AMO GmbH

Spindle encoder

with implemented operating status data acquisition

Product Information

May 2022

WMK 3010S – Spindle encoder

The WMK 3010S is a spindle encoder with implemented capture of operating status data. This sensor is designed for the use in main spindles in milling and turning applications and equipped with an incremental 1Vpp interface.

As an inductive modular encoder the WMK 3010S consists a scale tape ring and a scanning head. The design features of the modular encoder assure comparably fast mounting and easy adjustment.

Features :

- Integrated capture of operating status data
- High robustness due to the inductive scanning principle
- Compact mechanical design
- High maximum speed
- One reading head for all scale tape sizes
- Mechanical fault exclusion for scale tape ring and scanning head

Operating status data acquisition

The proper mounting and functionality of incremental AMO encoders can be checked by using the STU-60 diagnosis tool together with the AMO-check software.

The spindle encoder WMK 3010S supports in addition a capturing of operating status data.

During standard operation of the sensor in the application operating data are captured and stored in a nonvolatile memory.

The STU-60 supports the configuration of essential application specific data as for example speed and temperature range individually during commissioning.

Captured operating status data can be downloaded from the sensor offline. The AMO-Check software offers tables and histograms to visualize the captured operating status data.

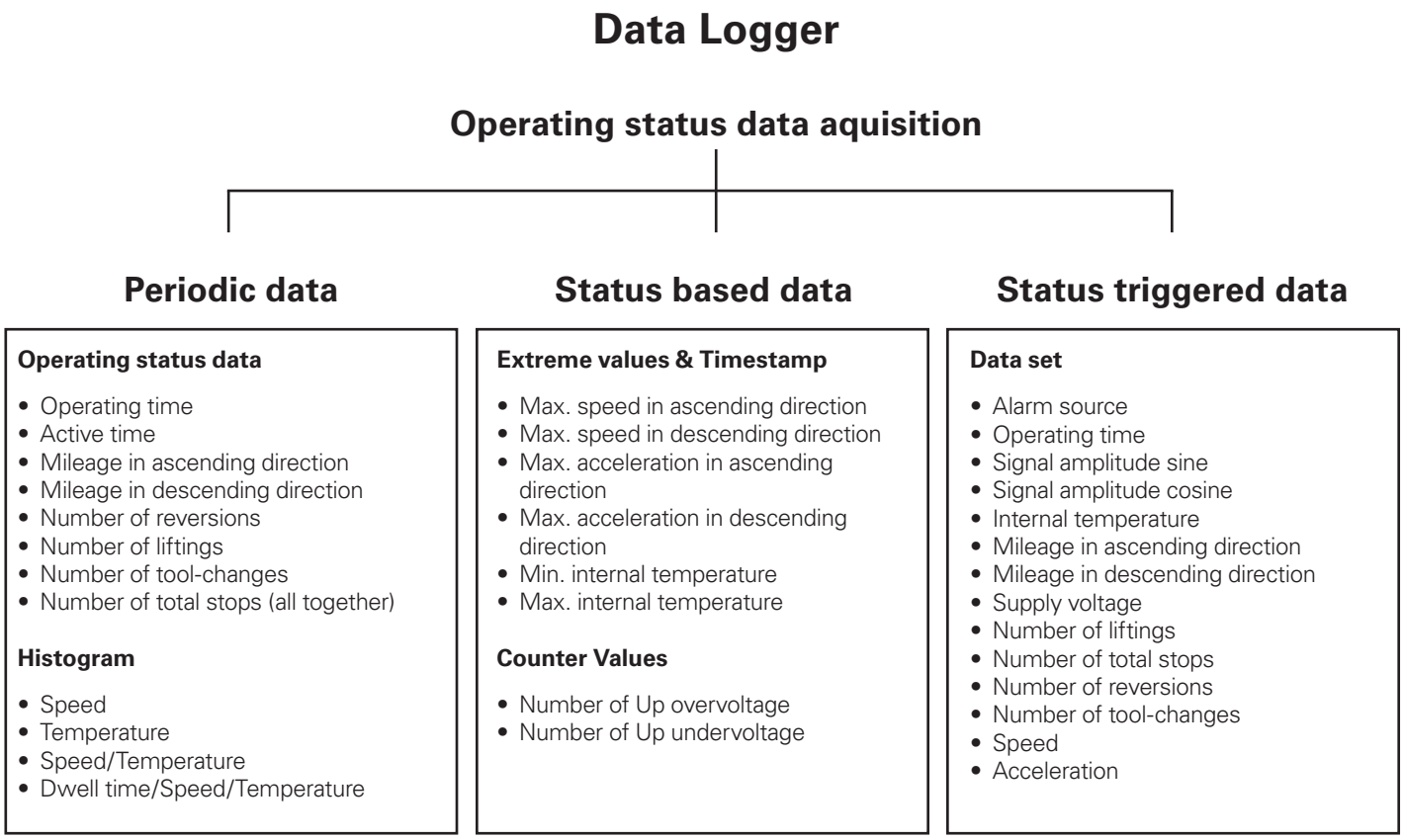
The collected data are divided into 3 categories:

- **Periodic data**
- **Status-based data**
- **Status-triggered data**

Periodic data records relevant information about the mileage of the axis during the entire period of use. Histograms are available as an evaluation for the recorded speed and temperature values. These histograms visualizing how the operating hours in relation to speed or temperature ranges and can be configured by the OEM according to the application requirements during commissioning.

Status-based data stores the extreme values of important parameters occurred over the entire operating time. All stored extreme values are provided with a time stamp.

Status-triggered data stores a data record with all essential information when the specified signal amplitude or operating temperature of the speed sensor is exceeded or undershot. The data records are provided with a time stamp.



Functional Safety

With the incremental spindle encoder WMK 3010S solutions for position detection and speed determination on rotary axes for safety-related systems can be offered.

These are scanning heads with a purely analogue 1 Vpp output signal thereby one signal period is corresponding to one grating period. Corresponding spindle encoders are marked with option „FA" in the order description. These spindle encoders can be used for numerous safety functions of the complete system according to EN 61800-5-2.

AMO provides MTTF values for spindle encoders and the annotated table D8 for motion and bearing sensors within the standard EN 61800-5-2 for the safety-related view of the complete system on demand.

In addition to the electrical interface, the mechanical connection of the encoders to the drive is also relevant to safety. In the standard for electrical drives EN 61800-5-2, Table D8, the loosening of the mechanical connection between the encoder and the drive is listed as a fault.

The fault exclusion against loosening the mechanical connection is required in many cases, because the control can't detect such errors compellingly.

Mechanical fault exclusion

Based on calculations and internal tests, AMO provides an opportunity for a mechanical fault exclusion for the spindle encoder WMK 3010S in combination with the scale tape ring WMR 3010.

In compliance with the specific mounting requirements and conditions of use below a mechanical fault exclusion against loosening of the mounting screws and loosening the scale tape ring from the carrier flange is available according to EN 61800-5-2, table D8.

Fault exclusion against loosening of the mounting screws on the scanning head

The scanning head must be mounted at room temperature and the components must be balanced in terms of temperature.

The tightening of the screws must be torque-controlled. Due to the free clamping length of the scanning head WMK 3010S, there is no need for an additional screw locking device for the screw connection.

	WMK 3010S
Design	40, 41, 42
Mounting screws	
Screws	ISO 4762 M4 x 16 - 8.8
Washer	ISO 7092 - 4 - 200 HV
Torque M_d	2,5 ± 0,25Nm
Length of thread engagement[1)]	> 9mm
Mating stator	
Material	Steel
Tensile strength R_m	≥ 360 N/mm²
Surface roughness R_z	10 to 40 µm
Coefficient of thermal expansion α	(10 to 16) .10 $^{-6}$ K^{-1}
Shock	6ms <1000 m/s² (EN 600068-2-27)

[1)] There must be a blind hole ø 4,3 x 1mm on the stator side at the mounting holes or a countersink with a corresponding depth must be provided.

Fault exclusion against loosening the scale tape ring from the carrier flange

A mechanical fault exclusion for the loosening of the scale tape ring from the carrier flange is given, when the carrier flange is designed according to the mechanical requirements specified by AMO for the respective measuring ring type.

The maximum permissible speeds and accelerations for standard measuring ring sizes are listed in the technical parameters.

Carrier flange	
Material	Steel
Tensile strength R_m	≥ 360N/mm²
Coefficient of thermal expansion α	(10 to 16) .10 $^{-6}$ K^{-1}
Shock	6ms ≤ 1000 m/s² (EN 600068-2-27)

The values for the maximum angular acceleration as stated in the technical data of the scale tape ring are based on calculations and tests at AMO.

These values includes a 10-fold coefficient of safety.

The OEM has the possibility to considerably reduce this coefficient of safety by further analysis and tests.

According to this higher values for the maximum angular acceleration can be achieved.

Cable

- **Technical Data**

	Cable for incremental encoder WMK 3010S
Jacket	PUR
Diameter	3,7 ± 0,1mm
Wires	6 x 2 x 0,05mm²
Bending radius [1)]	≥ 8mm for single bending
	≥ 40mm for continuous bending
Max. length	3m
Resistance according to	UL according to Style 20963 80°C 30V

[1)] Values are valid without liquid exposure

Mechanical design types and mounting

The inductive modular spindle encoder consist of a scale tape ring WMR 3010A and the corresponding scanning head WMK 3010S.

The position of the scanning head and graduation relative to each other is determined solely via the machine bearing. However, the design features of the modular encoders assure comparably fast mounting and easy adjustment.

The stated values for graduation accuracy and the position error within one signal period can be attained in the application if the requirements are fulfilled (see technical specifications).

Scale tape ring WMR 3010A

The scale tape ring WMR 3010A is designed for mounting on a prepared customer specific carrier at customer site. The mechanical requirements of the carrier for a proper mounting are shown in the technical specifications

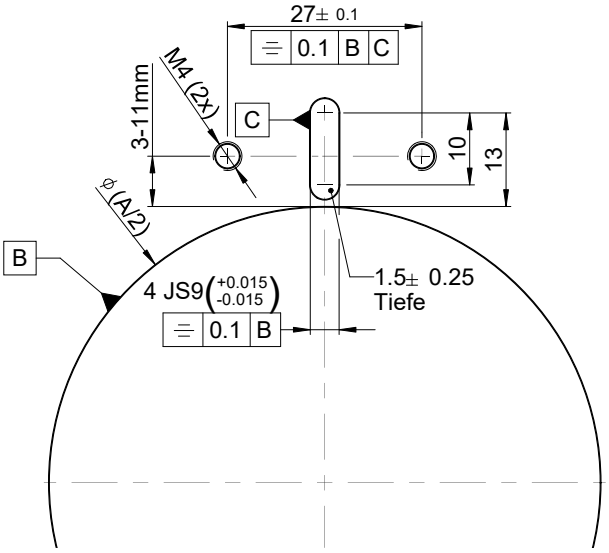
Mounting the scanning head

To ensure the proper function of the spindle encoder, the scale tape ring and the scanning head must be aligned accurately to each other. For this purpose the available mechanical designs of the scanning heads are equipped with a groove on the back. Therefore two recommended mounting variants are available.

In order to finally mount the scanning head, the provided spacer foil is applied to the surface of the circumferential scale drum. The scanning head is pressed against the foil, fastened, and the foil is removed.

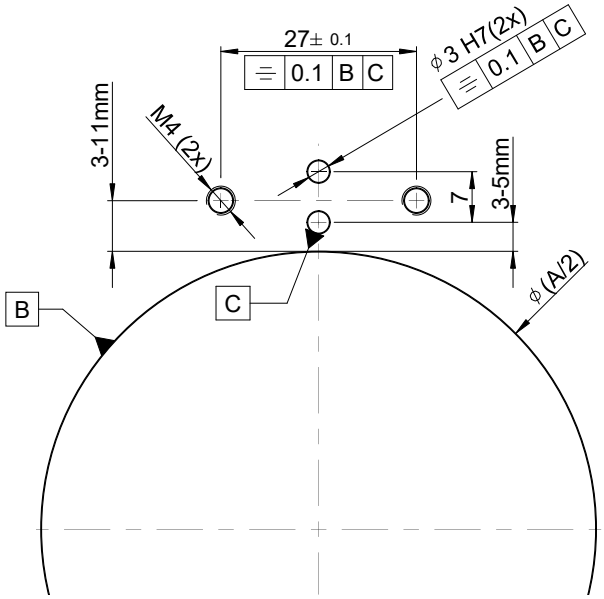
Mounting variant 1

The mounting surface is equipped with a groove. The scanning head will be mounted using a sliding block which is included in delivery.



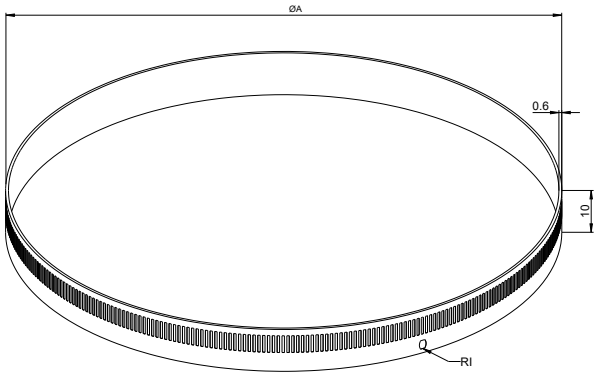
Mounting variant 2

The scanning head will be mounted via two dowel pins. The dowel pins are assuring the correct positioning of the scanning head in tangential direction.



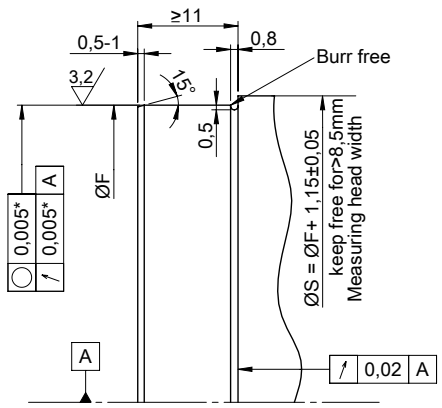
Incremental scale tape ring for outside scanning WMR 3010A

- **Combinable with the scanning head WMK 3010S**
- **Grating period 1000µm**



WMR 3010A

Mechanical requirements on the carrier flange



Line count	ØF [mm]
192	60,26 ±0,01
240	75,55 ±0,01
256	80,65 ±0,01
360	113,82 ±0,01
400	126,55 ±0,01
512	162,24 ±0,02

*) Recommended eccentricity: Higher values affect the positioning accuracy proportionally.

Technical data

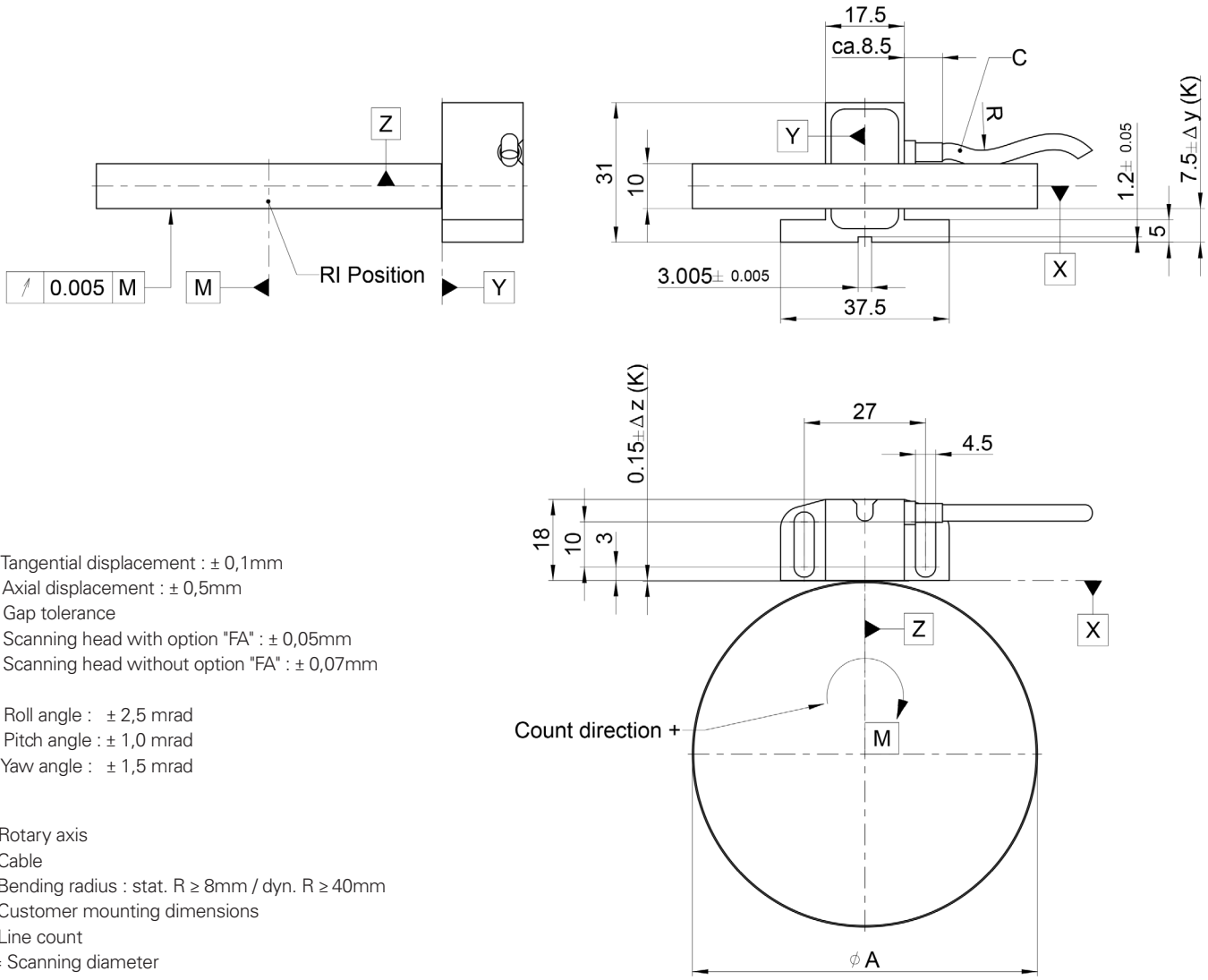
Scale tape ring 1000µm	**WMR 3010A**					
Line count	192	240	256	360	400	512
Reference mark	Single					
Grating period accuracy [1]						
± 15µm arc length	±105“	±85“	±80“	±55“	±50“	±40“
Outside ring diameter [mm]	61,46	76,75	81,85	115,02	127,75	163,44
Mech. speed [min^{-1}] [2]	62500	50000	47000	33000	30000	23500
Max. angle acceleration [$krad/s^2$] [2]	150	50	45	25	18	13

[1] The position error per grating period and the accuracy of the grating result toghether in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.
[2] Values should be considered to ensure a mechanical fault exclusion.

Series WMK 3010S

- **In combination with scale tape ring WMR 3010A**
- **Grating period 1000µm**
- **Scanning head with integrated electronics**

Design 41

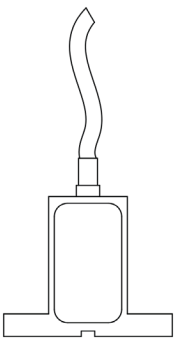


Δx = Tangential displacement : ± 0,1mm
Δy = Axial displacement : ± 0,5mm
Δz = Gap tolerance
Scanning head with option "FA" : ± 0,05mm
Scanning head without option "FA" : ± 0,07mm

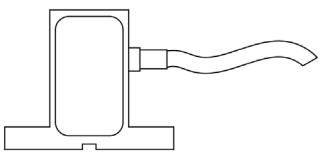
φx = Roll angle : ± 2,5 mrad
φy = Pitch angle : ± 1,0 mrad
φz = Yaw angle : ± 1,5 mrad

M = Rotary axis
C = Cable
R = Bending radius : stat. R ≥ 8mm / dyn. R ≥ 40mm
K = Customer mounting dimensions
N = Line count
ø A = Scanning diameter

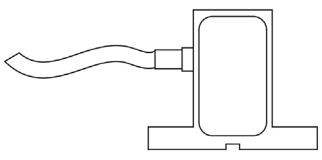
Available designs



Design 40
Cable outlet top



Design 41
Cable outlet right



Design 42
Cable outlet left

Technical data

Scanning head 1000µm	**WMK 3010S**					
Interface	1Vpp					
Max. positional deviation within a signal period	± 15µm	± 10µm				
1Vpp signal period						
Signal period multiplication	1000µm to 100µm 1 to 10					
Max. frequency output signal	400kHz					
Electrical connection	free cable end					
Cable length at scanning head	0,50m - 3,00m					
Supply voltage	DC 4,5V to 7,0V					
Power consumption	≤ 1300mW at 5V					
Typ. electricity recording	190mA at 5V (without load)					
Vibration	< 200m/s² for 55 - 2000Hz (EN 60068-2-6)					
Shock	< 2000 m/s^2 for 6ms (EN 60068-2-27)					
Operating temperature	-10°C to 110°C					
Storage temperature [2)]	-20°C to 85°C					
Protection	IP67					
Mass approximate	30g					
Line count	192	240	256	360	400	512
Positional deviation within a grating period [1)]	±105“	±55“	±55“	±40“	±35“	±30“
Electrical max. speed [min^{-1}]	≤ 62500	≤ 50000	≤ 47000	≤ 33000	≤ 30000	≤ 23500

[1)] The position error per grating period and the accuracy of the grating result toghether in the encoder specific error; additional deviations caused by mounting and bearing are not considered in this error.

[2)] The storage temperature range is valid when the unit remains in it´s packaging.

Ordering code

- **WMK 3010S - Scanning head for incremental spindle encoder**
- **Grating period 1000µm**

WMK 3010S . 08RI □□□□ - □□ - U / B01 - □,□□ - 01 - UJ

Interface

08 = 1Vpp

Reference mark

RI = Rectangle pulse linked (360° el.)/ for 1Vpp

Functional safety

.. = No
FA = Analog signal (1Vpp) can be used for safety related equipment. [1)]

Incremental Signal / Multiplication

01 = without
04 = 4-fold
08 = 8-fold
10 = 10-fold

Design of the scanning head

40 = Universal with slot, cable outlet top
41 = Universal with slot, cable outlet right
42 = Universal with slot, cable outlet left

Cable length

0,50 = 0,50 m
1,00 = 1,00 m
1,50 = 1,50 m
3,00 = 3,00 m

Pin configuration

UJ = for free cable end

Electrical connection

01 = free cable end

Additional function

B01 = Standard diagnosis with operating status data capturing

Scanning range

U = universal

[1)] Option „FA“ only used for dividing factor „01“.

Ordering code

- **WMR 3010 scale tape ring for incremental spindle encoder**
- **Grating period 1000µm**

WMR 3010 A15 - □□□□ - MF - R004 - 1RM

Grating period accuracy

15 = ±15µm

Line count

192
240
256
360
400
512

Safety concept

MF = Fault exclusion for loosing of the mechanical connetions possible

Reference mark

1RM= with 1 reference mark

Type of graduation carrier

R004 = Scale tape ring without cover tape

General electrical information

Supply voltage

Connect AMO-Encoders only to subsequent electronics whose supply voltage comes from PELV systems (for a definition, see EN 50178).

AMO-Encoders meet the requirements of the IEC 61010-1 standard if power is supplied from a secondary circuit with limited energy as per IEC 61010-1[3rd Ed.], Section 9.4, or with limited power as per IEC 62368-1[2nd Ed.], Section 6.2.2.5 PS2, or from a Class 2 secondary circuit as per UL1310.1)

A stabilized DC voltage UP is required for powering the encoders. Information on voltage and current consumption or power consumption can be obtained from the respective specifications.

Regarding the ripple voltage of the DC power, the following parameters apply:

- High-frequency interference
  UPP < 250 mV with dU/dt > 5 V/µs
- Low-frequency fundamental ripple
  UPP < 100 mV

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

The required supply voltage depends on the encoder interface. A distinction is made between encoders without an extended supply voltage range (e.g., DC 5.0 V ±0.25 V) and those with an extended supply voltage range (e.g., DC 3.6 V to 14 V).

[1] In place of IEC 61010-1[3rd Ed.], Section 9.4, the corresponding sections of the following standards can be used: DIN EN 61010-1, EN 61010-1, UL 61010-1, and CAN/CSA-C22.2 No. 61010-1. In place of IEC 62368-1[2nd Ed.], Section 6.2.2.5 PS2, the corresponding sections of the following standards can be used: DIN EN 62368-1, EN 62368-1, UL 62368-1, and CAN/CSA-C22.2 No. 62368-1.

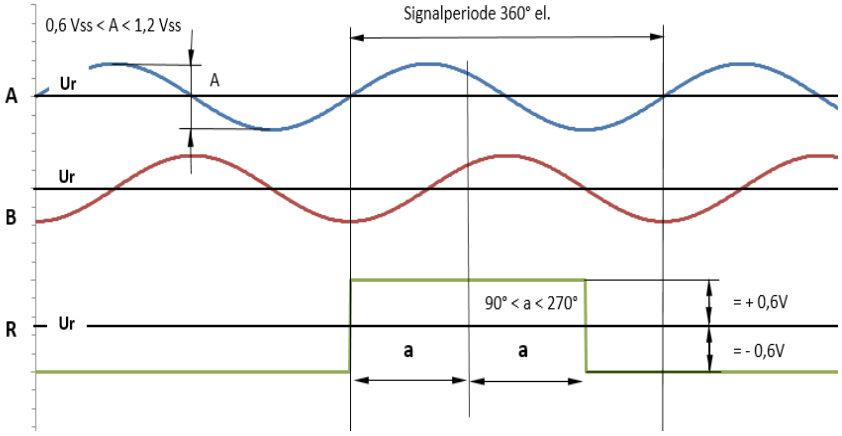
Interface

Incremental signals ~ 1 V_{pp}

AMO-Measuring systems with ~ 1 V_{PP}-Interface are outputing signals which can be highly interpolated.

The sine shaped **incremental signals** A and B are electrically 90° phase shifted and have a signal strenght from 1Vpp. The showed sequence of the outputet signals - B after A - is valid for the in the connection drawing stated movement direction.

The **reference mark** signal R has a clear assignment to the incremental signals.



Pin configuration

Electrical connection: 01 (free cable end)

	Power supply				Incremental signals						Other signals	
	U_P	**Sensor** U_P	**0 V**	**Sensor** 0 V	**A+**	**A–**	**B+**	**B–**	**R+**	**R–**	**Diag+**	**Diag-**
	brown/green	blue	white/green	white	brown	green	grey	pink	red	black	violet	yellow

Cable Shield is connected with the housing; **U_P** = Power supply voltage
Sensor: The sensor wire is connected internally with the corresponding power supply.
Non-used pins or wires must not be assigned!
DIAG-wires must not be assigned.
DIAG-signals are for checking the encoder with AMO-STU-60.

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The basis for ordering from AMO is always the brochure edition valid when the order is made.

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