

Functional Safety Sensors



ELECTRONIC PRESSURE TRANSMITTERS AND LINEAR POSITION TRANSDUCERS FOR APPLICATIONS WITH INCREASED FUNCTIONAL SAFETY

"Failsafe" is the keyword for vehicle designers of mobile machinery. No single error is allowed to cause a breakdown or malfunction of part or all of the system in safety-critical applications.

For use in safety-critical applications, these pressure transmitters are certified for Performance Level "d" (PLd) according to DIN EN ISO 13849. The linear position transducers PLd comply with DIN EN 13849-1 and also with the comparable safety level SIL 2 in accordance with the standard applicable worldwide for electronic products IEC 61508.

Pressure transmitters for applications with increased functional safety

HDA 4700

Linear position transducer for applications with increased functional safety

HLT 1100 - R2

Angle sensors for applications with increased functional safety

HAT 1000

HAT 3836

Further sensors for applications with increased functional safety can be found in the Chapter "*OEM Products for High Volume Production*".



Electronic Pressure Transmitter HDA 4700 for Applications with Increased Functional Safety

Functional Safety
PL d



Description:

This version of the pressure transmitter series HDA 4700 has been specially developed for use in safety circuits / safety functions as part of the functional safety of machinery and equipment up to PL d - Cat 3 (in accordance with ISO 13849).

The pressure transmitters are designed with two channels. Each channel consists of a sensor element and evaluation electronics. As a result, the pressure transmitter develops two separate and independent output signals in proportion to the pressure.

The safety function is tested by evaluating and comparing the two analogue output signals in a higher-level system.

The main areas of application are as sensor elements in mobile, safety-oriented systems such as load torque displays or load torque limitation in truck-mounted cranes or working platforms.

Special features:

- Two-channel, redundant pressure measurement
- Two separate, independent output signals
- Accuracy $\leq \pm 0.25\%$ FS typ.
- Highly robust sensor cell
- Outstanding performance in terms of temperature effect and EMC
- Small, compact design
- PL d, Cat. 3 certification

Technical data:

Input data				
Measuring ranges signal 1 in bar	25	40	60	100
Measuring ranges signal 2 in bar	25 / 40	40 / 60	60 / 100	100 / 160
	160	250	400	600
	160 / 250	250 / 400	400 / 600	600 / 1000
Overload pressures in bar	80	80	120	200
	320	500	800	1200
Burst pressures in bar	200	200	300	500
	800	1250	2000	2000
Mechanical connection (Torque value)	G $\frac{1}{4}$ A DIN 3852 with 0.5 mm orifice (20 Nm)			
Parts in contact with medium ¹⁾	Mech. conn.: Stainl. steel (2 x thin-film strain gauge) Seal: FPM			
Output data				
Output signal 1 ²⁾	4 .. 20 mA, 3 conductor			
Output signal 2 ²⁾	4 .. 20 mA, 3 conductor			
Accuracy to DIN 16086	$\leq \pm 0.25\%$ FS typ.			
Max. setting	$\leq \pm 0.5\%$ FS max.			
Accuracy at minimum setting (B.F.S.L.)	$\leq \pm 0.15\%$ FS typ. $\leq \pm 0.25\%$ FS max.			
Temperature compensation	$\leq \pm 0.008\%$ / °C typ.			
Zero point	$\leq \pm 0.015\%$ / °C max.			
Temperature compensation	$\leq \pm 0.008\%$ / °C typ.			
Over range	$\leq \pm 0.015\%$ / °C max.			
Non-linearity at max. setting to DIN 16086	$\leq \pm 0.3\%$ FS max.			
Hysteresis	$\leq \pm 0.1\%$ FS max.			
Repeatability	$\leq \pm 0.05\%$ FS.			
Rise time	≤ 2 ms			
Long term stability	$\leq \pm 0.1\%$ FS typ. / year			
Environmental conditions				
Compensated temperature range	-25 .. +85 °C			
Operating temperature range (fail safe) ³⁾	-40 .. +85 °C / -25 .. +85 °C			
Storage temperature range	-40 .. +85 °C			
Fluid temperature range ³⁾	-40 .. +85 °C / -25 .. +85 °C			
CE mark	EN 61000-6-1 / 2 / 3 / 4			
Vibration resistance according to DIN EN 60068-2-6 at 5 .. 2000 Hz	≤ 20 g			
Protection class to IEC 60529 to ISO 20653	IP 67 (when female connector is fitted) IP 69K (when female connector is fitted)			
Other data				
Electrical connection	M12x1, 4 pole; DT04, 4 pole			
Supply voltage	7 .. 35 V DC (max. load resistance 250 Ω) 12 .. 35 V DC (max. load resistance 500 Ω)			
Life expectancy	> 10 million load cycles (0 .. 100 %)			
Weight	~ 180 g			
Safety-related data				
Performance level				
Based on	DIN EN ISO 13849-1:2008			
PL	d			
Architecture	Category 3			

Note: Reverse polarity protection of the supply voltage, excess voltage, override and short circuit protection are provided
FS (Full Scale) = relative to the complete measuring range

¹⁾ Other seal materials on request

²⁾ Other output signals on request

³⁾ -25 °C with FPM seal, -40 °C on request

Model code:

HDA 4 7 4 X - C C - XXXX - XXXX - Pd- 000

Mechanical connection

4 = G1/4 A DIN 3852 (male)

Electrical connection

6 = Male M12x1, 4 pole
(connector not supplied)

V = Male Deutsch DT04, 4 pole
(connector not supplied)

Signal 1

C = 4 .. 20 mA, 3 conductor

Signal 2

C = 4 .. 20 mA, 3 conductor

Pressure ranges for Signal 1 in bar (max. oper. pressure)

0025; 0040; 0060; 0100; 0160; 0250; 0400; 0600

Pressure ranges for Signal 2 in bar

0025; 0040; 0060; 0100; 0160; 0250; 0400; 0600; 1000

Press. range for signal 2 = Pressure range for signal 1
or max. 1 pressure level higher

Functional safety

Pd = PL d – Cat 3 according to DIN EN 13849-1

Modification number

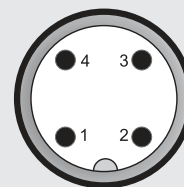
000 = Standard

Accessories:

Appropriate accessories, such as electrical connectors, can be found in the Accessories brochure.

Pin connections:

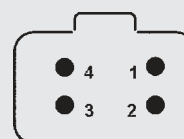
M12x1



Pin HDA 4746-CC

1	+U _B
2	Signal 2
3	0 V
4	Signal 1

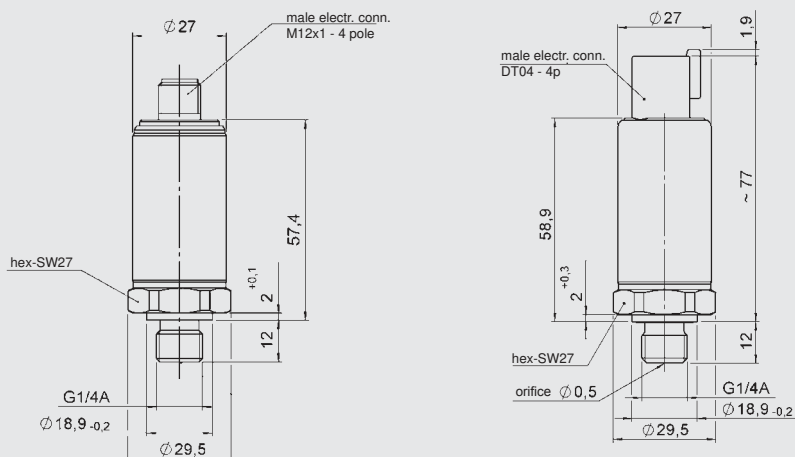
DT04



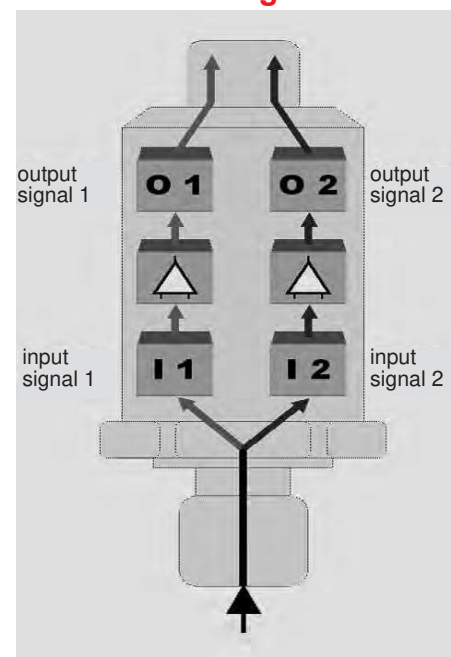
Pin HDA 474V-CC

1	+U _B
2	0 V
3	Signal 2
4	Signal 1

Dimensions:



Block circuit diagram:

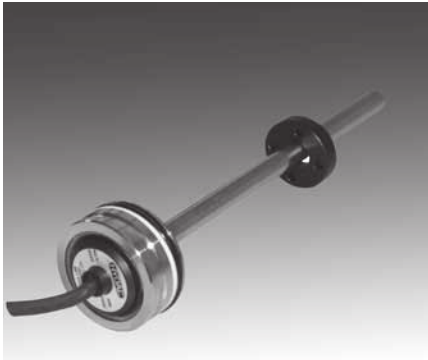


Note:

The information in this brochure relates to the operating conditions and applications described. For applications and operating conditions not described, please contact the relevant technical department. Subject to technical modifications.

HYDAC ELECTRONICS

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Linear Position Transducer HLT 1100-R2 for Applications with Increased Functional Safety

Functional Safety
PL d
SIL 2



Description:

This version of the linear position sensor series HLT 1100 has been specially developed for use in safety circuits / safety functions as part of the functional safety of machinery and equipment up to SIL 2 (IEC 61508) or PL d (ISO 13849).

The sensor works on the principle of magnetostriction.

This measuring principle determines with high-precision the position, the distance and/or the velocity and is based on elapsed time measurement.

Based on this non-contact and wear-free measuring system, HYDAC offers this version in a pressure-resistant stainless steel housing for full integration in hydraulic cylinders.

Special features:

- Very robust housing
- High resistance to shock and vibration
- Excellent EMC characteristics
- Non-contact and wear-free
- SIL 2 / PL d certification

Technical data:

Input data	
Measuring ranges	200 .. 2500 mm
Measured variable	Distance
Pressure resistance	6525 psi
Peak pressure	9135 psi
Parts in contact with medium	Stainless steel (1.4301 / 1.4571)
Output data	
Output signal	4 .. 20 mA, CANopen
Resolution	12 bit
Load resistance to GND	200 .. 500 Ohm
Accuracy to DIN 16086	≤ ± 0.5 % FS
Repeatability	≤ ± 0.1 % FS
Hysteresis	≤ ± 0.1 % FS
Non-linearity	≤ ± 0.1 % FS
Dynamics	≤ 30 ms (10 .. 90 %)
Environmental conditions	
Operating temperature range	-40 .. +185 °F
Storage temperature range	-40 .. +212 °F
Media temperature range	-40 .. +248 °F
Protection class to IEC 60529	IP67
Vibration resistance to DIN EN 60068-2-6	7.5 mm (5 .. 8.2 Hz) 2.0 g (8.2 .. 150 Hz)
Shock resistance to DIN EN 60068-2-27	20 g (11ms)
CE mark	EN 61000-6-1 / 2 / 3 / 4
Other data	
Supply voltage (V _{in}) nominal	9 ... 36 VDC
Residual ripple of supply voltage	≤ 250 mV
Current consumption (without output)	≤ 100 mA
Electrical connection	PUR cable, 3-core; flying leads Separate panel mount connection M12x1
Measurement principle	magnetostrictive
Installation position and travel speed	No restrictions
Weight (dependent on measurement and cable lengths)	~ 1000 g
Safety-related data	
Performance level	
Based on	DIN EN ISO 13849-1:2008
PL	d
Architecture	Category 2
Safety Integrity Level	
Based on	DIN EN 61508:2002
SIL	2

Note: Reverse polarity protection of the supply voltage, excess voltage and short circuit protection are provided.
FS (Full Scale) = relative to the full measuring range

Model code:

Mobile HLT 1 1 0 0 - R2 - XXX - XXX - XXXX - S2PD - 000

**Design/
Geometry type**
1 = Rod

Mechanical connection
R2 = Cylinder-integrated

Electrical connection

Cable output

K01 = Flying lead, length 1 m
K02 = Flying lead, length 2 m
K05 = Flying lead, length 5 m
K10 = Flying lead, length 10 m

Separate panel mount connection

M12x1 (4 pole for signal output analog
5 pole for signal output CANopen)

L06 = 60 mm cable length
L18 = 180 mm cable length
L24 = 240 mm cable length

Signal output

C01 = Analog 4 .. 20 mA, 3 conductor
CAN = CANopen

Measuring range in mm (200 to 2500 mm)

Example
0250 = 250 mm

Functional safety

S2PD = SIL 2 acc. to IEC 61508
and PLd – Cat 2 acc. to DIN EN 13849-1

Modification

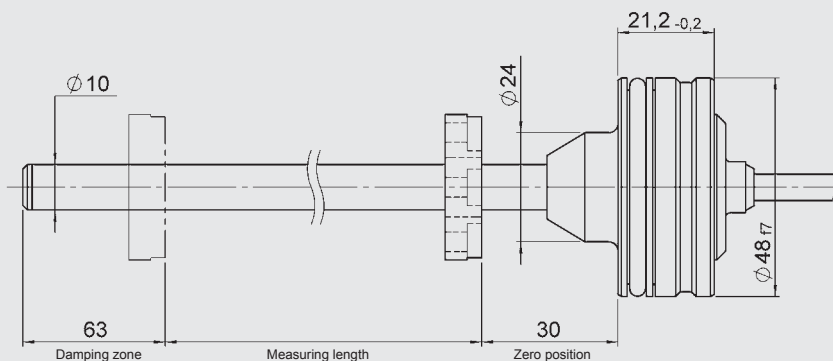
000 = Standard

Accessories:

Appropriate accessories, such as position magnets, etc. can be found in the Accessories section of the Electronics brochure.

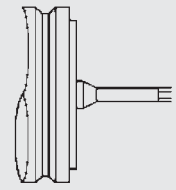
The recommended position magnet ZBL MR33, part no. 6084207, must be ordered separately.

Dimensions:



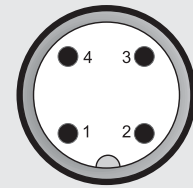
Pin connections:

Cable outlet



Core	Analog	CANopen
brown	+U _B	+U _B
white	0 V	0 V
green	Analog	CAN_L
yellow	n.c.	CAN_H

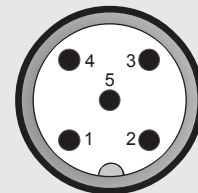
M12x1, 4 pole



Pin

1	+U _B
2	n.c.
3	0 V
4	Signal

M12x1, 5 pole



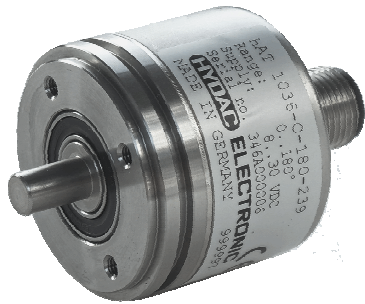
Pin	Signal	Description
1	n.c.	
2	+U _B	supply+
3	0 V	supply-
4	CAN_H	bus line dominant high
5	CAN_L	bus line dominant low

Note:

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Angle Sensor HAT 1000 Singleturn Absolute Value

Functional Safety
PL d
SIL 2

Description:


HAT 1000 is an absolute measuring singleturn angle sensor. Thanks to its contactless magnetic measuring method and its robust design, HAT 1000 is ideally suited for rotational angle measurement in mobile machines.

Due to its two-chamber design, the electronic unit is completely encapsulated which means it meets IP 6K9K if the electrical connection is carried out accordingly.

The sensors meet the safety requirements according to SIL2 (IEC 61508) or PL d (ISO 13849).

The sensor is therefore suitable for a large variety of applications, i.e. in automobile industry and in mobile work machines, especially for applications with increased safety requirements.

Special features:

- Measuring range from 0° to 360°, continuous rotation
- Robust stainless steel housing
- Fully encapsulated electronics unit, IP 6K9K
- Option: External magnetic actuator
- ECE type approval  (approved for road vehicles) ³⁾
- SIL2, PLd, Kat 2 Certification ³⁾

Technical Data:

Input data		
Type ¹⁾	Solid shaft	
Type	Absolute singleturn	
Mechanical adjusting angle	360° continuous rotation	
Measuring range ²⁾	0 .. 360°	
Direction of rotation	No orientation restrictions	
Max. speed	17.000 1/min	
Starting torque	< 1 Ncm	
Max. axial load	60 N	
Max. radial load	100 N	
Shaft material	Stainless steel	
Housing material	Stainless steel	
Output data		
Output signal ¹⁾	Analog: 4 .. 20 mA load ≤ 500 Ω	Digital: CANopen-Safety
Resolution	12 Bit	14 Bit
Accuracy	± 0.5° span over the entire measuring and temperature range	
Repeatability	± 0.2°	
Characteristic curve	linear, direction available factory-set (cw / ccw)	
Ambient conditions		
Operating temperature range	-40 .. +185°F	
Storage temperature range	-40 .. +185°F	
Protection class to IEC 60529	IP 67, IP 6K9K (electronics)	
CE mark	EN 61000-6-1 / 2 / 3 / 4	
Vibration resistance to DIN EN 60068-2-6: 2010	7.5 mm (5 Hz ≤ f < 8.2 Hz) 2 g (8.2 Hz ≤ f < 2000 Hz)	
Shock resistance to DIN EN 60068-2-27: 2011	20 g (11ms in 3 axes)	
Other data		
Supply voltage	9 .. 36 VDC	
Residual ripple of supply voltage	≤ 5%	
Power consumption	< 1.4 W	
Electrical connection ¹⁾	Male M12x1, 5 pole	
Life time	1.5 * 10 ⁹ rotations at 3000 min ⁻¹	
Weight	approx. 120 g	
Safety-related data		
Performance Level ³⁾		
Based on	DIN EN ISO 13849-1:2008	
PL	d	
Architecture	Category 2	
Safety Integrity Level ³⁾		
Based on	DIN EN 61508:2010	
SIL	2	

Note: Reverse polarity protection of the supply voltage, excess voltage and short circuit protection are provided.

¹⁾ Other models on request

²⁾ Further measuring ranges in intervals of 15°C within a range of 0..360° on request

³⁾ The ECE approval as well as the SIL2, PLd approval are pending

Model Code:

HAT 1X 36 - XXX - XXXX - P01 - XXXX - XXX - S2PD- 000

Resolution¹⁾

2 = 12 Bit
4 = 14 Bit

Flange diameter

36 = 36 mm

Signal output

C01 = Analog 4 .. 20 mA, 3 conductor
F13 = CANopen Safety

Measuring range in ° and rotational direction

360R = 360°, clockwise rotation
360L = 360°, anti-clockwise

Electrical connection²⁾

P01 = Installation plug M12x1; 5 pole, axial

Mechanical connection³⁾

V106 = Solid shaft, length 10 mm, diameter 6 mm

Fixing type

M21 = Clamping flange with 4 threaded bores

Functional safety

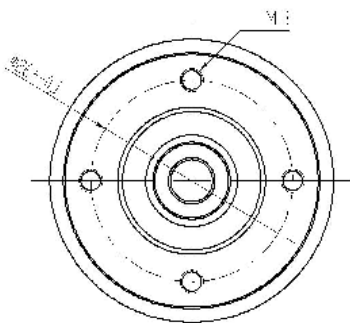
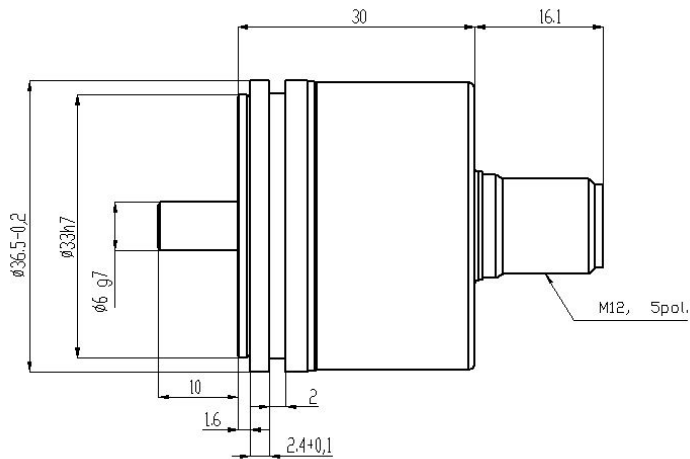
S2PD = SIL 2 acc. to IEC 61508 and PLd – Cat 2 acc. to DIN EN 13849-1

Modification

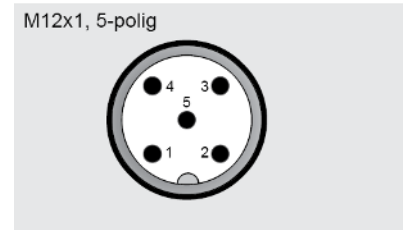
000 = Standard

- Note: ¹⁾ Resolution 2 (12Bit) only in conjunction with signal output C01
Resolution 4 (14Bit) only in conjunction with signal output F13
²⁾ Other models on request
³⁾ Other models, i.e. with external magnet, on request

Dimensions:



Pin Connections:



Analogue

PIN	Assignment
1	+U _b
2	n.c.
3	0 V
4	Signal
5	n.c.

CANopen Safety

PIN	Assignment	Description
1	n.c.	
2	+U _b	Supply+
3	-U _b	Supply-
4	CAN_H	Bus line dominant high
5	CAN_L	Bus line dominant low

Note:

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Angle Sensor HAT 3836

Magnetic	absolute	Singleturn, 18 Bit
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CANopen

Functional Safety
PL d
SIL 2

CANopen
safety easy to use

Description:

HAT 3836 is a high resolution absolute measuring Singleturn angle sensor. Thanks to its contactless magnetic measuring method and its robust design, HAT 3836 is ideally suited for rotational angle measurement in mobile machines as well as in industrial applications.

The sensor version designed for applications with increased functional safety meets the safety requirements according to SIL2 (IEC 61508) bzw. PL d (ISO 13849).

The sensor is therefore ideally suited for mobile machines and industrial applications, especially in applications with increased safety requirements and wherever high-resolution data recording is required.

Technical Data:

Input data	
Type ¹⁾	Solid shaft / D-contour
Type	Absolute Singleturn
Mechanical adjusting angle	360° continuous rotation
Measurement range	0 .. 360°
Direction of rotation	No orientation restrictions
Max. speed	1000 min ⁻¹
Starting torque	< 5 Ncm
Max. axial load	60 N
Max. radial load	100 N
Shaft material	Stainless steel
Housing material	Stainless steel
Output data	
Output signal ¹⁾	CANopen (Safety)
Resolution	18 Bit
Accuracy at RT	±0.1° typ. ±0.2° max.
Accuracy beyond temperature range	0.05° / 10K typ. 0.1° / 10K max.
Repeatability	≤ ± 0.05°
Angle increase	Factory-set (cw / ccw)
Ambient conditions	
Operating temperature range	-40 .. +185°F
Storage temperature range	-40 .. +185 °F
Protection class to DIN 60529	IP 67
CE mark	EN 61000-6-1 / 2 / 3 / 4
Vibration resistance to DIN EN 60068-2-6: 2010	7.5 mm (5 Hz ≤ f < 8.2 Hz) 2 g (8.2 Hz ≤ f < 2000 Hz)
Shock resistance to DIN EN 60068-2-27: 2011	20 g (11 ms in 3 axes)
Safety-related data	
Performance Level ²⁾	
Based on	DIN EN ISO 13849-1:2008
PL	d
Architecture	Category 2
Safety Integrity Level ²⁾	
Based on	DIN EN 61508:2010
SIL	2
Other data	
Supply voltage	9 .. 36 VDC
Residual ripple of supply voltage	≤ 5% U _b
Power consumption	< 1.4 W
Electrical connection ¹⁾	Male M12x1, 5 pole
Life time	1.5 * 10 ⁹ rotations at 1000 min ⁻¹
Weight	approx. 180 g

Note: Reverse polarity protection of the supply voltage, excess voltage and short circuit protection are provided.

¹⁾ Other models on request

²⁾ SIL2, PLd Certificates pending.

