



Position measurement & control



Products for the wind generator industry



# Pitch control

Pitch control systems have become an essential element in wind generators. They are installed directly in the nacelle with the function to control the motion of each blade.

The variation of blade angle is actively used to control rotor speed. During normal operation, the blades are rotated a few degrees during wind variations in order to maintain the optimal angle and maximum output for all wind speeds. This allows for constant electric power output, and also reduces the overall shear load on the rotor, tower and foundation.

An electric pitch control system typically consists of a controller, gear motor and rotary encoder. Hydraulic pitch control systems incorporate a cylinder and linear encoder.

## Pitch Control

## Control of rotor speed

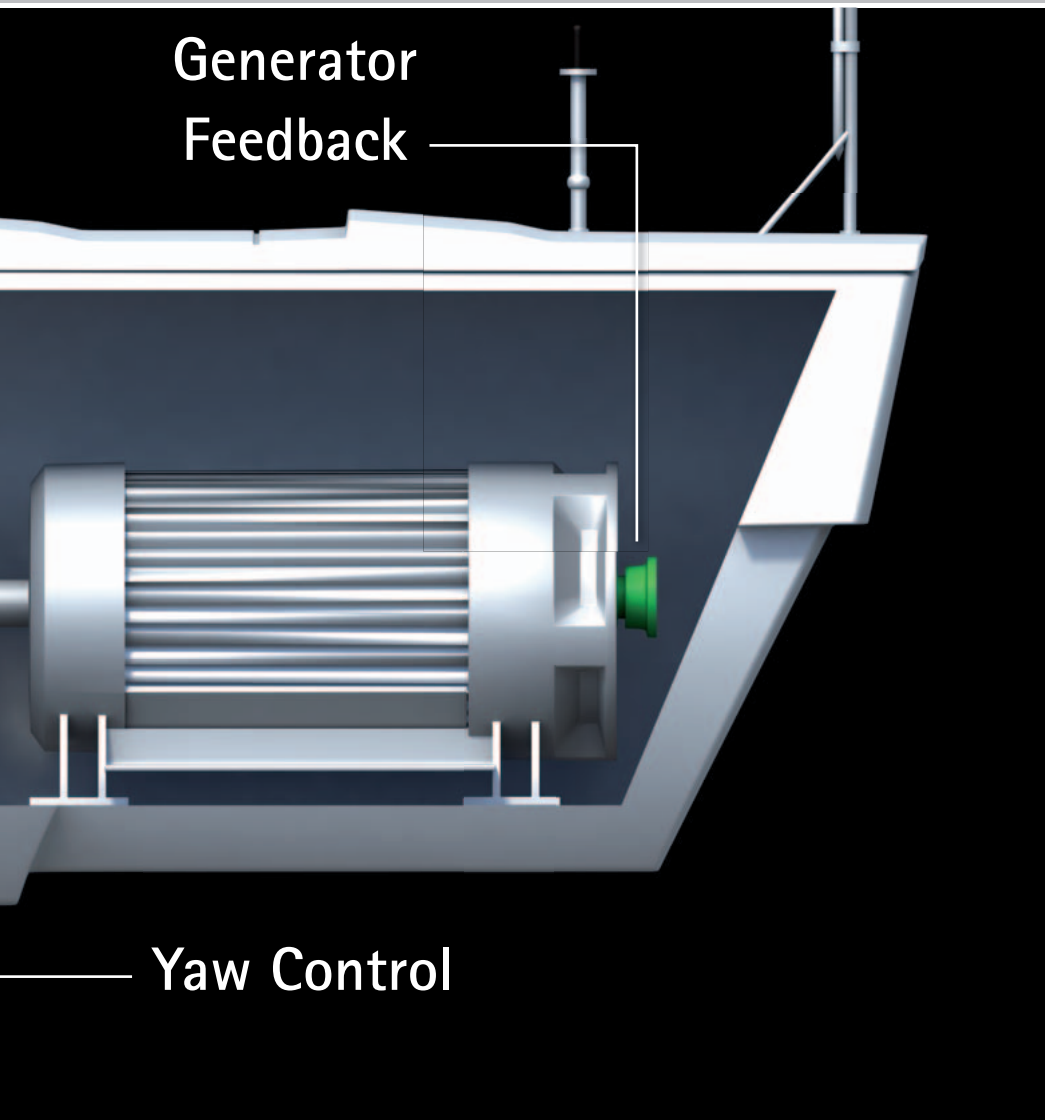
# Rotor speed measurement

Rotational speed is directly measured at the slow shaft zone of the wind turbine, which exists between the rotor and gearbox. Directly measuring the rotational speed at the slow speed shaft point allows the exact speed and acceleration determination of the rotor, while avoiding inaccurate measurements caused by coupling and gearbox malfunctions.

Modular magnetic ring encoders with large hollow shaft diameter are necessary for capturing this measurement. Resolutions above 30,000 PPR provide high accuracy speed and acceleration measurement, as well as excellent rotor positioning. Redundancy measurement functions are also available via multiple sensor implementation.

# Generator speed feedback encoders

Wind turbine generators are equipped with incremental rotary encoders for speed measurement feedback. Hollow and solid shaft versions of the encoder are offered for accommodating the mechanical requirements of the generator type. The most popular hollow shaft versions have electrically insulated bearings for protection against EDI currents, while solid shaft versions must be paired with an appropriate flexible coupling. Both versions are available with single or dual encoder signals for redundant feedback. Heavy-duty rugged housings have been designed to protect against impacts during installation and high shaft loads. These encoder housing materials are corrosion-resistant against salt water environments, ideal for integration in offshore installations.



# Yaw control & Azimuth position

Nearly all horizontal axis wind generators incorporate a wind measuring system which senses the azimuth position of the nacelle. The control system monitors variations several times per minute while the turbine is running. The yaw mechanism consists of a gear motor with absolute rotary encoder and is used to propel the rotor against the wind. The yaw angle is required to be minimal in order to reduce power loss, and also to avoid large fatigue loads during moments when the generator is not in a perpendicular direction against the wind. Wind turbines can be equipped with geared limit switches and built-in encoders to eliminate twisted cable issues in the long cable run through the system's tower.

# Encoders and wind generator couplings for Pitch control systems



## MH58S

Absolute heavy-duty encoder for electric Pitch-control systems

- Heavy-duty housing
- Preset-button for easy zero-setting
- IP67 protection
- 4096 cpr
- 4096 cpr x 4096 turns
- SSI interface
- 4-20 mA
- 0-10 V

- Operating temp. -40°C + 85°C

## SMAG

Absolute linear sensor for hydraulic Pitch-control systems

- Non-contact measurement
- Self-guiding sensor head

- 0.1, 0.05, 0.01, 0.005 mm

- SSI interface

- Operating temp. -40°C + 85°C

## Options

- Integrated Resolver
- Pressure balance valve
- Overmoulded circuits

- Custom length & fixing methods
- Overmoulded circuits

## Application

- Electric pitch control systems
- Yaw control systems

- Hydraulic pitch control systems

The SMAG is a proven magnetic linear measurement system consisting of a metal profile with embedded magnetic strip and guided sensor head with encapsulated circuitry. Mounting the profile with only one screw allows for multiple mounting positions and great flexibility when installing or retrofitting on hydraulic pitch control systems.

Rotary encoders for pitch control systems are designed to withstand large temperature ranges as well as high radial and axial shaft load. The robust metal housing provides an environmental protection of IP67.

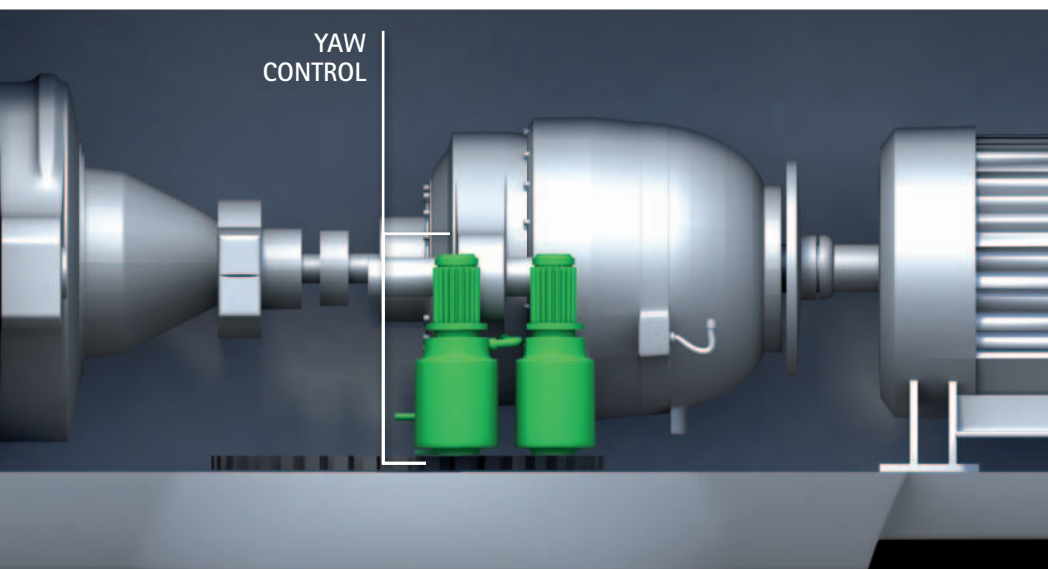
More compact units such as MI36 and MC37 may be integrated with geared limit switches used for yaw control systems.

These reliable and robust encoders must be installed properly and paired with an adequate flexible coupling. A specific range of couplings for wind generators has been designated to assure maximum lifetime use with pitch control encoders.

# Encoders for Yaw (Azimuth) control



HMCT	MI36-MC37	Couplings
<p>Absolute encoder for Yaw control and gear-limit switches</p> <ul style="list-style-type: none"> <li>• Very compact design</li> <li>• Through hollow shaft</li> <li>• High accuracy optical encoder</li> <li>• 65536 cpr x 4096 turns</li> <li>• Incremental output up to 16384 PPR</li> <li>• SSI interface</li> <li>• SSI + sin/cos</li> <li>• SSI + incremental</li> <li>• BiSS (B &amp; C-mode)</li> <li>• Operating temp. -40°C + 85°C</li> </ul>	<p>Incremental encoders for integration into gear-limit switches on Yaw control systems</p> <ul style="list-style-type: none"> <li>• Magnetic miniature encoders</li> <li>• Hollow shaft up to Ø10mm</li> <li>• IP67 protection</li> <li>• Up to 2048 PPR</li> <li>• Push-Pull (HTL) 10-30Vdc</li> <li>• Line Driver (TTL) 5Vdc</li> <li>• Operating temp. -40°C + 85°C</li> </ul>	<p>Reliable wind generator couplings for Pitch- &amp; Yaw control encoders</p> <ul style="list-style-type: none"> <li>• Zero backlash</li> <li>• Electrical insulation</li> <li>• Vibration absorption</li> <li>• Grub screw or collar fixing</li> <li>• Keyways</li> <li>• Operating temp. -40°C + 125°C</li> </ul>
<b>Options</b>		
	<ul style="list-style-type: none"> <li>• Overmoulded circuits</li> </ul>	<ul style="list-style-type: none"> <li>• Custom design</li> </ul>
<b>Application</b>		
<ul style="list-style-type: none"> <li>• Yaw control systems</li> <li>• Position control on geared limit switches</li> </ul>	<ul style="list-style-type: none"> <li>• Integration into geared limit switches</li> </ul>	<ul style="list-style-type: none"> <li>• For Pitch &amp; Yaw control encoders</li> </ul>

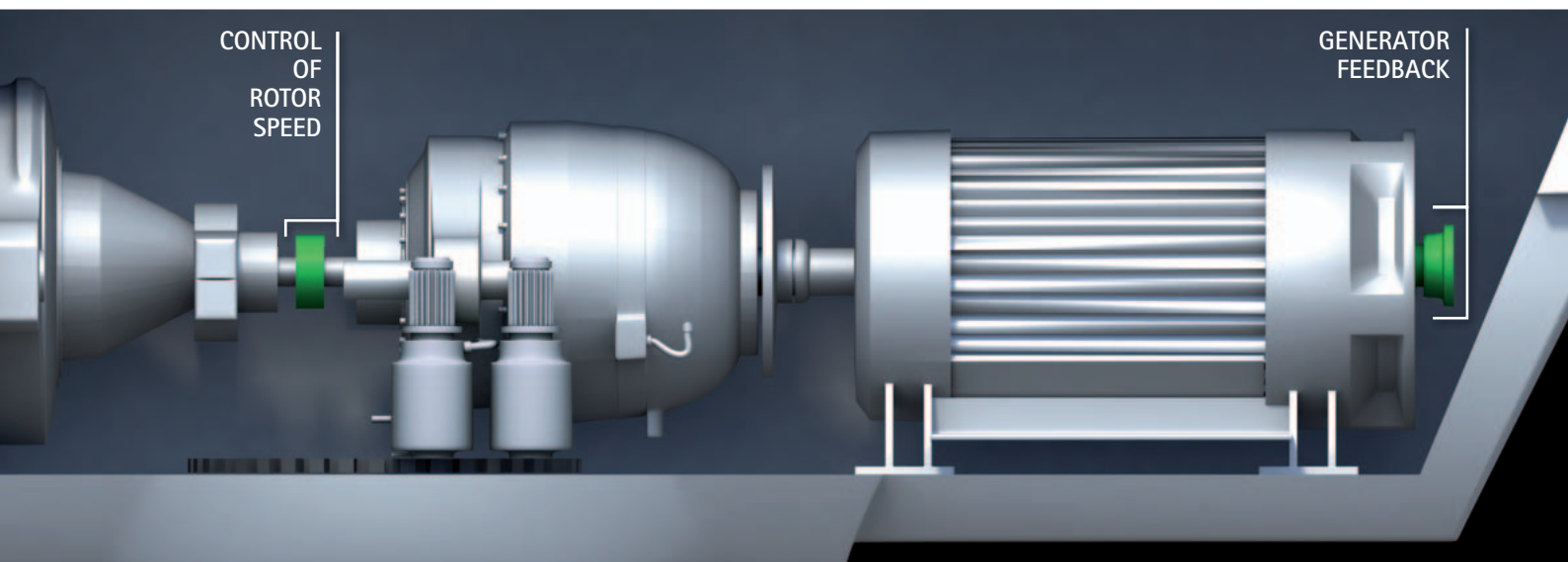




# Feedback encoders for Generators



C100	C101	I115
Heavy-duty incremental hollow shaft encoder	Heavy-duty incremental hollow shaft encoder	Heavy-duty incremental encoder, "tacho-design"
<ul style="list-style-type: none"> <li>• M23 connector or cable output</li> <li>• Electrically insulated bearings</li> </ul>	<ul style="list-style-type: none"> <li>• Galvanically separated double output circuits</li> <li>• Terminal block, M23 connector or cable output</li> <li>• Electrically insulated bearings</li> </ul>	<ul style="list-style-type: none"> <li>• Terminal block connections</li> <li>• Reversible terminal box</li> </ul>
<ul style="list-style-type: none"> <li>• 1024, 2048, 2500 PPR</li> </ul>	<ul style="list-style-type: none"> <li>• 1024, 2048, 2500 PPR</li> </ul>	<ul style="list-style-type: none"> <li>• Up to 10000 PPR</li> </ul>
<ul style="list-style-type: none"> <li>• Push-Pull (HTL) 10-30Vdc</li> <li>• Line Driver (TTL) 5Vdc</li> <li>• Universal circuit Lika (HTL+TTL) 5-30Vdc</li> <li>• Operating temp. -25°C + 85°C</li> </ul>	<ul style="list-style-type: none"> <li>• Push-Pull (HTL) 10-30Vdc</li> <li>• Line Driver (TTL) 5Vdc</li> <li>• Universal circuit Lika (HTL+TTL) 5-30Vdc</li> <li>• Operating temp. -25°C + 85°C</li> </ul>	<ul style="list-style-type: none"> <li>• Push-Pull (HTL) 10-30Vdc</li> <li>• Line Driver (TTL) 5Vdc</li> <li>• Universal circuit Lika (HTL+TTL) 5-30Vdc</li> <li>• Operating temp. -25°C + 85°C</li> </ul>
Options		
<ul style="list-style-type: none"> <li>• Extended Temp. range -40°C +100°C</li> </ul>	<ul style="list-style-type: none"> <li>• Extended Temp. range -40°C +100°C</li> </ul>	<ul style="list-style-type: none"> <li>• Extended Temp. range -40°C +100°C</li> </ul>
Application		
<ul style="list-style-type: none"> <li>• Feedback on generators</li> </ul>	<ul style="list-style-type: none"> <li>• Redundant feedback on generators</li> </ul>	<ul style="list-style-type: none"> <li>• Feedback on generators</li> </ul>



# Modular magnetic encoders for rotor speed control



## I116

Heavy-duty incremental encoder, "tacho-design"

- Two separated encoders in one housing
- Independent terminal block connections
- Reversible terminal box

- Up to 10000 PPR
- Push-Pull (HTL) 10-30Vdc
- Line Driver (TTL) 5Vdc
- Universal circuit Lika (HTL+TTL) 5-30Vdc
- Operating temp. -25°C + 85°C

## SMRI + MRI

Modular magnetic ring encoder

- Big hollow shaft diameters
- Non contact measurement
- IP67 protection
- Multiple sensing possibility
- Up to 90000 PPR
- Push-Pull (HTL) 10-30Vdc
- Line Driver (TTL) 5Vdc
- Operating temp. -40°C + 85°C

## Options

- Two different resolutions
- Extended Temp. range -40°C + 100°C
- Custom ring design

## Application

- Redundant feedback on generators
- Rotor shaft speed measurement (direct feedback on slow shaft)



The C100/C101 series of generator feedback encoders has been designed and offered with tapered or standard hollow shafts. Electric insulation of the shaft up to 10 kV protects against damage of ball bearings caused by EDI currents.

The flange has several available mounting points, allowing for use of torque arms or custom mounting plates for anti-rotation in varying positions.

The C101 and the I11x family may be supplied with removable cover for electrical connection via terminal blocks.

The I115 and I116 series with typical "tacho generator" design may be easily installed on standard mounting bells.

Similar to all electric motors, generators require an encoder for speed and position feedback. The incremental output signals can be transmitted to the drive over long cable lengths up to 300m. A precision optical disk made of unbreakable material provides stable output signals at high rotational speed.

A rugged mechanical design protects all components from harsh environment and temperature fluctuations.



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