

ABB AC Drives

ACS 6000c Cycloconverter
for high performance speed
and torque control of 1 to 27 MW
synchronous motors



ABB

Overview

Cycloconverter drives for all applications

ABB provides the most suitable cycloconverter product range for all of the typical applications:

- rolling mill main drives
- mine hoist drives
- ship propulsion
- SAG, ball and cement mill drives, etc

Experience to exceed your demands

ABB has wide experience in cycloconverter drives, having delivered about one third of the world's cycloconverter power. ABB cycloconverters were first used in 1969 for ring motor drives on cement mills and later also with marine propulsion, mine hoist and rolling mill main drives.

State-of-the-art technology

ABB is continuously improving its products using the latest technologies and components available. ABB's drive technology development is in the pioneering class. New drive concepts are implemented widely to utilise the benefits in customer's processes.



High quality rolling mill operation requires drive equipment with first class characteristics.



Propulsion motor being lifted into the engine room at the shipyard.

Excellent performance

Cold rolling mills, like tandem and sendzimir mills, are demanding higher dynamic response and accurate speed and torque control for the main and auxiliary drives. Hot rolling mills like roughers, hot strip and steckel mills require good torque control and high momentary overload capability.

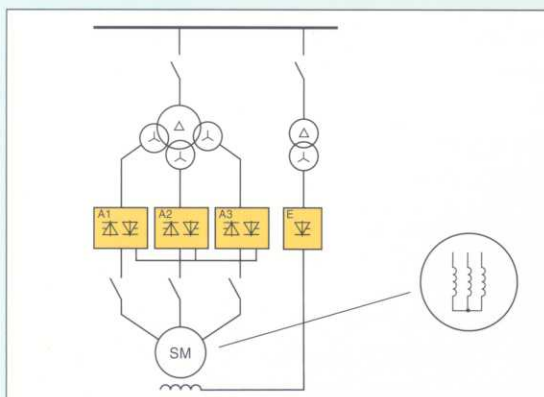
Cycloconverter drives delivered by ABB have proven capable of meeting the highest reliability requirements and running the customer's production with excellent availability and performance.

The Cyclo Propulsion Concept

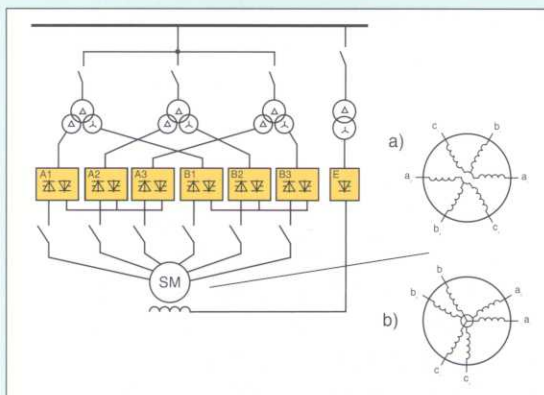
The Cyclo Propulsion is a concept which offers reduced operating costs and exhaust emissions, enhanced redundancy and freedom to locate the machinery components on board a ship. Together with the Azipod® system ABB's cycloconverter gives ships manoeuvrability beyond conventional limits.

Cyclo propulsion technology is used extensively on luxury cruise ships, nuclear icebreakers and tankers. As such, ABB has gained a world leading position in the field of electric propulsion.

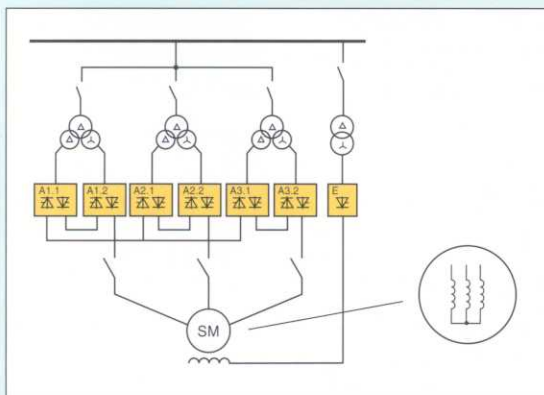
The main components of a cycloconverter drive are supply transformers, the cycloconverter, high speed circuit breakers and the synchronous motor.



Six-pulse Cycloconverter



12-pulse 2x3 phase Cycloconverter



12-pulse three phase Cycloconverter

Antiparallel connected six pulse thyristor bridges can be used in various combinations and are fed by transformer secondaries individually or parallel depending on the motor windings connection type.

Six-pulse Cycloconverter

The benefits of six-pulse circuit configuration are:

- the most cost effective solution
- saved volume
- minimum weight

The motor may be star connected or equipped with galvanically separated windings. The configuration where motor windings are separated, is widely used in ship propulsion. The volume and weight saved by the transformers can be used to increase passenger or load capacity.

12-pulse 2x3 phase Cycloconverter

The benefits of 2x3 phase circuit configuration are:

- redundancy of the hardware configuration
- low network harmonic distortion

When the motor windings are star connected, each phase 6-pulse converter is fed by an individual secondary winding of the transformer. With six-phase machines (2x3 phases 0 degrees or 30 degrees phase shift), it is possible to reduce or even eliminate the 5th and 7th, 17th and 19th etc. harmonic currents.

12-pulse three phase Cycloconverter

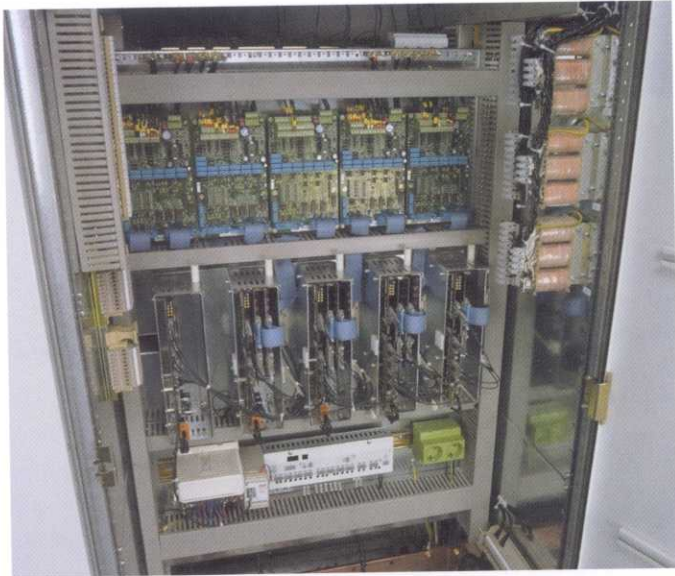
The benefits of 12-pulse circuit configuration are:

- fastest response times in current and torque control
- lowest network harmonic distortion
- lowest losses
- lowest shaft torque ripple
- maximum output frequency

The torque rise time which can be reached with a motor supplied by 12-pulse converter is better than the respective value of a 6 pulse converter. Furthermore, with this arrangement, the motor voltage can be increased to 3 kV, reducing cabling costs and energy losses.

The main output current ripple frequency is 600 Hz (720 Hz for 60 Hz supply) compared to the 300 Hz (360 Hz) of a 6-pulse converter. This means that the magnitude of torque ripple caused by current ripple is extremely low, and the torsional vibrations are negligible.

Control



The new control unit is compact and contains fewer components.

Control Configuration

Cycloconverters use new advanced control for current, flux and speed with a uniform full digital control concept throughout the whole ACS Product family. This concept fits most automation systems directly and improves flexibility to create optimal solutions for both small and large systems.

Windows™ tools, in common with the whole ABB's ACS Product family, can be used for application software editing. This results in reduced training and start up time, simpler operation and more flexibility with software adaptation to specific needs.

Advantages of the AMC concept

- Control System close to process
- Fast torque response
- Excellent motor control performance
- Flexible interface which can be expanded according to customer application needs
- Simple block programming with FCB (Function Chart Builder)
- Programming language common with ABB Advant control system and other ABB Drives products
- Freely programmable application software on AMC3
- Fault messages accessible on local control panel and also PC monitoring available.
- High reliability gained through extensive self monitoring
- Control and I/O interfaces common with ABB automation and drive products

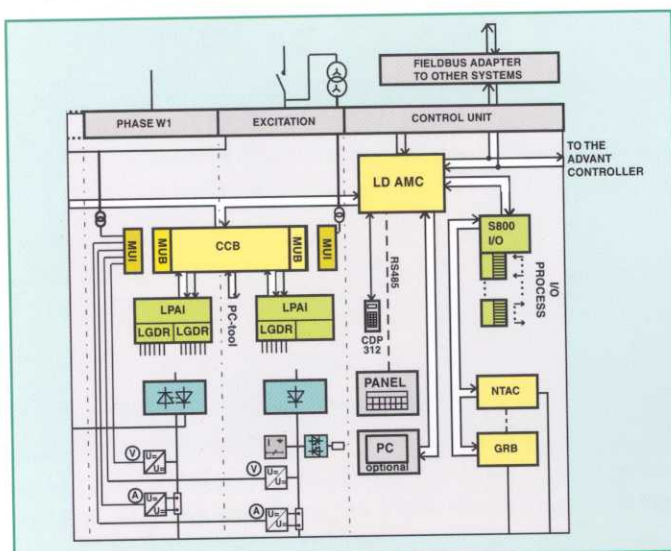
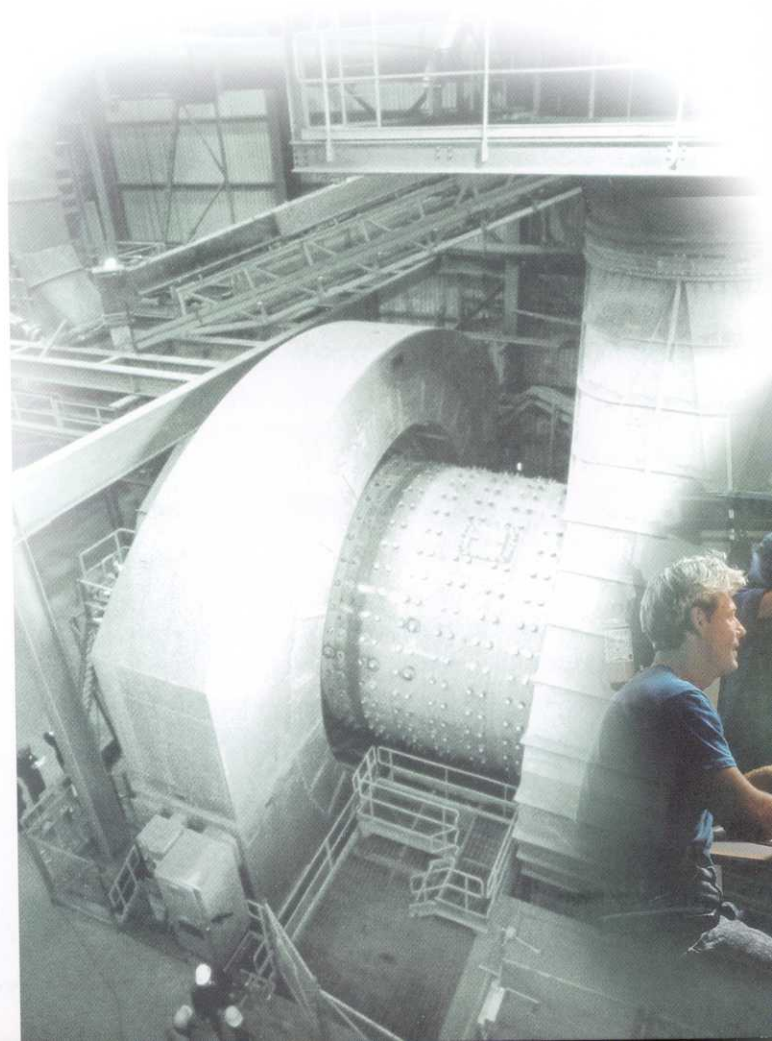
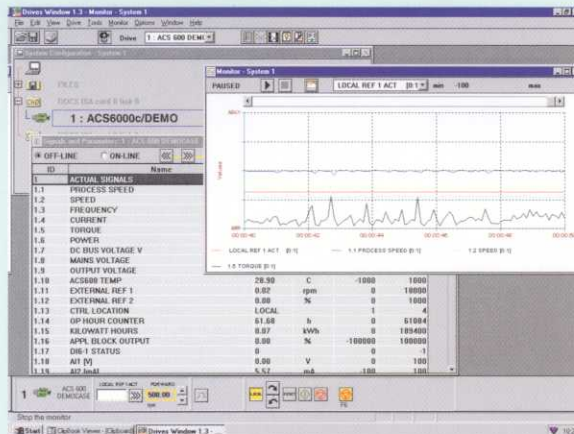
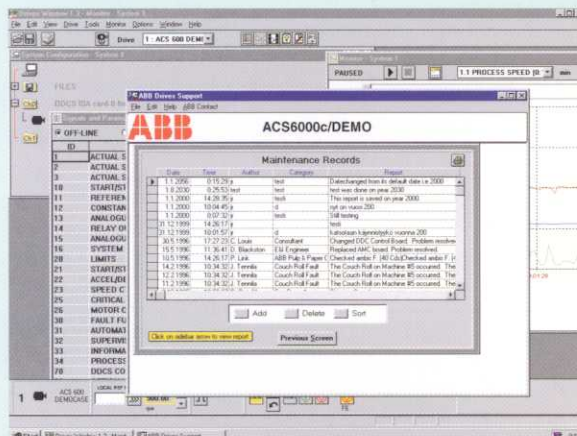


Diagram of control hardware configuration with AMC3 motor control.

Drive Ware



DriveWindow is a user-friendly PC tool for commissioning and maintenance.



DriveSupport is a diagnostics tool for troubleshooting and servicing drives.

DriveWindow

DriveWindow is common tool for the ACS 600 Product Family. The Windows™ environment with its user-friendly interface makes the tool easy to learn and use.

DriveWindow is used for commissioning and maintaining several types of drives at the same time. Target drives are identified automatically during initialisation.

DriveWindow offers versatile features for parameter setting, monitoring and controlling drives. Several display windows can be opened at the same time to work with the drives.

DriveWindow diagnostic features can also be used via remote operation.

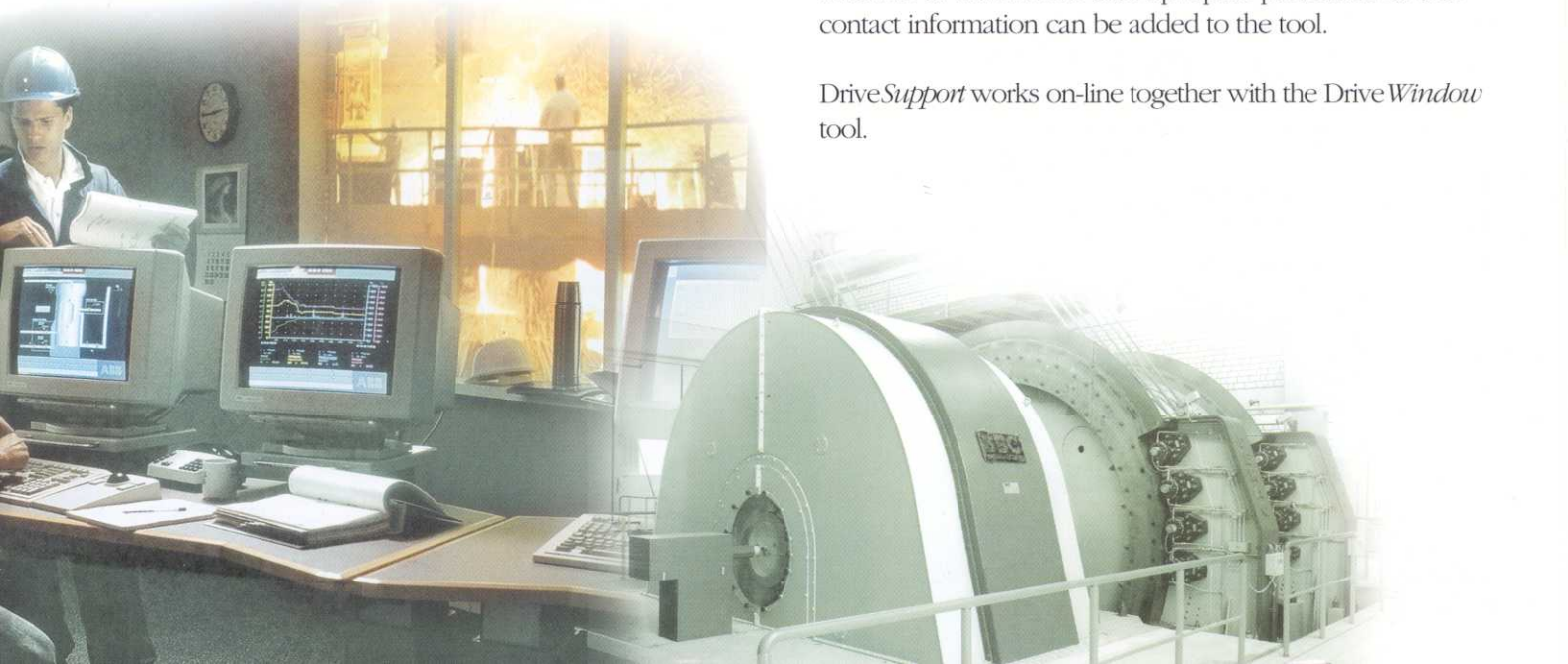
DriveSupport

DriveSupport is a diagnostics tool which identifies faults and warnings based on the signal values from drives. It provides expert knowledge for troubleshooting and servicing drives. Actual pictures and step-by-step replacement procedures are available within the tool.

DriveSupport is fully configurable for ABB drive products and/or projects. The user language can be customised, and special faults and warnings can be added based on experience.

In addition, DriveSupport keeps a record of all service activities that have been performed on any part of the machine or drives since start-up. Spare part numbers and contact information can be added to the tool.

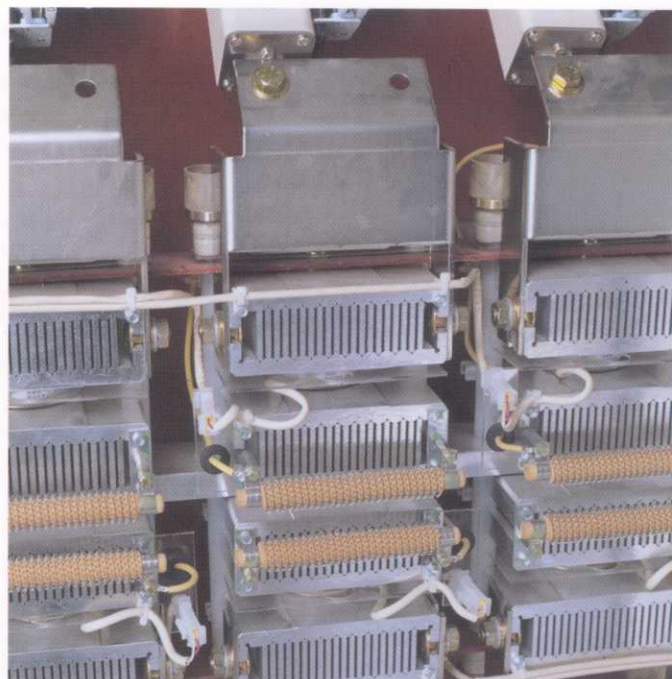
DriveSupport works on-line together with the DriveWindow tool.



Technical Data

Power stage and Excitation:

Topologies	3 pcs or 6 pcs stator phase converters in 6-pulse antiparallel connection 6-pulse thyristor bridge for excitation
Mains supply	3 x 1000 V AC max, 50/60 Hz
Excitation supply	690 V AC max, 50/60 Hz
Auxiliary supply	Common 3 x 230...480 V AC, 50/60 Hz, 100...400 A supply for all cycloconverter auxiliaries
Input power factor	approx. 0.76 ind. at rated load
Output power factor	approx. 1.0
Efficiency	> 99 % at rated load
Output frequency f_o	0...24/28 Hz
Static speed inaccuracy (typical)	± 0.01 %
Dynamic speed inaccuracy (typical)	0.25...0.5 % s
Torque ripple (air gap)	0.5 % r.m.s. (< 100 Hz frequencies)
Main ripple frequencies	$6 \times f_o = 0...144/168$ Hz $6 \times f_i = 300/360$ Hz $12 \times f_i = 600/720$ Hz $f_o = 0...24/28$ Hz
Cooling method	Deionized water supplied by cooling unit, water/water heat exchanger
Cooling water flow	2.8...14.8 m ³ /h (including excitation)
Cooling water temperature	min. +20 °C, max. +36 °C (external)
Cooling method	Forced air ventilation
Cooling air required	2.5...9.5 m ³ /s (including excitation)
Cooling air temperature	max. +40 °C (up to 1000 m above sea level)
Degree of protection	IP 21, IP23 as an option
Standards	IEC 146

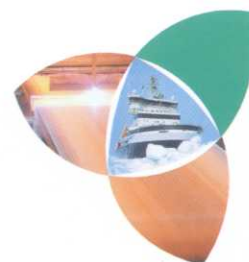


Cooling element is designed for extremely efficient heat dissipation.

Built in redundancy in cooling unit.



Technical Data



Main control hardware devices

- AMC3 Application and Motor Controller
 - Embedded watchdog functions
 - Fully digital DSP and ASIC technologies
 - Optical DDCCS high speed communication channels (8 Mbps)
 - Fast SRAM memory, Flash memory (subprint), Boot-PROM
 - RS485 interface for Modbus communication (panel)
 - Real time clock
 - Status indication by LEDs
 - MMI interface to DriveSupport, DriveWindow, Service Panel, Fieldbuses
- Fieldbus Adapter
 - AF 100, CS 31, DeviceNet, Modbus(/Plus), Profibus (/DP,/FMS) etc.
- S800 I/O -station
 - Expandable up to 192 DI/DO signals or 96 AI/AO signals per I/O Station, 24 I/O Modules per Station using ModuleBus and 7 clusters using ModuleBus Modems
- Converter Control Board, Pulse Amplifier Interface, Gate Driver
- Measuring & Protection Boards, Encoder boards
- Power supply
- Standard multiuse Service panel

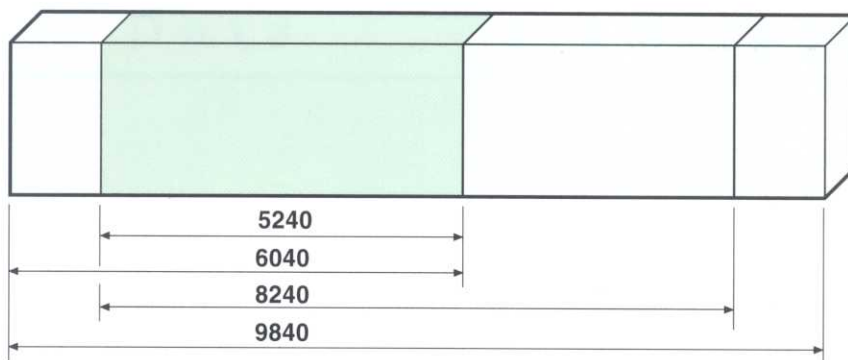


CONVERTER (Water Cooled)	Continuous current with 200 %/ 60 s Overload [A]	Max. continuous current [A]	Nominal Power [kVA]
3-phase			
NCYC 4/15/16/W6	925	1600	4150
NCYC 7/15/29/W6	1700	2850	7400
NCYC 11/15/42/W6	2625	4150	10800
NCYC 14/15/52/W6	3350	5200	13500
2x3-phase			
NCYC 8/15/2*16/W12	2 x 925	2 x 1600	8300
NCYC 15/15/2*29/W12	2 x 1700	2 x 2850	14800
NCYC 22/15/2*42/W12	2 x 2625	2 x 4150	21600
NCYC 27/15/2*52/W12	2 x 3350	2 x 5200	27000
3-phase 12-pulse			
NCYC 15/30/29/W12	1700	2850	14800
NCYC 22/30/42/W12	2625	4150	21600
NCYC 27/30/52/W12	3350	5200	27000

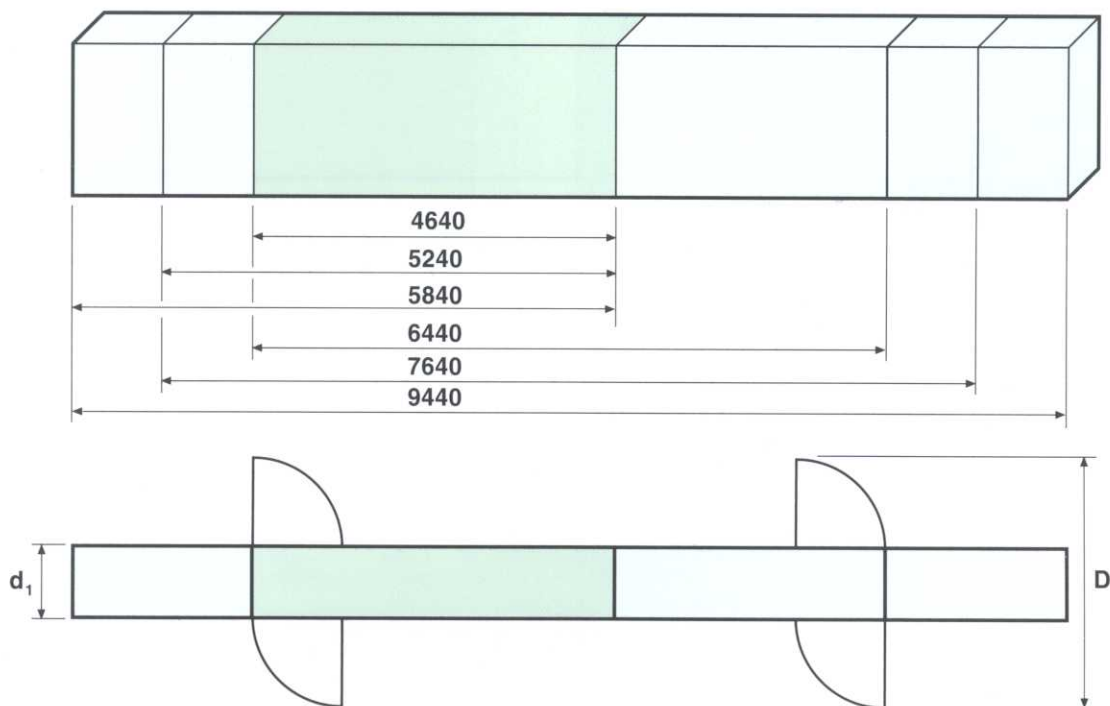
CONVERTER (Air Cooled)	Continuous current with 200 %/ 60 s Overload [A]	Max. continuous current [A]	Nominal Power [kVA]
3-phase			
NCYC 4/15/14/A6	880	1420	3690
NCYC 6/15/23/A6	1525	2300	6000
NCYC 7/15/27/A6	1600	2700	7000
NCYC 10/15/38/A6	2250	3750	9700
NCYC 12/15/45/A6	2800	4500	11700
2x3-phase			
NCYC 7/15/2*14/A12	2 x 880	2 x 1420	7380
NCYC 12/15/2*23/A12	2 x 1525	2 x 2300	12000
NCYC 14/15/2*27/A12	2 x 1600	2 x 2700	14000
NCYC 19/15/2*38/A12	2 x 2250	2 x 3750	19500
NCYC 23/15/2*45/A12	2 x 2800	2 x 4500	23400



Air Cooled:



Water Cooled:



TYPE (Air Cooled)	P/kVA	L/mm	D/mm	d ₁ /mm	W/kg
3-phase					
NCYC /A6	≤ 6000	5240	2400	860	2900
NCYC /A6	≥ 7000	6040	3000	1060	3600
2x3-phase					
NCYC /A12	≤ 12000	8240	2400	860	4700
NCYC /A12	≥ 14000	9840	3000	1060	5950

TYPE (Water Cooled)	P/kVA	L/mm	D/mm	d ₁ /mm	W/kg
3-phase					
NCYC /W6	4150	4640	2400	860	2600
NCYC /W6	7400...10800	5240	2600	1060	3250
NCYC /W6	13500	5840	3000	1060	3550
2x3-phase, 3-phase 12-pulse					
NCYC /W12	8300	6440	2400	860	3800
NCYC /W12	14800...21600	7640	2600	1060	4900
NCYC /W12	27000	9440	3000	1060	5900



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