ACS5000 drives
The power you require. The reliability you expect.
ACS5000 drives

ACS5000 medium voltage drives are tailored to meet the needs of demanding applications that require high power, reliability and safety. In addition to an advanced control technology, an ACS5000 has easy-to-use interfaces for simplified operation as well as ABB Ability™ remote condition monitoring, which ensures that the drive is accessible and maintainable anywhere in the world.

The ACS5000 is a reliable solution for controlling induction, synchronous and permanent magnet motors and for driving your high power applications, such as compressors, pumps and fans. Industry-specific functions and unique features ensure reliable control of your processes and systems.
ACS5000 drives
Based on long-term experience and in-depth knowledge

> 45 years experience

1969
AC drive development started

1972
Megastar 3-level PWM MV drive with vector control

1985
Self-healing capacitors

1993
Direct Torque Control (DTC)

1995
AC drive with VSI-MF topology

1999
ACA1000 first IGCT-based MV drive

2005
ACS6000 first MV multidrive with PEBB technology

2009
ACS2000 MV drive for direct-to-line connection

2012
ACS5000 second generation Power extension 13.8 kV

2014
ACS580MV introduction in China

2017
ACS6080 all-compatible MV multidrive

©ABB
**ACS5000 drives**
Complementing our broad portfolio of drive solutions

<table>
<thead>
<tr>
<th>Energy efficiency – emission reduction</th>
<th>Process Control</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ACS580MV</strong></td>
<td><strong>ACS1000 / ACS2000</strong></td>
</tr>
<tr>
<td>Applications:</td>
<td>Applications:</td>
</tr>
<tr>
<td>• pumps, fans</td>
<td>• Pumps, fans, mills, conveyors, extruders, mixers, hoists, ..</td>
</tr>
<tr>
<td>Segments:</td>
<td>Segments:</td>
</tr>
<tr>
<td>• Infrastructure, water, HVAC</td>
<td>• Mining, Cement</td>
</tr>
<tr>
<td>• Auxiliary applications in heavy industry, metals, cement, power generation, ..</td>
<td>• Oil &amp; gas, petrochem</td>
</tr>
<tr>
<td>Focus:</td>
<td>• Marine, offshore</td>
</tr>
<tr>
<td>• Non-specification driven</td>
<td>• Power generation, water</td>
</tr>
<tr>
<td>• Non-critical applications (can run without drive in bypass mode)</td>
<td>Focus:</td>
</tr>
<tr>
<td>• Capex – energy savings made affordable</td>
<td>• Flexible to configure for the specific needs</td>
</tr>
</tbody>
</table>

**ACS5000 / MEGADRIVE-LCI**

Applications:
- Large compressors, pumps, fans, GT starters,

Segments:
- Oil & gas
- Power generation
- Water
- Test stands, wind tunnels

Focus:
- High power
- High reliability and availability
- Highest level of personal safety

**ACS6080 / PCS6000**

Applications:
- Mills, conveyors, propulsion, wind mills, hoists, ..

Segments:
- Metals, mining, marine
- Test stands, special applications
- Renewable power gen.

Focus:
- Flexible to configure for specific needs
- High performance
- High reliability and availability
- Highest level of personal safety
ACS5000 drives
At a glance

Highlights

- Voltage source inverter, multilevel-fuseless (VSI-MF)
- Voltage range: 6 – 13.8 kV
- Power range
  - air-cooled: 1.5 – 7 MW
  - water-cooled: 5 – 36 MW
- 36-pulse rectifier
- Based on ABB’s well proven IGCT \(^1\) semiconductor platform

\(^1\) IGCT: Integrated gate-commutated thyristor
ACS5000 drives
At a glance

**Highlights**

- Non-aging, high voltage, thyristor-based semiconductors (IGCT) for the highest level of safety, reliability and efficiency

- Control synchronous and asynchronous motors

- Air-cooled available with external or integrated, water-cooled with external or combined transformer

- Advanced control method with the ability to ride-through main supply voltage interruptions

---

1. IGCT: Integrated gate-commutated thyristor
ACS5000 drives
Technical overview

- Output filter for limitation of motor stress - retrofit of DOL motors possible
- 36-pulse rectifier meeting the most stringent requirements for current and voltage harmonic distortion as defined by IEEE, IEC and EN
ACS5000 drives
Product overview (air-cooled with external transformer)

Terminal and control compartment
Contains the power terminals for the transformer as well as the motor connection and the control swing frame

Rectifier-inverter compartment
Contains the diode rectifier and the inverter (three power cells)

DC-link capacitor compartment
ACS5000 drives
Product overview (air-cooled with integrated transformer)

Transformer compartment
Contains the integrated input transformer, including transformer protection

Terminal and control compartment
Contains the power terminals for the transformer, motor connection and the control swing frame

Rectifier-inverter compartment
Contains the diode rectifier and the inverter (three power cells)

DC-link capacitor compartment
ACS5000 drives
Product overview (water-cooled)

Water Cooling Unit
Supplies deionized water for cooling the main power components

Terminal and Control Unit
Contains the power terminals for the motor connection and the control swing frame

3x Phase Converter Unit (PCU)
Contains the diode rectifier, the dc-link capacitors, the inverter phase module and the transformer cable connection
ACS5000 drives
Reliable and safe operation of high power applications

Modularity and flexibility
- Built to order - every drive is customized to fit your needs
- Choose from a broad range of configurations with flexible transformer and cooling arrangement

Performance and usability
- Smooth integration and easier operation throughout your entire installation
- Advanced process control
- Large variety of available fieldbus interfaces

Highest level of safety
- Arc resistant design based on "arc prevention" and for the water-cooled version "fast elimination"
- Electromechanically interlocked doors with DC grounding switch
- Certified functional safety

Reliability and availability
- ABB Ability™ condition monitoring for drives to monitor your drive condition all the time, anywhere in the world.
- Low parts count and fuseless design - ABB IGCT technology proven to be the best choice for high power applications
# ACS5000 drives

Benefits that add value to your operations

## Benefits and features

<table>
<thead>
<tr>
<th>Highest level of personal safety</th>
<th>High reliability and availability</th>
<th>Increase productivity</th>
<th>Custom-made solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arc resistant design (certified by 3rd party) with fast arc elimination ¹</td>
<td>Each configuration consists of very well-proven components and simple power circuit</td>
<td>High system efficiency due to multilevel-fuseless topology, IGCTs and DTC</td>
<td>For an optimized cooling system the air-cooled ACS5000 is available with integrated or external transformer</td>
</tr>
<tr>
<td>Integrated DC grounding switch</td>
<td>Low part count</td>
<td>Smoother integration and easier operation throughout your entire installation</td>
<td>The water-cooled ACS5000 can be customized with a dry-cooler and combined transformer connected to the same cooling system</td>
</tr>
<tr>
<td>Electromechanically interlocked doors to all MV compartments</td>
<td>Fuseless design</td>
<td>Best-in-class control in terms of dynamic performance and power quality</td>
<td>ACS5000 can be adapted for applications with very long motor cable</td>
</tr>
<tr>
<td>Certified functional safety features (E-off, E-stop, Safe Stop 1, STO, POUS)</td>
<td>Self healing capacitors</td>
<td>Precise process control</td>
<td></td>
</tr>
<tr>
<td>Highest availability during supply network disturbances</td>
<td>ABB Ability and cloud connection for remote condition monitoring and remote assistance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹: Arc resistant design, IAC certified according to IEC62271-200 available for the water-cooled version only
Water-cooled solutions for highest level of safety
ACS5000 drives
Electric arcs are hazardous to personnel and equipment. The water-cooled ACS5000 offers the highest possible level of personnel safety by detecting the arc and eliminating before it even occurs. The drive comes with an arc proof design and is certified according to IAC (internal arc classification). The water-cooled ACS5000 is equipped with ABB’s Arc Guard System™ for a superior/redundant protection function. No compromises

Arc extinction within ≤ 3 ms

Arc extinction within ≤ 3 ms
## Arc proof classes

### Personnel safety & equipment availability

<table>
<thead>
<tr>
<th>ARC PROOF CLASS</th>
<th>CLASS I</th>
<th>CLASS II</th>
<th>CLASS III</th>
<th>CLASS IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>PERSONNEL SAFETY BASED ON</td>
<td>ARC PREVENTION</td>
<td>ARC PREVENTION + PROTECTION</td>
<td>ARC PREVENTION + ELIMINATION</td>
<td>ARC PREVENTION + FAST ELIMINATION</td>
</tr>
<tr>
<td>BASED ON DESIGN ACC. TO IEC 60146-1-1 IEC 61800-4</td>
<td>BASED ON ARC RESISTANT ENCLOSURE</td>
<td>BASED ON HV-FUSES</td>
<td>BASED ON PROTECTION FIRING AND/OR FAST DETECTION</td>
<td></td>
</tr>
<tr>
<td>EQUIPMENT DAMAGE IN CASE OF ARC</td>
<td>SEVERE</td>
<td>SEVERE</td>
<td>MODERATE</td>
<td>NEGLIGIBLE</td>
</tr>
</tbody>
</table>

- Non-ABB Medium Voltage Drives
  - CERTIFIED SAFE FOR PERSONNEL ACC. TO IEC 62271-200: IAC AFLR
- ACS5000 water-cooled

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November 27, 2020 | Slide 15
## Arc fault safety

**ABB’s approach - the 4 safety classes**

<table>
<thead>
<tr>
<th>CLASS I</th>
<th>CLASS II</th>
<th>CLASS III</th>
<th>CLASS IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>protection based on arc prevention</td>
<td>protection based on arc resistant cabinet structure</td>
<td>protection based on external arc fault limitation and elimination</td>
<td>fast arc elimination</td>
</tr>
<tr>
<td>• Design of insulation systems in accordance with relevant IEC and NEMA standards to prevent arcs and provide personnel safety</td>
<td>• The <strong>cabinet is designed</strong> to withstand the pressure of an arc flash</td>
<td>• <strong>HV Fuses</strong> are applied externally to the drive in order to limit the arc fault current to less than half cycle of the fundamental AC frequency (&lt;10ms in case of 50Hz supply)</td>
<td>• This is a ABB patented method, ABB MV drives “protection firing” system. The arc fault is detected and converted into a non severe bolted short circuit</td>
</tr>
<tr>
<td>• Class I is not a certified arc resistant design, it is mainly focusing of arc fault prevention</td>
<td>• Arc fault is contained in the cabinet or guided through pressure relief vents</td>
<td>• This method is only used to reach arc resistant designs for MV drives connected without external drive transformer to the mains (integrated transformer solutions and DTL solutions)</td>
<td>• For an even faster detection and elimination an optical ABB <strong>arc fault detection system</strong> is available</td>
</tr>
<tr>
<td>• The drive will be face severe damage after an event</td>
<td>• The drive will be face severe damage after an event</td>
<td>• Provides highest level of personal safety and the equipment remains undamaged and can be immediately restarted after inspection and elimination of the arc ignition cause</td>
<td></td>
</tr>
</tbody>
</table>

**Non-ABB Medium Voltage Drives**

**ACS5000 water-cooled**

**Arc resistant design**

IAC Certified according IEC62271-200
Arc proof testing
Internal arc classification – Impressions

Classification test (IP42): 28kA, 0.5s

Additional classification tests
- IP54: 56kA, 0.5s
- IP00: 56kA, 0.5s
Certified functional safety features
For a safe and reliable system integration into your process

The ACS5000 water-cooled is equipped with safety integrity level 3 (SIL3) and performance level e (PL e) to provide the following safety functions:

- **Emergency off** - stop category 0 according to IEC 60204-1
- **Emergency stop** - stop category 1 according to IEC 60204-1
- **Safe torque-off (STO)** - according to IEC 61800-5-2
The grounding switch is a safety switch to ground the DC bus of the drive. When the drive is grounded, the door safety switches of the medium voltage units are released and the doors can be opened.

It is electromechanically interlocked with a discharge monitoring circuit that prevents the switch from closing when the DC-link capacitors are still charged.

Grounding the drive is only possible after main power supply is disconnected and the DC link has been discharged.
Reliability and availability

ACS5000 drives
Reliability and availability at the core of your application

Well-proven ABB IGCT-technology

Low part count and best-in-quality components

The main module of the drive is the Phase Converter Unit (PCU). Electrical and mechanical design principles are common for PCUs. PCUs can be arranged depending on the power requirements and contain the rectifier, DC-link and converter for one phase.

Their very compact cores are well proven power stacks based on ABB IGCT-semiconductors.

IGCT semiconductors are non-aging and enable highly efficient and reliable operation. They are the ideal switch for high power applications and have proven to be the most robust devices on the market.
Reliability and availability at the core of your application

Simple and robust design

**Features for reaching highest availability**

- Lower lifetime costs and higher reliability is assured by advanced, environmental friendly, oil-filled foil capacitors which have a substantially longer lifetime than electrolytic capacitors (10 vs 3 years)

- Fuseless design for faster and better protection than medium voltage power fuses

- 5-level VSI topology for an optimum considering the quality of the output waveform and the converter simplicity

- Easy front access to the drive’s components

- Redundancy options for cooling fans/pumps, connection of external redundant power supplies, internal power supplies, sensors (e.g. pressure, temperature, conductivity)
Reliability and availability at the core of your application
Advanced control method enables superior supply power loss ride-through capability

No tripping when main power supply lost

- Energy stored in the rotating system of machine and load keeps DC-link charged
- When the DC-link voltage is too low, the drive enters ride-through mode in which the machine is used as a generator to compensate for converter internal losses
- The ACS5000 stays in ride-through mode until either the main power is back to normal conditions or the machine speed reaches 10% rated speed
Special features for industry-specific solutions
ACS5000 drives
Combined transformer for cooling based on dry-cooler (FinFan)

ACS5000 water-cooled

Simple solution if external cooling water is not available

- Combined water-cooling circuit in converter and input transformer:
  - Only 1 water-cooling unit for the transformer-converter system
  - Typical configuration on site: “single-loop cooling” → only one dry-cooler (FinFan) system needed

- Available for
  - Frame size 1 and 2 ≤ 18 MVA
  - 4.16 kV ≤ input voltage ≤ 13.8 kV

Picture shows a PCU for frame size 2 and 4 (output current = 1500 Arms)
Energy efficient solution considering system cooling

ACS5000 water-cooled

**IP54 for extreme environment**

- Efficiency > 99%

- IP42 direct air-cooling
  - Approx. 92% of the drive losses dissipated into water
  - 8% of the losses dissipated into ambient air of the electrical room

- IP54 air to water (deionized) heat exchanger
  - Completely sealed cabinet making it suitable for operation in harsh environments
  - High ambient temperatures acceptable
  - Losses into air < 2% (via the cabinet)
Industry specific solutions
ACS5000 water-cooled

Flexibility for individual needs

- Certification for marine and offshore available
  - ABS (American Bureau of Shipping), USA
  - DNV (Det Norske Veritas), Norway

- Fast startup of hot stand-by systems for critical applications supported

- Bumpless transfer (make before break) for direct-online operation available
Industry specific solutions
ACS5000 air-cooled

Flexibility for individual needs

For highest transformer flexibility, the ACS 5000 air-cooled is available with an integrated or a separate input transformer:

– Integrated input transformer

When operating the drive with an integrated transformer, installation and commissioning is particularly simple and fast

– External input transformer

The use of an external input transformer minimizes heat losses into the electrical room and eliminates the need for additional ventilation systems
ABB Drives Services

Long-term commitment to maintain your assets
You choose, we respond. Globally and locally.

ABB is a reliable service partner

- Over 600 ABB field service engineers
- Services in more than 60 countries
- 500 service partners
- 30 service workshops
- Providing services for drives for 40 years
- Covered by closest Regional Service Center

Global Service Center (4)
Regional Service Center (8)
ABB or partner service
ABB Drives service portfolio
Services matching your needs

**Your needs**

- **Rapid response**
  We promise fast and flexible service response to restore your production or process to full working order within the agreed timeframe.

- **Lifecycle management**
  We provide you powerful tools and our knowledge base to analyze, optimize and extend the lifecycle of your drives.

- **Performance improvements**
  We help you optimize the availability and efficiency of your equipment and improve the profitability of your assets.

- **Operational excellence**
  We offer you a strategic partnership in improving productivity, safety, cost and energy efficiency of your equipment.

**Our services**

- Service Agreements - ABB Drive Care
  - Training
  - Installation and Commissioning
  - Spares and Consumables
  - Maintenance
  - Repairs
  - Engineering and Consulting
  - Advanced Services
  - Extensions, Upgrades and Retrofits
  - End-of-Life Services
  - Replacements
A lifetime of peak performance
Lifecycle management

Our approach to lifecycle management

Being committed
We are committed to serve customers throughout the entire lifecycle of the drive.
At the heart of drive services is a four-phase product lifecycle management model. This model defines the availability of the product and the availability of lifecycle support throughout the product lifespan.

Keeping you informed
We notify you every step of the way using lifecycle status statements and announcements.
Your benefit is clear information about your drives’ status and precise services available. It helps you plan the preferred service actions ahead of time and make sure that continuous support is always available.
Digital-aided on-site services

ABB Drives’ digital-aided on-site services makes sure that your drive is serviced efficiently and effectively.

Our service engineers have always latest equipment information at hand, including:
- Service history
- Service instructions
- Recommended services

Customer support - Follow the sun

ABB Drives’ customer support is close to customer site, provided in local language and guarantees quick response time.

Regional sales and technical customer support hubs located around the world are offering service around the clock and every day of the year.

Our follow-the sun concept ensures
- Unified high-quality support for all countries
- Quick response time as service is provided in the same time zone
- Effective escalation of issues
- Seamless flow of support
- Possibility to purchase 24x7 remote assistance

myABB – Your gateway to services

Find the right information, saving time & money
- Installed base information
- Quick and easy access to expert contacts
- One-stop-shop for drive-specific parts

Optimize capital outlays & operational budgets
- Identify upgrades and replacement
- Set maintenance and make end of life decisions

Plan maintenance operations and minimize downtime
- Review recommended service options
- Explore service history
- Access product and technical documentation

Make the right operational decisions
- Identify relevant training offerings
- Retrieve latest maintenance information and updates
- Review your equipment criticality
Modernization & consultancy

Highlights

Upgrade to latest technology
Benefit from technology improvements and incorporate our latest innovation. ABB Drives has defined a well-conceived modernization & migration path for the entire product portfolio. Choose from various options in order to...

- Manage component obsolescence
- Minimize operational risks
- Secure reliability and improve performance
- Improve usability & safety
- Ensure lifecycle support and services
- Extend the lifetime of your drive system

Drive system consulting
ABB provides consultation with leading-edge drive system expertise to help you develop customized solutions to optimize your drive system assets.

Failure mode and effect analysis
FMEA is a specific method to measure and evaluate the robustness of a drive system, design or process for potential failure mechanisms.

Electromechanical system interaction study
With this expert analysis electromechanical interaction of drive-train is studied in order to provide guideance for system design.

Control Upgrade service
ABB offers the possibility to migrate your ACS6000 drives to the ACS6080 all-compatible platform. Thus upgraded your drive system will benefit of all latest features and services.
ABB Ability™ for Drives
Digitalization opens new opportunities

Smart, connected drives...  ...send data to secure cloud...  ...where analysis turns data into knowledge...  Knowledge turns into predictive actions

Key performance indicators show where to focus the actions.

Detailed report gives more information on the issue.

Expert can recommend and support the actions needed.

Condition based predictive alerts ease follow up.
ABB Ability™ for Drives

Highlights

**ABB Ability™ Remote Assistance for Drives**

Rapid solution in case of problems

Should a fault be detected within a drive, ABB specialist provides rapid support by using the drive’s data which is stored remotely.

**ABB Ability™ Condition Monitoring for Drives**

Alerts and information, for customer to react

ABB Ability Condition Monitoring for Drives is a service that delivers you accurate, real-time information about drive condition and events to ensure your equipment is available, reliable and maintainable.
ABB Drive Care Agreements

Highlights

**Initial Care – More than warranty**

Initial Care is a free of charge service available to a newly purchased ABB Medium Voltage Drive during the first year of the warranty period.

It complements the warranty support with ABB Ability™ for Drives, including...

- ABB Ability™ Remote Assistance for Drives
- ABB Ability™ Remote Condition Monitoring for Drives

Explore ABB’s digital offering free of charge for a limited time of one year and decide afterwards, whether you want to enter the ABB Ability™ contract.

**Complete Care – Long-term lifecycle agreement**

ABB Drive Care agreement is designed to let you focus on your core business. With a fixed-price lifecycle agreement matching your needs you gain efficiency in handling routine and emergency maintenance and have improved cost control.

ABB Drives Complete Care contract includes:

- Maintenance & repair parts
- Labor for on-site service actions
- Biennial on-site inspection
- ABB Ability™ Remote Assistance for Drives

<table>
<thead>
<tr>
<th>Service budget</th>
<th>$</th>
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