Product Offering for Wound-Rotor Induction Motors

500kW up to 20MW

RotorProtek® control and protection
FlexStarter® Liquid Resistance Starters (LRS)
HyperDrive® and RecoveryDrive® Slip Energy Recovery drives (SER drives)
Medium voltage capacitor banks and harmonics filters

ELECTRODRIVES

Electrodrives

Born from International Electronics S.A. (IES) in 2009, Electrodrives quickly became a key name in developing excitation systems for hydropower plants. By 2018, we proudly merged with IES, enhancing our capabilities and strengthening our expertise in large motor applications.

Our main manufacturing facility is located in Getafe, Madrid, Spain, ensuring we deliver high-quality drives and starters for slip-ring motors. As global leaders in wound-rotor induction motor equipment, we offer a wide range that ensures smooth start-ups and adjustable speed operations. We prioritize your peace of mind by providing immediate technical remote support. Our expert engineers connect directly with you, helping navigate challenges and ensuring your operations run smoothly.

INTERNATIONAL ELECTRONICS

IES is a trademark of Electro Drives S.L.

Mining

In the challenging environment of copper, gold, platinum, nickel, and iron ore concentration plants, slip ring motors play a crucial role due to their ability to start with high motoring torque. This prominent torque is indispensable for powering large-scale machines such as mills, crushers, HPGR (High Pressure Grinding Rolls), and conveyors, all of which are essential to mining operations.

With a rich history of serving this sector, Electrodrives has become the preferred solution for powering grinding mill applications, including SAG mills, ball mills, and vertical mills, using our Slip Energy Recovery drives and Liquid Resistance Starters.

Cement

In the cement industry, slip ring motors are not just equipment; they are the backbone, driving critical applications such as kiln mills, fans, crushers, conveyors, and other heavy-duty machinery, ensuring operational continuity in a challenging environment. Particularly for kiln mills and fans, which are key in maintaining the material processing flow, the strength and reliability of our slip ring motors and Slip Energy Recovery drives have proven invaluable.

Electrodrives stands for cost savings, long-term benefits, and unparalleled support for the lifespan of your equipment, often extending beyond four decades. With an unwavering commitment to sustaining your operations, we don't just power machinery; we empower longevity, stability, and prosperity in your cement manufacturing endeavors.

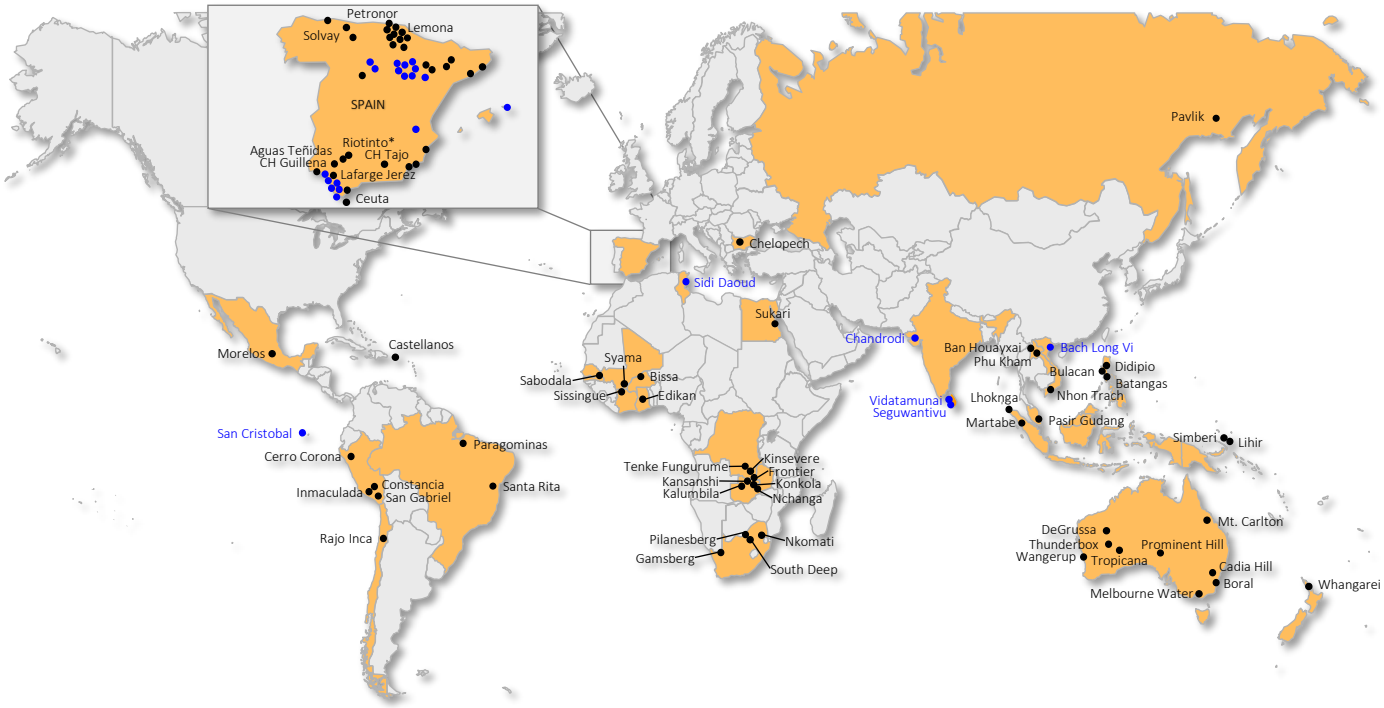
Steelworks, Shredders, Water treatment...

Slip ring motors from Electrodrives are essential not just for mining and cement applications, but they also support a wide range of industries with their outstanding starting torque and flexibility. These motors are especially valued in shredders that require robust torque and quick control. Furthermore, they serve a broad spectrum of sectors, such as the pulp and paper, water treatment, and maritime industries. Particularly in equipment like pumps, compressors and blowers, our Slip Energy Recovery drives ensure maximum energy efficiency and cost savings.

Technical Support

Based in Madrid, a strategic hub with immediate international access, we guarantee our global customers our ability to reach nearly any location worldwide within 24-hours of setting out. Our commitment goes beyond simply supplying products; we provide various levels of support designed to cater to the specific needs of your operations. Many of these support levels come at no extra cost to our clients, underscoring our commitment to support your activities with both advanced technology and consistent, adaptable assistance whenever and wherever required. Choose Electrodrives, where our expert assistance is always within your reach, ensuring your operations are perpetually powered and uninterrupted.

Remote support available channels include:



ELECTRODRIVES

RotorProtek®, Protection and Control for Slip-Ring Motors

The Ultimate Motor Control

RotorProtek® can calculate the motor speed and torque from measurements of instantaneous rotor currents, unlocking a wide range of possibilities. Motor starts no longer depend on load, electrolyte temperature, or grid conditions. Initiate your motor with the preferred smooth ramp. Prevent torque pulsations caused by variable conditions. Prevent damage to your slip ring chamber or drivetrain by utilizing condition monitoring from the recorded data. RotorProtek® is designed to protect and extend the lifespan of your motor and drivetrain, helping you avoid costly repairs to motors and gearboxes.

Main Features

Transducer. Measures motor speed, rotor RMS current and motor torque without the need for external sensor.

Motor rotor protection. Features advanced motor protection relay with alarms and trip thresholds to prevent damage to slip rings and the drivetrain.

Starts and events logger and analysis. Every start is recorded, and a smart analysis is provided to determine that the system is operating in optimal conditions.

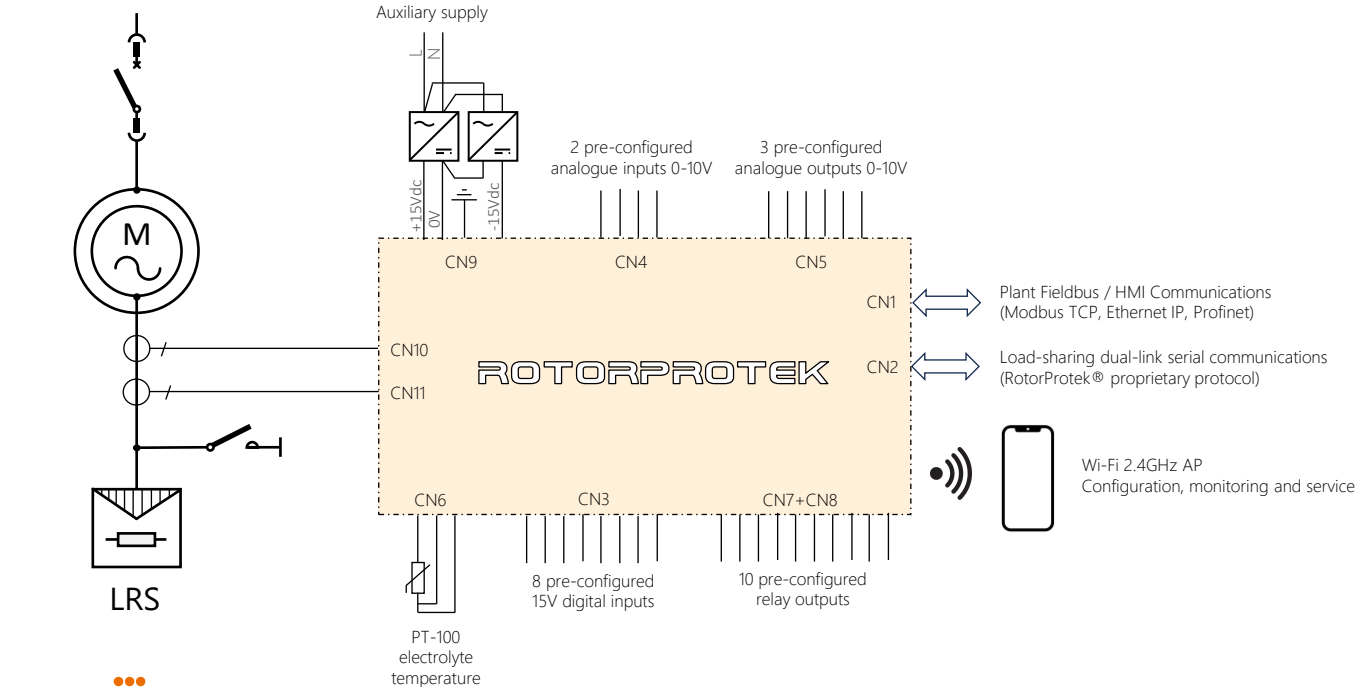
Conditioning monitoring. Proactively identifies potential failures through smart analysis of the motor's performance over time.

Closed-loop speed/torque control. Gain complete control over your motor's speed and torque, tailoring the starting profile to your process requirements.

LRS full protection package. Seamlessly integrate RotorProtek® into the LRS, eliminating the need for external PLCs or alternate controllers.

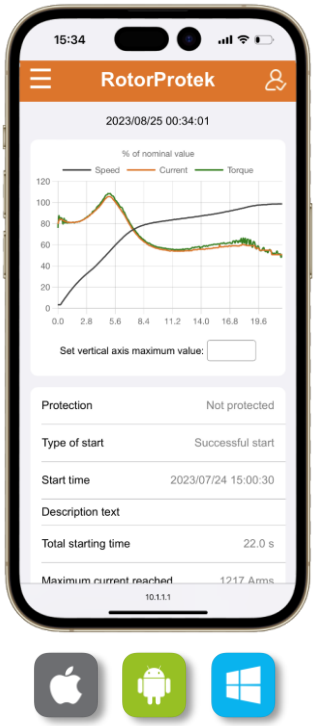
Grinding mill protection. Offers blocked-charge protection, protection against dual pinion imbalances, and controlled rollback capabilities.

Interface and connection



Communications

RotorProtek® offers a convenient communication method, enabling users to configure, monitor, or service equipment using just a mobile phone, tablet, or computer. No additional software or apps are necessary; simply connect to the device through your preferred web browser to access all features effortlessly. It's possible to connect even with the panels closed, from a distance of up to 20 meters from the equipment.



Upgrade LRS

RotorProtek® is now available in the new FlexStarter® Liquid Resistance Starters (LRS) produced by Electrodrives. Additionally, it can be procured as an upgrade package for existing LRS units from various manufacturers.

The essential upgrade package includes one RotorProtek unit, two power supplies, two hall-effect CTs, and the associated wiring.

Specifications

RotorProtek®	Go	Easy	Smart	Pro
Max. motor power	2000 kW	5000 kW	7000 kW	2x20000 kW
Max. motor rotor current	1000 A	1400 A	2000 A	4000 A
Rotor current measurements	1-phase	2-phases		
Features				
Transducer: Motor speed	■	■	■	■
Rotor RMS current	■	■	■	■
Motoring torque		■	■	■
Motor rotor protection	■	■	■	■
Starts and events logger/analysis	■	■	■	■
Conditioning monitoring		■	■	■
Closed-loop speed/torque control	■		■	■
LRS full protection package	■		■	■
Grinding mill protection*				■
Interface				
Supply voltage	$+/-24V_{dc}$ or $+/-15V_{dc}$			
Current sensor type	Open-loop or closed-loop hall-effect			
Digital signals	8-inputs, 10-relay outputs			
Analogue signals	(2) 0-10V inputs, (3) 0-10V outputs, (1) PT-100			
Local configuration and service	Wi-Fi AP 2.4GHz compatible iOS, Android, Windows			
Field communications	Modbus (standard), Ethernet IP or ProfiNet			
Other communications	-			Dual link
Environmental conditions				
Ambient temperature	-20ºC to +60ºC, no frost			
Relative humidity	5% to 95% non condensing			
Enclosure and dimensions	Stainless steel AISI-304, 246 x 150 x 41 mm			
Electromagnetic compability	Directive 2014/30/EU			

*Includes blocked-charge protection and pinions unbalance

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FlexStarter®, 2nd generation of Liquid Resistance Starters (LRS)

The new standard for slip ring motors

Traditional starters of slip ring motors relied on basic controls with limited features and protection.

On the other hand, squirrel cage motors have increasingly incorporated variable speed drives (VFDs) and softstarters with advanced control and protection.

FlexStarter® bridges this gap, offering superior control and protection for Wound-Rotor Induction Motors (WRIMs). By pairing the exceptional performance of slip ring motors with cutting-edge control and protection, it ensures complete command over the industrial process.

Main benefits over 1st generation LRS

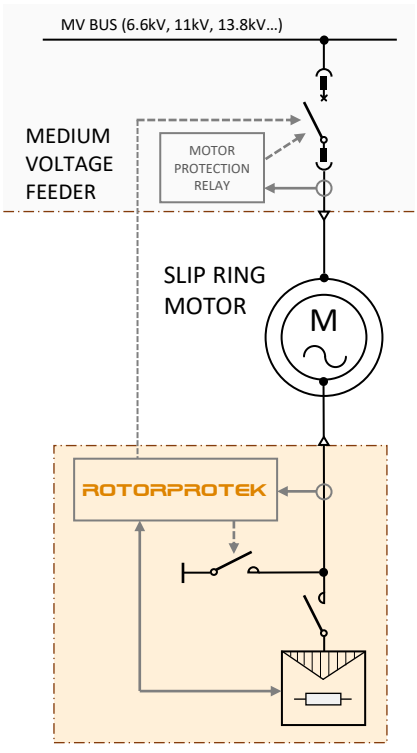
Control over speed and torque. FlexStarter® incorporates RotorProtek®, giving full control over motor speed and torque during start-up, regardless of factors like load, temperature, grid conditions, etc.

Protect your motor and drive train. Protective functionalities and conditioning monitoring safeguard against damage to slip rings, rotor windings, and other mechanical components.

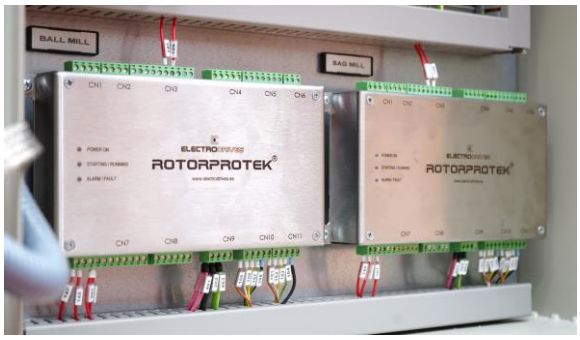
Application-specific features. Add-ons like blocked-charge protection and dual pinion torque sharing can be integrated into your starter setup.

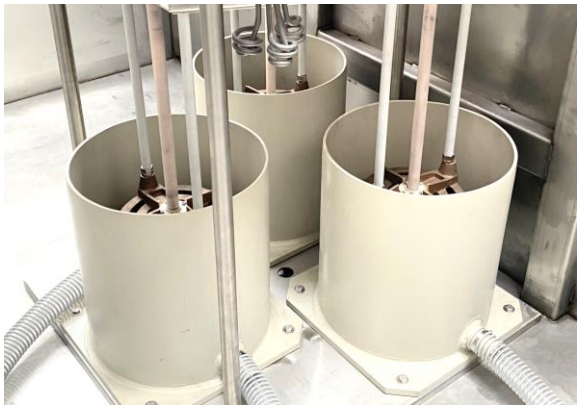
Robust design . Strong electrodes construction with delta arrangement for minimum phase unbalance and mechanical stress.

Interface (FlexStarter® LRS)



FlexStarter® LRS

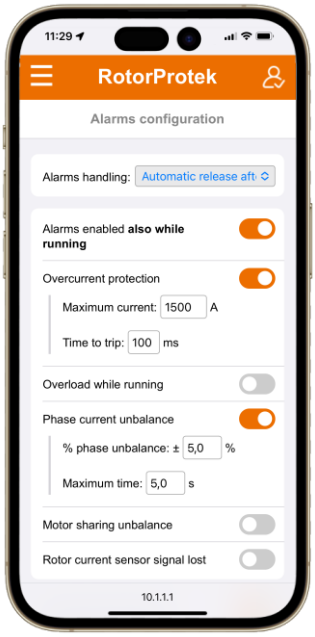




Easy and flexible

Starting a motor is simpler than ever with FlexStarter®. Set up, monitor, service and configure it using just your mobile device, without needing any additional software or cables.

In maintenance mode, you can simulate a start, test every component and ensure that everything works correctly. Review the performance of each start and compare it to decide the best starting profile.



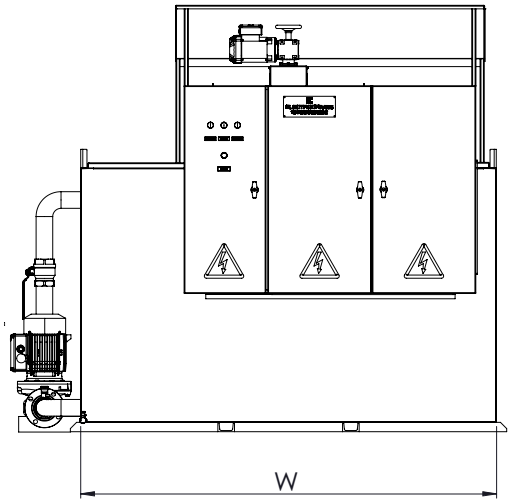
Special features

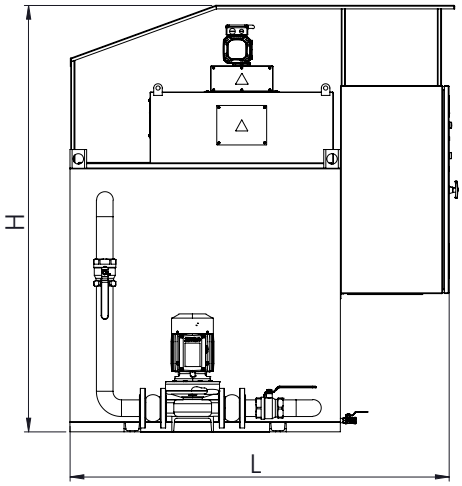
Different applications have specific needs. FlexStarter® offers tailored hardware and control features based on the application.

Some specific-application features includes:

- Starting of SAG and ball mills
- Shredders (metal-recycling, sugar cane…)
- Cement mills and fans

Dimensions





Specifications

FlexStarter® Type	Flex 10	Flex 15	Flex 25	Flex 45	Flex 60
Tank capacity	1000 liters	2000 liters	2500 liters	4500 liters	6000 liters
Motor power (f=0.7…2 × I_n)	500…2400 kW	1000…3500 kW	1900…5800 kW	3200…9500 kW	4500…13000 kW
Max. rotor current	900 A	1000 A	2000 A	2100 A	2500 A
Max. rotor voltage	2500 V	3000 V	3500 V	4200 V	4200 V
Max. energy (@ 40ºC)	190 MJ	285 MJ	470 MJ	850 MJ	1130 MJ
Electrode material	Stainless steel		Stainless steel (optional bronze alloy in Flex+)		
Turndown ratio	80:1		80:1 (optional 120:1 in Flex+)		
Footprint (L x W)	1.25 x 0.98 m	1.65 x 1.40 m	2.10 x 1.70 m	2.85 x 2.00 m	3.70 x 2.25 m
Enclosures	3 cubicles: tank, HV panel & LV panel IP55 carbon steel (standard) or stainless steel				
Electrodes arrangement	Delta arrangement, spindle with variable speed (VFD), vertical movement				
Shorting contactor	2-pole air contactor		3-pole bar contactor		
Protection & control	RotorProtek® (standard) and/or LS Electric PLC				
Communications	Wi-Fi AP 2.4GHz (configuration/service) + Ethernet IP, ProfiNet or Modbus (standard)				
Electrolyte cooling	Natural (standard), agitator		Agitator (standard), cooling pump, heat-exchanger		
Options and accesories	Sunroof, SER drive interface (variable speed), HMI, blocked charge protection,…				

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Achieving ultimate efficiency

Wound Rotor Induction Motor (WRIM) are exceptionally prepared to operate at variable speed, with the use of SER drive. Electrodrives provides two types of variable speed drives:

a) **HyperDrive®** for constant load applications (i.e. mills, crushers, conveyors,...)

b) **RecoveryDrive®** for quadratic load applications (i.e. fans, pumps,...)

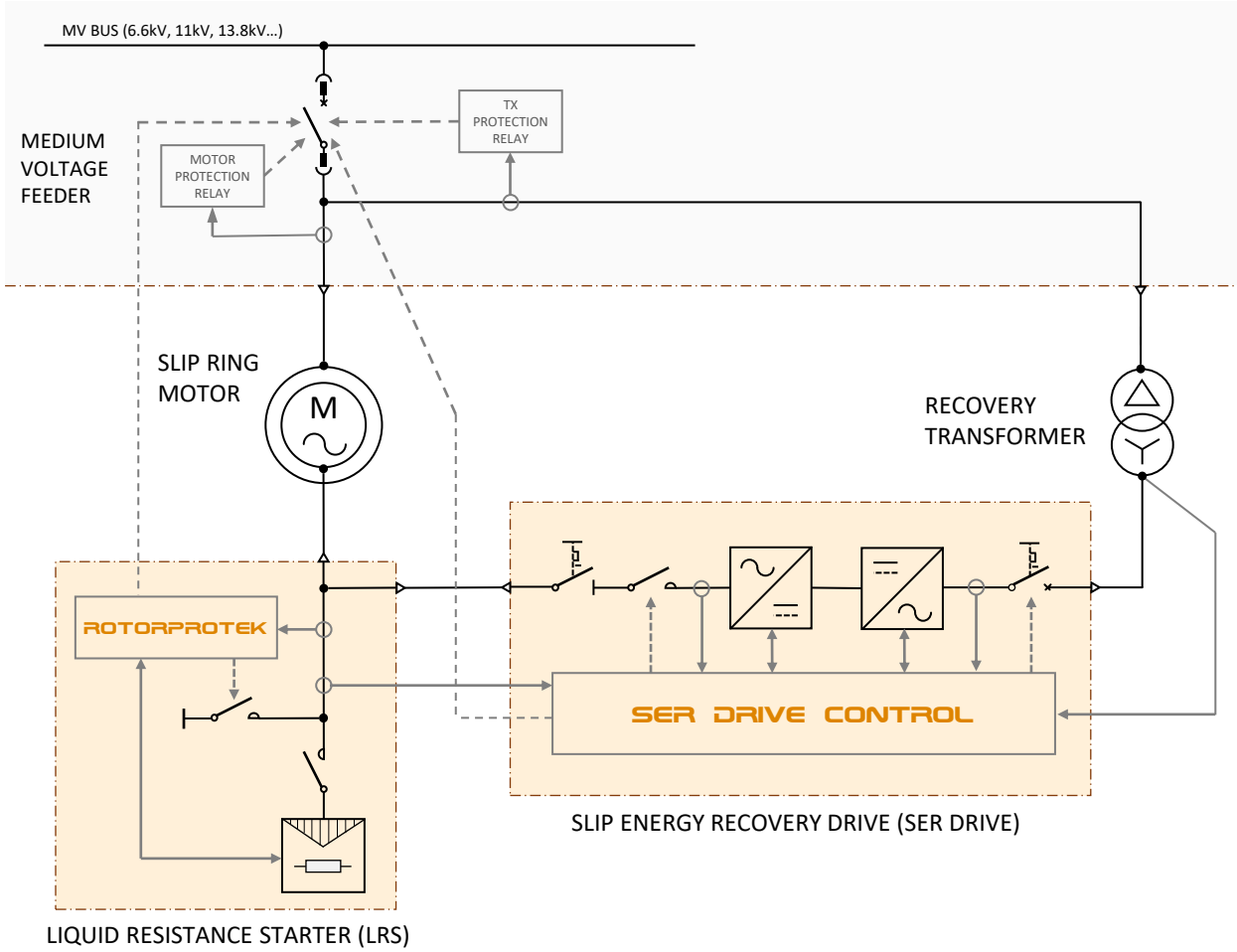
Key advantages over conventional VFDs

Maximum efficiency. The SER drive is the most efficient technology among all variable speed drives topologies due to its ability to recover the slip energy back to the grid handling only a fraction of the motor's energy.

Redundancy. Seamless bidirectional transfer between FlexStarter® and SER drive ensures continuous motor operation in any situation, preventing any unplanned shutdown.

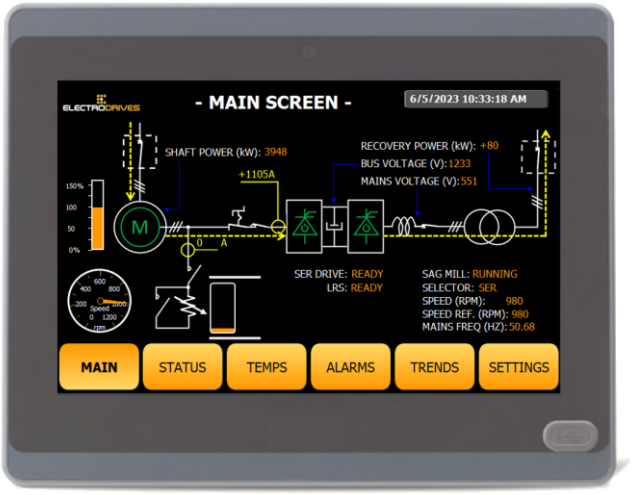
Hypersynchronous speed. HyperDrive® can exceed the motor's rated speed without torque reduction, increasing the power beyond their conventional limits.

Interface and connection (HyperDrive®)



Energy Recovery

The SER drive topology is widely used in renewable energy generation, particularly in wind turbines (also known as DFIG, or Doubly-Fed Induction Generation), because of its outstanding efficiency and compact footprint. This drive's capability to return excess energy, which is fed into the stator circuit via the rotor terminals, to the grid establishes it as the most efficient variable-speed setup for large motors. Consequently, it plays a pivotal role in reducing the carbon emissions of plants and in cutting down energy costs.



Upgrade VSD

The SER drive is also available as a containerized solution, complete with an e-room equipped with a cooling system tailored to the installation climate. This design streamlines the installation and commissioning process, enabling an upgrade from fixed speed to variable speed in just two days of downtime. The options available are:

- 20-feet HC container for HyperDrive® Ion and RecoveryDrive® Eco
- 40-feet HC container for HyperDrive® Max, Dual and Dual Max.

Specifications

	HyperDrive®				RecoveryDrive®
Type	Ion	Max	Dual	Dual Max	Eco
Motor nominal power	500....8000 kW	6000...10000 kW	... 2 x 8000 kW	...2 x 10000 kW	500...7000 kW
Max. rotor current	1250 A	2100 A	2 x 1250 A	2 x 2100 A	2000 A
Max. rotor voltage	4200 V				3000 V
Rotor configuration	AFE	AFE (x2)	AFE	AFE (x2)	6-pulse DFE
Recovery configuration	AFE	AFE	AFE	AFE	6-pulse SCR
Applications	SAG mills, ball mills, crushers, conveyors... (constant torque vs speed)				Fans, pumps,...
Starting method	Requires a separate LRS				Capable
Operating speed range	Typically up to 70%-120% of synchronous speed				0%-100%
Efficiency at full speed	99.3%	99.1%	99.3%	99.1%	99.5%
Power factor	0.99	0.99	0.99	0.99	0.87
Ambient temperature	0°C to 55°C with derating, 0°C to 40°C at maximum ratings				
Altitude above sea level	0 to 2000 m (standard) , up to 5000 m (high altitude version)				
Cooling method	Air-cooled				
Footprint (L x W)	4.65 x 1.20 m	7.25 x 1.30 m	9.30 x 1.20 m	1.45 x 1.30 m	3.90 x 1.00 m
Redundancy	Bi-directional bumpless transfer to LRS (manual/automatic)				Optional
Human Interface	Color touch screen HMI 7" (800 x 640)				
Communications	Ethernet IP, EtherCat, ProfiNet, Profibus-DP, DeviceNet, Modbus				
Recovery transformer	Outdoor ONAN (standard) / indoor dry cast-resin (optional)				

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Energy Management

Within the energy management division, Electrodrives manufacture the following types of equipment:

- Fixed MV capacitor banks
- Multi-stage automatic MV capacitor banks
- Static VAR Compensation (SVC)
- MV harmonics filters
- LV harmonics filters

Equipment can be offered for metal-enclosed or open rack configurations.

Power Quality Analysis

Electrodrives conducts thorough power quality measurements and assessments utilizing power quality analyzers that meet the stringent IEC 61000-4-30 class A requirements.

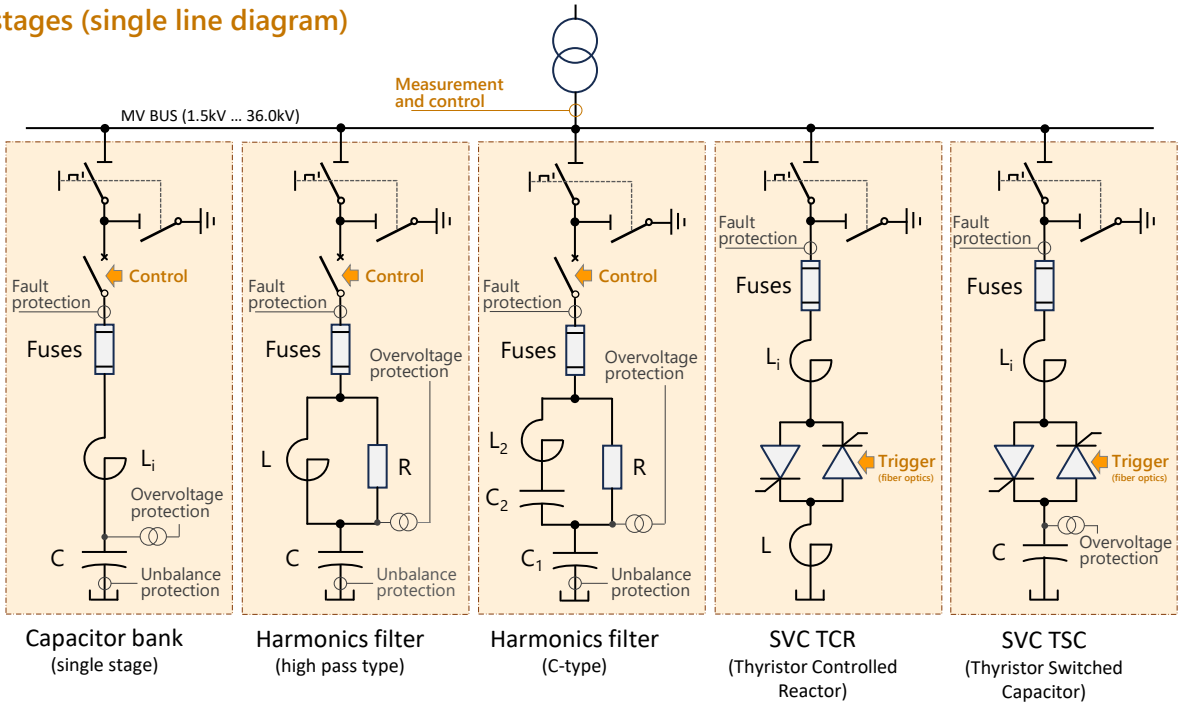
Analyses are based on various standards, such as IEC 61000-2-2, EN 50160, IEEE 519, and GOST 33073.

Key features of the measurement equipment includes up to 24 bits resolution and 1.000.000 samples/second (20.000 samples per 50Hz period).

The parameters assessed include:

- Harmonics currents and voltages up to 50th
- THD of current and voltage according IEC 61000-4-7
- Interharmonics of current and voltage
- Superharmonics in ranges from 2kHz up to 9kHz
- Phasers, power factor, transients, flickering, unbalances, load changes
- Voltage and current waveform during transients
- Variability of the above parameters along time

Types of stages (single line diagram)



Capacitor bank (single stage)

Harmonics filter (high pass type)

Harmonics filter (C-type)

SVC TCR (Thyristor Controlled Reactor)

SVC TSC (Thyristor Switched Capacitor)

Full scope

Electrodrives can provide various solutions for managing energy in your installation, including:

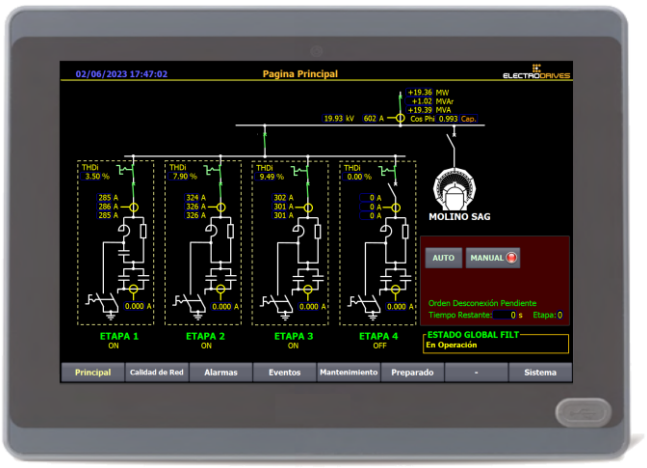
- System studies and simulations
- Power quality measurements and analysis
- Consulting and filtering design
- Design of civil works for open rack solutions
- Supply of capacitor banks and filters
- Installation and assembly at site
- Commissioning and verification

Control and protection

Electrodrives offers an advanced control system with flexible algorithms allowing you to prioritize different aspects of power quality in your plant.

You can choose to set up a particular power factor, or to optimize harmonics (THD) or fully control energy demand from your plant.

Additionally, this system can be combined with various strategies involving other equipment, such as battery energy storage (BES) systems, STATCOMs, photovoltaic solar plants, or other power generation sources.



Specifications

	Capacitor bank and harmonics filter					
	Metal-enclosed			Open rack		
Rated voltage	1.5...6.6 kW	6.7...13.8 kV	14...24 kV	6.0...13.8 kV	14...24 kV	24...36 kV
Nominal power rating	1...10 MVAr	2...20 MVAr	4...30 MVAr	2...50 MVAr	4...100 MVAr	5...200 MVAr
Basic insulation level (BIL)	75 kV	110 kV	150 kV	95 kV	125 kV	150 kV
Bank configuration	Fixed, switched single, multi-step, or SVC (static VAR compensation)					
System connection	Grounded Wye, floating Wye, delta, double Wye					
Short circuilt level	12 kA ... 63 kA for 1 s.					
Protection	Outdoor (IP54) or Indoor (IP43)			Outdoor		
Enclosure / structure	Painted steel or stainless steel (option)			Hot dipped galvanized steel		
Ambient temperature	-15°C to 45°C			-40°C to 50°C		
Filter types	De-tuned, single tune, multi-tune, high-pass, C-type					
Capacitors						
Type	Single capacitor or 3-phase capacitors with built-in discharge resistor					
Fusing	Externally fused, fuseless, internally fused (self-healing)					
Dielectric	Metalized polypropylene film					
Container	Stainless steel					
Reactors						
Inrush type	Single phase air-core					
Detuning/filter type	1-phase or 3-phase air-core or iron-core			1-phase air-core		
Contactors and switches	3-phase vacuum contactor up to 400A					
Isolator + ground switch	Air-insulated 3-phase					
Power factor control	Configurable digital controller or fully flexible algorithm with PLC and HMI					
Protection	Over-voltage, under-voltage, over-current, unbalance, overtemperature					

ELECTRODRIVES

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