



Data center cooling

Taking uptime, sustainability
and energy efficiency to a new
level

Improving data center performance through efficient energy use, increased reliability and advanced maintenance

The world depends increasingly on data, computing power and connectivity, making data centers mission-critical facilities requiring special attention. ABB provides data centers with reliable, flexible and secure operation. Its solutions ensure continuous availability while helping to improve performance in a productive and sustainable way.



System reliability and process continuity



“We need to keep data centers up and running, no matter what.”

Tackle air conditioning demands...

- Air conditioning is critical for server operation due to IT equipment's sensitivity to heat, humidity and dust.

... using best-in-class technology

- ABB's Variable frequency drive (VFDs) help maintain a favorable environment to avoid server failures and maximize IT equipment uptime.
- With ABB's standby generators, power is always available for servers and engineering systems during emergency situations.

Conform to industry standards...

- Data center equipment and engineering systems must meet the highest levels of infrastructure reliability and redundancy to sustain continuous operation.

... with solutions that build trust

- ABB's VFDs, motors and generators meet data centers' highest reliability and security standards.
- Ultra-low harmonic drives comply with the strictest harmonic requirements power quality issues.
- Drives' compliance with power-loss-ride-through standards secures operation during short power outages.
- VFDs withstand high vibrations fulfilling seismic standards of international building codes to ensure smooth data center operation even during earthquakes.



Energy efficiency and sustainability



“How can I cut our energy bill and carbon footprint.”

Find the big energy users...

- On average, the cooling system accounts for 40 percent of energy consumed by a data center.
- Server load varies depending on multiple factors and the cooling system must adjust accordingly.
- Power Usage Effectiveness (PUE) is a ratio of the total power consumed by a data center to the power consumed by IT equipment. The more efficient the data center's engineering networks, the closer is the PUE to 1.

... and unlock the saving potential

- VFDs replace throttling or bypass valves for better flow control, resulting, on average, in 20 to 60 percent energy savings for the air conditioning system, while improving the data center's PUE.
- Upgrading to IE4 or IE5+ (super premium and ultra premium) efficiency class motors significantly reduces energy consumption.
- ABB Ability™ Smart Sensors for motors, as well as VFD energy counters, help analyze energy use and implement improvements for the entire system.



Security



“Data center servers and engineering systems, must be protected from unauthorized access or cyber-attacks.”



Operation and maintenance



“I choose the most reliable solutions to avoid unplanned shutdowns.”

Capitalizing on the digital era...

- Modern automation and control systems are often interconnected, which makes them vulnerable compared to isolated systems. Cloud connection further adds to a system's vulnerability.
- Denial-of-Service (DoS) attacks and malware are all too common and have already impacted industrial control systems.
- VFDs enable remote (wired and wireless) operation and monitoring capabilities which increases the importance of hindering unauthorized access to automation systems.

... with data-secure solutions for processes and applications

- For VFD cyber security, parameter value change and software loading can be protected by a password.
- ABB software tools establish communication only with “recognized devices” like ABB VFDs or gateways.
- The ABB Ability™ Condition Monitoring for drives and remote assistance services meet strict cyber security standards in compliance with ABB test and verification procedures.
- As a member of IEEE and IEC, ABB recognizes the importance of cyber security standards. It makes sure that the needs of customers are considered when developing new standards. ABB also incorporates new standards into its products and systems, helping customers comply with upcoming regulations.

Eliminate operating process risks...

- Data center shutdowns are costly and result in business disruption and reputation damage.

... by utilizing smart functionality

- Temperature, overload, overcurrent, under/overvoltage and other protection features and warnings within VFDs help prevent failures in air conditioning system control.
- A VFD's real-time clock allows timed tracking of faults, so you know what happened and when.
- Ultra-low harmonic drives protect power quality in the data center network, making the power system and equipment more resilient.

“How can I control rising costs?”

Lower operational overheads...

- Operational costs can be optimized without compromising data center operation continuity.

... through advanced solutions and maintenance regimes

- Ultra-low harmonic drives save money by maintaining unity power factor and therefore eliminating reactive power penalties from the utility.
- ABB Ability™ Condition Monitoring service delivers real-time information about VFD and motor events and proposes targeted maintenance actions when needed, eliminating regular inspections.
- ABB Ability™ Energy Optimization for drives and motors analyzes the energy savings potential in data centers.
- Global service network and preventive maintenance contracts relieve pressure on in-house teams and increase speed of response to critical issues.

Air and power quality for increased data center reliability

Maintaining an optimal computer room environment, as well as a clean power network, helps sustain a data center's continuous and efficient operation.

1 COOLING ENERGY GENERATION

Cooling is required to maintain the indoor environment suitable for computing equipment operation

Applications:

- Central chillers including compressors, circulation pumps, condenser fans and cooling towers

Requirements:

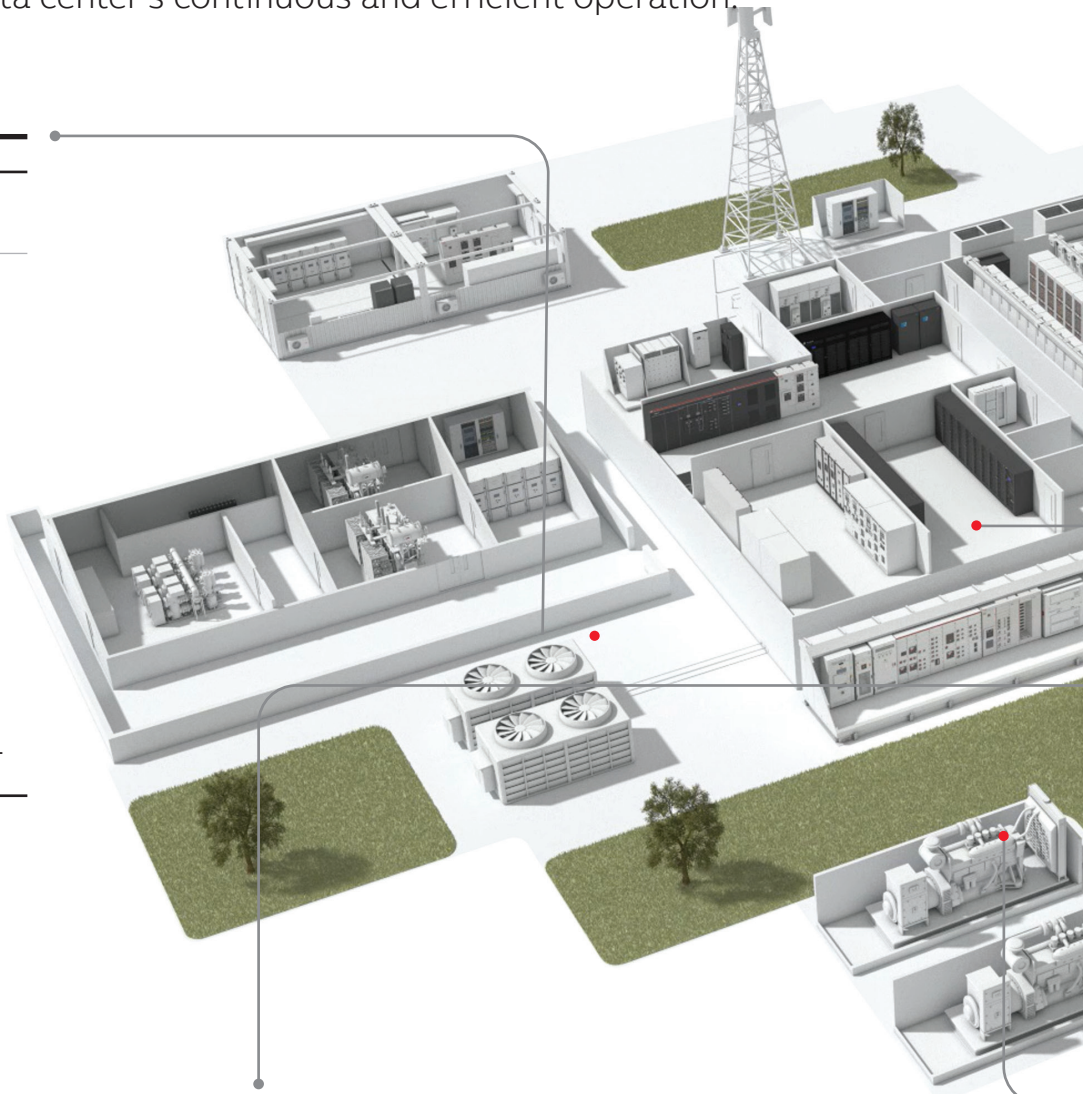
- Reliable control of fans, pumps and compressors even in communication loss situations
- Equipment redundancy to ensure cooling process continuity
- Minimized harmonic disturbances to the electric network impacting system and equipment reliability
- Increased energy efficiency through adjusting fan/pump/compressor speed in accordance to current need
- Reduced mechanical stresses on cooling equipment and piping system
- Condition monitoring for the powertrain components – drives, motors and pumps – for increased uptime

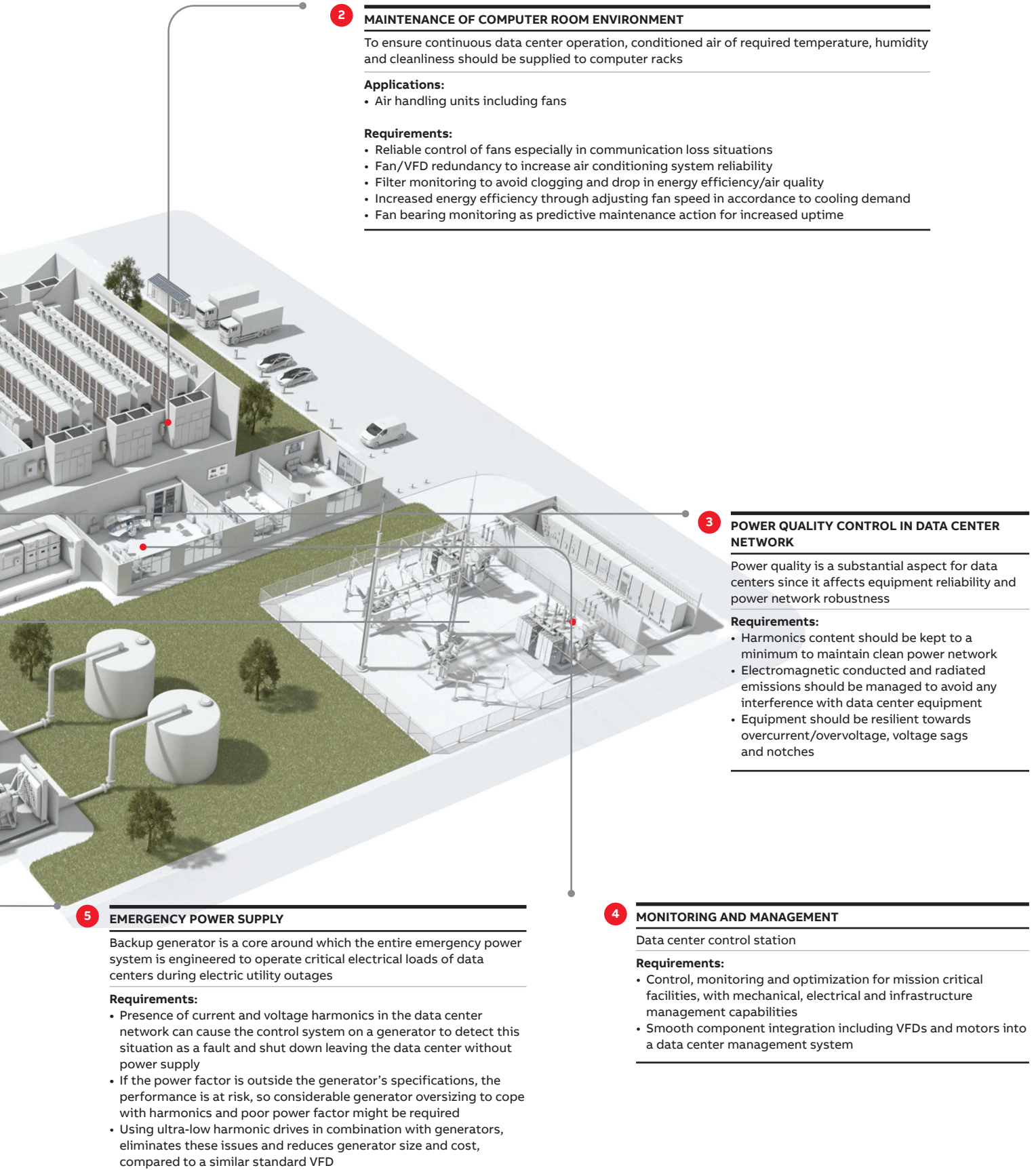
6 TRANSFORMING THE VOLTAGE LEVEL

Transformers step down voltage to the level of data center power network

Requirements:



- Harmonics present in the data center power network increase the core and winding losses of the transformer and reduce its efficiency. They also increase the stress on the transformer insulation leading to premature failures
- VFDs with high harmonic content can lead to transformer oversizing. Using VFDs with built-in harmonics mitigation allows transformers of a smaller size and therefore lower cost








Unlock the potential of data center cooling applications

Alongside cooling reliability, energy savings and security, there are many other benefits from using Variable frequency drive and high efficiency motor technologies on motor-driven applications.

	Challenge	Solution	Benefit
 Fans in CRAH or CRAC units	<ul style="list-style-type: none"> Fan/CRAH uptime 	<ul style="list-style-type: none"> VFD protection includes overcurrent, overvoltage, motor overheating and overload control Smart sensors collect information on fan bearing performance enabling predictive maintenance 	<ul style="list-style-type: none"> Reduced cooling system downtime and increased reliability
	<ul style="list-style-type: none"> High energy consumption 	<ul style="list-style-type: none"> Highly efficient motor-drive package with efficiency above IE4/NEMA super premium 	<ul style="list-style-type: none"> Typically, between 20 to 60 percent energy savings compared to damper control system
	<ul style="list-style-type: none"> Harmonics generated by fan speed control solutions can cause problems for the power network and connected equipment including stand-by generators 	<ul style="list-style-type: none"> Ultra-low harmonic drives keep harmonics content to a minimum 	<ul style="list-style-type: none"> No issues associated with harmonics including energy losses and unexpected power network shutdowns No extra costs due to oversized cables, transformers, generators to avoid harmonics related issues
	<ul style="list-style-type: none"> Computer room micro-climate maintenance 	<ul style="list-style-type: none"> Variable frequency drive: <ul style="list-style-type: none"> - Control airflow and cooling liquid flow through controlling pumps/control valves in humidification equipment - Monitor filter condition and alarm if the filter is dirty so it can be timely cleaned 	<ul style="list-style-type: none"> Properly maintained temperature, humidity and air cleanliness in server rooms prolong IT equipment lifetime and helps avoid shutdowns due to overheating, static discharges, corrosion of metal components
	<ul style="list-style-type: none"> BMS control reliability 	<ul style="list-style-type: none"> Control backup in VFDs – in case of external communication loss, VFDs can take over control 	<ul style="list-style-type: none"> CRAH unit will continue running at preset for local control speed until the external communication is recovered
	<ul style="list-style-type: none"> System restart after switchover from utility supply to generator and back 	<ul style="list-style-type: none"> Auto restart feature allows VFD to restart automatically after a short power supply failure 	<ul style="list-style-type: none"> No action on restarting the VFD and bringing the system back to normal operation needed
	<ul style="list-style-type: none"> Smoke management and personnel/equipment fire protection 	<ul style="list-style-type: none"> VFD features fireman's override mode which makes ventilation system behave in a pre-selected manner 	<ul style="list-style-type: none"> Data center operation continuity while keeping the personnel safe and the asset damage to a minimum
	<ul style="list-style-type: none"> High fan installation cost 	<ul style="list-style-type: none"> One VFD can control several fans in array 	<ul style="list-style-type: none"> Reduced installation cost while ensuring required redundancy level
	<ul style="list-style-type: none"> High fan maintenance or replacement cost in case of integrated speed control solutions e.g. EC fans 	<ul style="list-style-type: none"> Standalone VFDs 	<ul style="list-style-type: none"> Multi-motor to drive configurations offer a modular option that reduces replacement costs
 Pumps	<ul style="list-style-type: none"> Pump uptime 	<ul style="list-style-type: none"> VFD supervisory functions indicate upcoming mechanical failures like bearing wear Smart sensors measure vibration and temperature for pump performance monitoring 	<ul style="list-style-type: none"> Reduced cooling system downtime and increased reliability
	<ul style="list-style-type: none"> High energy consumption. 	<ul style="list-style-type: none"> VFDs bring energy savings for pumps: with half the speed only 1/8 power is needed 	<ul style="list-style-type: none"> Typically, between 20 to 60 percent energy savings compared to throttle control system
	<ul style="list-style-type: none"> Direct-on-line starting creates pressure shocks damaging pumps, seals, pipe joints and valves 	<ul style="list-style-type: none"> VFD's soft pump start and stop helps avoid pressure peaks and water hammer 	<ul style="list-style-type: none"> Increased lifetime of pump and piping system and decreased operating costs.
	<ul style="list-style-type: none"> Pipe leakage or pipe blockage 	<ul style="list-style-type: none"> VFD identifies if the pressure in a pipe increases to a maximum/drops to a minimum and sends an alarm 	<ul style="list-style-type: none"> The motor, pump, or piping system won't get damaged when the pipe is blocked Flood monitoring helps avoid severe server and infrastructure damage due to pipe burst



01

	Challenge	Solution	Benefit
 Chillers	<ul style="list-style-type: none">Chillers/compressors are the biggest single energy consumers	<ul style="list-style-type: none">Highly efficient motor-drive package with efficiency above IE4/NEMA super premiumInterlinking compressor control with condenser water pump and cooling tower fan for optimized efficiency	<ul style="list-style-type: none">Saving significant energy costs as right compressor speed achievedHigher system efficiency and better data center PUE
	<ul style="list-style-type: none">Harmonics generated by compressor speed control solutions can cause power interruptions and downtime	<ul style="list-style-type: none">Ultra-low harmonic drives with harmonic mitigation built-in	<ul style="list-style-type: none">No energy losses due to overheating and unexpected power network shut-downsNo extra costs associated with harmonic mitigation equipment or over-dimensioned transformers/cables
	<ul style="list-style-type: none">Resonance	<ul style="list-style-type: none">VFD's resonance control feature	<ul style="list-style-type: none">Elimination of increased vibrations leading to premature failures and negative acoustic effects
	<ul style="list-style-type: none">Compressor control optimization through scalability	<ul style="list-style-type: none">Multi-compressor control – when heat load cannot be covered by a running compressor, new compressor starts	<ul style="list-style-type: none">Best system efficiency, redundancy and minimal wear on individual compressors improving lifecycle costs
	<ul style="list-style-type: none">Ultimate reliability of compressor operation	<ul style="list-style-type: none">VFDs ensure soft start and stop eliminating mechanical and electrical stress of system components	<ul style="list-style-type: none">Reliable operation, longer equipment lifetime and reduced total cost of ownership
 Cooling towers	<ul style="list-style-type: none">Gearbox failures, oil leaks, misaligned drive shafts and vibration in traditional cooling tower systems containing a motor, drive shaft and gearbox	<ul style="list-style-type: none">ABB provides a direct drive motor and VFD package for cooling towers, eliminating the need for a gearbox and associated components	<ul style="list-style-type: none">Reduced maintenance time and costLonger life as motors have up to five times the life expectancy of gearboxesFast installation and high efficiencyReduced noise
 Humidifiers	<ul style="list-style-type: none">Required humidity level maintenance in computer rooms	<ul style="list-style-type: none">VFDs for controlling humidifier pumps	<ul style="list-style-type: none">VFDs maintain required humidity level through controlling pumps/valves in humidifiers eliminating the risk of static discharge causing failure of sensitive devices

02



- 01 Server equipment is sensitive towards temperature, humidity and dust
- 02 VFDs help maintain favorable environment for better server equipment performance and longer lifetime

Features and functions benefiting data centers

VFDs, motors and generators all play a vital role in keeping fluids moving in air conditioning systems. Choosing the right product features for such a demanding sector as data centers is essential in ensuring reliable and efficient operation while minimizing risks.



Variable frequency drive

Built-in redundancy

- External communication loss is handled seamlessly by VFD taking control. Application continues running in preset for local control mode until the external communication is recovered.

Protection features and robustness

- Coated boards, earth fault protection, overcurrent and undervoltage control contribute to cooling process reliability. Every VFD is factory-tested, verifying its performance.

Low harmonics

- Built-in active supply unit and integrated low harmonic line filter eliminate power supply disturbances that can interrupt data center operation.

Security

- Parameter value change and software loading can be protected by a password as part of VFD cyber security.

Energy efficiency

- Energy Optimizer feature improves energy use further by reducing motor iron losses.

Support of various communication protocols

- Communication capability ensures VFDs are integral part of a data center management system.

Flying start

- Reduces wear and saves time by starting a motor while the load is still spinning.

Automatic restart

- VFD restarts automatically after a short power supply outage e.g. when switching from utility supply to generator and back.



Power-loss-ride-through or undervoltage control

- Makes sure the VFD will continue to operate if the supply is cut off, as long as the motor rotates and generates energy to the VFD.

Built-in PID controls

- Control several air conditioning processes without employing external PLCs, eliminating infrastructure complexity and costs.

Multi-pump functionality

- Supports data center scalability allowing to interlink up to 8 pumps for optimized flow rate and efficiency.

Fireman's override mode

- Makes the VFD part of a data center fire suppression system protecting servers and personnel in case of emergency.



Drive and motor packages

Synchronous reluctance motor and drive

- Save energy across the full load cycle with tested and certified inverter duty motors exceeding IE4/NEMA super premium and drive packages.

Cooling tower packages

- An integrated solution that removes the gearbox and driveshaft from cooling towers reducing energy use, vibration, noise and maintenance costs.





Inverter duty motors

High reliability

- Suitable for inverter use per NEMA MG1 Part 31.4.4.2
- Internally mounted bearing protections ring or brush to help mitigate shaft currents
- Motors used outdoor have severe duty construction (IP55+)

Efficiency

- Baldor-Reliance motors meet and exceed all efficiency requirements for US, Canada and Mexico regulations
- IE5+ efficient EC Titanium and Critical Cooling are specially designed for data center use

Critical Cooling motors

- Specially designed for data centers and other mission-critical facilities
- Lifetime warranty against bearing failure from shaft currents
- Hybrid ceramic bearing installed on both motor ends
- IE5+ ultra premium efficiency

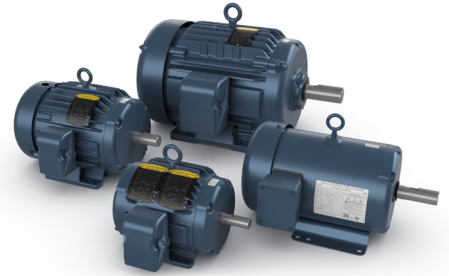


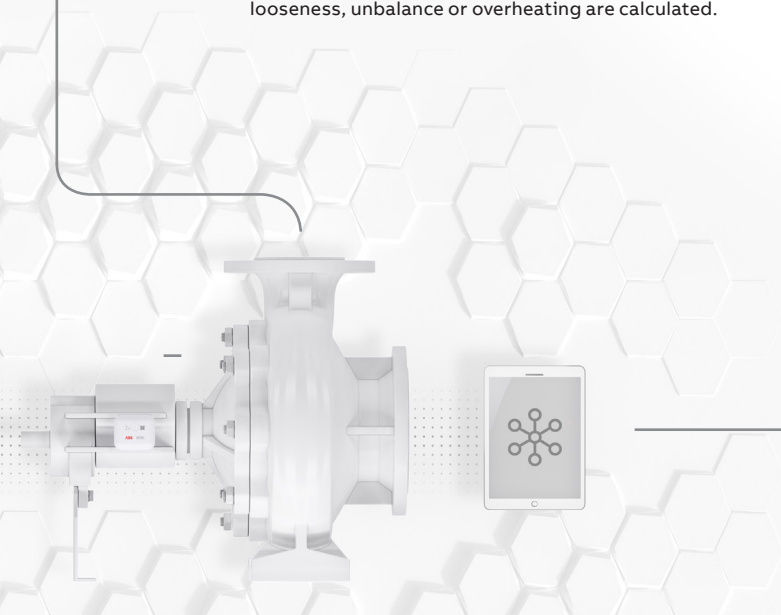
ABB Ability™ Smart Sensors

Smart Sensor for motors

- Converts traditional motors into smart, wireless connected devices.
- Picks up data on vibration, temperature and other parameters to gain information on motor overall performance.
- Helps to identify potential for energy savings, reduce risks related to unexpected breakdowns, extend equipment lifetime and lower maintenance costs.

Smart Sensor for pumps

- Measures vibration and temperature from the surface of the pump to gain information on the pump's performance.
- Based on the measurements, health indicators for detecting cavitation, bearing failure, blade problems, looseness, unbalance or overheating are calculated.



From the facility to the cloud and beyond

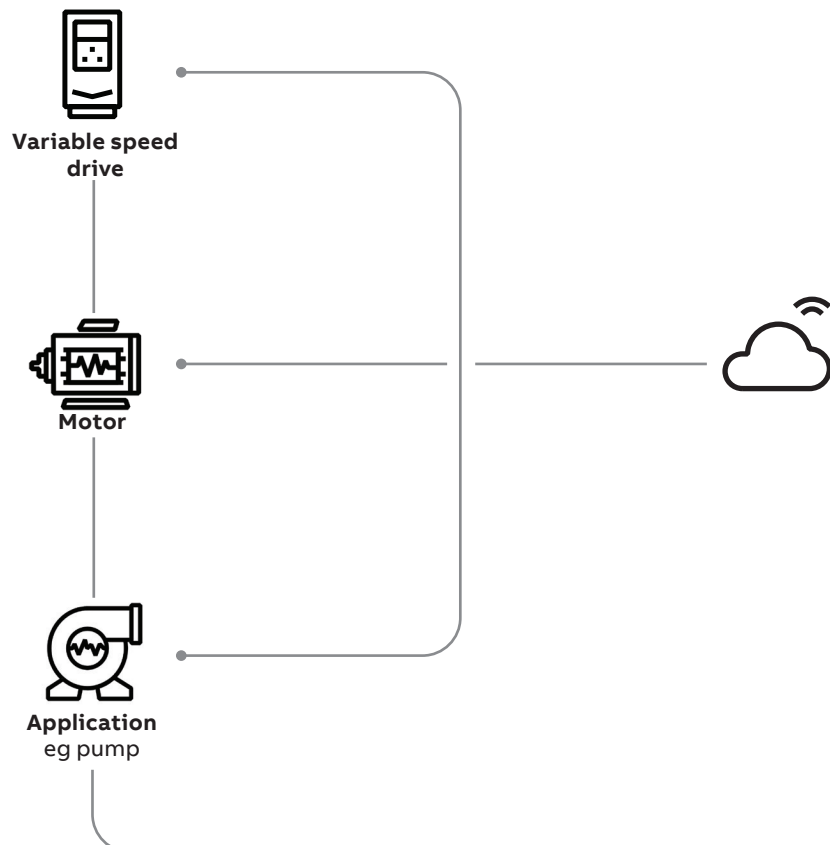
ABB Ability™ Condition Monitoring for powertrains optimizes the performance and efficiency of rotating equipment. It enables full transparency on all parameters for VFDs, motors and applications like pumps.

1 Intelligent powertrain

The powertrain is equipped with sensors and cloud connectivity and can comprise motors, drives and applications like pumps.

2 Turning data into valuable information

Data gathered from VFDs' built-in sensors and loggers, together with that collected from ABB Ability™ Smart Sensors fitted to motors, and pumps, can be collated, stored and further accessed via the cloud. The ability to gather and analyze this data can reveal information on the status and condition of your equipment, so that you can schedule proactive service.



3 Accessing data for analytics

You have access to a monitoring portal to view key operational parameters of individual assets as one unified system. Detailed dashboards give full transparency so that you can take actions that lead to less downtime, extended equipment lifetime, lower costs, safer operations and increased profitability.



4 Gain a digital advantage

Ensuring that the right person has the right information at the right time brings:

- Appropriate response to process challenges, minimizing operating costs.
- Greater insight into various aspects of the process, thereby improving system performance.
- Lower risk of process failure and change the maintenance from reactive to predictive.

Operation and maintenance



Energy efficiency and sustainability



Security



System reliability and process continuity



Keep your facility running

From spare parts and technical support to cloud-based remote monitoring solutions, ABB offers the most extensive service offering to fit your needs. The global ABB service units complemented by external Value Providers form a service network on your doorstep. Maximize performance, uptime and efficiency throughout the life cycle of your assets.

With you every step of the way

Even before you buy a generator, drive, motor, or softstarter, ABB's experts are on hand to offer technical advice from dimensioning through to potential energy saving.

When you've decided on the right product, ABB and its global network of Value Providers can help with installation and commissioning. They are also on hand to support you throughout the operation and maintenance phases of the products life cycle, providing preventive maintenance programs tailored to your facility's needs.

ABB will ensure you are aware of any upgrades or retrofit opportunities. If you've registered your drives and motors with ABB, then its engineers will proactively contact you advising on your most effective replacement option. All of which helps maximize performance, uptime and efficiency throughout the lifetime of your powertrain.



Replacements

Fast and efficient replacement services to minimize system downtime



End-of-life services

Responsible dismantling, recycling and reusing of products, according to local laws and industrial standards



Maintenance

Systematic and organized maintenance and support over the life cycle of your assets





With you, wherever you are in the world

Partnering with ABB gives you access to some of the world's most innovative technology and thinking.

Global reach

ABB operates in over 100 countries with its own manufacturing, logistics and sales operations together with a wide network of local channel partners that can quickly respond to your needs. Stock availability is good, with short delivery times for many products backed by 24-hour spare parts delivery.

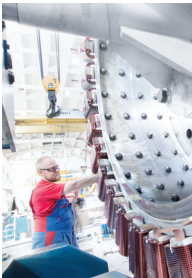
In addition, ABB interacts closely with data center industry players including consultants, system integrators, owners and facility managers to help increase data center uptime to an absolute maximum, eliminate risks and improve PUE.

ABB has seven global R&D centers with more than 8,000 technologists and invests \$1.5 billion annually on innovation.

End-to-end product portfolio

Alongside its diverse portfolio of VFDs, motors and generators, ABB offers data centers:

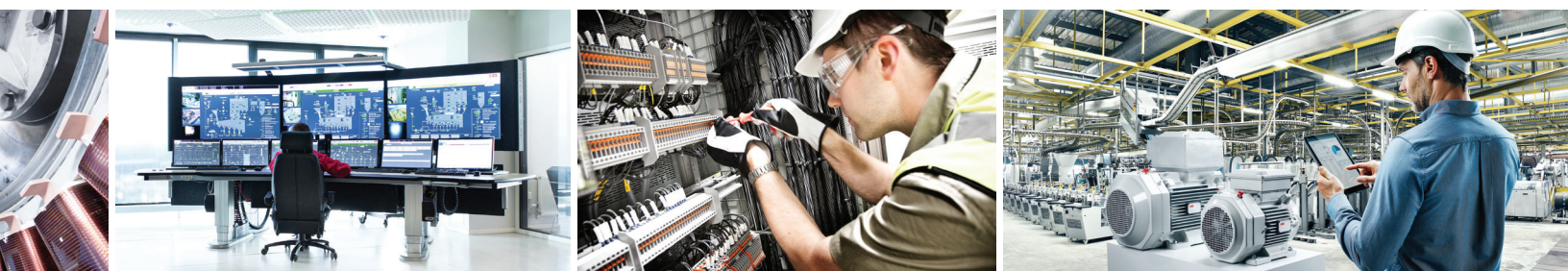
- Medium voltage components and systems such as air- and gas-insulated switchgears, uninterruptible power supply units, relays, ultra-fast earthing switches, Is-limiters to reduce high short-circuit currents and more.



- Low voltage components and systems such as switchgears, uninterruptible power supply units, breakers, industrial plugs and sockets, RCD blocks, power distribution units, remote power panels, a wide range of scalable PLCs and HMIs and more.
- Digital solutions including ABB Ability™ cross-product and system offering providing intelligence all the way to the component level, improving overall visibility and making the system simple, reliable and sustainable.

Streamline sourcing

ABB's end-to-end product and services portfolio streamlines your sourcing and purchasing activities and standardizes processes across multiple sites, saving you money on spare part inventories while reducing maintenance costs.





For more information, please contact your local ABB representative or visit

solutions.abb/us-drives-hvac

new.abb.com/service/motion

www.baldor.com/brands/baldor-reliance/products/motors/ac-motors/hvac

new.abb.com/buildings/smarter-building

new.abb.com/data-centers

