



PCS 6000 for large wind turbines
Medium voltage, full power converters
up to 9 MVA

ABB medium voltage converters – operating successfully in thousands of installations



The growing importance of regenerative energy has been accompanied by a continuous rise in the demand for wind power. However, state-of-the-art turbines are now attaining such high power ratings that low voltage systems are struggling to cope with the currents and losses occurring in generators, converters and cables.

The logical solution is to use medium voltage converters in large wind turbines – with real benefits when it comes to hardware and system performance.

Over the years, medium voltage technology has become well established. Worldwide, ABB has been a leader in the installation of medium voltage frequency converters. ABB medium voltage converters, with their excellent reputation for high-endurance, reliable operation in the harshest environments, are used in industrial and propulsion drive systems, railway grid entities, static VAR compensators, battery storage and many other demanding applications.

For any large-scale wind turbine, the PCS 6000 medium voltage converter is the perfect match when operating with synchronous and asynchronous generators – whether high- medium- or low-speed designs.

The PCS 6000 approach – more than delivering a product

From the early evaluation phase of a new wind turbine to final operation in the wind park, ABB provides first-class customer consulting, support, training and service.

ABB converter specialists are experts in all aspects of the system and will therefore build an electrical drive train that functions perfectly – from the generator through to grid integration.

ABB's life-cycle management involves a highly qualified service team who can rely on supporting software tools for remote monitoring. They will maximize the value of the equipment by maintaining trouble-free operation and ensuring maximum availability.

PCS 6000 medium voltage converters – for top system performance and gentle turbine operation

Full generator control

For optimal active and reactive generator power control, plus maximum wind utilization at any turbine speed.

DC link decoupling

For independent grid- and generator-side control without impact from one side to the other.

Full grid control

For optimal active and reactive grid power control, plus guaranteed grid-code compliance.

Gentle generator handling

For reduced mechanical stress thanks to optimum drive train damping, plus overspeed and overvoltage protection.

Dynamic brake chopper

For low voltage ride-through and safe turbine shutdown, even with a lost grid.

High and low voltage ride-through

For keeping the turbine on-line even during a major grid disturbance.

Motor operation

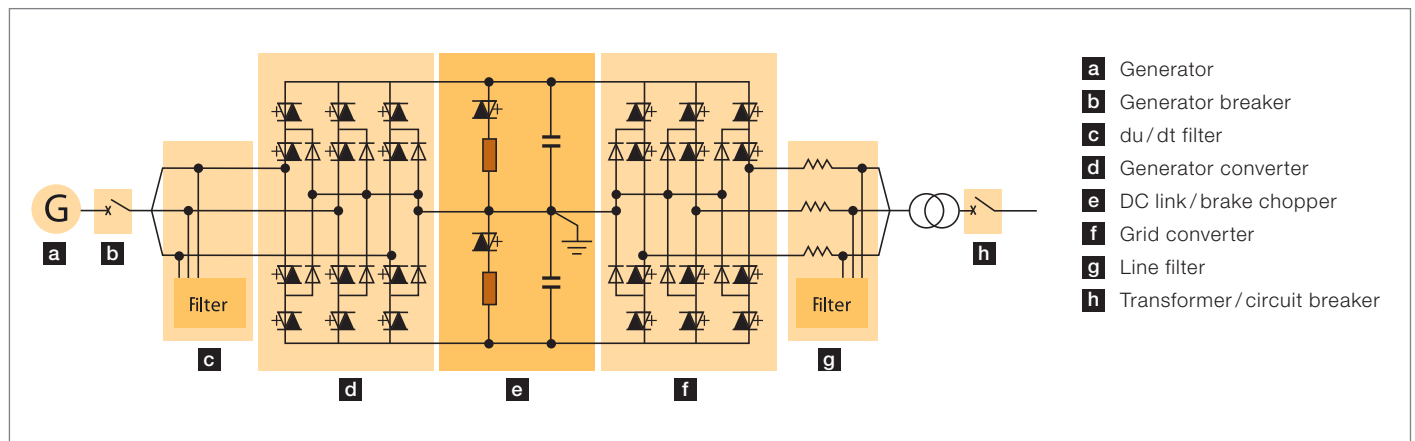
For back-to-back testing and precise rotor positioning.

Precharging soft start

For zero-current, flicker- and inrush-free grid synchronization.

Harmonic elimination

For reduced harmonics into the transformer and the grid.



When it comes to large turbines, ABB's PCS 6000 medium voltage technology is the right choice. With significantly lower currents, the result is a boost in efficiency, a lower part count, a smaller footprint along with easy cabling and fast installation.

The full power topology of the PCS 6000 gently decouples the turbine's mechanical drive train from the electrical grid, and vice versa, while minimizing turbine stress and allowing compliance with even the strictest grid codes.

The bottom line? With large wind turbines, the PCS 6000 medium voltage, full power converter is the most sustainable, efficient and economic choice for top performance, grid stability and trouble-free operation.

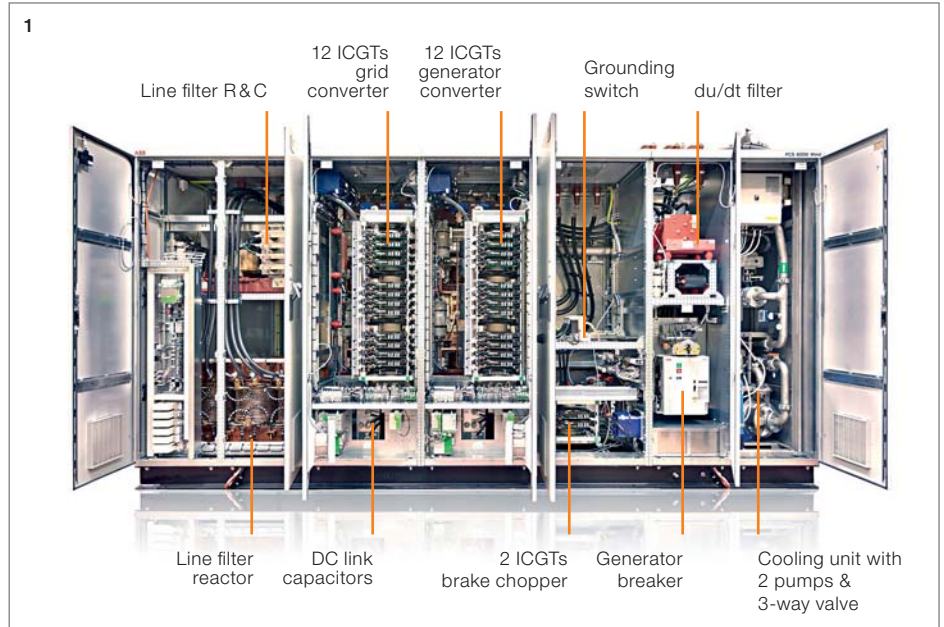
PCS 6000 medium voltage converters – fewer parts for maximum reliability

Only 26 semiconductors

No paralleling of components and therefore a lower part count, higher reliability, less complexity and a smaller footprint.

Condensation protection

To ensure a safe start-up even in humid environments.



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Effective converter cooling

Trouble-free operation thanks to the integrated closed-loop cooling circuit with redundant pumps and three-way valve.

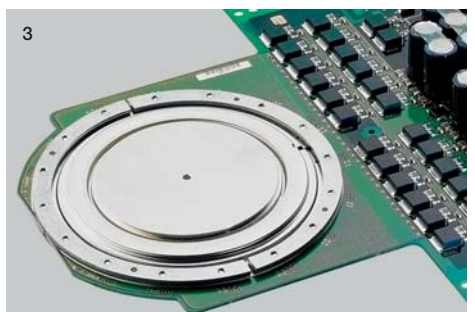
Fuseless design

To avoid site visits for fuse replacement after disturbances and allow a remote restart after a cleared failure.

DC link

Made up of high-quality, maintenance-free industrial film capacitors with a self-healing and internally fused design.

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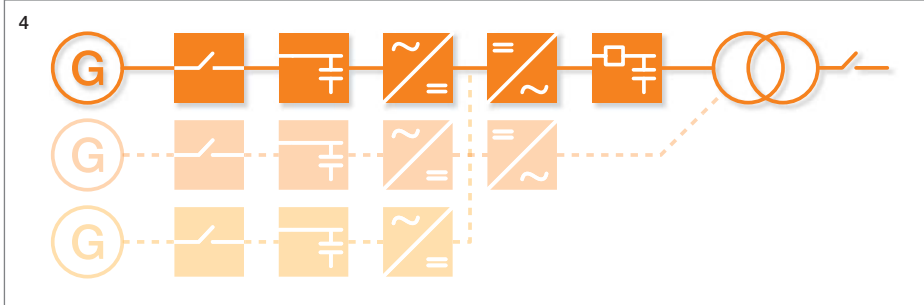


Using ABB's medium voltage technology, the paralleling of devices is not required. This keeps the part count low, resulting in a much lower failure rate compared to other solutions operating at such a power level.

Advanced protection and high-speed converter control are handled by ABB's AC 800PEC controller. All system communication is solely via fiber optical links and is therefore immune to electromagnetic interference.

With the emphasis on a well-balanced converter design and the use of high-quality components, the PCS 6000 is a market reference for long life and operational reliability.

PCS 6000 medium voltage converters – for high flexibility and modular design



- 1 Clear design with low parts count
- 2 Much smaller cross-section of tower cabling
- 3 Integrated Gate Commutated Thyristor (IGCT)
- 4 Modular design for customized applications
- 5 Physical separation of generator and converter
- 6 Flexible and space-saving layout



Back-to-back



Face-to-face



In-line

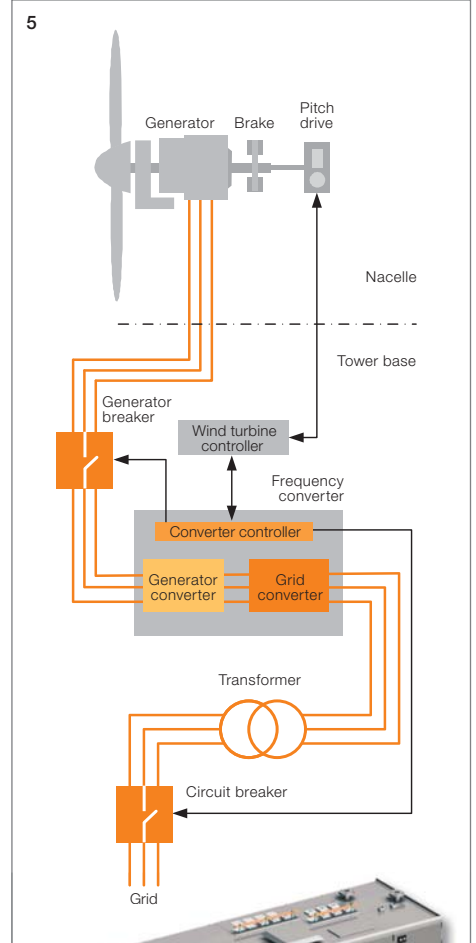
PCS 6000 modular design covers any configuration

The PCS 6000 is a modular type of frequency converter that is ideal for the majority of demanding single- or multi-generator applications. The design concept allows maximum flexibility at different power ratings and also customized solutions involving a minimum prototyping and engineering effort.

The PCS 6000 fits confined spaces

Medium voltage allows easy location of the converter at the base of the tower. The resultant reduction in nacelle weight and easier service access bring major wind turbine design benefits.

The modularity of the PCS 6000 permits the arrangement of the converter modules very flexibly even on a single deck – either back-to-back, face-to-face or in-line.



PCS 6000 medium voltage converters – facts and figures

Converter model	PCS 6000 Wind
Converter type	3-level, 4Q, VSI-NPC, fuseless design
Semiconductor	IGCT
Capacitors	Self-healing and self-protected film capacitors
Supported generators	High-, mid- and low-speed permanent magnet asynchronous induction generator static-excited synchronous generator

Converter data			
Converter voltage nom.	3.3 kV	4.16 kV	3.3 kV
Generator-side voltage	0 to 3.4 kV	0 to 4.3 kV	0 to 3.4 kV
Grid-side voltage	0 to 3.4 kV	0 to 4.3 kV	0 to 3.4 kV
Semiconductor type	RC-IGCT	RC-IGCT	Sym.-IGCT
Number of IGCTs	12 + 12		
Generator-side frequency nom.	8 – 100 ¹⁾		
Grid-side frequency	50/60 Hz		
Power rating	4 MVA	4.5 MVA	9 MVA
Efficiency at converters rated point	~0.980		
Generator side du/dt	< 1.5 kV / μ s		

Dimensions ^{2) 3)}		
In-line arrangement size (LxWxH mm)	5100 x 1200 x 2400	5700 x 1200 x 2400
Face-to-face arrangement size (LxWxH mm)	3300 x 1200 x 2400 1800 x 1000 x 2400	3500 x 1200 x 2400 2200 x 1000 x 2400
Back-to-back arrangement size (LxWxH mm)	2700 x 1200 x 2400 2400 x 1000 x 2400	2700 x 1200 x 2400 3000 x 1000 x 2400
Weight	~ 6600 kg	~ 8200 kg

Converter design cases					
Turbine power ratings	3 MW	4 MW	5 MW	6 MW	7 MW ⁵⁾
Converter rating on generator side	~ 3.3 MVA	~ 4.4 MVA	~ 5.5 MVA	~ 6.6 MVA	~ 7.7 MVA
Converter rating on grid side					
@ TenneT grid code	~ 3.7 MVA	~ 5.0 MVA	~ 6.2 MVA	~ 7.5 MVA	~ 8.7 MVA
@ UK grid code	~ 3.6 MVA	~ 4.8 MVA	~ 6.0 MVA	~ 7.2 MVA	~ 8.4 MVA

⁵⁾ to be clarified with coolant temperatures / generator frequency

Auxiliary supply	
Auxiliary supply voltage	3-phase, 400V, 50/60 Hz
Auxiliary supply power	~ 8 kW ~ 12 kW
Cooling	
Converter cooling	Closed-loop cooling unit deionized water / glycol mix coolant
Coolant inlet temperature	Up to 45°C ⁴⁾
Pumps	2 pumps with automatic changeover, 100 % redundancy with check valves
Heat exchanger	Water-air (external) / water-water (internal)
Coolant connections	DN 50 DN65
Instrumentation / transmitters	Temperature, pressure, conductivity
Deionization	Automatic by deionizer resin
Deaeration	Automatic by deaeration valve
Temperature control	Control logic / motor-driven three-way valve

¹⁾ other generator-side frequencies possible on request

²⁾ including cooling and generator breaker

³⁾ other arrangements possible on request

⁴⁾ higher temperatures possible on request

Generator breaker	
Type	ABB VD4 X0
Insulation / safety	Vacuum breaker / ground switch included
Rated voltage	6.6 kV
Rated current	800 A 1250 A / 1600 A

Brake chopper / resistor	
Chopper semiconductor	IGCT
Brake resistor type	Cast iron
Brake resistor capacity	15 MJ / 30 MJ
Brake resistor size (LxWxH mm)	1200 x 400 x 1000 / 1200 x 650 x 1000
Brake resistor weight	~ 200 kg / ~ 360 kg
Brake resistor cooling	Ambient air

Control	
Controller	ABB AC 800PEC
Generator-side control	Pulse width modulation
Grid-side control	Optimized pulse pattern
Field bus interface	Profibus DP / DPV1, Profinet IO, Modbus TCP, EtherCat, CANopen, InterBus
Ethernet	Service and maintenance access with software tool for Windows via installed IPC; VPN remote access ready
Transient recorder	Ring buffer, high resolution
Service IPC	Trending, data logger, remote access
Operation modes	Off / standby / production
Generator-side setpoints	Torque / power
Grid-side setpoints	Power factor / reactive power
Special operation modes	Positioning / test / static VAR compensation
Local control	Emergency off, local / remote control key switch
Local indication	Production, grid-breaker closed, DC link switch closed / released, rotor locked

Electrical interface	
Generator-side connections	From top (Pfisterer P3-AF01)
Grid-side connections	From top (Pfisterer P3-AF01)
Brake resistor connections	From back (Pfisterer P3-AF01)
Control connections	From bottom (wire terminals inside control cabinet)
Grid-side transducers	From high voltage side CT, VT ⁶⁾

Enclosure	
Constructional design	1.5 mm carbon steel, edge bended sheets on solid base-frame MNS system, riveted and bolted
Degree of protection	IP 54
Enclosure color	RAL 7035
Corrosion protection	Powder and / or zinc coating
Door locking	Mechanical security interlocking door release when grounded
Anticondensation	Humidity-, temperature-sensor, control logic and space-heater protection
Lifting	Bottom lifting with removable eyebolts

Environmental limits	
Ambient temperature	Transport -40 to +70 °C Storage -40 to +70 °C Operation -15 to +50 °C ⁷⁾
Altitude	0 – 1000 m

Service	
24/365 support line, product expert remote diagnostic	
Worldwide service and spare part network	

⁶⁾ CT/VT included in HV switchgear, not in PCS 6000 scope
⁷⁾ other ambient temperatures on request

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