Artificial Lift

Flexible and innovative solutions to optimize well production

EMERSON™
Industrial Automation

Reliable and efficient Artificial Lift solutions that increase well production

As the world's population continues to swell and the need for energy increases, oil and gas producers are under mounting pressure to improve their production methods and efficiency to meet growing global demands. Natural reserves are harder to access and increasingly complicated to produce from in an environmentally responsible and safe way, while also complying with more stringent safety standards. Emerson's integrated, customized and high power artificial lift drive and motor solutions ensure reliable, efficient and improved oil well production, meeting these challenges head-on.

Emerson's rich heritage in the oil and gas industry

Emerson's businesses have been involved globally in the oil and gas industry for around 35 years, with a proven record of success. Emerson Industrial Automation's highly reliable, high performance and efficient products allow us to develop solutions that can maximize production and extend the operational life of wells. Our systems are tailored to the exact requirements of individual well conditions, where our innovative and proven drive and motor technology controls, protects & monitors pump parameters, while simultaneously maintaining system integrity.

Emerson Industrial Automation's global solutions and services

With thousands of applications worldwide, covering the Middle East, Africa, Europe, the Americas and Asia, often located in some of the most challenging of environments, we provide:

Cutting edge drives and motors technology – enhancing well performance and energy efficiency by offering specific solutions for oil and gas production.

Scalable Automation Solutions – from simple drive and motor pump control up to a fully engineered oil well package, backed by industrial expertise and full support at local level.

Customized local services – ensuring all elements of your system requirements are supported, such as consultation, installation, commissioning, optimization, maintenance and training for maximum performance throughout the lifetime of your well application.

Locally developed oil and gas extraction solutions and expert support

We have a strong global presence with around 5,500 employees. Our 40+ Automation Centres, backed-up by numerous approved integrators worldwide, provide the capacity to develop solutions locally using standard stocked components for integration with nearby well sites. This network provides:

- A single point of contact for all oil and gas process automation requirements
- Industry-leading comprehensive sales and technical support services
- Regional despatch hubs for quick delivery of product

5,500 employees

40+ Automation Centers

23 Manufacturing sites

8 Engineering and Design Facilities

3 Regional Despatch hubs

Scalable and localized well management solutions and services

We can provide anything from a single drive for local integration, to a fully engineered variable speed drive surface package (drive, cabinet, monitoring and step-up transformer), providing the benefits of energy efficiency and flexible process control for Electrical Submersible Pump (ESP), Reciprocating Rod Pump (RRP) and Progressive Cavity Pump (PCP) applications.

Powerdrive MD2 and FX variable speed drives. Ideal for use in well management solutions.

Flexible and customizable modular systems to meet the challenges of oil well production

Our flexible and proven variable speed drive solutions using Powerdrive are based on a Modular concept, and can be customized to the requirements of each oil well:

- Our standard rectifier and inverter modules are combined to build any type of Front End architecture such as 6, 12, 18, 24 pulse or Active Front End (AFE) or any size of drive by paralleling.
- These modules are fitted in adaptable enclosures and footprints that can be installed indoor or outdoor, offshore or onshore.
- Conformance with standards, such as IEEE 519 and ATEX certification.
- Capability to power AC and permanent magnet surface motors, as well as ESP pumps.
- Excess energy can be regenerated back onto the power supply, saving energy and costs of oversizing or additional system components.

Active Front End (AFE) solutions boost artificial lift applications

AFE is a standard feature on our Powerdrive product and is becoming the most popular solution for oil pumping systems in artificial lift applications, because of the following benefits:

- Imparts only 3.5 % or less harmonic distortion on the mains supply, independent of the short circuit power and of the drive power, eliminating the need to perform harmonics calculations as required with active or passive filter solutions.
- Output voltage can be higher than the input voltage, which compensates for the voltage drop in the motor cables.
- The DC bus of an AFE is regulated at a higher voltage value than when using a 6-pulse rectifier, ensuring this type of converter is not impacted by fluctuations in mains voltage.
- Only active energy consumed, reducing the current and losses in subsea cables and surface equipment.

Customized well solutions to suit your requirements

Comprehensive shelter options

We provide fully configurable shelter solutions that are customized to the exact needs of your well field requirements. These are constructed onsite either by our Automation Centre or integrator partners and can include:

Full configuration of drive systems for controlling multiple wells

Easy integration with field control and monitoring systems

Suitable construction to match the requirements of the local environment

Easy to commission, operate and maintain well solutions

Our well solutions contain numerous features to enhance user experience and ensure the system is as simple to run as possible:

Commissioning:

User-friendly operator interface with 7” colour touch pad.

Application macros for every type of pump.

Intuitive parameter setting using appropriate operator terminology.

Drive settings are backed-up in HMI for easy cloning.

Operation:

Operating and diagnostic data shown clearly, including display of alarms (orange background) or Trip root cause (red background).

Preventive auto test of motor and main drive components where power-up occurs under reduced voltage to avoid catastrophic failure due to faulty system conditions.

In case of a fault condition the defective component is identified.

Maintenance:

Individual modules are simple and quick to replace onsite:

- Each power module is compact and lightweight (less than 20 kg) and can be handled easily, with no specific handling equipment required.
- Modularity through standard mass produced modules, available locally, reduces the need for spares onsite.
- Production downtime is minimized as one module can be replaced in 20 minutes.

Dedicated artificial lift features providing short and long term benefits

Our solutions incorporate dedicated artificial lift functionality that reduces equipment wear and down-time, while improving well productivity and system longevity:

- Real-time monitoring and regulation of the load level due to changing well conditions reducing equipment wear and down-time, while extending system life
- Back-spin protection
- Pump release ‘rocking start’ mode
- Intelligent power ride-through control allows the drive to take automatic action during supply disturbances to keep the pump running as long as possible
- Catch-a-spinning motor functionality enables the drive to automatically detect the pump direction and speed, smoothly synchronizing with it after a trip

Flexible Data Monitoring and Logging (DML) packages for basic to advanced performance

Our flexible DML packages give you precise monitoring and reporting of well and drive conditions, allowing operators to make informed decisions to boost well production:

Basic DML option

- Possibility to log 10 drive parameters with a 1 s sample time
- A single data log file is generated every 24 hours for simple manual analysis
- Data is stored on a USB memory stick or SD card
- Data can either be retrieved manually or via fieldbus
- Possibility to set-up alarms on any drive parameter
- Alarms are either displayed on HMI or communicated via fieldbus

Expanded DML option

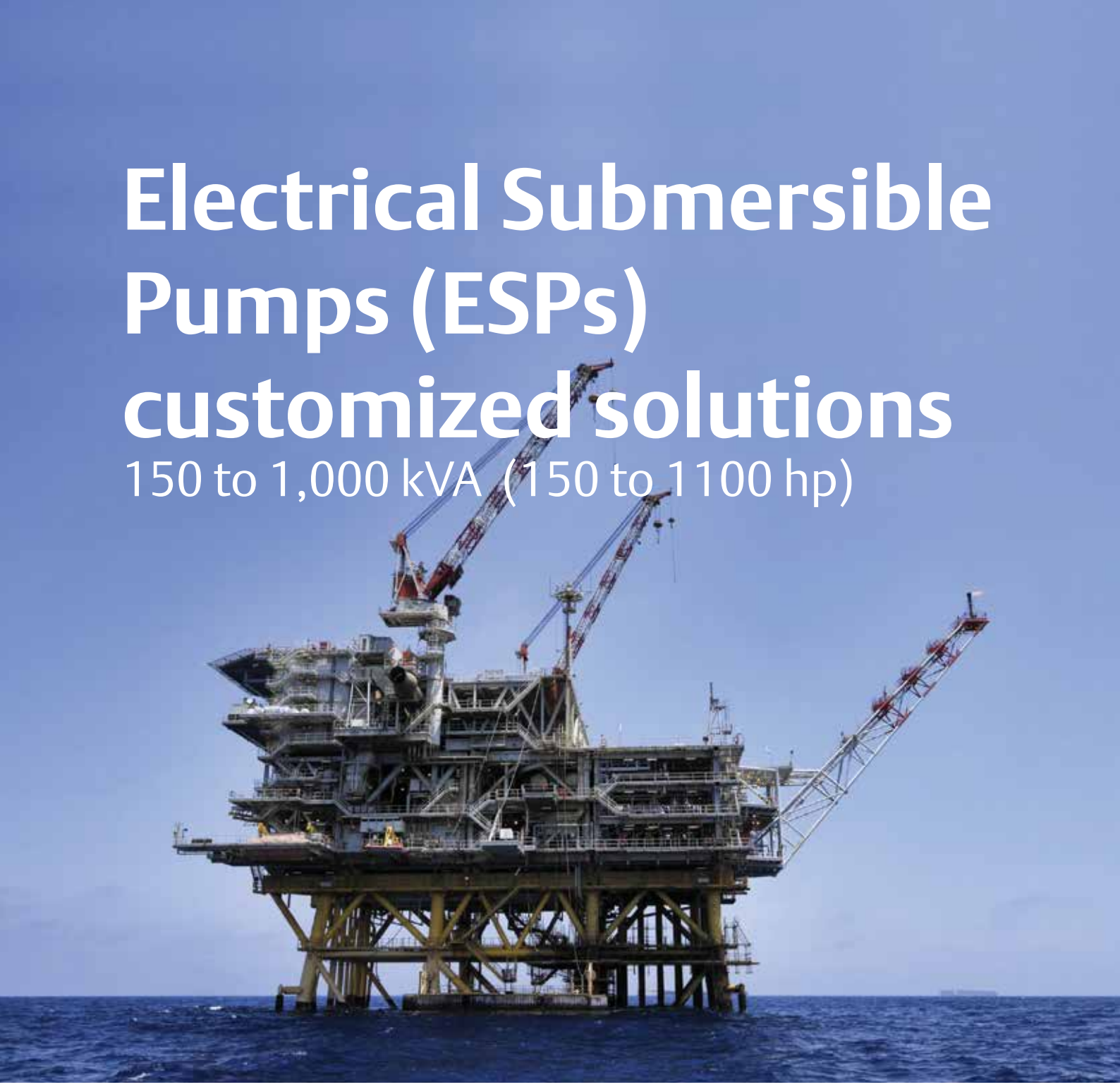
- Possibility to centralize downhole and well head operating data in the drive
- Number of recordable parameters extended to 40
- Enhanced programmable sampling time
- Extended number of alarms monitored
- Same level of local data logging as basic offer

Advanced DML option

- Automatic analysis of current operating data and trends using advanced algorithms provide real-time recommendations communicated to operators
- Operator decision making improved by the level of DML accuracy to significantly increase the well performance and reliability

Electrical Submersible Pumps (ESPs) customized solutions

150 to 1,000 kVA (150 to 1100 hp)



ESP systems associated with variable speed drives (VSD) are susceptible to problems associated with long cable lengths, signal quality to the submersible motor and interference due to numerous drives on the same mains supply. Harmonic currents often circulate due to network impedance, causing unwanted effects. Our unique ESP VSD solution combines Active Front End technology, optimized output sine filter and step-up transformer to overcome all of these risks. Benefits include:

- Total harmonic distortion (THDi) is limited to 3.5 %
- No need for oversizing power supply components such as cables, transformers and protections etc.
- No overheating of step-up transformers
- No electrical nor thermal stress to the motor
- No oscillating torque produced
- Constant motor voltage regardless of varying power supply voltage
- No disturbance of the downhole sensors

Outstanding downhole sensor protection

In addition to improving the accuracy of the downhole sensor readings by eliminating the potential disturbances, our VSDs increase the lifetime of these sensors by significantly reducing their exposure to low frequencies during acceleration.

Robust transformers customized to exact requirements

As part of our artificial lift solutions, we provide transformers in numerous voltage ranges and number of steps that can withstand severe environmental conditions. Options include:

- ATEX: certification by a notified body
- ONAN type cooling
- Secondary voltage and current measurements
- Compact add-on sine wave filter
- Customized terminal boxes
- Protection relays

Transformer *Powerdrive MD2*

Typical ESP solutions include:

Drive technology	Enclosure options	Optional hardware		Automation option
Powerdrive MD2 6, 12, 18, 24 pulse Active Front End	Indoor Outdoor onshore Outdoor offshore	Sine filter range	Transformers Step-up & step down	Data monitoring & logging (DML)

Flexible alternative technologies

The flexible design of Powerdrive allows the use of various front end technologies:

Drive	6-pulse	12-pulse	18-pulse	24-pulse	AFE
THDi (%)	< 35	< 12	< 8	< 6	< 4
Power supply transformer	Standard derated	2 outputs	3 outputs	4 outputs	Standard

Highly efficient and robust Reciprocating Rod Pumps (RRP) solutions

5 to 60 kVA (5 to 70 hp)

Although the majority of RRP pumps are operated at fixed speed, numerous concerns are driving demand for variable speed solutions. These include:

- Pump-off often occurs if production is too high due to incorrect pulley-belt ratio, with frequent adjustments required in new and young new wells to prevent this.
- The limitation of monitoring possibilities and potential difficulties in detecting fluid pound.
- Too many motors on the same electric network causing a lagging power factor, driving the need for capacitor banks

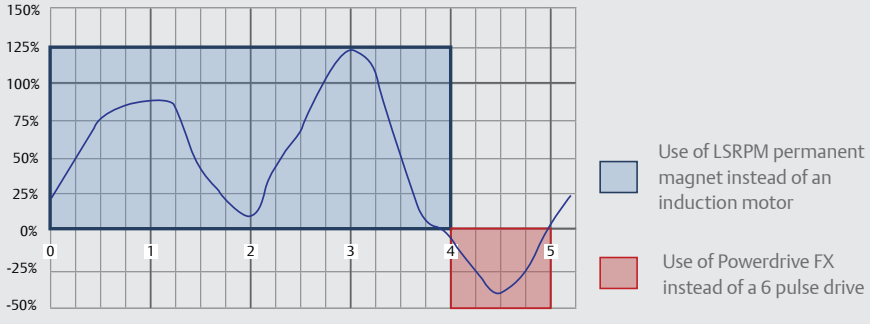
We can provide maintenance-free fixed and variable speed solutions for RRP applications, tailored for the specific requirements of each well. Not only can we provide robust applications that withstand the most challenging of environmental conditions where oil production and equipment life is optimized, we can ensure significant energy saving through our Dyneo® permanent magnet technology solutions.

Exploiting energy savings and reducing operating costs

Looking at the torque profile of an RRP pump there are opportunities for significant energy savings.

1. During the 4/5 of a cycle the average torque requested to drive the pump is 50%. At partial load a Permanent Magnet motor provides a significant efficiency advantage compared to an Induction motor, reducing the operating costs.
2. During the last 1/5 of the cycle, there are reverse torque conditions resulting in backing energy to the drive. A common 6 pulse drive needs to be oversized or braking resistors need to be added to the system to prevent tripping. Our 4 quadrant Powerdrive FX provides the opportunity for regenerating this energy back on to the power supply. In a multiple well field, this would deduct from the energy used by other pumps, reducing the operating costs even further.

Energy savings using a Dyneo® solution



Innovative variable speed Powerdrive FX RRP solutions (25 to 100 kVA / 25 to 125 hp)

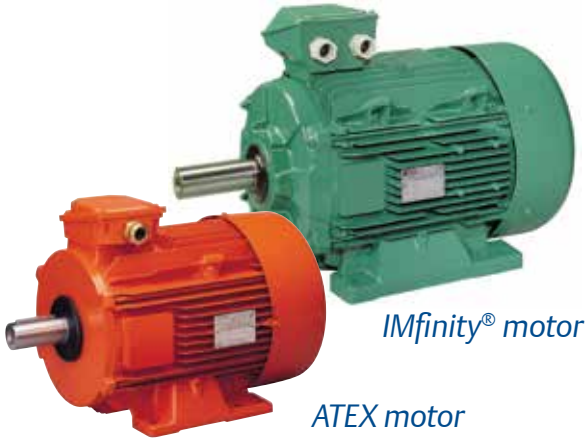
Powerdrive FX's innovative features are ideally suited to RRP applications with 4 automatically controlled quadrants (patented). This guarantees lower THD (total harmonic distortion) than a conventional 6-pulse solution, independent of the load. It is also easy to transport due to its compact dimensions and simple to start-up with less than 5 parameters to be adjusted.

Dedicated fixed-speed RRP solutions (10 to 75 kW /15 to 100 hp)

Our fixed-speed solutions based on high slip motor technology protects components through less ware, extending their service life through smooth movement. Installation and housing is easy due to light aluminium frames with easy cable connections through enlarged terminal box. Maintenance is minimized due to IP 55 design and anti-corrosion protection (C3L to C5M in accordance with ISO 12944-2), with NEMA Design 'D', ATEX and a choice of IE2 and IE3 versions.

Dyneo® *Powerdrive FX*

Recent field tests have confirmed that our RRP package using the Dyneo® Permanent Magnet solutions can save up 20% compared to traditional solutions.



IMfinity® motor

ATEX motor

Typical RRP solutions include:

Variable Speed		Enclosure option	Fixed Speed	Automation option
Motors (IP55)	Drives			
LSRPM IMfinity® IE2 or IE3	Powerdrive FX Powerdrive MD2 6 pulse	Outdoor onshore	LS slip motor C3L -C5M anti corrosion IP55, ATEX, IE2	Data monitoring and logging (DML)

Flexible Progressive Cavity Pump (PCP) solutions

5 to 150 kVA (5 to 150 hp)

Meeting safety standards with the motor fitted in a sensitive zone, protecting the pump rod and stator, while maximizing production is a challenge for PCP applications. Emerson offers a wide range of customized solutions dependent on the exact needs of the well site and customer requirements. Our Automation Center team, using our full range of drive and motor technology combined with various automation options, can design applications that guarantee optimum performance and safety in harsh environments.

Safe PCP ATEX solutions for sensitive environments

Emerson motors can be selected according to the ATEX zone, such as non-sparking (Ex nA) and flameproof (Ex d, Ex d e). Our packaged solutions, including AFE technology, guarantee ATEX certification by keeping the frame temperature within safe limits, counteracting the following heat generating issues:

- Additional losses from the drive
- Additional current in motor caused by voltage drop in long motor cable applications
- Poor sinewave quality

Bearing and winding sensors come as a standard in order to flag signs of overheat or to trip in case limits are exceeded.

Robust lightweight motor solutions for increased reliability

The most common solution to limiting the motor temperature is by oversizing. Often the additional size and weight will add mechanical stress to the well head. Emerson's solutions adapt the drive package to the operating conditions, ensuring the smallest motor size. Our robust aluminium alloy motor housing is more economical than traditional cast iron and provides a 20% weight reduction. This makes motors easier to handle and transport while improving the overall reliability.

Compact and effective solutions with reduced investment

Often on PCP applications, two motors are fitted to the same pump, usually requiring two drives for control. With our modular solution we can optimize the overall size and cost by supplying a system with a single rectifier, a common DC bus and two inverter modules. Another advantage is the load sharing, thanks to the common DC bus enhancing reliability and system longevity.

Precise control features for maximum and safe PCP production

Our PCP solutions provide the following features in order to minimize system component ware and provide safe well production:

- Precise speed control with torque limiting according to the load
- Specific ramp times which extend beyond 2 hours
- Outstanding micro cut management, back-spin control and auto reset
- Management of protective devices integrated in the safety chain
- Management of thermal probes and ATEX-certified relays

Powerdrive MD2

LSE and LSN ATEX motors

Typical RRP solutions include:

Drive Technology	Enclosure option	Motor Technology	Automation option
Powerdrive MD2 6 pulse Active Front End	Indoor onshore Outdoor onshore	LSE & LSN ATEX range	Data monitoring and logging (DML)

Emerson Industrial Automation's global strength is backed by our local service base

Our global experience in oil and well production is backed by our local expertize and support, provided by our own Automation Centers or an approved subsidiary from our service network. Each outlet provides a single point of contact with all the skills and local knowledge to:

- Design & build solution using standard stocked components, including power distribution to make our systems as efficient as possible
- Integrate with local supply chains to access to low cost and nearby-produced components such as steel enclosures, reducing overall system costs and help meet local regulations
- Deliver expert variable speed and process automation knowledge to produce optimized systems
- Design & build complete shelters
- Install, commission, tune & service on site, to ensure the application is up-and-running as soon as possible with production maximized throughout the lifetime of the well.

Shared benefits of locally produced solutions

As well as the obvious benefits of quicker lead times and reduced transportation costs, local integration means we are committed to the development of regional skill levels and stimulation of local economies. We aim to help nurture home grown talent through employment and partnerships in a sustainable way to support the industrial opportunities that local natural resources have provided. This process helps us gain greater insight into developing appropriate solutions and providing suitable support in specific locations.

Emerson offers a wide range of services and support

To back our innovative solutions, our Automation Centers can provide the following services, including:

- Preventive and proactive maintenance to ensure equipment operates at optimally throughout its lifetime
- Inventory audit solutions to ensure only minimal spares are kept in stock
- Retrofit capabilities for improving existing applications
- Extensive EMC testing
- Localized and application specific content for support documentation, including mechanical drawings, wiring diagrams, certification files (CE & UL) and integration manual

Customized local services and round the clock support

We also provide a range of expert local services tailored to meet our customers' expanding productivity, performance and process safety needs, while guaranteeing an exceptional response to emergency situations with round the clock support. Customized policies are defined locally and can include:

- 24/7 remote support
- Rapid response, with agreed timescales, to requests for onsite issues by skilled local support teams
- Scheduled conduction of thermographs for reducing connection issues and the development of hot points in drive panels
- Dedicated permanent workforce onsite

Customized onsite training

Scheduled training courses are available for your specific application and held onsite, or your designers, programmers and maintenance staff can attend regular courses offered at our local training centers. Typical training from industry experts can cover:

- Application operation
- Start-up and shutdown best practices
- Troubleshooting
- Periodic tuning of operating parameters and revision of system settings to improve production

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Industrial Automation

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