



ETOS<sup>®</sup> TD AND ETOS<sup>®</sup> ED

INNOVATIVE MOTOR-DRIVE  
SOLUTIONS WITH INTEGRATED  
MONITORING.

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# ETOS® TD AND ETOS® ED. THE INTELLIGENT DRIVE.

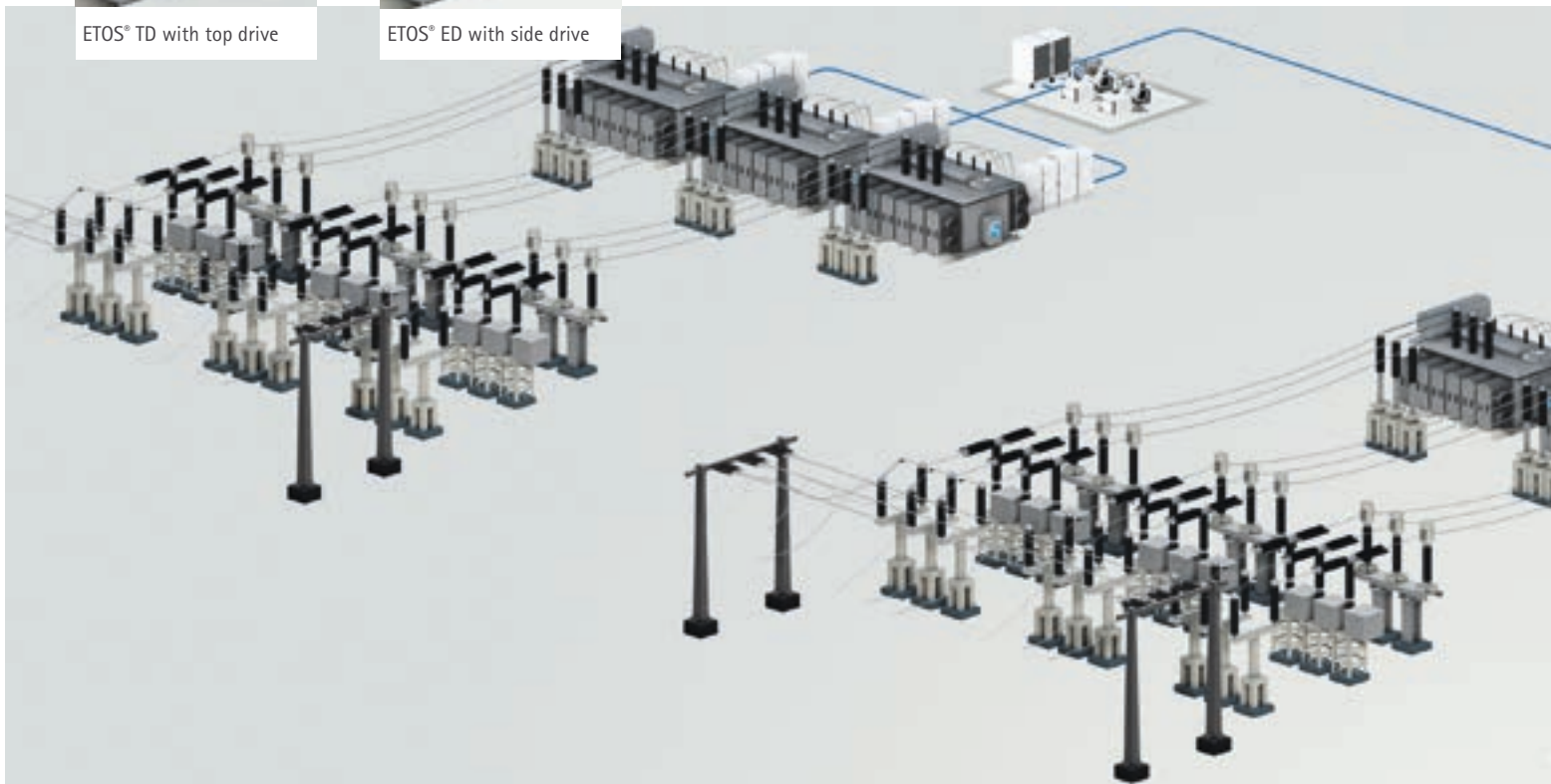
Our products for regulating power transformers ensure that we always address our customers and their needs. We are aware of the challenges they face and have made it our mission as a global market leader to respond to the changing requirements of the energy-technology sector with innovative solutions and process improvements. The ETOS® TD motor-drive unit provides a solution with a top drive that makes the drive energy available directly on the tap-changer cover. The ETOS® ED is available in the classic variant with a mechanical drive shaft.



ETOS® TD with top drive



ETOS® ED with side drive



## Key improvements – maximum customer benefit

In the ETOS® TD, the drive energy is made available precisely where it is needed – at the tap-changer cover. The drive commands generated in the control cabinet are transmitted via cable connection to the motor installed above. This eliminates the need for a rigid drive-shaft connection and the complex and time-intensive task of installing it. What's more, the precise motor torque delivered to the driven tap changer guarantees maximum safety during the tap changer diverter switch operation.

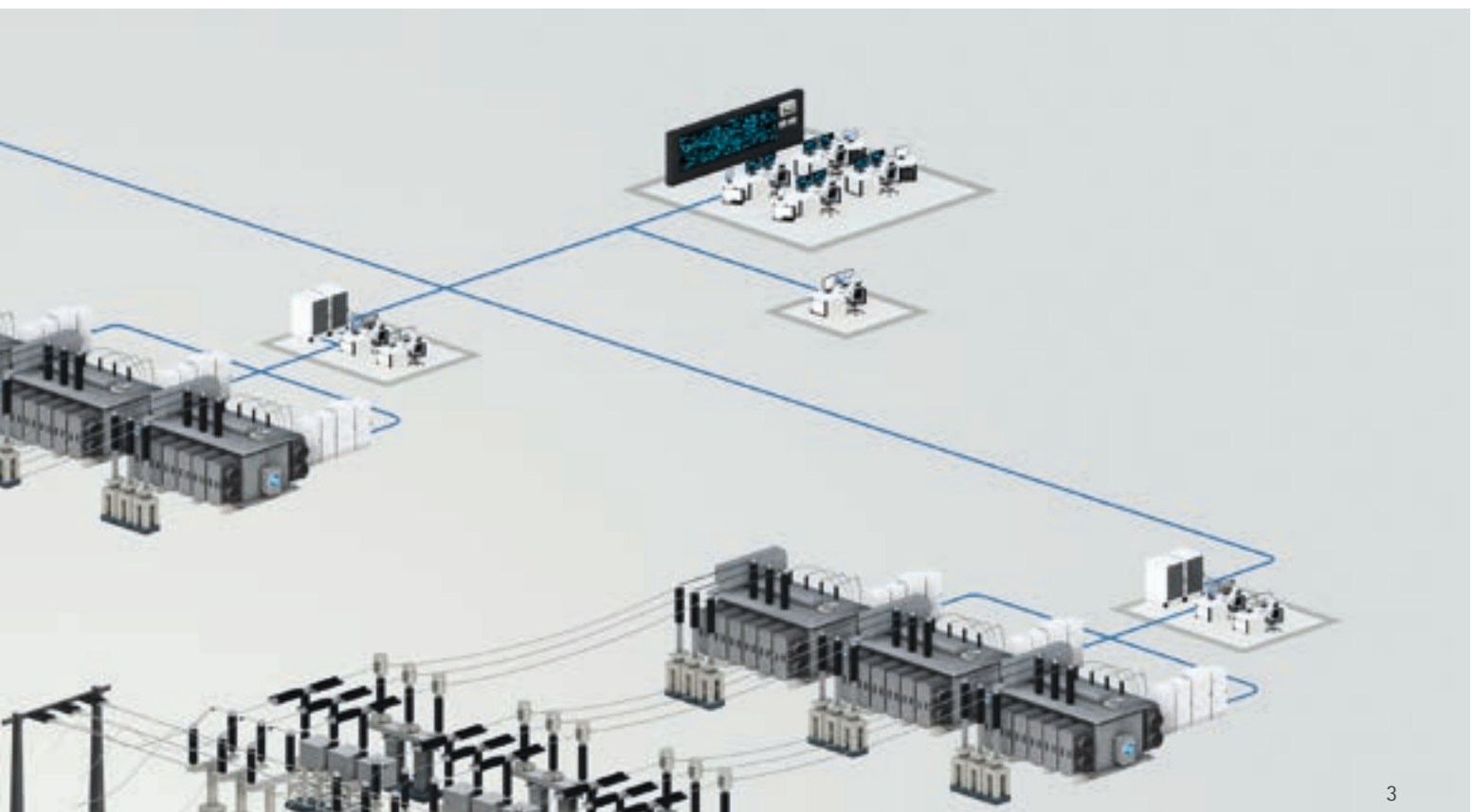
## ETOS® TD and ETOS® ED – the integrated drive solutions

ETOS® TD und ETOS® ED are factory-fitted with our very own ISM® technology (Integrated Smart Module). This electronic automation platform is particularly well suited to the special conditions of energy technology. In addition to controlling the drive of the on-load tap-changer, this state-of-the-art automation platform also enables the recording and evaluation of

all relevant operating data from the power transformer. This allows you to plan the operation, servicing and replacement of your equipment in a more efficient and targeted manner, providing you with intelligent operational management and optimized asset management.

The simple connection and configuration process for the transformer sensors means that commissioning can be carried out quickly. In addition to monitoring functions, you get the benefit of freely available inputs, the data of which can be viewed at any time. Furthermore, specially connected temperature sensors can be visualized graphically. As a result, you can configure your monitoring system individually.

The recorded and evaluated data can be transferred directly to the control system. This greatly reduces the amount of wiring needed during installation and significantly cuts costs compared to a conventional connection method. Visualization takes place via an integrated web server with ISM® IICI (Intuitive Control Interface). There is no need to install any other software.



# RELIABILITY MEETS AUTOMATION.

Based on experience from more than 100,000 delivered motor drives, our ETOS® TD and ETOS® ED ensure the highest security, reliability, and robustness.



ETOS® TD – the motor on the tap-changer head offers many advantages

- Gear motor IP protection class 66
- Integrated cable plug connector for simple connection of gear motor and control cabinet
- Motor torque is specifically optimized for the tap changer to be driven
- No alterations to the tap-changer cover
- Suitable as retrofit solution



ETOS® ED – classical side drive

- Motor in housing and actuation of the tap changer via mechanical drive shaft

## Facts about ETOS® TD and ETOS® ED

- Aluminum sheet housing (up to protection class IP 66)
- Passive cooling thanks to double-walled design
- Various corrosion classes available, from C4 high (in accordance with ISO 12944-2:2018), optionally up to CX (in accordance with ISO 12944-2:2018, offshore)
- Position display with mechanical counter and status indicator lights
- LED strips for interior lighting
- Integrated laptop holder
- Thermostat-controlled anti-condensation heating
- Key information also visible from outside through UV-resistant inspection window
- Integrated data interface and socket
- Manual operating level
- Optimized housing enables use in all climate zones
- ETOS® ED: Actuation with hand crank possible in manual mode



ETOS® TD

The modular design means that the system can be extended to suit individual needs, and equipment can be adapted to future tasks perfectly. Developed by experts for the special conditions that apply in the field of electrical energy technology.

### ETOS® TD and ETOS® ED

- Maximum flexibility thanks to modular design
- Efficient hardware designed specifically for primary substation requirements
- EMC-safe design
- 28 or 42\* digital inputs
- 15 or 20\* digital outputs
- 4 to 12\* analog inputs/outputs
- 1-ph. or 3-ph. voltage measurement\*
- 1-ph. or 3-ph. current measurement\*
- 32-bit CPU with various communication interfaces
- Position indication via 4...20 mA signal or BCD\*
- Optimized terminal arrangement for hassle-free electrical connection with user-friendly terminal technology



ETOS® TD

# MODULAR SYSTEM SOLUTION. ETOS® FUNCTIONS.

Efficient control and monitoring of transformers.

## ETOS® TD/ED drive function

- ▮ Innovative top drive or proven drive technology with mechanical drive linkage
- ▮ Integrated motor current monitoring and tap position indication
- ▮ Conforms to IEC 60214-1:2014

## Transformer monitoring



### Standard functions\*

- ▮ Status monitoring of the protective devices (e.g. RS2001, Buchholz relay, PRD)
- ▮ Monitoring of temperatures (e.g. oil temperature and direct winding temperature)
- ▮ System voltage, load current, frequency, load factor, active power, reactive power, apparent power
- ▮ Hot-spot calculation in accordance with IEC 60076-7 or ANSI/IEEE C57.91
- ▮ Calculation of aging rate and loss-of-life
- ▮ Tap position capture

### Advanced functions

- ▮ Capability of transformer to handle overload in the short or long term with live calculation and simulation of overload forecasts in accordance with IEC 60076-7 or ANSI/IEEE C57.91
- ▮ Calculation of the bubbling temperature
- ▮ Calculation of paper moisture content

## Cooling system monitoring



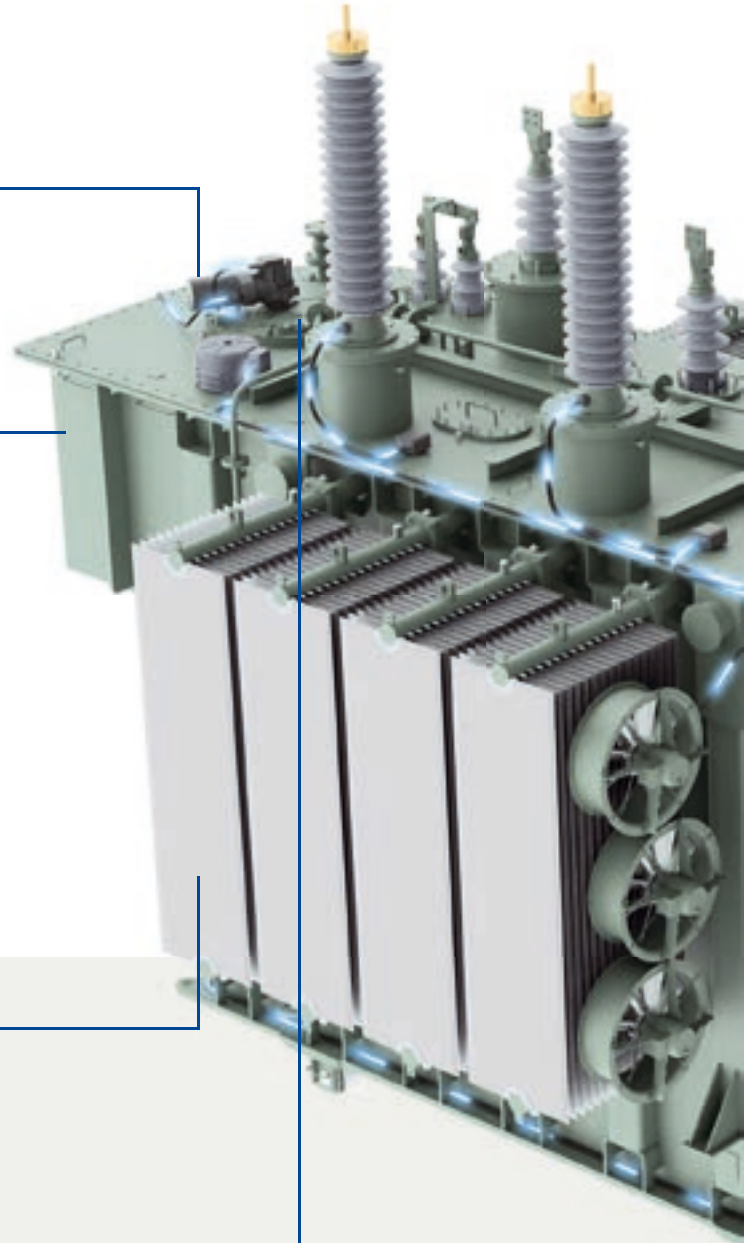
- ▮ Operating status (active, inactive, error) per cooling stage
- ▮ Number of starts per cooling stage
- ▮ Operating time per cooling stage
- ▮ Monitoring of thermal resistance and cooling efficiency

### Optional

- ▮ Monitoring of inlet and outlet temperature of the oil cooling circuit and the water cooling circuit (up to two circuits each)
- ▮ Calculation of the difference between inlet and outlet temperature of the oil cooling circuit (up to two circuits)
- ▮ Active monitoring by setting limit values for messages

## Cooling system control

- ▮ Cooling stages individually parameterizable with different control algorithms:
  - Temperature-dependent switching point control with hysteresis and delay time
  - Load-dependent mode (for early activation of the cooling stages)
  - Periodic mode (for regular activation of the cooling stages)
  - Alternating mode (for uniform loading of similar cooling stages)
- ▮ Fail-safe mode (function monitoring)
- ▮ Optionally as frequency-controlled cooling system control for increased capacity and less wear and tear on the fans



## OLTC Monitoring



### Standard functions

- ▮ Status monitoring of the motor-drive signals
- ▮ Maintenance recommendations and maintenance interval calculation for OILTAP® and VACUTAP®
- ▮ Calculation of contact wear for OILTAP®
- ▮ Tap-position statistics for the OLTC (number of tap-change operations/tap, duration per tap)
- ▮ Monitoring of OLTC oil temperature

### Advanced functions

- ▮ Motor Current Index in accordance with IEEE PC57.143
- ▮ Vibroacoustic analysis of the tap changer (VAM)
- ▮ ETOS® ED: OLTC torque monitoring



## Bushing monitoring

- Monitoring of changes in C1 capacitance
- Monitoring of the changes in the dissipation factor ( $\tan \delta$ )
- System voltage

## Additional functions

- Freely programmable digital and analog inputs and outputs
- Open programming with function blocks possible with TPLE function
- Optional: Integration of functions in a motor-drive for the on-load tap-changer (side drive or innovative top drive)
- Optional: Integration of the complete control including power unit of a conventional cooling system. Can also be combined with the advantages of intelligent cooling system control, such as predictive cooling, (on request)



## Voltage Regulation

### Standard functions

- Measurement of system voltage and load current (single- or three-phase)
- One desired value
- Voltage regulation with linear delay time T1
- Status of the motor-drive unit

### Advanced functions

- Various types of desired-value setting (three or five desired values, TAPCON® Dynamic Setpoint Control, desired-value setting via analog value, raise/lower pulse, desired value via BCD)
- Automatic voltage regulation with linear or integral time characteristics and two delay times T1 and T2
- Parallel operation via CAN bus (up to 16 transformers)
- Line drop compensation (RX or Z compensation)
- Monitoring of bandwidth
- Function monitoring
- Limit-value monitoring



## Online DGA monitoring

### Standard functions

- Online recording of up to nine dissolved gases, relative moisture in oil and relative overall gas content
- Configurable limit value for each gas
- Curve display of the measured values
- Measured value memory
- Universal 4...20mA or Modbus RTU interface for capturing the DGA sensor signals

### Advanced functions

- Standard evaluation methods in accordance with Duval, Rogers, Dörnenburg and IEC 60599

## Visualization

Visualization using web server (SVG and HTML 5) included as standard for various end devices

## Communication

- IEC61850 Ed. 1 and Ed 2. MMS, and GOOSE
- IEC60870-5-101, -103, -104
- DNP3
- Modbus TCP, RTU, ASCII
- Remote maintenance support

ETOS®  
Embedded Transformer  
Operating System

# ALWAYS IN THE BEST HANDS.

Consultancy, configuration, choice of appropriate design and engineering – ETOS®. Everything from a single source.

The ETOS® control cabinet can be configured in various designs and housings and mounted on any transformer. The ETOS® TD with top drive and ETOS® ED with side drive are the available drive designs. Fitting ETOS® directly on the transformer allows the captured data to be transferred to the control station via network protocol using a fiber-optic cable. This greatly reduces the amount of wiring needed during installation and significantly cuts costs compared to a conventional connection method.

## Customized systems are available for more demanding customers

On request, our experts will develop solutions matched perfectly to your needs. When it comes to the supply, transmission, and distribution of power, we offer customized systems for the areas of data management, link to control system, control and regulation, equipment automation, and power supply component monitoring. Benefit from our decades of experience in on-load tap-changer regulation and monitoring.

## Our complete service includes:

- Evaluation of existing the configuration
- Consulting
- Configuration and selection of an appropriate design
- Engineering of the control cabinet
- Implementation and commissioning
- Training

## Designed with future requirements in mind

ISM® (Integrated Smart Module), the centerpiece of the ETOS® TD, is also available as a retrofit module for all motor-drive units delivered thus far by MR. Your TAPMOTION® motor-drive unit is easy to equip with additional intelligence, allowing it to meet your individual requirements. As an option, we can also deliver the ISM® in a separate ETOS® control cabinet.

## ISM® hardware

- Modular and efficient hardware design
- Specific modules for various tasks, such as measurement or communication
- Supports all common interface standards
- Ambient temperature for operation of -25°C to +70°C
- Various voltage supplies with wide-range supply units





# MONITOR. CONTROL. REGULATE: ETOS<sup>®</sup>.

## Monitoring

### Transformer monitoring

- Monitoring of temperatures, powers and signals of other sensors and protective devices
- Limit-value assessments and calculation models to monitor the hot-spot temperature, bubbling temperature and ability to cope with overload
- Basic functions for all transformers included in standard package

### Online DGA

- Monitoring of active part and winding
- Early detection of thermal and electrical errors for preventing failures
- Integration of DGA sensors per 4...20 mA or Modbus RTU
- Interpretation of the gas concentrations using standard analysis methods such as Duval and Rogers

### Bushing monitoring

- Monitoring of oil-impregnated (OIP) or resin-impregnated (RIP) paper bushings for voltage levels  $U_m$  up to 765 kV
- Continuous recording of the state-relevant variables capacitance (C) and dissipation-factor ( $\tan \delta$ ) directly at the bushing

## OLTC Monitoring

- Online monitoring of temperatures, switching statistics and torques
- Individual calculation of maintenance intervals (particularly of oil tap changers)
- Efficient asset management through condition-based maintenance
- Vibroacoustic analysis (VAM) of the tap changer: Warnings regarding mechanical deterioration, contact problems or synchronization problems between drive and OLTC
- ETOS<sup>®</sup> ED: optimized real-time monitoring and analysis of the torque for the complete MR on-load tap-changer enables a longer maintenance interval

## Controlling and regulating

### Voltage regulation

- From simple voltage regulation to a wide range of parallel operation methods to complex regulation algorithms
- Based on 10,000 installed MR voltage regulators

### Cooling system control and monitoring

- Monitoring of cooler starts and cooling efficiency for up to six cooling levels
- Intelligent and predictive control of the cooling system, taking into account the load conditions and the thermal conditions of the transformer
- Optionally with frequency controlled fan control. This enables effective temperature management with minimal noise and a reduced-volume cooling system

## ETOS<sup>®</sup>. INTEGRATION SOLUTION IN THE MOTOR-DRIVE UNIT



ETOS<sup>®</sup> TD  
Innovative  
top drive



ETOS<sup>®</sup> ED  
Classic drive  
technology  
(with a mechanical  
linkage)

AVAILABLE  
PACKAGES



Transformer  
monitoring



Dissolved gas analysis  
(online DGA)



Bushing  
monitoring



OLTC  
monitoring



Voltage  
regulation



Cooling system control  
and monitoring

MONITORING

CONTROL AND REGULATION

# TECHNICAL DATA.

Motor-drive unit	ETOS® TD and ETOS® ED
Available tap-changer types	VACUTAP® VM®, VR®, VV® OILTAP® V, M, R, other MR on-load tap-changer on request
Motor power	0,12 kW (ETOS® TD) 0,75-2,2 kW (ETOS® ED)
Voltage supply of motor circuit	3 AC/380 V/400 V/415 V/440 V, other versions on request
Frequency	50 Hz/60 Hz*
Motor-drive unit running time per switching operation	ETOS® ED: approx. 5-6 s, ETOS® TD: approx. 6,5 s
Maximum number of operating positions	35, other versions on request
Voltage supply for control and heating circuit	AC 220 V/230 V/240 V, other versions on request
Ambient temperature	Standard: -25°C...+50°C, optional up to +55°C, others on request
Protection against foreign substances and water	Up to IP 66 in accordance with DIN EN 60529 Corrosion protection class: from C4 high (in accordance with ISO 12944-2:2018), optionally up to CX (in accordance with ISO 12944-2:2018, offshore)
Test voltage to ground	2 kV/60 s
ETOS® housing designs Dimensions (width x height x depth) (permitted total weight)	ETOS® TD S: 616 x 850 x 423 mm (85 kg) ETOS® TD L: 616 x 1350 x 423 mm (85 kg) ETOS® TD XL: 846 x 1800 x 440 mm (200 kg) ETOS® ED L: 710 x 1319 x 481 mm (155 kg) ETOS® ED XL: 710 x 1827 x 481 mm (200 kg)
Standards	IEC 60214 (2014)
<b>ISM® Technology (Integrated Smart Modules)</b>	
Measurement	3-phase U/I measurement (motor current) 1-phase U/I measurement (transformer) 3-phase U/I measurement (transformer)*
Digital inputs and outputs	Electrically isolated input groups; signal voltage 18-265 V AC/DC Floating relay outputs; signal voltage up to 265 V AC/DC
Analog inputs and outputs	Electrically isolated inputs 0..4..20 mA; 0..10 V DC; PT100 Electrically isolated outputs 0..4..20 mA; 0..10 V DC
Interfaces	Ethernet RJ45 for control system communication RJ45 for remote visualization* RJ45 for HMI connection* FO 1310 nm single port* FO 1310 nm dual port, redundancy protocols RSTP, PRP, HSR*  Serial RS232/422/485 for control system communication FO FST or FSMA 660 nm or 850 nm wavelength*
Standards	IEC 61010-1, IEC 61010-2-030, IEC 61000-6-2/-4, IEC 60255-21-1/-2/-3 Class 1

\* optional

# MORE POWER, MORE VALUE.

The ideal solution for operators of public and industrial distribution grids.



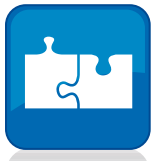
## Maintenance-free and long-lasting

- Torque supplied directly at the tap-changer cover
- Simple connection of control cabinet and gear motor via cable connection
- No need for complex drive shaft installation
- Secure coupling design – integrated self-centering function – maximum safety
- Optimized for the use of electronic components



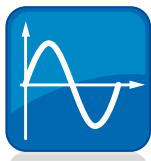
## Reliable transformer monitoring

- Recording, storage, and evaluation of the necessary transformer values enables condition-based maintenance
- Minimal wiring needed thanks to direct transmission of the information to the control or fleet monitoring system



## Functionally integrated drive with modular monitoring solutions

- Modular and efficient system that can be matched perfectly to any needs
- Installation on any power transformer possible (no additional sensors required)
- Complex and individual automation and monitoring tasks possible
- Suitable as retrofit solution
- Function integration (monitoring, voltage regulation and cooling system control) into the motor-drive unit with a tested and ready-to-connect solution



## Simple operation and state-of-the-art graphic display

- Intuitive user interface with simple operating concept
- Web-based visualization makes software installation unnecessary
- Interface for remote access included in standard scope of delivery
- Simple connection of the optionally available touch display



## Additional services

- Commissioning
- Performance of and support during factory/site acceptance tests (FAT/SAT)
- Modernization of facilities – including system consultations and wiring modifications
- General product training
- Technical training at our Regensburg training center or at local MR subsidiaries
- On-site practical training
- Support during facility certification

**Maschinenfabrik Reinhausen GmbH**

Falkensteinstrasse 8

93059 Regensburg, Germany

Phone: +49 941 4090-0

[ETOS@REINHAUSEN.COM](mailto:ETOS@REINHAUSEN.COM)

[WWW.REINHAUSEN.COM/ETOS](http://WWW.REINHAUSEN.COM/ETOS)

Please note:

The data in our publications may differ from the data of the devices delivered. We reserve the right to make changes without notice.

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THE POWER BEHIND POWER.

