



Precise, robust, non-contact: the innovative way to measure length and angles

Worldwide, Hengstler is one of the leading encoder manufacturers

■ The systems described here combine the high precision of optical encoders with the ruggedness of magnetic systems. Truly an innovative and unique concept – worldwide.

Speed and precision

With the high speed and maximum resolution offered by the inductive linear and angle measurement systems from Hengstler, you have the optimum solution for all industrial applications which call for precise linear or axial positioning.

Wide variety of applications

Due to its extreme ruggedness and low susceptibility to contamination, these systems are extremely well suited for the monitoring of machines and equipment under many different operating conditions.

- Electronics manufacturing
- Printed circuit board assembly
- Metalworking
- Woodworking
- Packaging
- Materials handling
- Punches, presses

High resolution values

High precision sine and cosine signals, offset by 90°, allow up to 1024-fold interpolation delivering resolutions right down to 0.25 µm. Optionally, integrated interpolation electronics create RS422 signals with a resolution of 5 µm. In this way, the systems are compatible with all servo drivers with sine 1 V_{pp} or RS422 encoder inputs.





Real-time output signals

Because there is no time delay with the output signals, you can utilise the complete bandwidth of servo controls, particularly in conjunction with linear motors. The application advantages are:

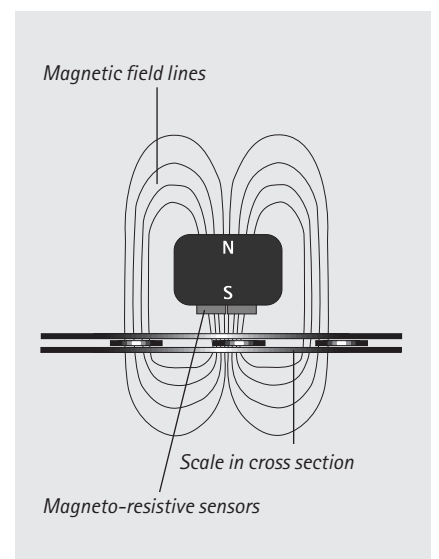
- Unlimited dynamics up to linear travel speeds of 1,200 m/min or rotational speeds of 20,000 1/min
- High processing quality
- Precise contours and short idle times

Extremely robust construction

Because of the inductive function principles employed, Hengstler's linear and angle measurement systems feature contact-free and friction-free operation. They meet IP66 protection requirements and are completely impervious to extreme environmental conditions such as dust, dirt, grease, oil or water as well as mechanical stresses.

High resolution sensor technology

The measuring systems apply the principle of variable reluctance which means that the encoder uses the reluctance of the etched metal base to distort the magnetic field produced by the read head. Two sensors detect these changes which are converted to high quality sinus signals by the electronic circuitry. The sensors are offset and produce phased sine and cosine signals. A separate sensor detects variations in the gap between the read had and the scale and adjusts the circuit's gain to stabilise signal amplitude. Optional interpolation electronics convert the analogue signals to high resolution phased rectangular signals.





The LI inductive linear measurement system

High precision metal scale

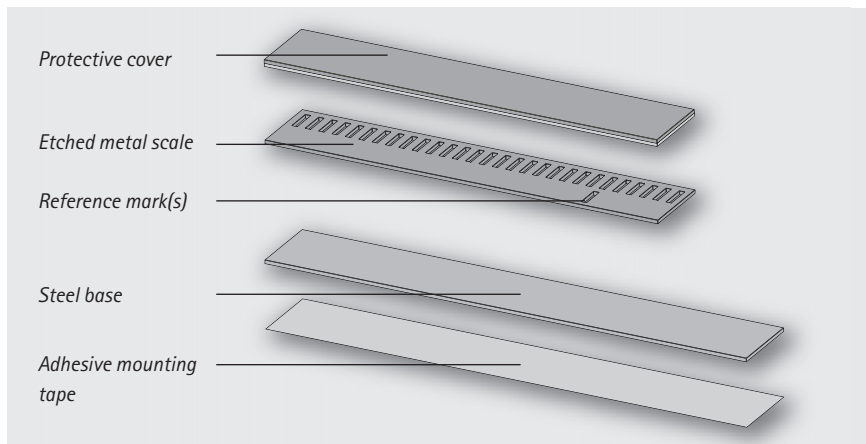
The 4-layer, flexible, non-magnetic and completely indestructible measurement scale is a significant component of this system. At its heart is a metal tape, etched with a grating pitch of 1mm as well as freely definable reference marks. It is welded to a metal base in order to provide the necessary rigidity and predictable thermal characteristics.

Measuring length "made to measure"

The measuring tape can be delivered in lengths from 40 to 30000 mm, exact right down to the millimetre and with no pitch limitations. It has integrated reference marks with freely definable gaps or as an alternative, distance coding is also possible.

Three versions to cover most applications

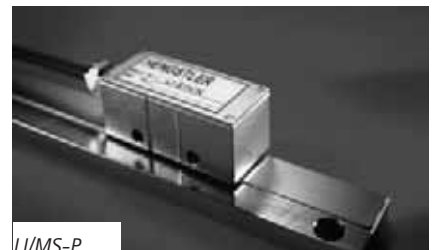
The measuring tape is available in three different designs, suitable for many different applications and installation requirements.



LI/MS-N

LI/MS-N Self-adhesive measurement tape

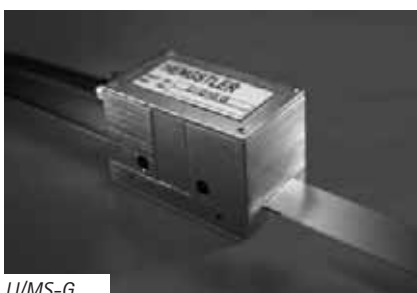
- Suitable for smooth and flat surfaces
- Minimal mounting height
- Template for easy adjustment of the read head gap
- Identical thermal characteristics as the mounting surface and the work-piece



LI/MS-P

LI/MS-P Measurement tape pre-mounted on aluminium profile

- Installation on flat surfaces which are not necessarily completely smooth
- Forms a bridge over any gaps in the carrier surface
- Template for easy adjustment of the read head gap
- Pre-drilled boreholes every 100 mm



LI/MS-G

LI/MS-G Guided system

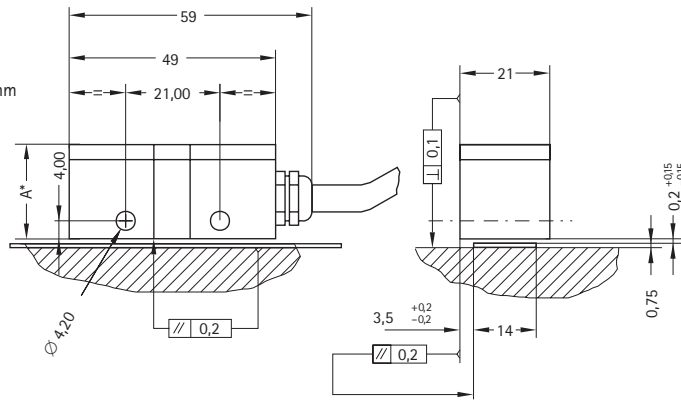
- Suited for applications with high mechanical tolerances, e.g. presses
- Roller bearing guided at the read head
- Optional dirt wiper

LI Dimensioned drawings

DIMENSIONED DRAWINGS

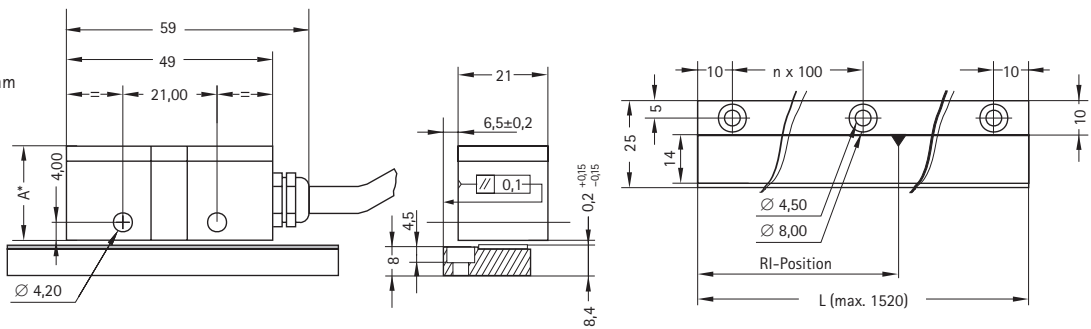
LIS/LIQ, Self-adhesive measuring scale (MS-N)

A* LI-S1V:21mm
 LI-Qxx:24mm
 L = Measuring
 length + 20mm



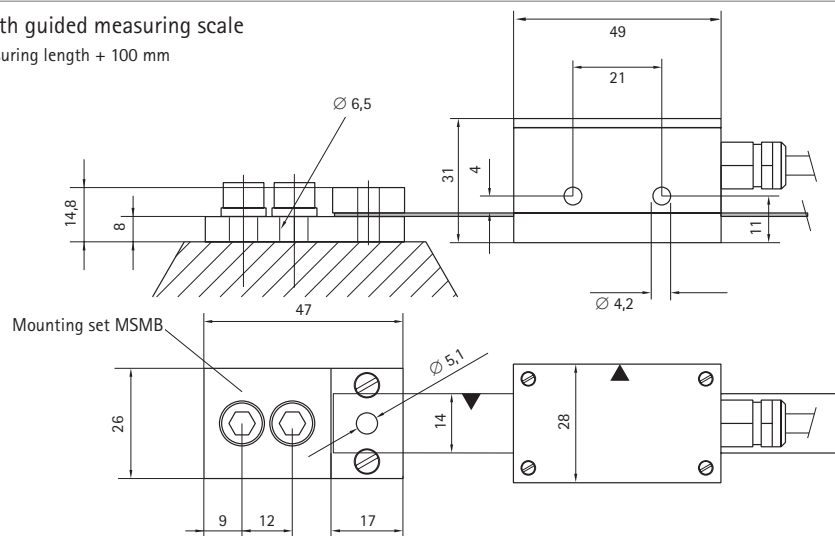
LIS/LIQ, Profile-mounted measuring scale (MS-P)

A* LI-S1V:21mm
 LI-Qxx:24mm
 L = Measuring
 length + 20mm



LI-G as LIS/LIQ, but with guided measuring scale

L = Measuring length + 100 mm



TECHNICAL DATA electrical

LI -S1V SINE/COSINE VERSION

Output signals	1 V _{pp} (at 120 Ω); sine/cosine, reference signal 0.4 V
Resolution	up to 0.25 μm, dependant on customer-supplied interpolation
Output frequency	Max. 20 kHz
Supply voltage	5 V ± 5% / max. 80 mA
Read head gap	0.15 ± 0.1 mm

LI-QXX RECTANGULAR VERSION

Output signals	RS422 (Channel A and B, reference pulse)
Resolution	5 μm ... 50 μm, dependant on version
Output frequency	Max. 500 kHz
Supply voltage	5 V ± 5% / max. 100 mA
Read head gap	0.2 ± 0.15 mm

TECHNICAL DATA mechanical

Grating pitch	1 mm
Measuring length	Max. 30 m; max 3 m with MS-G guided system
Travel speed	Max. 20 m/s
Accuracy	± (10 μm +20 μm/m)
Repeatability	± 1 increment of the resolution
Operating temperature	0°C ... 50°C
Coefficient of thermal expansion	~ 11 μm / °C m
Shock resistance	< 2000 m/s ² (11 ms)
Vibration resistance	< 200 m/s ² (55 ... 2000 Hz)
Protection class	IP 66 (Housing and cable outlet)
Cable	PUR, high flexibility (28 AWG); 10 million cycles

LI CONNECTOR ASSIGNMENT

RS422 signals or 1 V _{pp}			
Signal	12 pin Conin	SUB-D 9 pin	PUR cable
+5 V	12	7	red
0 V	10	2	blue
A +	5	6	green
A -	6	1	yellow
B +	8	8	brown
B -	1	3	white
RI +	3	9	pink
RI -	4	5	grey
N.C.	2	4	
N.C.	7		
N.C.	9		
N.C.	11		
Housing	Shield	Shield	Shield

LI ORDERING KEY

Read head	Output and resolution	Guidance and wiper	Cable length	Connector
LI	- <input type="text"/> <input type="text"/> <input type="text"/>	- <input type="text"/> <input type="text"/>	- <input type="text"/>	<input type="text"/>
	S1V Sine 1 mm 1Vss Q50 RS422 50 µm Q25 RS422 25 µm Q10 RS422 10 µm Q05 RS422 5 µm	NO not guided/without NW Not guided/with GO Guided/without GW Guided/with	1 1 m 3 3 m	N Without connector C Sub-D 9 pin (male) A Conin 12 pin coupling (ext. thread, male, CCW) B Conin 12 pin connector (coupling nut, male, CW)
Scale tape	Guidance	Length in mm	Reference marks	Distance of reference mark * from l. or r. in mm
MS	- <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	- <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
	N Not guided G Guided P Profile mounted	Please enter mm as 4 digits	L Left R Right B Both left and right C Centred (default) Z Cyclic D Distance coded N No reference X Special reference	0040 40 mm Distance coding 0080 80 mm Distance coding 0120 120 mm Distance coding nnnn Left/right/cyclical distance
Mounting set for guided system: MSMB (for one tape end)				
* Distance coding:				
$\text{Number of reference marks} = \frac{2 \times (\text{Length} - 40)}{\text{Distance coding}} - 1$			Example:	1000 mm length, 80 mm distance coding
There must be a minimum of 20 mm distance from the tape end			Order code:	MS-N1000-D0080
			Number of reference marks:	23 (always round result down)



Modular and very resistant – The AI inductive angle measurement system

Flexible by design

The AI inductive angle measurement system from Hengstler has the same hallmark characteristics as the linear system. It is resistant to contamination and mechanical influences and returns extremely accurate measurements. Applications, which at best were only possible with a large mechanical effort or at worst were not achievable at all, have now all been made possible through the AI's flexible and modular design.

Two components working together

The construction of the system is simplicity itself. There is a measuring flange and a read head. The outer ring of the measuring flange consists of a non-magnetic measuring tape. It has a constant, uniform structure and is equipped with one reference and one incremental track.

Wide application range

The AI system can handle a multitude of different mechanical dimensions and can be used in many different applications, e.g.:

- Rotary table drives
- C-axes
- Direct drive (torque motors)
- Roller positioning
- Speed control with large shaft diameters

Different reference marks

As well as the incremental track, you can also determine the absolute angle position using the reference marks on the measuring tape ring. Depending on the application, there are two versions to choose from:

Single reference marks

- As default, one reference pulse per rotation
- Can be positioned anywhere on the circumference

Distance coded reference marks

- Coded default spacing on the measuring tape ring
- Fixed angular degree to the rotation axis

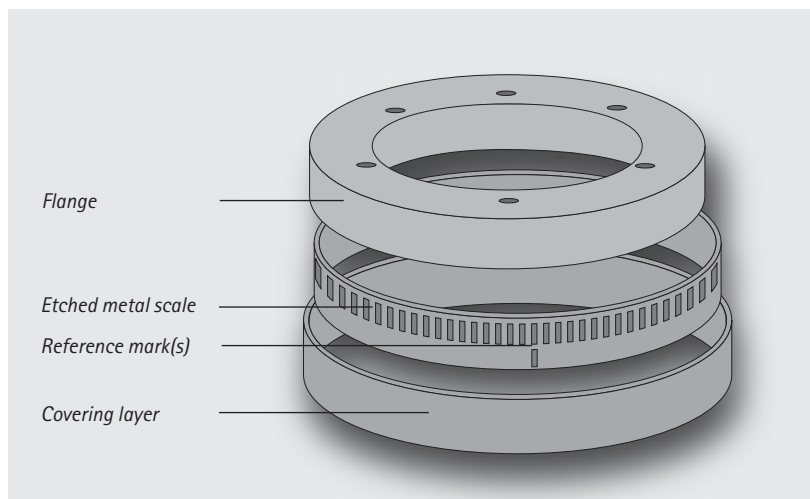
AI-S1V readhead

The scanner delivers a sinewave signal with 1 V_{pp}. It is suited for direct connection to a controller which is laid out for a specific input signal or to an external interpolation unit from Hengstler.

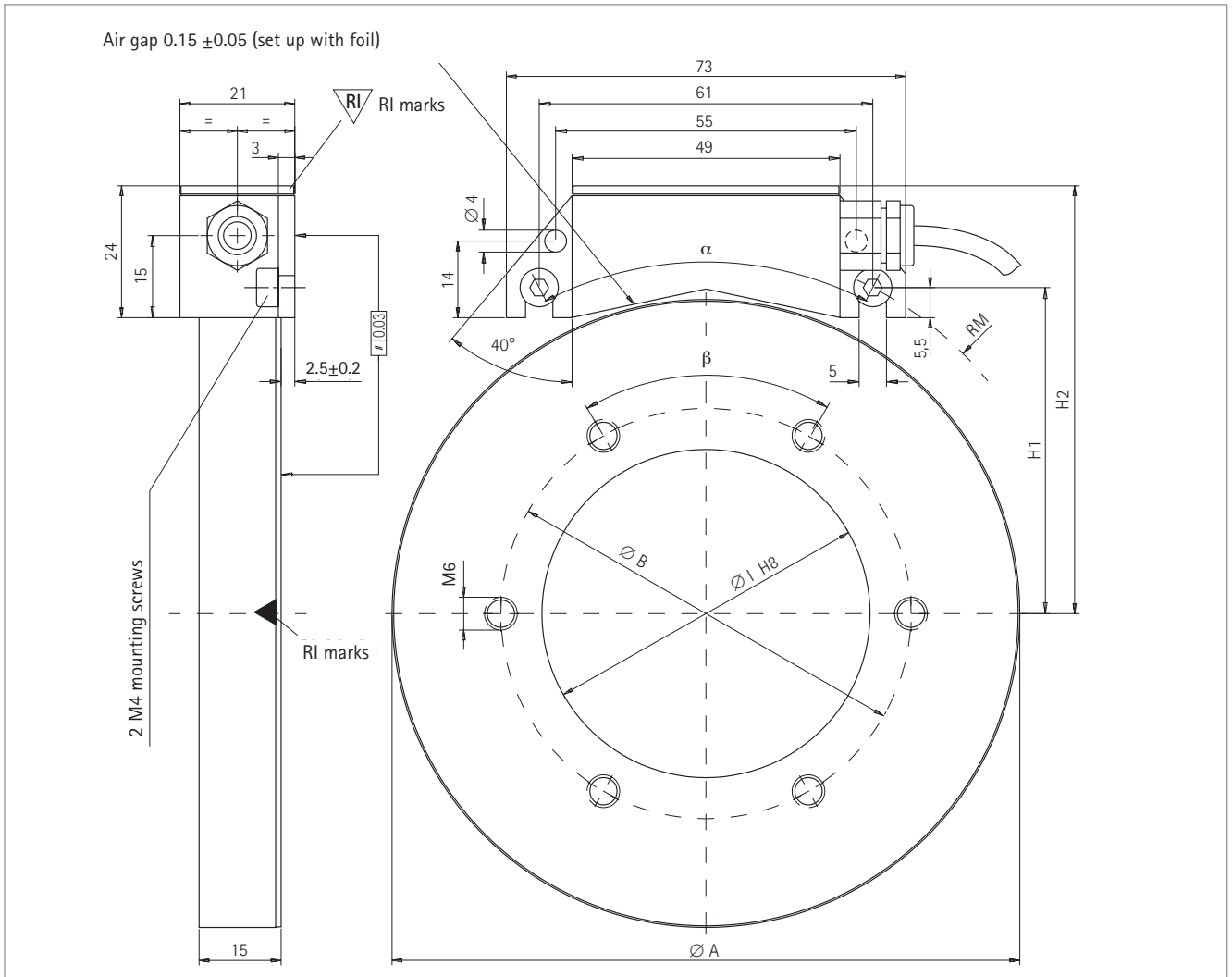
AI-Q read head

This scanner has an integrated interpolation. The interpolation factors can be 5, 10, 25 or 50.

Installation is carried out by lightly pressing the measuring flange direct onto the shaft of the machine or motor. In this way, possible measuring errors caused by couplings, cog wheels, gear boxes etc. are eliminated. The read head's self-centring shape results in an optimum tangential positioning.



AI DIMENSIONED DRAWING



AI-XXX	$\varnothing A$ (mm)	$\varnothing I$ (mm)	$\varnothing B$ (mm)	RM (mm)	α	H1 (mm)	H2 (mm)	β
0360-S	114.9	60	75	66.5	54.6°	59.1	77.7	6x60°
0360-L	114.9	95	105	66.5	54.6°	59.1	77.7	6x60°
0512-S	163.3	105	120	89.8	39.7°	84.4	103.0	6x60°
0512-L	163.3	143	153	89.8	39.7°	84.4	103.0	6x60°
0720-S	229.5	180	195	122.2	28.9°	118.3	136.9	6x60°
0720-L	229.5	209	219	122.2	28.9°	118.3	136.9	6x60°
0900-S	286.8	180	195	150.5	23.4°	147.4	166.0	12x30°
0900-L	286.8	266	276	150.5	23.4°	147.4	166.0	12x30°
1024-S	326.3	220	235	170.0	20.7°	167.2	185.8	12x30°
1024-L	326.3	296	311	170.0	20.7°	167.2	185.8	12x30°

Special applications are available on request

TECHNICAL DATA

AI-S1V

Supply voltage	5V ± 5% / max. 150 mA				
Output signals	1 V _{PP} (at 120 Ω), sine/cosine reference signal 0.4 V				
Signal periods per revolution	360	512	720	900	1.024
Angular accuracy (degrees)	0.015	0.01	0.005	0.004	0.0035
Max speed in min ⁻¹	20.000				
Operating temperature	0 °C ... +50 °C				
Protection class	IP 66				

AI-QXX

Supply voltage	5V ± 5% / max. 150 mA				
Output signals	TTL acc. RS 422 line driver				
Period / rotation count	360	512	720	900	1.024
Angular accuracy (degrees)	0.015	0.01	0.005	0.004	0.0035
Max rotations in min ⁻¹	6.600	4.600	3.300	2.600	2.300
Steps / rotation at	Q50	7.200	10.240	14.400	18.000
selected resolutions	Q25	14.400	20.480	28.800	36.000
(following 4-fold pulse-edge evaluations)	Q10	36.000	51.200	72.000	90.000
	Q05	72.000	102.400	144.000	180.000
Operating temperature	0 °C ... +50 °C				
Protection class	IP 66 (Housing and cable outlet)				

AI CONNECTOR ASSIGNMENT

RS422 signals or 1 V _{pp}			
Signal	12 pin Conin	SUB-D 9 pin	PUR cable
+5 V	12	7	red
0 V	10	2	blue
A +	5	6	green
A -	6	1	yellow
B +	8	8	brown
B -	1	3	white
RI +	3	9	pink
RI -	4	5	grey
N.C.	2	4	
N.C.	7		
N.C.	9		
N.C.	11		
Housing	Shield	Shield	Shield

ORDERING CODE

Reference marks / Distance ¹⁾
Code
0040 40 mm Distance coding
0060 60 mm Distance coding
0064 64 mm Distance coding
nnnn Cyclical distance

Output signal and resolution at the circumference

Slot count / circumference (Diameter)

Inside Ø
S Small
L Large

Cable length
1 1 m
3 3 m

AI - [] [] [] - [] [] [] [] - [] [] [] - [] [] [] - [] [] [] [] []

S1V Sine 1Vss 1 mm
Q50 RS422 50 µm
Q25 RS422 25 µm
Q10 RS422 10 µm
Q05 RS422 5 µm

0360 (Ø 114,7 mm)
0512 (Ø 163 mm)
0720 (Ø 229,2 mm)
0900 (Ø 286,5 mm)
1024 (Ø 326 mm)

Connector
N Without connector
C Sub-D 9 pin
A Conin 12 pin, coupling, male, CCW
B Conin, 12 pin, connector, male, CW

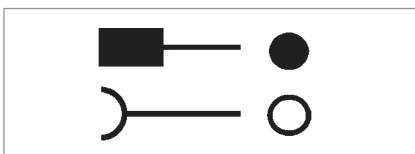
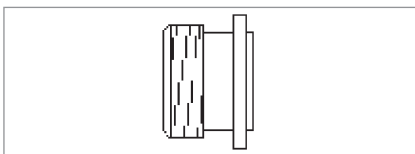
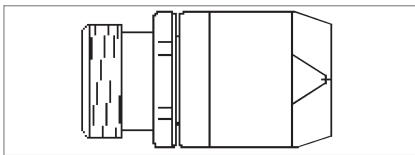
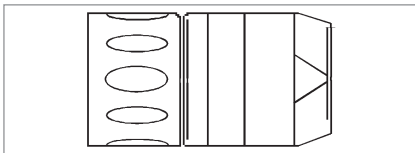
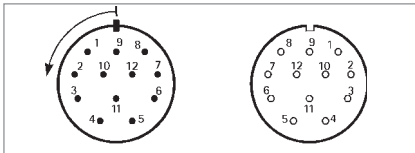
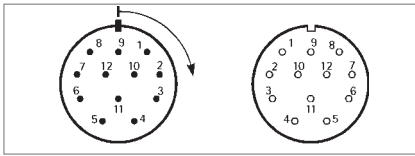
C 1 mark (default)
Z Cyclical
D Distance coding
N No reference
X Special reference

¹⁾ Distance coding

Number of reference marks = $\frac{2 \times \text{Circumference}}{\text{Distance coding}}$

Example: Ø 229.2 mm, circumference 720 mm, 60 mm distance coding
 Order code: AI-S1V-0720-S1B-D0060
 Number of reference marks: 24

Connectors



NUMBERING OF PINS

Clockwise system:

A connector with pin contacts, which is numbered clockwise, and the corresponding counter-plug connector with socket contacts (which consequently must be numbered counter-clockwise), is called right-turning.

Counter clockwise system:

A connector with pin contacts, which is numbered counter clockwise, and the corresponding counter-plug connector with socket contacts (which consequently must be numbered clockwise), is called left-turning.

PLUG

A connector with coupling nut is called plug, without regard to its pin or socket contacts.

COUPLING

A connector with outer thread is called coupling without regard to its pin or socket contacts.

CONNECTOR

A connector is fastened to the encoder or the machine's housing, has an outer thread (like the coupling) and is available with pin or socket contacts.

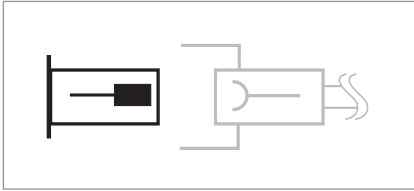
CONTACTS

Sign for pin contact

Sign for socket contact

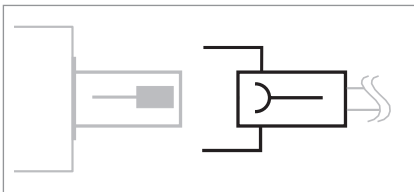
Connectors

CONNECTOR FOR MOUNTING IN ENCODER HOUSING (IDENTICAL WITH ENCODER CONNECTOR CONIN 12 POLE)



Connector (pins)	Ordering code
CONIN 12 pole, clockwise	3 539 198
CONIN 12 pole, counter clockwise	3 539 230

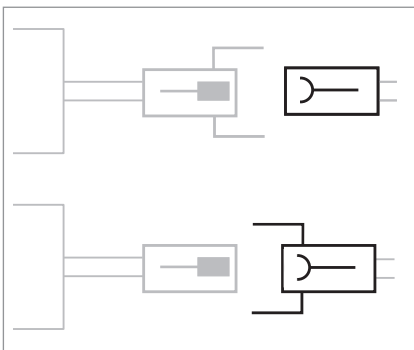
CONNECTOR MATCHING WITH ENCODER CONNECTOR ¹⁾



Encoder connector (pins)	Suitable plug (socket)
Conin 12 pole, clockwise (C, D) (3 539 198)	3 539 202 (PG 9)
Conin 12 pole, counter clockwise (G, H) (3 539 230)	3 539 229 (PG 9)
Conin 17 pole, counter clockwise (U, V)	3 539 256
Conin 17 pole, clockwise (W, Y)	3 539 254
Conin 21 pole, clockwise	1 540 232
Binder 6 pole (J)	3 539 472 (straight, IP 67) 3 539 209 (bent, IP 40)
MIL 6 pole (M, Q)	3 539 261
MIL 7 pole (L, P)	3 539 262
MIL 10 pole (K, O, R, T)	3 539 258
KPT 12-8P (1, 2)	3 539 333

¹⁾ Extension cables with plug refer to "Extension Cables"

CONNECTOR MATCHING WITH ENCODER CABLE WITH CONNECTOR

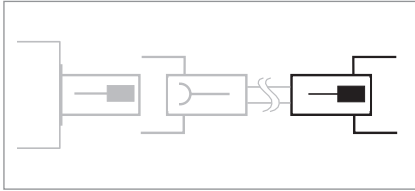


Encoder plug (pins)	Suitable coupling (socket)
Conin 12 pole, clockwise (-C) (3 539 186)	3 539 187
VDW ¹⁾ , 12 pole, clockwise (-B) (3 539 252)	3 539 304
SUB-D, 37pol., (-F) (1 542 025)	1 542 024
Encoder coupling (pins)	Suitable plug (socket)
Conin 12 pole, counter clockwise (-D) (3 539 273)	3 539 229
VDW ¹⁾ , 12 pole, counter clockwise (-E) (3 539 274)	3 539 305

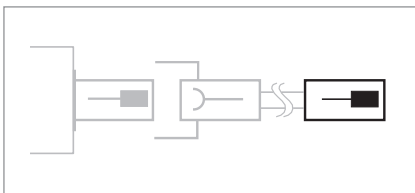
¹⁾ VDW corresponding to Conin plastic-coated

Connectors

CONNECTOR ON CONNECTING CABLE SUITABLE FOR DOWNSTREAM LOGIC CIRCUIT



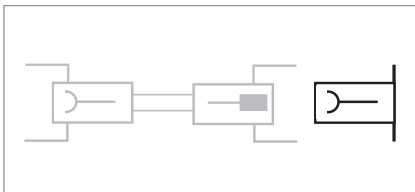
Plug (pins)	Ordering code
Conin 12 pole, clockwise	3 539 186
Conin 12 pole, counter clockwise	3 539 316
Conin 9 pole, clockwise	3 539 293
VDW ¹⁾ 12 pole, clockwise	3 539 252
Conin 17 pole, clockwise	3 539 317
Conin 17 pole, counter clockwise	3 539 309



Coupling (pins)	Ordering code
Conin 12 pole, clockwise	3 539 301
Conin 12 pole, counter clockwise	3 539 273
VDW ¹⁾ 12 pole, counter clockwise	3 539 274
Conin 17 pole, clockwise	3 539 302
Conin 17 pole, counter clockwise	3 539 303

¹⁾ VDW corresponding with Conin plastic-coated

CONNECTOR FOR MOUNTING INTO DOWNSTREAM LOGIC CIRCUIT HOUSING



Connector (socket)	Ordering code
Conin 12 pole, clockwise	3 539 318
Conin 12 pole, counter clockwise	3 539 319

MOUNTING ACCESSORIES

mounting spanner for Conin-connectors	Ordering code
	3 539 343

OTHER CONNECTORS

Conin 9 pole, clockwise, socket	Ordering code
	3 539 294