

PITCH SERVO DRIVE FOR WIND TURBINES

MODELS E40 AND L60



Rev. E, November 2012

ROBUST SERVO DRIVE FOR RELIABLE
OPERATION IN WIND TURBINES

YOUR PARTNER IN PITCH CONTROL

MOOG

Whenever the highest levels of motion control performance and design flexibility are required, you'll find Moog expertise at work. Through collaboration, creativity and world-class technological solutions, we help you overcome your toughest engineering obstacles. Enhance your machine's performance. And help take your thinking further than you ever thought possible.

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This catalog is for users with technical knowledge. To ensure all necessary characteristics for function and safety of the system, the user has to check the suitability of the products described herein. The products described in this document are subject to change without notice. In case of doubt, please contact Moog.

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PRODUCT OVERVIEW

Safety and reliability are the most important requirements for a profitable wind turbine operation. The Pitch Servo Drive maximizes the availability and output of your wind turbine.

This product allows you to benefit from our worldwide expertise with innovative pitch systems in the 1,5 MW up to 10 MW production range.

Most importantly, the Pitch Servo Drive guarantees you safety for your wind turbine investment.

Synchronous, asynchronous and DC motors can be controlled most efficiently with the drives high peak overload capability. The Pitch Servo Drive works continuously over a wide range of axis box internal temperatures, from -30 to +70 °C (-22 to +158 °F). A flexible ventilation design enables the equipment to be individually adapted to the hub. The high tolerance of the Pitch Servo Drive to vibration and shock is also critical to meet the high mechanical demands of the rotor hub.

Hardware

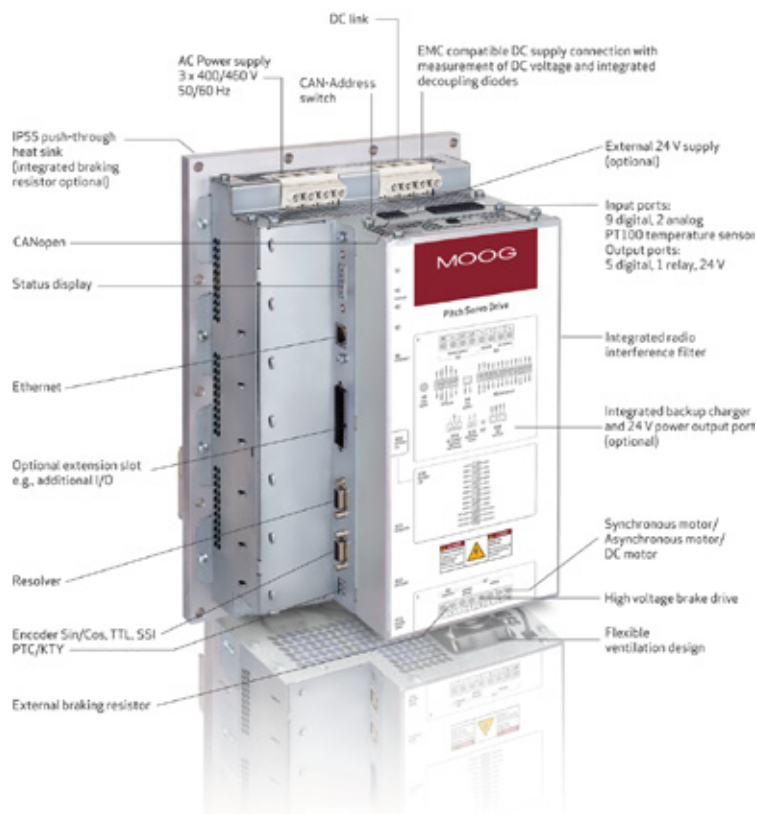
CANopen, INTERBUS or PROFINET interfaces are available to enable communication between devices as well as between the device and higher-level controls.

The I/O configuration includes:

- 9 digital input ports
- 2 analog input ports
- 1 PT100 input port
- 5 digital output ports
- 1 relay output port
- An optional port allows extending the I/O configuration by 16 digital I/O and 3 PT100 for additional temperature measurements.

A high voltage brake driver allows the brake system to be controlled according to the voltage level of the back-up system thus eliminating the need for brake contactors in the axis box. Moreover the integrated redundant decoupling diodes enhance the safety of the pitch system.

Functional overview



FEATURES AND BENEFITS

- | | |
|-------------------------------------|---|
| ✓ Improved operational availability | The Pitch Servo Drive has been optimized for an extended operating life. It increases the maintenance intervals and thus improves the operational availability of your wind energy plant |
| ✓ Includes functional safety | TÜV certified Pitch System feathering with Performance Level D according to EN ISO 13849-1 |
| ✓ Large scale integration | Simplifies box assembly with integrated charger, high voltage brake driver, 24 V _{DC} power supply, decoupling diodes and braking resistor |
| ✓ Designed for extreme environments | Designed for the tough conditions inside the hub and provides optimum operation even in permanent internal temperatures between -30 and +70 °C (-22 and +158 °F) and operating altitude up to 3,000 m a.s.l. |
| ✓ High loading capacity | This robust Pitch Servo Drive will withstand the high mechanical stresses in the rotating hub |
| ✓ Fits any system | The compact size of the Pitch Servo Drive allows it to be integrated into any pitch system |
| ✓ High level of reliability | A built-in acceleration sensor provides data on the rotation speed, position and vibration of the rotor. The phase-controlled DC-link pre-charging allows optimal Fault-Ride-Through handling and limitations of the slip ring peak loads |
| ✓ Long working life | An earthed brake driver allows the braking system to be controlled according to the voltage level of power storage, thus eliminating the need for switching equipment in the axis box |
| ✓ User-friendly operation | The software directly supports the control of synchronous, asynchronous and direct current motors |
| ✓ Easy commissioning | The preconfigured software functions support easy commissioning. It offers multiple feathering modes with automatic resets and mode changes |
| ✓ Great flexibility | CANopen, INTERBUS, PROFINET, Sin/Cos, TTL, SSI, Resolver and PT100 interfaces |
| ✓ Easy maintenance | Service diagnostics and remote maintenance via Ethernet. For analysis report the Pitch Servo Drive contains an extended operation data storage to log configuration changes and long term critical events |

MODELS E40 AND L60

Electrical data

	E40	L60
Asynchronous/Synchronous motor		
Nominal current	40 A	60 A
Peak current (3 s)	100 A	200 A
Continuous current motor		
Nominal current	55 A	70 A
Peak current (3 s)	100 A	180 A
Field current		
Nominal current	2 A	
DC supply input for 90 s		
Nominal voltage	200 to 500 V	
Nominal current	60 A	70 A
Peak current (3 s)	110 A	200 A
High voltage brake driver		
Nominal voltage	200 to 500 V	
Nominal current	2 A	
Peak current (3 s)	3 A	
Network input		
Minimum line choke inductance with $U_k = 4\%$	0,2 mH linear to 100 A	0,15 mH linear to 200 A
Power supply	280 to 460 V 3 ph	
Rated current	3 x 40 A	3 x 60 A
Frequency range	50/60 Hz	
Protection		
Axis box inside	IP20	
Axis box outside	IP55	
Connection terminal	IP00	
Pitch motors		
DC motor	Compound, series-wound and shunt-wound motors	
AC motor	Synchronous motors, asynchronous motors	

MODELS E40 AND L60

Safety relevant figures

TÜV certified parameters for the safety function feathering according to EN ISO 13849-1. A two out of three (2oo3) redundancy according to IEC 61508-6 is considered.

Parameters	E40	L60	Comment
PFH	2.29 E-08 1/h	2.46 E-08 1/h	
PFD _{AV} (T ₁ = 10 a)	7.51 E-04	8.05 E-04	
MTTF _d	42 a		High
DC _{avg}	90 %		Medium
PL	d		

General technical data

	E40	L60
Dimensions		
Dimensions W x H x D without charger	240 x 370 x 218 mm (9.5 x 14.6 x 8.6 in)	250 x 405 x 246 mm (9.9 x 16 x 9.7 in)
Depth inside without charger	128 mm (5.04 in)	161 mm (6.34 in)
Dimensions W x H x D with charger	240 x 370 x 261 mm (9.5 x 14.6 x 10.3 in)	250 x 405 x 289 mm (9.9 x 16 x 11.4 in)
Depth inside with charger	171 mm (6.73 in)	204 mm (8.03 in)
Mass		
Mass without charger	14 kg (30.9 lb)	15.9 kg (35.1 lb)
Mass with charger	14.9 kg (32.9 lb)	16.8 kg (37 lb)
Operating temperature range		
Axis box inside	-30 to +70 °C (-22 to +158 °F)	
Axis box outside	-20 to +60 °C (-4 to +140 °F)	
Ambient temperature range		
Storage temperature range	-40 to +85 °C (-40 to +185 °F)	
Relative air humidity	15 to 85 %, no dewing	
Range of application		
Nominal operational level	1,000 m (3,218 ft) a.s.l.	
Maximum operational level	3,000 m (9,654 ft) a.s.l. Above 1,000 m (3,218 ft) the nominal current is reduced by 1 % per 100 m (322 ft)	
Chemical resistance of cooling and ventilation systems	Salt water and fog, cleaning solvent, hydraulic oil, commercial lubricants and cleaning products	
Certificates/Approvals	CE, TÜV	

OPTIONS

Following options are available for E40 and L60.

Integrated charger with 24 V_{DC} power supply	
Closed loop and temperature compensated charging modes for pitch back-up system	
Charging voltage	0 to 450 V _{DC}
Charging current	0 to 1 A
Maximum power	250 W
Sensor interfaces	Backup voltage including balance detection, 1x PT100
Maximum current 24 V _{DC} output	3 A
I/O extension	
Additional digital and PT100 I/O for extra sensing tasks e.g., cold-climate versions	
Digital inputs	8 x
Digital outputs	8 x PLC compatible maximum 500 mA single line maximum 3 A total
PT100	3 x -50 to +200 °C (-58 °F to +392 °F) Short-circuit and wire breakage monitored
Braking resistor	
Integrated in the push-through heatsink	
Variant for rear ventilation	20 Ω / 300 W
Variant for longitudinal ventilation	15 Ω / 400 W
Profinet RT	
Conformance Class B	
Line choke (external)	
Certified to meet the EMC requirements for safety components according to EN 61326-3 and the C3 category according to EN 61800-3 with extended operation temperature range	
KDD 0,2	0.2 mH 400 V, 40 A _{rms} , linear zu 100 A
KDD 0,4	0,15 mH 400 V, 60 A _{rms} , linear to 200 A

Additional accessories for cabling of the pitch drive train can be provided on request.

DESCRIPTION OF OPERATION

Pitch Servo Drive functional schematic

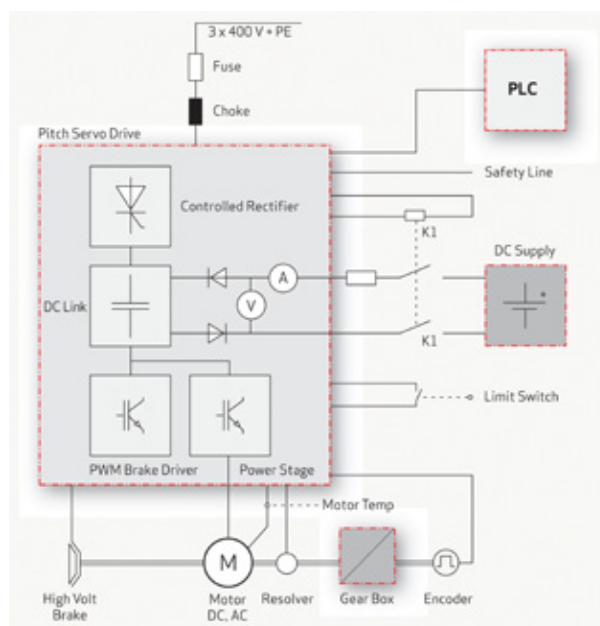
The Pitch Servo Drive is the central product of the pitch system. This device feeds, monitors and controls the operation, and reads and processes data from peripheral devices (e.g., sensors). The Servo Drive provides the communication interface to the main controller, enabling the exchange of data with higher level control. It performs the vital function of ensuring the safety of the wind turbine with a certified Performance Level in the event of a failure.

The broad operating range of the Pitch Servo Drive ensures rapid assembly of the whole pitch system. A system using this device can be installed anywhere, thanks to the compact dimensions of the axis box. Furthermore, the design of the axis box is clearly laid out, allowing training costs to be reduced. The long operating life of the Pitch Servo Drive extends maintenance intervals and increases the operational availability of your wind turbine. Thousands of wind turbines have been fitted worldwide with our systems and products and this number is growing constantly.

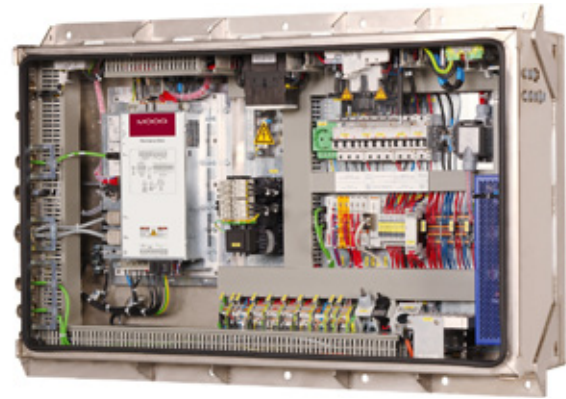
Advantages

- Only one supply voltage required
- Incorporates highly accurate measurement of the voltage level of back-up systems
- Optimized connection for external DC supply through integrated decoupling diodes to uncouple power storage and DC link

Functional schematic of the pitch system with the Pitch Servo Drive

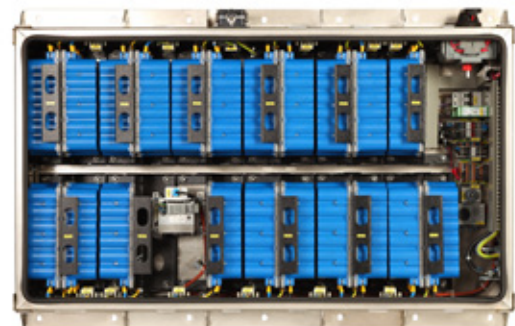


Pitch System



Pitch Products

Back-up System



Pitch Motor



CONFIGURATION SOFTWARE

The Pitch Servo Drive can be configured by using Moog's Pitchmanager Engineering Software. This software is a tool for the set-up, optimization and commissioning of the drive train.

Via the Ethernet interface remote diagnostics and maintenance can be done comfortably by the service technicians. The configuration tool contains a convenient status view and parameter set management functions. For performance analysis and optimization it includes a six-channel software oscilloscope for direct measurements and data storage.

Software requirements

- Windows XP Service Pack 2 (Microsoft.net Framework 2.0 or higher)
- Windows Vista (x32/x64)
- Windows 7 (x32/x64)

Hardware requirements

- Intel x86 compatible processor with 1 GHz or more
- 512 MB RAM
- 500 MB hard drive
- Network card 10/100 Mbit/s with Ethernet (RJ-45) connector

Moog's Pitchmanager configuration and monitoring software offers the following advantages:

- Simple, clearly organized configuration of the Pitch Servo Drive through single plug-ins
- Easy updating of device software
- System analysis using a software oscilloscope

Pitchmanager Engineering Software



ABOUT MOOG

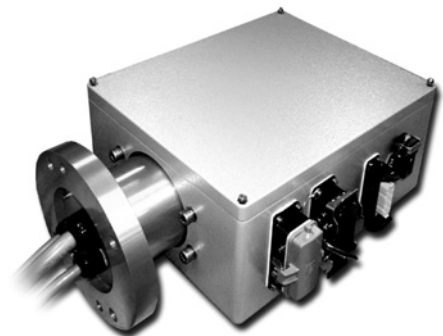
Moog's products and solutions have been used in power generation applications for over 40 years providing our engineering teams with vast experience in motion control for challenging environments. We are designers and manufacturers of high-performance electric, hydraulic and hybrid motion control solutions such as pitch systems, pitch products, slip ring solutions and blade sensing systems for onshore and offshore wind turbines.

Moog supplies products, systems and services worldwide to ensure maximum efficiency, reliable operation and a long operating life for your wind turbines.

Our experts in more than 26 countries around the world work with our customers to develop ideas to improve performance, reduce operating costs and design next generation installations that meet the every changing needs of the marketplace. The requirements for pitch control systems of wind turbines are highly complex, ranging from increasing efficiency to guaranteeing reliability and ensuring safety.



Rotor Blade Sensor



Slip Ring

Products

A range of products designed to provide high performance and the highest reliability form the building blocks of every Moog solution.

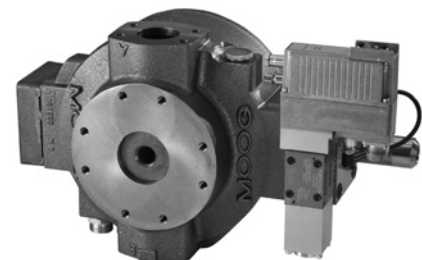
With increasing demand for wind energy plants to be installed in areas with extreme climate conditions, the technical requirements for systems and components also are greater. Our products are made to meet the challenges presented by the most demanding environments.

Moog Systems and Products:

- Pitch Systems
- Pitch Servo Drives
- Pitch Motors
- Slip Ring Solutions
- Blade Sensing Systems
- Rotor Monitoring Systems
- Pitch Valves - Direct Drive Valves (DDV) Design
- Hydraulic Pitch Pumps



Pitch Valve



Hydraulic Pitch Pump

ABOUT MOOG

Moog Global Support offers the quality, rapid processing, experience of trained technicians and unvarying performance worldwide which you require for the smooth operation of your wind turbine. Our experienced technicians are on hand to help you optimize your wind turbine, minimize downtime and enjoy problem-free operation of all Moog products.

Moog Service supports you worldwide with:

- Repairs to your products with as-new performance
- Diagnostics and fault analysis for your drive solution
- Regular maintenance visits to prevent downtime and repairs
- Support for setting up or commissioning new installations
- On-site exchanges, conversions or repairs
- Recommendations for improvement and cooperation in adapting product parameters
- Access to electronic and printed documentation and user information, drawings, software and other online information to help eliminate problems and minimize site visits

Visit us today.

Further information on Moog's world wide support can be found at www.moog.com/wind.



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