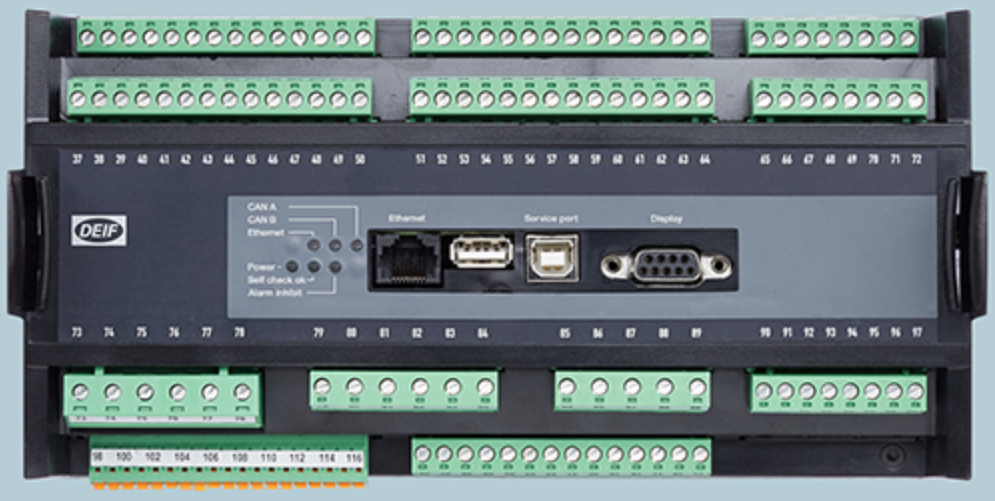
AGC-4

Options G4, G5 and G8
Power management



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1. Introduction

2. Setup

3. General functions

6. Mains functions

7. M-Logic

1. Introduction

1.1 Options G4, G5 and G8

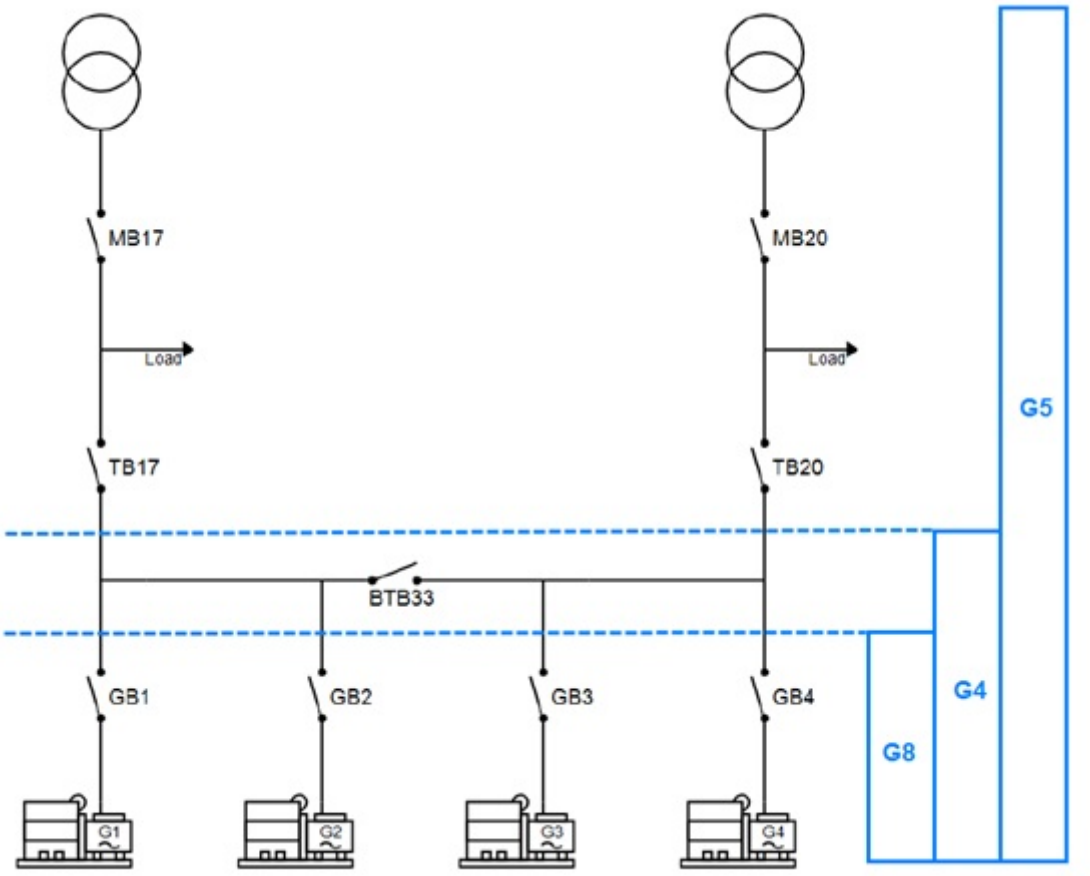
When power management is active, the controllers in the application exchange power management information over CAN bus connections. This allows the controllers to respond to meet the power management requirements. Only standard AGC-4 hardware (including CAN bus connections in slot 7) is required.

Options G4, G5 and G8 (power management) are software options. Options G4, G5 and G8 have the same basic functions. You can mix controllers with one of the three options in the same application.

1.1.1 AGC-4 controllers

For options G4, G5 and G8, there are three AGC-4 controllers:

- **Genset** controller: Controls a genset and a genset breaker. A genset consists of a prime mover (for example: an engine, a turbine) and an alternator. Power management starts, stops, connects, disconnects and regulates the gensets to meet the power management requirements.
- **BTB** controller: Controls a bus tie breaker. Power management synchronises, closes, deloads and opens the breaker to meet the power management requirements. When the bus tie breaker is open, two busbar sections are formed. Power management treats each busbar section as a separate power management system.
- **Mains** controller: Controls a mains breaker and optionally also a tie breaker. Power management synchronises, closes breakers, deloads and opens breakers to meet the power management requirements.



	AGC Genset	AGC BTB	AGC Mains
Option G8	X		
Option G4	X	X	

	AGC Genset	AGC BTB	AGC Mains
Option G5	X	X	X (required)
Touch display unit TDU 107	X		X
Display unit DU-2	Option Y1	Option Y5	Option Y4

All functions available in the G4 and G8 options are also available in the G5 option. However, all power management functions for the mains connections and the sequences handling the mains are not available in the G4 option. Only generator functions are available in the G8 option.

Extended power management

To use AGC-4 **Group** and **Plant** controllers, **Option G7** is required.

More information
See **Option G7 Extended Power Management** for more information.

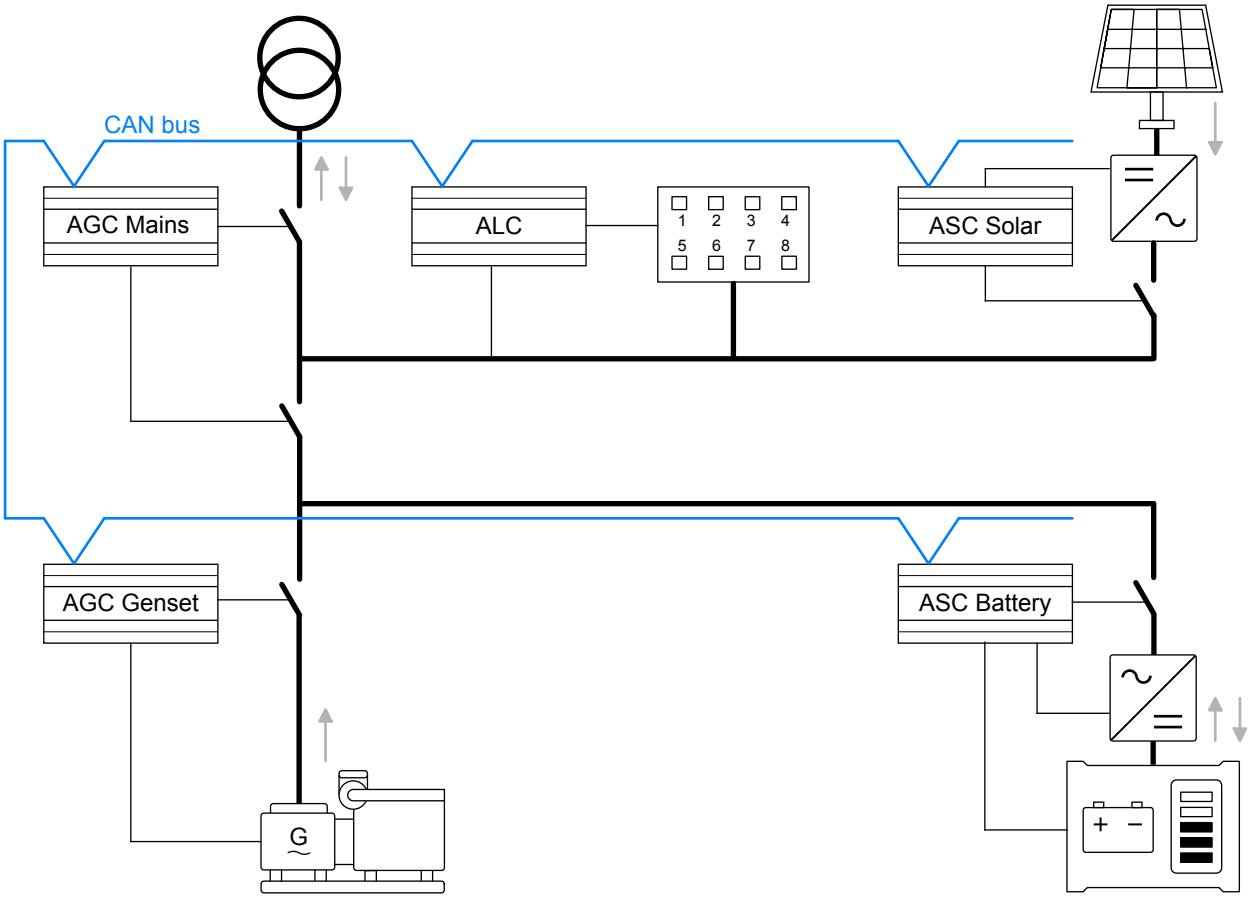
1.1.2 Power management with other controllers

You can use these controllers in a power management system with AGC-4:

- **AGC 150**: Advanced genset controller
  - Similar to AGC-4, but does not include all of the AGC-4 features.
- **AGC 200**: Advanced genset controller
  - Similar to AGC-4, but does not include all of the AGC-4 features.
- **ALC-4**: Automatic load controller
  - Can control up to 8 consumer feeders (including heavy consumers) per controller.
- **ASC-4 Solar**: Automatic sustainable controller
  - Controls PV solar inverters to maximise sustainable power.
- **ASC-4 Battery**: Automatic sustainable controller
  - Controls battery (ESS) charging and discharging.

These controllers all include power management. However, each AGC-4 controller in the system must have option G4, G5 or G8.

Power management example*



*Note: The example shows an ASC Solar connected to the mains load point. It is also possible to connect an ASC Solar to the busbar. See ASC Solar connection for more information.

1.1.3 Power management functions

This is an overview the AGC-4 power management functions.

Plant modes

- Island operation
- Automatic Mains Failure*
- Fixed power*
- Peak shaving*
- Load takeover*
- Mains power export*

*Note: Requires a mains controller.

Functions

General

- Application configuration
  - Easy connect (gensets only)
  - PC utility software (any systems)
- CAN bus communication
  - Redundant CAN
  - Configurable IDs
  - CAN flags
- Multi-master
- Controller type can be changed
- Software compatibility check
- Local/remote operation
- Common PF control

Genset controller

- Genset breaker control
- Genset priority
  - Manual
  - Running hours
  - Fuel optimisation
  - Fuel optimisation and running hours
- Load-dependent start/stop
  - Available power or percentage
  - Two sets of settings
- Load sharing
- Asymmetric load sharing (LS)
- Ramps and load steps
- Secured mode (N+1)
- Base load
- Multi-start gensets
- Load management
- Ground relay control

BTB controller

- Bus tie breaker control
- Section management
- Closed ring
- Direct close on dead busbar

Mains controller

- Mains breaker control
  - Synchronisation
  - Back synchronisation
  - Test mode
- Multiple mains
- ATS control
- Tie breaker control (optional)
  - Power capacity
  - Open point

More information
See the **AGC-4 Designer's Reference Handbook** for the standard functions that are not related to power management.

ASC-4

The ASC-4 controllers include additional power management functions for photovoltaic and energy storage systems. See the **ASC-4 Designer's Reference Handbook** for more information.

ALC-4

ALC-4 provides automatic load control, and includes a heavy consumer function. See the **ALC-4 Designer's Reference Handbook** for more information.

1.2 Software version

This document is based on the AGC-4 software version 4.79.

1.3 Applications

1.3.1 Overview

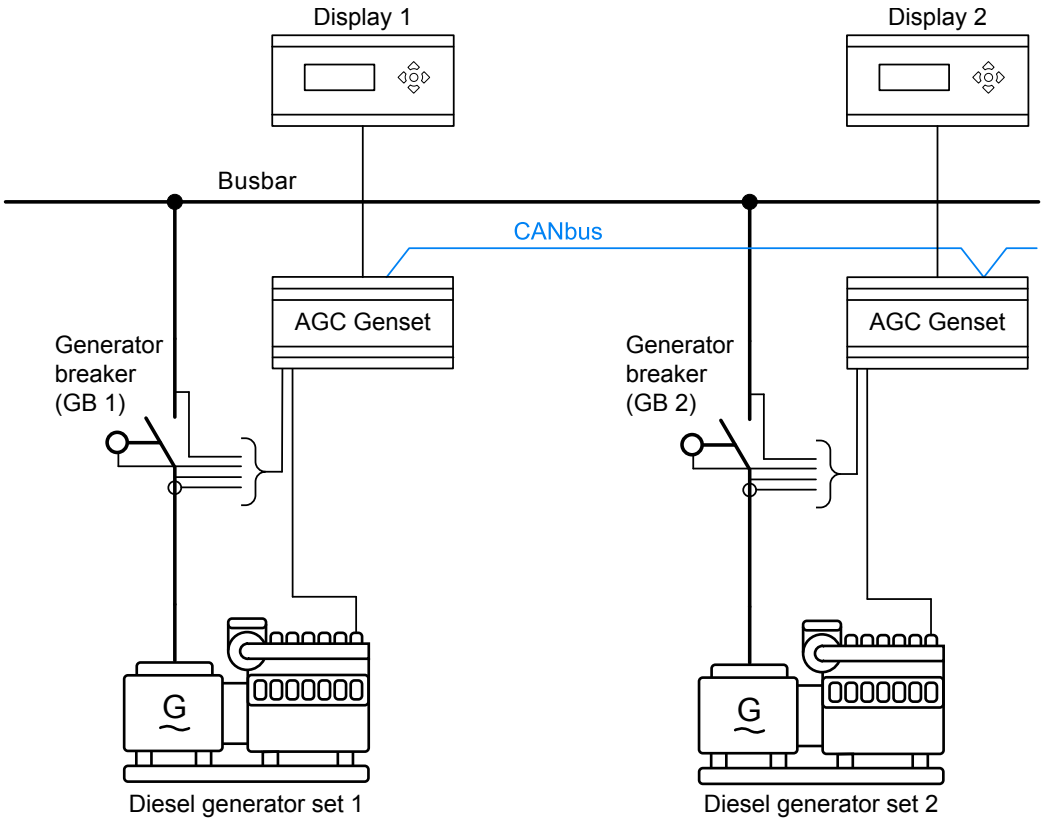
Controllers with options G4, G5 and G8 can be used to create the applications in the following sections. If the controllers only have the G8 option, only an island application with genset controllers is possible.

INFO
See the **Designer's reference handbook** for description of each of the genset modes.

INFO
For the AC and DC connections for each application, see the **Installation instructions**.

1.3.2 Island operation

Up to 32 gensets can run in parallel in island operation. When all the controllers in the plant have *Power management* selected in *Genset mode* (menu 6070), the status text READY ISLAND AUTO is shown in the display. PMS load sharing, load-dependent start/stop and all the other PMS features are now available.



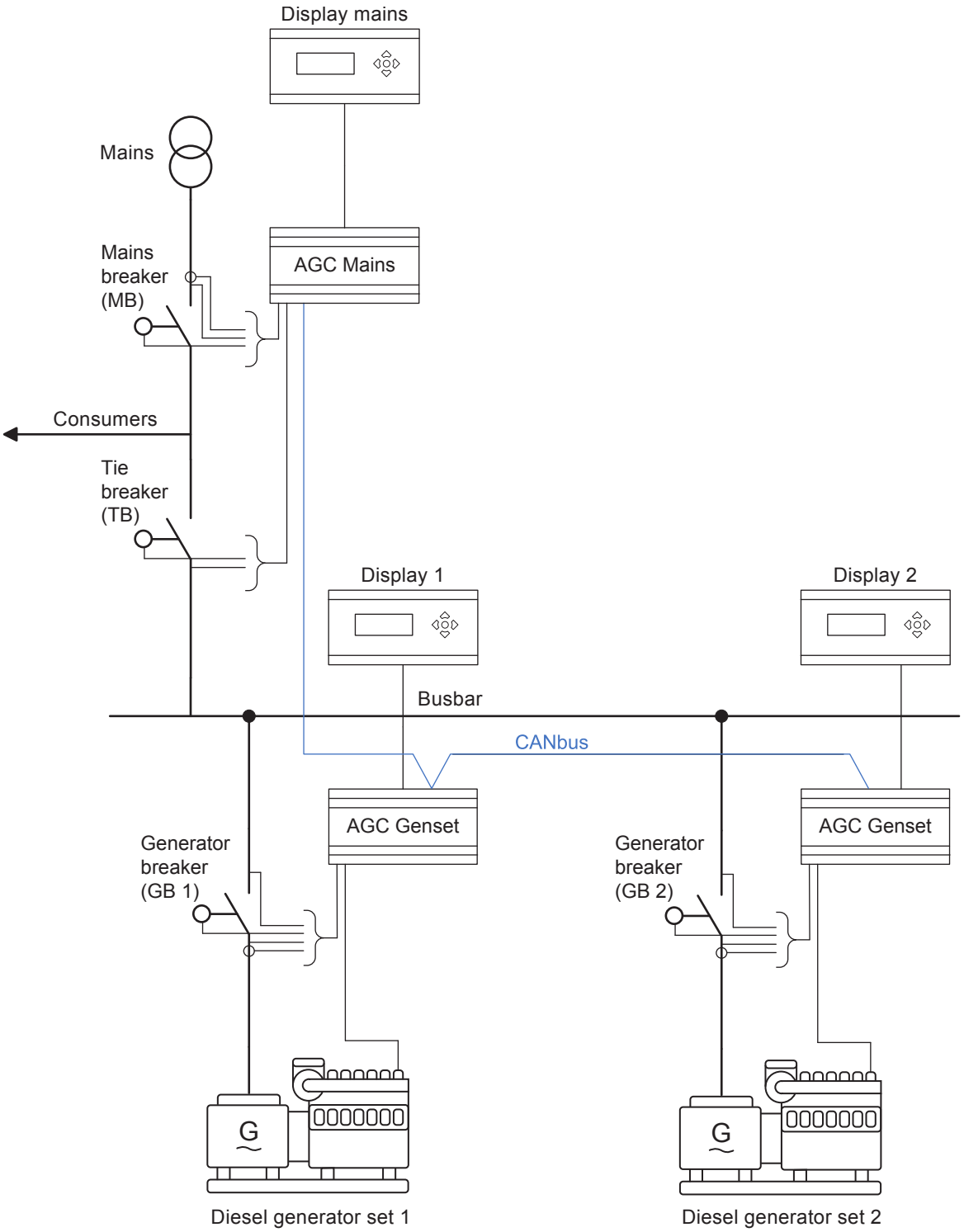
If a mains controller is installed and connected (for example, for future application requirements), island operation is selected in the mains controller.

INFO
You can also use M-Logic *Output, Command, Power management* to activate power management.

1.3.3 Parallel with mains

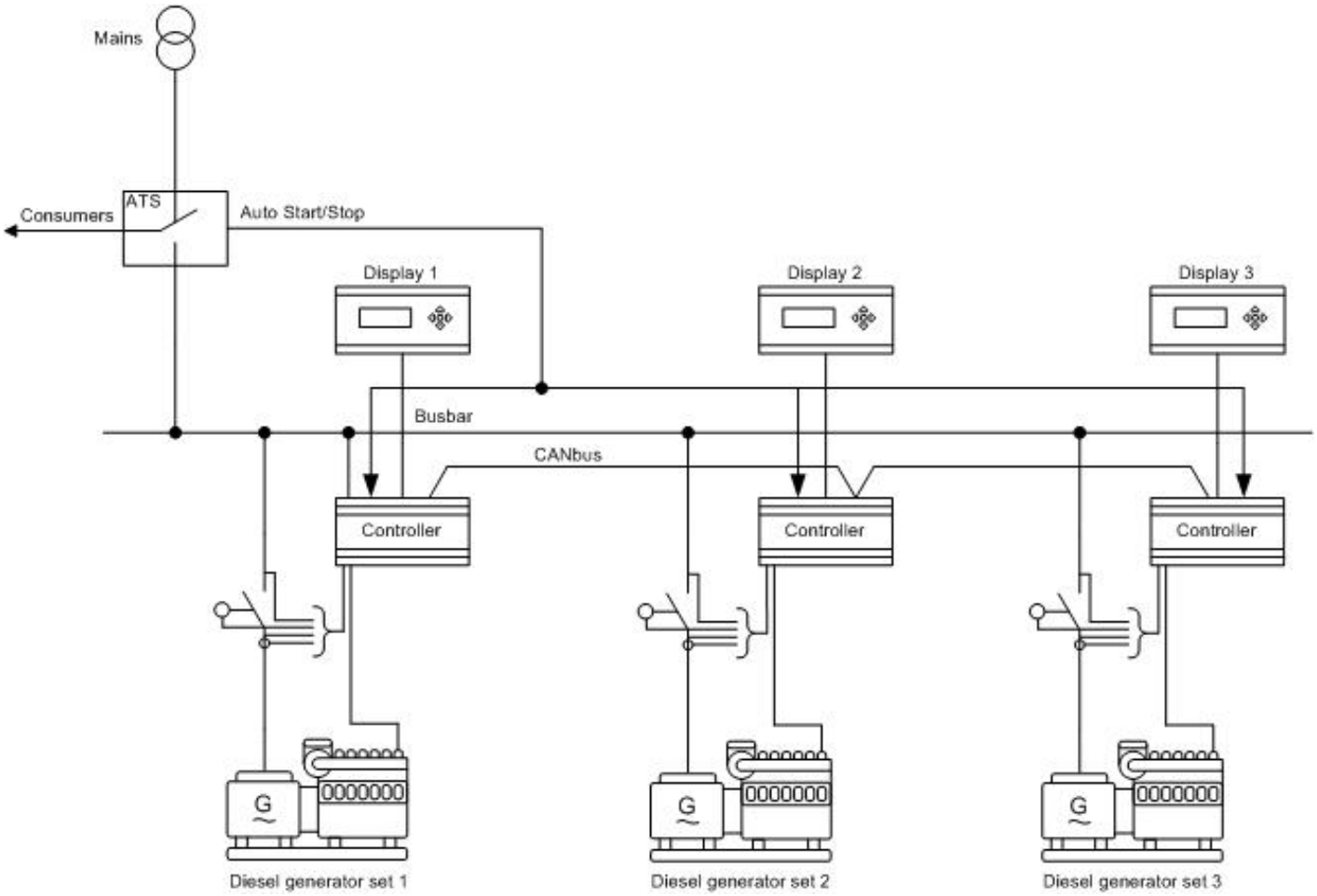
An application where a mains is installed together with up to 31 gensets is shown below.

The application is shown with a mains breaker and a tie breaker. It is also possible to create the application without a tie breaker or a mains breaker. The tie breaker cannot be placed on the busbar. If a breaker is needed on the busbar, use a BTB controller.



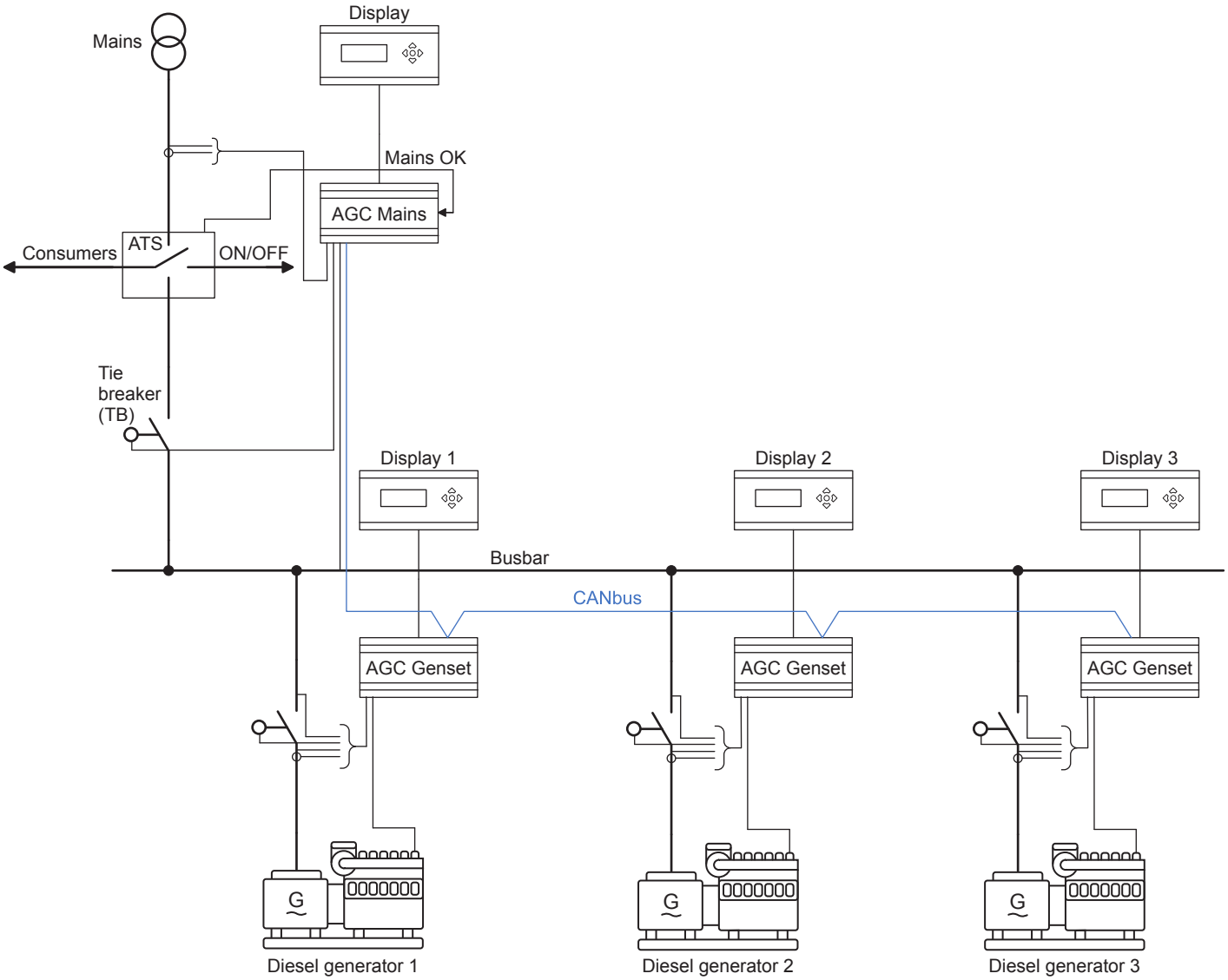
1.3.4 ATS, multiple start

Applications that use an ATS for switching between mains supply and generator supply are supported.



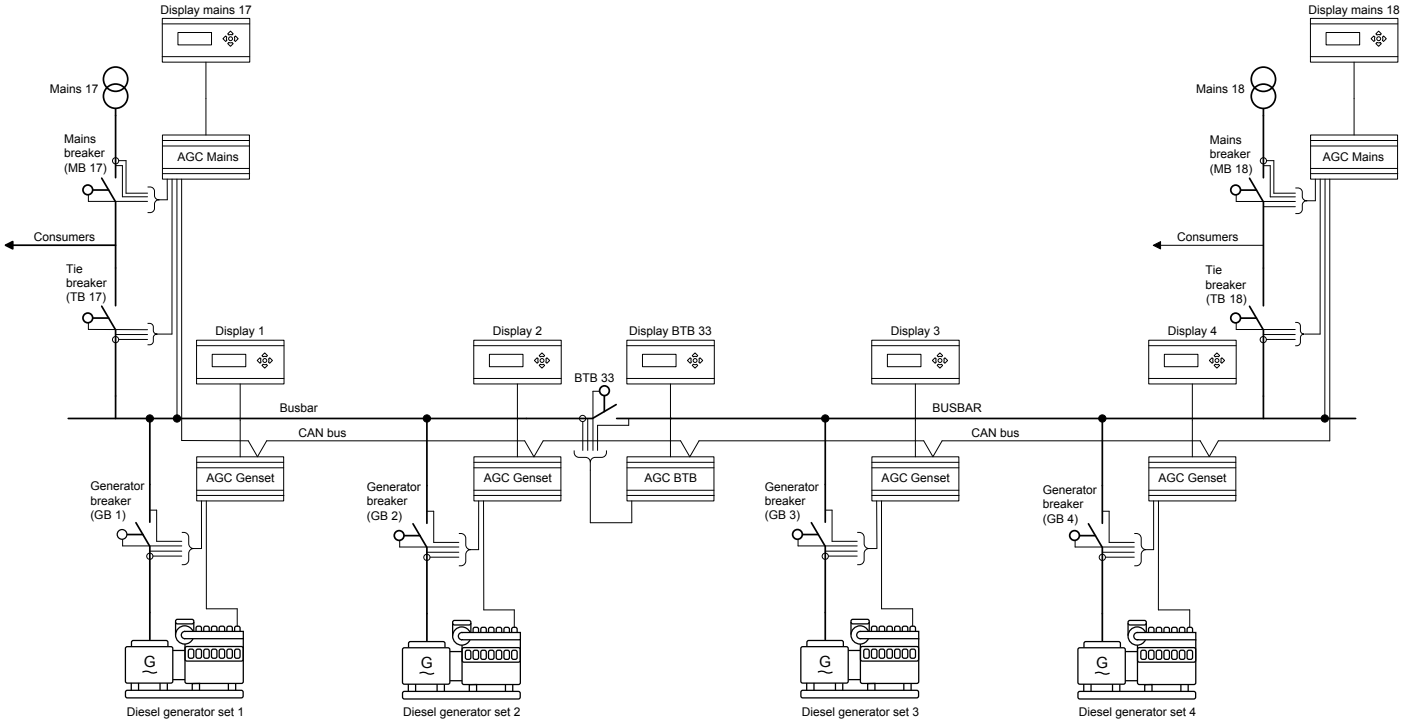
1.3.5 ATS, Mains controller

Applications that use an ATS for switching between mains supply and generator supply are supported.



1.3.6 Multiple mains

An example of a multiple mains application is shown below. See Multiple mains for more information about possible combinations.



1.4 Parameters

The relevant parameters are included in the function descriptions. For more information, see the **Parameter list**.

1.5 Glossary

Term	Abbreviation	Description
Additional Operator Panel	AOP	
AGC	AGC	There are AGC Genset, AGC BTB and AGC Mains controllers.
Automatic Load Controller	ALC-4	If there is a mains failure, the power management system automatically uses gensets to supply the load.
Automatic Mains Failure	AMF	
Automatic Sustainable Controller	ASC-4	The ASC-4 can be included in AGC power management applications. **Solar**: A solar hybrid controller to interface to PV solar inverters. **Battery**: A battery hybrid controller to interface to energy storage systems.
Automatic transfer switch	ATS	
Automatic voltage regulator	AVR	
Available power	$P_{AVAILABLE}$	P_{TOTAL} - $P_{PRODUCED}$
Busbar	BB	Generally, BB is the abbreviation for busbar.
Busbar A	BA	For a BTB, BA is busbar A (the busbar to the left of the BTB in the application configuration).
Busbar B	BB	For a BTB, BB is busbar B (the busbar to the right of the BTB in the application configuration).

Term	Abbreviation	Description
Bus tie breaker	BTB	
Connected		The genset is running and its breaker is closed.
Current transformer	CT	
Display unit	DU-2	An LCD display with push-buttons for AGC-4.
Genset	DG	
Genset breaker	GB	
Load takeover	LTO	
Mains breaker	MB	
Mains power export	MPE	
M-Logic		The PLC-type tool accessible from the utility software.
Multi-line-2	ML-2	A DEIF platform, which includes the AGC-4.
Nominal power	P nom or $P_{NOMINAL}$	
Power management system	PMS	
PC utility software	USW	
Produced power	$P_{PRODUCED}$	The sum of the measured power from the connected gensets. If the gensets are the only power sources, this is equal to the power consumed.
Software	SW	
Tie breaker	TB	
Total power	P_{TOTAL}	The sum of the nominal power of the connected gensets.
Touch display unit	TDU 107	A preprogrammed touch screen colour display for AGC-4.

1.6 Warnings, legal information and safety

1.6.1 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

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

Notes

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

1.6.2 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.

INFO
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.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

1.6.3 Factory settings

The Multi-line 2 unit is delivered from the factory with default settings. These are not necessarily correct for the engine/generator set. Check all the settings before running the engine/generator set.

2. Setup

2.1 Controller type

2.1.1 Selecting the AGC-4 type using the display

You can change the type of the AGC-4 controller. The only requirement is that the controller is an AGC-4 with option G5. The controller type can be changed by pressing the jump button on the display and going to menu 9100.

Select one of the following AGC types:

1. Mains unit (mains controller
2. DG unit (genset controller)
3. Bus tie breaker unit (BTB controller)

INFO
When this parameter is changed, the controller is reset to factory settings. Select the AGC type before starting the configuration.

2.2 Breaker feedbacks

2.2.1 Generator breaker (GB)

For a genset controller, you must connect the feedbacks of the generator breaker (terminals 26 and 27).

2.2.2 Mains breaker (MB)

For a mains controller, you must connect the feedbacks of the mains breaker (terminals 24 and 25).

INFO
If there is no MB, select this in the *Application configuration* (in the PC utility software). The MB open and close relays, and MB open and close feedback inputs (terminals 24 and 25) are then configurable.

2.2.3 Tie breaker (TB)

For a mains controller that controls a TB, you must connect the feedbacks of the tie breaker (terminals 26 and 27).

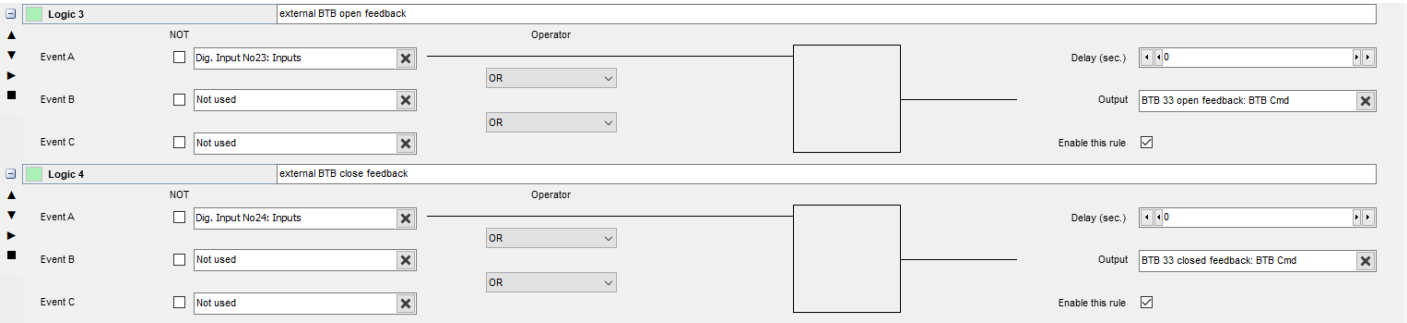
INFO
If there is no TB, select this in the *Application configuration* (in the PC utility software). The TB open and close relays, and TB open and close feedback inputs (terminals 26 and 27) are then configurable.

2.2.4 Bus tie breaker (BTB)

For a BTB controller, you must connect the feedbacks of the bus tie breaker (terminals 26 and 27).

For an externally controlled bus tie breaker, the breaker feedbacks must be connected to one or more AGCs. Use M-Logic (Output, BTB Cmd) to configure the digital inputs.

Example of externally controller bus tie breaker feedbacks in M-Logic



2.2.5 Busbar blocked

The *Busbar blocked* alarm (menu 2320) is a safety feature that prevents power sources from connecting when breaker feedback is missing.

Whenever a position failure alarm is present on a dead bus from a power source connected to the busbar, it generates another alarm called *Busbar blocked* on all the controllers in the same section of the power management system, preventing any breaker from connecting to the busbar in the specific section.

INFO
The status text "XXXX BUSBAR BLOCKED" is shown in all the controllers connected to a busbar where the position failure is present. XXXX identifies the controller with the position failure.

INFO
The busbar blocked function only affects the controllers in the same section as the position failure.

These are the only situations where the busbar is not blocked while a position failure is present:

- MB position failure while the tie breaker is open.
- BTB position failure.
- Any breaker position failure while the busbar's voltage and frequency is within the nominal settings.

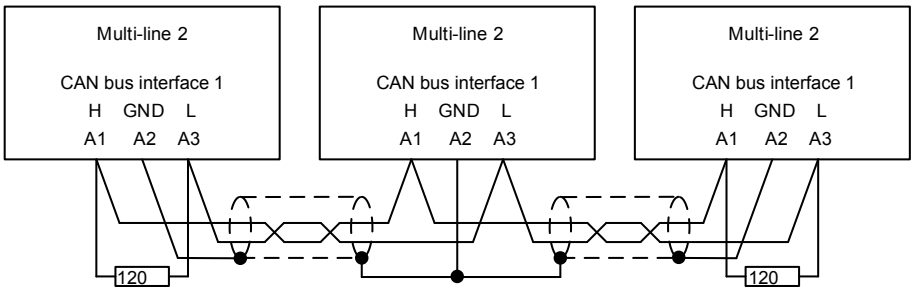
2.3 CAN bus

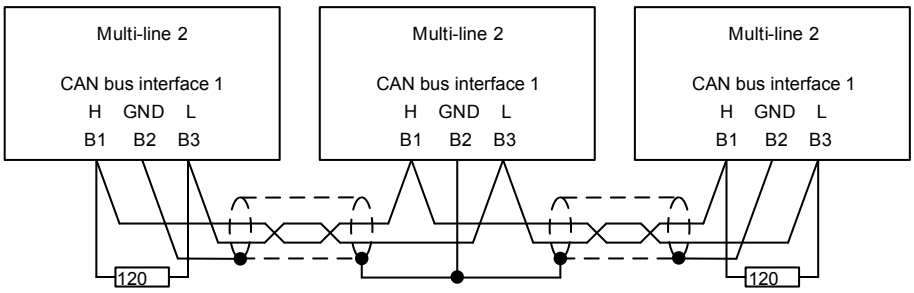
2.3.1 CAN bus connections

The CAN bus interface for the internal communication between AGC controllers is on the engine interface PCB in slot 7.

2.3.2 Diagrams

The following diagrams show examples with three AGC controllers connected. For example, this can be one mains controller and two genset controllers.





INFO
For distances above 300 metres DEIF recommends a CAN-to-fibre converter.

2.3.3 CAN bus setup

If it is critical for the application that the fastest possible inter-controller communication is established, adjust parameters 9171 and 9172 using the display unit.

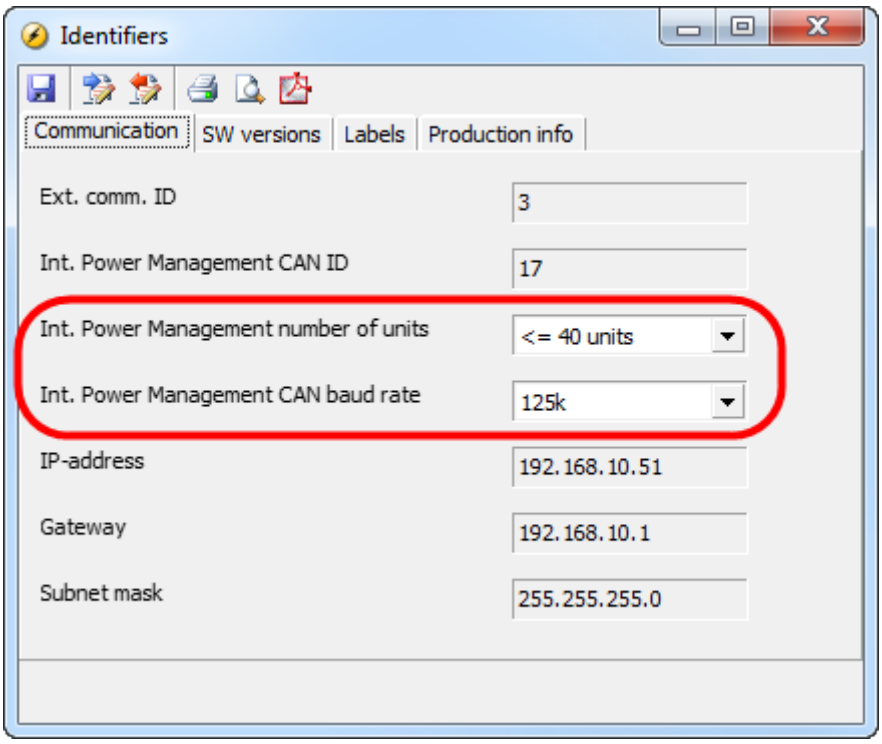
In 9171, select *Int CAN units* to choose the maximum number of units in the application. The lower the number of units, the faster the power management.

All units in the system must have the same setting, otherwise an *Appl. hazard* alarm is displayed. This *Appl. hazard* alarm also creates a *Unit number Error* entry in the event log.

If the CAN Baud rate is not identical on all controllers, an *Appl. hazard* alarm appears on all controllers. The one controller, on which the Baud rate has been changed so that it is no longer identical with the other controllers, is tagged with the alarm value 100 in the alarm log.

In 9172, select *Int CAN baud* to choose the Baud rate of the power management CAN bus communication line. With 125 kbit Baud rate chosen, a physical total CAN bus cable length of 300 metres can be installed. With 250 kbit Baud rate chosen, a physical total CAN bus cable length of 150 metres can be installed.

Parameters 9171 and 9172 can also be changed using the USW:



2.3.4 CAN connections between ML-2 controllers

Use the PC utility software to configure the power management communication between the controllers. The power management communication is CAN bus communication.

CAN line requirements

The wiring must be a daisy chain connection. Identify the terminals that the communication bus is connected to on each controller. The line must be a continuous communication bus, and it cannot be mixed with the other communication bus for power management.

If only one CAN bus line is present, you can select either *PMS Primary* or *PMS Secondary* in menu 7840. This selection must be the same in all controllers.

Redundant CAN lines

The power management communication lines can be redundant (*PMS Primary* and *PMS Secondary*). Follow the CAN bus lines and decide which one should be *PMS Primary*, and which one should be *PMS Secondary*.

INFO
There is no difference between the *PMS Primary* and *PMS Secondary* functions, but the lines must not be mixed up.

Mixing CAN A and CAN B

You cannot use controllers with a mixture of CAN A and CAN B if the application software in any of the controllers is older than version 4.5x.

To simplify the installation, the CAN lines normally run from CAN A to CAN A. It is however possible to mix the CAN lines. On AGCs, the power management lines can, for example, go from CAN port A on an AGC-4 (terminal numbers A1 and A3) on the first controller to CAN port B on an AGC 200 (terminal numbers 10 and 12) on the next controller.

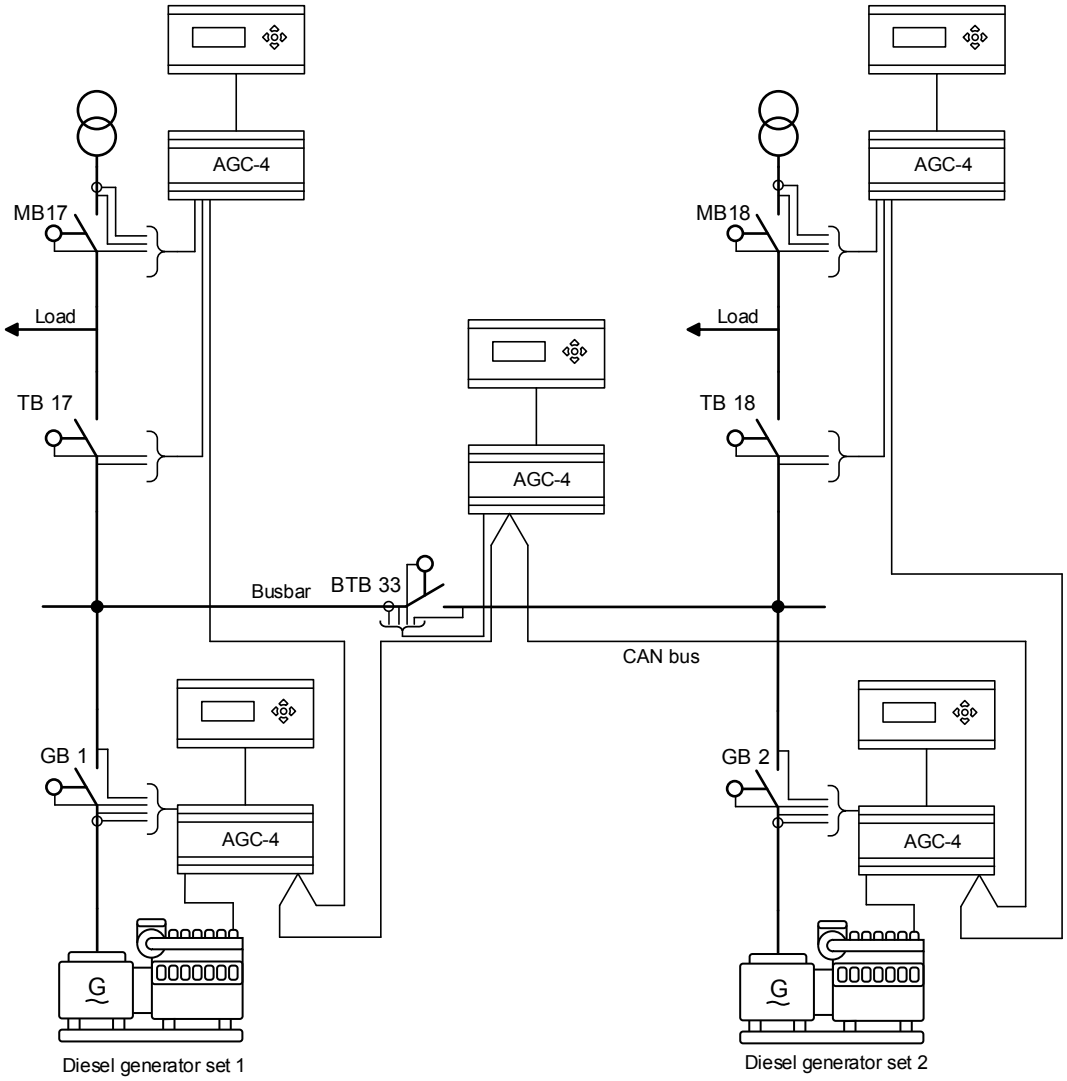
The CAN ports are not important, as long as the CAN protocol settings in the controllers are correct. Using the same CAN port on each controller is recommended. This can be helpful when troubleshooting, and for commissioning.

CAN terminals

The power management communication can be connected to different terminals, depending on the controller and the controller options.

Controller	CAN port	Terminal no.	Note
AGC-4, ASC-4, ALC-4	A	A1 - CAN High A3 - CAN Low	
AGC 24x	A	7 - CAN High 9 - CAN Low	Redundant CAN bus communication is not possible on AGC 200.
AGC-4, ASC-4, ALC-4	B	B1 - CAN High B3 - CAN Low	For AGC-4, instead of power management, option H7 can use CAN B.
AGC 150	B	30 - PMS Hi 32 - PMS Lo	
AGC 22x or AGC 24x	B	10 - CAN High 12 - CAN Low	Redundant CAN bus communication is not possible on AGC 200.

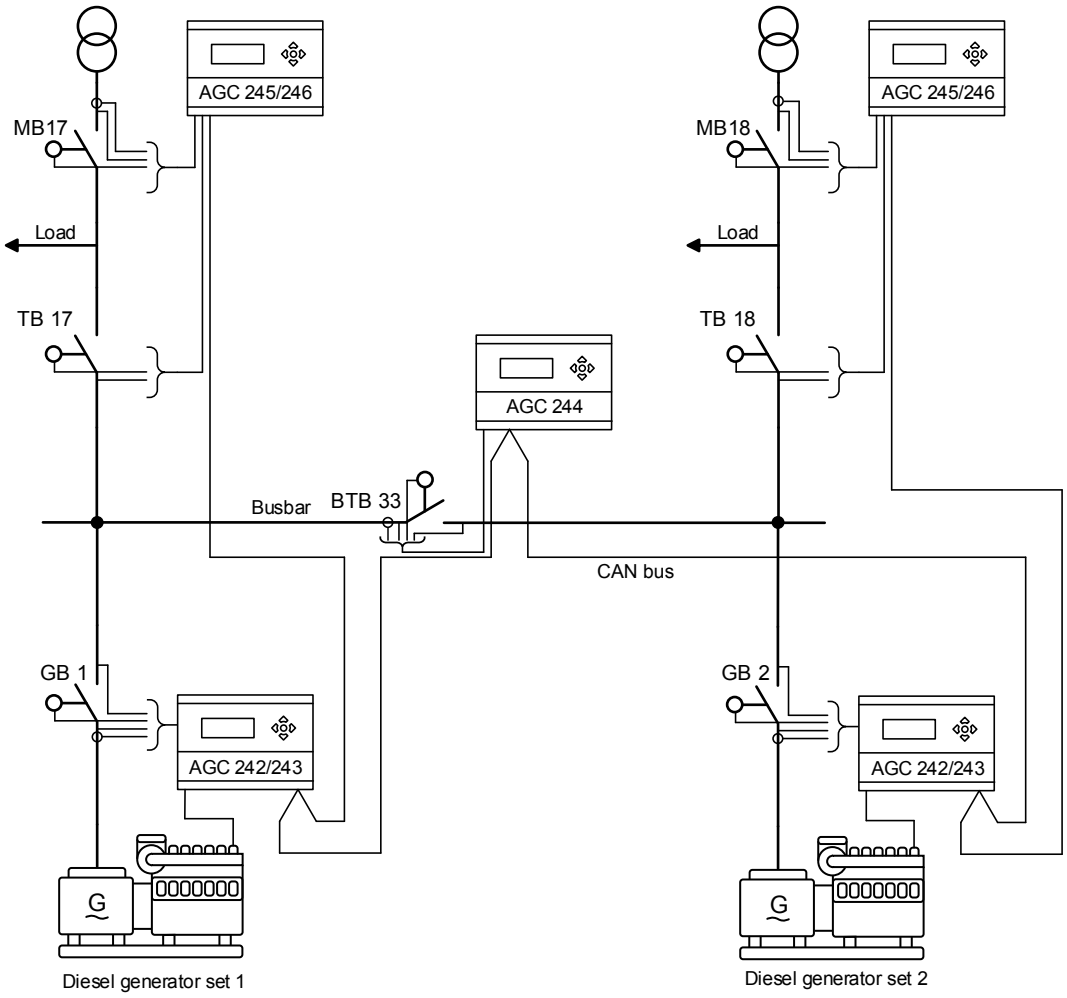
AGC-4 controllers example



In this example, the application consists of only AGC-4 controllers. The application is an H-coupling with two mains, two gensets and one BTB. The application only has one CAN bus line between the controllers. The CAN bus line is connected to the terminal numbers shown in the table below. In this example, *PMS Secondary* is selected. In all controllers, in menu 7840, set the CAN port to *PMS Secondary*.

Controller	Terminal no.	CAN port	CAN protocol
Genset 1 - AGC-4	A1 and A3	A	PMS Secondary
Genset 2 - AGC-4	B1 and B3	B	PMS Secondary
Mains 17 - AGC-4	A1 and A3	A	PMS Secondary
Mains 18 - AGC-4	B1 and B3	B	PMS Secondary
BTB 33 - AGC-4	A1 and A3	A	PMS Secondary

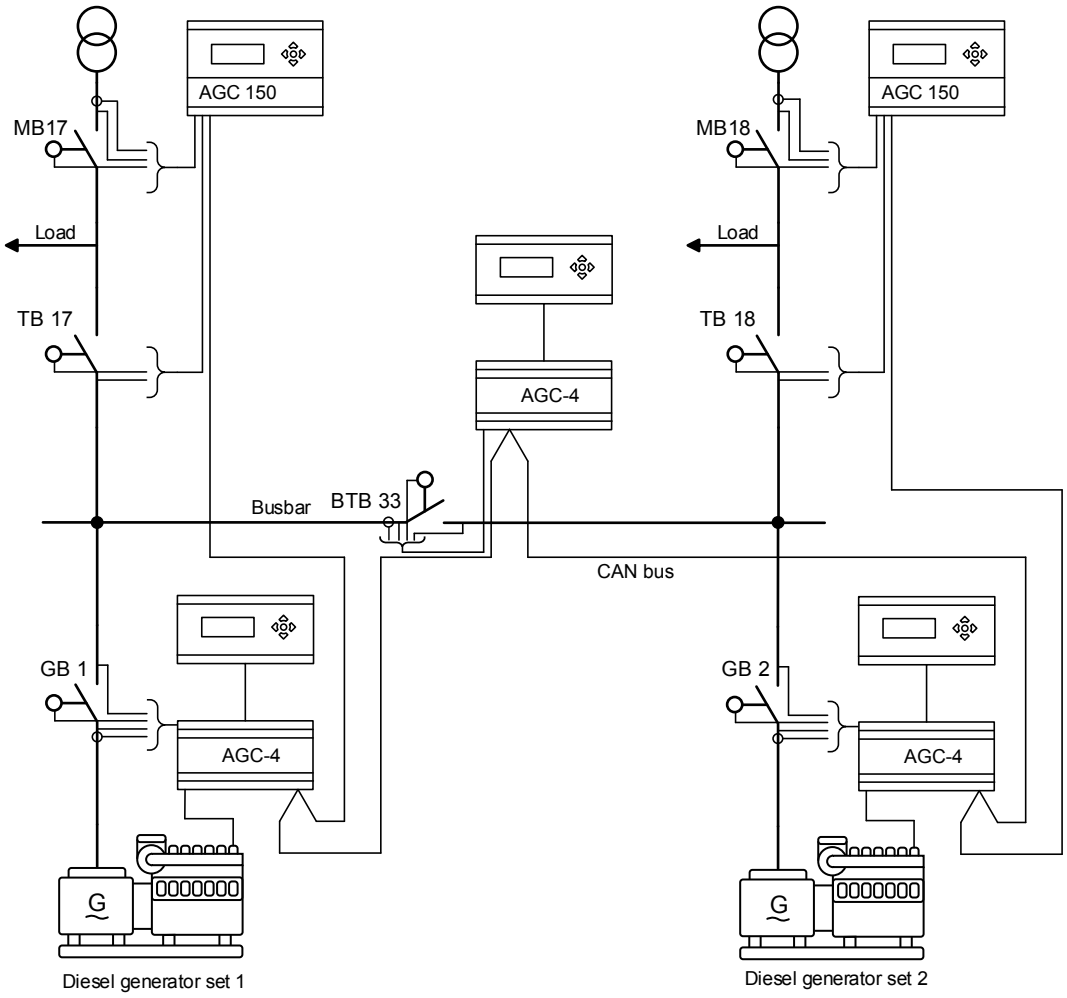
AGC 200 controllers example



In this example, the application consists of only AGC 200 controllers. The application is an H-coupling with two mains, two gensets and one BTB. The application has one CAN bus line between the controllers. The CAN bus line is connected to the terminal numbers shown in the table below. In this example, *PMS Primary* is selected. In all controllers, in menu 7840, set the CAN port to *PMS Primary*.

Controller	Terminal no.	CAN port	CAN protocol
Genset 1 - AGC 242/243	10 and 12	B	PMS Primary
Genset 2 - AGC 242/243	10 and 12	B	PMS Primary
Mains 17 - AGC 245/246	10 and 12	B	PMS Primary
Mains 18 - AGC 245/246	7 and 9	A	PMS Primary
BTB 33 - AGC 244	7 and 9	A	PMS Primary

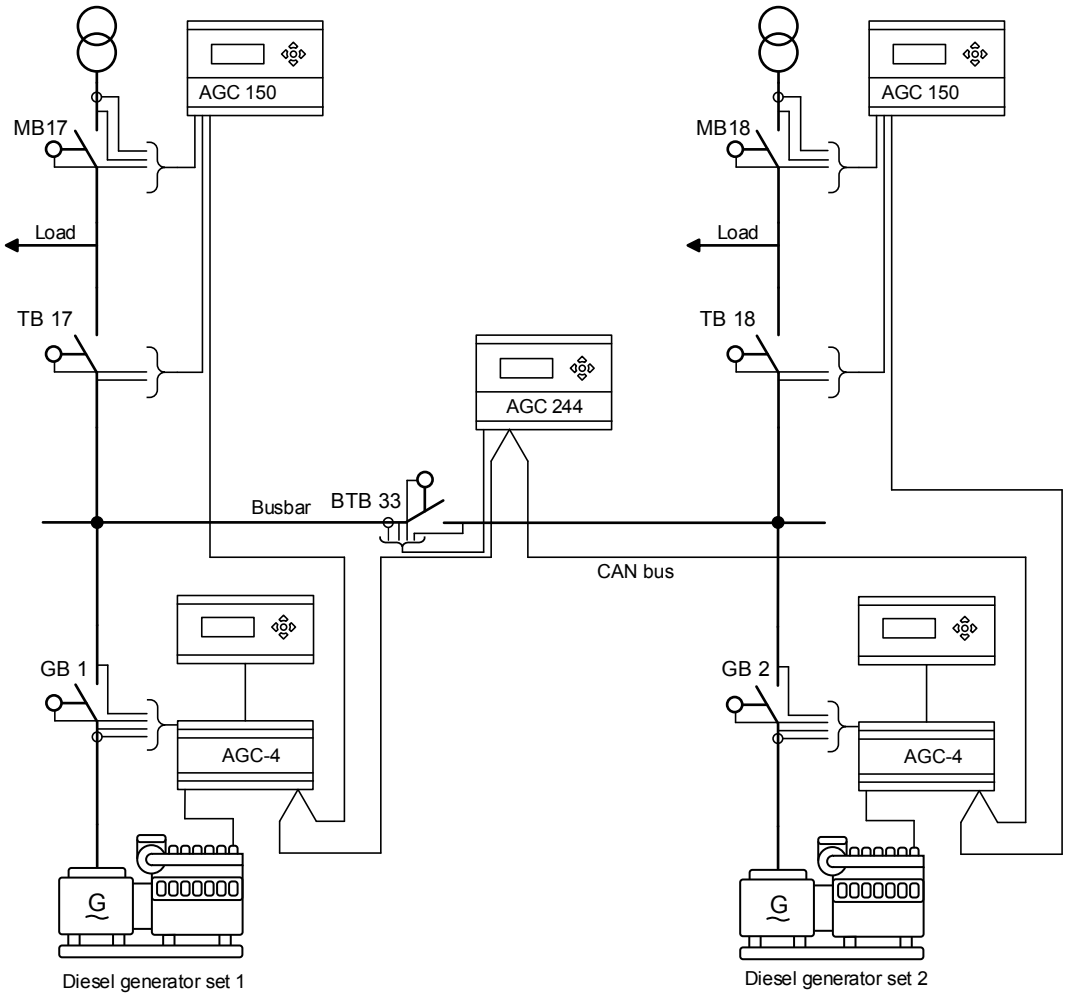
AGC-4 and AGC 150 controllers example



In this example, the application consists of a mix of AGC 150 controllers and AGC-4 controllers. The application is an H-coupling with two mains, two gensets and one BTB. The application only has one CAN bus line between the controllers. The CAN bus line is connected to the terminal numbers shown in the table below. In this example, *PMS Secondary* is selected. In all controllers, in menu 7840, set the CAN port to *PMS Secondary*.

Controller	Terminal no.	CAN port	CAN protocol
Genset 1 - AGC-4	B1 and B3	B	PMS Secondary
Genset 2 - AGC-4	B1 and B3	B	PMS Secondary
Mains 17 - AGC 150	30 and 32	B	PMS Secondary
Mains 18 - AGC 150	30 and 32	B	PMS Secondary
BTB 33 - AGC-4	A1 and A3	A	PMS Secondary

AGC-4, AGC 150 and AGC 200 controllers example

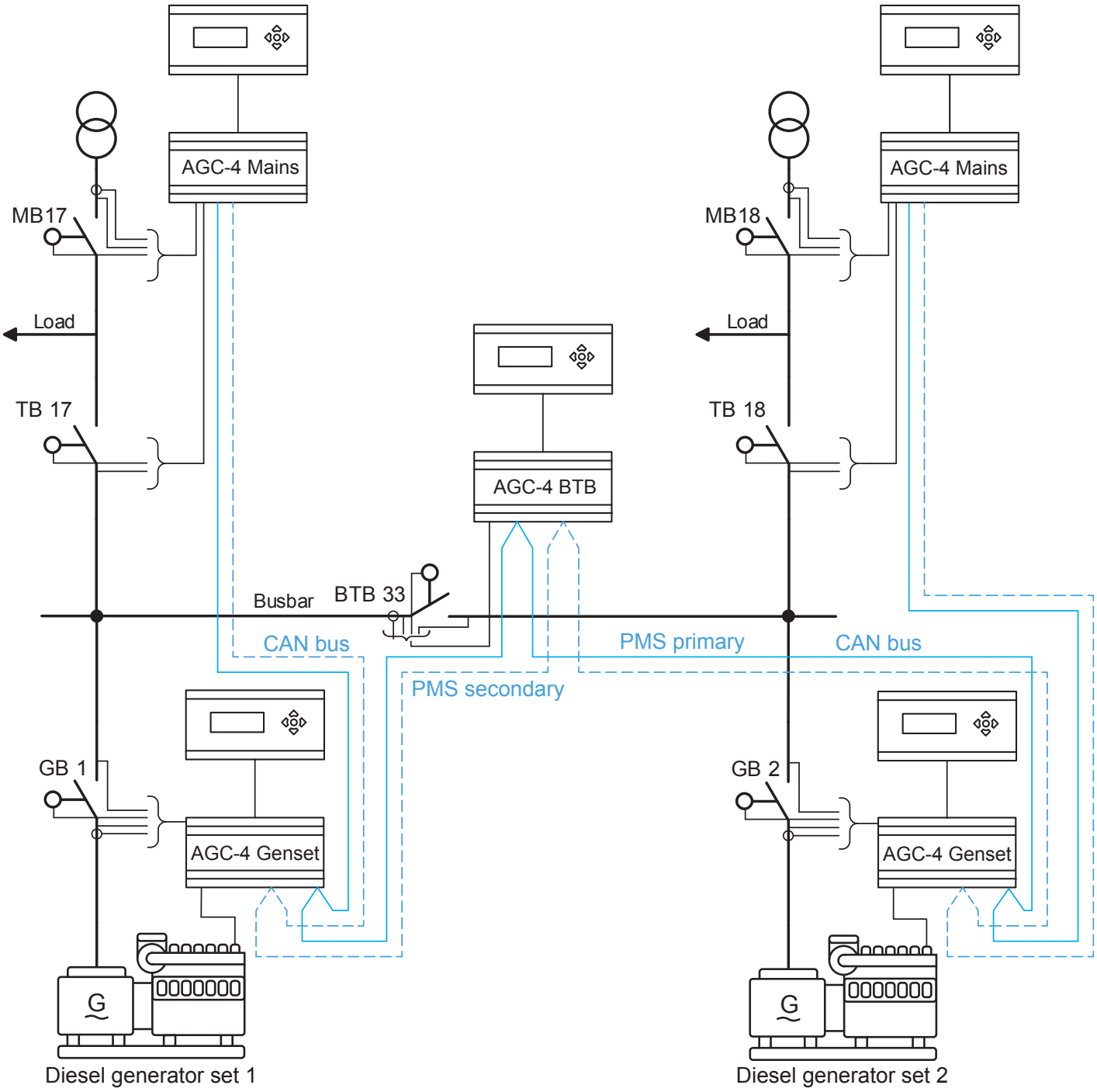


In this example, the application consists of different AGC controllers. The application is an H-coupling with two AGC 150 mains, two AGC-4 gensets and one AGC 200 BTB. The application only has one CAN bus line between the controllers. The CAN bus line is connected to the terminal numbers shown in the table below. In this example, *PMS Primary* is selected. In all controllers, in menu 7840, set the CAN port to *PMS Primary*.

Controller	Terminal no.	CAN port	CAN protocol
Genset 1 - AGC-4	A1 and A3	A	PMS Primary
Genset 2 - AGC-4	A1 and A3	A	PMS Primary
Mains 17 - AGC 150	30 and 32	B	PMS Primary
Mains 18 - AGC 150	30 and 32	B	PMS Primary
BTB 33 - AGC 244	7 and 9	A	PMS Primary

2.3.5 Redundant CAN bus

The AGC-4 can use redundant power management CAN lines. These could be used in an application like this, where there are only AGC-4 controllers with redundant CAN lines for power management:



If all controllers have software version 4.5x or later

In each controller, in menu 7840, assign one set of CAN bus lines to *PMS Primary*, and the other set to *PMS Secondary*.

If some controllers have software version before 4.5x

CAUTION

Mixing newer and older software is generally not recommended, since this creates a complex system, with an increased risk of errors. If possible, update all controllers to the latest software.

The controllers are a mix of newer and older software. For the example, the CAN lines go to these terminal numbers:

Controller	Terminal no. (1)	CAN port (1)	Terminal no. (2)	CAN port (2)
Genset 1 - AGC-4 (older software)	A1 and A3	A	B1 and B3	B
Genset 2 - AGC-4 (newer software)	B1 and B3	B	A1 and B3	A

Controller	Terminal no. (1)	CAN port (1)	Terminal no. (2)	CAN port (2)
Mains 17 - AGC-4 (newer software)	57 and 59	B	A1 and A3	A
Mains 18 - AGC-4 (older software)	A1 and A3	A	B1 and B3	B
BTB 33 - AGC-4 (newer software)	7 and 9	A	A1 and A3	A

INFO
Controllers with older software use the same CAN port for each CAN line.

When the controllers are mixed with software and CAN ports, the controllers with the older software determine the settings in parameter 7840 for the controllers with newer software. If the CAN line on the controller with older software goes to CAN port A, the setting for the controllers with newer software should be *PMS Primary*. The settings from the example are shown below.

The table shows which CAN ports should be set to *PMS Primary* in the controllers with newer software:

Table 2.1 CAN line A (PMS Primary)

Controller	CAN line A/PMS Primary setting (7840)
Genset 1 - AGC-4 (older software)	Not adjustable
Genset 2 - AGC-4 (newer software)	B
Mains 17 - AGC-4 (newer software)	B
Mains 18 - AGC-4 (older software)	Not adjustable
BTB 33 - AGC-4 (newer software)	A

The table shows which CAN ports should be set to *PMS Secondary* on the controllers with newer software:

Table 2.2 CAN line B (PMS Secondary)

Controller	CAN line B/PM CAN secondary setting (7840)
Genset 1 - AGC-4 (older software)	Not adjustable
Genset 2 - AGC-4 (newer software)	A
Mains 17 - AGC-4 (newer software)	A
Mains 18 - AGC-4 (older software)	Not adjustable
BTB 33 - AGC-4 (newer software)	B

If one of the CAN lines break, there are alarms which can be helpful when troubleshooting. This is described in the section CAN bus failure handling.

2.3.6 CAN failure mode

If there is a CAN failure on the CAN controlling the power management, the system can be set up to respond in a variety of ways.

For parameters 7533 to 7536, you can chose a fail class, for example, shutdown or trip MB. These parameters are for *Missing all units* (7533), *Any DG missing* (7535), *Any mains missing* (7536) and *Fatal CAN error* (7534).

Fatal CAN error

By default, when a controller has lost communication to two (or more) controllers in the power management system, it activates the *Fatal CAN error alarm* (which activates the fail class in parameter 7534). The number of controllers can be configured (from 2 to 32) using *CAN miss amount* (parameter 8800).

In *CAN fail mode* (parameter 7532) you can select which of three modes to go to.

Manual

If *Manual* is selected, all the AGC controllers change to manual mode. The regulators are frozen, and it is not possible to close any breakers (unless the breakers are already within the limits for the sync. window or black busbar). Note that manual mode is not selectable in BTB or mains controllers.

When the wire break on the CAN lines occurs, the regulators stop immediately, and no further action takes place. Protections are still active, so if, for example, a short circuit or an overload occurs, the AGC is still able to trip a breaker or shutdown an engine.

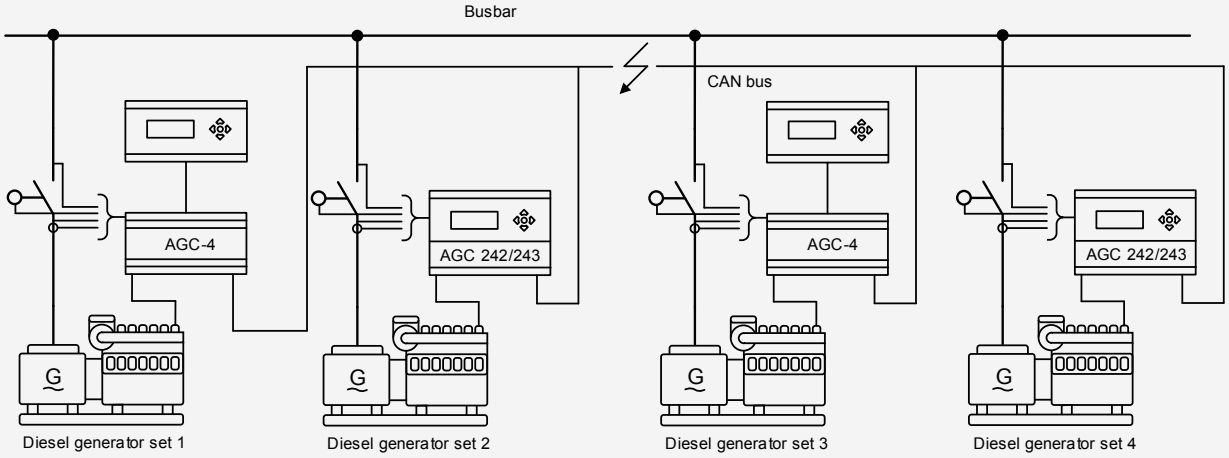
When a fatal CAN error is occurs, there is a risk of blackout, since there is no load sharing in manual mode.

Semi-auto

If *Semi-auto* is selected, the AGC controllers change to semi-auto mode when a fatal CAN error occurs.

In semi-auto mode, the regulators in the AGC controllers are still active. This means that the gensets that are visible to each other are able to share load. This is explained by an example:

Semi-auto example



In the diagram above, the CAN bus failure is between genset 2 and genset 3. This means that gensets 1 and 2 are visible to each other. Gensets 3 and 4 are also visible to each other. Gensets 1 and 2 are able to share load. Gensets 3 and 4 are able to share load. However, there is still a risk of blackout, since it is still possible to overload two of the gensets, while the other two are not very loaded.

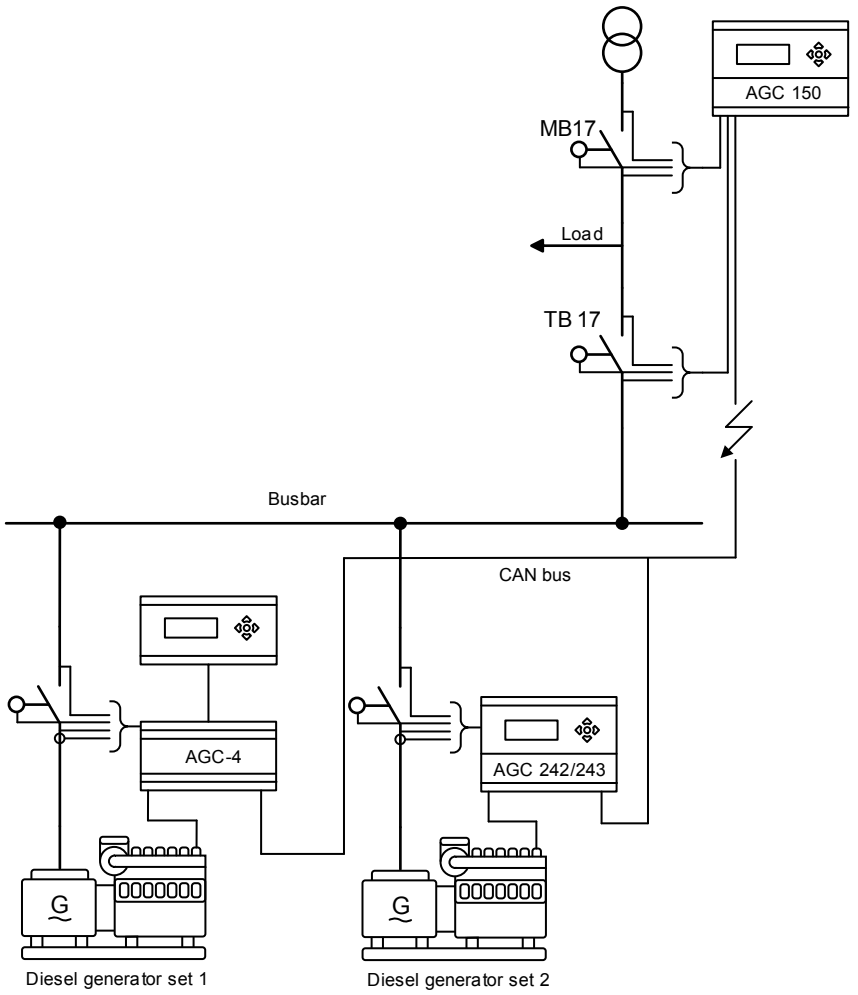
If a fatal CAN error occurs when the gensets are stopped, they are not blocked, and so it is possible to start them.

WARNING
If a fatal CAN error is present, it is possible to start two gensets and close the breakers onto the busbar at the same time (even though they are not synchronised).

No mode change

If *No mode change* is selected, all the AGC controllers are kept in the mode they were in before the fatal CAN error occurred. In an application with several mains, BTBs and gensets, if one genset is not visible anymore, the rest of the system can still behave almost like normal and continue in auto mode.

However, if the CAN bus failure occurs in a system like the one shown below, it might be a problem:



This application is for automatic mains failure. In this application, the CAN bus failure shown is a problem, since the mains controller sends the gensets a start signal when the mains fails. Since the CAN bus has a failure between the mains controller and the gensets, the gensets will not know when the mains fails and will therefore never start. If this setting is used, use the CAN bus fail class settings (menu 7530) to ensure that the system handles the situation correctly.

In the example above, only the mains controller gets a fatal CAN error. The genset controllers only have one controller missing, which is not enough to activate a fatal CAN error. You can use M-Logic to change the mode or take other actions in such a situation.

2.3.7 CAN bus alarms

Any DG missing

Activated when one (or more) genset controller is missing (activates the fail class in parameter 7535).

Any mains missing

Activated when one (or more) mains controller is missing (activates the fail class in parameter 7536). The fail class selected here is also used when a BTB controller is missing.

Appl. Hazard

The application configuration is not the same in all the controllers in the system. The power management system cannot operate correctly.

Duplicate CAN ID

Activated when two (or more) controllers with have same internal communication ID (7530). The power management system cannot operate.

Missing all units

Activated only when a controller cannot "see" any other controllers on the CAN bus line (activates the fail class in parameter 7533).

CAN bus communication failures

The following alarms can be displayed on an AGC controller. For all the *XXX missing* alarms, the alarm is activated on all the other controllers in the application.

CAN ID X P missing

The AGC controller has lost CAN bus communication to CAN ID on PMS Primary.

CAN MAINS X P missing

The AGC controller has lost CAN bus communication to a mains controller with ID X on PMS Primary.

CAN BTB X P missing

The AGC controller has lost CAN bus communication to a BTB controller with ID X on PMS Primary.

CAN ID X S missing

The AGC controller has lost CAN bus communication to CAN ID on PMS Secondary.

CAN MAINS X S missing

The AGC controller has lost CAN bus communication to a mains controller with ID X on PMS Secondary.

CAN BTB X S missing

The AGC controller has lost CAN bus communication to a BTB controller with ID X on PMS Secondary.

CAN setup CH: 784x

The controller can detect power management communication on a CAN port, but the correct protocol is not set. This alarm also monitors the CAN setup between the engine communication protocol (H5, H7, H13) and CAN port.

INFO
For a general description of fail classes, see the **Designer's Reference Handbook**.

2.4 Easy connect

If the application consists of only genset controllers, Easy connect is a fast and easy way to use the display or TDU 107 to add more genset controllers to a new or an existing application. Easy connect commands can also be sent from M-Logic and Modbus. You can also use Easy connect to remove gensets.

Once the Easy connect sequence starts, the operator cannot use the display unit to change parameters. Configure the parameters as required before the sequence starts, or use the PC utility software.

CAUTION
When a controller is added or removed, the controllers needs time to apply the change (around one minute). When *Receiving application* is shown, do not add or remove more controllers. Making multiple simultaneous changes can reset the application.

NOTE If a controller must be removed and another controller must be added to the plant, always first remove the controller then add the new controller.

Preconditions

- Controller software version 4.74.1 or higher.
- M4 Engine interface card, with software version 2.03.3 or higher.
- All controllers in the application have the same software version.
  - You can use Easy connect for an application with both AGC-4 and AGC 150. Both sets of controllers must support the same Easy connect functions.
- Easy connect is enabled in all controllers in parameter 8023, or M-Logic *Output, Easy connect, Enable Easy connect*.
- Quick setup is *Standard* in parameter 9126.
- The genset to be added or removed is not running.

NOTE Check the software version:

- On the controller display: **Menu > Jump > 9070**
- On the TDU 107: **Menu > Setup > About**

Activating Easy connect

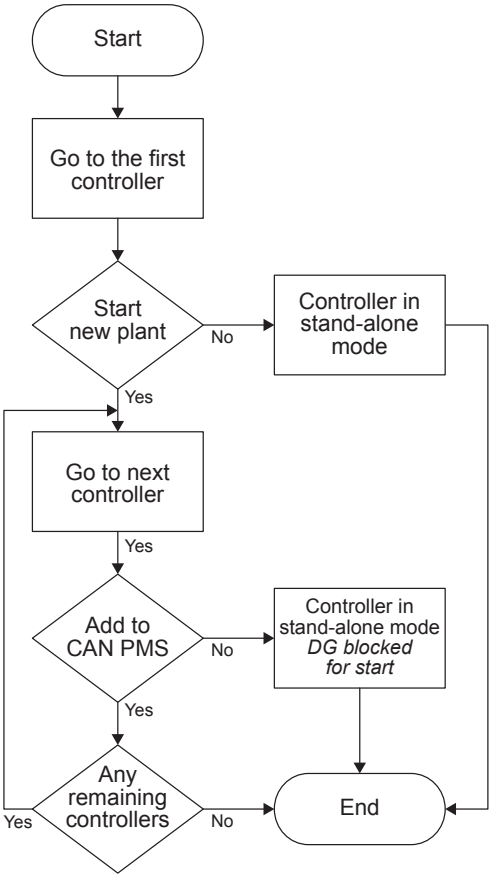
If the preconditions are met, the Easy connect sequence is activated whenever:

- Easy connect is enabled in parameter 8023.
- A controller powers up.
- The CAN conditions change (that is, if a controller is added or removed).

Parameters

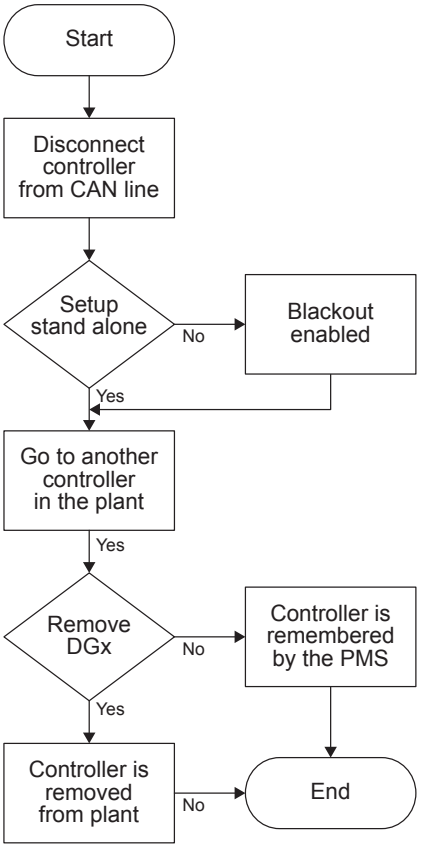
Parameter	Item	Range	Default	Note
8023	Easy connect: Enable	ON OFF	OFF	Only available in genset controllers. **ON**: The operator can use the function. **OFF**: The Easy connect sequence is not started.
9070	Jump menu	-	-	Check software versions • Controller: 4.74.1 or higher. • M4 Engine interface: 2.03.3 or higher.
9184	Quick setup	Pulse Continuous Compact	Pulse	Configure the genset breaker type.
9186	Quick setup	Standard Single DG	Standard	For Easy connect, this must be *Standard*.

Configuring a new application or adding new controllers



1. The preconditions are met, and the Easy connect sequence is activated.
2. **Go to the first controller:** The first controller keeps its CAN ID and is *DG1*.
3. **Start new plant:** The display unit for the first controller prompts *START NEW PLANT?*:
   - Select *Yes*: The first controller starts a new application configuration.
   - Select *No*: The first controller goes into stand-alone mode with *DG blocked for start*.
4. **Go to next controller:** The operator can connect the CAN line and power up the next controller.
5. **Add to CAN PMS:** The new controller checks the PMS CAN line for another controller. The new controller gets the lowest available CAN ID. The new controller prompts *ADD DG TO CAN PMS?*.
   - Select *Yes*: The controller is added to the application.
   - Select *No*: The controller goes into stand-alone mode with *DG blocked for start*.
6. If additional controllers are detected, steps 4 and 5 repeat. Otherwise, the sequence ends.

Removing controllers



1. **Disconnect controller from CAN line:** The controller to be removed from the plant is disconnected from the CAN bus, or the controller is powered down.
2. **Setup stand-alone:** If still powered, the disconnected controller prompts *SETUP STAND-ALONE?*:
   - Select *Yes*: The controller is disconnected from the plant.
   - Select *No*: The controller waits to be reconnected to the CAN line. When this happens, the controller automatically reestablishes the CAN PMS connection.
3. **Go to another controller in the plant:** The displays of all the remaining controllers in the plant prompt *REM. DG ## CAN PMS?*.
4. **Remove DG ##:** From the display of any remaining controller:
   - Select *Yes*: The disconnected controller is removed from the plant. The related alarms are cleared from all the remaining controllers.
   - Select *No*: The other controllers wait for the disconnected controller to be reconnected to the CAN line. When this happens, the controllers automatically reestablish the CAN PMS connection.

M-Logic commands and events

The following commands are available under *M-Logic, Output, Easy connect*:

Command	Description
Add DG	The user can connect multiple genset controllers to the CAN bus, then use this command to add the genset controller to the application.
Remove DG	The user can use this command to remove a genset controller from the application, without the need to disconnect the CAN bus.
Select yes on display	This command selects YES if there is a "YES/NO" prompt on the display.
Select no on display	This command selects NO if there is a "YES/NO" prompt on the display.
Enable Easy connect	This command selects *Enable ON* in parameter 8023.
Disable Easy connect	This command selects *Enable OFF* in parameter 8023.

The following events are available under *M-Logic, Events, Easy connect*:

Event	Description
Plant active	Activated for an Easy connect plant.
Stand alone	Activated for a stand-alone application.

2.5 Controller IDs

After connecting the CAN bus communication, each controller must have an internal communication ID. For Easy connect the ID is set automatically. Otherwise, the user must set the controller ID (*Int. comm. ID*) in parameter 7531 in all controllers. The different controller types have different ID ranges.

Controller ID ranges

Controller type	Controller	ID range (parameter 7530)
Genset	AGC-4 with option G5, G4 or G8 AGC 22x, AGC 242 or AGC 243 AGC 150*	1 to 32
Mains	AGC-4 with option G5 AGC 245 or AGC 246 AGC 150*	1 to 32
BTB	AGC-4 with option G5 or G4 AGC 244 AGC 150	33 to 40
Automatic Sustainable Controller	ASC-4 Solar or ASC-4 Battery	25 to 40
Automatic Load Controller	ALC-4	25 to 40

*Note: The maximum number of controllers is restricted for some software packages. See the **AGC 150 Data sheet** for more information.

INFO
Multiple controllers cannot have the same ID.

2.5.1 Software compatibility (flexible ID system)

Application software version 4.65.0 and newer includes a flexible ID system. In both the flexible ID system and the previous ID system, the maximum number of controllers in an application is 40.

Flexible ID system - application software 4.65.0 and newer

Explanation	ID range	Number of controllers
Genset (DG)	1-32	32 DG
Mains	1-32	32 mains
Bus Tie Breaker (BTB)	33-40	8 BTB
Automatic Sustainable Controller (ASC)	25-40	16 ASC
Automatic Load Controller (ALC)	25-40	8 ALC

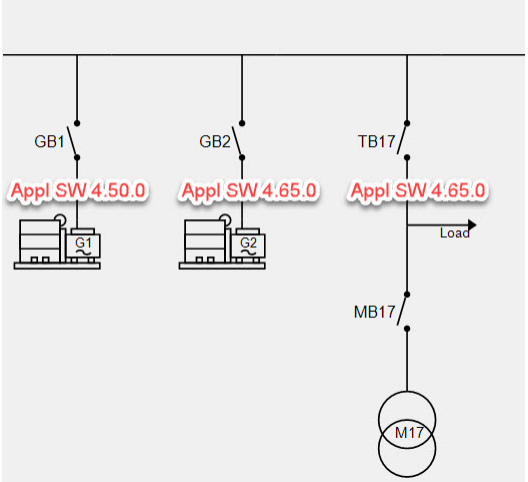
ID system before application software 4.65.0

Explanation	ID range	Number of controllers
Genset (DG)	1-16	16 DG
Mains	17-32	16 mains
Bus Tie Breaker (BTB)	33-40	8 BTB
Automatic Sustainable Controller (ASC)	33-40	8 ASC

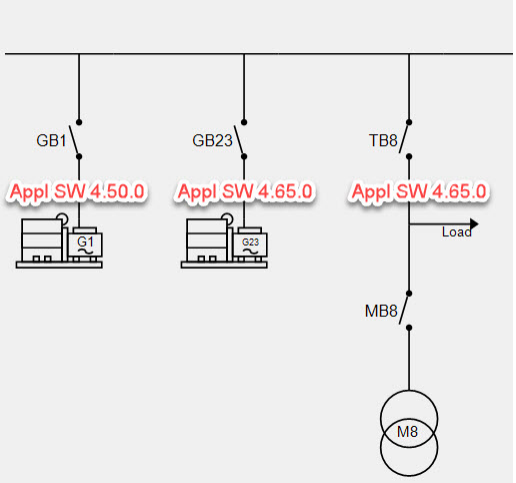
Combining software versions

If possible, use the same software in all controllers in the application. The examples below show the results of using different software versions in the same application.

Example 1: DG 1 only supports the previous ID system because the application software is older than 4.65.0. The IDs allocated to the AGCs match the previous ID system area, and therefore the power management runs as intended.



Example 2: DG 1 does not support the ID area that the other two AGCs are in. The two AGCs with application software 4.65.0 detect the ID compatibility problem, and a *PMS Protocol error*" occurs, informing the user that the power management is not working as intended.



CAUTION
Do not use the flexible ID system in an AGC-4 with an M4 version lower than 2.03.3. If you do this, the alarm *M4 version too low* appears, and the power management is not reliable.

INFO
In the AGC-4, it is possible to see the M4 SW version from the display using jump menu 9070. Alternatively, use the *Identifiers* button in the USW under the *SW versions* tab.

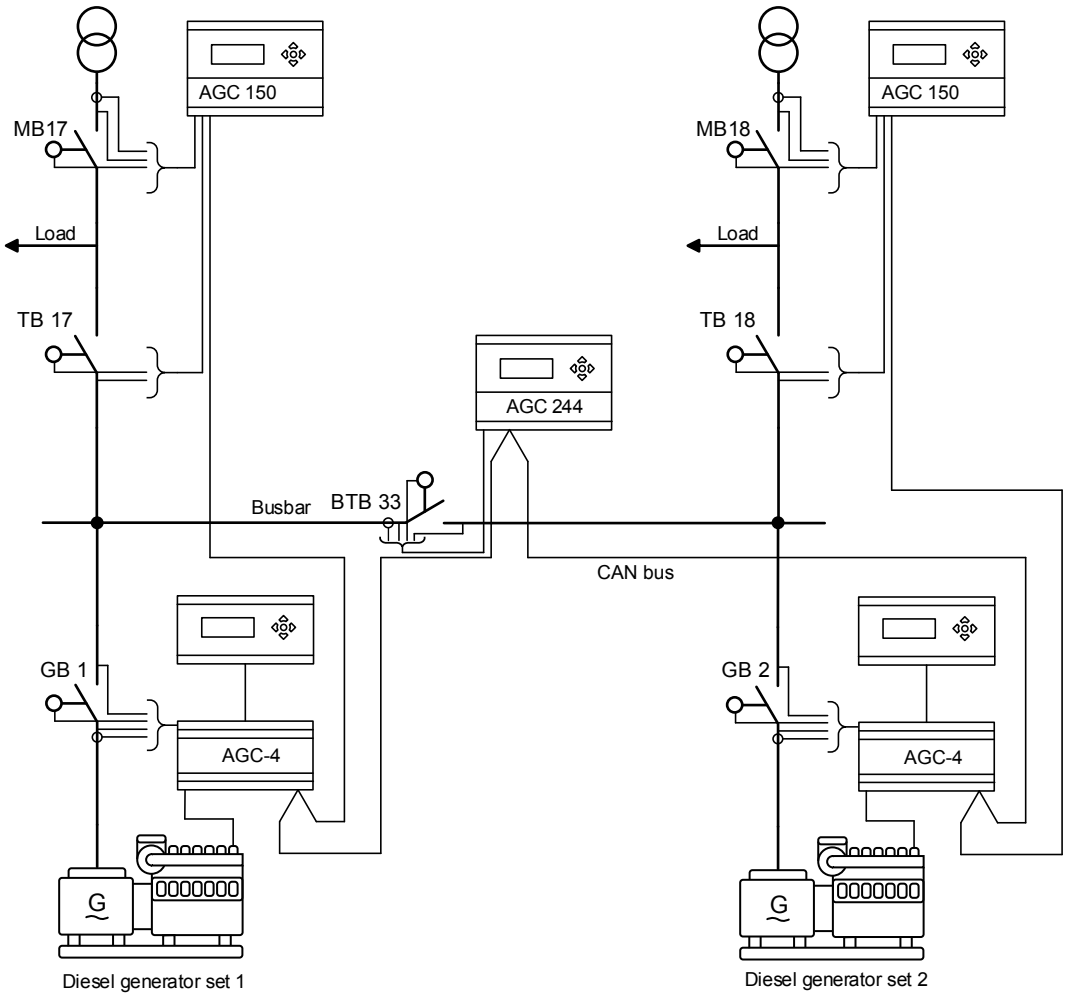
2.5.2 Older software and CAN ports

The AGC can be used in an application with AGC controllers with older software. However, there are some restrictions for the system to work correctly. In older software, the communication lines (CAN protocols) are called CAN A and CAN B. By default, these are set to a CAN port and cannot be switched.

CAN ports for different controllers

Controller	CAN port	Note
AGC-4, ASC-4 and ALC-4	A and B	CAN port A is CAN A. CAN port B is CAN B. If option H7 is used, only CAN B can be used for power management. If two CAN ports are required for power management communication, and the governor and AVR interfacing is to be done by EIC, then option H5.8 is required.
AGC 150	B	Only CAN B is available for power management.
AGC 200	A and B	CAN port A is CAN A. CAN port B is CAN B. The AGC 200 can only use one port at a time for power management communication. That is, redundant CAN is not possible.

For controllers with older software, you can only use the default ports for power management. For older software, you cannot mix the CAN ports. If CAN port A is used, this must be used on all older controllers. The same goes for the CAN port B on older controllers. It is possible to mix newer controllers' and older controllers' power management communication. The easiest way to explain this is with an example:



The setup shown above is the same as used in the example earlier. But the controllers now have different software versions. The CAN ports used are shown in the table below:

Controller	SW version*	Terminal no.	CAN port	CAN protocol
Genset 1 - AGC-4	4.4x or older	A1 and A3	A	CAN A
Genset 2 - AGC-4	4.5x or newer	B1 and B3	B	PMS Primary
Mains 17 - AGC 150	-	30 and 32	B	PMS Primary
Mains 18 - AGC 150	-	30 and 32	B	PMS Primary
BTB 33 - AGC 244	4.4x or older	7 and 9	A	CAN A

*Note: The controllers with older software (version 4.4x or older) use the same CAN port. When the controller with older software uses CAN port A for power management communication, the setting in the controller with newer software must be *PMS Primary*. If the controllers with older software had used CAN port B instead, the setting in the controller with newer software must be *PMS Secondary*.

An overview is shown in the table below:

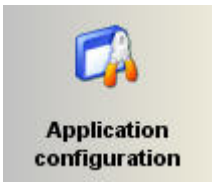
CAN port on controller with older software	CAN port on controller with newer software	Setting in controller with newer software
A	Does not matter	PMS Primary
B	Does not matter	PMS Secondary

2.6 Application configuration with PC utility software

2.6.1 Application configuration

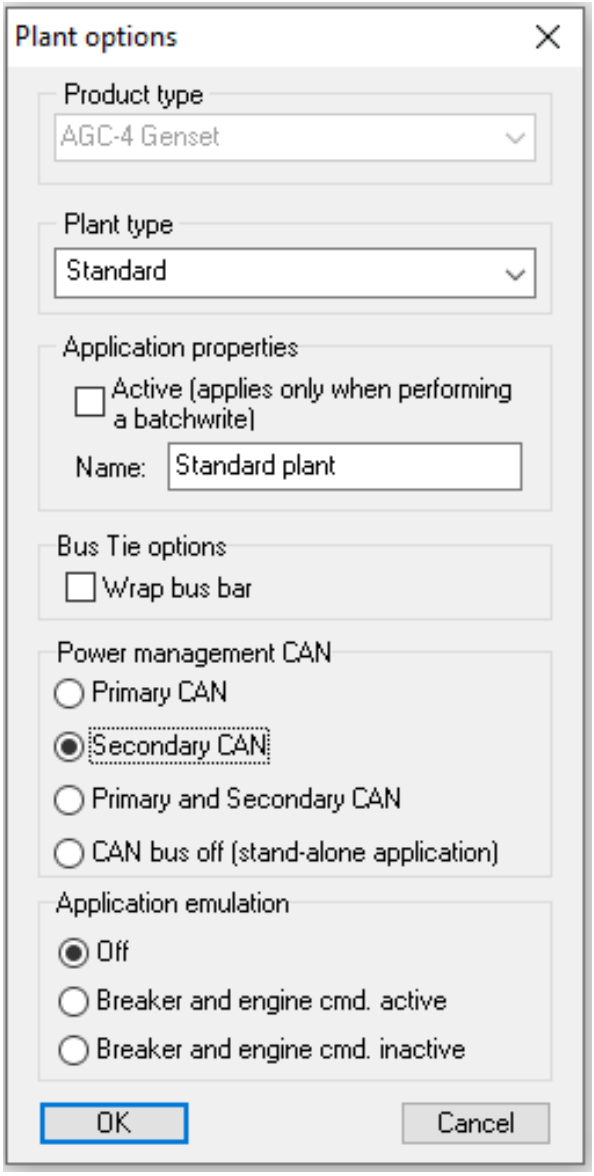
Once the IDs are configured, you can use the utility software and configure the application. To operate correctly, the controllers must know the application configuration.

Connect to a controller with the PC utility software, then select the *Application configuration* tab in the lower left corner.



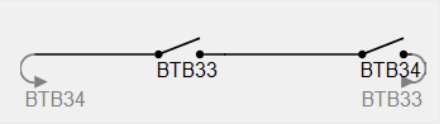
Select the *New plant configuration* icon. 

The *Plant options* window appears.

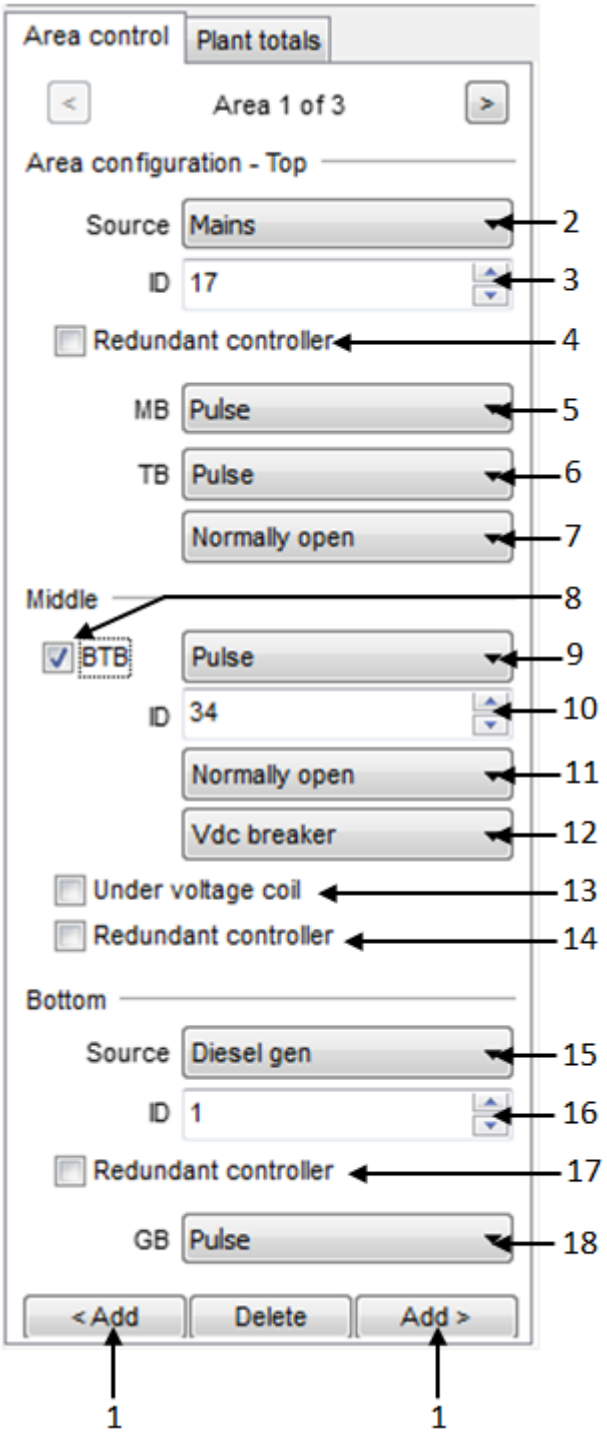


Plant options

	Description	Comments
Product type	The controller type is selected here.	This function is greyed out if a controller is already connected.
Plant type	• Single DG • Standard • Genset group plant • Genset group	Select *Standard* for power management systems. If *Single DG* is selected, the CAN ports for power management communication are turned off. *Genset group plant* and *Genset Group* are only relevant for controllers with plant management. Plant management is for power plants consisting of 33 to 992 gensets in the same application. Contact support@deif.com for more information.
Application properties	The application is activated when it is written to the controller. The application can also be named here.	It can be helpful to give the application a name if the controller is in a plant which can change application configurations. The controllers can have four different application configurations. Controllers that are connected to each other using CAN bus communication cannot have different application configurations activated.
Bus tie options	The *Wrap bus bar* option can be selected here.	Activate this option if the busbar is connected like a ring connection in the application. When wrap busbar is selected, it is shown like this:

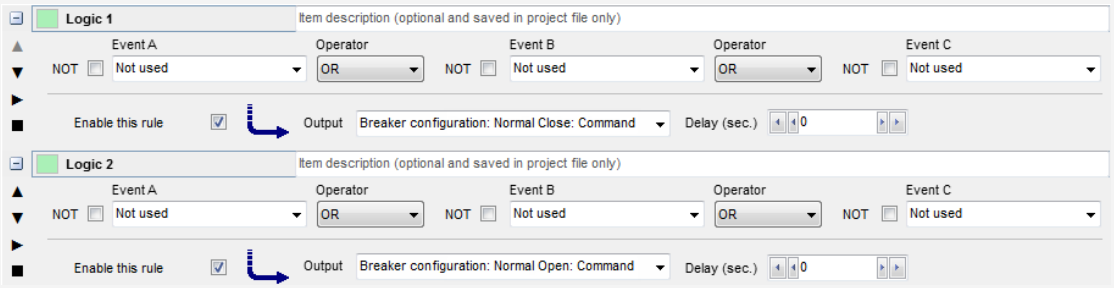
	Description	Comments
		
Power management CAN	Primary CAN Secondary CAN Primary and secondary CAN CAN bus off	The CAN protocol selected here should be identical to the settings in the controller. So if *PMS Primary* is selected in the controllers, *Primary CAN* must be selected in the plant settings as well. *Primary and secondary CAN* is only used for redundant CAN bus communication lines for power management. If this setting is selected and only one line is present, an alarm is activated. This alarm cannot be cleared. *CAN bus off* should only be used if the AGC is in a stand-alone application.
Application emulation	Off Breaker and engine cmd. active Breaker and engine cmd. inactive	The emulation is started here if the controllers have option I1. For *Breaker and engine cmd. active*, the controllers activate the relays and try to communicate with an ECU. If the controllers are mounted in a real installation, the breakers will open/close and the engine start/stop. This does not happen if *Breaker and engine cmd. inactive* is selected. In real installations, emulation can be used during the commissioning. When the commissioning is done, switch off emulation.

You can now create the application drawing in the controllers. From the left side of the page, you can add controllers to the configuration. You can also select the type of breakers in the application.



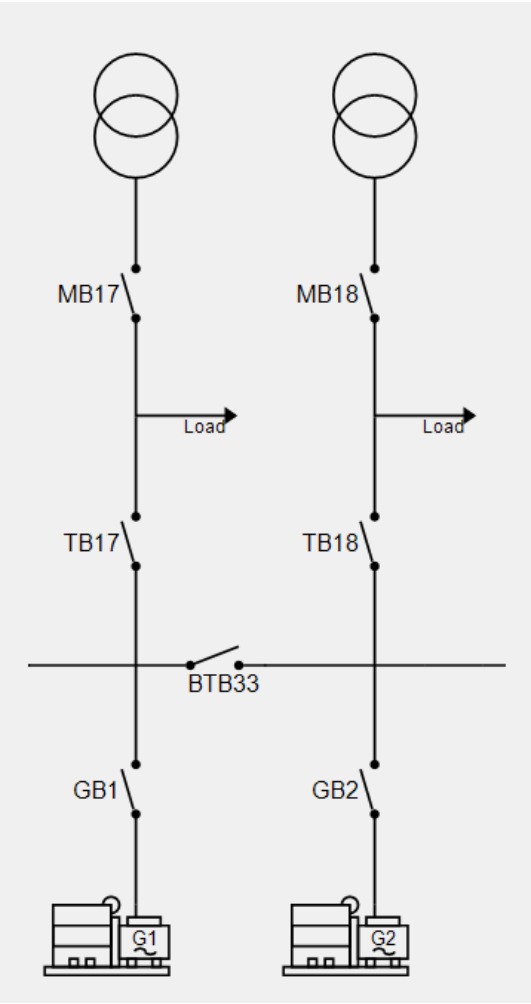
Plant configuration options

No.	Name	Description
1	Add/Delete	Add and delete areas. Adding areas makes the application configuration/plant bigger.
2	Source	Select the type of power source for the top area (None, Mains, Diesel gen, Photovoltaic, LG or Battery).
3	ID	Set the ID. This ID should correspond to the internal communication ID (parameter 7531) in the controller.
4	Redundant controller	Requires option T1 (Critical power). Select this to enable a redundant controller.
5	MB	Mains is selected as the source (no. 2), so it is possible to select the type of breaker* for the mains breaker (Pulse, Ext/ATS no control, Continuous NE, Compact, None, Continuous ND).

No.	Name	Description
6	TB	Mains is selected as the source (no. 2), so it is possible to select the type of breaker* for the tie breaker (Pulse, Continuous NE, Compact, None).
7	-	Select whether the tie breaker is *Normally open* or *Normally closed*.
8	BTB	Select to add a BTB controller.
9	-	The type of bus tie breaker* (Pulse, Ext, Continuous NE, Compact). Select *Ext* for an externally controlled BTB, that is, there is no AGC BTB controller. The bus tie breaker position feedbacks must be connected to any controller in the power management system.
10	ID	Set the ID. This ID should correspond to the internal communication ID (parameter 7531) in the controller.
11	-	Select whether the BTB is *Normally open* or *Normally closed*. If needed, this setting can be changed using M-Logic. The normal state of the breaker is selected in the application configuration, and the opposite is activated by M-Logic. 
12	-	If *Vdc breaker* is selected, the breaker can open and close when there is no voltage on the busbar. If *Vac breaker* is selected, voltage must be present on the busbar before the breaker can be handled.
13	Under voltage coil	Select this if the BTB has an under-voltage coil.
14	Redundant controller	Requires option T1 (Critical power). Select this to enable a redundant controller.
15	Source	Select the type of power source for the bottom area (None, Mains, Diesel gen, Photovoltaic, LG or Battery).
16	ID	Set the ID. This ID should correspond to the internal communication ID (parameter 7531) in the controller.
17	Redundant controller	Requires option T1 (Critical power). Select this to enable a redundant controller.
18	GB	Diesel genset is selected as the source (no. 15), so it is possible to select the type of breaker* for the genset breaker (Pulse, Continuous NE, Compact).

*Note: For more information about the breaker types, see the **Designer's reference handbook**.

Application configuration example



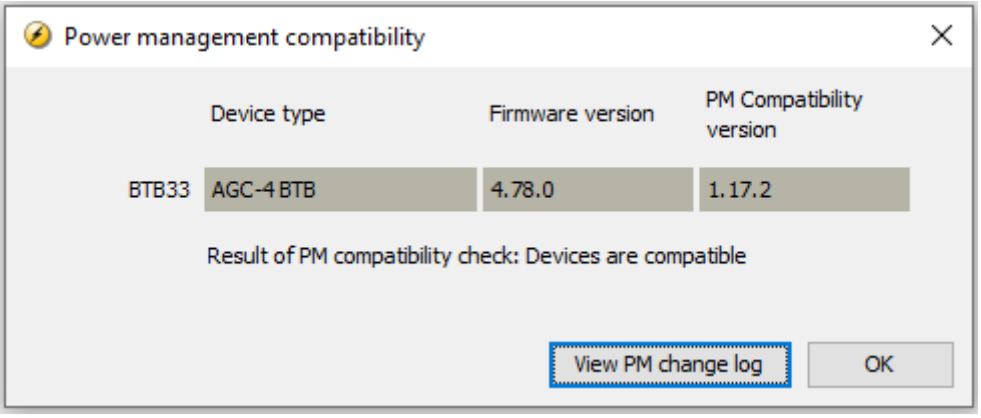
After you have created the application, send it to the controllers. Select *Write plant configuration to the device* . After this, only the controller connected to the PC utility software has the application configuration.

The application configuration can then be sent from this controller to all the other controllers. Select *Broadcast plant application* .

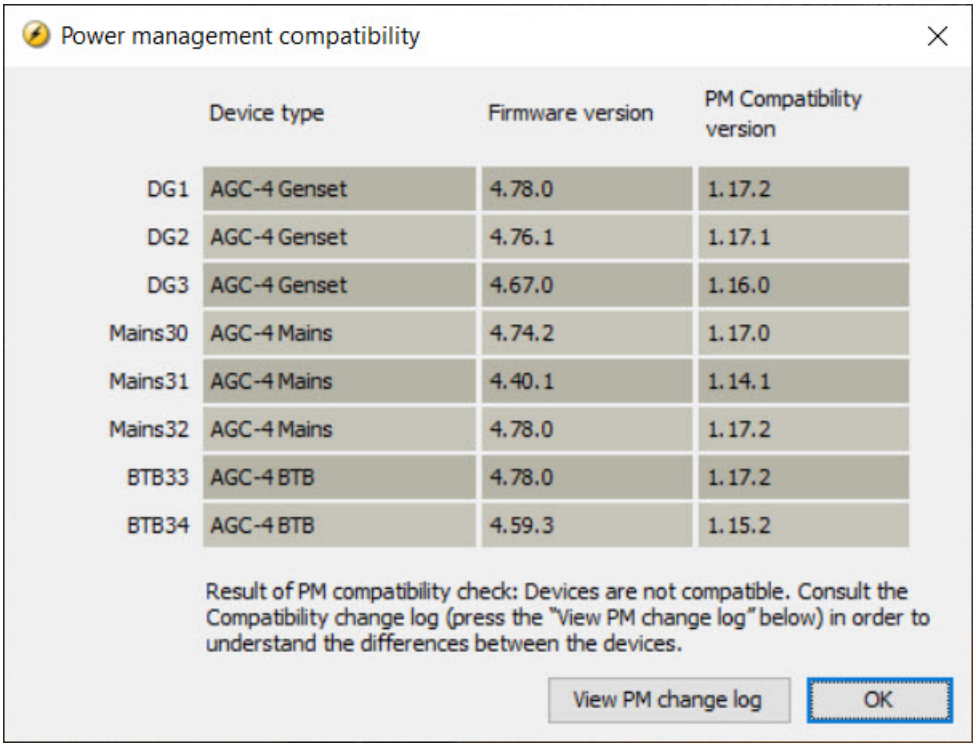
2.6.2 Power management compatibility

You can use the PC utility software to check the compatibility of the power management software for the controllers in the application. Under *Application supervision*, select *Compatibility check* . The *Power management compatibility* window opens.

Example of compatibility



Example of incompatibility



The software for each controller in the application is checked, and the result of the compatibility check is shown.

Select *View PM change log* to see an explanation of the 4-digit *PM Compatibility version*. This number has the format W.XY.Z. The change log includes details for all software changes since version 4.00.0.

M-Logic events

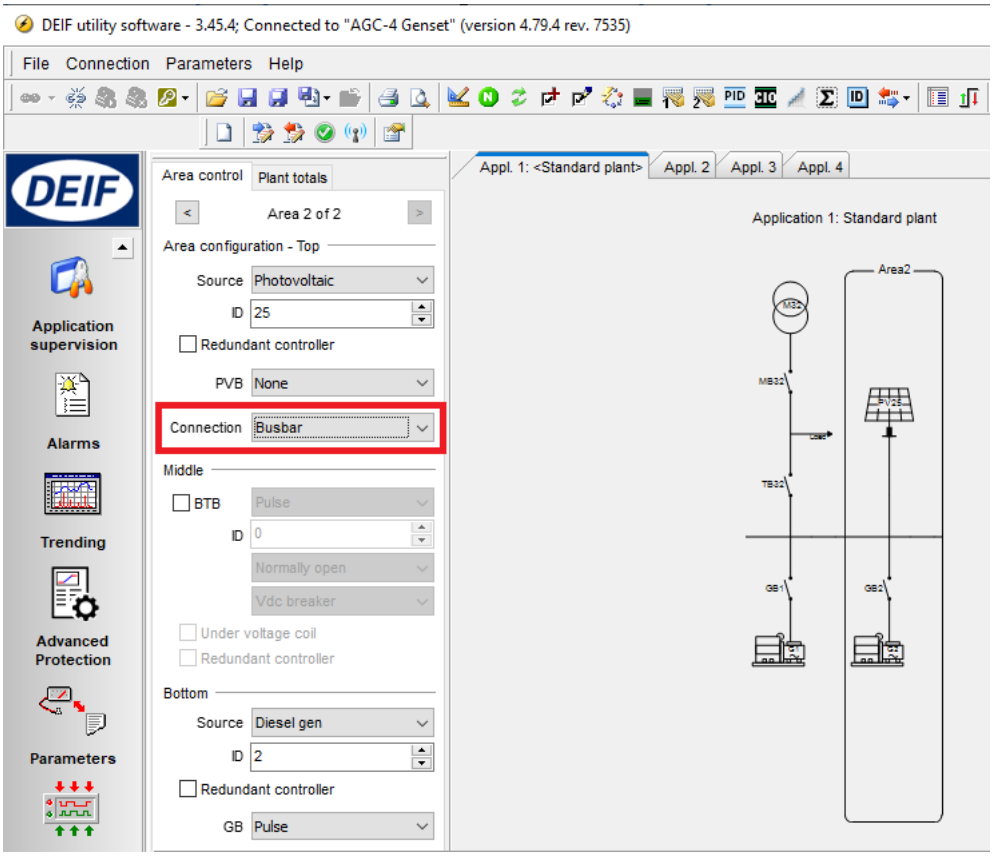
M-Logic events for power management compatibility are available under *Events* > *PM compatibility*.

Event	Activated when ...
Digit X compatible	The power management software is compatible.
Digit Y compatible	No controllers have newer power management features.
Digit Z compatible	No controllers have changes/modifications to power management features.
Digit W compatible	For rental applications, the power management software is compatible. Rental applications include: • Quick setup • 16 gensets in an island application • Load-dependent start and stop • Manual genset priority

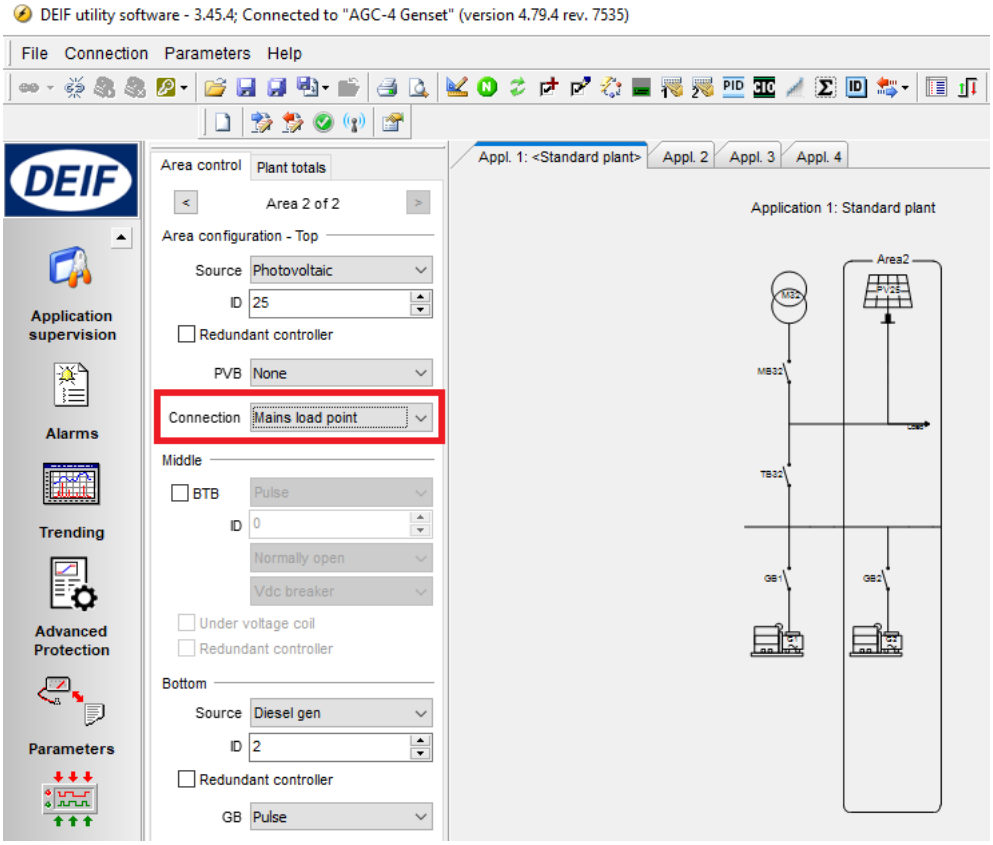
2.6.3 ASC Solar connection

The application drawing for the ASC Solar controller connection must match the single-line diagram. In the *Application configuration* in the utility software, select *Busbar* or *Mains load point*.

ASC Solar connection to the busbar



ASC Solar connection to the mains load point



More information
See the **ASC-4 Designer's Reference Handbook** for more information.

3. General functions

3.1 Command unit

The power management system is a multi-master system. In a multi-master system, the available generator controllers automatically perform the power management control. This means that the system never depends on only one master controller.

If for instance one controller ID is disabled, and this was the command unit, then the next available controller will take over the command functions.

The above also applies to the AGC mains controllers – in that case the command unit is called Mains Command Unit (MCU).

The command unit cannot be selected by the operator. It is automatically selected when power management is used.

3.2 Local/remote operation

To start the plant in AUTO mode, the controller can use local or remote operation. Select **Remote** or **Local** in parameter 8021 (*Start/stop*) in the command unit. The setting can also be changed in M-Logic (*Output, Command, Set to local start* or *Set to remote start*).

Local means that the plant can be started from the display (local operator).

Remote means that the plant can be started remotely, for example, by a PLC, a digital input or through Modbus/Profibus communication.

3.2.1 Local operation

All operation is done from the display. In island operation any genset controller display can be used.

In load takeover, mains power export and fixed power the mains controller display must be used. The mains controller mode must be AUTO.

3.2.2 Remote operation

Island

In island mode an *Auto start/stop* input on any of the genset controllers can be used to start the plant.

INFO
DEIF recommends wiring the *Auto start/stop* input to all of the AGCs to ensure that automatic operation can continue even though one of the DGs is taken out for service and/or the power supply to the AGC is disconnected.

In island mode, any running mode (MAN, AUTO, SEMI, BLOCK) can be selected on the genset controllers. The remote start signal still works for the AGCs in AUTO mode.

Parallel to mains

In load takeover, mains power export and fixed power mode the *Auto start/stop* input on the mains controller must be used for starting the plant.

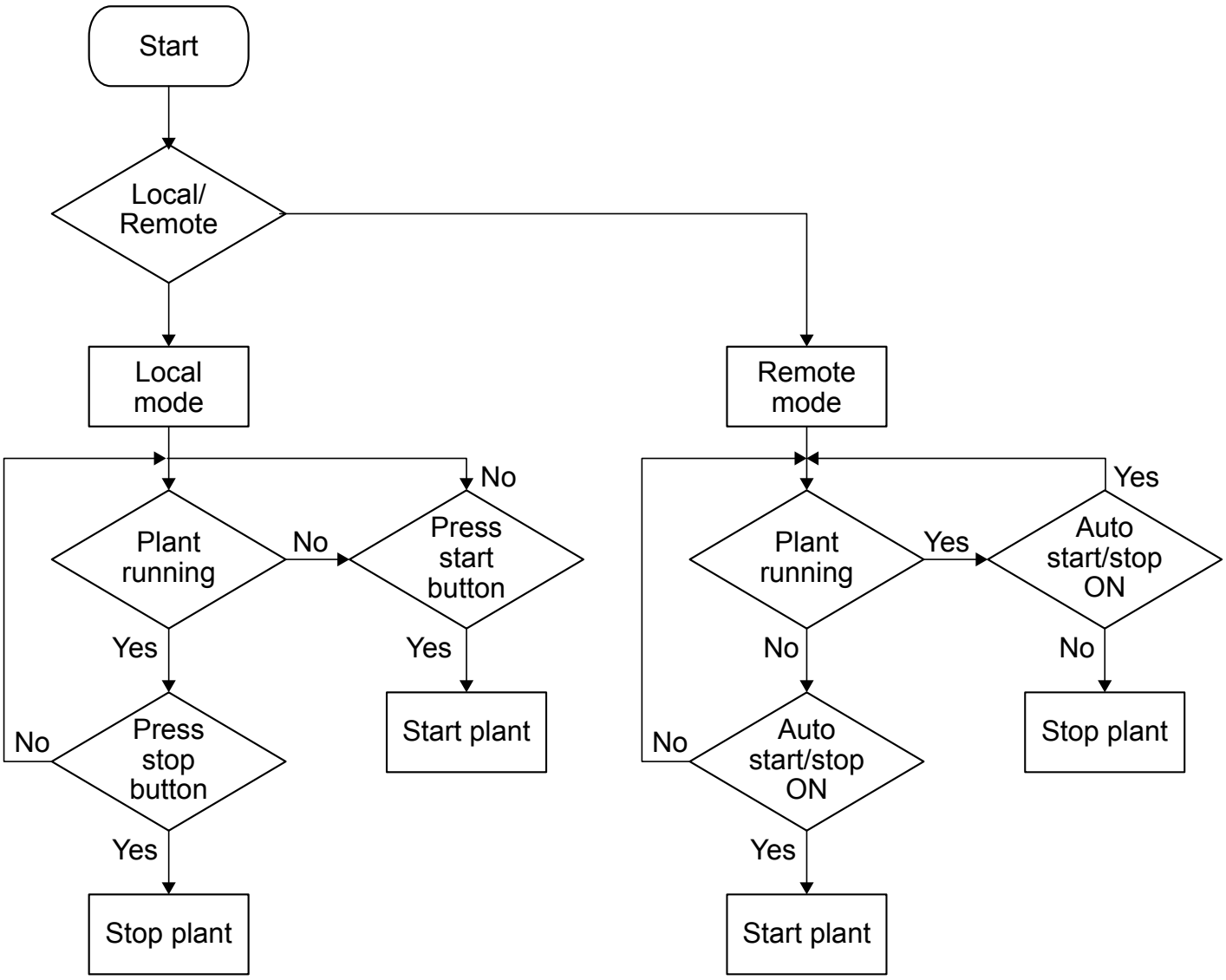
3.2.3 Starting the plant

The table shows how the plant is started:

Plant mode	Local	Remote
Island mode	Display on genset controllers	Auto start/stop on genset controllers
Fixed power mode	Display on mains controller	Auto start/stop on mains controller
Mains power export	Display on mains controller	Auto start/stop on mains controller
Load takeover	Display on mains controller	Auto start/stop on mains controller

INFO
In peak shaving and AMF, automatic operation starts automatically in response to the imported power (peak shaving) or mains failures (AMF).

3.2.4 Principle

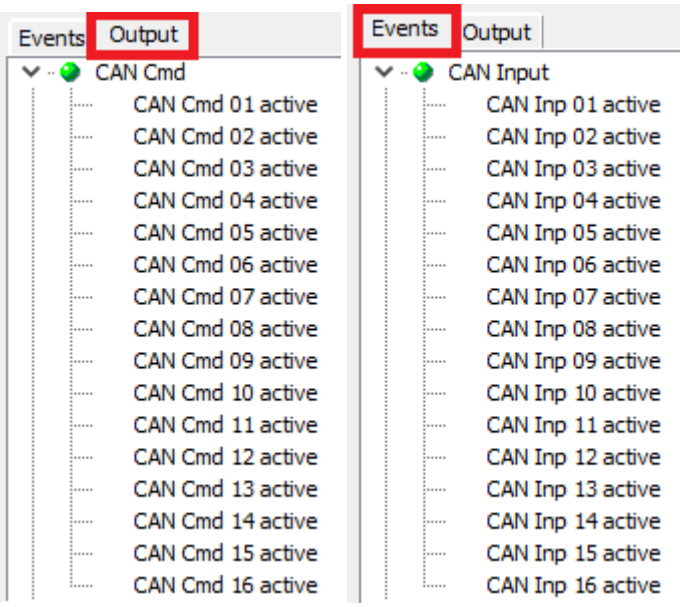


3.3 CAN flags

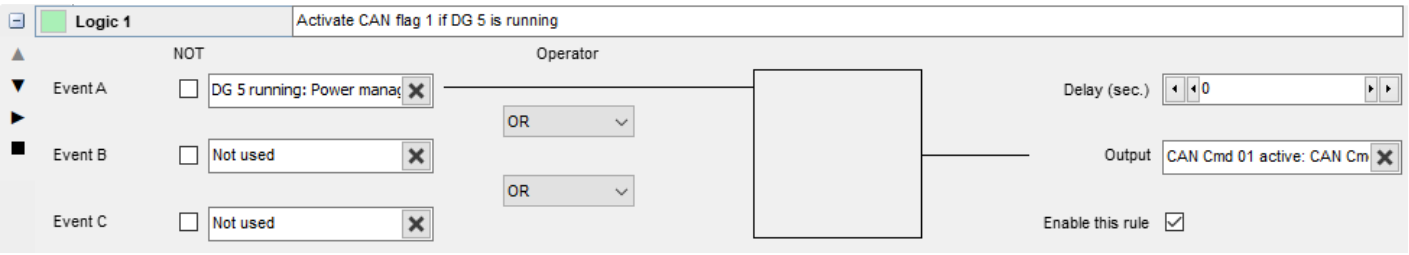
M-Logic has 16 CAN flags for CAN commands. They are like digital inputs. When a CAN command is sent from one controller, the corresponding CAN flag is activated in all the controllers. No wire is needed, as the CAN flags are communicated over the power management CAN bus.

INFO
Only use continuous signals from digital inputs or AOP buttons to activate the CAN inputs. AOP buttons are pulse inputs, so a latch function must be use to create a continuous signal.

M-Logic CAN flag outputs and events



M-Logic CAN command example



CAN Cmd 01 is activated when DG 5 is running. *CAN Inp 01 active* is then activated in all controllers in the power management system.

3.4 Common PF control

Common PF control can be configured in an AGC mains controller.

Parameter	Number	Range	Default	Details
Contr. sett. cosphi	7052	0.1 to 1.0	0.9	
Contr. sett. cosphi	7053	Inductive Capacitive	Inductive	
Contr. sett. cosphi	7054	Off Fixed for DG(s) Fixed for imp/exp	Off	**Off**: Power management ignores the mains set point (7052 and 7053). **Fixed for DG(s)**: The gensets use the set point in 7052 and 7053. **Fixed for imp/exp**: The gensets are regulated so that the mains import/export meets the set point in 7052 and 7053.

These set points can only be handled from the AGC mains controller. They are sent through the power management CAN bus to all the genset controllers in the system. The genset controllers then each adjust their PF control according to the set point.

INFO
Inductive/capacitive set points can be set up from M-Logic.

3.5 Heavy consumers

The heavy consumers function was available before software version 4.70. The heavy consumers function was removed in version 4.74 and is no longer available. Use an ALC-4 to control heavy consumers.

INFO
If you use AGC-4s with an older software version to control heavy consumers, all the genset controllers must have the older software version. To avoid unpredictable behaviour, the heavy consumer function must be enabled in every genset controller.

4. Genset functions

4.1 Genset controller mode

For power management to work, in each genset controller, for *Genset mode* (parameter 6070), you must select *Power management*.

INFO
Do not select other options (for example, AMF, Peak shaving, Mains power export, and so on) in parameter 6070. For gensets, these options are only for stand-alone applications. Select the Plant mode (parameter 6070) for the power management application in the mains controller(s).

In addition, each genset controller should be in AUTO mode. If a controller is not in AUTO mode, it will not automatically respond to power management requirements.

4.2 Fail class

The genset controller fail class descriptions in the **Designer's Reference Handbook** still apply when the power management option is selected.

Safety stop

In genset controllers with power management, the safety stop prioritises the load.

This means that when an alarm occurs, the faulty genset stays connected to the busbar until the next priority genset is started and synchronised to the bus. When the incoming genset has taken the load, the faulty genset ramps down the power, followed by trip of the breaker, cooling down of the engine and finally stop.

If the faulty genset has the last priority, or no standby gensets are available, then it stays connected to the busbar and does not trip.

INFO
If no genset can start in a safety stop situation, then the faulty genset is not stopped. Therefore it is important that the safety stop is backed up, for example, by a trip and stop alarm or a shutdown alarm.

4.3 Genset priority

The AGC has a number of ways to determine the genset priorities.

Parameter	Name	Range	Default
8031	Priority select	Manual abs. Running hours abs. Fuel optimization Manual rel. Running hours rel. Fuel optimization + Running hours	Manual abs.

Alternatively, use M-Logic, *Output, Command, First priority* to give the AGC the first priority. You can use M-Logic, *Output, Inhibits, Block priority swapping* to ensure that the start list is not changed.

INFO
The parameters for each priority type are only visible when the priority type is selected in parameter 8031.

4.3.1 Manual

Manual allows the operator to adjust the order of priority of the gensets. This means that each genset always has a specific priority setting.

Manual uses parameters 8081-8085, 8091-8096, 8101-8106, 8321-8326, 8331-8336, 8341-8343. These settings can be changed in one genset controller. After changing priorities, the new settings must be sent to the other gensets using the transmit function in menu 8086.

Example of priority DG3, DG1, DG2, DG4

Parameter	Name	Selection
8081	Priority 1	3
8082	Priority 2	1
8083	Priority 3	2
8084	Priority 4	4

Manual absolute

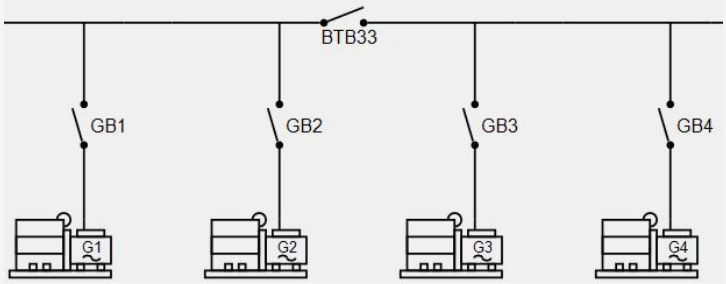
If the gensets are in AUTO, when *Manual abs.* is selected in parameter 8031, the power management system dynamically calculates the priority for each controller. If the sections are separated by opening a BTB, the two sections are treated as two independent applications.

Manual abs. example

The four gensets in the drawing below have the same priority and ID (that is, genset 1 has priority 1, and so on).

If the BTB is open and a genset is running on each side of the BTB, genset 1 and genset 3 run as the first priority gensets.

If the BTB is synchronised and closed the genset 2 starts and takes over the load from genset 3. When this is done, genset 3 is stopped. The busbar is now treated as one application with four gensets.



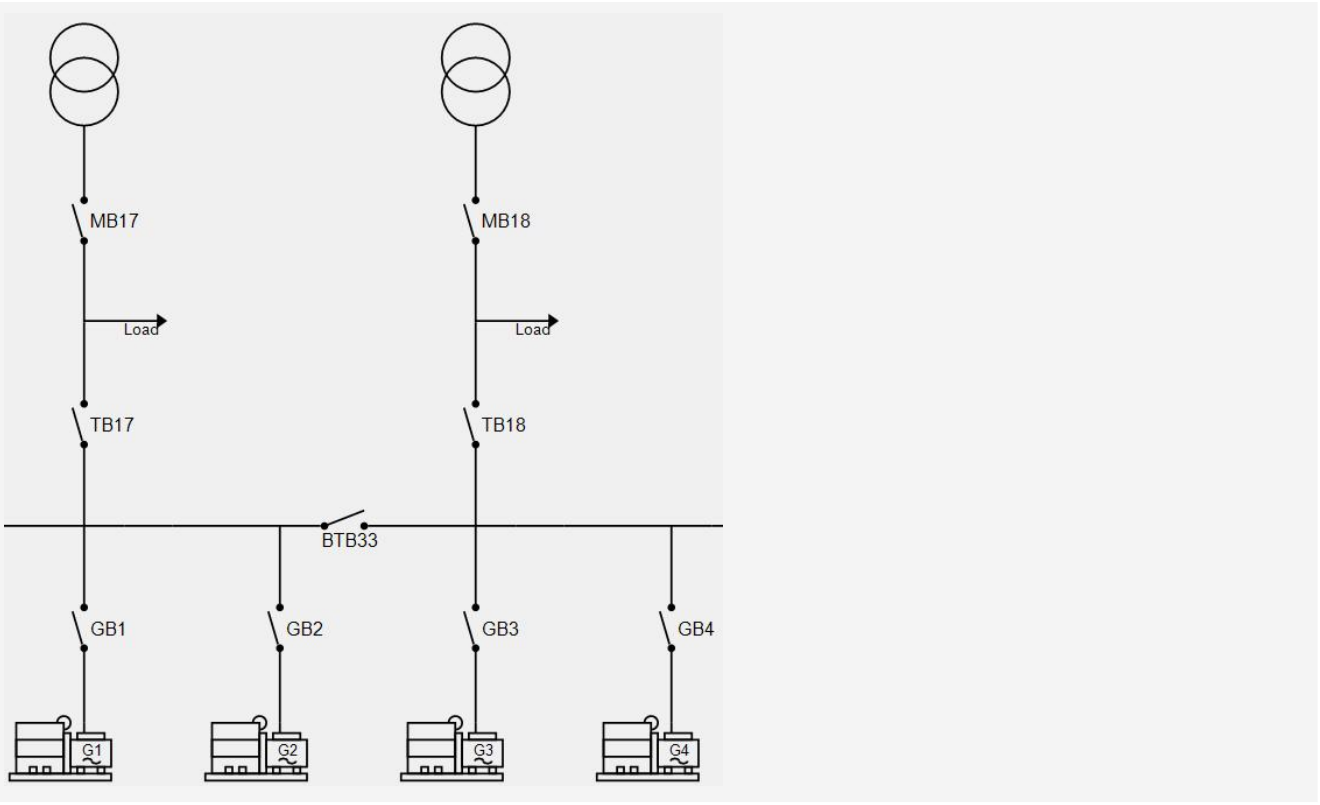
Manual relative

Selecting manual relative makes sense if there is a mains connection on each side of the BTB. When sections are separated by opening a BTB and the gensets are in AUTO, selecting *Manual rel.* in parameter 8031 means that the power management system automatically changes the priorities. The priorities depend on the position of the BTB.

Manual rel. example

The four gensets in the drawing below have the same priority and ID (that is, genset 1 has priority 1, and so on). *ID to run* is **18**.

If the BTB is open, only the section connected to MB18 runs. Thus gensets 3 and 4 could be running on the right side of the BTB. If the BTB is synchronised and closed, gensets 1 and 2 do not start and take over the load from gensets 3 and 4. Gensets 1 and 2 are seen as new gensets in an already running application. Gensets 1 and 2 therefore become priority 3 and 4.



4.3.2 Running hours

The purpose of the priority selection based on running hours is to ensure that the gensets have the same (or nearly the same) running hours.

Every time the *Priority update hour* in parameter 8111 is reached, a new priority order is calculated. The gensets with first priorities are started (if not already running), and the gensets with the last priorities will stop.

Priority select (parameter 8031) based on running hours can be absolute or relative. The choice between the absolute and relative routine determines whether an offset for the running hours is included in the priority calculation. For example, an offset can be used when the AGC is installed on an old genset which already has many running hours. An offset can also be used if an AGC is replaced.

Running hours type

You can set the running hours type in parameter 8112:

- Total (default): The AGC counts the running hours.
- Trip: The running hours counter can be reset to 0 using parameter 8113.
- Load profiled: The running hours are multiplied by the load percentage.
  - Example: 2 running hours x 80 % load = 1.6 load-profiled hours

Absolute running hours

The gensets with the lowest number of running hours have the highest priorities. The initial running hours are configured in each genset AGC in parameters 6101 and 6102 (typically at the commissioning). This allows each AGC to display the correct total running hours for each genset.

Absolute running hours can be impractical if the application consists of old gensets together with new gensets. In that situation the new gensets are the first priorities, until they have reached the same number of running hours as the old gensets. To avoid this, use relative running hours instead.

You can select absolute running hours using M-Logic, *Output, Command, Abs. prio. handling*.

Relative running hours

When *Running hours rel.* is selected in parameter 8031, all gensets in AUTO mode participate in the priority calculation independent of the running hours in menus 6101 and 6102. This selection allows the operator reset the priority calculation. If *Enable* is selected in the *Trip counter* (parameter 8113), the relative running hour counter in the AGC controller is reset to 0 hours. At the next priority selection the calculation is based on the reset values.

You can select relative running hours using M-Logic, *Output, Command, Rel. prio. handling*.

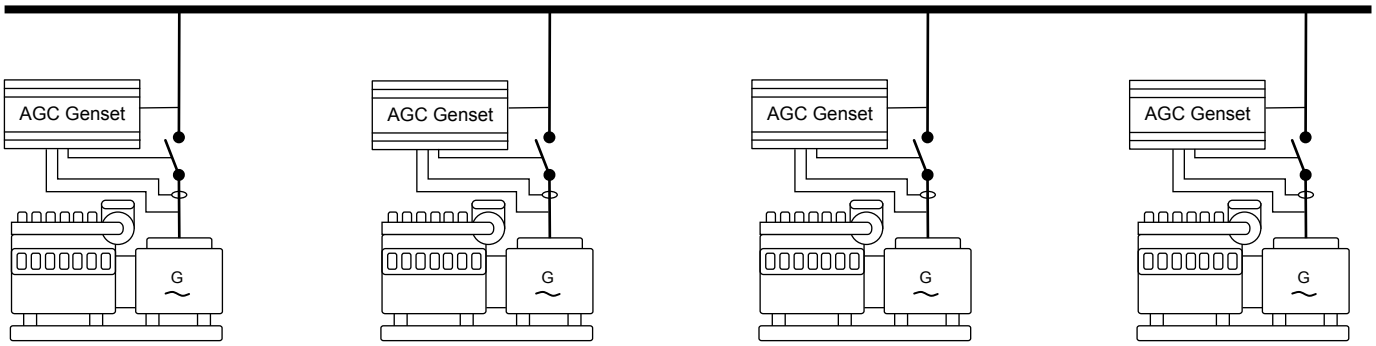
Principle for priority routine

The principle for the priority routine is shown in the following example where the *Priority update hour* (parameter 8111) is **24 hours**, and the load only requires one genset.

Day	Hours	DG1 (ID3)	DG2 (ID2)	DG3 (ID4)	DG4 (ID1)	Comment
Monday	0	1051 h	**1031 h**	1031 h	1079 h	DG2 starts since it has to the lowest internal ID number.
Tuesday	24	1051 h	**1055 h**	**1031 h**	1079 h	DG3 is started, and DG2 is stopped.
Wednesday	48	**1051 h**	1055 h	**1055 h**	1079 h	DG1 is started, and DG3 is stopped.
Thursday	72	**1075 h**	**1055 h**	1055 h	1079 h	DG2 is started since it has the lowest internal ID number, and DG1 is stopped.
Friday	96	1075 h	**1079 h**	**1055 h**	1079 h	DG3 is started, and DG 2 is stopped.
Saturday	120	**1075 h**	1079 h	**1079 h**	1079 h	DG1 is started, and DG3 is stopped.
Sunday	144	**1099 h**	1079 h	1079 h	**1079 h**	DG4 is started since it has the lowest internal ID number, and so on.

4.3.3 Fuel optimisation

If fuel optimisation is selected in parameter 8031, the genset priorities are disabled, and the gensets start and stop according to the load. The fuel optimisation function can be useful if the application consists of gensets with different nominal powers. The function is best described with an example:



Genset no. 1
P nominal = 1000 kW

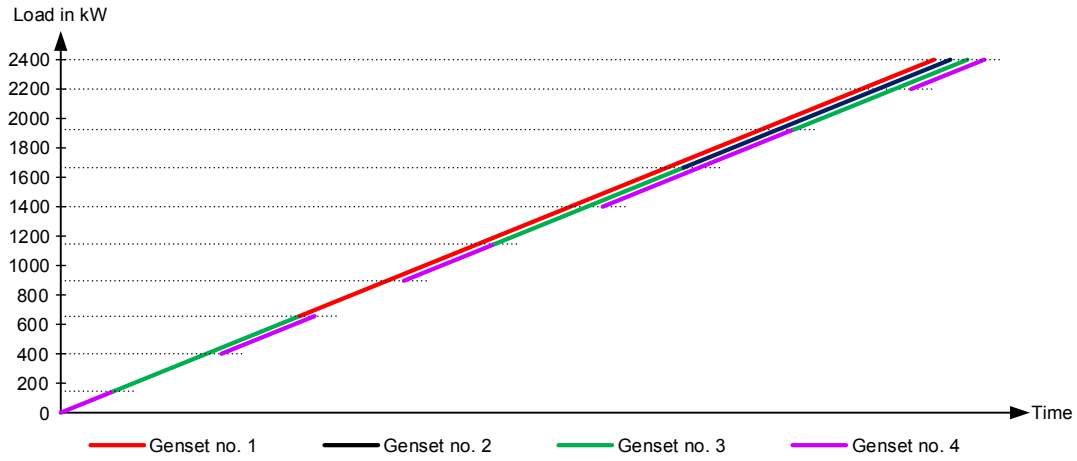
Genset no. 2
P nominal = 800 kW

Genset no. 3
P nominal = 500 kW

Genset no. 4
P nominal = 250 kW

Four gensets, with different nominal powers, are shown above. Fuel optimisation is activated, so there are no priorities. The AGC continuously calculates the optimised set of gensets to run.

The diagram below shows which gensets run as the load increases. In this example the load-dependent start limit is 100 kW. That is, when available power drops below 100 kW, the next genset starts. After the next genset starts, another one may stop to optimise the fuel consumption.



1. For fuel optimisation, the smallest possible genset (number 4) starts.
2. After that, genset 3 takes the load alone, since a bigger genset is not yet required.
3. Next, genset 4 starts again. At this point, two gensets are running, since the nominal power of gensets 3 and 4 is smaller than the nominal power of genset 2.
4. As the load increases, some gensets are stopped, and some bigger one are started.
5. For the maximum load, all the gensets run in parallel.

INFO
With fuel optimisation activated, it is still possible to use asymmetrical load sharing, or normal load sharing.

4.3.4 Fuel optimisation and running hours

If *Fuel optimisation + running hours* is selected in parameter 8031, the AGC ignores the genset priorities, and the gensets start and stop according to the running hours. If two or more gensets have the same running hours, the optimum genset combination is selected according to the load.

4.4 Load-dependent start and stop

4.4.1 Start and stop

This function ensures that sufficient power is always available on the busbar. Gensets are automatically started and stopped so that only the required number of gensets run. This optimises fuel usage and the maintenance intervals.

The load-dependent start/stop function is active when the plant is in AUTO mode. The starting and stopping of the gensets is automatically carried out according to the configured set points and priority selection.

The load-dependent start/stop function can be selected as:

- Rated power set point (P) [kW]
- Apparent power set point (S) [kVA]
- Actual or load percentage value [%]

The load-dependent start and stop can be based on either produced power calculation (%) or available power calculation (P or S). The easiest way is to use produced power calculation. However, for systems with three or more generators, this does not save enough fuel and running hours.

4.4.2 Terminology

The table shows the abbreviations used.

Short	Description	Comment
$P_{AVAILABLE}$	Available power	P_{TOTAL} - $P_{PRODUCED}$
P_{TOTAL}	Total power	$\Sigma P_{NOMINAL}$ of running sets with GBs closed
$P_{PRODUCED}$	Produced power	
$P_{NOMINAL}$	Nominal power	
$P_{NOMINAL-STOP}$	Nominal power of the genset to stop	Priority-dependent

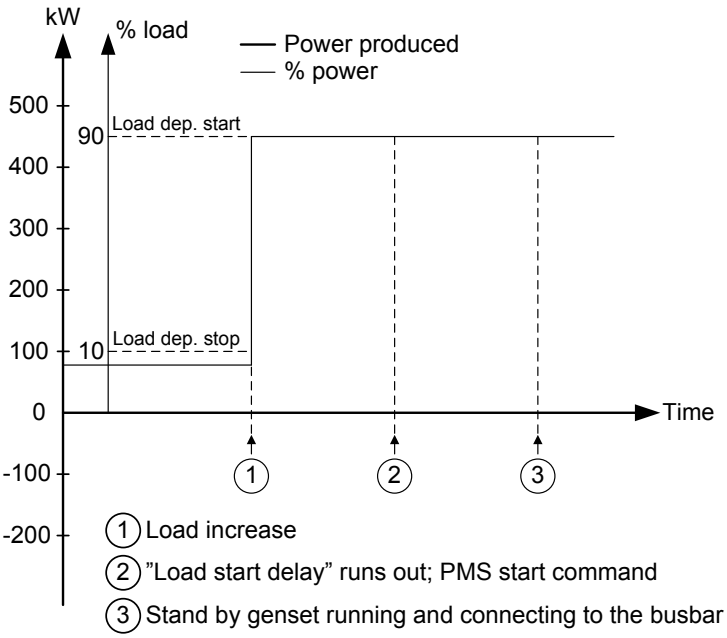
Produced power method

This method is in effect if *Percentage* is selected in menu 8882 as basis for the start/stop calculation.

If the load % of a generator exceeds the *Start next* set point, the start sequence of the lowest priority generator in stand-by will be initiated.

If the load % of a generator drops below the *Stop next* set point, the stop sequence of the running generator with the highest priority number will be initiated.

If the load of the plant decreases so much that the generator with the highest priority number can be stopped and an available power of at least the stop set point in % is available, then the stop sequence of this generator will be initiated.



Available power method

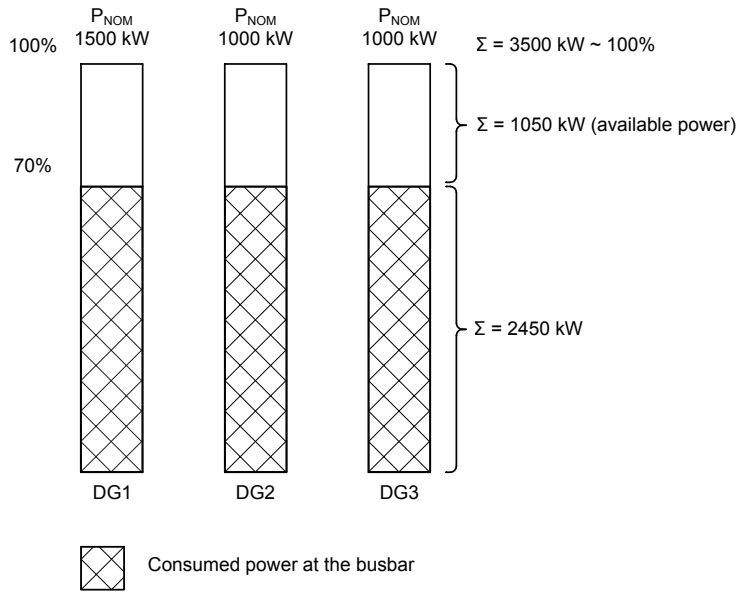
This method is in effect if P [kW] or S [kVA] is selected as basis for the start/stop calculation.

Independent of the selection (P [kW] or S [kVA]), the functionality is basically identical; therefore the example of the functionality below will be given for the load-dependent start function with selected rated power (P) value.

The apparent power set point is typically selected if the connected load has an inductive character and the power factor is below 0.7.

Description

This drawing illustrates the terms used.



Nominal power

The nominal power is the rated power of the genset that can be read on the type plate of the generator.

Total power

The total power is the sum of the rated nominal power of each individual genset. In the example above the plant consists of three DGs:

DG1 =	1500 kW
DG2 =	1000 kW
DG3 =	1000 kW
That is a total of	3500 kW

Produced power

The produced power is defined as the existing load on the busbar. In the example above the produced power is indicated as the hatched area, and the total of the three gensets = 2450 kW.

Available power

The available power is the difference between the maximum possible power produced by the gensets and the actual produced power.

In the example above the plant consists of three gensets, in total 3500 kW. The load consumes 2450 kW in total. Since the total load P_{TOTAL} is 3500 kW, and the produced load $P_{PRODUCED}$ is 2450 kW, then the available power $P_{AVAILABLE}$ is 1050 kW, meaning that the gensets can handle this load if it should be added to the busbar.

4.4.3 Principle – available power method

One genset is running and is supplying the load. The load increases which means that the available power/apparent power decreases. At a certain time the load has increased so much that only a little amount of power/apparent power is available, and the next priority genset will be started in order to increase the amount of available power/apparent power.

When the load drops, the available power/apparent power will increase. When the available power/apparent power has increased above the stop level plus the nominal power of the last priority genset, then the last priority genset will be stopped. Please note that the nominal power of the genset to be stopped is added to the adjusted stop level. The reason is that otherwise the available power/apparent power would immediately drop below the start level again.

Example

If the adjusted stop level is 200 kW (P_{STOP} = 200 kW), and the genset with the last priority is 1000 kW, it is necessary that the available power reaches 1200 kW, because the available power will be reduced with 1000 kW immediately after the last priority genset is stopped.

4.4.4 Principle – percentage method

One genset is running and is supplying the load. The load increases which means that the % load increases. At a certain time the load has increased so much that the load % start will start up the next priority genset in order to take some of the load.

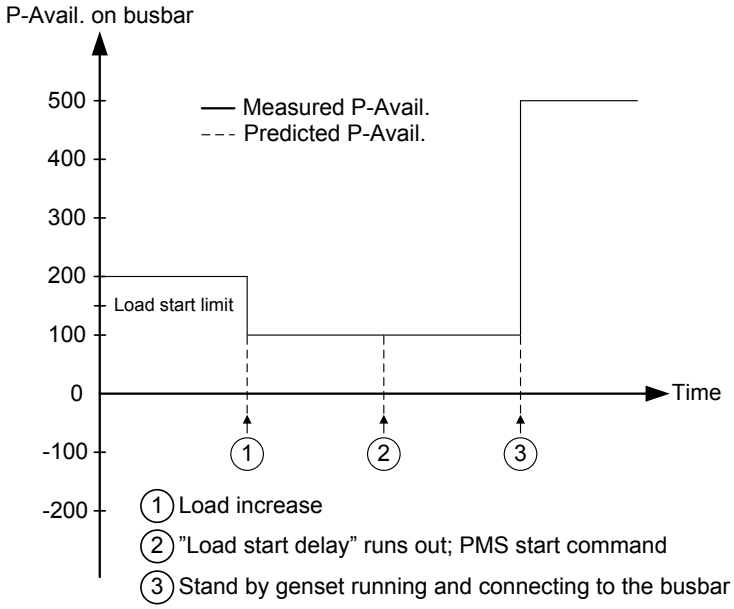
When the load drops, the produced power will decrease. When the produced power has decreased below the stop level plus the nominal power of the last priority genset, then the last priority genset will be stopped. Please note that the nominal power of the genset to be stopped is added to the adjusted stop level. The reason is that otherwise the produced power would immediately drop below the start level again.

Example

If the adjusted stop level is 10 % (100 kW produced power), and the genset with the last priority is 1000 kW, the last priority generator will produce 20 % (200 W) after stop. It is necessary that the start level is above this value, otherwise an ongoing starting and stopping will take place.

4.4.5 Adjusting load-dependent start

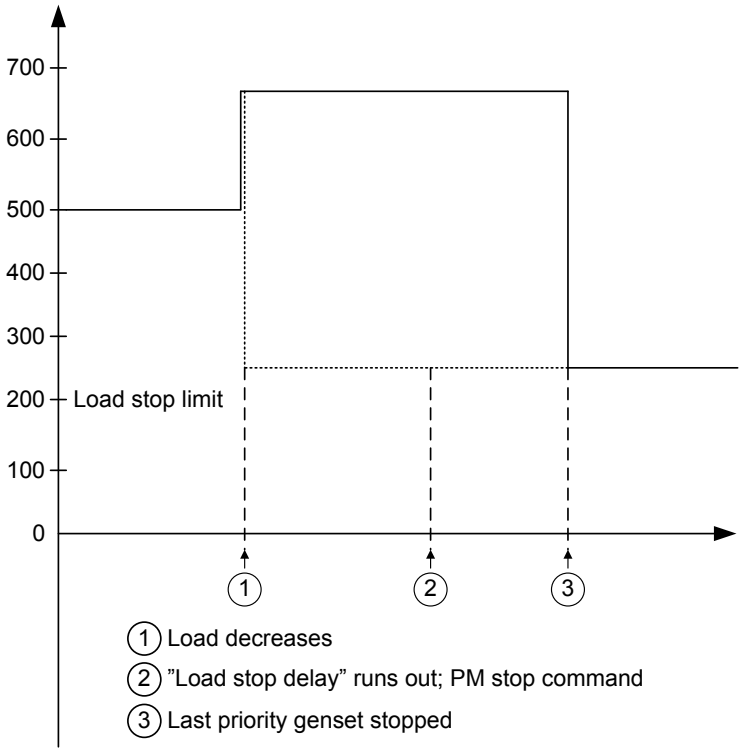
In the example below the available power is 200 kW. When the load increases, the available power drops below the start limit. The stand-by genset will start when the start timer runs out, and after the synchronising the available power increases (in this example to 500 kW).



4.4.6 Adjusting load-dependent stop

In the example below the available power is 500 kW. When the load decreases, the available power increases to 750 kW. The AGC now calculates what happens if the last priority genset is stopped. In the example below the last priority genset is 400 kW which means that it can be stopped, because the available power will still be above the stop level.

Now the difference between the stop level and the available power is 50 kW. This means that only if the genset, which now has the last priority, is 50 kW, it can be stopped!

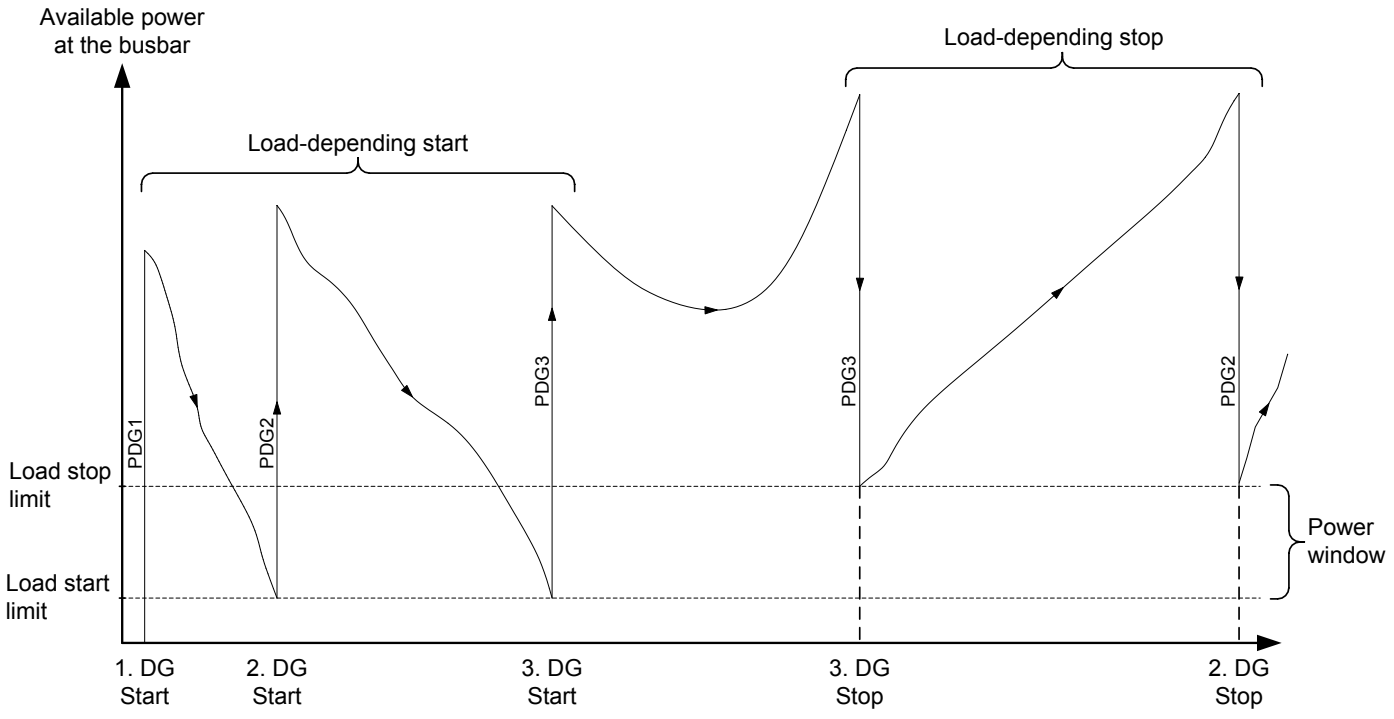


INFO
If the order of priority is changed, the following must be observed:

If the priority does not seem to change as expected, it is because the load-dependent stop function is not able to stop the lowest priority after having started the new first priority. That would cause two DGs to be running at low load instead of one DG.

4.4.7 Power window

The difference between the programmed load-dependent start and stop limits forms the power hysteresis between the start and stop. This is shown in the diagram below:



4.4.8 Two sets of LD start/stop settings

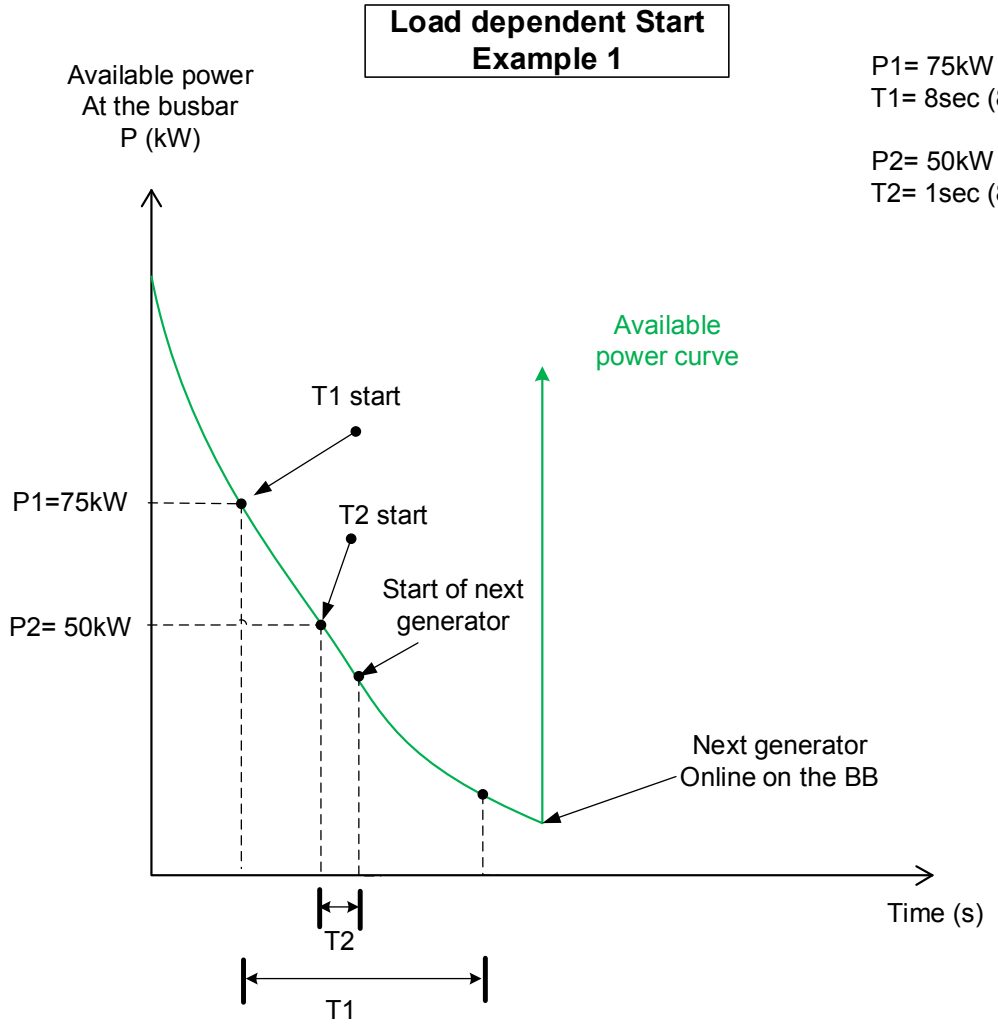
There are two sets of parameters for load-dependent starting and stopping. The available parameters are:

Set 1: 8001 to 8015

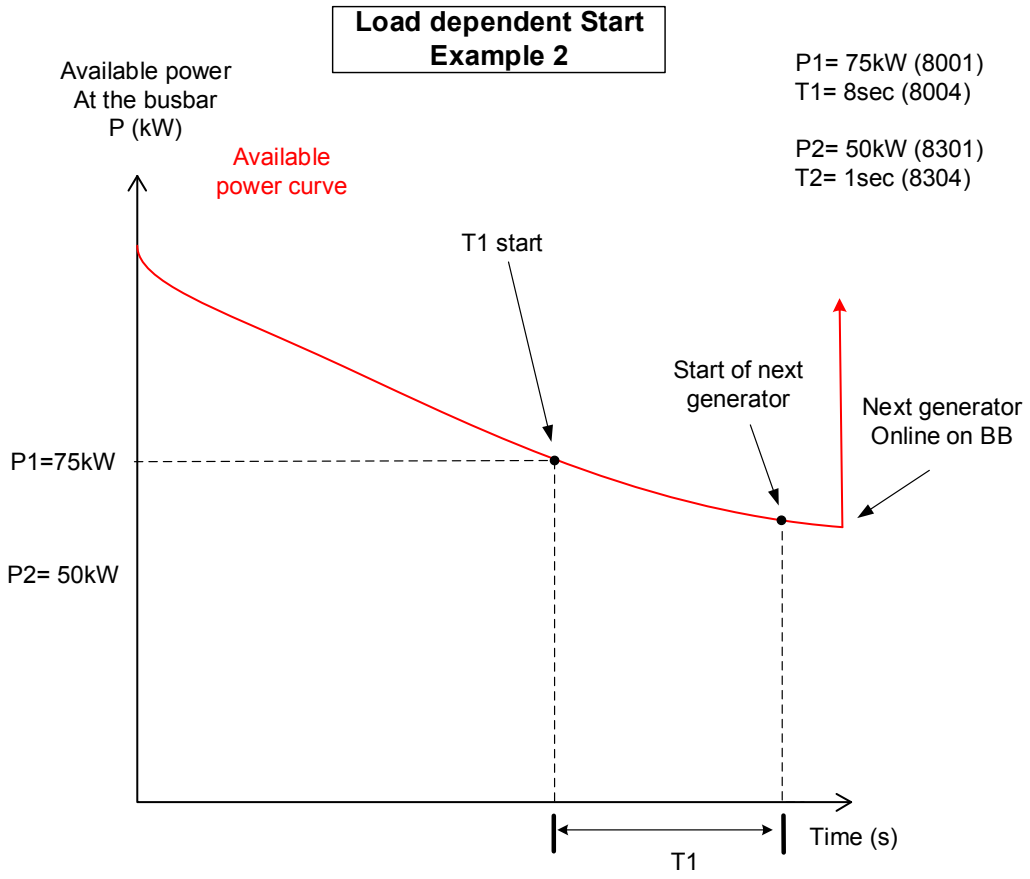
Set 2: 8301 to 8314

The reason for having two sets of parameters is that it enables the genset to act differently on different load curves. If, for example, the load increases fast, it is possible to configure a short timer (s) and a low P (kW) set point so the genset gets online faster, and the result is that the genset is not overloaded. In another situation the load will increase slower, and then it is possible to use the other set of set points with a longer timer (s) and a higher P (kW).

When the available power has reached the set point, the timer starts; and when the timer runs out, the genset starts. See the diagrams below for examples of how the configuration can be done. Be aware that the examples show available power on the busbar, that is why the curve goes down when the load increases.



Example 1 above shows that timer 1 will start at 75 kW and timer 2 will start at 50 kW, and because timer 2 runs out before timer 1, it is timer 2 that starts the genset.



Example 2 above shows that timer 1 will start at 75 kW, and when timer 1 runs out the genset will start. Timer 2 will not be started, because the load does not go under 50 kW (P2).

INFO
The diagrams above show load-dependent start. The principle for load-dependent stop is the same.

INFO
Only set 1 (parameters 8001 to 8015) can be used for the *Fuel optimisation* function.

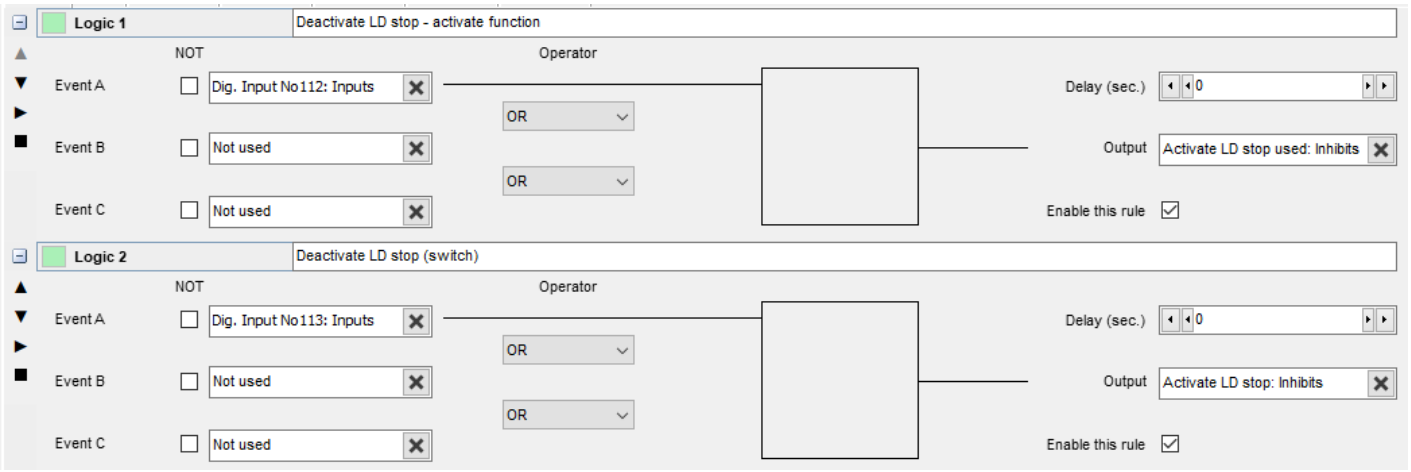
4.4.9 Activate/deactivate load-dependent start/stop

By default, the first set of load-dependent start/stop settings are active. You can use M-Logic inhibits to deactivate set 1. You can use M-Logic output commands to activate or deactivate set 2.

Set 1: Deactivate load-dependent stop

The set 1 load-dependent stop can be deactivated using M-Logic (*Outputs, Inhibits, Activate LD stop*). For example, this may be needed to allow operators to start the factory load after a blackout.

In the example below, the function (*Output, Inhibits, Activate LD stop used*) is activated by terminal 43. Now the operator can switch the load-dependent stop ON or OFF using a switch connected to terminal 44.



The controller uses the following logic:

- *Activate LD stop used* = True and *Activate LD stop* = False: The system cannot load-dependent stop.
- *Activate LD stop used* = True and *Activate LD stop* = True: Load-dependent stop is possible.
- *Activate LD stop used* = False and *Activate LD stop*" = False: The system uses the first set of load-dependent stop parameters.*

*Note: Unless the second set of load-dependent stop parameters is activated in 8314.

Set 2: Activate/deactivate load-dependent start/stop

To activate/deactivate the set 2 load-dependent start/stop parameters, you can select **On** or **Off** in *Ld. start timer 2* (parameter 8304) and *Ld. stop timer 2* (parameter 8314). Alternatively, you can use the following M-Logic (*Output, Command*):

- Activate Load Depend Start/Stop setting 2
- Deactivate Load Depend Start/Stop setting 2
- Activate Load Depend Start setting 2
- Deactivate Load Depend Start setting 2
- Activate Load Depend Stop setting 2
- Deactivate Load Depend Stop setting 2

4.5 Load sharing

When the power management communication is running, the load sharing between the gensets uses the CAN bus communication between the AGC controllers.

If both CAN bus ports are being used (A1-A3 and B1-B3) and **Primary and Secondary CAN** is selected in the *Plant options*, the communication automatically switches to the other port if, for example, A1-A3 is disconnected or faulty. See Redundant CAN bus.

Analogue load sharing if CAN bus fails

If both CAN bus lines are disconnected or faulty, the AGCs do not automatically switch over to analogue load sharing. This has to be set up in M-Logic: Use *Events, Alarms, Fatal CAN error* to activate *Output, Command, Use Ana LS instead of CAN*. Now load sharing continues based on the signals from terminals 37/38/39. Power management is lost, but the gensets that are already running stay stable.

INFO
To use analogue load sharing, option G3 must be active.

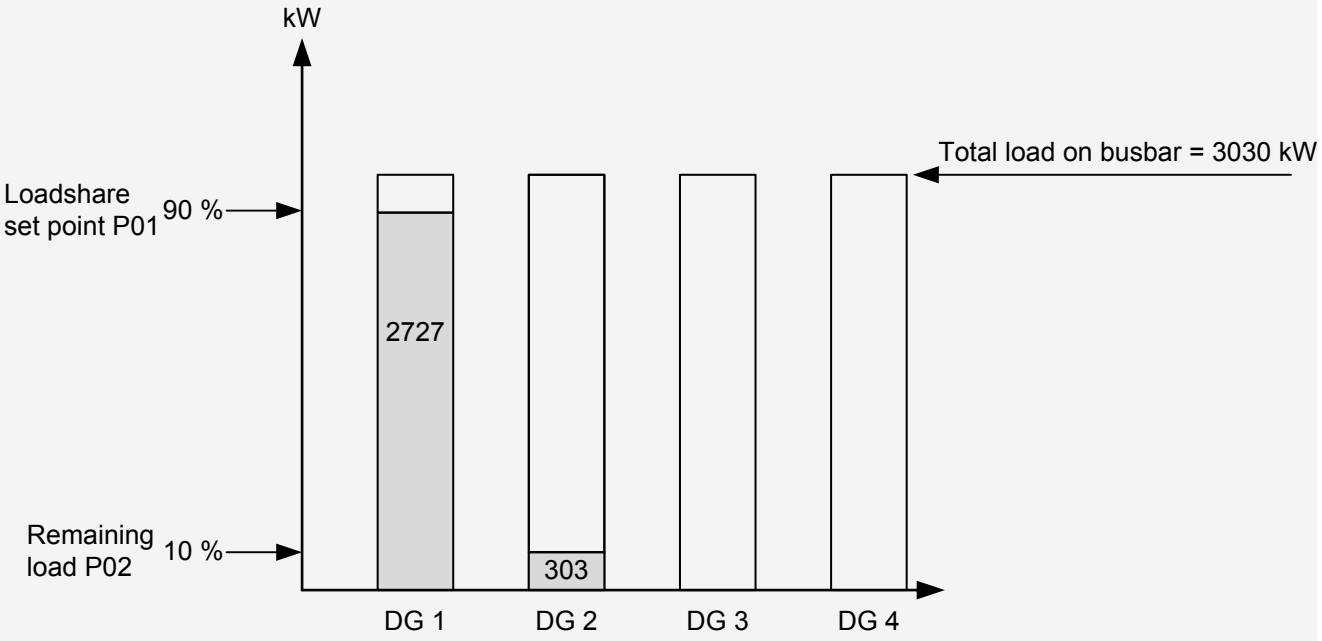
4.6 Asymmetric load sharing (LS)

When asymmetric LS is enabled in menu 8282 (or in M-Logic *Outputs, Commands, Activate Asymmetric LS/Deactivate Asymmetric LS*), the normal option G5 load sharing is deactivated in all AGC controllers in the system. The AGC controllers will then load share using the asymmetric LS set point in menu 8281.

Example

Four DGs each have a nominal power of 2800 kW . Asymmetric LS set point = 90 %. Load on the busbar is 3030 kW.

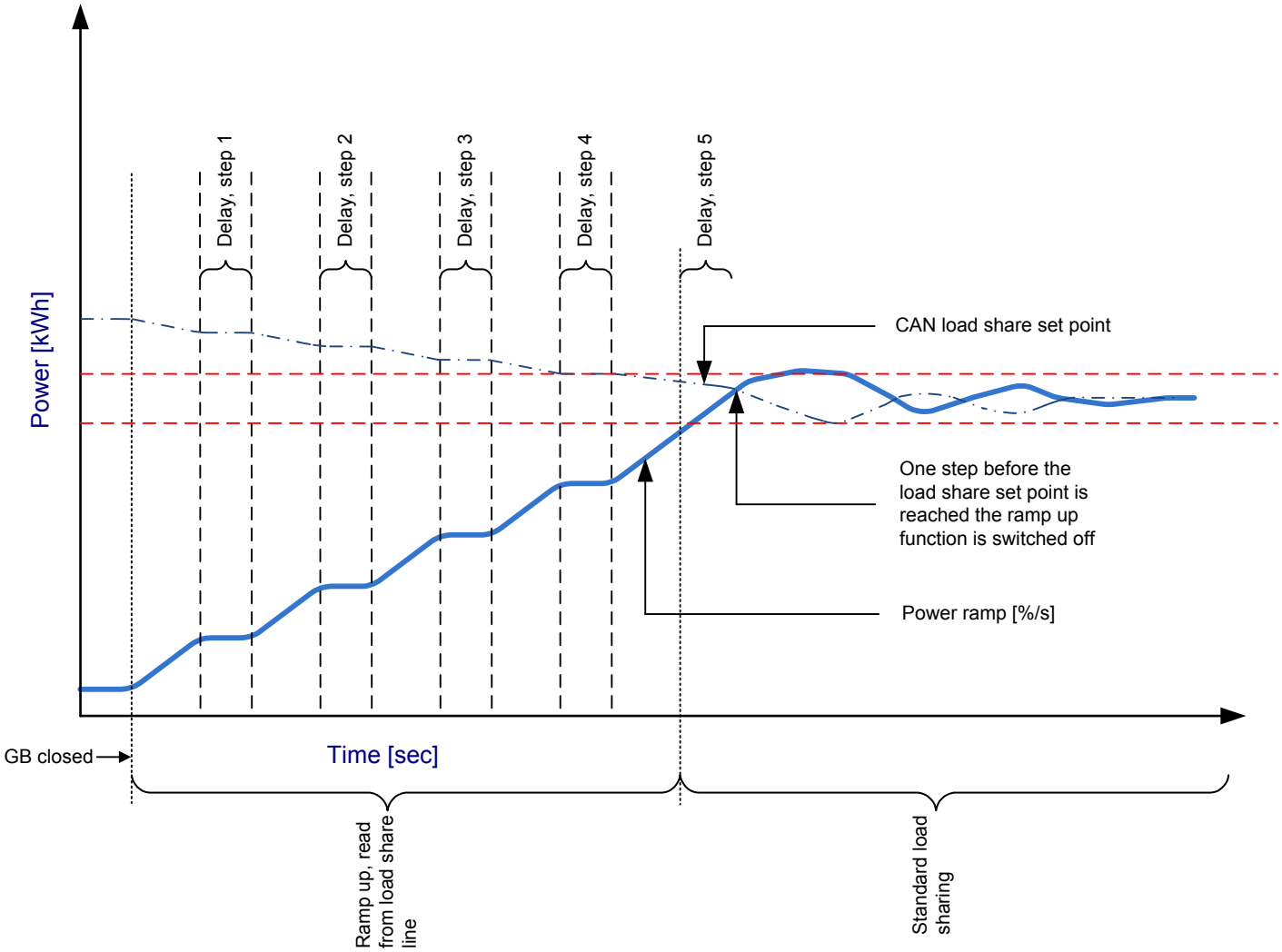
The generator with priority 01 starts up first, taking 90 % of the load = 2727 kW. The generator with priority 02 takes the rest of the load = 303 kW.



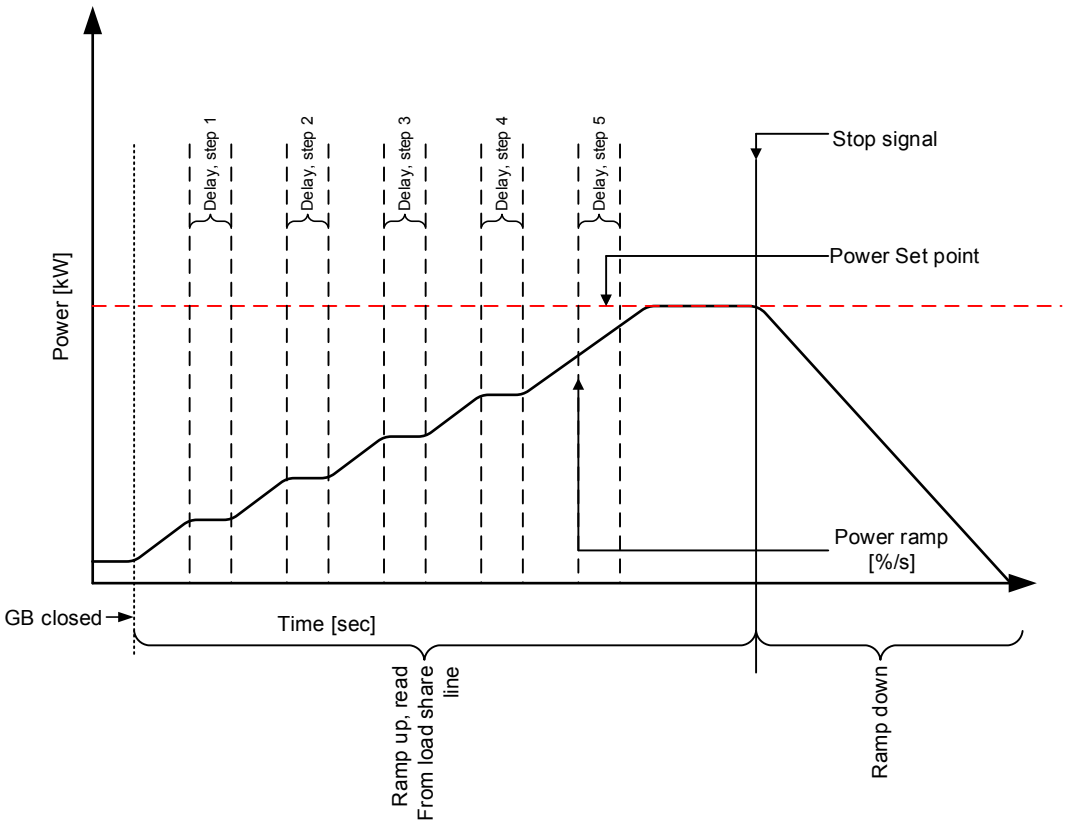
INFO

If the asymmetric LS set point in menu 8281 gives a kW value that is higher than the nominal power of the generators, the whole system switches back to symmetric.

4.7 Island ramp up with load steps



4.8 Fixed power ramp up with load steps



When menu 2614 is enabled, the power set point continues to rise in ramp up steps, determined by menu 2615, towards the load sharing set point. The delay time between each ramp up step will be determined by menu 2613. The ramp up will continue until the load sharing set point is reached and then switch the regulator to standard load sharing mode.

If the delay point is set to 20% and the number of load steps is set to 3, the genset will ramp to 20%, wait the configured delay time, ramp to 40%, wait, ramp to 60%, wait and then ramp to the system set point. If the set point is at 50%, the ramp will stop at 50%.

4.9 Freeze power ramp

A way to define the ramp up steps is to use the freeze power ramp command in M-Logic.

Freeze power ramp active:

- The power ramp will stop at any point of the ramp, and this set point will be kept as long as the function is active.
- If the function is activated while ramping from one delay point to the other, the ramp will be fixed until the function is deactivated again.
- If the function is activated while the delay timer is timing out, the timer will be stopped and will not continue until the function is deactivated again.

4.10 N + X

N + X (previously *Secured mode*) connects extra generators. That is, the power management system runs more gensets than required by the load-dependent start. X refers to the multiple of the nominal power for the largest running generator that must be connected. See the example.

It is only possible to activate *N + X* if the genset controller is in AUTO mode.

N + X can be activated/deactivated using digital inputs or via M-Logic (*Outputs, Commands, Activate N + X extra DGs/Deactivate N + X extra DGs*).

Parameter

Number	Name	Range	Default	Notes
8921	N + X setup	N + X OFF N + 1 extra DG ... N + 8 extra DGs	N + X OFF	The system starts and connects the specified multiple of the nominal power for the largest running generator.

Example

The system consists of one 1.5 MW genset and 9 x 500 kW gensets. Parameter 8921 is **N + 2 extra DGs**.

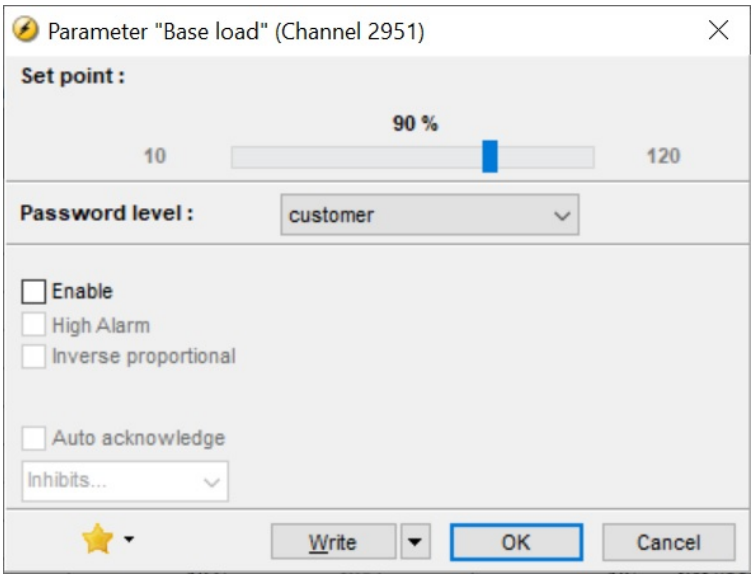
Scenario 1: The 1.5 MW genset and a 500 kW genset are running. The extra power required is therefore 2 x 1.5 MW (the biggest running). N + X therefore starts and connects an extra **six** of the 500 kW gensets.

Scenario 2: Four 500 kW gensets are running. The extra power required is therefore 2 x 500 kW (the biggest running). N + X therefore starts and connects an extra **two** of the 500 kW gensets.

4.11 Base load

In an island application, one genset controller in a power management system can be selected to run with a base load (enable parameter 2952). The busbar has to be active with one or more gensets connected. Only one AGC controller (per dynamic section) can run in base load at a time. If more than one controller has base load enabled, the controller with the lowest ID runs in base load.

Enable base load from the display unit, using M-Logic (*Outputs, Commands, Activate base load/Deactivate base load*) or using a digital input. When the controller runs with base load, the status message *FIXED POWER* is shown. Use parameter 2951 to adjust the base load set point (as a percentage of the genset nominal load).



If a generator runs in base load and the total load decreases to a point below the base load set point, the system lowers the base load set point. This is to prevent frequency control problems, as the generator running in base load does not participate in the frequency control. When the generator breaker is closed, the generator power is increased to the base load set point.

If AVR control (option D1) is selected, the set point is the adjusted power factor.

INFO
The controller for base load is automatically changed to SEMI-AUTO mode.

4.12 Multi-start gensets

The multi-start function can be used to determine the number of gensets to start. This means that when the start sequence is initiated via push-button, digital input or automatic start, then the adjusted numbers of gensets will start.

This function is typically used with applications where a certain number of gensets is required to supply the load.

The multi-start function is adjusted in parameters 8922-8926.

INFO
In an AMF application with a tie breaker, the tie breaker must not close before the maximum power is available (power capacity set point).

4.12.1 Multi-start configuration

The multi-start function can be adjusted to operate with two different settings. These settings consist of set points for how many gensets to start and the minimum number of running gensets.

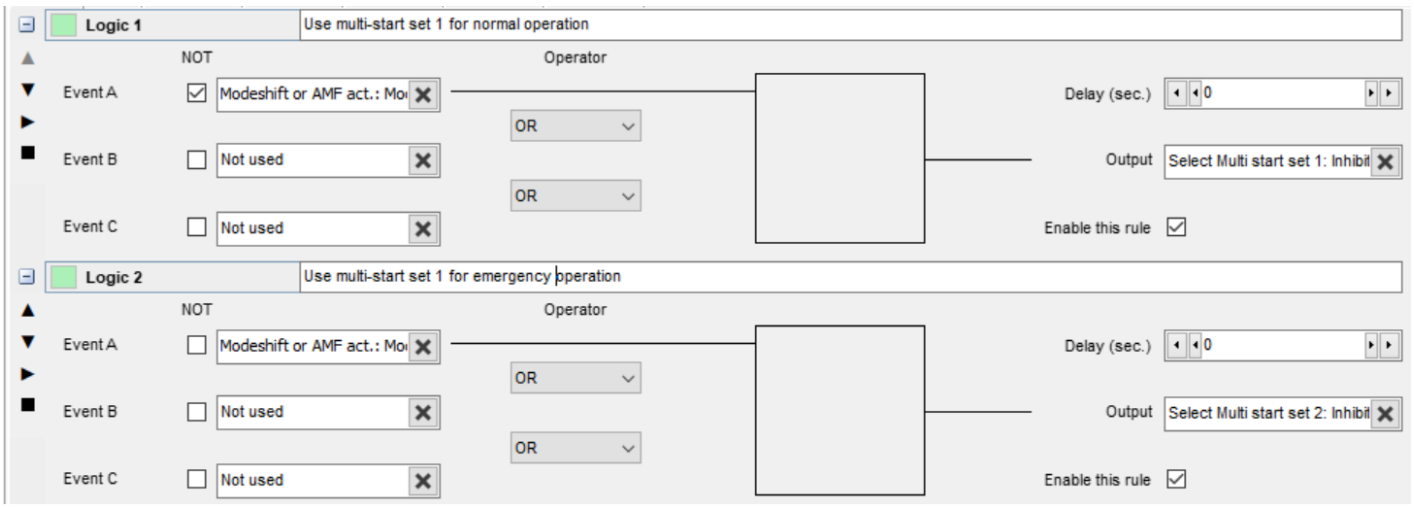
It is possible to switch between the settings using M-Logic or menu 8924.

	Set point 1	Set point 2
Multistart (numbers to start)	8922	8925
Min no. running	8923	8926

Using M-Logic to create the default settings

	Start condition	Set point 1	Set point 2	Default setting of DGs to start
Emergency operation	Mains failure	-	X	Start all DGs
Normal operation	No mains failure	X	-	Auto calculate

The default setting of the selection between set point 1 and set point 2 is made so the set point 1 is adjusted to "Auto calculation" and is used in all modes except for AMF. Set point 2 will automatically be selected in case a mains failure occurs (this is adjusted in M-Logic, *Output, Inhibits, Select Multi start set [1 or 2]*). Set point 2 is by default configured to 32 gensets, which means that all available gensets will start when the mains failure occurs.



INFO
The default setting can be changed.

4.12.2 Numbers to start

The numbers to start (menu 8922/8925) can be selected depending on the number of DGs available. The load-dependent start and stop function will be active as soon as the generator breakers are closed or, if a tie breaker is installed, as soon as the tie breaker is closed. It is possible to adjust the number of gensets, or an auto calculation can be selected.

INFO
If it is needed to delay the load-dependent start and stop function, it can be done through the M-Logic function.

Auto calculation

When auto calculation is selected, the sufficient number of gensets will be started as soon as the start command is given. This is not dependent on the plant mode.

Example

In a four DG plant, each generator is rated with 1000 kW. The set point for load-dependent start (menu 8001) is adjusted to 100 kW.

If a start command is given in fixed power mode and the set point is 2000 kW, then three gensets will be started immediately and the fourth genset will remain stopped. Three gensets will be started because two gensets are requested to supply the load (2*1000 = 2000 kW) and the load-dependent start function requests the third genset.

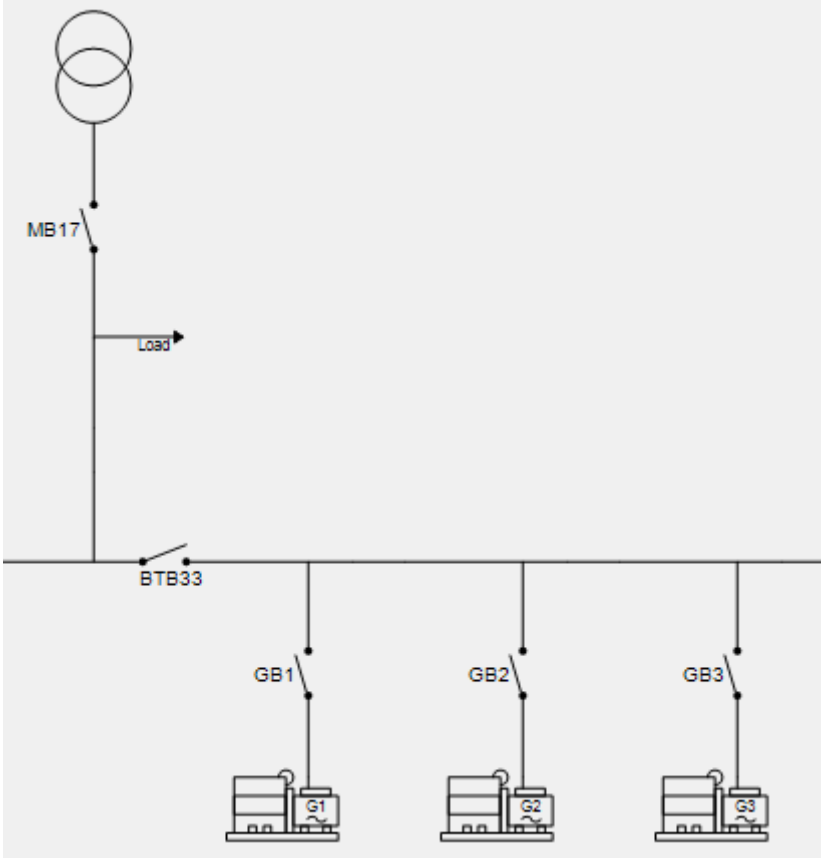
4.12.3 Minimum numbers running

The multi starting function can be combined with the setting of a minimum number of running gensets (menu 8923/8926). This means that the load-dependent stop function is disregarded when only the specific number of gensets is running. This is also the situation even though the load would justify a load-dependent stop.

INFO
"Numbers to start" (menu 8922/8925) and "Minimum numbers running" (menu 8923/8926) are available for all modes.

4.12.4 Multi-start all sections

This function can be used to start the generator section faster or to force the section to start if there is a mains failure. The application must include BTBs, with the generators in a section with no mains controller (as shown below).



The multi-start settings determine how many gensets start in the section. A genset only starts if:

- It is in island mode.
- The controller requesting help is a mains controller in AMF.
- The function is activated in the genset controller using M-Logic *Output, Command, Multi start all sections - this section*.

4.12.5 Fast start of engine

In some situations, a fast response of the power management system is desirable. This function makes it possible to initiate the start sequence of the engine with a minimum delay.

One application could be an AMF system, in which it is desirable to minimise blackout time after a mains failure. Another application could be an island system, in which the fastest possible start-up is desirable.

For fast start of engine to be activated, some requirements in DG controllers must be met; these are listed below:

General requirements in the DG controller for fast start of engine:

- Option M4 with protocol interface version 1.01.4 or higher (check in jump menu 9070)
- Run coil setup delay, parameter 6151: Timer must be set to 0.0 sec.
- Start prepare delay timer, parameter 6181: Timer must be set to 0.0 sec.
- DG controller in AUTO
- Parameter 6070: Power management

General recommendations in the DG controller for fast start of engine:

- MultiStart: Set to 32 DG (both 8922 and 8925)

Power management, DG display showing "READY ISLAND - AUTO" :

- Digital input 117 must be configured as "Auto start/stop" via "I/O list" in the USW
- M-Logic output activated: *Output, Command, Fast start sequence from Auto start/stop via Digital input 117*

Power management, AMF with MAINS controllers:

- M-Logic output activated (in the genset controllers): *Output, Command, Fast start sequence from Mains via Power management*
- M-Logic output activated (in the genset controllers): *Output, Command, MultiStart all sections - this section*

To verify that the fast start of engine is active, two events related to this feature can be found in M-Logic in a DG controller:

- *Event, Events, Fast start sequence from Auto start/stop via Digital input 117 READY*
- *Event, Events, Fast start sequence from Mains via Power management READY*

4.13 Load management

Load management activates a relay when a specific amount of power is available. This function allows the AGCs to connect load groups when the gensets of the emergency power plant are running.

In each of the gensets, five levels can be configured (menus 8220-8260):

- Available power 1
- Available power 2
- Available power 3
- Available power 4
- Available power 5

These set points can activate a relay when the specific amount of available power is reached. The relay output can be used for connecting load groups. The relays activate when the available power is higher than the set point. Note that when the load groups are connected, the available power decreases. The relay(s) deactivate if the available power is below the set point. An external holding circuit is therefore necessary.

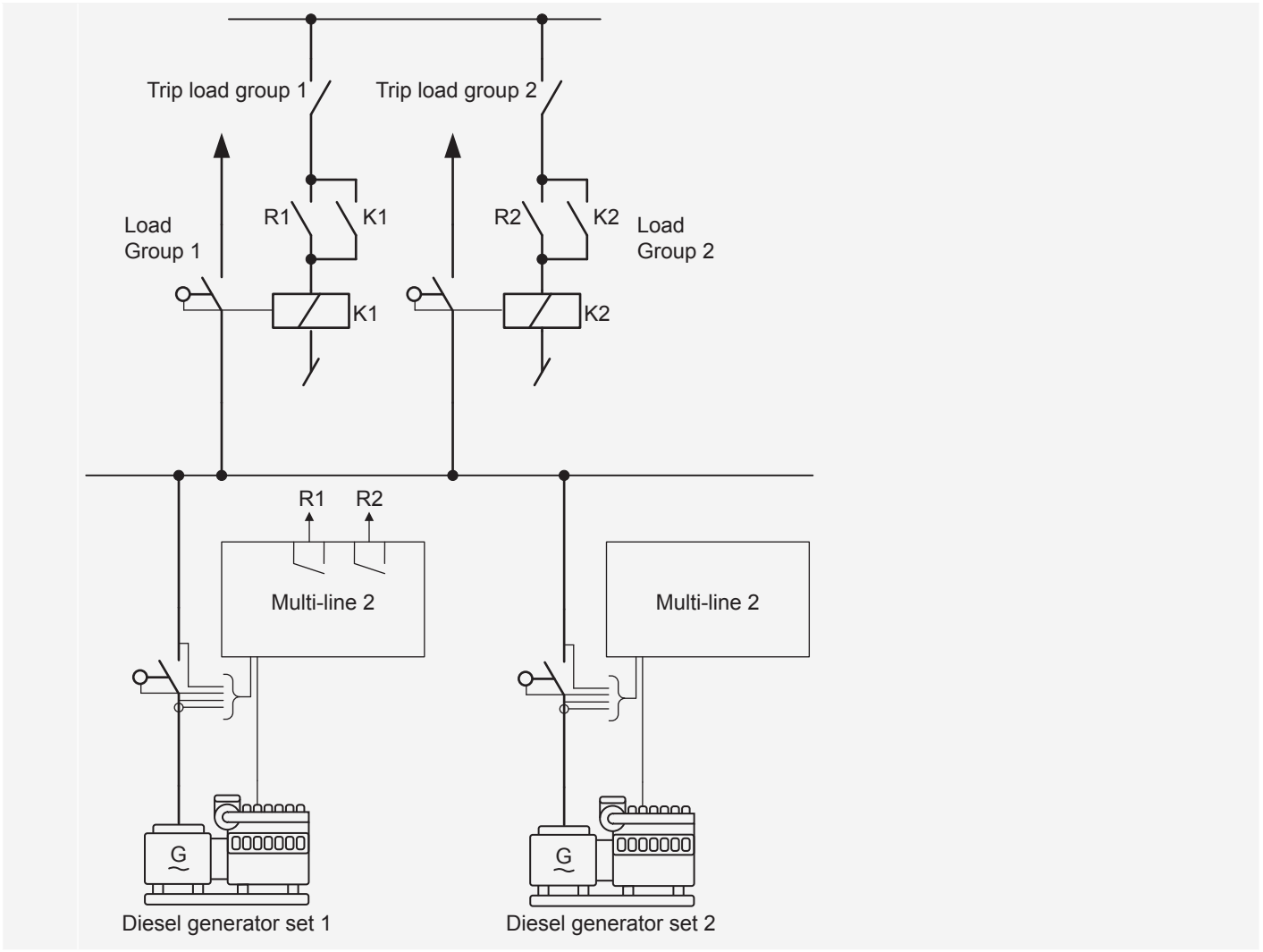
INFO
The number of available relays is option-dependent.

INFO
For more information about inhibits, see the **Designer's Reference Handbook**.

It is possible to configure different levels of available power in all gensets. This allows several load groups.

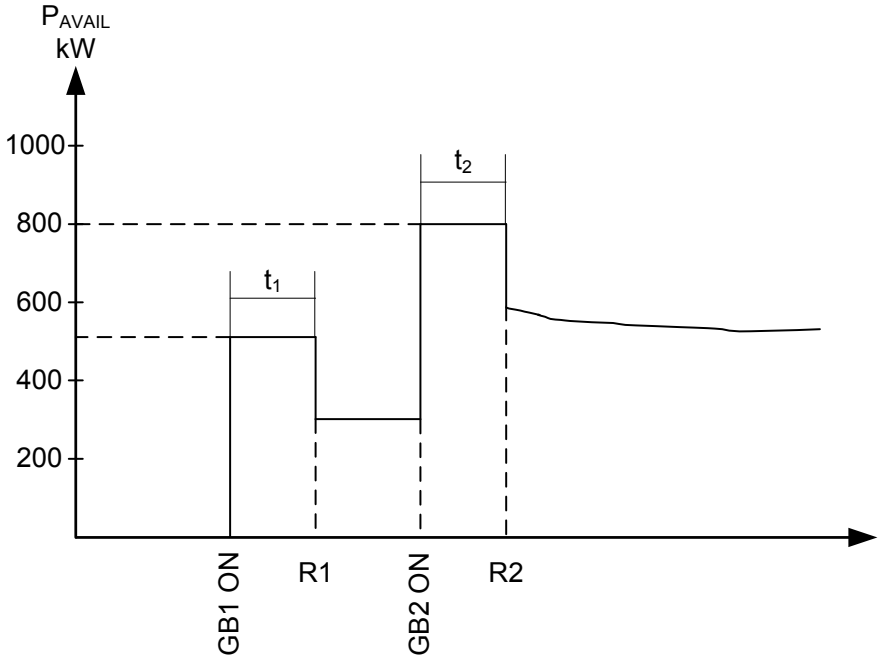
Load management example

In the simplified diagram below, generator 1 is started followed by generator 2. The two load groups are connected by the available power relays R1 and R2 on AGC1.



4.13.1 How load management works

In the diagram below, generator 1 is started. Timer t1 starts running when GB1 closes. When t1 expires, the selected relay activates (R1), and in the example a 200 kW load group is connected. Now the available power falls to 300 kW. After some time the generator 2 is started and its generator breaker is synchronised. When GB2 closes, timer t2 starts. When timer t2 expires, the selected relay activates (R2), and the second load group of 200 kW is connected. Now the available power falls to 600 kW.



To connect the load groups, the relays can be selected on each AGC or on only one of the AGC controllers.

4.13.2 Busbar measurement failure

If a genset controller loses voltage detection on the busbar and other controllers can detect voltage on the busbar, the alarm *BB meas failure* (menu 8921) appears in the controller with no voltage measurement. This alarm prevents the specific controller from closing the GB.

4.14 Ground relay

The ground relay function ensures that the star point of only one connected genset is connected to ground during island operation. This prevents circulating currents between the generators.

INFO
The relay for this function must be selected in each genset controller.

How it works

The ground relay function follows the following principles:

- If the genset is not connected to the busbar (that is, the genset breaker is open), the ground relay does not consider the rest of the system.
  - If the close condition is met, the ground relay is closed.
  - If the open condition is met, the ground relay is open.
- If more than one genset is connected to the busbar, then power management ensures that only the ground relay of the biggest genset stays closed. The ground relays of all other gensets are opened.
  - If the gensets are the same size, then the ground relay of the connected genset with the highest priority is closed.
- A new genset can connect to the busbar. If it is bigger (or the same size and a higher priority) than the genset with the closed ground relay, the new genset keeps its ground relay closed. The other genset opens its ground relay.
- The close condition, open condition and ground relay type are configurable.

Safety

CAUTION
Do not use the ground relay function when the gensets run in parallel with a mains connection.

The ground relay function is NOT supported in a **Single DG** application, even if the controller has power management.

More information
When a genset controller is in racked out breaker mode it is not possible to close the ground relay. See the **Designer's reference handbook** for more information about racked out breaker.

Ground relay parameters

Parameter	Name	Range	Default	Description
8121	Ground relay: Output A Ground relay: Output B Ground relay: Enable	Relays Relays OFF, ON	Not used Not used OFF	Enable the function and configure the AGC relay output for the ground relay. See parameter 8126 too.
8124	Ground failure: Timer Ground failure: Fail class	1 to 30 s	1 s Block	An alarm for the unusual situation where power management expects a genset's ground relay to close, but it does not. This may be due to a physical fault with the ground relay.
8126	Gnd relay type	Continuous Pulse	Continuous	**Continuous**: When the ground relay must be closed, the *Output A* relay selected in 8121 is activated continuously. **Pulse**: Configure Output A to open and Output B to close the ground relay. Ground relay breaker feedback is required.
8151	Gnd close conf	Hv/V OK RPM MPU level RPM EIC level Start active	Hv/V OK	Ground relay close condition. **Hv/V OK**: The ground relay closes if the generator voltage and frequency (parameters 2111 to 2114) are okay. **RPM MPU level**: The ground relay closes when the RPM measured by the MPU reaches the value in 8153. **RPM EIC level**: The ground relay closes when the RPM from the EIC reaches the value in 8153. **Start active**: The ground relay closes when the genset start is active.
8152	Gnd open conf	After cooldown After extended stop	After cooldown	Ground relay open condition. **After cooldown**: The genset breaker is open, and the cooldown must be completed before the AGC opens the ground relay. **After extended stop**: The genset breaker is open, the cooldown is complete, and the extended stop must be completed before the AGC opens the ground relay.
8153	Gnd close RPM	0 to 4000 RPM	1000 RPM	If *RPM MPU level* or *RPM EIC level* is selected in 8151, the RPM must reach this value before the AGC closes the ground relay.

Ground relay with breaker position

Position feedbacks from the ground relay are required for a pulse relay. Select these in the input list:

Ground relay failure alarms

Parameter	Name	Range	Default	Description
8131	Gnd Open fail	1 to 30 s	Timer: 1 s Fail class: Trip GB	Ground relay open failure. The AGC deactivated its output, but the ground relay did not open before the timer ran out.
8133	Gnd Close fail	1 to 30 s	Timer: 1 s Fail class: Block	Ground relay close failure. The AGC activated its output, but the ground relay did not close before the timer ran out.
8135	Gnd Pos fail	1 to 30 s	Timer: 1 s Fail class: Trip GB	Ground relay position failure. The breaker feedbacks are inconsistent for the specified time.

INFO
There is always an overlap where both ground relays are connected when transferring the ground relay from one genset to another. This function is not backwards compatible after software version 4.79.

4.15 Stop of non-connected gensets

If peak shaving is selected and the imported power increases above the start set point, the genset(s) will start. If the load now drops below the start set point, it will remain disconnected from the busbar but will not stop, because the imported power is higher than the stop set point.

The function "stop of non-connected DGs" (menu 8140) will make sure that the gensets stop after the adjusted time.

In other modes, the generator will also be stopped if it is in automatic without the GB closed.

5. BTB functions

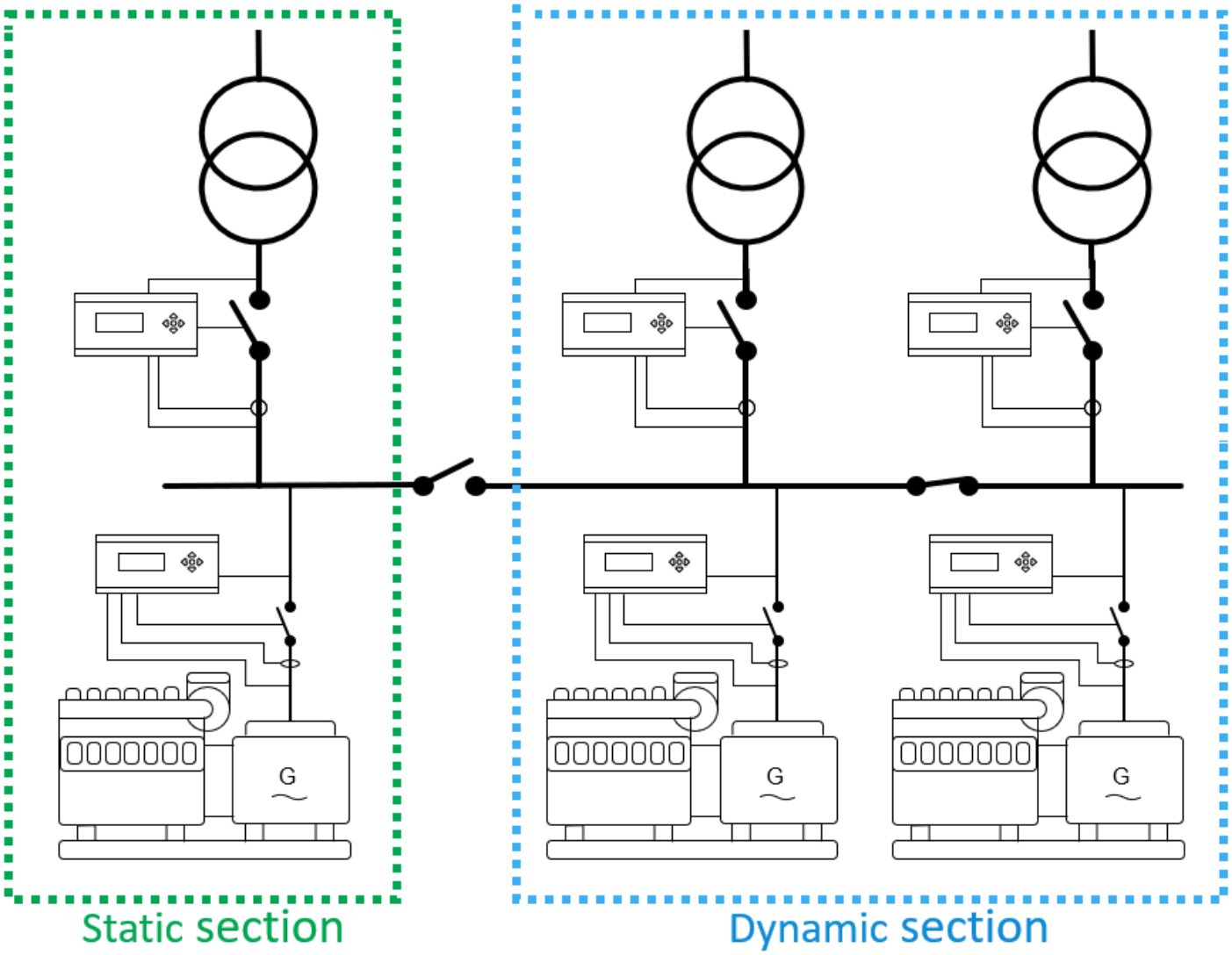
5.1 Definitions

Sections

The application consists of static and dynamic sections if one or more BTBs are installed. If no BTBs are installed, the application consists of a static section only. In this case, the dynamic section is the static section.

Section type	Definition
Static section	The smallest busbar section that the power management system can be divided into. There are no BTBs inside a static section.
Dynamic section	A continuous busbar section. This can be separated from the rest of the application by one or two open BTBs. There are no open BTBs inside a dynamic section. There may be one or more closed BTBs within the dynamic section. You can think of a dynamic section as two or more static sections, with the bus tie breakers between the static sections closed.

Static and dynamic section example



5.2 Fail class

The BTB controller fail classes are:

- Block: An open BTB cannot close.
- Warning
- Trip BTB: The bus tie breaker is opened.

5.3 Handling settings for sections

For applications with bus tie breakers, sections can have different power management settings. The power management settings for the sections therefore need special attention.

Common settings

Common settings refers to the power management settings that must be the same for all the controllers in a section. These include the load-dependent start-stop settings, and the mains controller plant mode.

Principles

The section settings handling follows these principles:

- In a static section, every change to the common settings automatically changes and **stores** the common settings in all the controllers in the section.
- When a BTB closes and a dynamic section is formed, the power management system ensures that all the controllers have the same common settings (see below). The user can also change parameters to make changes to the common settings. However, these common settings are **not stored**.
- You can use the M-Logic command *Store common settings* to force the power management system to **store** the dynamic system's common settings in each controller.
- When a BTB opens and a static section is formed, all the controllers in the static section return to their **stored** common settings.

Dynamic sections

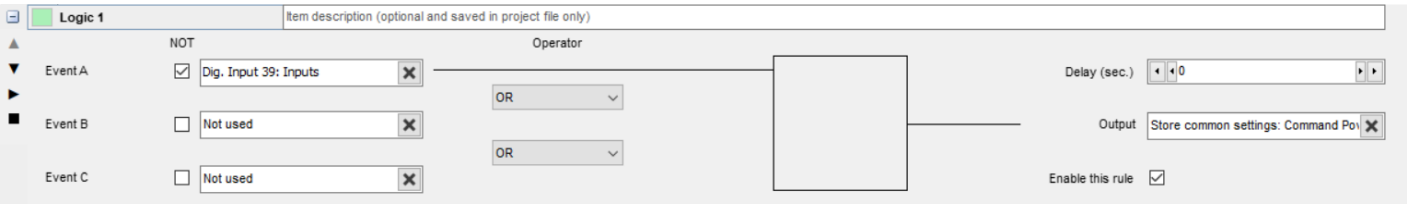
The power management system ensures that all the controllers have the same common settings. For example, if the BTB between a section with *Run all mains* closes to join a section with *Run one mains*, the new dynamic section must have one setting.

When the BTB closes, the power management system uses the application information in a weighted calculation to decide which section's settings to use. If the sections have the same weight, the power management settings in the right busbar section (BB) inherit the values from the left section (BA).

The stored common settings are not automatically updated when there are changes in the dynamic section. The changed dynamic section settings are lost when the BTB opens, since each controller returns to its stored common settings.

You can use the M-Logic command *Store common settings* to force the power management system to store the dynamic system's common settings in each controller.

Example of M-Logic to store section settings



INFO
When the settings are stored, the input must be activated for at least one second.

5.4 Ring busbar

If the busbar forms a ring (that is, the last section can be connected to the first section), you must include this in the application configuration. Under *Application configuration, Plant options, Bus Tie options*, select *Wrap bus bar*.

To allow the power management system to close the last breaker, select enable in *Closed ring* (parameter 8991).

5.5 Breaker power supply

The bus tie breaker power supply must be specified in the application configuration.

DC breaker

A direct current (DC) breaker is supplied from the switchboard power supply. Select *Vdc breaker*. It can operate if there is a blackout.

AC breaker

An alternating current (AC) breaker is supplied from the busbar. Select *Vac breaker*. It cannot operate if there is a blackout on both busbars. The breaker can operate when either of the busbars is live.

If there is a blackout on both busbars and the operator tries to close the BTB, then the power management system will start a genset.

5.6 Plant mode

For a bus tie breaker controller, the plant mode defines when a mains controller can request help. That is, a mains controller can request that the BTB close if the plant mode is:

- Automatic Mains Failure
- Load take over
- Island operation

For these plant modes, a BTB will not close automatically, even if more power is needed:

- Fixed Power
- Peak shaving
- Mains Power Export

5.7 Test mode

For a BTB controller, the BTB test response depends on the mains controller test mode. The BTB controller does not have a test mode.

For a bus tie breaker controller, a mains controller can request that the BTB close if the test mode is:

- Full test

For these mains controller test modes, a BTB will not close automatically, even if more power is needed:

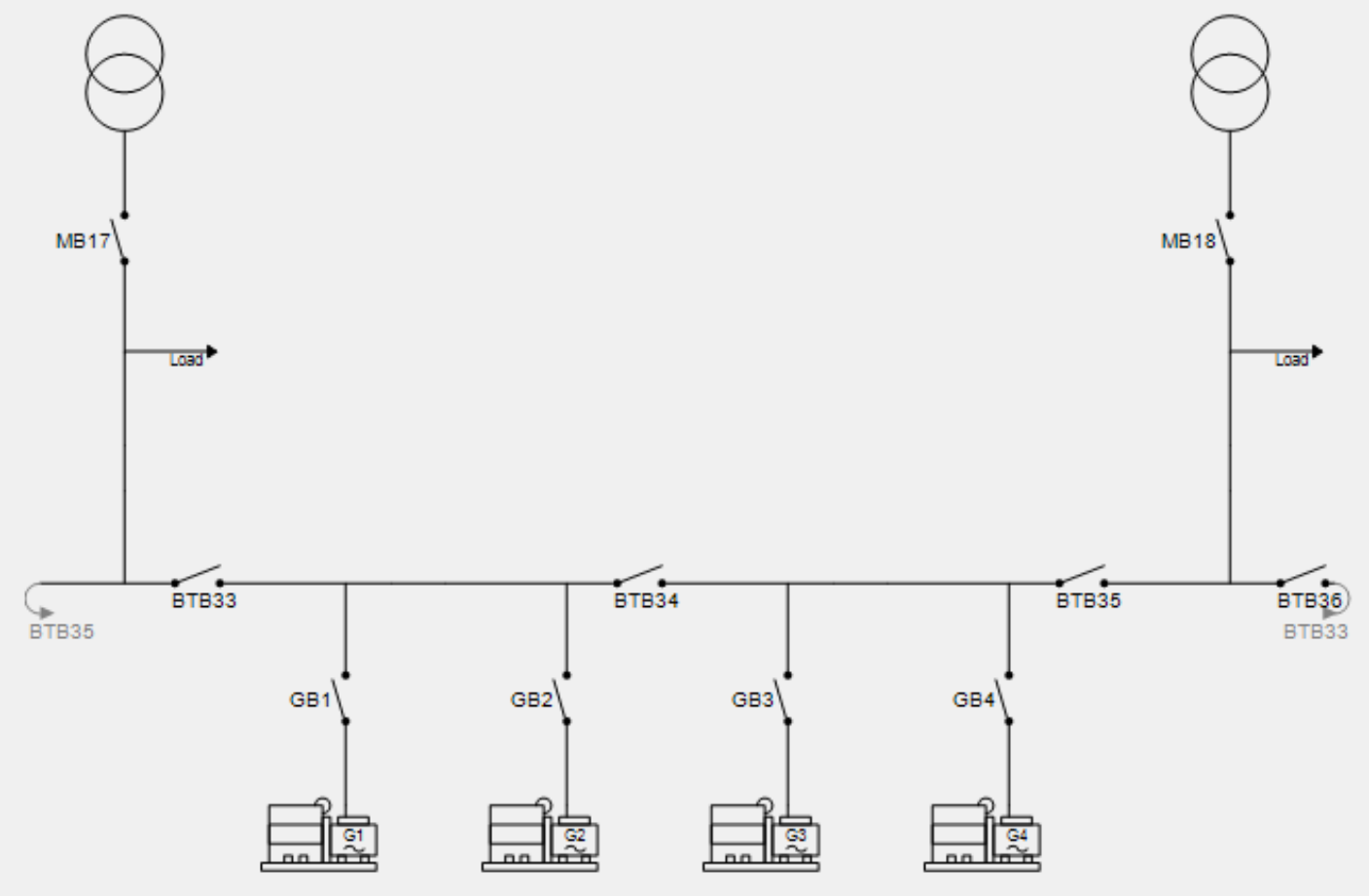
- Simple test
- Load test

5.8 BTB direct close (special M-Logic function)

This function bypasses the normal BTB close check procedure. The function can be enabled through two M-Logic commands: *Output, Command, Direct close on dead BA and dead BB* and *Output, Command, Direct close breaker on dead BA or dead BB*.

Direct close on two dead busbars

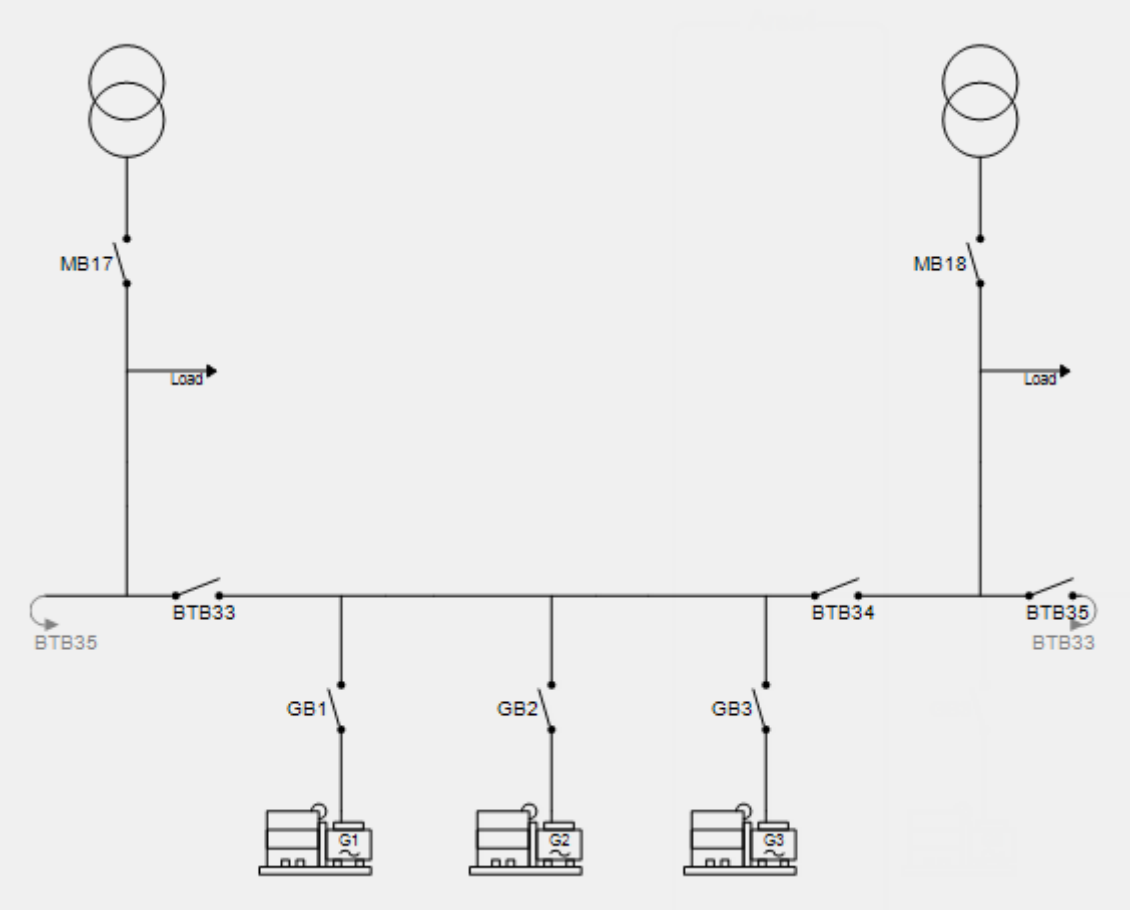
Direct close on dead BA and dead BB is for when a fast close of a BTB is needed, and there is no voltage on either side of the BTB. For example, in the application below, the two genset sections are closed together before a CBE start of all the gensets. The busbar is dead BB if the voltage is below 10 % of nominal value.



CAUTION
It can be very dangerous to use *Direct close breaker on dead BA or dead BB* in this application, because two generator sections are present.

Direct close on one dead busbar

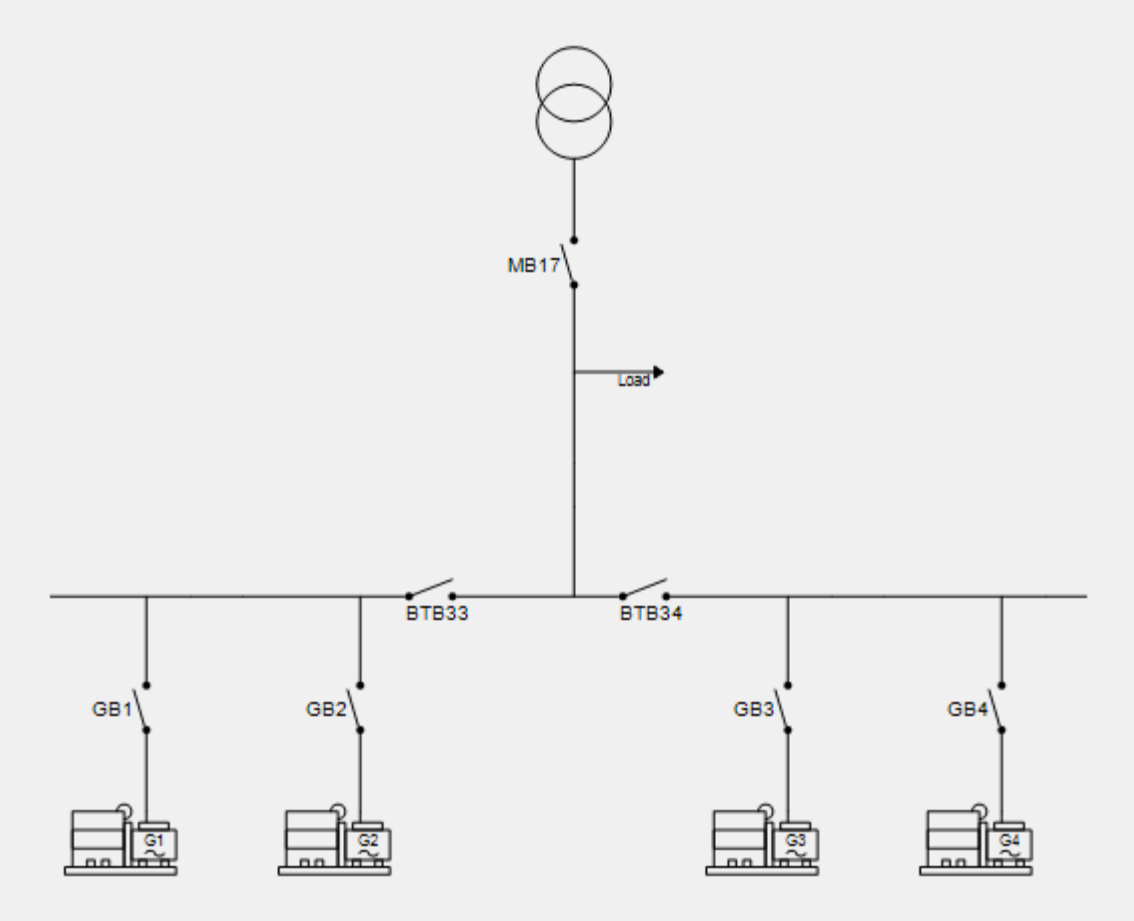
Direct close breaker on dead BA or dead BB is for when a fast close of a BTB is needed, and where one of the sides of the BTB has a voltage present when the closing is intended. This could be in an application as shown in the picture below. It could be that the genset sections are started and when Hz/V is OK, BTB33 and BTB34 are closed at the same time.



INFO
It is okay to use *Direct close breaker on dead BA or dead BB* in this application, because only one generator section is present.

Safety issues

To highlight potential danger, another example is shown below. This application has two genset islands with BTB in front of them. If *Direct close breaker on dead BA or dead BB* is used, and they get a close signal at the same time, a bad synchronisation occurs. This is because both BTBs are looking at a dead busbar and direct close is enabled. There are two ways of avoiding this: Either do not use *Direct close breaker on dead BA or dead BB*, or use an interlock on the BTB breakers.



CAUTION

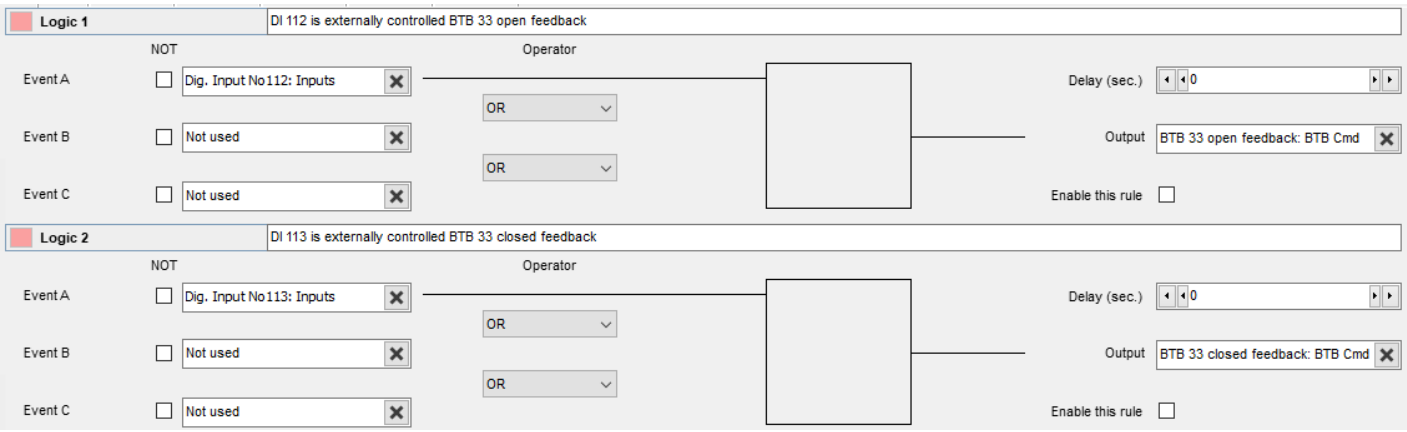
In all applications it is important to be sure that while the BTB or BTBs are asked to close, no MB can close. Similarly, do not allow two BTBs to close simultaneously if this could connect two unsynchronised genset sections. Since the normal BTB close check procedure is bypassed, two different energy sources can be connected through a dead bus without checking the synchronisation. The system designer has to include safety interlocks.

5.9 Externally controlled BTB

The application can include externally controlled BTBs. These BTBs are assigned an ID number in the application configuration (without an AGC-4 BTB controller). In total, there can only be 8 BTBs (AGC-4 controllers and externally controlled) in the application.

The breaker feedbacks for each externally controlled BTB must be wired up to an AGC-4 controller. The feedbacks are configured using M-Logic.

Example of externally controlled BTB feedbacks



The power management system monitors the external controlled BTB feedbacks and responds to changes in the breaker position. For example, when the BTB is opened, power management detects that there are new busbar sections.

6. Mains functions

6.1 Plant mode

For power management to work, in the mains controller(s), for *Plant mode* (parameter 6070), you must select the required plant mode. If there are no BTBs, you only need to set the plant mode in one mains controller. If there are BTBs, set the plant mode in a mains controller in each section.

In addition, each mains controller should be in AUTO mode. If a controller is not in AUTO mode, it will not automatically respond to power management requirements.

Parameter	Name	Range	Default
6070	Plant mode	Island operation Auto. Mains Failure Peak shaving Fixed Power Mains Power Export Load take over	Auto. Mains Failure

6.2 Test mode

For a mains controller, the test mode does not depend on the plant mode. The test mode determines whether or not the mains breaker and/or tie breaker closes.

Use parameters 7041 to 7044 in the mains controller to configure the mains test. Note that the load-dependent start-stop settings and the multi-start settings are also used in the test. During the test, only the gensets required to supply the test load will start.

6.3 Fail class

The mains controller fail classes are:

- Block: An open MB or TB cannot close.
- Warning
- Trip TB: The tie breaker is opened.
- Trip MB: The mains breaker is opened.
- Trip TB/MB: The controller first tries to open the MB. If no MB exists, the controller opens the TB. If an MB exists but is already open, the controller does not open the TB.

6.4 Synchronisation of MB, GB and TB

The mains controller parameters and breaker positions determine whether the power management system will synchronise across a breaker.

Synchronisation parameters

Parameter	Name	Range	Default	Details
7083*	Back synchronising	Not enabled, Enabled	Not enabled	**Not enabled**: Power management will not synchronise across the MB to the busbar. The MB can however close if the TB is open, since no synchronisation is required. If gensets are connected to the busbar, the TB cannot close if the MB is closed, since that would require back synchronisation.

Parameter	Name	Range	Default	Details
				Enabled: Power management can synchronise across the MB to the busbar. If the MB is closed, power management can also synchronise across the TB to the busbar.
7084*	Sync. to mains	Not enabled, Enabled	Enabled	**Not enabled**: Power management will not synchronise across the GB to the mains. The GB can however close if the MB is open, since no synchronisation is required. **Enabled**: Power management can synchronise across the GB to the mains.

*Note: These parameters are also present in genset controllers. When there is a mains controller, the power management system ignores the genset controller settings.

6.5 Mains power measurement

The mains power measurement is used for de-loading the mains breaker for all the plant modes. It is also used for peak shaving, mains power export, some grid protections, and so on. You can select the mains power measurement in parameter 7263.

Parameters

INFO
Scaling (parameter 9030) affects the range for the following parameters*. The values below are based on 100V-25000V.

Parameter	Name	Range	Default	Details
7263	Mains P measure	Multi input 102 (transducer) 3ph CT power meas CIO308 1.14 (transducer)	Multi input 102 (transducer)	Select the analogue input/measurement for the mains power. See below for details.
7261	Transducer Range	0 to 20000 kW*	0	Mains power transducer maximum. If this and 7262 are 0, the transducer measurement is not used.
7262	Transducer Range	-20000 to 0 kW*	0	Mains power transducer minimum. If this and 7261 are 0, the transducer measurement is not used.
10980	Multi inp. conf. 102	4-20mA 0-40VDC ...	0-40VDC	

Setting up a multi input

Connect the multi input to the power measurement transducer, for example, a DEIF TAS-331. Configure parameters 10980, 7263, 7261 and 7262.

Setting up current transformers

Select *3ph CT power meas* in parameter 7263.

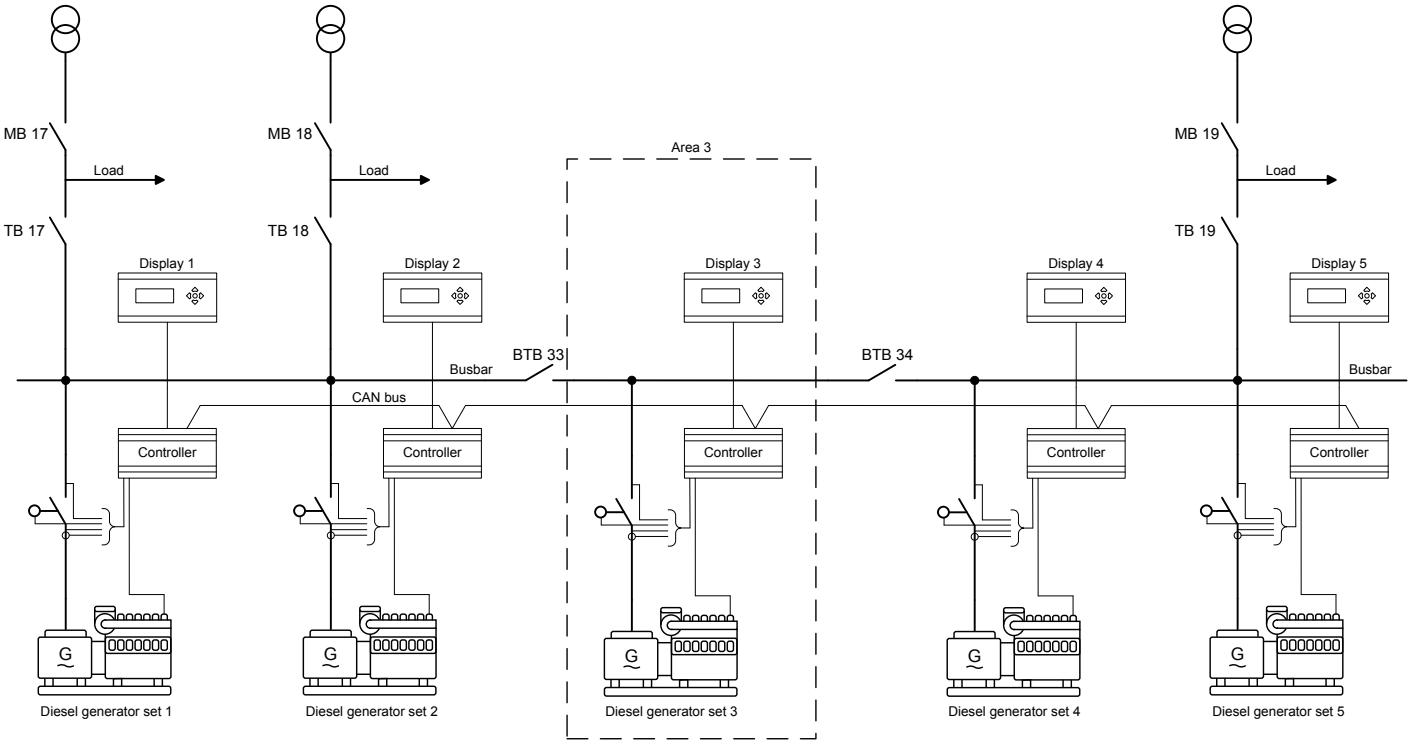
Setting up a CIO308 1.14

To configure the CIO analogue input, select the CIO icon:  . Configure parameters 7263, 7261 and 7262.

More information
See **Mains power transducer** and **Mains reactive power or voltage transducer** in the **Designer's reference handbook** for more information.

6.6 Multiple mains

The AGC can be used in an application with multiple mains incomers. This is an example of the multiple mains application:



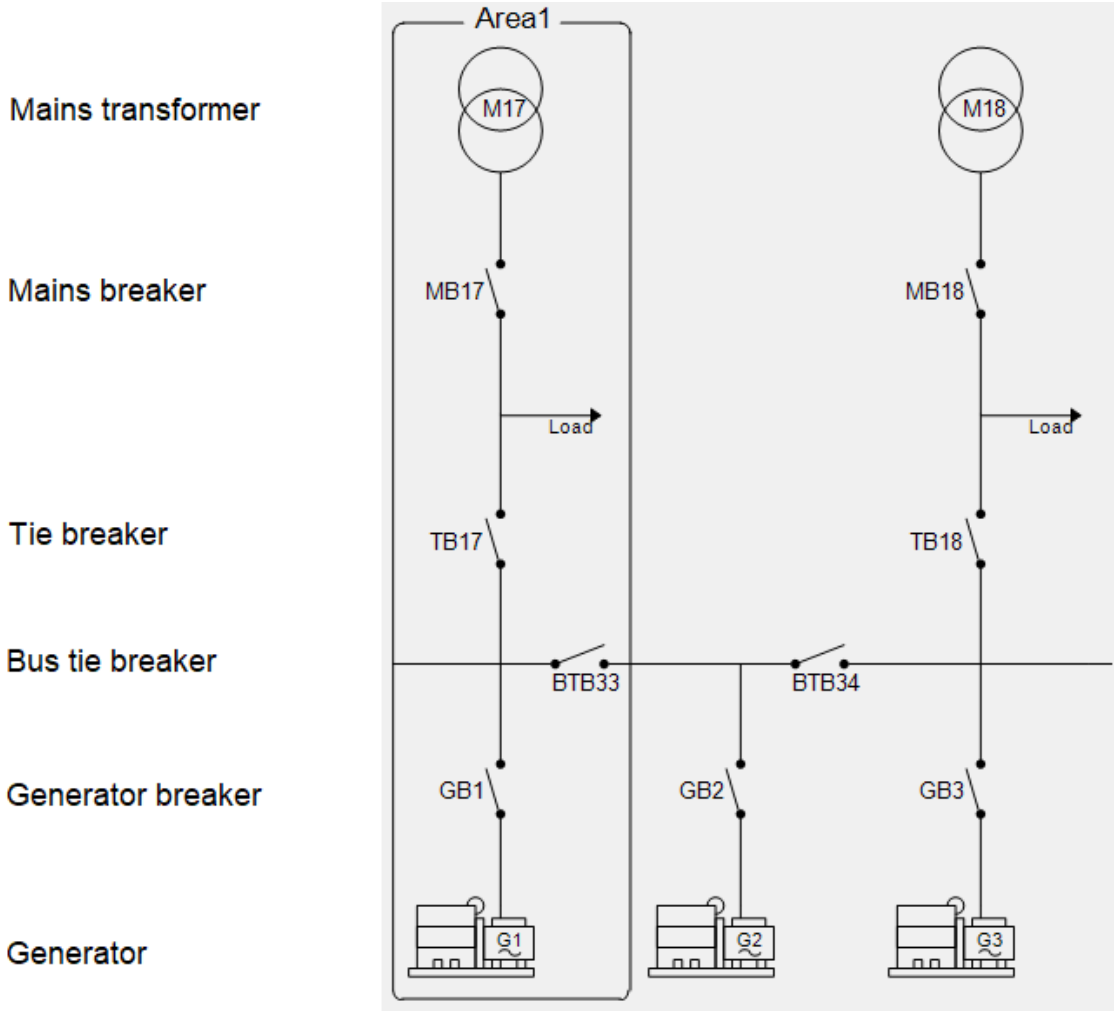
Each application can handle:

- 0 to 32 mains controllers in the same application
- 0 to 32 genset controllers in the same application
- 0 to 8 bus tie breaker controllers

INFO
The multiple mains functionality covers a wide variety of applications. Contact DEIF support (support@deif.com) if you have questions.

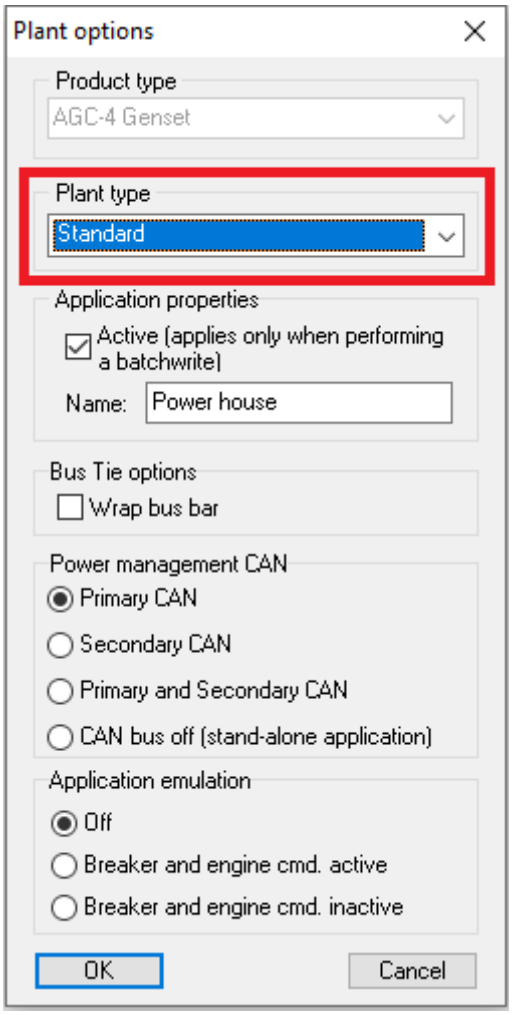
6.6.1 Definitions

A multiple mains application has more than one mains connection. It can include feeders and generators, as well as GBs, TBs, BTBs and MBs.

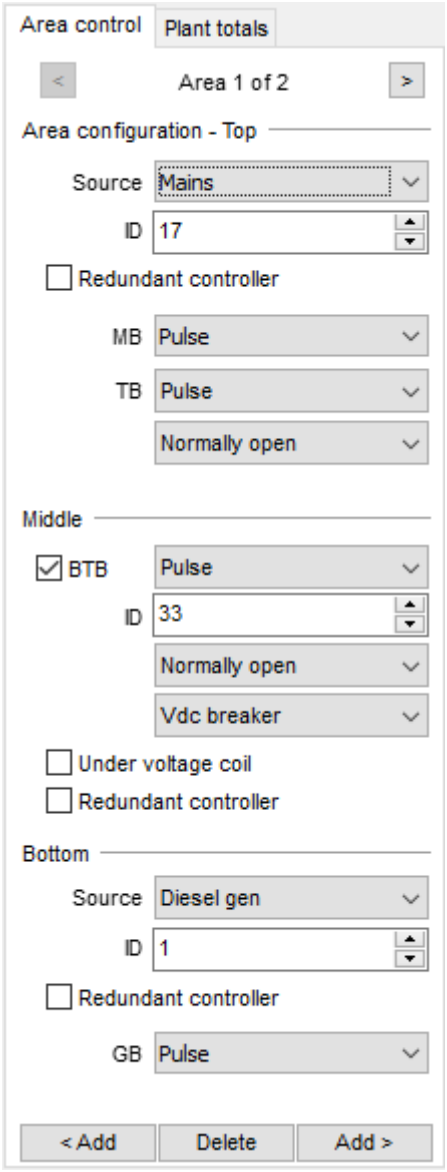


6.6.2 Configuration

Select **Standard** in the plant configuration tool to configure this application.



Now the application can be configured using the section control panel.



6.6.3 Plant mode handling

Parameters (mains controller)

No.	Setting		Range	Factory setting	Details
8181	MB failure start	Enable	Disable/Enable	Disable	See below.
8182	Parallel	Enable	Disable/Enable	Disable	See below.
8183	No break transfer	Enable	Disable/Enable	Disable	See below.
8184	Auto switch	Enable	Off Static section Dynamic section All sections	Off	See below.
8185	Run type	Run one/all mains	Run one mains Run all mains	Run one mains	See below.
8186	Run type	ID to run	1 to 32	32	The mains controller to run when 8185 is *Run one mains*.
8196	Excl. run all	Enable	Disable/Enable	Disable	**Disable**: No effect.

No.	Setting	Range	Factory setting	Details
				Enable: If 8185 is *Run all mains*, then this mains controller is not included in the mains to run. Alternatively, toggle this parameter with M-Logic, *Output, Inhibits, Exclude from Run All sequences*, and *Include in Run All sequences*.

MB close failure start

Parameter 8181 determines DGs should start if an MB close failure occurs.

INFO
If *MB failure start* is activated, the mode shift function is automatically enabled.

MB parallel

Parameter 8182 determines whether the mains connections (MBs) can run in parallel.

INFO
The setting of *MB parallel* affects the function of the *Auto switch* setting.

No break transfer

Parameter 8183 determines whether switching between the mains connections (MBs) is a black coupling or a synchronised coupling.

If the TBs in a section are normally closed and *MB parallel* is disabled, then only one of the TBs can be closed at the time.

The system tries to keep the ID selected in menu 8186 (*Run type*) to keep its TB closed. If, however, the selected ID does not have a TB configured as a normally closed breaker, or if it fails to close it, then the mains controller with the lowest ID without TB failures present will close.

If *Run type* (8186) is changed during operation, then the *MB parallel* setting decides whether there is a black or a synchronised change-over.

INFO
If *MB parallel* is activated, then *No break transfer* is automatically enabled.

Auto switch

Parameter 8184 determines whether a mains controller detecting a mains failure tries to get the connected load supplied by another mains or by the available DGs.

	Description
OFF	The auto switch function is switched OFF.
Static section	The back-up power must come from its own static section.
Dynamic section	The back-up power must come from its own dynamic section. The application never tries to synchronise/close a BTB to get help in an AMF situation.
All sections	The back-up power can come from all available sections.

INFO
Sections are divided by bus tie breakers. If no BTBs are installed, then the settings static, dynamic, and all have the same auto switch function.

CAUTION
If dynamic is selected, one mains controller is requested to carry all load from the dynamic section without any help from the gensets. Therefore the remaining mains feeders must be able to carry the load from the entire section.

Run type

Parameter 8185 determines how the system in a dynamic section reacts in all the plant modes, except island and AMF.

	Description	Comment
Run one mains	Only one mains breaker can be closed at a time.	*Run type* (menu 8186) determines which mains feeder is allowed to operate parallel to the mains. If other TBs are closed, they will be tripped so that only the TB of *Run type* is closed. If no TB is available in the section, the MB will be tripped (causing a blackout).
Run all mains	All mains breakers can be closed at the same time.	

Alternatively, you can use M-Logic, *Output, Command* in a mains controller:

Command	Effect when activated
Run my ID - constant	Close the mains breaker and (if possible) keep it closed.
Run my ID - activate	Close the mains breaker.
Run one mains	Close only one mains breaker at a time in the application.
Run all mains	Close all the mains breakers (if possible).

You can use M-Logic, *Events, Events* in a mains controller to see the status:

Event	Activated when ...
My ID to run selected	The mains controller selected to close its breaker.
Run one mains selected	Only one mains breaker is allowed to be closed at a time.
Run all mains selected	All mains breakers are allowed to be closed simultaneously.

6.7 Applications with an ATS

6.7.1 External ATS with an AGC mains controller

More information
See ATS Mains controller for the single-line diagram.

The external ATS switches between the generator supply and the mains supply. If ATS is selected in the application configuration (*MB: Ext/ATS no control*), then the AGC mains controller has no control over the ATS/mains breaker.

Description

Normally the AGC detects a mains failure based on the voltage and frequency measurement on the mains. However, when ATS is selected, you need a digital input (*Alternative start*) and the position feedbacks from the ATS (*Remote MB On* and *Remote MB Off*). Thus, the mains failure is not detected by the AGC measurements but by:

1. *Alternative start* ON

2. ATS (MB) feedback OFF

For this function, the mains controller can control a tie breaker. This is useful if more gensets must start before supplying the load, since the tie breaker does not close until the required gensets are available.

6.7.2 External ATS without an AGC mains controller (island mode)

More information
See ATS, multiple start for the single-line diagram.

If ATS island mode is needed, the gensets can be started by activating the "auto start/stop" input. The gensets are started and stopped according to the power demand. That is, they will operate in load-dependent start-stop mode.

INFO
Since no tie breaker is installed, it is important that the first genset to close on the busbar can carry the load. If the load is too high, the genset will be overloaded. Note that this application can be combined with the multi-start function.

6.8 AGC mains controller acting as ATS

6.8.1 Introduction

The AGC mains controller has a built-in automatic transfer switch (ATS) function. An external ATS is therefore not required. To use the mains controller ATS function, select *Application configuration, MB, Pulse/Continuous NE/Compact/Continuous ND*.

This function is intended as a backup function if the power management CAN bus has a failure. This means that a CAN bus ID has to be missing from the CAN bus. So if the application has redundant CAN bus, the same ID has to be missing on both of them. Furthermore, the function must be set to ON from the parameter or from M-Logic.

The ATS function can also be used if the controller is placed in a configuration with only the specific mains controller. It just has to be set to ON or to be activated through M-Logic. This is described in Stand-alone mains ATS.

Common for these two situations is that all breaker operation on the specific controller will be an open transition. This also means that the function can only be in applications where the mains controller controls both an MB and a TB.

The ATS function settings are NOT broadcast between the controllers. This means that it is possible to activate this function in only one mains controller. For example, if one mains controller is placed at a very critical load.

6.8.2 Activation of the function

The function can be activated from the parameters or M-Logic. If the M-Logic command *Output, Mains ATS commands, Activate mains ATS functionality* is configured, the controller ignores the selection in *Mains ATS* (parameter 7251). This means that if 7251 is ON, and the conditions for activation in M-Logic are false, the function is OFF!

When the mains controller is placed in an application with other controllers, there are two conditions that must be met before the ATS function becomes active:

1. Either the parameter (7251) must be ON, or the M-Logic command must be active (remember, if the M-Logic command is configured, it is always the state of the M-Logic command that determines whether the function is active).
2. The mains controller must have an alarm with either “Any DG missing”, “Any mains missing”, “Any BTB missing”, “Any PV missing” or “Any ALC missing”.

For some applications, it could be that the end-user does not want the ATS function to become active when “Any DG missing”, due to the fact that the controller could be powered OFF because of service. In that case the M-Logic command can be helpful because it provides the possibility to make some logic that “Any Mains missing” or “Any BTB missing” or “Fatal CAN error” or “Missing all units” is the reason to switch to the ATS function.

In stand-alone - mains applications, the controller does not need any CAN bus alarm before the function becomes active. It is controlled from the parameter or the M-Logic command.

Parameter	Item	Range	Default	Note
7251	Mains ATS	ON OFF	OFF	Only in mains controller

6.8.3 Operation at CAN bus fail

The controller has three different settings regarding the behaviour when the ATS function is active. These settings are found at parameter 7253. The three settings are:

- Prioritise mains
- Prioritise busbar
- Shift at blackout

The different behaviours are described below:

Prioritise mains: The controller tries to power the load from the mains, when possible. This means that if the mains fails and there is voltage on the busbar, the load is switched to the busbar. If the mains returns, the controller runs the “Mains OK timer”. When this expires, the load is switched back to mains via open transition. This means that whenever the mains is present and the “Mains OK timer” is expired, the load is shifted.

Prioritise busbar: With this setting, the controller tries to power the load from the busbar, when possible. The controller does not check whether the busbar is powered from another mains feeder or from gensets. The only criterion is that the busbar is live. If there is then a blackout on the busbar and the mains is OK, it shifts to this source. Should the busbar return, the controller shifts with the open transition back to the busbar.

Shift at blackout: With this setting, it is almost the same as if the “prioritisation” changes dynamically according to the situation. The purpose is to minimise the transitions/blackouts and stay on the source as long as it is alive and the ATS function is active. An example could be that if a CAN bus fail occurs, the generator starts up and closes the breaker. If the mains then fails, the load is shifted to the busbar. If the mains returns, the load stays on the busbar. If the busbar should fail and the mains is OK, the load is shifted to the mains. If the situation should occur that both the mains and the busbar have a blackout at the same time, the first one that is OK again is the source that has “first priority”. If both sources are down, the ATS function skips the “OK timer” when the first one returns.

If these selections are not sufficient for the present application, it is possible to change them through M-Logic. By this, the parameter can be changed via an input or by using an AOP button.

The ATS function respects if the mains controllers parameter 7065 (Mains fail control) has been set to “Start engine” instead of “Start engine + open MB”. This means that if the mains fails, and there is no busbar voltage, the AGC does not try to open the MB. It waits until the busbar comes live. This also works in another way: as if the TB is closed and the load is powered by the busbar. If this source should fail, the TB is not operated until there is a source present again.

It is important to notice that this feature does not check which source is on the busbar, but only that the busbar is alive. Furthermore, it does not check if there is sufficient rotating power on the busbar before closing.

The genset does not start automatically in this feature. The ATS function is only placed in the mains controller. So if the genset is to start due to a CAN bus failure, it must be started in SEMI. This programming must be done by the user and can be done via M-Logic.

If there is no CAN bus failure, the ATS function is OFF. This means that the mains controllers return to normal state again. This can cause an open transition – even though the controllers are not in ATS mode anymore. If, for example, the application is made so the genset starts in SEMI and closes the breaker, the busbar is live. If the mains then fails, the load is shifted to the busbar. The mains then returns, but the load stays on the busbar due to the “Shift at blackout” setting. When the CAN bus fail is cleared, the ATS function is stopped and the mains controller returns to normal state, which could be MB closed and TB open. If the load is at the genset in SEMI, the mains controller cannot find any genset in AUTO to request to back-synchronise. So it will make an open

transition at this point. If the genset instead was switched to AUTO when the CAN bus fail was cleared, the genset would have been able to back-synchronise.

Parameter	Item	Range	Default	Note
7253	Source priority	Prioritise mains Shift at blackout Prioritise busbar	Prioritise mains	Only in mains controller

6.8.4 Stand-alone mains ATS

If the mains controller is configured to be in an application with only the present controller, the ATS functionality only needs to be enabled. It does not need any CAN bus alarms before it can become active. The selections for the prioritisation still work, and they work in the same way as described earlier.

Parameter	Item	Range	Default	Note
7253	Source priority	Prioritise mains Shift at blackout Prioritise busbar	Prioritise mains	Only in mains controller

6.8.5 Changeover time

The ATS functionality has a function that can be helpful if, for example, there are some big rotating loads. The timer set for this parameter is a minimum blackout time that the load will see at changeover. This function is active in power management applications and in stand-alone applications.

Parameter	Item	Range	Default	Note
7252	Changeover time	0.0 s 30.0 s	0.5 s	Only in mains controller

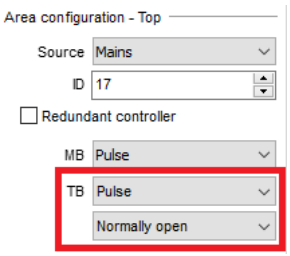
6.8.6 Additional information regarding ATS functionality

To help the user understand whether or not the ATS functionality is active in a specific situation, an M-Logic event can be used. The command is called “Mains ATS active”. The event can be used, for example, as an AOP LED or to give an M-Logic alarm.

Furthermore, it is also shown in the event log when the mains ATS function has been activated. This can be helpful if an open transition has taken place.

6.9 Tie breaker configuration

An AGC mains controllers can include a tie breaker. That is, the designer can add a breaker between the gensets and the load bus in the *Application configuration*. You can also configure the tie breaker as normally closed or normally open.



6.9.1 Tie breaker control

You can select whether the tie breaker should be open or closed when the generators are stopped. This depends on the application and the auxiliaries. If auxiliary load is connected to the generator busbar, the tie breaker must be closed. However, if no load is connected to the generator busbar, then an open tie breaker is often preferred when the generators are stopped.

The tie breaker opens or closes based on the *TB open point* (parameter 8191) only. The operating mode does not affect whether the tie breaker opens or closes.

6.9.2 Tie breaker open point

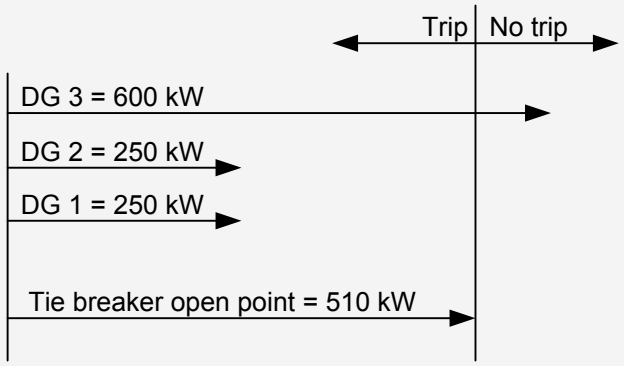
If the gensets are running parallel to mains and the mains breaker trips (for example, due to a mains failure) it can be necessary to also trip the tie breaker.

This depends on the total nominal power of the running gensets. If the gensets cannot supply the load in the *TB open point* (parameter 8191), then the tie breaker opens. It closes again when the *Power capacity* (parameter 8192) is reached.

This delay time in *TB Load time* (parameter 8195) can be used to trip non-essential load groups.

TB open point example

In the diagram below, the nominal powers of the gensets in the application are shown. The tie breaker trips if DG1 or DG2 is connected to the load, because they are smaller than 510 kW. If DG1 and DG2 are running together, the tie breaker also trips, because the total nominal power is still below 510 kW. If, however, DG3 is running alone or together with one of the two smaller DGs, then the tie breaker does not trip, because the total nominal power is higher than 510 kW.



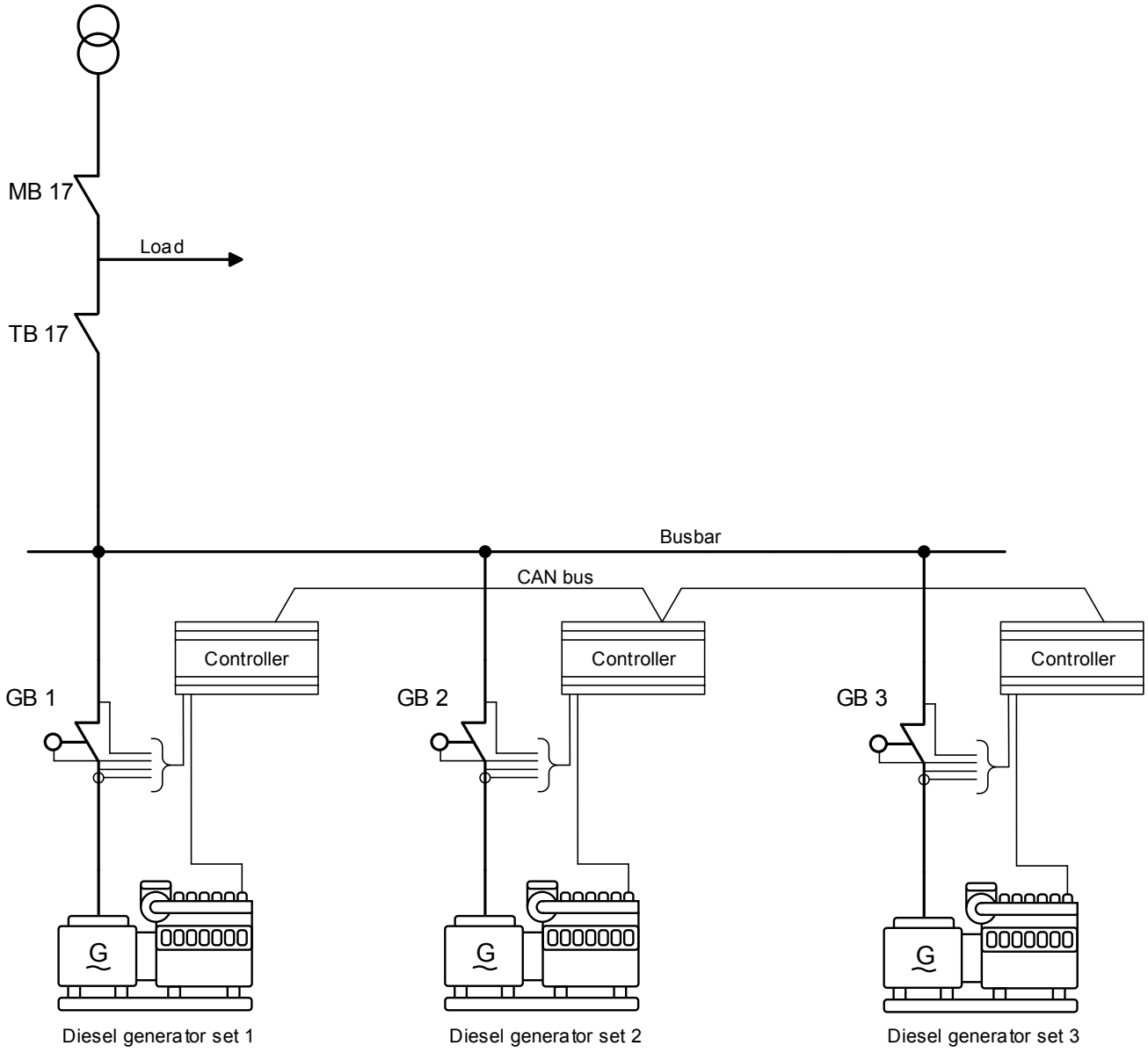
INFO
It is possible to deload the tie breaker semi-auto mode, using M-Logic *Output, Command, Act. TB deload*.

6.9.3 De-load sequence

This paragraph describes how a de-load sequence in a power management system functions when changing from generator to grid connection as power supply.

This could be relevant when reconnecting to the mains after an AMF situation, or when an auto start/stop signal has been removed from a peak shaving setup, fixed power setup, and so on.

The diagram illustrates the explanations below on the two different ways of de-loading where either the GB or the TB opens first.



GB de-load sequence (standard)

The GBs open when the “Power ramp down” set point is reached while de-loading. When all the GBs have been opened, the TB opens.

1. Auto start/stop signal has been removed/leaving AMF sequence.
2. Diesel generator set 1, 2 and 3 de-load.
3. GB 1, 2 and 3 open when “Power ramp down” set point is reached.
4. TB 17 opens.

Controller type	Description	Comment
AGC-4 DG	Power ramp down (parameter 2622)	Maximum load on GB before open

TB de-load sequence

When "Deload TB back sync." is enabled, the generators de-load and when “TB open point” is reached, the TB opens before the GB. This prevents the available power from decreasing on the BB until the TB is opened.

1. Auto start/stop signal has been removed/leaving AMF sequence.
2. Diesel generator set 1, 2 and 3 de-load.
3. TB 17 opens when “TB open point” is reached.
4. GB 1, 2 and 3 open.

Controller type	Description	Comment
AGC-4 MAINS	Deload TB back sync. (parameter 8273)	Enable/disable
AGC-4 MAINS	TB open point (parameter 8191)	Maximum load on TB before open

CAUTION
If the input type for the TB de-load function is not configured, the TB opens without de-loading.

6.9.4 Busbar Hz/V OK

Mains

The voltage and frequency on the busbar must be continuously within the limits of the delay timer in menu 6220, before the breaker can be closed.

Genset

The generator voltage and frequency must be continuously within the limits of the delay timer in menu 6220, before the breaker can be closed.

6.9.5 Power capacity

The *Power capacity* in parameter 8192 is used in AMF applications to determine how much power must be available, before the tie breaker can close. When the gensets are started, the generator breakers will close, and when sufficient power is available, then the tie breaker will be closed.

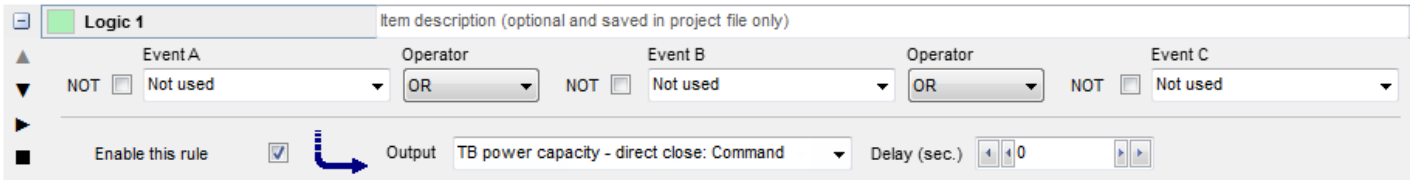
If there is more than one tie breaker in the power management system, the tie breaker with the lowest power capacity is closed first.

Power capacity overrule

If some of the gensets fail to start and the power capacity set point is not reached, the tie breaker will never be closed. Because of this, it is possible to overrule the power capacity set point after a period of time set in parameter 8193. The power capacity overrule timer starts after one of the gensets has a fault with a fail class that will stop the genset from connecting to the busbar. Power capacity overrule is enabled in parameter 8194.

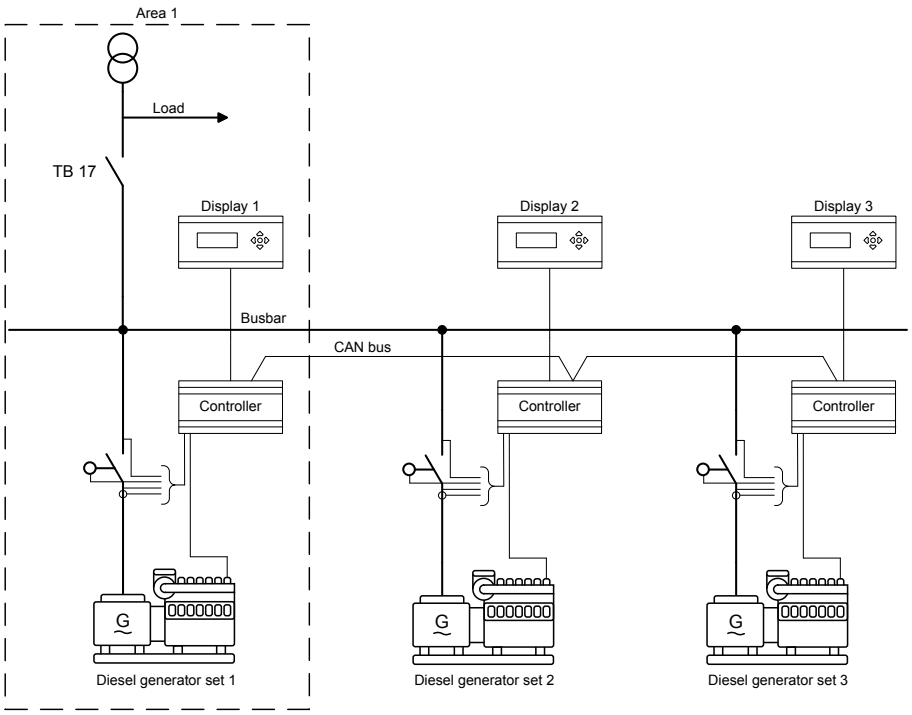
Tie breaker power capacity - direct close

Sometimes it is necessary to bypass the power capacity function completely. The direct close function allows the tie breaker to close after the busbar Hz/V timer runs out (and not wait for any additional timers). Note that this function only allows the controller to bypass the power capacity function, and therefore it is not a close command signal. Enable the M-Logic function *Command, Tie breaker power capacity - direct close* in the mains controller.



INFO
Use this function with great caution, since it can affect the load and stability of the generators.

6.10 Island application with TB



A tie breaker in the mains controller can be operated in an island application. It is controlled in the same way as ATS, Mains controller. The power capacity set point (parameter 8192) is used to ensure that the generators produce enough power to take the load. This protects the generators from going into overload.

7. M-Logic

7.1 Events

7.1.1 Power management events

M-Logic events for power management are available under *Events* > *Power management*.

Event	Activated when ...
All GB's opened	All GBs in the application are open.
Any GB closed	Any GB in the application is closed.
Any MB closed	Any MB in the application is closed.
Any other GB open	A GB is open for any other genset controller in the application.
Two or more GB's closed	Two or more GBs in the application are closed.
Unit has command status	The AGC is the command unit for PMS.
DG [1-32] GB closed	The GB of the specified genset controller is closed.
DG [1-32] GB opened	The GB of the specified genset controller is opened.
DG [1-32] volt/freq okay	The voltage and frequency from the specified genset is within the required range.
DG [1-32] running	There is running feedback for the specified genset.
DG [1-32] ready to auto start	The PMS can automatically start the specified genset if required.
DG [1-32] GB Synchronising	The specified genset controller is synchronising the genset to the busbar (by regulating the specified genset).
PM ID [1-32] has any alarm present	The controller with the specified PM ID has at least one active alarm.
Mains [1-32] MB closed	The MB of the specified mains controller is closed.
Mains [1-32] TB closed	The TB of the specified mains controller is closed.
Mains [1-32] MB opened	The MB of the specified mains controller is opened.
Mains [1-32] TB opened	The TB of the specified mains controller is opened.
Mains [1-32] volt/freq okay	The voltage and frequency measured by the specified mains controller is within the required range.
Mains [1-32] in auto or test	The specified mains controller is in AUTO or TEST mode.
Mains [1-32] MB Synchronising	The PMS is synchronising the busbar to the specified mains (by regulating the gensets).
Mains [1-32] TB Synchronising	The PMS is synchronising across the specified tie breaker (by regulating the gensets).
BTB [33-40] BTB closed	The specified BTB is closed.
BTB [33-40] BTB opened	The specified BTB is opened.
BTB [33-40] BTB Synchronising	The PMS is synchronising across the specified BTB (by regulating the gensets).
Mains [1-32] mains failure	The specified mains controller detects a blackout on the mains.
First/Second/Third standby	The genset controller is the First/Second/Third standby.
Secured mode	The genset controller is running in secured mode.
Baseload active	The baseload function is activated in the controller.
Baseload inhibited	The baseload function is inhibited in the controller.
LD start timer expired	The load-dependent start timer has expired.
LD stop timer expired	The load-dependent stop timer has expired.

Event	Activated when ...
Any mains on busbar	Any mains connection is connected to the busbar. That is, the main breaker (and tie breaker, if present) is closed.
Any MB synchronising	The PMS is regulating the gensets to synchronise to any mains.
Any TB synchronising	The PMS is regulating the gensets to synchronise the tie breaker.
Any TB deloading	The PMS is regulating the gensets to deload the tie breaker.
Any BTB deloading	The PMS is regulating the gensets to deload the bus tie breaker.
Asymmetric LS enabled	Asymmetric load sharing is enabled.
Asymmetric LS active	The PMS is using asymmetric load sharing.
Any mains sync. inhibit	Synchronisation is inhibited for any mains breaker.
Mains [1-32] in BLOCK	The specified mains controller is in block mode. That is, the controller cannot close the mains breaker.

7.1.2 Other events

There are other M-Logic events for power management.

Events > Events

Event	Activated when ...
DG in quarantine	The diesel generator cannot be used by the running hours priorities, unless there is no alternative. See Running hours.
Multi-start set [1/2] selected	Selection of gensets to be started upon blackout. See Multi-start gensets.
Single DG selected	The plant type is *Single DG*.
Multi mains selected	The application has more than one mains.
Dynamic section equal static section	There are no closed BTBs in the section. That is, the dynamic section is a static section.
Update mode local selected	If the mode is changed (for example, from SEMI to AUTO), the mode is only changed on the controller where the change was made.
Update mode on all selected	If the mode is changed (for example, from SEMI to AUTO), the mode is changed on all the controllers in the application.
Absolute prio. used	For running hours start priority, power management uses absolute running hours.
Relative prio. used	For running hours start priority, power management uses relative running hours.

Events > Modes

Event	Activated when ...
Power management	Power management is enabled.

7.2 Commands

7.2.1 General commands

M-Logic commands are available under *Output* > *Command*.

Command	Effect when activated
Store common settings	Only relevant for BTB controllers. During commissioning (or when other system changes are made), using the command stores the power management settings for the static section that the controller is in.

Command	Effect when activated
	When the BTB closes, the new dynamic section creates one new, consistent set of settings and updates the parameters. When the BTB opens again, the common settings stored by this command are restored in the static section.
Update mode local	If the mode is changed (for example, from SEMI to AUTO), the mode only changes on the controller where the change was made.
Update mode on all	If the mode is changed (for example, from SEMI to AUTO), the mode changes on all the controllers in the application.

7.2.2 BTB commands

M-Logic commands for BTBs are available under *Output* > *BTB Cmd*.

Command	Effect
BTB [33-40] open cmd	The controller sends a command to the specified AGC BTB controller to open its breaker. If the BTB controller is in SEMI mode, it deloads and opens its breaker. If the BTB controller is in AUTO mode, the BTB controller ignores the command.
BTB [33-40] close cmd	The controller sends a command to the specified AGC BTB controller to open its breaker. If the BTB controller is in SEMI mode, it synchronises and closes its breaker. If the BTB controller is in AUTO mode, the BTB controller ignores the command.

7.2.3 Inhibits

M-Logic inhibits are available under *Output* > *Inhibits*.

Command	Controller	Effect when activated
Inh. BTB close request	Genset or mains	The BTB controller will not close its breaker. That is, the section cannot ask for help.
Inh. request for section	Genset or mains	The power management system stops the section from helping other sections. That is, a close request from an adjacent section that needs help is ignored.
Force DG in quarantine	Only genset	The diesel generator cannot be used by the running hours priorities, unless there is no alternative.