SpinCo™ Incremental Magnetic Encoder System

SpinCo is an incremental magnetic encoder system designed for use as primary position and speed feedback sensor for machine tool spindles.

It consists of two key elements, a readhead and a magnetic ring.

RLS proven AMR and GMR sensor technologies are used for sensing magnetized pattern on the magnetic ring to ensure accurate and reliable operation over the entire operating range.





Features and benefits

- Speeds up to 55,000 rpm
- From 50 to 556 sin/cos periods per revolution
- ABZ digital incremental outputs with up to 4,096 steps per sin/cos period
- Analogue output signals (1 V_{pp})

- Signal stability
- IP67 protection
- Wide installation tolerances
- Small readhead size
- High accuracy

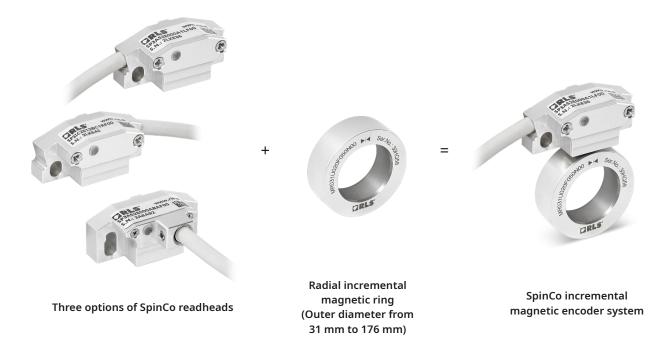


General information

The encoder continuously calibrates the sensed signals to ensure accurate and reliable output signals, which are reported as industry standard 1 V_{PP} analogue incremental signals.

The magnetic ring consists of an elastoferrite layer firmly bonded to a stainless steel hub. The elastoferrite layer is magnetised with alternating magnetic poles. The poles can be 1 mm or 2 mm long. To ensure safety and reliability even at the highest rotational speeds, all magnetic rings have a fully welded cover foil. This thin steel layer protects the elastoferrite from damage and the effects of cooling lubricant vapours and ensures optimum performance at high speeds and high temperatures. Various outer diameters are supported, ranging from 31 mm to 176 mm. The magnetic ring can be mounted by shrinkage press fitting, press fitting, gluing or by using fasteners.

The shape of the readhead has been designed to minimise the required mounting space. In addition, a visible status LED is provided to facilitate installation and troubleshooting. The readhead features an AGC that enables an optimum output signal within the installation tolerances, regardless of the ride height.



Choose your SpinCo magnetic encoder system

SpinCo system with right tangential cable exit

SpinCo system with left tangential cable exit



SpinCo system with axial cable exit





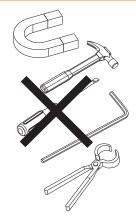
Storage and handling

Storage temperature Operating temperature Humidity $-40 \circ C$ to +85 $\circ C$ High resistance to humidity Image: temperature Image: temperature $-40 \circ C$ to +85 $\circ C$ High resistance to humidity Image: temperature Image: tempe



HANDLE WITH CARE. This encoder system is a high performance metrology product and should be handled with the same care as any other precision instrument. The use of industrial tools such as hammers and chisels or exposure to strong magnets such as a magnetic base is unacceptable and carries the risk of irreparable damage to the product.

The magnetic ring should not be exposed to magnetic field densities higher than 25 mT on its surface, as this can damage the ring.



Exposure to external magnetic fields during operation <1 mT AC (alternating field)

<2 mT DC (static field)



Readhead is ESD sensitive - handle with care.

Do not touch electronic circuit, wires or sensor area without proper ESD protection or outside of ESD controlled environment.

Packaging

Each readhead is packed individually in an antistatic bag.

Each magnetic ring is packed individually in an antistatic box.

Dimensions and installation drawings

Magnetic ring surface markings (engraved)

Magnetic ring markings include serial number, QR code, logo, part number and reference mark. They are engraved on the hub. The reference mark engraving can deviate from the actual position of the reference mark magnetization for ±5 °. The engraving is for orientation purposes only.

 \square

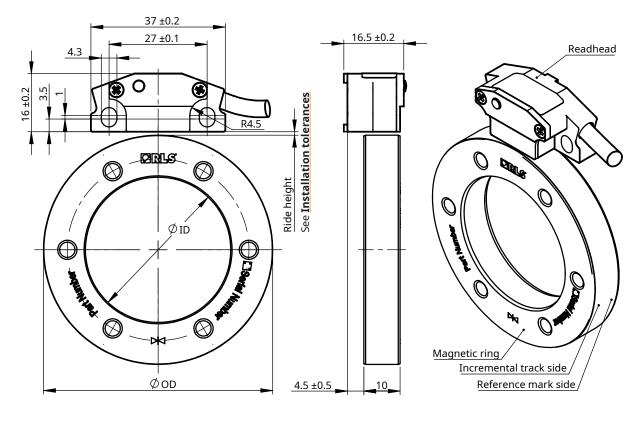
YD1B70

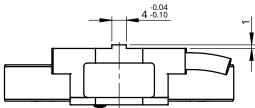
Reference mark sign

Serial number example - unique combination of six letters and digits

Encoder assembly with MR063U ring

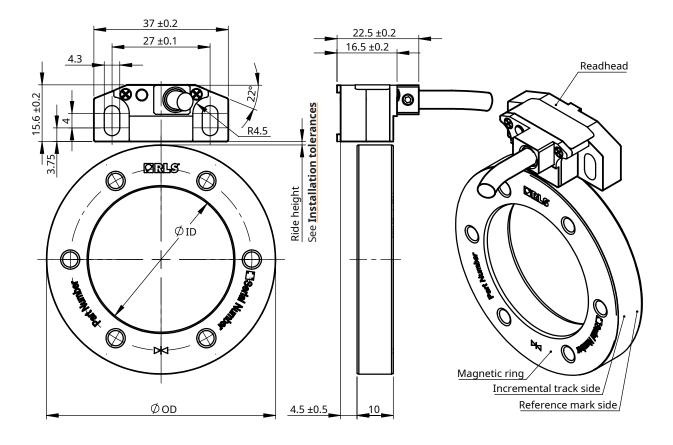
With tangential cable exit

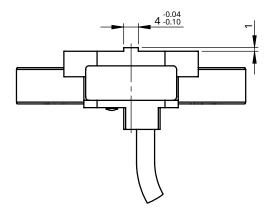






With axial cable exit

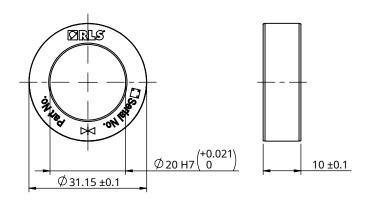




Dimensions and installation drawings continued

Magnetic rings

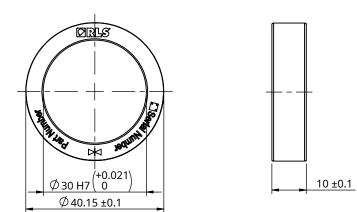
MR031U



Pole length (mm)	1	2
Number of poles	100	50
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	31.15 ±0.1	
Inner diameter (mm)	20	
Mass (g)	31	
Maximum speed	Refer to Maxiı	mum speed calculator
Moment of inertia (kgmm²)	5.3	
Accuracy of magnetisation (°)	±0.06	±0.1
Interpolation accuracy / SDE (°)	±0.015	±0.025



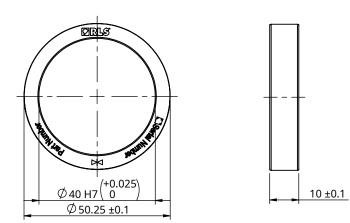
MR040U



Pole length (mm)	1	2
Number of poles	128	64
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	40.15 ±0.1	
Inner diameter (mm)	30	
Mass (g)	39	
Maximum speed	Refer to Maxim	um speed calculator
Moment of inertia (kgmm²)	12.1	
Accuracy of magnetisation (°)	±0.05	±0.08
Interpolation accuracy / SDE (°)	±0.012	±0.022

Dimensions and installation drawings continued

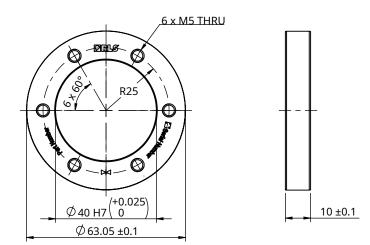
MR050U



Pole length (mm)	1	2
Number of poles	160	80
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	50.25 ±0.1	
Inner diameter (mm)	40	
Mass (g)	51	
Maximum speed	Refer to Maxim	um speed calculator
Moment of inertia (kgmm²)	25.9	
Accuracy of magnetisation (°)	±0.04	±0.07
Interpolation accuracy / SDE (°)	±0.01	±0.02



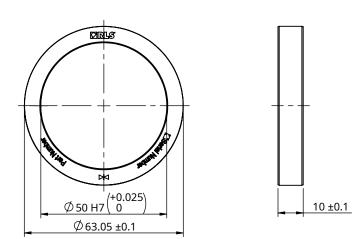
MR063U ID40



Pole length (mm)	1	2
Number of poles	200	100
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	63.05 ±0.1	
Inner diameter (mm)	40	
Mass (g)	131	
Maximum speed	Refer to Maxim	num speed calculator
Moment of inertia (kgmm²)	90.3	
Accuracy of magnetisation (°)	±0.035	±0.06
Interpolation accuracy / SDE (°)	±0.008	±0.015

Dimensions and installation drawings continued

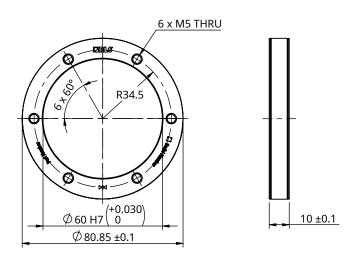
MR063U ID50



1	2
200	100
0.2 ±0.1	0.3 ±0.2
63.05 ±0.1	
50	
83	
Refer to <u>Maximu</u>	m speed calculator
66.3	
±0.035	±0.06
	0.2 ±0.1 63.05 ±0.1 50 83 Refer to Maximu 66.3



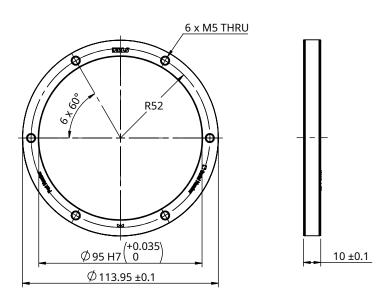
MR081U



Pole length (mm)	1	2
Number of poles	256	128
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	80.85 ±0.1	
Inner diameter (mm)	60	
Mass (g)	163	
Maximum speed	Refer to Maxim	um speed calculator
Moment of inertia (kgmm²)	204.9	
Accuracy of magnetisation (°)	±0.03	±0.05
Interpolation accuracy / SDE (°)	±0.007	±0.014

Dimensions and installation drawings continued

MR114U

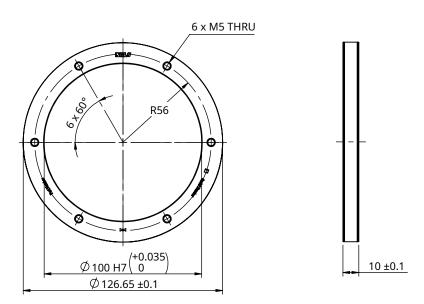


1	2
360	180
0.2 ±0.1	0.3 ±0.2
113.95 ±0.1	
95	
221	
Refer to Maximu	m speed calculator
604	
±0.02	±0.04
	+0.012
	0.2 ±0.1 113.95 ±0.1 95 221 Refer to Maximum 604



Dimensions and installation drawings continued

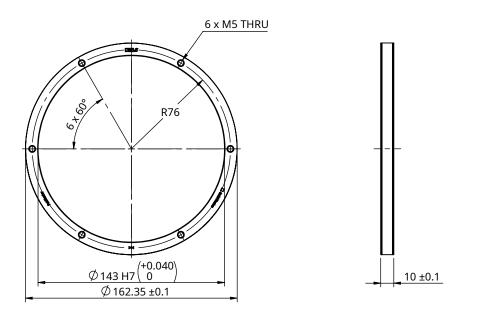
MR127U



Pole length (mm)	1	2
Number of poles	400	200
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	126.65 ±0.1	
Inner diameter (mm)	100	
Mass (g)	345	
Maximum speed	Refer to <u>Maxim</u>	um speed calculator
Moment of inertia (kgmm²)	1118	
Accuracy of magnetisation (°)	±0.02	±0.04
Interpolation accuracy / SDE (°)	±0.005	±0.01

Dimensions and installation drawings continued

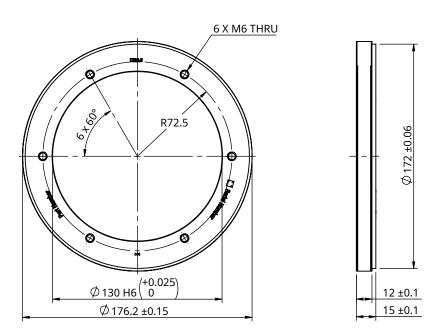
MR162U



Pole length (mm)	1	2
Number of poles	512	256
Ride height (mm)	0.2 ±0.1	0.3 ±0.2
Outer diameter (mm)	162.35 ±0.1	
Inner diameter (mm)	143	
Mass (g)	334	
Maximum speed	Refer to Maxim	um speed calculator
Moment of inertia (kgmm²)	1948.1	
Accuracy of magnetisation (°)	±0.015	±0.03
Interpolation accuracy / SDE (°)	±0.003	±0.006

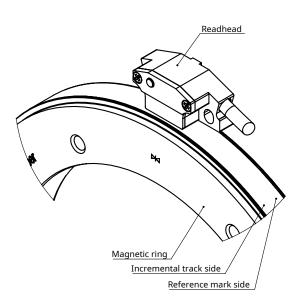


MR176X



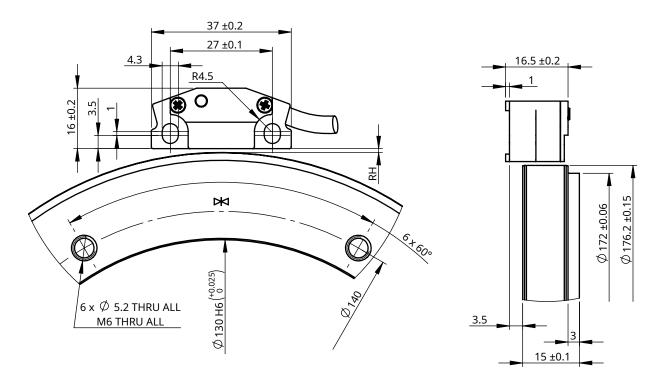
Technical features

Pole length (mm)	1
Number of poles	556
Ride height (mm)	0.2 ±0.1
Outer diameter (mm)	176.2 ±0.15
Inner diameter (mm)	130
Mass (g)	1200
	Refer to Maximum speed
Maximum speed	<u>calculator</u>
Moment of inertia (kgmm²)	7225
Accuracy of magnetisation (°)	±0.015
Interpolation accuracy / SDE (°)	±0.002



See the encoder assembly on the following page.

Dimensions and installation drawings continued



Encoder assembly with MR176X ring

Installation instructions

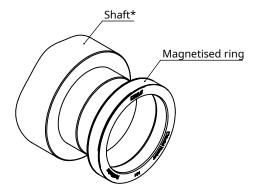
Installation of magnetic rings

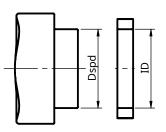
Machine the mounting shaft according to the dimensions given in the table below. Dimensions and tolerances are in mm.

Ring	Outer diameter - OD	Inner (clearance fit installation, (press fit or		(clearance fit installation,		(clearance fit installation, (press fit or shrinkage		rinkage
MD02411020		20.117	20	-0.007	- 20 *C	0.041		
MR031U020	31.15 ±0.1	20 H7	20 g6	-0.02	20 r6	0.028		
MD04011020	40.15 +0.1	20.117	20	-0.007	- 30 r6	0.041		
MR040U030	40.15 ±0.1	30 H7	30 g6	-0.02	30 16	0.028		
	50.25 +0.4	40.1.17	40	-0.009	40.00	0.05		
MR050U040	50.25 ±0.1	40 H7	40 g6	-0.025	– 40 r6	0.034		
	62.05 +0.4	40.1.17	40.5	-0.009	40.5	0.05		
MR063U040	63.05 ±0.1	40 H7	40 g6	-0.025	40 r6	0.034		
	62.05 +0.4	50.117		-0.009	50 r6	0.05		
MR063U050	63.05 ±0.1	50 H7	50 g6	-0.025		0.034		
	00.05 +0.4		606	-0.01	60 ×6	0.06		
MR081U060	80.85 ±0.1	60 H7	60 g6	60 g6	60 r6	0.041		
	112.05 + 0.1		05 6	-0.012	05.6	0.073		
MR114U095	113.95 ±0.1	95 H7	95 g6	-0.034	95 r6	0.051		
	126.65 +0.1	100.117		-0.012	100	0.073		
MR127U100	126.65 ±0.1	100 H7	100 g6	-0.034	100 r6	0.051		
MD46211442			143 g6	-0.014	1 12	0.09		
MR162U143	162.35 ±0.1	143 H7		143 g6	143 r6	0.065		
	176.2 . 0.45	120.116	120 5	-0.014	120 5	0.061		
MR176X130	176.2 ±0.15	130 H6	130 g5	-0.032	[–] 130 p5	0.043		

Installation by press-fitting

Slip the ring onto the mating shaft applying equal or uniform force along the whole ring circumference.

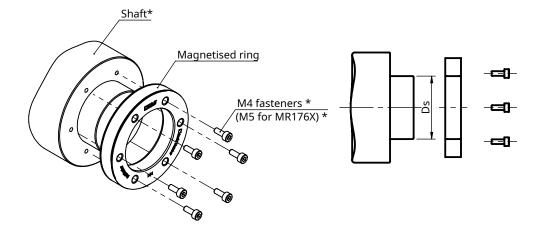




* Not provided.

Installation with fasteners

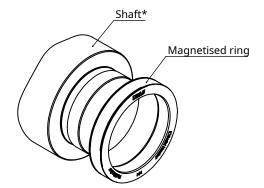
- 1.
- Slide the ring onto the mating shaft. Attach the ring with appropriate fasteners. 2.

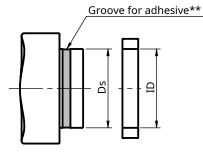


* Not provided.

See table of recommended tightening torques for RLS products (document TTD01) available at RLS media center.

Installation by gluing





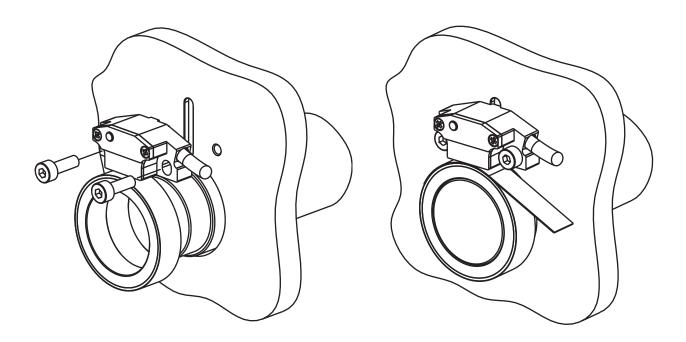
* Not provided.

** For the depth of the groove, please check the specifications of the adhesive.

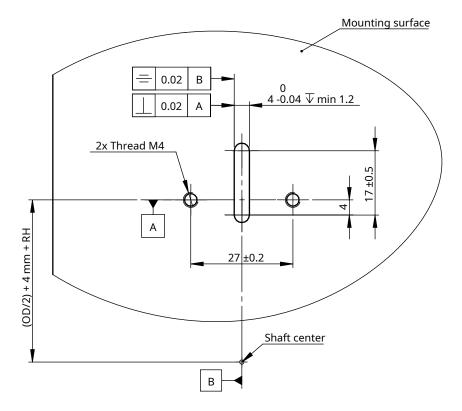


Installation of the readhead

Please use the supplied spacer for optimum ride height. For proper mounting, a mounting base should be made prior to installation.



Mounting base



A **RENISHAW** associate company

Installation tolerances (readhead to ring)

Radial displacement	1 mm pole length	0.2 ±0.1 mn	n	
(ride height)	2 mm pole length	0.3 ±0.2 mn	n	
Axial displacement		± 0.5 mm		↔
Tangential displacemer	nt of the sensor	± 0.5 mm		
Non-parallel mounting	(roll)	± 0.5°		∫ <mark>/ </mark>
Non-parallel mounting	(pitch)	± 0.5°		I []
Non-parallel mounting	(yaw)	±1°		Ţ
			Magnetic ring	SpinCo readhead



Technical specifications

System data

Pole length	1 mm or 2 mm
Hysteresis	Less than 1 electrical degree
Repeatability	Less than ±2 counts for maximum interpolation factor and less than unit of resolution for all other interpolation factors

Electrical data

Supply voltage	5 V ±10 % (absolute maximum 6 V)
	Reverse polarity and overvoltage protected
Current consumption	<50 mA (without load)
Set-up time	100 ms
Interface	1 Vpp or digital TTL (RS422)

Mechanical data

Mass	Readhead: 120 g (1 m cable, no connector)
Cable	TPE AWG 26, shielded, Ø4.8 ±0.15 mm
Ring hub material	EN 1.4057
Coefficient of thermal expansion (CTE)	11.2
of steel hub of the ring (ppm/°C)	

Environmental data

Temperature	–40 °C to +85 °C (Operating and storage)
Environmental sealing	IP67 (according to IEC 60529)*
EMC Immunity	EN 61000-4-2
EMC Emission	EN 61000-6-4
Vibrations	55 Hz to 2000 Hz: 300 m/s² (EN 60068-2-6)
Shocks	11 ms: 1000 m/s² (EN 60068-2-27)

* IP protection is only guaranteed when suitable connector with same or higher IP is used.

Electrical connections

Connector options

Function	Signal (analogue)	Signal (quadrature)	Colour of flying lead (option F)	9 pin D type plug (option A)	12 pin M23 coupling connector (option B)	12 pin M23 cable connector (option C)	15 pin D type plug (option D)	17 pin M23 type plug (option N)
	5 V	5 V	Brown	5	12	12	4	10
-	0 V	0 V	White	9	10	10	12	7
Power	5 V sense	5 V sense	Black	-	2	2	8	16
	0 V sense	0 V sense	Purple	-	11	11	15	15
	V ₁	А	Green	4	5	5	9	1
Incremental	V ₁ -	A-	Yellow	8	6	6	1	2
/ analogue signals	V ₂	В	Blue	3	8	8	10	11
	V ₂ -	B-	Red	7	1	1	2	12
Reference mark	V _o	Z	Pink	2	3	3	3	3
	V ₀ -	Z-	Grey	6	4	4	11	13
Shield	Shield	Shield	-	Case	Case	Case	Case	Case

When using flying lead connection type shield must be connected to custom connector or controllers shield connection pin.

Status indicator LED

LED colour	Output signals	Possible cause
Green	VALID	
		Rotational speed too high.
		Sensing distance too high.
Red	INVALID	Improper orientation of magnetised ring relative to readhead.
		Magnetically damaged magnetised ring.
		External magnetic field too high.

AGC - automatic gain control

If the strength of the magnetic field is changing, the internal AGC (automatic gain control) circuit is able to control the output signal amplitude around 1 V_{pp} . Via AGC SpinCo can monitor and keep the output signals for the ensuing sine-to-digital conversion constant regardless of changes in input signal level.



Maximum speed

For operation without errors during high speed rotation, correct edge separation setting must be selected. Edge separation can be calculated according to following equation:



Available edge separations:

В	25 ns	F	125 ns	J	400 ns	Ν	1.3 µs
с	50 ns	G	150 ns	к	550 ns	ο	1.6 µs
D	75 ns	н	200 ns	L	800 ns	Р	3.2 µs
Е	100 ns	I	300 ns	м	1 µs	Q	6.4 µs

For maximum speed table refer to Maximum speed calculator for SpinCo radial magnetic rings.

Test method to confirm maximum speed:

To verify of the prescribed speeds, the magnetic rings were first exposed statically at least 5 % above the temperature characteristics for a specified time and then rotated above their prescribed speed for 1 h.

Communication interfaces

Analogue output signals (1 V_{pp})

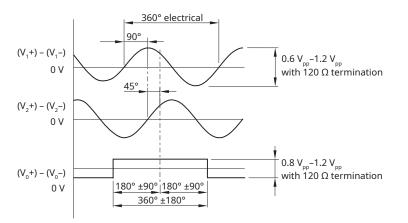
2 channels V_1 and V_2 differential sinusoidals (90° phase shifted) and differential, rectangular index pulse V_0

5 V ±10 %					
Reverse polarity and overvoltage	protected				
<50 mA (without load)					
~ 24 mV/m (without load)					
~ 30 mV/m (with 120 Ω load)					
V ₁ , V ₂ , V ₀	Short circuit protected				
Amplitude	0.6 V_{pp} to 1.2 V_{pp}				
(with 120 Ω termination)					
Phase shift	90° ±1°				
Amplitude	0.8 V _{pp} to 1.2 V _{pp}				
(with 120 Ω termination)					
Position	45° ± 45°				
Width	360° ± 180°				
Z_0 = 120 Ω between associated ou	utputs				
Max. 10 m					
	Reverse polarity and overvoltage <50 mA (without load)				

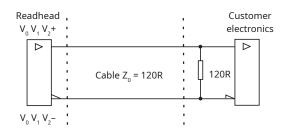
* Please consider voltage drop over cable.

Timing diagram

Rotating in positive direction



Recommended signal termination



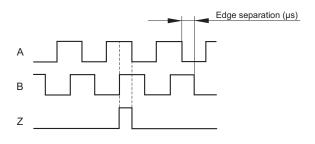
Incremental quadrature output signals (ABZ)

Power supply *	5 V ±10 % – voltage on readhead
	Reverse polarity and overvoltage protected
Current consumption	<50 mA (without load)
Voltage drop over cable	~ 24 mV/m (without load)
	~ 65 mV/m (with 120 Ω load)
Output signals	3 square-wave signals A, B, Z and their inverted signals A–, B–, Z–
Reference signal	1 square-wave pulse Z and its inverted pulse Z–
Signal level	Differential line driver to EIA standard RS422:
	$U_{\rm H} \ge 2.5$ V at $-I_{\rm H}$ = 20 mA
	$U_{L} \leq 0.5 \text{ V} \text{ at } I_{L} = 20 \text{ mA}$
Permissible load	$Z_{_0} \geq$ 120 Ω between associated outputs
Cable length *	Max. 10 m

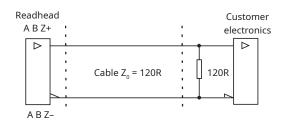
* Please consider voltage drop over cable.

Timing diagram

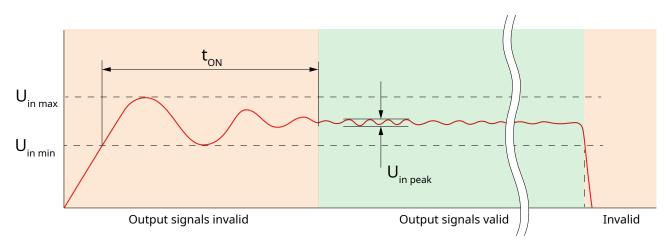
Complementary signals not shown



Recommended signal termination



Transient response of supply voltage



Switch-on/off behavior of the encoder:

After the switch-on time t_{on} , valid output signals are available.

 $t_{oN} = 2 s$ $U_{inmax} = U_{in} + 10 \%$, $U_{inmin} = U_{in} - 10 \%$

If the power supply is switched off, or when supply voltage falls below U_{inmin}, the output signals are also invalid.

The encoder require a stabilized DC voltage supply U_{in}. The permissible ripple content of the DC voltage is:

- High frequency interference: U_{inpeak} < 250 mV
- Low frequency ripple: U_{inpeak} < 100 mV

The limits of the supply voltage must not be violated by ripple content.

The values apply as measured at the encoder. The voltage can be monitored and adjusted with the encoders sensor lines, if available. If an adjustable power supply is not available, the voltage drop can be reduced by switching the sensor lines parallel to the corresponding supply wires.



Part numbering

Readhead

1 mm pole length 2 mm pole length teference mark 5 - With reference mark tesolution (steps per period) 1000 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 128 - 4 068 - 64 088 - 256 108 - 1024 138 - 8 D08 - 80 D40 - 400 2D0 - 2000 128 - 4 068 - 64 088 - 256 108 - 1024 138 - 8 D08 - 80 D40 - 400 2D0 - 2000 128 - 16 D10 - 100 D50 - 500 118 - 2048 1092 - 20 078 - 128 098 - 512 4D0 - 4000 158 - 32 D16 - 160 D80 - 800 128 - 4096 Winimum edge separation M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs 3 - 25 ns H - 200 ns N - 1.3 µs 2 - 50 ns J - 400 ns P - 3.2 µs 2 - 100 ns K - 550 ns Q - 6.4 µs 3 - 0.5 m Z - 1.5 m S - 5 m 3 - 0.5 m Z - 1.5 m S - 5 m 1 - 1 m D - 2.5 m F - 10 m Cable outlet A -				SP3	AS	1	E 0	00	A 1	A	Α	00
P3 - SP3 flat readhead communication interface S3 - Analogue voltage 1 V _{PD} , wide reference, 5 V C - Incremental, R5422; 5 V vole length : - 1 mm pole length : - 2 mm pole length : With reference mark Resolution (steps per period) 000 - N/A (for AS only) D4 - 40 D20 - 200 1D0 - 1000 28 - 4 068 - 64 088 - 256 108 - 1024 28 - 4 050 - 1150 M - 400 200 - 2000 28 - 4 050 - 500 118 - 2048 20 - 20 0078 - 128 098 - 512 4000 29 - 75 ns H - 200 ns N - 113 µs - 50 ns H - 200 ns N - 13 µs - 50 ns I - 300 ns O - 16 µs - 100 ns K - 550 ns Q - 64 µs : - 100 ns K - 550 ns Q - 64 µs : - 80n 2 - 2m 5 - 5m : - 100 ns K - 550 ns Q - 64 µs : - 12 ns L - 800 ns												
Simulation interface Simunulation interface												
SS - Analogue voltage 1 Vpp, wide reference, 5 V C - Incremental, R\$422; 5 V Vole length - 1 mm pole length - 2 nm pole length - 2 nm pole length - With reference mark Reference mark - With reference mark 100 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 228 - 4 068 - 64 068 - 256 108 - 1024 338 - 8 D08 - 80 D40 - 400 2D0 - 2000 244 - 166 D10 - 100 D50 - 500 118 - 2048 302 - 20 07B - 128 09B - 512 4D0 - 4000 328 - 32 D16 - 150 S0 - 800 800 - 800 356 - 32 D16 - 150 M - 1µs 3 - 55 ns H - 200 ns N - 1 ½ µs - 50 ns I - 300 ns O - 1.5 µs 3 - 0.5 m S - 5 m J - 400 ns P - 3.2 µs 5 - 125 ns L - 800 ns S - 5 m 1 - 1 m D - 2.5 m F - 10 m Other cable lengths available per special request. Minimum cable length is 10 m, maximum cable	SP3 - SP3 flat readhead	d										
C - Incremental, RS422; 5 V Pole length - 1 mm pole length 2 mm pole length - With reference mark - With reference mark - Weith reference mark - 200 100 - 1000 202 - 20 100 - 1002 203 - 100 - 100 500 228 - 4 0.68 - 600 - 100 500 228 - 4 0.68 - 160 D80 - 800 220 - 200 07B - 128 - 50 ns I - 300 ns - 1.5 m S - 15 µs - 50 ns I - 300 ns - 125 ns L - 800 ns - 125 ns L - 800 ns - 212 ns F - 10 m Cher cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 cm, maximum cable length is 10 m. - 212 in M23 coupling connector F - 5 pin D type plug - 12 pin M23 coupling connector F - 5 pin D type plug	Communication interfa	ace										
bole length 1 mm pole length 2 mm pole length terference mark With reference mark Wassed	AS - Analogue voltage	1 Vpp, wide referen	ice, 5 V									
 1 mm pole length 2 mm pole length 2 mm pole length efference mark with reference mark esolution (steps per period) 000 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 D28 - 4 O68 - 64 O88 - 256 108 - 1024 3038 - 8 D08 - 80 D40 - 400 200 - 200 HB - 16 D10 - 100 D50 - 500 118 - 2048 D02 - 20 O75 ns J - 400 ns P - 32 µs - 50 ns H - 200 ns N - 1.3 µs - 55 ns H - 200 ns N - 1.3 µs - 55 ns J - 400 ns P - 3.2 µs - 100 ns K - 550 ns Q - 6.4 µs Cable length Automatical and the second seco	IC - Incremental, RS42	22; 5 V										
2 - 2 mm pole length Reference mark I - With reference mark Resolution (steps per period) 000 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 228 - 4 06B - 64 08B - 256 10B - 1024 328 - 8 D08 - 80 D40 - 400 2D0 - 2000 328 - 8 D08 - 80 D40 - 400 2D0 - 2000 328 - 8 D08 - 80 D40 - 400 2D0 - 2000 328 - 8 D08 - 80 D40 - 400 2D0 - 2000 328 - 8 D08 - 80 D40 - 400 2D0 - 2000 328 - 8 D08 - 80 D28 - 800 12B - 4000 558 - 32 D16 - 160 D80 - 800 12B - 4096 Minimum edge separation M - 1µs 38 - 25n s M - 200 ns N - 1.3 µs 2 - 50 ns I - 300 ns Q - 1.6 µs 275 ns J - 400 ns P - 3.2 µs 2 - 125 ns L - 800 ns S - 5 m G - 15 m S - 5 m request. Minimum cable length is 10 cm, maximum cable length is 10 m. 3- 11 m D - 2.5 m F - 10 m Other cable lengths available per special requisext. Minimum cable length is 10 m.	Pole length											
Reference mark i With reference mark Resolution (steps per period) 000 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 128 - 4 06B - 64 08B - 256 10B - 1024 128 - 4 06B - 64 08B - 256 10B - 1024 128 - 4 06B - 64 08B - 256 10B - 1024 128 - 4 06B - 64 08B - 256 10B - 1024 128 - 4 06B - 160 D50 - 500 11B - 2048 128 - 25 D10 - 100 D50 - 500 11B - 2048 102 - 20 07B - 128 09B - 512 4D0 - 4000 1058 - 32 D16 - 160 D80 - 800 12B - 4096 Winimum edge separation - - - 100 ns I - 300 ns O - 1.5 m 3 - 3 m 2 - 55 ns I - 200 ns N - 1.3 µs - 2 - 10 ns K - 550 ns Q - 6.4 µs - 2 - 10 ns K - 550 ns Q - 6.4 µs - 2 - 10 ns K - 550 ns P - 10 m Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m.	1 - 1 mm pole length											
 With reference mark Resolution (steps per period) D00 - N/A (for AS only) D04 - 40 D20 - 200 1D0 - 1000 228 - 4 068 - 64 088 - 256 108 - 1024 338 - 8 D08 - 80 D40 - 400 2D0 - 2000 Atta - 16 D10 - 100 D50 - 500 11B - 2048 000 - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 1µs A - N/A (for AS only) G - 150 ns M - 130 ns Q - 6.4 µs Carbon S C - 1.5 m A - 300 ns C - 1.5 m F - 10 m Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial Left tangential C - 12 pin M23 coupling connector F - Flying lead N - 17 pin M23 type plug F - Flying lead N - 17 pin M23 type plug 	2 - 2 mm pole length											
According to the second term of term	Reference mark											
N00 N/A (for AS only) D04 40 D20 200 1D0 1000 N28 4 068 64 028 256 108 1024 N38 8 D08 80 D40 400 2D0 2000 N48 16 D10 100 D50 500 118 2048 202 20 078 128 098 512 $4D0$ 4000 202 20 078 128 098 800 128 4096 Winimum edge separation V NA (for AS only) G 150 ns M 1μ s 2.50 ns H 200 ns N 1.3μ s 5.50 ns Q 6.4μ s 2.50 ns L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns $S - 5 \text{ ms}$	E - With reference ma	rk										
N00 N/A (for AS only) D04 40 D20 200 1D0 1000 N28 4 068 64 028 256 108 1024 N38 8 D08 80 D40 400 2D0 2000 N48 16 D10 100 D50 500 118 2048 202 20 078 128 098 512 $4D0$ 4000 202 20 078 128 098 800 128 4096 Winimum edge separation V NA (for AS only) G 150 ns M 1μ s 2.50 ns H 200 ns N 1.3μ s 5.50 ns Q 6.4μ s 2.50 ns L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns $S - 5 \text{ ms}$												
N00 N/A (for AS only) D04 40 D20 200 1D0 1000 N28 4 068 64 028 256 108 1024 N38 8 D08 80 D40 400 2D0 2000 N48 16 D10 100 D50 500 118 2048 202 20 078 128 098 512 $4D0$ 4000 202 20 078 128 098 800 128 4096 Winimum edge separation V NA (for AS only) G 150 ns M 1μ s 2.50 ns H 200 ns N 1.3μ s 5.50 ns Q 6.4μ s 2.50 ns L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns P 3.2μ s $C + 1.5 \text{ ns}$ $S + 5 \text{ ns}$ 2.05 ms L 800 ns $S - 5 \text{ ms}$	Popolution (stone new	ariad)										
$228 - 4$ $068 - 64$ $088 - 256$ $108 - 1024$ $338 - 8$ $D08 - 80$ $D40 - 400$ $2D0 - 2000$ $348 - 16$ $D10 - 100$ $D50 - 500$ $118 - 2048$ $022 - 20$ $078 - 128$ $998 - 512$ $4D0 - 4000$ $558 - 32$ $D16 - 160$ $D80 - 800$ $128 - 4096$ <i>Minimum edge separation</i> V V $S75 - 512$ $4000 - 4000$ $558 - 32$ $D16 - 160$ $D80 - 800$ $128 - 4096$ <i>Minimum edge separation</i> V $S75 - 512$ $400 - 4000$ $5 - 55 ns$ $H - 200 ns$ $N - 1\mu s$ $S - 55n s$ $Q - 6.4 \mu s$ $2 - 10 ns$ $K - 550 ns$ $Q - 6.4 \mu s$ $S - 5m$ $Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. A - Axial V - 15pin D type plug P - 15pin D type plug F - Flying lead A - 9pin D type plug F - Flying lead N - 17pin M23 type plug A - 12 pin M23 cable connector N - 17pin M23 type plug N - 17pin M23 type plug$			D20 - 2	00	1D0 -	1000		1				
AB - 16 D10 - 100 D50 - 500 11B - 2048 A02 - 20 O7B - 128 O9B - 512 4D0 - 4000 J5B - 32 D16 - 160 D80 - 800 12B - 4096 Minimum edge separation Image: Separation Image: Separation Image: Separation A - N/A (for AS only) G - 150 ns M - 1µs Image: Separation Image: Separation A - N/A (for AS only) G - 150 ns M - 1µs Image: Separation Image: Separation A - N/A (for AS only) G - 150 ns M - 1µs Image: Separation Image: Separation A - N/A (for AS only) G - 150 ns N - 1.3 µs Image: Separation Image: Separation A - 0.3 ns L - 800 ns P - 3.2 µs Image: Separation Image: Separation S - 0.5 ns L - 800 ns S - 5 m Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. A - 0.3 m C - 1.5 m S - 5 m Other cable lengths is 10 m. A - Axial Image: Separatial Image: Separatial Image: Separatial A - Axial Image: Separatial D - 15 pin D type plug F - Flying lead A - 1	02B - 4											
$202 - 20$ $07B - 128$ $09B - 512$ $4D0 - 4000$ $55B - 32$ $D16 - 160$ $B80 - 800$ $12B - 4096$ Minimum edge separation $A - N/A$ (for AS only) $G - 150 \text{ ns}$ $M - 1\mu \text{s}$ $A - N/A$ (for AS only) $G - 150 \text{ ns}$ $M - 1\mu \text{s}$ $A - N/A$ (for AS only) $G - 150 \text{ ns}$ $M - 1\mu \text{s}$ $A - 55n \text{s}$ $H - 200 \text{ ns}$ $N - 1.3 \mu \text{s}$ $C - 50 \text{ ns}$ $J - 400 \text{ ns}$ $P - 3.2 \mu \text{s}$ $A - 0.3 \text{ m}$ $C - 1.5 \text{ m}$ $3 - 3 \text{ m}$ $A - 0.3 \text{ m}$ $C - 1.5 \text{ m}$ $3 - 3 \text{ m}$ $A - 0.3 \text{ m}$ $C - 1.5 \text{ m}$ $3 - 3 \text{ m}$ $A - 0.3 \text{ m}$ $C - 1.5 \text{ m}$ $3 - 3 \text{ m}$ $A - 0.3 \text{ m}$ $C - 2.5 \text{ m}$ $F - 10 \text{ m}$ Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 cm, maximum cable length is 10 m. Cable outlet $A - Axial$ $A - Axial$ $A - 12 \text{ pin M23 coupling connector}$ $D - 15 pin D type plug$ $A - 3 \text{ pin D type plug$ $P - 15 \text{ pin D type plug$ $F - Flying lead$ $N - 17 \text{ pin M23 type plug$	03B - 8											
32 D16 - 160 D80 - 800 12B - 4096 Winimum edge separation 4 $N/A (for AS only)$ $G - 150 ns$ $M - 1\mu s$ $3 - 25 ns$ $H - 200 ns$ $N - 1.3 \mu s$ $5 - 50 ns$ $I - 300 ns$ $O - 1.6 \mu s$ $2 - 50 ns$ $I - 300 ns$ $O - 1.6 \mu s$ $P - 3.2 \mu s$ $0 - 75 ns$ $J - 400 ns$ $P - 3.2 \mu s$ $2 - 75 ns$ $J - 400 ns$ $P - 3.2 \mu s$ $0 - 6.4 \mu s$ $0 - 5.5 ns$ $Q - 6.4 \mu s$ $2 - 15ns$ $L - 800 ns$ $E - 50 ns$ $Q - 6.4 \mu s$ $0 - 5.5 ns$ $Q - 6.4 \mu s$ $2 - 0 ns$ $Z - 2 m$ $S - 5 m$ $O ther cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial A - Axial A - Axial A - Axial A - 9 pin D type plug D - 15 pin D type plug P - 15 pin D type plug A - 12 pin M23 coupling connector F - Flying lead N - 17 pin M23 type plug A - 12 pin M23 cable connector N - 17 pin M23 type plug A - 17 pin M23 type plug $	04B - 16	D10 - 100	D50 - 5	00	11B -	2048						
Minimum edge separationA - N/A (for AS only)G - 150 nsM - 1 μ sA - N/A (for AS only)G - 150 nsM - 1 μ sB - 25 nsH - 200 nsN - 1.3 μ sC - 50 nsI - 300 nsO - 1.6 μ sD - 75 nsJ - 400 nsP - 3.2 μ sC - 100 nsK - 550 nsQ - 6.4 μ sC - 100 nsK - 550 nsQ - 6.4 μ sC - 0.3 mC - 1.5 m3 - 3 mC - 0.5 m2 - 2 m5 - 5 mC - 0.5 m2 - 2 m5 - 5 mC - 1.5 m3 - 3 mC - 0.5 m2 - 2 m5 - 5 mC - 1.5 m3 - 3 mC - 0.5 m2 - 2 m5 - 5 mC - 1.5 m3 - 3 mC - 1.5 m3 - 3 mC - 1.5 m3 - 3 mC - 0.5 m2 - 2 mC - 1.5 m3 - 3 mC - 0.5 m2 - 2 mC - 1.5 m5 - 5 mC - 1.5 m9 - 1.5 mF - 10 mOther cable lengths available per special request. Minimum cable length is 10 m.C - 1.5 m2.5 mC - 1.5 m5 - 5 mC - 1.5 m5 - 5 mC - 1.5 m5 - 5 mC - 1.5 m7 - 10 mC - 1.5 m9 n D - 2.5 mC - 1.5 m9 n D - 2.5 mC - 1.5 m9 n D type plugC - 1.5 m9 n D t	D02 - 20	07B - 128	09B - 5	12	4D0 -	4000						
AN/A (for AS only) G 150 ns M 1 µs $3 - 25 \text{ ns}$ H -200 ns N -1.3 µs $2 - 50 \text{ ns}$ I -300 ns O -1.6 µs $O - 75 \text{ ns}$ J -400 ns P -3.2 µs $2 - 75 \text{ ns}$ J -400 ns P -3.2 µs $= 100 \text{ ns}$ K -550 ns Q -6.4 µs $= 125 \text{ ns}$ L $= 800 \text{ ns}$ Q -6.4 µs Cable length $A - 0.3 \text{ m}$ C -1.5 m 3 $B - 0.5 \text{ m}$ Z 2 nm 5 - 5 m O ther cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 cm, maximum cable length is 10 m. $B - 10 \text{ m}$ $D - 2.5 \text{ m}$ $F - 10 \text{ m}$ $F \text{ request. Minimum cable length is 10 m.Cable outletA - AxialA \text{ raid}F \text{ raid}F \text{ request. Minimum cable length is 10 m.A - AxialA \text{ raid}F \text{ raid}F \text{ raid}F \text{ raid}A - 100 \text{ raid}D - 15 \text{ pin D type plugF \text{ raid}F \text{ raid}A - 9 \text{ pin D type plug}D - 15 \text{ pin D type plugF \text{ raid}A - 12 \text{ pin M23 cable connector}N \text{ raid}N \text{ raid}A - 12 \text{ pin M23 cable connector}N \text{ raid}N \text{ raid}$	05B - 32	D16 - 160	D80 - 8	00	12B -	4096						
AN/A (for AS only) G 150 ns M 1 µs $3 - 25 \text{ ns}$ H -200 ns N -1.3 µs $2 - 50 \text{ ns}$ I -300 ns O -1.6 µs $O - 75 \text{ ns}$ J -400 ns P -3.2 µs $2 - 75 \text{ ns}$ J -400 ns P -3.2 µs $= 100 \text{ ns}$ K -550 ns Q -6.4 µs $= 125 \text{ ns}$ L $= 800 \text{ ns}$ Q -6.4 µs Cable length $A - 0.3 \text{ m}$ C -1.5 m 3 $B - 0.5 \text{ m}$ Z 2 nm 5 - 5 m O ther cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 cm, maximum cable length is 10 m. $B - 10 \text{ m}$ $D - 2.5 \text{ m}$ $F - 10 \text{ m}$ $F \text{ request. Minimum cable length is 10 m.Cable outletA - AxialA \text{ raid}F \text{ raid}F \text{ request. Minimum cable length is 10 m.A - AxialA \text{ raid}F \text{ raid}F \text{ raid}F \text{ raid}A - 100 \text{ raid}D - 15 \text{ pin D type plugF \text{ raid}F \text{ raid}A - 9 \text{ pin D type plug}D - 15 \text{ pin D type plugF \text{ raid}A - 12 \text{ pin M23 cable connector}N \text{ raid}N \text{ raid}A - 12 \text{ pin M23 cable connector}N \text{ raid}N \text{ raid}$	Minimum edge senara	tion										
$ \begin{array}{c c c c c c c c c c c c c c c c c c c $			M 1uc									
$2 - 50 \text{ ns}$ $I - 300 \text{ ns}$ $O - 1.6 \mu \text{s}$ $2 - 75 \text{ ns}$ $J - 400 \text{ ns}$ $P - 3.2 \mu \text{s}$ $2 - 100 \text{ ns}$ $K - 550 \text{ ns}$ $Q - 6.4 \mu \text{s}$ $2 - 125 \text{ ns}$ $L - 800 \text{ ns}$ $Q - 6.4 \mu \text{s}$ Cable length $2 - 2 \text{ m}$ $3 - 3 \text{ m}$ $3 - 0.5 \text{ m}$ $2 - 2 \text{ m}$ $5 - 5 \text{ m}$ $1 - 1 \text{ m}$ $D - 2.5 \text{ m}$ $F - 10 \text{ m}$ Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m.Cable outlet $A - Axial$ $-$ Left tangential $A - Axial$ $D - 15 \text{ pin D type plug$ $D - 15 \text{ pin D type plug$ $B - 12 \text{ pin M23 coupling connector}$ $D - 15 \text{ pin D type plug$ $A - 9 \text{ pin D type plug}$ $D - 15 \text{ pin D type plug$ $B - 12 \text{ pin M23 cable connector}$ $N - 17 pin M23 type plug$												
D- 75 nsJ- 400 nsP- 3.2 μ s- 100 nsK- 550 nsQ- 6.4 μ s- 125 nsL- 800 nsCable lengthA- 0.3 mC- 1.5 m3- 3 mS- 0.5 mZ- 2 m5- 5 mOther cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m.Cable outletA- Axial- Left tangentialConnectorA- 9 pin D type plugD- 15 pin D type plugB- 12 pin M23 coupling connectorF- Flying leadC- 12 pin M23 cable connectorN- 17 pin M23 type plug	C - 50 ns			-								
Image: Norm of the second state is a second state in the second state is a second sta	D - 75 ns			-								
Cable length A = 0.3 m C = 1.5 m 3 = 3 m B = 0.5 m 2 = 2 m 5 = 5 m Conserved D = 2.5 m F = 10 m Cable outlet D = 2.5 m F = 10 m Cable outlet D = 2.5 m F = 10 m Cable outlet D = 2.5 m F = 10 m Cable outlet D = 15 pin D type plug D = 15 pin D type plug Connector D = 15 pin D type plug F = Flying lead N = 12 pin M23 coupling connector F = Flying lead N = 12 pin M23 cable connector N = 17 pin M23 type plug	E - 100 ns	-		-								
A - 0.3 m C - 1.5 m 3 - 3 m B - 0.5 m 2 - 2 m 5 - 5 m I - 1 m D - 2.5 m F - 10 m Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial - Left tangential R - Right tangential B - 12 pin M23 coupling connector F - 12 pin M23 cable connector M - 17 pin M23 type plug D - 15 pin D type plug F - Flying lead N - 17 pin M23 type plug	F - 125 ns	L - 800 ns										
A - 0.3 m C - 1.5 m 3 - 3 m B - 0.5 m 2 - 2 m 5 - 5 m I - 1 m D - 2.5 m F - 10 m Other cable lengths available per special request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial - Left tangential R - Right tangential B - 12 pin M23 coupling connector F - 12 pin M23 cable connector M - 17 pin M23 type plug D - 15 pin D type plug F - Flying lead N - 17 pin M23 type plug	Cable length											
 I - 1 m D - 2.5 m F - 10 m request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial Left tangential Reght tangential Connector A - 9 pin D type plug D - 15 pin D type plug F - Flying lead Connector N - 17 pin M23 type plug Special requirements	-	- 1.5 m	3 - 3 m									
I - 1 m D - 2.5 m F - 10 m request. Minimum cable length is 10 cm, maximum cable length is 10 m. Cable outlet A - Axial - Left tangential R - Right tangential R - 9 pin D type plug D - 15 pin D type plug B - 12 pin M23 coupling connector F - Flying lead C - 12 pin M23 cable connector N - 17 pin M23 type plug	B - 0.5 m 2			Other c	able len	gths av	ailable	per sp	ecial			
Cable outlet A - Axial - Left tangential R - Right tangential Connector A - 9 pin D type plug B - 12 pin M23 coupling connector F - Flying lead C - 12 pin M23 cable connector N - 17 pin M23 type plug	1 - 1 m D	- 2.5 m l	F - 10 m									
 A - Axial Left tangential Right tangential Romector 9 pin D type plug D - 15 pin D type plug A - 9 pin M23 coupling connector F - Flying lead Connector N - 17 pin M23 type plug 				maximu	ım cable	length	is 10 m	ı.				
 A - Axial Left tangential Right tangential Romector 9 pin D type plug D - 15 pin D type plug A - 9 pin M23 coupling connector F - Flying lead Connector N - 17 pin M23 type plug 												
 Left tangential Right tangential Connector 9 pin D type plug 0 - 15 pin D type plug 3 - 12 pin M23 coupling connector F - Flying lead N - 17 pin M23 type plug 												
R - Right tangential Connector A A 9 pin D type plug D - 12 pin M23 coupling connector F - 12 pin M23 cable connector N - 17 pin M23 type plug												
A - 9 pin D type plug D - 15 pin D type plug B - 12 pin M23 coupling connector F - Flying lead C - 12 pin M23 cable connector N - 17 pin M23 type plug	R - Right tangential											
A - 9 pin D type plug D - 15 pin D type plug B - 12 pin M23 coupling connector F - Flying lead C - 12 pin M23 cable connector N - 17 pin M23 type plug	Connector											
3 - 12 pin M23 coupling connector F - Flying lead 2 - 12 pin M23 cable connector N - 17 pin M23 type plug Special requirements Special requirements	A - 9 pin D type plug		D - 15 pin D	type plua								
C - 12 pin M23 cable connector N - 17 pin M23 type plug		g connector										
Special requirements					Jg							
			-	-								
00 - No special requirements	Special requirements											
	00 - No special require	ements										

Not all part number combinations are valid. Please refer to the table of available combinations on the next page.

Table of available combinations

Series	Output type	Pole length	Reference mark	Resolution	Minimum edge separation	Cable length	Cable outlet	Connector	Special requirements
	AS	1/2		000	А				
				02B / 03B / 04B / 05B / 06B / 07B / 08B / D02 / D04 / D10 / D16 / D20 / D80	B/C/D/E /F/G/H/ I/J/K/L / M/N/O/ P/Q				
				09B / D40 / D50	B/C/D/E /F/G/H/I /J/K/L/M /N/O/P				
		1		10B / 1D0 / D80	B/C/D/E /F/G/H/I /J/K/L/M /N/O				
		IC2	E	11B / 2D0	B/C/D/E /F/G/H/ I/J/K/L / N/O/P	1/2/3/5 A/B/C/ D/F	A / L / R	A/B/C/ D/F/N	00
SP3	IC			12B / 4D0	B/C/D/E /F/G/H/ I/J/L/M/ N/O/P				
				02B / 03B / 04B / 05B / 06B / 07B / 08B / 09B / D02 / D04 / D08 / D10 / D16 / D20 / D40 / D50	B/C/D/E /F/G/H/ I/J/K/L / M/N/O/ P/Q				
				10B / 1D0 / D80	B/C/D/E /F/G/H/I /J/K/L/M /N/O/P				
				11B / 2D0	B/C/D/E /F/G/H/I /J/K/L/M /N/O				
				12B / 4D0	B/C/D/E /F/G/H/ I/J/K/L / N/O/P				



Magnetic ring

		MR	040	U	030	F	128	Ν	00
Series									
MR - Magnetic inci	emental ring								
g	g								
Outer diameter									
031 - 31 mm	114 - 114 mm								
040 - 40 mm	127 - 127 mm								
050 - 50 mm	162 - 162 mm								
063 - 63 mm	176 - 176 mm								
081 - 81 mm									
Cross section									
	, radial magnetisation, fully w		oil						
X - Cross section	defined under Special require	ments							
Inner diameter									
0 20 - 20 mm	095 - 95 mm								
)30 - 30 mm	100 - 100 mm								
)40 - 40 mm	143 - 143 mm								
050 - 50 mm	130 - 130 mm								
060 - 60 mm									
Reference mark									
F - GMR reference	e mark								
Number of poles									
050 - 50 poles	160 - 160 poles	400 - 400							
064 - 64 poles	180 - 180 poles	512 - 512							
)80 - 80 poles	200 - 200 poles	556 - 556	poles						
100 - 100 poles	256 - 256 poles								
128 - 128 poles	360 - 360 poles								
Material									
N - Martensitic sta	ainless steel hub with bonded	rubber tape,	with cove	r foil					
Special requireme	nts								

00 - No special requirements

29 - Height 15 mm, radial magnetisation, fully welded cover foil

Not all part number combinations are valid. The inner diameter of rings is related to the outer diameter and cannot be randomly selected. Please refer to the table of available combinations on the next page.

Other magnetic ring sizes available per special request.

Table of available combinations

Series	Outer diameter	Cross section	Inner diameter	Reference mark	Number of poles	Material	Special requirements
MR	031	U	020	F	050	Ν	00
					100		
	040		030		064		
					128		
	050		040		080		
					160		
	063				100		
					200		
			050		100		
					200		
	081		060		128		
					256		
	114		095		180		
					360		
	127		100		200		
					400		
	162		143		256		
					512		
	176		130		556		29



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Document issues

Issue	Date	Page	Description	
4	16. 2. 2022	21	Hysteresis added	
5	2. 2. 2023	4	Surface markings added	
6	10. 7. 2023	24, 25	Max. length amended	
7	25. 10. 2023	22	Connector options amended	
		28	Table of available combinations amended	

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