



-power in control



APPLICATION NOTES



Protection and Power Management, PPM-3 Emergency/harbour diesel generator

- General overview
- Application descriptions



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1. General information

1.1 Warnings, legal information and safety

1.1.1 Warnings and notes

Throughout this document, a number of warnings and notes with helpful user information will be presented. To ensure that these are noticed, they will be highlighted as follows in order to separate them from the general text.

Warnings



Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

Notes



Notes provide general information, which will be helpful for the reader to bear in mind.

1.1.2 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set. If there is any doubt about how to install or operate the engine/generator controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the set must be contacted.



The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

1.1.3 Safety issues

Installing and operating the Multi-line 2 unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.



Be aware of the hazardous live currents and voltages. Do not touch any AC measurement inputs as this could lead to injury or death.

1.1.4 Electrostatic discharge awareness

Sufficient care must be taken to protect the terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

1.1.5 Factory settings

The Multi-line 2 unit is delivered from factory with certain factory settings. These are based on average values and are not necessarily the correct settings for matching the engine/generator set in question. Precautions must be taken to check the settings before running the engine/generator set.

1.2 About the Application Notes

1.2.1 General purpose

This document includes application notes for DEIF's Multi-line 2 unit. It mainly includes examples of different applications suitable for the unit.



For functional descriptions, the procedure for parameter setup, parameter lists etc., please see the Designer's Reference Handbook.

The general purpose of the application notes is to offer the designer information about suitable applications for the Multi-line 2 unit.



Please make sure to read this document before starting to work with the Multi-line 2 unit and the gen-set to be controlled. Failure to do this could result in human injury or damage to the equipment.

1.2.2 Intended users

The Application Notes are mainly intended for the person responsible for designing Multi-line 2 systems. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in this document.

1.2.3 Contents and overall structure

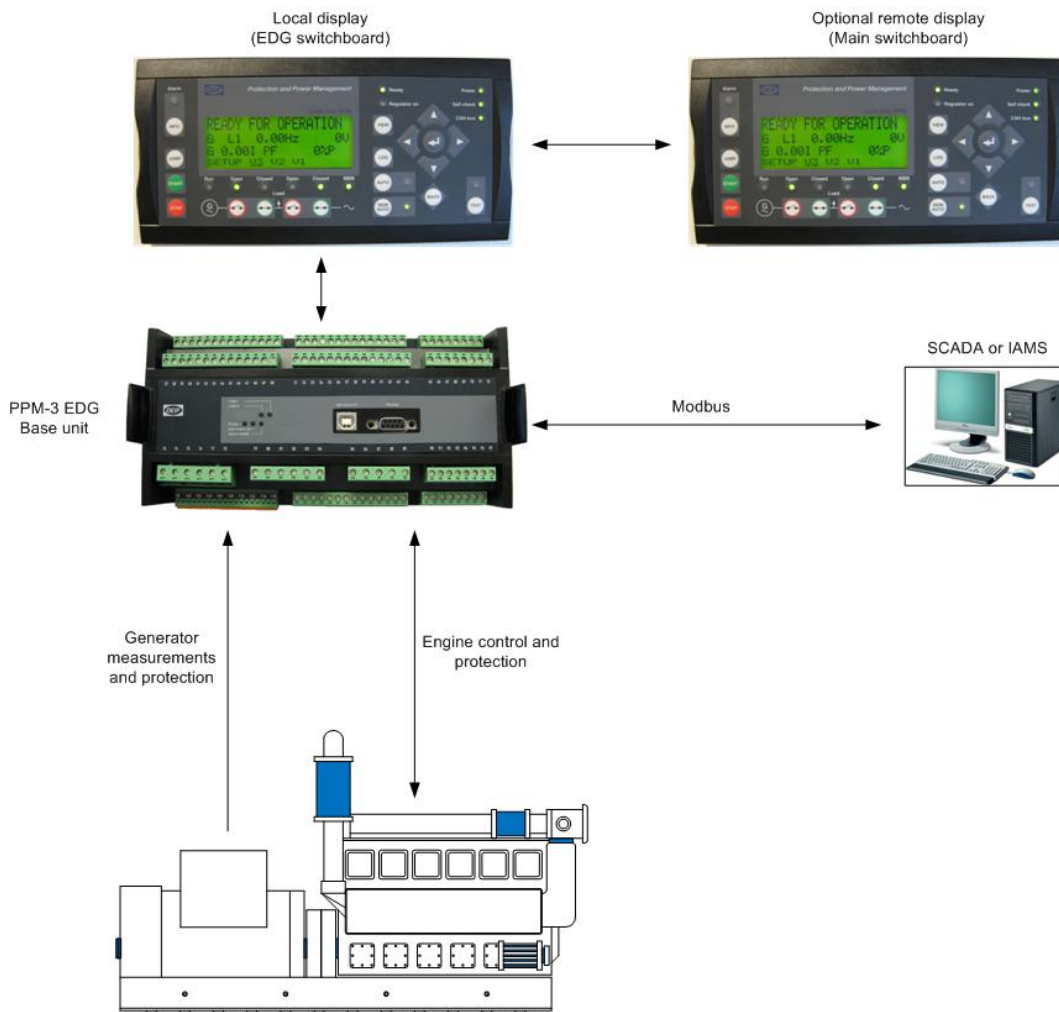
This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

2. Technical information

2.1 General overview

2.1.1 Required hardware, wiring and setup

This document describes the hardware, wiring and setup required to install the PPM-3 EDG marine gen-set controller in the emergency switchboard.



For further information about the terminal connections and adjustment of essential parameters, please refer to the installation instructions and/or the quick start guide.

2.1.2 Parameter settings

All EDG applications can be handled by setting the following three parameters:

2780 Regulator output

7083 Back synchronisation (not used for stand-alone applications)

7092 Deload (not used for stand-alone applications)

2.1.3 Variant overview

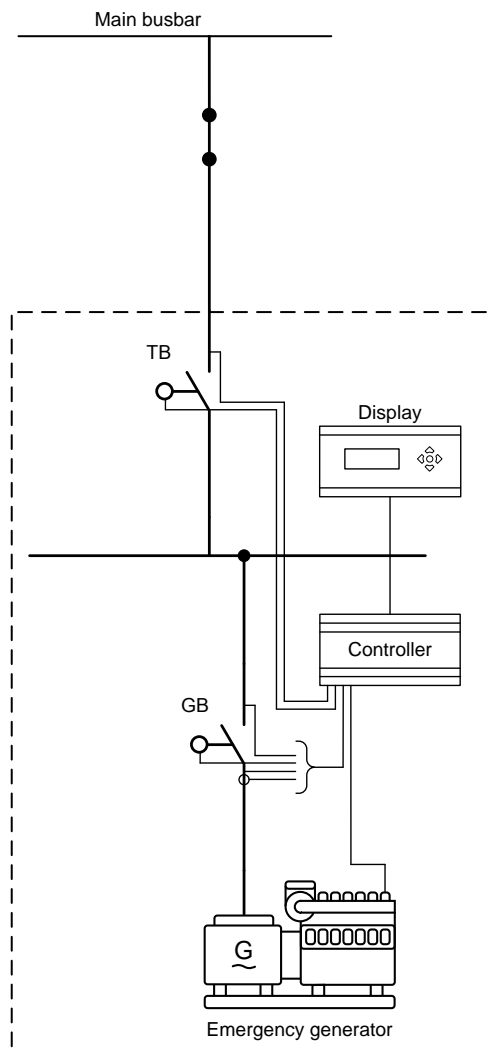
- PPM-3 EDG controller as **stand-alone without speed control**
(2780 Regulator output setting: OFF)
 - No parallel operation with main busbar
- PPM-3 EDG controller as **stand-alone with speed control**
(2780 Regulator output setting: ON)
 - Short time parallel operation with main busbar
- PPM-3 EDG controller as **part of a PPM-3 system without speed control**
(2780 Regulator output setting: OFF)
 - No parallel operation with main busbar
(7083 Back synchronisation setting: OFF, 7092 Deload setting: OFF)
 - Short time parallel operation with main busbar
(7083 Back synchronisation setting: ON, 7092 Deload setting: OFF)
(7083 Back synchronisation setting: ON, 7092 Deload setting: ON)
- PPM-3 EDG controller as **part of a PPM-3 system with speed control**
(2780 Regulator output setting: ON, 7083 Back synchronisation setting: ON, 7092 Deload setting: ON)
 - Short time parallel operation with main busbar
 - Long time parallel operation with main busbar (harbour mode)

2.2 Application descriptions

2.2.1 PPM-3 EDG controller as stand-alone without speed control (2780 Regulator output setting: OFF)

System overview:

- No parallel operation with main busbar



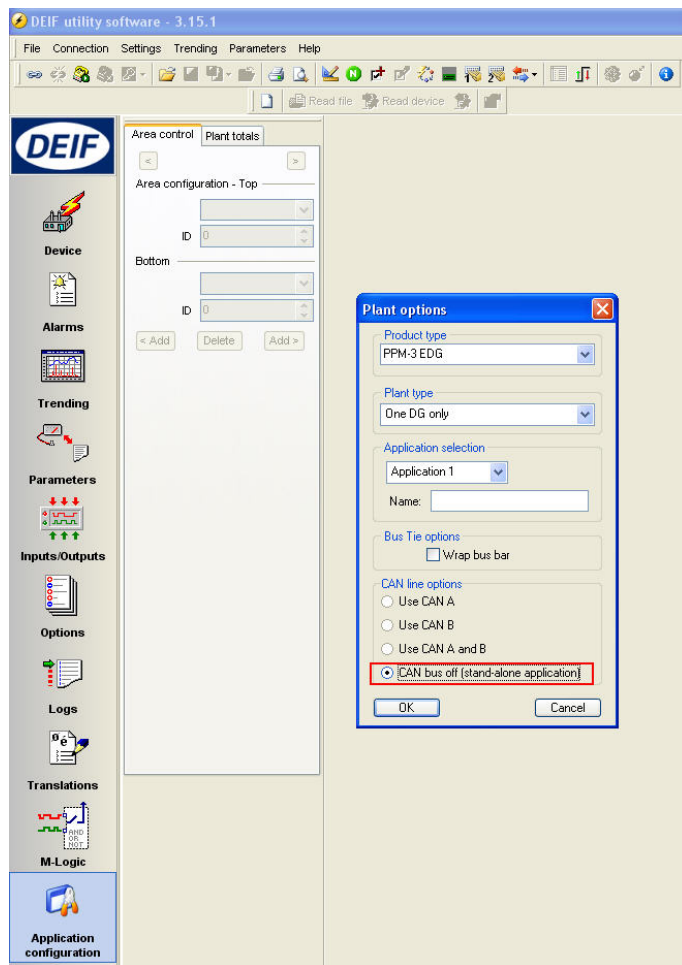
The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker ON/OFF commands
- Bus tie breaker protection
- Bus tie breaker ON/OFF commands
- Simple test mode

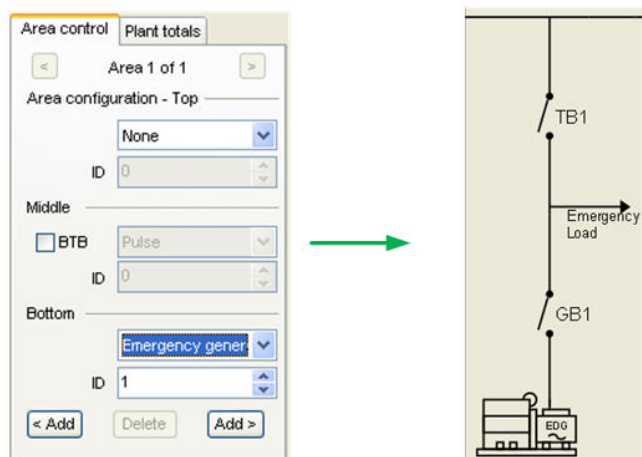
Application settings

The configuration of the application is done via the DEIF utility software.

First, you have to activate the application tool and define the plant options. Select the product type PPM-3 with CAN line option "CANbus off (stand-alone application)".



Under "Area control", select "Emergency generator".



Functionality:

Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the generator breaker will trip and the bus tie breaker will close immediately after. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the generator breaker will automatically trip and the bus tie breaker will close immediately after. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

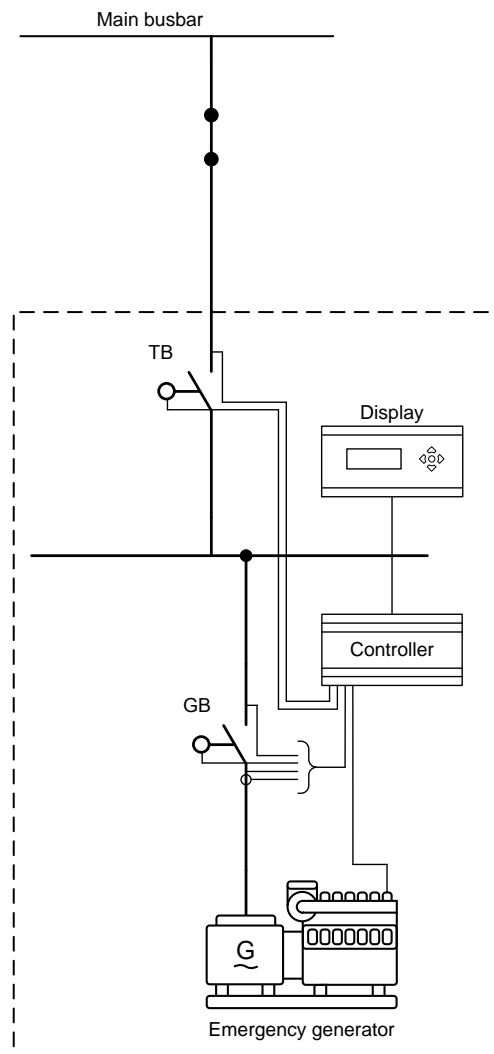
If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will only be possible to perform the simple test. The emergency generator will start up, and after the adjustable timer (7040 Test) has expired, the emergency generator will be stopped again. The operation mode will automatically change to the selected mode.

2.2.2 PPM-3 EDG controller as stand-alone with speed control

(2780 Regulator output setting: ON)

System overview:

- Short time parallel operation with main busbar



The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker synchronisation
- Bus tie breaker protection
- Bus tie breaker synchronisation
- All test modes

Application settings

Identical to paragraph 2.2.1.

Functionality:

Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the emergency generator will synchronise and close the bus tie breaker. Now, the operator can open the generator breaker by pressing the breaker open push-button. If the operator does not open the generator breaker within 30 seconds (adjustable protection timer 1950 EG/MBB Max. time), the bus tie breaker will automatically be tripped. When the generator breaker open push-button is activated, the emergency generator will deload and open the generator breaker. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the bus tie breaker will automatically synchronise and close. When the bus tie breaker is closed, the diesel generator breaker will automatically deload and open. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will be possible to perform a simple test, load test or full test. (Selectable with parameter 7044 Test type).

Simple test:

The emergency generator will automatically start up, and after the adjustable timer (7042 Test) has expired, the emergency generator will stop. The operation mode will automatically change to the selected mode (parameter 7043 Return mode).

Load test:

The emergency generator will automatically start up, synchronise and close the generator breaker. After the breaker is closed, the emergency generator will take some load from the main busbar (adjustable with parameter 7041 Test), and after the adjustable timer has expired, the emergency generator will deload and open the generator breaker and stop the engine. The operation mode will automatically change to the selected mode.

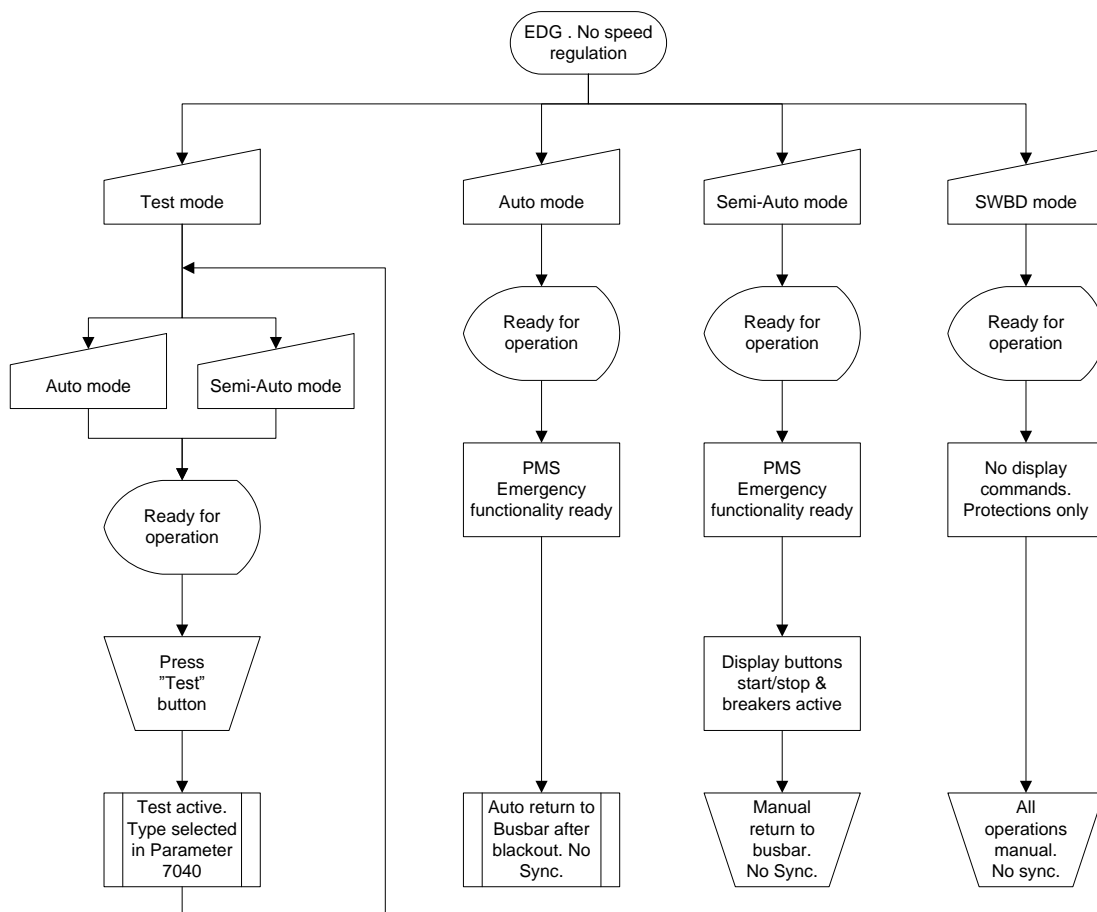
Full test:

The full test will automatically start the emergency generator, synchronise the generator breaker and transfer the adjusted load (parameter 7041) to the emergency generator before opening the bus tie breaker. When the test timer (parameter 7042) expires, the bus tie breaker will automatically synchronise and transfer the load back to the main busbar before opening the generator breaker and stopping the engine.



Should there be a blackout situation during any of the above test modes, the test mode will be interrupted immediately.

The above functionality converted into flowchart:



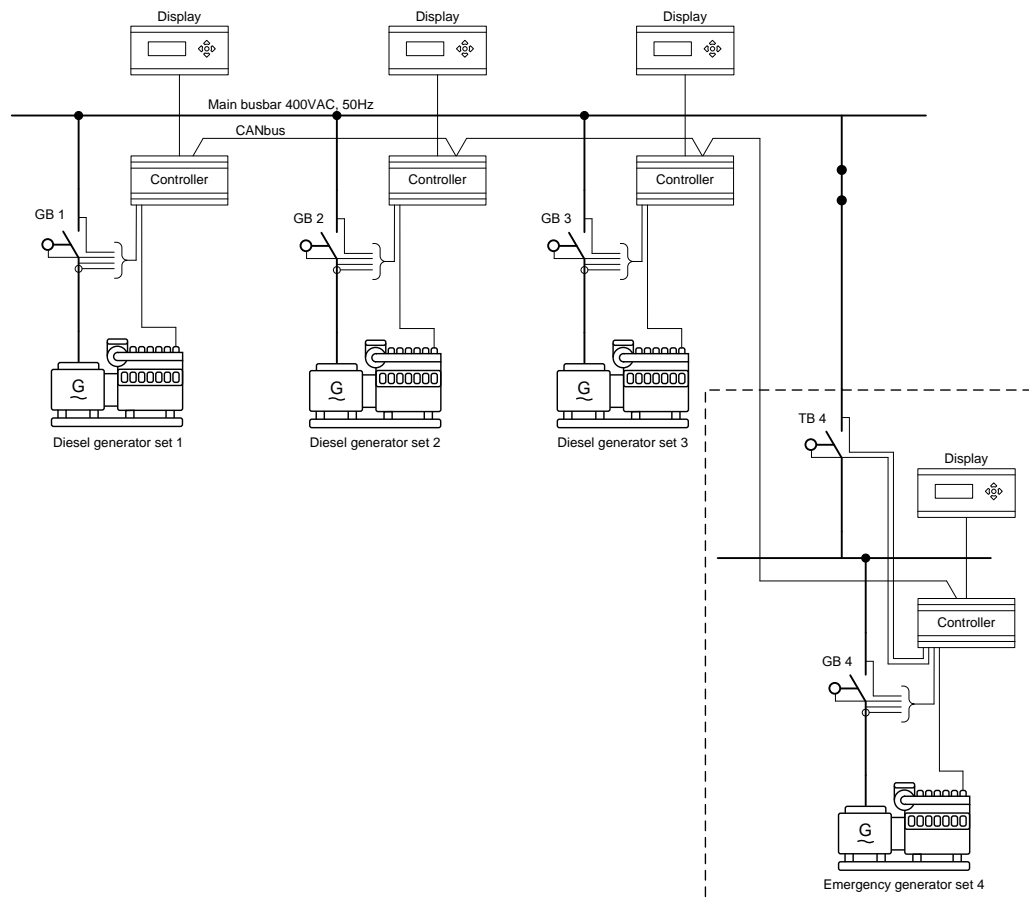
Flowchart shape explanation:



2.2.3 PPM-3 EDG controller as part of the PPM-3 system without speed control (2780 Regulator output setting: None)

System overview:

- No parallel operation with main busbar

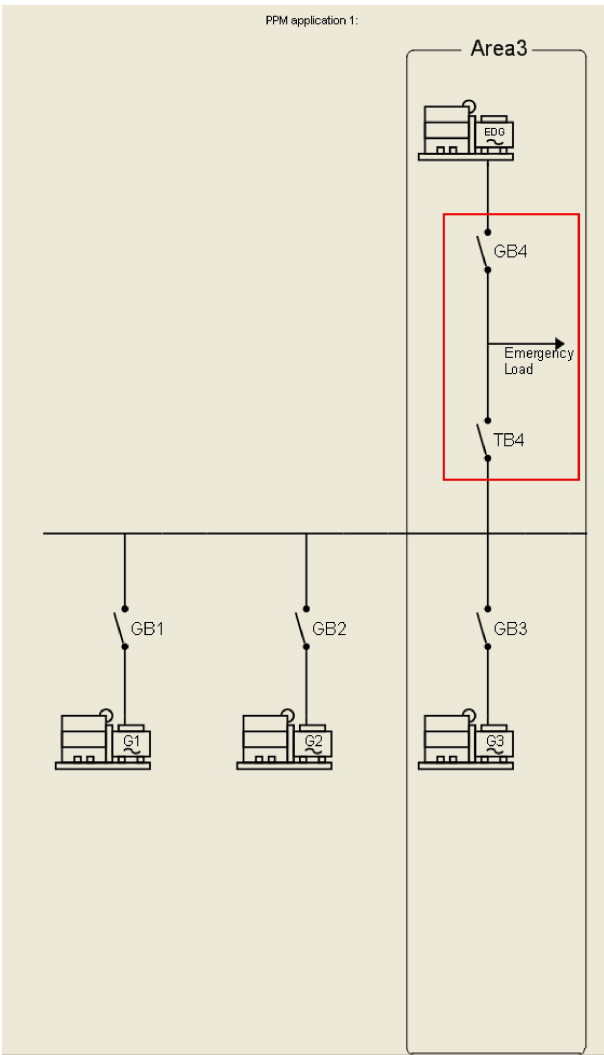


The system will have the following functionalities:

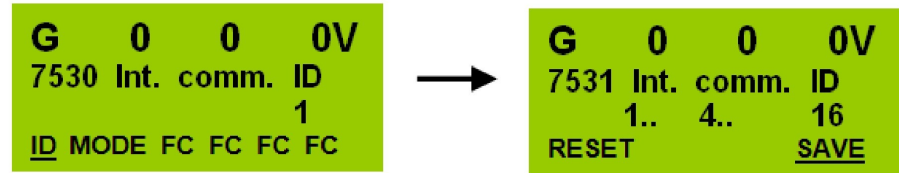
- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker ON/OFF commands
- Bus tie breaker protection
- Bus tie breaker ON/OFF commands
- Simple test mode

Application settings

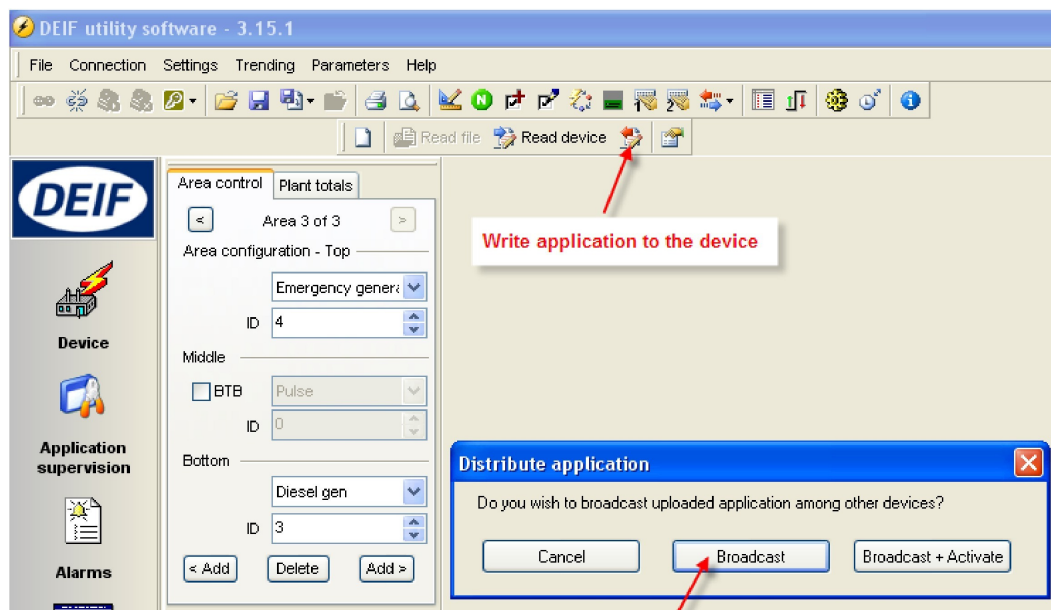
- Define the application by using the DEIF utility software application tool.



b) Define the ID numbers of each unit. In this example, the EDG unit has the ID number 4. Select parameter 7530 on the EDG unit and then select ID number 4.



c) After adjusting the ID numbers of the PPM-3 controllers, you can send and broadcast the application by using the DEIF utility software application tool.



Functionality:

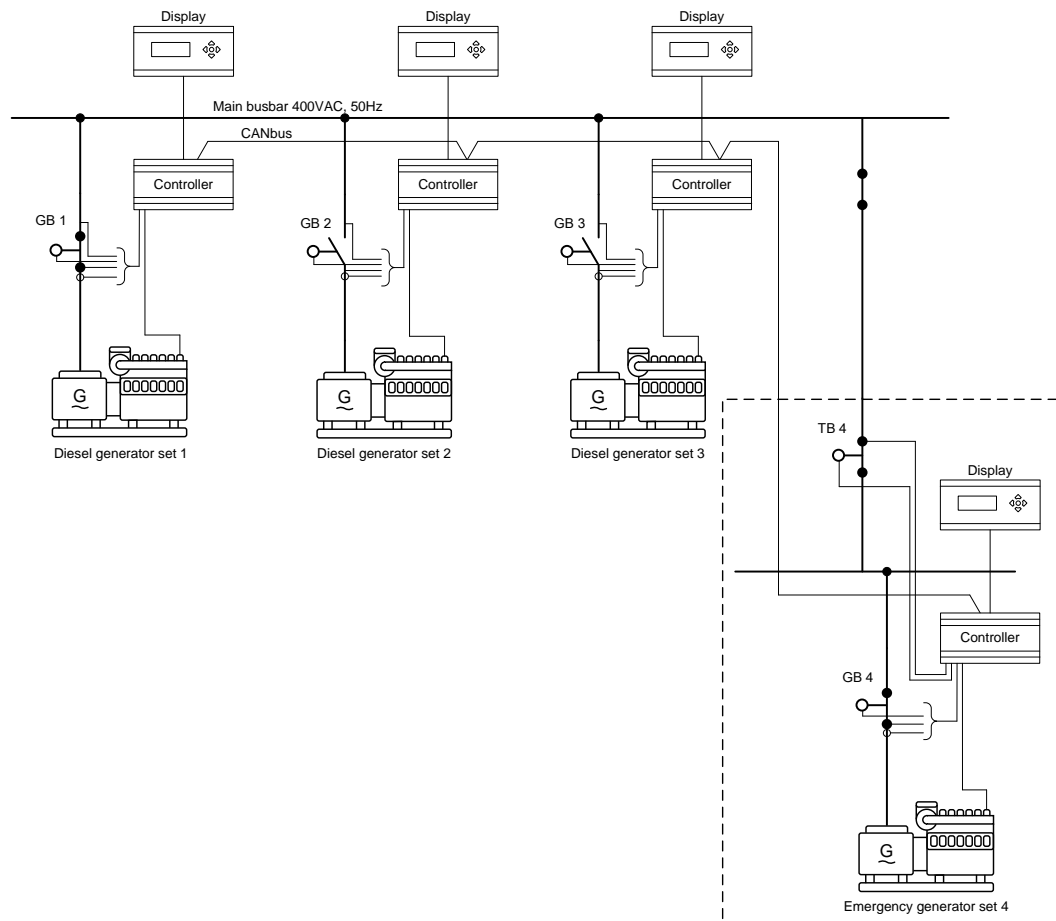
Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation. 7083 Back synchronisation setting: OFF. 7092 Deload setting: OFF.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the generator breaker will trip and the bus tie breaker will close immediately after. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation. 7083 Back synchronisation setting: OFF. 7092 Deload setting: OFF.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the generator breaker will automatically trip and the bus tie breaker will close immediately after. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will only be possible to perform the simple test. The emergency generator will start up, and after the adjustable timer (7040 Test) has expired, the emergency generator will be stopped again. The operation mode will automatically change to the selected mode.

System overview:

- Short time parallel operation with main busbar without deloading



The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker ON/OFF commands
- Bus tie breaker protection
- Bus tie breaker ON/OFF commands
- Simple test mode

Functionality:

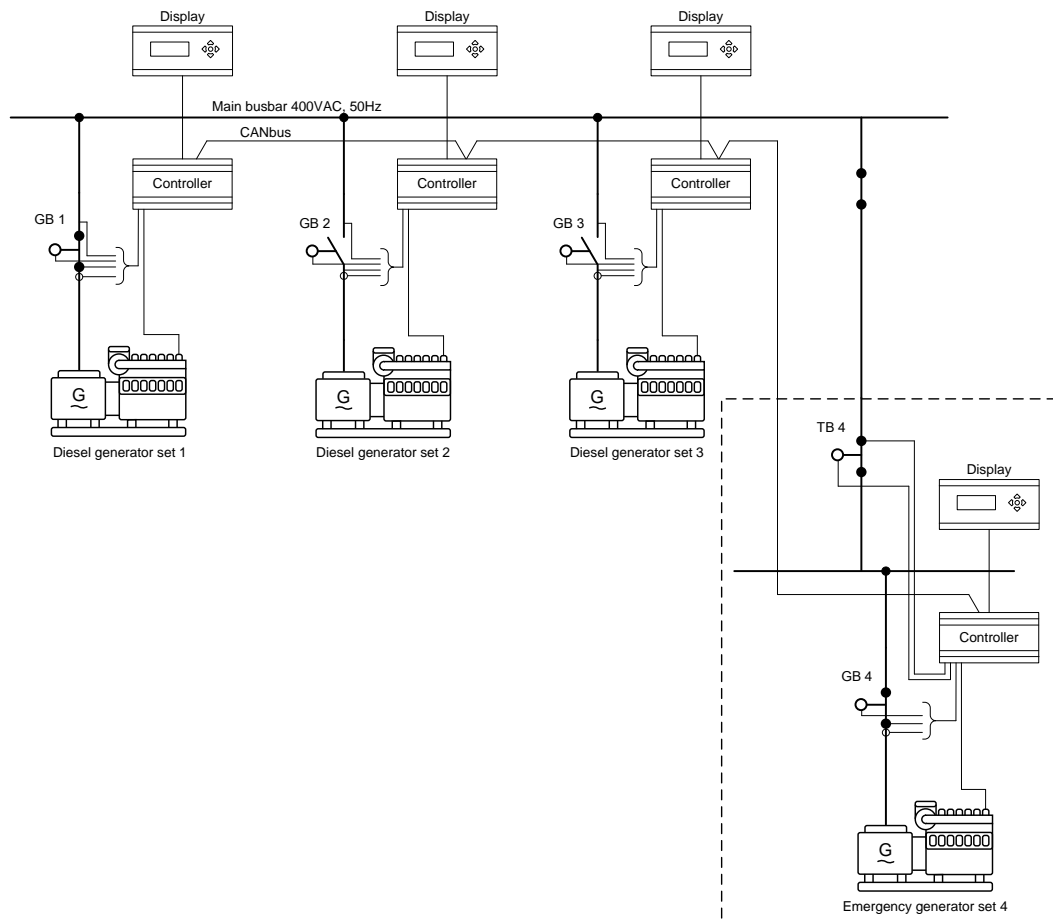
Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation. 7083 Back synchronisation setting: ON. 7092 Deload setting: OFF.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the diesel generator(s) on the main busbar will synchronise the bus tie breaker. When the bus tie breaker is closed, the generator breaker of the emergency generator will trip. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation. 7083 Back synchronisation setting: ON. 7092 Deload setting: OFF.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the diesel generator(s) on the main busbar will automatically synchronise the bus tie breaker. When the bus tie breaker is closed, the generator breaker of the emergency generator will trip. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will only be possible to perform the simple test. The emergency generator will start up, and after the adjustable timer (7040 Test) has expired, the emergency generator will be stopped again. The operation mode will automatically change to the selected mode.

System overview:

- Short time parallel operation with main busbar with deloading



The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker ON/OFF commands
- Bus tie breaker protection
- Bus tie breaker ON/OFF commands
- Simple test mode

Functionality:

Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation. 7083 Back synchronisation setting: ON. 7092 Deload setting: ON.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the diesel generator(s) on the main busbar will synchronise and close the bus tie breaker. Now, the operator can open the generator breaker by pressing the breaker open push-button. If the operator does not open the generator breaker within 30 seconds (adjustable protection timer 1950 EG/MBB Max. time), the bus tie breaker will automatically be tripped. When the generator breaker open push-button is activated, the diesel generator(s) on the main busbar will deload and open the emergency generator breaker. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation. 7083 Back synchronisation setting: ON. 7092 Deload setting: ON.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the diesel generator(s) on the main busbar will automatically synchronise and close the bus tie breaker. When the bus tie breaker is closed, the diesel generator(s) on the main busbar will deload and open the emergency generator breaker. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

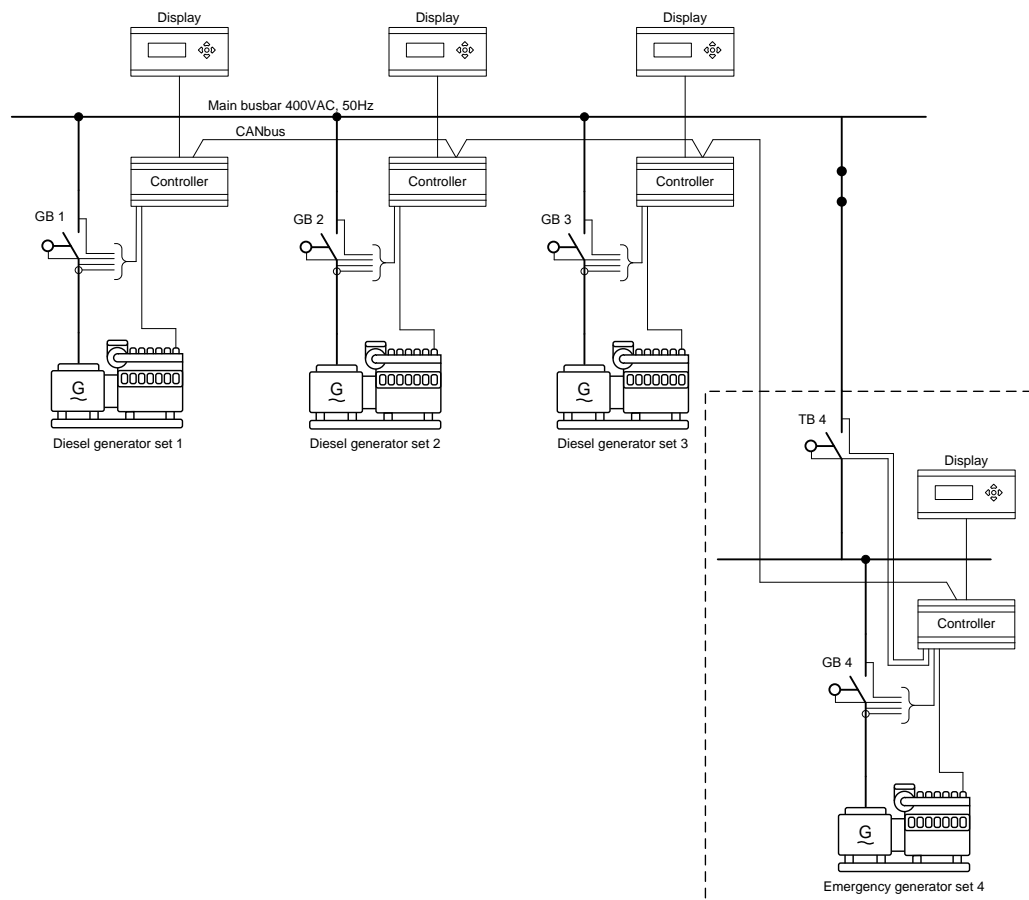
If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will only be possible to perform the simple test. The emergency generator will start up, and after the adjustable timer (7040 Test) has expired, the emergency generator will be stopped again. The operation mode will automatically change to the selected mode.

2.2.4 PPM-3 EDG controller as part of the PPM-3 system with speed control

(2780 Regulator output setting: ON)

System overview:

- Short time parallel operation with main busbar



The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker synchronisation
- Bus tie breaker protection
- Bus tie breaker synchronisation
- All test modes

Application settings

Identical to paragraph 2.2.3.

Functionality:

Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the operator can decide to close the bus tie breaker by activating the BTB ON push-button. In this case, the emergency generator will synchronise and close the bus tie breaker. Now, the operator can open the generator breaker by pressing the breaker open push-button. If the operator does not open the generator breaker within 30 seconds (adjustable protection timer 1950 EG/MBB Max. time), the bus tie breaker will automatically be tripped. When the generator breaker open push-button is activated, the emergency generator will deload and open the generator breaker. Now, the emergency generator can be stopped by activating the stop push-button.
Example 3	
AUTO mode and ready for operation.	In case of blackout on the main busbar, the bus tie breaker will be tripped by either the undervoltage coil of the breaker or by the PPM-3 EDG unit. The emergency generator will start up and connect the generator breaker to the emergency busbar. When the main busbar is powered up again, the bus tie breaker will automatically synchronise and close. When the bus tie breaker is closed, the diesel generator breaker will automatically deload and open. When the generator breaker is open, the emergency generator will automatically stop and cool down.

Test mode:

If the test mode is activated in SEMI-AUTO mode or in AUTO mode, it will be possible to perform a simple test, load test or full test. (Selectable with parameter 7044 Test type).

Simple test:

The emergency generator will automatically start up, and after the adjustable timer (7042 Test) has expired, the emergency generator will stop. The operation mode will automatically change to the selected mode (parameter 7043 Return mode).

Load test:

The emergency generator will automatically start up, synchronise and close the generator breaker. After the breaker is closed, the emergency generator will take some load from the main busbar (adjustable with parameter 7041 Test), and after the adjustable timer has expired, the emergency generator will deload and open the generator breaker and stop the engine. The operation mode will automatically change to the selected mode.

Full test:

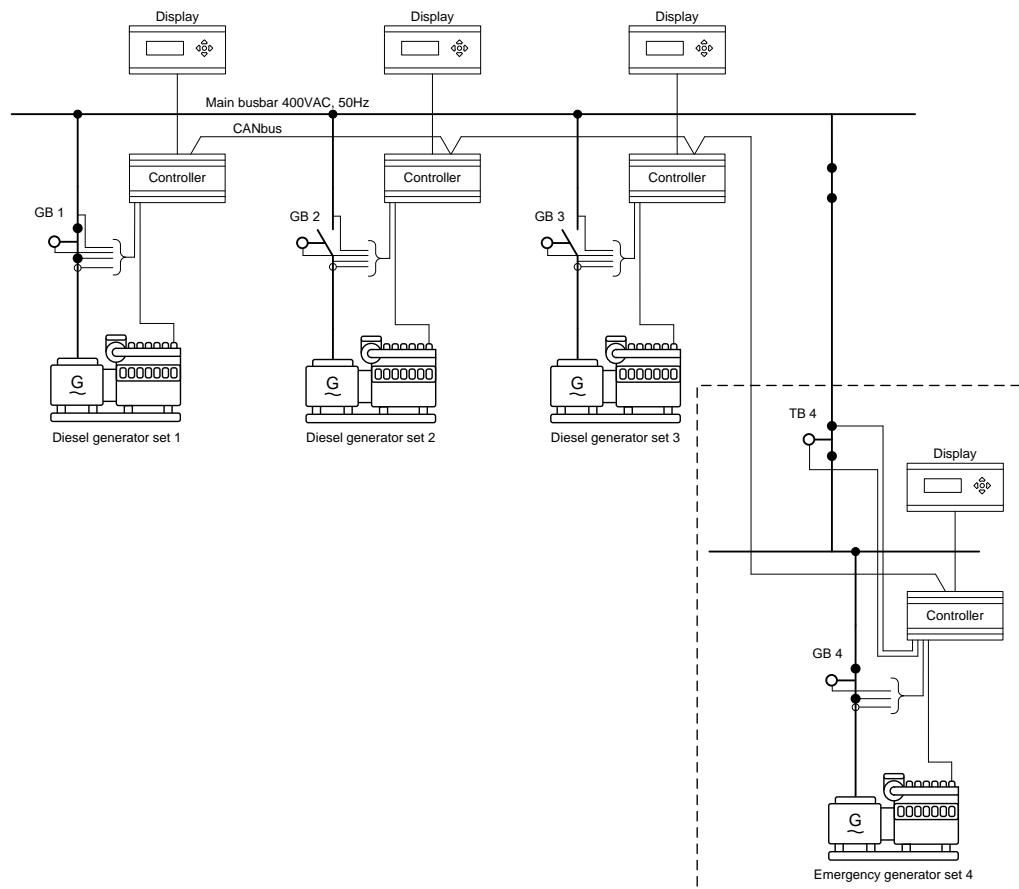
The full test will automatically start the emergency generator, synchronise the generator breaker and transfer the adjusted load (parameter 7041) to the emergency generator before opening the bus tie breaker. When the test timer (parameter 7042) expires, the bus tie breaker will automatically synchronise and transfer the load back to the main busbar before opening the generator breaker and stopping the engine.



Should there be a blackout situation during any of the above test modes, the test mode will be interrupted immediately.

System overview:

- Long time parallel operation with main busbar (harbour mode)



The system will have the following functionalities:

- Engine start/stop
- Engine protection
- Indication of engine and generator measurements
- Generator protection
- Generator breaker synchronisation
- Bus tie breaker protection
- Bus tie breaker synchronisation
- Parallel operation with main busbar
- All test modes

Functionality:

Starting condition	Reaction
Example 1	
Switchboard control and not ready for operation.	In switchboard control, the EDG unit does not perform any action. Only the protection functions are activated.
Example 2	
SEMI-AUTO mode and ready for operation. The bus tie breaker between main busbar and emergency busbar is closed. The digital input 43 "Harbour operation" is activated.	The operator can start the emergency generator by pressing the start push-button on the display unit. When the emergency generator is started, the operator can press the breaker ON push-button on the display unit, and the generator breaker will be synchronised to the main busbar. The emergency diesel generator is now running in parallel with the diesel generator(s) on the main busbar. Now, the operator is able to stop the diesel generator(s) on the main busbar if the emergency generator is able to handle the load situation on the main busbar. To turn back to diesel generator operation on the main busbar, the operator can start a diesel generator and synchronise the generator breaker to the emergency/harbour generator. By pressing the generator open push-button on the display of the EDG unit, the emergency/harbour generator will deload and open the breaker. Now, the operator can stop the emergency/harbour generator.
Example 3	
AUTO mode and ready for operation. The bus tie breaker between main busbar and emergency busbar is closed. The digital input 43 "Harbour operation" is deactivated.	When the digital input "Harbour operation" is activated, the emergency generator will automatically start up and synchronise to the busbar. If the emergency generator is able to handle the load situation on the main busbar, all other diesel generators, which are connected to the main busbar and are in AUTO operation, will stop load-dependent. Now, if the load on the busbar is increasing, the next available diesel generator according to the selected priority will start and synchronise to the main busbar. If the harbour operation is not needed anymore, the digital input "Harbour operation" can be deselected. When this is done, the emergency generator will deload and open the generator breaker and stop the engine. The emergency gen-set will only stop if the diesel generator on the main busbar is able to handle the load situation. If the diesel generator is not able to handle the load situation, the load-dependent start function will start the next available diesel generator and connect to the main busbar before stopping the emergency gen-set.