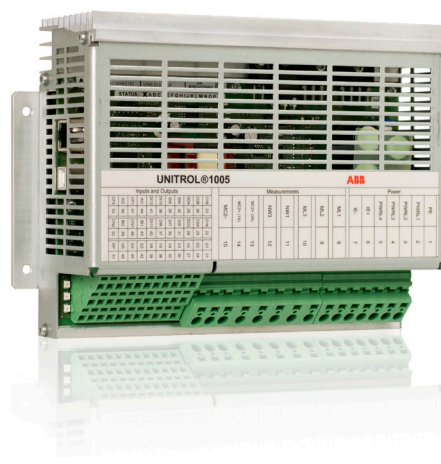


## UNITROL® 1005

Digital automatic voltage regulator UNITROL® 1005 improves reactive load sharing of Nordled ferry

The exchange of an analog voltage regulator with a UNITROL 1005 was rewarded by excellent performance on reactive load sharing as well as stable regulation.



UNITROL® 1005 Automatic Voltage Regulator (AVR)

ABB launches a digital automatic voltage regulator (AVR) that targets synchronous machines under 3.5 MVA. The AVR is suitable for synchronous machines used in grid connected units or in island operation where several units are connected in parallel. Such applications can be found in the marine industry as well as in standalone applications with variable speed such as diesel-electric locomotives, harbor cranes with diesel gensets and marine vessels with a DC onboard grid. This digital AVR is designed for demanding grid code requirements as well as for dynamic Fault-Ride-Through (FRT) detection.

An AVR controls the terminal voltage and the reactive power flow of a synchronous machine indirectly via the exciter machine. By means of power semiconductor switchgear, it generates the DC current which is required to control the field current in the main machine. The AVR itself is supplied by either AC (shunt / external) or DC (battery network).

In marine applications several synchronous generators are typically connected in parallel. Marine requirements define that the difference between the reactive loads of individual gensets have to be kept within a limited range. However, already small differences in the generator terminal voltage between the gensets can cause considerable imbalances in reactive load sharing. Therefore it is crucial that the AVR provide a stable voltage over its complete operating range and that temperature variations have a negligible impact. Due to their passive components, analog AVRs are usually sensitive against such temperature variations. For that reason, a tuning of these analog regulators is only optimal for a cer-

tain temperature range. Moreover, it is difficult to use exactly identical settings between different units. Potential consequences of these conditions are unwanted reactive load sharing imbalances.

Thanks to digital signal processing, the AVR UNITROL 1005 does not exhibit this temperature dependency. The digital AVR provides a more consistent performance which can be easily repeated across similar machines, thereby simplifying tuning and providing a more reliable operation over temperature and lifetime. A well-defined tuning process allows to find optimal controller parameters which ensure stable operation over the complete operational life cycle. Part of this tuning process is the usage of the specially developed PID tuning tool, which calculates initial controller settings depending on the system parameters. Therefore, commissioning can be simplified and accelerated considerably. Another feature of the UNITROL 1005 is the static droop compensation. In case there is a load imbalance between several gensets which may occur due to small differences in the voltage measurement, the individual generator voltages are automatically adapted in a way that the reactive power flow is balanced.

Unlike analog voltage regulators, the UNITROL 1005 offers a full range of operational limiters to keep the machine within its safe operating area. The machine is protected against overheating by stator and exciter current limiters as well as against underexcitation by a minimum reactive power limiter. The operator of the ferry was impressed and says that UNITROL 1005 is "the best reactive loadshare the chief engineer has ever seen".

The products UNITROL 1010 and UNITROL 1020, which are part of the UNITROL 1000 family, show a long proven track record. The new product line UNITROL 1005 is designed for generators with excitation currents up to 8 A continuous current at 55°C, respectively 5 A continuous current at 70°C.

Its first installation was successfully commissioned by the company Westcon Power & Automation, Husøy Norway, on NORLED ferry, MS FOLGEFONN, operating in the southwest of Norway in April 2015. The ferry is powered by 4 diesel gensets and supported by a battery storage system to optimize continuous operation in terms of low emissions and low fuel consumption. The originally installed analog AVR's were replaced by 4 UNITROL 1005 AVR's. The newly installed digital AVR's showed excellent performance in reactive load sharing as well as stable regulation even with high harmonics caused by frequency converters on the AC bus. Westcon Power & Automation stated that the new UNITROL 1005 fulfill the high expectations regarding quality and user-friendliness as it is known from the UNITROL 1000 family.



**NORLED ferry, MS FOLGEFONN, operating in the southwest of Norway with UNITROL 1005**

For grid connected power plants, the UNITROL 1005 brings the option to control power factor respectively reactive power flow directly or indirectly (via a cascaded regulator structure). The indirect reactive power control mode has the benefit that the machine terminal voltage is kept constant for a pre-defined time in case of a grid fault. This is especially useful to meet fault-ride-through grid code requirements. Grid-connected units benefit from software that is tried and tested on already existing units of the UNITROL family, ensuring that all UNITROL 1000 products have the same simulation models, thereby avoiding the need to re-certify products each time. Furthermore, control interfaces, such as analog and digital I/Os as well as Modbus TCP are uniform across the UNITROL 1000 family, eliminating the need to build new product know-how or undertake additional training.

The UNITROL 1005 features two software versions: ECO and Light. ECO software packages include the essential functions of an excitation system including all regulator modes, limiters, monitoring functions and voltage matching for pre-synchronization. The Light software package contains a history logger that records the last two hours of operation and Modbus TCP. The package also comprises the well-known commissioning and maintenance tool, CMT 1000, free of charge, along with

a PID tuning tool and E-learning order codes. The CMT 1000 can be operated on any PC, and is recognized for its easy and intuitive operation that helps to significantly reduce commissioning time. Amongst other features the CMT 1000 provides a real-time oscilloscope, where important quantities such as real and reactive power can be monitored.

In order to predict system behavior without having to perform extensive tests, ABB provides expertise in system modeling and supports its customers in executing performance, power system stability, and fault-ride-through studies.

For additional information on the product please visit:

**[www.abb.com/unitrol](http://www.abb.com/unitrol)**

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