DW2020
Compact Systems for Wind Energy Conversion

MOOG
COMPONENTS GROUP

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SYSTEM OVERVIEW

A flexible and modular design

- The DW2020 is a combined generator-regenerator (plus capacitive modules depending on the system configuration) designed to convert the energy produced by a wind turbine and its immission into the grid. The control platform for the turbine and the regenerated energy uses the technology and modular design of the consolidated system DM2020; the advanced control card and software improve the efficiency of energy conversion; a perfect system integration is a quality factor essential for new markets. The flexible design based on functional blocks and the support supplied during planning by our engineers to customize the product according to customer requirements, improve performance and reduce overall costs.

A compact design to minimize space and costs

- The architecture of the control cabinet, equipped with the modular regenerative power supply units , significantly reduces dimensions and bulk, compared to the stand-alone configuration.
- The main and auxiliary power supplies are distributed via internal connections between each module (regardless whether it is generator or regenerator) thus minimizing wiring.

Designed to extract the maximum power available from the shaft of the wind turbine

- The speed-torque relation is built into the system through a polynomial curve parameterized. The curve includes the setting of 16 operating points and the quadratic interpolation between the pairs of points. It is also provided a method of estimation of wind speed based on the speed of the generator (sensorless), and one based on the acquisition of an anemometer. This control mode is accompanied by the implementation of an MPPT algorithm, adaptable in real time to working conditions thanks to the speed of the data acquisition section of the HW and to a SW structure with high speed of execution, which allows a faster settling to the optimal regime and optimizes the maximum power output by reducing less favorable service intervals (transient).

Optimal control of the generator

- The control technique of the generator is optimized in relation to the speed and the mechanical torque provided. Every electric generator can work both with different values of the magnetic flux (mapped) and with calculated algorithms (dynamic optimization). The two working modes can also be used in parallel to minimize the sum of the iron losses and the copper losses of the magnetic circuit of the generator. The implemented algorithm is based on the principles described in the article "Robust DSP-Based Efficiency Optimization of a Variable Speed Induction Motor Drive", IEEE Trans. On IE, Vol. 50, No. 3, June 2003.

Generator control "Sensorless"

- The control algorithms of the generator are able to drive the phase and amplitude of the current so as to obtain maximum performance, even in the absence of the position transducer on the permanent magnet generator, thanks to the development of an observer software that derives the position of the rotor on the basis of the currents and voltages measured. Thus eliminating the wiring between the turbine and inverter relative to the transducer, reducing complexity, cost, and criticality of the system.

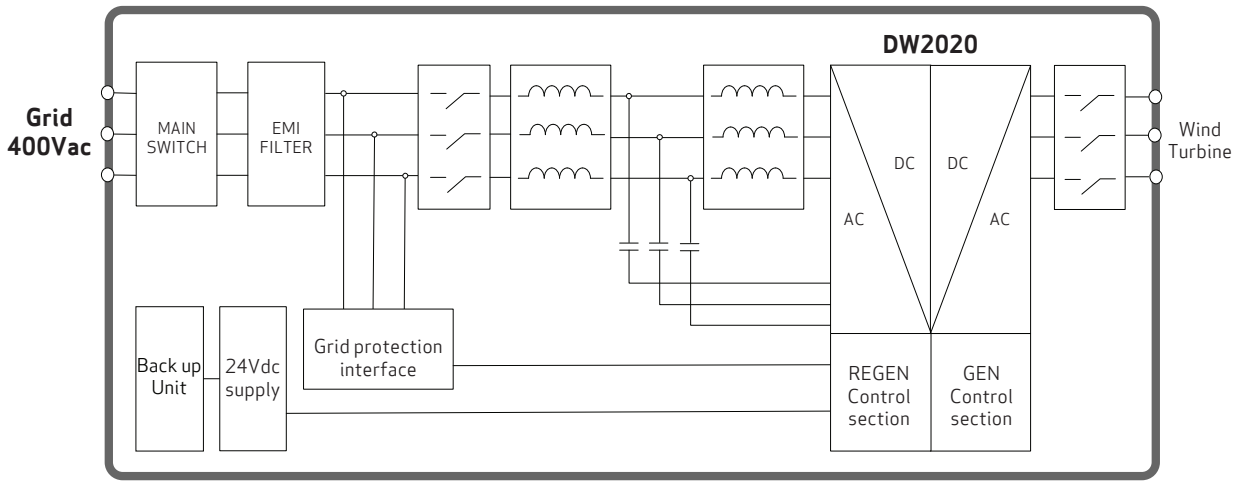
Network connection “Transformerless”

- In parallel to the simplification for the transducers it has been developed an HW and SW technology aimed at connecting systems (from the smallest to the largest) without the use of isolation transformers, thanks to the realization of a new system for the detection of minute voltages and currents. Combined with the dynamic control of the compensation of the waveforms, this technology allows to simply suppress the injection of DC current through the network. The end result is to be able to ensure the functioning of the system without an isolation transformer with a consequent reduction of costs and an increase in efficiency.

Characteristics of control panel

- All panels are suitable for operation in protected environments or outdoors. The standard solution proposed includes a degree of protection IP23 or higher, if necessary.
- Switches and monitoring devices of the energy fed into the grid comply with the rules laid down for the different countries where the system is installed (Italy - CEI 0-21).
- The ease of installation (reduced number of connections to be performed), the modularity of the system for energy conversion and the auxiliary components, all arranged frontally, allow a quick check, maintenance or replacement of all parts.
- All connections of the power and signal lines are located in the lower part of the cabinet and are equipped with screws for simple connection of the cables, without the need for special tools.
- For maximum flexibility in the management of the wind farm it is possible, if necessary, to install other I / O modules in addition to those already contained in standard generator and regenerator modules.
- The electrical panel can be equipped with an auxiliary brake of the turbine. With this option, braking resistors are allocated outside. All switches and control devices of the energy fed into the grid are fed to an auxiliary voltage of 24 Vdc, to simplify the structure and avoid the potential hazards of using higher voltages.

Example of a block diagram of an electrical panel in standard configuration Front-End.



Technical Data

Cabinet Models:

Module Power kW	10	20	30	40	50	60
Voltage (Vac)	380 / 500					
Frequency (Hz)	50/60					
Current (A rated max)	15	29	44	58	72	86
Total harmonic distortion of current	< 2 %					
Power factor	1					
Turbine	Three phase permanent magnet generator					
Current (A rated max)	15	29	44	58	72	86
Minimum operating voltage (Vac)	50					
Maximum operating voltage (Vac)	530					
Max voltage (Vac)	600					
Communication Port	RS232 - RS485 - prot. EtherCat					

Environmental data electric cabinet

Environmental operating temperature	from -10 °C to +40 °C
Storage temperature	from -25 °C to +55 °C
Transport temperature	from -25 °C to +70 °C
Relative humidity	15 ÷ 93 % condensation not allowable
Mounting height	Up to 1000 m from sea level (over 1000 m with reduced current)
	max 2000 m SLM (-2 % / 100 m)
Certification	CE, CEI 0-21
Protection grade	IP 23 - IP54
Mechanical resistance compliant with	EN 50178 : Vibration: 0,075 mm in frequency field 10 ÷ 57 Hz
	EN-60068-2-6 : Vibration: 9,8 m/s2 (1 g) in frequency field 57 ÷ 150 Hz

Cabinet dimensions

800 mm x 1400 mm x 500 mm (31.5 in. x 55.12 in. x 19.69 in.), available for modules 10 kW e 20 kW. Protection grade IP54 (only outdoor).

1200 mm x 1200 mm x 500 mm (47.24 in. x 47.24 in. x 19.69 in.), available for modules 30 kW, 40 kW, 50 kW e 60 kW. Protection grade IP54 (outdoor and indoor).

800 mm x 2000 mm x 800 mm (31.5 in. x 78.74 in. x 31.5 in.) air vent turret excluded, available for modules 50 kW e 60 kW. Protection grade IP23 (only indoor).

GENERATOR AND REGENERATOR MODULES

- Dimensions of the standard module are the same for all modules: height and depth 455 mm (17.91 in) and 249 mm (9.80 in) ; the variable size is the width, which increases according to the rated current from a minimum of 75 mm (2.95 in.).

- The main interface of external communication is the EtherCAT fieldbus working in real-time at high-performance; in the standard configuration also the encoder analog / simulated interface and serial communication lines are available .
  CIA 402 control modules are supported .

- In addition to the mode "sensorless", different feedback transducers from the generator are manageable; each generator module is provided with a resolver interface and a programmable encoder, both configurable as a main or secondary transducer. The resolver interface has compensations for attenuation, cable phase shift and gain in amplitude, in order to improve accuracy in all conditions. There is a second optional encoder interface with the same features as the main interface for Hall sensors or TTL.

- The architecture of the control software, designed with high-performance flexible structures, with quick analog-digital conversion and high precision, is easily customizable by means of high-level tools (such as Simulink and MatLab), in order to optimize its performance.

- Each module is equipped with a slot for a memory card (supplied separately). It automatically memorizes, locally, all the generator parameters and modules in order to facilitate the configuration in a new plant. The large storage capacity and high speed of writing also allow data logging of the operating conditions.

- The connections of signal and power are separated in the internal layout of the drive, in order to improve the EMC characteristics and the rejection of electrical noise induced by wirings. The signals arrive in the area above the front panel of the drive while the power is located on the bottom.

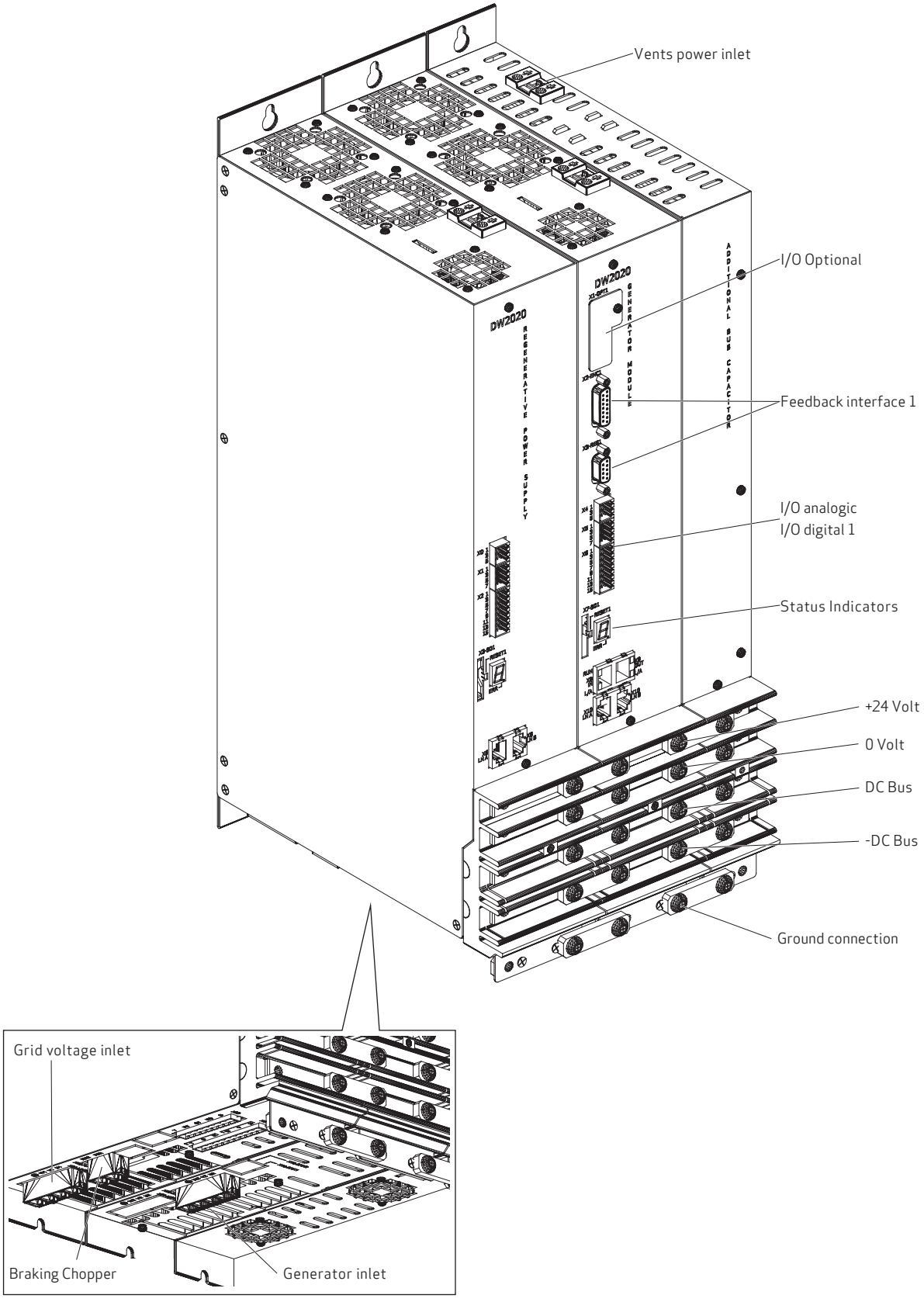
- The connection to the 24 volt auxiliary circuit and the DC bus share the same type of BUS BAR in order to reduce the number of components and replacement parts. The current of the BUS BAR can reach 250 Amps.

- The power connectors on the underside of the modules are equipped with screws for easy connection of cables without crimping tools.

- For each module (generator and regenerator) are available:

  - 2 analog inputs, differential, with 12-bit resolution and sampling performed every 3.9 us (256 kHz)
  - 2 analog outputs with 12-bit resolution
  - 2 digital inputs "fast", optically isolated, usable also as "capture"
  - 2 digital outputs, optically isolated
  - A contact Drive OK
  - A digital input, opto-isolated dedicated to the Reset function of the card. These interfaces allow to "read" the sensors of the generator and integrate their management directly into modules
  - The programmable connector X5 hosts other digital I / O, not optically isolated, dedicated to the application (TTL line driver)

Generator/ Regenerator /Capacitive Modules



Regenerator Models

Model/Code	**	**	**	**	**	**
Mechanical dimensions: Width	75 mm (2.95 in.)	100 mm (3.94 in.)	200 mm (7.87 in.)			
Depth	249 mm (9.80 in.)					
Height	455 mm (17.91 in.)					
Type	Three phases Regenerator					
Power supply	440 Vac (50/60 Hz)					
Vent power supply	24 Vdc +/- 10 %, 1 A (external supply)					
Cooling	Integrated ventilation					
Power kW	10	20	30	40	50	60
Rated current Arms	15	29	44	58	72	86

** For specific product codes, please contact Moog Casella

Please note: To three-phase generator modules from 10 kW 20 kW and 30 kW a capacitive module is added

Generator Models

Model/Code	**	**	**	**	**	**
Mechanical dimensions: Width	75mm (2.95 in.)	100mm (3.94 in.)	200mm (7.87 in.)			
Depth	249 mm (9.80 in.)					
Height	455 mm (17.91 in.)					
Confi guration	Single					
Type	Three phases Generator					
Vent power supply	24 Vdc +/- 10 %, 1 A (external supply)					
Cooling	Integrated ventilation					
Power kW	10	20	30	40	50	60
Rated current Arms	15	29	44	58	72	86

More information about the modules are available in the user manual

** For specific product codes, please contact Moog Casella

Capacitive Module Models

Model/Code	**
Mechanical dimensions: Width	50 mm (1.97 in.)
Depth	249 mm (9.80 in.)
Height	455 mm (17.91 in.)
Type	Capacitive module
Power supply	DC bus
Vent power supply	24 Vdc +/- 10 % / 500 mA
Cooling	Integrated ventilation
Module capacity (uF)	1800 uF / 5400 uF

** For specific product codes, please contact Moog Casella

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