High Power Motor Management Panorama

Motor Management offers for electric motor applications above 100 kW
General Contents

Introducing Motor Management 5

Expert services for motor applications 15

Advanced motor control 21

Power quality 29

Motor protection and control 35

Motor asset management 43

Motor Management glossary 49
# Introducing Motor Management

<table>
<thead>
<tr>
<th>The challenge of high power motors in electro-intensive industries</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Management by Schneider Electric</td>
<td>8</td>
</tr>
<tr>
<td>Our solution domains</td>
<td>10</td>
</tr>
<tr>
<td>How to use the offer selection panorama</td>
<td>12</td>
</tr>
</tbody>
</table>
The challenge of high power motors in electro-intensive industries

Electric motors represent 90% of electricity consumption in electro-intensive industries, and are the key driver of your process. That is why they are the focus of particular attention regarding their protection, control, maintenance, and impact on the electrical network and parallel loads.

Where do we find high power motors?

High power motors (>100 kW) can be found in electro-intensive industries, such as Oil and Gas, Water and Wastewater, Mining, Minerals, and Metals, and in some applications in the Marine segment. Typical high power motor applications include utilities, transportation operations, and industrial processes.

Why is there particular attention on high power motors?

Electric motors are used to convert electrical energy into mechanical energy, which is necessary for the industrial process. Motor performance is therefore the focus of particular attention in terms of the following parameters:

- Application characteristics (such as mechanical load torque, motor control, load, or inertia, or the type of process)
- Starting conditions and their impact on motor operation, lifespan, and the load it drives
- Motor selection and control, which are themselves influenced by grid power quality (e.g. harmonics, voltage unbalance, etc.) and the operating environment (e.g. seismic area, gaseous or dusty explosive atmosphere, etc.).

Did you know?

Electric motors consume…

45%...of electricity produced worldwide

60%...of electricity produced in manufacturing industries

>90%...of electricity produced in electro-intensive industries.

Source: U.S. Department of Energy Office of Industrial Technologies
Why is Motor Management critical for electro-intensive industries?
As the industrial process is at stake, high power motors should be rigorously controlled and protected to help ensure process availability. The higher the motor power, the greater the consequences of a fault. The lack of an efficient Motor Management strategy could cause significant damage to the motor and the process.

Through Motor Management, we are in fact helping to:
• Protect the process and ensure its availability and continuity of service
• Decrease the risk of damage to the motor and the process
• Reduce the potential loss of production
• Increase the global level of safety of the application
• Reduce the impact of the motor application on the electrical network and parallel loads

What are your Motor Management requirements?
Assessing the application characteristics, performance levels, operating environment, and investment, operating, and maintenance costs of your high power motors will allow you to:
• Optimize and simplify Motor Management through an efficient strategy
• Maintain the performance of operations and processes
• Increase motor application reliability and lifespan
• Reduce motor energy consumption
• Achieve a global system approach for motor protection solutions
• Optimize the total cost of ownership
• Increase the efficiency of the electrical system
Motor Management by Schneider Electric

At Schneider Electric, we care about the continuity and efficiency of your industrial processes. That is why we put our expertise at your service, to help meet the specific needs of your applications through a global approach to motors and their integration into your electrical system.

Motor Management by Schneider Electric is the ability to define an optimized solution for energy distribution, protection, and control of high power motors.

Our Motor Management approach for optimization

At Schneider Electric, we put your goals and requirements at the heart of our Motor Management approach. We hold the key to ensuring efficient energy management and continuity of your processes, and optimizing investment and operating costs. Our dual competency in the fields of electrical power network management and high power motor control means we adopt a global system approach. Every parameter of your electrical system is taken into account to build the most suitable Motor Management solution for your specific applications.
Your Motor Management needs

Cost optimization

- Optimization of the motor’s added value in the industrial process
- Smaller footprint
- Reduced maintenance

Simplification

- Smooth integration within energy and process control systems
- Less equipment
- Optimized network architecture

Performance

- Type-tested, large installed base solutions
- Long-time know-how in integrated solutions for electrical distribution and process control of significant MV and LV motor loads
- Coherent motor protection and control schemes with the rest of the electrical network protection systems

Safety & reliability

- Safety and reliability at all times, even in harsh environments or for heavy-duty operating modes
- Expert advice on choice of motor starting method
- Prevention and elimination of power quality issues
- Compliance with electric utility regulations
Our solution domains

Schneider Electric has identified 5 main Motor Management solution domains according to the specific functions the offers provide to your motor application. This offer selection panorama is thus divided into 5 corresponding sections.

After completing our Motor Management approach for optimization process, we can analyze the type of solution your specific high power motor application needs. Here are our 5 Motor Management solution domains, which can be identified in every motor feeder electrical diagram. In a more global overview, the solution domains apply to multiple motors connected to the same busbar, fed by the same transformer or contributing to the same industrial process.

1. Sub-domains included in "Expert services for motor applications":
   - Software
   - Analyses
   - Services

2. Sub-domains included in "Advanced motor control":
   - Autotransformer starters
   - Soft starters
   - Variable speed drives

3. Sub-domains included in "Power quality":
   - Power factor correction: capacitor banks
   - Harmonic mitigation
   - Transformers (indoor and outdoor)

4. Sub-domains included in "Motor protection and control":
   - Protection relays
   - Switchboards and motor starters

5. Sub-domains included in "Motor asset management":
   - Portfolio management
   - Operation performance
   - Asset condition assessment
Expertise is at the heart of the Motor Management solution. With dedicated software, relevant analyses, or services for electrical equipment, Schneider Electric supports your projects from the design phase through setup and commissioning to operation and maintenance.

Expert services for motor applications

Motor starting or operation control are fundamental for your process and the definition of the Motor Management solution. Schneider Electric offers a complete range of advanced motor controls for fulfilling all your process constraints with regard to your power system requirements.

Advanced motor control

Choosing the correct capacitor bank, harmonic mitigation system, or transformer will ensure correct operation of the motor in the process with minimum impact on the supplying power system. 30 to 40% of business downtime is caused by power quality disturbances; 60% of motor failures are due to overheating, for which poor power quality is a common cause.

Power quality

A Motor Management solution not only provides a means of starting the motor, but also includes a protection unit comprising switchgear and protection relays. Schneider Electric offers a wide range of circuit breakers, fuses, contactors, and protection relays integrated in enclosures for protecting the motor and ensuring correct starting, while helping to ensure operator safety by means of type-tested equipment.

Motor protection and control

Motor maintenance is key to industrial process availability. Through condition assessment or by using historian data, motor and application failures can be avoided in the early stages. Schneider Electric offers an extensive range of products to help you in this approach.

Motor asset management
How to use the offer selection panorama

This offer selection panorama is intended to give you a quick and simple overview of all the Schneider Electric offers that best fit your motor management needs.

Easy reading of the different solution domains

1. Motor Management solution domain
2. Motor Management solution sub-domain
3. Offer name and picture
4. Offer web page flash code
5. Offer description
6. Technical information, Motor Management functions and benefits of the offer
7. Application segment pictograms:
   - Mining, Minerals, and Metals
   - Water, Wastewater
   - Oil & Gas
   - Marine

For more information regarding the different technical terms and abbreviations used in the panorama, please refer to the "Motor Management glossary" section.
Scan your Schneider Electric products to get detailed information

With mySchneider app, it’s always at your fingertips!

How to use the flash codes

The flash codes (or QR codes*) used in this panorama allow you to access Schneider Electric web pages giving more detailed information on the offers. Simply scan the code with your smartphone, and you will be directed to a Schneider Electric web page via a short URL.

(*compliant with Bar code in selected countries).

1. Download mySchneider app on your Smartphone

[QR code image]

2. Launch mySchneider app on your smartphone and point your phone at the flash code until it is able to scan it.

3. Once correctly scanned, the flash code will automatically open the corresponding web page (or ask for authorization to open it, depending on the QR code reader app you are using).

With one-tap connection to Customer Care support, it’s easier than ever to stay in touch throughout a job. Available as a free download for iOS and Android™ devices, mySchneider app is a valuable productivity tool for every day.

NB: If you are using a digital version of this panorama, you can access the same information by simply clicking on the flash codes. The flash codes could also be used with a standard app.
Expert services for motor applications

Software 16

Analyses 16

Services 17
## Expert services for motor applications

### Software

<table>
<thead>
<tr>
<th>Motor Controller Smart Selector</th>
<th>ECO2.0</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protection coordination analysis</td>
<td>Motor starting analyses</td>
</tr>
</tbody>
</table>

### Analyses

- **Intuitively select your LV motor starter solution**
- **Energy savings estimation on HVAC pump & fan motor applications**
- **Protection of people and equipment**
- **Modeling and simulation of all starting methods**
- **Analyses of harmonics and solution proposal**

### Motor applications

- **Hoisting**
- **Conveying**
- **Lifting**
- **Packaging**
- **Material working**
- **Pump and fan motor applications up to 2.4 MW**
- **Any application with protection relays**
- **Compressors**
- **Fans**
- **Pumps**
- **All applications with VSD driven LV motors**

### Motor Management functions

- **Selection of starting solution between direct, reversing, star-delta, soft starter, VSD**
- **Short circuit protection embedded in combination motor starter (TeSysU), manual motor starter (TeSys GV), molded case circuit breaker (Compact), or fuses**
- **Overload protection embedded in motor starter, breaker, or separate relay**
- **Type 1, 2, or total coordination**
- **Allows you to:**
  - Select the right Altivar drive for your application
  - Obtain enriched information on selected solution(s)
  - Compare the energy consumption (with or without the drive)
  - Estimate the potential energy savings from a financial and electrical point of view, as well as your contribution to the environment (CO₂ emissions)
  - Save project data on your device or send it by email
- **Definition of protection equipment (sensors, relays) and protection principles in fault conditions**
- **Definition of protection relay settings**
- **Models the system:**
  - Motors (with mechanical load, inertia)
  - Generators (voltage/ power regulators)
  - Transformers
  - Starting method (contactor, soft starter, VSD, autotransformer, star-delta)
- **Typical in LV networks with variable speed drives**
- **Focuses on the power system taking account of:**
  - All the drives fed by the same transformer
  - The voltage distortion during normal operation of the system
  - Operation on back-up generators
  - The harmonic voltage factor for parallel running motors

### Motor Management benefits

- **Simple and complete: no need to use printed catalogs with coordination tables**
- **Fast: dedicated tool focused on motor starter vs. full calculation software for electrical network**
- **Continuously updated with the latest Schneider Electric products**
- **Save time**
- **Quickly estimate the payback period (non-contractual results)**
- **Cumulate estimates for your installation: up to 10-motor applications**
- **Export useful data related to your project**
- **Estimate potential energy savings**
- **Install on PC, smartphones, and tablets**
- **Obtain the most optimized coordination**
- **Maximize the process continuity**
- **Help ensure the safety of people and equipment**
- **Ensure compliance of the selected starting solution with the constraints of the electrical system and driven load (voltage sags, generator stability, thermal stress, mechanical stress)**
- **Be aware of the potential hot spots for harmonic mitigation**
- **Ensure compliance with the required standards (IEEE 519) or THD**
- **Have an assessment of the efficiency of the different possible harmonic mitigation solutions**

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**Please contact your Schneider Electric Customer Care Center**

**PM105246**

**PM105248**

**PM105329**

**Customer Care Center**

**Please contact your Schneider Electric**

**Advantage Service Plan &**

**Pre-commissioning**

**Commissioning**

**Delivery**

**After sales service**

**Application benefits**

**System benefits**

**Customer care**

**Performance**

**Energy**

**mp3**

**pdf**

**Software**

**Analyses**

**Motor Management functions**

**Motor Management benefits**

**Security**

**Maintenance & Training**

**Customer Care Center**

**Schneider Electric**

**Energy savings estimation**

**Protection of people and equipment**

**Modeling and simulation of all starting methods**

**Analyses of harmonics and solution proposal**

**Pumps**

**Fans**

**Compressors**

**Generators (voltage/load, inertia)**

** Transformers**

** Starters, VSD**

** Embedded in combination**

** Protection**

**Vacuum circuit breakers or motors, switched with chopping**

** Detailed modeling of: vacuum circuit breakers or motors, switched with chopping**

** Overvoltage protection switchgear side) installation (motor side or critical operations - 24/7 response time for your**

** Remote support - critical operations - 24/7 response time for your**

** Service +: Guaranteed**

** Improve reliability and reduce risk of unscheduled downtime**

** Extend life of system and components**

** Anticipate issues and prevent unscheduled downtime**

** Reduce maintenance costs**

** Assist you to identify the required level of inventory, and prepare your maintenance strategy**

** Reduce the risk of overheating and overloads**

** Optimize the reliability of the system**

** Secure your operations**

** Minimize startup time and commissioning procedure**

** online access to spare parts**

** Secure your time to market**

** Start your installation quickly and comfortably**

** Minimize startup time and commissioning procedure**

** Pre-commissioning**

** Commissioning**

** Delivery**

** After sales service**

** Application benefits**

** System benefits**

** Customer care**

** Performance**

** Energy**

** mp3**

** pdf**

** Software**

** Analyses**

** Motor Management functions**

** Motor Management benefits**

** Security**

** Maintenance & Training**

** Customer Care Center**

** Schneider Electric**

** Energy savings estimation on HVAC pump & fan motor applications**

** Protection of people and equipment**

** Modeling and simulation of all starting methods**

** Analyses of harmonics and solution proposal**

** Motor applications**

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## Expert services for motor applications

<table>
<thead>
<tr>
<th>Analyses</th>
<th>Services</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switching overvoltage analyses</td>
<td>Commissioning</td>
</tr>
</tbody>
</table>

### Analyses of the motor overvoltage protection

- **Solution commissioning**
- **All the spare parts you need by Schneider Electric**
- **Maximize uptime with preventive maintenance**
- **Technical knowledge for safe operation and maintenance**

### Motor applications

- **All applications with DOL starting HV motor**

### Motor Management benefits

- **Avoid damage to the motor due to interrupted motor starting**
- **Optimize the protection solutions and their installation (motor side or switchgear side)**

### Motor Management functions

- **For medium voltage motors, switched with vacuum circuit breakers or contactors**
- **Detailed modeling of: breaker/contactor (dielectric strength, current chopping)**
- **Motor connecting cables**
- **Recommended solutions include:**
  - Surge arresters
  - Surge capacitors
  - RC filters
  - ZORC (surge arrester and RC filter)

### Our services include:

- **Pre-commissioning**
- **Parameter setup**
- **Load testing**
- **Commissioning report**
- **Handover**
- **Technical training**

### Our services include:

- **Spare parts available for the full lifecycle of your equipment**
- **Dedicated eMRO spare parts supply chain**
- **Acquire and maintain the inventory levels required for optimal performance**
- **Assist you to identify critical parts and define the right level of required stock**
- **Spare parts available 24/7, whether stored at your premises or in a central store**

### Our services include:

- **Take complete control of your maintenance costs**
- **Anticipate issues and extend life of system and components**
- **Reduce risk of unscheduled downtime**
- **Improve reliability and safety of operations**
- **Service +: Guaranteed response time for your critical operations - 24/7 remote support**
- **Warranty beyond the standard period**

### Our services include:

- **Training for the complete field service chain, from commissioning through preventive maintenance and digitized service to renewal**
- **Training provided on drive products and systems within the whole lifecycle**
- **Maintenance and commissioning know-how deployed globally**
- **Unique programs for easy deployment**

### Our services include:

- **Setup by certified technicians, fulfills warranty**
- **Start your installation with an expert: ensure an unobstructed commissioning procedure**
- **Minimize startup time and secure your time to market efficiently**
- **Ensure equipment performs to design**
- **Initiate the digital maintenance booklet and secure your operations**

### Our services include:

- **Same as original product: same quality, same warranty, full compatibility**
- **Availability and lead time to meet your needs**
- **Door-to-door priority shipment**
- **Online access to spare parts database**
- **Optimized and controlled maintenance budget**
- **Guaranteed response time: immediate availability (on-site), contractual delivery time (off-site)**

### Advantage Service Plan combines:

- **Our preventive maintenance program to minimize downtime**
- **Annual inspection, worn parts exchanges, measurement campaign, report**
- **Our on-site warranty extension to secure your budget**
- **Exclusive use of original parts**
- **Certified Field Service Engineers**

### Advantage Service Plan combines:

- **New drive technologies reduce the amount of training required to the most relevant**
- **Training developed and deployed by experienced Field Service Engineers**
- **Mobile training equipment allows training to be delivered on your site or anywhere else that is more suitable for you**
- **Stay up to date**
## Expert services

### Services

<table>
<thead>
<tr>
<th>Digitized service</th>
</tr>
</thead>
</table>

### Connect to IoT

Motor applications

All applications

### Motor Mgmt functions

- Link to plant information database or to a cloud database
- Continuous monitoring
- Have the drive as a sensor, use the drive as an intelligent monitor
- Access to health data
- Access to operation data

### Motor Mgmt benefits

- Connection to PlantStruxure
- Transfer maintenance and health data into a Maintenance Response center
- Recognize deviations in advance to keep the process operating
- Reduce maintenance costs and avoid costly downtime
- Increase operating efficiency
Advanced motor control

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Autotransformer starters</td>
<td>22</td>
</tr>
<tr>
<td>Soft starters</td>
<td>22</td>
</tr>
<tr>
<td>Variable speed drives</td>
<td>24</td>
</tr>
</tbody>
</table>
## Advanced motor control

<table>
<thead>
<tr>
<th>Autotransformer starters</th>
<th>Soft starters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 6 MCC/iMCC RVAT</td>
<td>Altistart - ATS22</td>
</tr>
</tbody>
</table>

### Distribution and motor control switchboard

- Autotransformer motor starter
- Soft starters for pumps and fans
- Soft starters for heavy duty industry & pump
- LV distribution and motor control center

### Main standards and certifications

- NEMA, CSA, UL, ABS
- IEC, NEMA, DNV, BV, LR, ABS
- IEC/EN, UL, CSA, EAC (GOST), CCC, C-Tick
- IEC, UL, CSA, EAC, DNV, CCC, NOM, SEPRO, TCF
- IEC, CCC

### Motor voltage range

- 208...600 V
- 230...440 V/230...600 V/208...600 V
- 230...415 V/208...690 V
- 400...690 V

### Motor power range

- 11...300 kW
- 100...4,200 kW
- 4...500 kW
- 4...900 kW
- Up to 250 kW (315 kW @ 500 V)

### Application segments

- Motor applications
  - Compressor
  - Fan
  - Pump
  - Compressor
  - Fan
  - Pump
  - Centrifugal pumps
  - Compressors
  - Conveyors
  - Fans
  - Piston pumps
  - Compressors
  - Conveyors
  - Fans
  - High inertia machines
  - Pumps
  - Centrifugal compressor
  - Centrifugal pump
  - Fan

### Motor Management functions

- Gradual motor starting in steps
- Motor protection through protection relay
- Direct stop
- Circuit breaker or fused switch disconnects
- Start and bypass contactors
- Fixed, disconnectable, and withdrawable functional units
- Soft start/soft stop unit for 3-phase asynchronous motors
- Protection devices for monitoring the motor, the electrical installation, and the starter itself
- Integrates bypass and safety functions
- Prevents installation failure by detecting and signaling faults such as a blocked motor, underload, or incorrect grounding of one of the 3 phases
- Starting and stopping of the machine (TCS patent: Torque Control System)
- Thermal protection, underload and overload with adjustable threshold and times, locked rotor, rotation direction control
- Control of starter bypass contactor to prevent heat dissipation
- Dual motor configuration
- Cascaded starting and deceleration of a number of motors
- Integrated ATS48 soft starter
- Centralized and modular motor control, using conventional and intelligent motor control centers (MCC/iMCC)
- Mixed feeders (power distribution/motor control)

### Motor Management benefits

- IAC 100 kA/0.4 s, seismic qualified
- TVDA on the recommended communication architecture
- IAC 2.7G
- IAC (including autotransformer): 50 kA/0.25 s, 31.5 kA/0.5 s
- Available with PFC
- Space savings
- Reduced number of maintenance points (<40%)
- Standalone or coupled to PIX/MCset switchboard
- One tool and all operations from front
- Seismic 2.7G
- IAC including autotransformer: 50 kA/0.25 s, 31.5 kA/0.5 s
- Available with PFC
- Space savings
- Reduced number of maintenance points (<40%)
- Standalone or coupled to PIX/MCset switchboard
- One tool and all operations from front
- Reduces operating costs
- Saves time on wiring
- Saves space with a fully equipped product
- Increases the service life of your installations
- Reduces mechanical stresses (jolts and shocks) on the machines
- Preconfigured, ready for immediate start-up
- Saves time on wiring
- Extended communication functions
- Saves space with a fully equipped product
- IAC 85 kA/0.4 s, earthquake/seismic 2G
- Integration of capacitor banks and harmonic compensation
- TVDA on the recommended communication architecture
- IAC 85 kA/0.4 s, earthquake/seismic 2G
- Integration of capacitor banks and harmonic compensation
- TVDA on the recommended communication architecture
### Advanced Motor Control

#### Soft starters

<table>
<thead>
<tr>
<th>Okken PMCC/iPMCC soft starter</th>
<th>Model 6 MCC/iMCC soft starter</th>
<th>Motorpact RVSS</th>
<th>Motorpact RVSS S3</th>
<th>Motorpact RVSS standalone</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Okken PMCC/iPMCC soft starter image" /></td>
<td><img src="image2" alt="Model 6 MCC/iMCC soft starter image" /></td>
<td><img src="image3" alt="Motorpact RVSS image" /></td>
<td><img src="image4" alt="Motorpact RVSS S3 image" /></td>
<td><img src="image5" alt="Motorpact RVSS standalone image" /></td>
</tr>
</tbody>
</table>

**LV power distribution and motor control center**

- Distribution and motor control switchboard
- Reduced voltage soft starter
- Reduced voltage sequential soft starter
- Reduced voltage soft starter

**Main standards and certifications**

- IEC, DNV, RINA, BV, Shell DEP, EAC (GOST), CCC
- NEMA, CSA, UL, ABS
- IEC, NEMA, DNV, BV, LR, ABS
- IEC, NEMA, DNV, BV, LR, ABS
- IEC, NEMA, DNV, BV, LR, ABS

**Motor voltage range**

- 400…690 V
- 208…575 V
- 2.2…7.2 kV
- 2.2…7.2 kV
- 2.2…7.2 kV

**Motor power range**

- Up to 200 kW
- 2.5…440 kW
- 100…4,200 kW
- 100…4,200 kW
- 100…4,200 kW

**Application segments**

**Motor applications**

- Centrifugal compressor
- Centrifugal pump
- Fan
- Compressor
- Fan
- Pump
- Compressor
- Fan
- Pump
- Compressor
- Fan
- Pump
- Compressor
- Fan
- Pump

**Motor Management functions**

- Integrated ATS48 soft starter
- Centralized and modular motor control, using conventional and intelligent motor control centers (MCC/MCC)
- Mixed feeders (power distribution/motor control)
- Fixed, disconnectable, and withdrawable functional units
- Integrated ATS48 soft starter
- Centralized and modular motor control, using conventional and intelligent motor control centers (MCC/MCC)
- Mixed feeders (power distribution/motor control)
- Fixed functional units
- Soft start/soft stop unit for 3-phase asynchronous motors
- Dual ramp setup
- Integrated bypass contactor for motor running
- Motor protection through protection relay
- LSC2A with line disconnector
- 5 x In for 60 s
- Soft start/soft stop unit for 3-phase asynchronous motors
- Dual ramp setup
- Multi-motor sequential (cascaded) starting
- Integrated bypass contactor for motor running
- Motor protection through protection relay
- LSC2A with line disconnector
- 5 x In for 60 s
- Soft start/soft stop unit for 3-phase asynchronous motors
- Dual ramp setup
- Multi-motor sequential (cascaded) starting
- Integrated bypass contactor for motor running
- Motor protection through protection relay
- LSC2A with line disconnector
- 5 x In for 60 s
- Coupled to existing circuit breaker/contactor

**Motor Management benefits**

- Supporting several soft starters
- IAC 100 kA/0.4 s, seismic qualified
- TVDA on the recommended communication architecture
- Seismic 2.7G
- IAC: 50 kA/0.25 s, 31.5 kA/0.5 s
- Available with PFC
- Space savings
- Reduced number of maintenance points (<40%)
- Standalone or coupled to PIX/MCset switchboard
- One tool and all operations from the front
- Seismic 2.7G
- IAC: 50 kA/0.25 s, 31.5 kA/0.5 s
- Space savings
- Reduced number of maintenance points (<40%)
- Standalone or coupled to PIX/MCset switchboard
- One tool and all operations from the front
- Seismic 2.7G
- IAC: 50 kA/0.25 s, 31.5 kA/0.5 s
- Available with PFC
- Space savings
- Reduced number of maintenance points (<40%)
- Standalone
- One tool and all operations from the front
## Advanced speed motor control

### Variable speed drives

<table>
<thead>
<tr>
<th>Drives products - ATV630/650</th>
<th>Drives products - ATV930/950</th>
<th>Drive systems - ATV660</th>
<th>Drive systems - ATV680</th>
<th>Drive systems - ATV960</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drive products for pumping &amp; fan applications</td>
<td>Drive products for solid &amp; mechanics movement</td>
<td>ATV660 compact drive systems</td>
<td>ATV680 low harmonic drive systems</td>
<td>ATV960 high performance drive systems</td>
</tr>
</tbody>
</table>

### Main standards and certifications

<table>
<thead>
<tr>
<th>IEC, NEMA, DNV</th>
<th>IEC, NEMA, DNV</th>
<th>EN/IEC, UL</th>
<th>EN/IEC, UL, IEEE 519</th>
<th>EN/IEC, UL</th>
</tr>
</thead>
</table>

### Motor voltage range

<table>
<thead>
<tr>
<th>200...240 V, 380...480 V</th>
<th>200...240 V, 380...480 V</th>
<th>380...480 V</th>
<th>380...480 V</th>
</tr>
</thead>
</table>

### Motor power range

<table>
<thead>
<tr>
<th>0.75...315 kW</th>
<th>0.75...315 kW</th>
<th>1...800 kW</th>
<th>90...800 kW</th>
<th>1...800 kW</th>
</tr>
</thead>
</table>

### Application segments

- **Motor applications**
  - Compressor
  - Fan
  - Pump
  - Artificial lift
  - Conveyors
  - Crushing
  - Mills
  - Special cranes
  - Archimedes screws
  - Centrifugal and volumetric pumps
  - Compressors
  - Fans
  - Oil and fuel pumps
  - Motor control for asynchronous and synchronous motors
  - Multi-pulse solutions
  - Motor control for asynchronous and synchronous motors
  - Open loop control
  - No braking or 4Q
  - Intelligent services features: power measurement, Web server, dynamic QR code
  - Multi-pulse solutions
  - Motor control for asynchronous and synchronous motors
  - Open loop control
  - Motor braking features
  - Intelligent services features: power measurement, Web server, dynamic QR code
  - Low harmonic drive (for THDi <5%)
  - Advanced motor control for asynchronous, synchronous, and special motors
  - Open and closed loop control
  - Braking functionality
  - Intelligent services features: power measurement, Web server, dynamic QR code
  - Embedded dual Ethernet
  - Multi-pulse solutions

### Motor Management functions

- Advanced motor control law
- Smart services features: power measurement, Web server, dynamic QR code
- Advanced features for single pump and multipump systems management
- Advanced features for power consumption and pumping system monitoring
- Advanced motor control for asynchronous, synchronous, and special motors
- Full digital Master/Slave: MultiDrive Link
- Smart integration in PlantStruxure and Foxboro Evo process automation systems
- Intelligent services features: power measurement, Web server, dynamic QR code
- Motor control for asynchronous and synchronous motors
- Open loop control
- No braking or 4Q
- Intelligent services features: power measurement, Web server, dynamic QR code
- Multi-pulse solutions
- Motor control for asynchronous and synchronous motors
- Open loop control
- Motor braking features
- Intelligent services features: power measurement, Web server, dynamic QR code
- Low harmonic drive (for THDi <5%)
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- Open and closed loop control
- Braking functionality
- Intelligent services features: power measurement, Web server, dynamic QR code
- Embedded dual Ethernet
- Multi-pulse solutions

### Motor Management benefits

- Longer system lifetime thanks to pump protection and monitoring features
- Optimization of pumping system operating point
- Designed for harsh environments (IEC/EN60721 3C3-3S3, and high temperature range)
- Up to 60% energy savings at standby due to the innovative "Stop & Go" operation without additional costs
- Excellent motor performance on any type of motor
- Total control of any kind of coupling in master/slave applications
- Designed for harsh environments (IEC/EN60721 3C3-3S3, and high temperature range)
- Up to 60% energy savings at standby due to the innovative "Stop & Go" operation without additional costs
- Fully customizable drive systems
- Ready-to-use drive systems
- Tested at full load
- Designed for harsh environments with high level of conformal coating of printed boards and high temperature range
- Up to 60% energy savings at standby with "Stop & Go" without additional costs
- Ready-to-use and fully customizable drive systems
- New Low Harmonic system concept based on unique 3-level technology
- Improved life-time of the motor due to reduced voltage load
- Less heat losses compared to the classic AFE architecture
- Up to 60% energy savings at standby
- Fully customizable drive systems
- Ready-to-use drive systems
- Tested at full load
- Designed for harsh environments with high level of conformal coating of printed boards and high temperature range
- Up to 60% energy savings at standby with "Stop & Go" without additional costs
Advanced motor control

Variable speed drives

<table>
<thead>
<tr>
<th>Drive systems - ATV80</th>
<th>Drive systems - ATV990</th>
<th>Drive systems - ATV61 Plus</th>
<th>Drive systems - ATV61 Plus-Marine</th>
<th>Drive systems - ATV71 Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATV80 Drive systems</td>
<td>ATV990 MultiDrive</td>
<td>ATV61 Plus drives for</td>
<td>ATV61 Plus-Marine drives for heavy torque</td>
<td>ATV71 Plus drives for heavy duty industry</td>
</tr>
<tr>
<td>Main standards and certifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Motor voltage range

| 380…480 V | 380…480 V | 380…690 V | 380…690 V | 380…690 V |

Motor power range

| 90…800 kW | 1…1,000 kW | 1…2,400 kW | 90…2,400 kW | 1…2,400 kW |

Application segments

Motor applications
- Artificial lift
- Centrifuges
- Conveyors
- Crushers, slurry pumps
- Hoisting
- Mills
- Mixers

Motor Management functions
- Advanced motor control for asynchronous, synchronous, and special motors
- Highly efficient power regeneration
- Open and closed loop control
- Braking and 4Q applications
- Intelligent services features: Web servers, dynamic QR code
- Embedded dual Ethernet
- MultiDrive with DC or AC bus
- Motor control for asynchronous, synchronous, and special motors
- Highly efficient power regeneration
- Open and closed loop control
- Braking and 4Q applications
- Embedded dual Ethernet
- Archimedes screws
- Centrifugal and volumetric pumps
- Compressors
- Fans
- Oil and fuel pumps
- HVAC applications
- Propulsion
- Seawater and mud pumps
- Thrusters (azimuth, tunnel, and jet thrusters)
- Motor control for asynchronous and synchronous motors
- Open loop control
- No braking or 4Q
- Low harmonic variant for THDi <5%
- Multi-pulse solutions
- Motor control for asynchronous and synchronous motors
- Open loop control
- No braking or 4Q
- Low harmonic variant for THDi <5%
- Multi-pulse solutions
- Motor control for asynchronous and synchronous motors
- Open loop control
- No braking or 4Q
- Low harmonic variant for THDi <5%
- Multi-pulse solutions
- Motor control for asynchronous and synchronous motors
- Open and closed loop control
- Braking and 4Q applications
- Multi-pulse solutions

Motor Management benefits
- Ready-to-use and fully customizable drive systems
- New low harmonic system concept based on unique 3-level technology
- Improved lifetime of the motor due to reduced voltage load
- Less heat loss compared to the classic AFE architecture
- Up to 60% energy savings at standby
- Fully customizable drive systems
- MultiDrive offer with common DC or AC bus
- Ready-to-use drive systems
- Tested at full load
- Pre-set appropriate to the design
- Energy savings by highly efficient power regeneration
- Designed for harsh environments
- Preconfigured, ready-to-use drive systems
- Tested at full load operating conditions
- Operation in harsh environments IP55
- Fully customizable drive systems
- Designed for harsh environments (water-cooled)
- Preconfigured, ready-to-use drive systems for on- and off-shore applications
- Tested at full load operating conditions
- Operation in harsh environments IP55
- Fully customizable drive systems
- Designed for harsh environments (water-cooled)
- Preconfigured, ready-to-use drive systems
- Tested at full load operating conditions
- Operation in harsh environments IP55
- Fully customizable drive systems
- Designed for harsh environments (water-cooled)
### Advanced Motor Control

#### Variable Speed Drives

<table>
<thead>
<tr>
<th>Drive systems - ATV71 Plus-Marine</th>
<th>Blokset PMCC/iPMCC VSD</th>
<th>Okken PMCC/iPMCC VSD</th>
<th>Model 6 MCC/iMCC VSD</th>
<th>Altivar 1200</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATV71 Plus-Marine drives for heavy duty industry</td>
<td>LV motor control center</td>
<td>LV motor control center</td>
<td>Distribution and motor control switchboard</td>
<td>Medium voltage variable speed drive</td>
</tr>
</tbody>
</table>

**Main standards and certifications**

- DNV, BV, CCS, LR, IEEE 519
- IEC
- IEC, DNV, RINA, BV, Shell DEP, EAC (GOST), CCC
- NEMA, CSA, UL, ABS
- EN/IEC, IEEE, GOST

**Motor voltage range**

- 380…690 V  Up to 690 V
- 208…600 V  2.4…11 kV

**Motor power range**

- 90…2,000 kW  Up to 110 kW
- 0.75…370 kW  240…12,000 kW

**Application segments**

- Hoist applications (winches, cranes)
- HVAC applications
- Propulsion, thrusters
- Seawater and mud pumps
- Top drive, rotary table
- Centrifugal pump
- Compressor
- Fan
- Volumetric pump
- Compressor
- Fan
- Pump
- 2Q applications
- Ball mills
- Compressor
- Conveyors: uphill and flat
- Crusher
- Fans
- Pump

**Motor control functions**

- Motor control for asynchronous and synchronous motors
- Open and closed loop control
- Braking and 4Q applications
- Multi-pulse solutions
- LV distribution and motor control switchboard integrating VSD
- Motor control for asynchronous and synchronous motors
- Mixed feeders (power distribution/motor control, fixed/withdrawable functional units)
- LV distribution and motor control switchboard integrating VSD
- Motor control for asynchronous and synchronous motors
- Mixed feeders (power distribution/motor control, fixed/withdrawable functional units)
- LV distribution and motor control switchboard integrating VSD
- Motor control for asynchronous and synchronous motors
- Mixed feeders (power distribution/motor control, fixed/withdrawable functional units)
- Motor control for asynchronous and synchronous motors
- Multi-level topology featuring a 18-54 pulse diode rectifier and a low-voltage IGBT (THDi<3%)
- Large 10” touch screen multi-language HMI
- Soft start function (including synchronization and bypass)
- Multi-motor control
- Master-slave and droop control
- Reduced energy consumption, lower maintenance costs
- Complete range of services, optimized return on investment
- Open to most networks and easy to integrate into any MV or LV architecture
- All-in-one cabinet for reduced installation costs and quick commissioning
- Adapted to retrofit integration for DOL-operated motors

**Motor Management Benefits**

- Preconfigured, ready-to-use drive systems for on- and off-shore applications
- Tested at full load operating conditions
- Operation in harsh environments IP55
- Fully customizable drive systems
- Designed for harsh environments (water-cooled)
- IAC 85 kA/0.4 s, seismic 2G
- Ethernet IP embedded
- dv/dt harmonic filters embedded
- Flexible and simple keypad
- TVDA on the recommended communication architecture
- IAC 100 kA/0.5 s, seismic 2.7G
- Ethernet IP embedded
- dv/dt harmonic filters embedded
- Flexible and simple keypad
- TVDA on the recommended communication architecture
- IAC 100 kA/0.4 s, seismic qualified
- Ethernet IP embedded
- I/O harmonic filters embedded
- Flexible and simple keypad
- TVDA on the recommended communication architecture
- IAC 100 kA/0.4 s, seismic qualified
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<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power factor correction: capacitor banks</td>
<td>30</td>
</tr>
<tr>
<td>Harmonic mitigation</td>
<td>31</td>
</tr>
<tr>
<td>Transformers (indoor and outdoor)</td>
<td>32</td>
</tr>
</tbody>
</table>
## Power quality

### Power factor correction: capacitor banks

<table>
<thead>
<tr>
<th>VarSet LV</th>
<th>VarSet LV with detuned reactor</th>
<th>ReactiVar LV AV5000</th>
<th>ReactiVar LV AV6000</th>
<th>AccuSine PCS+ (LV active filters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LV capacitor banks for smart power factor correction</td>
<td>LV capacitor banks for polluted networks</td>
<td>Standard automatic power factor correction banks</td>
<td>Automatic anti-resonant power factor capacitor banks</td>
<td>LV active harmonic filters</td>
</tr>
</tbody>
</table>

### Main standards and certifications

<table>
<thead>
<tr>
<th>IEC, CSA, UL</th>
<th>IEC, CSA, UL</th>
<th>NEMA, CSA, UL</th>
<th>NEMA, CSA, UL</th>
<th>IEC, UL, cUL, ABS, C-Tick, CE</th>
</tr>
</thead>
</table>

### Motor voltage range

| 230...690 V (50 Hz) | 230...690 V (50 Hz) | 240...600 V (60 Hz) | 208...600 V (60 Hz) | 380...690 V |

### Power range

| 6...1,150 kvar | 6...1,150 kvar | 50...1,000 kvar | 50...1,500 kvar | 50...250 kvar @ 480 V (60...300 A) |

### Application segments

| DOL | DOL, VSD | DOL | DOL, VSD | VSD |

### Motor control type

| DOL | DOL, VSD | DOL | DOL, VSD | VSD |

### Motor Management functions

- **Reduces voltage drop during motor running**
- **Fixed (individual motor or static loads) or automatic type (frequently started motors)**
- **Applicable in systems with THD <3%**
- **Reduces voltage drop during motor running**
- **Fixed (individual motor or static loads) or automatic type (frequently started motors)**
- **Applicable in systems with THD <7%**
- **Avoids harmonic amplification**
- **Reduces voltage drop during motor running**
- **Fixed (individual motor or static loads) or automatic type (frequently started motors)**
- **Applicable in systems with THD <3%**
- **Avoids harmonic amplification**
- **Ultra fast response at <2 cycles**
- **Corrective capability: THD(i) <3% and near unity displacement power factor**
- **Reduces voltage drop during motor start and running**
- **Specially designed for networks containing harmonics**
- **Complies with harmonic standards worldwide**
- **Can be operated as a displacement power factor correction and load balancing device independent of or in conjunction with harmonic mitigation**
- **Maximizes uptime when used for harmonic and/or power factor correction**
- **Stops voltage sags and flicker due to load current fluctuations**

### Motor Management benefits

- **Reduced reactive energy billing penalties, saves up to 10% operating expenses**
- **Improved power system and equipment reliability**
- **Improved active power capacity of the installation**
- **Reduced conductor cross-section (motor cable) when installed at motor terminals**
- **Specially designed for networks containing harmonics**
- **Reduced reactive energy billing penalties and saves up to 10% operating expenses**
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- **Maximizes uptime when used for harmonic and/or power factor correction**
- **Stops voltage sags and flicker due to load current fluctuations**
### Power quality

#### Harm. mitigation

<table>
<thead>
<tr>
<th>ReactiVar LV AV7000</th>
<th>Oil distribution transformers: Minera</th>
<th>Cast resin transformers: Trihal</th>
<th>Minera MP</th>
<th>Minera Ex</th>
</tr>
</thead>
</table>

- **LV harmonic filtering and power factor correction**
  - Ground-mounted distribution transformer
  - Cast resin dry-type transformer (including 12-pulse and step-up)
  - Medium power transformer (MPT)
  - Oil-type transformer for explosive atmosphere

#### Main standards and certifications

<table>
<thead>
<tr>
<th>NEMA</th>
<th>IEC, ANSI, ABS, BS, AU</th>
<th>IEC, ANSI, ABS, BS, AU</th>
<th>IEC, ANSI, ABS, BS, AU</th>
<th>IEC, ANSI, ABS, BS, AU, DNV, BV, LR</th>
</tr>
</thead>
</table>

#### Motor voltage range

| 208…600 V (60 Hz) | Primary: up to 52 kV | Secondary: up to 36 kV | Primary: up to 40.5 kV | Secondary: up to 36 kV | Primary: up to 170 kV | Secondary: up to 36 kV | Primary: LV up to 36 kV | Secondary: up to 36 kV |

#### Power range

| 50…1,500 kvar | Up to 3.15 MVA | Up to 15 MVA | Up to 100 MVA | Up to 60 MVA |

#### Application segments

- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**

#### Motor control type

- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**
- **DOL, VSD**

#### Motor Management functions

- **Filtering of 5th harmonic**
- **Indoor installation**
- **Automatic compensation**

- For MV/LV distribution
- Ground/Pole-mounted, hermetically sealed or breathing type
- Normal, low, or very low level of losses (Ecodesign)
- Cooling type: ONAN, ONAF, OSAF, OWF, ODF, ODF
- Off-circuit tap changer or on-load tap changer
- Electrostatic screen between primary and secondary coils
- Preimpregnated foil winding on LV side
- Electrostatic screen between primary and secondary coils
- Cooling type: AN, AF, WF
- Thermal protection system
- H or F class insulation
- On-load tap changer
- Ecodesign

- For HV/MV/LV transmission and distribution
- Ground-mounted, oil-immersed transformer
- Hermetically sealed or breathing type
- Normal, low, or very low level of losses (Ecodesign)
- Cooling type: ONAN, ONAF, OSAF, OWF, ODF, ODF
- Off-circuit tap changer or on-load tap changer
- Ecodesign

- For HV/MV/LV transmission and distribution
- ATEX, IEC Ex certification for Explosive Areas (Zone 1 or Zone 2)
- Ground-mounted
- Hermetically sealed or breathing type
- Normal/low/very low level of losses
- Cooling type: ONAN, ONAF, OSAF, OWF, ODF, ODF
- Off-circuit tap changer or on-load tap changer

#### Increased effectiveness of harmonic energy absorption due to close tuning to the 5th harmonic

- Specific electrical design to match customer requirements
- Minimum maintenance (oil analysis every 5 years)
- Low noise level
- Reduced risk of fault between windings
- Can be designed according to the harmonics present on the primary and secondary sides
- Exact dimensioning
- Anti-vibration design
- Protected against fire hazards
- Easy installation and minimum maintenance
- Low noise level
- Reduced risk of fault between windings
- Can be designed according to the harmonics present on the primary and secondary sides
- Indoor and outdoor application
- Secured on-site process and operations
- Specific electrical design to match customer requirements
- Low noise level
- Electrostatic screen between primary and secondary coils
- Secured on-site process and operations
- Specific electrical design to match customer requirements
- High reliability on critical application
- Higher fire and flash points with Ester oils
- Environmentally friendly with biodegradable oil option
### Power quality

## Transformers (indoor & outdoor)

<table>
<thead>
<tr>
<th>Minera R</th>
<th>BC Imprego</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Minera R" /></td>
<td><img src="image2" alt="BC Imprego" /></td>
</tr>
</tbody>
</table>

- **Oil-type transformer for rectifier applications**
- **Vacuum pressure impregnated transformer**

### Main standards and certifications

- **IEC, ANSI, ABS, BS, AU**
- **IEC, ROHS, REACH, DNV, LLOYD’S, VERITAS, etc.**

### Motor voltage range

- **Primary:** up to 170 kV
- **Secondary:** up to 36 kV
- **Up to 12 kV**

### Power range

- **Up to 80 MVA**
- **Up to 5 MVA**

### Application segments

#### Motor control type

- **DOL, VSD**
- **VSD**

#### Motor Management functions

- For high current and harmonic levels
- Suitable for connection to main types of converters (6-pulse or 12-pulse) with diode or thyristors technology
- One or more output windings connected to the rectifier
- Very large regulating voltage range, from zero volts up to several hundred volts
- Off-circuit tap changer or on-load tap changer

- Coupling option: Dd0Y11, Zig Zag, extended delta, Yd5y6, angle shifting (±15°)
- Ambient temperature range: up to 60 °C
- Dry-type transformers
- Optional: one or more output windings connected to the rectifier

### Motor Management benefits

- Secured on-site process and operations
- Specific electrical design to match customer requirements
- Low noise level
- Electrostatic screen between primary and secondary coils

- Simple and reliable solution for harmonic reduction
- Avoids need for additional switchgear for connection to busbar
- Eliminates need for passive or active harmonic filter for large drives
- Galvanic insulation between network and drive
Motor protection and control (for asynchronous machines)

Protection relays 36

Switchboards and motor starters 37
Motor protection and control (for asynchronous machines)

<table>
<thead>
<tr>
<th>Protection relays</th>
<th>TeSys T</th>
<th>Sepam Series 20 &amp; 40</th>
<th>Easergy Sepam 60 &amp; 80</th>
<th>MiCOM P211</th>
<th>MiCOM P22x</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intelligent Motor Management system</td>
<td>Protection relays for demanding applications</td>
<td>Protection relays for complex applications</td>
<td>Intelligent motor controller and protection relays</td>
<td>Motor and overcurrent protection relays</td>
<td></td>
</tr>
<tr>
<td>Main standards and certifications</td>
<td>IEC, UL, CSA, EAC (GOST), ANSI</td>
<td>IEC, UL, CSA, IACS, EAC (GOST), ANSI</td>
<td>IEC, UL, CSA, ANSI</td>
<td>IEC, UL, CSA, ANSI</td>
<td></td>
</tr>
<tr>
<td>Motor voltage range</td>
<td>Low voltage</td>
<td>Medium voltage</td>
<td>Medium voltage</td>
<td>Medium voltage</td>
<td>Medium voltage</td>
</tr>
<tr>
<td>Motor power range</td>
<td>4…560 kW</td>
<td>200…750 kW</td>
<td>&gt; 500 kW</td>
<td>200…750 kW</td>
<td>200…750 kW</td>
</tr>
<tr>
<td>Application segments</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor control type</td>
<td>DOL, star-delta, reverse speed, etc...</td>
<td>DOL, soft start, reverse speed, autotransformer</td>
<td>DOL, soft start, reverse speed, autotransformer</td>
<td>DOL</td>
<td>DOL, VSD (CT only, 40-70 Hz)</td>
</tr>
<tr>
<td>Motor Management functions</td>
<td>• Connectivity via multiple industrial protocols: EtherNet/IP, Modbus/TCP, Modbus RTU, Profibus-DP, CANopen, DeviceNet</td>
<td>• Custom logic</td>
<td>• Measurements: current, voltage, active, and reactive power</td>
<td>• Protection: current/voltage: over/under, thermal protection, etc.</td>
<td>• Current/voltage phase and balance, load shedding, auto restart</td>
</tr>
<tr>
<td></td>
<td>• Phase-to-ground and interturn fault protection</td>
<td>• Operating time</td>
<td>• Directional ground fault protection (Series 40)</td>
<td>• Optimization of thermal image</td>
<td>• Temperature monitoring</td>
</tr>
<tr>
<td></td>
<td>• Underload and overload protection</td>
<td>• Breaker failure</td>
<td>• Directional active and reactive power (Series 40)</td>
<td>• Trip circuit supervision</td>
<td>• Tripping context</td>
</tr>
<tr>
<td></td>
<td>• Operating time</td>
<td>• Breaker failure</td>
<td>• Under/overvoltage (Series 40)</td>
<td>• Field loss</td>
<td>• Machine differential protection, Series 80</td>
</tr>
<tr>
<td></td>
<td>• Breaker failure</td>
<td>• Directional ground fault protection</td>
<td>• Optimized thermal image, temperature monitoring</td>
<td>• Machine differential protection, Series 80</td>
<td>• Tripping context</td>
</tr>
<tr>
<td></td>
<td>• Directional active and reactive power</td>
<td>• Under/overvoltage</td>
<td>• Optimized thermal image allowing efficient overload protection accounting for harmonics</td>
<td>• Visualize the motor start report and motor trend record on the display and in COMTRADE format</td>
<td></td>
</tr>
<tr>
<td>Motor Management benefits</td>
<td>• Appropriate for use in MV and LV applications</td>
<td>• Easily adaptable and equipped with Modbus RTU protocol</td>
<td>• Protection for motor current, voltage, and temperature</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Under/over-frequency</td>
<td>• Modbus RTU protocol allows interfacing with substation control and SCADA systems</td>
<td>• Under/overvoltage</td>
<td>• Anti-backspin protection for high inertia loads</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Voltage indicator system</td>
<td>• The relay is housed in a small case for rail or flush mounting</td>
<td>• Optimization of thermal image, temperature monitoring</td>
<td>• True RMS-based thermal image allowing efficient overload protection accounting for harmonics</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Circuit breaker failure</td>
<td></td>
<td>• Field loss</td>
<td>• Machine differential protection, Series 80</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Anti-backspin protection</td>
<td></td>
<td>• Circuit breaker failure</td>
<td>• Visualize the motor start report and motor trend record on the display and in COMTRADE format</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• True RMS-based thermal image allowing efficient overload protection accounting for harmonics</td>
<td>• Adaptive to specific applications through logic equations editor</td>
<td></td>
<td>• Programmable curve for ANSI 50/51 and ANSI 50N/51N</td>
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<tr>
<td></td>
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<td></td>
<td>• SIL 2 certification</td>
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<td></td>
<td>Cost-effective, flexible solution featuring a wide range of functions</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>• Reliable time-saving and cost-effective range of relays for increasing motor efficiency</td>
<td></td>
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<tr>
<td></td>
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<td></td>
<td>• Comprehensive functions for a wide range of applications</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>• More efficient protection and running of the motor</td>
<td></td>
</tr>
</tbody>
</table>

Motor Management benefits

• Advanced motor protection from basic to mission-critical applications
• Notice of potential issues through intuitive pre-fault alarms
• Maximum flexibility with expandable I/O module
• Adaptable to any process control system through custom programmable logic
• FDR: Fast Device Replacement service with screen to allow easy maintenance
• User-friendly
• Modularity, redundancy and connection to accessories
• Communication via IEC 61850 and Modbus TCP/IP protocols simultaneously on Series 40
• All electrical protocols (Modbus, DNP3.0 and IEC670-5-103)
• Adaptability to specific applications through logic equations editor
• Redundancy and GOOSE messaging via IEC 61850 and Modbus TCP/IP simultaneously
• Adaptability to specific applications through logic equations editor or Logipam (ladder) Series 80
• Visualize the motor start report and motor trend record on the display and in COMTRADE format
• Programmable curve for ANSI 50/51 and ANSI 50N/51N
• SIL 2 certification

| Cost-effective, flexible solution featuring a wide range of functions | • Reliable time-saving and cost-effective range of relays for increasing motor efficiency |
| | • Comprehensive functions for a wide range of applications |
| | • More efficient protection and running of the motor |
Motor protection and control (for asynchronous machines)

<table>
<thead>
<tr>
<th>Protection relays</th>
<th>Switchboards and motor starters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easergy MICOM P24x</td>
<td>TeSys F</td>
</tr>
<tr>
<td></td>
<td>TeSys B</td>
</tr>
<tr>
<td></td>
<td>Blokset PMCC/iPMCC</td>
</tr>
<tr>
<td></td>
<td>Blokset MB PMCC/iPMCC</td>
</tr>
</tbody>
</table>

- **Rotating machine and motor protection relays**
  - Contactors for motor control
  - Bar contactors for motor control
  - LV power distribution and motor control
  - LV power distribution and motor control

- **Main standards and certifications**
  - IEC, UL, CSA, ANSI
  - IEC, CCC, CB, UL, CSA, DNV
  - IEC, CSA, EAC (GOST)
  - IEC
  - IEC, DNV, GL, RINA, BV, CCS, ABS

- **Motor voltage range**
  - Medium voltage: 220…1,000 V
  - Motor power range:
    - > 500 kW @ 440 V
    - < 670 kW @ 440 V
    - < 450 kW @ 1,000 V
    - < 900 kW @ 690 V
    - < 750 kW @ 1,000 V
    - ≤ 250 kW
    - ≤ 250 kW

- **Application segments**
  - Motor control type
    - DOL, VSD (CT only, 40-70 Hz)
    - DOL, star-delta, reverse speed, etc.
    - DOL, autotransf., star-delta, slip-ring motors
    - DOL, VSD (standalone)
    - DOL, star-delta, reverse speed

- **Motor Management functions**
  - • Applicable for both induction and synchronous machines
  - • Includes differential protection function (87) and optimization of thermal image monitoring for machines
  - • Integrated in iMCC (with LR9 electronic relay, GV7 motor circuit breaker)
  - • Can be coordinated with fuse and Masterpact NW circuit breaker
  - • Mechanical interlocking with horizontal or vertical mounting kits
  - • Magnetic latching for long switching times
  - • Control coils can operate in DC mode or from 40 to 400 Hz AC mode
  - • Shock-proof contactor (TeSys FG)
  - • Withdrawable type coils
  - • Control for AC and DC motors (< 2,500 A @ 1,500 VDC)
  - • Application in severe switching conditions (AC-4, DC-5, etc. categories)
  - • Numerous adaptation possibilities: number and type of poles, number and type of auxiliary contacts, control circuit voltages, mounting bar length and fixing points
  - • Magnetic latching for long switching times
  - • Control coils can operate in DC mode or from 40 to 400 Hz AC mode
  - • Shock-proof contactor (TeSys FG)
  - • Withdrawable type coils

- **Motor Management benefits**
  - • Easy maintenance (withdrawable control coils)
  - • Electrical coordination provided by different protection devices (relay, fuse, circuit breaker)
  - • Similar frame sizes optimize panel size and reduce assembly time
  - • Long mechanical and electrical life and consistent low-voltage architecture ensure low OPEX and safer, more reliable operation
  - • Designed for high performance applications: high operating rate, high electrical durability, reduced clearance distance, high performance in DC
  - • Flexible and adaptable
  - • Proven service life 40+ years
  - • Reduced maintenance
  - • IAC 85 kA/0.4 s, earthquake/seismic 2G
  - • Up to 34 DOL functional units in a single column
  - • Ethernet IP embedded
  - • TVDA on the recommended communication architecture (32 units)
  - • Fast device replacement (FDR)
  - • Internal arc 65 kA/0.3 s @ 690 V
  - • Up to 8 DOL functional units in the fixed type column
  - • Up to 32 DOL functional units in the withdrawable type cubicle
  - • Fast device replacement (FDR)
Motor protection and control (for asynchronous machines)

<table>
<thead>
<tr>
<th>Switchboards and motor starters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Okken PMCC/iPMCC</td>
</tr>
<tr>
<td><img src="image1" alt="Okken PMCC/iPMCC" /></td>
</tr>
<tr>
<td>LV power distribution and motor control</td>
</tr>
</tbody>
</table>

Main standards and certifications

- IEC, DNV, RINA, BV, Shell DEP, EAC (GOST), CCC
- NEMA, CSA, UL, ABS
- IEC, Marine
- IEC, EAC (GOST), Marine (BV)
- IEC

Motor voltage range

- 380…690 V
- 208…600 V
- 2.2…12 kV
- 2.2…12 kV
- 2.2…12 kV

Motor power range

- ≤ 250 kW
- 0.25…300 kW
- Circuit breaker: up to 10,000 kW
- Contactor: up to 2,300 kW
- 100…10,000 kW
- 100…10,000 kW

Application segments

- Motor control type
  - DOL, VSD (standalone)
  - DOL, star-delta (non-UL), reverse speed, etc.
  - DOL
  - DOL
  - DOL

Motor control type

- DOL, VSD (standalone)
- DOL, star-delta (non-UL), reverse speed, etc.
- DOL
- DOL
- DOL

Motor Management functions

- LV distribution and motor control switchboard
- Fixed and withdrawable distribution and motor feeders
- LV distribution and motor control center
- Fast device replacement (FDR)
- Used for MV primary distribution or as motor starter
- Withdrawable circuit breaker or contactor
- LSC2B-PM
- LF circuit breaker (SF6)
- Evolis circuit breaker (vacuum)
- CTV1 contactor (7.2 kV vacuum)
- Rollarc R400 contactor (12 kV SF6)
- Coupled to Motorpact
- Used for MV primary distribution or as motor starter
- Withdrawable circuit breaker
- LSC2B-PM
- HVX circuit breaker (vacuum)
- Coupled to PIX-MCC
- LV distribution and motor control switchboard
- Fixed and withdrawable distribution and motor feeders
- LV distribution and motor control center
- Fast device replacement (FDR)
- IAC 100 kA/0.5 s, earthquake/seismic 2.7G
- Up to 36 DOL functional units in a single column
- Ethernet IP embedded
- TVDA on the recommended communication architecture (32 units)
- Fast device replacement (FDR)
- Used for MV primary distribution or as motor starter
- Withdrawable circuit breaker or contactor
- LSC2B-PM
- LF circuit breaker (SF6)
- Evolis circuit breaker (vacuum)
- CTV1 contactor (7.2 kV vacuum)
- Rollarc R400 contactor (12 kV SF6)
- Coupled to Motorpact
- Used for MV primary distribution or as motor starter
- Withdrawable circuit breaker
- LSC2B-PM
- HVX circuit breaker (vacuum)
- Coupled to PIX-MCC
- Used for MV primary distribution or as motor starter
- Withdrawable circuit breaker
- LSC2B-PM
- HVX circuit breaker (vacuum)
- Coupled to PIX-MCC
- MV primary distribution substation for electro-intensive applications, or motor starter
- HVX circuit breaker (12 kV vacuum)
- Coupled to PIX-MCC

Motor Management benefits

- IAC 100 kA/0.5 s, earthquake/seismic 2.7G
- Up to 36 DOL functional units in a single column
- Ethernet IP embedded
- TVDA on the recommended communication architecture (32 units)
- Fast device replacement (FDR)
- High level protection of people: each compartment is isolated from the others by grounded metal partitions, safety interlocking
- Reduced maintenance and probability of failure: monitoring of temperature rise, indication of the fault zone
- Provided with VAMP arc detection
- Safety function: simple use, safety interlock to prevent unauthorized operation
- Safe and reliable with a full 1 second Internal Arc Classification - AFLR
- Comprehensive interlocking, with all operations from the front
- Reduced maintenance and probability of failure: monitoring of temperature rise, indication of the fault zone
- Provided with VAMP arc detection
- Motorized withdrawal of the circuit breaker
- Safe and reliable with a full 1 second Internal Arc Classification - AFLR
- Comprehensive interlocking, with all operations from the front
- Reduced maintenance and probability of failure: monitoring of temperature rise, indication of the fault zone
- Provided with VAMP arc detection
- Can be fully installed from the front of the cubicle
# Motor protection and control (for asynchronous machines)

## Switchboards and motor starters

<table>
<thead>
<tr>
<th>Product</th>
<th>Image</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIX-12 kV with CVX</td>
<td><img src="image1.png" alt="Image" /></td>
<td>Motor control center</td>
</tr>
<tr>
<td>PIX-MCC 7.2 kV</td>
<td><img src="image2.png" alt="Image" /></td>
<td>Motor control center</td>
</tr>
<tr>
<td>Motorpact FVNR − 450 A</td>
<td><img src="image3.png" alt="Image" /></td>
<td>Full voltage motor starter</td>
</tr>
<tr>
<td>Motorpact FVNR − 720 A</td>
<td><img src="image4.png" alt="Image" /></td>
<td>Full voltage motor starter</td>
</tr>
<tr>
<td>Motorpact PFC</td>
<td><img src="image5.png" alt="Image" /></td>
<td>Full voltage motor starter with integrated power factor correction</td>
</tr>
</tbody>
</table>

### Main standards and certifications

| IEC, EAC (GOST), Marine (BV) | IEC, BV | IEC, NEMA, UL, DNV | NEMA, UL | IEC, NEMA, UL, DNV |

### Motor voltage range

| 6.9…12 kV | 2.2…7.2 kV | 2.2…7.2 kV | 2.2…7.2 kV | 2.2…7.2 kV |

### Motor power range

| 100…2,300 kW | 100…4,200 kW | 100…4,200 kW | 100…6,800 kW | 100…4,200 kW |

### Application segments

| ![Image](image6.png) | ![Image](image7.png) | ![Image](image8.png) | ![Image](image9.png) | ![Image](image10.png) |

### Motor control type

| DOL | DOL | DOL, star-delta, reverse speed, 2-speed | DOL | DOL, star-delta, reverse speed, 2-speed |

### Motor Management functions

- **MV motor starter**
  - Withdrawable contactor
  - LSC2B-PM
  - CVX contactor (12 kV vacuum)
  - Coupled to PIX-HVX
- **Compact single-tier fused vacuum contactor (CVX)**
  - Designed to meet O&G client specifications i.e. Shell DEP
  - Suitable for motor, feeder, and capacitor switching
  - LSC2B-PM compartmented
- **Standalone or coupled to PIX/MCset switchboard**
  - Controls and fully protects the motor through protection relay
  - All operations from the front
  - LSC2A with line disconnector
- **DOL motor starter**
  - Standalone or coupled to PIX/MCset switchboard
  - Controls and fully protects the motor through protection relay
  - All operations from the front
  - LSC2A with line disconnector
- **Standalone or coupled to PIX/MCset switchboard**
  - Controls and fully protects the motor through protection relay
  - Integrates capacitor bank up to 400 kvar
  - All operations from the front
  - LSC2A with line disconnector

### Motor Management benefits

- **Safe and reliable with a full 1 second Internal Arc Classification - AFLR**
- **IAC-compliant operator safety**
  - Directly coupled with PIX switchboard
- **IAC-compliant operator safety**
  - Space savings (375 mm wide in DOL version)
- **Reduced maintenance and probability of failure: monitoring of temperature rise, indication of the fault zone (MDT relay)**
  - Simple use, comprehensive interlocking, with all operations from the front
- **IAC-compliant operator safety**
  - Reduced maintenance and probability of failure: monitoring of temperature rise, indication of the fault zone (MDT relay)
  - Local cost-effective reactive power compensation
## Motor protection and control

### Switchboards and motor starters

<table>
<thead>
<tr>
<th>SM6 SF1</th>
<th>SM6 CVM</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="SM6 SF1" /></td>
<td><img src="image2" alt="SM6 CVM" /></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modular switchgear with circuit breaker</th>
<th>Modular switchgear with contactor</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Main standards and certifications</th>
<th>IEC, EAC (GOST), Marine (BV)</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Motor voltage range</th>
<th>2.2…12 kV</th>
<th>2.2…12 kV</th>
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</thead>
</table>

<table>
<thead>
<tr>
<th>Motor power range</th>
<th>Up to 10,000 kW</th>
<th>100…2,300 kW</th>
</tr>
</thead>
</table>

### Application segments

- **MV secondary distribution substation**
- **Fixed, disconnectable, or withdrawable metal-enclosed switchgear, using sulphur hexafluoride (SF6) or vacuum technology:**
  - switch-disconnector
  - circuit breakers: SF1, SFset, Evolis
  - disconnector
  - Compartmentalization of MV parts (insulated partitions)

### Motor control type

- DOL

### Motor Management functions

- **MV secondary distribution substation**
- **Fixed metal-enclosed switchgear, using vacuum technology contactor**
- **Switch-disconnector function**
- Motor starter contactor: CVM
- Compartmentalization of MV parts (insulated partitions)

### Motor Management benefits

- Compact
- Standardized engineering
- Easy installation and maintenance
- Easy and safe to operate
- Easy extension
- Maintenance with power on (LSC2A), very simple

- Compact
- Standardized engineering
- Easy installation and maintenance
- Easy and safe to operate
- Easy extension
- Maintenance with power on (LSC2A), very simple
Motor asset management

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Portfolio management</td>
<td>44</td>
</tr>
<tr>
<td>Operation performance</td>
<td>44</td>
</tr>
<tr>
<td>Asset condition assessment</td>
<td>45</td>
</tr>
</tbody>
</table>
Motor asset management

<table>
<thead>
<tr>
<th>Portfolio mgmt</th>
<th>Operation performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintenance Response Center</td>
<td>PlantStruxure SCADA</td>
</tr>
</tbody>
</table>

Main standards and certifications

| N/A | IEC, CSA, UL, ATEX | IEC/EN, CE, CSA, EAC, GL | IEC/EN, CE, CSA, UL, FM | IEC/EN, CE, CSA, UL |

Application segments

| Maintenance response center | Remote monitoring and control (telemetry) | Distributed control system (DCS) for hybrid applications | Process automation system for medium to large scale process applications | Energy management & control system |

Main standards and certifications

| N/A | IEC, CSA, UL, ATEX | IEC/EN, CE, CSA, EAC, GL | IEC/EN, CE, CSA, UL, FM | IEC/EN, CE, CSA, UL |

Motor Management functions

- Condition monitoring
- Unified workspace to report health of all asset categories
- Clear and understandable asset alerts, with action recommendations
- Mobility and workflow capability

- Manages your remote operations and assets
- Integrates a comprehensive range of smart RTUs (Remote Telemetry Unit)
- Integrates Wonderware System Platform with PlantStruxure HMI
- For remote and geographically dispersed assets

- Based on PLC/HMI with DCS functionality
- Targeted for light processing industries
- Combines energy and process data in a single operational interface
- Ethernet-based architectures
- Single environment for engineering, operation, and maintenance

- Heavy processing industries
- Fault-tolerant
- Highly available components; no single point of failure
- Specific HMI for optimized operation
- Optimizes maintenance with real-time, contextualized alerts and analytics

- Operation and maintenance of high, medium, and low voltage electrical distribution installations
- Fault-tolerant
- Distributed automation
- Power management
- Load management

Motor Management benefits

- Maximize operational uptime
- Minimize operation and maintenance costs
- Maximize workforce productivity and safety

- Tightly manage the cost of ownership
- Secure and reliable SCADA system across a wide area network
- Operational efficiency from field to enterprise
- Complete integrated sensor-to-enterprise solution
- Minimized risk by improved safety and regulatory compliance

- Simplified engineering, operation, and maintenance activities
- Faster and better decision making
- Reduced energy consumption and increased process efficiency

- Reduce engineering workload
- Operate with improved response and productivity
- Maintain plant-wide assets proactively
- Manage to increase plant profitability and lowest cost of ownership

- Maximize uptime
- Increase people and asset safety
- Savings on CapEx and OpEx
Motor asset management

**Op. performance** | **Asset condition assessment**
---|---
Avantis PRISM | TeSys T | Sepam 40, Easergy Sepam 60 & 80 | MiCOM 10, 20, Easergy MICOM 40 | MCM - Avantis motor condition monitor

**Predictive analytics** | Motor management system | Protection relays for industrial applications (motor protection) | Comprehensive protection relays | Asset management device for medium criticality machines or remote machines

**Main standards and certifications**
N/A | IEC/EN, UL, CSA, DNV, ATEX | IEC, UL, IEEE | IEC, UL, IEEE | IEC

**Application segments**

**Motor Management functions**
- Predictive analytics based on build-up correlations between asset behaviour and continuous observation of environment changes
- Alerts triggered when the operation differs from the historical norm
- Advanced analysis capabilities including problem identification
- TeSys T is an intelligent motor management system
- Covers all load monitoring and protection needs, from feeders to critical process automation
- Multiple industrial protocols: Modbus, Profinet, CANopen, DeviceNet, Modbus/TCP, and EtherNet/IP
- Measurements: currents, voltages, frequency, power, temperatures, etc.
- Data logging
- Machine diagnosis: temperature rise, motor starting time, remaining operating time before overload tripping, waiting time after tripping, etc.
- Reports: motor start reports and motor start trends
- Network, switchgear, and self-diagnosis
- Measurements: current, voltage, frequency, power, etc.
- Event records are generated by status changes to logic inputs, outputs, settings, and alarms
- Readily available for viewing on the LCD display
- Fault records
- Disturbance records
- Oscillographic analysis using MiCOM S1 Studio software
- Monitor critical motors with basic metering plus 0.2% energy accuracy, modular digital and analog I/O, and voltage sag/swell detection
- Programmable including simple control functionality
- Designed for: compressors, conveyors, crushers, feedwater pumps, fans, HVAC, mills, mixers

**Motor Management benefits**
- Reduce unscheduled downtime
- Prevent equipment failures
- Reduce maintenance costs
- Increase asset utilization
- Extend equipment life
- Identify underperforming assets
- Advanced motor protection from basic to mission-critical applications
- Notice of potential issues through intuitive pre-fault alarming
- Maximum flexibility with expandable I/O and custom programmable logic
- Modularity, redundancy, and connection to accessories
- Communication via multiple protocols
- Adaptability to specific applications through logic equations editor

These relays not only improve monitoring conditions, but they also facilitate machine maintenance and save on wiring costs
- 2-4% energy savings
- 15-50% reduction in maintenance-related OpEx
- Up to 20% CapEx efficiency saving (reduced cost for same output)
- Reduction in performance penalties
- Process safety improvements, early failure detection
- Easy integration into existing LV switchboard
- Intuitive interface for non-specialists
## Motor asset management

### Asset condition assessment

<table>
<thead>
<tr>
<th>PowerLogic PM5000 series</th>
<th>PowerLogic PM8000 series</th>
<th>PowerLogic ION7650 series</th>
<th>Wireless vibration monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
</tbody>
</table>

Please contact your Schneider Electric Customer Care Center

<table>
<thead>
<tr>
<th>Basic power meter</th>
<th>Basic power meter</th>
<th>Advanced power quality meter</th>
<th>Wireless vibration monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Image]</td>
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### Main standards and certifications

<table>
<thead>
<tr>
<th>IEC/EN, cUL, CE, EAC, C-Tick</th>
<th>IEC/EN, cUL, CE, C-Tick</th>
<th>IEC/EN, cUL, CE, C-Tick</th>
<th>N/A</th>
</tr>
</thead>
</table>

### Application segments

- ![Image]  
- ![Image]  
- ![Image]  
- ![Image]  

### Motor Management functions

- **Basic power meter**
  - Monitor control panels with basic metering with 0.5% or 0.2% energy accuracy, plus power, amps, volts, harmonics, alarms, and fixed digital I/O
  - Serial and Ethernet communications to tie into SCADA with Modbus and Modbus/TCP

- **Advanced power quality meter**
  - Monitor critical motors with basic metering plus 0.2% energy accuracy, modular digital and analog I/O, and voltage sag/swell detection
  - Programmable including simple control functionality

- **Wireless vibration monitoring**
  - Monitor the most critical motors with advanced metering functionality plus advanced power quality monitoring and reporting including transient detection and flicker
  - Monitors the mechanical and electrical health of both motor and driven load
  - Wireless vibration and temperature sensor(s), data acquisition unit, software for analyses
  - Vibration signature analyses to determine root cause

### Motor Management benefits

- **Basic power meter**
  - Better understanding of operational costs driven by energy usage
  - Alarm to warn of voltage unbalance and harmonic issues

- **Advanced power quality meter**
  - Better understanding of operational costs driven by energy usage
  - Trending functionality to track usage and detect energy use changes that may indicate maintenance issues
  - Capture voltage sags that can cause contactor dropout (ITI-CBEMA plots)
  - NEMA motor voltage unbalance derating curve
  - Determine if voltage problems originate from the utility or within the facility

- **Wireless vibration monitoring**
  - Better understanding of operational costs driven by energy usage
  - Trending functionality to track usage and detect energy use changes that may indicate maintenance issues
  - Capture voltage sags that can cause contactor dropout (ITI-CBEMA plots)
  - Use high-speed meter inputs from drive trip signals to record voltage sags causing drive trips
  - Determine if voltage problems originate from the utility or within the facility
  - Detect transients that cause printed circuit board failures in drives and PLCs

- **Maximize operational uptime**
- **Minimize operation and maintenance costs**
- **Maximize workforce productivity and safety**
Motor Management glossary
Motor Management glossary

This glossary explains all the technical terms and acronyms used in this high power Motor Management offer selection panorama.

2-speed motors

Asynchronous motors can be built for 2 different speeds. This can be by means of a Dahlander arrangement, with a common point in the winding, where the ratio between the 2 speeds is always 2. Another method is to use 2 independent windings per phase allowing any speed. In both cases one speed or the other is selected by changing the wiring of the windings. This will change the number of pole pairs.

4 quadrants (4Q)

In motor control solutions using variable speed drives, 4 quadrant refers to the capability of the drive to reverse the power flow, for example, for cranes, or downhill conveyors, where the load will temporarily transform the motor into a generator.

Advanced control

A means of control where there is a possibility of gradual starting/stopping and/or control of the speed.

Asset condition assessment

The assessment consists in providing condition status, alarm, and diagnostic information for a particular asset, motor, generator, transformer, etc.

Autotransformer

In a motor management context, an autotransformer is a power component used to transform the voltage applied to its primary side into a lower voltage, with a common connection between the primary and the secondary. It does not provide any galvanic isolation between the primary and secondary.

Autotransformer starters

This type of motor starter uses an autotransformer in order to start a motor in 3 steps:

- The motor power is supplied through the autotransformer under a reduced voltage compared to that of the network. The starting current and torque, as well as mechanical stress, are greatly reduced compared to a DOL start.
- After a predefined time, the start point of the autotransformer is opened, changing it into a series inductance, supplying the motor with a voltage value between the autotransformer and the network voltage. This step provides a higher current and torque allowing the motor to continue to accelerate.
- Finally, the motor is connected directly to the line for the end of the start and continuous operation.

Capacitor banks

Power factor correction is important for the correct sizing of electrical network components (transformer, cables, etc.) and to avoid penalties on the energy bill. This correction is often achieved by connecting capacitors as a source of reactive energy. When the necessary reactive power is high and the network load is varying, it is necessary to arrange the capacitors in several banks that will be connected sequentially to provide only the required amount of compensation (automatic compensation).

Capital expenditure (CapEx)/Operational expenditure (OpEx)

- Capital expenditure encompasses all the expenses linked to the installation of an asset.
- Operational expenditure covers all the expenses linked to the operation of an asset. It represents 90% of the total cost of a motor.

Control systems

Device or set of devices, including software programs, used for controlling the industrial process or machines.
Cooling types (ONAN, ONAF, OFAF, OFWF, ODWF, ODAF, AN, AF)

Mainly used for transformers, this acronym indicates the type of cooling system used. 2 letters are used to represent a single cooling method and 4 letters are used if 2 methods exist, indicating either inside or outside the tank for oil-immersed transformers or normal or boosted modes for dry-type transformers.
- The first letter indicates the nature of the fluid:
  - O = oil,
  - A = air,
  - W = water.
- The second letter indicates the type of circulation:
  - N = natural convection,
  - F = forced circulation,
  - D = directed circulation.

Distributed control system (DCS)

System (hardware and software) used to control the process in continuous and hybrid process industries.

Direct-on-line (DOL)

The starting method is called direct-on-line when a motor is started by connecting it directly to the electrical network line through a contactor or circuit breaker without any other equipment in series with the stator or the rotor. This is one of the least expensive starting methods but it needs a large amount of energy from the electrical network and imposes a mechanical and electrical stress on the motor.

Energy management and control system (EMCS)

Energy management and control systems are used for controlling energy-consuming devices in order to minimize energy demand and consumption.

Fast device replacement (FDR)

The capability to replace a configured device with a new one while keeping time and effort at a minimum in order to optimize system availability. The new device boots, is configured with the same parameters as the original device, then switches to operating mode.

Harmonics/5th harmonic

- Harmonics represent the pollution, or distortion in the form of the voltage and the current in industrial electrical systems. Harmonics are signals at frequencies multiple to the fundamental 50 or 60 Hz in industrial systems.
- The 5th harmonic is produced from the rectifier part of a 6-pulse variable speed drive. It is the highest harmonic in magnitude.

Harmonic mitigation

Solution for reducing the harmonic content in the electrical system (typically a filtering solution).

Harmonic voltage factor

The harmonic voltage factor measures the pollution of the voltage in the presence of harmonics (5th and above). It is used for determining the derating of the motor. The HVF is typically below 2%, but for some motors it can be up to 3%.

Human machine interface (HMI)

Usually comprises a keypad and a (touch) display.

Insulated gate bipolar transistor (IGBT)

Power electronic component used in the input and output stages of variable speed drives.

LSC1/LSC2A/LSC2B(-PI/-PM)

Introduced in 2003 by the standard IEC 62271-200, this defines the loss of service continuity level of a switchboard when opening compartments (other than busbar, in single busbar designs) as follows:
- LSC1: Other functional units or some of them shall be disconnected
- LSC2A: All other functional units can be energized
- LSC2B: All other functional units and all cable compartments can be energized:
  - PI (Isolated Partition): with one or more non-metallic partitions and/or shutters
  - PM (Metallic Partition): with metallic partitions and/or shutters that are intended to be grounded
**MDT relay**

Temperature electronic module used for thermal diagnosis in MV switchboards by permanently monitoring the connection temperatures and reducing maintenance costs.

**Motor Control Center (MCC)/Intelligent Power & Motor Control Center (iPMCC)**

A system integrating intelligent motor protection relays (iMCC) and intelligent circuit breakers (iPCC) in a functional installation system (i.e. switchboard, panel, etc.) providing connectivity to a DCS and/or SCADA through an industrial communications network.

**Off-circuit tap changer (Off-load tap changer)**

The tap changer is used to modify the transformer ratio in a limited range, such as to adapt to the variation in the magnitude of the supply voltage. This adaptation is made with the transformer unloaded.

**On-load tap changer (OLTC)**

A tap changer with the possibility to make the adaptation with the transformer loaded.

**Power factor correction (PFC)**

The source (generator, transformer, etc.) is designed for a rated apparent power that is the sum of the active and reactive power. The power factor is the ratio of active power over apparent power. Power factor correction consists in limiting the reactive power the source has to deliver. The reactive power is provided by another source: capacitor banks.

**Programmable logic controller (PLC)**

A device used in automation systems for controlling the industrial process or machines.

**Process control**

A device or set of devices controlling the industrial process or machines.

**Protection relays**

A protection relay continuously measures the electrical parameters of the equipment it protects, either directly, in low voltage, or through signal conditioners (current transformers and voltage transformers), in medium voltage. When a parameter passes a threshold set by the user, the relay issues an alarm or a trip signal. A trip signal is used to open the circuit breaker connecting the equipment to the network.

Modern digital relays also offer metering of acquired and calculated signals, diagnosis of network and equipment, communication, and control-command possibilities.

**Reverse speed**

The rotation of the rotor in the opposite direction.

**Root mean square (RMS)**

This is the constant characteristic of alternating current or voltage used for calculating the power dissipation in a load.

**Supervisory control and data acquisition (SCADA)**

Generic name for monitoring and control systems – used for energy or process control of customer installations.

**Slip-ring motors/Winding motors**

Motors with a wound rotor that can be connected to an auxiliary power supply, or to starting resistances in order to reduce the current on starting and increase the torque.

**Soft starter (SS)/Reduced voltage soft starter (RVSS)**

Power electronics based solution used for smoothing the motor start by controlling the current supplied to the motor, without modifying its frequency, in contrast to a variable speed drive.

For low voltage applications, the usual term is soft starter (SS), whereas reduced voltage soft starter is used for medium voltage applications.

**Soft stop**

Smooth stopping of the motor, typically for soft-starter device, by linearly reducing the supplied current. Reduces the mechanical stress on the load, very useful in pump applications.

**Star-delta**

Starting method used to reduce the startup current. Needs a motor with a delta arrangement designed for the voltage network. It is first connected to the line with a wye arrangement, being equivalent to a higher voltage motor supplied by a lower voltage. After a delay, the arrangement is changed to delta to finish the acceleration and for normal operation.

Mainly used for low to medium power LV motors.
Switchboard and motor starters
A switchboard is the point at which an incoming power supply divides into separate circuits, each of which is controlled and protected by the fuses or switchgear of the switchboard. Motor starters are integrated in switchboard.

Synchronous/Asynchronous machine
In a rotating machine, there is one static part, typically called the stator, and another rotating part, called the rotor.
- In synchronous machines, the rotation speed is equal to the speed of the magnetic flux in the stator (i.e. they are synchronized) and to achieve this the rotor is also supplied with energy through a dedicated system.
- In asynchronous machines, the rotor is not supplied with power; it rotates at a speed close to but not equal to the speed of the magnetic flux, and the difference in the speeds is used to provide the energy necessary to make the rotor spin.

Total harmonic distortion (THD/THDi)
- THD refers to the ratio of the square root of the sum of the square of the powers of all harmonic components to the power of the fundamental voltage.
- THDi is the same ratio applied to the current.

Tested, validated, and documented architecture (TVDA)
TVDAs are generic solutions supplying comprehensive system documentation, wiring diagrams, HMI application, and project templates that reduce the time required for design, installation, and commissioning.

Torque control system (TCS)
A patented principle for controlling motors using an LV soft starter, integrated in the ATS48 offer.

Transformers
In a motor management context, a transformer is a power component used to transform the voltage applied to its primary side into another voltage, providing a galvanic isolation between them. It can be either step-down, where the secondary voltage is lower than the primary, or step-up, where the opposite is true.

Tripping context
When a digital protection relay issues a trip command it can record several parameters, other than the one at the origin of the trip. These parameters, like currents, voltages, powers, and frequency, are saved together in a record. This record is called a tripping context record.

Variable speed drive (VSD)/Variable frequency drive (VFD)
- VSDs are electronic power systems used to adapt the speed of an electric motor.
- VFDs are dedicated to AC induction and synchronous motors where the speed is modified through the change of the applied frequency.