



Delta Wind Turbine Converter



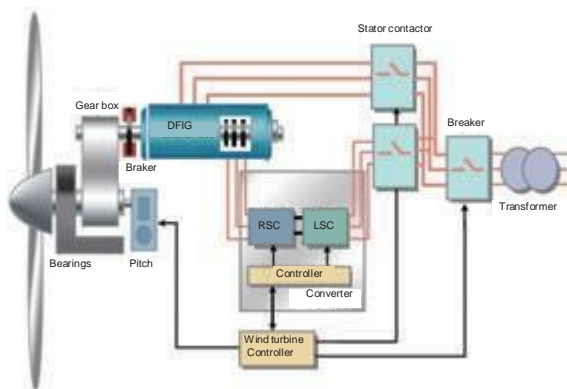
DFIG Converters

A doubly-fed induction generator (DFIG) converter is a key component in a DFIG wind turbine, a mainstream technology for wind turbines. It features grid-friendly operation to enable optimization of the system in wind turbines. Delta converters are available for 2.0, 2.5 and 3.0 MW DFIG Wind Turbines.



Fundamental

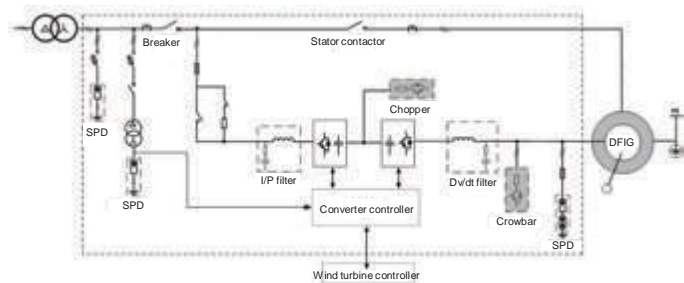
The stator of the doubly-fed induction generator is connected to the grid through the main circuit breaker while the rotor is connected through DFIG converter to the grid. When a turbine's rotation speed varies with the wind speed, the converter changes the frequency of the rotor magnetizing current by controlling the excitation current frequency of the rotor, which results in the output voltage and frequency of turbines consistent with those of the grid.



System Architecture

DFIG converter consists of a distribution cabinet, control cabinet and power cabinet. The distribution cabinet provides the housing for the switch gears which connect the converter and the grid as well as the stator. The auxiliary power supplies and the protection switches are included to meet customers' distribution requirements.

The control cabinet provides signal conditioning, control, and communication. The power cabinet enables the interaction and the transmission between rotor slip power and the grid, and controls the rotor excitation current, thus controlling the voltage, frequency, and active and reactive status of the stator.



Technical Advantages

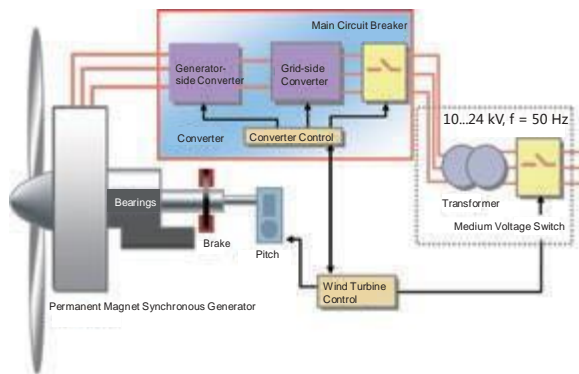
- Unique converter control architecture provides high reliability and complete monitoring
- Optimized IGBT switch frequency and grid-connected filter design results in low harmonics
- Completely isolated power conversion circuitry and control circuitry enables higher insulation and safe operation
- Optimum control for grid connection results in low in-rush current
- Compact and neat mechanical design enables space saving and easy installation
- Built-in fault ride-through design for grid faults ensures to meet the requirement of LVRT/ZVRT/HVRT.

A full power liquid-cooled converter is one of the key components of a wind turbine using permanent magnetic synchronous generator (PMSG), a technology widely used in today's wind turbines. The full power converter couples with permanent magnet synchronous generator to realize effective grid-connected power generation. Delta's fully enclosed converters meet the protection requirements of IP54 and with the flexibility of being installed either in the tower bottom or in a nacelle. Delta converters are available for 2.0, 2.5, 3.0 and 6.0 MW PMSG Wind Turbines.



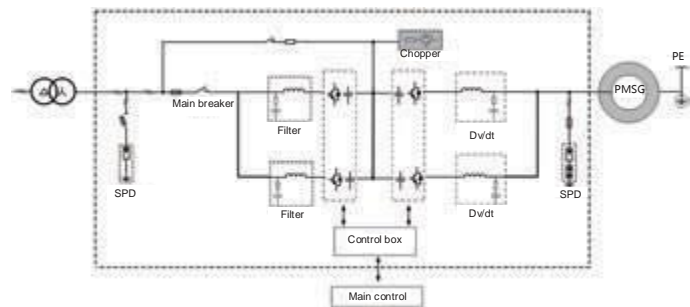
Fundamental

The stator of the synchronous generator is connected directly to the generator-side of the converter, while the grid-side connects to the grid. All the power is transmitted to the grid through the converter. The converter tracks the frequency and phases of grid voltage to keep the output current and frequency of turbines in consistent with those of the grid.



System Architecture

A converter contains 1 to 3 sub-converter systems, depending on the power level required by the system. Each sub-converter system further contains a generator-side converter and a grid-side converter.



Technical Advantages

- Vector control and multiple PWM control technology ensures high-efficient power generation at low wind speed
- Highly reliable power modules enhances protection performance and system efficiency
- Unique control architecture provides redundant control of various protections.
- Modular design enables front access for service and maintenance; the power modules could be replaced interchangeably
- Completely isolated power conversion circuitry and control circuitry enables higher insulation and safe operation
- Compact and neat mechanical design enables space saving and easy installation
- Cabinet supplied from famous manufactures which is neat and compatible with mainstream products
- Built-in cooling design provides a total solution combining converter and cooling system

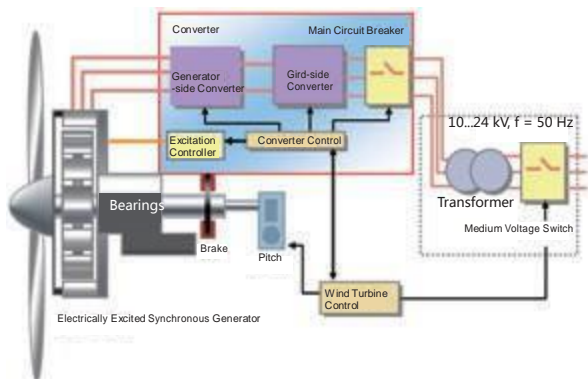
Full Power Wind Turbine Converter – Electrically excited synchronous generator (EESG)

A full power liquid-cooled converter capable of providing electrically excitation is a main component of a wind turbine with the electrically excited synchronous generator (EESG). The full power converter couples with electrically excited synchronous generator to realize effective grid-connected power generation. Delta's fully enclosed converters meet the protection requirements of IP54 and with the flexibility of being installed either in the tower bottom or in a nacelle. Delta converters are available for 2.0, 2.5, 3.0 and 6.0 MW EESG Wind Turbines.



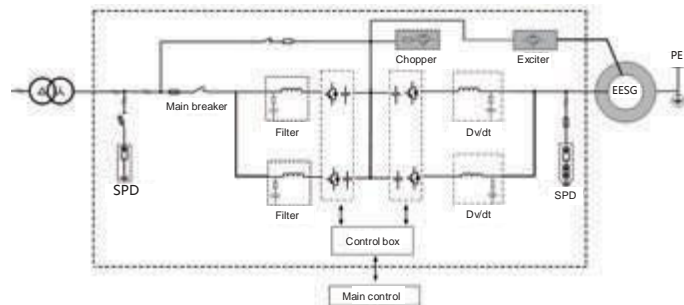
Fundamental

The electrically excited synchronous generator is connected directly to the generator-side of the converter, while the rotor excitation is provided by excitation controller which is equipped with the converter. All the power is transmitted to the grid through the converter. The converter tracks the frequency and phases of grid voltage to keep the output current and frequency of turbines in consistent with those of the grid



System Architecture

A converter contains 1 to 3 sub-converter systems, depending on the power level required by the system. Each sub-converter system further contains a generator-side converter and a grid-side converter.



Technical Advantages

- Excitation controller is integrated in the converter
- Excitation controller, as part of the converter, communicates to the main controller at the turbine
- Inlet of excitation controller passing through the space reserved for main cable enables easy connection
- Excitation system providing redundant design ensures high reliability
- Using nonlinear resistance to reduce the lead time of excitation suppression
- AC power input is available for commissioning and maintenance
- Output filters reduce excitation winding dc/dt
- Built-in cooling design provides a total solution combining converter and cooling system

Full Power Wind Turbine Converter – Induction generator (IG)

A full power liquid-cooled converter is one of the key components of a wind turbine equipped with induction generator (IG). The full power converter couples with induction generator to realize effective grid-connected power generation. Delta's fully enclosed converters meet the protection requirements of IP54 and with the flexibility of being installed either in the tower bottom or in a nacelle. Delta converters are available for 2.0, 2.5, 3.0 and 6.0 MW IG FPC Wind Turbines.

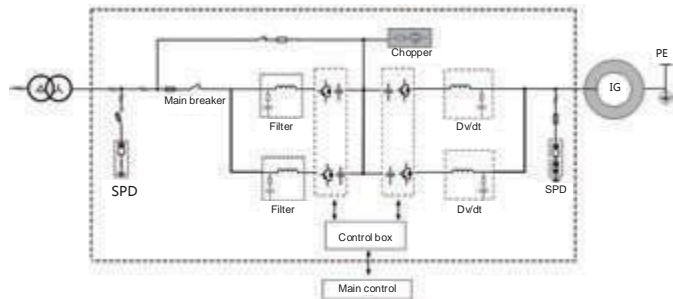
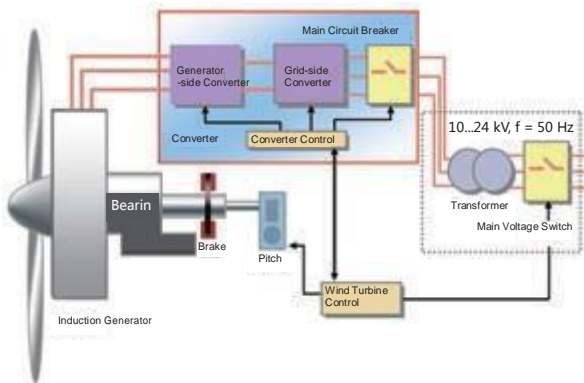


Fundamental

The induction generator is connected directly to the generator-side of the converter, while the grid-side connects to the grid. All the power is transmitted to the grid through the converter. The converter tracks the frequency and phases of grid voltage to keep the output current and frequency of turbines consistent with those of the grid

System Architecture

A converter contains 1 to 3 sub-converter systems, depending on the power level required by the system. Each sub-converter system further contains a generator-side converter and a grid-side converter.

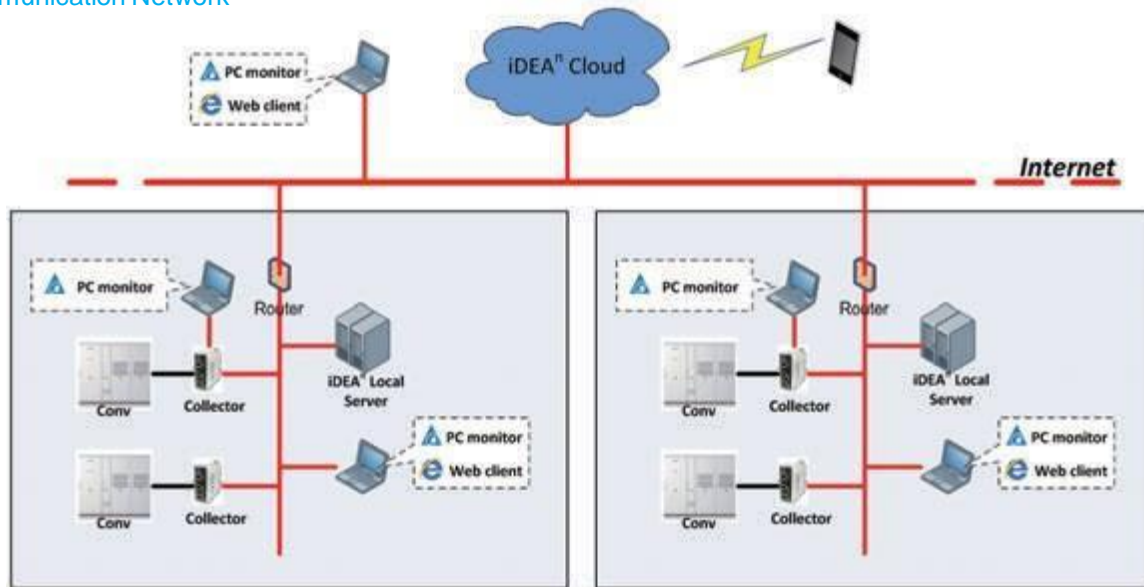


Technical Advantages

- Vector control and multiple PWM control technology ensures high-efficiency power generation at low wind speed
- Highly reliable power modules enhances protection performance and system efficiency
- Unique control structure provides redundant control of various protections.
- Modular design enables front access for service and maintenance; the power modules could be replaced interchangeably
- Optical fiber communication provides excellent EMI immunity
- Completely isolated power conversion circuitry and control circuitry enables higher insulation and operation safety
- Compact and neat mechanical design enables space saving and easy installation
- Cabinet supplied from famous manufactures which is neat and compatible with mainstream products
- Built-in cooling design provides a total solution combining converter and cooling system

Intelligent Remote Monitoring for Wind Converter

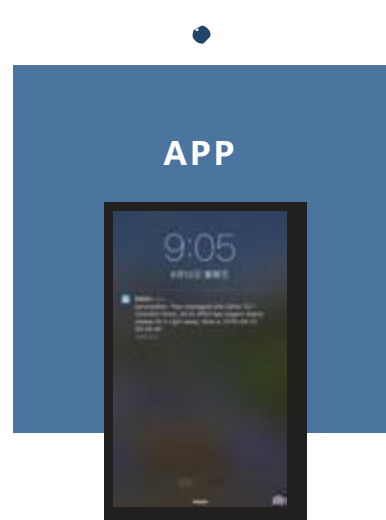
Communication Network



- iDEAⁿ installed either at control room of wind farm or on Delta Cloud Servers realizes the management of wind converters through intelligent remote control.
- Wind converter is with the function of networking communication which supports three alternatives to access Internet, including wifi at wind tower base, optical fiber ring network at wind farm, and 3G/4G networks.
- Customers can access iDEAⁿ through smartphones.

Functions

- This software realizes real-time remote data reading, historical events and fault data recording, rapid positioning of the failure, reduction of the loss of power generation.
- iDEAⁿ enables on-line parameter setting and software update on the converter, which saves the cost of operation and maintenance.
- iDEAⁿ supports comprehensive evaluation for the historical data and provides statistic and graphic reports, which increases operational efficiency.



- Smartphone APP enables technicians manage, track, and be aware of the status of the converter at real time.

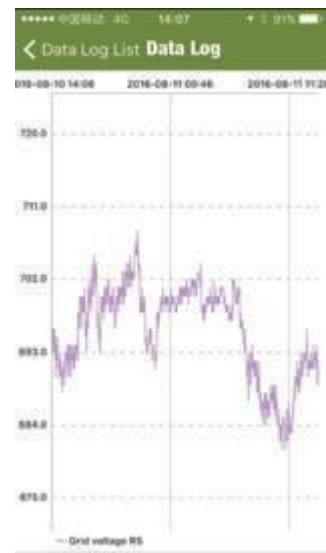
List of wind Turbines



Status of wind Turbines



Data and Graphics



Awards and Certificates



Grid Compliance Test Report (2.0MW EESG)

PQC Test Report (2.0MW DFIG)

LVRT Test Report (2.0MW FPC)

LVRT Test Report (2.0MW DFIG)

GL Test Report (2.0MW FPC)

Technology at Delta

Delta spending more than 5% of yearly sales revenue on RD investment ranks no. 431 at worldwide according to the reserch from UK Department of Trade and Industry.

In accordance with ISO/ IEC17025 quality management system, Delta set up several labs, including semiconductor failure analysis, quality engineering, electromagnetic compatibility, precision measurement, materials analysis, and etc. Those labs recognized as post-doctoral innovation center were certified by China National Accreditation (CNAS) in 2005, and also qualified by TAF, IC, and FCC.



Manufacturing at Delta

Delta have manufacturing facilities in China and in India for wind turbine converter. We ensure our quality performance through improving automation in production, robust quality assurance system, complete testing coverage, and etc.



Service at Delta

Delta's global operations and branch offices in China enables us to provide best and comprehensive service to our customers in a timely manner, including product selection at design stage, intergration tests, testing and commissioning at wind farm, after-sales support, trainings, and etc.



Delta Wind Converters at Wind Farms



Maojing, Gansu, P.R.C (2.0MW DFIG)



Mahuangtan, Gansu, P.R.C (2.0MW FPC)



Jingyuan, Gansu, P.R.C (2.0MW FPC)



Maharashtra, India (2.6MW FPC)



Xinghe, Inner Mongolia, P.R.C (3.0MW FPC)



Boisbergues, France (2.0MW)

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