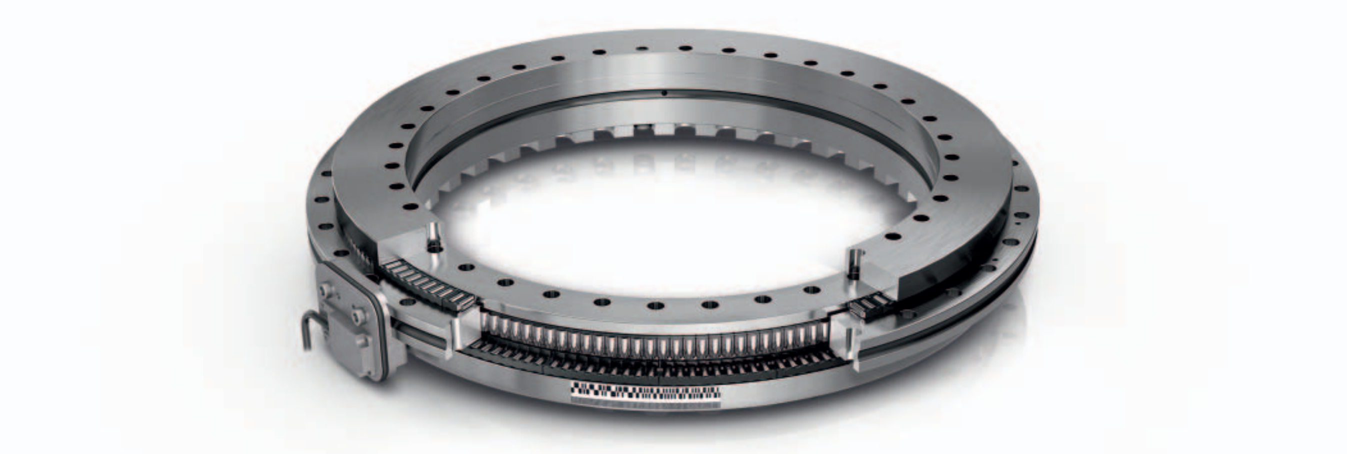
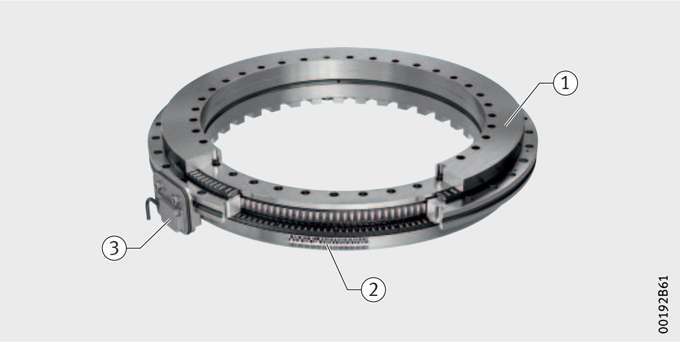


Rotary table bearings with integrated angular measuring system

Bearing-integrated angular measuring system

The bearing-integrated angular measuring system is intended for use in electrically driven, position-controlled machine tool axes for the purpose of recording actual angular values. It consists of two assemblies – the measuring system bearing and the measuring head, *Figure 1*.



① Rotary table bearing YRTCMA
② Measurement ring
③ Measuring head MHA...-0

Figure 1
Bearing-integrated inductive measuring system (absolute)

The measuring system bearing is identical in design to the rotary table bearings YRTC and YRTS, except for the additional inclusion of a measurement ring of type AMO on the inner ring of the measuring system bearing, which features a regular grating structure as angular pitch with a pitch period of 1000 μm. A stainless steel strip is used as the carrier material for the measurement ring, into which the periodic angular pitch is introduced by means of a high-precision photolithographic method with subsequent etching process.
The measuring system bearings are alternatively available with absolute coded measurement rings, *Figure 1*, or with incrementally coded measurement rings, *Figure 2*, page 2. The product designation YRTCMA or YRTSMA refers to the first design and YRTCMI to the second.

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Rotary table bearings with integrated angular measuring system

① Rotary table bearing YRTCMI
② Measurement ring
③ Measuring head MHI...-0

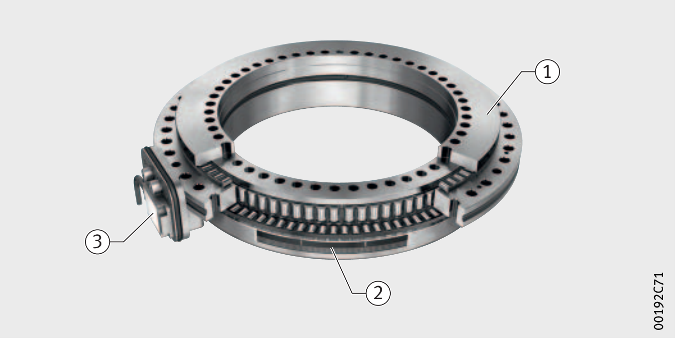


Figure 2
Bearing-integrated inductive measuring system (incremental)

The measuring head works according to the inductive AMOSIN® measuring principle. The measuring head contains the primary and secondary coils for the inductive scanning of the measurement ring, the electronic measuring head system, interfaces, line driver and a cable with plug connector. The measuring heads with absolute measuring system interfaces in the MHA design are matched to the absolute variant of the measuring system bearing. The measuring heads with an incremental measuring system interface in the MHI design are matched to the incremental variant of the measuring system bearing. AMOSIN® is a trademark of AMO GmbH.

The measuring heads can be screwed directly onto the respective outer ring of the measuring system bearing. There are two mechanical variants of the measuring heads. With the variant that is suitable for radial screw mounting to the outer ring, *Figure 3*, there is no adjustment of the measurement gap and accessibility is very good. As a result, the expenditure associated with mounting work is reduced. In contrast, the version for axial screw mounting to the bearing outer ring, *Figure 4*, requires an adjustment of the measurement gap, but is smaller than the version referred to above.

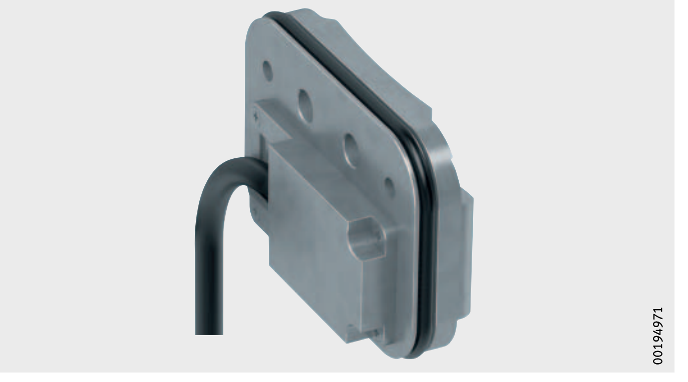


Figure 3
Radial measuring head
MHA...-0

Figure 4
Axial measuring head
MHA...-2

Rotary table bearings with integrated angular measuring system

Advantages of the measuring system

- very good control characteristics (high control stability and high dynamics) due to the rigid mechanical connection to the adjacent construction
- extremely high system accuracies achieved with a single measuring head due to the use of precision components
- hollow shaft design; the centre of the axis is freely available for additional components
- non-contact and wear-free
- measurement carried out irrespective of tilting and position
- unaffected by oils, greases, cooling lubricants and magnets
- easy to mount as adjustment of the measurement gap is not required
- no need for alignment of the bearing and a separate measuring system
- no additional parts; the resulting space saved can be used for the machining area of the machine
- gives savings on components, overall design envelope and costs due to the compact, integrated design requiring fewer components
- available with all common measuring system interfaces
- reference search movement is not required with absolute measuring systems
- incremental measuring systems are electronically compatible with all common machine tool controllers

Characteristics of measuring system bearings

The measuring system bearing:

- has very high tilting rigidity
- has a very low frictional torque
- permits high mechanical limiting speeds
- undergoes minimal heating in continuous operation
- permits maximum positional accuracy

Operating principle

The AMOSIN® operating principle for scanning the angular pitch works on an inductive and non-contact basis. The planar coil structure, which is built into the measuring head (sensor), is unique and consists of multiple coil units arranged in a line in the direction of measurement, which in turn are composed of primary and secondary coils arranged on top of each other, *Figure 5*, page 6.

As a result of manufacturing the sensor unit on a flexible substrate using multi-layer technology, the curvature of the coil structure is matched to the curvature of the measurement rings.

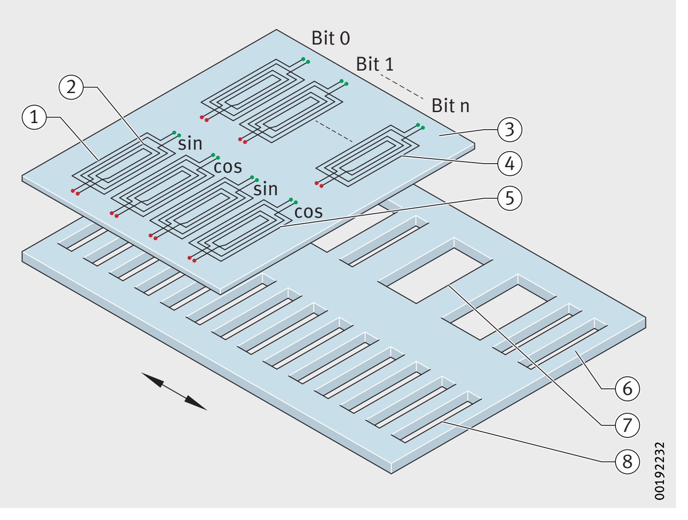
The primary coils are excited with a high-frequency alternating voltage for inductive scanning of the measurement ring. This leads to the generation of electromagnetic alternating fields around the primary windings, which are damped by the crosspieces in the measurement ring and not damped by gaps.

For the measurement ring that is attached to the inner ring featuring a rotation facility, the following applies: The inductive coupling factor between the primary and secondary coils is influenced and modulated when the measurement ring moves relative to the measuring head (sensor). Depending on whether crosspieces or gaps are opposite the secondary coils, a lower or higher alternating current is induced in the secondary windings. The positional value in the measuring head is determined as follows from these differently modulated voltages.

Rotary table bearings with integrated angular measuring system

Determination of position with absolute angular measuring systems

In absolute measuring systems, an angular pitch with absolute coding and an angular pitch with incremental coding are arranged on the measurement rings in a circumferential direction, *Figure 5*. Both angular pitches are scanned using primary and secondary coils designed specifically for this purpose. Immediately after switching on the operating voltage, all primary coils are excited by alternating voltage. This leads to the generation of a unique bit pattern in the absolute secondary coils, from which the absolute angular position is determined by the measuring head for each pitch period. SIN-COS-modulated voltages are also generated in the incremental secondary coils, on the basis of which exact positions are determined and more finely resolved within a pitch period. The absolute actual angular position is calculated from these two sets of angle data – the angular position per absolute pitch period and the high-resolution angular position within the incremental pitch period – and transmitted to the controller via the serial data interface.

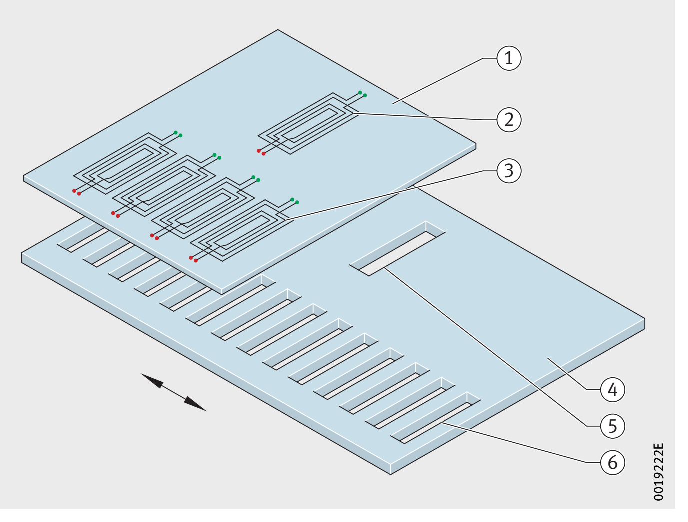


① Primary windings
② Secondary windings
③ Sensor substrate, microcoils
④ Absolute scanning
⑤ Incremental scanning
⑥ Measurement ring
⑦ Angular pitch with absolute coding
⑧ Angular pitch with incremental coding

Figure 5
Operating principle of inductive, absolute AMOSIN® angular measuring systems

Determination of position with incremental angular measuring systems

In incremental measuring systems, an angular pitch with incremental coding and several pitch-coded reference marks are arranged on the measurement rings in a circumferential direction, *Figure 6*. These two structures are scanned using primary and secondary coils designed specifically for this purpose. Immediately after switching on the operating voltage, all primary coils are excited by alternating voltage. As a result, SIN-COS-modulated voltages are generated in the incremental secondary coils, which are transmitted to the controller as analogue SIN-COS voltage signals. In the controller, the analogue voltage signals undergo A/D conversion and higher interpolation to generate the current incremental actual angular position. The pitch-coded reference marks are also scanned as a result of scanning the reference marks. This requires a search movement, in which the absolute actual angular position can be determined by the controller by passing over a minimum of two reference marks.



① Sensor substrate, microcoils
② Reference mark scanning
③ Incremental scanning
④ Measurement ring
⑤ Reference mark
⑥ Incremental angular pitch

Figure 6
Operating principle of inductive, incremental AMOSIN® angular measuring systems

Electronic interfaces

Absolute interface EnDat 2.2

The measuring system interface EnDat 2.2 is a digital, bi-directional interface for measuring devices. It is able to output positional values as well as read out and update information stored in the measuring device, or store new information. Due to the serial transmission of data, four signal lines are sufficient.

The data DATA are transmitted synchronously with the clock signal CLOCK predetermined by the electronic post-processor.

In addition to the EnDat-2.2 command set, no analogue 1 Vss signals are output.

The achievable clock frequency is determined by the length of the cable (maximum 100 m). With running time compensation in the electronic post-processor, clock frequencies of up to 16 MHz or cable lengths up to a maximum of 100 m are possible.

Transmission frequencies of up to 16 MHz in combination with long cable lengths place high technical demands on the cable. Longer cable lengths are achieved with the 1 m long measuring head cable and an extension cable. As a general rule, the entire transmission path must be designed for the respective clock frequency. For this reason, the sole use of extension cables specified and approved for EnDa 2.2 is recommended. Any interruptions in the signal line, due to slip rings for example, should also be avoided.

The digital electronic interface EnDat 2.2 is compatible with the Heidenhain TNC 640 controller and additionally compatible with the Siemens Sinumerik 840D sl controller via the Siemens sensor module SMC40, from firmware version 4.5 and 4.6.

The measuring systems EnDat 2.2 are self-configuring, therefore no parameters specific to the measuring system have to be entered into the controller.

Absolute interface DRIVE-CLiQ®

The measuring system interface DRIVE-CLiQ® is a digital, bi-directional interface for measuring devices. It is able to output positional values as well as read out and update information stored in the measuring device, or store new information. Due to the serial transmission of data, four signal lines are sufficient.

The data DATA are transmitted synchronously with the clock signal CLOCK predetermined by the electronic post-processor.

Longer cable lengths are achieved with the 1 m long measuring head cable and an extension cable. As a general rule, the entire transmission path must be designed for the respective clock frequency. For this reason, the sole use of extension cables specified and approved for DRIVE-CLiQ® is recommended. Any interruptions in the signal line, due to slip rings for example, should also be avoided.

The digital electronic interface DRIVE-CLiQ® is compatible with the Siemens Sinumerik 840D sl controller.

The measuring systems DRIVE-CLiQ® are self-configuring, therefore no parameters specific to the measuring system have to be entered into the controller.

Absolute interface SSI+1Vss (mixture of digital and analogue)

The SSI interface is a serial, digital interface via which absolute positional values are output. The data DATA (28 data bits) are transmitted synchronously with the clock signal CLOCK predetermined by the electronic post-processor. In addition, three places are available for special bits (error, warning and parity), whereby the warning bit is active and constantly at “0”. If an internal error was detected in the measuring head, the error bit is set at “1”.

Two analogue voltage signals, SIN and COS, which can be highly interpolated in the electronic post-processor, are also output via the incremental 1 Vss interface. The sinusoidal incremental signals SIN and COS have an electrical phase-offset of 90° and an amplitude of nominally 1 Vss.

The interface SIN COS SSI+1Vss is compatible with the Siemens Sinumerik 840D sl controller and with the Siemens Sinamics S120 via the sensor modules SMC20, SMC30, SME25 and SME125, from firmware version 2.4.

The measuring systems SS1+VSS are not self-configuring, therefore the parameters which are specific to the measuring system have to be entered into the controller and are made available to the user on request.

Rotary table bearings with integrated angular measuring system

Absolute interface Fanuc02 (FANUC α)

The Fanuc02 interface (interface version High Resolution Type B) is a serial, digital interface via which absolute positional values are output.

The data DATA are transmitted synchronously with the clock signal CLOCK predetermined by the electronic post-processor.

The measuring systems Fanuc02 are not self-configuring, therefore parameters specific to the measuring system have to be entered into the controller.

Incremental interface SIN COS 1Vss + REF (analogue)

The measuring system outputs two analogue voltage signals, SIN and COS, which can be highly interpolated in the electronic post-processor, and a pitch-coded reference signal REF, via the incremental 1 Vss interface.

The sinusoidal incremental signals SIN and COS have an electrical phase-offset of 90° and an amplitude of nominally 1 Vss.

The interface SIN COS is compatible with the Siemens Sinumerik 840D sl controller and with the Siemens Sinamics S120 via the sensor modules SMC20, SME20 and SME120.

The incremental measuring systems SIN COS 1Vss are not self-configuring, therefore the parameters which are specific to the measuring system have to be entered into the controller and are made available to the user on request.

Functional safety

The angular measuring systems with the digital, electronic measuring system interfaces EnDat 2.2, DRIVE-CLiQ® and analogue measuring system interface SIN COS 1Vss are intended for positional determination on rotary axes in applications with a safety focus. These angular measuring systems can be used under normal conditions and in authorised operation for safety-related positioning control loops in applications with a safety focus to IEC 61508 and EN ISO 13849-1.

The mechanical connection of the measuring device to the drive also has safety implications, in addition to the electronic interface. As the controller cannot necessarily detect such errors, an error exclusion is often required in order to loosen the mechanical connections.

In the standard Adjustable speed electrical power drive systems, DIN EN 61800-5-2:2017-11, Table D.8, the loosening of the mechanical connection between the measuring system and drive is listed as an error case for consideration.

In order to be able to use the angular measuring system in a safety-focussed application, the user must use a suitable controller. The fundamental task of the controller is to communicate with the measuring system and reliably evaluate the measuring system data.

For this reason, the safety parameters for the angular measuring systems and the error assumption/error exclusion analysis in Table D.8 for motion and position feedback sensors in accordance with standard DIN EN 61800-5-2:2017-11 are available on request for safety-related analyses of the entire system.

The user of the angular measuring system is solely responsible for:

- the correct implementation, on the machine side, of the signal monitoring of digital interfaces and of analogue interface SIN COS 1Vss in accordance with safety integrity (for example, specification and implementation of the evaluation circuit and logic)
- evaluating the safety integrity of the measuring system in its application environment on the basis of technical data (for example, MTTFd)
- the correct design, on the application side, of the adjacent construction of the measuring system bearing in accordance with the design specifications
- the correct fitting or mounting of the measuring system bearing in accordance with the mounting manual
- the correct fitting or mounting of the measuring head in accordance with the mounting manual

The data in the following documents must be observed in relation to the intended use of the angular measuring system:

- product information
- design specifications
- mounting instructions
- error assumption/error exclusion analysis and safety parameters of the angular measuring system
- CE declaration of conformity (by agreement)
- specification of a reliable controller from the respective controller manufacturer
- datasheet for encoder system connection to sensor module

Rotary table bearings with integrated angular measuring system

Technical data

Angular resolution and system accuracy

The achievable angular resolution, i.e. the number of analogue output signal periods (pitch periods) with incremental measuring systems or the smallest possible resolvable angular step for absolute measuring systems with digital interfaces, depends on the diameter of the measuring system bearing. The system accuracy also depends on the diameter of the measuring system bearing, see table, page 13, and is additionally influenced by the:

- pitch accuracy of the measurement ring
- positional deviations during a signal period
- scanning quality of the measuring head
- quality of the electronic signal processing system of the measuring head
- eccentricity of the bearing outer ring and measurement ring relative to the theoretical axis of rotation
- roundness of the bearing outer ring

The listed values for system accuracy without compensation are maximum approved values that will not be exceeded. Some of the influencing variables lead to reproducible (repeatable) error quotas and some to non-reproducible (random) error quotas. The reproducible error quotas can be determined metrologically with the aid of the reference angular measuring system, stored in the controller as a correction table and compensated for mathematically. The values listed with compensation in the System accuracy column can be achieved with the aid of this compensation method.

The following influences are excluded from the values for system accuracy:

- mechanical deviations doe to mounting
- external electronic influences
- resolution of the positional regulator or controller

Angular resolution and system accuracy of absolute measuring system bearings YRTCMA, YRTSMA

Designation	Pitch periods [number per revolution]	Angular resolution		System accuracy	
		SSI+1Vss [per revolution]	EnDat 2.2, FANUC α, DRIVE-CLiQ® [per revolution]	Without compensation [± angular seconds]	With compensation [± angular seconds]
YRTCMA150	672	672×1 024	23 bit	9,7	3
YRTCMA180	768	768×1 024	23 bit	9,3	2,6
YRTCMA200, YRTSMA200	860	860×1 024	23 bit	8,3	2,3
YRTCMA260, YRTSMA260	1 088	1 088×1 024	24 bit	6,6	1,8
YRTCMA325, YRTSMA325	1 302	1 302×1 024	24 bit	6	1,5
YRTCMA395, YRTSMA395	1 530	1 530×1 024	24 bit	5,1	1,3
YRTCMA460, YRTSMA460	1 760	1 760×1 024	24 bit	4,4	1,1
YRTCMA580	2 196	2 196×1 024	25 bit	6,2	1,3
YRTCMA650	2 508	2 508×1 024	25 bit	5,4	1,1
YRTCMA850	3 200	3 200×1 024	25 bit	4,3	0,9
YRTCMA950	3 540	3 540×1 024	25 bit	3,9	0,8
YRTCMA1030	3 808	3 808×1 024	25 bit	3,6	0,7

The description provided above for the absolute measuring system bearings YRTCMA and YRTSMA also applies analogously to the incremental measuring system bearings YRTCMI, see table.
The basic differential pitch of the pitch-coded reference marks is also listed for the measuring system bearings.

Angular resolution and system accuracy of incremental measuring system bearings YRTCMI

Designation	Pitch periods	Basic pitch of the reference marks	System accuracy	
	[number per revolution]	[pitch periods]	Without compensation [± angular seconds]	With compensation [± angular seconds]
YRTCMI180	768	48	11,9	5,1
YRTCMI200	860	86	10,6	4,6
YRTCMI260	1 088	64	8,4	3,6
YRTCMI325	1 302	62	7,5	3
YRTCMI395	1 530	90	6,4	2,6
YRTCMI460	1 760	80	5,5	2,2

Rotary table bearings with integrated angular measuring system

Measuring heads MHA

The absolute measuring head MHA is available with the fully digital interfaces EnDat 2.2, FANUC α and DRIVE-CLiQ®, as well as with the mixed digital and analogue interface SSI+1Vss.

Characteristics		Unit	Measuring head MHA			
Interface		–	EnDat 2.2	FANUC α	DRIVE-CLiQ®	SSI+1Vss
Designation		–	EnDat 2.2	Fanuc02	DQ	SSI+1Vss
Grating period		μm	1 000			
Maximum input frequency		kHz	20			
Clock frequency		–	≦ 16 MHz	–	100 MBit/sec	≦ 1 MHz
Safety parameters		–	Available by agreement	Not applicable	Available by agreement	
Supply voltage range		DC V	3,6 to 14		10 to 36	3,6 to 14
Power consumption		W	1,5		2,1	1,5
Current consumption		mA	300 (at DC 5 V)		85 (at DC 24 V)	300 (at DC 5 V)
Cable	Sheath material	–	PUR UL Style 20963 80°C 30V			
	Ends	–	$4 \times 0{,}09$ mm^2 $4 \times 0{,}14$ mm^2			$6 \times 2 \times 0{,}09$ mm^2
	Length at measuring head	m	$1^{+0{,}03}$			
	Diameter	mm	$4{,}5^{\pm 0{,}1}$			
	Bending radius with single bend	mm	≧ 10			
	Bending radius with deflection	mm	≧ 50			
Plug connection		–	8-pin coupling M12, pins			17-pin coupling M23, pins
Working temperature range		°C	–10 to +85			
Storage temperature range		°C	–20 to +85			
Electrical protection type		–	IP67 (type MHA...-2) IP68 (type MHA...-0)			
Rotary table bearing series		–	YRTCMA150 to YRTCMA1030 YRTSMA200 to YRTSMA460			

DRIVE-CLiQ® is a protected trademark of Siemens AG.

Measuring heads MHI

The incremental measuring head MHI is available with the analogue interface SIN COS 1Vss + REF.

Characteristics		Unit	Measuring head MHI
Interface		–	Analogue output signals SIN COS 1Vss
Designation		–	SIN COS 1Vss
Grating period		μm	1 000
Maximum input frequency		kHz	100
Safety parameters		–	Available by agreement
Supply voltage range		DC V	4 to 7
Power consumption		W	approx. 1,3
Current consumption		mA	approx. 260 (at DC 5 V)
Cable	Cable sheath material	–	PUR UL Style 20963 80°C 30V
	Ends	–	$6 \times 2 \times 0{,}09$ mm^2
	Cable length of measuring head	m	$1^{+0,03}$
	Cable diameter	mm	$4{,}5^{\pm 0,1}$
	Bending radius with single bend	mm	≧ 10
	Bending radius with deflection	mm	≧ 50
Plug connection		–	12-pin coupling M23, pins
Working temperature range		°C	–10 to +85
Storage temperature range		°C	–20 to +85
Electrical protection type		–	IP67 (type MHI...-2) IP68 (type MHI...-0)
Rotary table bearing series		–	YRTCMI180 to YRTCMI460

Rotary table bearings with integrated angular measuring system

Technical data on measuring system bearings

Technical data on measuring system bearings

Designation	Basic load ratings, rigidity of rolling elements		
	axial		
	C_a	C_{0a}	C_{aL}
	kN	kN	kN/μm
YRTC150, YRTCMA150	128	650	12
YRTC180, YRTCMA180, YRTCMI180	135	730	13,5
YRTC200, YRTCMA200, YRTCMI200	147	850	15,5
YRTC260, YRTCMA260, YRTCMI260	168	1 090	19
YRTC325, YRTCMA325, YRTCMI325	247	1 900	33
YRTC395, YRTCMA395, YRTCMI395	265	2 190	37
YRTC460, YRTCMA460, YRTCMI460	290	2 550	43
YRTC580, YRTCMA580	577	4 450	41,8
YRTC650, YRTCMA650	916	6 800	51,4
YRTC850, YRTCMA850	1 017	8 500	61,9
YRTC950, YRTCMA950	1 080	9 500	72,7
YRTC1030, YRTCMA1030	1 130	10 300	74,9

1) Short operating duration.

2) Consultation with Schaeffler.

			Rigidity of bearing		Tilting rigidity		Limiting speed		Bearing frictional torque
radial			axial	radial	Rolling elements	Bearing			
C_r	C_{0r}	C_{rL}	C_{aL}	C_{rL}	C_{kL}	C_{kL}	n_G		Mr
							Continuous operation	Swivelling operation[1)]	at 5 min^{-1}
kN	kN	kN/μm	kN/μm	kN/μm	kNm/mrad	kNm/mrad	min^{-1}	min^{-1}	Nm
75	146	4,8	3,8	3,2	61	18,6	800	[2)]	4
100	200	5,3	4,7	3,6	88,5	29	600	[2)]	5
123	275	6,2	4,9	4,1	128	40	450	[2)]	6
140	355	8,1	6,9	5,3	265	104	300	[2)]	9
183	530	9,9	7,1	6,3	633	159	200	[2)]	13
200	640	13	9,9	5,8	1 002	280	200	[2)]	19
265	880	17	12	6,5	1 543	429	150	[2)]	25
235	730	11,2	11,9	2,9	1 960	735	80	200	60
458	1 300	8,2	20,6	7,3	3 554	1 193	70	170	70
520	1 690	12	26,5	11,9	6 772	2 351	50	125	130
550	1 890	17,9	30,7	13,6	11 494	3 058	45	110	170
577	2 050	19	36,4	15,2	14 285	5 400	40	100	250

Rotary table bearings with integrated angular measuring system

Dimensions

(1) Shaft locating washer
(2) Outer ring
(3) Measurement ring

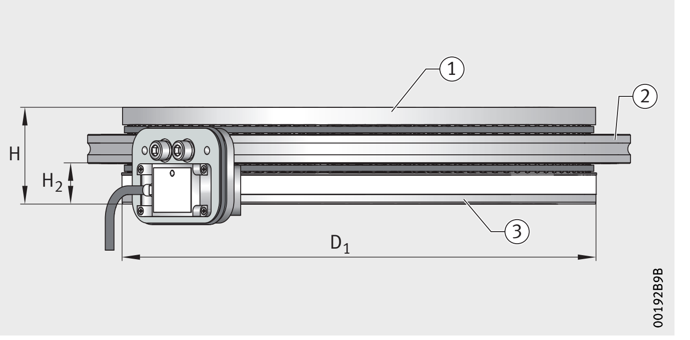


Figure 7
Dimensions

Dimensions of YRTCMA, YRTSMA, YRTCMI

Designation	Dimensions in mm		
	H	H_2	D_1 ∅
YRTCMA150	47	21	214,5
YRTCMA180, YRTCMI180	50	21	245,1
YRTCMA200, YRTSMA200, YRTCMI200	51	21	274,4
YRTCMA260, YRTSMA260, YRTCMI260	57,5	21	346,9
YRTCMA325, YRTSMA325, YRTCMI325	61	21	415,1
YRTCMA395, YRTSMA395, YRTCMI395	65	22,5	487,7
YRTCMA460, YRTSMA460, YRTCMI460	70	24	560,9
YRTCMA580	90	30	699,7
YRTCMA650	122	44	799
YRTCMA850	124	43,5	1 019,3
YRTCMA950	132	46	1 127,5
YRTCMA1030	145	52,5	1 212,8

Dimensions of YRTC, YRTS

Designation	Dimensions in mm		
	H	H_2	D_1 ∅
YRTC150	40	14	214
YRTC180	43	14	244
YRTC200, YRTS200	45	15	274
YRTC260, YRTS260	55	18,5	345
YRTC325, YRTS325	60	20	415
YRTC395, YRTS395	65	22,5	486
YRTC460, YRTS460	70	24	560
YRTC580	90	30	700
YRTC650	122	44	800
YRTC850	124	43,5	1 018
YRTC950	132	46	1 130
YRTC1030	145	52,5	1 215

For additional bearing-specific performance data, dimensions and tolerances, as well as design and mounting recommendations, please also refer to the Technical Product Information for rotary table bearing series YRTC and YRTS.

3D CAD data files are available on the entire bearing and measuring head series, which can be sent on request or downloaded from the Schaeffler website.

Connector assignment of interfaces

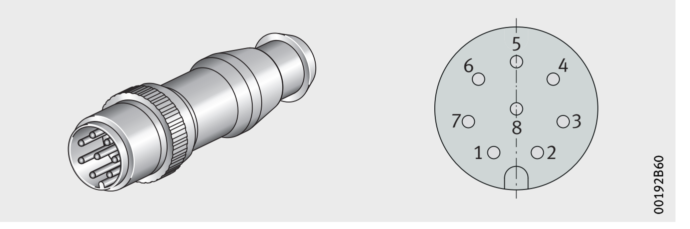


Figure 8
Plug connection interfaces EnDat 2.2, FANUC α and DRIVE-CLiQ®

Connector assignment for interfaces EnDat 2.2, FANUC α and DRIVE-CLiQ®

Parameters	Signal designation	PIN	Cable colour
Power supply	Up	8	Green/brown
	Sensor Up	2	Blue
	0V	5	Green/white
	Sensor 0V	1	White
Signals for absolute positional value	DATA+	3	Grey
	DATA–	4	Pink
	CLOCK+	7	Purple
	CLOCK–	6	Yellow

Rotary table bearings with integrated angular measuring system

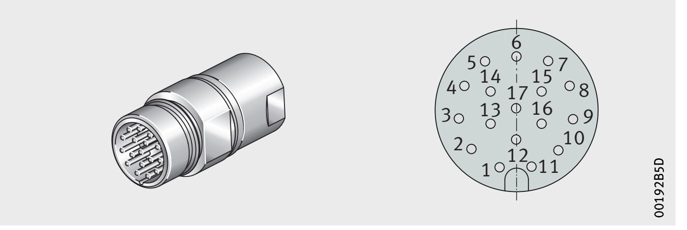


Figure 9
Plug connection interface
SSI+1Vss

Connector assignment for interface SSI+1Vss

Parameters	Signal designation	PIN	Cable colour
Power supply	Up	7	Green/brown
	Sensor Up	1	Blue
	0V	10	Green/white
	Sensor 0V	4	White
Increment signals	A+	15	Brown
	A–	16	Green
	B+	12	Grey
	B–	13	Pink
Signals for absolute positional value	DATA+	14	Red
	DATA–	17	Black
	CLOCK+	8	Violet
	CLOCK–	9	Yellow

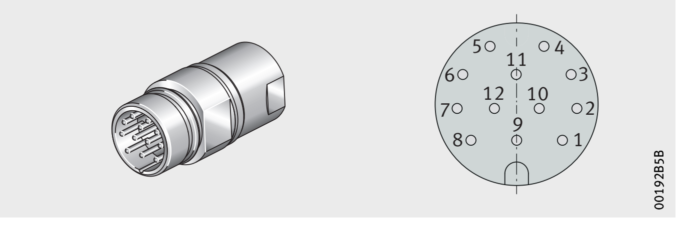


Figure 10
Plug connector interface
SIN COS 1Vss + REF

Connector assignment for interface SIN COS 1Vss + REF

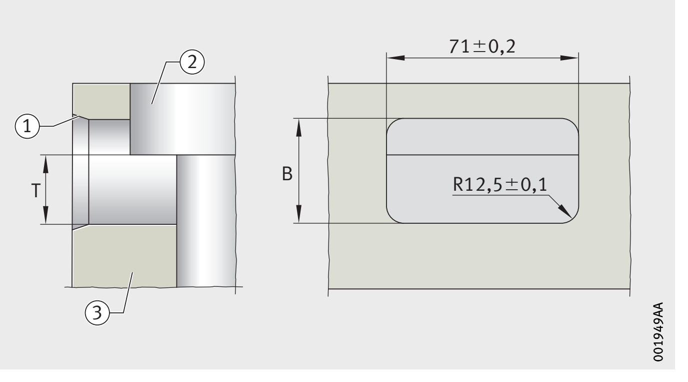
Parameters	Signal designation	PIN	Cable colour
Power supply	Up	12	Green/brown
	Sensor Up	2	Blue
	0V	10	Green/white
	Sensor 0V	11	White
Output signals	A+	5	Brown
	A–	6	Green
	B+	8	Grey
	B–	1	Pink
	REF+	3	Red
	REF–	4	Black
Other signals	Diag+	7	Violet
	Diag–	9	Yellow

Adjacent construction

Measuring head MHA...-0, which is suitable for radial screw mounting, has a flange into which a circumferential groove, containing an O ring, is incorporated, *Figure 11*. The purpose of this O ring is to protect the interior of the rolling bearing against external environmental influences and to retain the rolling bearing grease.

Figure 11
Measuring head MHA...-0
suitable for radial screw mounting

A suitable opening, with dimensions matched to this seal, can be milled into the axis housing, *Figure 12*.



① Joining bevel for O ring
② Observe mounting position of bearing and measuring head in the housing
③ Housing (customer side)

Figure 12
Dimensions

Dimensions

Designation	Depth T mm	Width B mm
YRTCMA180, YRTCMI180	30,5±0,1	50±0,1
YRTCMA200, YRTSMA200, YRTCMI200	30,5±0,1	50±0,1
YRTCMA260, YRTSMA260, YRTCMI260	30,5±0,1	53±0,1
YRTCMA325, YRTSMA325, YRTCMI325	30,5±0,1	55±0,1
YRTCMA395, YRTSMA395, YRTCMI395	30,5±0,1	55±0,1
YRTCMA460, YRTSMA460, YRTCMI460	30,5±0,1	57±0,1
YRTCMA580	34,5±0,1	69±0,1
YRTCMA650	39,5±0,1	78±0,1

Rotary table bearings with integrated angular measuring system

Ordering numbers

The structure of the designations and the ordering numbers for rotary table bearings and measuring heads can be found below.

Structure of designations of rotary table bearings YRTCMA

Components of designation		Possible data	Description
①	Bore diameter	150	–
		180	
		200	
		260	
		325	
		395	
		460	
		580	
		650	
		850	
		950	
		1030	
②	Pitch accuracy	03 ± 3 µm	with YRTCMA150 to YRTCMA460
		05 ± 5 µm	with YRTCMA580 to YRTCMA1030
③	Pitch periods, 360°	0672	with YRTCMA150
		0768	with YRTCMA180
		0860	with YRTCMA200
		1088	with YRTCMA260
		1302	with YRTCMA325
		1530	with YRTCMA395
		1760	with YRTCMA460
		2196	with YRTCMA580
		2508	with YRTCMA650
		3200	with YRTCMA850
		3540	with YRTCMA950
		3808	with YRTCMA1030

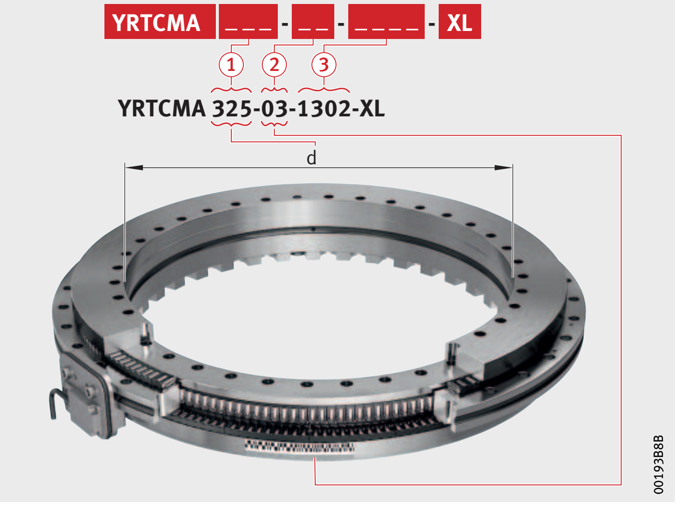


Figure 13
Ordering number code for absolute measuring system bearings YRTCMA

Structure of designations of rotary table bearings YRTSMA

	Components of designation	Possible data	Description
①	Bore diameter	200 260 325 395 460	–
②	Pitch accuracy	03 ±3 μm	–
③	Pitch periods, 360°	0860	with YRTSMA200
		1088	with YRTSMA260
		1302	with YRTSMA325
		1530	with YRTSMA395
		1760	with YRTSMA460

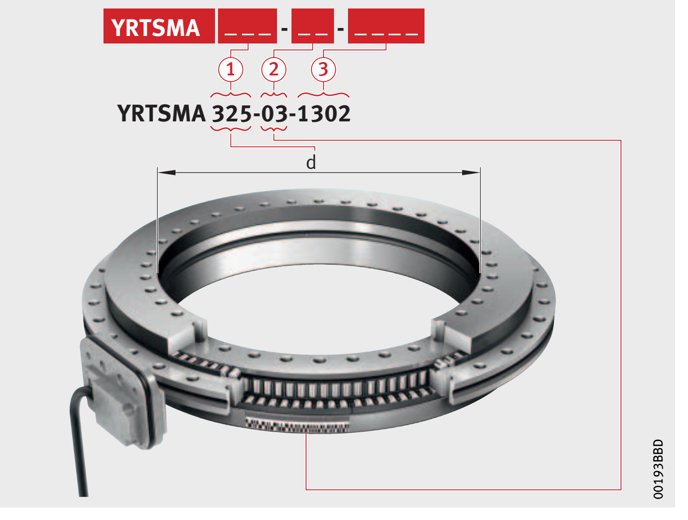


Figure 14
Ordering number code for absolute measuring system bearings YRTSMA

Rotary table bearings with integrated angular measuring system

Structure of designations of absolute measuring head MHA

	Components of designation	Possible data	Description
①	Type	150 180 200 260 325 395 460 580 650 850 950 1030	Matched to bearing type (bore diameter)
②	Mechanical design	0	Suitable for radial screw mounting
		2	Suitable for axial screw mounting
③	Electronic interface	0	SSI+1Vss
		2	DRIVE-CLiQ® (DQ)
		3	Fanuc02 (FANUC α)
		6	EnDat 2.2
④	Absolute resolution per pitch period	1	10 bit (SSI+1Vss)
		3	14 bit (EnDat 2.2, FANUC α, DQ)
⑤	Maximum input frequency	4	20 kHz (standard)
⑥	Analogue pitch factor	0	Factor 1 (not subdivided) for SSI
		N	EnDat 2.2, FANUC α, DQ
⑦	Pitch periods, 360°	0672	with MHA150
		0768	with MHA180
		0860	with MHA200
		1088	with MHA260
		1302	with MHA325
		1530	with MHA395
		1760	with MHA460
		2196	with MHA580
		2508	with MHA650
		3200	with MHA850
		3540	with MHA950
		3808	with MHA1030
⑧	Cable length in m	1	Standard
⑨	Electrical connections	7	17-pin coupling M23, pin for SSI +1Vss
		8	8-pin coupling M12, pin for EnDat 2.2, FANUC α, DQ
⑩	Direction of cable connection	1	Left (standard)
⑪	Circuit version	A	–

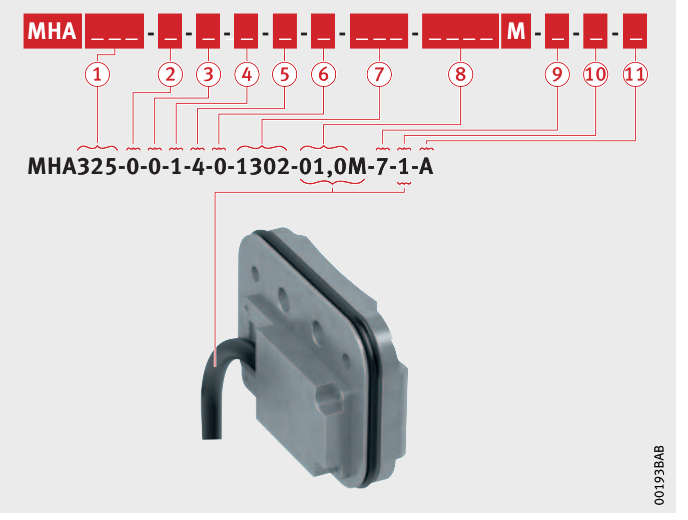


Figure 15
Ordering number code for
absolute measuring heads MHA

Rotary table bearings with integrated angular measuring system

Structure of designations of rotary table bearings YRTCMI

Components of designation		Possible data	Description
①	Bore diameter	180 200 260 325 395 460	–
②	Pitch accuracy	03 ±3 μm	–
③	Pitch periods, 360°	0768	with YRTCMI180
		0860	with YRTCMI200
		1088	with YRTCMI260
		1302	with YRTCMI325
		1530	with YRTCMI395
		1760	with YRTCMI460

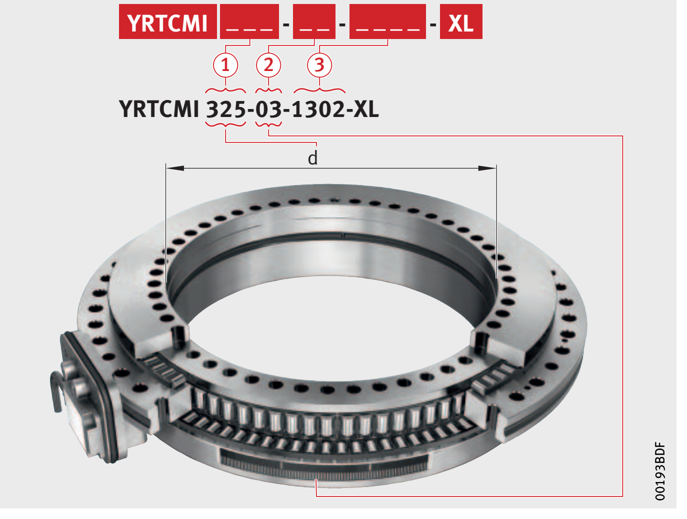


Figure 16
Ordering number code for incremental measuring system bearings YRTCMI

Structure of designations of incremental measuring head MHI

Components of designation		Possible data	Description
①	Type	180 200 260 325 395 460	Matched to bearing type (bore diameter)
②	Mechanical design	0	Suitable for radial screw mounting
		2	Suitable for axial screw mounting
③	Electronic interface	1	SIN COS 1Vss
④	Maximum input frequency	1	100 kHz
⑤	Analogue pitch factor	1	Factor 1 (not subdivided)
⑥	Pitch periods, 360°	0768	with MHI180
		0860	with MHI200
		1088	with MHI260
		1302	with MHI325
		1530	with MHI395
		1760	with MHI460
⑦	Cable length in m	1	Standard
⑧	Electrical connections	1	12-pin coupling M23, pins
⑨	Direction of cable connection	1	Left (standard)
⑩	Circuit version	A	–

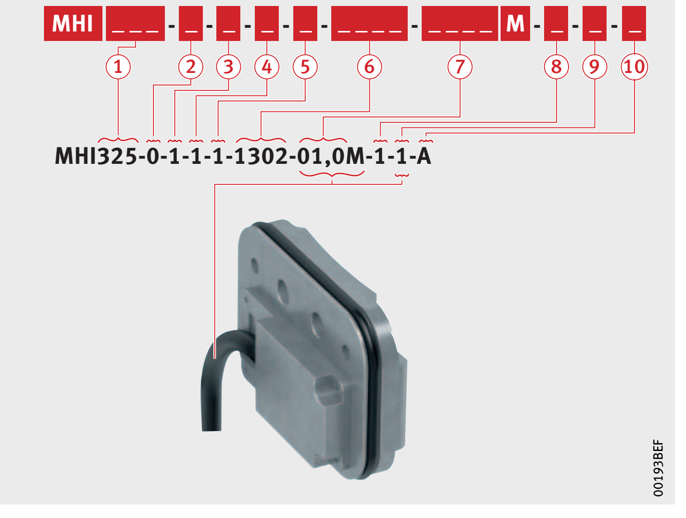


Figure 17
Ordering number code for incremental measuring heads MHI

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