

**HPSD 5000 Pressure Transducer****General description**

The HPSD 5000 is a pressure sensing device acting as pressure transducer. Signal conditioning consist of complete temperature compensation and adjusted amplifier in single, programmable ASIC. High performance and accuracy enables use of this transducer in many applications. Programmable temperature compensation provides 1% total error over 0 to 70°C temperature range. Wide supply range 7 to 40 V, standard 0.5 to 4.5 V voltage output, digital output and switching output provides users maximum freedom for any type of application with dry air or non-corrosive gases and liquids.

The model HPSD 5000 is designed for standard M8 electrical connector. The whole group consists for pressure ranges from 20 mbar to 7 bar. Gage pressure configuration available for this group.

**Features**

- Wide supply voltage range 7 to 40 V
- Wide compensated range (0 to 70°C)
- Total accuracy down to 1% over 0 to 70°C, all effects included (maximum)
- Standard 0.5 to 4.5 V analog output
- Digital I2C output up to 15 bits (pressure + temperature)
- Overcurrent and overvoltage protection
- Overload and short circuit protection
- High performance OEM applications
- Standard M8 output connector
- Gage pressure configuration
- Pressure ranges: from 20 mbar to 7 bar or vacuum

**Applications**

- Industrial Process Control
- Transducer voltage transmitter
- Air flow monitoring
- Process control
- Leak detection

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**Types overview**

$T_{AMB} = 25^{\circ}\text{C}$

$V_{CC} = 5\text{ V, unless otherwise noted}$

**Low pressure range**

Pressure range	20 mbar (0.15psi)	50 mbar (0.3psi)	100 mbar (0.8psi)	350 mbar (5psi)
ID group	HPSD 5000-020M	HPSD 5000-050M	HPSD 5000-100M	HPSD 5000-350M
Pressure types	gage bidirectional gage	gage bidirectional gage	gage bidirectional gage	gage bidirectional gage
V <sub>OUT</sub>	0.5 to 4.5 V	0.5 to 4.5 V	0.5 to 4.5 V	0.5 to 4.5 V
Temperature ranges	Operating: -25 to 85°C Compensated: 0 to 70°C Storage : -40 to 125°C			
Over pressure <sup>1)</sup>	200 mbar	500 mbar	1 bar	1 bar
Burst pressure <sup>2)</sup>	300 mbar	750 mbar	1.5 mbar	1.7 bar

**High pressure range**

Pressure range	1 bar (15psi)	2 bar (30psi)	4 bar (60psi)	7 bar (100psi)	0 bar (vacuum)
ID group	HPSD 5000-001B	HPSD 5000-002B	HPSD 5000-004B	HPSD 5000-007B	HPSD 5000-000B
Pressure types	gage bidirectional gage	gage bidirectional gage	gage bidirectional gage	gage bidirectional gage	gage bidirectional gage
V <sub>OUT</sub>	0.5 to 4.5 V	0.5 to 4.5 V	0.5 to 4.5 V	0.5 to 4.5 V	0.5 to 4.5 V
Temperature ranges	Operating: -25 to 85°C Compensated: 0 to 70°C Storage : -40 to 125°C				
Over pressure <sup>1)</sup>	3 bar	6 bar	8 bar	14 bar	3 bar
Burst pressure <sup>2)</sup>	5 bar	10 bar	12 bar	21 bar	5 bar

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## Performance characteristics

$T_{AMB} = 25^{\circ}\text{C}$   
 $V_{CC} = 5\text{ V}$ , unless otherwise noted

Parameter	Symbol	Min.	Type	Max.	Unit
<b>Power supply</b>					
Supply voltage	$V_{CC}$	4.75		5.25	V
Current consumption	$I_{CC}$		4	6.5	mA
<b>Analog output (pressure) <sup>3)</sup></b>					
Offset voltage <sup>4)</sup>	$V_O$		0.50		V
Full scale output (FSO) <sup>5)</sup>	$V_{FS}$		4.50		V
Full scale span (FSS) <sup>6)</sup>	$V_{FSS}$		4.00		V
Offset voltage (bidirectional devices)	$V_O$		2.50		V
<b>Digital output (pressure), 15 bits <sup>3)</sup></b>					
Offset voltage <sup>4)</sup>	$V_O$		3277		counts
Full scale output (FSO) <sup>5)</sup>	$V_{FS}$		29491		counts
Full scale span (FSS) <sup>6)</sup>	$V_{FSS}$		26214		counts
Offset voltage (bidirectional devices)	$V_O$		16384		counts
<b>Digital output (temperature), 15 bits <sup>7)</sup></b>					
Temperature output @ 0°C	$T_o$		8192		counts
Temperature output @ 70°C	$T_s$		24576		counts
<b>Accuracy (pressure) @ 25°C <sup>8)</sup></b>					
Low pressure (20 to 100 mbar FS devices)	$E_a$			±1.5	%FSO
Standard pressure	$E_a$			±0.8	%FSO
<b>Total accuracy (pressure) @ 0 to 70°C <sup>9)</sup></b>					
Low pressure (20 to 100 mbar FS devices)	$E_{ta}$			±2	%FSO
Standard pressure (all other devices)	$E_{ta}$			±1	%FSO
<b>Resolution</b>					
A/D converter	$D_i$			15	bit
D/A converter	$D_o$		11		bit
Response time	$E_{rt}$		1.5		ms
Repeatability <sup>10)</sup>	$E_r$		±0.05		% FSO
Nonlinearity & pressure hysteresis (BFSL) <sup>11)</sup>	$E_l$		±0.1	±0.3	% FSO
Load resistance	$R_L$	2		∞	k
Media compatibility			See spec. note <sup>12)</sup>		
Weight	W		9		g

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## Specification notes

- 1) Over pressure is the maximum pressure which may be applied without causing damage to the sensing element.
- 2) Burst pressure is the maximum pressure which may be applied without causing leakage damage to the sensing element.
- 3) Analog output signal is ratiometric to power supply  $V_{cc}$ , digital signal is not ratiometric to the power supply.
- 4) Offset voltage is the voltage output at zero pressure.
- 5) Full scale output is the voltage output at full pressure range.
- 6) Full scale span is the algebraic difference between the output at full scale pressure range and offset.
- 7) Digital output signal (temperature) is not ratiometric to power supply  $V_{cc}$ . Temperature data are read directly on the sensing element.
- 8) Accuracy includes all effects (offset, span, nonlinearity, pressure hysteresis and repeatability) at room temperature and represents maximum deviation of transducer signal from ideal characteristic.
- 9) Total accuracy includes all effects (offset, span, nonlinearity, pressure hysteresis and repeatability) included with all temperature effects of offset and span. It describes overall error and represents maximum deviation of transducer signal from ideal characteristic in compensated temperature range from 0 to 70°C.
- 10) Repeatability is defined as typical deviation of the output signal after 10 pressure cycles.
- 11) Nonlinearity is defined as the BFSL (best fit straight line) across entire pressure range.
- 12) Media compatibility: clean, dry and noncorrosive gases and liquids to silicon, RTV, ceramics  $Al_2O_3$ , polymer.

## I2C communication

### General description

HPSD 5000 pressure transducers have I2C communication availability. When this device is connected to bidirectional I2C digital bus, the digital readouts with resolution up to 15 bits of pressure (1<sup>st</sup> and 2<sup>nd</sup> byte) and temperature (3<sup>rd</sup> and 4<sup>th</sup> byte) can be read from serial register of the internal ASIC.

HPSD 5000 works as a slave configured device which replies to the requests from the master (normally microcontroller). The I2C bus is controlled from the master which generates START and STOP conditions.

### Digital I2C interface

States descriptions:

**Idle period:** the bus is free when both data line (SDA) and clock line (SCL) are HIGH.

**START condition (S):** is generated in transition of SDA line from HIGH(H) to LOW(L) when SCL line (clock) is HIGH. It can be only generated by the master. Each data request needs to starts with START condition.

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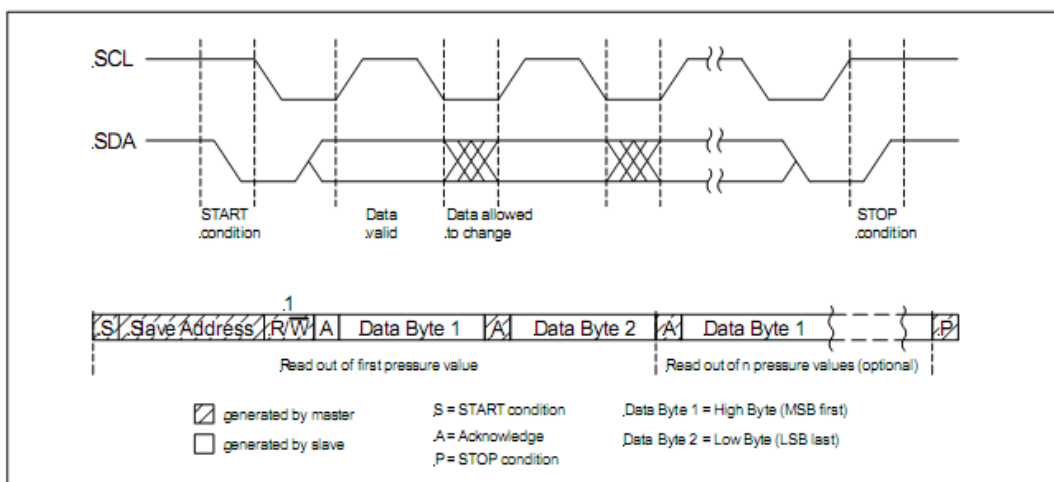
**STOP condition (P):** is generated in transition of SDA line from LOW(H) to HIGH(L) when SCL line (clock) is HIGH. It can be only generated by the master. Each data request needs to end with STOP condition.

**DATA valid (D):** Data is transmitted in bytes (8 bits) starting with pressure data (2 bytes) with the MSB (most significant bit) first and followed by 2 bytes of temperature data with MSB first. Each data bit is transferred with each clock pulse. Valid data are presented after start condition when data line is stable during HIGH clock is generated. SDA changes must be done while clock is LOW.

**ACKNOWLEDGE (A):** Information data are transferred in bytes (8 bits) on data bus with MSB first. After receiving of each byte master or slave must pull down SDA line to LOW as acknowledge for receiving the data. For that reason master must generate an extra clock. If acknowledge is missed slave becomes inactive, which means that master must either repeat last command or to generate STOP condition.

**SLAVE address:** Default slave address of HPSD 5000 devices are factory calibrated to 0 x78. According to I2C specification there are 127 different addresses available, which gives possibility for multi-slave communication where the user can connect up to 127 devices with unique addresses to the same I2C bus. After generating START condition master sends address containing 7 bits followed by a R/W (read="1", write="0").

I2C communication protocol:



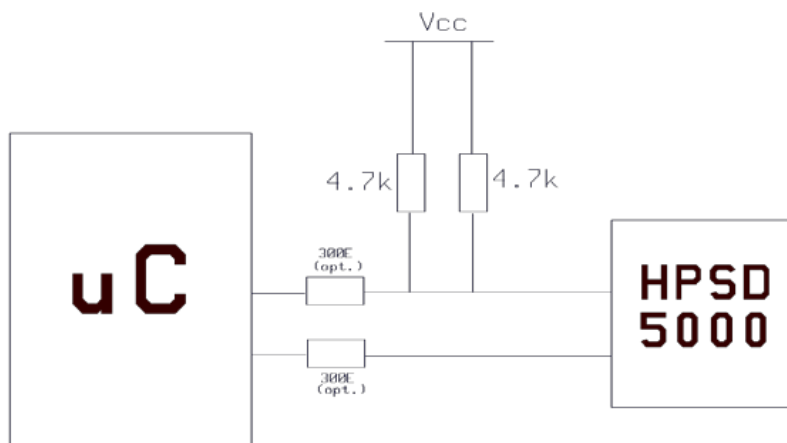
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I2C interface parameters:

Parameter	Min.	Max.	Unit
Input HIGH level	90	100	%V <sub>cc</sub>
Input LOW level	0	10	%V <sub>cc</sub>
Output LOW level		10	%V <sub>cc</sub>
Pull up resistor	700		Ω
Clock frequency SCL	100	400	kHz
Load capacitance (SDA)		400	pF
Input capacitance (SCL/SDA)		10	pF

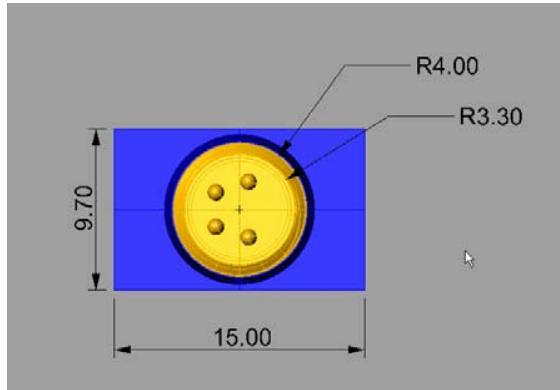
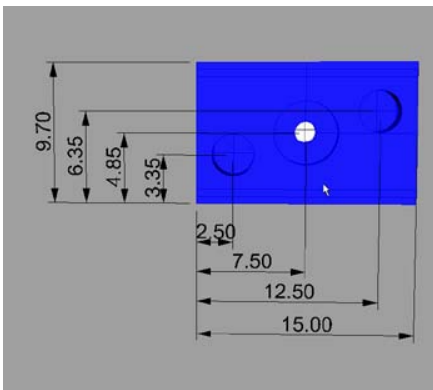
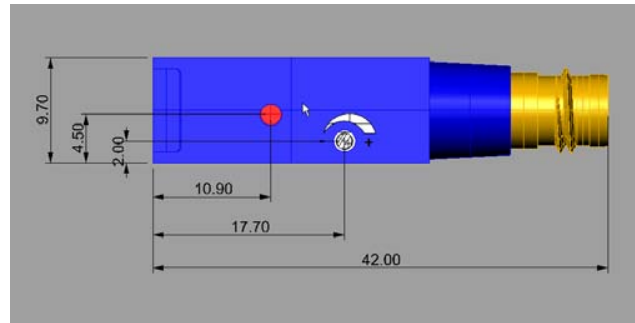
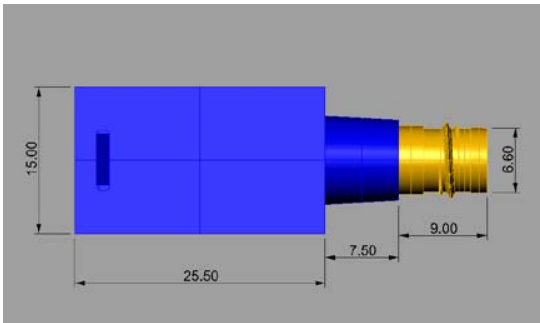
I2C application circuit:

Both I2C lines have to be connected to V<sub>cc</sub> with pull up resistors (recommended 4.7k ohms), additional serial resistors 300 ohms recommended also (optional).

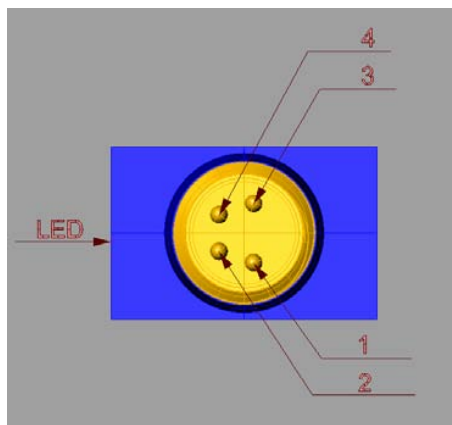


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**Outline dimensions**



**Pinout**



**DIGITAL I2C VERSION:**

1	+Vin
2	SDA
3	GND
4	SCL

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Ordering guide

Transducer type	Pressure range	Pressure type	Direction
HPSD 5000	020M	G	0
	050M		B
	100M		
	350M		
	001B		
	002B		
	004B		
	007B		
	000B		

Pressure range	
020M	20 mbar
050M	50 mbar
100M	100 mbar
350M	350 mbar
001B	1 bar
002B	2 bar
004B	4 bar
007B	7 bar
000B	vacuum

Pressure type	
G	Gage

Pressure direction	
0	0 to press. range
B	-press range to +press. range (bidirectional)

Other configurations possible on special request.

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