

## HDS 4712 Miniaturized pressure transmitter

### FEATURES

- Calibrated and temperature compensated pressure sensor with two-wire 4 ... 20 mA current loop output
- 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
- Current limitation
- Protected against reverse polarity
- 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 4712 is a series of miniaturized pressure transmitters suitable for industrial applications and high precision measurements. All HDS 4712 can be powered within a supply voltage range of  $V_s = 8 \dots 36 \text{ V}$  and provide an industrial two-wire 4 ... 20 mA current loop output. They are calibrated and temperature compensated in a wide temperature range of -25 ... +85°C.

HDS 4712 comes in a robust plastic package and is ready to use. Pressure is applied either 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 two-wire current loop output is established using an M5 circular sensor connector. HDS 4712's package is dust- and water-tight conforming to IP67.

The pressure transmitters in the HDS 4712 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 pressure differences.

Other pressure 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 <sup>1)</sup> in bar	Pressure range in PSI	Burst pressure <sup>1)</sup> in PSI
<b>Ultra low pressure</b>					
HDS 4712-0005-D	differential / relative	0 ... +5	> 0.35	0 ... 0.073	> 5
HDS 4712-0010-D	differential / relative	0 ... 10	> 0.35	0 ... 0.145	> 5
HDS 4712-0005-D-B	bidirectional differential	-5 ... +5	> 0.35	-0.073 ... +0.073	> 5
HDS 4712-0010-D-B	bidirectional differential	-10 ... +10	> 0.35	-0.145 ... +0.145	> 5
<b>Low pressure</b>					
HDS 4712-0020-D	differential / relative	0 ... 20	> 0.5	0 ... 0.290	> 7
HDS 4712-0050-D	differential / relative	0 ... 50	> 1	0 ... 0.725	> 15
HDS 4712-0100-D	differential / relative	0 ... 100	> 1	0 ... 1.450	> 15
HDS 4712-0020-D-B	bidirectional differential	-20 ... +20	> 0.5	-0.290 ... +0.290	> 7
HDS 4712-0050-D-B	bidirectional differential	-50 ... +50	> 1	-0.725 ... +0.725	> 15
HDS 4712-0100-D-B	bidirectional differential	-100 ... +100	> 1	-1.450 ... +1.450	> 15
<b>Standard pressure</b>					
HDS 4712-0200-D	differential / relative	0 ... 200	> 5	0 ... 2.901	> 72
HDS 4712-0350-D	differential / relative	0 ... 350	> 5	0 ... 5.076	> 72
HDS 4712-0500-D	differential / relative	0 ... 500	> 5	0 ... 7.251	> 72
HDS 4712-1000-D	differential / relative	0 ... 1000	> 5	0 ... 14.50	> 72
HDS 4712-2000-D	differential / relative	0 ... 2000	> 5	0 ... 29.01	> 72
HDS 4712-0200-D-B	bidirectional differential	-200 ... +200	> 5	-2.901 ... +2.901	> 72
HDS 4712-0350-D-B	bidirectional differential	-350 ... +350	> 5	-5.076 ... +5.076	> 72
HDS 4712-1000-D-B	bidirectional differential	-1000 ... +1000	> 5	-14.50 ... +14.50	> 72
HDS 4712-1000-A	absolute	0 ... 1000	> 5	0 ... 14.50	> 72
HDS 4712-2000-A	absolute	0 ... 2000	> 5	0 ... 29.01	> 72
HDS 4712-1200-B	barometric	700 ... 1200	> 5	10.15 ... 17.40	> 72

**Table 1: HDS 4712 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
Absolute maximum supply voltage: $V_{\max}$			40	V
Operating and storage temperature: T	-25		85	°C
Common mode pressure $p_{\text{CM}}^{1)}$			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  $V_S = 24\text{ V}$ ,  $T_{\text{op}} = 25^\circ\text{C}$  and  $R_L = 100\ \Omega$ , unless otherwise stated.

Parameter	Minimum	Typical	Maximum	Units
<b>Current loop output signal</b>				
@ specified minimum pressure (see „pressure ranges“) <sup>1)</sup>		4		mA
@ specified maximum pressure (see „pressure ranges“) <sup>1)</sup>		20		mA
Full span output (FSO) <sup>2)</sup>		16		mA
without pressure (only bidirectional differential types)		12		mA
<b>Accuracy<sup>3)</sup> @ <math>T_{\text{op}} = 25^\circ\text{C}</math></b>				
Ultra low pressure types (5, 10 mbar)		$\pm 1.0$	$\pm 1.5$	%FSO
Low pressure types (20, 50, 100 mbar)		$\pm 0.5$	$\pm 1.0$	%FSO
Standard pressure types ( $\geq 200$ mbar)		$\pm 0.3$	$\pm 0.5$	%FSO
<b>Overall error<sup>4)</sup> @ <math>T_{\text{op}} = -25 \dots 85^\circ\text{C}</math></b>				
Ultra low pressure types (5, 10 mbar)		$\pm 1.5$	$\pm 2.5$	%FSO
Low pressure types (20, 50, 100 mbar)		$\pm 1.0$	$\pm 2.0$	%FSO
Standard pressure types ( $\geq 200$ mbar)		$\pm 0.5$	$\pm 1.0$	%FSO
Long term stability			< 0.5	%FSO/a
Nonlinearity <sup>5)</sup>	-0.3	< 0.1	0.3	%FSO
Resolution analog output signal			0.05	%FSO
Supply voltage ( $V_S$ to Ground)	$V_{S,\text{min}}^{6)}$	24	36	V
Transmitter power consumption ( $I_{\text{OUT}} = 20\text{ mA}$ , $R_L = 0\ \Omega$ )			0.48	W
Current limitation $I_{\text{OUT,max}}$			22.5	mA
Protection against reverse polarity			40	V
Response time (10% ... 90% rise time)		2,5	4	ms
Load resistor $R_L$			600	$\Omega$
Dependency of $I_{\text{OUT}}$ on $V_S^{7)}$			< 0.1	%FSO
Pressure Changes		$10^6$		
Compensated operating temperature range	-25		85	°C

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Parameter	Minimum	Typical	Maximum	Units
Weight without cable		20		gram
Media compatibility	See "Specification notes" <sup>8), 9)</sup>			
Protection classification <sup>10)</sup>	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 current loop output at the specified minimum pressure and the current loop output at the specified maximum pressure (nominal FSO = 16 mA).
- 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 minimum supply voltage  $V_{s,min}$  depends on the used load  $R_L$  and is given by  $V_{s,min} = 8 V + 20 mA \cdot R_L$ .
- 7) The given value is the maximum deviation from the output voltage at  $V_s = 24 V$  over the complete supply voltage range at any pressure in the specified range. It is normalized to the FSO.
- 8) 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.
- 9) 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 4712)
- 10) With tubes connected at port 1 and port 2 for differential and bidirectional differential pressure transmitters and with a tube connected at port 2 for absolute and barometric pressure transmitters.

## HDS 4712 Miniaturized pressure transmitter

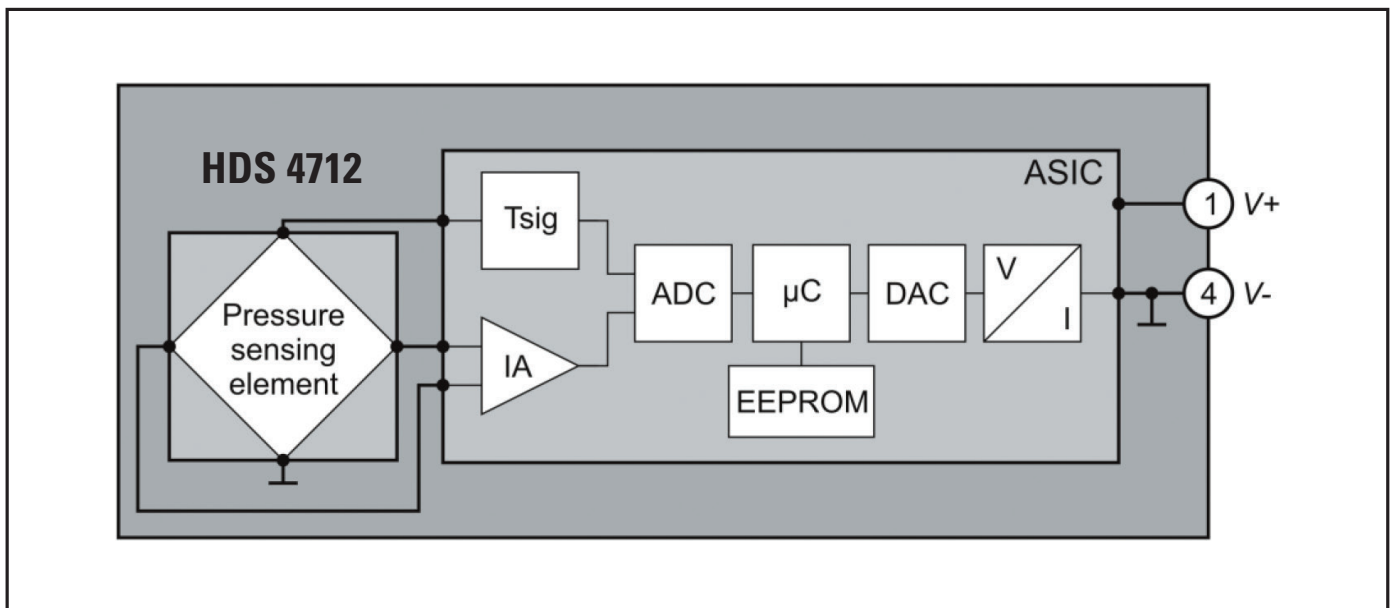
### FUNCTIONAL DESCRIPTION

HDS 4712 uses a piezoresistive silicon chip as sensing element and a mixed-signal integrated circuit (ASIC) for signal conditioning, which are assembled on a ceramic substrate and housed in a robust plastic package.

The physical pressure applied to the transmitter's pressure ports is measured at HDS 4712's piezoresistive pressure sensing element, where the pressure is converted into a differential voltage signal, which is almost proportional to the pressure. Using the signal conditioning ASIC this differential voltage signal is converted into a standardized analog two-wire current loop output of  $I_{OUT} = 4 \dots 20 \text{ mA}$ .

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 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 4712's factory calibration process. The temperature value needed for the temperature compensation is measured directly at the piezoresistive sensing element, too. An 11-bit D/A converter (DAC) converts the corrected digital signal into a voltage signal, which is converted into a two-wire current loop output by the voltage-to-current converter.

The standardized two-wire current loop output  $I_{OUT} = 4 \dots 20 \text{ mA}$  (or  $12 \pm 8 \text{ mA}$  for bidirectional differential types) is a linear function of the applied pressure.<sup>1)</sup> It is independent of the applied supply voltage.



**Figure 1: HDS 4712'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 4712'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 (Ø 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 (V+) is directly connected to the power supply's positive output and pin 4 (V-) is connected to Ground via a load resistor  $R_L$ , which can be installed far away from the pressure transmitter.  $I_{OUT}$  can be measured using the voltage drop  $V_A$  over  $R_L$  with  $I_{OUT} = V_A / R_L$ <sup>1)</sup>

The required minimum supply voltage  $V_{S,min}$  depends on the used load  $R_L$  and is given by the following equation:

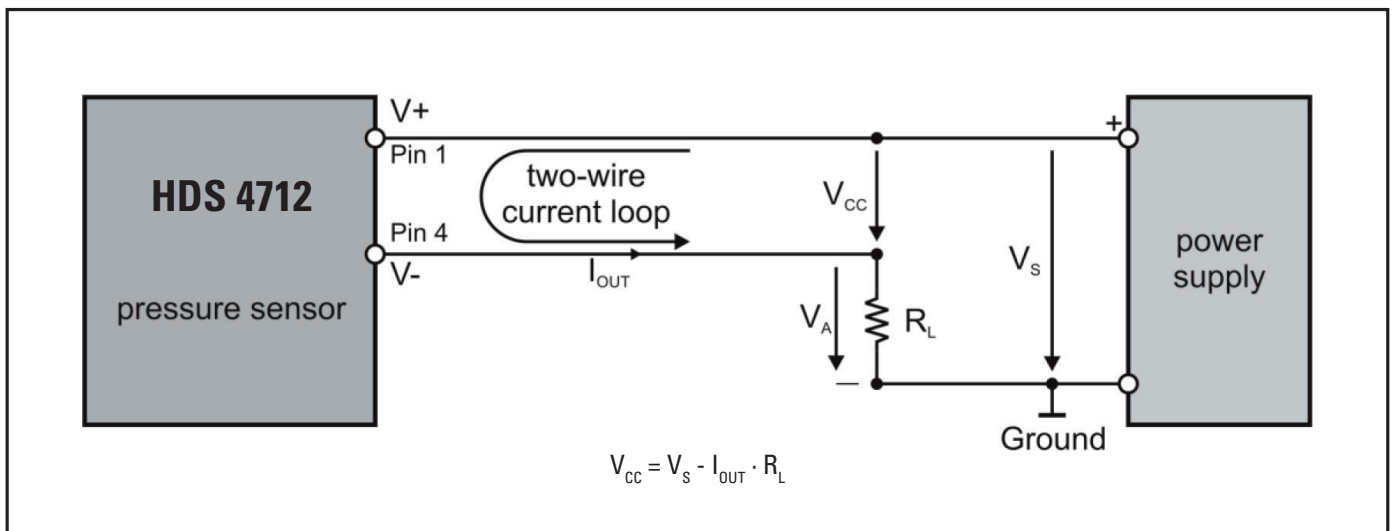
$$V_{S,min} = 8\text{ V} + 20\text{ mA} \cdot R_L$$

Please take care that the power supply can provide at least 20 mA.

The pressure connection is made using the package's pressure ports (barbed hose connectors). Depending on the type of pressure transmitter and the type of 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 definition of the ports 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 4712-XXXX-D):                 | $p_1 > p_2$                                      |
| for relative / gage pressure (type HDS 4712-XXXX-D):              | $p_1 > p_{ambient}$ , $p_1 =$ measuring pressure |
| for bidirectional differential pressure (type HDS 4712-XXXX-D-B): | $p_1 > p_2$ or $p_1 < p_2$ possible              |
| for absolute pressure (type HDS 4712-XXXX-A):                     | $p_2 =$ measuring pressure                       |
| for barometric pressure (type HDS 4712-XXXX-B):                   | $p_2 =$ measuring pressure                       |

The maximum pressures (see *Table 1*) and the guidelines concerning media compatibility (see "Specification notes" 8) and 9)) have to be taken into account.

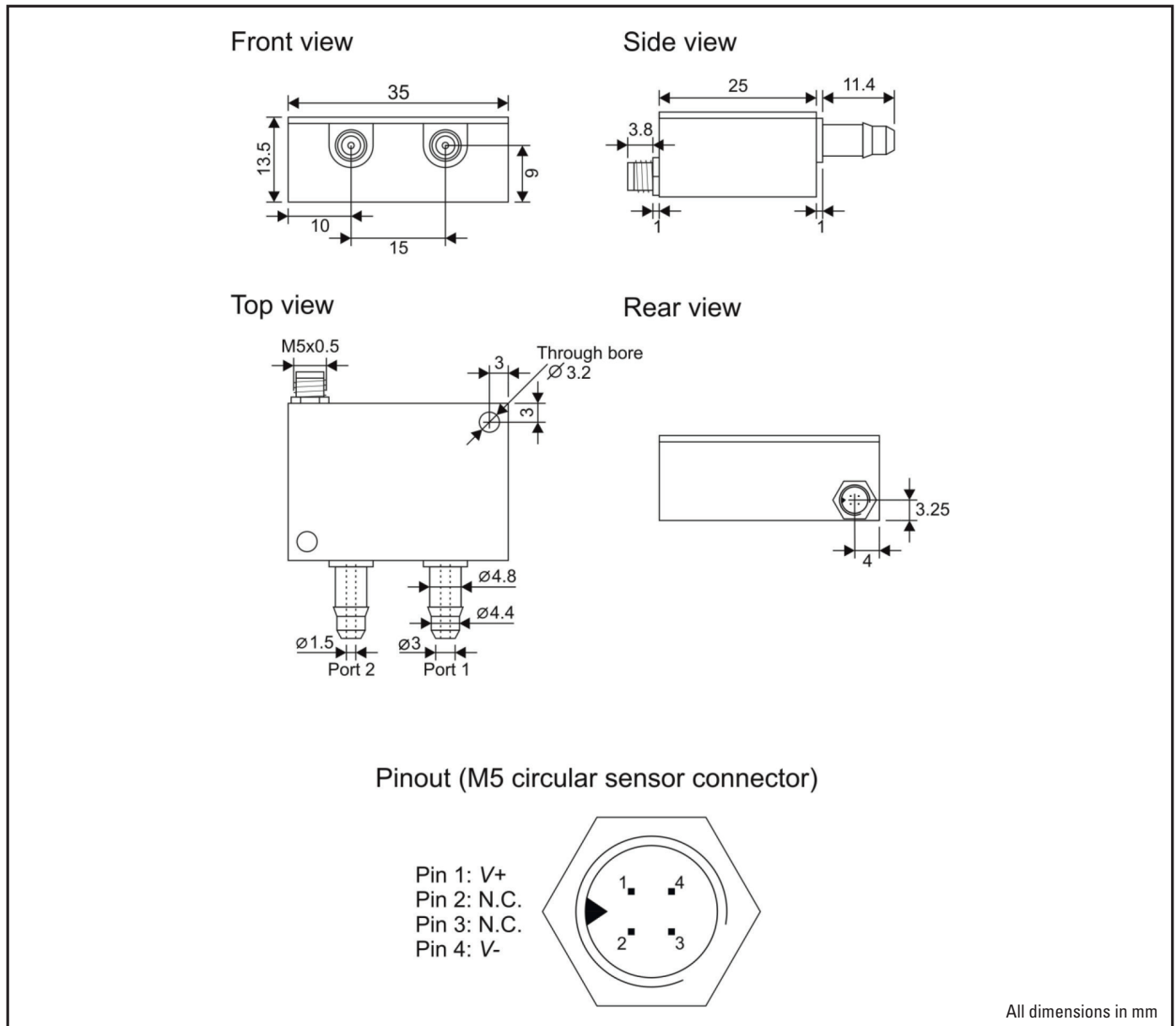


**Figure 2: Electrical connection of HDS 4712**

1) If very long cables are used to connect HDS 4712 with  $R_L$  the voltage drop over the cable resistance should be taken into account for the determination of  $V_S$ .

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### DIMENSIONS AND PINOUT



**Figure 3: Dimensions and pinout of HDS 4712's package**

**Notes:**

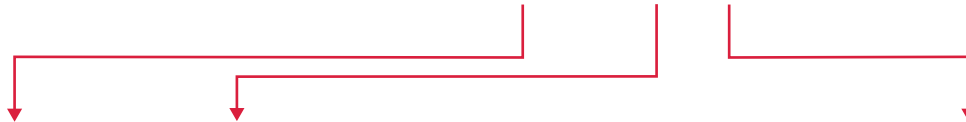
- 1) For absolute and barometric pressure transmitters only pressure port 2 is available.
- 2) Package material is Zytel PA66.
- 3) The electrical connection is established using an M5 sensor connector series 707 from Binder GmbH.
- 4) For pressure connections HJK Sensoren + Systeme recommends a silicone tubing (inner diameter  $\varnothing_{id} = 3.2$  mm, outer diameter  $\varnothing_{od} = 6.4$  mm) or soft PU tubing ( $\varnothing_{id} = 4$  mm,  $\varnothing_{od} = 6$  mm).
- 5) If silicone tubing is used it is recommended to use hose clamps to reduce the risk of leaks at high pressure.

# HDS 4712 Miniaturized pressure transmitter

## INFORMATION FOR ORDERING

Ordering code:

**HDS 4712 - 0100 - D**



Model	Pressure range			
	Pressure range code	mbar	PSI	kPa
HDS 4712	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 4712-CABLE	3-wire cable with mating M5 sensor connector (2 m long) wiring: brown – V+, blue – NC, black – V-
HDS 4712-PU-TUBING	matching soft PU-Tubing (please order in meters)

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