



High power rectifiers

Product portfolio overview



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One ABB solution

ABB's high power rectifiers provide maximum availability and highest productivity. As a leading worldwide supplier of rectifiers for any industrial application, ABB has the experience and technological expertise to fulfill demanding requirements of the process industry with high priority on personnel safety.

Key benefits

- Global service footprint
- Customized system solutions
- Upgrades on all rectifier systems

Medium current rectifiers (MCR) and high current rectifiers (HCR) provide DC current in the range of 5,000 A to 550,000 A, as single or multiple units. To boost efficiency ABB recently developed a new converter ARCARE™ for AC electric furnaces based on the SPLC technology from Hatch Ltd.

Maximized efficiency, reliability and trouble-free integration into the overall power system as well as with minimum maintenance needs are key requirements in the aluminium industry, and arc furnace plants, wherever high currents are needed.

For working out operational cost of a rectifier system, various direct and indirect costs should be considered over the system's entire life cycle. With ABB rectifiers you achieve lowest total cost of ownership and enhance your production.

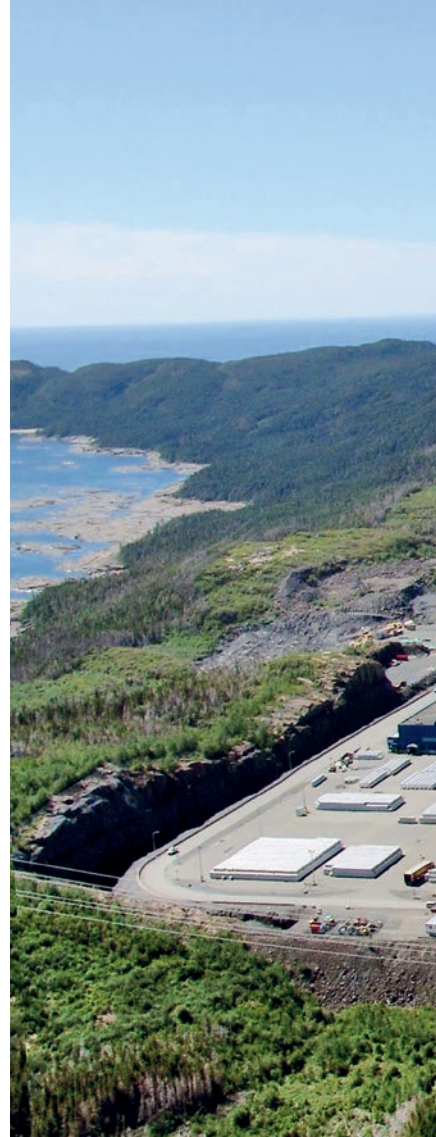
ABB's high current rectifier product family gives nearly unlimited current and voltage possibilities and meets most plant specific requirements. These products are characterized by exceptional reliability, optimum design, easy accessibility, minimum maintenance and low losses. The high current rectifiers are especially developed for the DC arc furnace and aluminium industry, neverthe-

less they can be used wherever high currents are needed.

Main technical data

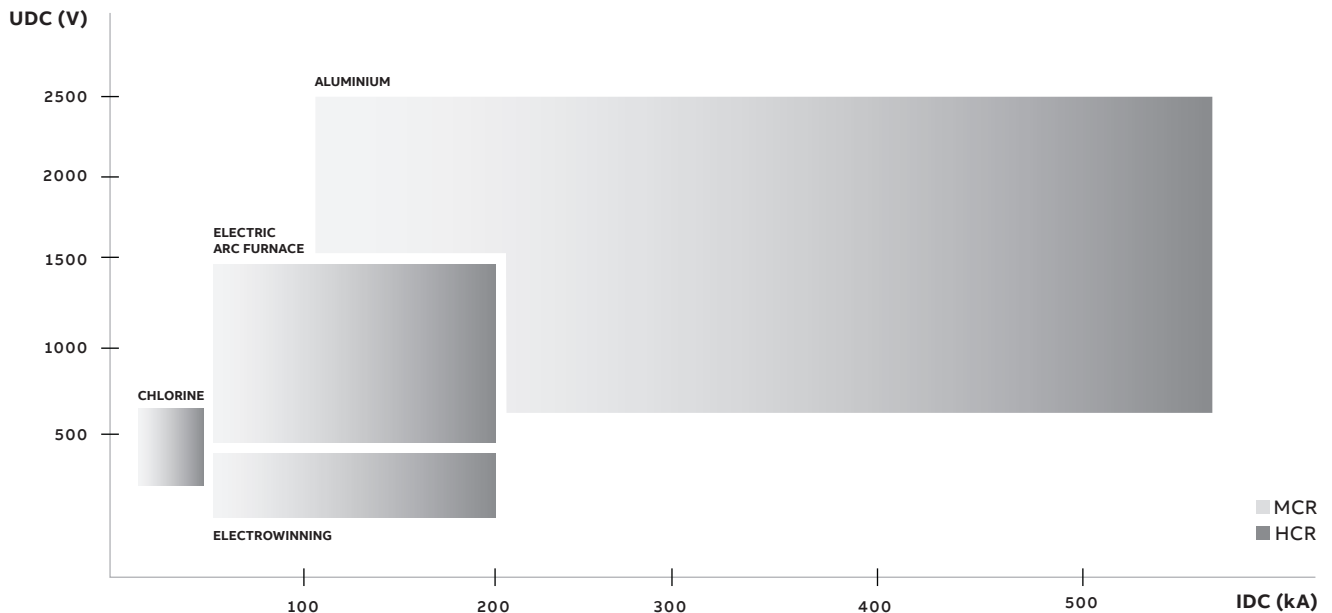
The self-supporting rectifier frame is built of aluminium profiles that have specially designed shapes for most effective cooling by de-ionized water or a glycol mixture flowing inside. The inside water channels are routed and welded in such a way that extensive external hose connections are not required anymore. Semiconductor and fuses are cooled on both sides by high efficiency cooling boxes.

Except the connection to the transformer bushing the complete rectifier structure is without any bolted connection. The clear design allows for easy and quick access to every rectifier component. For long-term best conductivity in the rectifier all contact areas are nickel-plated. Each semiconductor path is equipped with a high-speed current limiting fuse for selective isolation in case of a failure. If desired, the built-in redundancy allows nominal load operation even with one or more semiconductor per leg out of service. In such a case, the striker pin with its micro-switch mounted on fuse or a Rogowski-type fuse supervision identifies the faulty element.



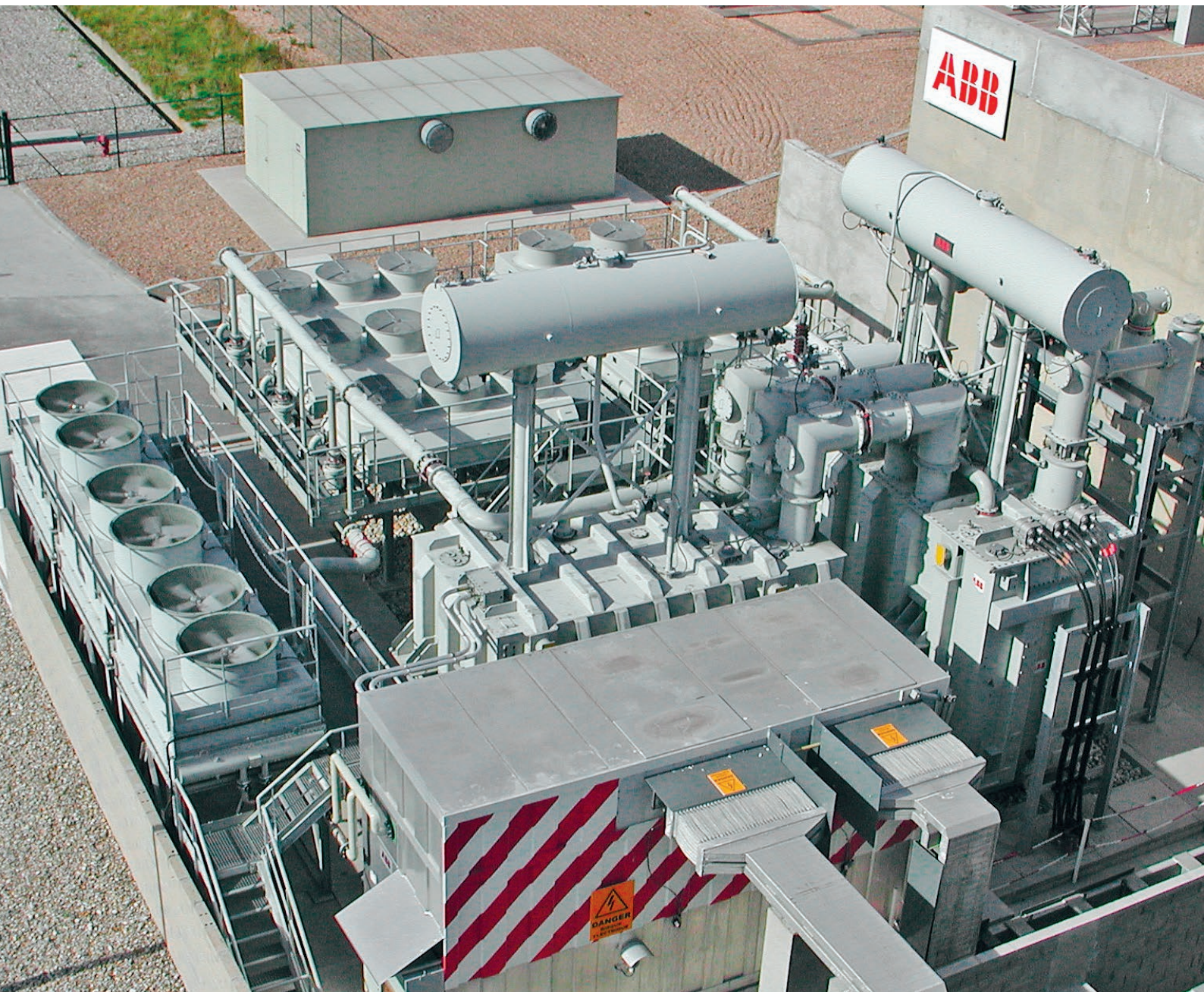


Electrically the rectifier is protected against hole-storage effect surges and overvoltage disturbances coming from the network or process by a suitable rated capacitor circuit arrangement. All stages of production are tested in our in-house power testing facility to ensure safe operation of the rectifier.



High power rectifiers HCR9000 and HCR8000

ABB's HCR9000 and HCR8000 rectifiers are manufactured to the highest quality standards based on proven designs and a long history. We have a replacement schedule for all components. This ensures maximum efficiency, lifetime and minimum maintenance. With the wide current and voltage range the HCR9000/HCR8000 meets the most demanding plant requirements and provides customers with maximum benefits.



Highlights HCR9000 and HCR8000

- Common parts shared with ABB's complete rectifier portfolio
- Flexible design to reach specified customer needs, without overdimensioning
- Upgradable from 3 to 4 inch semiconductors for higher performance or less losses with proper system study

HCR9000 and HCR8000 – robust, proven, simple water-cooled rectifier

Typically the HCR9000 is installed on aluminium smelters or other applications where high current and/or high voltages are required. The design is optimized for the use as diode rectifier, but also thyristor solutions are available. Single unit operation as well as parallel operation are standard for this type of rectifier.

The self-supporting rectifier frame is built of special designed aluminium heat sink profiles with integrated water channels for most effective cooling. The integrated water channels are routed in such a way to minimize extensive external hose connections. All semiconductors and fuses are double side cooled by high efficient cooling boxes and the aluminium heat sink profiles.

Beside the function as water cooled DC current conductors it also acts as mechanical support and mounting area for the semiconductor clamping sets, over-voltage protection components and the gate firing electronic in case of a thyristor solution. Except the connection to the transformer bushing the complete rectifier structure is without any bolted connections. For long-term best conductivity at the rectifier all contact areas are nickel-plated. The HCR9000's modularity and simplicity makes it highly scalable, with high availability and easy maintenance.

Each semiconductor is equipped with a high-speed current limiting fuse for selective isolation in case of a semiconductor failure. This allows nominal load operation even with one or more semiconductors out of service if requested.

Main technical data	HCR9000	HCR8000
Rated DC voltage	Up to 2,000 V*	Up to 2,000 V*
Rated DC current	Up to 220 kA*	Up to 220 kA*
DC voltage control	– Coarse regulation with on-load tap changer (OLTC) – Fine regulation with saturable reactors or thyristor phase angle	– Coarse regulation with on-load tap changer (OLTC) – Fine regulation with thyristor phase angle or saturable reactors
Semiconductors	– Typically diodes, thyristor possible – 3 to 4 inch types	– Typically thyristors, diodes possible – 3 to 4 inch types
Semiconductors in //	6–24*	6–24*
Semiconductor redundancy	Yes	Yes
Rectifier connection	DB or DSS	DB or DSS
Pulse number/ unit	6 or 12 pulse	6 or 12 pulse
Cooling media	De-ionized water/glycol mixture	De-ionized water / glycol mixture
Installation	– Indoor as IP00 or IP21 (enclosure) – Outdoor as IP54 (enclosure or container)	– Indoor as IP00 or IP21 (enclosure) – Outdoor as IP54 (enclosure or container)

* Other ratings on request



Customer value and product features

Customer value

High reliability

- Minimized number of components
- High EMC immunity by optical transmission of gate pulse for thyristor firing
- Long-term stable contact surface for semiconductors, fuses and bolted connections by nickel plating
- Minimum amount of bolted connections
- Reduced mechanical forces on fuses by ultra-flexible connections between fuses and semiconductors
- Solid mechanical structure
- Clamping with equalizing pressure principle

High level of protection

- Verification tests of semiconductor and fuse in coordination
- Effective, fully integrated and separately fused overvoltage and surge protection
- Double insulated wires by cable ducts, pipes or sleeves
- Temperature supervision of aluminium heatsink profiles

High level of safety

- ABB's unique semiconductor protection ring
- Mechanical separation of positive and negative DC potential
- Arc resistant phase barriers

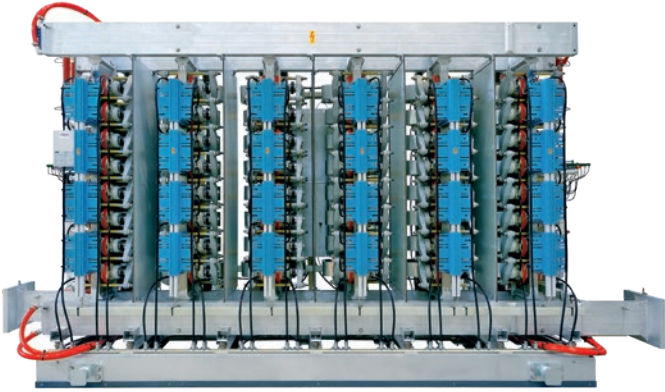
Low maintenance

- Minimum amount of cooling hoses by integrated water channels
- Clamping yoke with integrated clamping force indicator
- Minimum amount of bolted connections within the rectifier
- Low corrosion due to high quality material in cooling
- Use of nonmagnetic materials to prevent hotspots

Product features

- Small rectifier footprint
- Wide selection of semiconductors from different suppliers and sizes
- Wide selection of fuses (single or double body fuses) from different suppliers
- Double side water-cooled semiconductors and fuses
- Solid and self-supporting aluminium main-circuit structure
- Specially designed for rough industrial environment and long life time
- Several units can be connected in parallel





Example of ABB's HCR8000 rectifier cabinet



Example of ABB's HCR9000 rectifier enclosure



High power rectifiers

HCR6000

As the rectifier technology leader, ABB is dedicated to rectifier technology development and services for the non-ferrous and ferrous metallurgical industry.

With more than several decades' of successful application and service experiences, ABB is well-equipped to deliver the best rectifier solutions to meet each customer's specific requirements, and supply technology that is more reliable and energy efficient than our customers' expect along with comprehensive services. ABB's always tries to offer rectifier solutions that exceed user expectations, providing more satisfaction and safety. As part of our technology leadership, we have developed the "state of the art" rectifier solution – the HCR6000.

ABB's mature rectifier design concepts and technologies perfectly matches to the co-phase anti-parallel transformer design which is widely used in China and other countries. This bus bar

connection method simplifies problems and issues, experienced in earlier design for co-phase anti-parallel transformer. All connections are composed by only using two kinds of parts simple and straight forward – that is how we connect to transformers.

Optimized AC connection perfectly matches Chinese co-phase anti-parallel transformer. Rectifier AC connection phase shifting to match transformer secondary bushings. ABB HCR6000 rectifier solutions are fully suitable with local transformer and accessories to optimize the full system. Due to the perfect connection solution, the length of the busbars are shorter, as a result, losses are reduced. Meanwhile, the flexible connection eliminates the stress which comes from expansion and contraction, or slight deviation, and realizes the best performance of the rectifier.

HCR6000 DC outlets adopts big aluminium welding plate as the standard solution, which not only effectively reduces the connection loss, improve the connection reliability, but also avoids material contact effects between copper and aluminium as existed in the old design. Furthermore, it simplifies site installation and therefore reduces costs. For mechanical separation of positive and negative DC outlets, the typical distance of 1790 mm is enough; DC outlets can straight connect to DC Isolators to potline collection busbar, which minimizes DC busbar length and reduces busbar operation losses. Meanwhile, the complete mechanical separation of positive and negative potential improves the rectifier safety level significantly. The bolted connection of DC outlet is the optional available and adoptable based on site situation and requirements.

Main technical data	
Rated DC voltage	Up to 1,650 V*
Rated DC current	Up to 60 kA*
DC voltage control	<ul style="list-style-type: none"> – Coarse regulation with on-load changer (OLTC) – Fine regulation with saturable reactors
Semiconductors	Diodes or thyristor
Semiconductors in //	6–24*
Semiconductor redundancy	Yes
Rectifier connection	DB or DSS
Pulse number/ unit	6 or 12 pulse
Cooling media	De-ionized water
Installation	<ul style="list-style-type: none"> – Indoor as IP00 or IP21 (enclosure) – Outdoor as IP54 (enclosure or container)

* Other ratings on request

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Example of
ABB's HCR6000
rectifier enclose



Customer value and product features

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Highlights HCR6000

- Common parts shared with ABB's complete rectifier portfolio
- Flexible design to reach specified customer needs, without overdimensioning
- Upgradable from 3 to 4 inch semiconductors for higher performance or less losses

Customer value

High reliability

- Minimized number of components
- Long-term stable contact surface for semiconductors, fuses and bolted connections by nickel plating
- Minimum amount of bolted connections
- Reduced mechanical forces on fuses by ultra-flexible connections between fuses and semiconductors
- Solid mechanical structure
- High EMC immunity by optical transmission of gate pulse for thyristor firing

High level of protection

- Verification tests of semiconductor fuse performance
- Effective, fully integrated and separately fused overvoltage and surge protection
- Double insulated wires by cable ducts, pipes or sleeves
- Temperature supervision of aluminium heatsink profiles

High level of safety

- ABB's unique semiconductor protection ring
- Mechanical separation of positive and negative DC potential
- Arc resistant phase barriers

Low maintenance

- Minimum amount of cooling hoses by integrated water channels
- Clamping yoke with integrated clamping force indicator
- Minimum amount of bolted connections within the rectifier
- Low corrosion due to high quality material in cooling circuit
- Use of nonmagnetic materials to prevent hotspots

High power rectifiers

MCR1000

The water-cooled Medium Current Rectifier MCR1000 is specifically developed for the electrochemical and electrowinning industry. It represents reliable technology, including significant features to provide customers with maximum benefits.

Highlights MCR1000

- Optimized design to ensure lowest costs and lowest losses
- Upgradable from 3"-4" diameter semiconductors for higher performance or less losses
- Common parts shared with ABB's high current rectifier (HCR) series
- Flexible design to reach specified customer needs, without overdimensioning

The centerpiece of the MCR1000 is a specially designed self-supporting heat sink profile with integrated water channels for the most effective cooling. Besides the function as a DC current conductor, it also acts as a mechanical support and mounting area for the semiconductor clamping sets, the over-voltage protection and the thyristor gate firing electronics. The integrated water channels are routed to minimize extensive outside hose connections. All semiconductors and fuses are cooled on both sides by high efficient cooling boxes and the heat sink profile. The MCR1000's modularity and simplicity makes it highly scalable, with high availability and easy maintenance.

With a wide selection of semiconductors available for three to four inch diameter, MCR1000 has the flexibility to meet specific customer ratings.

An external semiconductor protection ring also used in ABB's high current rectifiers (HCR) is integrated within the MCR1000, to prevent flashovers from failing semiconductors.

Main technical data

Rated DC voltage	Up to 1,000 V
Rated DC current	Up to 200 kA
Semiconductors	– diode or thyristor – 3 to 4 inch types
Semiconductors in //	2–6
Semiconductor redundancy	Yes
Rectifier connection	DB or DSS
Pulse number / unit	6 or 12 pulse
Cooling media	De-ionized water/ glycol mixture
Installation	– Indoor as IP00 or IP21 (enclosure) – Outdoor as IP54 (enclosure or container)

* Other ratings on request



Customer value and product features

Customer value

High reliability

- Minimized number of components
- High EMC immunity by optical transmission of gate pulse for thyristors
- Long-term stable contact surface for semi-conductors, fuses and bolted connections by nickel plating
- Minimum amount of bolted connections
- Reduced mechanical forces on fuses by ultra-flexible connections between fuses and semiconductors
- Solid mechanical structure

High level of protection

- Integrated RC snubber
- Verification tests of semiconductor fuse performance
- Effective, fully integrated and separately fused overvoltage and surge protection

High level of safety

- ABB's unique semiconductor protection ring
- Mechanical separation of positive and negative DC potential

Low maintenance

- Minimum amount of cooling hoses by integrated manifolds and water channels
- Preloaded clamping yoke with true force indicator

Product features

- Small rectifier footprint
- Wide selection of semiconductors from different suppliers and sizes
- Available for 2 to 6 semiconductors in parallel
- Wide selection of fuses (single or double body fuses) from different suppliers
- Double side water-cooled semiconductors and fuses
- Solid and self-supporting aluminium main-circuit structure
- Vertical and horizontal arrangement available (5 and 6) semiconductors in parallel only available in horizontal arrangement
- Indirect water cooled snubber resistors
- Applicable for DB and DSS connection types
- Applicable for 6 or 12 pulse systems
- IP00 protection class specially designed for rough industrial environment

Example of ABB's MCR1000 rectifier enclosure



High power rectifiers Power Quality system for industrial applications

AC and DC furnaces operators need to install a Power Quality (PQ) system to meet increasingly stringent demands by utilities for network performances.

The PQ system is primarily installed to reduce the flicker, improve the power factor, stabilize the voltage and meet total voltage distortion requirements. This also synchronizes the line currents in case of the AC furnace operation. AC and DC power supplies can be used for melting ferrous and non-ferrous metals.

Constant voltage on the bus means more power to the furnace, which means higher productivity.

The utilization of the PQ systems has also become important on the rolling mill. With a stable bus voltage and a high constant power factor maintained at all times, the performance of the mill and the power quality at the point of common coupling (PCC) meet the grid requirement. Additionally, in the PQ system family a Static Power Compensator (SPC) will play an important role. It helps furnace operators that are operating in island mode to maintain the frequency constant.

Static Var Compensator industrial application

A static Var compensator is a set of electrical equipment for providing fast-acting reactive power on high-voltage bus on industrial application. SVCs are part of the Power Quality system family, regulating voltage, power factor, harmonics and stabilizing the system. A static Var compensator has no significant moving parts (other than internal switchgear).

The SVC is an automated impedance matching device, designed to bring the system closer to unity power factor. SVC's used in industrial applications, are typically placed near high and rapidly

varying loads, such as arc furnaces, where they can smooth flicker voltage.

The main advantage of SVC's simple mechanically switched compensation schemes is their near-instantaneous response to changes in the system voltage. For this reason they are often operated at close to their zero-point in order to maximize the reactive power correction they can rapidly provide when required.

Static VAR Compensator industrial application – Furnaces & Ladle Furnace

Electric Arc Furnaces (EAF) and Ladle Furnace (LF) are high power industrial loads which cause power quality problems at all voltage levels due to their unbalanced and nonlinear characteristics. They consume large and quickly varying amounts





of reactive power, during various phases in their process, thereby causing fluctuations in the surrounding network and on the furnace bus itself.

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ABB has developed a unique patented solution for DC Electrical Arc Furnaces; the fast forward concept called ArcComp system.

With conventional Static VAR Compensator (SVC) the reactive power demand is measured from the current and voltage transformers of the incomers. Based on this, the firing angle of thyristors controlled reactors (TCR) are adjusted to deliver the required compensation.

This firing angle change is only possible after a summation the delays related to the measurement and firing system, which limits the performance of the SVC. The Arc-Comp system works on the basis that the rectifier control system sends the requirement of the reactive power compensation, based on firing angle and DC current, even before the change takes place. With this, SVC is ready to deliver required compensation without any delay.

There is a fiber optic connection between the two systems to exchange this information between Rectifier and SVC, that improves the response time.



Key benefits

- Less vibrations
- Less stress on Hydraulics
- Reduced maintenance
- Better quality of maintenance
- Shorter melt downtime
- Reduced energy losses (operating cost)
- Extended electrode life
- Uniform arc power and better arc stability

Inherent features of furnace operation

- Unbalance currents (AC EAF)
- Injects harmonics into the network
- Voltage drops
- Voltage distortion
- Flicker
- Poor power factor
- Negative sequence currents into the local generation

Static Power Compensator industrial application

While AC and DC EAF operation is suited to weak grids, it poses various challenges to rectifier controls and generator equipment for island mode operation or for extremely weak grids.

The network frequency can be stabilized by installing static power compensator (SPC). Static Power Compensator (SPC) is used to maintain constant active power. For example, when active power swings are caused by arc dynamics, they must be compensated. This helps to maintain constant frequency on weak grids or in island operation.

SPC sizing depends upon the power range to be compensated during normal working. If the SPC has to handle furnace trips, then sufficient short-time rating of the SPC is necessary to handle the total EAF power.

The SPC consists of a proven thyristor stack which is also used for SVC applications along with a resistor bank.

Power Quality system for maintaining active power constant

Static Var compensators (SVC) have been used in plants for decades. ABB's proven Arc-Comp technology improves the performance compared to a conventional SVC. The SVC system maintains a constant voltage up to certain limit, depending upon the size of the SVC. Next level of action to maintain constant voltage is from excitation system in island operation.

As the SVC is intended to handle reactive power compensation, it cannot compensate active power during furnace operation. Alternative means are necessary to stabilize active power loading on the network.

This compensates for power swings or power perturbations resulting from furnace operation. An intelligent monitoring system can be implemented that supervises generation levels, available spinning reserve and frequency, and also connects governors, SVC, SPC and excitation.

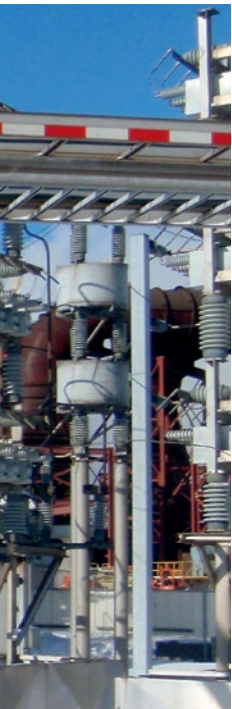
SPC sizing depends upon the power range to be compensated during normal working. If the SPC has to handle furnace trips, then sufficient short-time rating of the SPC is necessary to handle the total EAF power. It consists of a proven thyristor stack which is also used for SVC applications along with a resistor bank.

Harmonic filters for high voltage application

Electrical equipment generating harmonic currents are becoming more and more common. Such nonlinear loads usually contain power electronics – rectifiers, converters, etc.

Modern electronics power control devices provide many advantages over conventional control method, and are widely used in industrial process.

These types of devices offer an efficient energy use, but at the same time they generate disturbances in the form of harmonics.



The most difficult harmonics generator is the electric arc furnace that generates all kinds of harmonics and inter-harmonics.

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Harmonic filters are most commonly used in cases where reactive power compensation is required.

Harmonic distortion generation becoming more and more common problem

Harmonic currents can be amplified due to parallel resonance between inductive and capacitive parts of an electrical system. Harmonic currents cause higher electrical losses in the installation.

Most equipment is designed for the fundamental frequency, 50 or 60 Hz. Voltage and current of other frequencies are energy that the machine cannot make use of, it turns into heat losses.

Furthermore, many meters use the voltage zero crossing for its operation, an amplified harmonic voltage may contain more zero crossings than the fundamental voltage and the measured result will then be wrong. An instrument designed for fundamental frequency may not take harmonics into account and will measure incorrectly.

Harmonic Filters eliminate harmonic distortion problem

The SPC consists of a proven thyristor stack which is also used for SVC applications along with a resistor bank.

Power Quality system for maintaining active power constant

The installation of a filter is the most common method of reducing the harmonics in a system. ABB's engineering team have successfully designed filters to eliminate harmonic distortion problem for customer in countries all over the world. With accurate modelling techniques, input data obtained from on-side measurements the optimum customized design solution can be quickly and reliably engineered, installed and commissioned.

The filter forms a series resonance circuit for a given frequency, the tuning frequency, which means that for the tuning frequency an impedance minimum is created. Consequently, currents of frequencies close to the tuning frequency will be short-circuited through the filter.

Harmonic current content is reduced, depending on the tuning frequency, can be achieved by means of a filter. Distortion is reduced to the required level utilizing the different models of filter (refer Fig.1 and Fig. 2).



High power rectifiers

ARCARE™

Sophisticated power supply for AC electric arc furnace that boosts furnace efficiency and productivity.

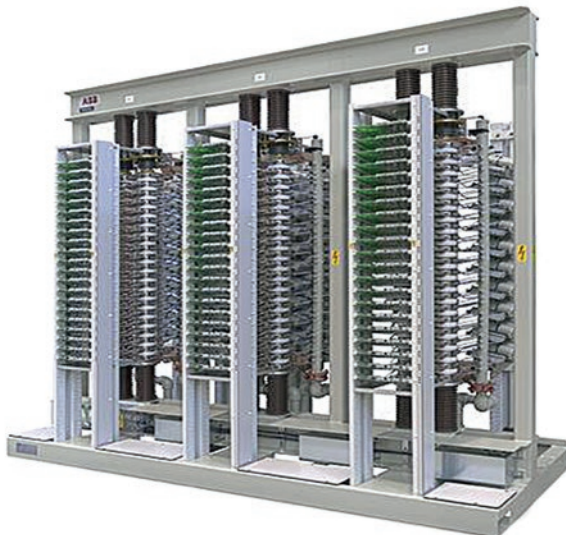
Key benefits

- Higher power leading to increased production
- Reduced electrical energy consumption
- Reduced electrode consumption
- Reduced maintenance
- Eliminating electrode breakages

Scrap is melted in electric arc furnaces in order to recycle steel. These furnaces can be constructed for alternating current (AC) as well as for direct current (DC).

High demands are made on the power supply for an electric arc furnace. The most important thing for the steel manufacturer is to obtain the liquid steel in the shortest possible melting time using the electric arc. One of the issues that limits the melting time is the high fluctuation of the electric arc. As the arc fluctuations are faster than the electrode movement, this can cause the current fluctuations.

Example of ABB's
ARCARE™



ARCARE™ – an active stabilizing system for AC electric arc furnaces

An active stabilizing system for AC electric arc furnaces called ARCARE™ is the solution to fluctuating currents. The current-limiting inductors are controlled by thyristors to continuously stabilize the furnace current.

Main technical data

Primary furnace trafo voltage	< 34,5 kV
Primary furnace transformer current	< 3000 A
Frequency	50 Hz or 60 Hz
Cooling medium	– DIW / DIW glycol
Re-cooling	WF or AF



Equipment

PERMS (Process Earth Resistance Monitoring System)

The Process Earth Resistance Monitoring System (PERMS) is a unique monitoring system from ABB to measure the earth impedance of a floating system that can be used for electrolysis processes. With PERMS it is possible to continuously monitor the resistance between the process and earth. The system gives a warning if the resistance value drops below a defined level. By indicating the earth impedance, PERMS helps you to ensure a safe working area at the plant site and thus protect personnel and installed equipment.

Protection of the process insulation system

Key benefits

- Increased human safety without the need for manual work when measuring the impedance
- Equipment is better protected which helps ensure longer life time, less shutdowns and greater productivity
- Fast and easy installation without any shutdown requirement

Electrolysis plants are typically operated without earthing the process (floating system). To detect earth fault currents, it is necessary to measure the impedance between the DC voltage system and earth. The measurement helps in conducting predictive maintenance of the process insulation system. The resistance to earth depends on the dirt, dust and moisture between the DC process and earth. Leaking of process fluids or hot metal run out can cause low resistance paths to earth. The insulation between high current carrying busbars ("collector busbars") to earth is critical for the safe operation of the plant. The resistance value may be used to indicate when preventive maintenance is due.

Metering principle

The metering principle of PERMS is based on a modulated AC voltage. This measuring voltage is generated with help of the AC 800PEC controller and applied between the process and plant earth without making an earth connection for the DC process. There is a very low and safe current flowing through the process, to earth and back to the measurement system. Out of the impedance and the phase shift the real resistance and capacitance is calculated.

Main features

- Monitoring of resistance to earth for floating electrolysis-systems
- Monitoring of capacitance to earth for floating electrolysis systems (optional)
- Two adjustable alarm levels with potential free change over contacts
- Local indication of actual values on process panel mounted in the cubicle
- Test functionalities of process
- Integrated self-test (for testing and calibration)

Main advantages

- No earth potential applied on process
- Very wide measuring range (20...2500 Ω)
- Very easy installation and commissioning
- Can be used for process voltages up to 2000 VDC
- Possible to detect an earth fault behind the active components (AC part of the rectifier)
- The measuring signal is maximum 50 VAC/ 25mA which is considered a safe voltage according to relevant standards



Equipment AC 800PEC

The AC 800PEC is a high-performance application with extremely fast control algorithms – cycle times that range from 100 microseconds for fast control loops to seconds for long-term operational transients.



Tuned for performance and efficiency

Level 1: System engineering

ABB's system engineering solution supports all 5 IEC61131-3 programming languages and uses ABB's Control Builder as the programming tool. This is the level on which system engineers implement functions that do not require high-speed performance but demand quick and easy adaptation to a specific project.

Level 2: Product & control development (Matlab/Simulink™)

Fast closed-loop control applications are designed using MATLAB® / Simulink®. C-code is automatically generated and downloaded to the embedded device using Real-Time Workshop® from Mathworks®. Typically, it is on this level that control developers will implement the control, the protection, the state machine and other functions.

Level 3: Communication and very fast logic (VHDL)

Extremely fast processes are programmed in VHDL. Protocols and some control logic requiring extremely short cycle times are implemented on this level.

Powerful hardware for efficient high-speed processing

The AC 800PEC combines the floating-point computing performance of the CPU with the flexibility and high speed capability of a Field Programmable Gate Array (FPGA). The system is separated into three performance levels covering different cycle times. Control tasks are allocated depending on their speed requirements:

- Very fast tasks down to 25 ns
- Fast tasks down to 100 µs
- Slow tasks down to 1 ms

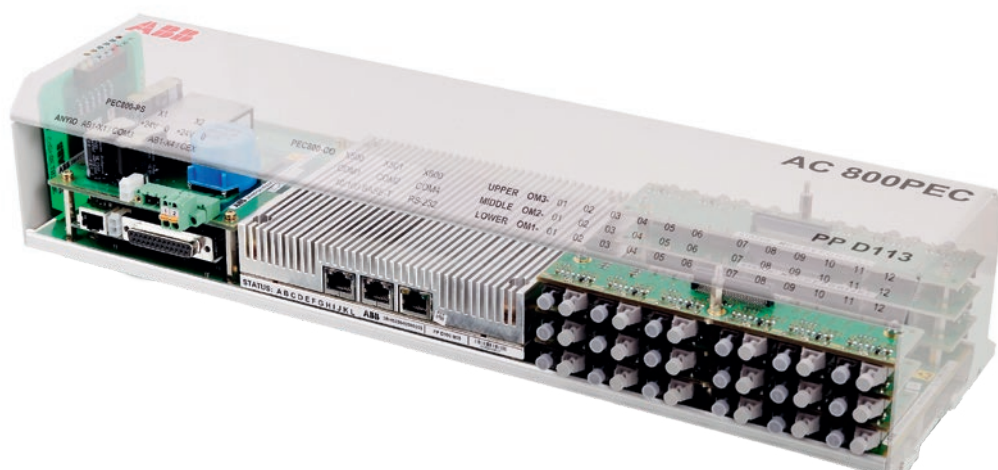
Seamless integration into plant control

In today's demanding market, a controller must not only deliver maximum performance but also provide transparency. In this respect, the AC 800PEC provides a large range of possibilities. Integrated communication ensures transparent, plant-wide data exchange and control – from overall plant control down to separate processes. Strict security procedures and effective firewalls prohibit unauthorized intrusions and ensure permanent system safety.

Embedded into a robust and flexible system structure with integrated standard communication, the AC 800PEC is unique in the field of industrial process controllers.

The AC 800PEC provides connectivity, using either native (built-in) or add-on functionality.

Example of ABB's AC 800PEC



Applications

Primary aluminium industry

DC power supplies for aluminium smelters

The primary aluminium smelter process requires reliable, highly efficient DC power supplies. Continuous availability is essential for a successful smelter operation. ABB, a worldwide leading supplier of rectifiers, has the experience and technical expertise to fulfill your requirements and to come up with the optimum solution. This outstanding reliability has been proven in over 100 aluminium smelters worldwide. Our technology offers you a technical solution that minimizes risk, provides total system integration and ensures a high return on investment.

DC power from ABB – reliable, efficient and safe

Having a reliable power supply implemented by highly efficient rectifiers minimizes operational costs. The safety of personnel is a high priority for all our systems. Although the cost of the power supply is minor compared to the total investment, a loss of power can result in a tremendous production loss.

Overall system supply

We take care of all aspects of planning, designing, manufacturing, testing, shipping, installing, site testing, and starting up the rectifier system.

State-of-the-art technologies like well-proven diode and thyristor rectifiers, current compensation loops and booster rectifiers, in combination with increased voltage levels and robust and reliable design, demonstrate our market-leading position and our thorough understanding of the aluminium smelting process.

ABB's success comes from the ability to develop highly customized integrated solutions that match our customers' most demanding specifications.

Enhance production

ABB designs and builds rectifiers to the highest quality standards. Our extensive industry experience enables us to understand your specific requirements. We provide a DC power supply that keeps your potlines running and enhances productivity.

Lowest cost of ownership

In an economic calculation of the operational cost of a rectifier system, various direct and indirect costs throughout the system's entire lifetime should be considered.

With ABB rectifiers you achieve the lowest total cost of ownership and boost your production through:

- maximized availability
- minimized losses
- minimized maintenance
- highest personnel safety
- longest lifetime
- global presence for service



Electric arc furnaces

DC power supply for steel, ferrochrome, titan-oxid, ferronickel and arc furnaces – Increasing power quality for faster return on investment (ROI).

The primary goal of any electric arc furnace operator is to minimize overall capital costs, optimize production line quality and maximize efficiency and revenue. A further requirement is smooth and gentle operation in order to boost the production line quality and lower the impact on the power grid. When it comes to power quality, power utilities can be very demanding, especially in the case of weak grids in remote locations.

That is why ABB offers an integrated system of DC power supplies for arc furnaces including power quality equipment that provides an unrivalled low life cycle cost to give you technical performance that boosts productivity and allows a fast ROI (Return On Investment) on your plant.

We design the power supply – you focus on the results

We design the power supply to achieve the required performance and take care of both, power quality and furnace power performance.

- Low electrode consumption thanks to extensive work in optimizing system regulation maximum arc stability

- Excellent power quality even under weak grid conditions
- Independent voltage and current control
- Maximum flexibility with respect to raw material types
- Robust and reliable design

Reasons for choosing ABB

- Customized rectifier, transformer and DC reactor system
- Maximum arc stability
- Intelligent control add-on packages for even higher electrode regulation performance
- Support throughout the full life cycle and access to our worldwide 24 x 7 support line
- Vast experience in various DC arc furnace applications
- Total power system simulation capability
- Integration of rectifier and power quality control equipment (e.g. SVC, SVC light, STATCOM) to enhance flicker performance



Electrowinning industry

Rectifiers for electrowinning processes – copper, zinc and other non-ferrous metals

ABB DC power supply to minimize overall capital costs and maximize productivity

The primary goal of any electrowinning plant operator is to minimize overall capital costs and maximize productivity and revenues.

In addition, maximum efficiency and reliability as well as trouble-free integration into the overall power system with minimum maintenance requirements under extreme environmental conditions are key deliverables in the extraction and refining of copper, zinc and other non-ferrous metals.

DC power from ABB – reliable, efficient and robust

The electrowinning industry is characterized by extraction plants located in some of the world's most remote and inaccessible regions and facing some of the most difficult and extreme climatic conditions.

Extreme heat or cold, dust, earthquakes and high altitudes do not allow any compromise on the ruggedness and reliability of the equipment.

As a leading worldwide supplier of rectifiers, ABB has the experience and expertise to fulfill demanding requirements with the MCR1000, which is best suitable but not limited to the following applications:

- Copper industry
- Magnesium smelters
- Zinc plants
- Graphite

Graphitization industry

DC power supplies for graphite electrode plants

ABB's high current rectifier product family offers nearly unlimited current and voltage possibilities and meets almost all plant specific requirements. These products are characterized by exceptional reliability, optimum design, easy accessibility, minimum maintenance and low losses.

The graphitization process demands a large variation of voltage and current from the DC power supply. The DC power supply should provide the constant power to the furnace irrespective of changing process resistance.

ABB has a great experience and expertise in delivering a maximum power density power supply unit for the given minimum space at the graphitization furnace shop. ABB also delivers mobile rectifier systems (on rails) from the incoming AC pantographs to DC disconnect to feed the several furnace lines. The power supply train is designed to withstand the harsh industrial environment such as carbon dust and extreme temperatures being close to the furnace. Special care is taken to ensure higher system efficiency and lower impact on the power quality.

Chlor-alkali industry

DC power supplies for electrochemical processes like chlor-alkali

Continuous operation is crucial for a successfully operating of electrochemical plants. Then, not only is the production output maximized, but the overall capital cost is minimized and the return on investment is clearly in the owner's favor. That is why ABB offers integrated systems of DC power supplies for electrochemical processes that provide unrivalled availability and uptime in combination with the market's lowest life cycle cost.

DC power from ABB – equipment you can trust

The electrochemical industry is characterized by an aggressive and corrosive environment that is very threatening for the electrical equipment. Compromises on the ruggedness and reliability of the equipment are not permitted. Although the investment for the DC power supply is minor compared to the total plant cost, a loss of power results in tremendous loss in production and increased maintenance cost. As a leading worldwide supplier of rectifiers, ABB has the experience and technological expertise to fulfill your demanding requirements. Attention to detail through many years of experience has given us deep knowledge of all components of a DC power supply for a chlor-alkali system. Our solutions are based on a total quality program, perfectly fitting a specific plant.

Total system design

The focus of our expertise and experience is on designing complete rectifier systems. This means that our knowledge goes far beyond the rectifier itself. In fact we also supply transformers, filter banks, busbars, DC isolators, switchgear and many other electrical equipment you may require. We take care of all aspects of planning, installation and successful start-up of the rectifier system based on the knowledge acquired by executing hundreds of projects.



Services

Performance review

With more than 100 years of experience, ABB is your partner for reliable equipment and a successful future. We know how to ensure safety and reliability for your complete high power rectifier system that is essential to your success – from start-up and commissioning through its entire life cycle.

ABB has created a performance review program for high power rectifiers to increase the reliability of your assets. This results in maintaining all elements suffering from aging effects. We assess your system and critical spare parts to evaluate the life cycle status. Those components which are susceptible to aging are replaced at appropriate intervals. Furthermore, this program ensures the correct and safe operation of the system by testing all critical protection devices and system settings in various operating conditions.

ABB identifies possible improvements to increase the overall performance of your system.

The performance review is offered in all phases of the life cycle. We have the ability to define an optimal operation strategy based on the results of the performance review, always considering the life cycle of your assets.

Upgrades and replacements

Extend the lifetime of your system with new technology.

As an alternative to extensive spare part investments and maintenance programs, ABB's upgrades are time and cost effective solutions improving the performance and extending the life cycle of operational equipment.

Control upgrade

The control platform of a high power rectifier contains very specialized electronic equipment. In an age of rapid technological progress, such equipment can become obsolescent earlier than the rest of the equipment. This obviously restricts the life cycle of the whole rectifier system. Thanks to ABB's experience, we can perform a control upgrade with a minimum of shutdown time. You will benefit from a state-of-the-art controller and therefore extend the lifetime of your asset. In addition our full service product portfolio is guaranteed as defined in our Product Life Cycle Management model.

Rectifier group upgrades

In addition to offering upgrades for the rectifier power electronics parts, replacements of sub-systems such as cooling units and measurement systems are also available. This enables us to increase the efficiency of your equipment and also to extend its lifetime.

Performance review

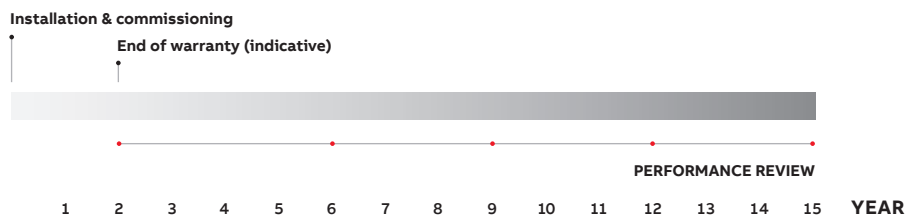
Key benefits

- Increasing the reliability of your asset
- Ensuring the correct and safe operation of your system
- Minimizing risk exposure to unexpected downtime
- Identifying possible system improvements

Upgrades and replacements

Key benefits

- Optimized asset performance
- Increased maintainability of your equipment
- Long-term availability of spare parts
- Minimum shutdown and commissioning time
- Re-use of customer terminals and busbars
- Long-term availability of engineering and support competences



Site services

Site services

Key benefits

- Providing immediate response and field support
- Availability of a global network of certified and experienced engineers
- Advanced diagnostic and repair practices

Service contract

Key benefits

- Fast response time
- Reduced investment risk
- Individual technical support through highly experienced and skilled engineers to reduce downtime
- Pro-active life cycle management will support your system availability and lower your total life cycle cost

The key to providing world-class services is not only to respond quickly, but also to guarantee high competence and professionalism.

Our certified field service engineers play an essential role in ensuring a professional and timely start-up as well as optimized adjustments to your equipment.

Commissioning and installation

Commissioning and installation services are available to meet customer needs anywhere in the world, regardless of the size or complexity of all products offered.

Preventive maintenance

Preventive maintenance programs maximize the performance of your equipment. ABB service personnel are trained in the latest diagnostic, repair and maintenance methods to ensure high value for your maintenance investment.

Repairs and troubleshooting

Investigated and fixed as quickly as possible, customer problems are treated with top priority. Our field support provides a full range of services in case of technical problems to fulfill your facility's needs. Besides advanced troubleshooting, our field service engineers carry out detailed failure investigations, data collection and replacement of components and spare parts.

Service contract

A service contract is a flexible and cost effective way to realize the benefits of ABB's product, system, application and process expertise.

Support line

ABB offers professional product support for all types of systems. The support line offers one general entry point for all technical issues. Managed by experienced former field service engineers, the support line helps you to reduce the downtime of systems through fast and precise technical support.

Emergency support

In the event of emergency issues outside our office hours, there is a hotline service operated 24/7, 365 days a year. During office hours this hotline is served by our support line. Outside of office hours our specialists will answer phone calls for first support and collect information to ensure a fast response.

Remote services

Remote services allow real-time access to system data. Long-term monitoring functions deliver important information on equipment status, upcoming service tasks, and input for possible performance improvements. The remote monitoring option allows secure access to the system from any location in the world.





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