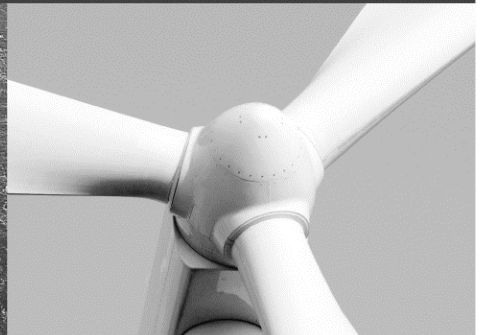
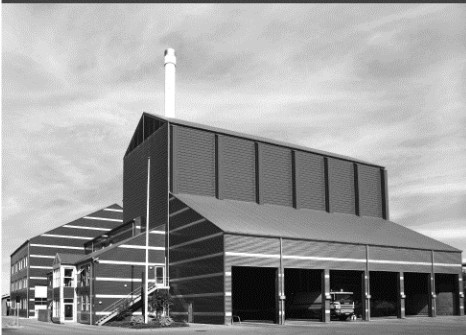




-power in control



Delomatic 4 DM-4 Land/DM-4 Marine



Internal system supervision Part 2, chapter 14



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14. System Supervision

The DGUs in the Delomatic system are implemented with an extensive number of internal system supervision functions for supervision of their ability to carry out **safe and correct operation**.

So it is recommended to read this paragraph carefully in order to get familiar with the system alarm messages, if a system failure should occur.

Each DGU continuously carries out the below-mentioned system supervision functions:

- PCM (Power Control Module) supervision of internal communication and power supply
- Supervision of the diesel/shaft generator breaker position feedback signals
- Supervision of the bus tie breaker position feedback signals
- Supervision of I/O configuration (hardware)
- Supervision of the multi-transducer unit in SCM modules
- Cable supervision

An active "SYSTEM ALARM" in a DGU is indicated by means of the following hardware interface.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• SYSTEM ALARM	Relay output	(IOM 4.1)



A "SYSTEM ALARM" indicates a fault, which may prevent the DGU from carrying out safe and correct operation.

PCM supervision of the ARCNET communication (using PCM 4-1)

The Delomatic software supervises if normal communication is carried out between the DGUs in the system.

SIGNAL NAME	SIGNAL TYPE	LOCATION
• ARCNET	ARC network connector, twisted pair cable, 120 ohm	(PCM 4-1)

Normal activity at the ARCNET is indicated by

- a green "ARCNET OK" LED at the PCM module.

PCM indication of ARCNET failure (using PCM 4-1)

If the PCM module detects any failures at the DM-4 LAN,

- the "ARCNET OK" LED at the PCM module is **turned off** (normally green).

Supervision of mutual communication between the DGUs

The main PMS DGU and all other DGUs (called "slave" DGUs) in the Delomatic system carry out mutual communication in order to implement superior control of the power plant.

If a "slave" DGU is unable to communicate with the main PMS DGU, the following alarm message is shown at the corresponding DU(s)

- alarm "COM. ERROR DGU n".

The letter **n** indicates the main PMS DGU no.

At the DU(s) of the main PMS DGU, the following alarm message is displayed

- alarm "COM. ERROR DGU x".

The letter **x** indicates the "slave" DGU no.



The "slave" DGU is forced into SWBD control until the system alarm disappears, and the main PMS DGU excludes the defective DGU until the communication is re-established.

DM-4 LAN general (using PCM 4-5)

DM-4 LAN is the local area network that allows the DGUs to share information. The network is an extensive industrial network based on the ARC-net standard, communicating at a baud rate of 2.5 Mbit. This ensures a fast responding and reliable system. For redundancy purpose, it is possible to use a dual network by adding an additional network cable between the DGUs. See the illustration below. Redundant ARCnet is based on the PCM 4-5 which is optional for the DM-4 system.

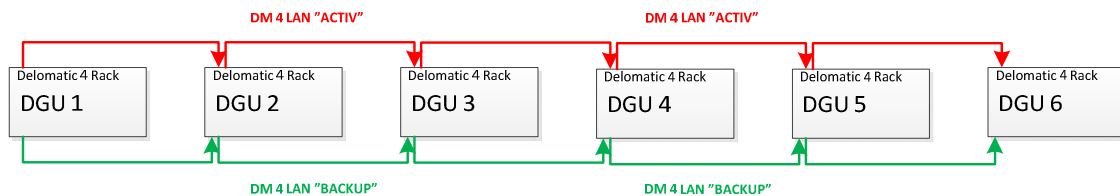
The network has supervision and an error handling function. The network supervision function will check for any cable or communication failures and notify the user in case of failures. The error handling function will detect any missing DGU, and the system will take action according to the present situation.

PCM supervision of the DM-4 LAN communication (using PCM 4-5)

The Delomatic software supervises if normal communication is carried out between the DGUs in the system.

Each PCM4.5 is connected to two networks via two separate ARCnet network controllers. The PCM 4-5 card has four galvanic separated DM-4 LAN ports, which in pairs can be switched on/off depending on the option configuration by the application software. The units supervise the different networks by continuous communication with "Supervisory packages".

In case that the DM-4 ACTIV LAN cable is interrupted or short-circuited, the system will continue to communicate over the DM-4 BACKUP LAN.



Signal name	Signal type	Location
DM-4 LAN	ARC network connector RJ45, CAT5S, twisted pair cable, 100 ohm	PCM 4-5

The "**DM-4 LAN OK**" LED indicates activity on the LAN network:

- If redundant network enabled:
 - If this LED is green, there is activity on both ARC networks
 - If this LED is yellow, one network is down.
 - If this LED is red, both networks are down.
- If redundant network is not enabled:
 - If this LED is green, there is activity on the enabled ARC network
 - If this LED is red, the enabled network is down.

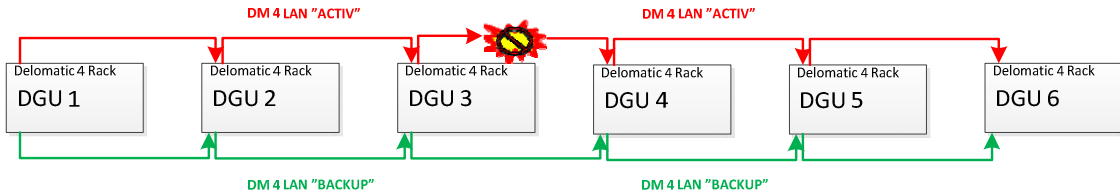
The LEDs located at the RJ45 connector block indicate activity on the LAN port. The LEDs for the same network show the same information:

- Yellow:
 - Flashing (5 times/sec) – connection is missing
 - Flashing (20 times/sec) – connection is ok

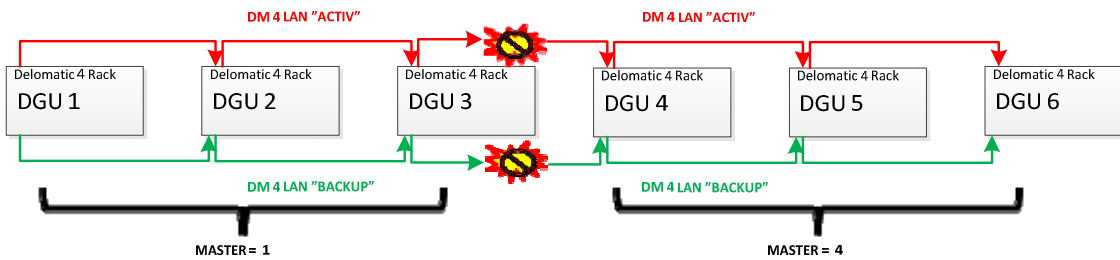
- Green: Power OK to the ARC-net controller
- "Black" power supply to the ARC-net controller is defect.

The PCM-4-5 units maintain the different networks by continuous communication with separate "Supervisory packages" on both "Active network" and "backup network". Each "supervisory package" transmitted on the two arcnet networks includes a "transaction id". The other PCM 4-5 units in the network shall upon reception of the package with a transaction ID or upon long absence determine if there are "holes in the reception".

Selection of DM-4 LAN "master" is based on the lowest PCM 4-5 ID at the present network.



In case of failure in one of the DM-4 LAN lines, all DGU's in the system will maintain communication. In the case above, there is still only one DM-4 LAN "master" after one DM-4 LAN line is failed.



In case of failure on both DM-4 LAN lines, a DM-4 LAN "master" is chosen individually for each network. In the case above, the masters in the two systems are ID 1 and ID 4.

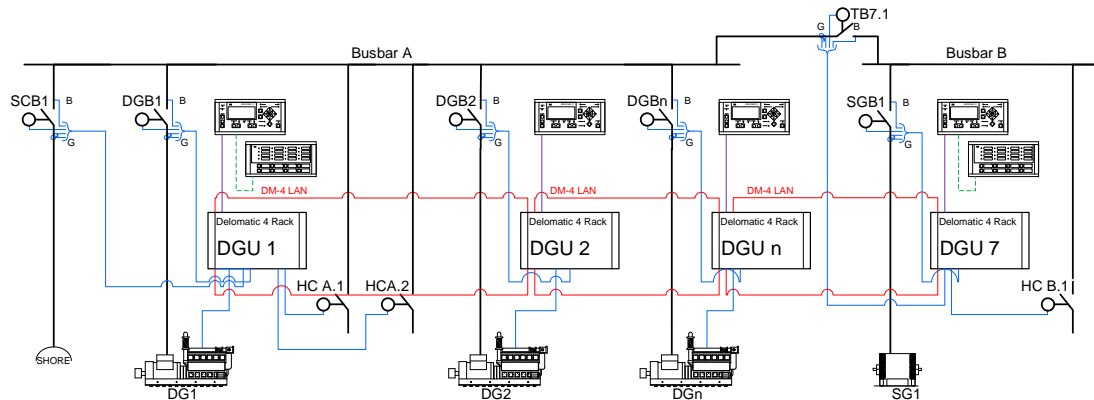
A Percent Error Rate (PER) is calculated for each DM-4 LAN. The PER is calculated by the number of lost transactions between the units on the DM-4 LAN connection.

Loss of a unit is determined by the Percent Error Rate (PER) from a single unit on the DM-4 LAN connection.

Active network selection is based Percent Error Rate (PER) on the network.

PCM indication of DM-4 LAN failure (using PCM 4-5)

If a DGU in the system is not “visible” on the communication lines, the “COM error DGU nn” alarm will be given. Depending on the system setup, the system will act on the communication alarm.



Supervision of mutual communication between the DGUs

The main PMS DGU and all other DGUs (called "slave" DGUs) in the Delomatic system carry out mutual communication in order to implement superior control of the power plant.

If a "slave" DGU is unable to communicate with the main PMS DGU, on either LAN1 or LAN2, the following alarm message is shown at the corresponding DU(s)

- alarm “LAN1 com. err DGU n”.
- alarm “LAN2 com. err DGU n”.

The letter **n** indicates the main PMS DGU no.

At the DU(s) of the main PMS DGU, the following alarm message is displayed

- alarm “LAN1 com. err DGU x”.
- alarm “LAN2 com. err DGU x”.

The letter **x** indicates the main PMS DGU no.



The "slave" DGU is forced into SWBD control if both LANs fail, until one of the system alarms disappears, and the main PMS DGU excludes the defective DGU until the communication is re-established.

Breaker position supervision

Each DGU continuously supervises, if the position feedback signals from the diesel/shaft generator breaker or any other circuit breaker have a conflicting status.

The ON and OFF feedback may not have an identical status at the same time, and at least one of them must be present.

Supervision of signals for the diesel/shaft generator breakers and any other circuit breaker position feedback is controlled via the following hardware interface.

Signal name	Signal type	Location
GB/SGB/TB POSITION FEEDBACK ON	Binary input	SCM
GB/SGB/TB POSITION FEEDBACK OFF	Binary input	SCM

If a conflicting position feedback is registered, the following alarm message is shown at the DU (DGU DG)

- alarm “**CB POS. FAIL SCM n**” The letter **n** indicates node ID no. set on the SCM card



The defective DGU is forced into SWBD control, until the system alarm disappears.

I/O supervision

Each DGU continuously supervises, if the actual hardware configuration is as defined in the software and generates an alarm message, if

- two modules of identical type have the same I/O address in the DGU
- the expected number of a specific module type is not present in the DGU.
- communication failure between the PCM and a specific module type in the DGU.

In case of I/O failure, the following alarm message is shown at the DU

- alarm “**IOM ID: n missing**”.
- alarm “**IOM ID: n duplicate**”.
- alarm “**SCM ID: n missing**”.
- alarm “**SCM ID: n duplicate**”.

The alarm is indicated in words what is missing. The letter **n** indicates the module ID no.

In case of communication failure on the backplane, one of the below alarm messages is shown at the DU

- alarm “**IOM ID: n FIFO error**”.
- alarm “**IOM ID: n FIFO reset**”.
- alarm “**IOM ID: n RX timeout**”.
- alarm “**IOM ID: n CRC error**”.
- alarm “**IOM ID: n RX error**”.
- alarm “**IOM ID: n TX error**”.
- alarm “**IOM ID: n Com hold**”.
- alarm “**SCM ID: n FIFO error**”.

- alarm “**SCM ID: n FIFO reset**”.
- alarm “**SCM ID: n RX timeout**”.
- alarm “**SCM ID: n CRC error**”.
- alarm “**SCM ID: n RX error**”.
- alarm “**SCM ID: n TX error**”.
- alarm “**SCM ID: n Com hold**”.

The alarm is indicated in words, what the fault condition is. The letter **n** indicates the module ID no. The fault can be related to the specific module indicated in the alarm text or the PCM module.



The defective DGU is forced into SWBD control, until the system alarm disappears.

Power supply supervision

The Power Control Module (PCM) continuously supervises (measures) the power supply.

The measured power supply voltage is continuously compared to the minimum acceptable supply voltage: 18V DC (24V DC -25%).

If the measured supply voltage has been continuously lower than the minimum acceptable supply voltage for a programmed time, the following alarm message is shown at the DU

- alarm “**Low supply volt**”.

Disabling DGU due to low supply voltage

At approx. 14V DC, the supply voltage becomes too low for the PCM module to maintain a sufficient power supply to the DELOMATIC modules, and the entire DGU is disabled (shut off).

Disabling of a DGU due to a very low supply voltage is indicated by

- the “**POWER OK**” LED at the front of the PCM being turned off.



The DGU remains disabled, until the supply voltage is above 18V DC again.

Supervision of the multi-transducer in the SCM module

Each SCM module in a DGU supervises, if the multi-transducer unit is functional and transmitting valid data (measured and calculated AC values) to the PCM module.

If the data from the multi-transducer unit becomes invalid, the DGU may not be able to carry out safe and correct operation.

Supervision of the multi-transducer in the SCM module is controlled via the following hardware interface.

Signal name	Signal type	Location
U _{GEN}	3-phase voltage in from diesel/shaft generator	SCM
U _{BB}	3-phase voltage in from busbar	SCM

Invalid data from the multi-transducer unit may be caused by one of the following events:

- The entered value in set-point “**NOM. VOLTAGE**” is outside the selected measuring range at the SCM module.
- The measured diesel/shaft generator frequency is outside the max. measuring range,

- specified in the diesel/shaft generator set software with a closed circuit breaker.
- The measured diesel/shaft generator voltage is below the min. acceptable measuring level with a closed circuit breaker.
- Communication sequence failure from the multi-transducer unit.

If an SCM module repeatedly receives invalid data from the multi-transducer unit, the following alarm message is shown at the DU

- alarm “**Measure error SCM n**”.

The letter **n** indicates the SCM module ID no.



The defective DGU is forced into SWBD control, until the system alarm disappears.

Cable supervision

Cable supervision is an enhanced safety function, which detects a broken cable, e.g. used for supervision of significant signals.

Cable supervision is possible for both analogue and binary input channels. Cable supervision of binary input channels and analogue input channels is an option. Implementation of cable supervision on binary input channels requires a resistor placed in parallel with the contact function. Implementation of cable supervision on analogue input channels requires an offset (e.g. 4...20 mA). Please refer to the document INSTALLATION INSTRUCTION for detailed information.

If an IOM 4.1 module detects a cable failure, the following alarm message is shown at the DU

- alarm “ **Cable fail IOM n:C##** ”.

The letter **n** indicates the module ID no. and the **##** indicates the channel no.

DEIF A/S reserves the right to change any of the above.