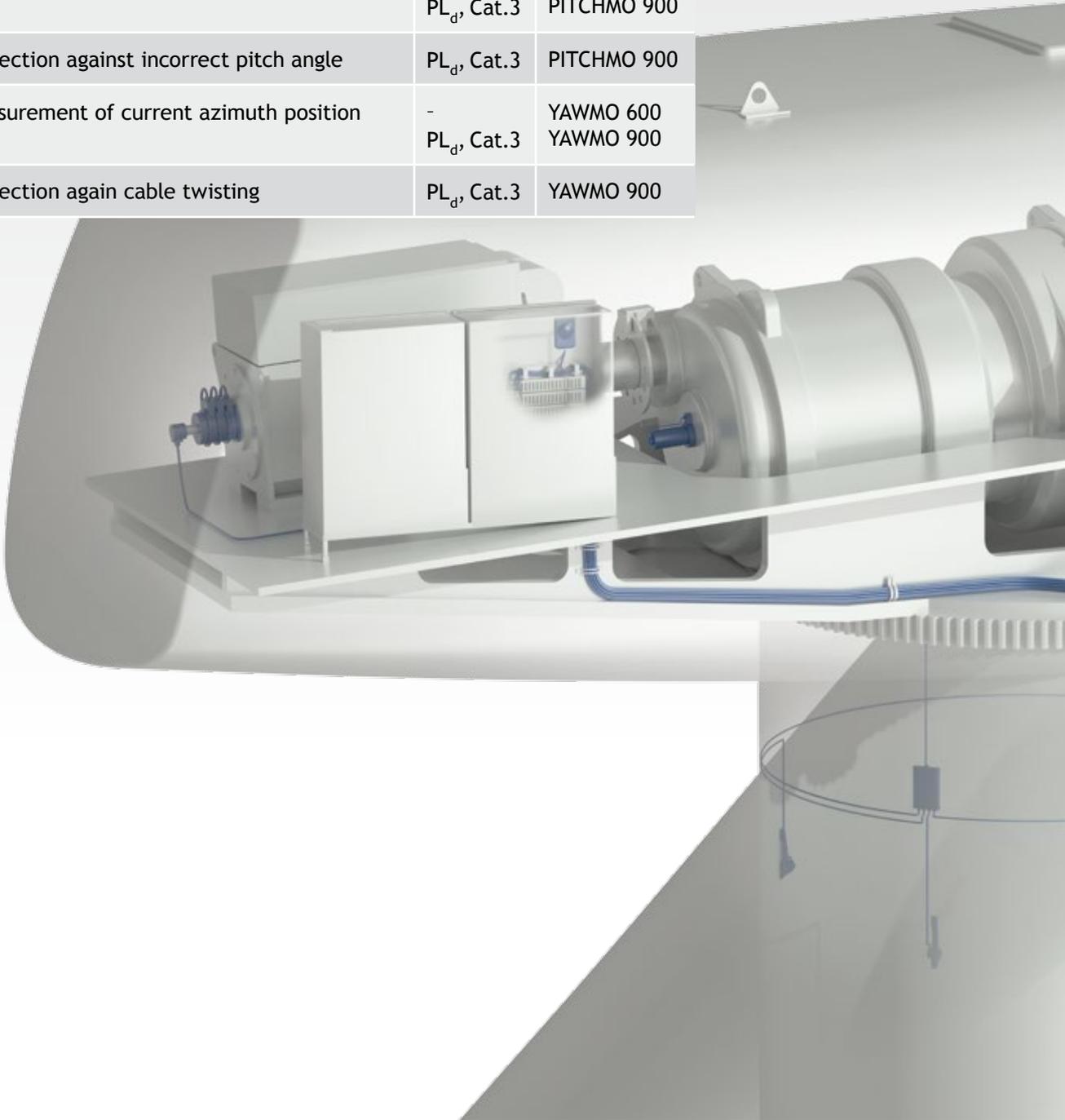




YAWMO[®]
PITCHMO[®]

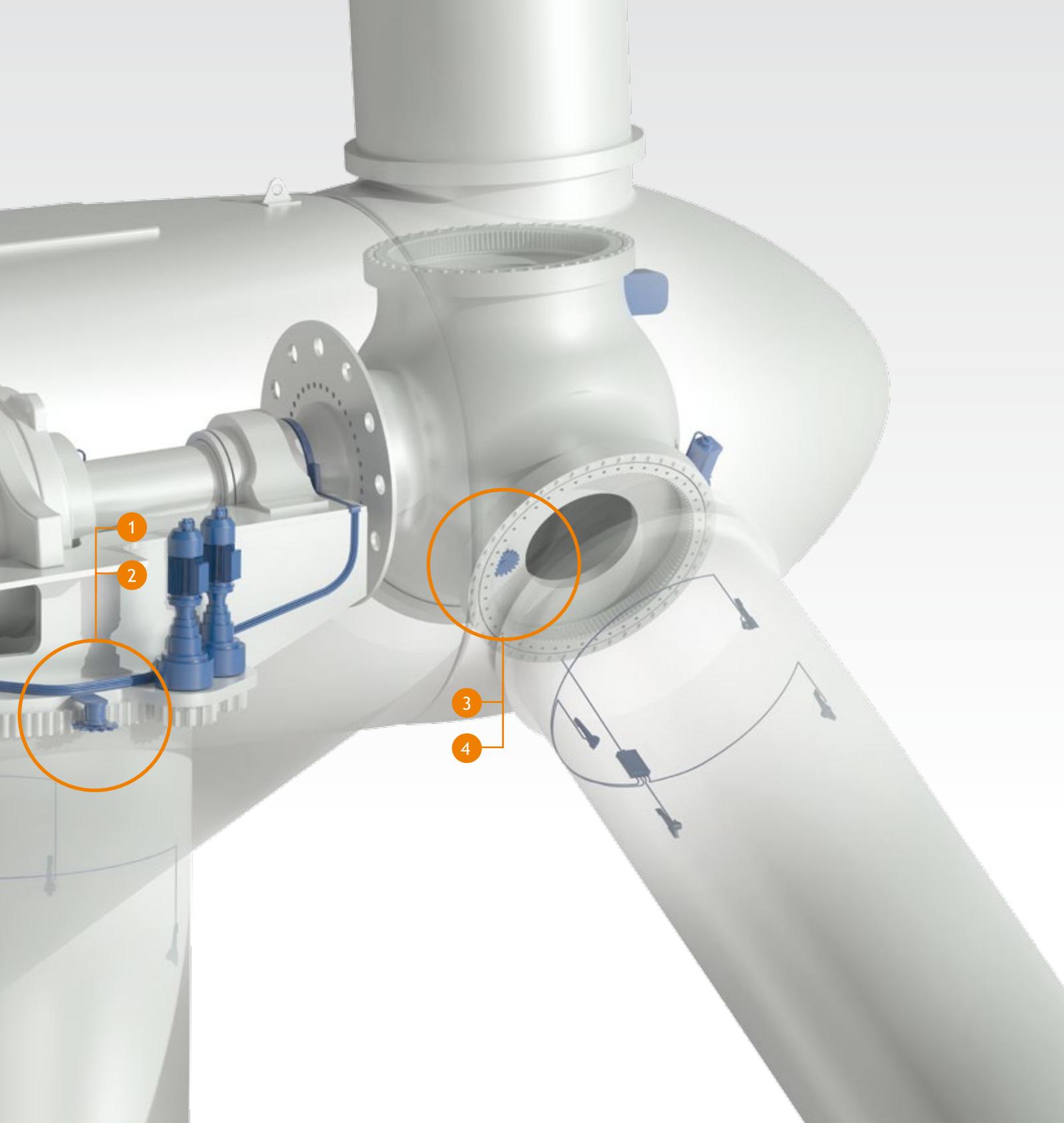
Position sensor & limit switch
for the azimuth and pitch system

Functions	EN 13849	Product
1 Measurement of current pitch position	- PL _d , Cat.3	PITCHMO 600 PITCHMO 900
2 Protection against incorrect pitch angle	PL _d , Cat.3	PITCHMO 900
3 Measurement of current azimuth position	- PL _d , Cat.3	YAWMO 600 YAWMO 900
4 Protection again cable twisting	PL _d , Cat.3	YAWMO 900



1 2 Azimuth application

The yaw system in wind turbines is responsible for the orientation of the nacelle and rotor towards to the wind. For proper turbine control, the nacelle-tower position must be determined as accurately as possible to ensure that the rotor is facing the wind and to minimize material load. In addition, the cables leading from the tower to the nacelle must be protected against twisting. This function is part of the safety system inside the wind turbine.

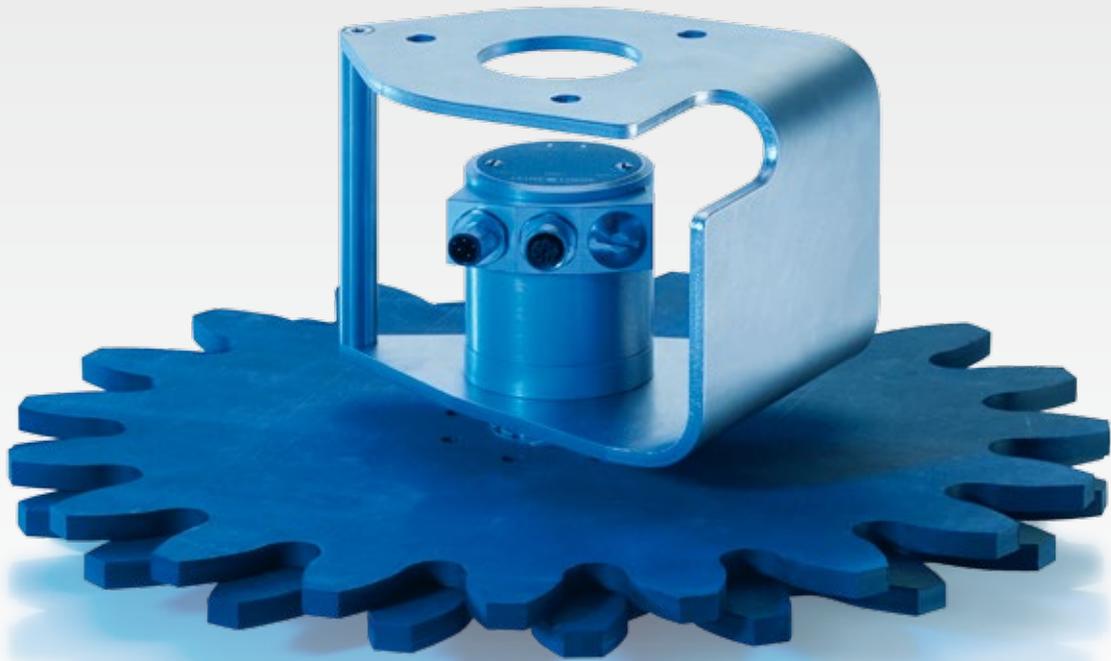


3 4 Pitch application

The rotor blades are the point of origin for generating the power and major system loads in a wind turbine. The purpose of pitch system control is to maximize energy yield while minimizing the structural load on the rotor blades as well as the mechanical load. In this regard, reliable and accurate knowledge about the current pitch position is critical for efficient turbine control.



YAWMO[®] 600
PITCHMO[®] 600



Robust and flexible position sensor for optimizing turbine control.

The YAWMO[®]-/PITCHMO[®] 600 is based on the ISA 600 series and detects the exact position of a wind turbine nacelle and the angle of each rotor blade. The tried and tested singleturn and multi-turn rotary encoder renders the position - via inductive scanning - immune to vibration, moisture, dust, heat and cold. Large-diameter ball bearings reduce the number of costly components and obviates the need for a conventional bearing block. The wide selection of fieldbus interfaces ensures compatibility with almost any kind of wind turbine control system. The 19-bit encoder/single-turn resolution is further optimized by a backlashed, customer-specific gear so that permanent contact with the gearing of the wind turbine can be guaranteed at all times.

Products

Robust encoder/gear solution for the yaw and pitch system

Electrical interfaces

Thanks to the use of a well-established encoder model, a variety of different communication interfaces can be selected. These interfaces include market-standard fieldbuses and the electrical connection can be adjusted to the needs of the customer.

Mechanical interfaces

When installing the 600 series, the customer-specific mounting brackets can be adjusted to ensure optimal integration. Various gear sizes are offered that perfectly match the turbine design. Backlashed gears can be manufactured based on the customer's requirements. This increases measurement accuracy and simplifies installation.

Designs



Enclosure

Anodized aluminum

Mounting brackets

Aluminum, stainless steel



Operating range

Temperature: -40°C ... $+70^{\circ}\text{C}$, Operating height: max. 3000 m



Protection class

IP 67



Voltage supply

9 ... 36 VDC



System resolution

19 bit single-turn, 12 bit multi-turn

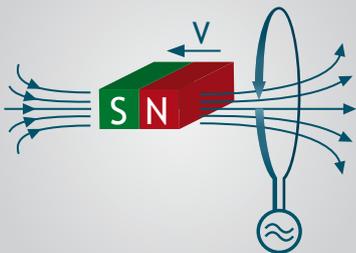
Fieldbus interfaces

PROFIBUS, PROFINET, EtherCAT, CANopen, DeviceNet, EnDat 2.2, SSI



Additional features

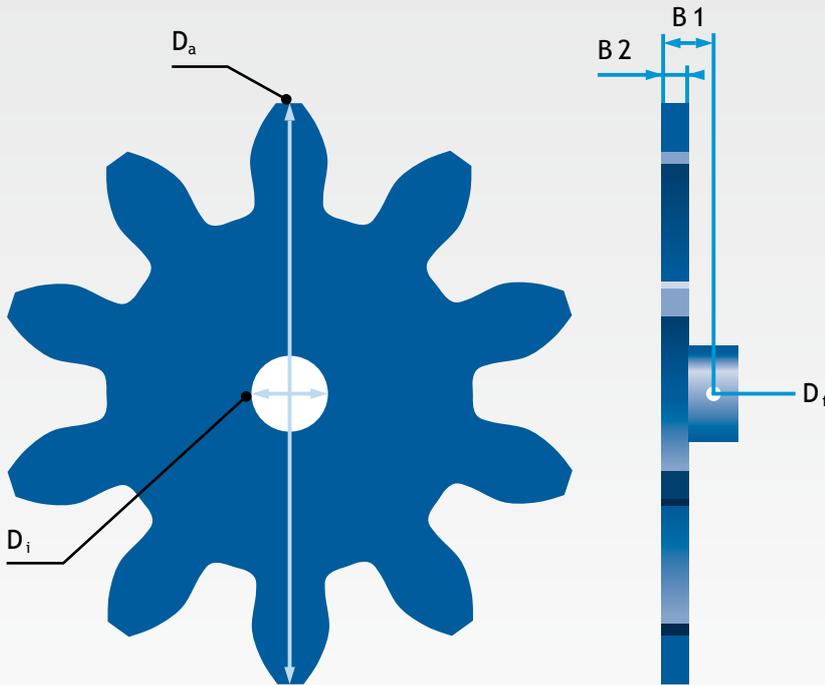
More versions and functions available upon request



Principle of inductive scanning

Electro-magnetic induction refers to a law of physics which states that any motion in a magnetic field (e.g. rotating the shaft) induces an electrical voltage. This voltage signal is analysed to determine position. Advantage: Signal generation is largely immune to vibrations, impacts and dirt.

Gears for the YAWMO®-/PITCHMO® 600 series



Dimensions	
M	Module
Z	Number of gear teeth
D_a	Outer diameter pinion
D_i	Outer diameter Shaft encoder
D_f	Outer diameter for shaft attachment
B1	Width pinion up to the shaft attachment
B2	Width pinion
α	Pressure angle of pinion

Pos.	Product	M	Z	D_a (mm)	D_i (mm)	D_f (mm)	B1 (mm)	B2 (mm)	α
1	PGMOM5Z12S	5	12	70	12	4	16	8	20
2	PGMOM6Z11S	6	11	78	12	4	16	8	20
3	PGMOM8Z12S	8	12	112	12	3,9	16,5	10	20
4	PGMOM10Z12S	10	12	140	12	4	16,5	10	20
5	PGMOM12Z10S	12	10	144	12	4	16	10	20
6	PGMOM12Z12S	12	12	168	12	4	16	10	20
7	PGMOM14Z10S	14	10	168	12	4	16	10	20
8	PGMOM16Z10S	16	10	192	12	4	16	10	20
9	PGMOM18Z10S	18	10	216	12	4	20,5	11	20
10	PGMOM18Z11S	18	11	234	12	4	15	8	20
11	PGMOM18Z12S	18	12	252	12	4	16	10	20
12	PGMOM20Z11S	20	11	260	12	4	15	8	20
13	PGMOM20Z8S	20	8	200	12	4	16	10	20
14	PGMOM22Z10S	22	10	264	12	4	17	10	20
15	PGMOM24Z12S	24	12	336	12	4	17	10	20

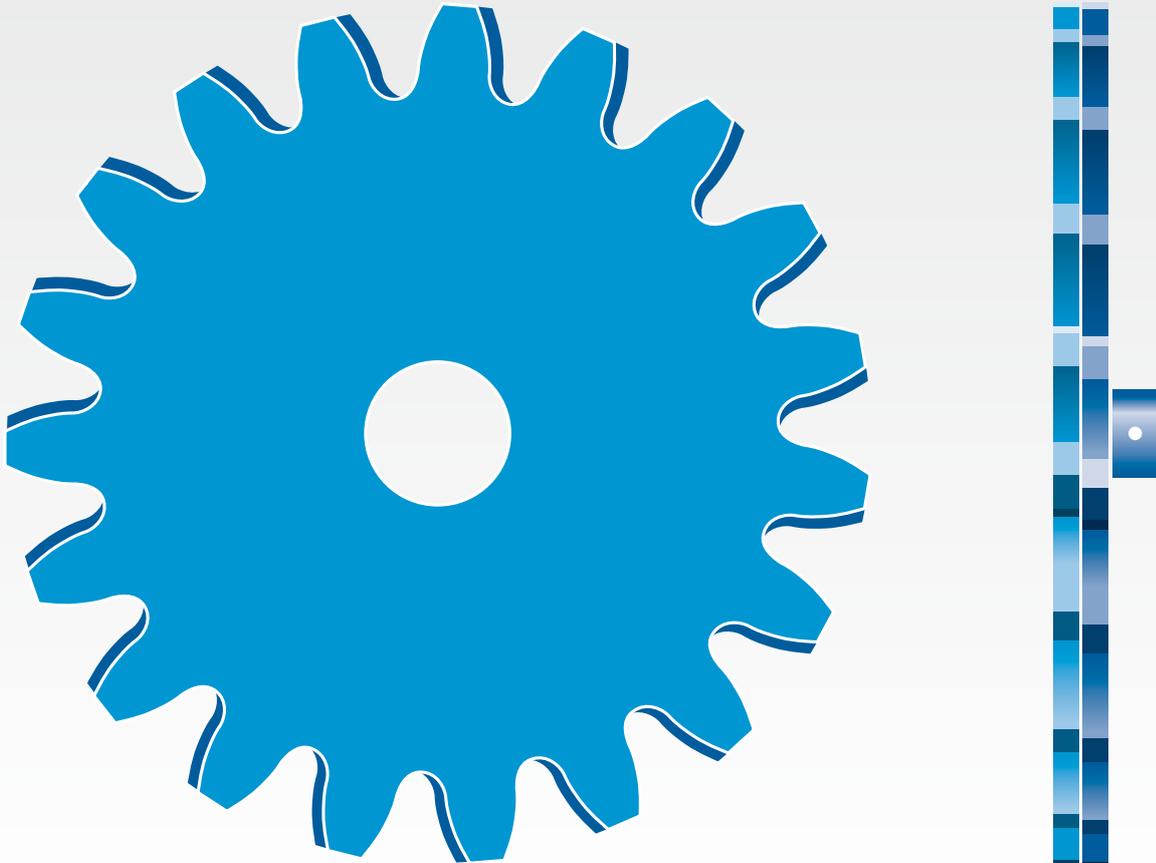
Material properties

Temperature resistance: -40 ... +70°C

Material: PA6, POM

Resistance: UL 94 tested, resistant to oil and grease

Zero backlash gears for the YAWMO[®]-/PITCHMO[®] 600 series



Advantages:

- High positioning accuracy
- High repeating accuracy
- Simplified positioning and mounting
- Customizable
- Robust and secure construction thanks to shim ring and slot for tapered shaft with key

Mounting bracket for the YAWMO[®]-/PITCHMO[®] 600 series

Design:

- Tailored to customer-specific installation
- Mounting brackets in S, C, and L forms available

Material:

- Stainless steel, steel or aluminum

Delivery of YAWMO[®]-/PITCHMO[®] 600 series

- Rotary encoder with mounting bracket and gear can be delivered pre-assembled
- Direct out-of-the-box installation



YAWMO[®] 900
PITCHMO[®] 900



Position sensor & limit switch. Functional safety in accordance with SIL 2, PL_d/Cat. 3

The YAWMO[®]/PITCHMO[®] 900 is based on the FSI 900 series and contains an integrated electronic limit switch with position sensor and fieldbus interface. A dual-channel single-turn and multi-turn position sensor that uses inductive scanning ensures a functionally safe solution with limit switches in accordance with SIL 2, PL_d/Cat. 3. Failsafe relays included. The exact gear position and other information can be queried at any time. The modular design offers easy customization to match the WT design and allows the use of a backlashed, customer-specific gear for optimized system resolution and turbine control. Software is included that lets the customer make custom configurations and carry out device monitoring and diagnostics.

Products

YAWMO® -/PITCHMO® 900 - Highly customizable to wind turbine design

Electrical interfaces

Thanks to the modular design of the FSI 900 series, the data interfaces for communication with the turbine control system can be defined separately from the safety functions. A separate module is responsible for the safety function that shuts down the device when the end position is reached. Optionally, a button for confirming the zero offset can be integrated.

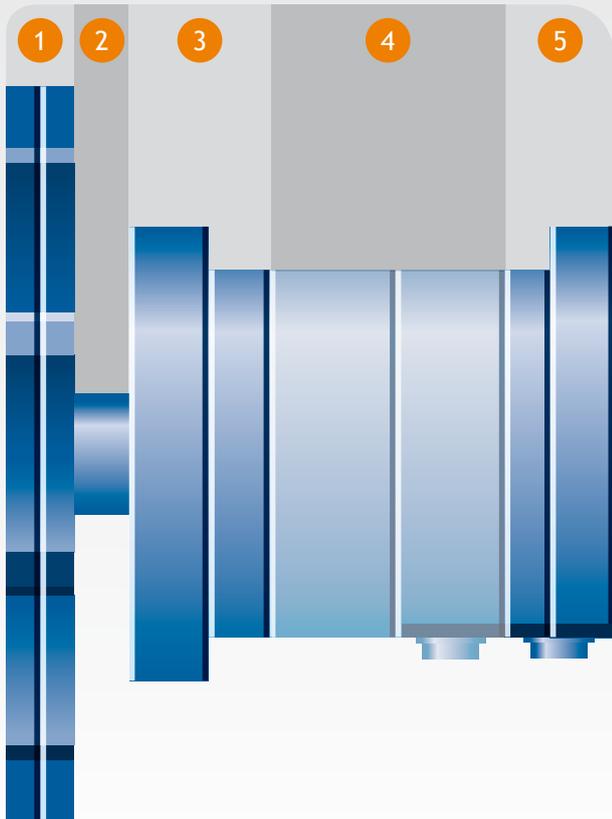
Mechanical interfaces

When installing the FSI 900 series, the customer-specific mounting brackets can be adjusted to ensure optimal integration. Various gear sizes are available that perfectly match any turbine design. Backlashed gears can be manufactured based on the customer's requirements. This increases measurement accuracy and simplifies installation.

Designs

	Operating range	Temperature: -40°C ... +70°C, Operating height: max. 3000 m	
	Protection class	IP 67	
	Enclosure	Anodized aluminum	
	Mounting brackets	Aluminum, steel, stainless steel	
	Voltage supply	18 ... 30 VDC	
	System resolution	19 bit single-turn, 12 bit multi-turn	
	Fieldbus interface	PROFINET	
	Inputs	B module with failsafe relay	B module with failsafe relay and signal relay
	Outputs	3 x digital (failsafe)	3 x digital (failsafe)
		2 x relay (failsafe) 1 x digital (diagnostic)	1 x relay (failsafe) 2 x signal relay, 1 x digital (diagnostic)
	Service life	25 years	
	Safety features	Secure cam, safety limited acceleration, additional safety features	
	Safety certificates	SIL 2 (IEC 61508), PL _d , Cat. 3 (DIN EN ISO 13849)	
	Configuration	PC program, preconfigured upon delivery	
	Additional features	More versions and features available upon request	

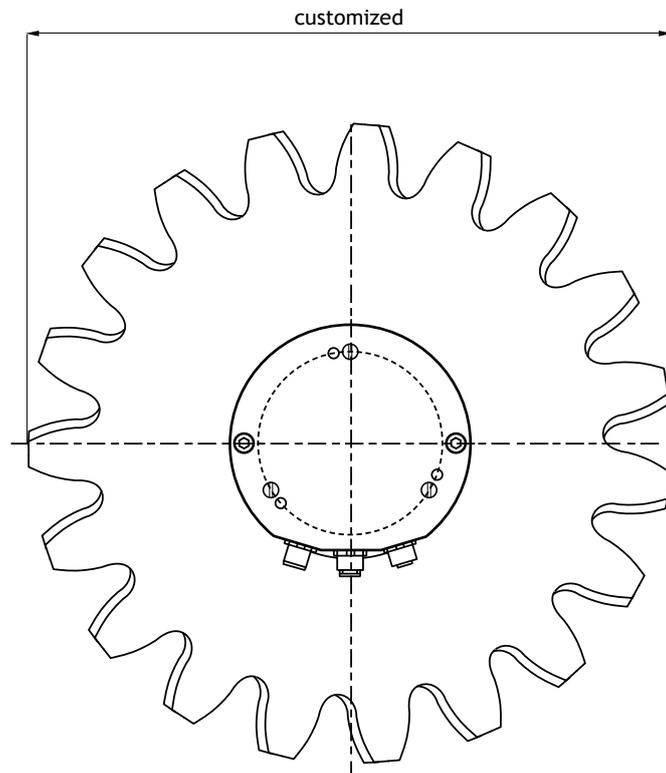
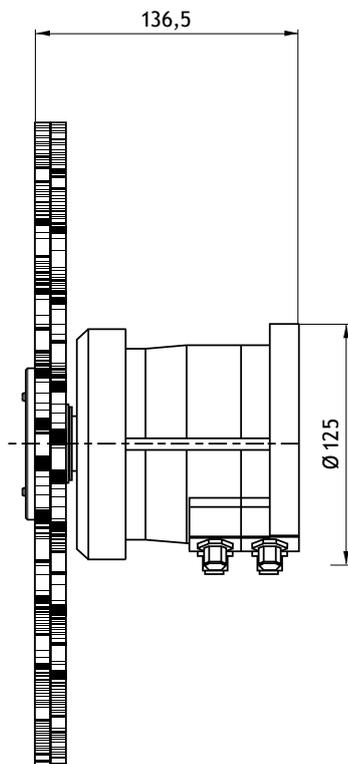
YAWMO® / PITCHMO® 900 - Modular design



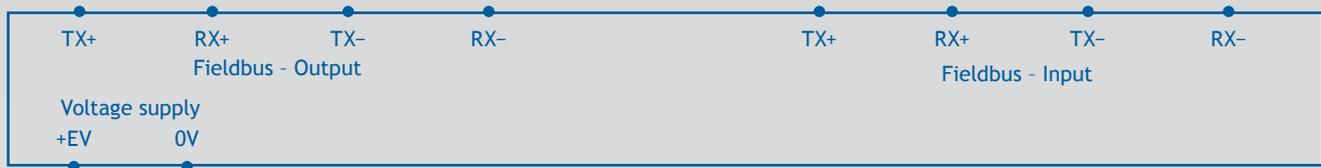
Modules

- 1 Pinion
- 2 Shaft encoder
- 3 Position sensor for safe single-turns and multi-turns
- 4 A module: Process data interface and voltage supply
- 5 B module: Two versions for safety-related functions

Sample depiction and dimensions

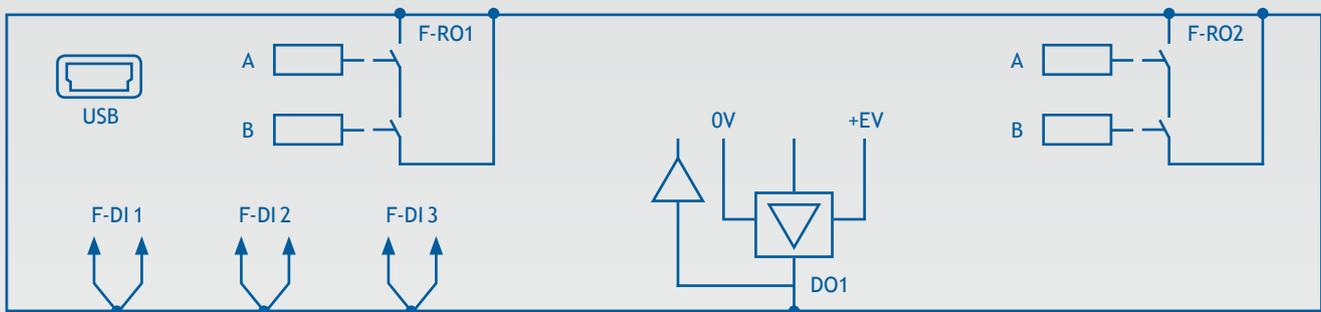


A module



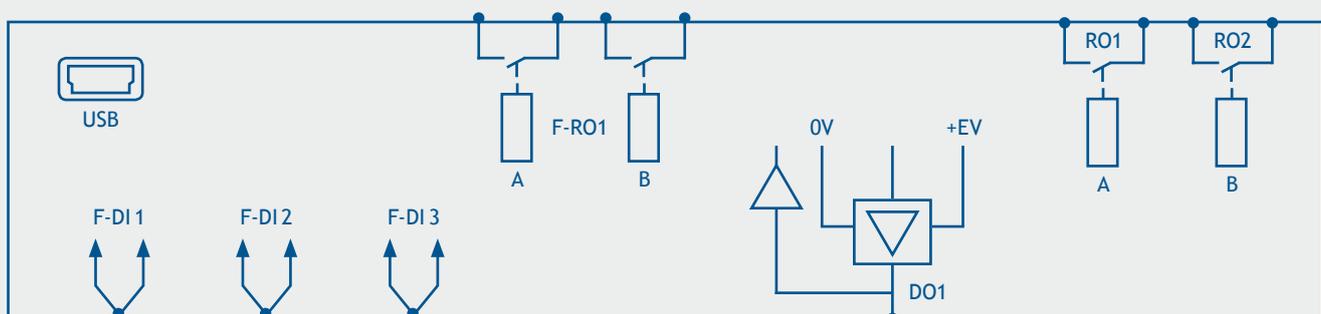
	Interface	Function
+EV, 0V	Voltage supply for the entire unit	18 ... 30 VDC, 0 V
TX+, RX+, TX-, RX-	process data / fieldbus interface	PROFINET input
TX+, RX+, TX-, RX-	process data / fieldbus interface	PROFINET output

B module with failsafe relay outputs



	Interface	Function
USB	Interface to PC program	Monitoring, configuration, diagnostics
F-RO1 to F-RO2	Failsafe relay outputs 1 and 2	Switches at end positions, acceleration too high
F-DI1 to F-DI3	Failsafe digital inputs 1 to 3	Confirmation of alerts and errors, 0 position setting
DO1	Non-secure digital output	Information on status of B module

B module with failsafe relay and signal relay



	Interface	Function
USB	Interface to PC program	Monitoring, configuration, diagnostics
F-RO1	Failsafe relay output	Switches at end positions, acceleration too high
RO1 to RO2	Non-secure relay outputs	Signaling of end positions, acceleration too high
F-DI1 to F-DI3	Failsafe digital inputs 1 to 3	Confirmation of alerts and errors, 0 position setting
DO1	Non-secure digital output	Information on status of B module

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