

ACS 1000

Medium Voltage AC Drives for Speed and Torque Control
of 315–5000kW Motors



Industrial^{IT}
enabled™

ABB



Simplified Performance

Drawing from over a century of industrial manufacturing experience, ABB provides a simple, reliable approach to electronic power control: the ACS 1000 medium voltage drive for speed and torque control of 315 – 5000kW asynchronous motors for voltages of 2.3, 3.3 and 4.0kV.

Rugged Reliability

We know that reliability is of paramount importance. The low component count of the ACS 1000 makes it inherently more reliable. Furthermore, we test each component individually and load test every drive before delivery.

Key Product Features

- **Retrofit-ready**
for existing motors and suitable for most medium voltage applications including pumps, fans, compressors, extruders, conveyors
- **Output sine filter**
for pure sinusoidal voltage and current output: standard motors, no motor derating, no voltage stress and no common mode voltages on the motor insulation
- **IGCT power semiconductors**
for highest reliability
- **Fuseless design**
for reliable, non-aging, maintenance-free circuit protection.
- **DTC control platform** for exceptionally high torque and speed performance

Smooth System Integration

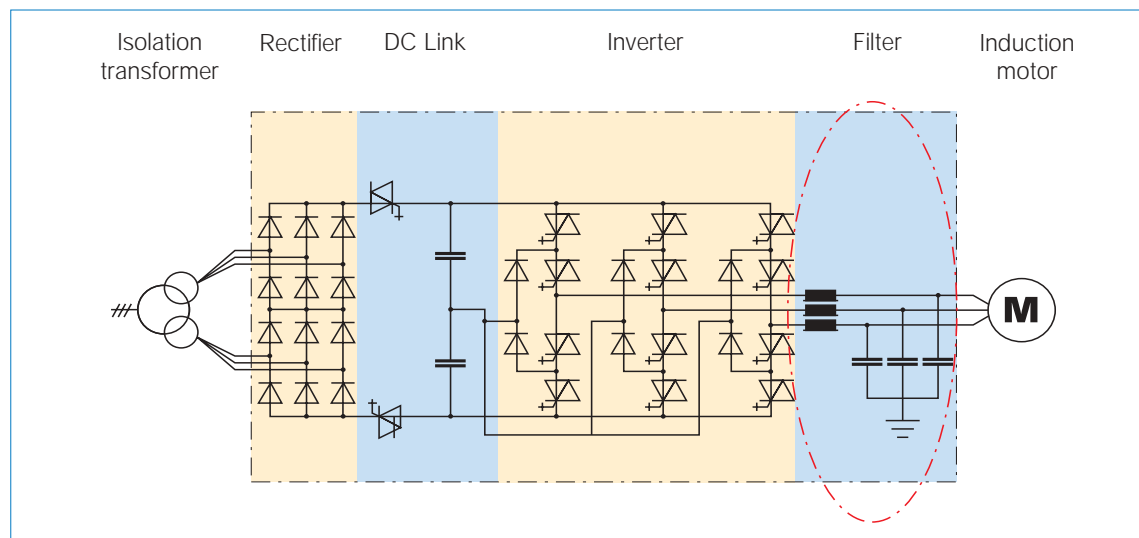
The ACS 1000 is retrofit-ready with a variety of flexible options you can choose according to your needs. Network harmonics and disturbances to existing electrical equipment are minimized. Standard motors can be used without any derating or need for special motor insulation.

High Levels of Performance

The ACS 1000 delivers precise process control through ABB's patented Direct Torque Control (DTC) technology. DTC can provide the quickest torque step response of any motor control platform. This ensures the highest control accuracy without the use of an encoder, despite input power variations or sudden load changes.

Comprehensive Service

We have the largest service organization worldwide which backs every drive we deliver. From training to technical support, we stand ready to provide you with a comprehensive program of service options.



The ACS 1000 drive's three-level voltage source inverter topology with sine filter output

Smooth System Integration

Clean Integration into Existing Systems

Due to its on-board macros and user-friendly software tools, the ACS 1000 is probably the fastest commissioned medium voltage drive in the world.

ABB offers an open communication strategy enabling connection to a PLC or a DCS system. Fieldbus connectivity with a wide variety of protocols is available.

The ACS 1000 meets the IEEE 519-1992 and IEC 61000-2-4 specifications for voltage and current harmonic distortion for virtually all installations. This eliminates the need for expensive harmonic filters and protects other electrical equipment from harmonic disturbances.

The ACS 1000 meets EN (IEC), CE, UL, cUL and other standards to ensure smooth system integration worldwide.

Retrofit-ready Simplicity

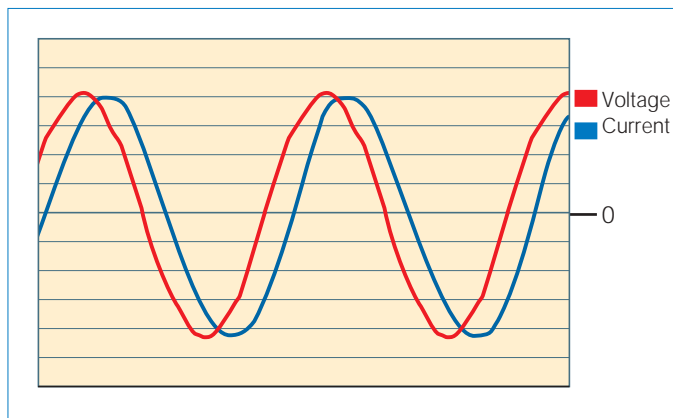
The ACS 1000 is optimized for retrofits. With its small footprint and input isolation transformer flexibility the drive can fit where you need it. Its enhanced motor identification routine simplifies the start-up procedure by determining all the key motor parameters automatically – simply enter the motor name plate data and the ACS 1000 does all the rest. Thanks to the perfectly sinusoidal output waveform existing asynchronous motors can be used without derating. The design also ensures that the motor is not subjected to harmful common mode voltages. This means special motor insulation is not required.

ACS 1000 System Integration

- Retrofit-ready
- Sinusoidal output
- Low network harmonics
- High power factor
- Small footprint
- Fast commissioning
- EMC compliant
- Gentle on system components

System Design Flexibility

The ACS 1000 can be configured with either an integrated dry-type or separately installed input isolation transformer. This flexibility enables the use of oil filled transformers when the transformer will be mounted outdoors. The advantage is that you are not forced to accept dissipated heat losses from the input isolation transformer in the electrical room.



Output Sine Filter

- Ensures sinusoidal voltage and current output on the motor side
- Provides compatibility with standard asynchronous motors
- Avoids need to derate motor
- Eliminates voltage stress and common mode voltages to the motor insulation
- Reduces motor noise
- Allows using existing non-shielded cables

Output waveforms with the motor running at full speed. The ACS 1000 drive's sine filter ensures a perfectly sinusoidal voltage and current on the motor side.

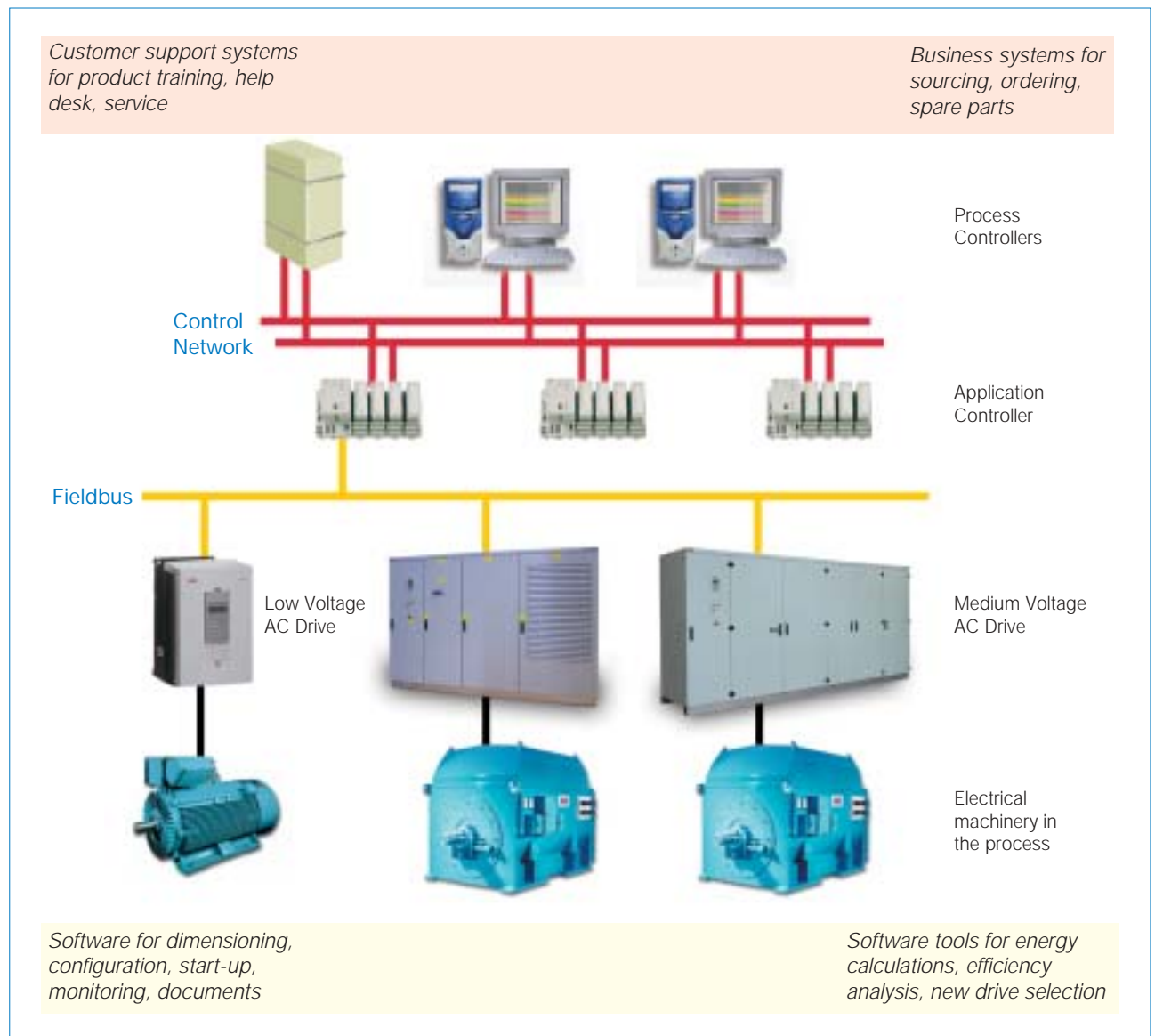
Industrial^{IT}

ABB's Industrial^{IT} means increased standardization and seamless interaction of different ABB products.

The ACS 1000 has been certified to bear the Industrial^{IT} Enabled symbol, a special mark indicating that the drive can be easily integrated into the Industrial^{IT} architecture in a 'plug & produce' manner.

Benefits

- Easy integration of the drive into customer industrial environment
- All drive information readily available in electronic form
- Drive communication with the environment through control panels, standardized fieldbus adapters and interfaces (OPC, OLE for Process Control)
- Easy to use start-up and maintenance tools



The Principle of Industrial^{IT}

Streamlined Technology

The Medium Voltage Challenge

Until now, the power switches for medium voltage drives have been either Gate Turn Off Thyristors (GTO) or Insulated Gate Bipolar Transistors (IGBT). For medium voltage applications, such devices force design trade-offs that increase the cost and complexity of power control systems. ABB is intimately familiar with these trade-offs. We have invested in and further developed these devices for many years.

IGBT: Conventional Transistorized Approach

Both low voltage and high voltage IGBTs have been used in medium voltage drives. IGBTs are fast switching but conduction losses are high at medium voltage levels and complicated series connections of multiple IGBTs are required. High voltage IGBTs have fewer series-connected devices relative to low voltage IGBTs, but conduction losses are even higher. Overall parts count increases resulting in bigger drives. Costs go up. Reliability goes down.

GTO: Thyristor Standard

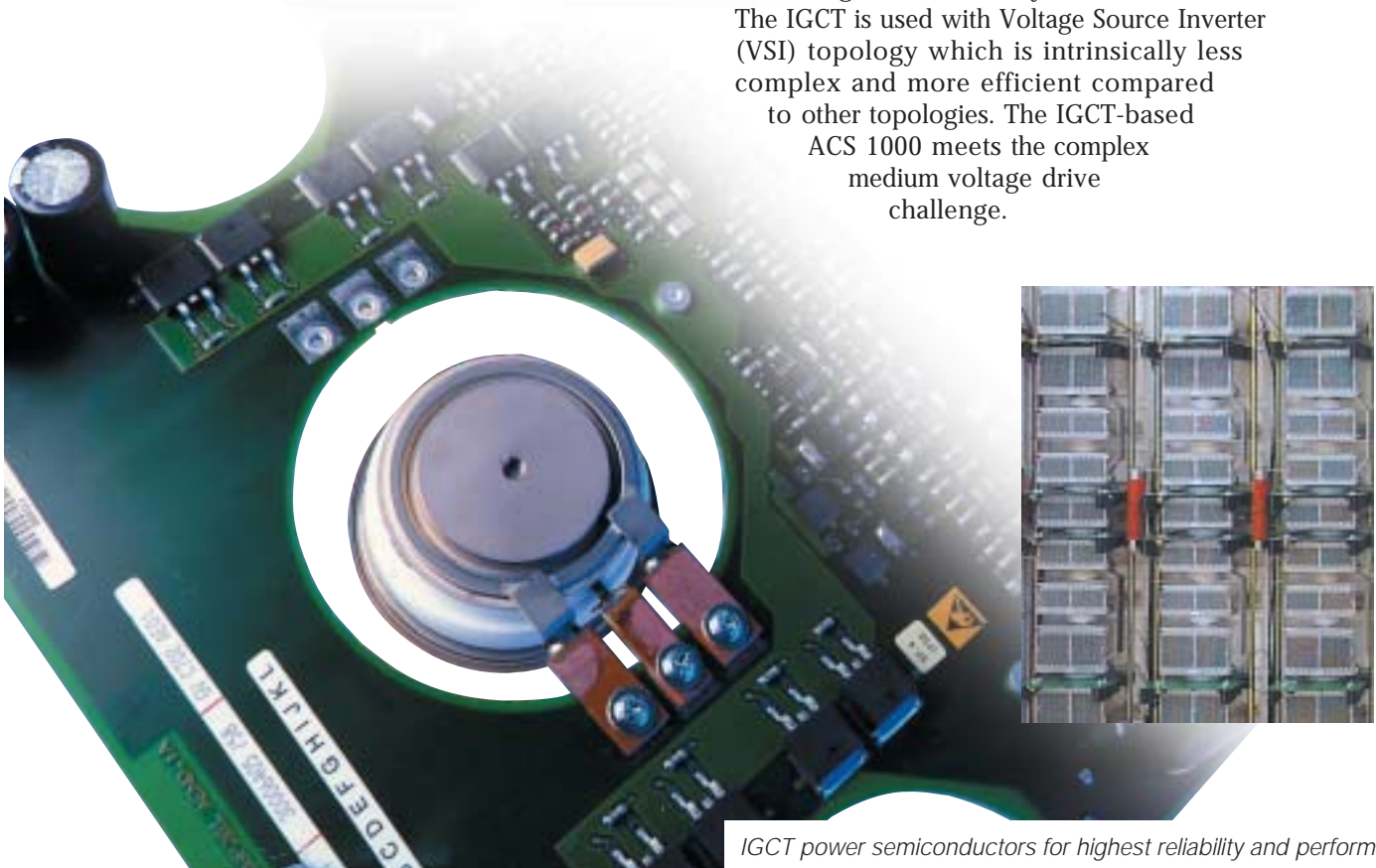
GTO technology is reliable and conduction losses at medium voltage levels are tolerable. The problem is that non-homogeneous switching requires huge additional circuitry for turn off. Again, parts count increases resulting in larger drives. Costs increase. Reliability decreases.

IGCT: Specifically Designed for Medium Voltage

ABB is keenly aware of the need for a power-switching device that displays:

- High-speed switching like an IGBT
- Low-loss conduction like a GTO
- Reliability in a wide range of medium voltage applications

ABB has developed the simple solution based on proven technology: the Integrated Gate Commutated Thyristor (IGCT). This evolutionary technology consists of a redesigned GTO, which incorporates significant design breakthroughs. The new IGCT delivers fast, homogeneous switching and inherently low losses. The IGCT is used with Voltage Source Inverter (VSI) topology which is intrinsically less complex and more efficient compared to other topologies. The IGCT-based ACS 1000 meets the complex medium voltage drive challenge.



IGCT power semiconductors for highest reliability and performance

Streamlined Technology Requires Fewer Parts

Depending on the voltage level, an IGCT-based medium voltage drive typically requires as little as one fifth the number of power semiconductor devices as existing low voltage IGBT solutions. IGCT's lower losses mean less cooling equipment and higher inherent reliability. Fewer parts. Higher reliability. Simple solution.

IGCT greatly improves performance and reliability – extending beyond conventional solutions.

Switching Technology Comparison – for Medium Voltage Applications

	GTO	LV IGBT	HV IGBT	IGCT
Switching technology	Available for most MV levels	Only available for MV levels with series connection	Only available for MV levels with series connection	Available for most MV levels
	Low on-state losses	Moderate on-state losses	High on-state losses	Low on-state losses
	High switching losses	Low switching losses	Moderate switching losses	Low switching losses
	Low switching frequency	High switching frequency	High switching frequency	High switching frequency
	Snubbers required	Snubberless but requires synchronized gate driver	Snubberless but requires synchronized gate driver	Snubberless
	Separate gate driver	Compact gate driver	Compact gate driver	Integrated gate driver
Power circuitry	Safe from catastrophic failure	Additional protection needed	Additional protection needed	Safe from catastrophic failure
	Moderate parts count	High parts count	Moderate parts count	Low parts count
Equipment design	Moderately compact	High parts count leads to reduced reliability and large equipment size	Moderately compact	Very compact
	Moderate cabling and interconnection	High cabling and interconnection	Moderate cabling and interconnection	Low cabling and interconnection

The ACS 1000 Medium Voltage AC Drive Air-cooled

Small footprint and no rear or side access required for less floor space and increased retrofit flexibility

EMC compliant cabinet for problem-free operation in electro-magnetic environment

Electromechanically interlocked doors of power sections for safety



Control section

- Same layout for air-cooled and water-cooled units

User-friendly control panel for local operation

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

DC bus grounding switch for safety

Cooling air intake

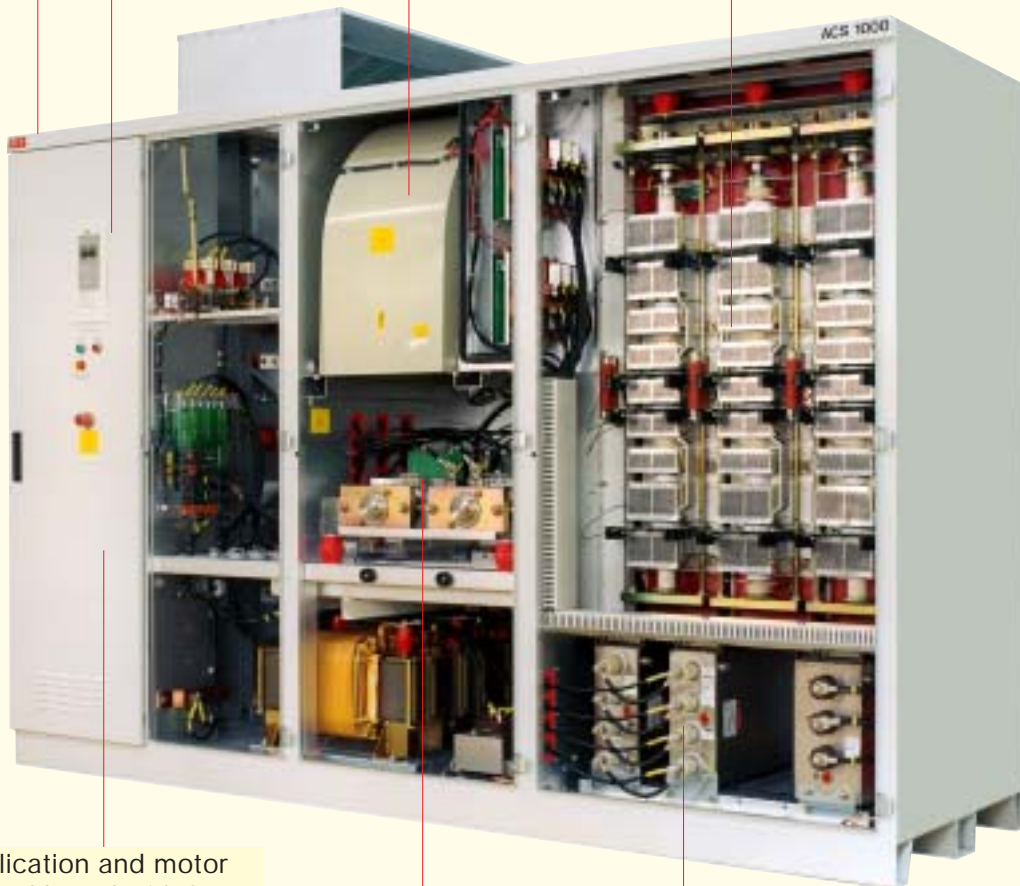
Separated connection section for power cables

Top and bottom cable entry/exit as standard

Control electronics mounted on swing frame for easy access

Integrated fan for low noise level

IGCT power semiconductors for highest reliability and performance



Application and motor control board with fast digital signal processor and DTC

Fiber optics for noise immunity and galvanic isolation

Standard and optional I/O boards for greater functionality

Battery back-up for electronic power supply for maximum reliability

12-pulse input bridge as standard
24-pulse input bridge as option, for stringent harmonic mitigation

Output filter for smooth sinusoidal current and voltage waveform

The ACS 1000 Medium Voltage AC Drive Water-cooled

Small footprint for less floor space
and increased retrofit flexibility

EMC compliant
cabinet for problem-
free operation in
electro-magnetic
environment



Control section

- Same layout for air-cooled and water-cooled units

User-friendly control panel for local operation

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

DC bus grounding switch for safety

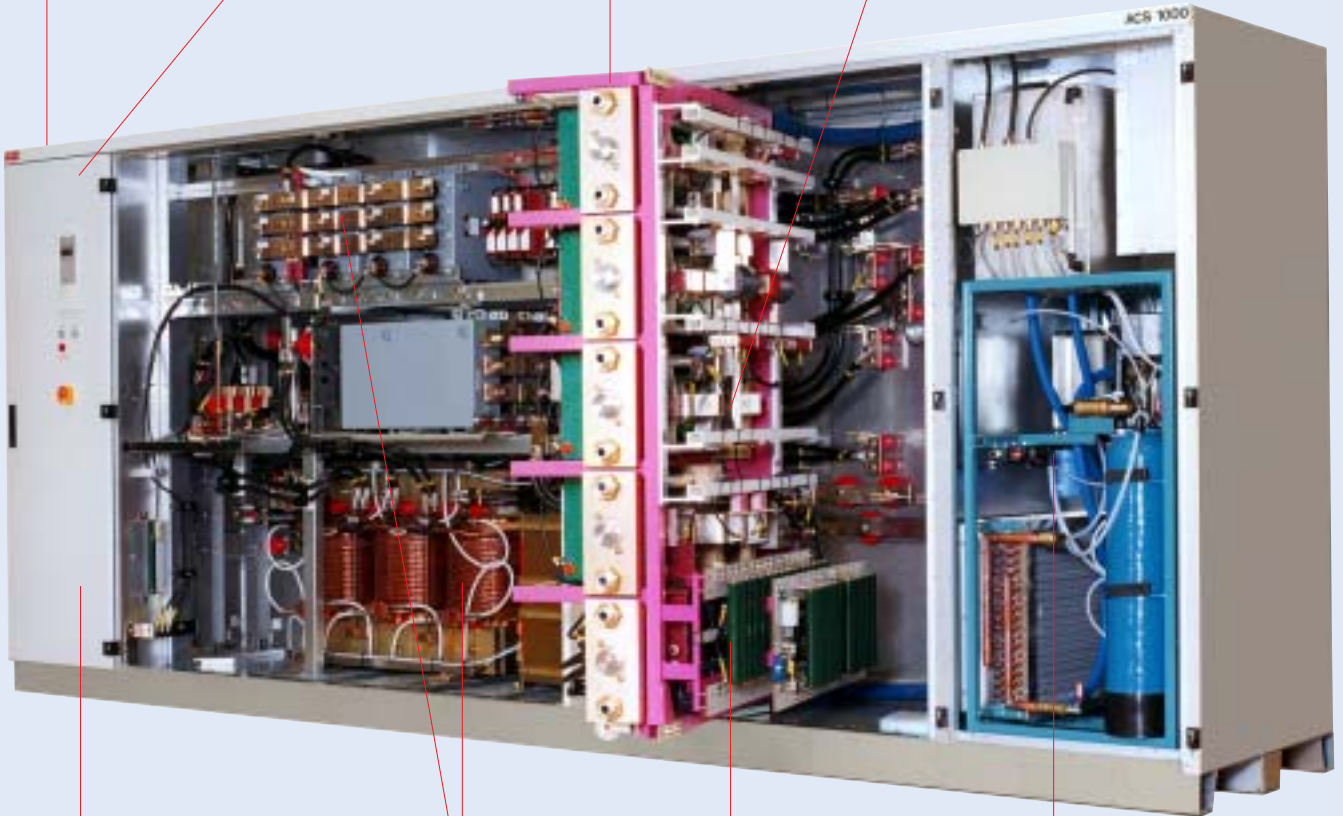
Electromechanically interlocked doors of power sections for safety

Separated connection section for power cables
Top and bottom cable entry/exit as standard

Control electronics mounted on swing frame for easy access

Inverter stacks on swing frame for easy accessibility and performance

IGCT power semiconductors for highest reliability and performance



Application and motor control board with fast digital signal processor and DTC

Fiber optics for noise immunity and galvanic isolation

Standard and optional I/O boards for greater functionality

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24-pulse input bridge as option, for stringent harmonic mitigation

Water cooling cabinet incorporating: main, secondary and water treatment sub-systems

- Accessible during drive operation
- Design allows for service without the need to drain the water circuit
- Redundant pump optional

Performance

DTC Technology at the Heart of the ACS 1000

Direct Torque Control (DTC) is an optimized motor control method for AC drives that allows direct control of all the core motor variables. This opens up AC drive capabilities never before realized and offers benefits for all applications.



What is Direct Torque Control?

In DTC, stator flux and torque are used as primary control variables. The motor state calculations are updated 40,000 times a second (i.e. every 25 μ s) in the advanced motor software model by the high-speed digital signal processor. Due to the continuous updating of the motor state and the comparison of the actual values to the reference values, every single switching in the inverter is determined separately.

Encoderless

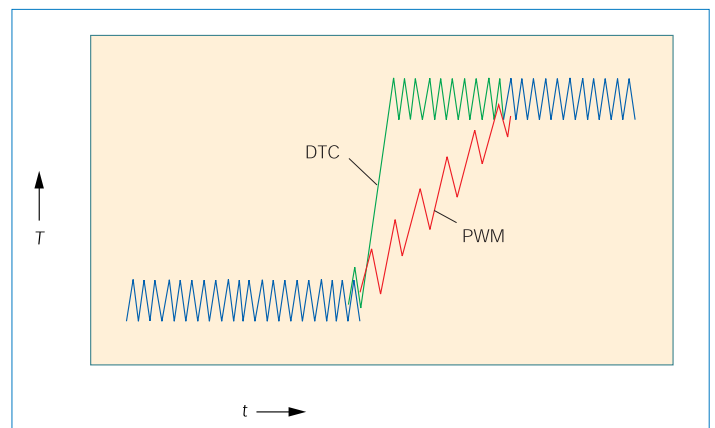
Encoders are sensitive instruments in a harsh process environment and are known to be susceptible to failures. Due to DTC the ACS 1000 can run the motor at nominal speed accuracy and under full performance without any speed feedback.

Maximized Starting Torque

Precise torque control provided by DTC allows the ACS 1000 to provide maximized starting torque that is both controllable and smooth.

Fast Response to Mains Fluctuations and Process Side Changes

The exceptionally fast torque step response of the ACS 1000 means that it can respond to process and mains changes extremely fast. This enables easy handling of power-loss situations and sudden load changes.



Typical torque (T) response of a DTC drive, compared with flux vector control and open loop pulse width modulation (PWM)

Reduced Noise

Because of the separately determined switching, the ACS 1000 has no fixed switching frequency. This eliminates resonances that cause irritating noise associated with AC drives using conventional PWM technology.

Highest Efficiency

The inherently total low losses of the IGCT switching devices are ideally complemented by the high economical performance of DTC, switching the inverter devices precisely but only when necessary.

DriveWare, the Tools to Increase Productivity

Easy-to-use ACS Family Tools

The ACS 1000 incorporates the same suite of user-friendly tools as other drives of the ACS product family. This makes it easier when working with different ABB drives in one plant.

The PC-based tools include *DriveWindow*, *DriveSupport* and *DriveOPC*. They work on-line and provide simple start-up, control, monitoring and maintenance features.

DriveWindow

ABB's *DriveWindow* is an advanced, easy-to-use tool for commissioning and maintenance of drive systems in different industries.

Features

- Access to all drives connected to the same network
- Graphical presentation of signal values
- Monitoring and editing of drive signals and parameters off-line or on-line
- Back-up of drive parameters
File can be easily reloaded
- Fault diagnosis. Indication of drive status and fault history
- Modbus compatibility, RS485

DriveSupport

DriveSupport is a simple, clear and concise multimedia-based service tool which provides pictures and clear instructions for troubleshooting and servicing drives. *DriveSupport* makes fault correction easier than ever before.

Features

- Diagnostics of faults and warnings
- Testing and verifying possible fault causes
- Locating of faulty components
- Performing step-by-step replacement procedures
- Recording maintenance activities

DriveOPC

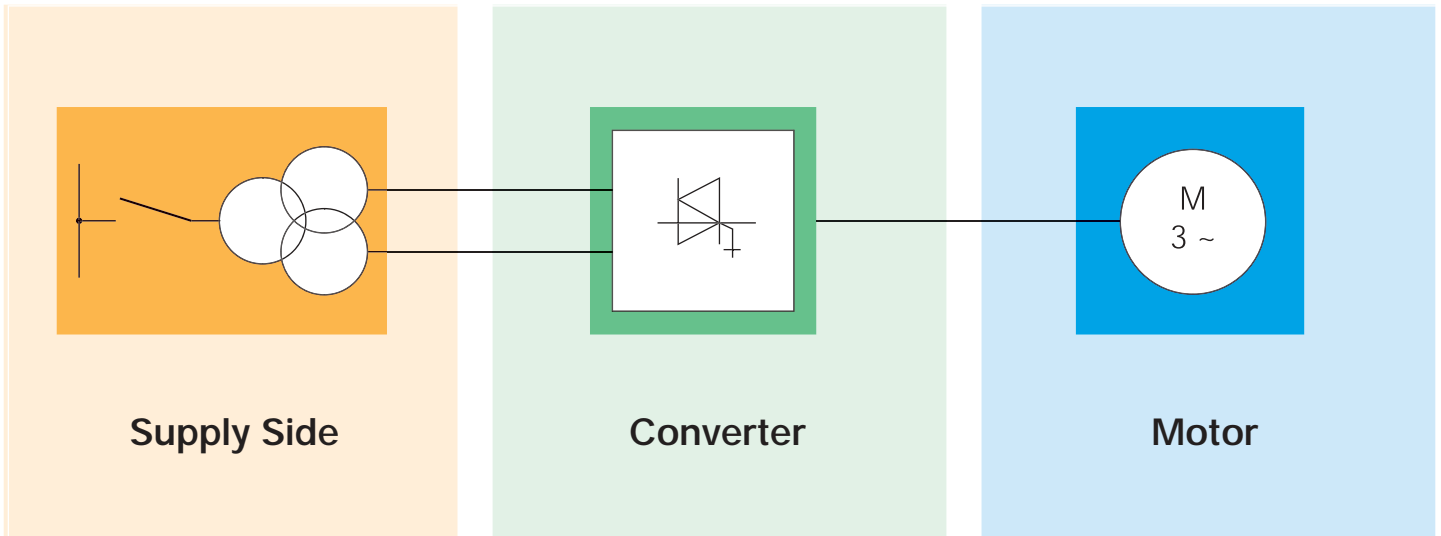
DriveOPC is a software package which allows communication between windows applications and ABB drives.

Features

- Controlling and monitoring with PC-based process control software
- Standard interface
- Remote connection via LAN (Local Area Networks)
- Access to
 - Drive control
 - Signals and parameters
 - Data and fault loggers

Issues and ACS 1000 Solutions

The ACS 1000 addresses customers concerns in all three areas indicated.



Basic drive system configuration

Supply Side

ACS 1000 Solutions

- Conforms to IEEE 519.1992 and IEC 61000-2-4
- Fundamental power factor of 0.97 and constant total power factor of 0.96 over entire speed range
- Transformer can be placed away from converter or outdoor to keep its heat losses out of the electrical building
- 24-pulse diode bridge rectifier for more demanding networks

Benefits

- Avoids penalties and system damage:
5th and 7th harmonics are suppressed by 12-pulse diode bridge rectifier
- Extra and costly reactive power compensation equipment is not needed
- Only 6 transformer cables needed instead of up to 45 with multi-level configurations

Converter

ACS 1000 Solutions

- IGBT power semiconductor technology for maximum reliability
- Small footprint
- Complies with EMC legislation
- Sinusoidal output voltage and current

Benefits

- Highly reliable and highly efficient converter design
- Retrofit-ready
- Meets health and safety legislation
- Prevents electromagnetic emissions to neighbouring equipment

Motor

ACS 1000 Solutions

- Compatibility with standard asynchronous motors
- DTC and output filter contribute to low audible motor noise
- No voltage stress and common mode voltages on the motor insulation

Benefits

- Avoids expense of “Engineering” a dedicated drive and designing a new motor
- No motor derating
- No voltage reflections with long motor cables
- Saves motor insulation, prevents motor bearing damages
- No shielded motor cables required

Reliability and Service

Dedicated ACS 1000 Test Facility

ABB knows how important reliability is to your success. We are committed to ensuring the reliability of every drive we deliver. To this end, we have made a major investment in a dedicated ACS 1000 test facility.

You can be assured that your drive has been thoroughly prepared for smooth integration into your facility. Simply reliable.

The ACS 1000 is backed by the largest drives service team in the industry. This means faster service for your specific plant needs.



View of ABB's test machines at the drive factory in Switzerland. Every ACS 1000 drive will undergo a load test driving a medium voltage motor with load, in order to subject it to 'real life' operating conditions, before shipping it to customer's site.

Training

Extensive training can be provided for our medium voltage drives customers at dedicated ABB University centers in Asia, North America and Europe. A range of training is offered from basic tutorials to programs tailored to your specific needs.

www.abb.com/abbuniversity

Extensive Experience

As originators of AC drives technology in the late 1960's, ABB has over 30 years of application know-how in all industrial sectors, in virtually every country. We have gained our experience by listening to our customers and developing products which fulfill their needs.

Whatever your industry, you will find ABB engineers able to communicate in the language of your business – not in drives jargon.

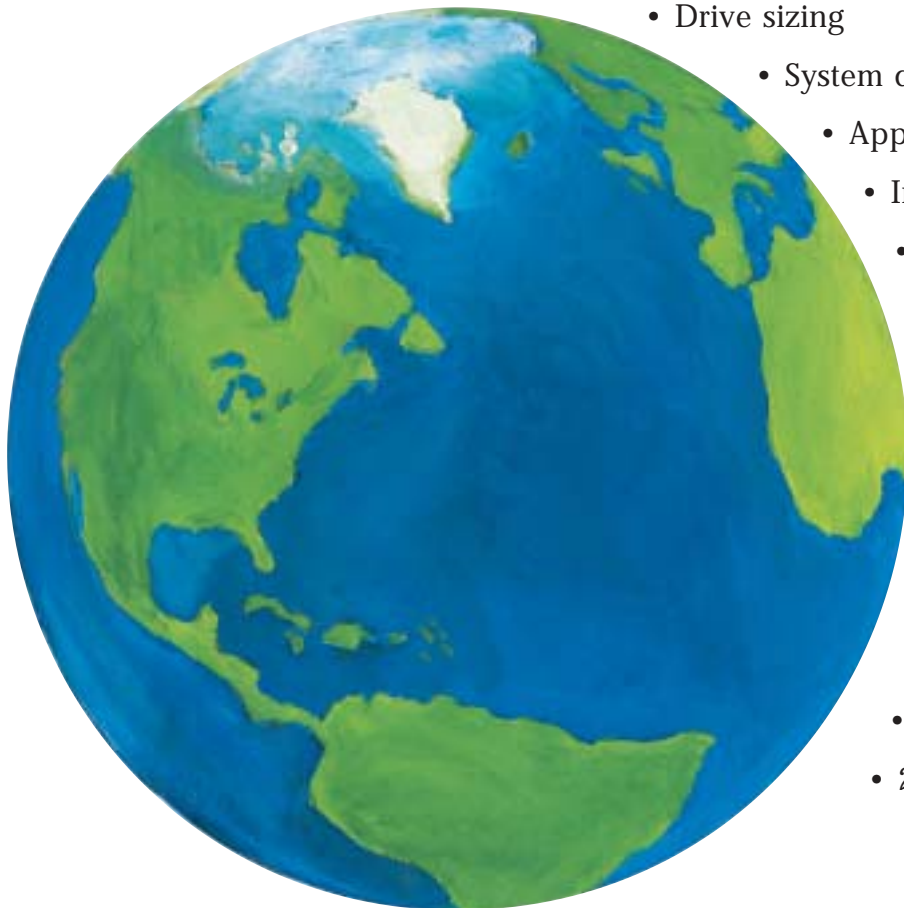
We listen. We learn. We deliver the best solutions. Your choice is simple.

Service and Commissioning

ABB's experts will help you sizing, designing and commissioning your new drive.

In addition, our extensive worldwide service network is at your disposal to ensure that your drive and plant remain on-line when it most matters to you.

Comprehensive Service



- Drive sizing
- System design
- Application engineering
- Installation
- Commissioning
- Training
- On-board diagnostics
- Remote diagnostics
- Customized service programs
- Local technical support
- Local service support
- Spare parts & logistics network
- Worldwide service network
- 24 x 365 Support line

Our service experts are located in more than 55 countries
We provide service around the clock, around the world



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