



ABB drives in metals
Medium voltage drives for improved
product quality and process control



ABB – one of the world’s leading suppliers of variable speed drives for the metals industry

ABB’s extensive experience and history of innovation helps metals and foundry customers worldwide to minimize down-time, enhance production safety, improve energy efficiency and increase productivity.

Harnessing know-how to your advantage

For over 100 years ABB has provided drive products and systems to its customers in different industries. ABB’s unmatched experience in AC drive technology, combined with its long experience in the metals industry, results in innovative drive solutions with superior performance and reliability.

ABB’s reliable drive products and systems operate and integrate seamlessly into the customer’s automation world to maximize total plant performance.

ABB drives for metals applications

ABB supplies drive products and systems for various kinds of applications in the metals industry:

- Profile rolling mills
- Hot flat rolling mills
- Tube rolling mills
- Cold rolling mills
- Blast furnace blowers
- Fans
- Pumps

Controlling processes with variable speed drives results in:

- Optimized production quality and output
- Optimized production output
- Increased process reliability
- Lower energy consumption
- Reduced CO₂ emissions
- Minimal wear and tear of equipment



Variable speed drives for rolling mills

Rolling mills demand high precision and high overload capability. The mill is subjected to rapid change in load speeds, forcing equally quick generating and braking actions. This demands a constant torque in a wide speed range and large torque steps.

ABB medium voltage drives are the perfect answer for the requirements of the metals industry. By accurately controlling the rolling mill process with ABB drives, customers in the metals industry are able to optimize production, minimize wear, enhance reliability and ensure the quality of the end product. ABB has a dedicated team specialized in providing optimized drive systems for demanding rolling mill applications.

A rolling mill drive system includes:

- Medium voltage converters
- Motors
- Transformers
- Services such as training, commissioning and spare parts

Cold rolling and non-ferrous mills

High dimension accuracy, better surface quality and better strip strength are achieved with ABB's medium voltage drives for all rolling mills, including:

- Foil mills
- Skin-pass mills
- Two-stand mills
- Tandem mills (TCM)
- Break-down mills
- Reversing cold mills (RCM, Z-mill)
- Two-stand reversing mills (eg CCM)

Hot rolling mills

ABB's innovative and highly dynamic drive solutions have contributed to production process improvements, high uptime and optimized product quality in the following mills:

- Rod and bar mills
- Wire rod mills
- Section mills
- Tube mills
- Conventional hot strip mills
- Compact mills based on thin slab in line production
- Steckel mills
- Plate mills
- Blooming mills



Benefits of ABB drives for rolling mills

The investment in highly efficient and reliable variable speed drives improves product quality and process control while reducing energy costs.

Powerful performance

Fast and accurate control of torque and speed under all operating conditions is an important pre-requisite within a rolling mill for the successful control of material profile, thickness, flatness and tension.

ABB's motor control platform, Direct Torque Control (DTC), results in the highest torque and speed performance ever achieved in medium voltage drives. Control of the drive is immediate and smooth under all conditions.

Power factor correction

The influence of the industrial production on the power supply system is often underestimated. Difficult conditions exist in metal processes where big load changes and large speed-controlled drives can cause voltage deviations and harmonics. Optimized drive selections can minimize the disturbances as well as compensate the need for reactive power.

Regenerative braking

For applications with high braking energy, such as reversing rolling mills, ABB provides variable speed drive solutions for an optimized energy flow. Braking energy is fed back to the line supply which reduces the overall energy consumption.

Benefits to rolling mills

- Fast and precise torque and speed control under all conditions through DTC
- Several motors can be connected to one multidrive
- Regenerative braking capabilities
- Minimized system energy consumption
- Control compatibility with other ABB drives
- Easy interfacing with upper level automation systems
- Optimal power factor throughout the speed range
- Minimized harmonic content with optimized pulse pattern

Multi-motor operation

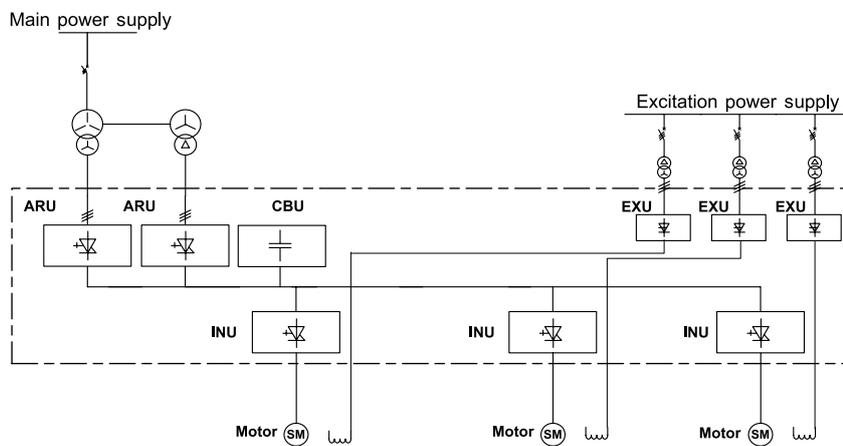
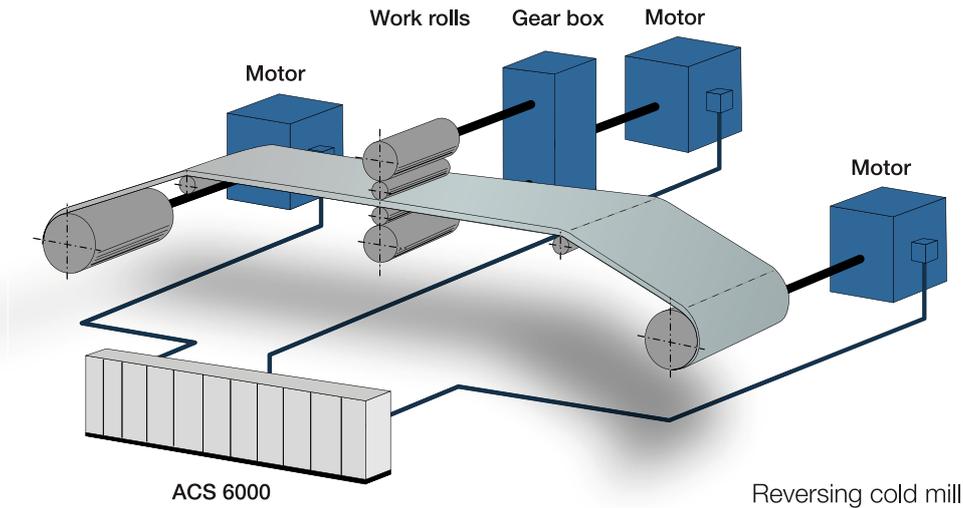
ABB offers solutions for multi-motor operation where several motors can be linked to one multidrive. This provides motoring and generating power flow between the different inverters of the multidrive. Controlling a rolling mill with a variable speed multidrive allows energy that is regenerated from one section in braking mode to be directly used by another section, without power consumption from the supply network.



Configuration concepts

The examples illustrate how the modular platform of ABB's ACS 6000 multidrive is applied to provide the optimum converter configuration for any specific rolling mill.

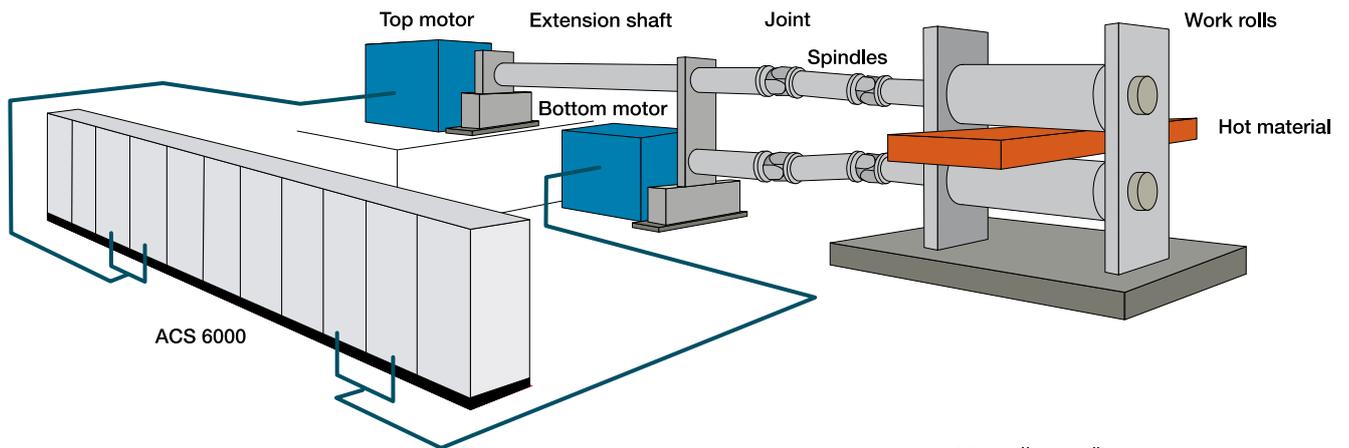
Reversing cold mill



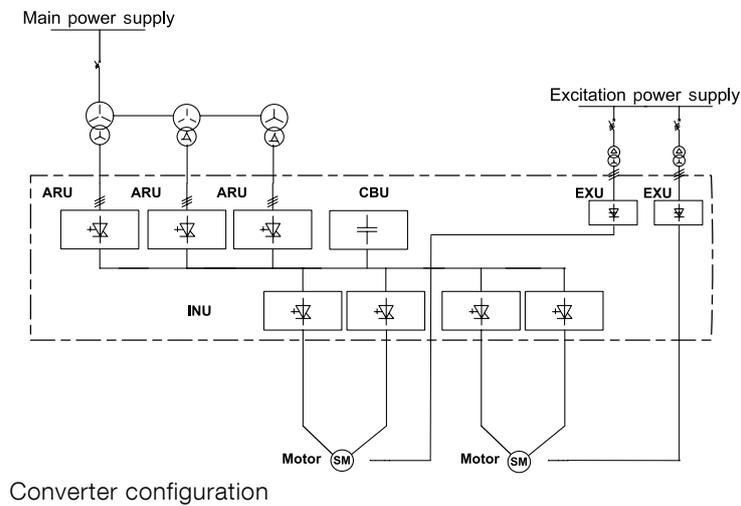
Converter configuration

Reversing cold mill features	Benefits of ABB medium voltage drives
The mill consists of one or two mill stands and two or three coilers; the material may be recoiled several times	A modular and proven solution minimizes the system complexity, installation and commissioning time
High torque and speed accuracy and reliability is required	Direct Torque Control (DTC) ensures highest product quality
A wide range of final products is produced in one mill	A wide tension control range can increase the product mix with full flexibility
One of the coiler motors is always regenerating	The common DC bus reduces energy consumption
Coiler motors have a very long field-weakening range	Optimized motors and inverters from the same supplier ensure best performance and lowest losses
Wide speed and load variations can cause disturbances in the network	Active elimination of harmonics and a unity power factor are essential features of ABB drives

Hot rolling mill



Hot rolling mill



Converter configuration

Hot rolling mill features	Benefits of ABB medium voltage drives
Typically very high torques and overloads are required	Direct Torque Control (DTC) ensures highest torque quality over the full speed range
The rolling mill stand is fed by one motor or by two motors in twin-drive configuration	ABB offers reliable technology with full flexibility in single and multi-motor configurations
One or several stands in one process; reversing or continuous multi-stand operation is required	The common DC bus ensures optimized energy consumption
High power requirements and rapid load changes pose a challenge to the supply network design	ABB medium voltage drives minimize voltage fluctuations towards the network and suppress harmonic currents; also in weak networks

Variable speed drives for auxiliary applications such as fans, pumps and blast furnace blowers

Auxiliary motors, controlled by variable speed drives, consume significantly less energy than fixed-speed motors.

Flow and pressure control

Air and water consumption vary greatly during a day. As such, continuous control of the processes and equipment, such as fans, pumps and blast furnace blowers is required.

Mechanical vs. electrical control

Processes driven by pumps or fans are usually controlled either electrically with variable speed drives, or mechanically with inlet guide vanes, throttling valves or hydraulic couplings.

	Electrical	Mechanical
Variable speed	variable speed drive	hydraulic coupling
Fixed speed	on-off	throttling valve or inlet guide vane

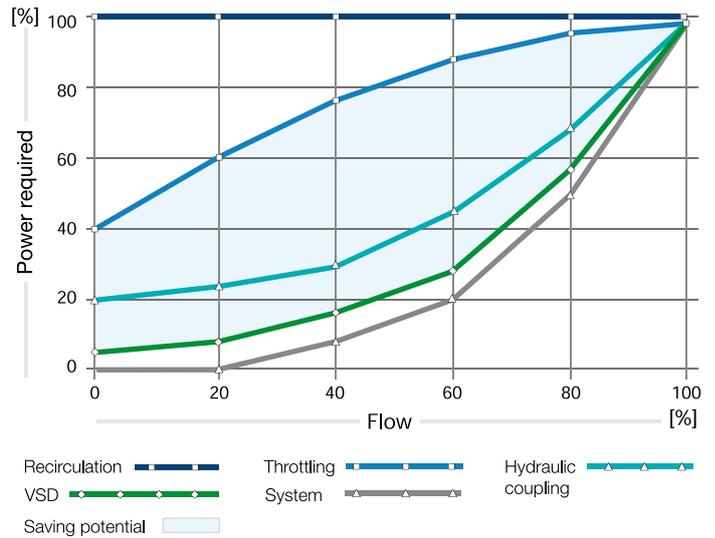
With mechanical fixed-speed solutions, it is difficult to achieve the optimal process efficiency over the whole control range.

With electric variable speed drives, changing the production volume is simply achieved by changing the motor speed. This saves energy, decreases CO₂ emissions and minimizes the total operating costs. Electric variable speed drives have the highest efficiency and are superior to hydraulic couplings and other mechanical control systems.

Electric variable speed drives provide the most efficient process control.

Benefits of drives on auxiliary applications

- High availability
- Fast and precise process control under all conditions
- Lower energy consumption
- Reduced emissions
- Minimal actuator equipment
- Soft starting capability for a longer lifetime of electrical and mechanical equipment



Power consumption for various pump control methods

Energy savings and reduced emissions

Since pumps and fans typically run at partial load, huge energy savings can be achieved by controlling their speed with variable speed drives. A small reduction in speed can make a big reduction in the energy consumption. A pump or a fan running at half speed may consume as little as one eighth of the energy compared to one running at full speed.

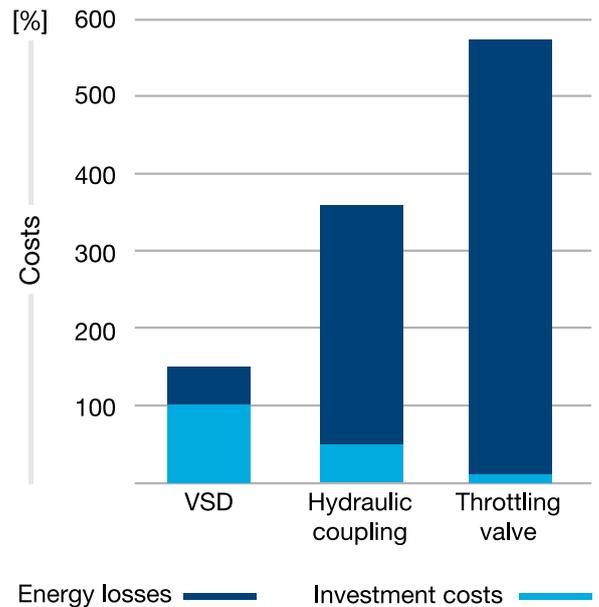
By employing variable speed drives on centrifugal pumps and fans instead of using throttling, damping or inlet guide vanes, the energy bill can be reduced by as much as 60 percent. Consequently, electric variable speed drives also help to reduce NO_x and CO₂ emissions.

Soft starting

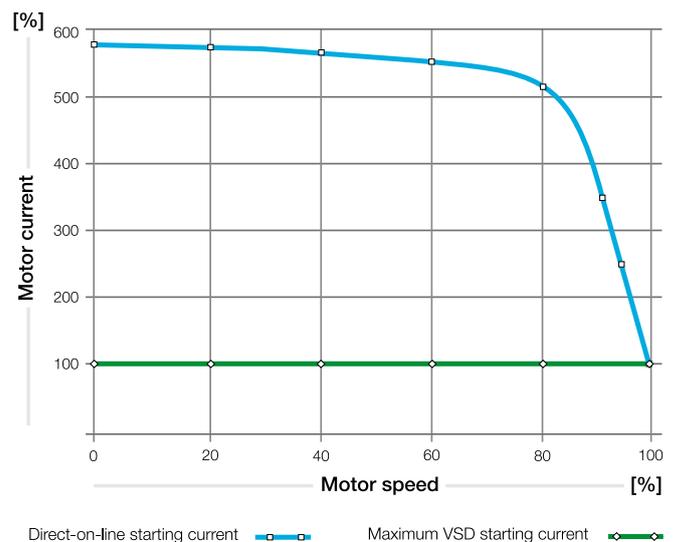
Accelerating rotating machinery with heavy load torque and/or high mass moment of inertia, such as blast furnace blowers, imposes large stress on the electrical supply network and on the mechanical parts of the shaft string. A direct-on-line started electric motor can cause starting currents of up to six times the nominal current. This will cause a voltage drop that is likely to disturb the process, especially if the supply network is weak.

Variable speed drives act as soft starters reducing the stress on the network, motors, pumps and fans. During the starting process, the variable speed drive progressively increases the motor speed and smoothly accelerates the load to its rated speed.

Soft starters eliminate high starting currents and voltage dips which can generate process trips. With soft starters, maintenance costs will be reduced and the lifetime of the equipment extended.



Comparison of investment costs and energy losses of different control methods.*



Motor current for various starting methods

*Calculated for a 1300 kW (1740 hp) pump application, for three years operation

Medium voltage drives

The heart of a medium voltage drive system is the frequency converter. ABB offers the entire range of frequency converters for medium voltage applications in the power range of 315 kW to more than 100 MW.

ACS 6000 for rolling mills (3 - 36 MW (higher on request), up to 3.3 kV)

The ACS 6000 is the optimum solution for demanding rolling mill applications. Since its market introduction, the ACS 6000 has gained an excellent reputation for high quality and reliability. As a result ABB has, worldwide, one of the largest installed bases of medium voltage multidrives.

Modular design

ABB's ACS 6000 is a modular drive designed for the most demanding single-motor and multi-motor applications in the metals industry. It is available with several different inverter modules in the power range from 3 to 13 MVA. The optimum configuration for specific applications can be reached by combining the modules with minimum engineering effort.

Several multidrive motors can be connected to the ACS 6000 via a common DC bus, enabling multi-motor operation with only one multidrive converter. A multidrive, common DC-bus converter offers a solution with optimum efficiency. It allows motoring and generating power flow between the inverters through the DC link. Energy regenerated from one section in braking mode can be directly used by another section via the DC bus without power consumption from the supply network.

Regeneration and reactive power compensation

The ACS 6000 can be equipped with an Active Rectifier Unit (ARU). It allows four-quadrant operation for regenerative braking, which reduces the overall energy consumption, and controls the power factor to unity in the whole operation range even at very low speeds. Optionally, the ARU can be dimensioned to compensate reactive power generated by other loads connected to the same network.

Network friendly

For applications where high power is required, ARU modules can be connected in parallel. The transformer design of such a configuration results in extremely low harmonics.

Simple and efficient maintenance

The ACS 6000 is designed to allow easy front access to the drive's components. The design features easily replaceable phase modules which allow the end user to rapidly replace a module within minutes.



Medium voltage drives for auxiliary applications such as fans, pumps and blast furnace blowers

ABB has a wide range of medium voltage variable speed drives for energy-efficient operation of auxiliary applications such as fans, pumps and blast furnace blowers.

ACS 1000 (315 kW – 5 MW, up to 4.16 kV)

The ACS 1000 product family of medium voltage drives is an unbeatable solution for auxiliary processes in the metals industry. Due to its specially designed output sine filter, which eliminates voltage reflections and common mode voltages, the ACS 1000 is suitable for standard motors and retrofit applications. The ACS 1000i is a fully integrated drive including input transformer and input contactor.

ACS 2000 (250 – 2,600 kW, 4.0 – 6.9 kV)

The ACS 2000 is suitable for retrofit applications and new standard induction motors up to 6.9 kV. It can be used without an input isolation transformer, thereby allowing a direct connection to the line supply (direct-to-line), with an integrated transformer, or for connection to an external input isolation transformer. The general purpose drive provides simple and reliable motor control for applications such as fans and pumps.

ACS 5000 (2 – 36 MW, up to 6.9 kV)

The ACS 5000 can be applied to standard industrial motors (induction and synchronous) up to 6.9 kV. It is ideal for applications such as blast furnace blowers, fans and pumps.

MEGADRIVE-LCI (2 – 72 MW, up to 10 kV)

ABB's MEGADRIVE-LCI converter is an optimal solution for high voltage and high power applications. Standard designs are available for ratings up to 72 MW; engineered designs for more than 100 MW. These converters are mainly used as soft starters or drives for blast furnace blowers, ID/FD fans and single-stand wire rod mills.



Technology highlights

Reliability is the main guiding principle of the research and development activities for medium voltage drives.

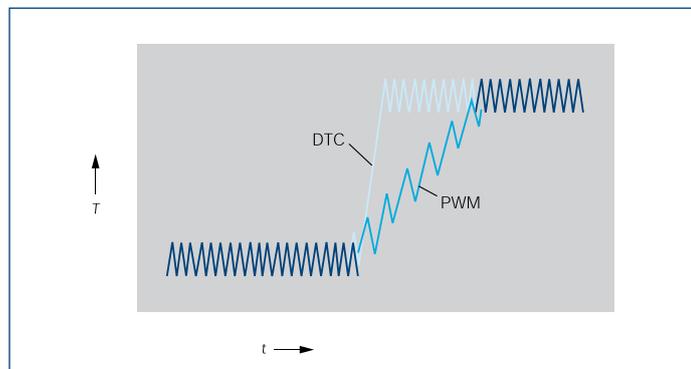


Direct Torque Control (DTC)

The ACS drive control platform is based on ABB's award-winning Direct Torque Control (DTC), resulting in the highest torque and speed performance, as well as, lowest losses ever achieved in medium voltage drives. Control of the drive is immediate and smooth under all conditions.

DTC allows accurate control of both motor speed and torque without pulse encoder feedback from the motor shaft.

In DTC, stator flux and torque are used as primary control variables. The motor state calculations are updated 40,000 times a second (ie, every 25 μ s) in the advanced motor software model by the high-speed digital signal processor. Due to the continuous updating of the motor state and the comparison of the actual values to the reference values, every single switching in the inverter is determined separately. DTC ensures the absolute lowest losses by switching the power semiconductors only when necessary.



Typical torque (T) response of a DTC drive, compared with flux vector control with open loop pulse width modulation (PWM)

Fast response to mains fluctuations and process side changes

The exceptionally fast torque step response of the drive means that it can respond to process and mains changes extremely fast. This enables easy handling of power-loss situations and sudden load changes.

Power loss ride through

Due to its power loss ride through function, the drive system is able to withstand disturbances of the power supply. The drive will continue to operate in an active but non-torque producing mode if the incoming supply voltage is cut off. The drive will be active as long as the motor rotates and generates energy to the drive. It will resume normal operation immediately upon return of power supply.

Low parts count

The fewer the parts the higher the reliability. ABB uses high power semiconductor switching devices and a topology that brings down the part count to a minimum.

Fuseless design

ABB medium voltage drives are designed to operate safely without fuses which are known to be unreliable, costly and subject to aging. The fuseless design results in less spare parts and fast re-starting after an overcurrent trip.

Encoderless

Encoders are known to cause failures. They have an exposed position on the motor. ABB's medium voltage drives can operate without an encoder, thereby reducing maintenance costs and ensuring high levels of availability.

Simple and efficient maintenance

Simple and efficient maintenance is an important factor in keeping operating costs down.

ABB medium voltage drives are designed to maximize uptime and to facilitate quick repair. The drives' components can be easily accessed and the modular design lends itself to quick and effective replacement of components.



ACS 6000 phase module exchange

Drive Performance Optimization tool (DPO)

The tool calculates mechanical system natural frequencies, maximizing drive dynamic performance and minimizing wear and tear. Actual application software is used to simulate real torque and speed control features.

Rolling mill drive control

Enhanced Dynamic Features (EDF) control is a set of functions designed to increase the performance of rolling mill drive trains and to handle speed control related problems such as torsional vibrations and backlash.

Remote monitoring and diagnostics

DriveMonitor™ allows secure real-time access to the drive. It supports monitoring and diagnostics of ABB drives independent of the implemented control method, thus also enabling the connection of existent installations.

The optional tool consists of a hardware module, as well as a software layer that automatically collects and analyzes selected drive signals and parameters.

Long-term monitoring functions deliver important information on equipment status, tasks needed and possible performance improvements. Diagnostic procedures and trending can cover not only the converter itself but other parts of the shaft train as well.



DriveMonitor™ with screen

Motors and transformers

ABB drive packages include medium voltage converters, motors and transformers.

Converter motors

ABB's converter motors have earned an excellent reputation for performance and reliability. ABB's product range includes induction as well as synchronous motors.

Synchronous motors are the optimal solution for high power and high torque applications which require high overload capability over the entire speed range. In addition, synchronous motors offer the benefits of high efficiency and high performance.

Squirrel cage induction motors are the workhorses of the industry due to their versatility, reliability and simplicity. Typical applications are rolling mills, coilers, pumps and fans. They are available up to 18 MW.

Converter transformers

Converter transformers are especially designed for operation with variable speed drives. They adapt the converter to the supply network and provide a galvanic isolation between drive and supply network.

Converter transformers are available for nearly all ratings. Secondary voltages are optimized to match the converter and motor voltage. Oil or dry types for indoor or outdoor mounting are available. Busbar connections can also be provided.



Testing, service and support

ABB drives are backed by comprehensive service and support, from the customer's initial inquiry throughout the entire life cycle of the drive system.

Testing

ABB is committed to ensuring the reliability of every drive it delivers. To verify that quality standards and customer requirements are fully met every component of a drive is subjected to thorough testing in ABB's modern test facilities.

Routine tests and functional tests form an integral part of the scope of supply of ABB's medium voltage drives. They are performed in accordance with international standards and ABB quality assurance procedures.

Additionally, ABB can perform a combined test with the complete drive system – including transformer, converter and motor – to verify the performance and to ensure a smooth integration into the customer's facility.

Installation and commissioning

Proper installation and commissioning of the equipment, done by qualified and certified commissioning engineers, reduces start-up time, increases safety and reliability and decreases life-cycle costs. In addition, operators can be given practical training by experienced specialists on site.

Life-cycle management

ABB's drive life-cycle management model maximizes the value of the equipment and maintenance investment by maintaining high availability, eliminating unplanned repair costs and extending the lifetime of the drive.

Life-cycle management includes:

- providing spare parts and expertise throughout the life cycle
- providing efficient product support and maintenance for improved reliability
- adding functionality to the initial product
- providing a smooth transition to a new technology at the end of the life cycle

Training

From basic tutorials to tailored training ABB provides extensive training for its medium voltage drives. A range of training programs is offered from basic tutorials to programs tailored to the customer's specific needs.

Global network, local presence

After sales service is an integral part of providing the customer with a reliable and efficient drive system. The ABB Group of companies operates in more than 100 countries and has a worldwide network of service operations.



Services for ABB's medium voltage drives

- Supervision of installation and commissioning
- Training
- Remote diagnostics
- Customized maintenance contracts
- Local support
- 24 x 365 support line
- Spare parts and logistics network
- Worldwide service network

Contact us

For more information contact your local ABB representative or visit:

www.abb.com/drives