

TR-Electronic Robust solutions for wind turbines

- Azimuth and pitch adjustment
- Generator speed monitoring

















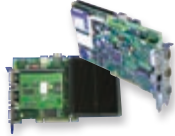

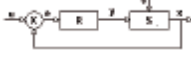




TR-Electronic – Your Partner in Automation

TR-Electronic can look back on more than 25 years of success, and is represented worldwide with an export share of more than 40 %. The core business comprises the development and manufacture of industrial angular and position measuring technology, as well as compact drive technology with integrated position control and measurement. The company is divided into three Business Units (BU) and is thus well positioned for further growth in the future.

Products in the **Rotary Encoder Business Unit** with optical or magnetic scanning precisely acquire position in steel production, wind power plants, cranes and ships as well as in explosion-proof versions in painting lines. Miniature versions ensure the correct position in medical technology. SIL3 approved absolute rotary encoders ensure the necessary safety.

In the **Linear Encoders Business Unit** magnetostrictive position sensors position injection molding machines, for example, or are directly integrated into hydraulic cylinders. Cascadable distance measurement sensors position parting units. With their high precision, glass scales on machine tools ensure precise position. Laser sensors based on phase difference measuring techniques position aisle stackers in warehousing and materials handling technology.

In the **Drives Business Unit** angle sensors are combined with compact drives: no external electronics are required, position, speed and torque controllers, power electronics and absolute rotary encoders are compactly integrated into the drive and thus bring intelligence directly to the drive shaft via the field bus. Compact drives are used for diverse applications in the printing and packaging industry and on palletizers.

					
					
Rotary Encoder	Linear Encoder	Drives	Components	Engineering	Unidor
 Incremental Encoder  Absolute Encoder  Draw Wire Encoder	 Magnetostriction  Glass scale  TOF laser  Barcode Positioning	 Actuator  Positioning Drive  Processing Drive	 I/O Module  Controls  Industrial-PC	Automation Solutions  Retrofit 	Punching and forming Measurement and control systems  Sensors  Process monitoring tools 

The portfolio is supplemented by the affiliated **TRsystems** with customized controls, industrial PCs, hydraulic controls as well as control units and sensors for punching and forming.

An essential factor for the success of **TR-Electronic** are the now more than **300 employees** who actively help to shape the product portfolio with innovations and successfully implement customer projects. Through its commitment to the regional colleges, TR-Electronic supports the high quality training of young employees and thus guarantees the highest level of innovation and quality at its Trossingen location.

A high degree of vertical integration allows customer-specific requirements to be responded to very quickly. The constantly new requirements on the mechanical design of sensors, on innovative new operating interfaces and new plug connectors result in a rapidly increasing product diversity. With **TR-Electronic** you have a partner who can fulfil these requirements.

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Interfaces for our devices (others on request)

SSI ISI Parallel SIN/COS LWL					
					

*in the pipeline

Functional safety in wind turbines

The Machinery Directive has had a powerful impact on the implementation of safety requirements in automation technology. These methods are also increasingly applied for the design and construction of wind turbines. Different requirements result, depending on the function for which a component is used. TR-Electronic meets these challenges and thanks to its many years of experience is a reliable and expert partner for manufacturers of wind turbines and system suppliers. TR-Electronic develops and produces certified components with functional safety.

Previous solution

The respective manufacturer is responsible for the safety design of different regulation, control and monitoring functions. Each manufacturer has designed its own individual (sub-)system and must prove its capability.

Certified solution

The standards for the safety assessment of systems and components are now established in general automation technology and have proven themselves. TR-Electronic provides the necessary characteristics. Wind turbine manufacturers and system suppliers receive certified sensors individually tailored to requirements. These components are therefore considered safe and are suitable for the desired safety function. This saves users of TR-Electronic's components from having to provide their own proof for the sensors.

The CD_75 M absolute rotary encoder records the revolution information by means of mechanical transmission without battery-buffered rev counter. The development, technology and production of these devices are certified by TÜV. They are used in systems which require Safety Integrity Level 3 (SIL 3: IEC 61508/EN 62061) or Performance Level e (PLe: EN ISO 13849 -1). The CD_75 PROFIsafe also outputs speed values which are deemed safe.

TR follows the concept of integrated safety here. The measured values are output directly via certified safety buses. Additional evaluation units are unnecessary. The measured values are transparently available in the higher level (safety) control.

Graduated safety concepts

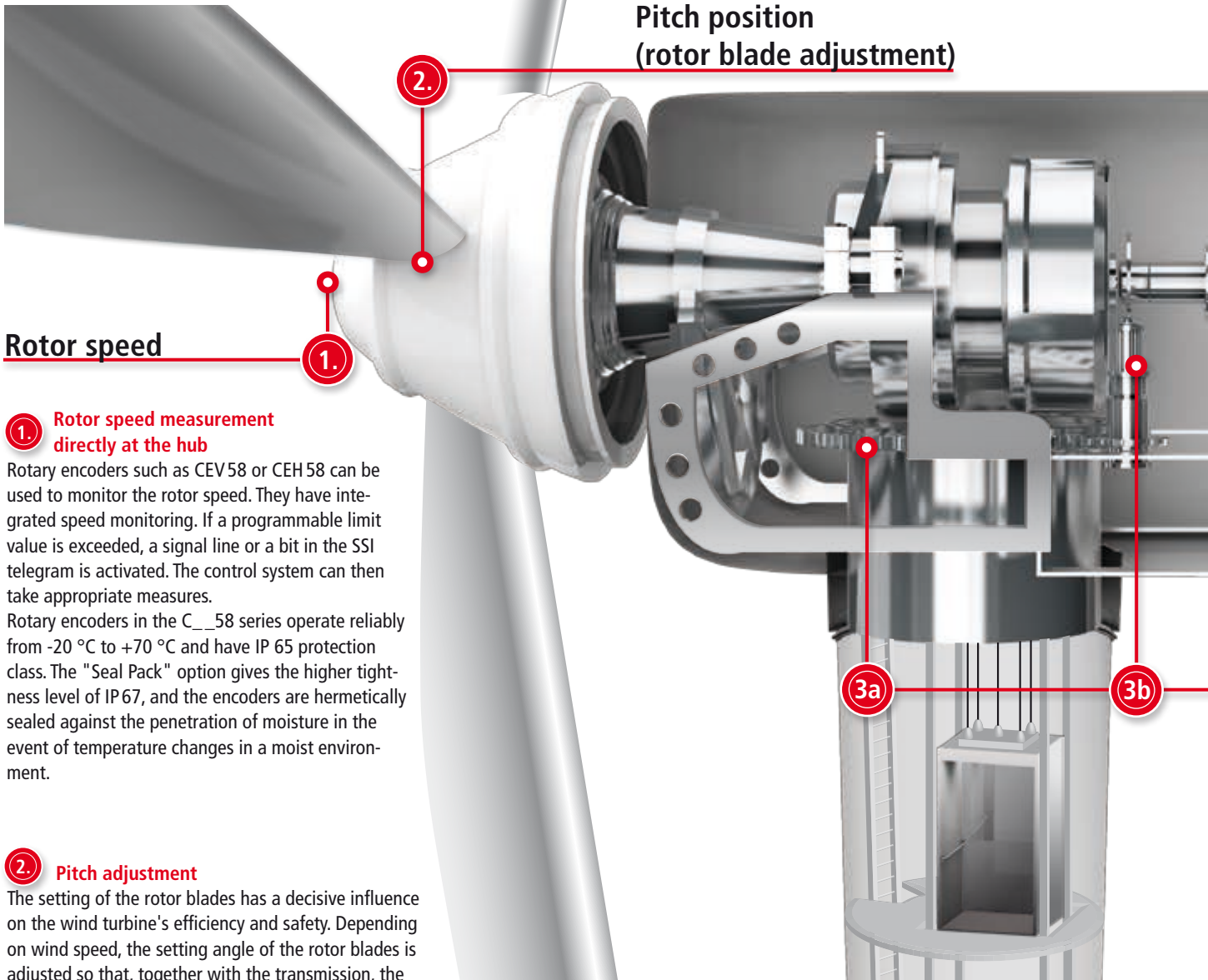
The safety requirements of the individual functions in a wind turbine are subject to different degrees of safety. In pitch adjustment, for example, the requirements are high. Therefore redundant systems have previously been used. In order to continue to guarantee and increase this safety, the use of safety-certified rotary encoders from TR-Electronic is recommended.

The design of other axes is facilitated by the fact that the necessary safety factors are supplied by the component manufacturer (determination of PL according to EN ISO 13849-1 from the component failure rates).

SIL and PL – two scales for safety

SIL The Safety Integrity Level (SIL) is described in international standard IEC 61508. Its purpose is to assess electrical/electronic/electronically programmable (E/E/PE) systems in relation to the reliability of safety functions. The targeted level specifies which safety-oriented design principles must be observed in order to minimize the risk of malfunctions.

PL EN ISO 13849-1 defines five so-called Performance Levels (PL) based on the categories: a, b, c, d, e. The Performance Levels serve to categorize safety-related performance. They are determined from the average probability value of a hazardous failure and the diagnostic coverage, and also take account of the structural design of a system (how many channels the system has, how independent these are of each other). Our safety rotary encoders are certified to PLe: "e" is the highest Performance Level.



Rotor speed

1. Rotor speed measurement directly at the hub

Rotary encoders such as CEV 58 or CEH 58 can be used to monitor the rotor speed. They have integrated speed monitoring. If a programmable limit value is exceeded, a signal line or a bit in the SSI telegram is activated. The control system can then take appropriate measures.

Rotary encoders in the C__58 series operate reliably from -20 °C to +70 °C and have IP 65 protection class. The "Seal Pack" option gives the higher tightness level of IP 67, and the encoders are hermetically sealed against the penetration of moisture in the event of temperature changes in a moist environment.

2. Pitch adjustment

The setting of the rotor blades has a decisive influence on the wind turbine's efficiency and safety. Depending on wind speed, the setting angle of the rotor blades is adjusted so that, together with the transmission, the generator operates optimally.

Electrical pitch axes

Robust absolute encoders have proven themselves for the position control of electrical pitch axes. They provide the real position value even after failure and restoration of the power supply. The CEH 58 M hollow shaft encoder is inserted directly in the power train, the second shaft end of the motor, while the CEV 58 M solid shaft encoder with collar bearing and pinion measures the setting angle at the drive ring gear.

CEV 58 M



CEH 58 M

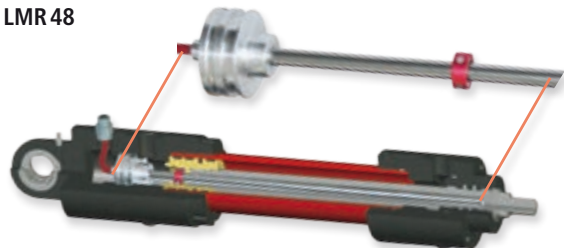


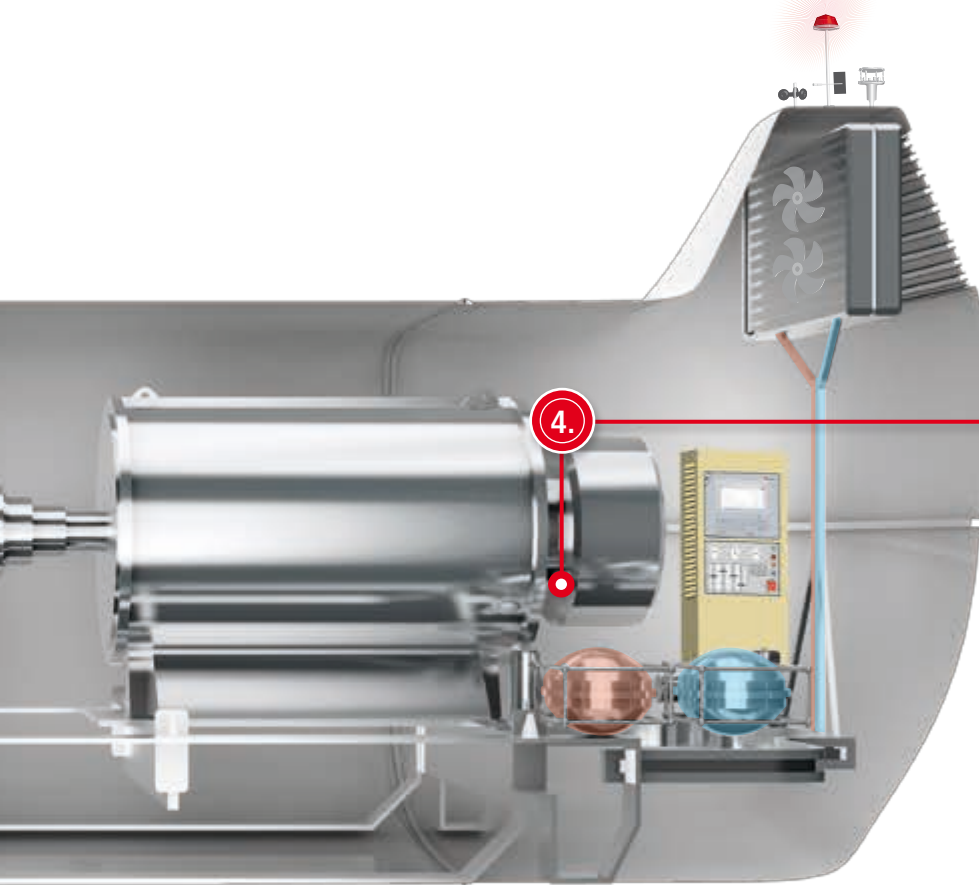
Hydraulic pitch axes

The LMR 48 is a compact measuring system for hydraulic drives. The proven magnetostrictive, wear-free measuring process guarantees precise and reliable position feedback with an accuracy of $\pm 0.05\%$. The flat, compact design of the sensor facilitates its complete integration into the hydraulic cylinder.

The sensor is optimally protected. The overall length of the cylinder drive is reduced as a result. The cylinders can be coupled by means of rod eyes. The LMR 48 can operate in a temperature range from -40 °C to +85 °C. The casing duct is pressure-tight up to 450 bar constant and up to a peak value of 750 bar.

LMR 48





Generator speed

Azimuth position of the gondola

a) directly at the ring gear b) at the second motor shaft

3. Azimuth tracking of gondolas

The gondola of the wind turbine is aligned to follow the wind direction. Similarly to the pitch adjustment, the position value for the control can be recorded directly in the power train on the second motor shaft end (3a) or on the ring gear of the gondola bearing (3b). The number of revolutions which the gondola can make is not unlimited. The cables between gondola and tower usually only allow a limited number of revolutions. Therefore the position must also be constantly recorded over a number of revolutions. The extended revolution range of CEH 58 M/CEV 58 M of 256,000 recorded absolute revolutions makes this possible, even if the motor shaft is used for position detection.

2.13. Certified sensors for integrated safety in pitch and azimuth drives

TR-Electronic is one of the first manufacturers to produce / offer certified absolute rotary encoders with integrated safety. The sensors are certified by independent bodies. Safe rotary encoders from TR are proven in countless applications. The CDH 75 M and the CDV 75 M will provide your system with optimal protection and fulfil the highest safety standards. The CD_75 M absolute rotary encoder records the revolution information by means of mechanical transmission without battery-buffered rev counter. The development, technology and production of these devices are certified by TÜV. They are used in systems which require Safety Integrity Level 3 (SIL3: IEC 61508 / EN 62061) or Performance Level e (PLe: EN ISO 13849-1). Safe position and speed values are output via the certified PROFIsafe protocol, either via PROFIBUS or PROFINET.

4. Monitoring of the generator speed – protection against excessive speed

The speed of the generator shaft, including position detection, can be measured with the CEH 80 or CEH 110. Monitoring is especially important here in order to protect the system from overheating. Hollow shaft rotary encoders can take shafts of up to 50 mm diameter and withstand strong vibrations. They provide the current position value as soon as the system is switched on. Both hollow shaft rotary encoders operate reliably in a temperature range from -20 °C to +70 °C and with protection class IP54.

CEH 80

- Shaft diameter 16–27 mm



CEH 110

- Shaft diameter 27–50 mm



No further intermediate switching group is required for evaluation (except for a suitable control system). Fewer components means a reduced failure risk.

CDV 75 M

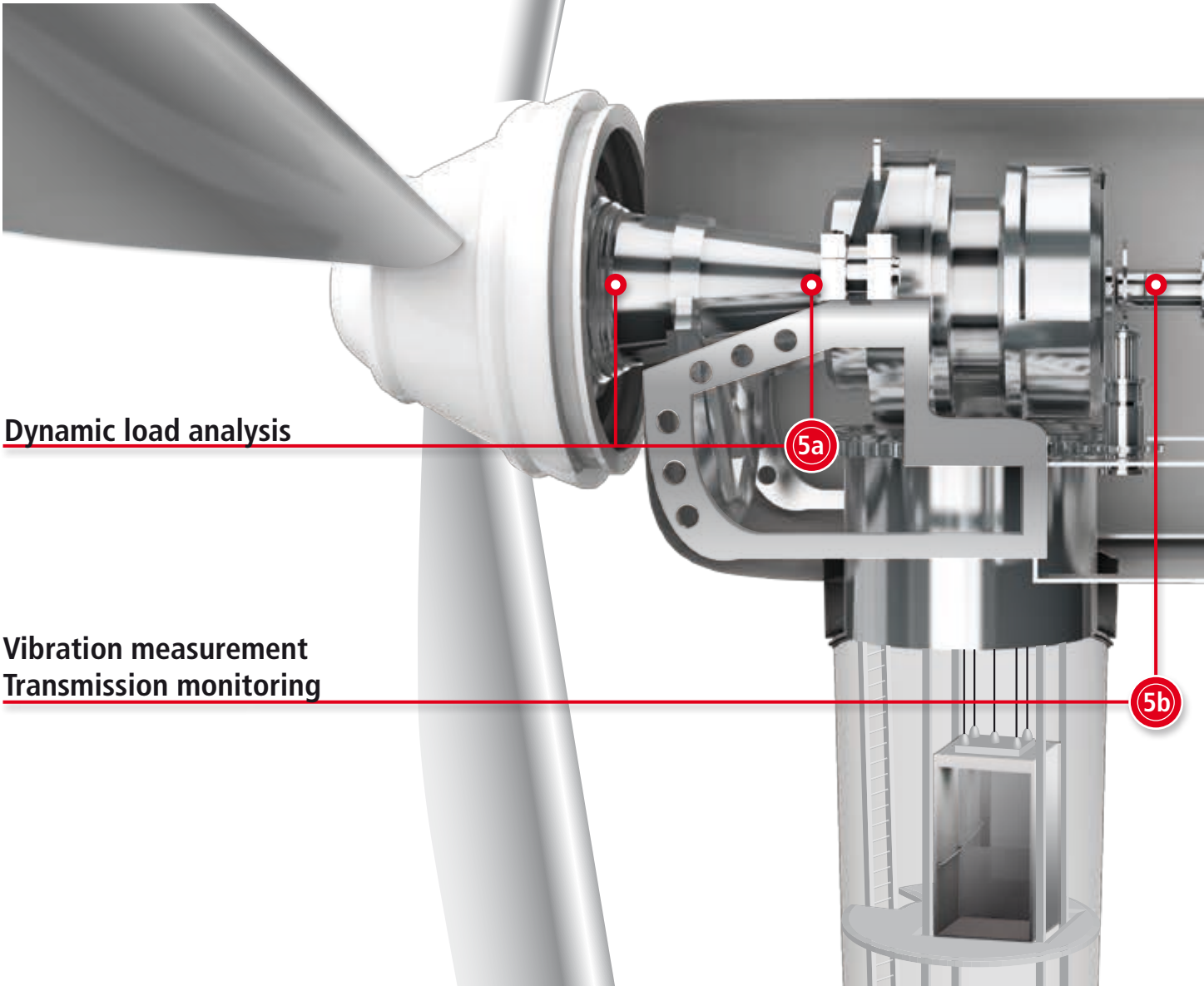


SIL3, PLe
PROFIsafe

CDH 75 M



Ideal solutions for the wind industry



Dynamic load analysis

**Vibration measurement
Transmission monitoring**

5 Load analysis (5a), vibration measurement and transmission monitoring (5b) with SmartControl

Deformations and material damage can mean the end for the system. It must therefore operate completely safely in defined load limiting ranges.

All recorded values are monitored and logged. **SmartControl**, with its specially developed Piezo sensors, is used for this purpose. The system visualizes, measures and checks all sensor signals and combines them. Any violation of preset target or limit values is indicated and recorded. It is quick to install and ready for operation in a few easy steps.

Convenient data output / evaluation is enabled by special software on the powerful industrial PC.

SmartControl reliably protects the system. Special sensors record all deviations and provide a reliable warning as soon as the defined limit values are exceeded.

SmartControl

- _ indicates deformation or surface defects
- _ the SmartLine software indicates important processes and faults
- _ parallel recording of up to 12 measuring channels possible
- _ 24 VDC operating voltage, either via plug-in power supply unit or switch cabinet control voltage

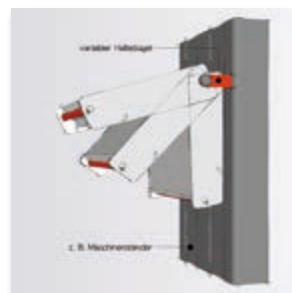
smartLINE touch surface

- _ easy to operate
- _ intuitive navigation



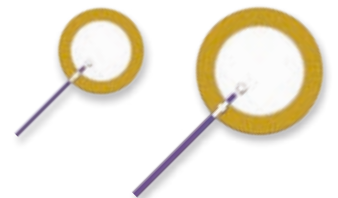
Combi mounting bracket

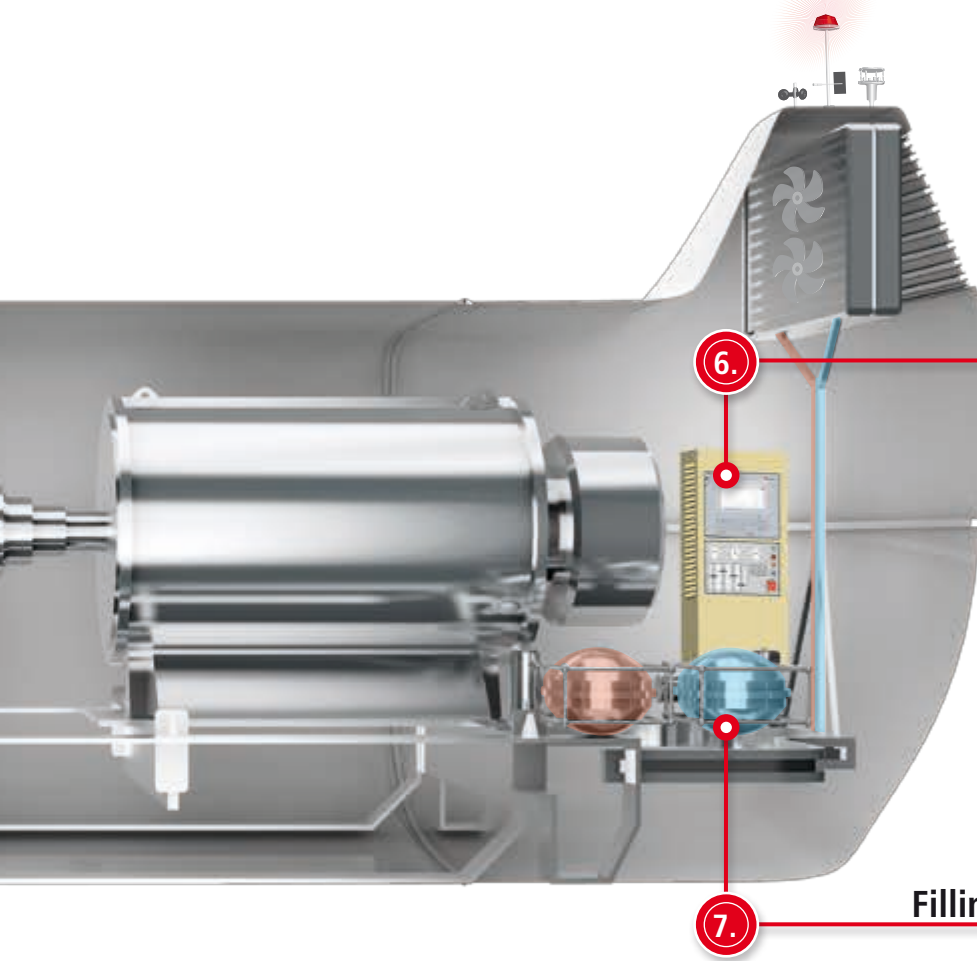
- _ The PC can be mounted horizontally or vertically



Piezo sensors

- _ easy to install
- _ robust handling
- _ two sizes to choose from





System monitoring

Filling level monitoring

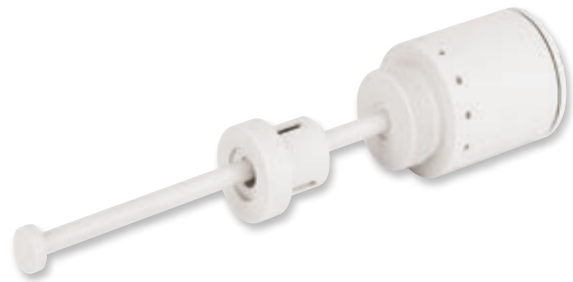
6. System monitoring with box or panel PC

The control technology of wind turbines is now completely PC-based. Control system, monitoring or remote monitoring can run in an industrial PC. Panel PCs and box PCs from TRsystems can be integrated optimally into the environment. Ventilated wall or DIN-rail mountable PCs can be perfectly accommodated in the switch cabinet. Panel PCs are a convenient solution for the operating interface. Integrated into a front panel, they are sufficiently sealed. Arm-mounted PCs have the same interface, but are sealed on all sides and can be freely positioned. Moving parts are minimized to give a particularly long service life. Cooling is guaranteed by a coordinated system of heat pipes and heat sinks. The hard disk is replaced by Flash modules, and access is minimized by intelligent writing technology. Keyboards or conventional operating elements such as emergency stop, maintenance and key-operated switches can be integrated into the front panel according to customer requirement; USB access can also be provided for simple local data exchange. Cutting-edge multi-touch devices enable operating concepts with gesture recognition. The displays have a diagonal of 10 to 19 inches, in an aspect ratio of 4:3 or 16:9. The devices are usually pre-equipped with two network interfaces for Industrial Ethernet; traditional field buses such as CANopen and Profibus are integrated as option cards.



7. Level monitoring for cooling and braking systems

Many wind turbines have hydraulic systems for cooling or for the operation of safety brakes. Thanks to continuous monitoring of the levels in the tanks, leaks are detected at an early stage. Consequential costs are minimized or even eliminated. The LA 80 from TR-Electronic is one such level measuring system. The plastic (PP) housing is resistant even to aggressive coolants or oil additives. The LMR 48 or LA 46 with float gauge are also suitable for simpler applications. Medium temperatures up to +85 °C present no problem. The systems are contactless, pressure-tight and have no openings below the liquid line. Consequently their use does not affect the leak tightness of the overall system.



In order to achieve a high chemical resistance, the measuring system and electronics are installed in a tube with a polypropylene flange. The measuring principle is based on a travel time measurement in the ultrasonic range. This is proportional to the distance and is evaluated in an electronic unit. The protecting tube contains the ferromagnetic wire, which is subjected to a current pulse. The current pulse produces a radial magnetic field around the wire. The time difference between emission of the current pulse and arrival of the torsion pulse converts the measuring electronics into a distance-proportional output signal, which it makes available as a digital or analog signal.

TR-Electronic – Your Partner in Automation

General

Monitoring

Analysis / Evaluation



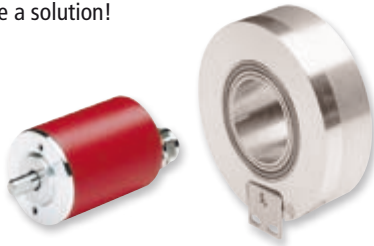
Programmable rotary encoder

The standard of automation technology, available with all current fieldbus systems: PROFIBUS, Interbus, CANopen, DeviceNet and Industrial Ethernet. Including TR-Electronic's variety of mechanics, interfaces and functions.



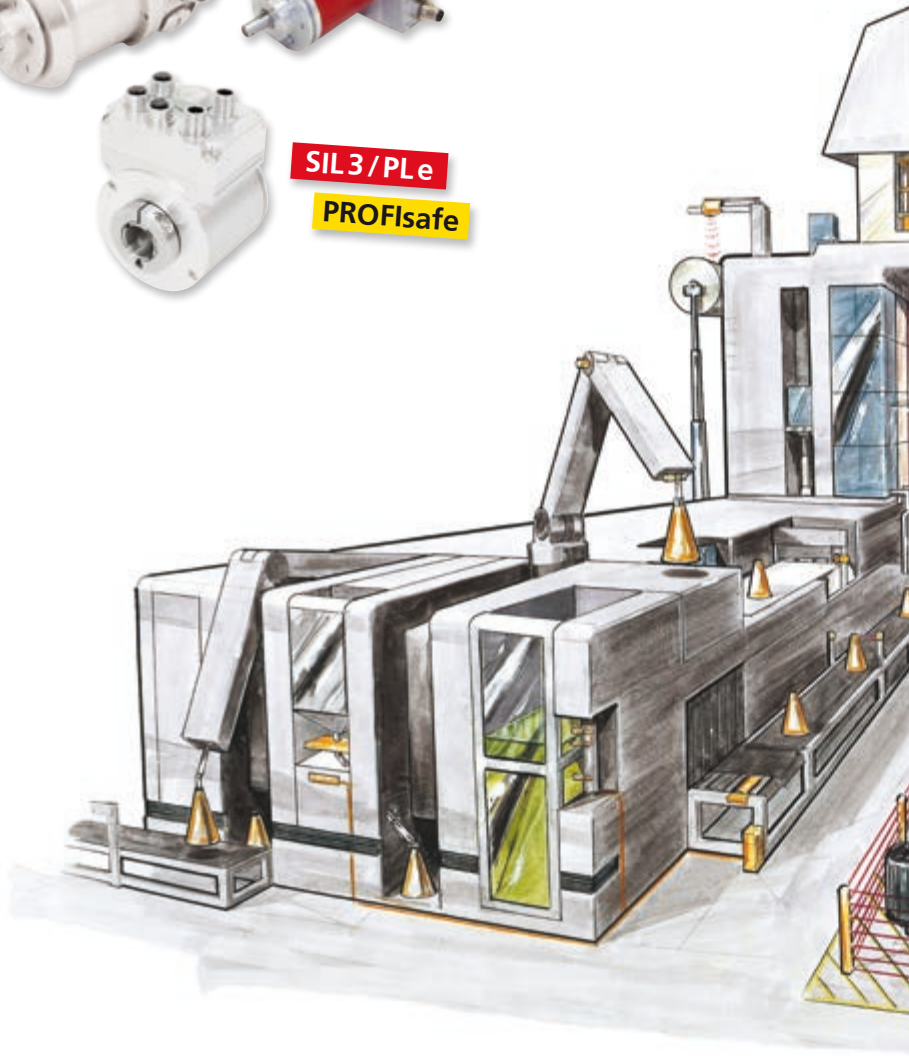
Incremental rotary encoder

From 24 mm external diameter up to 55 mm hollow shaft – we always have a solution!



Motor feedback systems

Feedback encoder for modern positioning drives. Optional integrated or directly mounted on the drive shaft via hollow shaft.



Linear absolute displacement sensors

The compact class for linear absolute measurement. Directly bus-ready, suitable for harsh environmental conditions and for installation in hydraulic cylinders.



Absolute high resolution linear measurement systems

Linear measurement with absolute sub-micron resolution without referencing.



Intelligent positioning drive

Absolute positioning directly via fieldbus. Integrated motor, power electronics, closed loop controller, absolute encoder, PLC functions and fieldbus interface.



Heavy-duty industrial PC

Double shock proof mounted housing isolates the electronics from vibration, while front access (MIPC) simplifies configuration and start up. Choose from our wide selection of housings.



SPC – the PLC for PC

Turns every PC into an efficient PLC under S5/S7 or IEC 1131 protocols. Combines the comfort of PC control with the safety of a separate processor for PLC tasks.



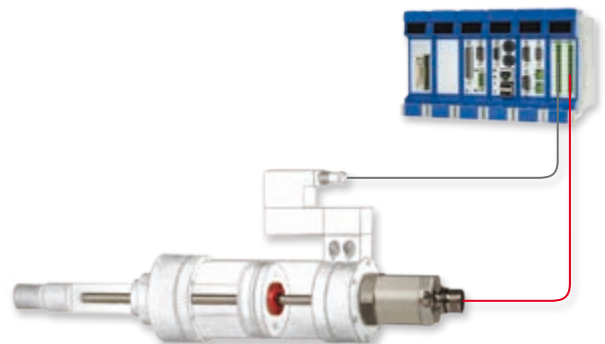
@ctivelO – more than fieldbus modules

Modular, rugged fieldbus node system I/O-node, small-scale PLC, decentralized axis controller, high performance cam controller, DIN-rail mounted industrial PC, servo controller for the hydraulic ... with commercial fieldbus systems, such as Profibus-DP, CANopen, DeviceNet, LightBus ... and ETH-ERNET as option!



Laser distance measuring systems

Absolute and wear-free measurement of distances up to 200 m via SSI, fieldbus and Ethernet.



Headquarter

TR-Electronic GmbH
Eglshalde 6
D-78647 Trossingen
Germany

Tel.: +49/7425 228-0
Fax: +49/7425 228-33
info@tr-electronic.de
www.tr-electronic.de

International

Argentina

AEA Aparatos Eléctricos
Automáticos
S.A.C.I.E./Asunción 2130
AR-1419 Buenos Aires
Tel.: +54/11 - 4574 1155
Fax: +54/11 - 4574 2400
servicioalcliente@aea.com.ar
www.aea.com.ar

Australia

Sensor Measurement Pty Ltd.
Unit 8/26 Shields Crescent
P.O. Box 1079
AU-Booragoon
Western Australia 6154
Tel.: +61/8-93 17 25 52
Fax: +61/8-93 17 24 52
sales@
sensormeasurement.com.au
www.sensormeasurement.com.au

Austria

TR-Electronic GmbH
Tragösserstraße 117
A-8600 Bruck/Mur
Tel.: +43/38 62-5 50 06 0
Fax: +43/38 62-5 50 06 33
info@tr-electronic.at
www.tr-electronic.at

Belgium

Martek SPRL - BVBA
Rue du Broux 16
B-1320 Beauvechain
Tel.: +32/10 86 82 80
Fax: +32/10 86 82 89
info@martek.be
www.martek.be

Brazil

Grupo C+ Tecnologia
Rua dos Caetés
601 - Perdizes
BR - São Paulo - SP
CEP-05016-081
Tel.: +55/11-2168 6554
Fax: +55/11-2168 6555
info@ctecnologia.com.br
www.ctecnologia.com.br

Canada

TR Electronic
P.O. Box 2543, Station B
CDN-London, Ontario Canada
N6A 4G9
Tel.: +1/519-452 1999
Fax: +1/519-452 1177
customercare@trelectronic.com
www.trelectronic.com

China

TR-Electronic (Beijing) CO., LTD.
Rm. 1302, Side A, Lucky Tower
No. 3 Dongsanhuan North Road
Chaoyang District
CN-100027 Beijing, P.R. China
Tel.: +86/10 - 646 131 96
Fax: +86/10 - 646 135 51
lu.yu@tr-electronic.de
www.tr-electronic.com.cn

Czech Republic, Slovakia

DEL a.s.
Strojírenská 38
CZ-59101 Ždár nad Sázavou
Tel.: +420/566 657 100
Fax: +420/566 621 657
zastoupeni.tr@del.cz
www.del.cz

Denmark

TR-Electronic Danmark ApS
Hustedgårdvej 22
DK-8722 Hedensted
Tel.: +45/75 89 06 03
Fax: +45/75 89 06 36
cbj@tr-electronic.dk
www.tr-electronic.dk

Finland

Sarlin Oy Ab
P.O. Box 750
FI-00101 Helsinki
Tel.: +358/10 - 550 4000
Fax: +358/10 - 550 4201
info@sarlin.com
www.sarlin.com

France

TR-Electronic France SARL
1 Av. Christian Doppler
Bâtiment 2
F-77700 Serris
Tel.: +33/1-64 63 68 68
Fax: +33/1-61 10 17 66
info@tr-electronic.fr
www.tr-electronic.fr

Great Britain

TR-Electronic Limited
4 William House, Old St.
Michaels Drive, Braintree
GB-Essex CM7 2AA
Tel.: +44/1 371-876 187
Fax: +44/1 371-876 287
info@tr-electronic.co.uk
www.tr-electronic.co.uk

India

Global-Tech (India) Pvt Ltd
404 White House
1482 Sadashiv Peth
IND-Tilak Road, Pune - 411 030
Tel.: +91/20- 2447 00 85
Fax: +91/20- 2447 00 86
info@globaltechindia.com
www.globaltechindia.com

Israel

DOR Drive Systems L.T.D.
P.O.Box 6
ISR-49910 Kibbutz Einat
Tel.: +972/3 9007595
Fax: +972/3 9007599
sales@dor1.co.il
www.dor1.co.il

Italy

Telestar S.r.l.
Via C. Colombo 13
I-22069 Rovellasca (Co)
Tel.: +39/02-96 74 02 68
Fax: +39/02-96 74 02 73
telestar@telestar-automation.it
www.telestar-automation.it

Japan

SANTEST CO. LTD.
1-60 Tsuneyoshi, 1-Chome
Konohanaku
J-Osaka 554-8691
Tel.: +81/6-6465 5561
Fax: +81/6-6465 5921
info@santest.co.jp
www.santest.co.jp

Mexico

TR Electronic
P.O. Box 2543, Station B
CDN-London, Ontario Canada
N6A 4G9
Tel.: +1/519-452 1999
Fax: +1/519-452 1177
customercare@trelectronic.com
www.trelectronic.com

Netherland

TR-Electronic Nederland BV
Postbus 1682
NL-6201 BR Maastricht
Tel.: +31/43 352 3614
Fax: +31/43 352 3555
info@tr-electronic.nl
www.tr-electronic.nl

Norway

TR Electronic Norway AS
Fusdal Terrasse 3
N-1387 Asker
Tel.: +46 708 696 533
Fax: +46 875 676 80
E-Mail: info@trelectronic.no
Homepage: www.trelectronic.no

Poland

Stoltronic-Polska Sp. z o.o.
ul. Dabrowskiego 238C
PL - 93-231 Lodz
Tel.: +48/42-649 12 15
Fax: +48/42-649 11 08
stoltronic@stoltronic.pl
www.stoltronic.pl

Singapore

Globaltec Electronics (Far East)
Pte. Ltd.
50 Bukit Batok Street 23
#06-27 Midview Building
SIN-659578 Singapore
Tel.: +65/6267 9188
Fax: +65/6267 8011
info@globaltec.com.sg
www.globaltec.com.sg

Slovenia

S.M.M. d.o.o.
Jaskova 18
SI-2001 Maribor
Tel.: +386/2450 2300
Fax: +386/2450 2302
smm@siol.net
www.smm.si

South Africa

Angstrom Engineering (Pty) Ltd.
19 Tom Muller Road
P.O. Box 793
SA-Meyerton 1960
Tel.: +27/16 3620300
Fax: +27/16 3620725
info@angstromeng.co.za
www.angstromeng.co.za

South Korea

MS Intech Co., Ltd.
B-306, Gasan Digital 1 Ro 119
Keumcheon-Gu
KOR-Seoul
Tel.: +82/2-334 0577
Fax: +82/2-862 1591
sales@msintech.com
www.msintech.com

Spain, Portugal

Intertronic Internacional, SL
C/Johannes Gutenberg, 4 y 6
P.I. Parque Tecnológico
E-46980 Valencia
Tel.: +34/96-375 8050
Fax: +34/96-375 1022
info@intertronic.es
www.intertronic.es

Sweden

TR Electronic Sweden AB
Enebybergsvägen 10B
S-182 36 Danderyd
Tel.: +46/8-756 72 20
Fax: +46/8-756 76 80
mailbox@trelectronic.se
www.trelectronic.se

Switzerland

TR-Electronic SA
14, Ch. Pré-Fleuri
CH-1228 Plan-les-Ouates/Genève
Tel.: +41/22-7 94 21 50
Fax: +41/22-7 94 21 71
info@tr-electronic.ch
www.tr-electronic.ch

Taiwan

Asia Jyujiang Enterprise Co., Ltd.
5F., No. 456, Minguang 2nd.
Qianzhen Dist.
Kaohsiung City 80654
Taiwan (R.O.C.)
Tel.: +886/7-3385067
Fax: +886/7-3380271
asiataiwan@seed.net.tw

Thailand

T+R Electronic (Thailand) Co.,
Ltd.
120/62 Moo 8 Bang Sare
TH - Sattahip, Chonburi 20250
Tel.: +66/38 737 487
Fax: +66/38 737 171
trthailand@trelectronic.co.th
www.trelectronic.co.th

Turkey

Üniversa İç-Dis Tic. ve
Mak. San. Ltd. Sti.
Cemal Gürsel Caddesi
No: 11 D: 4
TR-35600 Karsiyaka-IZMIR
Tel.: +90/232 382 23 14
Fax: +90/232 382 23 24
info@universa.com.tr
www.universa.com.tr

USA (TR-Electronic)

TR Electronic
P.O. Box 4448
US-Troy, MI 48099
Tel.: +1/248-244-2280
Fax: +1/248-244-2283
customercare@trelectronic.com
www.trelectronic.com

USA (TRsystems)

TRS Fieldbus Systems, Inc.
666 Baldwin Court
US-Birmingham, MI 48009
Tel.: +1/586 826-9696
Fax: +1/586 826-9697
support@trs-fieldbus.com
www.trs-fieldbus.com

Eastern Europe, CIS

Stoltronic Handels GmbH
Karl-Kurz Gasse 21
A-2482 Münchendorf
Tel.: +43/2259 30133
Fax: +43/2259 30149
stoltronic@aon.at



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TR-Electronic GmbH
Eglishalde 6
D-78647 Trossingen

Tel. +49 (0)7425 / 228-0
Fax +49 (0)7425 / 228-33
info@tr-electronic.de

www.tr-electronic.de