

DRAW WIRE SENSOR



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Series MH60 for mobile hydraulics applications

Key-Features:

- Cost-effective sensor for construction machinery
- Measurement ranges from 1 to 4 m
- extreme robust construction
- Analog outputs: Potentiometer, 0...5 V, 0...10 V, 4...20 mA, optional redundant
- teachable outputs: 0...5 V, 0...10 V, with an additional Open-Collector switching output
- Digital output: CANopen, optional redundant
- Linearity up to ± 0.1 % of full scale
- Protection class up to IP69K (suitable for close-range high pressure, high temperature spray downs)
- Temperature range -20...+85 °C (optional -40 °C)

INTRODUCTION

The draw wire sensors of the mobile hydraulic series MH were specially developed for the demanding area of construction machines and construction equipment. The sensor can be individually configured depending on the application, in which it is used. Small adhesive and abrasive particles with small grain size can easily be removed when using the open MH versions. Seawater resistant protective grating provide a maximum protection against larger foreign objects like tree branches. In case of applications with high safety requirements, thicker stainless-steel wire ropes are available, as well as redundant, analogue outputs. This mobile hydraulics series offers the possibility to perform accurate and cost-effective distance measurement on construction machinery.

HOUSING VARIANTS

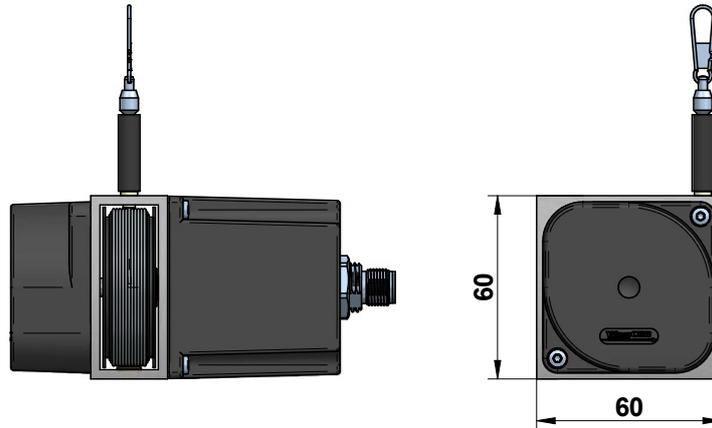
The MH60 series comprises three different types of housings.

Common to all versions:

- Aluminium housing with bore holes for the mounting, optionally with base plate
- easy rope fixation by rope clip, secured against twisting
- stainless steel wire rope with synthetic coating
- Sensor element inside an enclosed housing
- M12 connector system or cable output
- dynamic spring drive with PA6 case

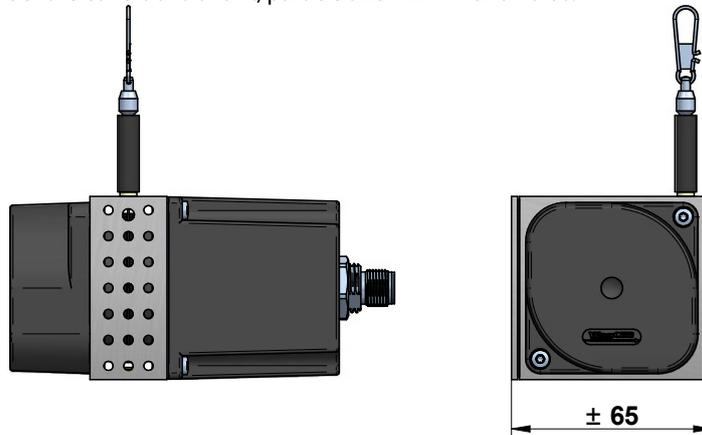
Standard: open housing

Especially suited for applications under the conditions of fine dust and fluids.



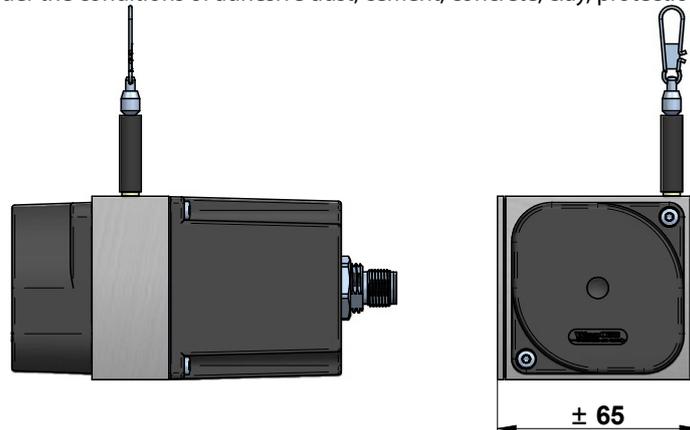
Version C1: housing with perforated plate covering

Especially suited for applications under the conditions of dirt, particle size > 2 mm and fluids.



Version C3: closed housing

Especially suited for applications under the conditions of adhesive dust, cement, concrete, clay, protection against impact and shock.



TECHNICAL DATA

Measurement range	[m]	1			1.5			2			2.5			3			3.5			4		
Draw wire diameter	[mm]	0.5	0.7	1	0.5	0.7	1	0.5	0.7	1	0.5	0.7	1	0.5	0.7	1	0.5	0.7	0.5	0.7	0.5	0.7
Linearity	[±%]	0.5			0.5			0.5			1			0.5			1			0.5		
Improved linearity L25 ¹⁾		√	√	√	√	√	√	√	√	-	√	-	-	√	-	-	-	-	-	-	-	-
Improved linearity L10 ¹⁾		√	√	√	√	√	√	√	√	-	√	-	-	√	-	-	-	-	-	-	-	-
Resolution		see output types																				
Sensor element		potentiometer																				
Output signals ²⁾		potentiometer, 0...5 V, 0...10 V, 0...5 V (teachable), 0...10 V (teachable), 4...20 mA, CANopen																				
Redundant output signals		optional for: potentiometer, 0...5 V, 0...10 V, 4...20 mA, CANopen																				
Connection		connector output M12 radial or cable output radial (TPE cable, standard length 2 m)																				
Protection class		IP67, optional IP69K (only in combination with cable output)																				
Humidity		max. 90 % relative, no condensation																				
Temperature		see output types below																				
Rope extraction speed	[m/s]	max. 3																				
Acceleration	[m/s ²]	max. 50																				
Extraction force	[N]	approx. 4 up to 6																				
Housing		Aluminium, spring case PA6																				
Weight	[g]	up to approx. 500 (depending on the measurement range)																				

¹⁾ Options L25 and L10 only in combination with rope tube (see page 6) and not possible in combination with options S1 and S2.

The row show the possible combinations of improved linearity, measurement range and draw wire diameter.

√ = combination possible

- = combination **not** possible

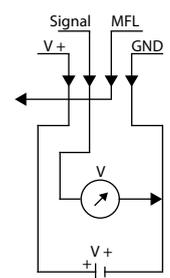
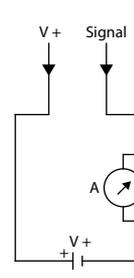
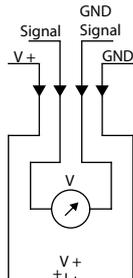
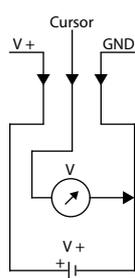
Sensors with improved linearity are delivered with calibration protocol.

²⁾ other output signals on request

ANALOG OUTPUTS

	Potentiometer 1 kΩ	Voltage 0...5 V, 0...10 V	Current 4...20 mA	Voltage 0...5 V, 0...10 V (teachable)
Output	1 kΩ	0...5 V, 0...10 V, galvanically isolated, 4 conductors	4...20 mA, 2 conductors	0...5 V, 0...10 V, 3 conductors
Supply	max. 30 V	12...30 VDC		8...35 VDC
Recommended cursor current	< 1 μA	-		
Current consumption max.	-	22.5 mA (unloaded)	-	
Current consumption max.	-	-	-	150 mW
Output current	-	max. 10 mA, min. load 10 kΩ	max. 50 mA in case of error	max. 10 mA, min. load 1 kΩ
Dynamics	-	< 3 ms from 0...100 % and 100...0 %	< 1 ms from 0...100 % and 100...0 %	1 ms
Resolution	theoretically unlimited, limited by the noise			1 mV
Noise	dependent on the quality of the power supply	0.5 mV _{eff}	1.6 μA _{eff}	2 mV _{eff}
Inverse-polarity protection	-	yes		
Short-circuit proof	-	yes	-	yes
Working temperature	-20...+85 °C / optional: -40...+85 °C			
Temperature coefficient	±0.0025 %/K	0.0037 %/K	0.0079 %/K	0.0016 %/K
Electromagnetic compatibility (EMC)	-	according to EN 61326-1:2013		

Circuit



MFL = multi-functional line

DIGITAL OUTPUT CAN_{OPEN}

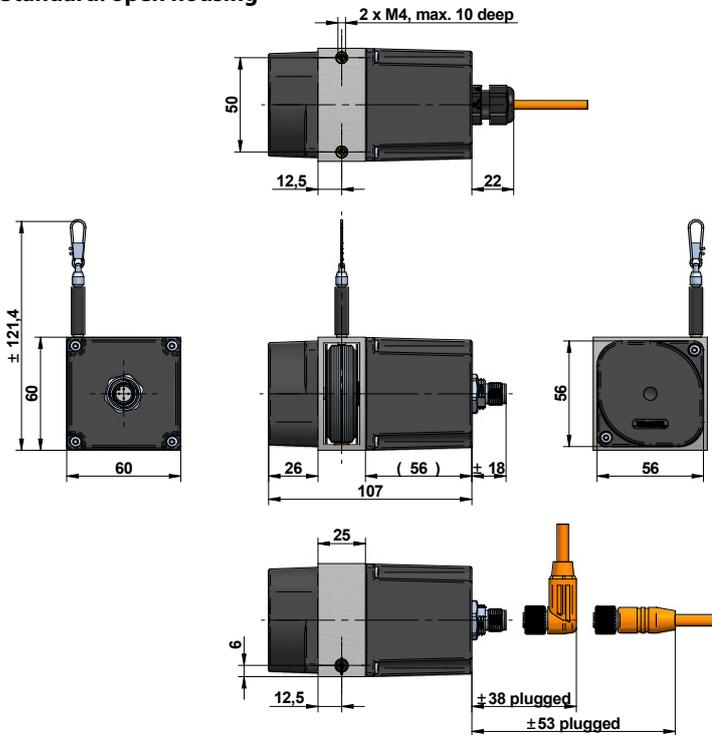
Link to the manual		CANopen (WCAN)
CAN specification		Full CAN 2.0B (ISO11898)
Communication profile		CANopen CiA 301 V 4.2.0
Device profile		Encoder, absolute linear; CiA 406 V 3.2.0
Error control		Producer Heartbeat, Emergency Message, Node Guarding
Node ID		Default: 7, configurable via SDO and Squeezer (offline configuration) ¹⁾
PDO		1 x TPDO, static mapping
PDO Modes		Event-triggered, Time-triggered, Sync-cyclic, Sync-acyclic
Transmission rate		1 Mbps, 800, 500, 250, 125, 50, 20 kbps configurable via SDO and Squeezer (offline configuration) ¹⁾
Bus connection		M12 connector, 5 pins
Integrated Bus termination resistor		120 Ω, connectible via SDO and Squeezer (offline configuration) ¹⁾
Bus, galvanic separation		No
Supply	[VDC]	8...30
Current consumption		10 mA typical at 24 V, 20 mA typical at 12 V
Measurement rate		1 kHz with 16-bit resolution
Repeatability	[%]	±0.5, ±0.25 or ±0.1 (according to the selected linearity)
Resolution		0.002 % of measurement range
Electrical protection		inverse polarity protection
Working temperature	[°C]	Standard: -20...+85 / optional: -40...+85
Temperature coefficient	[%/K]	0.0014
EMV		DIN EN61326-1:2013, conformity with directive 2014/30/EU

¹⁾ Offline configuration via Squeezer only in combination with M12 connector 8 pins.

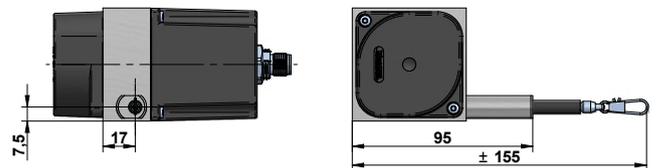
For more information on the offline configuration please refer to the CANopen [manual](#).

TECHNICAL DRAWING

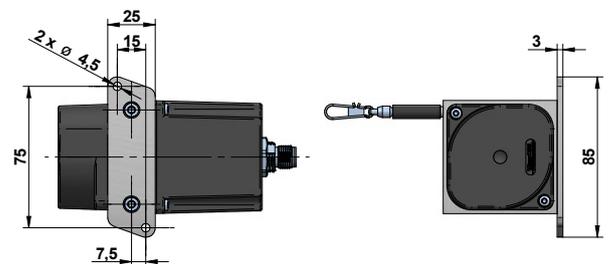
Standard: open housing



Version with rope tube (options L10 and L25)



Version with base plate (option BP)



OPTIONS

The following table gives an overview of frequently used options, with which the standard sensors can be equipped.

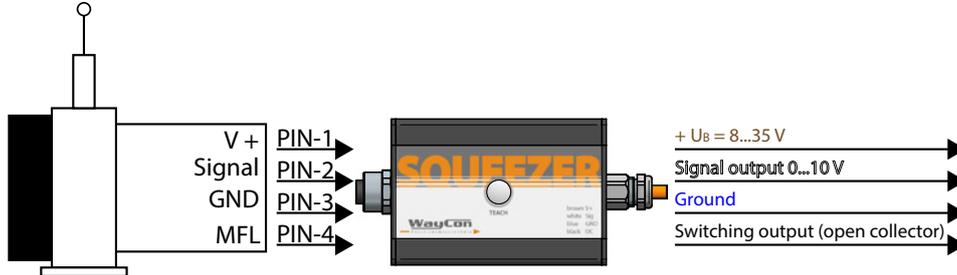
Option	Order code	Description
Improved linearity (not in combination with S1 or S2; further restriction see page 3)	L10, L25	Improved linearity 0.1 % (L10) or 0.25 % (L25)
Inverted output signal (only analog output)	IN	The analog signal of the sensor is increasing by extracting the rope (standard). Option IN inverts the signal, i.e. the signal of the sensor declines by extracting the rope. <div style="text-align: right;"> </div>
Redundant output signal	R1, R2, R3, R4	By using a double potentiometer the sensor delivers two independent output signals. R1: 2 x 1 kΩ R2: 2 x 0...5 V or 2 x 0...10 V R3: 2 x 4...20 mA R4: 2 x CANopen
Changed rope outlet (only in combination with C1 or C3)	S1, S2	Standard: rope outlet at the top S1: rope outlet on the right side S2: rope outlet on the left side <div style="text-align: right;"> </div>
Sensor housing	C1, C3	Standard: open housing C1: housing with perforated plate covering C3: closed housing
Wire rope diameter	D05K, D07K, D10K	The wire rope is made of V4A stainless steel, 1.4401 with a synthetic coating. Please choose the wire rope diameter in part two of the order code. D05K: Ø 0.5 mm (Standard) D07K: Ø 0.7 mm D10K: Ø 1 mm (not with measurement ranges 3.5 m and 4 m)
Rope fixation by M4 thread	M4	Optional, pivoted rope fixation with screw thread M4, length 22 mm. Ideal for attachment to through holes or thread holes M4. <div style="text-align: right;"> </div>
Rope fixation with cylindrical pin and M6 through bore	ZH, ZR	ZH: cylindrical pin with M6 through bore ZR: cylindrical pin with M6 through bore and carbine ring <div style="text-align: right;"> </div>
Protection class IP69K (only in combination with cable output)	IP69	All relevant components are completely encapsulated. Suitable for close-range high pressure or high temperature spray downs.
Increased temperature range Low	T40	The use of special components allow a working temperature down to -40 °C (up to +85 °C).
Base plate	BP	The MH60 is equipped with a base plate.

ACCESSORY SQUEEZER FOR TEACHABLE OUTPUTS

Draw wire sensors with the analogue output versions 5VT and 10VT are equipped with teachable, internal electronics, called VT-Electronics. The signals provided by the sensor's potentiometer are digitized by the VT-Electronics. This digital information is first processed by the electronics, then transformed back and given out as an analogue output signal 0 to 5 V or 0 to 10 V.

The digitization offers two possibilities of adjustment, by which the sensor can be configured individually using the Squeezer:

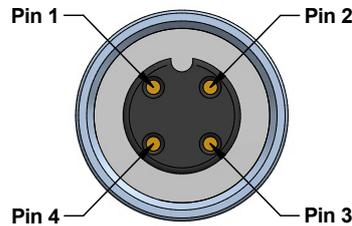
1. Teaching of the measurement range. After a successful teaching process, the squeezer can be pulled off the sensor and be replaced by a standard cable or connector.
2. Setting an individual switching point. The squeezer allows the setting of an individual switching point open collector. The switching signal is emitted through the multi-functional line MFL.



A detailed description of the functions can be found in a separate [manual](#).

Electrical connection Squeezer

Accessory:
Connection cable sensor to
Squeezer:
K4P1,5M-SB-M12



Connector (to sensor)

PIN 1	+V
PIN 2	Signal
PIN 3	GND
PIN 4	MFL*

MFL = multi-functional line

Cable ends (to PLC)

BN	+V
WH	Signal
BU	GND
BK	NPN*

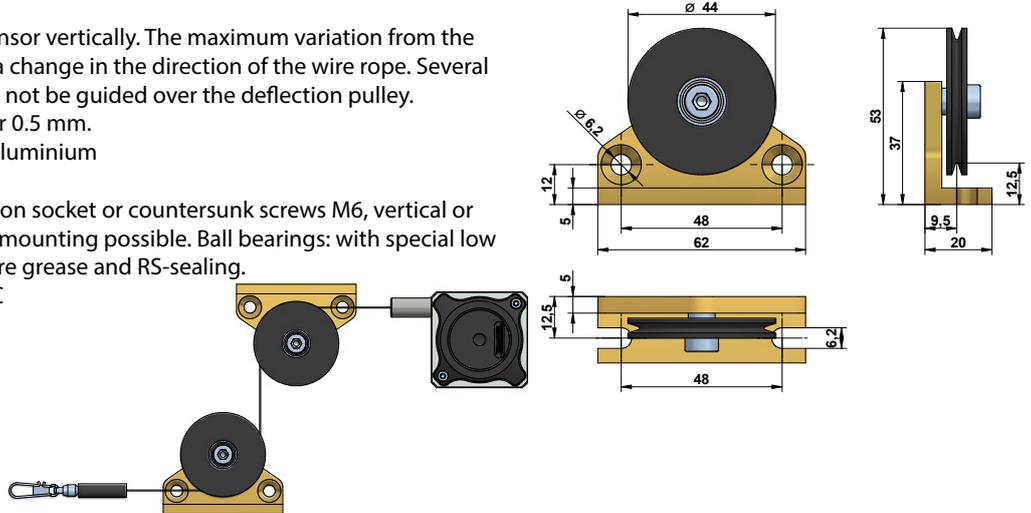
* The open collector is a NPN switching output

GENERAL ACCESSORIES

Deflection pulley - UR2

The rope must be extracted from the sensor vertically. The maximum variation from the vertical is 3°. A deflection pulley allows a change in the direction of the wire rope. Several pulleys may be used. The rope clip must not be guided over the deflection pulley. Suitable for standard wire rope diameter 0.5 mm.

Material foot: anodised aluminium
Material rope wheel: POM-C
Mounting: by 2 hexagon socket or countersunk screws M6, vertical or horizontal mounting possible. Ball bearings: with special low temperature grease and RS-sealing.
Temperature: -40...+80 °C



Rope extension - SV

For bridging a greater distance between the measuring target and the sensor a rope extension can be applied. The rope clip must not be guided over the deflection pulley.

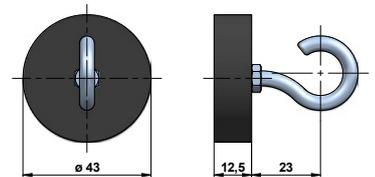
Please specify the length needed in your order (XXXX). The minimum length is 150 mm:

- SV1-XXXX: rope extension (150...4995 mm)
- SV2-XXXX: rope extension (5000...19995 mm)
- SV3-XXXX: rope extension (20000...40000 mm)



Magnetic clamp - MGG1

Use the magnetic clamp to quickly attach the rope to metallic objects without any assembly time. A rubber coating provides gentle contact (e. g. on varnished surfaces) and prevents from slipping due to vibration. The magnet consists of a neodym core for an increased adhesive force of 260 N. The hook makes it easy to attach the rope clip.

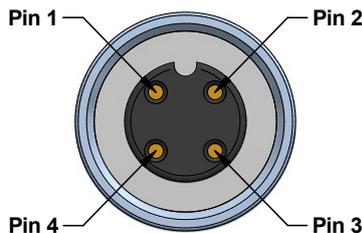


ACCESSORIES CABLES AND CONNECTORS

Single analog signal

Cable with connector M12, 4 poles, shielded

K4P2M-S-M12	2 m, connector straight
K4P5M-S-M12	5 m, connector straight
K4P10M-S-M12	10 m, connector straight
K4P2M-SW-M12	2 m, connector angular
K4P5M-SW-M12	5 m, connector angular
K4P10M-SW-M12	10 m, connector angular



Mating connector M12, 4 poles, shielded, IP67

D4-G-M12-S	straight, M12 for self assembly
D4-W-M12-S	angular, M12 for self assembly
	cable passage: \varnothing 4...8 mm
	wire cross-section: 0.14...0.75 mm ²

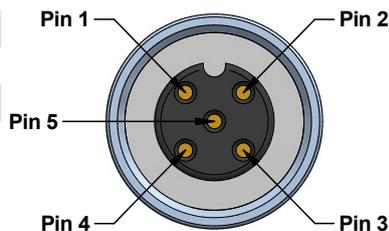


PIN	1	2	3	4
Cable colour	BN	WH	BU	BK

Digital signal CANopen

Cable with connector M12, 5 poles, shielded

K5P2M-S-M12	2 m, connector straight IP67
K5P2M-SW-M12	2 m, connector angular, IP67

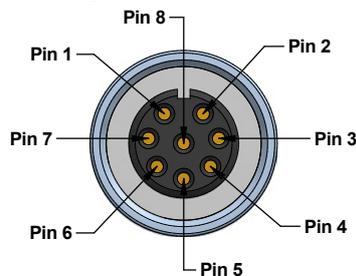


PIN	1	2	3	4	5
Cable colour	BN	WH	BU	BK	GY

Redundant analog signal and CANopen with offline configuration via Squeezer

Cable with connector M12, 8 poles, shielded

K8P2M-S-M12	2 m, connector straight
K8P5M-S-M12	5 m, connector straight
K8P10M-S-M12	10 m, connector straight
K8P2M-SW-M12	2 m, connector angular
K8P5M-SW-M12	5 m, connector angular
K8P10M-SW-M12	10 m, connector angular



Mating connector M12, 8 poles, shielded, IP67

D8-G-M12-S	straight, M12 for self assembly
D8-W-M12-S	angular, M12 for self assembly
	cable passage: \varnothing 4...8 mm
	wire cross-section: 0.14...0.34 mm ²



PIN	1	2	3	4	5	6	7	8
Cable colour	WH	BN	GN	YE	GY	PK	BU	RD

WARNING NOTICES

- Do not let the rope snap back. If the rope is retracted freely, this may lead to injuries (whiplash effect) and the device may be damaged.
- Caution when unhooking and retracting the rope into the sensor.
- Never exceed the specified measurement range when extracting the rope!
- Do not try to open the device. The stored energy of the spring drive may lead to injuries when being mishandled.
- Do not touch the rope when operating the sensor.
- Avoid guiding the rope over edges or corners. Use a deflection pulley instead.
- Do not operate the sensor if the rope is buckled or damaged. A ripping of the rope may lead to injuries or a damaging of the sensor.
- Only for standard version with open housing: the free turning of the rope drum **must** be ensured. In case the rope drum gets blocked there is a serious danger of injury and the sensor may get destroyed.

ORDER CODE

MH60 - - - - -

Measurement range MR [m] 1 / 1.5 / 2 / 2.5 / 3 / 3.5 / 4	
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Wire rope Diameter 0.5 mm (Standard) Diameter 0.7 mm Diameter 1 mm (not MR 3.5...4)	D05K D07K D10K
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Output signal		
Potentiometer	1 kΩ	1R
Voltage	0...5 V	5V
Voltage	0...10 V	10V
Voltage	0...5 V (teachable)	5VT
Voltage	0...10 V (teachable)	10VT
Current	4...20 mA	420A
Digital	CANopen	WCAN
Digital	CANopen ¹⁾	WCANP

Connection		
Connector output M12 axial, 4 pole ²⁾	SA12	
Cable output, axial, 2 m	KA02	
Cable output, axial, 5 m	KA05	
Cable output, axial, 10 m ³⁾	KA10	

Version		
Standard	-	
Sensor with options	O	

¹⁾ offline configurable via Squeezer
²⁾ 5 pole in combination with WCAN or option R4
 8 pole in combination with WCANP or options R1, R2, R3
³⁾ larger length on request

Option	Description (see page 6)
L10	improved linearity ±0.1 %
L25	improved linearity ±0.25 %
	(possible combination for improved linearity see page 3)
IN	inverted output signal
R1	redundant output signal 1R
R2	redundant output signal 5V, 10V
R3	redundant output signal 420A
R4	redundant output signal WCAN
S1	rope outlet on the right side (only in combination with C1 or C3)
S2	rope outlet on the left side (only in combination with C1 or C3)
C1	perforated plate covering
C3	closed housing
M4	rope fixation M4
ZH	cylindrical pin
ZR	cylindrical pin with carbine ring
IP69	protection IP69K, only cable output
T40	temperature range -40...+85 °C
BP	version with base plate

Option	not combinable with
L10	see page 3, S1, S2, T40
L25	see page 3, S1, S2, T40
IN	WCAN, WCANP
S1	S2, L10, L25
S2	S1, L10, L25
C1	C3
C3	C1
M4	ZH, ZR
ZH	M4, ZR
ZR	M4, ZH
IP69	SA12
T40	L10, L25

GENERAL ACCESSORIES

SQUEEZER2M	accessory for VT or WCANP output, 2 m cable
SQUEEZER5M	accessory for VT or WCANP output, 5 m cable
SQUEEZER10M	accessory for VT or WCANP output, 10 m cable
UR2	deflection pulley (for rope diameter 0.5 mm)

MGG1	magnetic clamp
SV1-XXXX	rope extension (150 mm up to 4995 mm)
SV2-XXXX	rope extension (5000 mm up to 19995 mm)
SV3-XXXX	rope extension (20000 mm up to 40000 mm)

ACCESSORIES CABLES AND CONNECTORS

Cable with mating connector M12, 4 poles, shielded

K4P2M-S-M12	2 m, straight connector
K4P5M-S-M12	5 m, straight connector
K4P10M-S-M12	10 m, straight connector
K4P2M-SW-M12	2 m, angular connector
K4P5M-SW-M12	5 m, angular connector
K4P10M-SW-M12	10 m, angular connector

Mating connector M12, 4 poles, shielded

D4-G-M12-S	straight, M12 for self assembly
D4-W-M12-S	angular, M12 for self assembly

Cable with mating connector M12, 5 poles, shielded

K5P2M-S-M12	2 m, straight connector
K5P2M-SW-M12	2 m, angular connector

Cable with mating connector M12, 8 poles, shielded

K8P2M-S-M12	2 m, straight connector
K8P5M-S-M12	5 m, straight connector
K8P10M-S-M12	10 m, straight connector
K8P2M-SW-M12	2 m, angular connector
K8P5M-SW-M12	5 m, angular connector
K8P10M-SW-M12	10 m, angular connector

Mating connector M12, 8 poles, shielded

D8-G-M12-S	straight, M12 for self assembly
D8-W-M12-S	angular, M12 for self assembly

Connection cable sensor to Squeezer

K4P1,5M-SB-M12	1.5 m, 4-pole, shielded
K48P03M-SB-M12	0.3 m, shielded, 8 poles to 4 poles ¹⁾

Adapter cable WCANP to CAN-Bus

K58P03M-SB-M12	0.3 m, shielded, 8 poles to 5 poles
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¹⁾ for redundant analog signal and CANopen with offline configuration via Squeezer (WCANP)

ACCESSORIES DISPLAYS

Digital displays for sensors with analog output, 2 channel

WAY-AX-S	touch screen, supply: 18...30 VDC
WAY-AX-S-AC	touch screen, supply: 115...230 VAC

For more information and options please refer to the [WAY-AX data sheet](#).

Subject to change without prior notice.