

HDS 4711 Miniaturized pressure transmitter

FEATURES

- Calibrated and temperature compensated pressure sensor with 0 ... 5 V output voltage
- Differential / gage, bidirectional differential, absolute and barometric versions
- Wide variety of pressure ranges:
5 mbar up to 2 bar
- Piezoresistive sensing element
- High precision digital signal conditioning
- High accuracy at room temperature
- Low overall error within a temperature range of -25 ... +85°C
- Supply voltage range: 8 ... 36 V
- Compact and robust package
- Dust- and water-tight (IP67)
- M5 circular sensor connector
- Ready to use, simple and quick installation
- RoHS and REACH compliant



GENERAL DESCRIPTION

HDS 4711 is a series of miniaturized pressure transmitters suitable for industrial applications and high precision measurements. All HDS 4711 can be powered within a supply voltage range of $V_S = 8 \dots 36 \text{ V}$ and provide an industrial output voltage range of $V_{OUT} = 0 \dots 5 \text{ V}$. They are calibrated and temperature compensated in a wide temperature range of $-25 \dots +85^\circ\text{C}$.

HDS 4711 comes in a robust plastic package and is ready to use. Pressure is either applied via two barbed side ports for differential (relative) or bidirectional differential pressure transmitter types or via a single port for absolute or barometric types. The electrical connection is realized with an M5 circular sensor connector. HDS 4711's package is dust- and water-tight conforming to IP67.

The pressure transmitters in the HDS 4711 series are available for various applications and pressure ranges: Differential (relative) devices in pressure ranges from 0 ... 5 mbar up to 0 ... 2 bar, absolute pressure variants for 0 ... 1 bar and 0 ... 2 bar as well as a barometric type for 0.7 ... 1.2 bar. Bidirectional-differential devices are available from -5 ... +5 mbar up to -1 ... +1 bar for measurement of positive and negative differential pressure.

Other pressure ranges and customized output voltage ranges are available on request.

TYPICAL APPLICATIONS

- Static pressure sensing
- Dynamic pressure sensing
- Barometric pressure sensing
- Vacuum measurement
- Level measurement
- Gas flow measurement
- Heating, Ventilation and Air Conditioning (HVAC)

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PRESSURE RANGES

Pressure transmitter type (code)	Pressure type	Pressure range in mbar	Burst pressure ¹⁾ in bar	Pressure range in PSI	Burst pressure ¹⁾ in PSI
Ultra low pressure					
HDS 4711-0005-D	differential / relative	0 ... 5	> 0.35	0 ... 0.073	> 5
HDS 4711-0010-D	differential / relative	0 ... 10	> 0.35	0 ... 0.145	> 5
HDS 4711-0005-D-B	bidirectional differential	-5 ... +5	> 0.35	-0.073 ... +0.073	> 5
HDS 4711-0010-D-B	bidirectional differential	-10 ... +10	> 0.35	-0.145 ... +0.145	> 5
Low pressure					
HDS 4711-0020-D	differential / relative	0 ... 20	> 0.5	0 ... 0.290	> 7
HDS 4711-0050-D	differential / relative	0 ... 50	> 1	0 ... 0.725	> 15
HDS 4711-0100-D	differential / relative	0 ... 100	> 1	0 ... 1.450	> 15
HDS 4711-0020-D-B	bidirectional differential	-20 ... +20	> 0.5	-0.290 ... +0.290	> 7
HDS 4711-0050-D-B	bidirectional differential	-50 ... +50	> 1	-0.725 ... +0.725	> 15
HDS 4711-0100-D-B	bidirectional differential	-100 ... +100	> 1	-1.450 ... +1.450	> 15
Standard pressure					
HDS 4711-0200-D	differential / relative	0 ... 200	> 5	0 ... 2.901	> 72
HDS 4711-0350-D	differential / relative	0 ... 350	> 5	0 ... 5.076	> 72
HDS 4711-0500-D	differential / relative	0 ... 500	> 5	0 ... 7.251	> 72
HDS 4711-1000-D	differential / relative	0 ... 1000	> 5	0 ... 14.50	> 72
HDS 4711-2000-D	differential / relative	0 ... 2000	> 5	0 ... 29.01	> 72
HDS 4711-0200-D-B	bidirectional differential	-200 ... +200	> 5	-2.901 ... +2.901	> 72
HDS 4711-0350-D-B	bidirectional differential	-350 ... +350	> 5	-5.076 ... +5.076	> 72
HDS 4711-1000-D-B	bidirectional differential	-1000 ... +1000	> 5	-14.50 ... +14.50	> 72
HDS 4711-1000-A	absolute	0 ... 1000	> 5	0 ... 14.50	> 72
HDS 4711-2000-A	absolute	0 ... 2000	> 5	0 ... 29.01	> 72
HDS 4711-1200-B	barometric	700 ... 1200	> 5	10.15 ... 17.40	> 72

Table 1: HDS 4711 standard pressure ranges (other ranges on request)

Notes:

- 1) Burst pressure is defined as the maximum pressure, which can be applied to one pressure port relative to the other port (or while only one pressure port is connected) without causing damages / leaks.

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MAXIMUM RATINGS

Parameter	Minimum	Typical	Maximum	Units
Maximum supply voltage: $V_{S'_{max}}$			36	V
Operating and storage temperature: T	-25		85	°C
Common mode pressure $p_{CM}^{1)}$			5	bar

Table 2: Maximum ratings

Notes:

- 1) Common mode pressure is defined as the maximum pressure, which can be applied simultaneously on both pressure ports of a differential or bidirectional transmitter without causing damages, while no differential pressure is applied.

SPECIFICATIONS

All parameters apply to $V_S = 24\text{ V}$, $T_{op} = 25^\circ\text{C}$ and $R_L = 10\text{ k}\Omega$, unless otherwise stated.

Parameter	Minimum	Typical	Maximum	Units
Analog output signal				
@ specified minimum pressure (see "pressure ranges") ¹⁾	0	< 0.025	0.05	V
@ specified maximum pressure (see "pressure ranges") ¹⁾		5		V
Full span output (FSO) ²⁾		5		V
without pressure (only bidirectional differential types)		2.5		V
Accuracy³⁾ @ $T_{op} = 25^\circ\text{C}$				
Ultra low pressure types (5, 10 mbar)		± 1.0	± 1.5	%FSO
Low pressure types (20, 50, 100 mbar)		± 0.5	± 1.0	%FSO
Standard pressure types ($\geq 200\text{ mbar}$)		± 0.5	± 1.0	%FSO
Overall error⁴⁾ @ $T_{op} = -25 \dots 85^\circ\text{C}$				
Ultra low pressure types (5, 10 mbar)		± 1.5	± 2.5	%FSO
Low pressure types (20, 50, 100 mbar)		± 1.0	± 2.0	%FSO
Standard pressure types ($\geq 200\text{ mbar}$)		± 0.7	± 1.5	%FSO
Long term stability			< 0.5	%FSO/a
Nonlinearity ⁵⁾	-0.3	< 0.1	0.3	%FSO
Resolution analog output signal			0.05	%FSO
Supply voltage (V_S to GND)	8	24	36	V
Current consumption			5	mA
Response time (10% ... 90% rise time)		1	2	ms
Load resistor R_L	2			k Ω
Capacitive load			50	nF
Dependency of V_{OUT} on V_S ⁶⁾			< 0.1	%FSO
Pressure Changes	10^6			
Compensated operating temperature range T_{Op}	-25		85	°C
Weight without cable		20		gram

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Parameter	Minimum	Typical	Maximum	Units
Media compatibility	See "Specification notes" ^{7), 8)}			
Protection classification ⁹⁾	IP67			

Table 3: Specifications

Specification notes:

- 1) Pressure ranges are specified in *Table 1*.
- 2) The Full Span Output (FSO) is the algebraic difference between the output voltage at the specified minimum pressure and the output voltage at the specified maximum pressure (nominal FSO = 5 V).
- 3) The accuracy is defined as the maximum deviation of the measurement value from the ideal transfer function at room temperature (RT) in %FSO including the adjustment error (offset and span), nonlinearity, pressure hysteresis and repeatability. Nonlinearity is the measured deviation from the best fit straight line (BFSL) across the entire pressure range. Pressure hysteresis is the maximum deviation of the output value at any pressure within the specified range when the pressure is cycled to and from the specified minimum or maximum pressure. Repeatability is the maximum variation of the output value at any pressure within the specified range over 10 pressure cycles.
- 4) The overall error is defined as the maximum deviation of the measurement value from the ideal transfer function in %FSO across the entire temperature range (-25 ... 85 °C).
- 5) Defined as best fit straight line (BFSL).
- 6) The given value is the maximum deviation from the output voltage at $V_s = 24\text{ V}$ over the complete supply voltage range at any pressure in the specified range. It is normalized to the FSO.
- 7) Media compatibility of pressure port 1 (for a description of port 1, see *Figure 3*): fluids and gases non-corrosive to ceramics, silicon, Pyrex, RTV silicone rubber and Zytel PA66.
- 8) Media compatibility of pressure port 2 (for a description of port 2, see *Figure 3*): clean, dry gases, non-corrosive to ceramics, silicon, RTV silicone rubber, gold, tin and Zytel PA66 (alkaline or acidic liquids can destroy HDS 4711)
- 9) With tubes connected to port 1 and port 2 for differential and bidirectional differential pressure transmitters and with a tube connected to port 2 for absolute and barometric pressure transmitters.

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FUNCTIONAL DESCRIPTION

HDS 4711 uses a piezoresistive silicon chip as sensing element and a mixed-signal integrated circuit (ASIC) for signal conditioning, which are assembled together on a ceramic substrate and housed in a robust plastic package.

The physical pressure, which is applied to the transmitter's pressure ports is measured at HDS 4711's piezoresistive pressure sensing element. There the pressure is converted into a differential voltage signal, which is almost proportional to the pressure. This differential voltage signal is converted into a standardized analog output voltage of $V_{OUT} = 0 \dots 5 \text{ V}$ by the signal-conditioning ASIC.

The signal-conditioning is done in the following way (see *Figure 1*):

At first the sensing element's differential voltage signal is pre-amplified and converted into a digital signal using a 14-bit A/D converter (ADC). This digitized pressure signal is processed mathematically by the ASIC's integrated microcontroller unit. To achieve a calibrated and temperature compensated output signal the microcontroller unit uses individual correction coefficients and a mathematical correction algorithm, which are stored in the ASIC's EEPROM during HDS 4711's factory calibration process. The temperature value needed for the temperature compensation is measured directly at the piezoresistive sensing element, too. To obtain an analog output voltage the corrected digital signal is converted back into an analog voltage by an 11-bit D/A converter (DAC).

The standardized output voltage $V_{OUT} = 0 \dots 5 \text{ V}$ (or $2.5 \text{ V} \pm 2.5 \text{ V}$ for bidirectional differential types) is a linear function of the applied pressure.¹⁾ It is independent of the applied supply voltage.

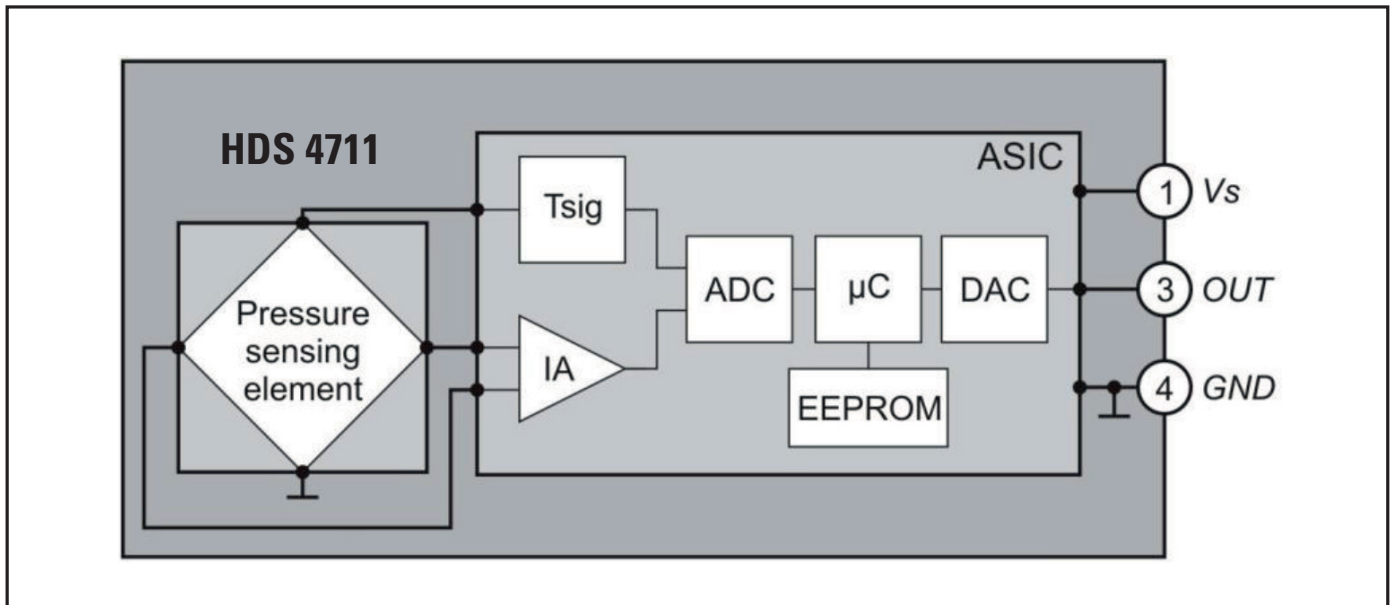


Figure 1: HDS 4711's block diagram

1) The applied pressure is the pressure difference between port 1 and port 2 for differential and bidirectional differential pressure transmitters. For relative pressure types it is the pressure difference between port 1 and ambient pressure and for absolute and barometric pressure types it is the pressure at port 2 (for the definition of ports see *Figure 3*).

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INITIAL OPERATION

HDS 4711's package provides a dust- and water-tight protection and a maintenance-free lifetime. The package can be screw mounted in a fast and easy way using the two through bores ($\varnothing 3.2$ mm) at the package's edges.

The electrical connection is established using the integrated M5 circular sensor connector (for pinout see *Figure 3*) and a suitable cable with female M5 sensor connector (see "additional equipment"). As shown in *Figure 2* pin 1 (Vs) is directly connected to the power supply's positive output and pin 4 (GND) is connected to GND. Pin 3 can be connected to a voltmeter directly to measure the output signal voltage V_{OUT} (referenced to GND) or a load resistor R_L can be connected between pin 3 and GND and V_{OUT} can be measured parallel to R_L .

HDS 4711's output voltage $V_{OUT} = 0 \dots 5$ V at pin 3 (OUT) is a linear function of the applied pressure and does not depend on the supply voltage. Please take care that the power supply is set to a voltage in the range between 8 and 36 V and that it is able to source at least 5 mA (for $R_L \geq 10$ k Ω)

The pressure connection is made using the package's pressure ports (barbed hose connectors). Depending on the type of pressure transmitter and measuring pressure one or two of the pressure ports are connected to the measuring media/volume. For the pressures at port 1 and port 2 (for port definition see *Figure 3*) the following requirements have to be fulfilled, where p_1 is the pressure at port 1 and p_2 is the pressure at port 2:

for differential pressure (type HDS 4711-XXXX-D):
for relative / gage pressure (type HDS 4711-XXXX-D):
for bidirectional differential pressure (type HDS 4711-XXXX-D-B):
for absolute pressure (type HDS 4711-XXXX-A):
for barometric pressure (type HDS 4711-XXXX-B):

$p_1 > p_2$
 $p_1 > p_{ambient}$, $p_1 =$ measuring pressure
 $p_1 > p_2$ or $p_1 < p_2$ possible
 $p_2 =$ measuring pressure
 $p_2 =$ measuring pressure

The maximum pressures (see *Table 1*) and the guidelines concerning media compatibility (see "Specification notes" 7) and 8)) have to be taken into account.

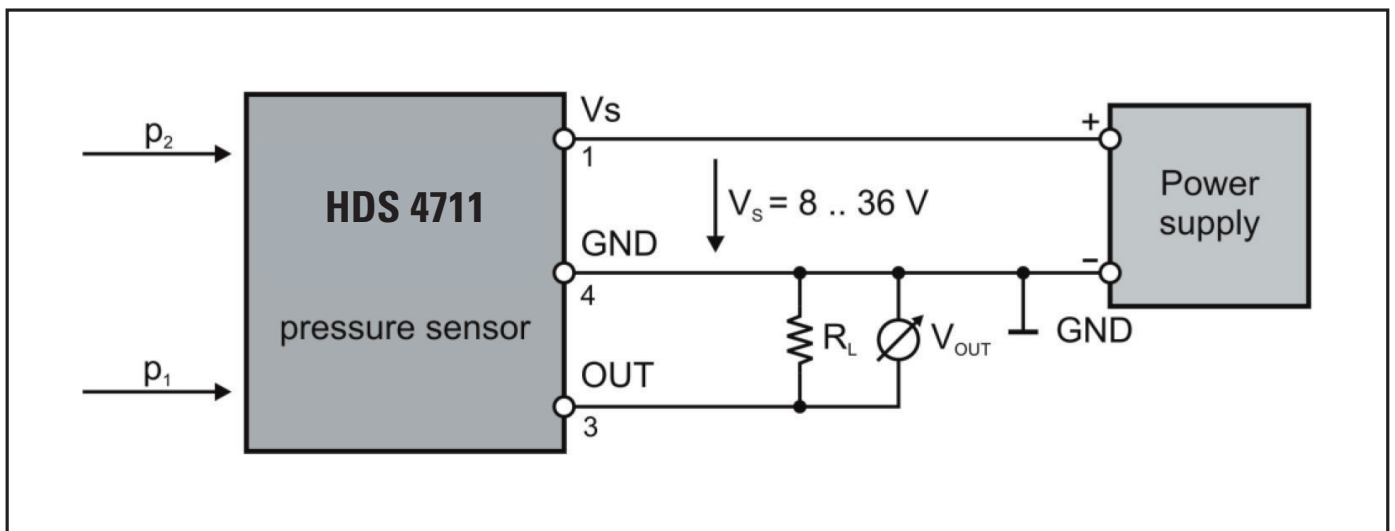


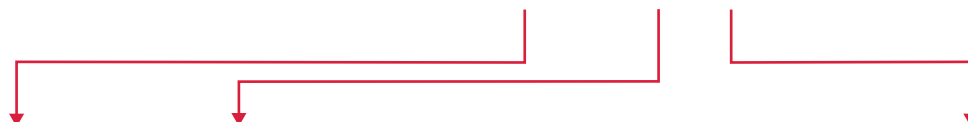
Figure 2: Electrical connection of HDS 4711

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INFORMATION FOR ORDERING

Ordering code:

HDS 4711 - 0100 - D



Model	Pressure range			
	Pressure range code	mbar	PSI	kPa
HDS 4711	0005	5	0.073	0.5
	0010	10	0.145	1
	0020	20	0.290	2
	0050	50	0.725	5
	0100	100	1.450	10
	0200	200	2.901	20
	0350	350	5.076	35
	0500	500	7.251	50
	1000	1000	14.50	100
	1200	1200	17.40	120
	2000	2000	29.01	200

Table 4: Pressure ranges

Pressure type	
Pressure type code	Available pressure ranges
D differential / relative (gage)	0 ... 5 mbar to 0 ... 2000 mbar
D-B bidirectional differential	-5 ... +5 mbar to -1000 ... +1000 mbar
A absolute	0 ... 1000 mbar and 0 ... 2000 mbar
B barometric (absolute)	700 ... 1200 mbar

Table 5: Pressure types

ADDITIONAL EQUIPMENT

Order number	Delivery form
HDS 4711-CABLE	3-wire cable with mating M5 sensor connector (2 m long) wiring: brown – Vs, blue – OUT, black – GND
HDS 4711-PU-TUBING	matching soft PU-Tubing (please order in m)

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