



IMD 100

RELIABLE PITCH DRIVE





Pitch system design and technology

Reliable Pitch Drive

In modern wind turbines, the pitch system is the only brake capable of stopping the wind turbine during operation. This makes the pitch drive a safety-critical component.

Pitch Design

DEIF designs pitch systems to individually match the specific wind turbine design in order to optimise the operation under the following conditions; high, medium, low wind and extraordinary situations such as IVRT (low Voltage Ride Through) conditions and emergency stop. Our R&D teams base their system design on the load data and aerodynamic characteristics of the turbine. For your pitch design, we customize a matching solution. A complete package of cabinets and components can be implemented as a complete system or as separate components, all based on our robust and reliable Pitch drive, IMD 100. We design the pitch drive according to the highest ISO 13849 standards and, at the same time, we optimise the pitch systems cost and performance. Wind turbines today have to be approved by

the standards and guidelines “Guideline for the Certification of Wind Turbines Edition 2010”, which refer to the functional safety standard ISO 13849. This standard describes both personal safety and machine safety.

Customisation

DEIF operates globally and depending on the location demands for the turbine function and performance are likely to vary. The pitch system and drive are both vital parts of meeting these demands. For example, in China, there is, LVRT, Low Voltage Ride Thru, describing a complete grid drop up to 3 seconds and, HVRT, High Voltage Ride Thru describing a 30% overvoltage up to 2 seconds. Under these conditions, the pitch system should continue operation without triggering any alarms. The only way for the wind turbine to control these situations is to pitch the blades and keep the rotor power in control. The pitch drive, IMD 100, is designed to “do the job” under extreme climate conditions such as harvesting wind power in high altitudes, remote and non-friendly locations where the temperature is very low or very

»You can easily put a blade into high wind, but if you don't pitch correctly, you can destroy the turbine.«

Jacob Danielsen
Product Manager
DEIF Wind Power Technology



high. In such locations, you don't want to have mal-function or too much service.



Model based design and dynamic model

Reduce risks of design failures and R&D resources from design to implementation.

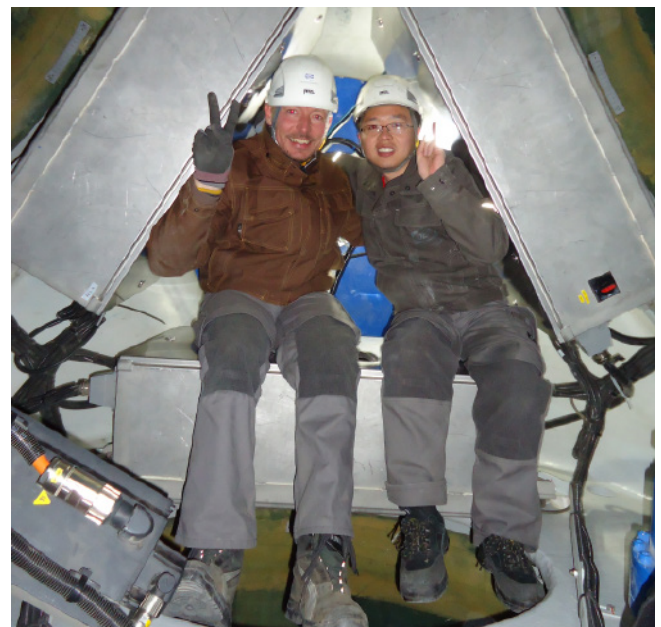
DEIF has a specialized team for Model Based

Design and control for the purpose of supporting customer design teams with Dynamic Link Library, (.Dll). By including .Dll in your mechanical design to verify the loads and performance.

New wind turbine designs

Optimize performance, reduce load/stress on new turbines and at the same time perform cost hunting. All this, should result in the best cost of energy form your turbine.

For new turbines, it is possible to develop state-of-the-art pitch control and design, we can deliver simulation tools such as Matlab/Simulink to bring mechanical design and electronic control strategies together.



IMD 100

Pitch drive built to last



Engineered-to-Application

The Integrated Motor Drive, IMD, has been developed on the basis of DEIF's decades of accumulated knowhow about the entire wind turbine and its pitch systems. With its integrated motor solutions, the IMD reduces cabling in your system and provides maximum reliability at minimum cost. Engineered to your application, the IMD is bound to become your preferred choice for pitch and yaw control.

All-in-one

IMD comes with components such as I/O, ballast resistor, EMC filters, choke and power supply and therefore eliminates the need for a variety of external components. This minimizes both the risk of errors and the need for man hours during installation and service. The motor and feedback interface have been designed for easy installation for both motor, sensors and the electromechanical brake supply. All terminals and connectors are spring loaded for easy installation and high vibration resistance. The Can interface offers any pitch controller or PLC full control of the distributed I/O's and drive functions and at the same time feedback for SSI and resolver positioning or motor temperatures.

Built to last

the IMD is designed to operate in harsh environments, similar to other DEIF products designed for offshore and marine applications. The selection of components and design are different from other similar drives, with a high temperature spec and long lifetime for maximum reliability. The maritime standards are stricter than industrial standards in terms of for instance temperature spanning, shock and vibration resistance, EMC immunity, etc. this is why the IMD represents a more robust and reliable solution than an ordinary industry-normed controller, making it ideal for offshore and onshore wind turbine installations. For instance, the IMD operates from -30 to +70C° and can be stored from -40 to +85C°. The durability of the hardware is verified by HALT testing (Highly accelerated Life test). As a result, we offer the longest warranty in the industry: 5 years. Choosing the IMD drive equals choosing a hassle-free solution with a minimum of downtime.

Wind turbines are installed in many different environments and some sites are located in high altitude, where the air densities are different. This makes the electrical design demands higher due to electrical distances have to be increased. The IMD is designed for high altitude and can perform in up to 4000 meters.

All our PCB modules are coated with an eco-friendly protective layer.



IMD 100

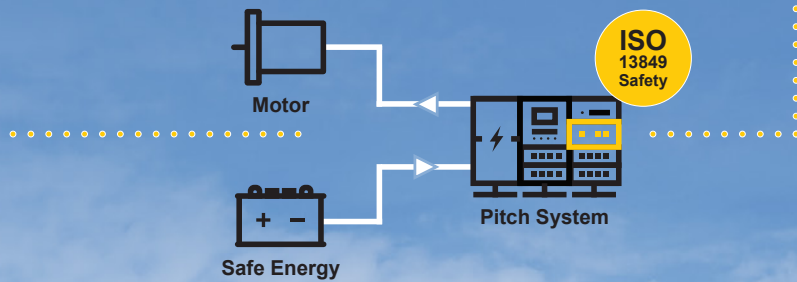
Pitch into the future - safety and reliability

Functional safety

The IMD is a critical function in electric pitch systems, controlling the blade angle during turbine operation and in safe stop situations.

the IMD complies with the ISO 13849 safety standards due to the failsafe hardware resulting in a high MTTFd and high performance level PL. offering redundant safety chain I/O, automatic safety homerun function and RFE/RUN for direct hardware control, the drive has been designed to provide the highest possible safety.

The IMD complies with performance level d on single blade and performance level e on 3 blade system level.



IMD 100

All-in-one pitch drive

Power Supply

The IMD contains a built-in switch mode power supply for the internal and external functions, all supplies are galvanically isolated to prevent short circuits on one supply from causing malfunction on others. The primary input of the power supply is the DC link of the drive, so the power supply will be in full operation on either mains supply or safe energy supply.

IMD has a failsafe motor brake supply output fully controlled and monitored to detect wire break or short circuit.

To supply external components like relays or I/O's the IMD have a 24 v DC power supply with up to 100 W external load.

Distributed I/O

IMD comes with distributed digital inputs, outputs and Pt100 temperature inputs. The number of inputs and outputs matches the need of control I/O in one pitch control cabinet. The Can interface offers any pitch controller or PLC full control of the distributed I/O's. The distributed IO also eliminates wires and cables between the pitch cabinets. All terminals and connectors are spring loaded for easy installation and high vibration resistance.

Mains connection & EMI Filter

To eliminate as many risks of failure as possible, the number of components and number of connections in a pitch system should be reduced to a minimum. Although a simple design, the IMD includes as many functions as possible.

Some of the big components in standard drive applications is the EMI filter and line choke which protects the grid from the electric switching power noise and the mains breaker disconnecting the drive from grid.

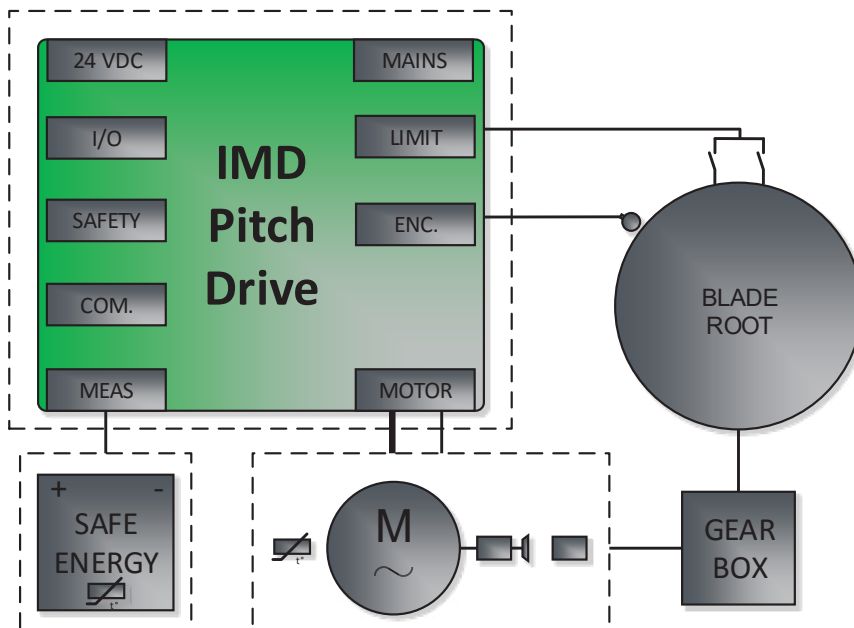
Both of these components are integrated in the IMD, allowing for direct connection of 400 A AC to the IMD. The EMI filter is built to comply with the toughest standards IEC 61800-3 Category 2. The grid disconnect can be controlled via the CAN interface.

IMD is designed to operate in a very wide mains input voltage range giving full operation in LVRT and HVRT conditions.

Motor, Brake resistor & Sensors

Motor and sensor interface is a vital part of the pitch system. The IMD is compatible with different types of motors and sensors, from very simple temperature feedback such as KTY and Pt 100 to very complex sensor feedback such as the analogue resolver and the digital SSI sensor.

On the heat sink of the IMD, two brake and ballast resistors are fixed to take the brake power induce back from the motor.



IMD 100

Easy configuration and set-up

Interfaces – CAN/CANopen,USB

the communication and configuration of the IMD is carried out utilising one of many communication interfaces. For easy installation, configuration and test a USB service port is place on the front, allowing for access to all parameters and values using the PC tool IMD manager.

The primary control and command interface is CAN or CANopen. The CAN port is connected directly to the pitch motion controller located in the hub or turbine controller over the slip rings.

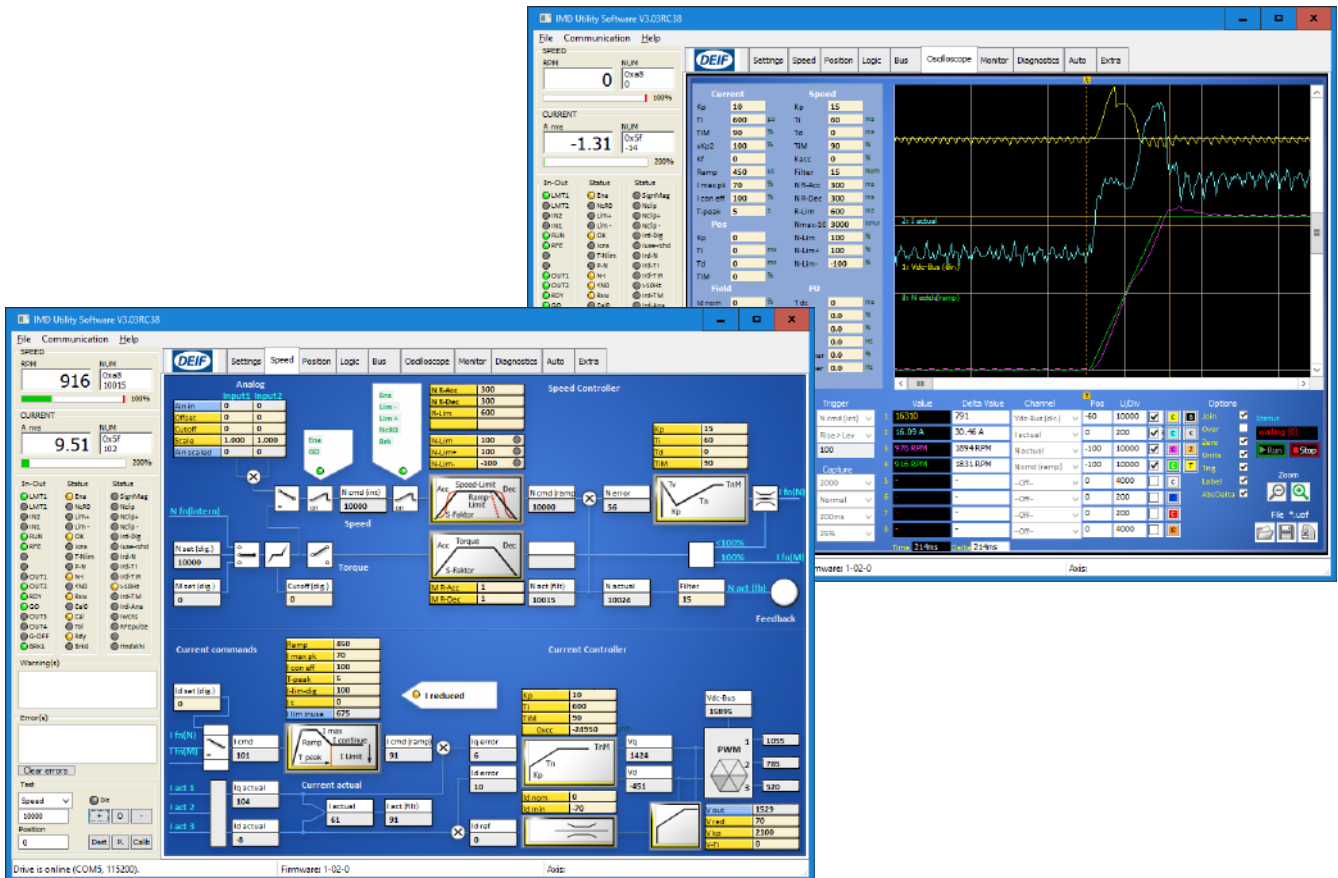
To select the Can ID a switch is located on the front, so IMD change and setup can be done simply by selecting the Can ID on the switch, so pitch motion controller can initiate and configure the new IMD.

Together with the Can ID switch on the front we also have a very simple multi-colour visual interface LED and a seven segment display, giving simple information on status and errors.

Configuration & Service

The IMD can be operated with the complimentary IMD manager software using a direct USB connection. Service staff has full access to all parameters and data, thus providing technicians with a good commissioning overview. In addition, it is possible to carry out remote support.

The software also contains trending functionality similar to an oscilloscope, displaying all measured and calculated values.



IMD 100

Installation

Mechanical & electrical Installation

The compact design of the IMD allows for installation in any pitch cabinet and contains all electrical connections and interface in only two directions. This makes it mountable in the corner or the side of the cabinet with full access to all terminals.

Mechanical installation and service can be a challenge due to the limited space and different directions. The IMD is designed with a cabinet-fixed mounting frame for easy installation, eliminating the nuts and fixes both the gasket and the uneven edges from cut out to be tight. At the same time, all mounting can be done inside out.

In the turbine hub, the rotation and vibration can easily result in wire break or loose wires. All IMD connections are spring loaded to comply with the mechanical challenges and keep the same torque on the wires. D-sub connectors are secured by screws and give EMC protection to the communication signals



IMD 100

ISO 13849 safety



The Integrated Motor Drive, IMD 100, is a robust microprocessor-based drive containing all necessary functions for functional safety, motor control, sensor input and distributed I/O.

The IMD is intended for wind turbine pitch systems interfacing to a Pitch Motion Controller or directly to a wind turbine main controller. The IMD 100 is a motor drive designed to fit into the small space in pitch panels installed in the hub. Climate and operation conditions are among the toughest in any application. Continuous rotating, continuous vibration, continuous temperature change 24/7 in 20 years is extreme.

The IMD 100 is designed to fulfil the functional safety standards ISO 13849 and Drive standard IEC/EN 61800.

To guaranty a safe stop of the turbine, the IMD automatically carries out a cyclical self-test at start-up. If any errors are found during start up and operation, the pitch drive will open the safety relay giving signal to the safety-chain/safety logic,. Status and errors will be displayed by the LED and the display.

Pitch Drive Features

- ▶ Robust construction with extended vibration and temperature spec.
- ▶ Up to 190 A Peak current
- ▶ Up to 4000 meters altitude operation
- ▶ Built in EMC filter (No need of external line filter)
- ▶ Distributed I/O and temperature over CAN/CAN Open
- ▶ ISO 13849 1+2 Safety compliant. Functional safety,
 - PL = d (Blade), PL = e (System)
 - Double channel safety-chain I/O (2 x SCI, 2 x SCO)
 - Automatic Safety run function
- ▶ Position, speed and current control
- ▶ Incremental resolver and SSI encoder input
- ▶ Safe Energy measurement on DC input
- ▶ Built in 400 V mains disconnect function
- ▶ Processor-independent safety by hardware (IGBT, Voltage, Short circuit, temperature)
- ▶ Motor brake control
- ▶ Optional internal 24 VDC power supply
- ▶ EMC-safe, all-steel and aluminium housing
- ▶ Built in ballast resistor with Processor-independent overcurrent protection
- ▶ 5 years product warranty
- ▶ Input rated voltage 3 phase 230, -10% to 400, +30% VAC
- ▶ Output voltage 3ph (0 to mains voltage VAC)
- ▶ Frequency 0 to 300 Hz
- ▶ Rated motor power 20 kW continous
- ▶ Output nominal current 45 A
- ▶ Operating temp. -30 to 70 °C, Storage temp. -40 to 85 °C
- ▶ Humidity, 97 % non-condensing

Maximum reliability for remote areas

Cutting-edge pitch design for Sewind

In 2011, DEIF Wind Power Technology was chosen as supplier of pitch systems by Chinese Sewind. Sewind is a Top 15 manufacturer measured in terms of global market share – the company is a subsidiary of Shanghai Electric, China's largest power equipment manufacturer offering solutions for fossil power plants, nuclear power plants, renewable energy generation, power transmission, etc. Sewind's portfolio consists of 1.25, 2.0 and 3.6MW machines.

Mr Xun from Sewind says 'for our high runner model – the 2.0MW machine – we were looking for an alternative to the pitch solution the turbine was originally designed with. We were looking for a more open partner in terms of willingness to share the technology so that we could optimise the entire design in a teamwork. At the same time, we were looking for a partner with a strong local presence in China. Working with complex technical applications across several time zones is not convenient' Mr Xun stresses.

'Eventhough we are a conservative company, we also wanted cutting-edge technology in our second generation pitch system. We wanted maximum yield and maximum reliability from the solution' Mr Xun continues – that is why we chose to cooperate with SPERI (Shanghai Power Equipment Research Institute) in the screening of solutions available in the market which could fulfill our wants and needs.

Both in terms of the technology the solution was based on and the attitude of the supplier, SPERI singled out DEIF Wind Power Technology as a possible partner, and we decided to go for a full-scale test by ordering prototypes for real life testing. Initially, we were intrigued by the open attitude of DEIF' Mr Xun says. 'DEIF's openness towards sharing the technology so that together we were able to develop a solution which Sewind could continue the development and maintenance of was exactly what we were looking for.

The first generation of our wind turbine was pretty much a 'black box' solution delivered to us by the supplier – we now wanted to move on, opening the 'black box' so we could make optimisations on our own. Exactly that attitude we found at DEIF', Mr Xun adds. 'In terms of technology, we also found the solution from DEIF to be right for us.

We liked the concept simplicity from DEIF – a minimum of components equalling a maximum of reliability. The robustness of the solution is crucial to us because many of our wind turbines are deployed to remote areas. Locations we try to avoid having to send people to for unplanned service. Yet another reason why we prefer the general pitching strategy of the DEIF solution is that the continuous pitch motion keeps the idle time of the moving components at a level where no corrosion will occur. At the same time, the soft movements resulting from this strategy minimise the mechanical stress imposed on the entire construction.



Maximum reliability for remote areas

Cutting-edge pitch design for Sewind



»We were looking for a more open partner in terms of willingness to share the technology so that we could optimise the entire design in a teamwork.«

Mr Xun
Owner
Sewind

We decided to make the first solution from DEIF based on traditional energy storage technology, and we have now developed it into a cutting-edge solution based on ultra-cap technology', and Mr. Xun adds with a smile 'that is the benefit of working with a partner mastering several technologies, it simply gives us full freedom of choice'.

'In addition, the choice becomes a safe one given the fact that DEIF can also supply all the critical system components. Maximum supply security combined with individual customer needs, we design advanced technological solutions and offer them to our customers. Combined with the fact that DEIF has an entire R&D and service team right here in Shanghai is a unique combination we have not found elsewhere'. 'That particular combination allows us to sleep peacefully at night', Mr. Xun concludes with satisfaction.

- ▶ Pitch Drive, Integrated Motor Drive (IMD series)
- ▶ Pitch Motion Controller (AWC series)
- ▶ Optimised panel design and safety by DEIF
- ▶ Pitch Battery Charger (PBC series)
- ▶ Reduced number of components – minimise risk of failure
- ▶ Permanent Magnet Synchronous Motor (PMSM series)
- ▶ Cooperation and knowledge share with panel builder
- ▶ 5 year warranty on DEIF hardware



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