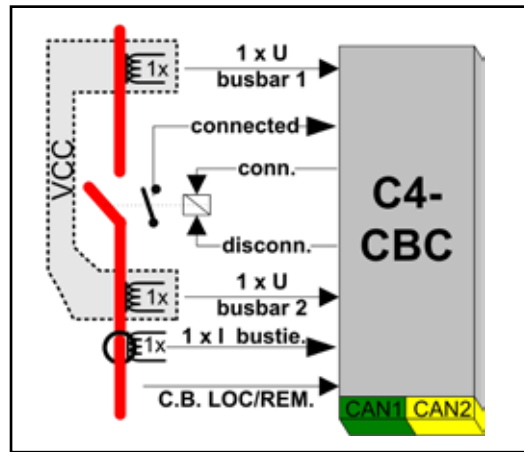


Circuit Breaker Control

The DPU, C4-CBC, controls the bus-tie breaker between two bus-bars. It has an automatic synchronizing mechanism for the bus-tie breaker. It measures the frequency of the two bus-bars and communicates with the other DPU's to control the bus-bar frequency, so that correct

synchronizing conditions are obtained.

The C4-CBC can also be set to measure the current through the bus-tie breaker. When it is disconnected, it controls the load on each bus-bar to obtain zero current.

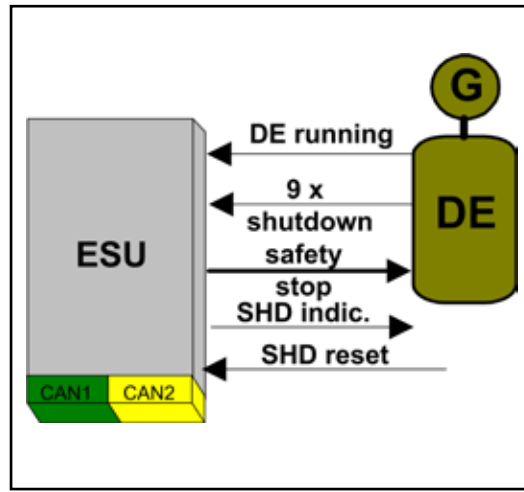


Diesel Engine Safety Stop

The ESU is an engine safety-monitoring and emergency shut down unit. It has interface to maximum 9 shutdown sensors. All ON/OFF contacts with loop-fail detection. Shutdown of diesel engine is provided by solenoid driver channels. All shutdown parameters and loop fail definitions are preset to engine supplier's specifications.

The module is equipped with six

digital input channels, in use for emergency switches, which have direct connection to output channels of solenoid type. If the modules CPU should fail, three extra digital input channels are connected directly to the output channels. These are intended to be used for critical shutdown signals as Overspeed, low Lub-oil pressure and high Freshwater cooling temperatures.



Voltage Converter Controller

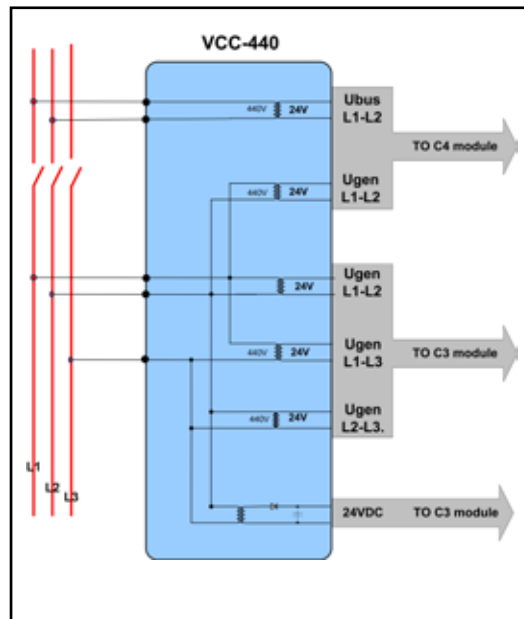
The Voltage Converter Controller module (VCC-440) is dedicated to use in main switchboards. The module secures the installation of the power management and generator protection, by transforming the higher voltages to low and safe voltage levels. The VCC-440 module is equipped with 6 voltage transformers, 440 / 24 V AC.

The module has three major tasks to handle:

- Supply the C3 generator protection module with maximum 24V AC from the measured three phase generator bus bars, L1-L2, L1-L3 and L2-L3.

- Supply the C3 generator protection module with a 24V DC power, with the generator bus-bar (L2-L3) as a source.
- Supply the C4 power management module with single phase maximum 24V AC, from the generator bus-bar L1-L2 and the switchboard bus-bar L1-L2.

As an option the VCC module can be equipped with transformers based on the primary voltage 690 V AC; VCC-690.



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Power Management System



Including generator protection

General description

The K-Chief 500 Power Management System (PMS) comprises several C20 type-approved Distributed Processing Units (DPU). They are developed according to the strong requirements for components operating inside the main switchboard cubicle.

The PMS is designed to control any switchboard configuration. As operator interface there is a choice between a Midi Operator Station (MOS) and a more advanced K-Chief 500 Alarm, Monitoring and Control System. It can also operate as a standalone system.



All marine generators have to be protected according to the rules of the classification societies. The Kongsberg Maritime PMS also comprises generator protection functionality, such as short circuit, over-current and reverse power protection of a generator.

The following functions are available:

- Multi switchboard management
- Automatic control of operating modes for switchboard and propulsion

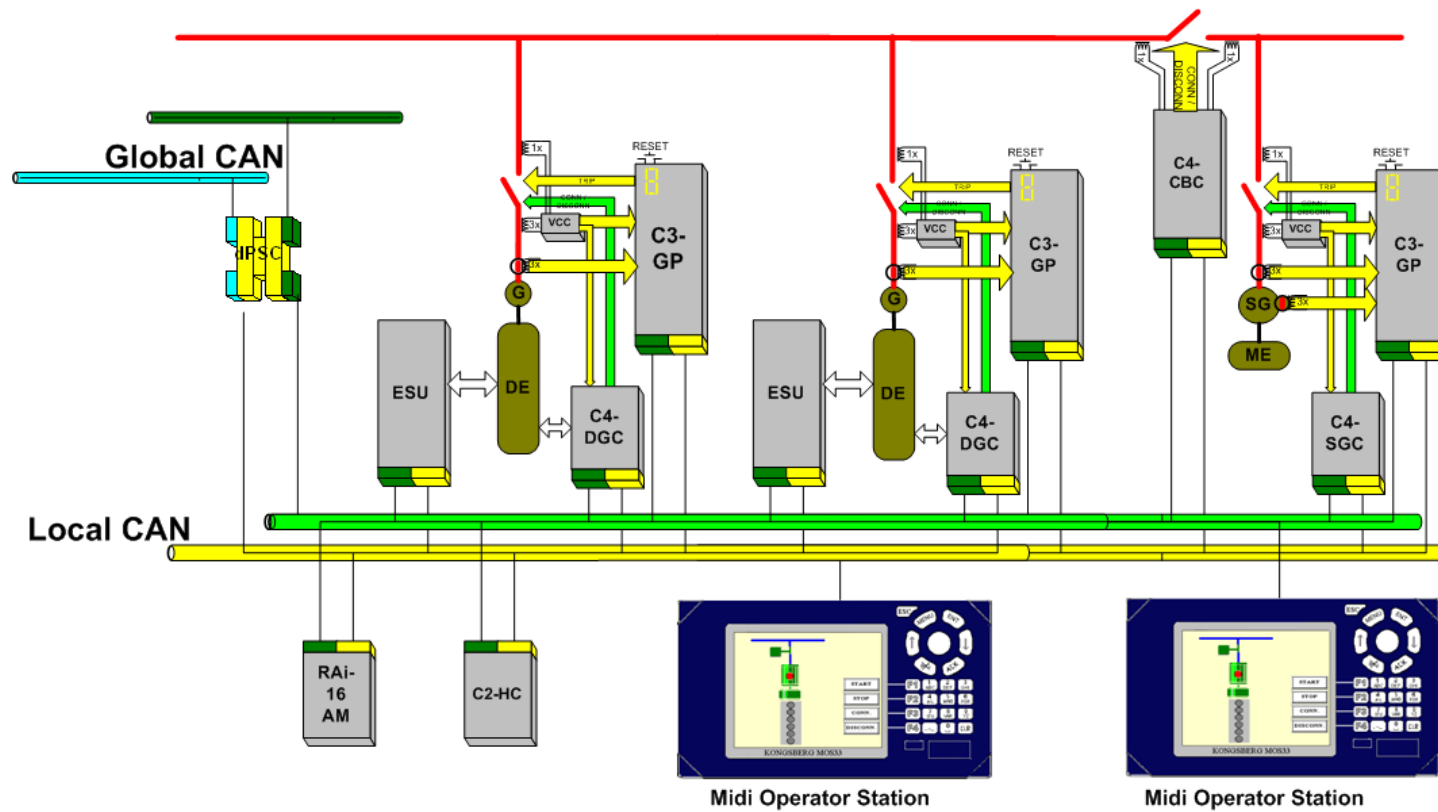
- Automatic start and connect at blackout
- Selection between droop and isochronous load-sharing
- Load-sharing between generators in droop-mode
- Frequency control
- Automatic synchronizing of generator- and bus-tie breakers
- Load-dependent start and stop
- Changeover from generator with failure
- Control of diesel-generators with

- dual circuit-breakers
- Diesel engine safety stop system
- Tripping of non essential consumers
- Heavy consumer start surveillance
- Automatic control of Power Take-In (PTI) operations
- Generator Protection functions
- Modbus Remote Terminal Unit (RTU) slave interface for communication with external systems



System configuration

The figure below illustrates a typical PMS configuration with generator protection.

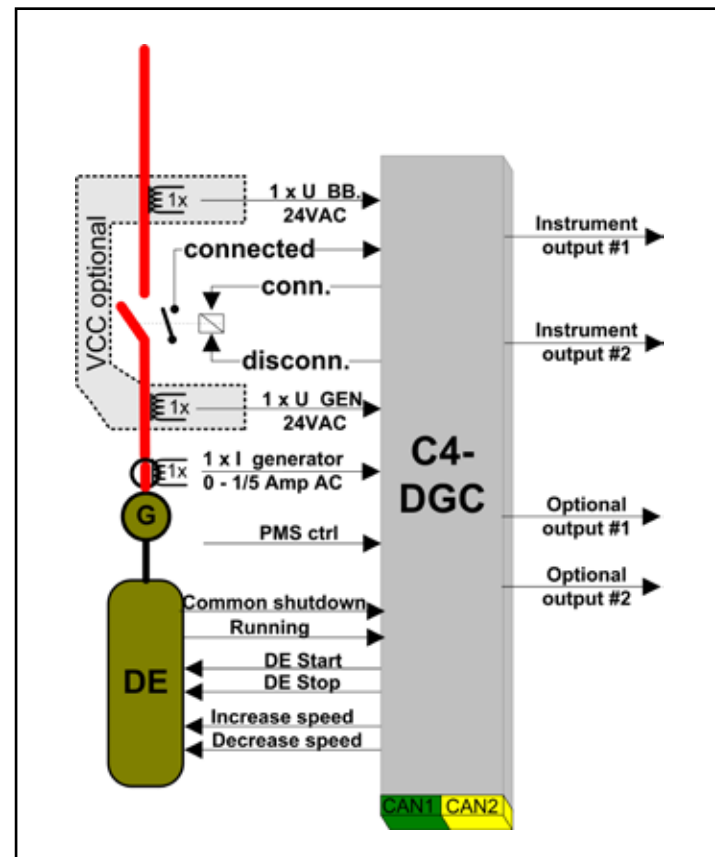


Diesel Generator Control

The DPU, C4-DGC, has the control of the diesel-generator. It controls the starting and stopping sequence of the diesel engine, as well as automatic synchronization. The frequency of the diesel-generator is controlled by increase or decrease command to the speed-controller of the diesel-engine.

When the diesel-generator is connected to the bus-bar, it controls frequency and active load (kW) according to calculated load-sharing set-point. It can receive already calculated load-feedback from the C3-GP, or it can calculate load by measuring generator current and voltage.

The C4-SGC, has the control of the shaft-generator. It has automatic synchronizing mechanism for the SG circuit breaker. It measures the frequency of the two bus-bars and communicates with the other DPU's to control the bus-bar frequency so that correct synchronizing conditions are obtained.



Generator Protection

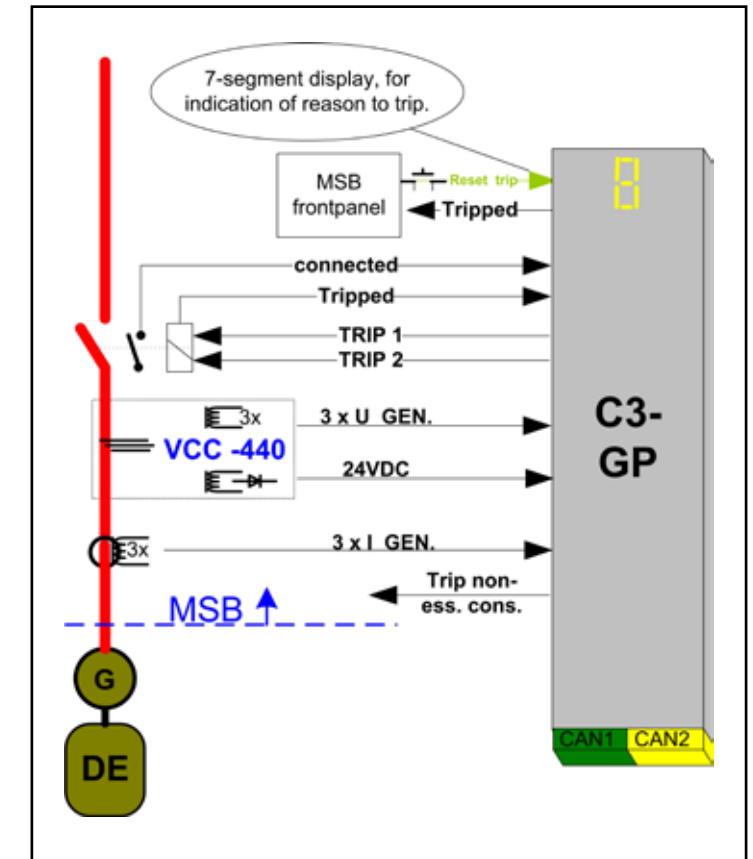
The DPU, C3-GP, ensures tripping of the generator circuit breaker at any malfunction of the generator or the switchboard.

As the C3-GP has interface to three phases AC voltage, all generator load calculations will be performed, like cosine phi, kW, kVA, kVAR. All these parameters can be displayed on MOS or Remote Operator Station (ROS). Partly based on these parameters the generator circuit breaker is tripped on detection of over-current on one of the three phases (three levels), reverse power (negative % active load), overload (kW, two levels) over- and under- voltage, over- and under- frequency, all with two levels. A 7-segment display located on the module indicates which of the phase was the reason for the short circuit tripping.

Resetting of the tripping function can be done in three ways:

- Locally by the use of a switch on the module
- Remotely from a switch in the switchboard front-door
- At the MOS

When the C3-GP is connected to a MOS or a ROS, the tripp alarms will be notified with audible sound and alarm description. The alarms will also be time-stamped when they occur.



Generator & Differential Current Protection

The C3-GP module can in addition to Generator Protection provide differential current protection. Internal current on each phase in the generator is monitored by use of current transducers. The current measurements and scaling of the current range are totally independent between all channels.

The C3-GP calculates the current difference between the reading at switchboard and generator, and trip the generator circuit breaker. Then de-energize the generator if the difference exceeds more than a preset percentage limit (i.e. 5%).

The difference is calculated independently for all three phases.

