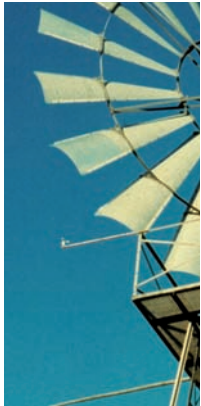


# THE NEXT GENERATION-

## YAW AND PITCH POSITION MONITORING



B-COMMAND®



# INFO

## 2 COMPANY INFO

The team of B-COMMAND has a long tradition and many years of experience in the Wind Power branch. The company with its headquarter in Hamburg, Germany, has a major focus on the production of rotary limit switches for wind turbines. In addition to our engineers, responsible for 100% quality of our products, our international sales team is able to assist you immediately for all your commercial or technical issues.

B-COMMAND is the centre of a global network of specialists. Product and design engineers in different countries are searching for new options and new technologies to be implemented or used together with our rotary limit switches on the one hand side, international sales teams are presenting our products in the local markets on the other hand side. The result is a customized high-performance product indicating all customers' requirements.

All products of B-COMMAND are designed, constructed and manufactured according to the latest state-of-the-art in technology.

B-COMMAND believes in complementary and cooperative relations to all partners in the supply chain - customers and suppliers.

 **B-COMMAND®** - your reliable partner for yaw and pitch position monitoring.



### 3 PERFORMANCE FOR WIND POWER




Since many years rotary limit switches have been used for wind power applications. Originally developed for limiting the end position of bridge cranes or winches the switches were newly processed for wind power applications. By modifying the rotary limit switches some manufacturers were able to enter the wind power market, but still based on a product originally designed for crane and hoist industry.

B-COMMAND now starts the next generation of rotary limit switches. Our switches, especially our rotary limit switch series FRM, are designed, tested and certified especially for wind power purposes according to all known requirements.

During the construction process of FRM we could bring together a team with over 80 years of mechanical experience and 15 years of experience in wind power. The result is a new technology manufactured with only high-quality components in order to match lifetime requirements of wind turbines.

All materials used are build for cold climate conditions and are certified for -40°C operational temperature. The gear units of all rotary limit switch series offer a maximum of accuracy in accordance with a minimum of hysteresis. New contact elements and special encoder solutions allow integration into modern industrial networks. The switches are constructed for the implementation into all current interfaces like PROFIBUS, CANopen and SSI. High resolution encoder solutions allow a positioning accuracy of 0,001°.

The high quality of the products was proofed under all climatic conditions in all parts of the world – onshore and offshore.

 **B-COMMAND**® - reliability and quality are the arguments we stand for.

# PITCH

## 4 PITCH CONTROL

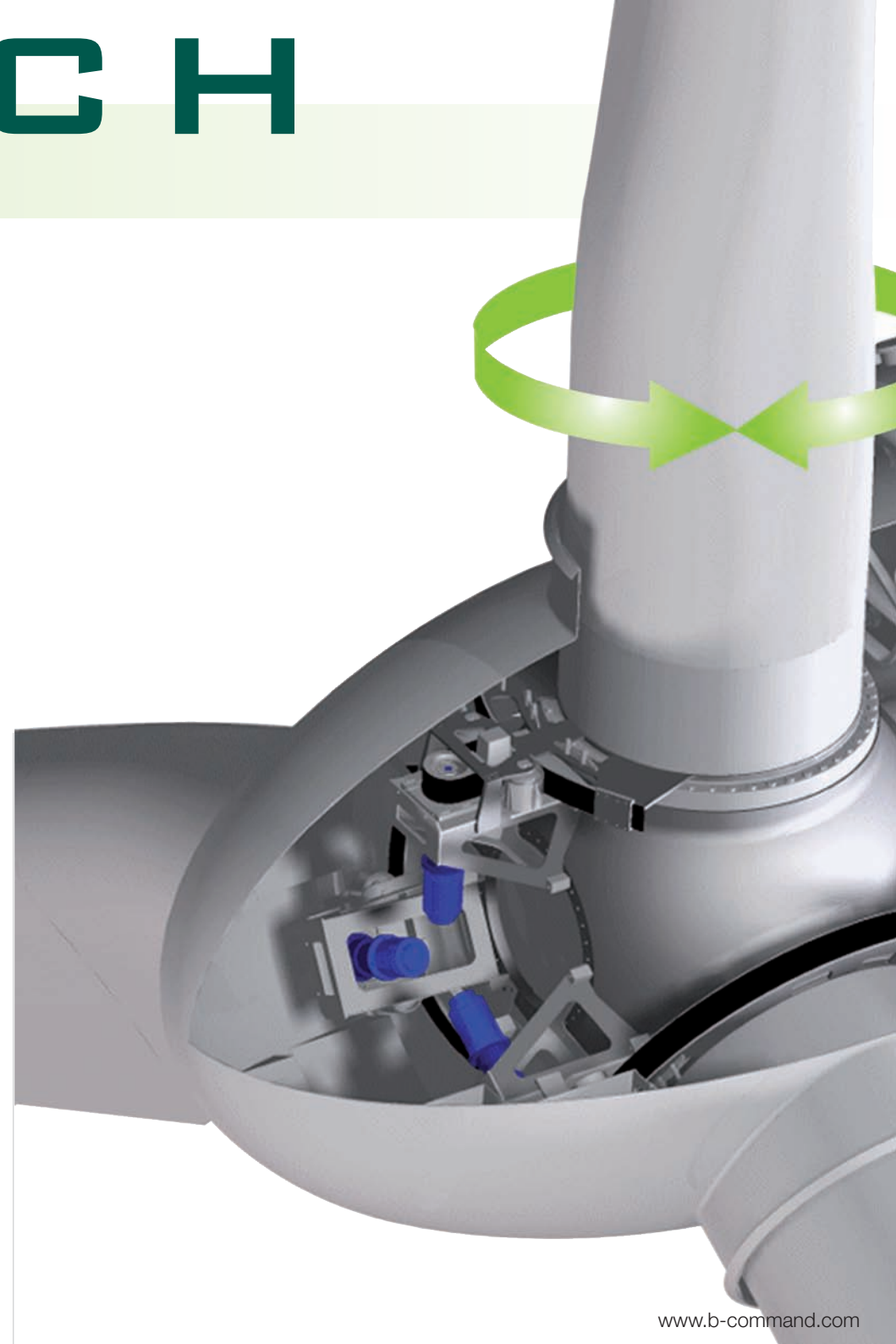
The pitch control system is used to vary the angle of the blades into or out of the wind. By changing the blade pitch, the rotation speed and the generated power can be adjusted. When power output reaches a critical level the blade pitch mechanism turns the rotor blades slightly out of the wind. Whenever the wind drops again the blades will be turned back. The adjustment of the blade pitch has a major effect on the efficiency of the wind turbine.

The rotary limit switches are used for limiting the end positions of the blade pitch, setting pre-warning points and affording precise position signals.

This real-time blade pitch position signals enable the whole system to optimize power output. Therefore high-resolution encoders are used directly mounted inside the switch.

Various BUS-systems can be covered regarding to the specifications.

The rotary limit switch allows the combination of different safety-relevant tasks in only one application. This of course associates an economization referring to cost and space capabilities. By the use of only one B-COMMAND rotary limit switch per blade all so far used devices for position monitoring can be saved (e.g. proximity sensors and all mechanical devices required therefore, limit switches and encoders on the engines).



# YAW

## 5 YAW CONTROL

In order to gain the maximum efficiency out of wind turbine generators, it is necessary to keep the rotor perpendicular to the wind. Yawing the turbine against the wind reduces fatigue loads and ensures a higher durability of all components.

Therefore B-COMMAND offers a wide range of rotary limit switches. The switches provide a maximum of customization possibilities by offering high liability at the same time. The rotary limit switch is connected by a pinion gear either with the yaw bearing around the outer edge or with the gear wheel of one of the yaw control engines.

The switch offers two general functions for yaw control:

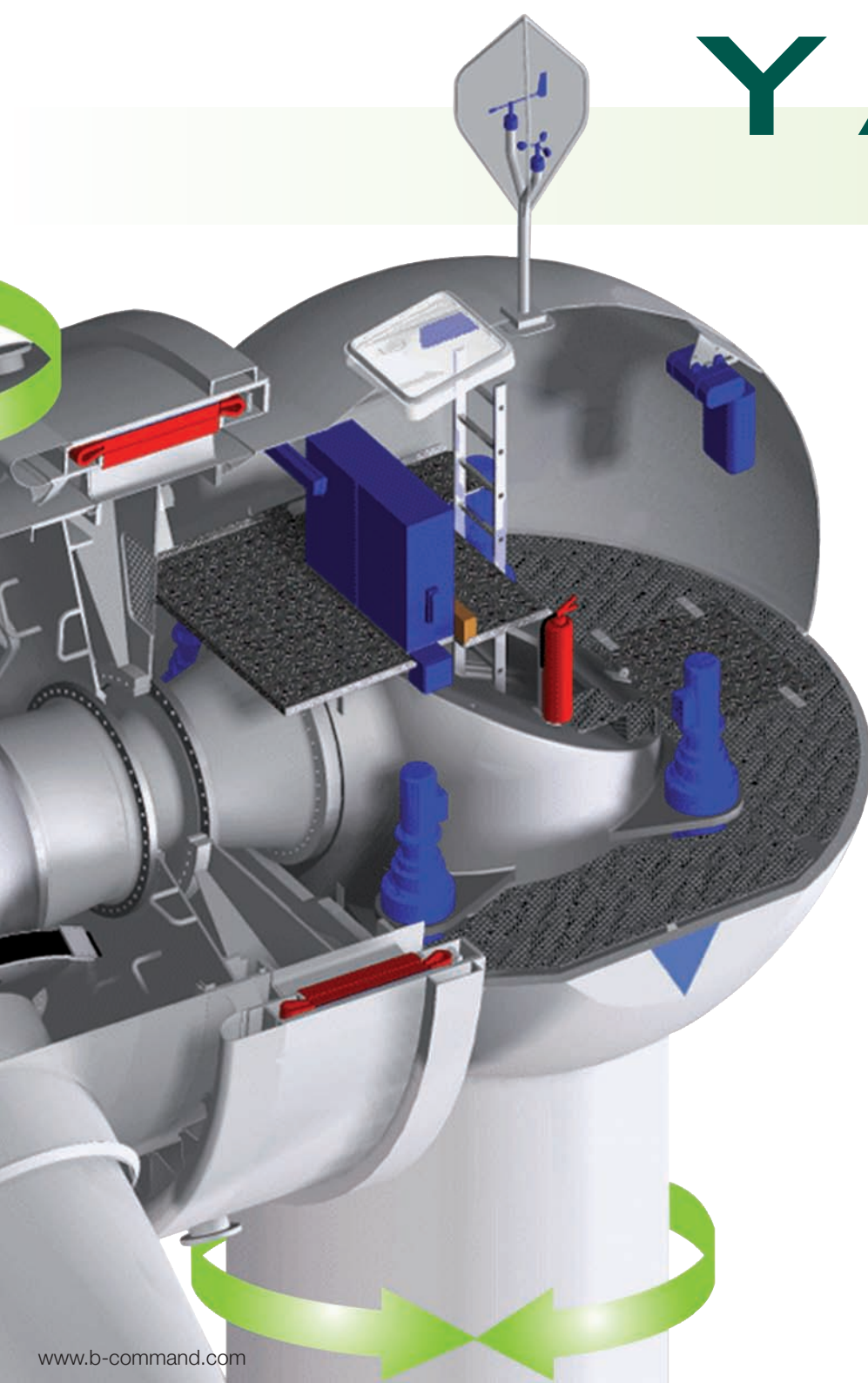
### 1. Cable Twist Sensor

The cables connecting the nacelle with the ground components have to be secured against twisting. Yawing the turbine in the same direction for a longer time increases the risk of twisting the cables. The switch meters the rotations and limits the end positions for each direction.

### 2. Yaw Position Control

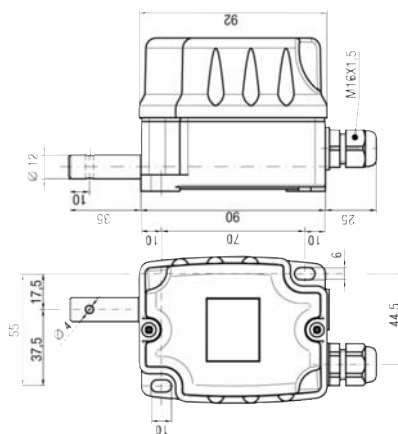
Besides limiting only the end positions B-COMMAND is able to mount different types of incremental or absolute encoders in the switch for monitoring the exact yaw position. Depending on the type of encoder we are able to reach an accuracy of  $0,001^\circ$ . The position signal of the nacelle generated by the B-COMMAND rotary limit switch compared with the wind direction signal of the anemometer allows the most efficient positioning for high power output.

The high-performance and future-proof solutions for monitoring yaw movement and cable twist protection - B-COMMAND rotary limit switches.



# 6 ROTARY LIMIT SWITCHES

## SERIES FRS

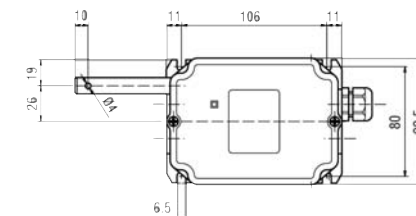
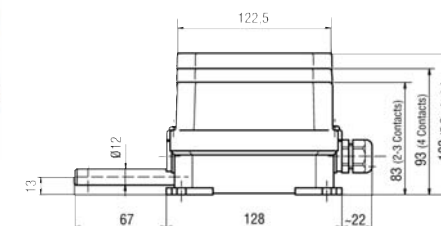


- 1 to 4 contact elements (1NO/1NC changeover contact each)
- Snap action switches
- 7 different cam types available
- Revolution ratio 1:15 up to 1:175
- Protection degree IP65
- Operational temperature: -20°C to 60°C (-40°C optional)
- Shaft: 12mm stainless steel

### Options:

- Pinion gears customized
- Extended shaft for encoder mounting
- Special shaft versions
- Mounting for potentiometer/encoder inside

## SERIES FCN



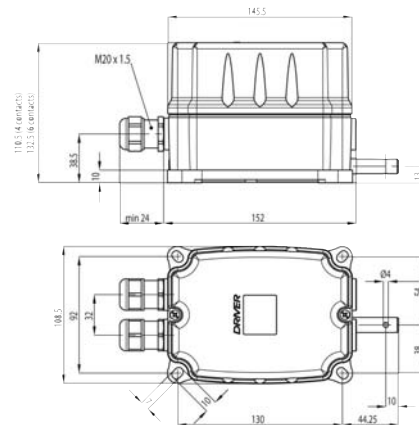
- 1 to 5 contact elements (1NO/1NC changeover contact each)
- Snap or slow action switches
- 7 different cam types available
- Revolution ratio 1:7,5 up to 1:550
- Protection degree IP55
- Operational temperature: -20°C to 60°C (-40°C optional)
- Shaft: 12mm stainless steel

### Options:

- Pinion gears customized
- Extended shaft for encoder mounting
- Special shaft versions
- Mounting for potentiometer/encoder inside



## SERIES FRM



- 1 to 10 contact elements  
(1NO/1NC changeover contact each)
- Snap action switches
- 7 different cam types available
- Revolution ratio 1:1 up to 1:900
- Protection degree IP66
- Operational temperature: -40°C to 60°C
- Shaft: 12mm stainless steel

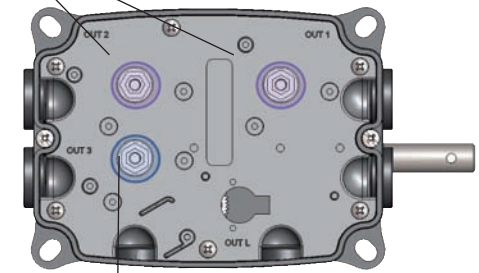
### Options:

- 3 different revolution ratios at once possible
- Pinion gears customized
- Extended shaft for encoder mounting
- Special shaft versions
- Mounting for potentiometer/encoder inside

### GEAR OUTTAKES

FRM is equipped with 4 separate gear outtakes named OUT 1, OUT 2, OUT 3 and OUT L. It is possible to use 3 of the gear outtakes simultaneously. OUT 1 is carrying the cam unit, OUT 2 can also carry a cam unit to reach 10 contacts. Otherwise OUT 2 can be equipped with a potentiometer or encoder using the same or a different ratio than OUT 1. OUT 3 is a high accuracy 1:1 outtake using a minimum of gear wheels in order to avoid any hysteresis. It can be used with incremental or absolute encoders. OUT L can be used together with our speed reader analyzing rotation and speed of the shaft for creating redundancy for the total system.

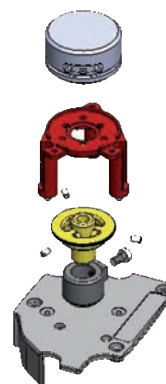
OUT 1 and OUT 2: Several types of ratios are available.  
Standard ratios:  
1 to: 5-15-25-30-50-60-75-100-120-150-200 up to 900.



OUT 3: Direct Ratio 1:1 with bevel gear

### OPTIONS FOR SENSORS

FRM was designed for offering a high-accuracy platform for a wide range of sensors. By using the different gear outtakes together with the multifunctional mounting option for sensors the FRM can be seen as an open base for all requested solutions. That has been the main aim during the research and development for FRM.



High-Precision Potentiometer



Incremental Encoder



Magnetic Absolute Encoder



Hall Effect Sensor contactless

# 8 SPECIAL SOLUTIONS

## FRM INCLUDING IN-HOUSE MOUNTED ABSOLUTE ENCODER AND SWITCHBOARD

During design and construction process of FRM we focussed on a high-accuracy 1:1 gear outtake inside the housing. With a minimum of perfect fitting gear wheels we reached this aim and are now able to use also high-resolution absolute encoders inside the housing for precise positioning. The switch is delivered pre-adjusted and pre-wired. The accuracy of this system can cover yaw and pitch applications.

Remarks:

- Position signal also available and revolving during loss of power
- High-resolution magnetic absolute encoder
- Interface: SSI
- Easy to use solution pre-wired and pre-adjusted



## FRM WITH HIGH PRECISION POTENTIOMETER

On the multifunctional mounting option for sensors a high precision potentiometer can be used. It will be pre-wired on a small circuit board what makes the installation easier for the customer. Beside a high durability this solution is very non-susceptible to faults and easy to evaluate due to the analogue output.

Remarks:

- Position signal also available and revolving during loss of power
- Interface: analogue, 0-10V, 4-20mA



## FRM WITH INCREMENTAL ENCODER AND SWITCHBOARD

By using the FRM together with an incremental encoder and a switchboard inside, we are able to supply a completely pre-wired and pre-adjusted system plug-and-play ready for mounting inside the wind turbine. The position signal gained by the incremental encoder has to be backed up into the PLC. This system is used for yaw applications.

Remarks:

- Resolution: 1 to 12.500 ppr.
- Signals: A,B,Z and inverted
- Economic and easy to use solution pre-wired and pre-adjusted





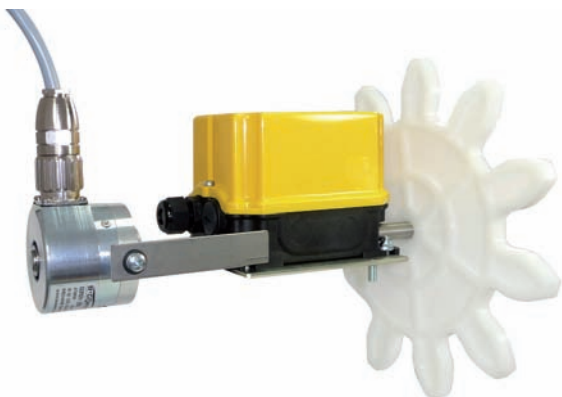
# 9 SPECIAL SOLUTIONS

## FCN WITH EXTENDED SHAFT AND ABSOLUTE ENCODER

The main focus for this special solution is the accuracy of the absolute encoder. The customers demand is an accuracy of  $<0,1^\circ$  for the yaw position combined with the cable twist protection function via mechanical contacts. Therefore we elongated the drive shaft for direct mounting of the absolute encoder. The result is high-resolution system with maximum of accuracy for the position signal. This system can be used for both yaw and pitch applications.

Remarks:

- Position signal also available and revolving during loss of power
- Interface: SSI
- Accuracy:  $<0,01^\circ$



## FRM WITH EXTENDED SHAFT AND ABSOLUTE ENCODER

The main focus for this special solution is the accuracy of the absolute encoder. Also for FRM we are able to elongate the drive shaft and connect it directly with an absolute encoder. This system is used for blade pitch positioning.

Remarks:

- position signal also available and revolving during loss of power
- Interface: SSI
- Accuracy:  $<0,01^\circ$



## FRM INCLUDING IN-HOUSE MOUNTED ABSOLUTE ENCODER

During design and construction process of FRM we focussed on a high-accuracy 1:1 gear outtake inside the housing. With a minimum of perfect fitting gear wheels we reached this aim and are now able to use also high-resolution absolute encoders inside the housing for precise positioning. The switch is delivered pre-adjusted and pre-wired. The accuracy of this system can cover both applications, yaw and pitch.

Remarks:

- Position signal also available and revolving during loss of power
- High-resolution optical absolute encoder
- Interface: CanOpen
- Easy to use solution pre-wired and pre-adjusted



# MECHANIC

## 10 PINION GEAR



Our range of pinion gears with its special module sizes and numbers of teeth is designed for wind power usage. The pinion gears are supplied already assembled on our rotary limit switches or on encoders.

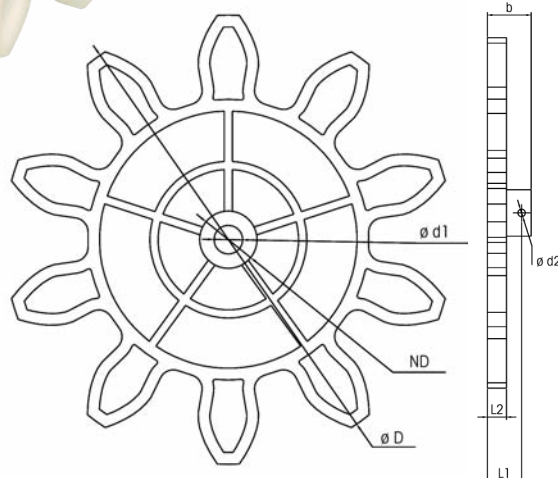
All pinion gears are designed and tested for heavy duty applications where choice of the right materials plays an important role. Our full range is produced of special thermoplastic materials certified for operational temperature of -40°C, which is unique on the market.

On this page you can see some of our standard pinion gears which are constantly available in our main warehouse in Hamburg.

Beside the standard solutions we have recognized the basic necessity of a flexible tooling process and production. By usage of a special tooling process we are able to manufacture prototypes of new types of pinion gears within two weeks and arrange series production after five to six weeks.

Based on this special process the production of new tools is profitable also for smaller series.

We would be pleased to execute a calculation of profitability also for your demands of pinion gears not listed in our standard range.



Item No.	Module Size	No. Teeth	D (mm)	d1 (mm)	b (mm)	L1 (mm)	d2 (mm)	ND (mm)	L2 (mm)
M5Z12	M5	12	70	12	23	13	4	25	8
M6Z11	M6	11	78	12	23	13	4	25	8
M8Z12	M8	12	112	12	23	13	4	25	9
M10Z12	M10	12	144	12	23	13	4	25	10
M12Z10	M12	10	144	12	23	16	4	25	10
M12Z12	M12	12	168	12	24,2	17	4	25	10
M14Z10	M14	10	168	12	24	17	4	24	10
M16Z10	M16	10	192	12	23	18	4	24,5	10
M18Z10	M18	10	216	12	26	20,5	4	27	11
M18Z11	M18	11	234	12	20	15	4	32	8
M18Z12	M18	12	252	12	23	16	4	25	10
M20Z8	M20	8	200	12	23	17	4	24,5	10
M20Z11	M20	11	260	12	20	15	4	32	8

# ACCESSORY

## 11 SHAFTS / MOUNTING PLATES

### SHAFTS

The position of the rotary limit switch inside the turbine differs. Often it is required to use a defined position inside the nacelle or hub. To simplify the assembling B-COMMAND is able to customize also the shaft length of the rotary limit switch. Also following special works on the shaft are possible:

- Extended shaft for encoder mounting
- Milling works for screw threads
- Holes
- Fit-in-keys

Many other solutions are possible. For further details or special wishes please contact us.



### MOUNTING PLATES

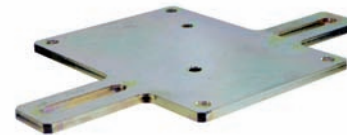
The aim of B-COMMAND is a perfect implementation of the rotary limit switch in the machine in order to maximize the efficiency. Beside special solutions for the shaft we are also able to manufacture the complete mounting for the switch.

The complete package consisting of rotary limit switch, pre-wired and pre-adjusted, encoder, pinion gear, cables including plugs and also the mounting for the switch is a plug-and-play solution which can be assembled also by non-engineers.

This of course saves much time in the production process.

Any types of rotary limit switch mounting plates are possible, we manufacture it customized referring to your drawings.

For further details or special wishes please contact us.





# 1 2 ELECTRONIC ACCESSORY ELECTRONIC



## POTENTIOMETER

High precision potentiometers with conductive plastic resistance track for in-house mounting. Available in 2kOhm, 5kOhm or 10kOhm. Used for single-turn applications.

Resolution: 0,008°  
Linearity: +/-0,075%  
Lifetime: 100x10<sup>6</sup> movements



## ANGLE SENSOR

The contactless sensor utilizes the orientation of a magnetic field for the determination of the measurement angle. It is used for in-house mounting. Redundant sensors possible. Used for single-turn applications.

Linearity: +/-0,3%  
Resolution: 12-14 bit  
Interfaces: 4-20mA, PWM, SPI



## INCREMENTAL ENCODER

Single-turn or multi-turn incremental encoders for in-house mounting. Counting pulses during rotation of the sensor. It is used for in-house mounting.

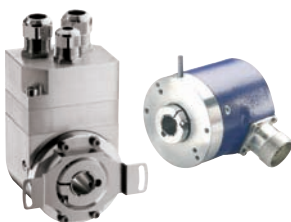
Resolution: 30-12.500 ppr  
Output: A,B,Z and inverted



## MAGNETIC ABSOLUTE ENCODER

Single-turn or multi-turn absolute encoder with magnetic sensing method. Heavy duty sensor used for in-house mounting. Various diagnostic and parametric functions.

Resolution: 10 bit single-turn,  
15 bit multi-turn  
Interface: SSI, CanOpen



## OPTICAL ABSOLUTE ENCODER

Single-turn or multi-turn absolute encoders with optical sensing method. Either for external mounting with 1:1 connection to the drive-shaft or in-house mounting. Various diagnostic and parametric functions.

Resolution: 14 bit single-turn,  
12 bit multi-turn  
Interfaces: Profibus, DeviceNet, CANopen, SSI

# SLIP RINGS

## 1 3 SLIP RINGS



### SLIP RING PRS

- Aluminium enclosure
- IP 55
- 20A/30A/50A rings
- 6-15 rings
- Mixed executions
- Brushes brass or copper-graphite



### SLIP RING EXD

- Aluminium enclosure
- IP 65
- 0,5A/7A/27A rings
- 4-6 rings
- ATEX 6032
- Brushes copper-graphite



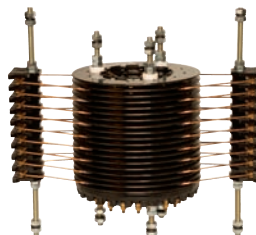
### SLIP RING PMS

- Aluminium enclosure
- IP 55
- 20A/50A rings
- 6-30 rings
- Mixed executions
- Optional absolute encoder
- Brushes copper-graphite



### SLIP RING PMT

- Aluminium enclosure
- IP 55
- 10A rings
- 6-30 rings
- Including cable
- Brushes copper-graphite



### SLIP RING PSG

- Without enclosure
- IP 00
- 20A/60A rings
- 4-36 rings
- Brushes copper-graphite



### SLIP RING PME

- Aluminium enclosure
- IP 65
- 20A, 50A, 100A
- 20-60 rings
- Mixed executions
- Brushes copper-graphite

# ADDITIONAL

## 14 ADDITIONAL PRODUCTS FOR WIND POWER



### MAIN SWITCHES

- Panel mounted, din-rail mounted
- 16-250A
- 3-9 poles



### MAIN SWITCHES

- Enclosure version
- 16-250A
- 3-9 poles



### EMERGENCY-OFF-BUTTONS

- Panel mounted or enclosure version
- Illuminated, key interlock, actuation protection, ASI Safety at Work
- Individual contact elements



### DC CONTACTORS

- Logo TL20
- 150A
- 12, 24, 36, 48, 72, 80 or 96V DC



### DC CONTACTORS

- Logo TL40
- 220A
- 12, 24, 36, 48, 72, 80 or 96V DC



### DC-CONNECTORS

- 80, 160, 320A
- High quality electrolytic copper contacts
- DIN 43589-1, DIN 43589-2



### EMERGENCY LIGHTS

- IP 65
- Rechargeable battery, 3h operation
- LED 50.000h lifetime
- Autotest-Function
- Optional: cold climate version for -30°C operational temperature



### PENDANT CONTROL STATIONS

- Auxiliary circuit control
- Max. 12 pushbuttons
- 1 or 2 speed levels
- Customized labelling



# CONTACT

## 15 CONTACT

B-COMMAND HAS FORMED A TEAM OF SPECIALISTS RESPONSIBLE FOR WIND POWER PROJECTS AND CUSTOMERS ONLY. BECAUSE OF THE CLOSE CONTACT BETWEEN THE ENGINEERS OF WIND TURBINE MANUFACTURERS AND OUR WIND POWER TEAM WE ARE ABLE TO ANSWER ALL OF YOUR QUESTIONS DIRECTLY OR WITHIN SHORT TIME. PLEASE CONTACT US.

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