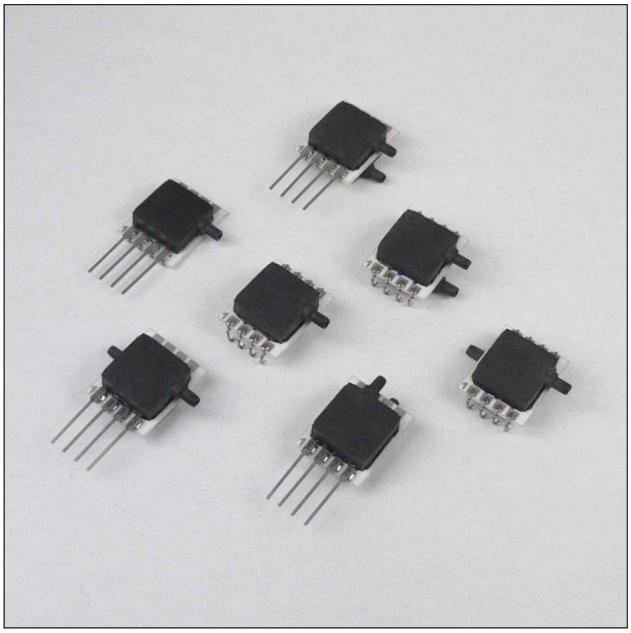
SQ277 Series
Miniature amplified pressure sensors

FEATURES

- **0 ... 12.5 mbar to 0 ... 7 bar, 0 ... ±12.5 mbar to 0 ... ±7 bar, absolute, differential or gage**
- **Barometric pressure ranges**
- **Output: 0.25...4.25 V and I²C-bus (SPI and switching outputs optional)**
- **Precision ASIC conditioning**
- **Calibrated and temperature compensated**
- **Matched pressure port volumes**
- **Miniature SMT and SIL housings**
- **Sensortechnics PRO services**

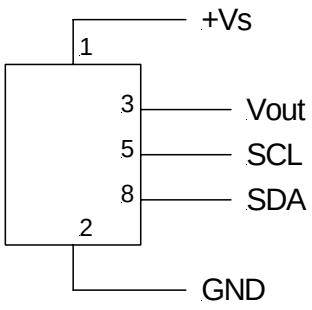


SPECIFICATIONS

Maximum ratings

Supply voltage V_S	4.5 V ... 5.5 V_{DC} (optional 2.7 ... 3.3 V_{DC})
Maximum pressure on any port[8]	
all devices up to 500 mbar	4 bar
all other devices	14 bar
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	
Compensated	-25 ... 85°C
Operating	-25 ... 85°C
Storage	-40 ... 125°C
Humidity limits (non-condensing)	0 ... 95 %RH

ELECTRICAL CONNECTION



Note: **Pins 5 and 8 (connections for digital I²C-bus) are only available for SMD package styles (H, E and Q housings)**

PRESSURE SENSOR 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)

Part no.	Operating pressure	Proof pressure[5]	Burst pressure[6]	Output
SQ277-...3...B...	0...±12.5 mbar(g,d)	250 mbar	500 mbar	
SQ277-...4...B...	0...±25 mbar(g,d)	500 mbar	750 mbar	
SQ277-...5...B...	0...±50 mbar(g,d)	750 mbar	1.2 bar	
SQ277-...6...B...	0...±75 mbar(g,d)	1.2 bar	2 bar	
SQ277-...7...B...	0...±100 mbar(g,d)	1.2 bar	2 bar	
SQ277-...8...B...	0...±250 mbar(g,d)	2 bar	3 bar	2.25 ±2 V
SQ277-...9...B...	0...±500 mbar(g,d)	2 bar	3 bar	
SQ277-...A...B...	0...±1 bar(g,d)	3 bar	5 bar	
SQ277-...B...B...	0...±2 bar(g,d)	6 bar	10 bar	
SQ277-...C...B...	0...±5 bar(g,d)	12 bar	14 bar	
SQ277-...H...B...	0...±7 bar(g,d)	14 bar	14 bar	
SQ277-...3...U...	0...12.5 mbar(g,d)	250 mbar	500 mbar	
SQ277-...4...U...	0...25 mbar(g,d)	500 mbar	750 mbar	
SQ277-...5...U...	0...50 mbar(g,d)	750 mbar	1.2 bar	
SQ277-...6...U...	0...75 mbar(g,d)	1.2 bar	2 bar	
SQ277-...7...U...	0...100 mbar(g,d)	1.2 bar	2 bar	
SQ277-...8...U...	0...250 mbar(g,d)	2 bar	3 bar	
SQ277-...9...U...	0...500 mbar(g,d)	2 bar	3 bar	
SQ277-...A...U...	0...1 bar(g,d)	3 bar	5 bar	0.25 - 4.25 V
SQ277-...B...U...	0...2 bar(g,d)	6 bar	10 bar	
SQ277-...C...U...	0...5 bar(g,d)	12 bar	14 bar	
SQ277-...H...U...	0...7 bar(g,d)	14 bar	14 bar	
SQ277-...D...U...	600...1100 mbar(a)	3 bar	5 bar	
SQ277-...E...U...	800...1100 mbar(a)	3 bar	5 bar	
SQ277-...F...U...	0...1 bar(a)	3 bar	5 bar	
SQ277-...G...U...	0...2 bar(a)	3 bar	5 bar	

Specification notes:

1. Shift is relative to 25°C.
2. Shift is within the first hour of excitation applied to the device.
3. Non-linearity refers to the **B**est **S**traight **L**ine fit, measured for lowest specified pressure, highest specified pressure and 1/2 full scale pressure.
4. Full Scale Span (FSS) is the algebraic difference between the output signal for the highest and lowest specified pressure.
5. Proof pressure is the maximum pressure which may be applied without causing durable shifts of the electrical parameters of the sensing element.
6. Burst pressure is the maximum pressure which may be applied without causing damage to the sensing element or leaks to the housing.
7. Delay time between sampling and signal change at the output.
8. Maximum pressure on any port is the maximum operating plus common-mode pressure for differential pressure devices which can be applied without damaging the sensor. Common Mode Pressure is the pressure applied to both sides of the diaphragm simultaneously.

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 devices

Characteristics		Min.	Typ.	Max.	Unit
Non-linearity and hysteresis (BSL)[3]			±0.05	±0.25	%FSS
Thermal effects (-25 to 85°C)[1]	Offset			±1.0	
	Span			±1.0	
Response delay[7]			0.5		ms
Current consumption (no load)			3		mA

SQ277...B... (bidirectional devices)

Characteristics		Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS					
Zero pressure offset		370A	3999	3C28	Count Hex
Full scale span (FSS)[4]		63D6	6666	68F5	
Output	at max. specified pressure		6CCC		
	at min. specified pressure		0666		
ANALOGUE PERFORMANCE CHARACTERISTICS					
Zero pressure offset		2.15	2.25	2.35	V
Full scale span (FSS)[4]		3.90	4.00	4.10	
Output	at max. specified pressure		4.25		
	at min. specified pressure		0.25		

SQ277...U... (unidirectional devices)

Characteristics	Min.	Typ.	Max.	Unit
DIGITAL PERFORMANCE CHARACTERISTICS				
Zero pressure offset	03D7	0666	08F6	Count Hex
Full scale span (FSS)[4]	63D6	6666	68F5	
ANALOGUE PERFORMANCE CHARACTERISTICS				
Zero pressure offset	0.15	0.25	0.35	V
Full scale span (FSS)[4]	3.90	4.00	4.10	

INTRODUCTION

The SQ277 series is capable to generate a digital output signal. These devices run a cyclic program, which will store a corrected sensor value with 12 bit resolution about every 250 µs within the output registers of the internal ASIC. In order to use the SQ277 pressure sensors for digital signal readout, they 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 SQ277 is designed to work as a slave, hence it will only respond to requests from a master device.

DIGITAL I²C INTERFACE

The SQ277 series complies with the following protocol (FIG. 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 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 SQ277 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 SQ277 sensors start to send 2 data bytes containing the current pressure value as a 15 bit information placed in their output registers.

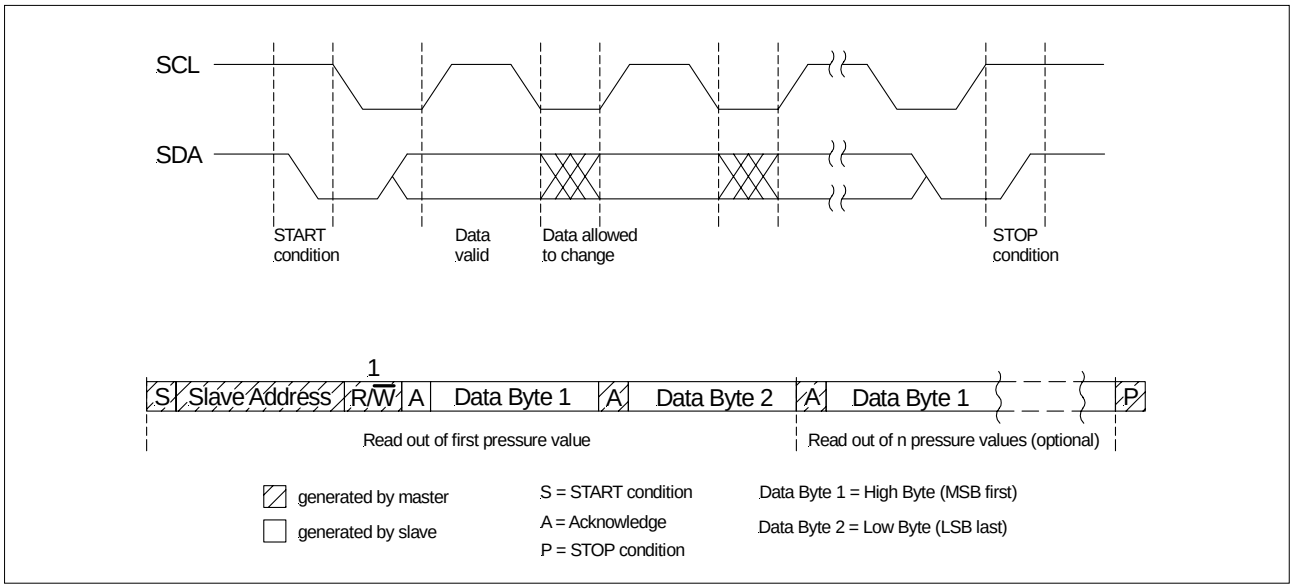


FIGURE I: **I²C-BUS Protocol**

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					10	
Pull-up resistor			500			Ω
SCL clock frequency	F_{SCL}		---		400	kHz
Bus free time between STOP and START condition	t_{BUF}		1.3			µs
Hold time (repeated) START condition	$t_{HD.STA}$	to first clock pulse	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			

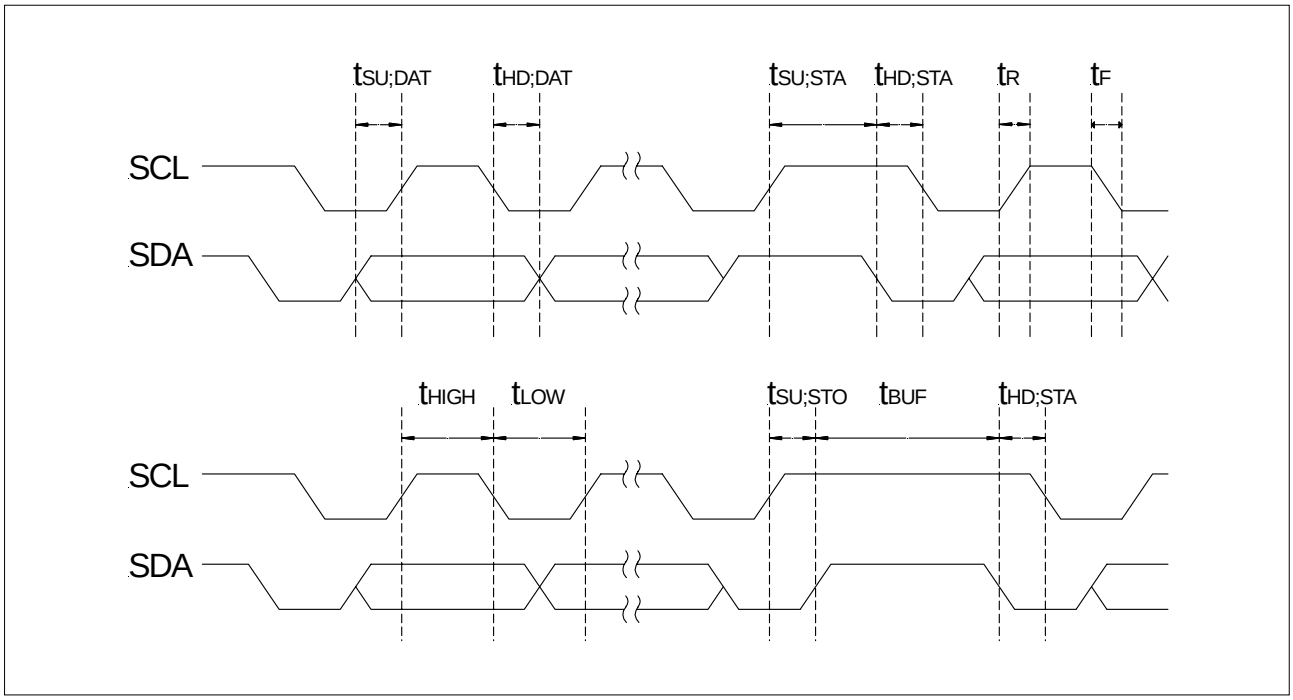
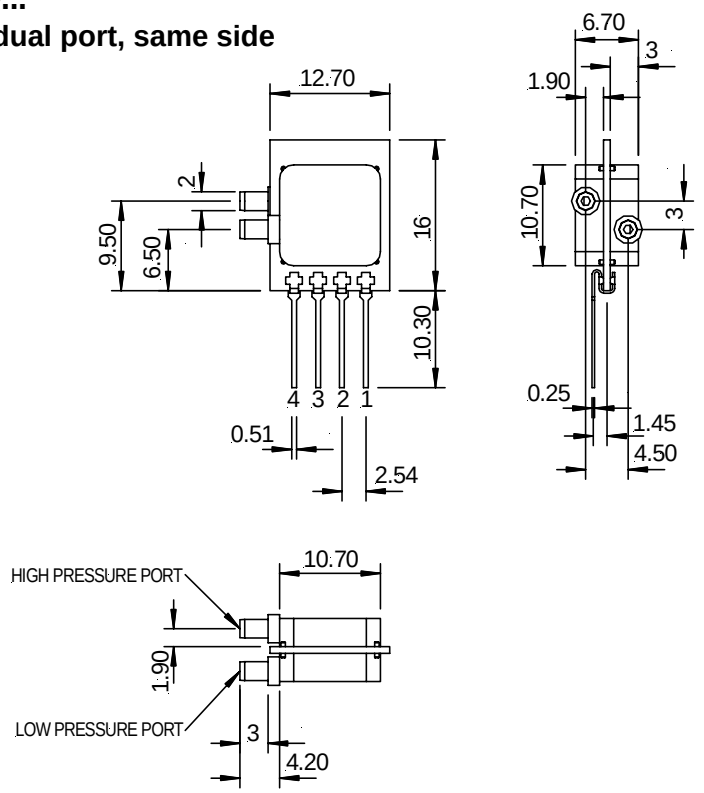


FIGURE II: **Timing characteristics of the serial interface**

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTIONS

SQ277...D...

Package: dual port, same side



Pin	Connection
1	+Vs
2	GND
3	Vout
4	I / C*

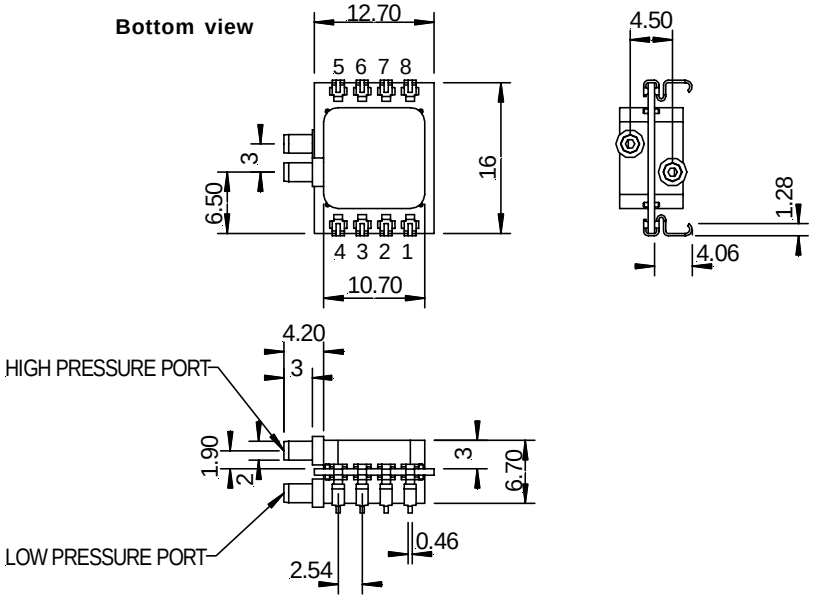
* Internal connection.
Do not connect for any reason

third angle projection

dimensions in mm

SQ277...E...

Package: SMD dual port, same side



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

* Internal connection.
Do not connect for any reason

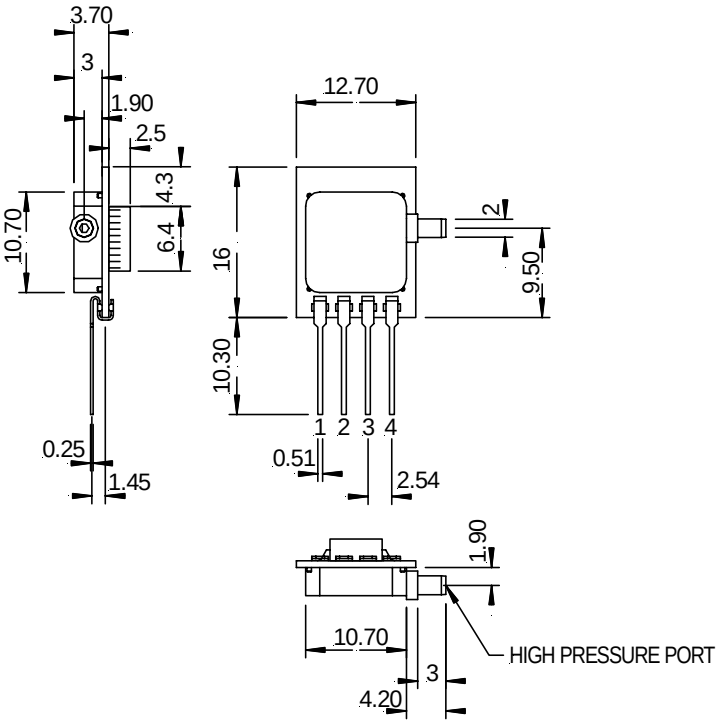
third angle projection

dimensions in mm

PHYSICAL DIMENSIONS AND ELECTRICAL CONNECTIONS (cont.)

SQ277...G...

Package: single port



Pin	Connection
1	+Vs
2	GND
3	Vout
4	I / C*

* Internal connection.
Do not connect for any reason

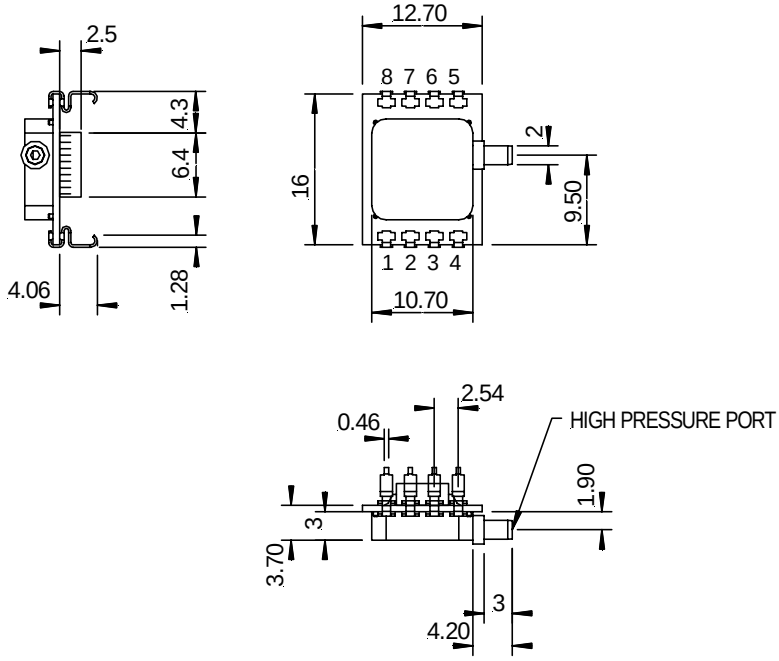
third angle projection

dimensions in mm

SQ277...H...

Package: SMD single port

Top view



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

* Internal connection.
Do not connect for any reason

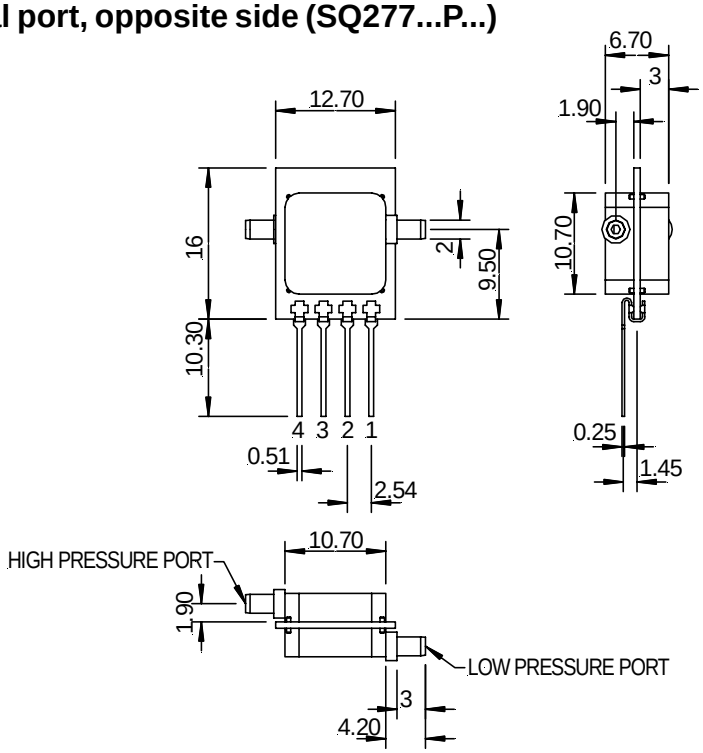
third angle projection

dimensions in mm

HOUSING OPTIONS

(please contact your nearest Sensortechnics sales office for further information)

Dual port, opposite side (SQ277...P...)



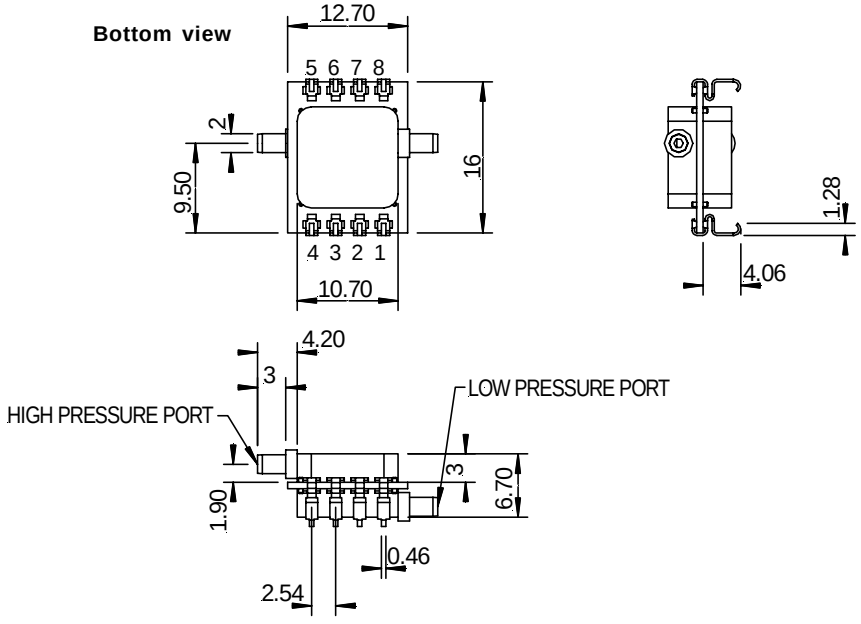
Pin	Connection
1	+Vs
2	GND
3	Vout
4	I / C*

* Internal connection.
Do not connect for any reason

third angle projection

dimensions in mm

SMD dual port, opposite side (SQ277...Q...)



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

* Internal connection.
Do not connect for any reason

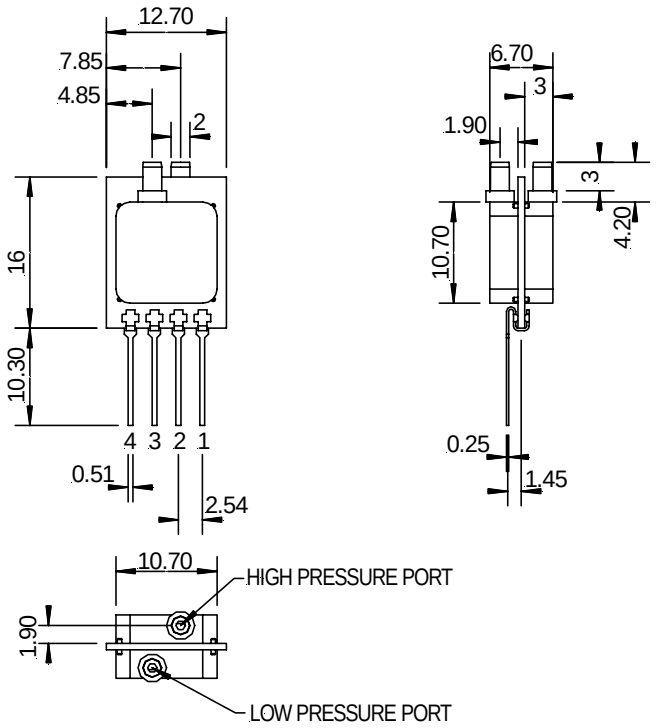
third angle projection

dimensions in mm

HOUSING OPTIONS (cont.)

(please contact your nearest Sensortechnics sales office for further information)

Dual port, top side (SQ277...T...)



Pin	Connection
1	+Vs
2	GND
3	Vout
4	I / C*

* Internal connection.
Do not connect for any reason

third angle projection

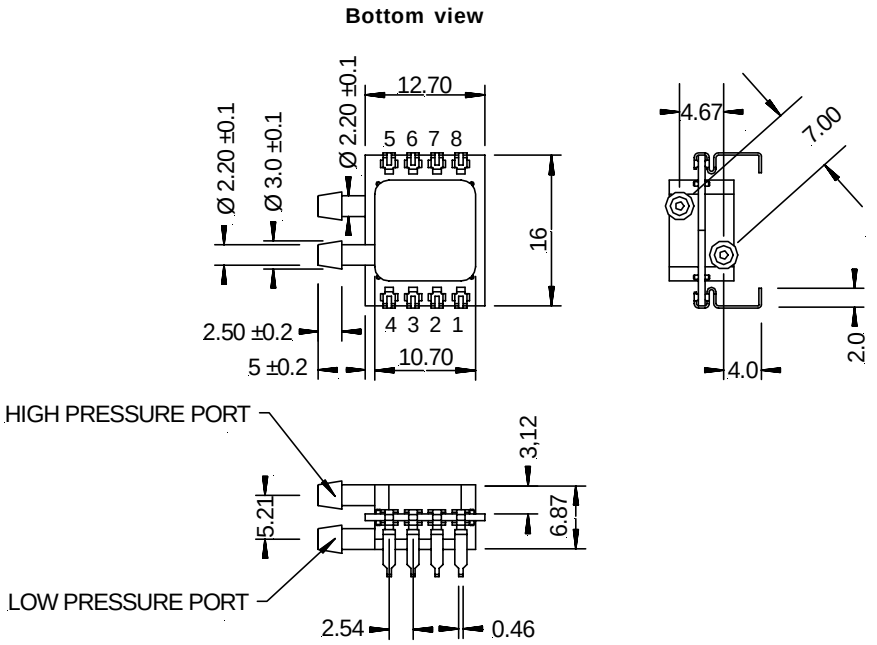
dimensions in mm

HOUSING OPTIONS (cont.)

(please contact your nearest Sensortechnics sales office for further information)

Barbed pressure ports

(Available for all housing styles. Sample package shown: SMD dual port, same side)

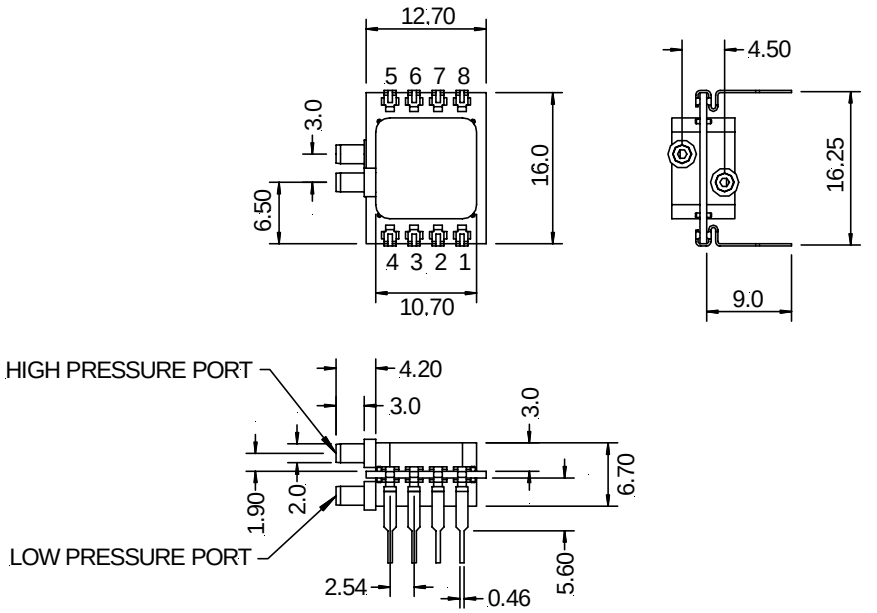


third angle projection

dimensions in mm

Dual Inline Packages (DIP)

(Available for all housing styles. Sample package shown: DIP dual port, same side)



third angle projection

dimensions in mm

SQ277 Series
Miniature amplified pressure sensors

ORDERING INFORMATION

	Series	Output signal		Pressure range		Housing		Calibration		Porting	
Options	**SQ277-**	**0**	Analog	**3**	12.5 mbar	**D***	Diff SIL same side	**B***	Bidirectional	**( )**	Straight
		1	I²C and analog	**4**	25 mbar	**E**	Diff SMD same side	**U**	Undirectional	**B***	Barbed, long SMD pins
		(2)*	SPI and analog	**5**	50 mbar	**G***	Gage/absolute SIL				
				6	75 mbar	**H**	Gage/absolute SMD				
				7	100 mbar	(P)*	Diff SIL opposite side				
				8	250 mbar	(Q)	Diff SMD opposite side				
				9	500 mbar	(T)*	Diff SIL same top side				
				A	1 barg						
				B*	2 barg						
				C*	5 barg						
				D	600...1100 mbar						
				E	800...1100 mbar						
				F*	1 bara						
				G*	2 bara						
				H*	7 barg						
		* Available on request. Please contact Sensortechnics		* only available with barbed pressure ports (B)		Housings P, Q, T available on request. Please contact Sensortechnics. * not available with digital output		* not available for pressure ranges D, E, F, G		* Available on request. Please contact Sensortechnics	
Sample order no:	**SQ277-**	**1**		**A**		**E**		**B**			

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

- 3 V power supply
- SPI, switching and custom specific outputs
- barbed pressure ports
- Dual inline packages (DIP)

... etc.

Please contact your nearest Sensortechnics sales office for further information.

Sensortechnics PRO services:

- Extended guarantee period of 2 years
- Improved performance characteristics
- 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