

# TOGETHER ON COURSE

Redundant controllers for diesel electric propulsion systems on ships

Special safety concepts ensure a high level of reliability and safety for a ship propulsion system. New functions are continuously being integrated in the ship's control system. A collaboration between SAM Electronics and Bachmann electronic produced an innovative concept for use with diesel electric drives.

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▼ The Royal Princess with diesel electric propulsion – controlled by the Bachmann M1 automation system.



**S**AM Electronics GmbH is a company headquartered in Hamburg, Germany, and is one of the leading international suppliers of ship automation solutions. Its offering includes systems for seagoing navigation and communication. The extensive expertise of the company in the field of shipbuilding and the shipping industry is based on over 100 years of experience.

#### Concept: redundant propulsion

The main components of a diesel electric drive are the diesel generator(s), frequency inverters, propulsion motor, propeller and controller. Unlike conventional systems with two engines, which are each coupled directly to a propeller, with diesel electric propulsion systems the diesel engines drive generators. These all feed the same busbar from which both the drives as well as the other loads are supplied. This therefore makes the availability

of a drive independent of an individual diesel engine since a reduced propulsion capacity is still provided in the event of a failure. Considerable importance is placed on a high level of redundancy, particularly with the design of diesel electric propulsion systems for cruise liners. This redundancy is always based on a single fault event. Simultaneous multiple faults are not considered here.

The propeller motors themselves are provided with two stator winding systems, each fed by a separate 6/3 phase, 12/6 pulse power section of a frequency inverter. Each converter section is supplied by an independent transformer with its own circuit-breaker.

#### Distributed control has major benefits

The SAM propulsion system controller integrates the frequency inverters in the ship system. For this various remote I/O systems distributed over the entire ship are connected to the controller via fieldbuses. The frequency inverters are run in active standby mode. This means that the active controller collects the signals and also makes these available to the standby controller via Ethernet. If one controller fails, the standby system can then take over all control tasks seamlessly. This approach also saves on

cabling and enables an improved monitoring of the interfaces.

If a single I/O system fails, the decentralized arrangement of the I/Os also ensures that not all of the system information is lost. Appropriate processes are triggered depending on which I/O system is no longer available. If the fieldbus to the bridge

fails, for example, the drive saves the last control lever setting and initiates an alarm: The failure of a steering console is indicated and control can be switched to another console, such as in the engine control room.

#### Changeover to the M1 controller

The implementation of these complex concepts and control tasks requires the use of a powerful controller. SAM Electronics therefore decided to use here the M1 automation system from Bachmann electronic. "The scalable M1 system comes with the certificates required for ship applications and offers the right controller for every performance ►►

» The scalable M1 system offers the right controller for every performance level. «

*Hermann Knirsch,  
Drives and Special Systems Manager  
of Technology and Design,  
SAM Electronics GmbH*



an L3 communications company

SAM Electronics is a subsidiary of the US company, L-3 Communications. The company is based in Hamburg and has branches worldwide as one of the leading system integrators in the shipbuilding industry. In 2011 the SAM Group achieved a turnover of 312 million euros with 1,390 employees.

► [www.sam-electronics.de](http://www.sam-electronics.de)

►► level, whilst still ensuring downward compatibility,” explains Hermann Knirsch, Drives and Special Systems Manager of Technology and Design at SAM Electronics. “It thus offers the level of flexibility required, whilst the guaranteed long-term availability ensures also the level of safety required for current projects and those in the future.”

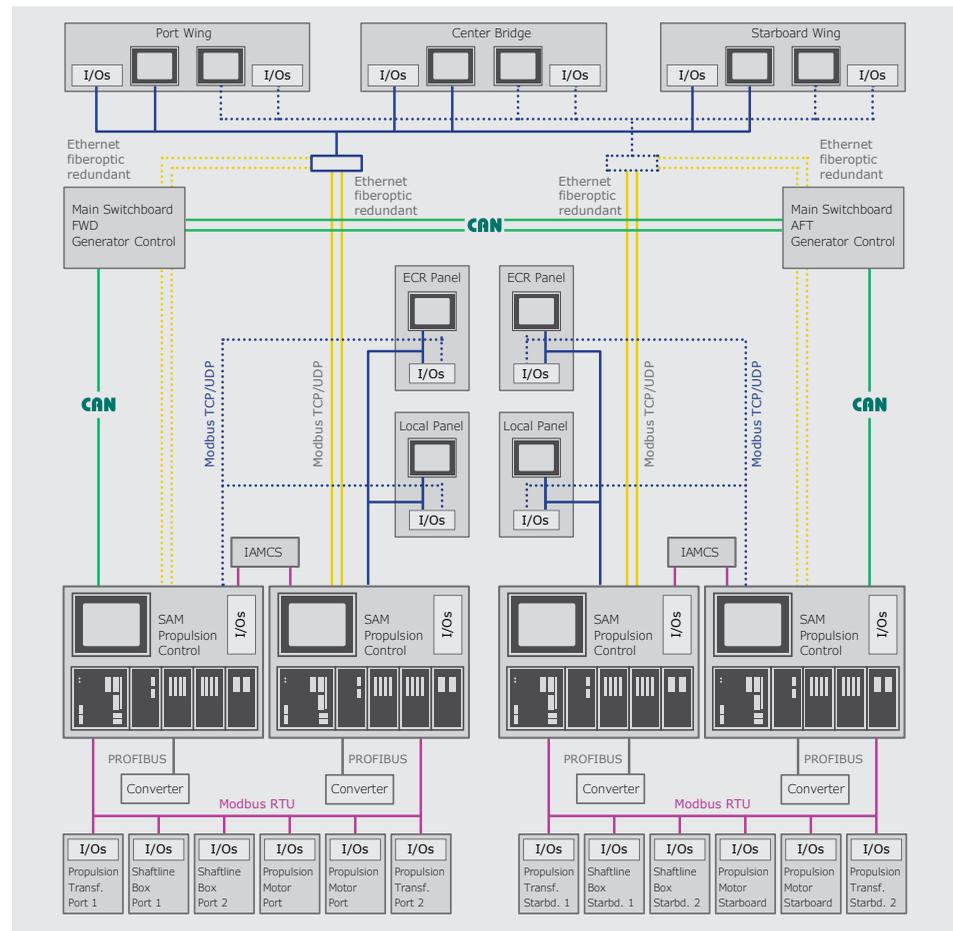
“The Modbus UDP protocol was specially implemented for us at short notice by Bachmann,” explains Hermann Knirsch, delighted with the excellent cooperation. The controllers can also be expanded with serial, CAN, DeviceNet and PROFIBUS communication modules as required.

**All interfaces “on board”**

The M1 controller covers all the interfaces required: Modbus RTU / TCP, PROFINET, CANOpen and SAE J1939 come as standard.

**Integrated controller library**

“Bachmann electronic is a cooperative partner offering excellent technical support on site,” says Verena Franzen, from Drives and Special Systems Technology and Design at



► Diesel electric drive control for a cruise liner: Redundant controller design with the M1 automation system.

SAM Electronics. "The cooperation thus enabled the joint and successful integration of a SAM controller library on the Bachmann system. All the tried and tested functions are thus still available. It offers SAM also the possibility of using other previously unused fieldbus protocols such as PROFIBUS, PROFINET, Modbus/TCP etc. In this way, components such as the frequency inverters can be integrated even better."

### Clearly designed PLC editor

The adaption of SAM Electronic's own PLC editor specially developed for complex applications considerably simplified the work processes for the engineering and commissioning of the first project. The graphical editor enables the creation and visualization of complete functions. The status of signals is very clearly displayed in different colors. Faults can be localized and rectified quickly.

This graphical editor is used for maintaining the software of the old and the new system. Partial applications from existing installations that are still implemented on the previous systems can thus be used again easily for new installations.

» **Bachmann is a cooperative partner.** «

*Verena Franzen,  
Drives and Special Systems  
Technology and Design,  
SAM Electronics GmbH*

### New functions: Teleservice

"Another benefit of Bachmann's M1 system is the greater CPU performance and range of interfaces compared to the controllers we used previously," Verena Franzen explains. This enables us to integrate completely new functions



▲ One of the two propeller motors in the cruise liner Royal Princess.

into the system. "For example, it will be possible in future to access the system directly from shore via satellite. This means that diagnostics can be carried out without having to send out a technician to the ship and that expert help can be given to the crew in the event of failures," Verena Franzen describes the resulting benefits. "Software updates or controller adaptations for refurbishments can thus also be carried out at a later time from shore. This saves time – and money."

### Perfect redundancy: hot standby

Another new function provided is the 'hot standby' function. Thanks to the high-speed Ethernet communication between the two controllers of a drive, the standby controller can be activated quickly in the event of a fault. The

standby controller thus takes over as soon as the active controller fails, for example, due to a fault in the power supply: The drive is immediately activated and runs at the old speed value. This offers additional safety and the availability of the drive is always ensured in the event of a fault.

### Successful cooperation – with a future

Controllers for diesel electric propulsion systems must be able to be integrated simply into the existing network structures of the ship, and master the increasing requirements with regard to functionality, safety and availability. "With the Bachmann M1 automation system SAM Electronics has been completely successful in this," Hermann Knirsch is convinced.

"We therefore aim to continue the cooperation developed from this collaborative work for future propulsion system projects."