



Product brochure

# Medium voltage AC drive

## ACS 2000, 400 – 1000 kVA, 6.0 – 6.9 kV



# ACS 2000 – simple and reliable motor control

The ACS 2000 is the latest member of the ABB medium voltage AC drives family providing reliable motor control for a wide range of applications.

The ACS 2000 is designed for high reliability, easy installation and fast commissioning reducing the total cost of ownership.

With the integration of an Active Front End (AFE), line side harmonics are minimized without the use of expensive, specialized transformers and with the added benefit of regeneration and power factor correction.

With its compact footprint, the ACS 2000 can be retrofitted to control standard induction motors via a direct connection to 6.0 – 6.9kV line supply (direct-to-line). Alternatively, the ACS 2000 can be operated with an input isolation transformer to allow for flexible line side power voltages. It is available with an integrated transformer or it can be connected to an external two-winding transformer.

The ACS 2000 direct-to-line combines the cost savings of a transformerless variable speed drive system with the benefits of Voltage Source Inverters (VSIs), including excellent availability and reliability, high and constant power factor and superior dynamic control performance.

The heritage of ABB's VSI topology, along with a patented IGBT-based multi-level control, provides a proven track record for reliable and motor friendly medium voltage AC drive solutions.

## Key product features

- Suitable for use with or without an input isolation transformer
- Direct-to-line connection (transformerless) provides lowest cost of ownership
- Active Front End (AFE) for minimal line side harmonics, regeneration and power factor correction
- Simple drive system integration
- Three in - three out cabling technique for quick and easy installation
- Suitable for new or existing induction motors
- Modular design provides high reliability and low maintenance costs

## Fields of application

Industries	Applications
Cement, mining and minerals	Conveyors, crushers, mills, mine hoists, fans and pumps
Chemical, oil and gas	Pumps, compressors, extruders, mixers and blowers
Metals	Fans and pumps
Pulp and paper	Fans, pumps, refiners, vacuum pumps and chippers
Power generation	Fans, pumps, conveyors and coal mills
Water	Pumps
Other applications	Test stands, wind tunnels and sugar mills

# Key features

The ACS 2000 general purpose drive offers unique features which provide superior application flexibility with a standard solution.

## Line supply connection flexibility

The ACS 2000 provides different line supply connection options, each offering unique benefits. The ACS 2000 is available for connection to an external input isolation transformer, with an integrated input isolation transformer or for use without a transformer. The latter allows a direct connection to the industrial line supply (direct-to-line).

## Direct-to-line

The ACS 2000 direct-to-line can lower investment costs substantially. Due to its compact size and lighter weight compared to a drive requiring a transformer, it also results in lower transportation costs and needs less space in the electrical room.

The ACS 2000 can be easily retrofitted to fixed speed motors while the direct-to-line technology results in quick and easy installation and commissioning.

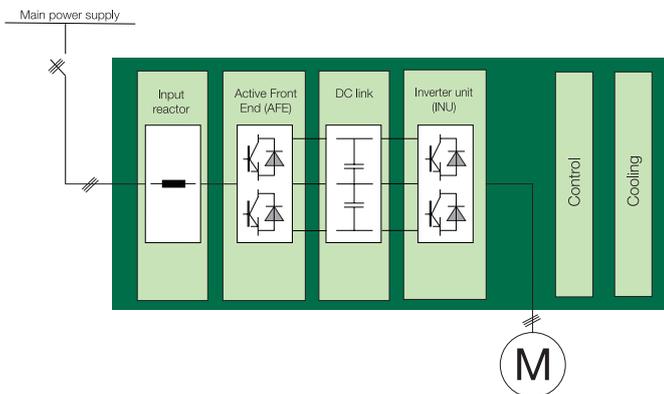
## For operation with transformer

### External transformer

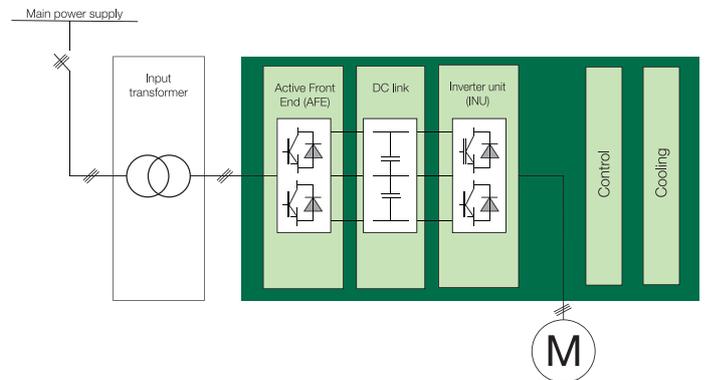
For applications where a voltage-matching input transformer is needed or galvanic isolation from the power supply is required, the ACS 2000 can be connected to a conventional two-winding oil or dry-type converter link transformer.

### Integrated transformer

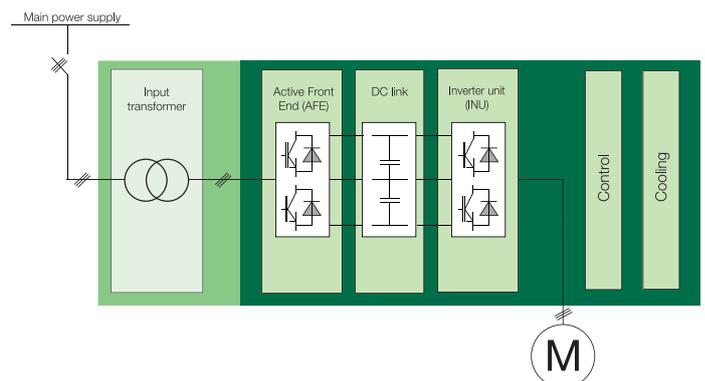
Alternatively, the ACS 2000 is also available with an integrated input isolation transformer.



Topology of the ACS 2000 for direct-to-line connection



Topology of the ACS 2000 for operation with an external transformer



Topology of the ACS 2000 with an integrated input transformer



### Active Front End for network friendly and energy efficient operation

The ACS 2000 is equipped with an Active Front End (AFE) which can be used in conjunction with a simple input isolation transformer or for direct connection to 6.0 – 6.9 kV line supply. It provides low harmonics and enables regeneration and reactive power compensation.

#### Low harmonic signature

The AFE provides a low harmonic signature which meets the most stringent requirements for harmonic distortion as defined by relevant standards. This avoids the need for harmonic analysis or the installation of network filters.

#### Regeneration

For applications with high braking energy, the ACS 2000 is available with optional regeneration capability, which feeds back braking energy to the line supply. This further reduces the overall energy consumption.

#### Power factor correction

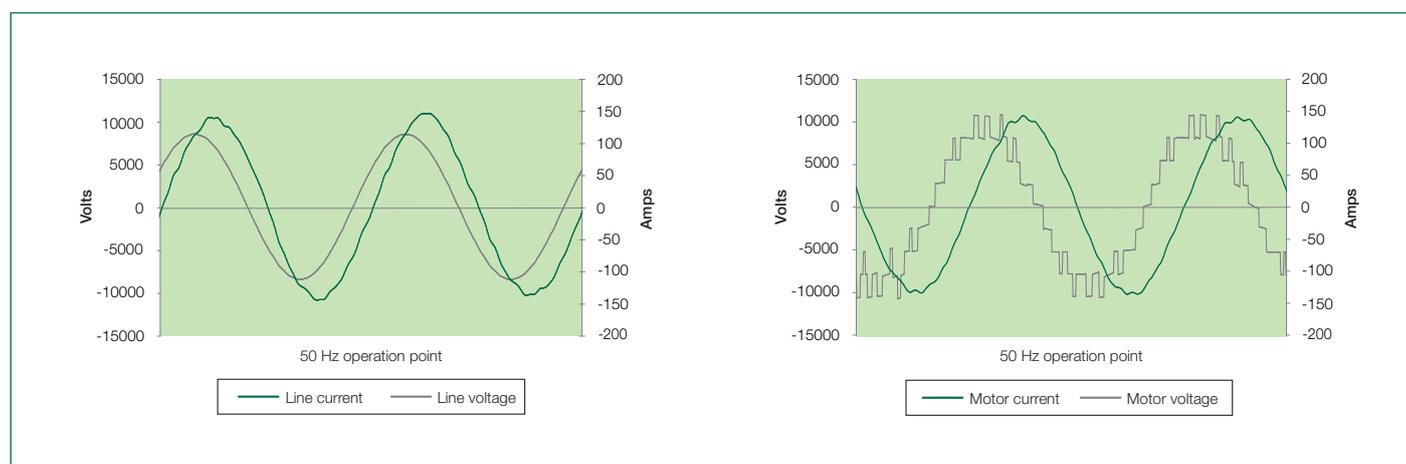
For applications where other loads connected to the same line supply cause leading or lagging power factor, the ACS 2000 is available with a static VAR compensation option. With static VAR compensation, a smooth line supply voltage profile can be maintained and reactive power penalties can be avoided.

### Powerful performance with DTC

Precise and reliable process control, together with low energy consumption, results in top performance. The ACS 2000 drive control platform uses ABB's award-winning Direct Torque Control (DTC), resulting in the highest torque and speed performance as well as the lowest losses ever achieved in medium voltage AC drives. Control of the drive is immediate and smooth under all conditions.

### Motor friendly output waveform for use with new or existing motors

The ACS 2000 provides near sinusoidal current and voltage waveforms making it compatible for use with standard motors and cable insulation. This is achieved with ABB's patented multilevel topology which utilizes one DC link enabling a multi-level output waveform with a minimum number of power components.



Line and motor current and voltage

# ACS 2000 – the right choice for general purpose applications

Depending on the application, variable speed drives have to fulfill different requirements. The ACS 2000 provides the right solution for general purpose applications.

## ACS 2000, low harmonic drives

ABB's low harmonic drives offer optimal low harmonic performance which does not require any additional filtering.

They feature an Active Front End (AFE), which minimizes line side harmonics without the use of specialized transformers. Due to the AFE, line side harmonics of the ACS 2000 are compliant with all relevant standards. This avoids the need for harmonic analysis or the installation of a multi-pulse transformer, network filters or other additional equipment for harmonics reduction.

## ACS 2000, regenerative drives

ACS 2000 regenerative drives provide enhanced active braking and power factor correction.

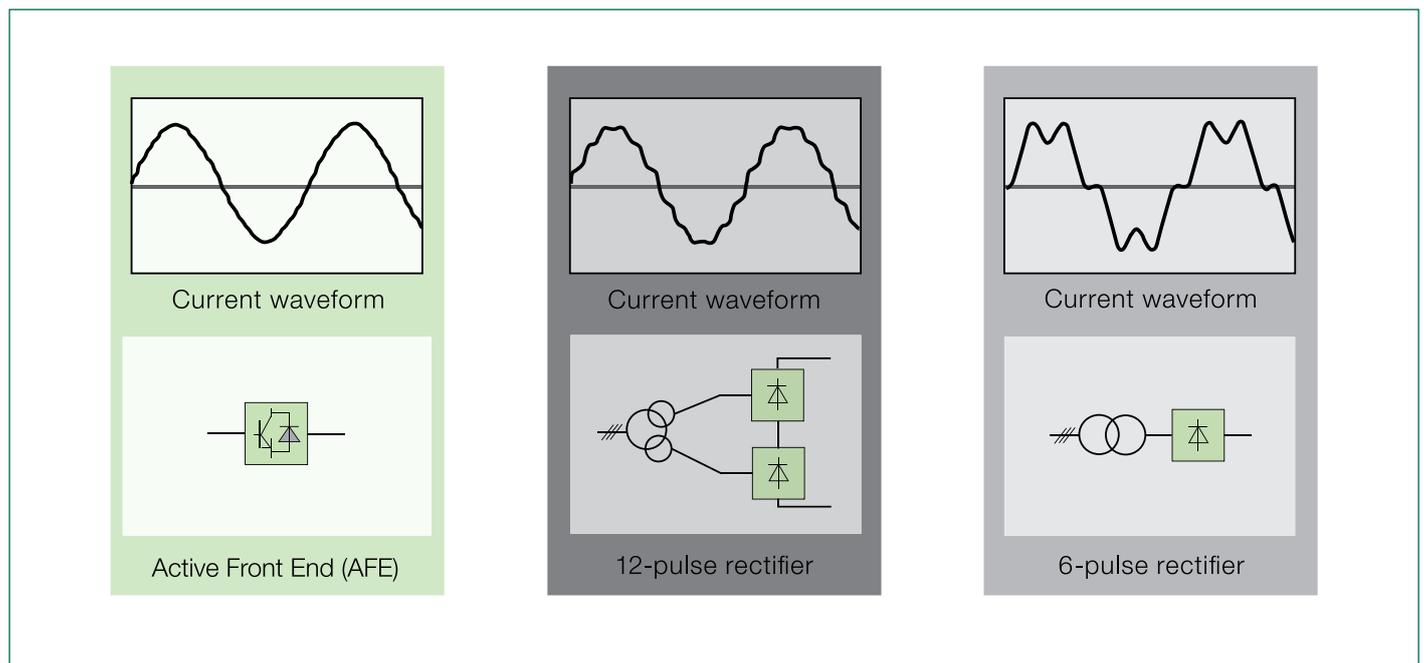
### Regenerative braking

The AFE allows regenerative braking which allows full power flow both in motoring and generating mode. Regeneration offers significant energy savings compared to other braking methods as energy is fed back to the supply network.

Regeneration is especially suitable for applications with frequent starts and stops. It allows energy efficient continuous braking of applications such as downhill conveyors or expanders in gas pipelines.

### Power factor correction

The AFE can also provide reactive power (VAR) compensation. With VAR compensation, the voltage level can be controlled to stay within tight limits. A smooth network voltage profile can be maintained and reactive power penalties can be avoided.



Different rectifier designs generate different line currents. An active front end (AFE) is a superior way to minimize harmonics.

# Features and benefits

Features	Advantages	Benefits
Operation without transformer (direct-to-line)		
	No transformer required	Reduces capital expenditure
	Easy retrofit to fixed-speed motors	Minimizes investment
	Easy and fast commissioning	Lowers downtime
	Compact and light drive system	Lowers transportation costs; less space required in electrical room
Operation with transformer		
The ACS 2000 is available with an integrated transformer or for operation with an external transformer	Connection to any voltage level	Easy integration into existing infrastructure
	Conventional two-winding oil or dry-type input isolation transformer	No special input isolation transformer required
	Galvanic isolation to the line supply	Operation under ground fault without impact on the drive
	Separate input isolation transformer can be located outside	Heating losses are not dissipated into electrical room, reducing load on HVAC system
	Integrated transformer for quick installation and commissioning	Lowers downtime
Active Front End (AFE)		
	Inherent low harmonic signature	Harmonic emissions compliant with all relevant standards
	Power factor adjusted to compensate for reactive power	Reduces energy loss in distribution system, avoiding need for larger cables and utility penalties
	Allows operation with an input isolation transformer or for direct connection to the line supply	Flexibility of installation
	Four-quadrant operation (regenerative braking)	Minimizes energy consumption
Multilevel topology		
	Patented multilevel topology	Low parts count, which boosts drive availability
	Provides near sinusoidal current and voltage waveforms	Compatible with standard new or existing motors
Voltage Source Inverter (VSI) topology		
	Excellent availability, reliability and efficiency	Higher uptime of plant or process
	High and constant power factor	Eliminates utility penalties
	Superior dynamic control performance	Safe ride through during supply voltage dips and better process control
Direct Torque Control (DTC)		
	Precise and reliable process control with superior performance	Higher productivity
Compact size		
	Requires less space in electrical room	Frees up valuable floorspace

# ACS 2000

The air-cooled general purpose drive provides simple and reliable motor control for a wide range of applications.

ACS 2000, 800kW, 6.6 kV  
for operation with an external  
transformer

Control unit

Cable connection section  
for top and bottom entry

Inverter unit  
(INU)

Withdrawable  
phase modules

Active Front End  
(AFE)

User-friendly drive control panel for local operation

- Keypad with multi-language display
- Main supply on/off pushbuttons
- Emergency off pushbutton

It is designed for easy installation, fast commissioning and efficient maintenance reducing the total cost of ownership.

ACS 2000 direct-to-line,  
800kW, 6.6 kV



Control unit

Cable connection  
section for top  
and bottom entry

Common mode  
filter cabinet for  
direct-to-line  
connection with  
integrated fan

Inverter unit  
(INU)

Withdrawable  
phase modules

Active Front  
End (AFE)

## Simple drive system integration

Installing a medium voltage AC drive could not be easier with ABB's three in - three out concept. Simply disconnect the direct-on-line cable, connect the drive, and connect the drive to the motor.

Along with its flexible line supply connection options and advanced software tools the ACS 2000 allows smooth and simple drive system integration into any industrial environment.

### Flexible control interface

ABB offers an open communication strategy, enabling connection to higher-level process controllers. The ACS 2000 can be installed with all major fieldbus adapters for smooth integration, monitoring and controlling of different processes, according to customer requirements.

### DriveOPC

DriveOPC is a software package, which allows communication between ABB drives and the customer's Windows®-based applications.

### DriveStartup

The commissioning wizard DriveStartup is an advanced tool which simplifies and speeds-up commissioning, reducing plant downtime considerably.

## Maintenance

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



The ACS 2000 is designed to maximize uptime as well as to facilitate quick repair. The modular design lends itself to quick and effective replacement of components, resulting in industry leading Mean Time to Repair (MTTR).

### Reliable components

ABB drive technologies, such as the multilevel VSI topology, provide a low parts count, which increases reliability, extends Mean Time Between Failures (MTBF) and improves availability.

### Easy access

The ACS 2000 has been designed to allow easy front access to all drive components.

### Redundant cooling

The ACS 2000 is available with redundant fans which increases availability.

# Data sheet ACS 2000

## Inverter type

Voltage Source Inverter (VSI), 9 levels line-to-line, with high voltage IGBT (Insulated Gate Bipolar Transistor) power semiconductors

## Motors

Induction motors; 315 – 800 kW (430 – 1090 hp)

## Standards

All common standards including EN, IEC, CE, NEMA

## Input

5-level self-commutated IGBT Active Front End (AFE) for operation with two-winding input isolation transformer or direct-to-line (DTL), i.e. without transformer

Rated input voltages:

6.0 / 6.6 kV, +10% to -10% (-30% with derating)

6.9 kV, +5% to -10% (-35% with derating)

The ACS 2000 with integrated transformer is available with primary transformer voltages of 6.0, 6.6, 10 and 11 kV (+10% to -10%).

Input frequency 50 / 60 Hz

## Auxiliary voltage

Common 400 – 480 VAC, 3-phase, 50 Hz / 60 Hz

## UPS (Uninterruptible Power Supply)

If available, a UPS can be connected for control power supply, 110 – 240 VAC, single phase or 220 VDC. Alternatively, the drive can be equipped with an internal UPS.

## Output frequency

0 to 75 Hz

## Rated output voltage

6.0 – 6.9 kV

## Efficiency of converter

Typically 97.5%

## Input power factor

Controlled up to 1 or adjustable to compensate for reactive power of other loads connected to the same network

## Ambient temperature

+ 1 °C to 40 °C (higher with derating)

## Enclosure classes

IP21 to IP42

## Control interface (optional)

All common fieldbuses including Profibus, Modbus, DeviceNet, Ethernet, ACS Drivebus, ABB Advant Fieldbus AF100, others

## Standard protection functions

Auxiliary voltage fault, cabinet temperature supervision, over-current, short circuit detection, motor overload, motor stall and overspeed protection, communication fault (I/O watchdog), earth fault, main circuit breaker supervision/tripping, emergency off signal supervision

## Example options

- Motor supervision I/Os
  - Fault/alarm: overtemperature, vibration of bearings
  - PT 100: winding and bearing temperatures
- Transformer supervision I/Os
  - Fault/alarm: overtemperature, Buchholz
  - PT 100: winding temperatures
- Hardwired signals for remote drive control
  - References: start/stop, speed/torque etc.
  - Status feedback signals: ready/running
  - Analog signals: current/voltage/power etc.
- Redundant cooling fans with automatic switch over for duty cycling and upon fan failure
- ABB DriveWindow service and diagnostic software
- ABB DriveMonitor™ for remote monitoring and diagnostics

# Data sheet ACS 2000

Motor data			Converter	Converter data		Converter length and weight					
						direct-to-line		for operation with ext. transformer		with integrated transformer	
Voltage *	Shaft power **		Type code ***	Power	Current	Length	Approx. weight	Length	Approx. weight	Length	Approx. weight
kV	kW	hp		kVA	A	mm	kg	mm	kg	mm	kg
<b>6,000 V</b>											
6.0	315	430	ACS 2060-1x-AN1-a-0E	430	40	2,200	2,000	1,740	1,500	3,440	4,000
6.0	355	480	ACS 2060-1x-AN1-a-0G	470	45	2,200	2,000	1,740	1,500	3,440	4,000
6.0	400	540	ACS 2060-1x-AN1-a-0J	530	50	2,200	2,000	1,740	1,500	3,440	4,000
6.0	450	610	ACS 2060-1x-AN1-a-0L	590	55	2,200	2,000	1,740	1,500	3,440	4,000
6.0	500	680	ACS 2060-1x-AN1-a-0N	650	60	2,200	2,000	1,740	1,500	3,440	4,000
6.0	560	760	ACS 2060-1x-AN1-a-0Q	730	70	2,200	2,000	1,740	1,500	3,440	4,000
6.0	630	860	ACS 2060-1x-AN1-a-0S	820	80	2,200	2,000	1,740	1,500	3,440	4,000
6.0	710	970	ACS 2060-1x-AN1-a-0U	910	90	2,200	2,000	1,740	1,500	3,440	4,000
6.0	800	1,090	ACS 2060-1x-AN1-a-0W	1,020	100	2,200	2,000	1,740	1,500	3,440	4,000
<b>6,600 V</b>											
6.6	315	430	ACS 2066-1x-AN1-a-0E	430	38	2,200	2,000	1,740	1,500	3,440	4,000
6.6	355	480	ACS 2066-1x-AN1-a-0G	470	41	2,200	2,000	1,740	1,500	3,440	4,000
6.6	400	540	ACS 2066-1x-AN1-a-0J	530	45	2,200	2,000	1,740	1,500	3,440	4,000
6.6	450	610	ACS 2066-1x-AN1-a-0L	590	50	2,200	2,000	1,740	1,500	3,440	4,000
6.6	500	680	ACS 2066-1x-AN1-a-0N	650	55	2,200	2,000	1,740	1,500	3,440	4,000
6.6	560	760	ACS 2066-1x-AN1-a-0Q	730	65	2,200	2,000	1,740	1,500	3,440	4,000
6.6	630	860	ACS 2066-1x-AN1-a-0S	820	70	2,200	2,000	1,740	1,500	3,440	4,000
6.6	710	970	ACS 2066-1x-AN1-a-0U	910	80	2,200	2,000	1,740	1,500	3,440	4,000
6.6	800	1,090	ACS 2066-1x-AN1-a-0W	1,020	90	2,200	2,000	1,740	1,500	3,440	4,000
<b>6,900 V</b>											
6.9	315	430	ACS 2069-1x-AN1-a-0E	430	35	2,200	2,000	1,740	1,500	n/a	n/a
6.9	355	480	ACS 2069-1x-AN1-a-0G	470	40	2,200	2,000	1,740	1,500	n/a	n/a
6.9	400	540	ACS 2069-1x-AN1-a-0J	540	45	2,200	2,000	1,740	1,500	n/a	n/a
6.9	450	610	ACS 2069-1x-AN1-a-0L	590	50	2,200	2,000	1,740	1,500	n/a	n/a
6.9	500	680	ACS 2069-1x-AN1-a-0N	650	55	2,200	2,000	1,740	1,500	n/a	n/a
6.9	560	760	ACS 2069-1x-AN1-a-0Q	730	60	2,200	2,000	1,740	1,500	n/a	n/a
6.9	630	860	ACS 2069-1x-AN1-a-0S	820	70	2,200	2,000	1,740	1,500	n/a	n/a
6.9	710	970	ACS 2069-1x-AN1-a-0U	910	75	2,200	2,000	1,740	1,500	n/a	n/a
6.9	800	1,090	ACS 2069-1x-AN1-a-0W	1,030	85	2,200	2,000	1,740	1,500	n/a	n/a

**Notes:**

\* 6.0 / 6.6kV according to IEC; 6.9kV according to ANSI/NEMA

\*\* Indicative information referring to typical 4-pole motor, under nominal supply voltage conditions.

\*\*\* 'x' indicates the different converter types:

- A - for operation with external transformer, regenerative
- D - for operation with external transformer, low harmonic
- T - direct-to-line, regenerative
- L - direct-to-line, low harmonic
- I - with integrated transformer, regenerative
- M - with integrated transformer, low harmonic

**Dimensions:**

Height: 2,100 mm cabinet height  
 2,490 mm (incl. cooling fans on top)  
 2,700 mm with redundant cooling fans

Depth: 1,140 mm

# Service and support

The ACS 2000 is backed by unrivalled service and support from the customer's initial enquiry throughout the entire life cycle of the drive system.

## Installation and commissioning

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

With its three in - three out principle, flexible line supply connection options and advanced software tools, such as the commissioning wizard, start-up of the ACS 2000 is easy and fast, thereby minimizing plant downtime.

## Life cycle management

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

Life cycle management includes:

- providing spare parts and expertise throughout the life cycle
- providing efficient product support and maintenance for improved reliability
- adding functionality to the initial product

## Training

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

## Global network, local presence

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

## Services for ABB's medium voltage AC drives

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



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