

Micro Gas Turbines With High Speed Motors

Converters for high-speed electric motors deal with the operational modes of micro turbines in power generation applications

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The CC-75-500 converter for electric motors by Switzerland-based Celeroton is part of a family of sensor-less converters to control permanent magnetic synchronous machines and brushless DC motors.

Switzerland-based manufacturer of electric motors, compressors and converters Celeroton has launched a line of electric converters which can control the operational modes of micro gas turbines for stationary or mobile power generation. All Celeroton converters allow the sensor-less control of permanent magnetic synchronous machines and brushless DC motors.

Celeroton said that high speed motors are nowadays used not only to drive compressors or machining spindles, but are more and more used in gas turbines, in some cases with speeds beyond 300 000 r/min.

These high-speed drive motors face various challenges, as for example a controller that has to cope with various operating modes of the overall system (e.g. the generator system first has to be run up to a certain speed before power generation

can be initiated, and it has to be shut down in a controlled fashion). Damages due to over speed or overvoltage also have to be avoided by security functions, and current has to be synchronized to the angle and the speed of the common shaft connecting generator and gas turbine. In addition to those, drive electronics have to cope with sudden load changes.

Celeroton said its converter line, as for example type CC-75-500, can cope with the different operating modes of the gas turbine. During start-up and ignition, both open-loop and closed-loop (sensor-less) motor speed control is employed. For normal operation, the converter firmware allows the selection of speed control, torque control or power control modes, or even a combination of them. For shut down, speed control can be employed and the behavior of the turbine can be monitored by using the measurements from the converter.

According to the company, the sensor-less control algorithm of its converters allows for an easy synchronization of the generator currents to the rotating common shaft which connects the generator and the gas turbine. Even flying starts can be handled, which is where the generator current is synchronized to a running gas turbine.

During the development phase of the gas turbine, it is often desirable to simulate and test load changes with an external electrical load attached to the generator. For this task, the Celeroton chopper module CB-120-1500 can be used in combination with a Celeroton converter, and be utilized to simulate and test various application settings such as constant power or constant speed operation. In addition, this configuration can be used to test the standalone generator and, when the chopper module is operated in combination with two converters, the system forms a motor-generator test bench.

The chopper module CB-120-1500 allows power flow between the input and output as well as between both outputs, and enables highly-dynamic voltage control for fast transient operation of the motor. It offers a display for the visualization of the main operating parameters, such as input and output power, current, voltage and others.

These products by Celeroton have been employed in a micro gas turbine project by the Korea Institute of Machinery and Materials (KIMM). Celeroton reported that

the researchers at KIMM stated: “We are very glad to have Celeroton in our project as the supplier of the generator and electronics that runs the generator in motor-mode at start-up of the gas turbine and then after synchronization switches to generator operation.

“Celeroton also provided us with an electronic load, which allows us to draw power out of the generator during development and testing of the gas turbine in our lab. The cooperation has been very beneficial for all parties involved.”

Celeroton was founded in 2008 and moved quickly to an internationally-operating company. In a matter of a few years the company has launched a series of converters, radial turbo compressors, and high-speed magnetic bearings. Celeroton is headquartered in Volketswil, in the outskirts of Zurich, Switzerland.