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.

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

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
- VSDs 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 efficiency class motors significantly reduces energy consumption.
- ABB Ability™ Smart Sensors for motors, as well as VSD energy counters, help analyze energy use and implement improvements for the entire system.

Energy efficiency and sustainability

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

Security

System reliability and process continuity

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

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

Operation and maintenance

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

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 VSD and motor events and proposes targeted maintenance actions when needed, eliminating regular inspections.
  - ABB Ability™ Energy Optimization service designs the energy savings potential in data centers.

Energy efficiency and sustainability

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

“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.
- VSDs enable remote (wired and wireless) operation and monitoring capabilities which increases the importance of hindering unauthorized access to automation systems.

…and with data-secure solutions for processes and applications
- For VSD 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 VSDs 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.

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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 VSDs help prevent failures in air conditioning system control.
  - A VSD’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.
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.

**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

**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, couplings, pumps - for increased uptime

**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
- VSDs with high harmonic content can lead to transformer over-sizing. Using VSDs with built-in harmonics mitigation allows transformers of a smaller size and therefore lower cost

**POWER QUALITY CONTROL IN DATA CENTER NETWORK**

Power quality is a substantial aspect for data centers since it affects equipment reliability and power network robustness

**Requirements:**
- Harmonics content should be kept to a minimum to maintain clean power network
- Electromagnetic conducted and radiated emissions should be managed to avoid any interference with data center equipment
- Equipment should be resilient towards overcurrent/overvoltage, voltage sags and notches

**MAINTENANCE OF COMPUTER ROOM ENVIRONMENT**

To ensure continuous data center operation, conditioned air of required temperature, humidity and cleanliness should be supplied to computer racks

**Applications:**
- Air handling units including fans

**Requirements:**
- Reliable control of fans especially in communication loss situations
- Fan/VSD redundancy to increase air conditioning system reliability
- Filter monitoring to avoid clogging and drop in energy efficiency/air quality
- Increased energy efficiency through adjusting fan speed in accordance to cooling demand
- Fan bearing monitoring as predictive maintenance action for increased uptime

**EMERGENCY POWER SUPPLY**

Backup generator is a core around which the entire emergency power system is engineered to operate critical electrical loads of data centers during electric utility outages

**Requirements:**
- Presence of current and voltage harmonics in the data center network can cause the control system on a generator to detect this situation as a fault and shut down the data center without power supply
- If the power factor is outside the generator’s specifications, the performance is at risk, so considerable generator oversizing to cope with harmonics and poor power factor might be required
- Using ultra-low harmonic drives in combination with generators, eliminates these issues and reduces generator size and cost, compared to a similar standard VSD

**MONITORING AND MANAGEMENT**

Data center control station

**Requirements:**
- Control, monitoring and optimisation for mission critical facilities, with mechanical, electrical and infrastructure management capabilities
- Smooth component integration including VSDs and motors into a data center management system
Unlock the potential of data center cooling applications

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

<table>
<thead>
<tr>
<th>Challenge</th>
<th>Solution</th>
<th>Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fans in CRAH or CRAC units</td>
<td>VSD protection includes overcurrent, overvoltage, motor overheating and overload control</td>
<td>Reduced cooling system downtime and increased reliability</td>
</tr>
<tr>
<td>• Fan/CRAH uptime</td>
<td>VSDs bring energy savings for pumps; half the speed only 1/8 power is needed</td>
<td>Reduced cooling system downtime and increased reliability</td>
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<td>• High energy consumption</td>
<td>VSDs bring energy savings for pumps; with half the speed only 1/8 power is needed</td>
<td>Typically, between 20 to 60 percent energy savings compared to damper control system</td>
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<td>• Harmanics generated by fan speed control solutions can cause problems for the power network and connected equipment including stand-by generators</td>
<td>Ultra-low harmonic drives keep harmonics content to a minimum</td>
<td>No issues associated with harmonics including energy losses and unexpected power network shutdowns</td>
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<tr>
<td>• Computer room micro-climate maintenance</td>
<td>Variable speed drives: - Control airflow and cooling liquid flow - Help maintain required humidity level through controlling pumps/control valves in humidification equipment - Monitor filter condition and alarm if the filter is dirty so it can be timely cleaned</td>
<td>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</td>
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<td>• BMS control reliability</td>
<td>Control backup in VSDs – in case of external communication loss, VSDs can take over control</td>
<td>CRAH unit will continue running at preset local control speed until the external communication is recovered</td>
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<td>• System restart after switchover from utility supply to generator and back</td>
<td>Auto restart feature allows VSD to restart automatically after a short power supply failure</td>
<td>No action on restarting the VSD and bringing the system back to normal operation needed</td>
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<tr>
<td>• Smoke management and personal/equipment fire protection</td>
<td>VSD features Freddie’s override mode which makes ventilation system behave in a pre-selected manner</td>
<td>Data center operation continuity while keeping the personnel safe and the asset damage to a minimum</td>
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<td>• High fan installation cost</td>
<td>One VSD can control several fans in array</td>
<td>Reduced installation cost while ensuring required redundancy level</td>
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<tr>
<td>• High fan maintenance or replacement cost in case of integrated speed control solutions e.g. EC fans</td>
<td>Standalone VSDs</td>
<td>VSDs mounted separately with motors eliminate a need for complete fan unit replacement in case of component failure which significantly reduces the cost</td>
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<td>Pumps</td>
<td>VSD supervisory functions indicate upcoming mechanical failures like bearing wear</td>
<td>Reduced cooling system downtime and increased reliability</td>
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<td>• Pump uptime</td>
<td>VSDs bring energy savings for pumps; with half the speed only 1/8 power is needed</td>
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<td>• Direct-on-line starting creates pressure shocks damaging pumps, seals, pipe joints and valves</td>
<td>VSD’s soft pump start and stop helps avoid pressure peaks and water hammer</td>
<td>Increased lifetime of pump and piping system and decreased operating costs.</td>
</tr>
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<td>• Pipe leakage or pipe blockage</td>
<td>VSD identifies if the pressure in a pipe increases to a maximum/drops to a minimum and sends an alarm</td>
<td>The motor, pump, or piping system won’t get damaged when the pipe is blocked</td>
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<td>Chiller/Compressors</td>
<td>• Chillers/compressors are the biggest single energy consumers</td>
<td>Highly efficient motor-drive package with efficiency above IE4/NEMA Super premium</td>
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<tr>
<td>• Harmonics generated by compressor speed control solutions can cause power interruptions and downtime</td>
<td>Ultra-low harmonic drives with harmonic mitigation built-in</td>
<td>No energy losses due to overheating and unexpected power network shut-downs</td>
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<tr>
<td>• Harmanics generated by fan speed control solutions can cause power interruptions and downtime</td>
<td>VSD’s resonance control feature</td>
<td>Elimination of increased vibrations leading to premature failures and negative acoustic effects</td>
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| Cooling towers | • Gearbox failures, oil leaks, misaligned drive shafts and vibration in traditional cooling tower systems containing a motor, cardan drive shaft and gearbox | ABB provides a direct drive motor and VSD package for cooling towers, eliminating the need for a gearbox and associated components |
| • Ultimate reliability of compressor operation | VSDs ensure soft start and stop eliminating mechanical and electrical stress of system components | Reliable operation, longer equipment lifetime and reduced total cost of ownership |

| Humidifiers | Required humidity level maintenance in computer rooms | VSDs for controlling humidifier pumps | VSDs maintain required humidity level through controlling pumps/valves in humidifiers eliminating the risk of static discharge causing failure of sensitive devices |

G5 Server equipment is sensitive towards temperature, humidity and dust. G2 VSDs help maintain favorable environment for better server equipment performance and longer lifetime.
Features and functions benefiting data centers

VSDs, 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 speed drives

- **Built-in redundancy**
  - External communication loss is handled seamlessly by VSD 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 VSD 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 VSD cyber security.

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

- **Support of various communication protocols**
  - Communication capability ensures VSDs 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**
  - VSD 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 VSD will continue to operate if the supply is cut off, as long as the motor rotates and generates energy to the VSD.

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 VSD 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 motors exceeding IE4 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.

Motors

**High reliability**

- Protection against external conditions with IP55 as standard.
- Surface treatment according to corrosion class C3M and optional C4 and C5.
- Protection against bearing currents with an extended portfolio of solutions including insulated bearings and shaft grounding.
- Bearings either greased for life or regreasable, fitted with grease relief system.
- Bearings locked at D-end to avoid axial play.

**Efficiency**

- IE3, IE4 or IE5 efficiency levels to reduce energy consumption and improve total cost of ownership.

**Easy installation**

- Oversized terminal box as standard to ease installation.
- Various mounting arrangements including direct drive, belt or transmission.

Generators

**High reliability**

- Meets demands for low voltage ride-through events, vibration, mechanical and electrical stresses, fast response times and frequent starts.
- Improves the quality of an electricity supply reducing harmonic content.

**Efficiency**

- Reduced fuel consumption for a longer operation in emergency situations.

**Compactness**

- The best kWh production at given size and weight.

**Wide offering**

- Available over a large range of operating parameters and enclosures, complying with all internationally accepted standards.
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 VSDs, motors, mounted bearings and applications like pumps.

Intelligent powertrain

The powertrain is equipped with sensors and cloud connectivity and can comprise motors, drives and mechanical components including bearings, couplings and applications like pumps.

Turning data into valuable information

Data gathered from VSDs’ built-in sensors and loggers, together with that collected from ABB Ability™ Smart Sensors fitted to motors, bearings 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.

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.

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 every step of the way

Even before you buy a generator, drive, motor, bearing 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.

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Global service network 24/7

"I need operational excellence, rapid response, improved performance and life cycle management."

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Agreements
Comprehensive bundling of relevant services into one contract to suit your needs

Training
Comprehensive and professional training either at ABB premises or your own facilities

Installation & commissioning
Highly-trained and reliable installation and commissioning experts

Technical support & repairs
Quick and accurate response during emergencies and efficient support during planned breaks

Spare parts & consumables
Authentic, high-quality ABB spare parts and consumables with quick delivery

Engineering & consulting
Identify ways to improve the reliability, usability, maintainability and safety of your processes

Advanced services
Gain the unique ABB Ability™ digital advantage through data collection and analytics with advanced services

Extensions, upgrades & retrofits
Up-to-date systems and devices with the best possible performance level

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

Replacements
Fast and efficient replacement services to minimize system downtime

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"I need operational excellence, rapid response, improved performance and life cycle management."
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 VSDs, 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 HMI’s 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.