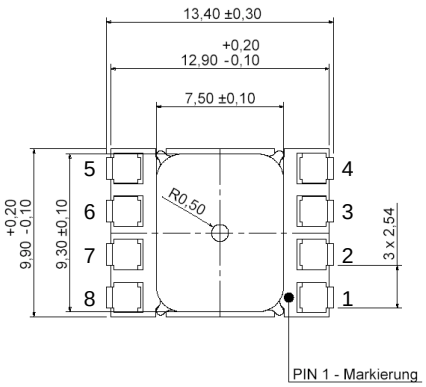


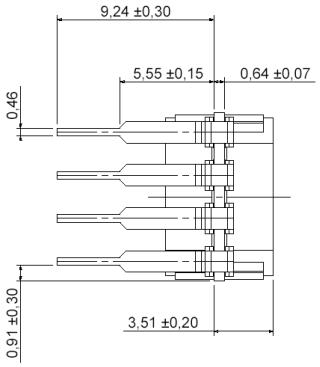
first angle projection

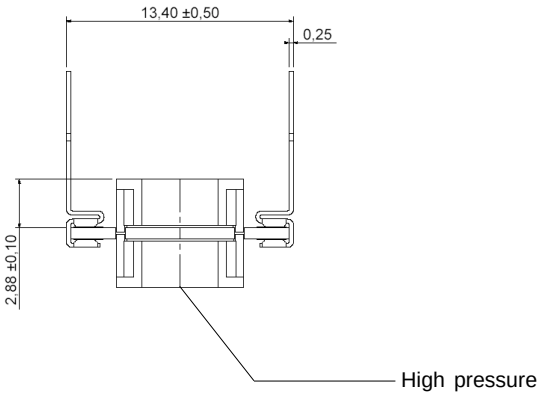
dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...W1... (DIP, axial no ports)

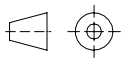






Pin	Connection
1	+Vs
2	GND
3	C
4	I / C*
5	SCL
6	I / C*
7	I / C*
8	SDA

* Internal connection. Do not connect for any reason

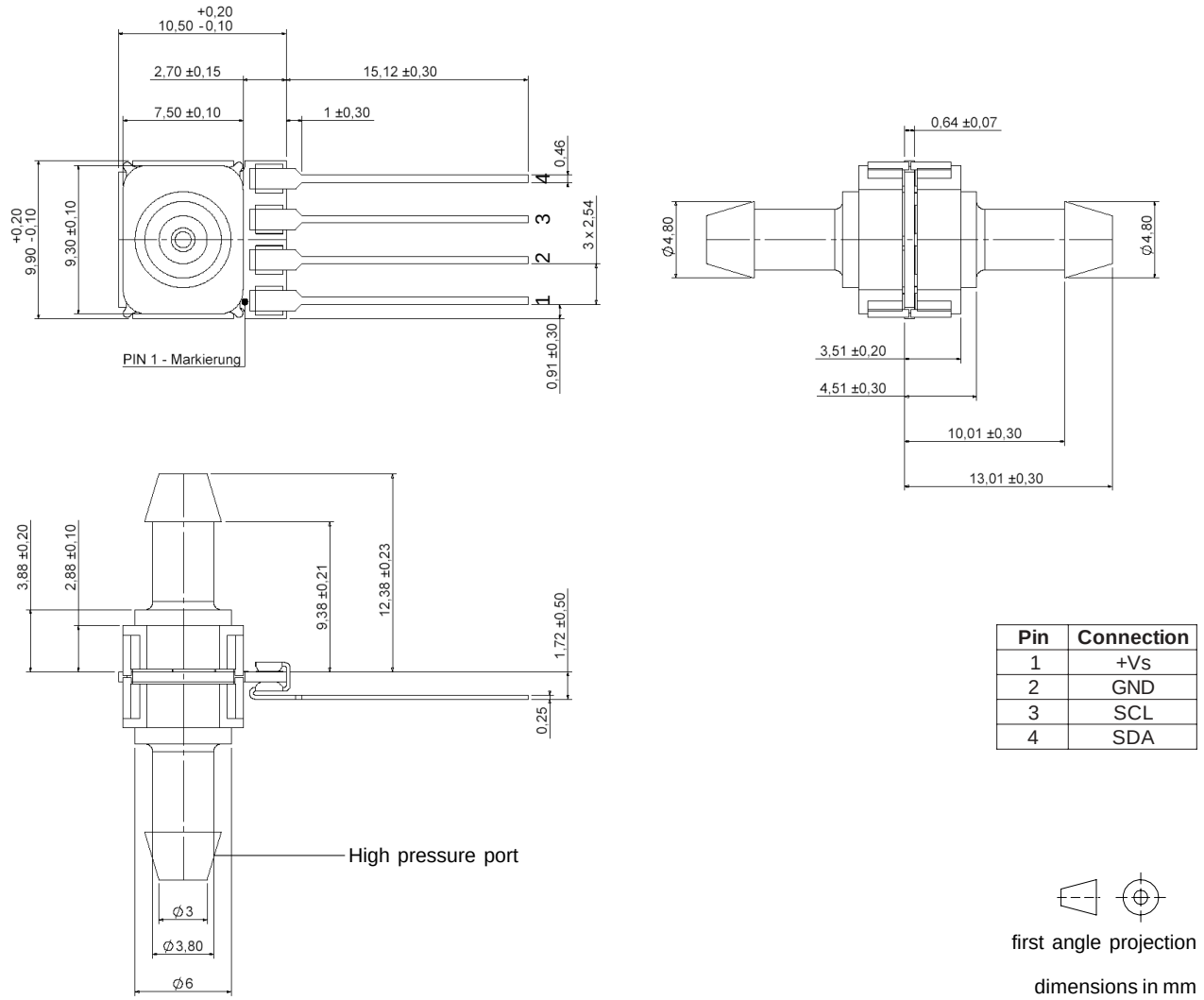


first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...U7... (SIL, 2 ports axial opposite side, barbed)



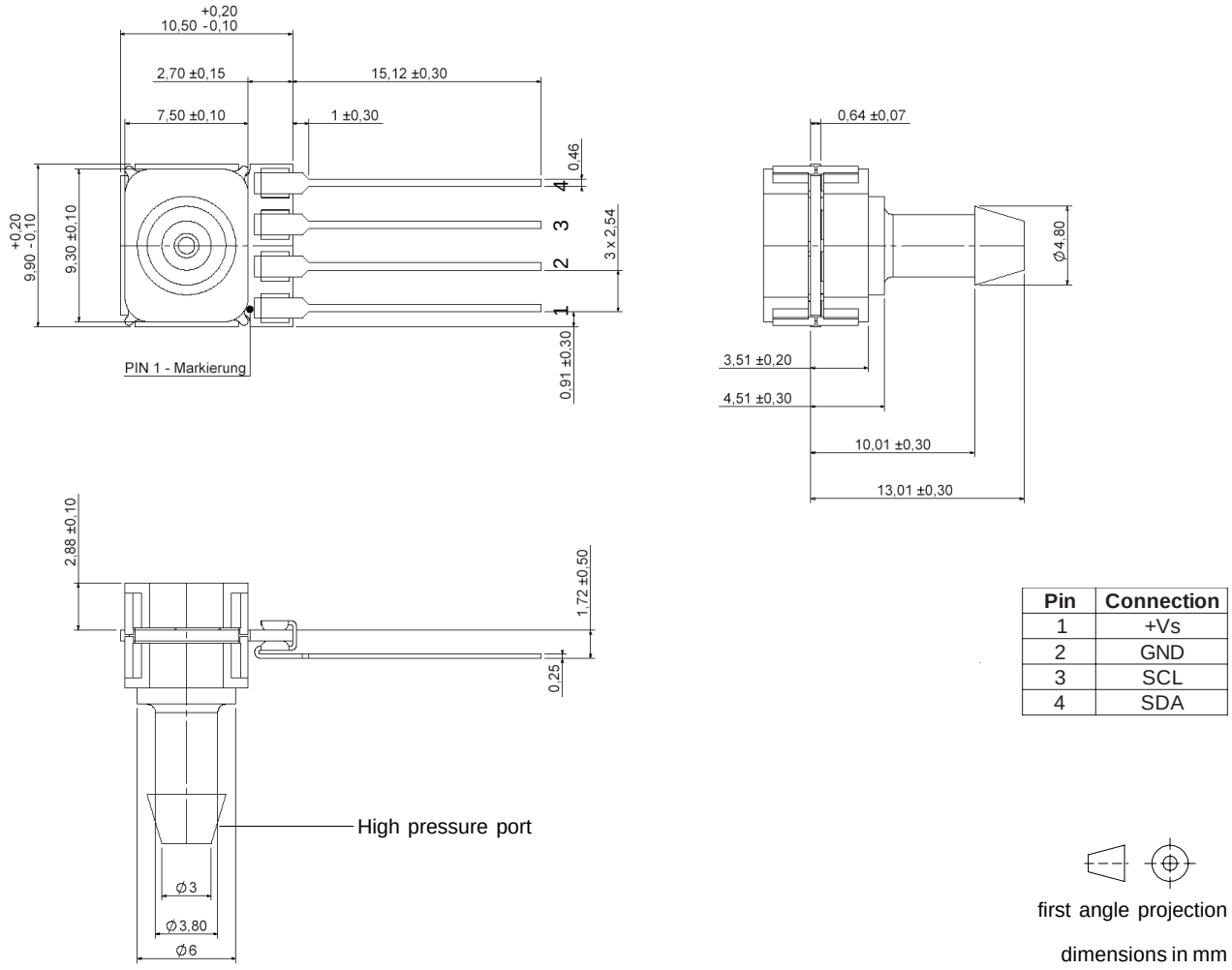
Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...X7... (SIL, 1 port axial, barbed)



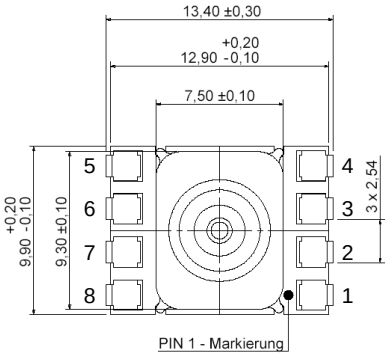
Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

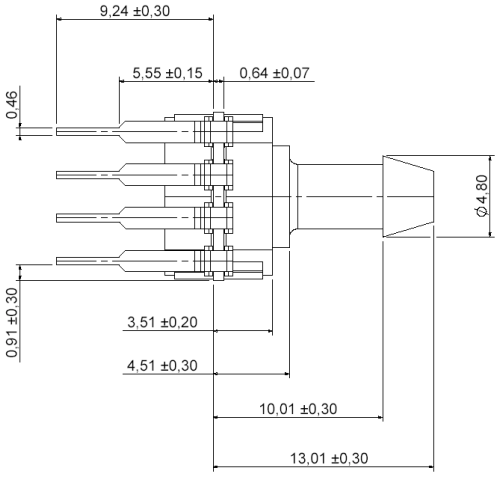
first angle projection

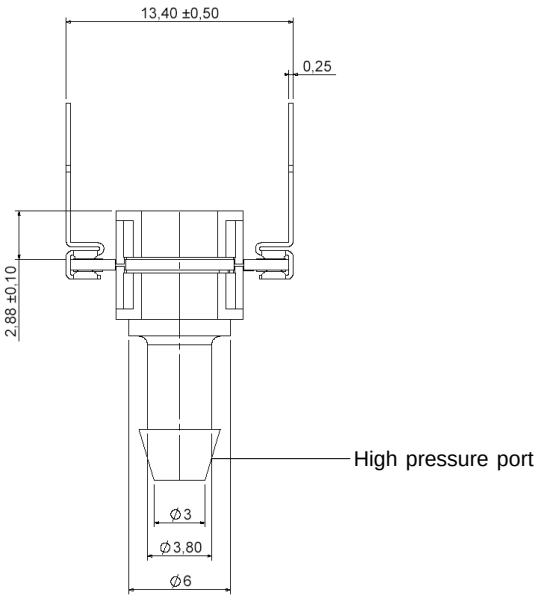
dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...Z7... (DIP, 1 port axial, barbed)

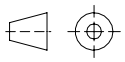






Pin	Connection
1	+Vs
2	GND
3	C
4	I / C*
5	SCL
6	I / C*
7	I / C*
8	SDA

* Internal connection. Do not connect for any reason

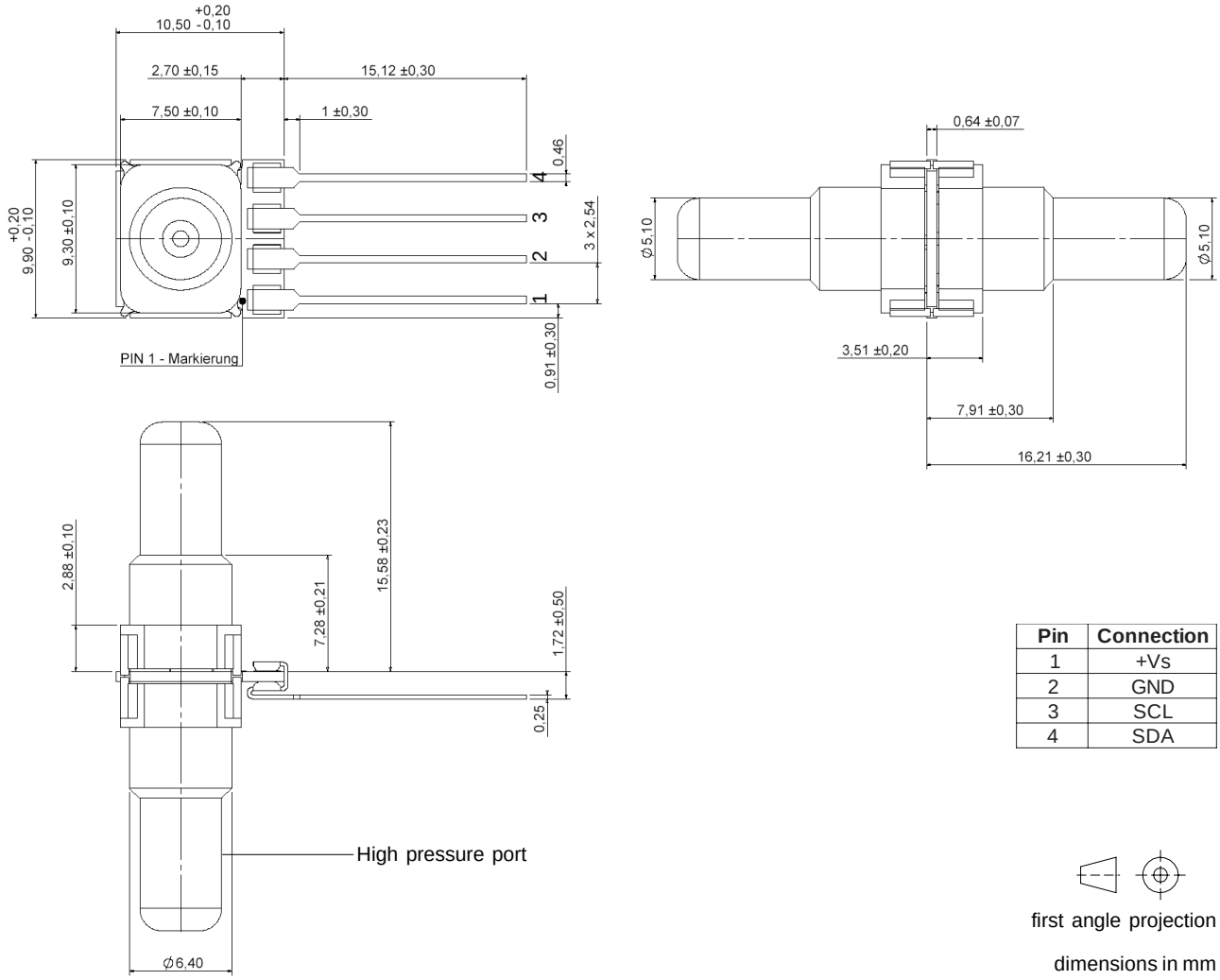


first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...U6... (SIL, 2 ports axial opposite side, straight big)



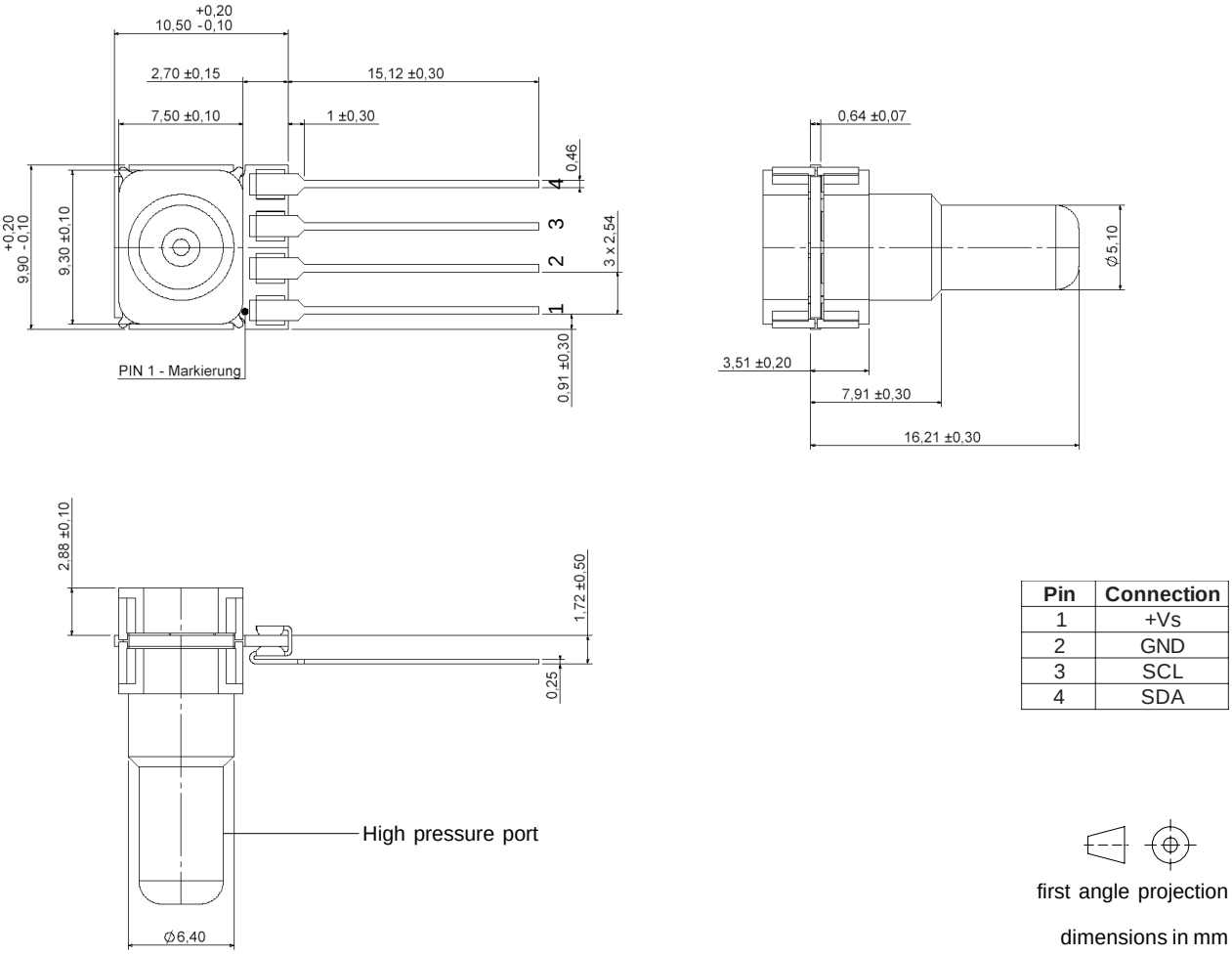
Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...X6... (SIL, 1 port axial, straight big)



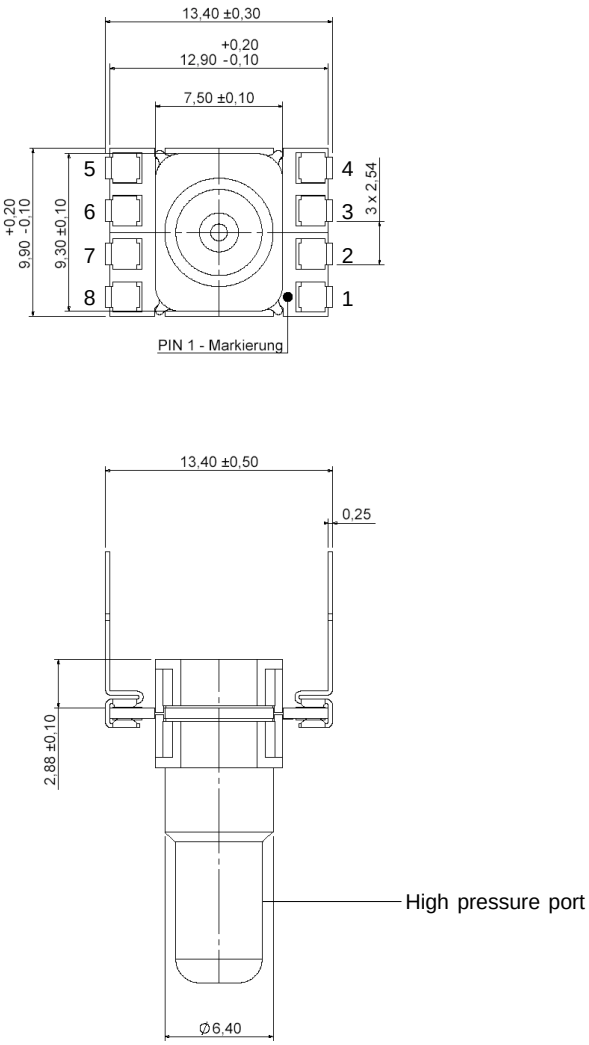
Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

first angle projection

dimensions in mm

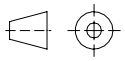
PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...Z6... (DIP, 1 port axial, straight big)



Pin	Connection
1	+Vs
2	GND
3	C
4	I / C*
5	SCL
6	I / C*
7	I / C*
8	SDA

* Internal connection. Do not connect for any reason

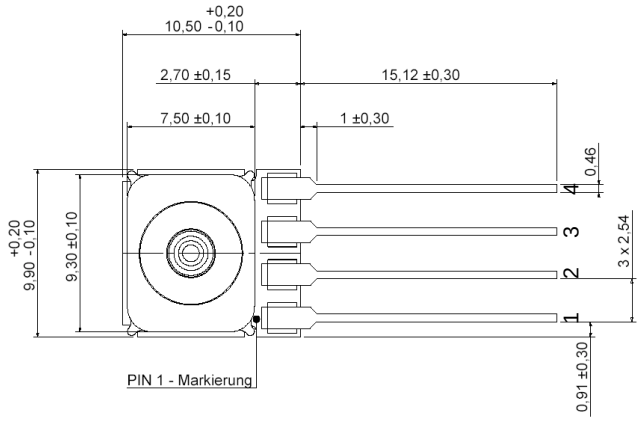


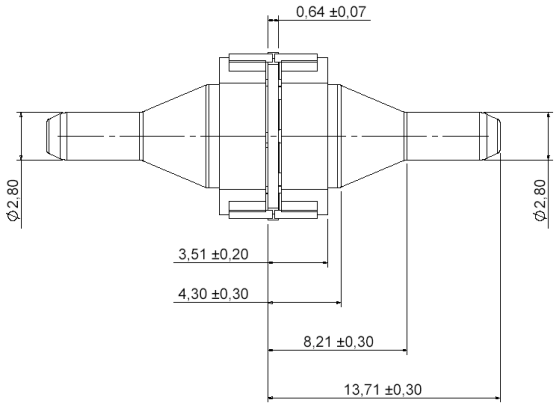
first angle projection

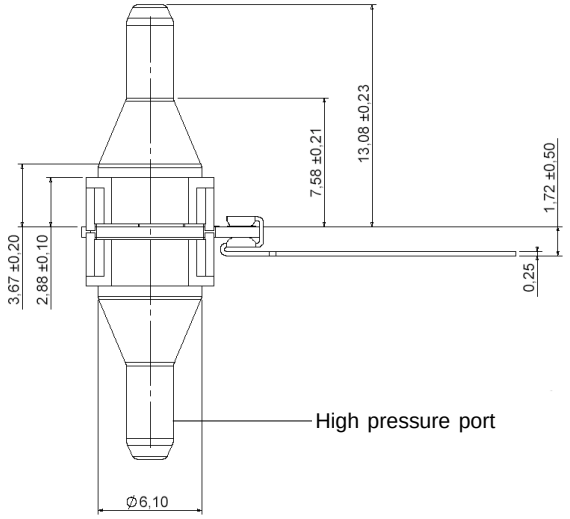
dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

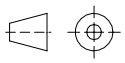
HMI...U5... (SIL, 2 ports axial opposite side, needle big)







Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

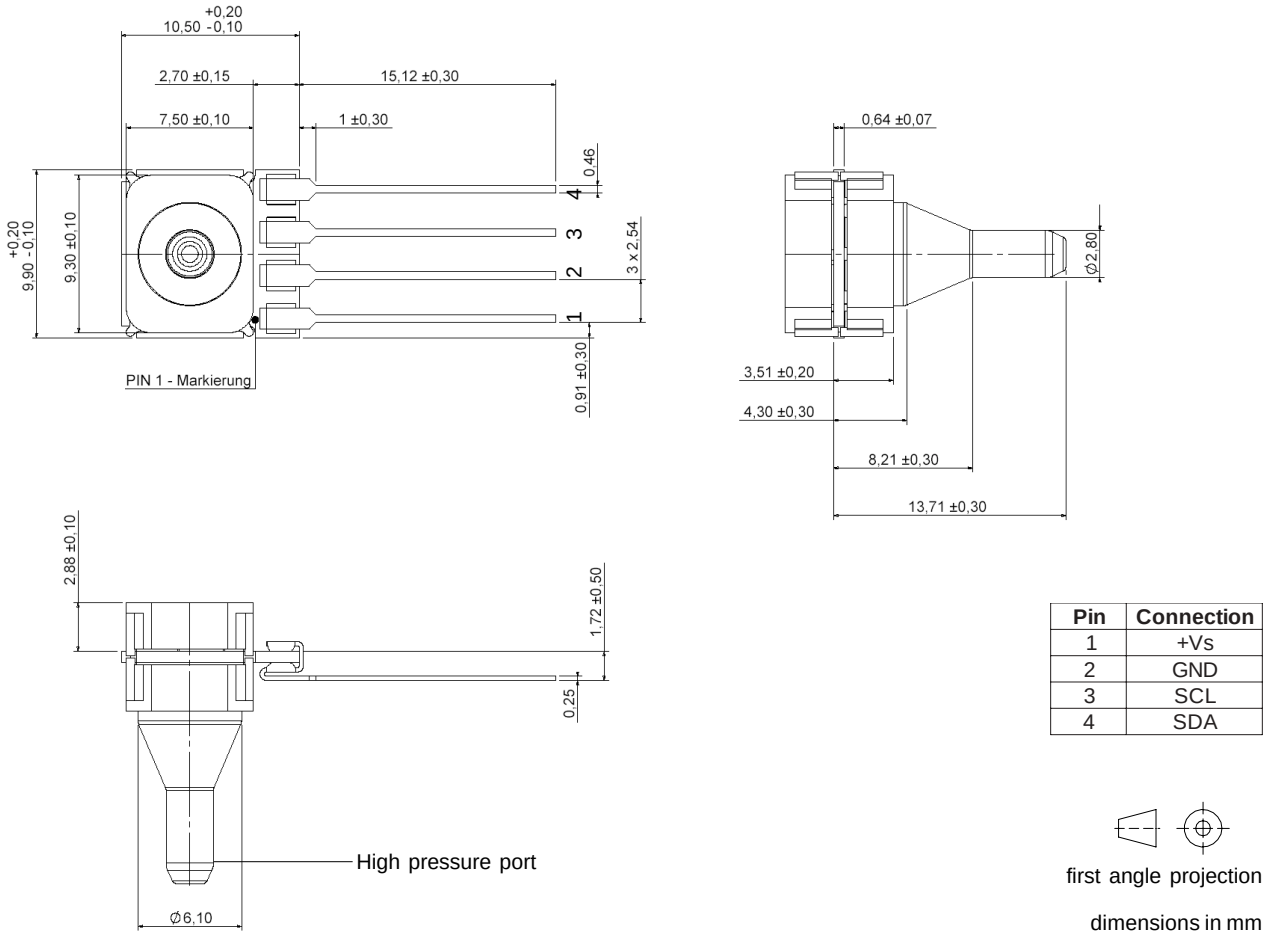


first angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...X5... (SIL, 1 port axial, needle big)



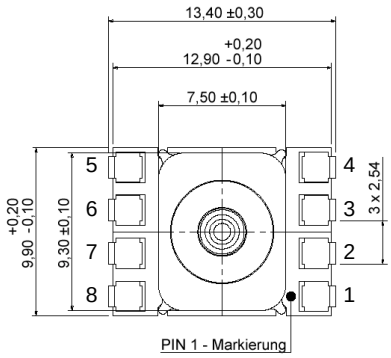
Pin	Connection
1	+Vs
2	GND
3	SCL
4	SDA

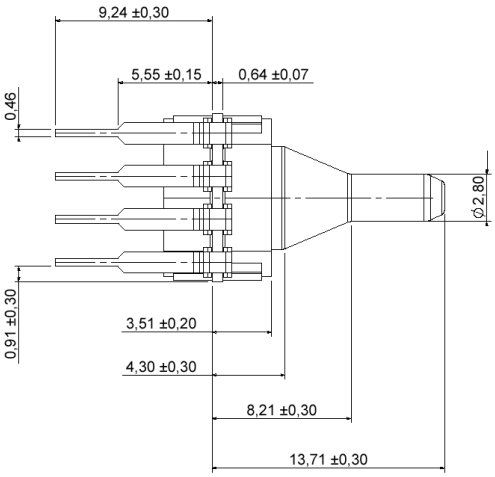
first angle projection

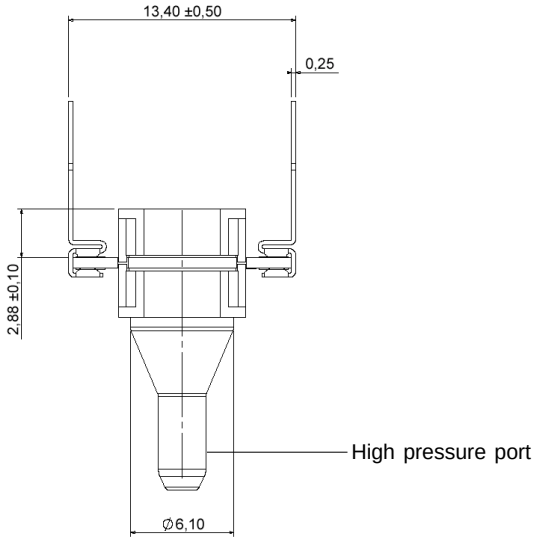
dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTION (cont.)

HMI...Z5... (DIP, 1 port axial, needle big)







Pin	Connection
1	+Vs
2	GND
3	C
4	I / C*
5	SCL
6	I / C*
7	I / C*
8	SDA

* Internal connection. Do not connect for any reason

dimensions in mm

Specification notes:

1. All wetted materials are selected to give a high level of media compatibility. Media compatibility refers to media inside the pressure port and lid. Improved media compatibility on high pressure port (backward side of sensor chip) since media has no contact to electronic components. Nevertheless tests with the media used in the specific application are recommended.
2. Sensor is calibrated in air, changes in sensor behaviour based on physical effects caused by the specific media can occur. Weight of the media and wetting forces can influence the sensor characteristics.
3. Storage temperature of the sensor without package.
4. Proof pressure is the maximum pressure which may be applied without causing durable shifts of the electrical parameters of the sensing element.
5. Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.
6. Non-linearity is the measured deviation based on Best Fit Straight Line (BFSL).
7. Accuracy is the combined error from non-linearity and hysteresis. Hysteresis is the maximum output difference at any point within the operating pressure range for increasing and decreasing pressure.
8. Total accuracy is the combined error from offset and span calibration, non-linearity, pressure hysteresis, and temperature effects. Calibration errors include the deviation of offset and full scale from nominal values.
9. Max. delay time between pressure change at the pressure die and signal change at the output.
10. Tested 1h, up to 85 °C.

Sensors are electronic components and should be handled only in ESD save environments.

NOMENCLATURE

	Series	Pressure range		Calibration		Housing		Porting		Grade		Voltage	
Options	HMI	M100	100 mbar	B	Bidirectional	U	SIL, 2 ports axial opposite side	(1)	no port	H	High	(3)	3 V
		M250	250 mbar	U	Unidirectional			7	Barbed			5	5 V
		B001	1 bar			(W)	DIP, 2 ports axial opposite side	(5)	Needle big				
		B2x5	2.5 bar					(6)	Straight big				
		B005	5 bar			X	SIL, 1 port axial						
		B010	10 bar			Z	DIP, 1 port axial						
		P001	1 psi										
		P100	100 psi										
						( ) available on request. Please contact First Sensor.							
Example:	HMI	M100		U		U		7		H		5	

LABEL INFORMATION

Digit	1 2 3	4		5		6		7		8		9 10 11 12 13 14
	Series	Pressure range		Pressure unit / pressure mode / calibration		Housing		Porting		Grade/ voltage		Production code
Char	M I - HMI	6	1 psi	U	bar, gage/differential, unidirectional	U	SIL, 2 ports axial opposite side	1	no port	-	High, 5 V	
		7	100 mbar	B	bar, gage/differential, bidirectional	W	DIP, 2 ports axial opposite side	7	Barbed	/	High, 3 V	
		8	250 mbar			X	SIL, 1 port, axial	5	Needle big			
		A	1 bar			Z	DIP, 1 port axial	6	Straight big			
		B	2.5 bar									
		C	5 bar									
		L	100 psi									
		M	10 bar