iE 150 PMS lite

4189341498-A

Designer's handbook

Improve
Tomorrow

5. General functions

1. Introduction

1.1 About

PMS lite operation

The PMS lite controllers are for off-grid plants with up to 254 generators and/or bus tie breakers. PMS lite operation is only for generators - no other power sources are possible. Each PMS lite controller protects and controls a genset, and the genset breaker. Each bus tie breaker is controlled by a bus tie breaker controller. The operator can easily configure the plant from the display, without needing to use a PC with utility software. When the plant is running, the operator can see the total available and consumed power on each display, along with an overview of the operating information for all the generators in the plant.

The power management system makes sure that generators are started or stopped according to the load and priority. The controllers make sure that the generators share the load equally. The plant set up is quick because the controllers use the CAN bus connections to automatically detect each other and assign IDs.

Single controller operation

Alternatively, for maximum flexibility, the PMS lite controller can be used as a single controller. The controller can protect and control a genset, a genset breaker, and a mains breaker in single-controller applications.

General

The controller is a compact, all-in-one controller. Each controller contains all necessary 3-phase measuring circuits.

Values and alarms are shown on the LCD display screen, which is sunlight-readable. Operators can easily control the plant, gensets, and breakers from the display units. Alternatively, use the communication options to connect to a PLC. The PLC can then control the plant.

1.2 About the Designer's handbook

General purpose

This document gives information about the controller's functionality and its applications, and for configuring the controller.

CAUTION

Installation errors

Read this document before working with the controller. Failure to do this may result in human injury or damage to the equipment.

Intended users of the Designer's handbook

This Designer's handbook is primarily intended for the panel designer in charge. Based on this document, the panel designer can give the electrician the necessary information to install the controller, for example detailed electrical drawings.

The Designer's handbook can also be used during commissioning to check the parameters, and operators may find it useful for understanding the system and for troubleshooting.

1.2.1 Software version

This document is based on the iE 150 software version 1.38.

1.3 Warnings and safety

1.3.1 Symbols for hazard statements

DANGER!

This shows dangerous situations.

If the guidelines are not followed, these situations will result in death, serious personal injury, and equipment damage or destruction.

WARNING

This shows potentially dangerous situations.

If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.

CAUTION

This shows low level risk situation.

If the guidelines are not followed, these situations could result in minor or moderate injury.

NOTICE

This shows an important notice

Make sure to read this information.

1.3.2 Symbols for general notes

NOTE This shows general information.

More information
This shows where you can find more information.

Example

This shows an example.

How to ...
This shows a link to a video for help and guidance.

Safety during installation and operation

Installing and operating the controller may require work with currents and voltages. The installation must only be carried out by authorised personnel who understand the risks involved in working with electrical equipment.

Factory settings

The controller is delivered pre-programmed from the factory with a set of default settings. These settings are based on typical values and may not be correct for your system. You must therefore check all parameters and settings before using the controller.

Electrostatic discharge

Electrostatic discharge can damage the controller terminals. You must protect the terminals from electrostatic discharge during the installation. When the controller is installed and connected, these precautions are no longer necessary.

Data security

To minimise the risk of data security breaches:

- As far as possible, avoid exposing controllers and controller networks to public networks and the Internet.
- Use additional security layers like a VPN for remote access, and install firewall mechanisms.
- Restrict access to authorised persons.

1.4 Legal information

Third party equipment

DEIF takes no responsibility for installation or operation of any third party equipment. In no event shall DEIF be liable for any loss of profits, revenues, indirect, special, incidental, consequential, or other similar damages arising out of or in connection with any incorrect installation or operation of any third party equipment.

Warranty

NOTICE

Warranty

The controller 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.

Copyright

2. Utility software

2.1 Download the utility software

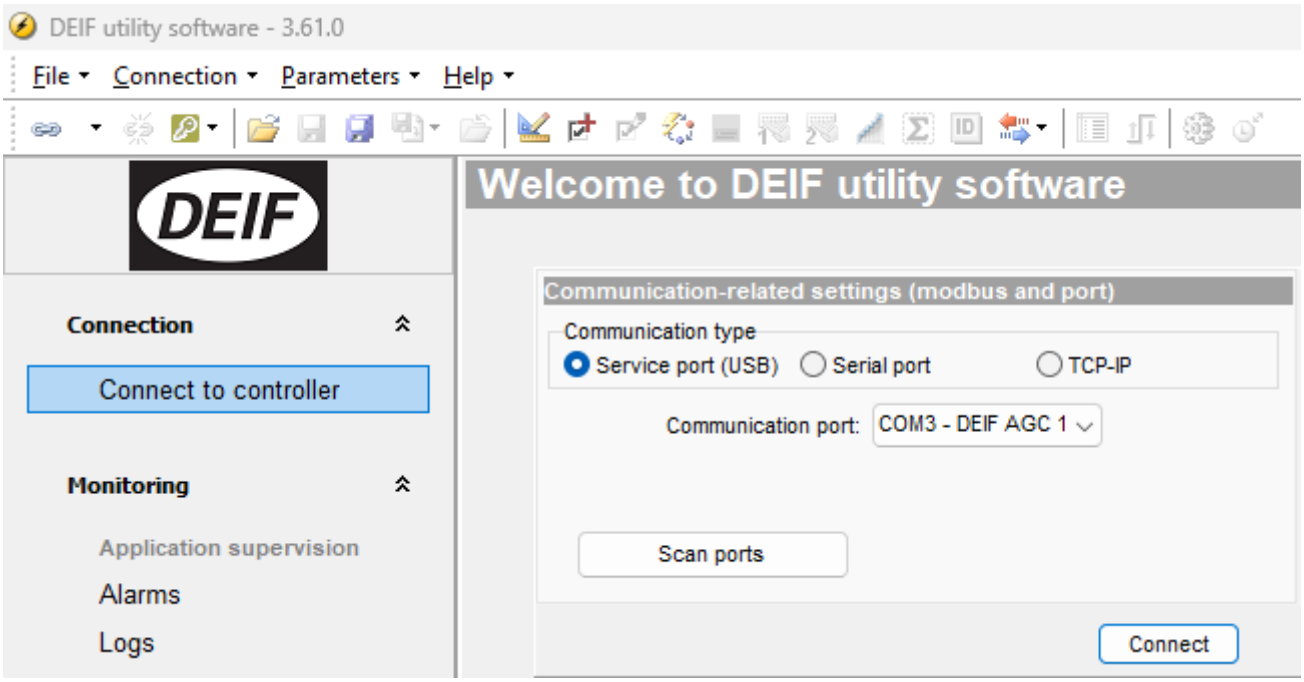
The **Multi-line 2 Utility Software v.3.x** is the software interface between a PC and the controller. The software is free of charge. Download it from www.deif.com

2.2 Connection

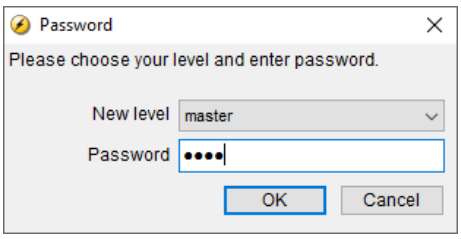
2.2.1 USB connection

You need a USB cable (USB A to B) to connect the controller to a PC.

1. Install the utility software on a PC.
2. Use the USB cable to connect the controller service port to the PC.
3. Start the utility software.



4. If needed, *Scan ports*, then select a service port option.
5. When prompted, select the access level, enter the password, and select OK.



More information
See **General functions, Password** for the default passwords.

2.2.2 TCP connection

You can use TCP/IP communication to connect to the controller. This requires an Ethernet cable, or a connection to the network that includes the controller.

Default controller network address

- IP: 192.168.2.2
- Gateway: 192.168.2.1
- Subnet mask: 255.255.255.0

Configuring the controller IP address using the display unit or a USB connection

When connecting to a controller using TCP/IP, you must know the controller's IP address. Find the IP address on the display under: `Communication > Ethernet setup`.

You can use the display to change the controller's IP address.

Alternatively, you can use a USB connection or an Ethernet connection and the utility software to change the controller IP address.

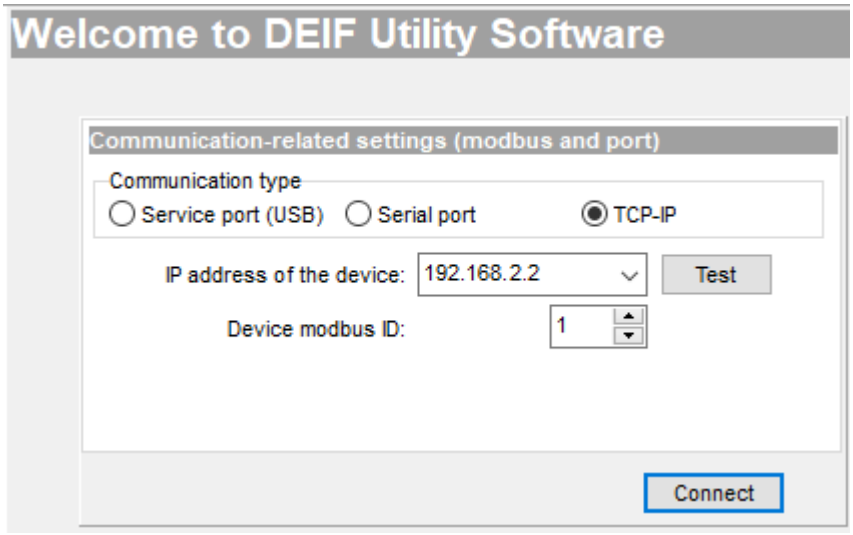
Point-to-point Ethernet connection to the controller

If you do not want to use the display unit or a USB connection to change the IP address, you can use a point-to-point Ethernet connection. The PC must have a static IP address. For the default controller network address, the PC static IP address must be 192.168.2.xxx, where xxx is a free IP-address in the network (note: xxx cannot be 2 (the controller IP address) or 1 (the gateway)).

If you change the controller address (for example, from 192.168.**2**.yyy to 192.168.**47**.yyy) the connection is lost. A new static IP for the PC is needed. In this case, 192.168.47.zzz, where zzz is a free IP-address in the network. The PC address, IP address, and gateway must be in the same subnet.

When the PC has the correct static IP address:

1. Use an Ethernet cable to connect the PC to the controller.
2. Start the utility software.
3. Select *TCP-IP*, and enter the controller IP address.

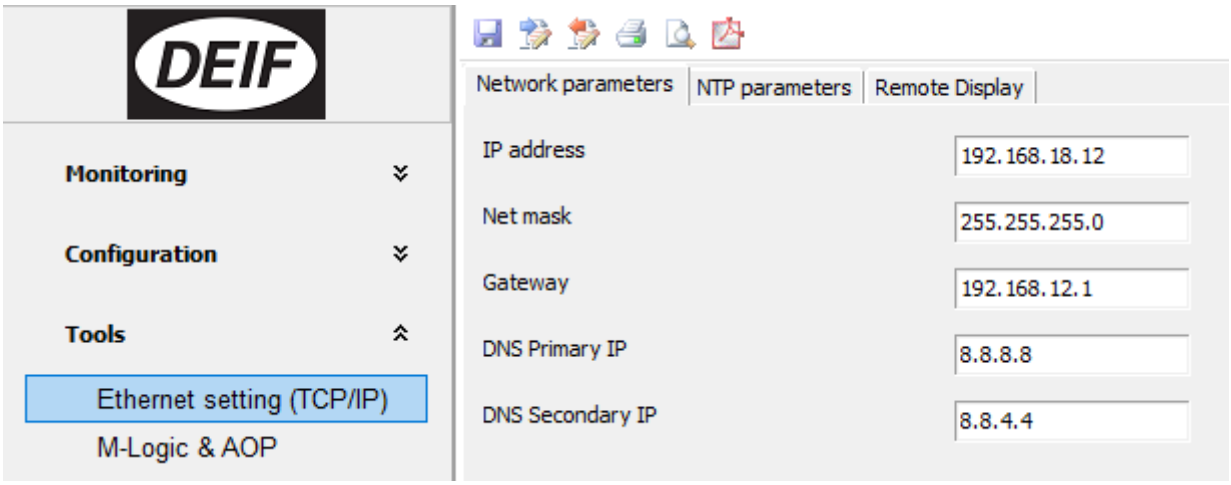


4. You can use the *Test* button to check if the connection is successful.
5. Select *Connect* to connect to the controller using TCP-IP.

Configuring the controller IP address using the utility software

1. Select *Connect* to connect to the controller using TCP-IP.
2. Select *Ethernet setting (TCP/IP)*.

The *Network Parameters* window opens:



When the controller network parameters have been changed, press the *Write to device* button.

The controller receives the new network parameters and reboots the network hardware.

To connect to the controller again, use the new controller IP address (and a correct PC static IP address).

NOTE Please note that not all controllers support DNS and NTP settings. Features described in this document apply only if they are available on the controller.

Using a switch

For a system with multiple controllers, all controllers can be connected to a switch. Create a unique IP address for each controller in the network before connecting the controllers to a switch.

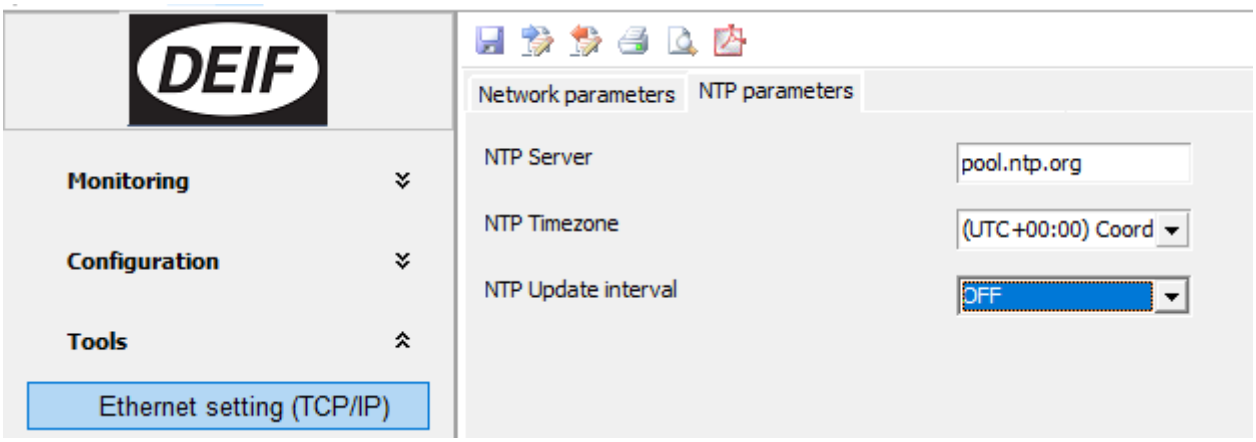
The PC can then be connected to the switch, and the Ethernet cable can be in the same port of the switch at all times. You can enter the controller IP address in the utility software.

The TCP-IP connection is faster than other connections. It also allows the user to shift between controllers in the application supervision window in the utility software.

2.3 Using NTP

To ensure that the controller always has the right time, you can use the network time protocol (NTP) function.

Select *Ethernet setting (TCP/IP)* in the Utility software, then select the *NTP parameters* tab in the *Network Parameters* window:



You can select an NTP server, a time zone and an update interval. Write the changes to the controller to activate the NTP function.

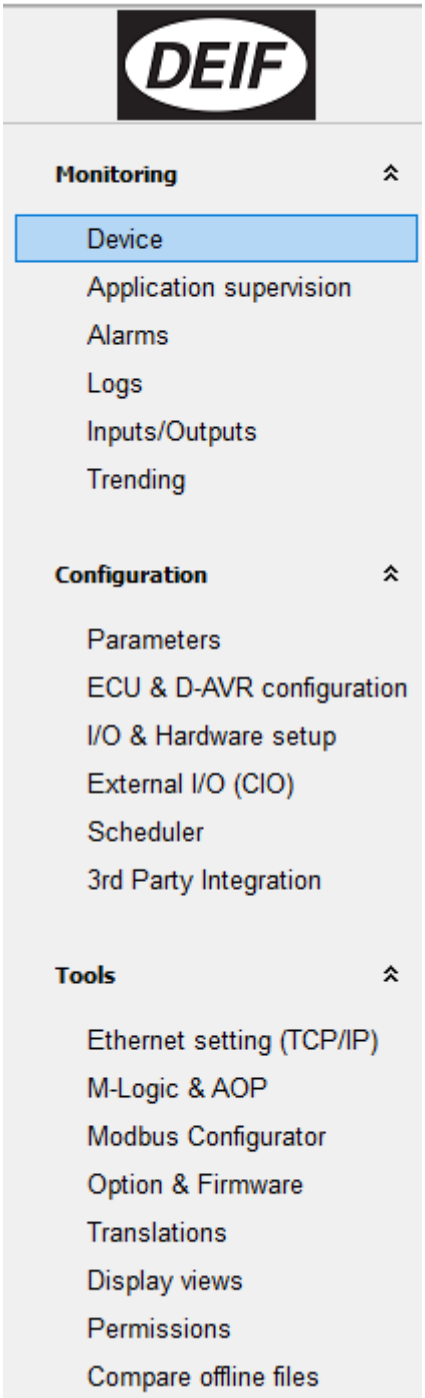
NOTE The selected NTP server must be available in the network.

2.4 Utility software interface

2.4.1 Top toolbar

1. Connect to a controller.
2. Disconnect from a controller.
3. Permission level.
4. Application settings.
5. Enter an upgrade code (received from DEIF support).
6. Add options (create an option code and send it to support@deif.com).
7. Update the controller firmware.
8. Not used.
9. Configure the AOP-2 buttons and LEDs (Additional Operator Panel).
10. Read the controller counters.
11. Information on the controller and the software.
12. Read, write, backup and restore the device.
13. Data tracing (shows the max./min. of a value, as long as the data tracer window is open).
14. Configure the controller I/O settings.
15. Synchronise the controller clock with the connected PC.

2.4.2 Left menu



- **DEIF**
  - Link to www.deif.com
- **Monitoring**
  - Device
    - See operating information for the connected controller.
  - Application supervision
    - See the plant operation, including how much power each genset produces.
  - Alarms
    - An overview of the active alarms.
    - See the history for the alarms that are activated while the PC is connected.
  - Logs
    - See the alarms and events logs from the controller.
  - Inputs/Outputs
    - The controller input and output status.
  - Trending
    - See real-time operation.
    - Trending is possible when a PC is connected and the trending window is open. The controller cannot save the data.
- **Configuration**
  - Parameters
    - Configure and view parameters. You can view the parameters as a list or in a tree structure.
  - ECU & D-AVR configuration
    - EIC configuration, ECU alarms, ECU regeneration, and SPN ignore list
    - DAVR configuration and alarms
    - Fuel rate alarms
    - Configurable RX
  - I/O & Hardware setup
    - Configure the inputs and outputs.
    - Average AC and DC measurements.
    - Emulation
  - External I/O (CIO)
    - Detect and configure the external inputs and outputs.
  - Scheduler
  - 3rd Party Integration
- **Tools**
  - Ethernet setting (TCP/IP)
    - Configure Ethernet settings and communication.
  - M-Logic & AOP
    - Configure M-Logic and additional operator panels.
  - Modbus Configurator
    - Configure the configurable Modbus addresses.
  - Option & Firmware
    - See the available options.
  - Translations
    - Customise or translate the text in the controller.

- Display views
- Permissions
  - See and change the user permissions.
- Compare offline files
  - Compare utility software project files.

2.5 Emulation

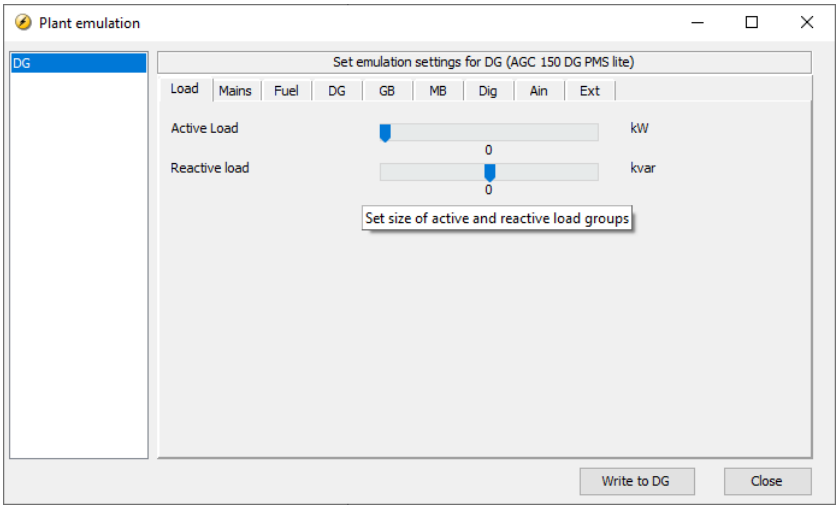
You can use the utility software to emulate the application.

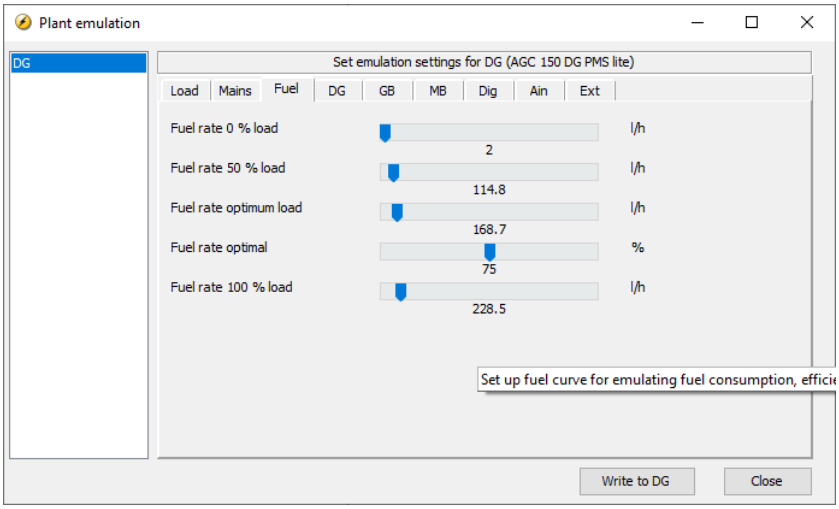
Requirements:

- A controller with a power supply.
- A USB or TCP/IP connection to the controller.
- Digital input 4 (the emergency stop) must be activated. Alternatively, deactivate the *Emergency STOP alarm* (3490).

NOTE During emulation, if the controller detects AC voltage, it activates the Live voltage detected alarm.

1. Go to *I/O & Hardware setup*.
2. Select the *Emulation* tab, tick the box next to *Enable emulation* and click *Write to device* to write the settings to the controller.
3. In *Application supervision*, select *Emulation stimuli* to open the plant emulation window. You can adjust a range of plant input settings.





4. You can see the emulation data in the overview table on the *Application supervision* page.

3. Power management system

3.1 Introduction to power management

The power management system makes sure that generators are started or stopped according to the load and priority or running hours. The PMS lite controllers make sure that the generators share the load equally. The controllers use the CAN bus connections to automatically detect each other and assign IDs.

When the plant is in operation, the operator can see the total available and consumed power on each display, and an overview of the operating information for all the generators in the plant.

If bus tie breakers are present, the power management system calculates the power for each dynamic section. The PMS lite controllers makes sure that the generators in each dynamic section share the load equally, and are started or stopped as required.

3.2 Applications

3.2.1 Suitable controllers

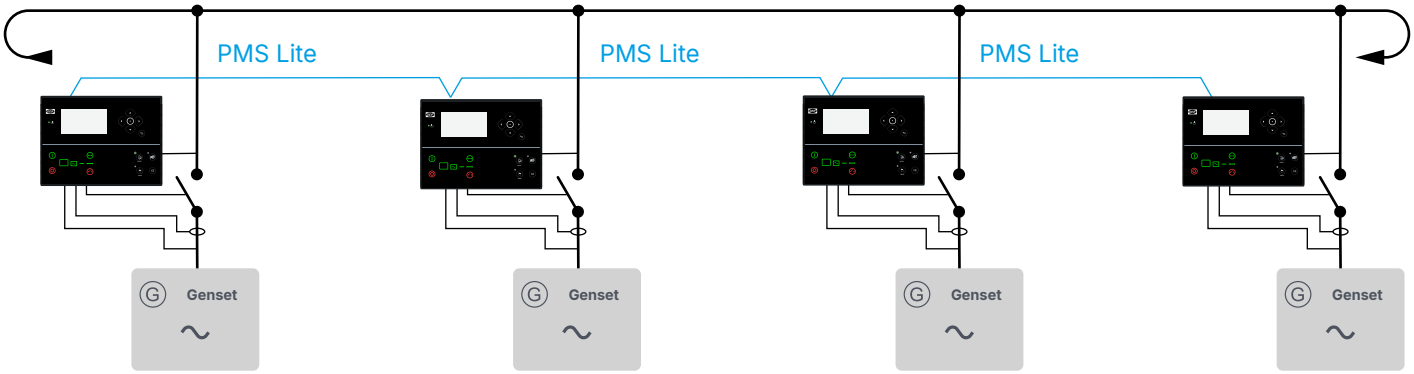
PMS lite controllers can only be used with other PMS lite controllers. PMS lite controllers includes both iE 150 and AGC 150 PMS lite controllers, as well as iE 150 and AGC 150 Generator controllers configured for PMS lite. AGC-4 Mk II Genset controllers can also be configured for PMS lite.

The PMS lite controllers can be used with the standard BTB controllers. However, they cannot be used with the other power management system controllers. To control gensets in a standard power management system, use iE 150 Generator or AGC 150 Generator controllers.

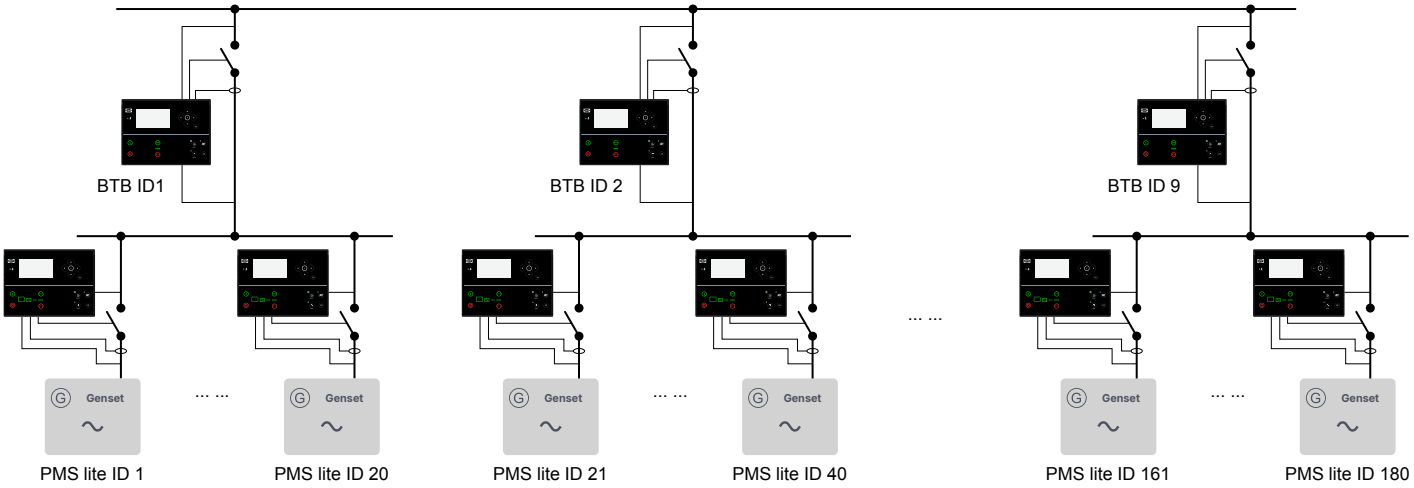
NOTE For up to 254 gensets and/or bus tie breakers, all controllers must have software version 1.34 or later. For older software (versions 1.16 to 1.33), the limit is 127 gensets. For older software, bus tie breakers are not possible. Older software is not compatible with software version 1.34 or later.

3.2.2 Single-line drawings

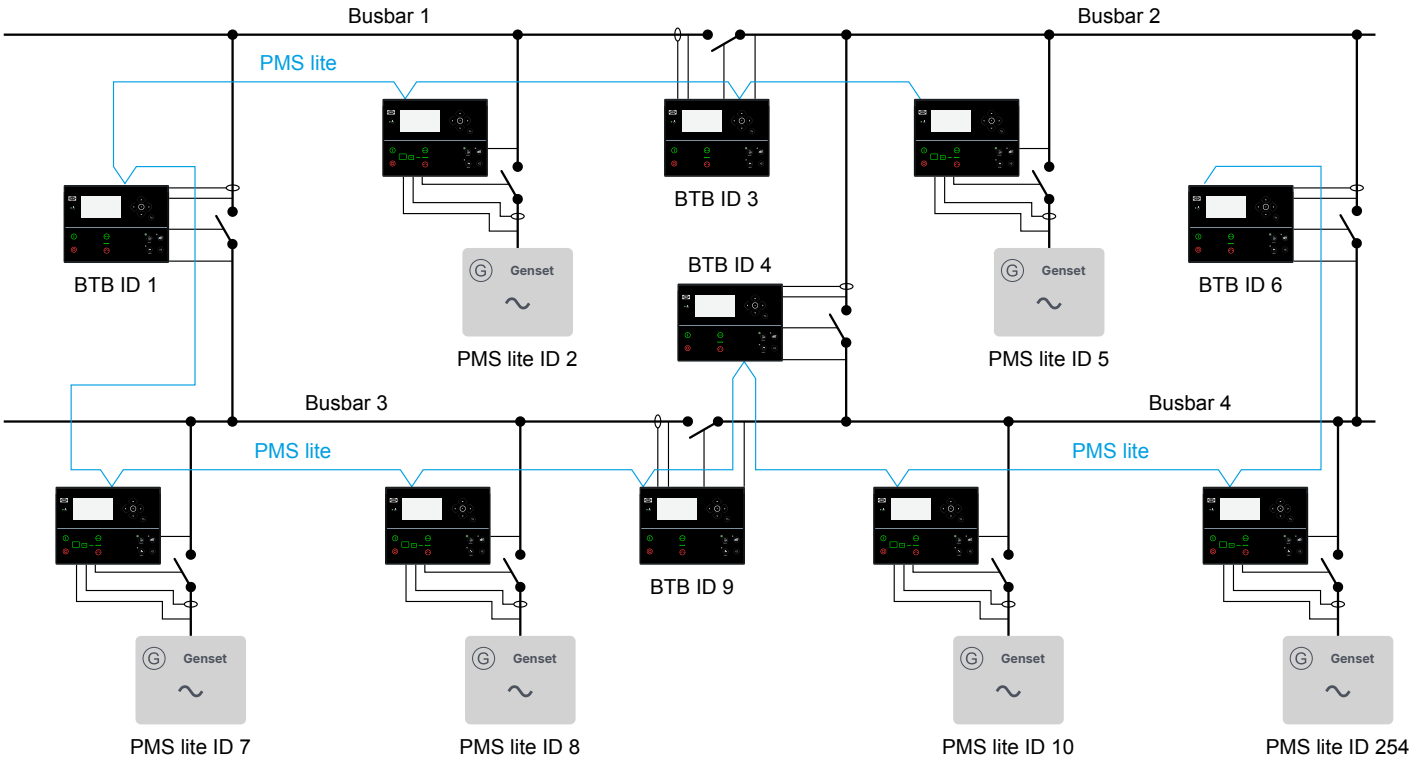
PMS lite, with gensets only



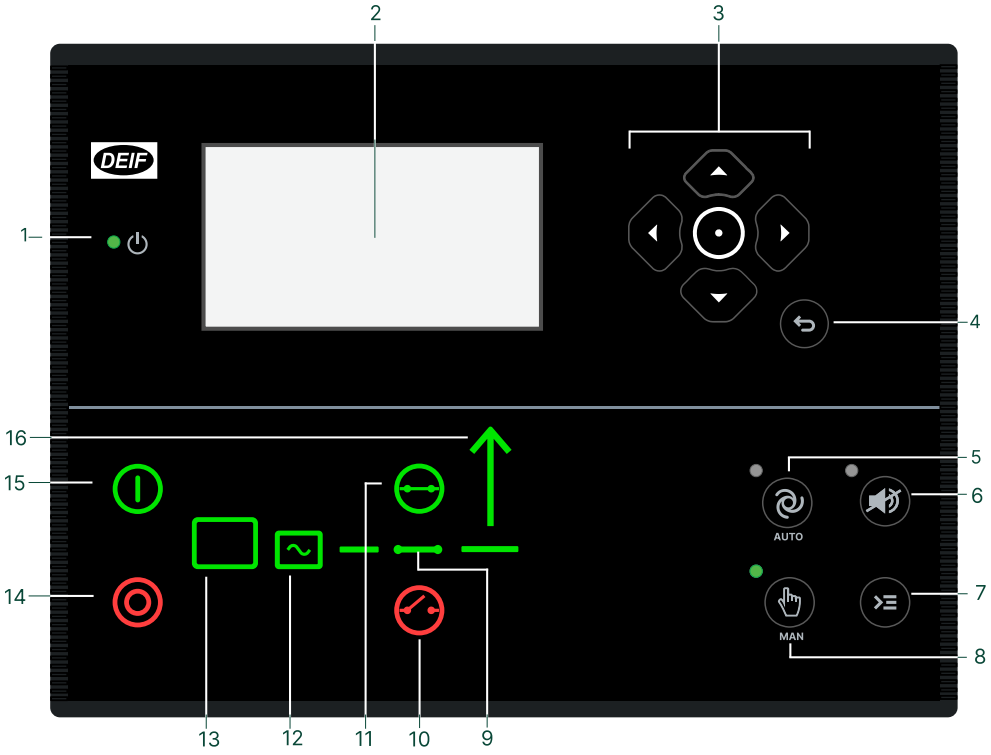
PMS lite, with genset groups



PMS lite, with interlinked busbars, and up to 254 single gensets and/or bus tie breakers



3.3 Display layout



No.	Name	Function
1	Power	Green: The controller power is ON. OFF: The controller power is OFF.
2	Display screen	Resolution: 240 x 128 px. Viewing area: 88.50 x 51.40 mm. Six lines, each with 25 characters.
3	Navigation	Move the selector up, down, left, and right on the screen.
	Enter button	Go to the Menu system. Confirm the selection on the screen.
4	Back button	Go to the previous page.
5	AUTO mode	Use to switch to AUTO mode. The controller automatically starts and stops (and connects and disconnects) gensets. No operator actions are needed. The controllers use the power management configuration to automatically select the power management action.
6	Silence horn	Stops an alarm horn (if configured) and enters the Alarm menu.
7	Shortcut menu	Access the Jump menu, Mode selection, Test, and Lamp test.
8	MANUAL mode	Use to switch to MANUAL mode. The operator or an external signal can start, stop, connect or disconnect the genset. The generator controller cannot automatically start, stop, connect or disconnect the genset. The controller automatically synchronises before closing a breaker, and automatically deloads before opening a breaker.
9	Breaker symbols	Green: Breaker is closed. Green flashing: Synchronising or deloading. Red: Breaker failure.
10	Open breaker	Push to open the breaker.

No.	Name	Function
11	Close breaker	Push to close the breaker.
12	Generator	Green: Generator voltage and frequency are OK. The controller can synchronise and close the breaker. Green flashing: The generator voltage and frequency are OK, but the V&Hz OK timer is still running. The controller cannot close the breaker. Red: Generator voltage and/or frequency are not OK
13	Engine	Green: There is running feedback. Green flashing: The engine is getting ready. Red: The engine is not running, or there is no running feedback.
14	Stop	Stops the genset if MANUAL mode is selected.
15	Start	Starts the genset if MANUAL mode is selected.
16	Load symbol	OFF: Power management application. Green: The supply voltage and frequency are OK. Red: Supply voltage/frequency failure.

3.4 Set up PMS lite

3.4.1 Set up PMS lite (no BTBs)

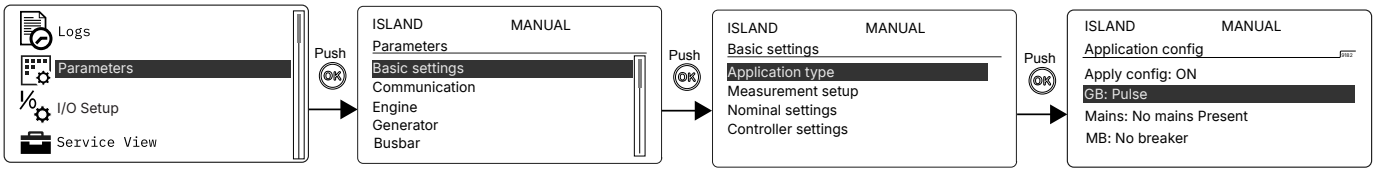
If the application does not have bus tie breakers, you can set up the CAN protocol and the application in each controller. You can set the parameters from the display.

Set the CAN protocol from the display or utility software

Go to `Communication > CAN Protocols > CAN [A or B] Protocol` and select `PMS lite` as the set point for parameter 7841 or 7842.

Use the display parameters to set up the application

1. To set up the application, go to `Parameters > Basic settings > Application type`.
2. Select the *GB* type as pulse, continuous, or compact (9182).
3. For *Mains*, select *No mains present* (9183).
4. For *MB*, select *No MB* (9184).
5. Select *On* for *Apply config* in parameter 9181.



It is also possible to use the utility software to set up the controller.

`Parameters > Basic settings > Application type`

Parameter	Name	Range	Default
9182	GB Type	Pulse Continuous Compact	Pulse
9183	Mains Present	Mains present No mains present	No MB

Parameter	Name	Range	Default
9184	MB Type	Pulse No MB Continuous Compact	Pulse
9181	Apply config	Off On	Off

How it works

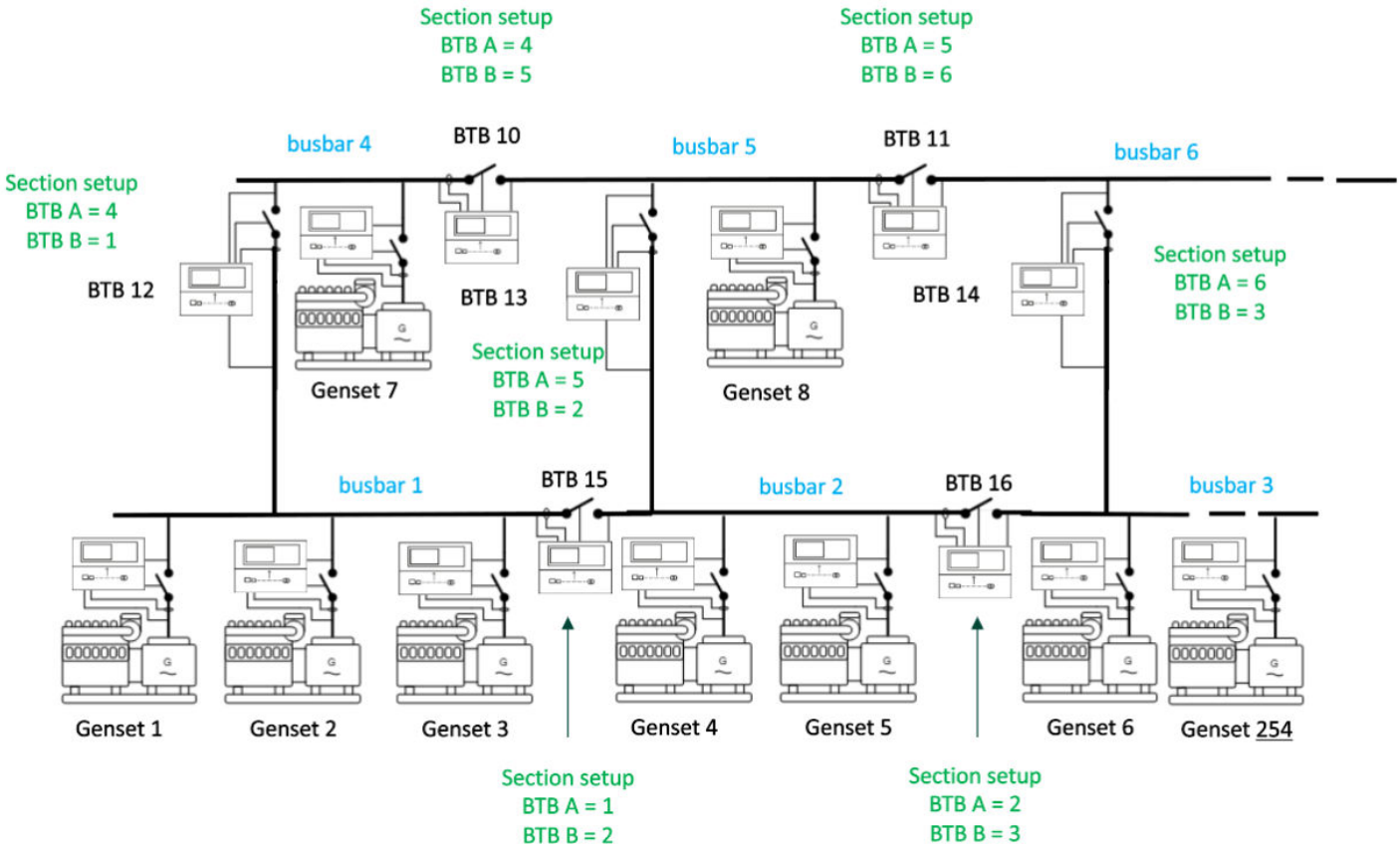
When the controller connects to the CAN bus line, PMS lite automatically assigns the controller an ID. When a controller disconnects from the CAN bus line, the system automatically removes it from the PMS lite system.

3.4.2 Set up PMS lite with bus tie breakers

When there are bus tie breakers (BTB) in the application, you need to configure both the PMS lite controllers and the BTB controllers.

You can set up the CAN protocol and the application parameters from the display.

Sketch the application



To identify the busbar sections, sketch the application (as shown in the example above). You can then identify all the sections that can be created by the BTBs. For each BTB, you can then identify the section number of the A side (where the current is measured) and the section number of the B side.

Configure the BTB controllers

Use the parameters in each of the BTB controllers to configure the application.

Communication > CAN protocols

Parameter	Name	Range	Default	Notes
7841 or 7842	CAN [A or B] protocol	A variety of protocols	Off	Select *PMS lite* for the CAN connections that are used for PMS lite. Note: When the controller is used for a PMS lite application, the parameters for CAN A and CAN B must not be *Canshare*, *PMS Primary* or *PMS Secondary*.

PMS lite > PMS lite general

Parameter	Name	Range	Default	Notes
8601	BTB Section-A	0 to 65	0	The section number connected to the A-side (where the current is measured).
8602	BTB Section-B	0 to 65	0	The section number connected to the B-side.

Configure the PMS lite controllers for an application with BTBs

Parameters > Basic settings > Application type

Parameter	Name	Range	Default	Notes
9182	GB Type	Pulse Continuous Compact	Pulse	You can select any breaker type.
9183	Mains Present	Mains present No mains present	No mains present	For PMS lite, this must be *No mains present*.
9184	MB Type	Pulse No MB Continuous Compact	Pulse	For PMS lite, this must be *No MB*.
9181	Apply config	Off On	Off	For PMS lite, this must be *On*.

PMS lite > Section

Parameter	Name	Range	Default	Notes
8603	DG Busbar	0 to 65	0	Select the section number for the generator. If there is no section (that is, there are no BTBs), use 0.

NOTE There are a lot of other parameters that you can configure for PMS lite. These are described elsewhere in this document. This topic only describes the parameters that are required for a PMS lite application with busbar sections.

3.5 Configuration

3.5.1 Load-dependent start and stop

Configure these parameters for load-dependent start and stop.

PMS lite > Load dependendt start/stop config > LDSS percent/timer config

Parameter	Name	Range	Default	Description
8501	Ld. start	1 to 100 % of nominal power	90 % 10 s	Send a request over PMS lite to start the next priority genset. The request is sent when the power of the controller's genset is more than the set point for the time duration.

Parameter	Name	Range	Default	Description
		0 to 990 s		
8503	Ld. stop	1 to 100 % 5 to 990 s	70 % 30 s	Send a request over PMS lite to stop the next priority genset. The request is sent when the power of the controller's genset is less than the set point for the time duration.

NOTE The load-dependent settings are not automatically shared between the PMS lite controllers. You can therefore use different load-dependent settings in each controller.

Calculating load-dependent stop power

The plant consists of two gensets with 1500 kW nominal power each. The controllers have the default load-dependent stop settings.

When both gensets are running, the second genset can only stop if the load on the remaining genset would be below 70 %. That is, the second genset only stops if the load is below 1050 kW for 30 seconds.

3.5.2 Multi-start

The multi-start function is used when there is a black busbar and auto start is enabled. The function has these three dimensions:

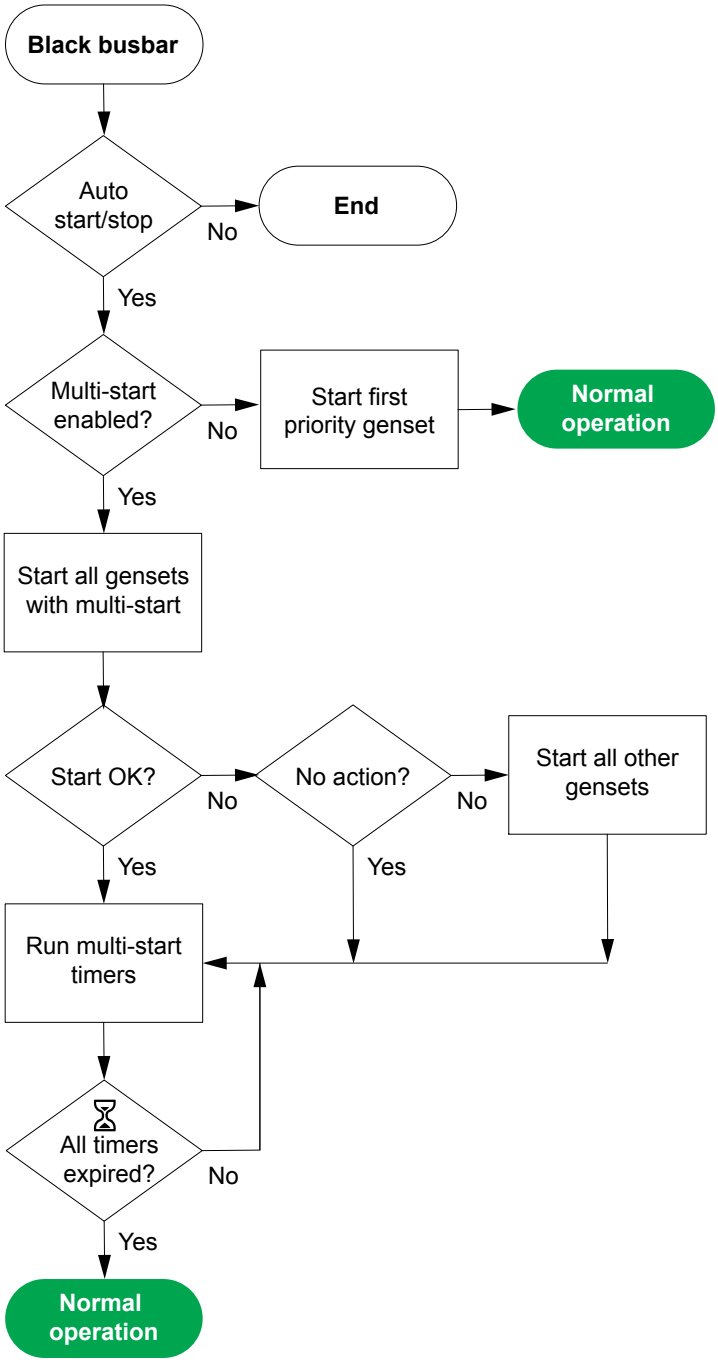
- For all the controllers where multi-start is enabled, the function makes sure that the gensets start. The gensets synchronise and connect to the busbar.
- If *Start all other DGs* is selected and a genset cannot start, the controller requests that all the other PMS lite controllers start their gensets.
- The timers delay the start of PMS lite load-dependent start and stop, until the last multi-start timer in the PMS lite application has run out.

The first priority genset connects to the busbar first. Once the first priority genset has connected to the busbar, the next priority genset connects to the busbar. If a genset fails to connect to the busbar, the next priority genset tries to connect to the busbar.

`PMS lite > Load dependent start/stop config > Multi start config`

Parameter	Name	Range	Default
8521	Multi start config	No action on fail Start all other DGs 0 to 999.9 s Enabled, Not enabled	No action on fail 60 s No enabled

Multi-start flowchart



3.5.3 Priority

You can configure a load-dependent start and stop priority for the controller. Multiple controllers can have the same priority. Controllers with the same priority are started and stopped at the same time. If multiple gensets have the same priority and multi-start is enabled, the genset with the lowest ID number connects to the busbar first.

The priority list starts with the configured priority. Next, where there are no configured priorities, the controller IDs are used for the priority list.

PMS lite > PMS lite general

Parameter	Name	Range	Default	Description
8512	Priority	0 to 254	0	**0:** The controller does not have a priority. **1 to 254:** Priority 1 starts first, and stops last.

Genset on DUTY (force to run)

The *Genset on DUTY (force to run)* digital input forces the genset to become the duty genset and it is automatically the first priority genset regardless of previous configurations. The DUTY genset operates at the same time as the first priority genset. The duty genset is also part of the load-dependent start/stop calculations. For example, if the load requires 3 gensets to run and a fourth genset is activated to run as the duty genset, the priority 3 genset shuts down when the duty genset has taken the load.

It is possible to have more than one duty genset in the power management system.

The auto start/stop input must be active for the duty genset to start.

3.5.4 Running hours

You can select how the running hours affect the genset priority. When the running hour conditions for a genset are met, PMS lite starts extra gensets until load-dependent stop can stop the genset.

If the running hour function is activated on one controller, it is also activated on the other PMS lite controller in the system. You need to select the same running hour mode on all the controllers, otherwise, a *PMS lite Run hour type* alarm is shown.

`Parameters > PMS lite > Running hour config`

Parameter	Name	Range	Default	Details
8531	Running hours	1 to 20000 h	2 h	Select the running hours for the priority change.
8533	Running hour type	Absolute Relative/trip Load profiled	Relative/trip	Select the running hours function. See below for more information.

Absolute

The running hours are based on the total genset running hours. You can see and adjust the total genset running hours in the *Counters* window in the utility software.

Relative/trip

The running hours are based on the time since the last reset. When the running hours conditions are met, the counter is reset.

Load profiled

The running hours are based on the time since the last reset, and weighted according to the genset load. For example, if the running hours set point is 100 hours, and the genset has been running at 50 % of nominal power, the genset will have to run for 200 hours before the running hours conditions are met.

3.5.5 Available power

The user can create an available power alarm. The user can use this alarm to activate M-Logic to respond to low available power.

`PMS lite > Available power`

Parameter	Name	Range	Default	Details
8540	Available power	10 to 30000 kW	1000 kW	If you select *Enable*, the alarm is activated if the required available power is not available.

3.5.6 Minimum number to run

The user can create a minimum number of genset to run alarm. The user can use this alarm to activate M-Logic to respond if there are too few running gensets.

PMS lite > Minimum number to run

Parameter	Name	Range	Default
8550	Min. run.	1 to 254 0 to 360 s	1 1 s

NOTE This is not a function to control the number of running gensets.

3.5.7 Baudrate

PMS lite > PMS lite general

Parameter	Name	Range	Default	Details
8515	PMS lite baudrate	125kbps 250kbps	125kbps	For 50 or more PMS lite controllers, use 250kbps.

NOTE You must use the same baudrate in all of the PMS lite controllers.

3.5.8 Sharing parameters

You can use parameter 8514 to make the controller broadcast the PMS lite parameter settings to the other PMS lite controllers on the CAN line.

Parameters that are broadcast when using *Share parameters* (8514)

Parameter	Name
8501	Ld. start
8503	Ld. stop
8513	PMS lite fail mode
8531	Running hours
8533	Running hour type
8540	Available power
8550	Min. run
8560	Min. units
8570	ID missing/added
8580	ID not available
8590	Duplicated ID

PMS lite > PMS lite general

Parameter	Name	Range	Default	Details
8514	Share parameters	Off On	Off	Select **On** to broadcast the parameters.

3.6 PLC control

If required, a PLC can control the genset starts and stops. When a PMS lite controller is in PLC control:

- The controller ignores its own settings for load-dependent starts and stops.
- When it gets a PLC start signal, the controller starts its genset.
- When it gets a PLC stop signal, the controller stops its genset.

Activating PLC control

You can use parameter 8505 to activate PLC control. Alternatively, use the *PLC control start/stop* digital input or M-Logic to activate PLC control.

PMS lite > Load dependent start/stop config > Start/stop config

Parameter	Name	Range	Default	Details
8505	Start/stop	Load dependent start/stop PLC start/stop	Load dependent start/stop	Select **PLC start/stop** to activate PLC control.

NOTE If PLC control is not activated, the controller ignores PLC control start and stop signals.

PLC control start signals

You can use one of these to start the controller's genset:

- Digital input: *PLC control start*
- M-Logic: *Output > PMS lite commands > PLC control start*
- Modbus: Function code (01;05;15), Modbus address 14 or PLC address 15 (*Start+sync. (MANUAL) / PLC control start +sync*)

PLC control stop signals

You can use one of these to stop the controller's genset:

- Digital input: *PLC control stop*
- M-Logic: *Output > PMS lite commands > PLC control stop*
- Modbus: Function code (01;05;15), Modbus address 15 or PLC address 16 (*Deload/stop (MANUAL) / PLC control deload +stop*)

PLC control in operation

The PMS lite application can include both gensets that are under PLC control, and others that use load-dependent start and stop.

Be careful when doing a PLC control stop, because the PMS lite cannot make sure that there is enough available power after the genset stops.

Similarly, when you use a PLC control start, the load-dependent stop settings in the other controllers may respond by stopping a genset.

If you use PLC control when the controller is in AUTO mode, you must activate the auto start/stop input. If this is not activated, the controller ignores the PLC control start and stop signals.

3.7 PMS lite in operation

Controller IDs

When the controllers are connected to the CAN line, PMS lite IDs are automatically assigned to each controller (starting from ID 1).

You can manually assign an ID to a controller (parameter 8511). If you select an ID that has already been automatically assigned to another controller, the other controller automatically loses the ID (then reconnects to get a new automatic ID). If you select the same ID in two controllers, the *PMS lite duplicate ID* alarm is activated.

The user-defined priorities are the primary source of controller priority. The user-defined priorities determine the order of the first part of the priority list.

The controller IDs are the secondary source of controller priority. Controllers that do not have user-defined priorities make up the second part of the priority list. For these controllers, the priority order is determined by their controller IDs.

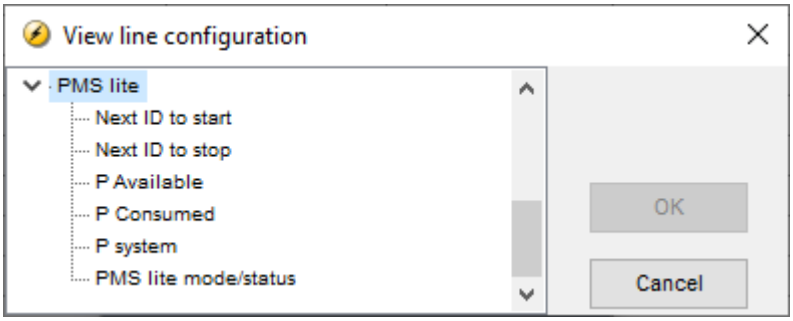
NOTE To avoid disrupting the plant, do not change the IDs while the plant is running.

Parameter	Name	Range	Default	Details
8511	PMS lite ID	0 to 254	0	**0**: The PMS lite ID is automatically assigned.
8590	PMS lite duplicate ID	Fail classes	Warning	

More information
See **PMS lite ID not available** in **Communication failures** for what to do when the *PMS lite ID not available* alarm is shown.

PMS lite information in the display

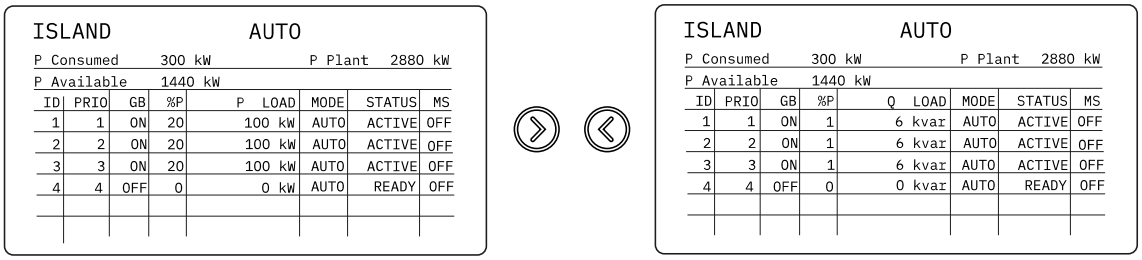
In the utility software, select *Configuration of the user views*. In the *Device display* box, select a view line to configure. In the *View line configuration* box, select the information to display. Remember to write the selection to the controller.



PMS lite overview

The PMS lite overview shows an overview of the operating information for all the generators. The operator can also see the total available power and the consumer power. Use the *left arrow* and *right arrow* buttons on the controller to change between the Power (kW) page and the Reactive power (kvar) page.

`Service View > PMS lite overview`



NOTE MS is the multi-start function. OFF means the function is enabled and ON means the function is enabled.

3.8 Communication failures

Minimum number of PMS lite controllers

An alarm can be activated if the required number of PMS lite controllers is not detected on the CAN line.

Parameter	Name	Range	Default	Details
8560	PMS lite min. units	1 to 254 0 to 360 s	1, 0 s	Select the minimum number of PMS lite controllers.

PMS lite ID missing or added

This alarm can only be activated if the plant has been stable (no controllers added or removed) for at least 30 seconds. The number of controllers and 30 second timer resets after the alarm is acknowledged.

Parameter	Name	Range	Default	Details
8570	PMS lite miss/add	0 to 10 s	0 s	The alarm is activated when PMS lite controller(s) are missing or added for the timer duration.

PMS lite ID not available

The alarm is activated if the PMS lite ID cannot be manually assigned:

- For the controller where the user is trying to manually assign the ID, the genset is running*.
- The ID is already manually assigned to another controller.
- Another controller has the ID (automatically or manually assigned), and its genset is running*.

NOTE The controller ID cannot be changed if its genset is running.

Parameter	Name	Range	Default	Details
8580	PMS lite ID not aval	You can select the alarm action.	Warning	The alarm is always enabled.

Duplicate controller IDs

An alarm is activated if two or more controllers have the same ID. This can happen during plant initialisation or when two PMS lite plants are connected.

Parameter	Name	Range	Default	Details
8590	PMS lite duplicat ID	You can select the alarm action.	Warning	The alarm is always enabled.

3.9 M-Logic commands and events

`Output > PMS lite commands`

Description	Notes
PLC control start	If PLC control is active, start the genset.
PLC control stop	If PLC control is active, stop the genset.
Enable multi start	Change *Multi start config* (parameter 8521) to *Enabled*.
Disable multi start	Change *Multi start config* (parameter 8521) to *Not enabled*.
Share PMS lite set points	Share the PMS lite parameters. This corresponds to selecting *On* in *Share parameters* (parameter 8514).
Set LDSS control	Use the controller's PMS lite load-dependent start and stop settings, and ignore the start and stop commands from a PLC. This corresponds to selecting *Load dependent start/stop* in *PMS lite start/stop* (parameter 8505).
Set PLC control	Use start and stop commands from a PLC, and ignore the PMS lite load-dependent start and stop settings. This corresponds to selecting *PLC start/stop* in *PMS lite start/stop* (parameter 8505).
Set multi start failure mode to no action	Change *Multi start config* (parameter 8521) to *No action on fail*.
Set multi start failure mode to start all DGs	Change *Multi start config* (parameter 8521) to *Start all other DGs*.
Start all available DGs	Start all available gensets. The controller must be in AUTO mode and the gensets ready to start.
Genset on DUTY (force to run)	The genset becomes the duty genset and is automatically the first priority genset regardless of previous configurations.

Events > PMS lite event

Description	Notes
Min number to run alarm	The *Minimum number to run* alarm is activated in the controller.
Min number of units alarm	The *Minimum number of units* alarm is activated in the controller.
Available power alarm	The *Available power* alarm is activated in the controller.
Next to start	The controller is the next to start its genset if this is required by PMS lite.
Next to stop	The controller is the next to stop its genset if this is required by PMS lite.
Multi start enabled	*Multi start config* (parameter 8521) is *Enabled*.
LDSS control active	PLC control is not active for the controller.
PLC control active	PLC control is active for the controller.
First priority	The controller has first priority.

4. Single-controller applications

4.1 Single controller

The PMS lite controller can operate as a single controller (that is, without any power management communication to other PMS lite controllers). In single-controller applications, the controller can control and protect a generator, a generator breaker, and a mains breaker.

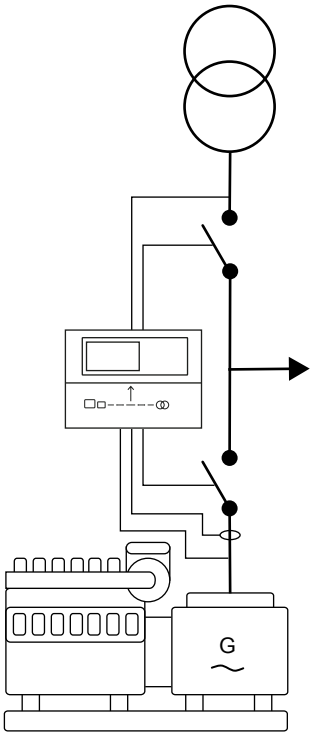
A single controller operates as the only controller in the system and cannot be part of a power management system with other controllers.

4.2 Modes of operation

In single-controller applications, the controller can have these modes of operation:

- Automatic mains failure (AMF)
- Fixed power
- Peak shaving
- Load take-over
- Mains power export (MPE)

Automatic mains failure (AMF) and fixed power



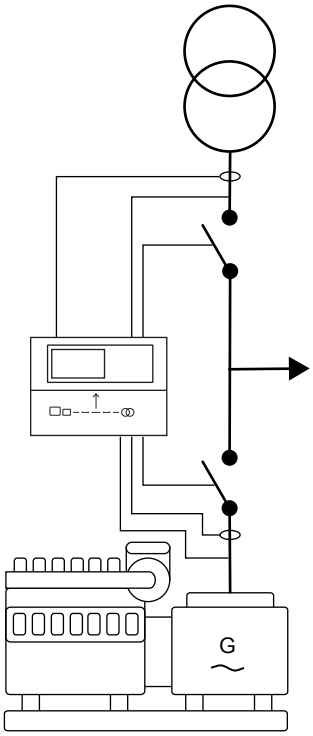
In AMF mode, the controller can automatically start the genset and change to generator supply at a mains failure after an adjustable time.

In fixed power mode, when a signal is given, the controller automatically starts the genset and synchronises to the mains.

`Parameters > Power set points > Fixed power`

Parameter	Text	Range	Default
7051	Fixed power set	0 to 100 %	100 %

Peak shaving, load take-over, and mains power export (MPE)



Peak shaving is used in power plants where the generator supplies the peak load demand and runs parallel to mains. Load take-over is a plant mode where the load is moved from mains to generator, for example, during peak demand periods.

The mains power export mode can be used to maintain a constant level of power through the mains breaker. The power can be exported to the mains or imported from the mains.

Power set points > Cos phi or Q

Parameter	Text	Range	Default
7052	Cos phi Set	0.60 to 1.00	1.00
7053	Type	Inductive Capacitive	Capacitive
7054	Reac power set	-100 to 100 %	0 %
7055	Type	OFF Superior (PMS) Fixed Q	OFF

Power set points > MPE/Peak shaving > Day/Night power set

Parameter	Text	Range	Default
7001	Mains power, Day	-20000 to 20000kW	750 kW
7002	Mains power, Night	-20000 to 20000kW	1000 kW
7021	Start generator set point	5 to 100 %	80 %
7023	Start generator min. load	0 to 100 %	5 %
7031	Stop generator set point	0 to 80 %	60 %

Power set points > MPE/Peak shaving > Day/Night settings

Parameter	Text	Range	Default
7011	Daytime period, start hour	0 to 23	8
7012	Daytime period, start min.	0 to 59	0
7013	Daytime period, stop hour	0 to 23	16
7014	Daytime period, stop min.	0 to 59	0

4.3 Single generator with mains power measurement

If a single generator is used, the controller needs a mains power measurement to do peak shaving, load take-over, and mains power export.

Mains power measurement from the 4th CT

By default, the controller uses the current measurement from the 4th CT to calculate the mains power (parameter 7005).

More information
See **I4 current** in the **Installation instructions** for wiring of the 4th CT for the mains current measurement.

Basic settings > Nominal settings > Power > 4th CT nom. P 1

Parameter	Text	Range	Default
6055	4th CT Power	10 to 9000 kW	480 kW

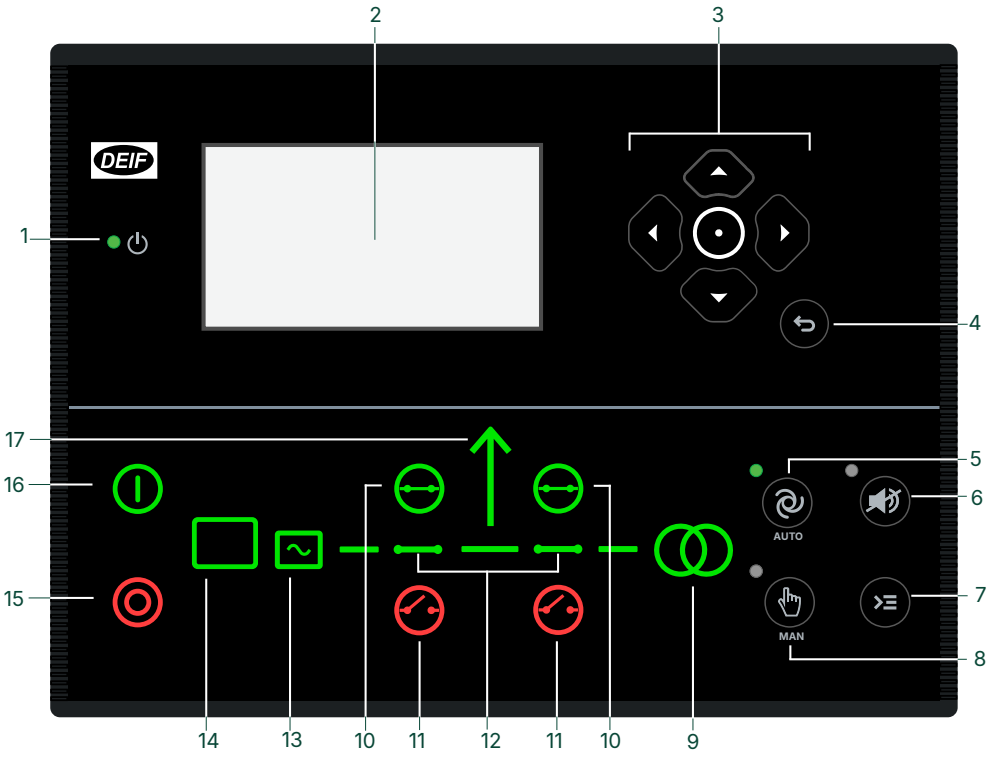
Mains power measurement from a transducer

Select *Multi input 20 (transducer)* in parameter 7005. Configure the transducer range in parameters 7003 and 7004, and configure the scaling in 7006.

Configure the input from the transducer under *I/O & Hardware setup, MI 20*.

More information
See **Analogue inputs** in the **Installation instructions** for wiring a transducer as the mains power measurement.

4.4 Display layout



No.	Name	Function
1	Power	Green: The controller power is ON. OFF: The controller power is OFF.
2	Display screen	Resolution: 240 x 128 px. Viewing area: 88.50 x 51.40 mm. Six lines, each with 25 characters.
3	Navigation	Move the selector up, down, left, and right on the screen.
	Enter button	Go to the Menu system. Confirm the selection on the screen.
4	Back button	Go to the previous page.
5	AUTO mode	Use to switch to AUTO mode. The controller automatically starts and stops (and connects and disconnects) the genset. No operator actions are needed. The controller also automatically opens and closes the mains breaker (open transitions, since there is no synchronisation).
6	Silence horn	Stops an alarm horn (if configured) and enters the Alarm menu.
7	Shortcut menu	Access the Jump menu, Mode selection, Test, and Lamp test
8	MANUAL mode	Use to switch to MANUAL mode. The controller cannot automatically start, stop, connect or disconnect the genset, or open and close the mains breaker. The operator or an external signal can start, stop, connect or disconnect the genset, or open or close the mains breaker.
9	Mains symbol	Green: Mains voltage and frequency are OK. The controller can close the breaker. Red: Mains voltage and/or frequency are not OK.
10	Close breaker	Push to close the breaker.

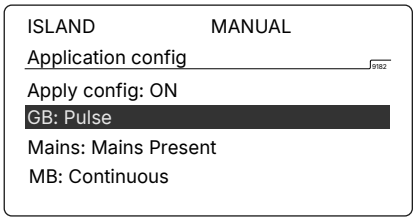
No.	Name	Function
11	Open breaker	Push to open the breaker.
12	Breaker symbols	Green: Breaker is closed. Red: Breaker failure.
13	Generator	Green: Generator voltage and frequency are OK. The controller can close the breaker. Green flashing: The generator voltage and frequency are OK, but the V&Hz OK timer is still running. The controller cannot close the breaker. Red: Generator voltage and/or frequency are not OK.
14	Engine	Green: There is running feedback. Green flashing: The engine is getting ready. Red: The engine is not running, or there is no running feedback.
15	Stop	Stops the genset if MANUAL mode is selected.
16	Start	Starts the genset if MANUAL mode is selected.
17	Load symbol	Green: The supply voltage and frequency are OK. Red: Supply voltage/frequency failure.

4.5 Setup of a single-controller application

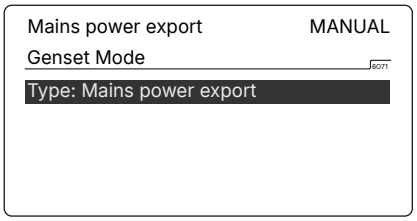
In a single-controller application, the controller can control one genset, a genset breaker, and a mains breaker.

Use the display parameters to set up the application

1. Go to `Communication > CAN protocols > CAN [A and B] Protocol` (7841 and 7842) and make sure that the set point is **NOT** *PMS lite*.
2. Go to `Basic settings > Application type > Application config`.
3. Select the *GB* type as continuous, pulse, or compact (9182).
4. For *Mains*, select *Mains present* (9183).
5. Select the mains breaker (MB) type as continuous, pulse, or compact (9184) .
6. Select *ON* for *Apply config* (9181).



7. Go to `Basic settings > Application type > Genset type`, and select the type of genset mode (6071).



You can also set up the application with the utility software.

4.6 Mains breaker

The PMS lite controller can control one mains breaker in a single-controller application.

4.6.1 Breaker settings

Synchronisation > Dynamic sync.

Parameter	Text	Range	Default
2026	Synchronisation time MB	40 to 300 ms	50 ms

Synchronisation > Mains parallel settings

Parameter	Text	Range	Default	Description
7083	Back synchronisation	OFF ON	OFF	Enables synchronisation from mains to generator. **With back synchronisation**: When the *GB* or *MB* button is activated, the controller starts synchronising if the generator or mains voltage is present. The GB can close directly if the MB is open, and the MB can close directly if the GB is open. **Without back synchronisation**: The GB can only be closed if the mains breaker is open. The MB can only be closed if the generator breaker is open.
7084	Synchronisation to mains	OFF ON	ON	Enables synchronisation from generator to mains.

Breakers > Mains breaker > Breaker configuration

Parameter	Text	Range	Default	Description
7082	MB close delay	0.0 to 30.0 s	0.5 s	The time from GB OFF to MB ON, when back synchronisation is OFF.
7085	Load time	0.0 to 30.0 s	0.0 s	After opening the breaker, the MB ON sequence is not initiated before this delay has expired.

4.6.2 Breaker sequences

AMF MB opening

If the controller operates in Automatic Mains Failure (AMF), it is necessary to select the functionality of the mains breaker opening function. This can be helpful, when the MB can only be operated with voltage on the mains or on the busbar.

Mains > AMF functions > Start seq. in AMF mode

Parameter	Text	Range	Default
7065	Start-up fail control	Start engine + open MB Start engine Open MB when eng ready	Start engine + open MB

Mains > AMF functions > AMF timers

Parameter	Text	Range	Default
7061	U mains failure timer	0.5 to 990.0 s	5.0 s
7062	Mains OK Delay U	2 to 9900 s	60 s
7071	f mains failure timer	0.5 to 990.0 s	5.0 s
7072	Mains OK Delay f	2 to 9900 s	60 s
7081	Mode shift	OFF ON	OFF

Mains > Voltage and freq. limits > Voltage settings

Parameter	Text	Range	Default
7066	U unbalance	2 to 100 %	100 %

The voltage unbalance must be below the unbalance set point before the controller can treat the voltage as okay. The lower the set point, the less voltage imbalance is accepted before a mains failure occurs.

Breakers > Mains breaker > Breaker configuration

Parameter	Text	Range	Default
7082	MB close delay	0.0 to 30.0 s	0.5 s
7085	Load time*	0.0 to 30.0 s	0.0 s

NOTE * The *Load time* timer is only active if back synchronisation is deactivated.

Conditions for breaker operations

The breaker sequences depend on the breaker positions and the frequency/voltage measurements.

Sequence	Condition
MB ON, direct closing	Mains frequency/voltage OK GB open
MB ON, synchronising	Mains frequency/voltage OK GB closed No generator failure alarms
MB OFF, direct opening	Alarms with fail classes: Shut down or Trip MB alarms
MB OFF, deloading	Alarms with fail class: Trip and stop

4.6.3 Inhibit conditions before synchronising mains breaker

This function is used to inhibit the synchronising of the mains breaker after blackout. After blackout a timer starts to run and if the mains voltage and frequency are inside the limits before the timer runs out, the short interruption timer starts. When the timer has run out, the synchronising of the MB starts.

Configure the mains synchronisation inhibits with parameters 2281, 2282, 2283, 2284, 2285, and 2286. If the Delay activate recovery 2 timer runs out, the long interruption timer starts to run. Use parameters 2291, 2292, and 2293 to configure the recovery delay timer.

Example: Recovery timer 1 (short interruption timer)

- Delay activate recovery 2 timer = 3 s
- Recovery delay 1 timer = 5 s

If the short interruption timer is set to ≤ 3 s, and the grid is back and voltage and frequency are inside the acceptable range, then after 5 s the MB can be closed.

More information
See the **iE 150 Generator Mains BTB Designer's handbook** for more details on how the function works.

4.6.4 Digital mains breaker control

The controller normally executes the Automatic Mains Failure sequence based on the parameters in the system setup. You can also configure the Mains OK digital to be used to control the mains return sequence. The purpose of this function is to let an external device (for example, a PLC) or an operator control the mains return sequence.

More information
See the **iE 150 Generator Mains BTB Designer's handbook** for more details.

4.6.5 Breaker failures

Breakers > Mains breaker > Breaker monitoring > MB Open fail

Parameter	Text	Range	Default
2201	Timer	1.0 to 10.0 s	2.0 s
2202	Output A	Relays and M-Logic	Not used
2203	Output B	Relays and M-Logic	Not used
2204	Enable	ON	ON
2205	Fail class	Fail classes	Warning

Breakers > Mains breaker > Breaker monitoring > MB Close fail

Parameter	Text	Range	Default
2211	Timer	1.0 to 5.0 s	2.0 s
2212	Output A	Relays and M-Logic	Not used
2213	Output B	Relays and M-Logic	Not used
2214	Enable	ON	ON
2215	Fail class	Fail classes	Warning

Breakers > Mains breaker > Breaker monitoring > MB Pos fail

Parameter	Text	Range	Default
2221	Timer	1.0 to 5.0 s	1.0 s
2222	Output A	Relays and M-Logic	Not used
2223	Output B	Relays and M-Logic	Not used
2224	Enable	ON	ON
2225	Fail class	Fail classes	Warning

4.6.6 Mains condition at controller start up

You can use a parameter to set the condition of the mains when the controller starts up.

Parameter	Text	Range	Default	Notes
7075	Mains fail assumpt.	Mains has recovered Mains is recovering	Mains has recovered	**Mains has recovered**: If the voltage and frequency are okay when the controller starts up, then the mains breaker can close. **Mains is recovering**: If the voltage and frequency are okay when the controller starts up, then the mains OK timer starts. When the timer runs out, the mains breaker can close.

5. General functions

5.1 Password

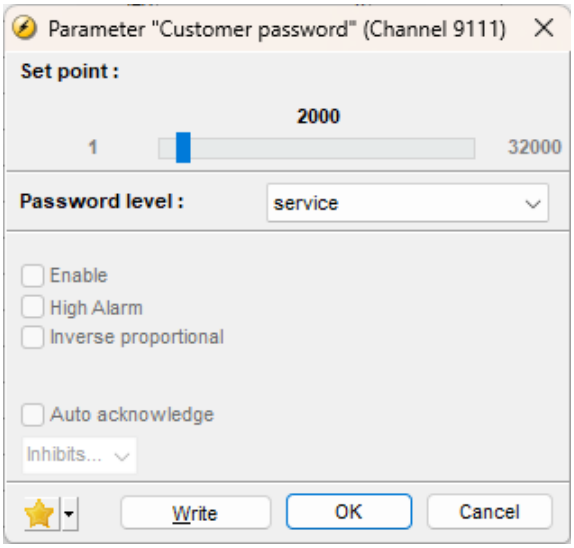
The controller has three password levels that can be configured on the controller or from the utility software. Parameter settings cannot be changed with a lower ranking password, but are shown on the display.

Parameters

`Basic settings > Controller settings > Password`

Parameter	Name	Range	Default	Customer access	Service access	Master access
9111	Customer password	00001 to 32000	2000	●		
9112	Service password	00001 to 32000	2001	●	●	
9113	Master password	00001 to 32000	2002	●	●	●

With the utility software it is possible to protect each parameter with a specific password level. Enter the parameter and select the correct password level.



The password level can also be changed from the parameter view in the Level column:

1. Right-click the appropriate field in the Level column.
2. Select *Change access level*.
3. Select the required access level.
   - *Customer*
   - *Service*
   - *Master*

You can see and edit permissions in the utility software on the *Tools* > *Permissions* page.

5.2 AC measurement systems

The controller is designed for measurement of voltages in systems with nominal voltages between 100 and 690 V AC. The AC system can be three-phase, single-phase, or split phase.

More information
See the **Installation instructions** for how to wire the different systems.

CAUTION

Incorrect configuration is dangerous

Configure the correct AC configuration. If in doubt, contact the switchboard manufacturer for information.

Basic settings > Measurement setup > Wiring connection > AC configuration

Parameter	Text	Range	Default
9131	AC configuration	3 phase 3W4 3 phase 3W3 2 phase L1/L3* 2 phase L1/L2* 1 phase L1*	3 phase 3W4
9132	AC configuration BB	3 phase 3W4 3 phase 3W3	3 phase 3W4

NOTE * If this is selected, the same system is used for the busbar, and parameter 9132 is disabled.

5.2.1 Three-phase system

The three-phase system is the default setting for the controller. When this is used, all three phases must be connected to the controller.

The following configuration is required for three-phase measuring.

Basic settings > Nominal settings > Voltage > Generator nominal U

Parameter	Text	Range	Adjust to value
6004	Generator nominal U	100 to 25000 V	U_{NOM}

Basic settings > Measurement setup > Voltage transformer > Generator VT

Parameter	Text	Range	Adjust to value
6041	U primary G	100 to 25000 V	Primary VT
6042	U secondary G	100 to 690 V	Secondary VT

Basic settings > Nominal settings > Voltage > Busbar nominal U

Parameter	Text	Range	Adjust to value
6053	Busbar voltage	100 to 25000 V	U_{NOM}

Basic settings > Measurement setup > Voltage transformer > Busbar VT

Parameter	Text	Range	Adjust to value
6051	U primary BB	100 to 25000 V	Primary VT
6052	U secondary BB	100 to 690 V	Secondary VT

NOTE The controller has two sets of busbar transformer settings, which can be enabled individually in this measurement system.

5.2.2 Split-phase system

The split-phase system is a special application, where two phases and neutral are connected to the controller. The controller shows phases L1 and L2/L3 in the display. The phase angle between L1 and L3 is 180 °. Split-phase is possible between L1-L2 or L1-L3.

The following configuration is required for the split phase measuring (example 240/120 V AC).

Basic settings > Nominal settings > Voltage > Generator nominal U

Parameter	Text	Range	Adjust to value
6004	Nom. U 1	100 to 25000 V	120 V AC

Basic settings > Measurement setup > Voltage transformer > Generator VT

Parameter	Text	Range	Adjust to value
6041	G primary U	100 to 25000 V	U_{NOM}
6042	G secondary U	100 to 690 V	U_{NOM}

Basic settings > Nominal settings > Voltage > Busbar nominal U

Parameter	Text	Range	Adjust to value
6053	BB nominal U 1	100 to 25000 V	U_{NOM}

Basic settings > Measurement setup > Voltage transformer > Busbar VT

Parameter	Text	Range	Adjust to value
6051	BB primary U 1	100 to 25000 V	U_{NOM}
6052	BB second. U 1	100 to 690 V	U_{NOM}

The measurement U_{L3L1} shows 240 V AC. The voltage alarm set points refer to the nominal voltage 120 V AC, and U_{L3L1} does not activate any alarm.

NOTE The controller has two sets of busbar transformer settings, which can be enabled individually in this measurement system.

5.2.3 Single-phase system

The single-phase system consists of one phase and the neutral.

The following configuration is required for the single-phase measuring (example 230 V AC).

Basic settings > Nominal settings > Voltage > Generator nominal U

Parameter	Text	Range	Adjust to value
6004	Nom. U 1	100 to 25000 V	230 V AC

Basic settings > Measurement setup > Voltage transformer > Generator VT

Parameter	Text	Range	Adjust to value
6041	G primary U	100 to 25000 V	$U_{NOM} \times \sqrt{3}$
6042	G secondary U	100 to 690 V	$U_{NOM} \times \sqrt{3}$

Basic settings > Nominal settings > Voltage > Busbar nominal U

Parameter	Text	Range	Adjust to value
6053	BB nominal U 1	100 to 25000 V	$U_{NOM} \times \sqrt{3}$

Basic settings > Measurement setup > Voltage transformer > Busbar VT

Parameter	Text	Range	Adjust to value
6051	BB primary U 1	100 to 25000 V	$U_{NOM} \times \sqrt{3}$
6052	BB second. U 1	100 to 690 V	$U_{NOM} \times \sqrt{3}$

NOTE The voltage alarms refer to U_{NOM} (for example, 230 V AC).

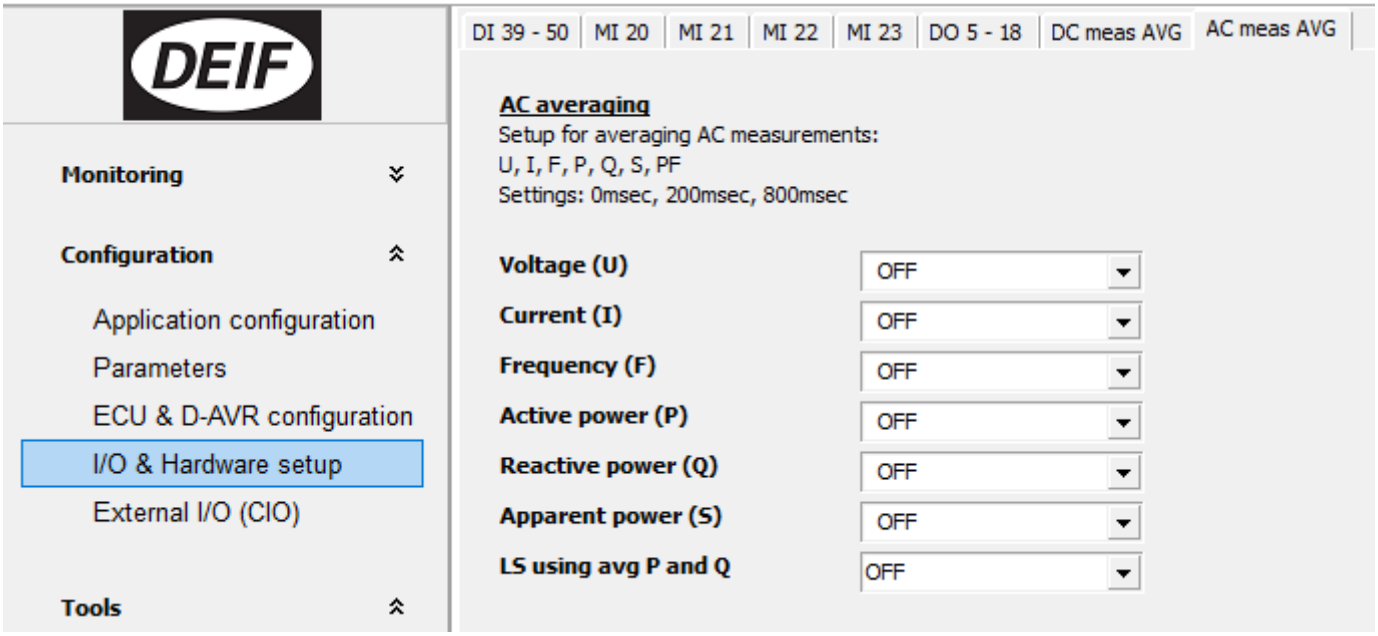
The controller has two sets of busbar transformer settings, which can be enabled individually in this measurement system.

5.2.4 AC measurement averaging

You can use the utility software to set up averaging for a number of AC measurements. The averaged values are then shown on the display unit and in the Modbus values. However, the controller continues to use real-time measurements.

In the utility software, under *I/O & Hardware setup*, select the *AC meas AVG* tab. For each measurement, you can select no averaging (0 ms), averages calculated over 200 ms, or averages calculated over 800 ms.

From the *AC meas AVG* tab, you can also set up averaging for load-sharing using active power (P) and reactive power (Q) measurements. Set *LS using avg P and Q* to ON, and select 200 ms or 800 ms for the *Active power (P)* and *Reactive power (Q)* measurements.



5.3 Nominal settings

The controller has six sets of nominal settings for the generator and one set for the busbar. The sets of nominal generator settings can be individually configured.

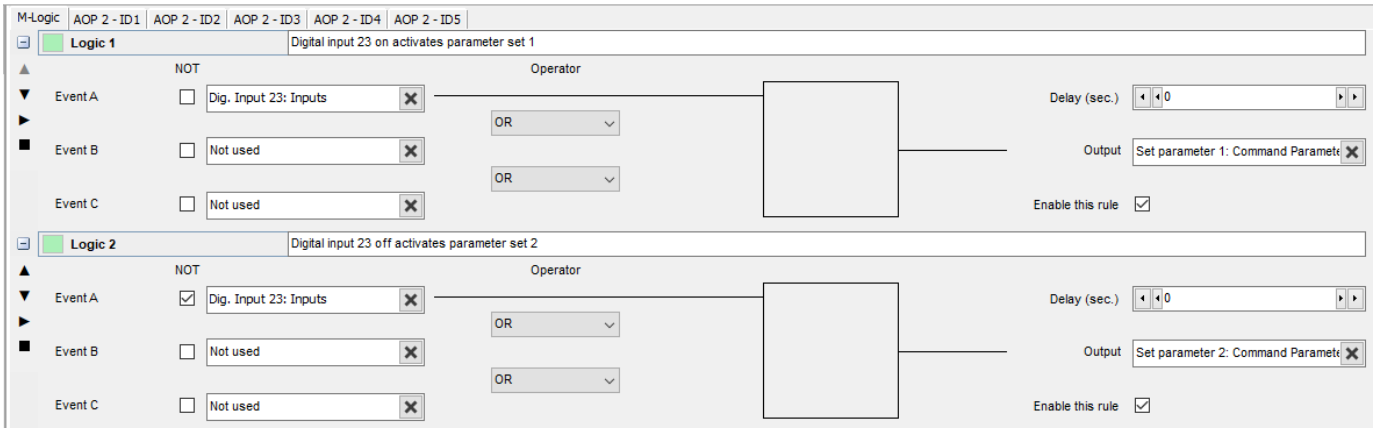
Alternative configuration > Generator nominal settings

Parameter	Text	Range	Default
6006	Enable nom. set	Nominal setting [1 to 6]	Nominal setting 1

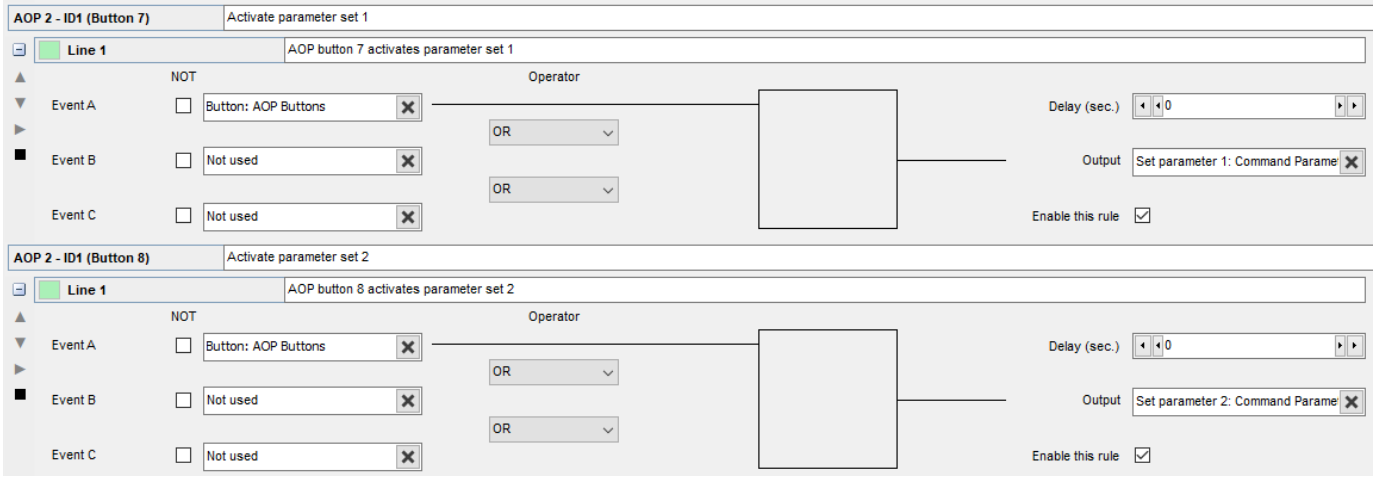
Switch between the nominal settings

You can use the following to switch between the sets of nominal settings:

1. **Digital input**: M-Logic is used when a digital input is needed to switch between the sets of nominal settings. Select the required input among the input events, and select the nominal settings in the outputs. For example:



2. **AOP**: M-Logic is used when the AOP is used to switch between the sets of nominal settings. Select the required AOP button among the input events, and select the nominal settings in the outputs. For example:



3. **Menu settings**: On the controller or with the utility software.

Block nominal settings change

Use the *Block nom chang* function to stop the nominal settings for the generator and busbar being changed. Go to parameter *6017* and change the set point to *On* to enable the function.

5.3.1 Default nominal settings

The default nominal settings are settings 1.

Basic settings > Nominal settings

Parameter	Text	Range	Default
6001	Frequency Nom. f	48.0 to 62.0 Hz	50 Hz
6002	Power Nom. P	10 to 20000 kW	480 kW
6003	Current Nom. I	0 to 9000 A	867 A

Parameter	Text	Range	Default
6004	Generator nominal U	100 to 25000 V	400 V
6005	Setpoint Nom. rpm	100 to 4000 RPM	1500 RPM
6007	4th current Nom. I	0 to 9000 A	867 A
6053	Busbar nominal U	100 to 25000 V	400 V
6055	4th current Nom. P	10 to 9000 kW	480 kW

5.3.2 Alternative nominal settings

`Alternative config. > Generator nominal settings > Nominal settings [2 to 6] > Basic settings`

Parameter	Text	Range	Default
6011, 6021, 6031, 6801, 6811	Frequency Nom. f	48.0 to 62.0 Hz	50 Hz
6012, 6022, 6032, 6802, 6812	Power Nom. P	10 to 20000 kW	480 kW
6013, 6023, 6033, 6803, 6813	Current Nom. I	0 to 9000 A	867 A
6014, 6024, 6034, 6804, 6814	Generator nominal U	100 to 25000 V	400 V
6015, 6025, 6035, 6805, 6815	Setpoint Nom. rpm	100 to 4000 RPM	1500 RPM
6016, 6026, 6036, 6806, 6816	Nom. I E/N/M	0 to 9000 A	867 A

`Alternative config. > Generator nominal settings > Nominal settings [2 to 6] > Offset ctrl. signals`

Parameter	Text	Range	Default
2552, 2553, 2554, 2555, 2556	GOV output offset	0 to 100 %	50 %
2672, 2673, 2674, 2676, 2676	AVR output offset	0 to 100 %	50 %

5.3.3 Scaling

For applications above 25000 V and below 100 V, adjust the input range to match the actual value of the primary voltage transformer.

Changing the voltage scaling also affects the nominal power scaling.

`Basic settings > Measurement setup > Scaling`

Parameter	Text	Range	Default	Notes
9030	Scaling	10 to 2500 V 100 to 25000 V 10 to 160 kV 0.4 to 75 kV	100 to 25000 V	**10 to 2500 V**: This is recommended for power sources up to 150 kVA. The nominal power must be less than 900 kW. **100 to 25000 V**: This is recommended for power sources over 150 kVA.

NOTICE

Incorrect configuration is dangerous

Correct all nominal values and the primary VT settings after the scaling (parameter 9030) is changed.

5.4 Mode overview

The controller has four running modes and one block mode:

- **AUTO**: The controller operates automatically, and the operator cannot initiate any sequences manually.
- **MANUAL**: The operator has to initiate all sequences. This can be done using the buttons, Modbus commands or digital inputs. When started, the genset runs at nominal values.
- **Test**: The test sequence starts.
- **No regulation**: The digital increase/decrease inputs can be used (if they have been configured) as well as the *Start* and *Stop* buttons. When starting, the genset starts without any subsequent regulation.
- **Block**: The controller cannot initiate any sequences, for example the start sequence. Block mode must be selected when maintenance work is carried out on the genset.

NOTICE

Sudden genset stop

If block mode is selected while the genset is running, the genset shuts down.

5.4.1 MANUAL mode

The controller can be operated in MANUAL mode. This means that the controller will not initiate sequences automatically, as is the case with the AUTO mode. It will only initiate sequences, if external signals are given.

An external signal may be given in three ways:

1. Buttons on the display are used
2. Digital inputs are used
3. Modbus command

NOTE The controller has a limited number of digital inputs. See **Digital inputs** for availability.

When the genset is running in MANUAL mode, the controller controls the speed governor and the AVR.

MANUAL mode commands

Command	Description
Start	The start sequence is initiated and continues until the genset starts or the maximum number of start attempts is reached. The frequency (and voltage) will be regulated to make the GB ready to close.
Stop	The genset is stopped. Without the running signal, the stop sequence continues to be active in the Extended stop time period. The genset is stopped with cooling down time. The cooling down time is cancelled if the *Stop* button is activated twice.
Close GB	The controller synchronises and closes the generator breaker. In **single-controller applications**, the controller closes the generator breaker if the mains breaker is open, or synchronise and closes the generator breaker if the mains breaker is closed. When AMF mode is selected, the controller will not regulate after breaker closure.
Open GB	The controller opens the generator breaker instantly.

Command	Description
	In **single-controller applications**, the controller ramps down and opens the generator breaker at the Breaker open point if the mains breaker is closed. The controller opens the generator breaker instantly if the mains breaker is open.
Close MB*	In **single controller applications**, the controller closes the mains breaker if the generator breaker is open, or synchronises and closes the mains breaker if the generator breaker is closed.
Open MB*	In **single controller applications**, the controller opens the mains breaker instantly.
Manual GOV UP	The regulator is deactivated and the governor output is activated as long as the GOV input is ON.
Manual GOV DOWN	The regulator is deactivated and the governor output is activated as long as the GOV input is ON.
Manual AVR UP	The regulator is deactivated and the governor output is activated as long as the AVR input is ON.
Manual AVR DOWN	The regulator is deactivated and the governor output is activated as long as the AVR input is ON.

NOTE * Only for single-controller applications.

5.4.2 Test mode

The test mode function is activated by selecting test with the *Shortcut* button on the display or by activating a digital input.

`Power set points > Test`

Parameter	Text	Range	Default
7041	Set point	1 to 100	1
7042	Timer	0.0 to 999.0 min	0.0 min
7043	Return mode	• MANUAL • AUTO • NoReg • No mode change	No mode change
7044	Type	Simple test Load test Full test	Simple test

NOTE If the timer is set to 0.0 min., the test sequence is infinite.

If the controller is in the stop sequence in test mode and the mode is changed to MANUAL, the genset continues to run.

Simple test

The simple test will only start the genset and run it at nominal frequency with the generator breaker open. The test will run until the timer expires.

Load test

The load test will start the genset and run it at nominal frequency, synchronise the generator breaker and produce power according to the set point. The test will run until the timer expires.

Full test

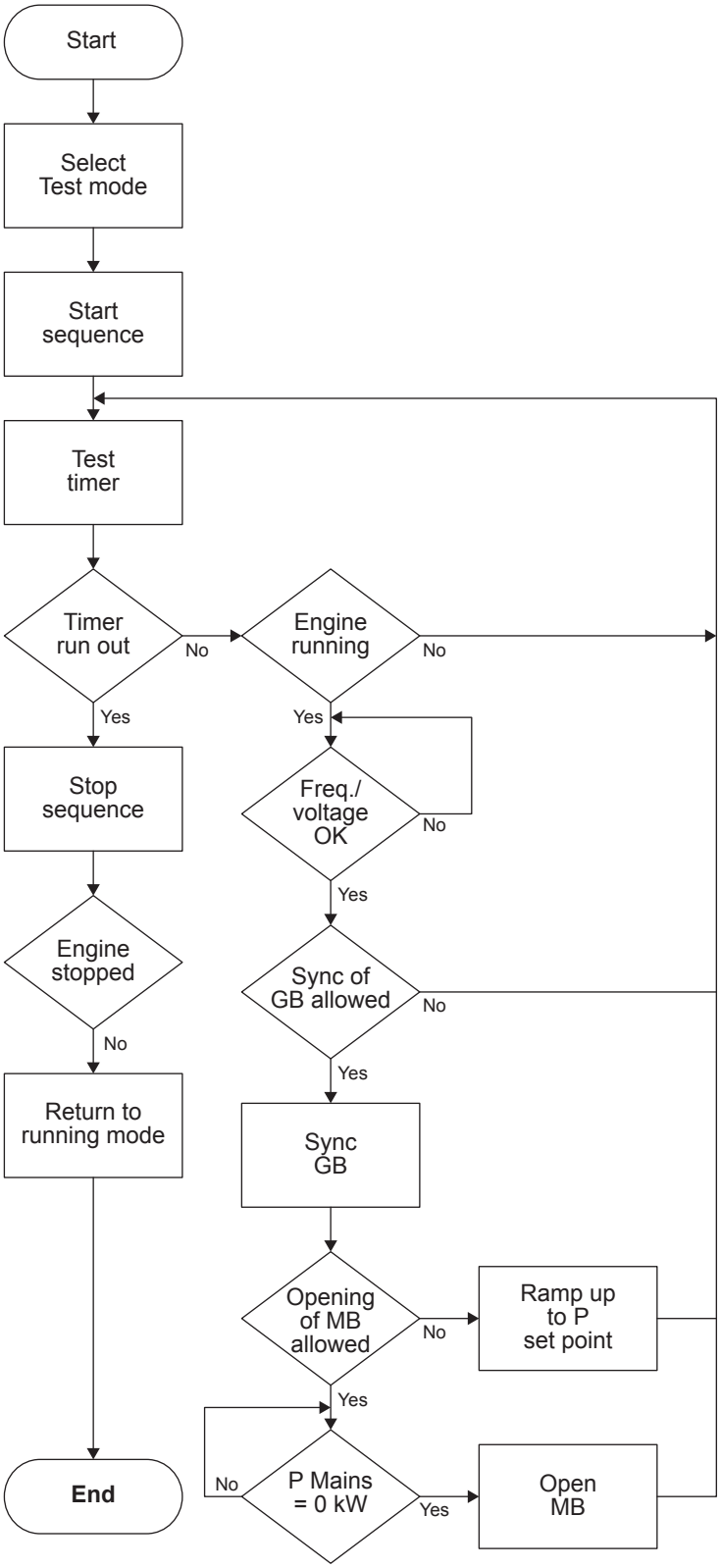
The full test starts the genset and runs it at nominal frequency. If possible, the generator breaker closes. When the test timer expires, the generator breaker is opened and the generator is stopped.

In single-controller applications, the full test will start the genset and run it at nominal frequency, synchronise the generator breaker and transfer the load to the generator before opening the mains breaker. When the test timer expires, the mains breaker synchronises and the load is transferred back to the mains before the generator breaker is opened and the generator is stopped.

Synchronisation > Mains parallel settings > Sync. to mains

Parameter	Text	Range	Default	Notes
7084	Sync. to mains	OFF ON	OFF	To run a Load test or a Full test, the parameter must be enabled.

Test sequence flowchart



5.4.3 No regulation mode

When **No reg** mode is selected, the genset can be controlled from the display and with digital inputs.

No regulation mode commands

Command	Description
Start	The start sequence is initiated and continues until the genset starts or the maximum number of start attempts are reached. Note: There is no automatic regulation.
Stop	The genset is stopped. Without the running signal, the stop sequence remains active in the extended stop time period. The genset is stopped with cooling down time.
Close GB	If there is no voltage on the busbar, the controller closes the generator breaker (GB). If there is voltage on the busbar, the operator must manually regulate the genset to synchronise. When synchronised, the controller closes the GB. Note: There is no automatic regulation. Sync. failure is deactivated.
Open GB	The controller opens the generator breaker instantly.
Close MB*	In **single-controller applications**, if there is no voltage on the busbar, the controller closes the mains breaker (MB). If there is voltage on the busbar, the operator must manually regulate the genset(s) to synchronise. When synchronised, the controller closes the MB. Note: There is no automatic regulation. Sync. failure is deactivated.
Open MB*	In **single-controller applications**, the controller opens the mains breaker instantly.
Manual GOV UP	The controller gives increase signal to the speed governor.
Manual GOV DOWN	The controller gives decrease signal to the speed governor.
Manual AVR UP	The controller gives increase signal to the AVR.
Manual AVR DOWN	The controller gives decrease signal to the AVR.

NOTE * Only for single-controller applications.

5.4.4 Block mode

When the block mode is selected, the controller is locked for certain actions. This means that the controller cannot start the genset or do any breaker operations.

To change the running mode from the display, the user will be asked for a password before the change can be made. It is not possible to select Block mode when running feedback is present.

If the digital inputs are used to change the mode, it is important that the input configured to *Block mode* is a constant signal:

- When the signal is ON, the controller is blocked.
- When the signal is OFF, the controller returns to the mode selected before block mode.

If block mode is selected using the display after the digital block input is activated, the controller will stay in block mode after the block input is deactivated. The block mode must now be changed using the display. The block mode can only be changed locally by display or digital input. Alarms are not influenced by block mode selection.

NOTE The genset shuts down if block mode is selected while the genset is running.

CAUTION

Be careful when starting the genset

Before the running mode is changed, check that people are clear of the genset and that the genset is ready for operation. If possible, start the genset from the local engine control panel (if installed), rather than local cranking and starting of the genset.

5.4.5 Not in AUTO mode

This function activates an alarm if the system is not in AUTO mode.

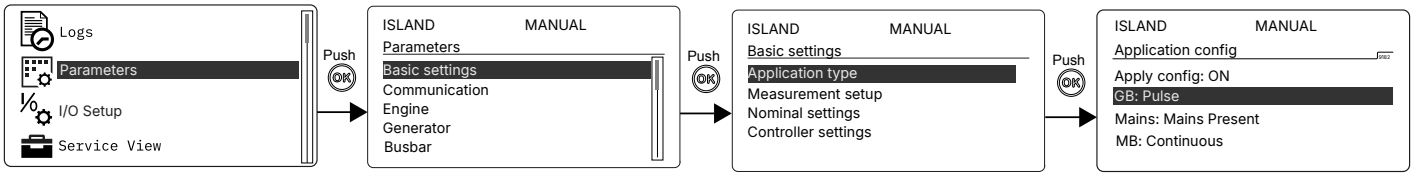
`Functions > Not in Auto`

Parameter	Text	Range	Default
6541	Timer	10.0 to 900.0 s	300.0 s
6544	Enable	OFF ON	OFF
6545	Fail class	Fail classes	Warning

5.5 Breakers

5.5.1 Breaker types

There are three breaker type settings. You can set the breaker type on the display. Go to `Parameters > Basic settings > Application type > Application config` and select continuous, pulse, or compact for the genset breaker (GB) type (9183). Then, select *On* for *Apply config* in parameter 9181.



You can also set the breaker type with the utility software.

Continuous

The controller only uses the *Close breaker* output:

- Closed: This closes the contactor.
- Open: This opens the contactor.

The *Open breaker* output can be configured for another function.

Pulse

This setting is usually used in combination with a circuit breaker. The controller uses these outputs:

- To close the circuit breaker, the *Close breaker* output is activated (until there is breaker close feedback).
- To open the circuit breaker, the *Open breaker* output is activated (until there is breaker open feedback).

Compact

This setting is usually used in combination with a direct controlled motor driven breaker. The controller uses these outputs:

- The *Close breaker* output closes briefly to close the compact breaker.
- The *Open breaker* output closes to open the compact breaker. The output stays closed long enough to recharge the breaker.

If the compact breaker is tripped externally, it is recharged automatically before next closing.

5.5.2 Breaker spring load time

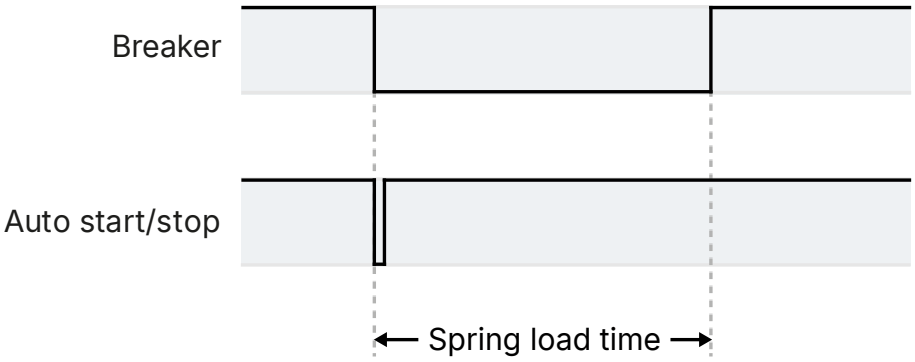
To avoid breaker close failures in situations where the breaker close command is given before the breaker spring has been loaded, the spring load time can be adjusted.

Principle

You could have a close failure if:

1. A genset is in AUTO mode, the Auto start/stop input is active, the genset is running, and the GB is closed.
2. The Auto start/stop input is deactivated, the stop sequence is executed, and the GB is opened.
3. If the Auto start/stop input is activated again before the stop sequence is finished, the controller activates a GB close failure, since the GB needs time to load the spring before it is ready to close.

The diagram shows an example where a single genset is controlled by the Auto start/stop input.



- When the Auto start/stop input deactivates, the GB opens.
- The Auto start/stop is re-activated immediately after the GB has opened, for example by the operator using a switch in the switchboard.
- The controller waits a while before sending the close signal again, because the spring load time must expire.

Ensuring time to reload

If the breaker needs time to reload the spring after it has opened, the controller can take this delay into account. This can be controlled through timers in the controller or through digital feedbacks from the breaker, depending on the breaker type:

1. **Timer-controlled.** A load time set point for breakers with no feedback indicating that the spring is loaded. After the breaker has been opened it will not be allowed to close again before the delay has expired. When the timer is running, the remaining time is shown in the display.
2. **Digital input.** Two configurable inputs are used for feedbacks from the breakers: One for GB spring loaded and one for MB spring loaded*. After the breaker has been opened it cannot close before the configured input is active.

NOTE This is only for single-controller applications.

If both a timer and breaker feedback are used, both requirements must be met before the breaker is allowed to close.

5.5.3 Breaker position failure

The breaker position failure alarm is activated if a controller has no breaker position feedback, or if both feedbacks from the breaker are high.

When a controller has a breaker position failure, the genset is blocked for operation. The breaker is not closed and the genset cannot start. If the genset is running and breaker is closed, it is possible to open the breaker and stop the engine.

You can assign a fail class to try to trip the faulty breaker when the controller discovers a breaker position failure.

5.6 Alarms

5.6.1 Fail classes

Fail class/Action	Alarm horn relay	Alarm display	Deload	Trip GB	Trip MB*	Cooling down genset	Stop genset
Block	●	●					
Warning	●	●					
Trip GB	●	●		●			
Trip + stop	●	●		●		●	●
Shutdown	●	●		●			●
Trip MB*	●	●			●		
Safety stop	●	●	(●)			●	●
Trip MB/GB	●	●		(●)	●		
Controlled stop	●	●	●	●		●	●

NOTE * Only for single-controller applications.

The table shows the action of the fail classes. For example, if an alarm is configured with the *Shutdown* fail class, the following occurs:

- The alarm horn relay activates.
- The alarm is displayed on the alarm info screen.
- The generator breaker opens instantly.
- The genset is stopped instantly.
- The genset cannot be started from the controller (see next table).

The *Safety stop* fail class only deloads the genset if it is possible. An extra genset can start up and replace the faulty one, or the others have spinning reserve enough to stop the faulty genset.

In single-controller applications, *Safety stop* has no effect in Load take-over and Automatic Mains Failure (AMF) modes.

Trip MB/GB only trips the generator breaker if the genset controller controls a mains breaker. Otherwise, the fail class always trips the generator breaker.

When the engine is stopped

Fail class/Action	Block engine start	Block MB sequence*	Block GB sequence
Block	●		●
Warning			
Trip GB	●		●
Trip + stop	●		●
Shutdown	●		●
Trip MB*		●	

Fail class/Action	Block engine start	Block MB sequence*	Block GB sequence
Safety stop	●		●
Trip MB/GB*	(●)	●	(●)
Controlled stop	●		●

The fail class *Trip MB/GB* does not block *Start* and *Block GB* sequences if the genset controller is in a single-controller application with a mains breaker.

NOTE * Only for single-controller applications.

5.6.2 Inhibits

Function	Notes
Inhibit 1	M-Logic outputs: Conditions are programmed in M-Logic.
Inhibit 2	
Inhibit 3	
GB ON	The generator breaker is closed.
GB OFF	The generator breaker is open.
Run status	Running detected and the timer has expired*.
Not run status	Running not detected or the timer has not expired*.
Generator voltage > 30 %	Generator voltage is above 30 % of nominal.
Generator voltage < 30 %	Generator voltage is below 30 % of nominal.
MB ON	**For single-controller applications only:** The mains breaker is closed.
MB OFF	**For single-controller applications only:** The mains breaker is open.
Parallel	Genset(s) are parallel to grid/utility.
Not parallel	Genset(s) are not parallel to grid/utility.
Shutdown override	The shutdown override input is activated.

NOTE * The run status timer is configured under `Functions > Run status > Timer`. With binary running feedback the timer is not used.

5.6.3 Alarm list monitoring

larm list monitoring allows you to view all active alarms using Modbus, which is useful for remote monitoring and touch screen devices, for example AGI and SCADA/BMS systems. The alarms are in Modbus addresses 28000 to 28099 and these are not listed in the *Input register (04)*.

The Modbus address for an active alarm corresponds to the address value in the utility software. For example, Modbus address 109 is equal to parameter 2220 MB Pos fail as the address in the utility for this parameter is 109.

All groups | Protection | Synchronisation | Regulation | Digital In | Analogue In | Outputs | General | Mai

Drag a column header here to group by that column

Category	Channel	Text	Address	Value	Unit
Synchronisation	2111	Blackout / f<	1307	3	Hz
Synchronisation	2154	Phase rotation	1193	0	
Synchronisation	2240	Sep Sync relay	110	N/A	
Synchronisation	2220	MB Pos fail	109	N/A	

5.6.4 Unsupported application

The PMS lite controller has configuration limitations. If a configuration rule is broken, the controller activates the *Unsupported application*. The alarm value shows which rule was broken. You can see the alarm value in the alarm log in the utility software.

Alarm value	Configuration rule
2	A single controller cannot be in a system with a mains controller or a BTB controller.
3	CANshare and PMS lite cannot both be enabled.
7	The controller type is unknown.
36	To control a mains breaker, the PMS lite controller must be configured as a single controller.
49	If the PMS lite controller is configured as a single controller with third party load sharing, it cannot be in AUTO mode.
50	For third party load sharing, the PMS lite controller must be configured as a single controller.

More information
See **Single-controller applications** for how to configure the PMS lite controller as a single controller.

5.7 M-Logic

The main purpose of M-Logic is to give the operator/designer more flexibility.

M-Logic is used to execute different commands at predefined conditions. M-Logic is not a PLC but substitutes one, if only very simple commands are needed.

M-Logic is a simple tool based on logic events. One or more input conditions are defined, and at the activation of those inputs, the defined output will occur. A great variety of inputs can be selected, such as digital inputs, alarm conditions and running conditions. A variety of the outputs can also be selected, such as relay outputs, change of modes.

You can configure M-Logic in the utility software.

5.7.1 General shortcuts

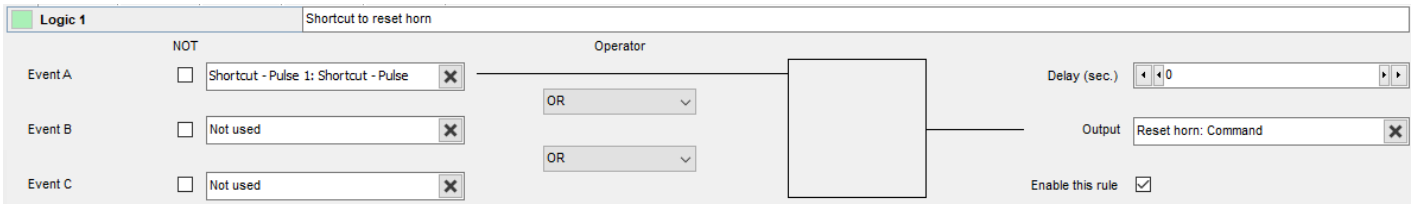
You can configure your own shortcuts with M-Logic in the utility software. You can see the configured shortcuts when you push the *Shortcut* button and select *General shortcuts*. If you have not configured a shortcut, then the *General shortcuts* menu is empty.

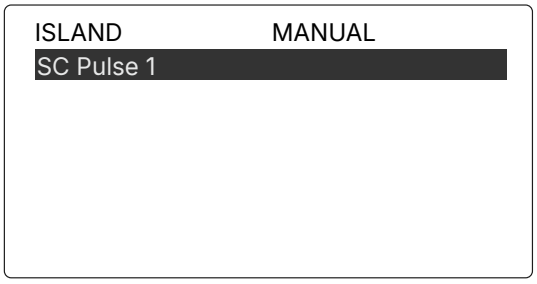
For a pulse shortcut, the command is sent each time you select the shortcut and press OK in the display menu.

For a switch shortcut, the switch is toggled (on/off) each time you select the shortcut.

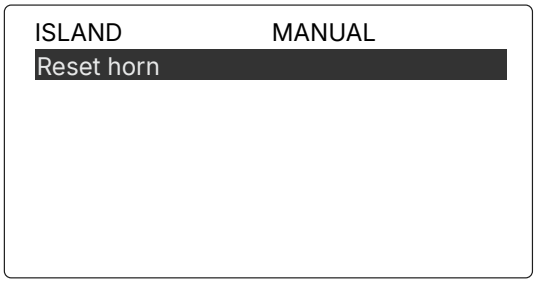
Use the *Translations* interface to rename the shortcut.

Example of shortcut pulse

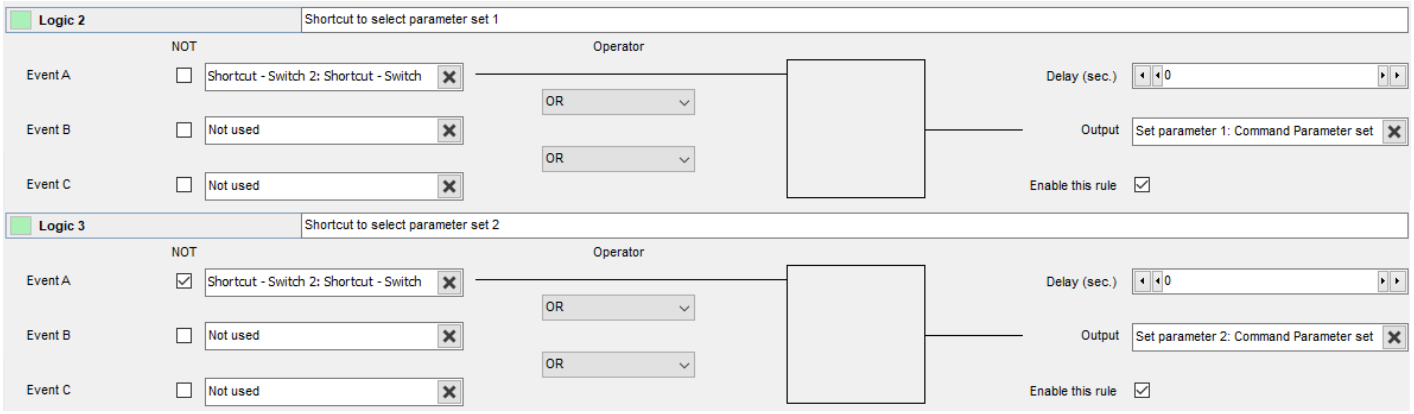


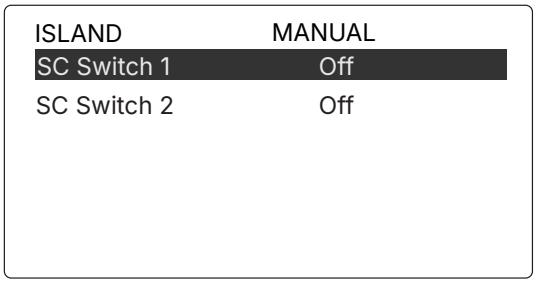


Rename *SC Pulse 1* to *Reset horn*.

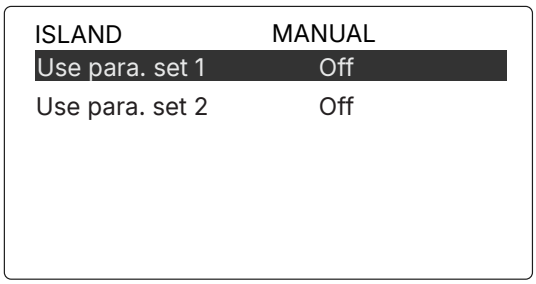


Example of shortcut switch





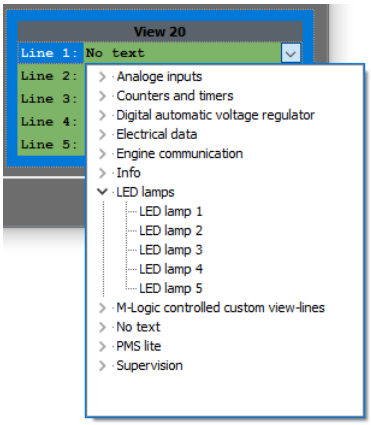
Rename *SC Switch 2 on* to *Use para. set 1*. Rename *SC Switch 2 off* to *Use para. set 2*.

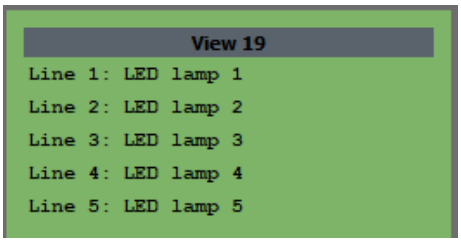


5.7.2 LED lamps

You can configure LED lamps with M-Logic in the utility software. The LED lamps are shown on a configurable page on the display.

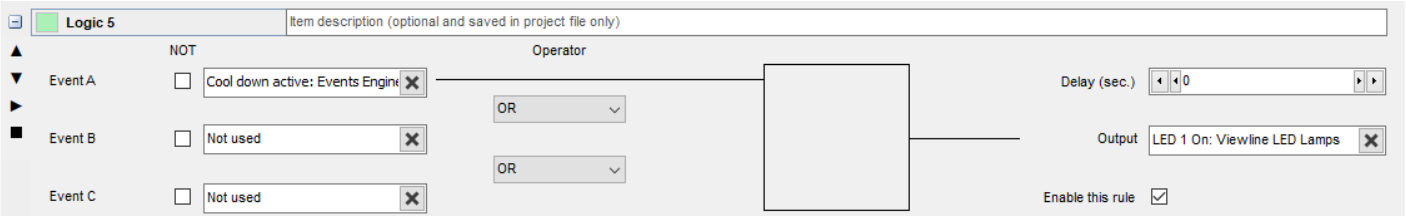
In the utility software, select the *Configuration of the user views* icon from the top toolbar. Select the page you want the LED lamps to be shown on and use the drop-down menu to select an LED lamp.



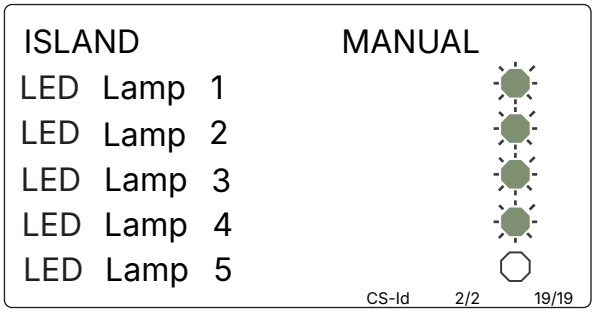


To configure the LED lamps in M-Logic, go to the *M-Logic & AOP* tab. From the *Viewline LED Lamps* menu in the *Output* tab, select the LED number and type.

Example of LED lamp configuration

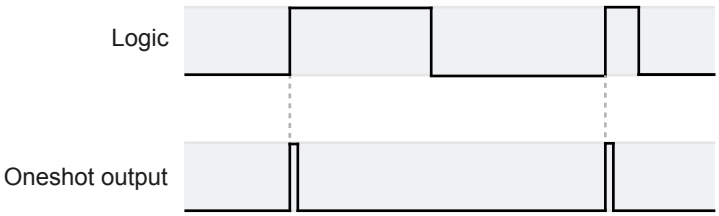


LED lamps on the display



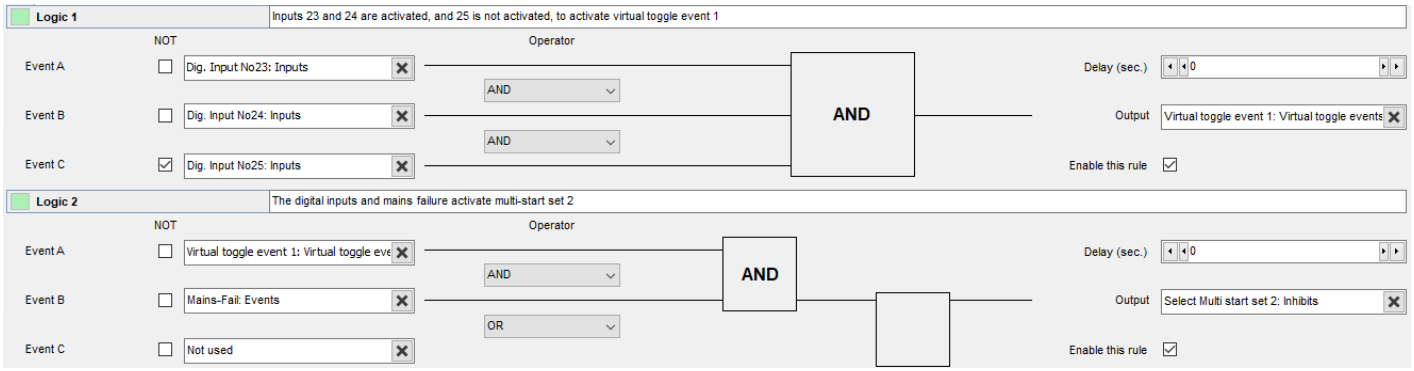
5.7.3 Oneshots

Description	Notes
Oneshot set [1-16]	The oneshot is activated for a short time (about 100 ms) when the logic is true. If the logic remains true, the oneshot is not activated again. When the logic is false, the function is reset.



5.7.4 Virtual event outputs

Virtual event outputs are used to expand the number of outputs in a logic sequence. For example, the output of Logic 1 can be used to continue the sequence in Logic 2.



- The *Logic 1* output is set to *Virtual event output 1*.
- *Event A* in *Logic 2* is *Virtual event output 1*.

Up to five outputs that can be used in this logic sequence (A + B + C in Logic 1 and B + C in Logic 2).

Virtual event outputs

Description	Notes
Virtual event output [1-96]*	Virtual event outputs 1 to 96 can be activated by Modbus. They can also be used in multiple lines of logic to increase the number of events possible in one sequence.

NOTE * Previously *Virtual toggle event [1-96]*.

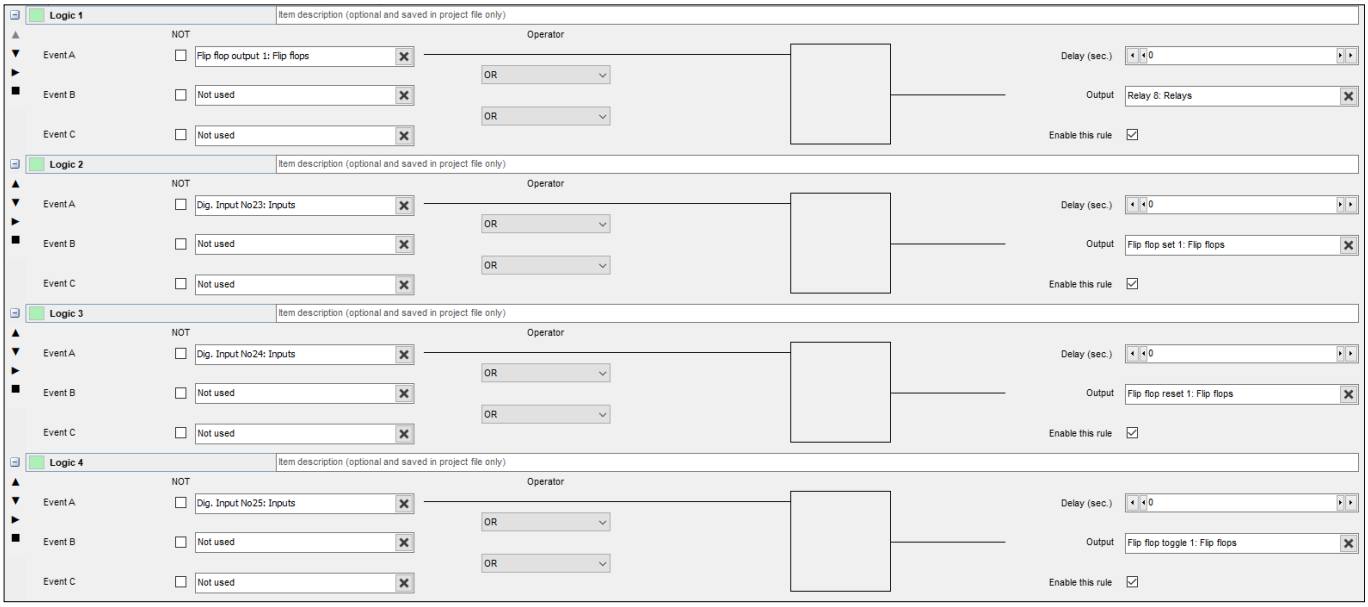
5.7.5 Flip flop function

The flip flop function makes it easy for a pulse input to latch an output, for example a relay.

The Event selects a flip flop output [1-16], and the Output selects the output function:

- Flip flop set [1-16] = Change the flip flop output state to High.
- Flip flop reset [1-16] = Change the flip flop output state to Low.
- Flip flop toggle [1-16] = Shift the flip flop output state from Low to High or from High to Low.

Example



The example shows how flip flop set 1 could be configured to set relay 8:

- Logic 1: Flip flop output 1 is selected to set the relay output.
- Logic 2: Digital input 23 is used to trigger flip flop set 1 and thus sets the relay output active.
- Logic 3: Digital input 24 is used to deactivate the relay output by triggering flip flop reset 1.
- Logic 4: Digital input 25 is used to toggle the flip flop output state.
- Relay 8 must be set to *M-Logic / Limit relay*.

If reset and set are active at the same time, the flip flop will prioritise the reset command. The set or reset function may not be active when the toggle function is used.

The flip flops are also accessible from Modbus.

5.7.6 Virtual toggle outputs

Description	Notes
Virtual toggle output [1-32] *	Virtual toggle outputs 1 to 32 can be activated by Modbus. They can also be used in multiple lines of logic to increase the number of events possible in one sequence.

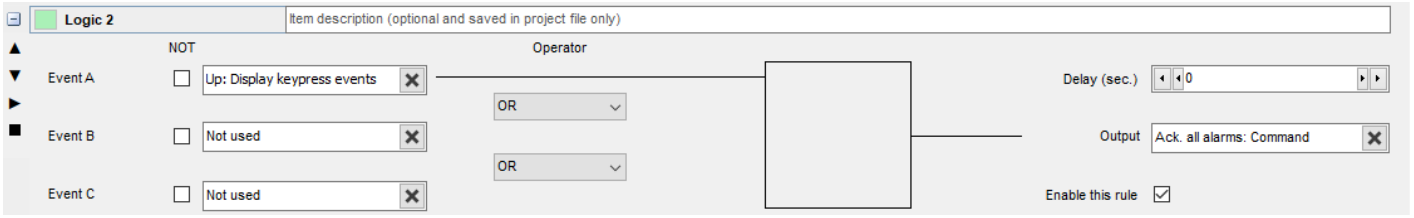
NOTE * Previously *Virtual switch event [1-32]*

5.7.7 M-Logic event counters

Description	Notes
M-logic event counter limit [1-8]	The event counter has reached the limit selected in the *Counters > M-logic event counter* window.
M-logic event reset counter [1-8]	The event counter has been reset. The reset conditions are in the *Counters > M-logic event counter* window.

5.7.8 Display keypress events

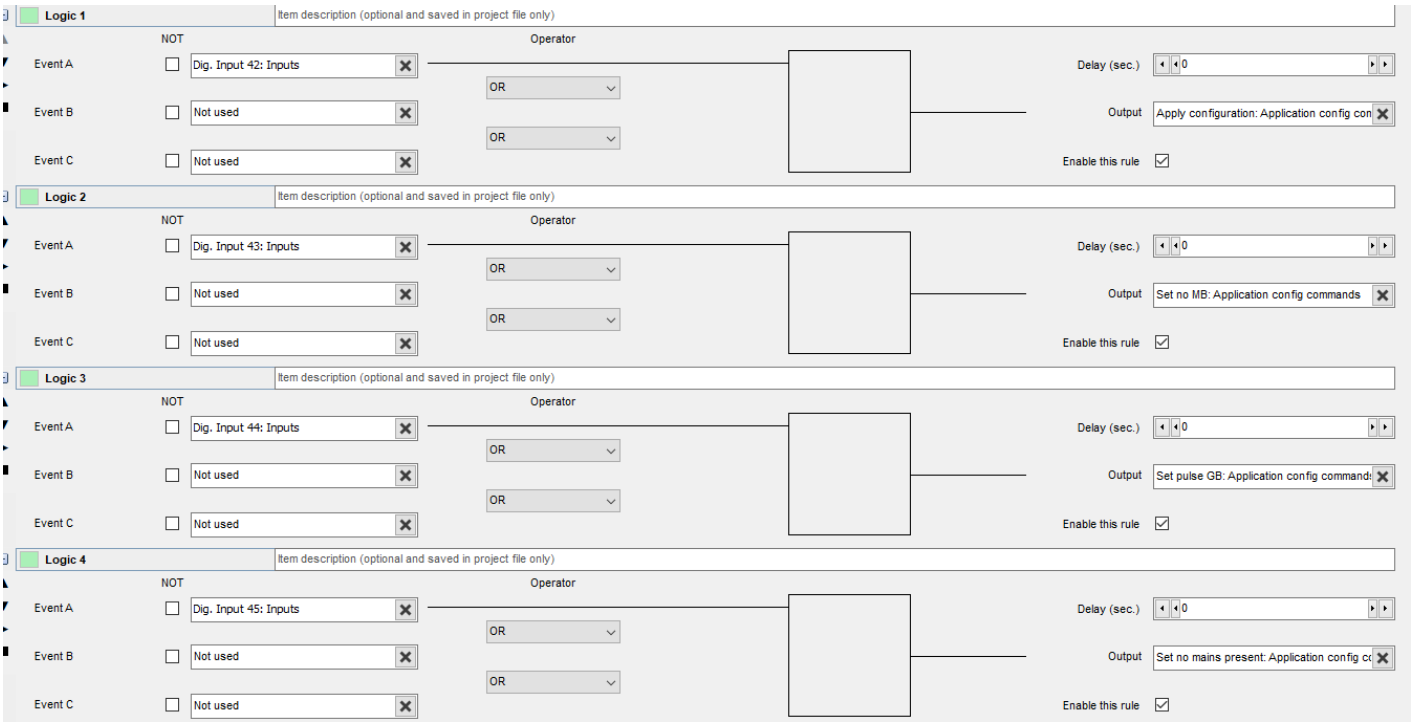
Use the display keypress events to activate an output with the display buttons. For example, you can configure the *UP* button to acknowledge all alarms when you push it.



The function can also be used to detect when a button is pushed.

5.7.9 Application configuration commands

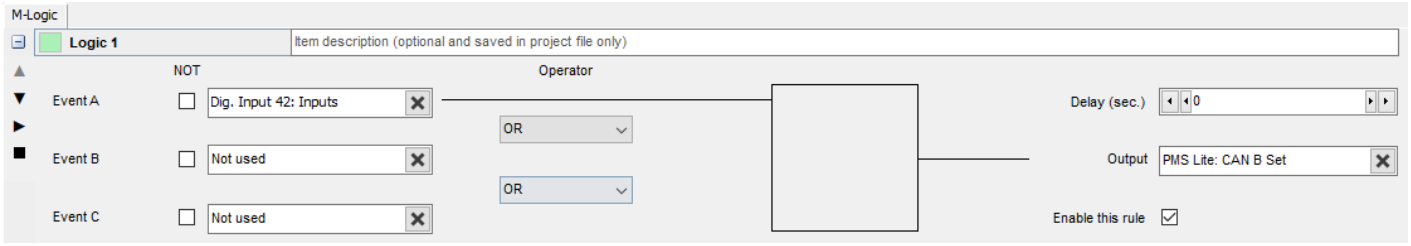
The *Application config commands* allows you to change the application configuration.



5.7.10 CAN B protocol

The *CAN B Set* output in M-Logic allows you to change the CAN B protocol. Select *PMS Lite* as the set point for a PMS lite power management system. For a single controller, set the set point to *OFF*.

M-Logic CAN B output example



5.7.11 M-Logic function spreadsheet

More information
See the **Application notes, M-Logic** spreadsheet for a complete list of the M-Logic functions in the controller.

5.8 Timers and counters

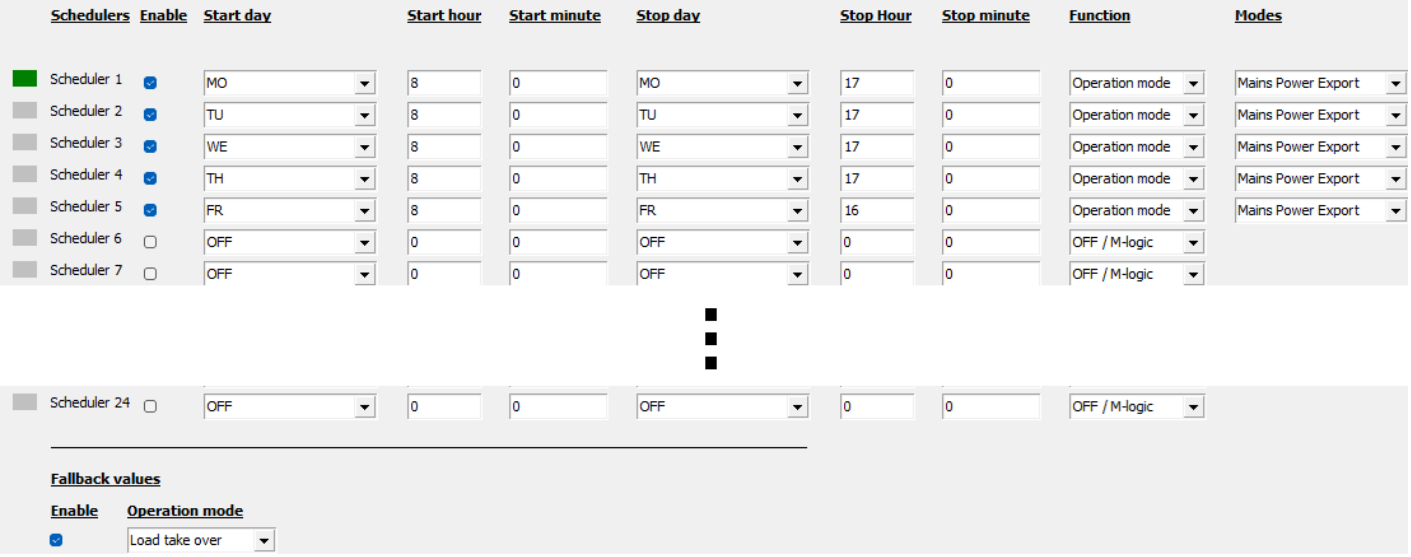
5.8.1 Command schedulers

You can use the scheduler to configure up to 24 schedules for the controller operation modes.

You can view active scheduler from the display unit (from *Service view*) or from the utility software (select *Scheduler* and *Turn ON Live data*). When the schedulers are enabled and active, the corresponding M-Logic events are also activated.

To configure the schedulers, in the utility software, select *Scheduler*.

Example of Scheduler configuration



This business is using the controller to control a single genset. The genset uses *Mains power export* to export power during business hours. At the start of each period that is not covered by a scheduler (that is, outside business hours), the controller changes the operation mode to *Load take over*, so that the genset only supplies the site's own needs.

If the controller operation mode or set points need to be changed at any time, the operator can do so. However, each time a scheduler or the fallback is activated, it will change the controller operation mode.

How it works

When each scheduler starts, the controller changes its parameters according to the values configured for that scheduler. If a scheduler ends and no other scheduler starts, if the fallback values are enabled, the controller uses the fallback value to change its parameters.

If their functions are different, two schedulers can run and be active on the same time. If two schedulers with the same function are active at the same time, the scheduler with the higher number takes priority.

Conflicting schedulers

Schedulers 10 and 20 are configured to be active at the same time, and both have the *Operation mode* function. However, scheduler 10 is configured for *Fixed power*, while scheduler 20 is configured for *Auto. Mains Failure*.

Since there is a conflict, scheduler 20 takes priority, since it has a higher number. The controller therefore only changes the *Operation mode* set point to *Auto. Mains Failure* when the schedulers are activated.

5.8.2 Command timers

Command timers are used to execute a command at a specific time. For example, to start and stop the genset automatically at specific times on certain weekdays.

For single controller application in AUTO mode, this function is available in load take-over, mains power export, and fixed power operation.

Up to four command timers can be configured with M-Logic. Each command timer can be set for the following time periods:

- Individual days (MO, TU, WE, TH, FR, SA, SU)
- MO, TU, WE, TH
- MO, TU, WE, TH, FR
- MO, TU, WE, TH, FR, SA, SU
- SA, SU

To start in AUTO mode, the Auto start/stop command can be programmed in M-Logic or in the input settings. The time-dependent commands are flags that are activated when the command timer is in the active period.

5.8.3 Diagnostics timer

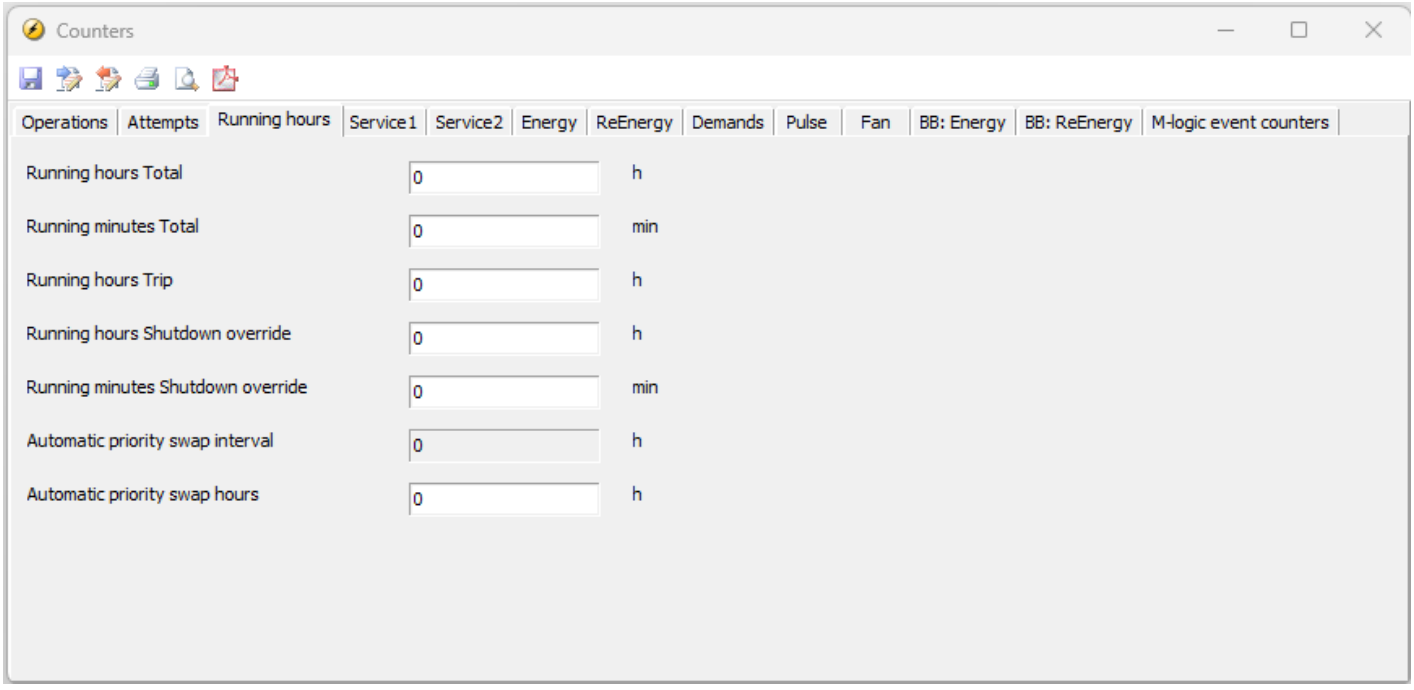
This function is useful when the ECU power is connected to the run coil. The function activates the run coil. This allows the controller to communicate with the ECU and read information even though the engine is not running.

Diagnostics mode is activated when the diagnostics timer expires, and continues until the stop button is pressed. To configure the timer and enable diagnostics, go to *Parameters* in the utility software, and select parameter 6701.

5.8.4 USW counters

You can view and adjust a number of counters using the USW. Click the **Σ** icon to open the counters window.

Counters example

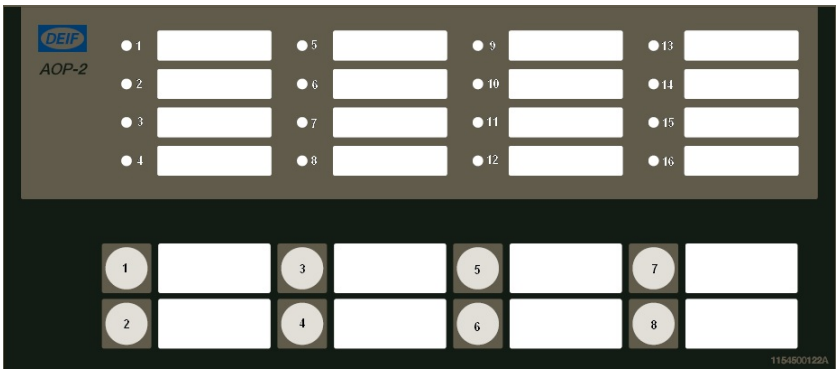


Counters	Notes
Operations	Breaker operations
Attempts	Genset starts and start attempts
Running hours	Running hours and timers
Service 1	Service intervals
Service 2	Service intervals
Energy	Energy export and import totals
ReEnergy	Reactive energy export and import totals
Demands	L1, L2, and L3 currents
Pulse	Pulse counters
Fan	Fan hours
BB: Energy	Energy to/from the mains
BB: ReEnergy	Reactive energy to/from the mains
M-Logic event counters	Counters, limits, and resets

5.9 Interfaces

5.9.1 Additional operator panel, AOP-2

The AOP-2 is an additional operator panel that can be connected to the controller using a CAN bus communication port. It can be used as an interface to the controller for indication of status and alarms together, and with buttons for, for example, alarm acknowledge and mode selection.



The configurable LEDs are named 1 to 16, and the buttons are named 1 to 8.

CAN Node ID configuration

The CAN Node ID for the AOP-2 can be set to 1-9:

1. Press buttons 7 and 8 simultaneously to activate the CAN ID change menu. The LED for the present CAN ID number is ON, and LED 16 is flashing.
2. Use button 7 (increase) and button 8 (decrease) to change the CAN ID according to the table below.
3. Press button 6 to save the CAN ID and return to normal operation.

CAN ID	Indication of CAN ID selection
0	LED 16 flashes (CAN bus OFF)
1	LED 1 ON. LED 16 flashes (default value).
2	LED 2 ON.

CAN ID	Indication of CAN ID selection
	LED 16 flashes.
3	LED 3 ON. LED 16 flashes.
4	LED 4 ON. LED 16 flashes.
5	LED 5 ON. LED 16 flashes.

Programming

Use the utility software to program the AOP-2. See the **Help** in the utility software.

5.9.2 Access lock

With the access lock on, the operator cannot change controller parameters or running modes. The input to be used for the access lock function is defined in the utility software.

Access lock is typically activated from a key switch installed behind the door of the switchboard cabinet. As soon as access lock is activated, changes from the display cannot be made.

Access lock only locks the display and does not lock any AOP or digital input. AOP can be locked by using M-Logic. It is still possible to read all parameters, timers and the state of inputs in the service menu.

You can read alarms, but not acknowledge them when access lock is activated. Nothing can be changed from the display.

This function is ideal for rental or critical equipment. The operator cannot change anything. If there is an AOP-2, the operator is still able to change up to 8 different predefined things.

5.9.3 Language selection

The controller can show several languages. The default master language is English, which cannot be changed. Different languages can be configured with the utility software.

`Basic settings > Controller settings > Language`

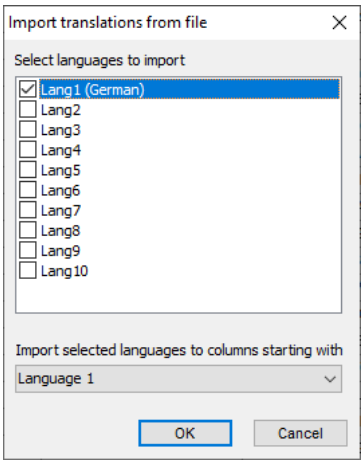
Parameter	Text	Range	Default
6081	Language selection	English Language [1 to 11]	English

5.9.4 Translations

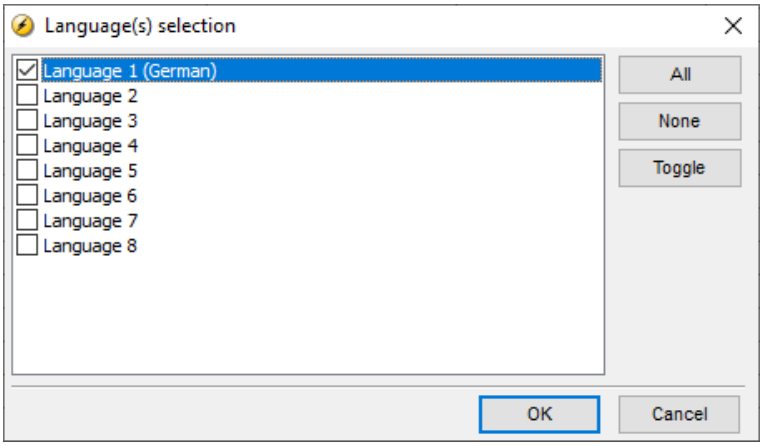
You can translate and customise the text in the controller with the utility software.

Translate the text in the controller

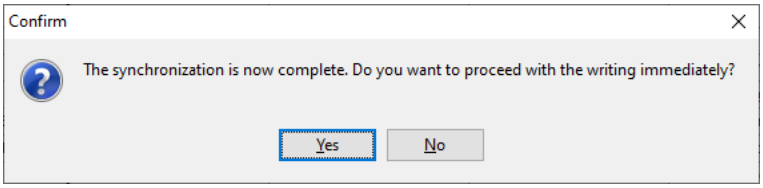
1. Go to the *Translations* tab in the left toolbar.
2. Click the *Import translations from file*  icon.
3. From the pop-up window, select the language file you want to import.
4. Select the language to import (lang1), and select the column to import the translations to.



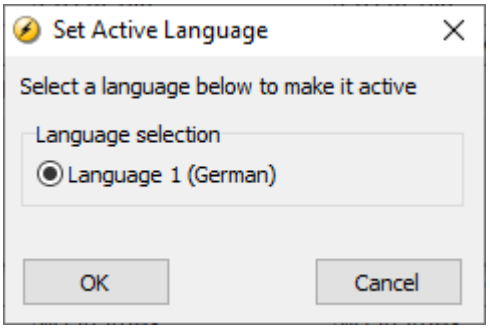
5. Once the translations are imported, you might get a warning stating that *Some translations were not imported*. Click *OK*.
6. To write the imported translations to the controller, click the *Write to controller* icon.
7. In the pop-up window, select the language you want to write to the controller.



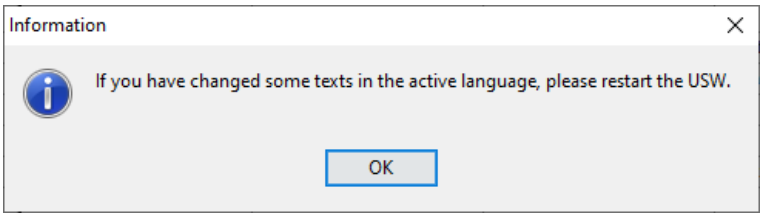
8. Click *OK*.
9. Select *Yes* to confirm you want to continue the writing procedure.



10. In the pop-up window, select the language you want to activate and click *OK*.



11. Click the *OK* button on the information message and if necessary, restart the utility software.



12. The text in the controller is now updated.

Customise the translations

To customise the translations, click on the cell with the text you want to edit. You can now edit the text. The text is automatically saved when you have finished editing.

You can also double-click on the phrase or word you want to edit in the *Master language* column. In the pop-up window, you can edit that particular phrase for all the language columns.

Change the placement of the translations

1. Select the *Edit language sequence* icon.
2. From the list on the left, select the language you want as the first in the sequence (after the master language), and click the > button to move the selected language.
3. Repeat step 2 for the remaining languages in the current sequence.
4. To change the position of a language in the new sequence, click on the language you want to move, and use the *Up* and *Down* buttons to move the language.
5. Click *OK* when you have finished.

NOTE You cannot edit the Master language.

6. Engine functions

6.1 Engine sequences

The engine START and STOP sequences are started automatically if:

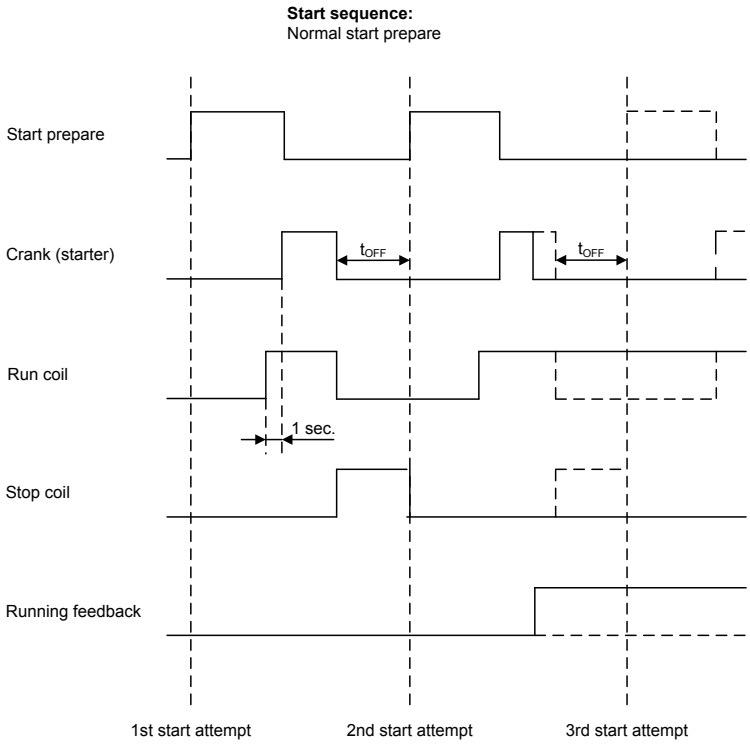
- AUTO mode is selected.
- MANUAL mode: The command is selected.
  - Only the selected sequence is started. For example, when the *START* button is pressed, the engine starts.

6.2 Engine start functions

6.2.1 Start sequence

Normal start prepare or extended start prepare are the possible start sequences for the engine. In both cases, the running coil is activated 1 s before the start relay (starter).

Normal start prepare sequence



The run coil opens between the start attempts, because the run coil type is set to pulse. When the engine receives running feedback, the run coil is closed until the stop sequence is started. If the run coil type is set to continuous, the run coil is closed between the start attempts until start failure, or the stop sequence opens it.

`Engine > Start sequence > Before crank > Run coil`

Parameter	Text	Range	Default
6151	Run coil timer	0.0 to 600.0 s	1.0 s
6152	Run coil type	Pulse Continuous	Pulse

Engine > Start sequence > Before crank > Start prepare

Parameter	Text	Range	Default
6181	Start prepare	0.0 to 600.0 s	5.0 s
6182	Ext. prepare	0.0 to 600.0 s	0.0 s

Double starter

In some emergency installations, the prime mover is equipped with an extra start motor. Dependent on the configuration, the double starter function can toggle between the two starters or try several attempts with the standard starter before switching to the *double starter*. The function is set up in parameters 6191 and 6192, and a relay for cranking with the alternative starter is chosen in the *I/O & Hardware setup*.

Engine > Start sequence > Crank > Start attempts

Parameter	Text	Range	Default	Notes
6191	Single starter attempts	1 to 100	3	
6192	Double starter attempts	0 to 10	0	You can also enable an alarm here. The alarm is activated when the primary starter fails and the double starter is used.

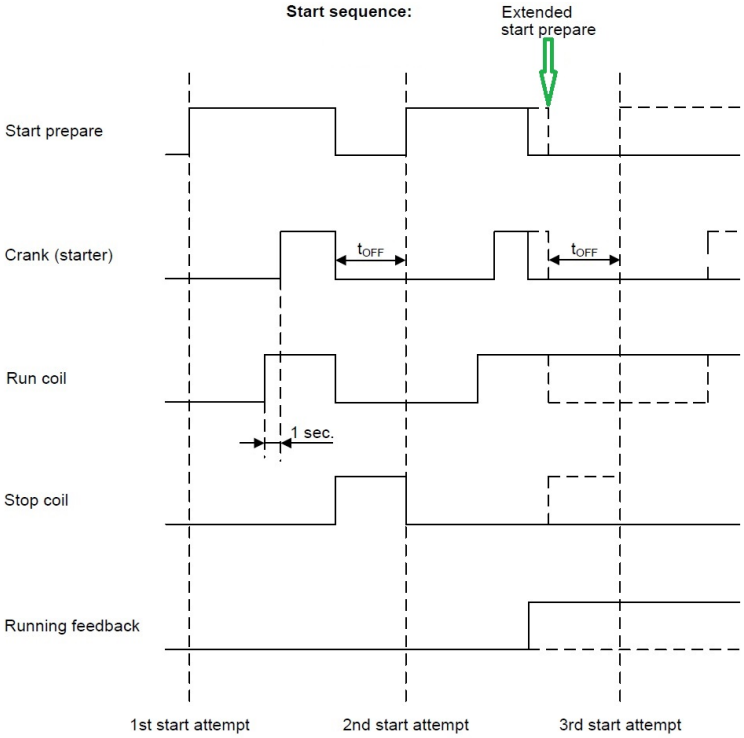
Choose a value that is more than zero in parameter 6192. This value determines the amount of attempts on each starter before switching to the next. The standard starter has first priority. When the maximum allowed number of attempts is reached, the start attempts stop and the alarm *Start failure* (menu 4570) is activated. Select the maximum number of attempts with parameter 6191.

- A value of 1 in parameter 6192 results in a toggle function with 1 attempt on each starter between toggling.
- A value of 2 in parameter 6192 results in a toggle function with 2 attempt on each starter between toggling.

Engine > Start sequence > Crank > Crank timers

Parameter	Text	Range	Default
6183	Start ON time	1.0 to 600.0 s	5.0 s
6184	Start OFF time	1.0 to 99.0 s	5.0 s

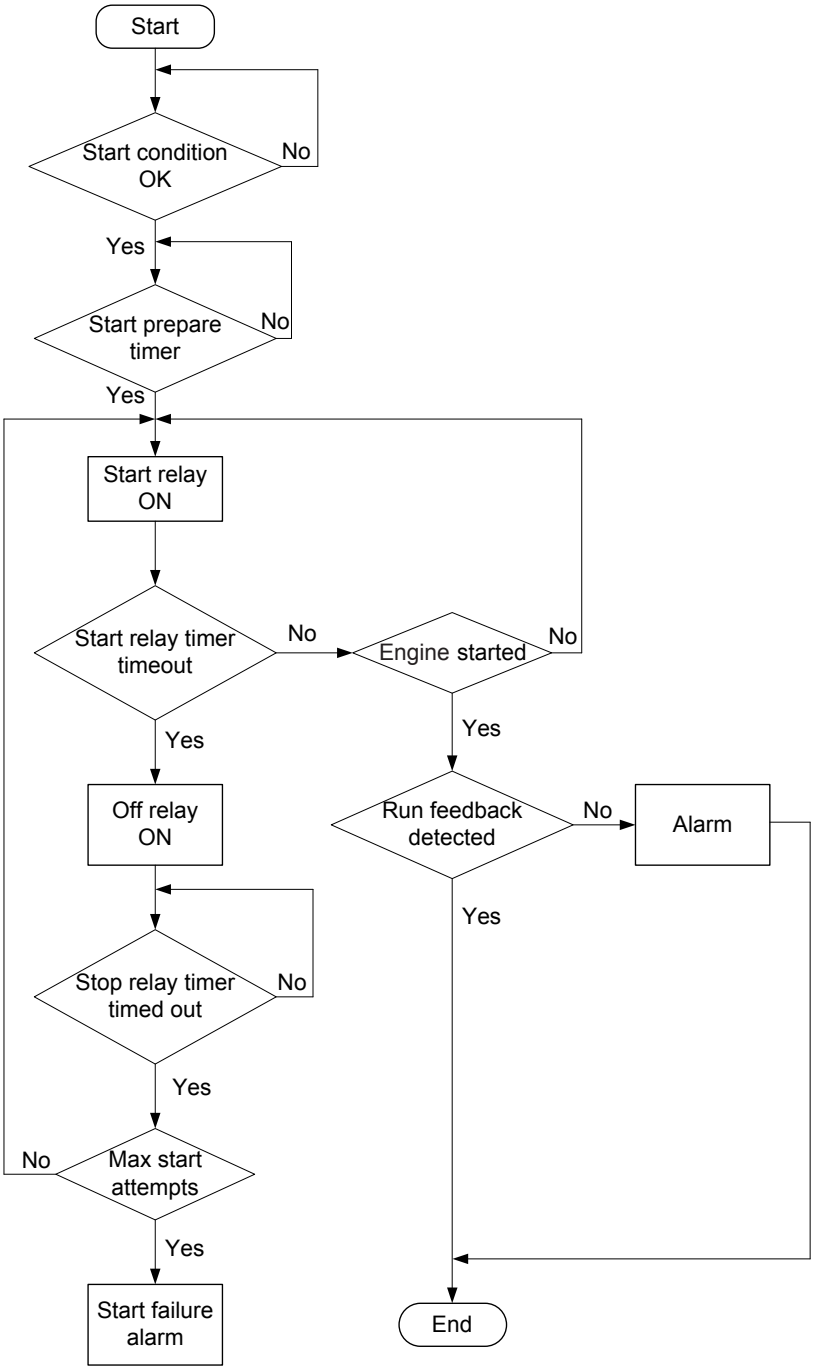
Extended start prepare sequence



You can active the run coil 0 to 600 s before crank (starter) is executed. In this example, the timer is set to 1.0 s.

The extended start prepare function keeps the start prepare relay closed until remove starter or running detection is reached. This function is helpful if booster pumps for start fuel are used, because they are kept on until the engine is running.

Start sequence flowchart



6.2.2 Start sequence conditions

The start sequence initiation is controlled by these multi-input conditions:

- RMI oil pressure
- RMI water temperature
- RMI fuel level
- RMI Custom
- Binary input

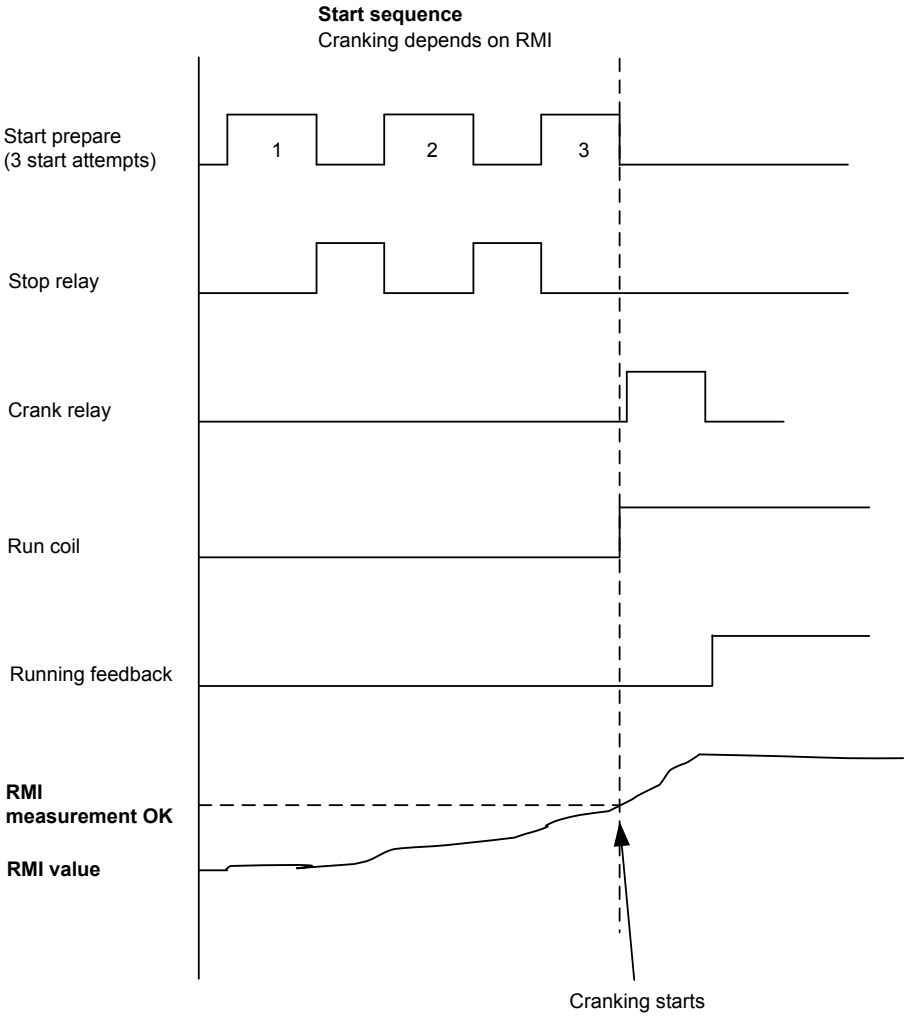
This means that if, for example, the oil pressure is not primed to the sufficient value, the crank relay will not engage the starter motor.

You can only configure these multi-input conditions with the utility software.

More information
See Inputs and outputs for how to configure the inputs.

If the binary start threshold is used, the input is chosen from the I/O list in the utility software.

The diagram below shows an example where the RMI oil pressure signal builds up slowly and starting is initiated at the end of the third start attempt.

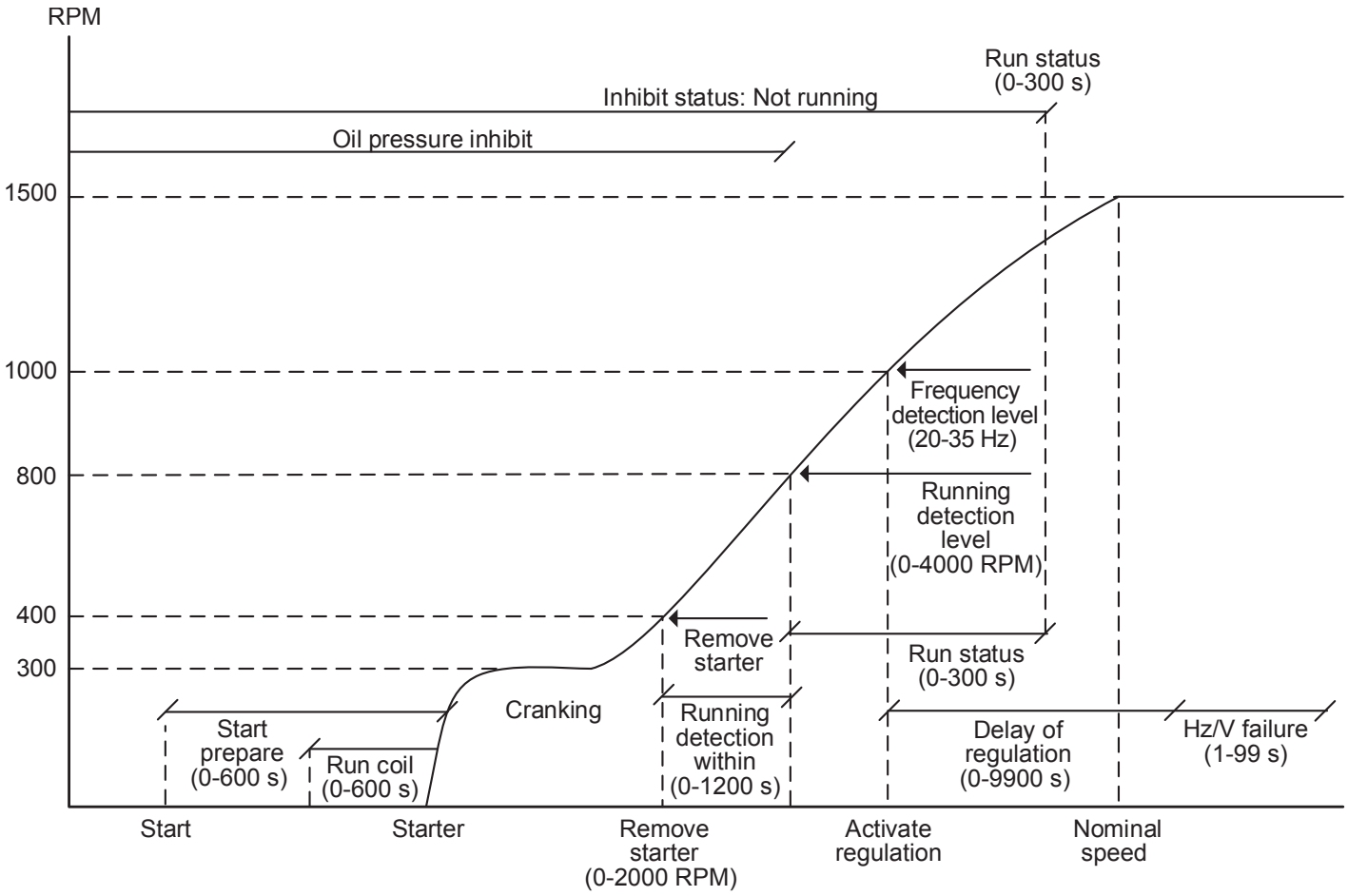


The start is initiated as soon as the start threshold limit is reached. By default, the controller waits until the start prepare timer is over and the start threshold conditions are correct before the crank relay/start is initiated. You can configure this in parameter 6185. You can change the start prepare type to interrupt start prepare, which means the controller is permitted to interrupt the start prepare and initiate the start when the start threshold conditions are correct.

`Engine > Start sequence > Before crank > Start threshold`

Parameter	Text	Range	Default
6185	Start threshold type	Multi-input [20 to 23]	Multi-input 20
6186	Start threshold	0.0 to 300.0	0.0

6.2.3 Start-up overview



Set points related to the start sequence

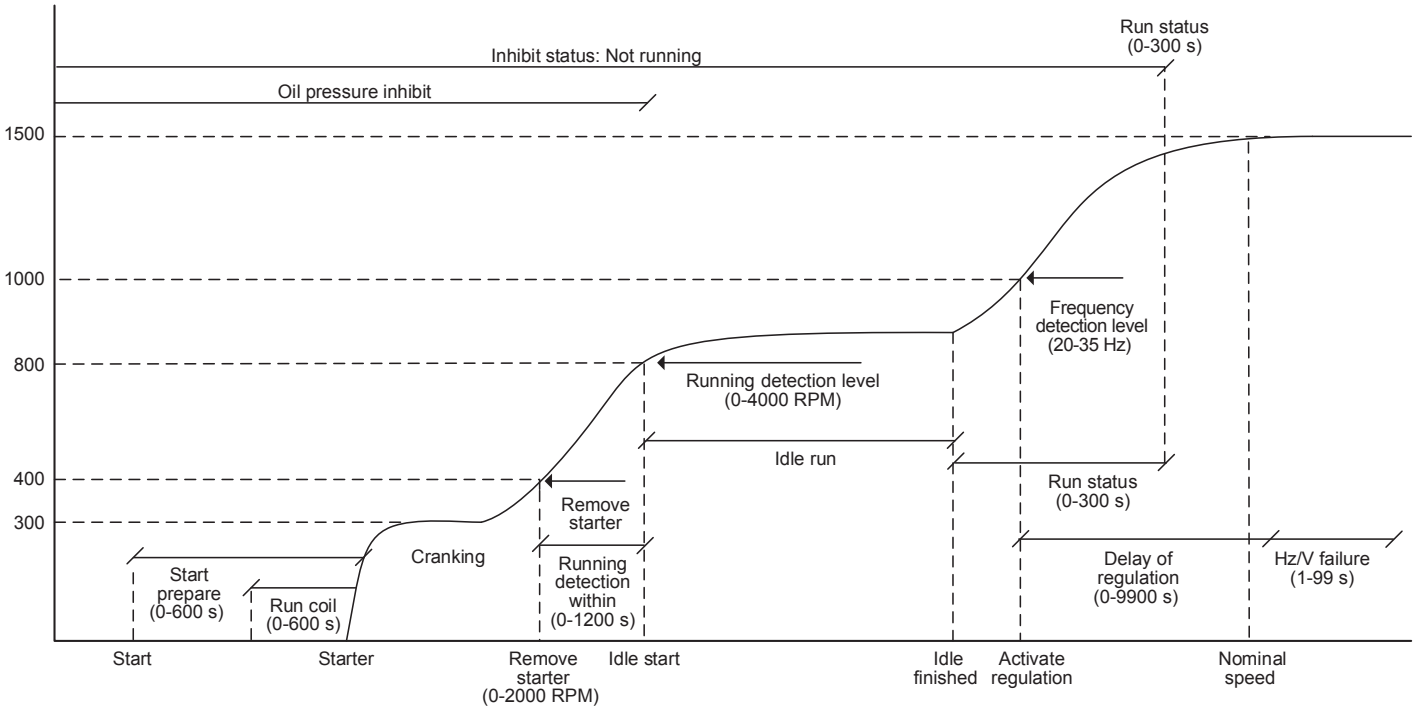
Parameter	Text	Description
6181	Start prepare	Start prepare is used for start preparation, for example pre-lubrication or pre-glowing. The start prepare relay is activated when the start sequence is initiated, and deactivated when the start relay is activated. If the timer is set to 0.0 s, the start prepare function is deactivated.
6182	Ext. start prepare	Extended prepare activates the *Start prepare* relay when the start sequence is initiated. The relay is activated until the specified time has expired. If the extended prepare time exceeds the *Start ON time*, the *Start prepare* relay is deactivated when the start relay deactivates. If the timer is set to 0.0 s, the extended prepare function is deactivated.
6183	Start ON time	The starter is activated for this period when cranking.
6184	Start OFF time	The pause between two start attempts.
6151	Run coil delay	The timer for the run coil is a set point for how long the run coil will be activated before cranking the engine. This gives the ECU time to start up before cranking.
6174	Remove starter	The starter is removed, when the RPM set point is reached. This function is only active if the running detection type is configured as either MPU or EIC RPM. For MPU, if the configured number of teeth is 0, the controller calculates the genset speed from the frequency.
6173	Running detect	The set point defines the running detection level in RPM (only when the running detection type is configured as either MPU or EIC RPM).
6351	Run detection	This timer is set to make sure that the engine goes from the RPM level, Remove starter and Running detection level (only when the running detection type is configured as either MPU or EIC RPM).

Parameter	Text	Description
		If other running detection types than MPU or EIC RPM are used, the starter is ON until the frequency detection level is reached. If the timer is exceeded, and the level is not reached, the start sequence is repeated, using a start attempt. If all start attempts are used, the *Start failure* alarm is activated.
6165	Freq. Detect Lvl	When the configured level is reached, the regulators start working to reach the nominal values. The regulators can be delayed using *Delay regulation*.
2740	Delay reg.	The regulation start can be delayed with this timer. If the setup is running on nominal settings, and delay regulation is set to 0, the genset overshoots the nominal frequency on start-up, as the regulators start increasing as soon as they are turned on. If this timer is used, the regulation is delayed until the timer has expired. The timer is usually set so the generator can reach the nominal frequency and voltage within the time frame.
6160	Run status	The timer starts when the running detection/frequency detection level is reached. When the timer runs out, the *Not running* inhibit is deactivated, and the running alarms and failures are enabled.

Alarms related to the start sequence

Parameter	Text	Description
4530	Crank failure alarm	This alarm is activated, if MPU is configured as the primary running feedback and the specified RPM is not reached before the delay has expired.
4540	Run feedback fail	This alarm is activated, if there is a failure on the primary running feedback. For example, if the primary running feedback is configured to digital input without running detection, and an active secondary running feedback detects the engine to be running. The delay to be set is the time from the secondary running detection until the alarm is activated.
4560	Hz/V failure	This alarm is activated, if the frequency and voltage are not within the limits configured in Blackout df/dUmax, after the running feedback is received.
6352	External engine stop	This alarm is activated, if the running sequence is active and the engine is below the running detection and frequency detection level without any command from the controller.

Start up overview with idle run



The set points and alarms are the same as above, except for the idle run function.

More information
See Idle running.

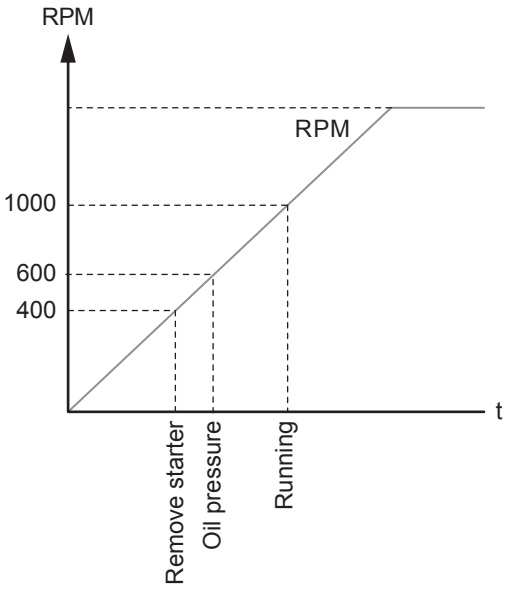
6.2.4 Start functions

The controller starts the engine when the start command is given. The start sequence is deactivated when the remove starter event occurs or when the running feedback is present.

The reason for having two possibilities to deactivate the start relay is to be able to delay the alarms with run status.

If it is not possible to activate the run status alarms at low revolutions, the remove starter function must be used.

An example of a critical alarm is the oil pressure alarm. Normally, it is configured according to the shutdown fail class. However, if the starter motor has to disengage at 400 RPM, and the oil pressure does not reach a level above the shutdown set point before 600 RPM, then the engine shuts down if the specific alarm is activated at the preset 400 RPM. In that case, the running feedback must be activated at a higher number of revolutions than 600 RPM.

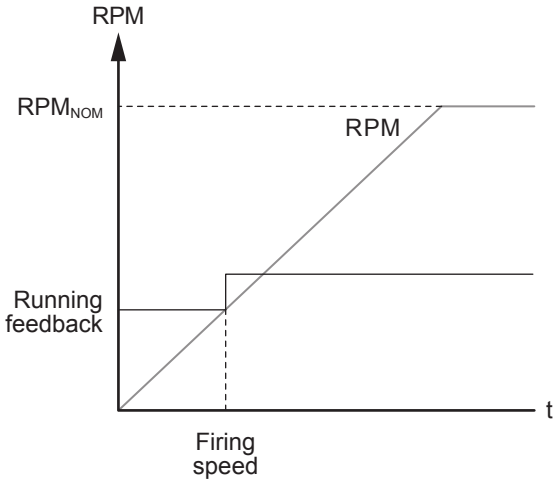


6.2.5 Digital feedbacks

If an external running relay is installed, then the digital control inputs for running detection or remove starter can be used.

Running feedback

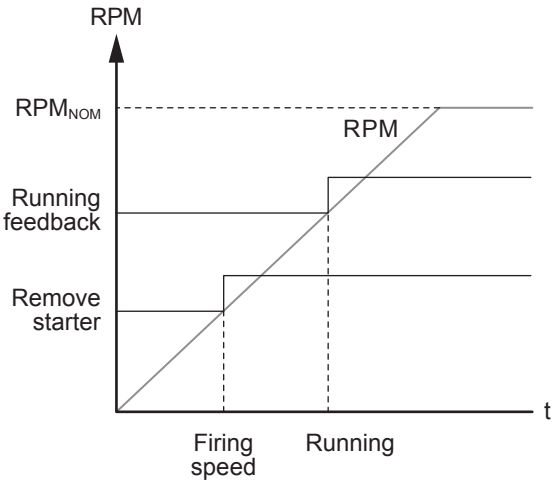
When the digital running feedback is active, the start relay is deactivated and the starter motor will be disengaged.



The diagram shows how the digital running feedback is activated when the engine has reached its firing speed.

Remove starter

When the digital remove starter input is present, the start relay is deactivated and the starter motor will be disengaged.



The diagram shows how the remove starter input is activated when the engine has reached its firing speed. At the running speed, the digital running feedback is activated.

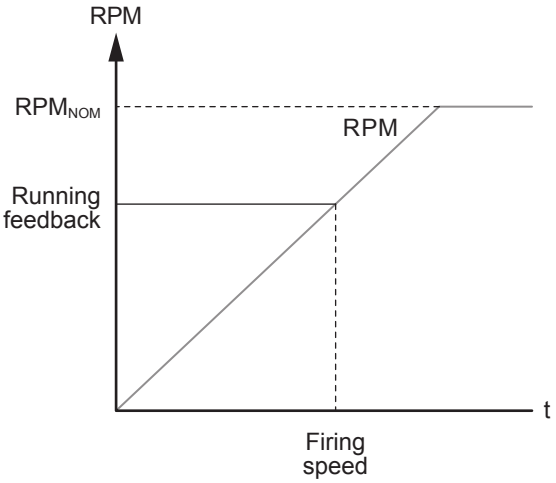
NOTE The remove starter input must be configured from a number of available digital inputs.

6.2.6 Analogue tacho feedback

When a magnetic pickup (MPU) is being used, the specific level of revolutions for deactivation of the start relay can be adjusted.

Running feedback

The diagram shows how the running feedback is detected at the firing speed level. The factory setting is 1000 RPM.



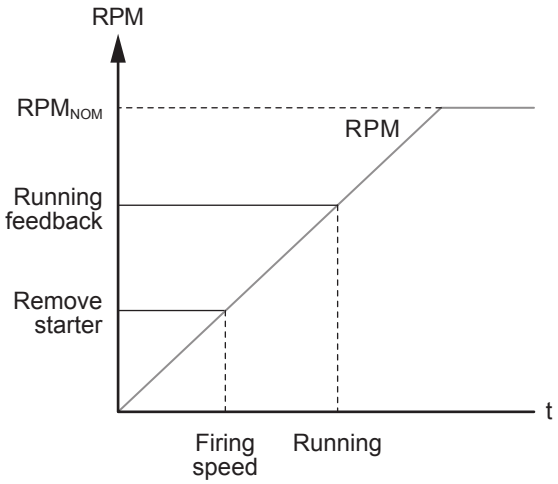
CAUTION

Caution

The factory setting of 1000 RPM is higher than the RPM level of typical starter motors. Adjust the setting to a lower value to avoid damage of the starter motor.

Remove starter input

The diagram shows how the set point of the remove starter is detected at the firing speed level. The factory setting is 400 RPM.



The number of teeth on the flywheel must be configured when the MPU input is used. If zero, for the remove starter function, the controller calculates the speed from the genset frequency.

`Engine > Start sequence > After crank > Remove starter`

Parameter	Text	Range	Default
6174	Remove start	1 to 2000 RPM	400 RPM

NOTE The *Remove starter* function can use the MPU or a digital input.

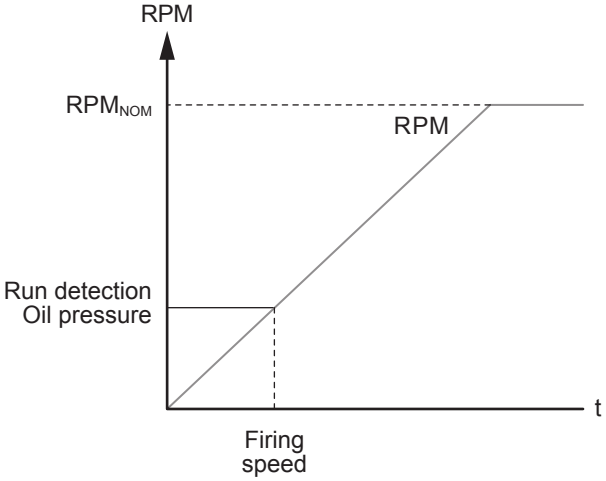
6.2.7 Oil pressure

The multi-inputs on terminals 20, 21, 22 and 23 can be used for the detection of running feedback. The terminal in question must be configured as an RMI input for oil pressure measurement. This is done with the utility software:

1. Select *I/O & Hardware setup* tab.
2. Select the relevant multi-input tab.
3. For *Input type*, select *RMI oil pressure*.

When the oil pressure increases above the adjusted value, running is detected, and the start sequence is ended.

Running feedback



More information
See **Running feedback** for how to configure the parameters.

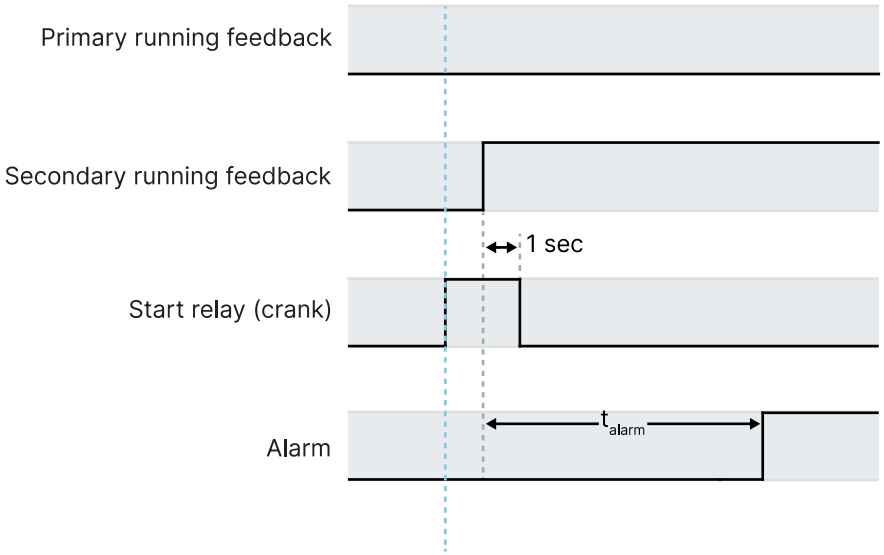
6.3 Running feedback

The controller uses running feedback to detect whether the engine is running:

- A digital input
- RPM, measured by magnetic pick-up (set point 0 to 4000 RPM)
- EIC
- Frequency measurement (20 to 35 Hz)

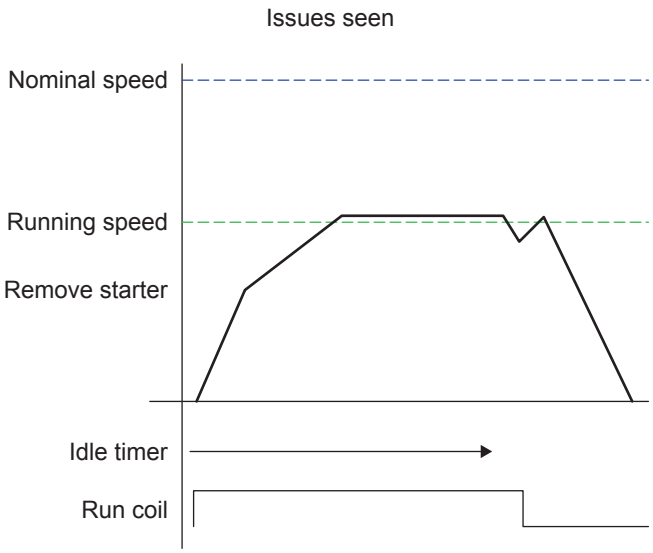
The selected running feedback is the primary feedback. However, all available running feedback is used for running detection. If the primary running feedback does not detect any running feedback, the starter relay stays activated for one additional second.

6.3.1 Start sequence running feedback



- If a running feedback is detected based on one of the secondary choices, the engine will start.
- If no running feedback is detected, the start sequence is interrupted.
- In parameter 6176 you can configure a delay time, before the start sequence is stopped.

6.3.2 Not running delay time



The engine will still be functional, even though a tacho sensor is damaged or dirty.

As soon as the engine is running, the running detection will be based on all available types.

6.3.3 Interruption of the start sequence

The start sequence is interrupted in the following situations:

Event	Notes
Stop signal	
Start failure	
Remove starter feedback	Tacho set point.
Running feedback	Digital input.
Running feedback	Tacho set point.
Running feedback	Frequency measurement is between 30.0 and 35.0 Hz. The frequency measurement requires a voltage measurement of 30 % of U_{NOM}. The running detection based on the frequency measurement can replace the running feedback based on tacho or digital input or engine communication.
Running feedback	Oil pressure set point.
Running feedback	EIC (engine communication).
Emergency stop	
Alarm	Alarms with Shutdown or Trip and stop fail class.
Stop button on the display	Only in MANUAL or No regulation mode.
Modbus stop command	MANUAL or No regulation mode.
Digital stop input	MANUAL or No regulation mode.
Deactivate the Auto start/stop	AUTO mode in the genset modes Island operation, Fixed power, Load take-over or Mains power export mode.
Running mode	It is not possible to change the running mode to Block as long as the genset is running.

`Engine > Running detection`

Parameter	Text	Range	Default
6171	Number of teeth	0 to 500 teeth	0 teeth*
6172	Run detect type	Digital input MPU input Frequency EIC Multi-input 20 to 23	Frequency
6173	Running detect	0 to 4000 RPM	1000 RPM
6175	Oil pressure level	0.0 to 150.0 bar	0.0 bar
6176	Not running delay	0.0 to 5.0 s	0.0 s

NOTE * If there is no MPU (that is, parameter 6171 is 0), the controller calculates the genset speed from the frequency. This value is used for the remove starter function, and the overspeed and underspeed protections.

6.3.4 MPU wire break

The MPU wire break function is only active when the engine is not running. In this case, an alarm is activated if the wire connection between the controller and the MPU breaks. The MPU wire alarm is activated, when there is more than 400 kΩ.

Engine > Running detection > MPU wirebreak

Parameter	Text	Range	Default
4551	MPU sensor type	Tacho sensor Hall sensor*	Tacho sensor
4552	MPU wirebreak	Fail classes	Warning

NOTE * There is no wire break on a Hall sensor.

6.3.5 D+ (Charger generator fail)

When the D+ function is enabled, the start relay is deactivated. The D+ turns off when the start disengages. The alarm is activated if there is no D+ feedback from the charging alternator after the delay time runs out.

Engine > Running detection > Charger Gen fail

Parameter	Text	Range	Default
4990	Set point	5.50 to 30.00 V	6.00 V
	Timer	0.0 to 999.0 s	10.0 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

Engine > Start sequence > After crank > Remove starter

Parameter	Text	Range	Default
6174	Remove starter	1 to 2000 RPM	400 RPM

6.3.6 Running output

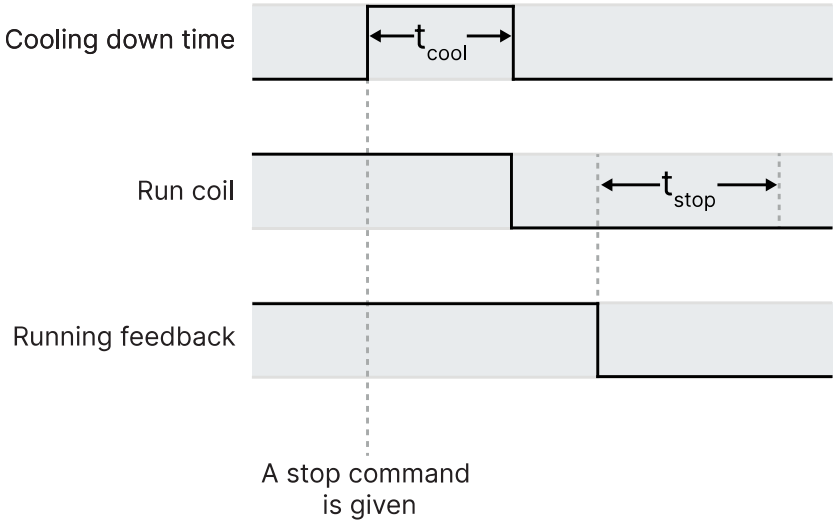
The run status timer can be configured to activate a digital output when the engine is running.

Configure the run status under `Functions > Run status` (parameter 6160). Configure the timer for the time that running detection must be present before *Run status* is activated. If the timer for run status is changed, it also affects the alarm inhibit for *Not run status*.

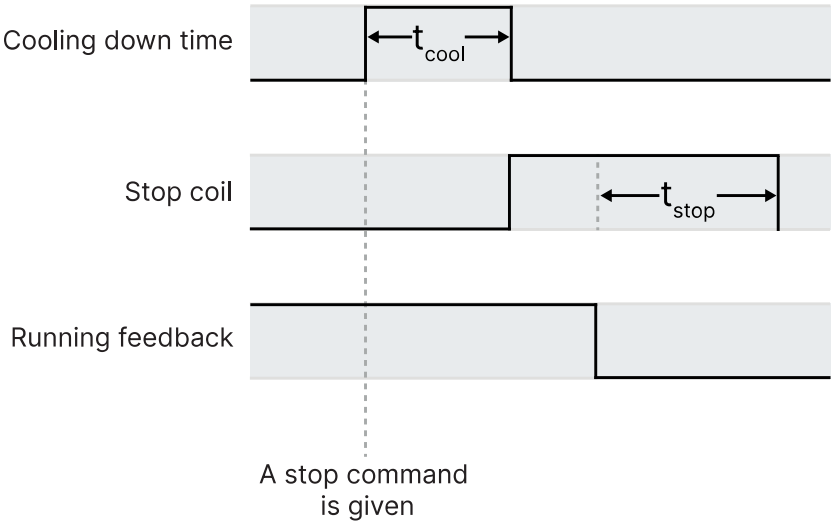
6.4 Engine stop functions

6.4.1 Stop sequence

Stop sequence: Run coil



Stop sequence: Stop coil



The stop sequence is activated if a stop command is given. The stop sequence includes the cooling down time if the stop is a normal or controlled stop.

`Engine > Stop sequence > Cooldown`

Parameter	Text	Range	Default
6211	Cooldown time	0 to 9900 s	240 s

6.4.2 Stop sequence commands for the generator

Description	Cooling down	Stop	Notes
AUTO mode stop	●	●	
Trip and stop alarm	●	●	
Stop button on the display	(●)	●	MANUAL or No regulation mode. Cooling down is interrupted if the *Stop* button is activated twice.
Remove Auto start/stop	●	●	For **single-controller applications** in AUTO mode: • Island operation • Fixed power • Load take-over • Mains power export
Emergency stop		●	GB opens and engine shuts down.

Interruption of the stop sequence can only occur during the cooling down period. If the status of the genset is engine stopping, then starting a new start sequence is only possible when the genset is stopped.

Interruption of the cool down period can occur if the start button is pushed or a remote command is given. In MANUAL mode the engine will run in idle or at nominal speed.

For **single-controller applications**, interruption of the cool down period can also occur if there is a mains failure in AMF mode (or mode shift is ON) and AUTO mode is selected, or if the set point is exceeded in peak shaving mode and AUTO mode is selected. A digital start input can also be used to interrupt the cool down period when fixed power, load take-over, or mains power export is selected and the controller is in AUTO mode.

NOTE When the engine is stopped, the analogue speed governor output is reset to the offset value.

6.4.3 Set points related to the stop sequence

`Engine > Stop sequence > Stop failure`

Parameter	Text	Range	Default
4580	Stop failure timer	10.0 to 120.0 s	30.0 s
	Stop failure, Output A	Relays and M-Logic	Not used
	Stop failure, Output B	Relays and M-Logic	Not used
	Activation of the stop failure alarm	OFF ON	ON
	Stop failure alarm fail class	Fail classes	Shutdown

`Engine > Stop sequence > Extended stop`

Parameter	Text	Range	Default
6212	Extended stop time	0 to 300.0 s	5.0 s

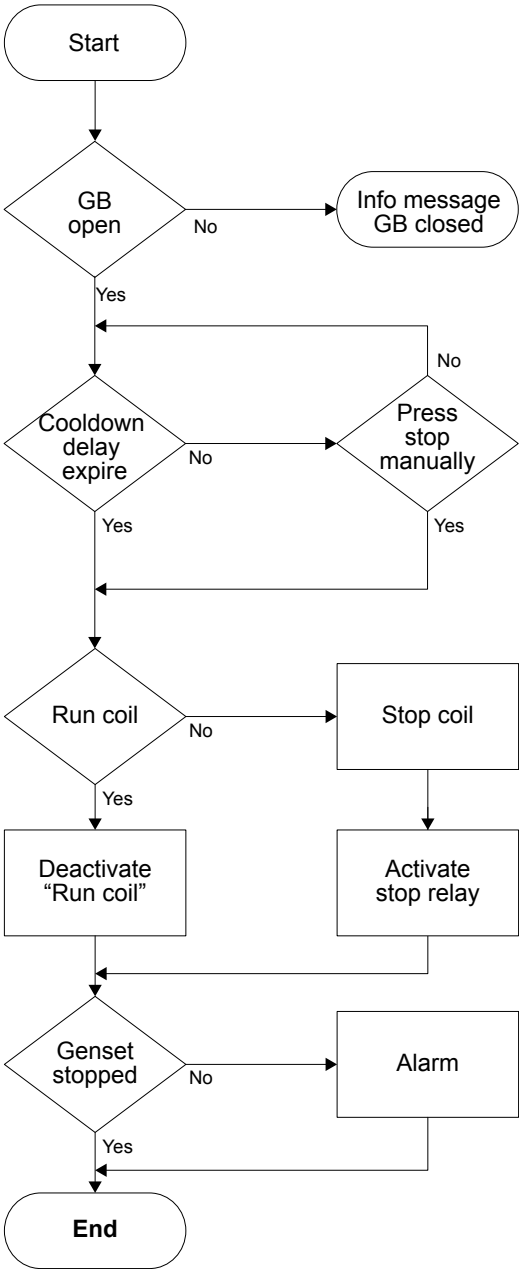
`Engine > Stop sequence > Stop threshold`

Parameter	Text	Range	Default
6213	Stop threshold type	Multi input 20 to 23 M-Logic	Multi input 20

Parameter	Text	Range	Default
		EIC temp. inputs	
6214	Stop threshold	0 to 482 °	0 °

NOTE If the cooling down timer is set to 0.0 s, the cooling down sequence will be infinite.

6.4.4 Stop sequence flowchart



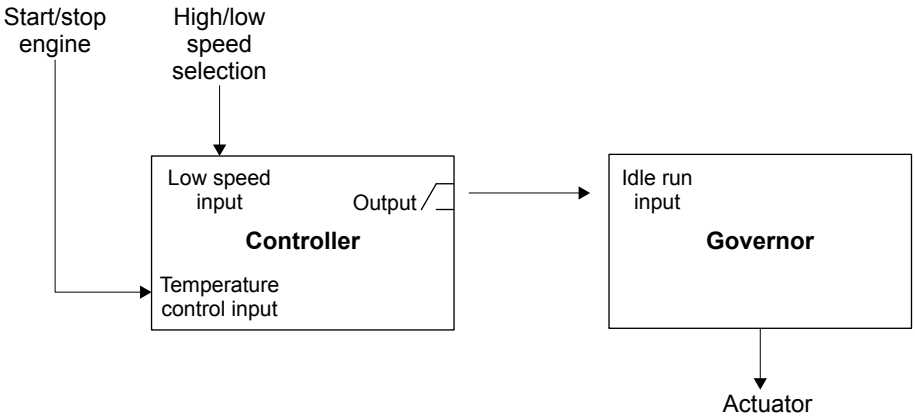
6.5 Idle running

Idle running changes the start and stop sequences so the engine can run at low temperature conditions.

The function is typically used in installations where the engine has to operate at low temperatures. This can cause starting problems or damage the engine. You can also use the function when the engine has to run at low RPM until a specified temperature is reached.

It is possible to use the idle run function with or without timers. Two timers are available, one timer is used in the start sequence, and one timer is used in the stop sequence. The timers make the function flexible.

You must prepare the speed governor for the idle run function using a digital signal from the controller.



When the function is enabled, two digital inputs are used for control purposes:

1. Low speed input. This input is used to change between idle speed and nominal speed. This input does not prevent the engine from stopping. It is only a selection between idle and nominal speed.
2. Temperature control input. When this input is activated, the engine starts. It is not able to stop as long as this input is activated.

You can use the low speed input together with a timer to select the idle run function. If an input and a timer are used at the same time, the digital input is prioritised. For example, if the idle run function is activated with the low speed input and the start timer is enabled, the idle run function is still active if the timer expires before the digital input is deactivated.

NOTE Turbo chargers not originally prepared for operating in the low speed area can be damaged if the engine is running in idle run for too long.

It is possible to interrupt the idle run sequence in MANUAL mode with parameter 6297 enabled. If you push the *START* button, the engine regulates to nominal values, and if you push the *STOP* button, the engine is stopped.

`Engine > Start sequence > Idle run`

Parameter	Text	Range	Default
6291	Idle start timer	0.0 to 999.0 min	300.0 min
6292	Idle start enable	OFF ON	OFF
6295	Output A	Relays and M-Logic	Not used
6296	Enable idle run	OFF ON	OFF
6297	Idle interrupt	OFF ON	OFF

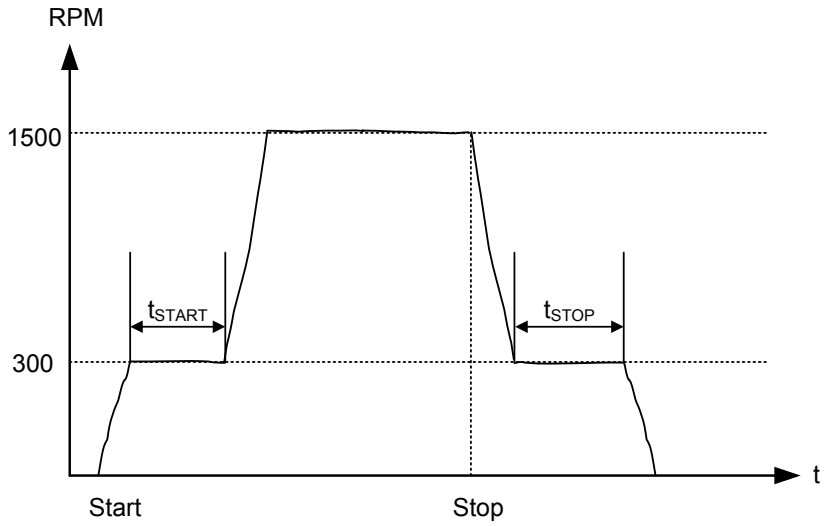
`Engine > Stop sequence > Idle stop`

Parameter	Text	Range	Default
6293	Stop timer	0.0 to 999.0 min	300.0 min
6294	Enable stop	OFF ON	OFF

Examples

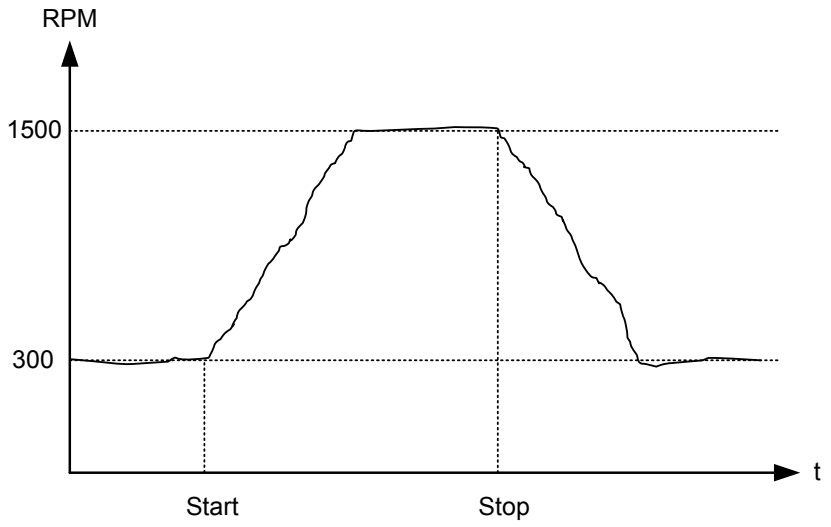
Idle speed during starting and stopping

- Both the start and the stop timers are activated.
- The start and stop sequences are changed to let the engine stay at the idle level before speeding up.
- It also decreases the speed to the idle level for a specified delay time before stopping.



Idle speed with a digital input configured to low speed

- The idle speed with low speed activated runs in idle speed until the low speed input is deactivated, and then the engine regulates to nominal values.
- To prevent the engine from stopping, then the digital input *Temp control* must be left ON at all times. The engine speed-time curve then looks like this:



NOTE The oil pressure alarm (RMI oil) is enabled during idle run if set to ON.

6.5.1 Temperature-dependent idle start-up

This is an example of a system that will start up in idle run, if the coolant temperature is below a specified value. When the temperature exceeds the specified value, the engine will ramp up to nominal values.

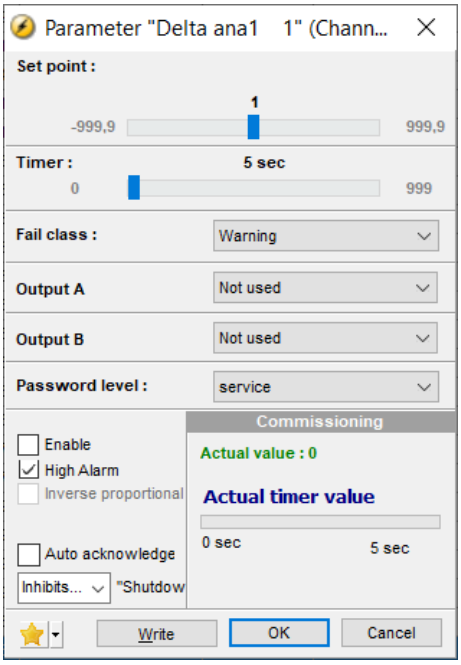
For this function to work, you must turn idle running ON and configure the digital output.

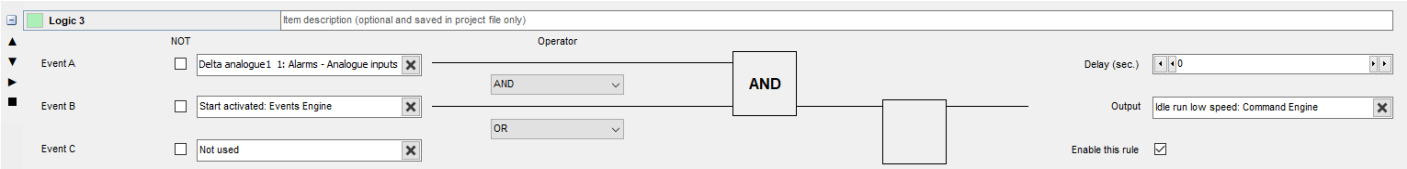
Engine > Start sequence > Idle run

Parameter	Text	Range	Set value to
6295	Idle active	OFF ON	ON

Example

The function uses delta analogue 1 (parameters 4601, 4602, 4610 and 4620) and one M-Logic line. After starting, when the coolant temperature is below 110 °C, the controller idles. Once the temperature reaches 110 °C, the controller automatically ramps up to full speed.





6.5.2 Inhibit

The alarms that are deactivated by the inhibit function are inhibited in the usual manner, except for the oil pressure alarms, RMI oil 20, 21, 22 and 23. These alarms are active during Idle run as well.

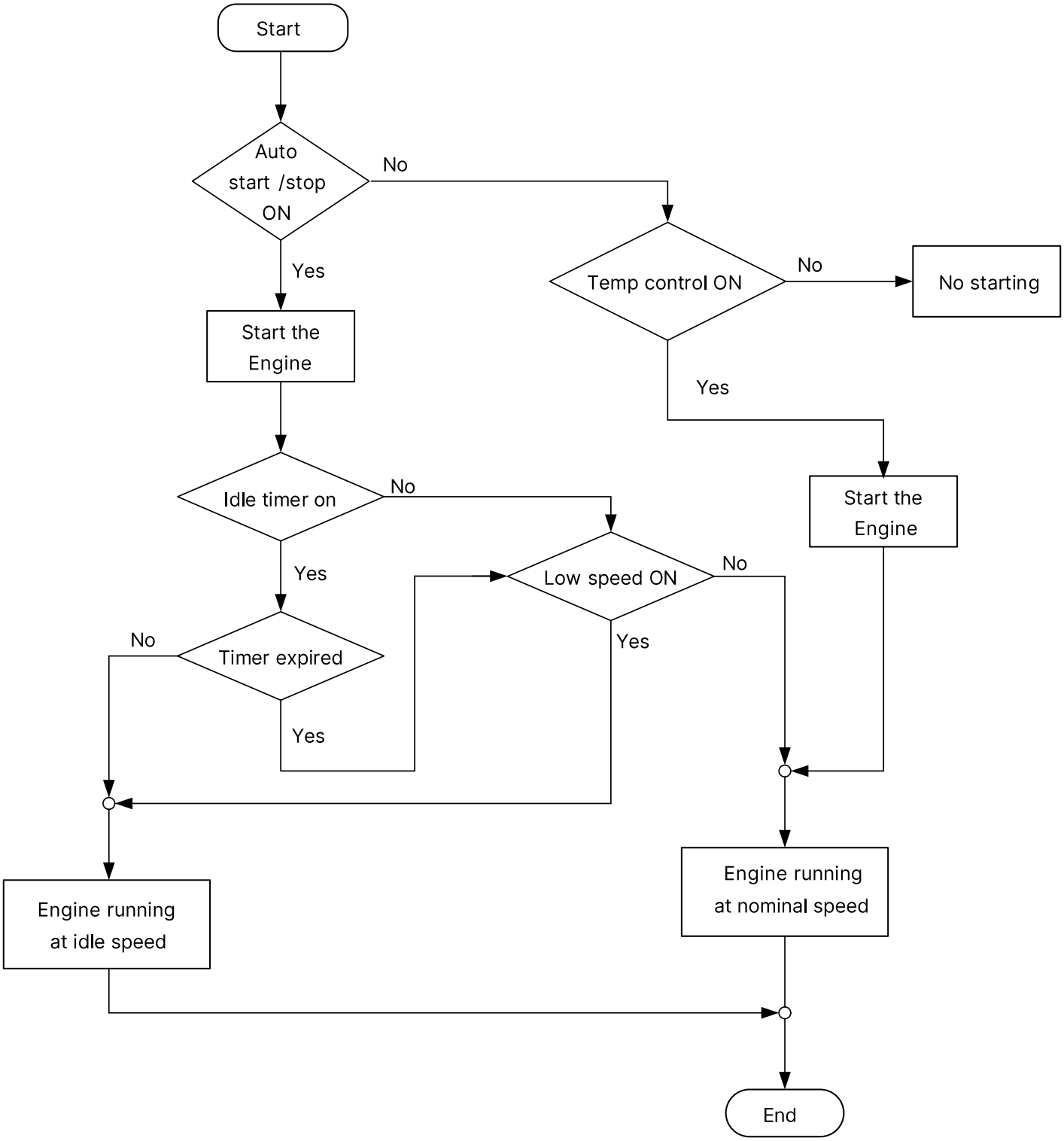
6.5.3 Running signal

You must activate the running feedback when the engine is running in idle mode.

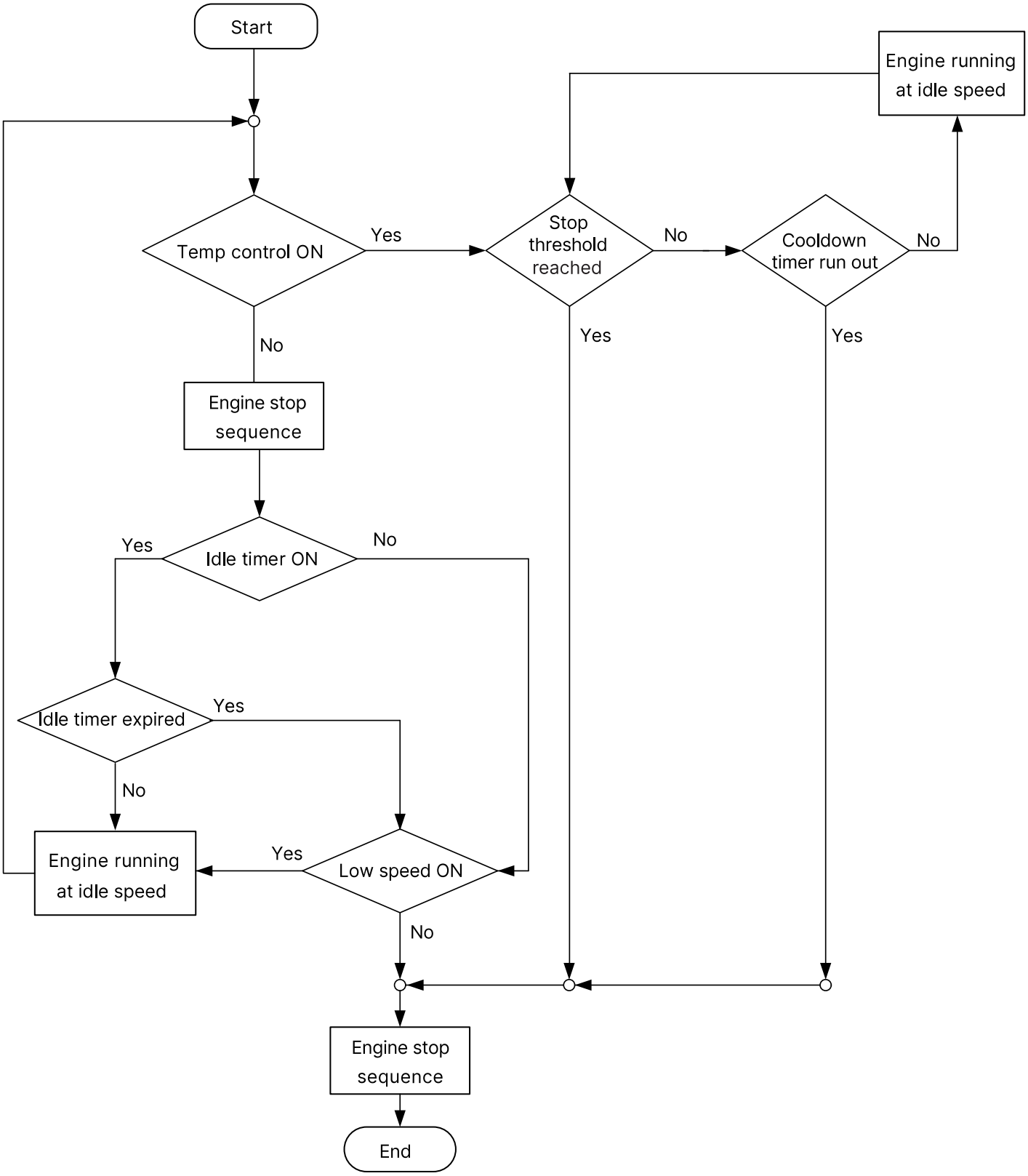
6.5.4 Idle speed flowcharts

The flowcharts show the start and stop of the engine by the inputs *Temp control* and *Low speed*.

Start flowchart



Stop flowchart



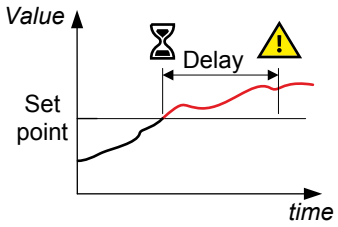
6.6 Engine protections

Protection	IEC symbol (IEC 60617)	ANSI (IEEE C37.2)	Operate time	Alarms
Over-speed	-	12	-	2
Under-speed	-	14	-	1

6.6.1 Overspeed

These alarms alert the operator that the engine is running too fast.

The alarm response is based on the engine speed as a percentage of the nominal speed. If the engine speed rises above the set point for the delay time, the alarm is activated.



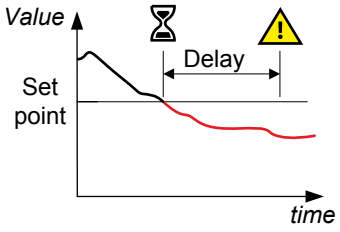
Engine > Protections > RPM-based protections > Overspeed > Overspeed [1 or 2]

Parameter	Text	Range	Overspeed 1	Overspeed 2
4510 or 4520	Set point	80 to 150 %	110 %	120 %
	Timer	0 to 3200 s	5 s	1 s
	Output A	Relays and M-Logic	Not used	Not used
	Output B	Relays and M-Logic	Not used	Not used
	Enable	OFF ON	OFF	OFF
	Fail class	Fail classes	Warning	Shutdown

6.6.2 Underspeed

This alarm alerts the operator that the engine is running too slowly.

The alarm response is based on the engine speed as a percentage of the nominal speed. If the engine speed drops below the set point for the delay time, the alarm is activated.



Engine > Protections > RPM-based protections > Underspeed > Underspeed

Parameter	Text	Range	Default
4590	Set point	50 to 120 %	90 %
	Timer	0 to 3200 s	5 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

6.7 Engine communication

The controller supports J1939 and can communicate with any engine that uses generic J1939. In addition, the controller can communicate with a wide range of ECUs and engines.

More information
See the **Engine communication** document for a full list of supported ECUs and engines, along with detailed information for each protocol.

Exhaust after-treatment (Tier 4/Stage V)

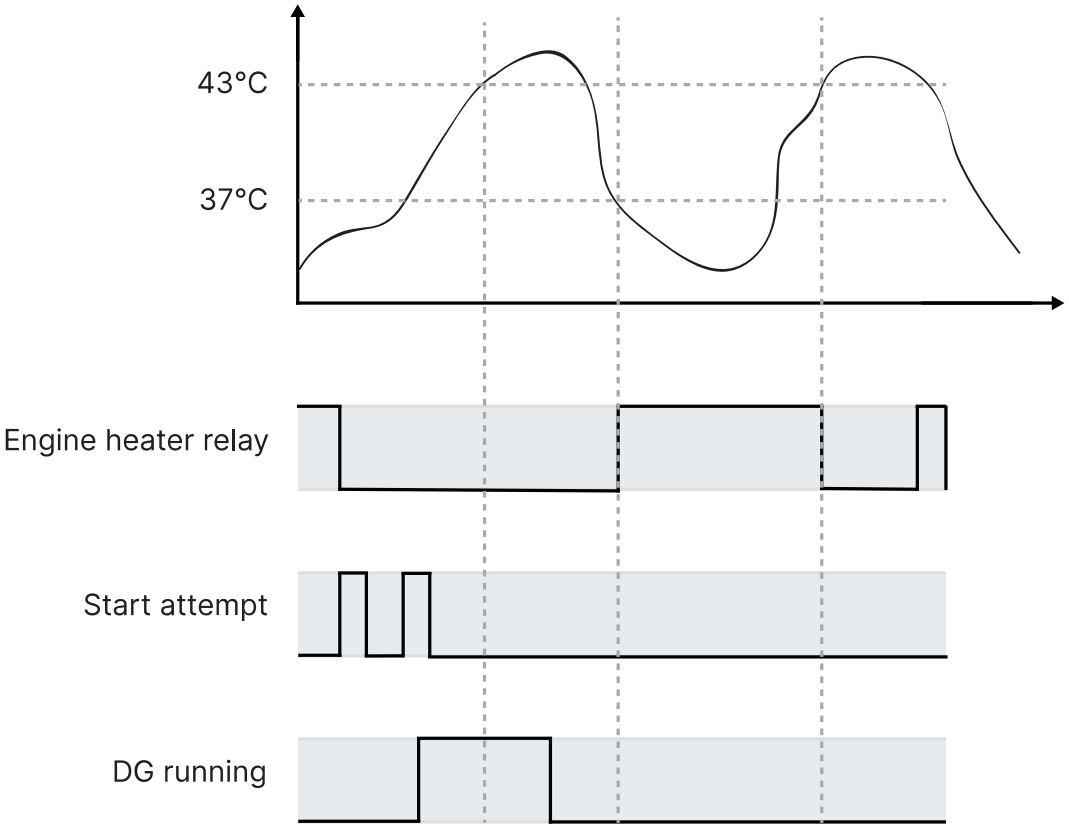
The controller supports Tier 4 (Final)/Stage V requirements. It provides monitoring and control of the exhaust after-treatment system, as required by the standard.

More information
See the **Operator's manual** for a description of the exhaust after-treatment.

6.8 Engine pre-heater

This function is used to control the temperature of the engine. A temperature sensor is used to activate an external heating system to keep the engine at a minimum temperature. This function is only active when the engine is stopped.

Example: Engine pre-heater sequence



The function includes a set point and a hysteresis. In the example, the set point is 40 °C with a hysteresis of 3 °C. The controller opens the engine heater relay when the engine has reached 43 °C, and closes when the engine temperature is 37 °C.

A relay must be chosen for the engine heater. If a slave relay of the chosen relay is wanted, this can be programmed in M-Logic.

If the engine heater is active, and the manual control command has been activated, the engine heater relay is opened. When the command is activated again, the heater relay closes if the temperature is below the set point.

`Functions > Engine heater`

Parameter	Text	Range	Default
6321	Engine heater setp	20 to 250 °C	40 °C
6322	Engine heater relay	Relays and M-Logic	Not used
6323	Engine heater input	Multi-input 20 to 23	Multi-input 20

Parameter	Text	Range	Default
		EIC temp. inputs	
6324	Engine heater hyst	1 to 70 °C	3 °C

6.8.1 Engine heater alarm

The engine heater alarm has a temperature set point and a timer. If the temperature gets below the set point, and the engine heater relay is closed, the timer starts. If the timer expires, and the temperature is below the set point, the alarm is activated.

Functions > Engine heater > Engine heater 1

Parameter	Text	Range	Default
6330	Set point	10 to 250 °C	30 °C
	Timer	1.0 to 300.0 s	10.0 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

6.9 Ventilation

The ventilation function is used to control the cooling of the engine. The purpose is to use a multi-input for measuring the cooling water temperature. This way an external ventilation is activated to keep the engine below a maximum temperature.

Select the type of input to use in parameter 6323 *Engine heater*.

Functions > Fan > Single fan start/stop > Fan configuration > Max ventilation

Parameter	Text	Range	Default
6460	Max ventilation setp	20 to 250 °C	90 °C
6461	Max ventilation conf	Terminals and limits	Not used
	Enable	ON OFF	OFF
6463	Max ventilation hyst	1 to 70 °C	5 °C

6.9.1 Max. ventilation alarms

There are two ventilation alarms.

Functions > Fan > Single fan start/stop > Fan Alarms

Parameter	Text	Range	Default
6470 and 6480	Set point	20 to 250 °C	95 °C
	Timer	0 to 60 s	1 s
	Output A	Terminals and limits	Not used
	Output B	Terminals and limits	Not used
	Enable	ON OFF	OFF
	Fail class	Fail classes	Warning

6.10 Fuel pump logic

6.10.1 Fuel pump logic

The fuel pump logic is used to start and stop the fuel supply pump to keep the fuel in the service tank at the required level. The fuel level is detected from one of the three multi-inputs.

Parameters

Parameter	Name	Range	Default	Details
6551	Fuel pump log. start	0 to 100 % 1 to 10 s	20 % 1 s	Fuel transfer pump start point.
6552	Fuel pump log. stop	0 to 100 %	80 %	Fuel transfer pump stop point.
6553	Fuel fill check	0.1 to 999.9 s Fail classes	60 s Warning	Fuel transfer pump alarm timer and fail class. The alarm is activated if the fuel pump relay is activated, but the fuel level does not increase by 2 % within the delay time.
6554	Fuel pump log. input	Multi input [102/105/108], Ext. Ana. In [1 to 8], Auto detection	Auto detection	The multi-input or external analogue input for the fuel level sensor. Configure the input in the utility software under *I/O & Hardware setup*. Select the multi-input if 4-20 mA is used. Select *Auto detection* if a multi input with RMI fuel level is used.
6557	Fuel fill slope	1 to 10%	2%	The fuel fill slope percentage.

Relay output

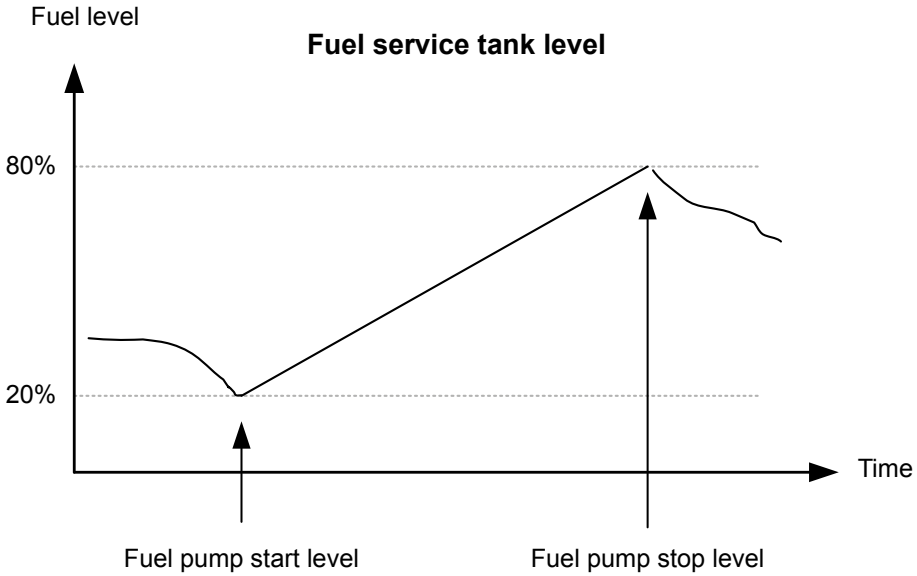
In the utility software under *I/O & Hardware setup*, select the output relay to control the fuel pump, as shown in the following example. If you do not want an alarm whenever the output is activated, configure the output relay as a limit relay.

The controller activates the relay when the fuel level is below the start limit. The controller deactivates the relay when the fuel level is above the stop limit.

NOTE The fuel pump relay can be activated using M-Logic (`Output > Command > Activate Fuel pump`). The fuel pump relay can also be inhibited using M-Logic (`Output > Command > Inhibit Fuel pump`).

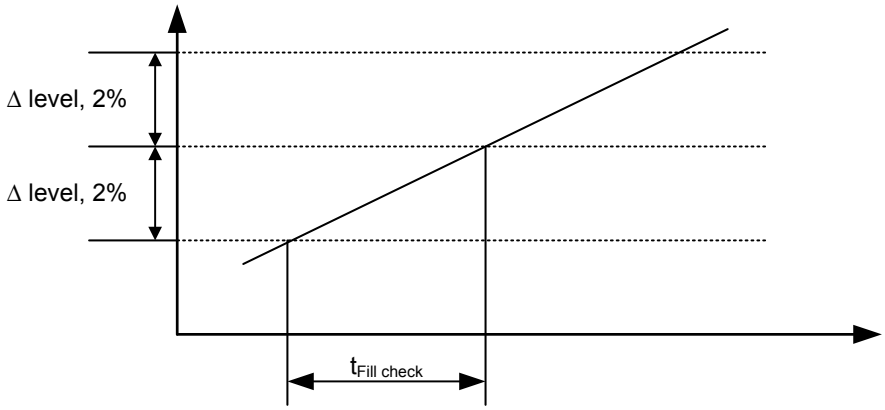
How it works

The diagram below shows how the fuel pump is started when the fuel level is 20 % and stopped again when the level is 80 %.



Fuel fill check

When the fuel pump is running, the fuel level must increase by 2 % within the **Fuel fill check** timer set in menu 6553. If the fuel level does not increase by 2 %, the controller deactivates the fuel pump relay and activates a **Fuel fill alarm**.



NOTE The level increase is fixed at 2 % and cannot be changed.

Fuel tank level and volume

You can set the capacity of the day tank in parameter 6911. The controller uses this value and the fuel level to calculate the fuel volume. The fuel volume is shown in the utility software in *Application supervision, Genset data, General*.

6.10.2 DEF pump logic

The DEF pump logic can start and stop the DEF pump to keep the DEF at the required level. For this function, engine interface communication (EIC) must provide the DEF level. If the EIC cannot provide the DEF level, you can use the generic fluid pump logic instead.

Functions > Diesel Exhaust Fluid

Parameter	Name	Range	Default	Details
6721	DEF pump log. start	0 to 100 % 1 to 10 s	20 % 1 s	DEF transfer pump start point.
6722	DEF pump log. stop	0 to 100 %	80 %	DEF transfer pump stop point.
6723	DEF fill check	0.1 to 999.9 s Fail classes	60 s Warning	DEF transfer pump alarm timer and fail class. The alarm is activated if the DEF pump relay is activated, but the DEF level does not increase by the DEF fill slope (see 6724) within the delay time.
6724	DEF fill slope	1 to 10 %	2 %	When the DEF pump relay is activated, this is the amount by which the DEF level must increase in the time defined in 6723.

Relay output

In the utility software under *I/O & Hardware setup*, select the output relay to control the DEF pump, as shown in the following example. If you do not want an alarm whenever the output is activated, configure the output relay as a limit relay.

The controller activates the relay when the DEF level is below the start limit. The controller deactivates the relay when the DEF level is above the stop limit.

NOTE The DEF pump relay can be activated using M-Logic (`Output > Command > Activate DEF Pump`). The DEF pump relay can also be inhibited using M-Logic (`Output > Command > Inhibit DEF pump`).

6.10.3 Generic pump logic

The fluid pump logic can start and stop a pump to keep any fluid at the required level.

Functions > Generic Fluid

Parameter	Name	Range	Default	Details
6731	Fluid pump start	0 to 100 % 1 to 10 s	20 % 1 s	Fluid transfer pump start point.
6732	Fluid pump stop	0 to 100 %	80 %	Fluid transfer pump stop point.
6733	Fluid check	0.1 to 999.9 s Fail classes	60 s Warning	Fluid transfer pump alarm timer and fail class. The alarm is activated if the fluid pump relay is activated, but the fluid level does not increase by the fluid fill slope (see 6735) within the delay time.
6734	Fluid pump log.	Multi input [20 to 23], Ext. Ana. In [1 to 8]	Multi input 20	Select the analogue input for the fluid level. Configure the input in the utility software under *I/O & Hardware setup*.
6735	Fluid fill slope	1 to 10 %	2 %	When the fluid pump relay is activated, this is the amount by which the fluid level must increase in the time defined in 6733.

Relay output

In the utility software under *I/O & Hardware setup*, select the output relay to control the fluid pump, as shown in the following example. If you do not want an alarm whenever the output is activated, configure the output relay as a limit relay.

The controller activates the relay when the fluid level is below the start limit. The controller deactivates the relay when the fluid level is above the stop limit.

NOTE The fluid pump relay can be activated using M-Logic (`Output > Command > Activate Generic Pump`). The fluid pump relay can also be inhibited using M-Logic (`Output > Command > Inhibit Generic pump`).

6.11 Other functions

6.11.1 Service timers

The controller has two service timers to monitor maintenance intervals. Click the Σ icon in the utility software to see the service timers.

The timer function is based on running hours. When the adjusted time expires, the controller displays an alarm. The running hours are counted when there is running feedback. An alarm occurs when the running hours or days expires.

The controller remembers the last reset on each service timer.

`Engine > Maintenance > Service timer [1 to 2]`

Parameter	Text	Range	Default
6111 or 6121	Service timer [1 to 2] hour	0 to 9000 hours	500 hours
6113 or 6123	Service timer [1 to 2] day	1 to 1000 days	365 days
6116 or 6126	Service timer [1 to 2] res	OFF ON	OFF

6.11.2 Keyswitch

Output function

Under **I/O & Hardware setup, DO**, configure the *Keyswitch* function.

Wiring

Wire the keyswitch relay output to the ECU power. When the keyswitch relay is open, the ECU has no power.

How it works

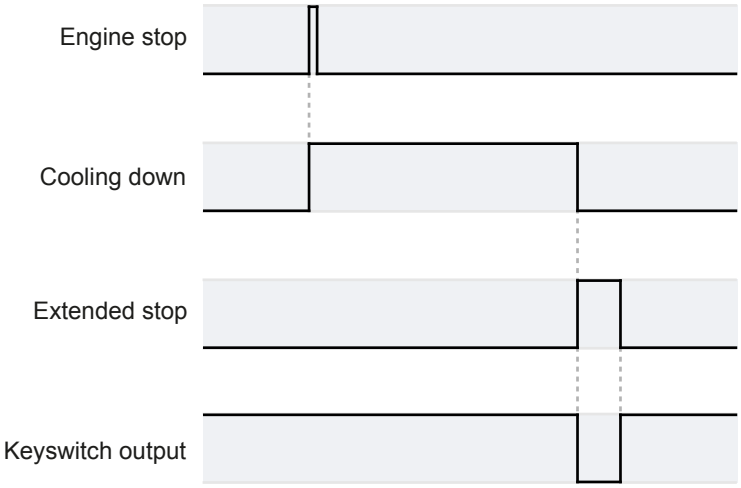
For the first 5 seconds after the controller is powered on, the keyswitch relay is open.

When the keyswitch relay is open, the controller inhibits the engine interface communication error alarm.

The keyswitch function works as follows:

1. There is an engine stop command.
2. The *Cooling down* (parameter 6211) timer starts.

3. When the cooling down timer runs out, the controller starts the *Extended stop* (parameter 6212) timer, and opens the keyswitch relay.
4. The keyswitch relay stays open until the extended stop timer runs out.



NOTE The keyswitch function does not require engine communication.

6.11.3 Supervision

For some of the engine operating values shown in the utility software under *Application supervision*, you can use the following parameters to select the sources of the operating values.

`USW specific parameters > Sensor selection`

Parameter	Name	Range	Default	Notes
13010	Oil press. input USW	Multi input [20 to 23] EIC Oil pressure Auto detection	Auto detection	
13011	Cool water input USW	Multi input [20 to 23] EIC Water temp Auto detection	Auto detection	
13012	Fuel level input USW	Multi input [20 to 23] Auto detection	Auto detection	
13013	RPM input USW	Auto detection EIC MPU Generator frequency	Auto detection	**Auto detection**: The priority is EIC, MPU, then frequency. **Generator frequency**: The controller calculates the speed using the formula: Engine speed (N) = 120 x Generator frequency (f) / Number of poles (P), where P = 4.

7. Generator functions

7.1 Generator breaker

7.1.1 Breaker settings

Synchronisation > Dynamic sync.

Parameter	Text	Range	Default
2025	Sync. time GB	40 to 300 ms	50 ms

Breakers > Generator breaker > Breaker configuration

Parameter	Text	Range	Default
6231	GB close delay	0.0 to 30.0 s	2.0 s
6232	GB Load time	0.0 to 30.0 s	0.0 s
6234	GB reclose attempts	No reclose attempts 1 reclose attempt 2 reclose attempts 3 reclose attempts	No reclose attempts

7.1.2 Breaker sequences

The controller activates the breaker sequences according to the selected mode.

Controller operation modes

Controller operation mode	Breaker control
AUTO	Controlled by the controller
MANUAL	Button/remote command
No regulation	Button/remote command
Block	None (only possible to open breakers)

Voltage and frequency OK

Before closing the breakers, the voltage and frequency must be stabilised within a defined time frame.

Generator > AC configuration > Voltage and freq. OK > Hz/V OK

Parameter	Text	Range	Default
6221	Hz/V OK timer	0.0 to 99.0 s	5.0 s

Generator > AC configuration > Voltage and freq. OK > Blackout / Hz/V OK*

Parameter	Text	Range	Default
2111	Blackout dfMin	0.0 to 5.0 Hz	3.0 Hz
2112	Blackout dfMax	0.0 to 5.0 Hz	3.0 Hz
2113	Blackout dUMin	2 to 20 %	5 %
2114	Blackout dUMax	2 to 20 %	5 %

NOTE * The settings are used for both Hz/V OK and Blackout.

Generator > AC configuration > Voltage and freq. OK > Hz/V failure

Parameter	Text	Range	Default
4561	Timer	1.0 to 99.0 s	30.0 s
4562	Output A	Relays and M-Logic	Not used
4563	Output B	Relays and M-Logic	Not used
4564	Enable	OFF ON	OFF
4565	Fail class	Fail classes	Shutdown

Generator > AC configuration > Voltage and freq. OK > Hz/V OK

Parameter	Text	Range	Default
6221	Hz/V OK timer	0.0 to 99.0 s	5.0 s

Conditions for breaker operations

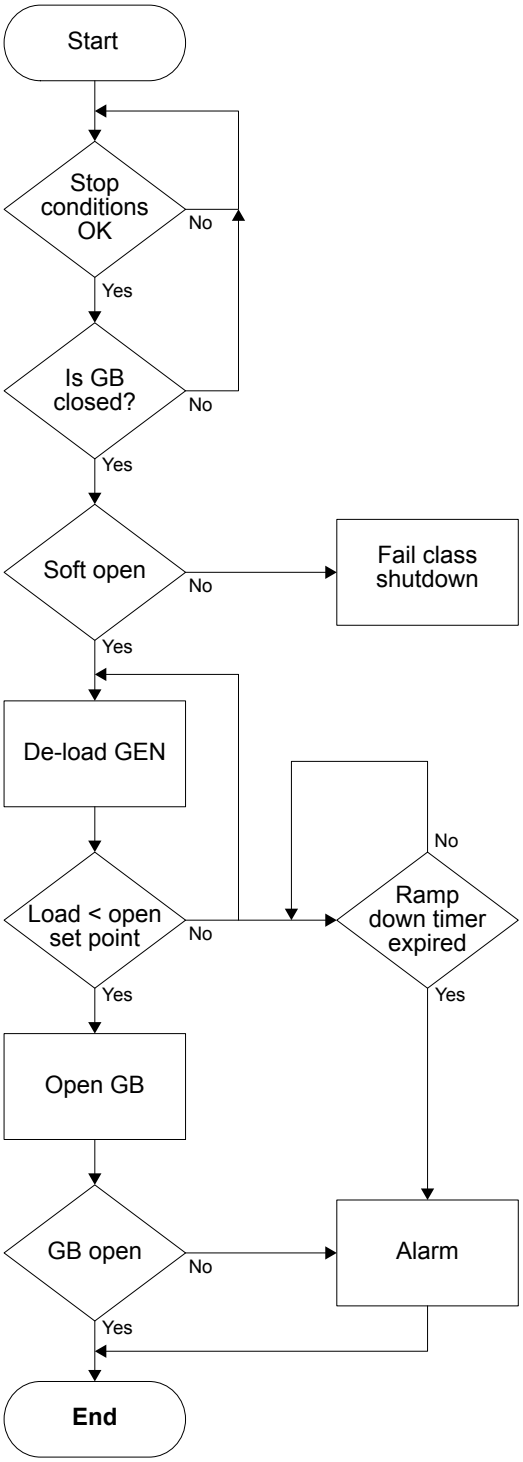
The breaker sequences depend on the breaker positions and the frequency/voltage measurements.

Sequence	Condition
GB ON, direct closing	Running feedback Generator frequency/voltage OK MB open*
GB ON, synchronising	Running feedback Generator frequency/voltage OK MB closed* No generator failure alarms
GB OFF, direct opening	MB open*
GB OFF, de-loading	MB closed*

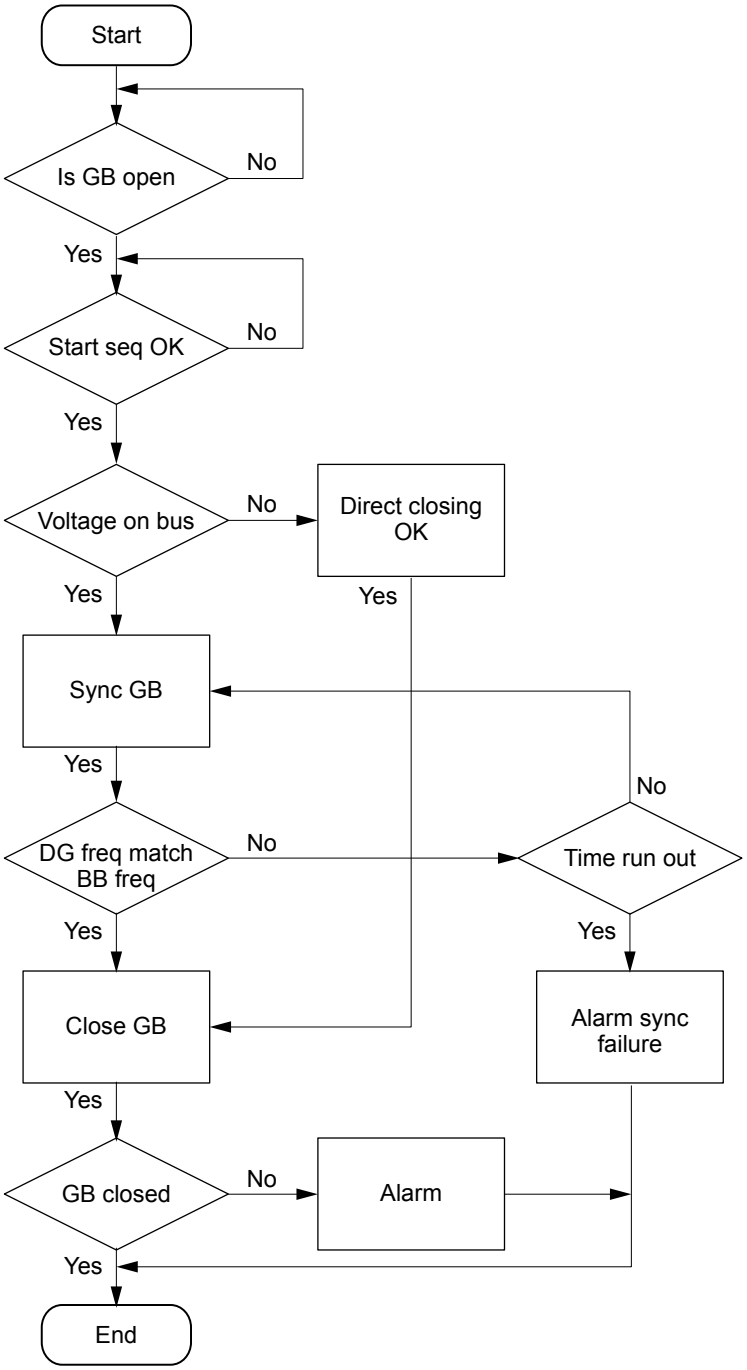
NOTE * Only for single-controller applications.

7.1.3 Flowcharts

GB open sequence flowchart



GB close sequence flowchart



7.1.4 Breaker failures

`Breakers > Generator breaker > Breaker monitoring > GB Open fail`

Parameter	Text	Range	Default
2160	Timer	1.0 to 10.0 s	2.0 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	ON	ON
	Fail class	Fail classes	Warning

Breakers > Generator breaker > Breaker monitoring > GB Close fail

Parameter	Text	Range	Default
2170	Timer	1.0 to 10.0 s	900 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	ON	ON
	Fail class	Fail classes	Warning

Breakers > Generator breaker > Breaker monitoring > GB Pos fail

Parameter	Text	Range	Default
2180	Timer	1.0 to 5.0 s	1.0 s
	Output A	Relays and M-Logic	Not used
	Output B	Relays and M-Logic	Not used
	Enable	ON	ON
	Fail class	Fail classes	Warning

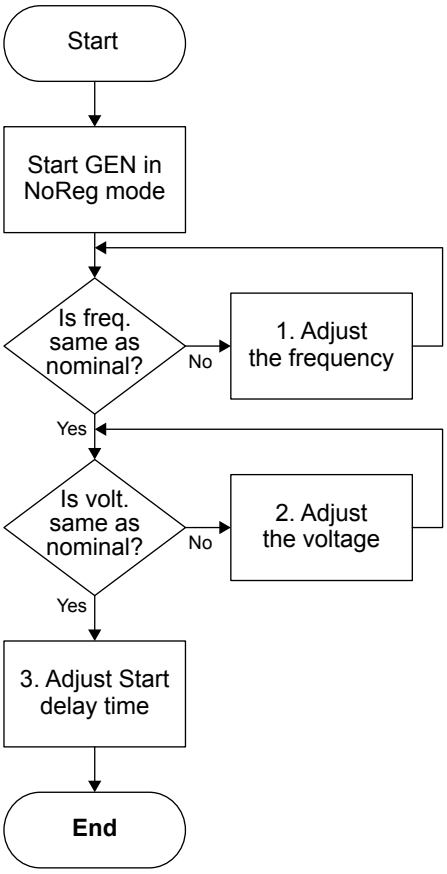
7.2 Governor and AVR configuration

7.2.1 Configuration of controller with EIC governor and analogue AVR

Initial settings

No.	Setting	Path	Parameter
1	Set the GOV type to EIC	Engine > Speed control > General configuration	2781
2	Select the engine type	Engine > ECU configuration > Engine type	7561
3	Set the EIC controls to ON	Engine > ECU configuration > EIC controls	7563
4	Set the AVR type to Analogue	Generator > AVR > General configuration	2782
5	Set the AVR output to Ana Out 55	Generator > AVR > Analogue configuration	5991
6	Set the output limits for analogue AVR control	Generator > AVR > Analogue configuration > AOUT 55 Limits	5811, 5812, 5813

Adjustments in No regulation mode

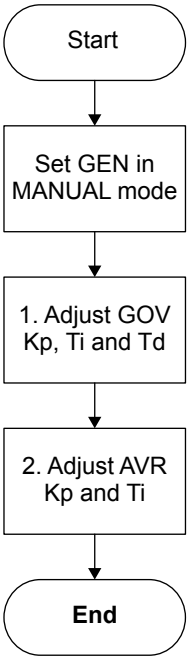


1. Adjust the frequency:
`Engine > Speed control > Offset for control signal` (2551).

2. Adjust the voltage:
`Generator > AVR > Offset for control signal` (2671).

3. If needed, adjust the start regulation delay time:
`Engine > Start sequence > After crank > Reg. delay at start > Delay reg.` (2741).

Adjustments in MANUAL mode



1. Adjust GOV Kp, Ti and Td:

- Island settings: `Engine > Speed control > Speed PID > Island` (2511, 2512 and 2513).
- Load share settings: `Engine > Speed control > Speed PID > Load share` (2541, 2542 and 2543).
- Sync. regulator settings: `Synchronisation > Sync. regulator` (2041, 2042 and 2043).

Single-controller applications

- Mains parallel settings: `Engine > Speed control > Speed PID > Mains parallel` (2531, 2532 and 2533).

2. Adjust AVR Kp and Ti:

- Island settings: `Settings > Generator > AVR > Voltage PID > Island` (2641 and 2642).
- Load share settings: `Generator > AVR > Voltage PID > Load share` (2661 and 2662).

Single-controller applications

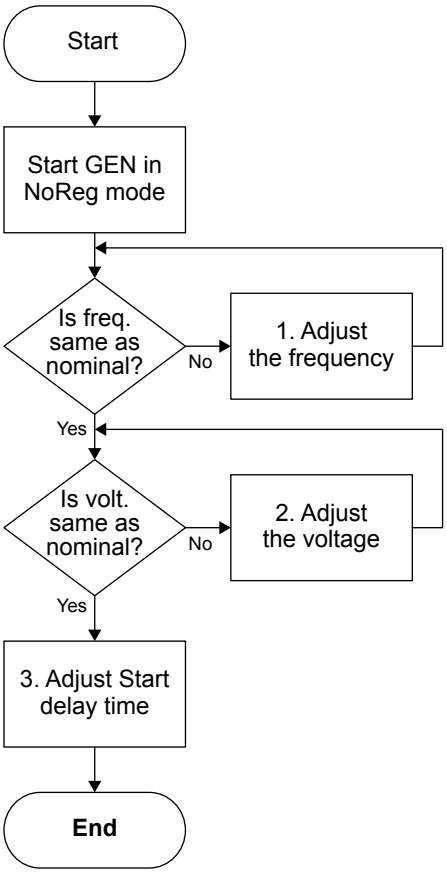
- Mains parallel settings: `Generator > AVR > Voltage PID > Mains parallel` (2651 and 2652).

7.2.2 Configuration of controller with analogue governor and analogue AVR

Initial settings

No.	Setting	Path	Parameter
1	Set the GOV type to Analogue	`Engine > Speed control > General configuration`	2781
2	Set the AVR type to Analogue	`Generator > AVR > General configuration`	2782
3	Set the GOV output to Transducer 52	`Engine > Speed control > Analogue configuration`	5981
4	Set the AVR output to Ana Out 55	`Generator > AVR > Analogue configuration > AVR output`	5991
5	Set the output limits for analogue AVR control	`Generator > AVR > Analogue configuration > AOUT 55 Limits`	5811, 5812, 5813
6	Set the output limits for analogue GOV control	`Engine > Speed control > AOUT 52 GOV limits`	5801, 5802, 5803

Adjustments in No regulation mode

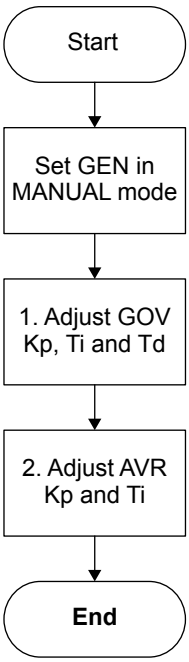


1. Adjust the frequency:
`Engine > Speed control > Offset for control signal` (2551).

2. Adjust the voltage:
`Generator > AVR > Offset for control signal` (2671).

3. Adjust the Start delay time:
`Engine > Start sequence > After crank > Reg. delay at start > Delay reg.` (2741).

Adjustments in MANUAL mode



1. Adjust GOV Kp, Ti and Td:

- Island settings: `Engine > Speed control > Speed PID > Island` (2511, 2512 and 2513).
- Load share settings: `Engine > Speed control > Speed PID > Load share` (2541, 2542 and 2543).
- Sync. regulator settings: `Synchronisation > Sync. regulator` (2041, 2042 and 2043).

Single-controller applications

- Mains parallel settings: `Engine > Speed control > Speed PID > Mains parallel` (2531, 2532 and 2533).

2. Adjust AVR Kp and Ti:

- Island settings: `Generator > AVR > Voltage PID > Island` (2641 and 2642).
- Load share settings: `Generator > AVR > Voltage PID > Load share` (2661 and 2662).

Single-controller applications

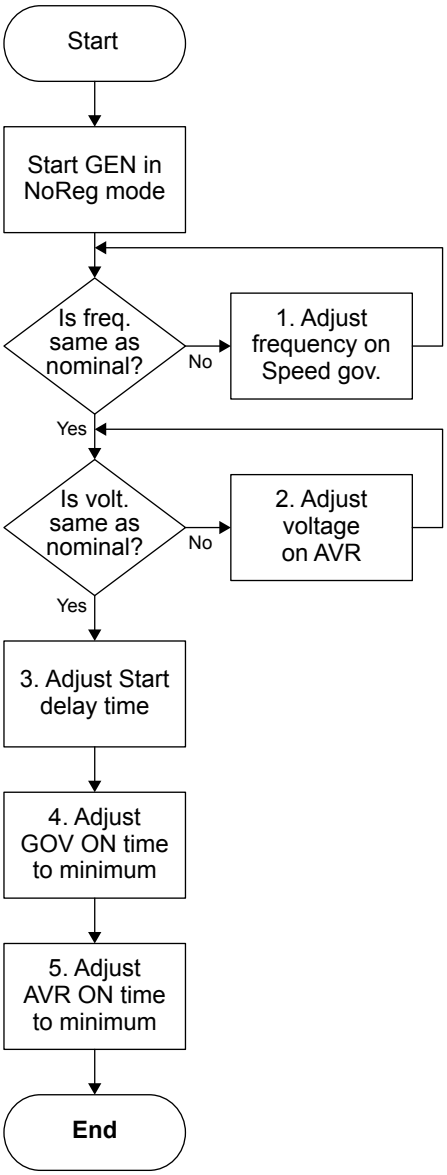
- Mains parallel settings: `Generator > AVR > Voltage PID > Mains parallel` (2651 and 2652).

7.2.3 Configuration of controller with relay governor and relay AVR

Initial settings

No.	Setting	Path	Parameter
1	Set the GOV type to Relay	`Engine > Speed control > General configuration`	2781
2	Set the AVR type to Relay	`Generator > AVR > General configuration`	2782
3	Select the Increase relay for AVR	`Generator > AVR > Relay configuration > Output and period`	2723
4	Select the Decrease relay for AVR	`Generator > AVR > Relay configuration > Output and period`	2724
5	Select the Increase relay for GOV	`Engine > Speed control > Relay configuration > Output and period`	2603
6	Select the Decrease relay for GOV	`Engine > Speed control > Relay configuration > Output and period`	2604

Adjustments in No regulation mode



1. Adjust the frequency on the external Speed governor.

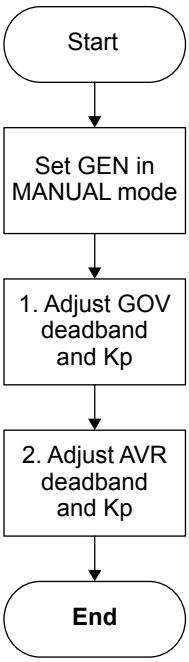
2. Adjust the voltage on the external AVR.

3. Adjust the Start delay time:
`Engine > Start sequence > After crank > Reg. delay at start > Delay reg.` (2741).

4. Adjust the GOV ON time to minimum:
`Engine > Speed control > Relay configuration > Output and period` (2601).

5. Adjust the AVR ON time to minimum:
`Generator > AVR > Relay configuration > Output and period` (2721).

Adjustments in MANUAL mode



1. Adjust GOV deadband and Kp:

- Island settings: `Engine > Speed control > Speed PID > Island` (2571 and 2572).
- Load share settings: `Engine > Speed control > Speed PID > Load share` (2591, 2592, 2593 and 2594).
- Sync. regulator settings: `Synchronisation > Sync. regulator` (2051).

Single-controller applications

- Mains parallel settings: `Engine > Speed control > Speed PID > Mains parallel` (2581 and 2582).

2. Adjust AVR deadband and Kp:

- Island settings: `Generator > AVR > Voltage PID > Island` (2691 and 2692).
- Load share settings: `Generator > AVR > Voltage PID > Load share` (2711, 2712, 2713 and 2714).

Single-controller applications

- Mains parallel settings: `Generator > AVR > Voltage PID > Mains parallel` (2701 and 2702).

7.2.4 Manual governor and AVR control

This function can be activated in MANUAL or No regulation mode by the digital inputs or the *AOP* buttons for governor or AVR control. The function must be configured through M-Logic, and it gives the commissioning engineer a helpful tool for adjustment of the regulation.

When using digital inputs or an *AOP* button to increase/decrease the GOV/AVR signal, the length of the pulse can be adjusted.

The manually controlled regulator is not active as long as a manual step signal is active. When the manual step signal has expired, the normal regulator will be active again.

Example: A genset is running with the GB open. An AOP is configured with manual up and down and a signal length of 5 s. When the AOP button is pressed for manual GOV up, the RPM for the genset will increase for five seconds. The GOV regulator is deactivated for five seconds. When the five seconds have expired, the normal regulator will regulate the genset down again to the nominal set point.

Governor settings

`Engine > Speed control > General configuration`

Parameter	Text	Range	Default
2781	Reg. output GOV	Relay Analogue EIC	EIC

`Engine > Speed control > Manual step`

Parameter	Text	Range	Default
2783	Man. Step GOV	0.1 to 10.0 s	5.0 s

Engine > Speed control > Offset for control signal

Parameter	Text	Range	Default
2551	GOV output offset 1	0 to 100 %	50

AVR settings

Generator > AVR > General configuration

Parameter	Text	Range	Default
2782	Reg. output AVR	Relay Analogue EIC	EIC

Generator > AVR > Manuel step

Parameter	Text	Range	Default
2784	Man. Step AVR	0.1 to 10.0 s	5.0 s

7.2.5 External set points

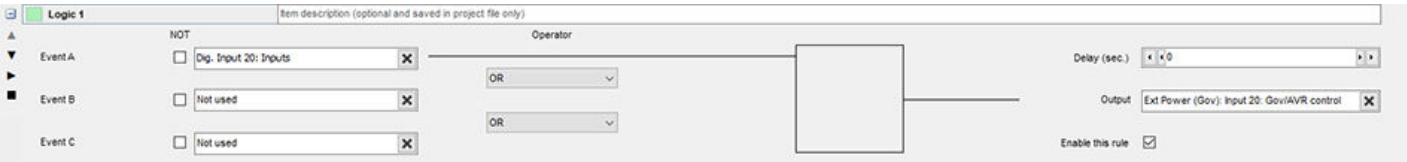
It is possible to control the governor and the AVR externally. A multi-input can be configured to receive a signal with the desired set point. The external control is enabled through M-Logic. The internal set point is discarded when the external control is enabled.

The governor can be controlled using the modes *External frequency control* and *External power control*. The AVR can be controlled using the modes *External voltage control*, *External reactive power control* and *External cos phi control*.

The signal used to control the modes can be set up within the limitations of the multi-inputs. The inputs are configured with the utility software. See the utility software help function (F1) for more details.

Example: Configuring M-Logic

In M-Logic, external power control from input 20 is enabled as an output by using the command *Ext Power (Gov): Input 20: Gov/AVR control*. Commands relevant for external governor/AVR control are found under *Gov/AVR control*. Any relevant events can be used to activate the command.



M-Logic outputs that activate external Gov/AVR control

GOV/AVR control	M-Logic output	Multi-input selection
GOV Ext. frequency	Input: When mA is selected, a 4 to 20 mA signal is used for control and the nominal frequency is 12 mA	Multi-input 20 Multi-input 21 Multi-input 22 Multi-input 23
GOV Ext. power	Input: When mA is selected, a 12 to 20 mA signal is used for control (0 to 100 %)	
AVR Ext. voltage	Input: When mA is selected, a 4 to 20 mA signal is used for control	
AVR Ext. cos phi	Input: When mA is selected, a 12 to 20 mA signal is used for control	
AVR Ext. var	Input: When mA is selected, a 4 to 20 mA signal is used for control	

NOTE When external control is enabled, the internal set point is discarded.

Power set points > Ext. power set point

Parameter	Text	Range	Default	Notes
7501	Comm bus control P	OFF ON	OFF	This parameter can be changed by the M-Logic output *Command > [Activate/Deactivate] active power control via comm*.
7502	Comm bus control f	OFF ON	OFF	This parameter can be changed by the M-Logic output *Command > [Activate/Deactivate] frequency control via comm*.
7503	Comm bus control U	OFF ON	OFF	This parameter can be changed by the M-Logic output *Command > [Activate/Deactivate] voltage control via comm*.
7504	Comm bus control cos phi	OFF ON	OFF	This parameter can be changed by the M-Logic output *Command > [Activate/Deactivate] cosphi control via comm*.
7505	Comm bus control Q	OFF ON	OFF	This parameter can be changed by the M-Logic output *Command > [Activate/Deactivate] reactive power control via comm*.

Range of regulation for external set points

Parameter	Input voltage	Description	Notes
Frequency	4 to 20 mA	f_{NON} ± 10 %	Active when SCB is OFF.
Power	4 to 20 mA	P_{NON} ± 100 %	
Voltage	4 to 20 mA	U_{NOM} ± 10 %	Active when GB is OFF.
Reactive power	4 to 20 mA	Q_{NOM} ± 100 %	
Power factor	4 to 20 mA	0.6 capacitive to 1 to 0.6 inductive	

More information
The external set point can also be controlled using Modbus. See the **Modbus tables** on deif.com.

7.2.6 Regulation failure

The controller has alarms for regulation failure. The alarm set point is a deviation percentage, as explained in this example:

A genset has the nominal of 440 V AC. In a situation where there is an inductive load, it is not possible for the genset to regulate up to its nominal voltage. If the genset is capable of regulating up to 400 V AC, there is a deviation of 9.1 %. If the regulation failure alarm deadband is 9 %, the controller activates a regulation failure alarm, if the voltage is not back within the range before the timer expires. However, if the deadband is 9.2 %, no alarm is activated.

The regulation failure alarms can be used to detect that the controller has been regulating towards the set point, and may be at its maximum, but has not been able to reach the set point. The regulation failure alarm can also be activated if the regulation is too slow.

Engine > Speed control > Regulation failure > GOV reg. fail

Parameter	Text	Range	Default
2560	Deadband	1.0 to 100.0 %	30.0 %
	Timer	10.0 to 300.0 s	60.0 s
	Output A	Terminals and M-Logic	Not used
	Output B	Terminals and M-Logic	Not used
	Fail class	Fail classes	Warning

Generator > AVR > Regulation failure > AVR reg. fail

Parameter	Text	Range	Default
2680	Deadband	1.0 to 100.0 %	30.0 %
	Timer	10.0 to 300.0 s	60.0 s
	Output A	Terminals and M-Logic	Not used
	Output B	Terminals and M-Logic	Not used
	Fail class	Fail classes	Warning

7.2.7 DAVR configuration

Generator > AVR > DAVR configuration > DAVR type > Digital AVR

Parameter	Text	Range	Default
7565	DAVR type	OFF Caterpillar CDVR Leroy Somer D510C DEIF DVC310 DEIF DVC350 DEIF DVC550 NIDEC D550	OFF

Generator > AVR > DAVR configuration > DAVR AC configuration

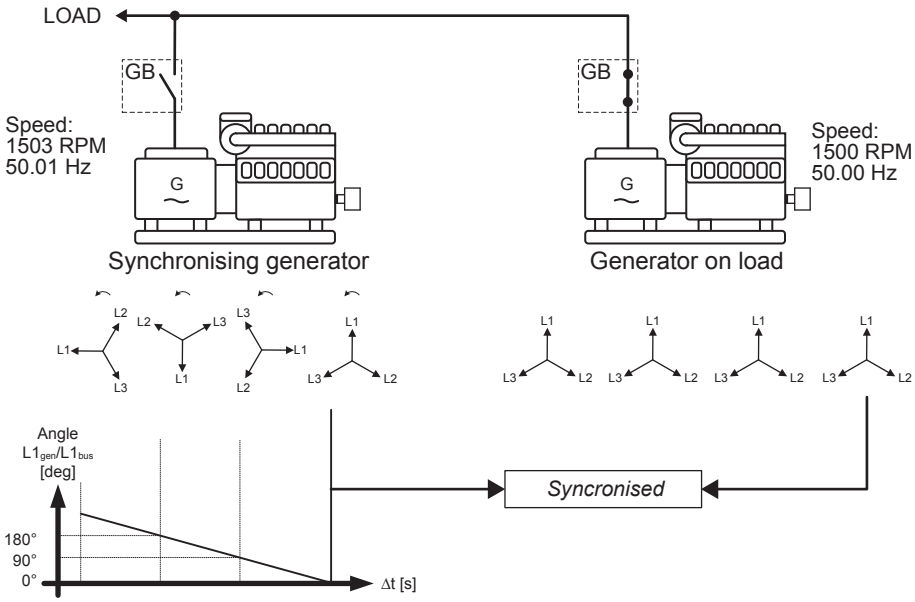
Parameter	Text	Range	Default
7741	DAVR Gen U primary	400 to 32000 V	400 V
7742	DAVR Gen U secondary	50 to 600 V	400 V
7743	DAVR Bus U primary	400 to 32000 V	400 V
7744	DAVR Bus U secondary	50 to 600 V	400 V
7745	Enable	OFF ON	OFF
7746 *	DAVR AC config	Follow AGC AC config Split phase W-U (L1L3) Split phase V-W (L2L3) 3-phase U-V-W (L1L2L3)	Follow AGC AC config

NOTE * See the **DVC 550 Designer's handbook** for phase selection for the DAVR when used with DVC 550.

7.3 Dynamic synchronisation

With dynamic synchronisation, the synchronising genset is running at a different speed than the generator on the busbar. This speed difference is called slip frequency. Typically, the synchronising genset has a positive slip frequency (a higher speed than the generator on the busbar). The objective is to avoid a reverse power trip after the synchronisation.

Dynamic principle



In this example, the synchronising genset is running at 1503 RPM ~ 50.1 Hz. The generator on load is running at 1500 RPM ~ 50.0 Hz. This gives the synchronising genset a positive slip frequency of 0.1 Hz.

Synchronising means to decrease the phase angle difference between the two rotating systems, the three-phase generator system and the three-phase busbar system. In the diagram above, phase L1 of the busbar is always pointing at 12 o'clock, whereas phase L1 of the synchronising genset is pointing in different directions due to the slip frequency.

NOTE Both three-phase systems are rotating, but to simplify the diagram the vectors for the generator on load are not shown to be rotating.

When the generator is running with a positive slip frequency of 0.1 Hz compared to the busbar, the two systems can be synchronised every 10 seconds.

$$tsync = \frac{1}{50.1 - 50.0} = 10\,\text{sec}$$

In the example above, the phase angle difference between the synchronising set and the busbar gets smaller and is eventually zero. Then the genset is synchronised to the busbar, and the breaker is closed.

7.3.1 Settings for dynamic synchronisation

`Synchronisation > Dynamic sync.`

Parameter	Text	Range	Default
2021	Maximum slip frequency, dfMax	0.0 to 0.5 Hz	0.3 Hz
2022	Minimum slip frequency, dfMin	-0.5 to 0.3 Hz	0.0 Hz
2023	Maximum voltage difference, dUMax	2 to 10 %	5 %

Parameter	Text	Range	Default
2024	Minimum voltage difference, dUMin	-10 to 0 %	-5 %
2025	GB response time	40 to 300 ms	50 ms
2026*	MB response time	40 to 300 ms	50 ms

NOTE * Only for single-controller applications.

Dynamic synchronisation is recommended where fast synchronisation is required, and where the incoming gensets are able to take load just after the breaker has been closed.

Dynamic synchronisation is relatively fast because of the adjusted minimum and maximum slip frequencies. When the controller is aiming to control the frequency towards the set point, synchronising can still occur as long as the frequency is within the limits of the slip frequency settings.

7.3.2 Close signal

The controller calculates when to close the breaker to get the most accurate synchronisation. This means that the close breaker signal is actually issued before being synchronised (read L1 phases exactly at 12 o'clock).

The breaker close signal will be issued depending on the breaker closing time and the slip frequency (response time of the circuit breaker is 250 ms, and the slip frequency is 0.1 Hz):

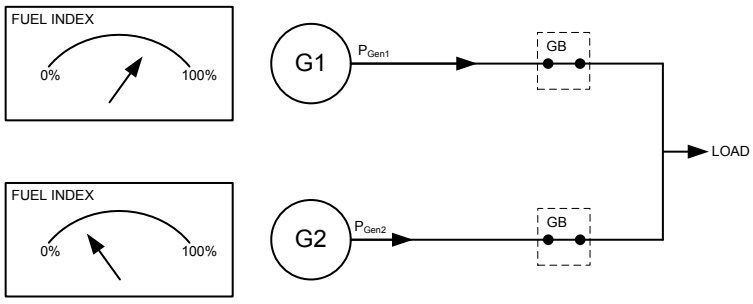
- deg close = 360*tCB*fSLIP
- deg close = 360∗0.250∗0.1
- deg close = 9 deg

The length of the synchronisation pulse is the response time + 20 ms. The synchronisation pulse is always issued, so the closing of the breaker will occur at the 12 o'clock position.

7.3.3 Load picture after synchronising

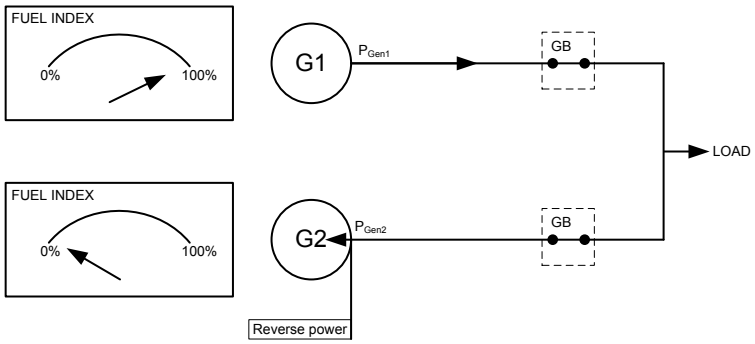
When the incoming genset has closed its breaker, it will take a portion off the load depending on the actual position of the fuel rack.

Positive slip frequency



The diagram shows that at a given positive slip frequency, the incoming genset *exports* power to the load.

Negative slip frequency

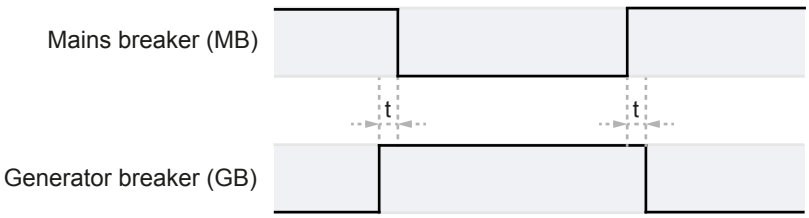


The diagram shows that at a given negative slip frequency, the incoming genset *receives* power from the original genset (reverse power).

NOTE To avoid nuisance trips caused by reverse power, configure a positive slip frequency.

7.4 Short-time parallel

For single-controller applications, if *Overlap* (menu 2760) is *On*, the controller enforces a maximum paralleling time for the generator and mains supply. This is used to meet local requirements for short-time parallel. The overlap function is only available for single controllers in automatic mains failure and load take-over operations.



When the generator breaker is closed, the mains breaker is opened automatically before the timer runs out (t). Similarly, when the mains breaker is closed, the generator breaker is opened before the timer runs out (t). The timer is configurable (0.10 to 99.90 seconds).

NOTE The timer is a maximum time. The two breakers are never both closed for longer than the set point.

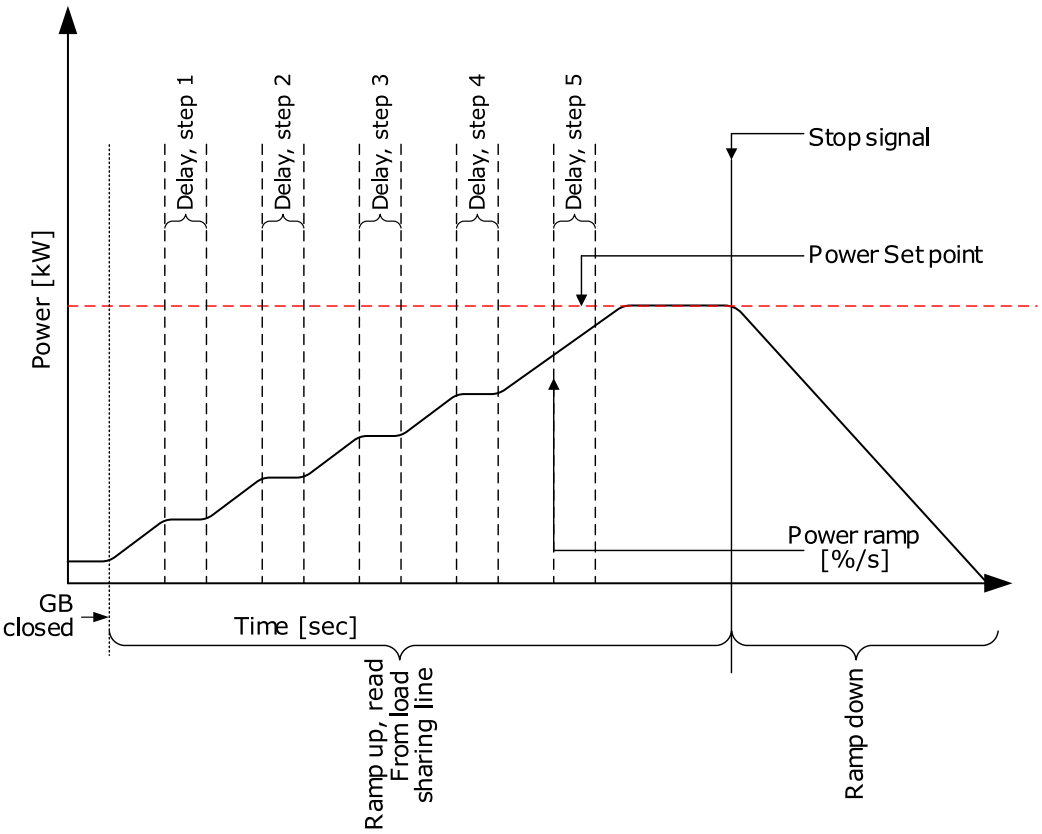
7.5 Power ramp

The power ramp function is used to ramp up or down towards the set points. For example, when a genset is started in a power management system with other gensets running. When the generator breaker is closed, the incoming genset takes load with the power ramp as slope. In single-controller applications, the power ramp is also used. For example, when a breaker has just been closed, and a genset is parallel to the grid. The power ramp then ramps up towards the power set point.

Power ramp is set in %/s, which determines how fast the controller should ramp up towards the set point. The regulators can then be fine tuned, so the genset is kept on the power ramp when going up or down towards the set point. When the set point is reached, the regulators keep the power set point even though there are frequency deviations.

The power ramp up can have load steps. You can configure how many steps the power ramp should have from 0 to 100 % power, and how many percent between each step. When each step is reached, there can be a delay time, before regulating further up on the power ramp. The power ramp up speed and power ramp down speed are configured individually, and are used in all running modes.

The diagram below gives an overview of how the speed and power ramp function can be configured.



Power set points > Loading/Deloading ramps > kW ramp up speed

Parameter	Text	Range	Default
2611	Power ramp up speed 1	0.1 to 20.0 %/s	2.0 %/s
2612	Power ramp up delay point	1 to 100 %	10 %
2613	Power ramp up delay at each step	0 to 9900 s	10 s
2614	Power ramp up island ramp	OFF ON	OFF
2615	Power ramp up steps	0 to 100	1
2616	Power ramp up speed 2	0.1 to 20.0 %/s	0.1 %/s

Power ramp 1 is the primarily used power ramp. Power ramp 1 is only ignored during frequency-dependent power droop or if power ramp 2 is activated with M-Logic.

Power ramp 2 is a secondary power ramp. It is normally used for frequency-dependent power droop, but it can also be activated using any M-Logic event. Set *Auto Ramp Select* to OFF, if Power ramp 2 should be activated by M-Logic.

Power set points > Loading/Deloading ramps > Auto Ramp Select

Parameter	Text	Range	Default
2624	Auto Ramp Select	OFF ON	OFF

Ramp up with load steps

When the GB is closed, the power set point continues to rise in steps (determined by the setting in parameter 2615). If the delay point is set to 20 %, the delay time to 10 seconds, and the number of load steps is set to 3:

1. The genset ramps to 20 %

2. Wait 10 seconds
3. Ramp to 40 %
4. Wait 10 seconds
5. Ramp to 60 %
6. Wait 10 seconds
7. Ramp to the power set point

Power set points > Loading/Deloading ramps > kW ramp down speed

Parameter	Text	Range	Default
2621	Power ramp down speed 1	0.1 to 20.0 %/s	3.3 %/s
2623	Power ramp down speed 2	0.1 to 20.0 %/s	0.1 %/s

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 stops at any point of the power ramp, and this set point is maintained as long as the function is active. If the function is activated while ramping from one delay point to another, the ramp is fixed until the function is deactivated again.

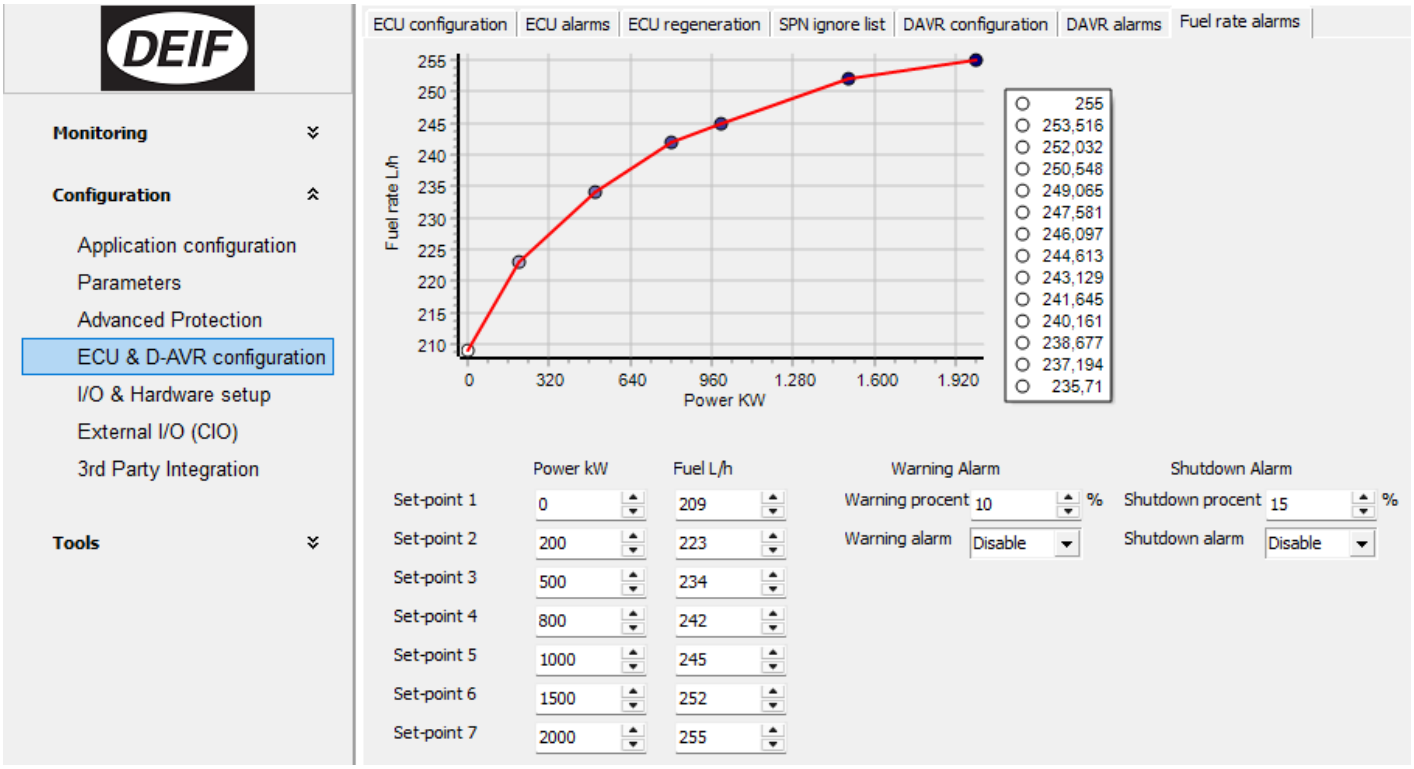
7.6 Fuel rate alarm

To ensure that the fuel consumption remains within the expected range, the controller has alarms for the fuel rate.

The fuel rate function lets you configure the expected fuel use relative to the generator power. If the fuel rate is above the expected range, the controller can activate alarms. The controller uses the fuel rate from the ECU.

Use the utility software to configure the fuel rate-power curve. You can define the ranges that activate the warning alarm and shutdown alarm.

ECU & DAVR configuration > Fuel rate alarms



7.7 Droop mode

7.7.1 Principle and setup

Droop mode can be used when a new genset is installed together with existing gensets which operate in droop mode. This ensures equal load sharing with the existing gensets. Droop mode can be used when the generator frequency must (or should) drop with increasing load.

The droop mode parameters can be adjusted between 0-10 % droop. If the value is different from 0 %, the droop percentage is applied on top of the regulation output of the governor (f) or AVR (U).

Frequency droop is determined as a percentage of the nominal frequency:

- If the active power is 0 %, the reference frequency is equal to the nominal frequency.
- If the active load is 100 %, the reference frequency is 96 % of the nominal frequency.

Voltage droop is determined as a percentage of the nominal voltage:

- If the reactive power is 0 %, the reference voltage is equal to the nominal voltage.
- If the reactive inductive load is 100 %, the reference voltage is 96 % of the nominal voltage.
- If the reactive capacitive load is 100 %, the reference voltage is 104 % of the nominal voltage.

`Engine > Speed control > Speed PID > Island`

Parameter	Text	Range	Default
2514	f droop	0.0 to 10.0 %	4.0 %
2573	f droop relay	0.0 to 10.0 %	4.0 %

`Generator > AVR > Voltage PID > Island`

Parameter	Text	Range	Default
2644	U droop	0.0 to 10.0 %	4.0 %
2693	U droop relay	0.0 to 10.0 %	4.0 %

NOTE When using droop mode, the frequency PID (f) and voltage PID (U) is active.

Activating droop regulation with M-Logic commands

The following M-Logic commands are used to activate droop regulation. This gives more options to activate the droop regulation with, for example, a digital input, AOP button, or an event.

M-Logic output	M-Logic command	Note
GOV/AVR control	Act. frequency droop regulation	Activates the use of frequency droop parameters mentioned above.
GOV/AVR control	Act. voltage droop regulation	Activates the use of voltage droop parameters mentioned above.

NOTE The command *Inhibit analogue loadshare* must be activated in M-Logic to force the controller from load sharing PID to frequency PID (f) and voltage PID (U). Otherwise, the droop function does not work.

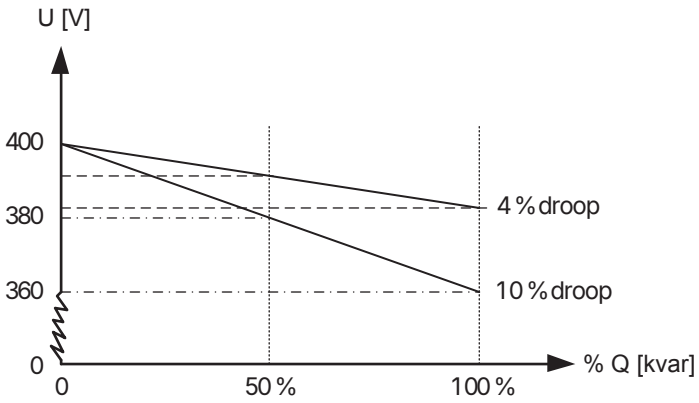
Application configuration

When operating in droop mode, the controller must have a single genset application drawing. This is done with the utility software. Use one of the pre-configured applications, or configure a single genset application.

More information
See **Setup of applications** for application configuration.

7.7.2 Voltage droop example

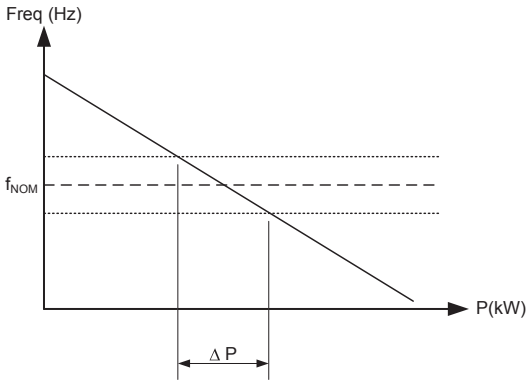
The diagram below shows an example for one generator where the voltage droop setting is 4 % and 10 % in proportion to the reactive power, Q (kvar). As it is shown in the example, the voltage drops as the load increases. The principle is the same with generators in parallel where the generators will use the droop to share the load and allow the voltage/frequency to drop accordingly.



7.7.3 Droop settings

High droop setting

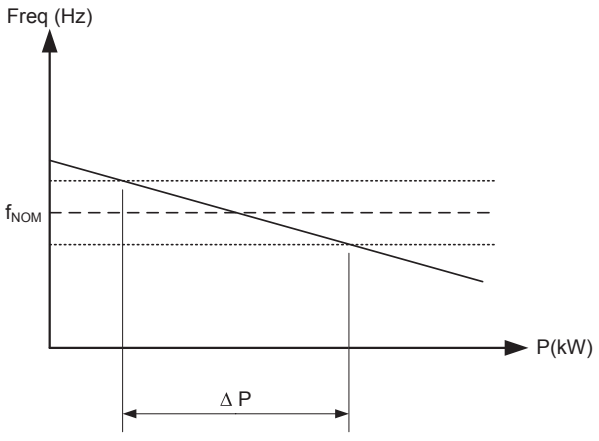
The diagram below shows how a frequency variation gives a change in the load. The principle is the same with voltage regulation. The load change is marked as ΔP.



This can be used if the generator must operate base-loaded.

Low droop setting

In this diagram, the load change (ΔP) is larger than before. This means that the generator load varies more than with the higher droop setting.



This can be used if the generator must operate as a peak load machine.

7.7.4 Compensation for isochronous governors

When the genset is equipped with a governor only providing isochronous operation, the droop setting can be used to compensate for the missing droop setting possibility on the governor.

7.8 4th current transformer input

The 4th current transformer input (terminals 60-61) can be used for one of these functions:

- **Mains power measurement**: Place the CT on L1 of the mains connection.

More information
See **Single generator with mains power measurement**.

- **Neutral line over-current protections**: Place the CT on the N line from the genset.
- **Generator earth current (ground fault) protections**: Place the CT on the generator star point ground connection. The function includes third harmonics filtering of the signal.

`Basic settings > Measurement setup > Current transformer > 4th CT`

Parameter	Text	Range	Default
6045	I primary E/N/M	5 to 9000 A	1000 A
6046	I secondary E/N/M	1 A 5 A	1 A

4th CT input selection

Select what the 4th current transformer input is used for.

`Basic settings > Measurement setup > 4th CT protection > 4th CT trip selector`

Parameter	Text	Range	Default
14201	4th CT trip select	OFF Mains/BB current Neutral current Earth fault current	OFF

7.9 Inputs and outputs

7.9.1 Digital input functions

Default

Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
GB position ON	The input function is used as an indication of the generator breaker position. The controller requires this feedback when the breaker is closed or a position failure alarm occurs.	●	●	●	●	●	C
GB position OFF	The input function is used as an indication of the generator breaker position. The controller requires this feedback when the breaker is opened or a position failure alarm occurs.	●	●	●	●	●	C

Configurable

Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
Start enable	This input must be activated to be able to start the engine. When the genset is started, the input can be removed.	●	●	●	●		C
Auto start/stop	The genset starts when this input is activated. The genset stops if the input is deactivated.	●					C
PLC control start	A PLC is used to initiate the start sequence of the genset.		●	●	●		C
PLC control stop	A PLC is used to initiate the stop sequence of the genset.		●	●	●		C
PLC control start/ stop	This input activates PLC control.		●	●	●		C
Remote start	This input initiates the start sequence of the genset when MANUAL or No reg mode is selected.		●		●		C
Remote stop	This input initiates the stop sequence of the genset when MANUAL or No reg mode is selected. The genset stops without cooling down.		●		●		C
Alternative start	**For single-controller applications only:**This input is used to simulate an AMF failure and this way run a full AMF sequence without a mains failure actually being present	●	●	●	●	●	C
Remove starter	The start sequence is deactivated. This means the start relay deactivates, and the starter motor disengages.	●	●	●	●		C
Low speed	Disables the regulators and keeps the genset running at a low RPM. The governor must be prepared for this function.	●	●	●	●		C
Binary running detection	The input is used as a running indication of the engine. When the input is activated, the start relay is deactivated.	●	●	●	●	●	C
Oil pressure alarm	The oil pressure alarm is activated if the oil pressure exceeds the set point. The function automatically sets *Not run status* as the inhibit, the alarm input as *Low*, and *Shutdown* as the fail class.	●	●	●	●	●	C
Water temperature alarm	The water temperature alarm is activated if the water temperature exceeds the set point. The function automatically sets *Shutdown override* as the inhibit, the alarm input as *Low*, and *Shutdown* as the fail class.	●	●	●	●	●	C
Remote GB ON	The generator breaker close sequence is initiated and the breaker synchronises and closes. **Single-controller applications:** The generator breaker close sequence is initiated and the breaker synchronises if the mains breaker is closed, or close without synchronising if the mains breaker is open.		●				P

Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
Remote GB OFF	The generator breaker open sequence is initiated. The generator load is deloaded to the breaker open limit followed by a breaker opening. **Single-controller applications:** The generator breaker open sequence is initiated. If the mains breaker is open, then the generator breaker opens instantly. If the mains breaker is closed, the generator load is deloaded to the breaker open limit followed by a breaker opening.		●				P
Remote MB ON	**For single-controller applications only:** The mains breaker close sequence is initiated and the breaker synchronises if the generator breaker is closed, or close without synchronising if the generator breaker is open.		●				P
Remote MB OFF	**For single-controller applications only:** The mains breaker open sequence is initiated, and the breaker opens instantly.		●				P
MB Position On	**For single-controller applications only:** The mains breaker is closed. The controller requires this feedback when the breaker is closed and for a position failure alarm.	●	●	●	●	●	C
MB Position Off	**For single-controller applications only:** The mains breaker is open. The controller requires this feedback when the breaker is opened and for a position failure alarm.	●	●	●	●	●	C
GB close inhibit	When this input is activated, the generator breaker cannot close.	●	●	●	●	●	C
MB close inhibit	**For single controller applications only:** When this input is activated, the mains breaker cannot close.	●	●	●	●	●	C
GB racked out	The breaker is considered as racked out when pre-requirements are met and this input is activated.		●		●		C
MB racked out	**For single controller applications only:** The breaker is considered as racked out when pre-requirements are met and this input is activated.		●		●		C
GB spring loaded	The controller does not send a close signal before this feedback is present.	●	●	●	●	●	C
MB spring loaded	**For single controller applications only:** The controller does not send a close signal before this feedback is present.	●	●	●	●	●	C
GB OFF and BLOCK	The generator breaker opens, and the genset activates the stop sequence. When the genset is stopped, it is blocked for start.		●				P
Enable GB black close	When the input is activated, the controller is allowed to close the generator on a black busbar, providing that the frequency and	●	●	●	●	●	C

Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
	voltage are inside the limits in parameter 2110.						
Enable sep. sync	Activate to split the breaker close and the breaker synchronisation functions in two different relays. The breaker close function remains on the relays dedicated for breaker control. The synchronisation function is moved to a configurable relay.	●	●	●	●	●	C
MANUAL mode	Changes the running mode to MANUAL.	●		●	●	●	P
Test mode	Changes the running mode to test.	●	●		x	x	P
AUTO mode	Changes the running mode to AUTO.		●	●	●	●	P
No reg mode	Changes the running mode to No reg.		●	●		●	P
Block mode	Changes the running mode to Block.	●	●	●	●		C
Total test	**For single controller applications only:** This input is logged in the event log to show that there was a planned mains failure.	●	●	●	●	●	C
Enable mode shift	**For single controller applications only:**If there is a mains failure, the input activates the mode shift function, and the controller follows the AMF sequence. When the input is configured, the setting in parameter 7081 (Mode shift) is disregarded.	●	●	●	●	●	C
Deload	A running genset starts to ramp down the power.	●					C
Mains Okay	Deactivates the Mains OK delay timer. The synchronisation of the mains breaker only happens when the input is activated.	●	●	●	●	●	C
Man. GOV up	In No reg mode, the governor output is increased.				●		C
Man. GOV down	In No reg mode, the governor output is decreased.				●		C
Man. AVR up	In No reg mode, the AVR output is increased.				●		C
Man. AVR down	In No reg mode, the AVR output is decreased.				●		C
Reset Ana GOV output	Reset analogue GOV/AVR outputs. The analogue ±20 mA controller outputs are reset to 0 mA.	●	●	●	●	●	C
Access lock	Activating the access lock input deactivates the control display buttons. It is only possible to view measurements, alarms and the log.	●	●	●	●	●	C
Remote alarm ack.	Acknowledges all activated alarms, and the alarm LED on the display stops flashing.	●	●	●	●	●	C
Shutdown override	This input deactivates all protections except the over-speed protections, the emergency stop input, the fast over-current protection, and the EIC over-speed protection. A special cool down timer is used in the stop sequence after activation of this input.	●	●	●	●		C

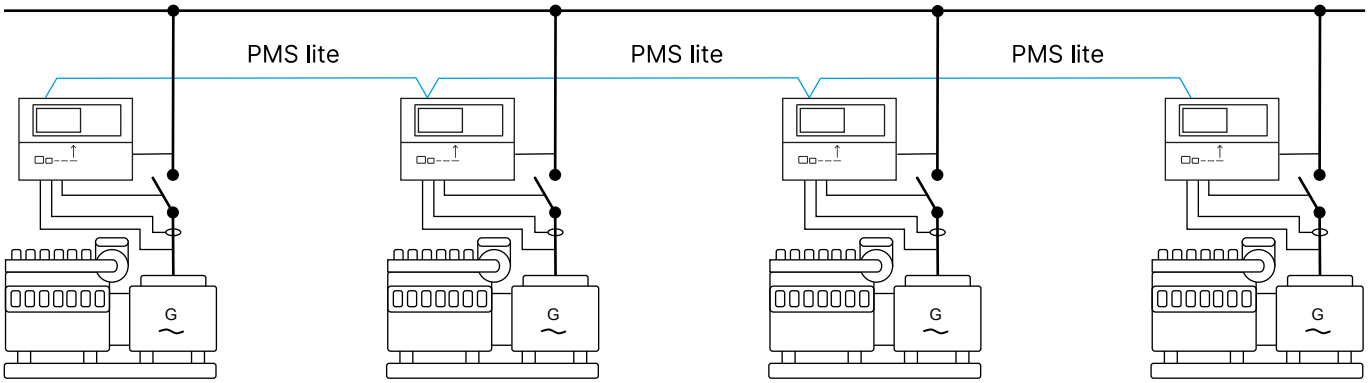
Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
	Active alarms for deactivated protections are shown in the alarm list and log, but the fail class is still inhibited.						
Battery test	Activates the starter without starting the genset. If the battery is weak, the test makes the battery voltage to drop more than acceptable, and an alarm is activated.	●	●				P
Temperature control	This input is part of the idle mode function. When the input is high, the genset starts. It starts at high or low speed, depending on the activation of the low speed input. When the input is deactivated, the genset goes to idle mode (low speed = ON), or it stops (low speed = OFF).	●	●	●			C
Allow safe regeneration	Refer to the EIC manual for more information.	●	●	●	●		C
Simulate start button push	This input is used to simulate the start button being pushed.		●	●	●		P
Simulate stop button push	This input is used to simulate the stop button being pushed.		●	●	●		P
Simulate GB close button push	This input is used to simulate the close breaker (generator) button being pushed.		●	●	●		P
Simulate GB open button push	This input is used to simulate the open breaker (generator) button being pushed.		●	●	●		P
Simulate MB close button push	This input is used to simulate the close breaker (mains) button being pushed.		●	●	●		P
Simulate MB open button push	This input is used to simulate the open breaker (mains) button being pushed.		●	●	●		P
Simulate AUTO mode button push	This input is used to simulate the AUTO mode button being pushed.		●	●	●		P
Simulate MANUAL mode button push	This input is used to simulate the MANUAL mode button being pushed.		●	●	●		P
Simulate alarm list button push	This input is used to simulate the alarms button being pushed.		●	●	●		P
No mains present + CAN B PMS lite + Apply config	This input applies a PMS configuration with no mains present and sets the CAN B (7842) set point as *PMS lite*.		●	●	●		P
Mains present + CAN B OFF + Apply config	This input applies a single-controller configuration with mains present and sets the CAN B (7842) set point as *OFF*.		●	●	●		P
Genset on DUTY (force to run)	When this input is activated, the genset becomes the duty genset and is automatically the first priority genset regardless of previous configurations. The duty genset runs at the same time as the first priority genset. The		●	●	●		C

Function	Details	AUTO mode	Manual mode	Test mode	No reg mode	Block mode	Type*
	duty genset is also part of the load-dependent start/stop calculations. For example, if the load requires 3 gensets to run and a fourth genset is activated to run as the duty genset, the priority 3 genset shuts down when the duty genset has taken the load. It is possible to have more than one duty genset in the power management system.						
Start all available gensets	This input starts all available gensets. The controller must be in AUTO mode and the gensets ready to start.	●					C
A variety of EIC digital inputs	See the **Engine communication** document.						

NOTE * C = Continuous, P = Pulse

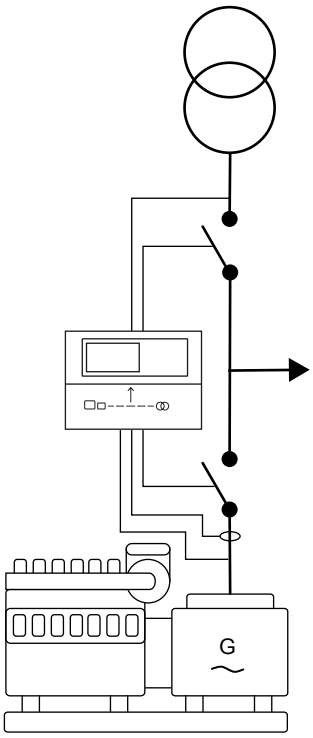
No mains present + CAN B PMS lite + Apply config function

Use this function to quickly set up a power management application. This function applies the correct CAN B* protocol and mains settings for a PMS lite configuration.



Mains present + CAN B OFF + Apply config

Use this function to quickly set up a single-controller application. This function applies the correct CAN B* protocol and mains settings for a single controller configuration.



NOTE * These functions only affect the protocol selection for CAN B (7842). If CAN A (7841) has been used for PMS lite, Canshare, or 3rd party loadshare, these functions will not work.

7.9.2 Relay output functions

Function	Activated when
Not used	The digital output is not used.
Status ok	The controller status is okay.
Horn	An alarm is activated and not silenced.
Start prepare	The start sequence activates the start prepare.
Starter (Crank)	The start sequence activates the crank.
Run coil	The start sequence activates the run coil.
Stop coil	The stop sequence activates the stop coil.
Double starter	The start sequence activates the double starter.
Siren	An alarm is activated and not silenced.
Keyswitch	The controller has had power for 5 seconds, and the extended stop timer is not running.
DEF tank output	This output controls the DEF pump. The controller activates the relay when the DEF level is below the start limit.
Generic fluid output	This output controls the fluid pump. The controller activates the relay when the fluid level is below the start limit.
Fuel tank output	This relay controls the fuel pump. The controller activates the relay when the fuel level is below the start limit.
MANUAL mode	MANUAL mode is activated.
Auto mode	AUTO mode is activated.
Test mode	Test mode is activated.
Block mode	Block mode is activated.
No Reg mode	No regulation mode is activated.

Function	Activated when
Any alarm present	The controller activates the output when there is an active alarm.
Hz/V OK expired	The controller activates the output when the Hz/V OK timer has expired.
In Sync	The controller activates the output when the generator is in sync with the busbar (that is, the voltage, frequency, and phase angle are OK).
A variety of EIC digital outputs	See the **Engine communication** document.

7.10 Demand of peak currents

It is possible to have two different readings shown in the display:

1. **I thermal demand** shows the average maximum peak current over a time interval.
2. **I max. demand** shows the latest maximum peak current value.

I thermal demand

This measurement is used to simulate a bimetallic system, which is specifically suited for indication of thermal loads in conjunction with for example cables and transformers.

The calculated average is **not** the same as the average current over time. The I thermal demand value is an average of the maximum peak current in the adjustable time interval.

The measured peak currents are sampled once every second, and every six seconds an average peak value is calculated. If the peak value is higher than the previous maximum peak value, it is used to calculate a new average. The thermal demand period will provide an exponential thermal characteristic.

The time interval in which the average maximum peak current is calculated can be adjusted or reset. If the value is reset, it will be logged in the event log and the reading on the display is reset to 0*.

Generator > Current protections > Peak and Mean values

Parameter	Text	Range	Default
6841	Timer	0.0 to 20.0 min.	8.0 min.
6842	Reset	OFF ON	OFF

I max demand

When a new maximum peak current is detected, the value is shown on the display, and updated every six seconds. If the value is reset, it will be logged in the event log.

Generator > Current protections > Peak and Mean values

Parameter	Text	Range	Default
6843	Reset	OFF ON	OFF

NOTE Both reset functions are also available as commands through M-Logic.

8. AC protections

8.1 About protections

8.1.1 Protections in general

All protection set points are a percentage of the nominal values.

For most of the protections a set point and time delay is selected. When the timer runs out, the output is activated. The operate time is the delay setting + the reaction time.

When setting up the controller, the measuring class of the controller and an adequate safety margin has to be taken into consideration, for example:

- A power generation system must not reconnect to a network when the voltage is < 85 % of U_{NOM} ±0 % or > 110 % ±0 %. To ensure reconnection within this interval, the controller's tolerance/accuracy has to be taken into consideration. If the reconnection tolerance is ±0 %, set a controller's set points 1-2 % higher/lower than the actual set point.

General parameter ranges for protections

Setting	Range
Output A	Not used 12 relays: 5, 6, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18 External I/O: Relays available in the connected CIO(s) Limits
Output B	
Enable	OFF ON
Fail class	See the controller type

Inhibits

You can only select inhibits using the utility software. Each alarm has a selection list for the inhibit conditions. Inhibit of the alarm is active as long as one of the selected inhibit functions are active.

8.1.2 Phase-neutral voltage trip

If the voltage alarms are to work based on phase-neutral measurements, the voltage detection type for the generator must be set to phase neutral.

`Generator > Voltage protections > Voltage detect. type`

Parameter	Text	Range	Default
1201	G U detection type	Phase - Phase Phase - Neutral	Phase - Phase

`Busbar > Voltage protections > Voltage detect. type`

Parameter	Text	Range	Default
1202	BB U detection type	Phase - Phase Phase - Neutral	Phase - Phase

As shown in the vector diagram below, there is a difference in voltage values at an error situation for the phase-neutral voltage and the phase-phase voltage.

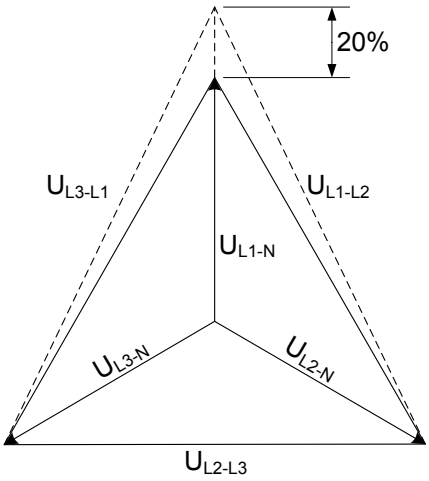
Example: Actual measurements at a 10 % under-voltage situation in a 400/230 volt system

	Phase-neutral	Phase-phase
Nominal voltage	400/230	400/230
Voltage, 10 % error	380/207	360/185

The alarm will occur at two different voltage levels, even though the alarm set point is 10 % in both cases.

The 400 V AC system below shows that the phase-neutral voltage must change 20 %, when the phase-phase voltage changes 40 volts (10 %).

Example



U_{NOM} = 400/230 V AC
Error measurements

- U_{L1L2} = 360 V AC
- U_{L3L1} = 360 V AC
- U_{L1-N} = 185 V AC
- ΔU_{PH-N} = 20 %

8.1.3 Phase sequence error and phase rotation

The controller monitors the rotation of the voltage, and activates an alarm if the voltage is rotating in the wrong direction. The controller can monitor the rotation in both directions.

Voltage terminals

- A-side voltage terminals: 62 to 65
- B-side voltage terminals: 66 to 69

The controller has two alarms for phase sequence error (with different fail classes).

`Generator > AC configuration > Phase sequence error`

Parameter	Text	Range	Default
2153	Fail class	Fail classes	Block

`Generator > AC configuration > Phase direction`

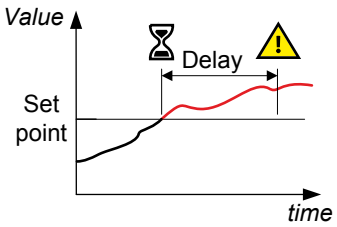
Parameter	Text	Range	Default
2154	Rotation	L1/L2/L3 L1/L3/L2	L1/L2/L3

8.2 Generator protections

8.2.1 Over-voltage (ANSI 59)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-voltage	U>, U>>	59	< 100 ms

The alarm response is based on the highest phase-to-phase voltage, or the highest phase-to-neutral voltage, from the source, as measured by the controller. The phase-to-phase voltage is the default.



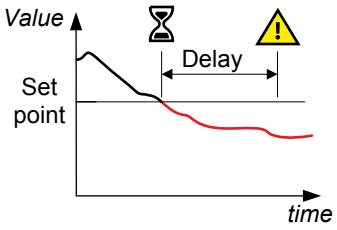
Generator > Voltage protections > Over-voltage > G U> [1 or 2]

Parameter	Text	Range	G U> 1	G U> 2
1150 or 1160	Set point	100 to 130 %	103 %	105 %
	Timer	0.1 to 100 s	10 s	5 s
	Enable	OFF ON	OFF	OFF
	Fail class	Fail classes	Warning	Warning

8.2.2 Under-voltage (ANSI 27P)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Under-voltage	U<, U<<	27P	< 100 ms

The alarm response is based on the lowest phase-to-phase voltage, or the lowest phase-to-neutral voltage, from the source, as measured by the controller. The phase-to-phase voltage is the default.



Generator > Voltage protections > Under-voltage > G U< [1 to 3]

Parameter	Text	Range	G U< 1	G U< 2	G U< 3
1170, 1180 or 1190	Set point	40 to 100 %	97 %	95 %	95 %
	Timer	0.1 to 100 s	10 s	5 s	5 s
	Enable	OFF ON	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning

NOTE Under-voltage protection is inhibited, when the controller is in idle mode.

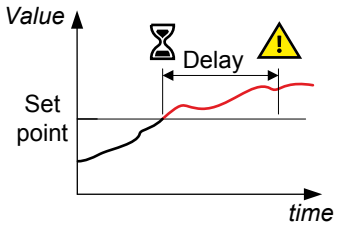
8.2.3 Voltage unbalance (ANSI 47)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Voltage unbalance (voltage asymmetry)	UUB>	47	< 200 ms*

NOTE * The operate time includes the minimum user-defined delay of 100 ms.

The alarm response is based on the highest difference between any of the three phase-to-phase voltage or phase-to-neutral true RMS values and the average voltage, as measured by the controller. The phase-to-phase voltage is the default.

If phase-to-phase voltages are used, the controller calculates the average phase-to-phase voltage. The controller then calculates the difference between each phase-to-phase voltage and the average voltage. Finally, the controller divides the maximum difference by the average voltage to get the voltage unbalance.



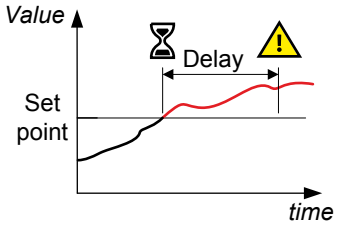
Generator > Voltage protections > Voltage unbalance > G Unbalance U

Parameter	Text	Range	Default
1510	Set point	0 to 50 %	10 %
	Timer	0.1 to 100 s	10 s
	Enable	OFF ON	OFF
	Fail class	Fail classes	Trip GB

8.2.4 Over-current (ANSI 50TD)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-current	3I>, 3I>>	50TD	< 100 ms

The alarm response is based on the highest phase current true RMS value from the source, as measured by the controller.



Generator > Current protections > Over-current > I> [1 to 4]

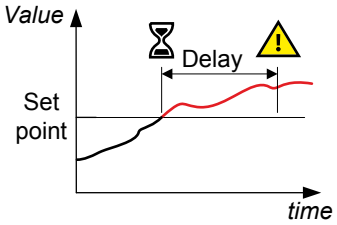
Parameter	Text	Range	I> 1	I> 2	I> 3	I> 4
1030, 1040, 1050 or 1060	Set point	50 to 200 %	115 %	120 %	115 %	120 %
	Timer	0.1 to 3200 s	10 s	5 s	10 s	5 s
	Enable	OFF ON	ON	ON	ON	ON
	Fail class	Fail classes	Warning	Trip GB	Trip GB	Trip GB

8.2.5 Fast over-current (ANSI 50P)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Fast over-current	3I>>>	50P*	< 40 ms

NOTE * ANSI 50 applies when the Delay parameter is 0 s.

The alarm response is based on the highest phase current true RMS values from the source, as measured by the controller.



Generator > Current protections > Fast over-current > I>> [1 or 2]

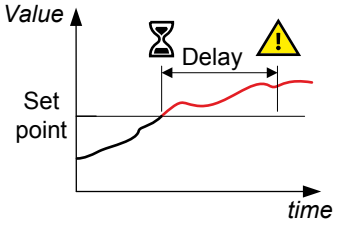
Parameter	Text	Range	I>> 1	I>> 2
1130 or 1140	Set point	150 to 300%	150%	200%
	Timer	0 to 3200 s	2 s	0.5 s
	Enable	OFF ON	OFF	OFF
	Fail class	Fail classes	Trip GB	Trip GB

8.2.6 Current unbalance (ANSI 46)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Current unbalance	IUB>	46	< 200 ms*

NOTE * The operate time includes the minimum user-defined delay of 100 ms.

The alarm response is based on the highest difference between any of the three phase current true RMS values, as measured by the controller. You can choose either the *Average* method (ANSI) or the *Nominal* method to calculate the current unbalance.



Generator > Current protections > Unbalance current > Unbalance I [1 or 2]

Parameter	Text	Range	Unbalance I 1	Unbalance I 2
1500 or 1710	Set point	0 to 100 %	30 %	40 %
	Timer	0.1 to 100 s	10 s	10 s
	Enable	OFF ON	OFF	OFF
	Fail class	Fail classes	Trip GB	Trip GB

Generator > Current protections > Unbalance current > Type

Parameter	Text	Range	Default
1203	Unbalance I	Ref. to Nominal Ref. to Average	Ref. to Nominal

NOTE The *Average method* is very sensitive at low loads.

The average method uses the ANSI standard calculation method to determine current unbalance. The controller calculates the average current for the three phases. The controller then calculates the difference between each phase current and the average current. Finally, the controller divides the maximum difference by the average current to get the current unbalance.

Average method example

The controller controls a genset with a nominal current of 100 A. The L1 current is 80 A, the L2 current is 90 A, and the L3 current is 60 A.

The average current is 76.7 A. The difference between the phase current and the average is 3.3 A for L1, 13.3 A for L2 and 16.7 A for L3.

The current unbalance is therefore 16.7 A / 76.7 A = 0.22 = 22 %.

With the nominal method the controller calculates the difference between the phase with the highest current, and the phase with the lowest current. Finally, the controller divides the difference by the nominal current to get the current unbalance.

Nominal method example

The controller controls a genset with a nominal current of 100 A. The L1 current is 80 A, the L2 current is 90 A, and the L3 current is 60 A.

The current unbalance is (90 A - 60 A) / 100 A = 0.3 = 30 %.

8.2.7 Voltage dependent over-current (ANSI 50V)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Voltage-dependent over-current	Iv>	50V	-

This is a voltage-dependent over-current alarm for generators without permanent magnets. This protection occurs when a short circuit is present and the voltage drops. The current rises briefly, before it falling to a lower level.

The short circuit current level can drop below the rated current of the generator, and thus the short circuit will not be tripped, if a standard ANSI 50/50TD is used. When the short circuit is present, the voltage will be low. This can be used for tripping at a lower current, when the voltage is low.

Generator > Current protections > Voltage dep. over-curr.

Parameter	Text	Range	Default
1101	G Iv> (50 %)	50 to 200 %	110 %
1102	G Iv> (60 %)	50 to 200 %	125 %
1103	G Iv> (70 %)	50 to 200 %	140 %
1104	G Iv> (80 %)	50 to 200 %	155 %
1105	G Iv> (90 %)	50 to 200 %	170 %

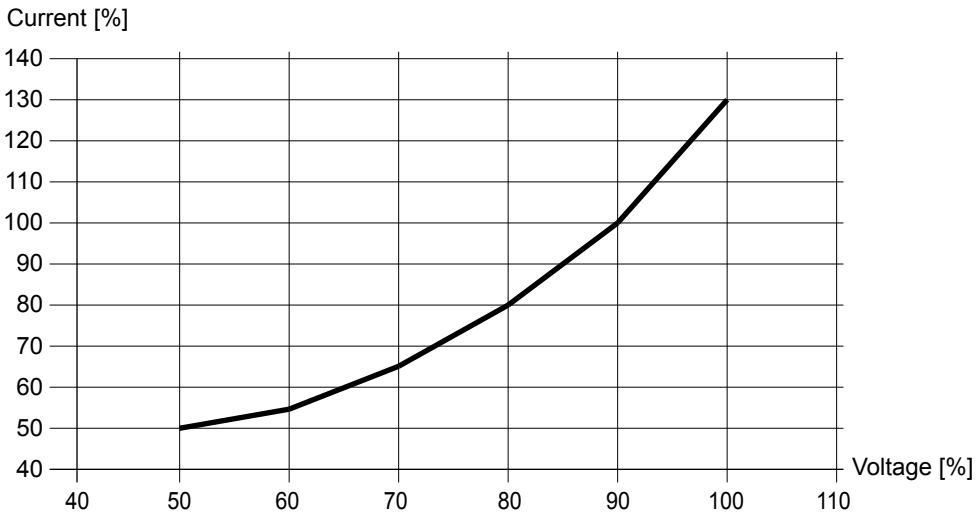
Parameter	Text	Range	Default
1106	G Iv> (100 %)	50 to 200 %	200 %
1110	Fail class	Fail classes	Trip GB

Example

There are six current and voltage level set points. The voltage levels are pre-set, so only the current levels must be set. All values are in percentage of the nominal settings. The default values are shown in the table below.

Parameter	Voltage level (not adjustable)	Current level (adjustable)
1101	50 %	50 %
1102	60 %	55 %
1103	70 %	65 %
1104	80 %	80 %
1105	90 %	100 %
1106	100 %	130 %

The set points can be shown on a curve:



When the operating values are above the curve, the breaker is tripped. The generator breaker also trips when the generator voltage is below 50 % of rated, and the current is above 50 % of rated.

8.2.8 Inverse time neutral over-current (ANSI 50N)

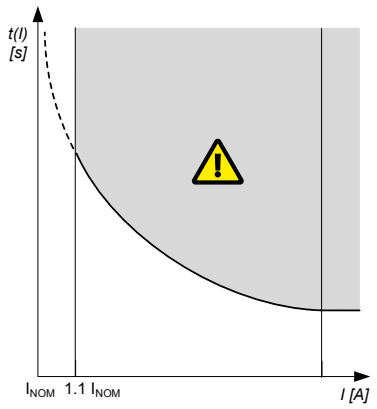
Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Inverse time neutral over-current		50N	-

This is the inverse time over-current alarm for the neutral current measurement.

The alarm response is based on the unfiltered (except for anti-aliasing) neutral current, as measured by the 4th current measurement.

The alarm response time depends on an approximated integral of the current measurement over time. The integral is only updated when the measurement is above the activation threshold.

NOTE The diagram on the right is a simplified representation of this alarm. The diagram does not show the integral over time.



Generator > Current protections > Neutral inverse time over-current (4th CT)

Parameter	Text	Range	Default
1721	In> inverse Type	IEC Inverse IEC Very Inverse IEC Extremely inverse IEEE Moderately Inv. IEEE Very Inverse IEEE Extremely Inv. Custom	IEC Inverse
1722	In> inverse Limit	2. to 120 %	30 %
1723	In> inverse TMS	0.01 to 100.00	1.00
1724	In> inverse k	0.001 to 32.000 s	0.140 s
1725	In> inverse c	0.000 to 32.000 s	0.000 s
1726	In> inverse a	0.001 to 32.000 s	0.020 s
1727	Enable	OFF ON	OFF
	Fail class	Fail classes	Trip GB

More information
See **Inverse time over-current (ANSI 51)** for the calculation method, the standard curves, and information about the definite time characteristic.

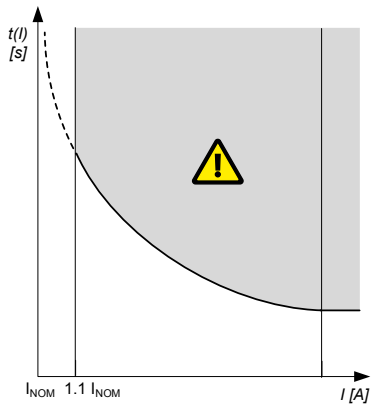
8.2.9 Inverse time earth over-current (ANSI 50G)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Inverse time earth over-current		50G	-

This is the inverse time over-current alarm for the ground current measurement.

The alarm response is based on the ground current, as measured by the 4th current measurement filtered to attenuate the third harmonic (at least 18 dB).

NOTE The diagram on the right is a simplified representation of this alarm. The diagram does not show the integral over time.



Generator > Current protections > Earth fault inverse time over-current (4th CT)

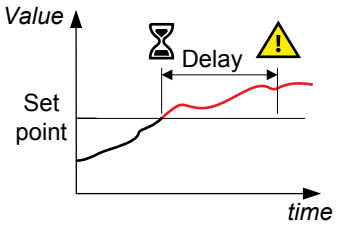
Parameter	Text	Range	Default
1731	Ie> inverse Type	IEC Inverse IEC Very Inverse IEC Extremely inverse IEEE Moderately Inv. IEEE Very Inverse IEEE Extremely Inv. Custom	-
1732	Ie> inverse Limit	2 to 120 %	10 %
1733	Ie> inverse TMS	0.01 to 100.00	1.00
1734	Ie> inverse k	0.001 to 32.000 s	0.140 s
1735	Ie> inverse c	0.000 to 32.000 s	0.000 s
1736	Ie> inverse a	0.001 to 32.000 s	0.020 s
1737	Enable	OFF ON	OFF
	Fail class	Fail classes	Trip GB

More information
See **Inverse time over-current (ANSI 51)** for the calculation method, the standard curves, and information about the definite time characteristic.

8.2.10 Over-frequency (ANSI 81O)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-frequency	f>, f>>	81O	< 100 ms

The alarm response is based on the fundamental frequency (based on phase voltage), due to the selection made in parameter 1204.



Generator > Frequency protections > Over-frequency > G f> [1 to 3]

Parameter	Text	Range	G f> 1	G f> 2	G f> 3
1210, 1220 or 1230	Set point	100 to 120 %	103 %	105 %	105 %
	Timer	0.2 to 100 s	10 s	5 s	5 s
	Enable	OFF ON	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning

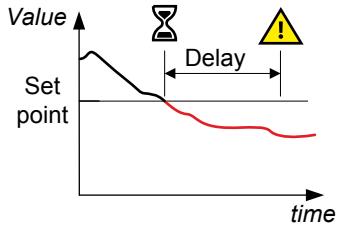
Generator > Frequency protections > Frequency detect. type

Parameter	Text	Range	Default
1204	Freq. detect type	L1 L2 L3 L1 or L2 or L3 L1 and L2 and L3	L1 or L2 or L3

8.2.11 Under-frequency (ANSI 81U)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Under-frequency	f<, f<<	81U	< 100 ms

The alarm response is based on the highest fundamental frequency (based on phase voltage), from the source. This ensures that the alarm only activates when all of the phase frequencies are below the set point.



Generator > Frequency protections > Under-frequency > G f< [1 to 3]

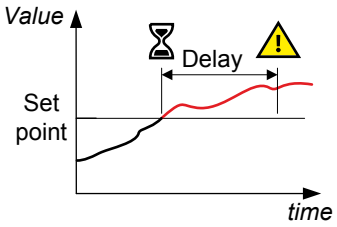
Parameter	Text	Range	G f< 1	G f< 2	G f< 3
1240, 1250 or 1260	Set point	80 to 100 %	97 %	95 %	95 %
	Timer	0.2 to 100 s	10 s	5 s	5 s
	Enable	OFF ON	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning

NOTE Under-frequency protection is inhibited, when the controller is in idle mode.

8.2.12 Overload (ANSI 32F)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Overload	P>, P>>	32F	< 100 ms

The alarm response is based on the active power (all phases), from the source, as measured by the controller.



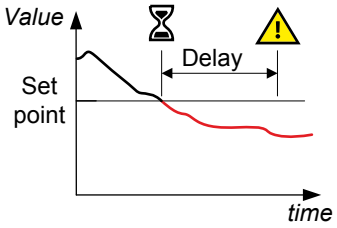
Generator > Power protections > Overload > P> [1 to 4]

Parameter	Text	Range	P> 1	P> 2	P> 3	P> 4
1450, 1460, 1470 or 1480	Set point	-200 to 200 %	100 %	110 %	100 %	110 %
	Timer	0.1 to 3200 s	10 s	5 s	10 s	5 s
	Enable	OFF ON	OFF	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Trip GB	Trip GB	Trip GB

8.2.13 Low power

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Low power	-	-	< 100 ms

The alarm response is based on the active power (all phases), from the source, as measured by the controller.



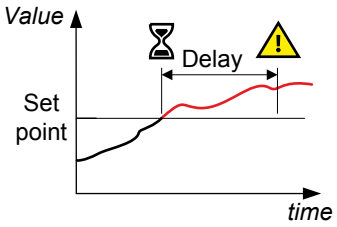
Generator > Power protections > Overload > P< 5

Parameter	Text	Range	P< 5
1490	Set point	-200 to 200 %	30 %
	Timer	0.1 to 3200 s	3200 s
	Enable	OFF ON	OFF
	Fail class	Fail classes	Trip GB

8.2.14 Reverse power (ANSI 32R)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Reverse power	P<, P<<	32R	< 100 ms

The alarm response is based on the active power (all phases), to the source, as measured by the controller.



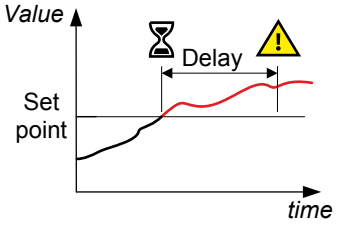
Generator > Power protections > Reverse power > -P> [1 to 3]

Parameter	Text	Range	-P> 1	-P> 2	-P > 3
1000, 1010 or 1070	Set point	-200 to 0 %	-5 %	-5 %	-5 %
	Timer	0.1 to 100 s	10 s	10 s	10 s
	Enable	OFF ON	ON	ON	OFF
	Fail class	Fail classes	Trip GB	Trip GB	Trip GB

8.2.15 Over-excitation or reactive power export (ANSI 32FV)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-excitation or reactive power export	Q>, Q>>	32FV	< 100 ms

The alarm response is based on the reactive power (Q) from the source, as measured and calculated by the controller. Reactive power export is when the generator is feeding an inductive load.



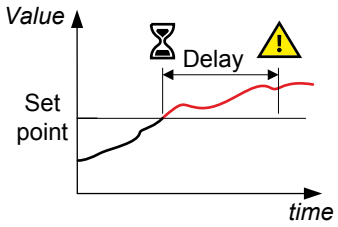
Generator > Reactive power protect. > Overexcitation > Q>

Parameter	Text	Range	Default
1530	Set point	0 to 100 %	60 %
	Timer	0.1 to 100 s	10 s
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

8.2.16 Under-excitation or reactive power import (ANSI 32RV)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Under-excitation or reactive power import	Q<, Q<<	32RV	< 100 ms

The alarm response is based on the reactive power (Q) to the source, as measured and calculated by the controller. Reactive power import is when the generator is feeding a capacitive load.



Generator > Reactive power protect. > Underexcitation > -Q>

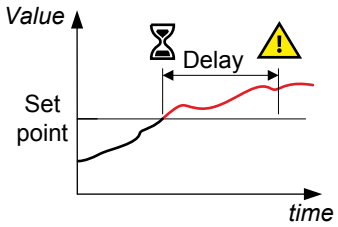
Parameter	Text	Range	Default
1520	Set point	0 to 150 %	50 %
	Timer	0.1 to 100 s	10 s
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

8.3 Busbar protections

8.3.1 Busbar over-voltage (ANSI 59P)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-voltage	U>, U>>	59P	< 50 ms

The alarm response is based on the highest phase-to-phase voltage, or the highest phase-to-neutral voltage, from the busbar, as measured by the controller.



Busbar > Voltage protections > Over-voltage > BB U> [1 to 3]

Parameter	Text	Range	BB U> 1	BB U> 2	BB U> 3
1270, 1280 or 1290	Set point	100 to 120 %	103 %	105 %	105 %
	Timer	0.04 to 99.99 s	10 s	5 s	5 s
	Enable	OFF ON	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning

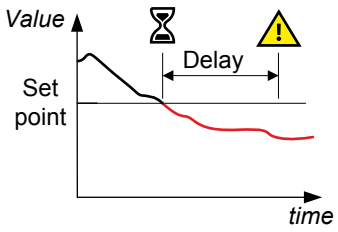
Busbar > Voltage protections > Voltage detect. type

Parameter	Text	Range	Default
1202	BB U detect. type	Phase-Phase Phase-Neutral	Phase-Phase

8.3.2 Busbar under-voltage (ANSI 27P)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Under-voltage	U<, U<<	27P	< 50 ms

The alarm response is based on the lowest phase-to-phase voltage, or the lowest phase-to-neutral voltage, from the busbar, as measured by the controller.



Busbar > Voltage protections > Under-voltage > BB U< [1 to 4]

Parameter	Text	Range	BB U< 1	BB U< 2	BB U< 3	BB U< 4
1300, 1310, 1320 or 1330	Set point	40 to 100 %	97 %	95 %	97 %	95 %
	Timer	0.04 to 99.99 s	10 s	5 s	10 s	5 s
	Enable	OFF ON	OFF	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning	Warning

Busbar > Voltage protections > Voltage detect. type

Parameter	Text	Range	Default
1202	BB U detect. type	Phase-Phase Phase-Neutral	Phase-Phase

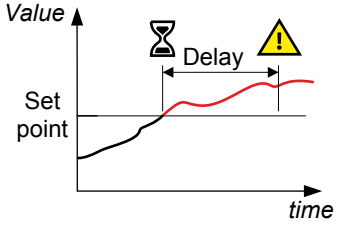
8.3.3 Busbar voltage unbalance (ANSI 47)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Voltage unbalance (voltage asymmetry)	UUB>	47	< 200 ms*

NOTE * The operate time includes the minimum user-defined delay of 100 ms.

The alarm response is based on the highest difference between any of the three busbar phase-to-phase voltage or phase-to-neutral true RMS values and the average voltage, as measured by the controller. The phase-to-phase voltage is the default.

If phase-to-phase voltages are used, the controller calculates the average phase-to-phase voltage. The controller then calculates the difference between each phase-to-phase voltage and the average voltage. Finally, the controller divides the maximum difference by the average voltage to get the voltage unbalance. See the example.



Busbar > Voltage protections > Voltage unbalance > BB Unbalance U

Parameter	Text	Range	Default
1620	Set point	0 to 50 %	6 %
	Timer	0.1 to 100 s	10 s
	Enable	OFF ON	OFF
	Fail class	Fail classes	Warning

Busbar voltage unbalance example

The busbar has a nominal voltage of 230 V. The L1-L2 voltage is 235 V, the L2-L3 voltage is 225 V, and the L3-L1 voltage is 210 V.

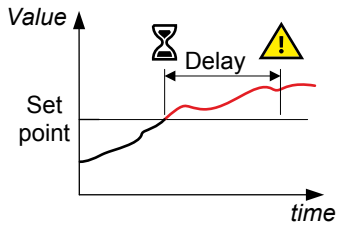
The average voltage is 223.3 V. The difference between the phase-to-phase voltage and the average is 12.7 V for L1-L2, 2.7 V for L2-L3 and 13.3 V for L3-L1.

The busbar voltage unbalance is 13.3 V / 223.3 V = 0.06 = 6 %

8.3.4 Busbar over-frequency (ANSI 81O)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-frequency	f>, f>>	81O	< 50 ms

The alarm response is based on the lowest fundamental frequency (based on phase voltage), from the busbar. This ensures that the alarm only activates when all of the phase frequencies are above the set point.



Busbar > Frequency protections > Over-frequency > BB f> [1 to 4]

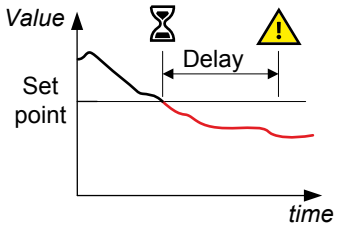
Parameter	Text	Range	BB f> 1	BB f> 2	BB f> 3	BB f> 4
1350, 1360, 1370 or 1920	Set point	100 to 120 %	103 %	105 %	105 %	102 %
	Timer	0.04 to 99.99 s	10 s	5 s	5 s	5600 s*
	Enable	OFF ON	OFF	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning	Warning

NOTE * The range for this alarm is 1500 to 6000 s.

8.3.5 Busbar under-frequency (ANSI 81U)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Under-frequency	f<, f<<	81U	< 50 ms

The alarm response is based on the highest fundamental frequency (based on phase voltage), from the busbar. This ensures that the alarm only activates when all of the phase frequencies are below the set point.



Busbar > Frequency protections > Under-frequency > BB f< [1 to 5]

Parameter	Text	Range	BB f< 1	BB f< 2	BB f< 3	BB f< 4	BB f< 5
1380, 1390, 1400, 1410 or 1930	Set point	80 to 100 %	97 %	95 %	97 %	95 %	95 %
	Timer	0.04 to 99.99 s	10 s	5 s	10 s	5 s	5600 s*
	Enable	OFF ON	OFF	OFF	OFF	OFF	OFF
	Fail class	Fail classes	Warning	Warning	Warning	Warning	Warning

NOTE * The range for this alarm is 1500 to 6000 s.

8.4 Mains protections

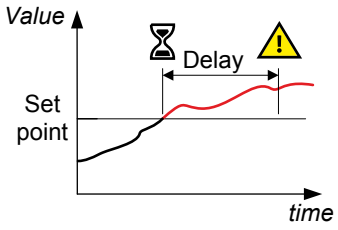
The mains protections are only relevant when the PMS lite controller is operating as a single controller in applications with a mains connection.

More information
See **Single-controller applications** for how to configure the PMS lite controller as a single controller.

8.4.1 Over-current (4th CT)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Over-current for 4th CT measurement	3I>, 3I>>	-	-

The alarm response is based on the highest phase current true RMS value from the source, as measured by the controller.



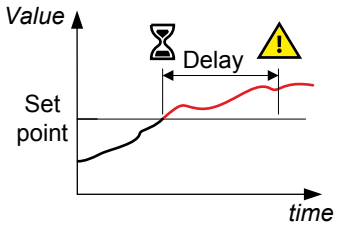
Shore > Protections > Current protections (4th CT) [1 to 2]

Parameter	Text	Range	I> 1	I> 2
7421, 7431	Set point	50 to 200 %	115 %	120 %
7422, 7432	Timer	0.1 to 3200 s	10 s	10 s
7425, 7435	Enable	OFF ON	OFF	OFF
7426, 7436	Fail class	Fail classes	Warning	Warning

8.4.2 Reverse power (4th CT)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Reverse power	P<, P<<	-	-

The alarm response is based on the active power (all phases), to the source, as measured by the controller.



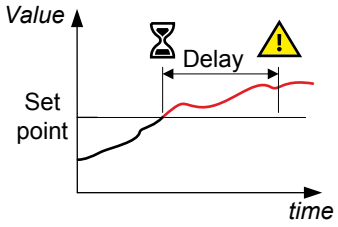
Mains > Protections > Power protections (4th CT) [1 to 2]

Parameter	Text	Range	-P> 1	-P> 2
7441, 7451	Set point	-200 to 0 %	-5 %	-5 %
7442, 7452	Timer	0.1 to 100 s	10 s	10 s
7445, 7455	Enable	OFF ON	OFF	OFF
7446, 7456	Fail class	Fail classes	Warning	Warning

8.4.3 Overload (4th CT)

Protection	IEC symbol (IEC60617)	ANSI (IEEE C37.2)	Operate time
Overload	P>, P>>	-	-

The alarm response is based on the active power (all phases), from the source, as measured by the controller.



Mains > Protections > Power protections (4th CT) [1 to 2]

Parameter	Text	Range	P> 1	P> 2
7461, 7471	Set point	-200 to 200 %	100 %	110 %
7462, 7472	Timer	0.1 to 3200 s	10 s	5 s
7465, 7475	Enable	OFF ON	OFF	OFF
7466, 7476	Fail class	Fail classes	Warning	Warning

9. Inputs and outputs

9.1 Digital inputs

9.1.1 Standard digital inputs

The controller has as standard 12 digital inputs, located on the terminals 39 to 50. All inputs are configurable.

Digital inputs

Input	Text	Function	Technical data
39	In	Auto start/stop	Negative switching only, < 100 Ω
40	In	Configurable	Negative switching only, < 100 Ω
41	In	Configurable	Negative switching only, < 100 Ω
42	In	Configurable	Negative switching only, < 100 Ω
43	In	Configurable	Negative switching only, < 100 Ω
44	In	Configurable	Negative switching only, < 100 Ω
45	In	Configurable	Negative switching only, < 100 Ω
46	In	Configurable	Negative switching only, < 100 Ω
47	In	Configurable	Negative switching only, < 100 Ω
48	In	Configurable	Negative switching only, < 100 Ω
49	GB position on	Configurable	Negative switching only, < 100 Ω
50	GB position off	Configurable	Negative switching only, < 100 Ω

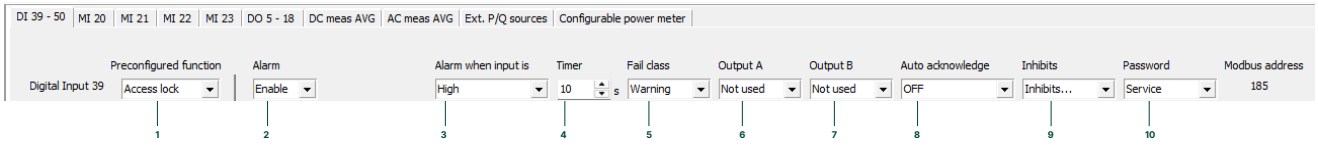
9.1.2 Configuring digital inputs

The digital inputs can be configured from the controller or with the utility software (some parameters can only be accessed with the utility software).

NOTE The configuration of digital inputs 39 to 50 has been moved from parameters 3001 to 3116 to *I/O & Hardware setup*.

Configure a digital input with the utility software

In the utility software, in *I/O & Hardware setup*, select the digital input to configure.



No.	Text	Description
1	Preconfigured function	Select a function for the digital input.
2	Alarm	Enable the alarm function.
3	Alarm when input is	The alarm is activated when the input is high or low.
4	Timer	The timer setting is the time from the alarm level is reached until the alarm occurs.
5	Fail class	Select the required fail class from the list. When the alarm occurs, the controller reacts according to the selected fail class.

No.	Text	Description
6	Output A	Select the terminal (or *Limits*) to be activated by an alarm. Limits make the alarm usable as an input event in M-Logic.
7	Output B	Select the terminal (or *Limits*) to be activated by an alarm. Limits make the alarm usable as an input event in M-Logic.
8	Auto acknowledge	ON: The alarm is automatically acknowledged when the alarm conditions are no longer met.
9	Inhibits	Select the exceptions to when the alarm must be activated.
10	Password level	Select the password level that is needed to modify this parameter.

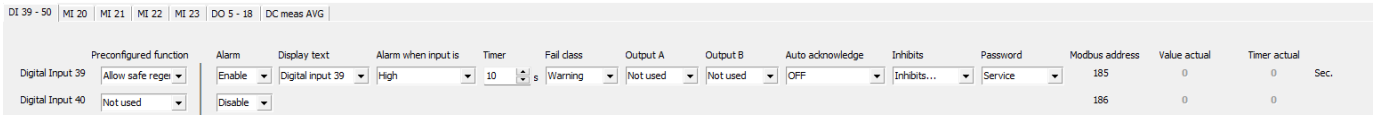
Select *Write to device* to write the settings to the controller.

9.1.3 Custom alarms

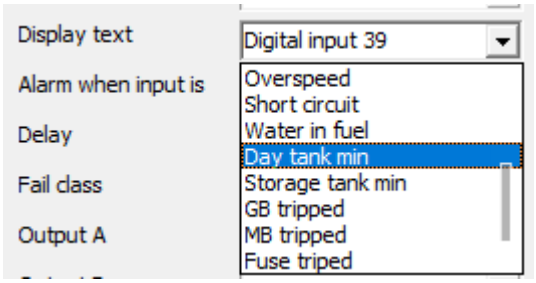
You can configure custom alarms for the digital inputs using the utility software or on the controller.

In the utility software

1. Select the *I/O & Hardware setup* tab.
2. Select one of the digital input tabs.
3. You can configure custom alarms for each active digital input. You must select *Enable* from the *Alarm* drop-down menu to see the alarm options.

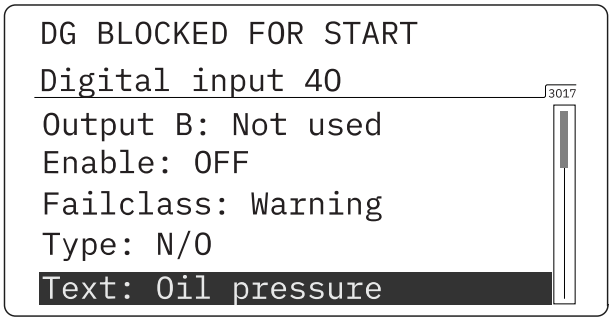


4. Pre-defined display text options are available for the custom alarms:



On the controller

Go to `Parameters > I/O settings > Inputs > Digital inputs > Digital input XX > Text`. Select from a range of pre-defined text options.



9.2 DC relay outputs

The controller has 12 x DC relay outputs as standard. The outputs are divided in two groups with different electrical characteristics.

All outputs are configurable, unless other stated.

Relay outputs, group 1

Electrical characteristics

- Voltage: 0 to 36 V DC
- Current: 15 A DC inrush, 3 A DC continuous

Relay	Genset default setting
Relay 05	Run coil
Relay 06	Starter (Crank)

Relay outputs, group 2

Electrical characteristics

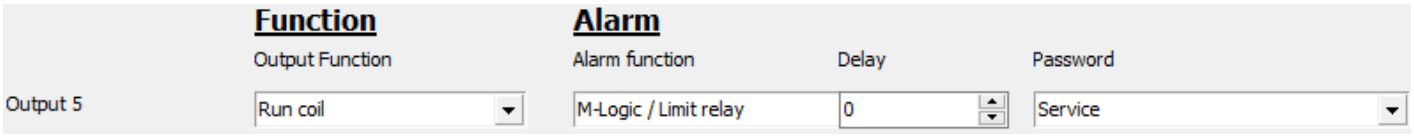
- Voltage: 4.5 to 36 V DC
- Current: 2 A DC inrush, 0.5 A DC continuous

Relay	Genset default setting
Relay 09	Start prepare
Relay 10	Stop coil
Relay 11	Status OK
Relay 12	Horn
Relay 13	No default
Relay 14	No default
Relay 15	No default
Relay 16	No default
Relay 17	GB ON relay*
Relay 18	GB OFF relay*

NOTE * Not configurable.

9.2.1 Configure a relay output

Use the utility software, under *I/O & Hardware setup, DO 5 - 18* to configure the relay outputs.



Setting	Description
Output function	Select an output function.
Alarm function	Alarm relay NE M-Logic / Limit relay

Setting	Description
	Alarm relay ND
Delay	The alarm timer.
Password	Select the password level to modify this configuration (cannot be edited by a user with lower privileges).

9.3 Analogue inputs

9.3.1 Introduction

The controller has four analogue inputs (also known as multi-inputs): Multi-input 20, multi-input 21, multi-input 22, and multi-input 23. Terminal 19 is the common ground for the multi-inputs.

The multi-inputs can be configured as:

- 4-20 mA
- 0-10 V DC
  - Custom
  - Pressure
- Pt100
- RMI oil pressure
- RMI water temperature
- RMI fuel level
- RMI Custom
- Binary (digital input)

The function of the multi-inputs can only be configured with the utility software.

Wiring

The wiring depends on the measurement type (current, voltage, or resistance).

More information
See **Wiring** in the **Installation instructions** for examples of wiring.

9.3.2 Application description

The multi-inputs can be used in different applications, for example:

- Temperature sensor. Pt100 resistors are often used to measure temperature. In the utility software, you can choose whether the temperature should be shown as Celsius or Fahrenheit.
- RMI inputs. The controller has three RMI types; oil, water and fuel. It is possible to choose different types within each RMI type. There is also a configurable type.
- An extra button. If the input is configured as digital, it works like an extra digital input.
- Max. difference between ambient and generator temperature. Differential measurement can be used to give an alarm, if two values are too far apart.

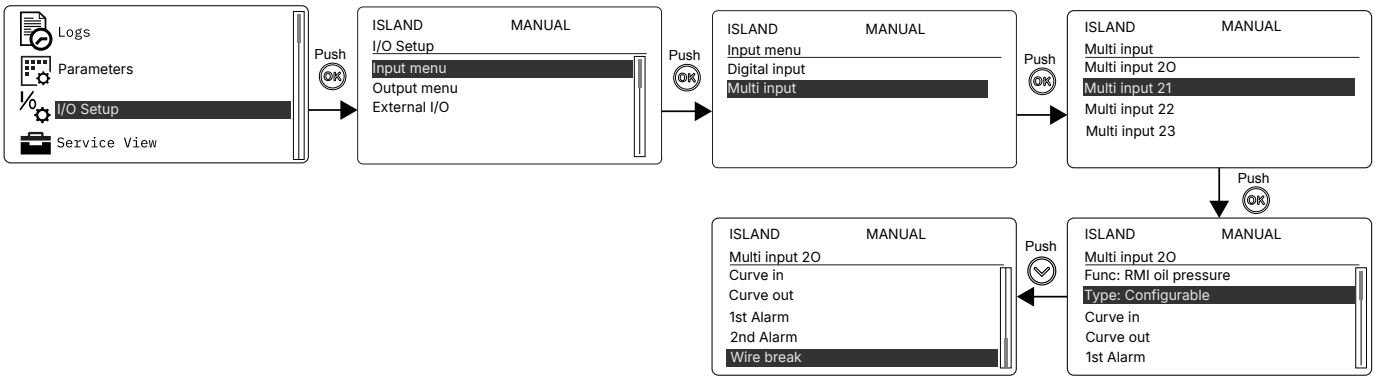
9.3.3 Configuring multi-inputs

Configure each multi-input to match the connected sensor.

On the display

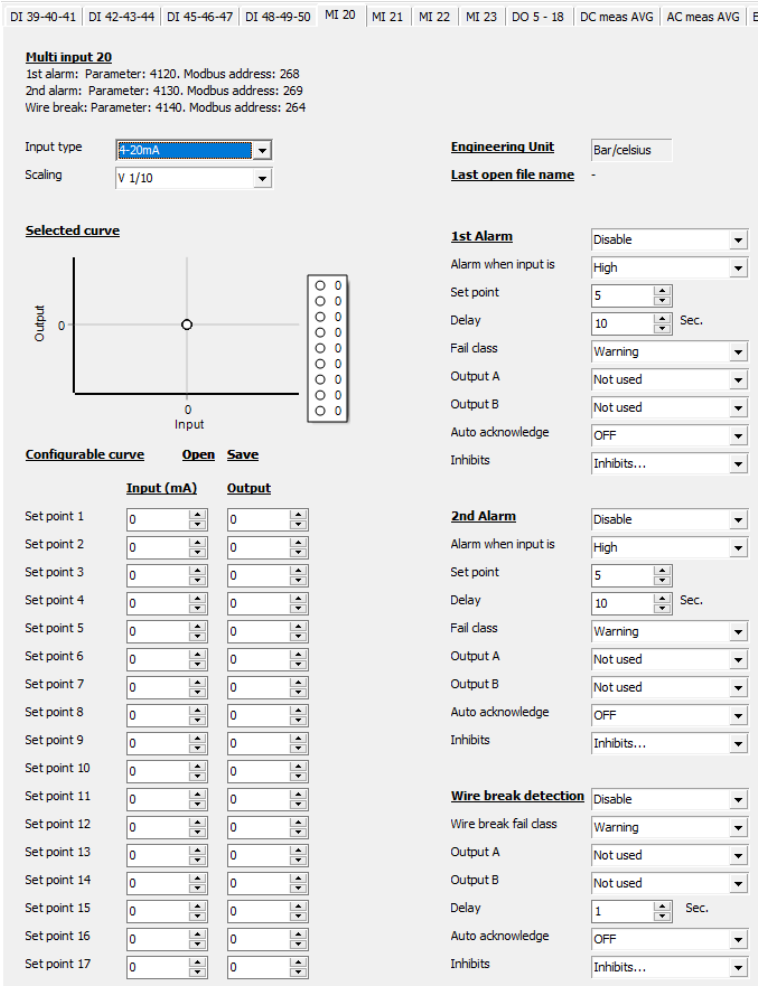
1. Go to `I/O Setup > Input menu > Multi input > Multi input #`. You can select multi input 20, 21, 22, or 23.
2. For the selected input, configure these parameters:
   - Func: select the input.

- Type: for the RMI inputs, select the type.
- Scaling: for the 4-20 mA input and the 0-10 V DC input, select the scaling.
- PTI resistance: for the PT100 input, select the resistance.
- Curve in: select the input values.
- Curve out: select the output values.
- 1st Alarm: configure the 1st alarm parameters.
- 2nd Alarm: configure the 2nd alarm parameters.
- Wire break: configure the wire break parameters.



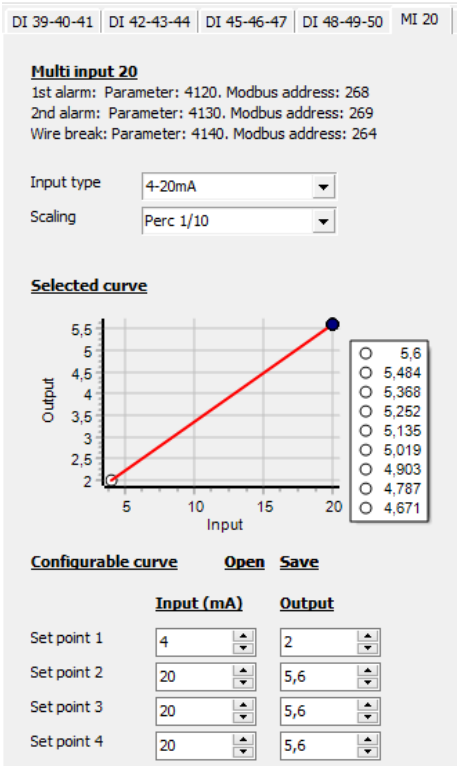
With the utility software

1. In the utility software, select *I/O & Hardware setup*, then select *MI 20 / 21 / 22 / 23*.

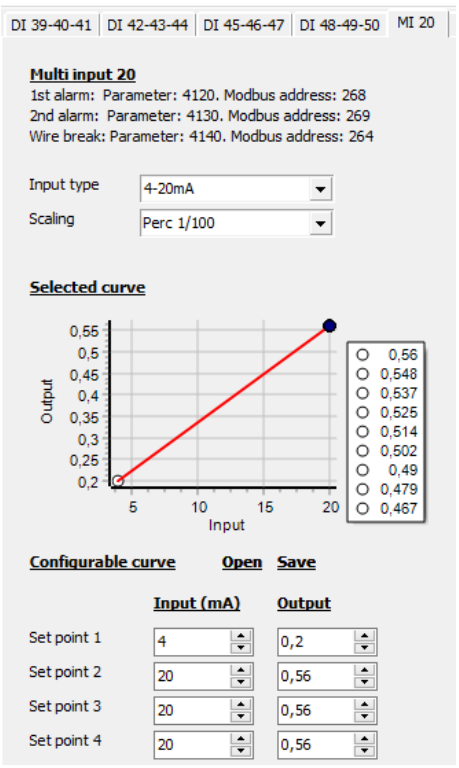


2. Select the appropriate *Scaling*.

Examples



Scaling 1/10

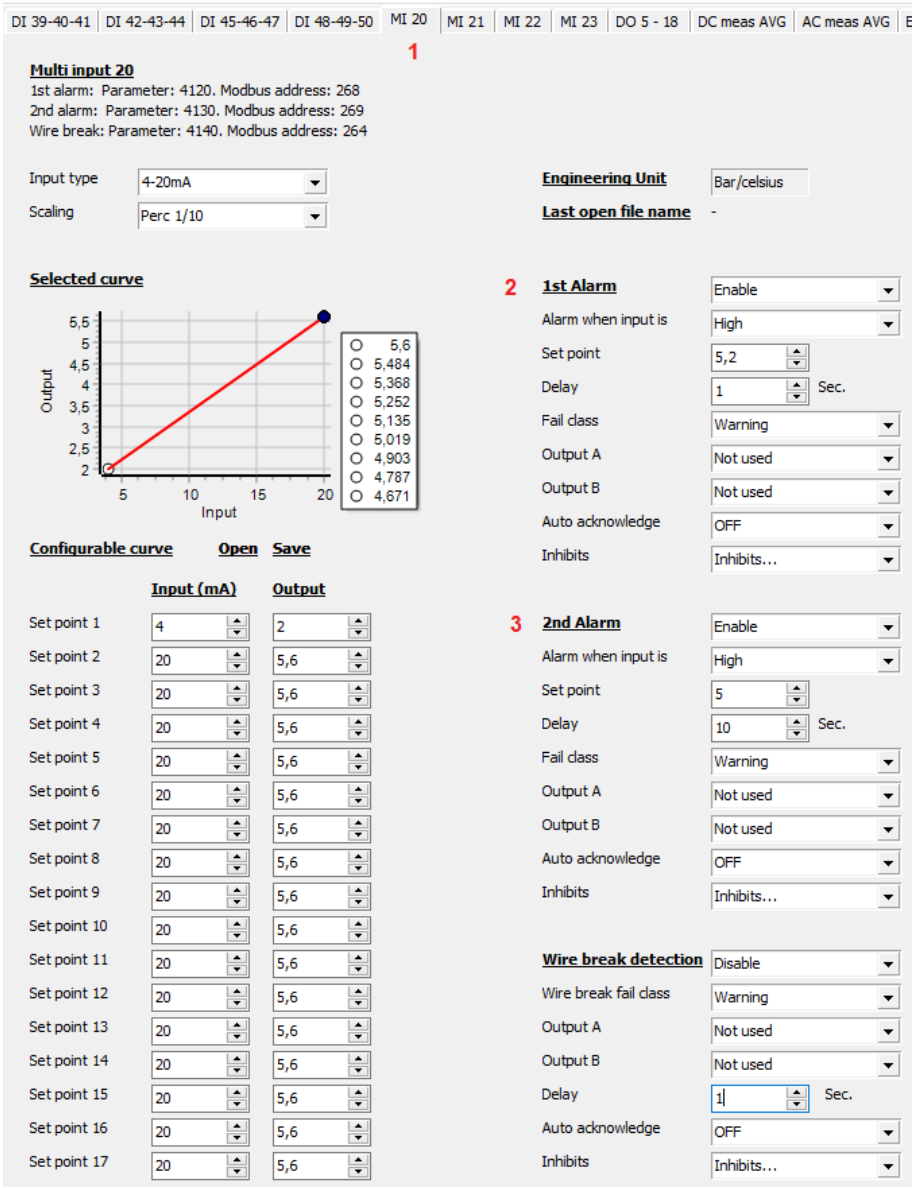


Scaling 1/100

9.3.4 Alarms

For each multi-input, two alarm levels are available. With two alarms it is possible to have the first alarm reacting slow, while the second alarm can react faster. For example, if the sensor measures generator current as protection against overload, a small overload is acceptable for a shorter period, but in case of a large overload, the alarm should activate quickly.

Use the utility software to configure the multi-input alarms. Select *I/O & Hardware setup*, then select *MI 20 / 21 / 22 /23*.



1. Select the desired multi-input tab.
2. Configure the parameters for 1st alarm.
3. Configure the parameters for 2nd alarm.

Sensors with max. output less than 20 mA

If a sensor has a maximum output less than 20 mA, it is necessary to calculate what a 20 mA signal would indicate.

Example: A pressure sensor gives 4 mA at 0 bars and 12 mA at 5 bar.

- (12 - 4) mA = 8 mA = 5 bar
- 1 mA = 5 bar/8 = 0.625 bar
- 20 - 4 mA = 16 × 0.625 bar = 10 bar

Configuring multi-input alarms from the display

Alternatively, you can use the display to configure the multi-input alarms: `I/O settings > Inputs > Multi input > Multi input [20 to 23].1 / 2`

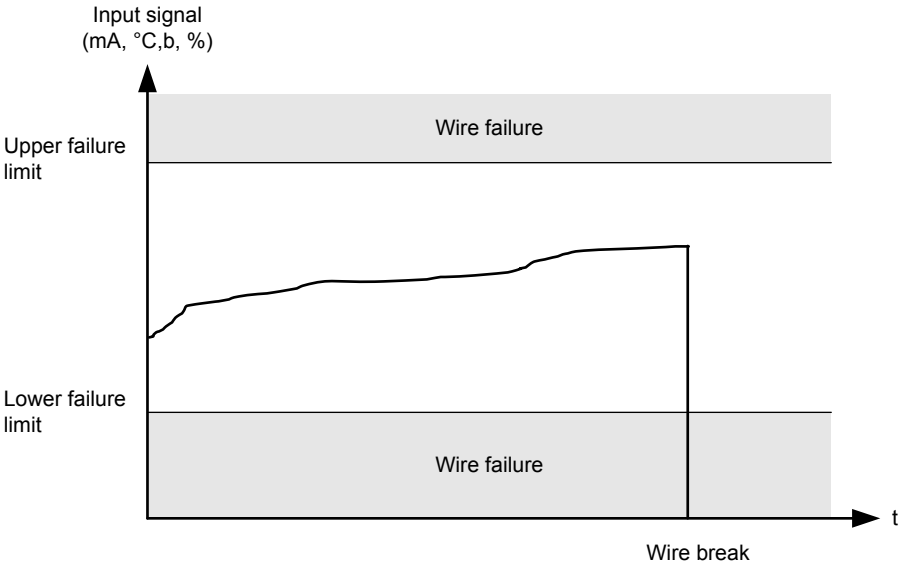
9.3.5 Wire break

To supervise the sensors/wires connected to the multi-inputs and analogue inputs, you can enable the wire break function for each input. If the measured value on the input is outside the normal dynamic area of the input, it is detected as a short circuit or a break. An alarm with a configurable fail class is activated.

Input	Wire failure area	Normal range	Wire failure area
4-20 mA	<3 mA	4-20 mA	>21 mA
0-10 V DC	≤0 V DC	-	N/A
RMI Oil, type 1	<10.0 Ω	-	>184.0 Ω
RMI Oil, type 2	<10.0 Ω	-	>184.0 Ω
RMI Oil, type 4	<33.0 Ω	-	240.0 Ω
RMI Temp, type 1	<10.0 Ω	-	>1350.0 Ω
RMI Temp, type 2	<18.2 Ω	-	>2400.0 Ω
RMI Temp, type 3	<3.6 Ω	-	>250.0 Ω
RMI Temp, type 4	<32.0 Ω	-	>2500.0 Ω
RMI Fuel, Type 1	<1.6 Ω	-	>78.8 Ω
RMI Fuel, Type 2	<3.0 Ω	-	>180.0 Ω
RMI Fuel, type 4	<33.0 Ω	-	>240.0 Ω
RMI configurable	<lowest resistance	-	>highest resistance
RMI Custom	<lowest resistance	-	>highest resistance
Pt100	<82.3 Ω	-	>194.1 Ω
Level switch	Only active if the switch is open		

Principle

The diagram shows that when the wire of the input breaks, the measured value drops to zero, and the alarm is activated.



Configuring wire break alarms from the utility software or display

You can use the utility software to configure wire break alarms. Alternatively, you can use the display to configure wire break alarms: `I/O settings > Inputs > Multi input > Wire fail [20 to 23]`

9.3.6 RMI sensor types

The multi-inputs can be configured as RMI inputs.

The available RMI input types are:

- RMI oil pressure

- RMI water temperature
- RMI fuel level
- RMI Custom

For each RMI input type, you can select different curves, including a configurable curve. The configurable curve has up to 20 set points. The resistance and the pressure can be adjusted.

NOTE The sensor range is 0 to 2500 Ω.

NOTE If the RMI input is used as a level switch, then no voltage must be connected to the input. If any voltage is applied to the RMI inputs, it will be damaged.

9.3.7 Differential measurement

Differential measurement compares two measurements, and gives an alarm or trip if the difference between two measurements become too large (or too small). To have the alarm activate if the difference between the two inputs is lower than the alarm's set point, remove the check mark from *High Alarm* in the alarm configuration.

It is possible to have up to six comparisons. Two alarms can be configured for each comparison.

Using differential measurement to create an extra analogue alarm

If the same measurement is selected for input A and input B, the controller uses the value of the input for the differential measurement alarm.

`Functions > Delta alarms > Set [1 to 6]`

Parameter	Text	Range	Default
4601, 4603, 4605, 4671, 4673 or 4675	Input A for comparison set [1 to 6]	See the controller	Multi-input 20
4602, 4604, 4606, 4672, 4674 or 4676	Input B for comparison set [1 to 6]		

`Functions > Delta alarms > Set [1 to 6] > Delta ana[1 to 6] [1 or 2]`

Parameter	Text	Range	Default
4611, 4631, 4651, 4681, 4701 or 4721	Set point 1	-999.9 to 999.9	1.0
4621, 4641, 4661, 4691, 4711 or 4731	Set point 2	-999.9 to 999.9	1.0
4612, 4632, 4652, 4682, 4702 or 4722	Timer 1	0.0 to 999.0 s	5.0 s
4622, 4642, 4662, 4692, 4712 or 4732	Timer 2	0.0 to 999.0 s	5.0 s
4613, 4633, 4653, 4683, 4703 or 4723	Output A set 1	Relays and M-Logic	-
4623, 4643, 4663, 4693, 4713 or 4733	Output A set 2		
4614, 4634, 4654, 4684, 4704 or 4724	Output B set 1		
4624, 4644, 4664, 4694, 4714 or 4734	Output B set 2		
4615, 4635, 4655, 4685, 4705 or 4725	Enable set 1	OFF ON	OFF
4625, 4645, 4665, 4695, 4715 or 4735	Enable set 2		
4616, 4636, 4656, 4686, 4706 or 4726	Fail class set 1	Fail classes	Warning
4626, 4646, 4666, 4696, 4716 or 4736	Fail class set 2		

9.4 Analogue outputs

The controller has two analogue outputs that are active and galvanically separated. No external supply can be connected.

Function	ANSI no.
Selectable ±10 V DC or relay output for speed control (governor)	77
Selectable ±10 V DC or relay output for voltage control (AVR)	77
PWM speed control output for CAT® engines	77

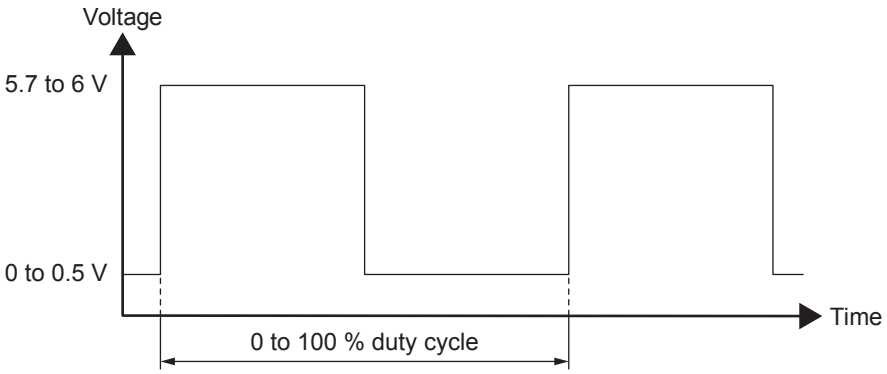
Duty cycle

The PWM signal has a frequency of 500 Hz ±50 Hz. The resolution of the duty cycle is 10,000 steps. The output is an open collector output with a 1 kΩ pull-up resistor. Frequency and amplitude are configurable.

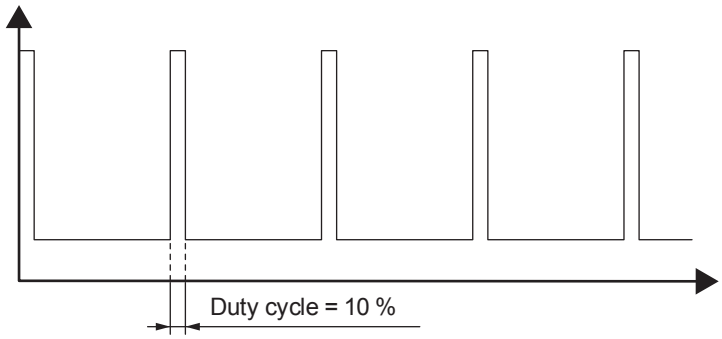
`Engine > Speed control > Analogue configuration > PWM 52 setup`

Parameter	Text	Range	Default
5721	Limits minimum	0 to 50 %	10 %
5722	Limits maximum	50 to 100 %	90 %
5723	GOV type	Adjustable Caterpillar: 6 V/500 Hz	Adjustable
5724	Amplitude set point	1.0 to 10.5 V	5.0 V
5725	Frequency set point	1 to 2500 Hz	500 Hz

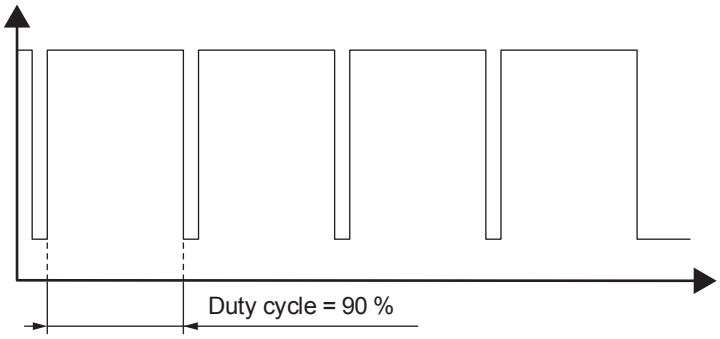
Duty cycle (min. level 0 to 0.05 V, max. level 5.7 to 6.0 V)



Example: 10 % duty cycle



Example: 90 % duty cycle



9.4.1 Using an analogue output as a transducer

If transducers 52 and/or 55 are not selected for regulation, you can configure them to transmit values to an external system. The values include the controller's set points, and AC measurements. The transducer output range is -10 to 10 V.

You can select a scale for some of the values. For example, for the busbar voltage (parameter 5913), select the minimum in 5915, and select the maximum in 5914.

NOTE These values are also available using Modbus.

Parameters for using an analogue output as a transducer

Parameter	Value	Details
5693	P ref	The controller's power set point.
5713	cos phi ref	The controller's cos phi set point
5823, 5824, 5825	P1	Genset active power
5853, 5854, 5855	S	Genset apparent power
5863, 5864, 5865	Q	Genset reactive power
5873, 5874, 5875	PF	Power factor of the power from the genset
5883, 5884, 5885	f	Genset frequency
5893, 5894, 5895	U	Genset L1-L2 voltage
5903, 5904, 5905	I	Genset L1 current
5913, 5914, 5915	U BB	Busbar L1-L2 voltage
5923, 5924, 5925	f BB	Busbar frequency

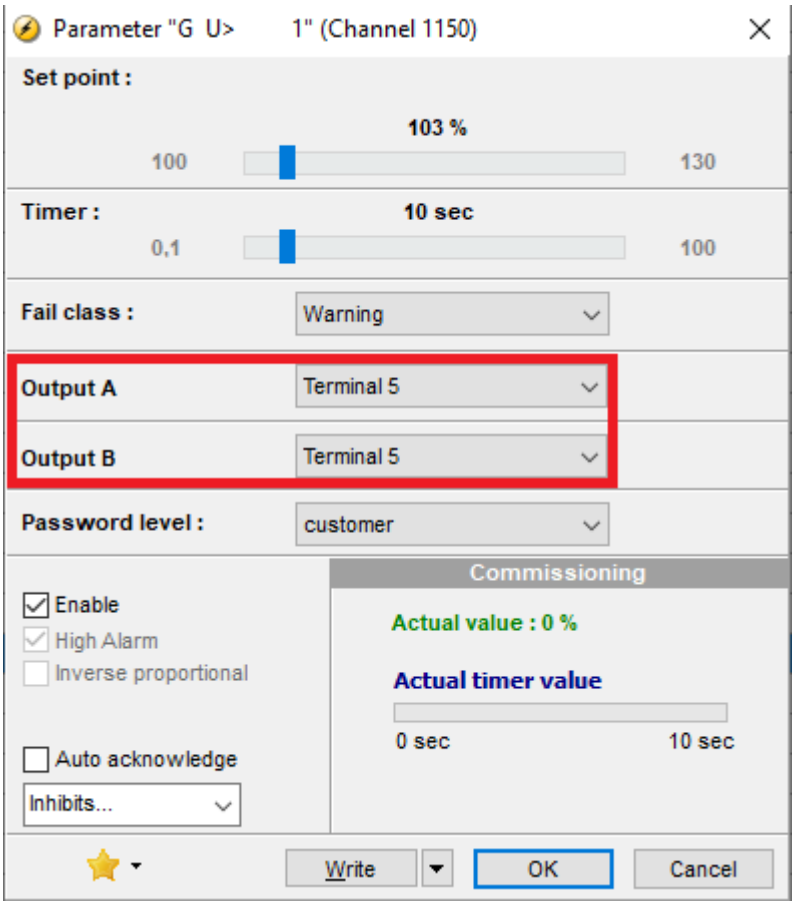
9.5 Limit relay

For all alarm functions, you can activate one or two output relays as shown below. The following explains how to use an alarm function to activate an output without activating an alarm. ON and OFF delay timers are described too.

If no alarm is needed, it is possible to do one of the following things:

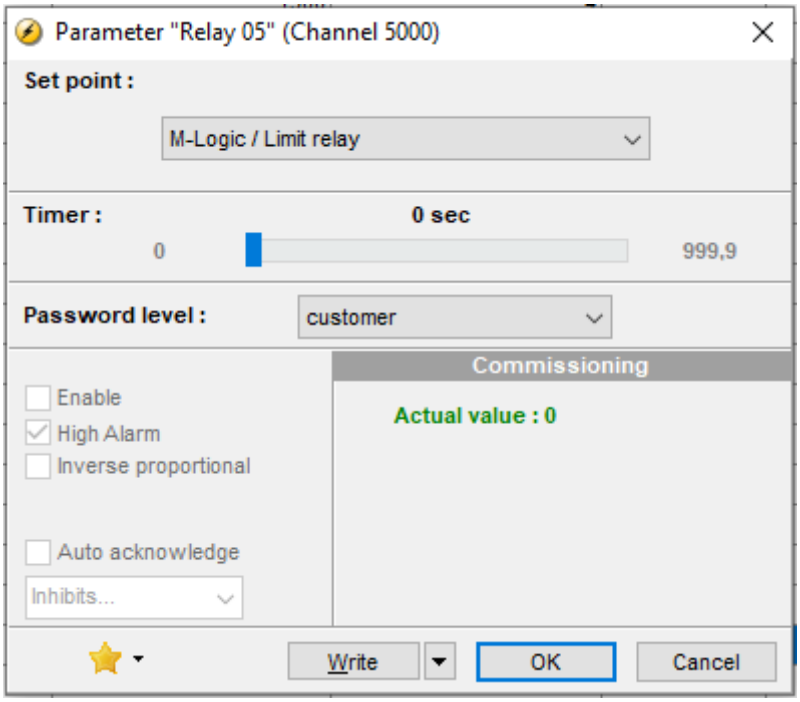
- Set both output A and output B to **Limits**.
- Set both output A and output B to the same terminal. If terminal alarm is not required, the alarm function in the specified relay is set to *M-Logic / Limit relay*.

In the example below, the relay closes when the generator voltage is above 103 % for 10 seconds, and no alarm is activated because both output A and output B are configured to relay 5, which is configured as *M-Logic / Limit relay*.

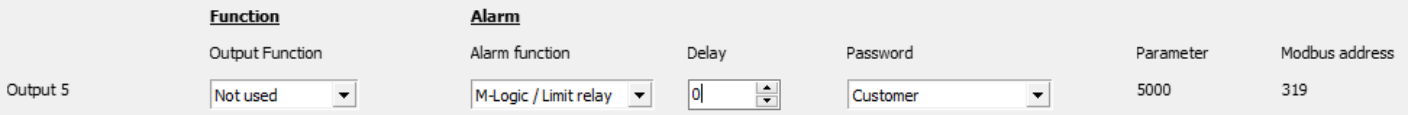


The timer configured in the alarm window is an ON delay that determines the time during which the alarm conditions must be met before activation of any alarms or outputs.

When a relay is selected (relay on terminal 5 in this example), it must be set up as a limit relay as shown below, otherwise an alarm indication will still appear.



Alternatively, you can configure the relay in the USW under *I/O Setup*:



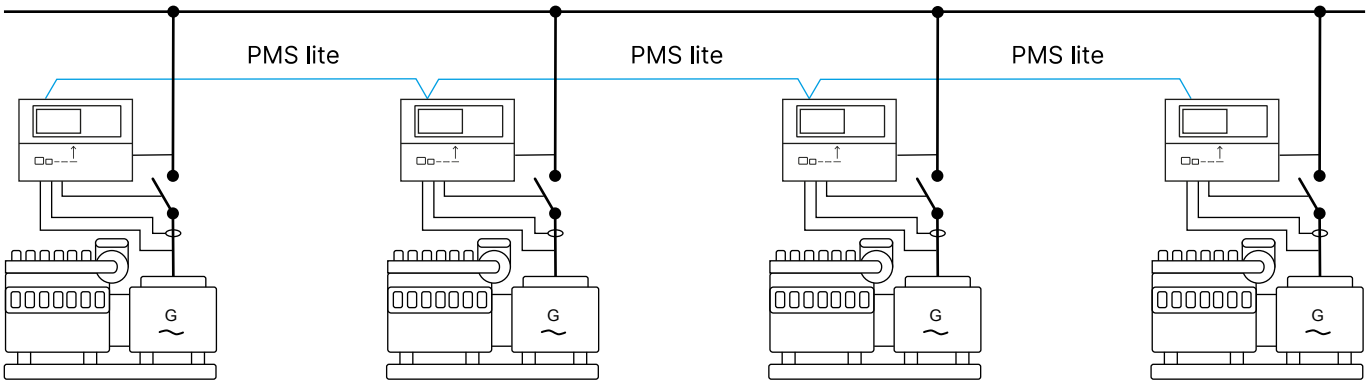
The timer in the image above is an OFF delay, meaning that when the alarm level is OK again, the relay will remain activated until the timer runs out. The timer is only effective when it is configured as *M-Logic / Limit relay*. If it is configured to any *Alarm relay*, the relay is deactivated when the alarm conditions disappear and the alarm is acknowledged.

10. PMS lite application example

10.1 Introduction

A simple example of how to set up a PMS lite controller is shown in this chapter. The controller is part of a simple power management system with three other PMS lite controllers, which means there are four generators in total in the system. The load-dependent start and stop function is used to start and stop the gensets depending on the load requirements of the system.

10.2 Application setup

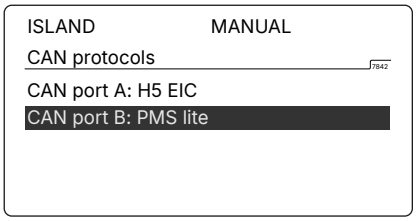


System information

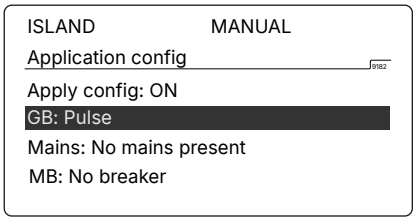
- Three-phase system, 50 Hz, 400 V phase-phase
- 4 gensets: 1500 kW with PMS lite controllers
- Application: Rental application, where the controllers must be quick and easy to set up.
  - The load-dependent start and stop function makes sure that sufficient power is always available on the busbar. Gensets are automatically started and stopped so that only the required number of gensets run.

Create the application on the display

1. Go to `Parameters > Communication > CAN Protocols`. In parameter 7842, select PMS lite.



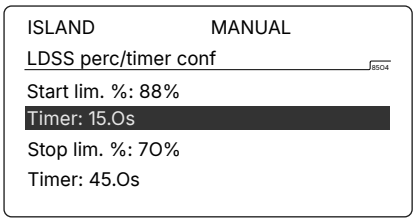
2. Go to `Parameters > PMS lite` and configure these parameters:
   - GB (9182): **Pulse**
   - Mains present (9183): **No mains present**
   - MB (9184): **No MB**
   - Apply config (9181): **ON**



3. Complete steps 1 and 2 for the other three PMS lite controllers in the system.

Configure the load-dependent start and stop (LDSS) settings on the display

1. Go to `Parameters > PMS lite > Load dep Strt/Stp config > LDSS perc/timer config` and configure these parameters:
   - Ld. Start (8501): **88%, 15 s**
   - Ld. Stop (8503): **70%, 45 s**



   - The load-dependent settings are not shared between the PMS lite controllers. You therefore need to configure these LDSS settings on the other three PMS lite controllers.

NOTE It is possible for the controllers to have different LDSS settings as the settings are not shared between the controllers.

Controller IDs

When the controllers connect to the CAN bus line, the PMS lite controller automatically assigns the controller an ID, starting from ID1. The controller IDs are used for the priority list for load-dependent start and stop.

NOTE It is also possible to configure a priority for the controller. The priority list would then start with the configured priority, and use the automatically assigned IDs where there are no priorities. You can also manually assigned IDs to the controllers. See the **Power management system** chapter for more information.

10.3 Inputs and outputs

The *Auto start/stop* is a default setting and should already be configured. Go to `I/O Setup > Input menu > Digital input > Digital input 39` to see the *auto start/stop* settings.

10.4 Wiring

The minimum required wiring is listed in the following table.

More information
See the **Installation instructions** for complete wiring information.

Terminal(s)	Function	Details
1-2	Power supply	6.5 to 35 V DC power for the controller
1-4	Emergency stop	Digital input
4-7	Engine start	Digital inputs
8-17	Close GB breaker	Maximum 500 mA relay
8-18	Open GB breaker	Maximum 500 mA relay
19-23	Engine GND	Input 19 must be grounded to Engine GND
24-26	Tacho	
27-29	CAN A ECU	Not isolated
30-32	CAN B PMS lite	Isolated
33	Genset comm DATA + (A)	RS-485

Terminal(s)	Function	Details
35	Genset comm DATA - (B)	RS-485
49	GB breaker closed	Negative switching only, < 100 Ω
50	GB breaker open	Negative switching only, < 100 Ω
56	S1 L1 AC current	Use an x/1 A or x/5 A current transformer
59	S2 L1 AC current	Use an x/1 A or x/5 A current transformer
57	S1 L2 AC current	Use an x/1 A or x/5 A current transformer
59	S1 L2 AC current	Use an x/1 A or x/5 A current transformer
58	S1 L3 AC current	Use an x/1 A or x/5 A current transformer
59	S1 L3 AC current	Use an x/1 A or x/5 A current transformer
63	L1 Genset voltage	Maximum 690 V AC phase-phase
64	L2 Genset voltage	Maximum 690 V AC phase-phase
65	L3 Genset voltage	Maximum 690 V AC phase-phase
67	L1 Busbar voltage	Maximum 690 V AC phase-phase
68	L2 Busbar voltage	Maximum 690 V AC phase-phase
69	L3 Busbar voltage	Maximum 690 V AC phase-phase

10.5 Parameters

For this example, set the following parameters. You can do this on the display or with the utility software.

NOTE Not all parameters are shown in the list below. Parameters with factory defaults that are suitable for this example are not included. Irrelevant parameters are not included either.

Parameter	Name	Description
6001	Nom. f 1	Select *50 Hz*.
6002	Nom. P 1	Use the genset information to configure the nominal power set point.
6003	Nom. I 1	Use the genset information to configure the nominal current set point.
6004	Nom. U 1	Use the genset information to configure the nominal voltage set point.
6005	Nom. Q 1	Use the genset information to configure the nominal reactive power set point.
6006	Nom. S 1	Use the genset information to configure the nominal apparent power set point.
6041	Genset primary U	The genset primary voltage. If necessary, adjust this set point.
6042	Genset secondary U	The genset secondary voltage. If necessary, adjust this set point.
6043	Genset Primary I	The genset primary current. If necessary, adjust this set point.
6044	Genset secondary I	The genset secondary current. If necessary, adjust this set point.
6051	BB primary U 1	The busbar primary voltage. If necessary, adjust this set point.
6052	BB second. U 1	The busbar secondary voltage. If necessary, adjust this set point.
6053	BB nominal U 1	The busbar nominal voltage. If necessary, adjust this set point.
6071	Operation mode	Select *Island operation*
8513	PMS lite fail mode	Select *MANUAL*
8514	Share parameters	Select *Off*
8515	PMS lite baudrate	Select *125kbps*

Parameter	Name	Description
8540	Available power	Select *1500 kW* as the set point. Select *Warning* as the fail class.
8550	Minimum number to run	Select *1* as the set point. Select *5 s* as the timer. Select *Warning* as the fail class.
8560	PMS lite min. units	Select *1* as the set point. Select *0 s* as the timer. Select *Warning* as the fail class.
8570	PMS lite miss/add	Select *0 s* as the timer and *Warning* as the fail class.
8590	Duplicate IDs	Select *Warning* as the fail class.

10.6 Commissioning

DANGER!

Incorrect wiring and configuration are dangerous

Before using the system, check that the wiring and parameters are correct for the application.

Before starting operation, check that all the wiring is correct.

Check that the parameters are correct for the application.

10.7 Operation

Push the AUTO button on the controller. When the controller is in AUTO mode, the LED next to the AUTO button is green. Use digital input 39, *auto start/stop*, to activate a start signal for the gensets. When the controllers connect to the CAN line, the PMS Lite IDs are automatically assigned to each controller (starting from ID 1).

The controller automatically operates the genset according to the configured parameters. The power management system makes sure that the generators are started and stopped according to the configured load and the automatically assigned IDs. The controllers also make sure that the load is shared equally.

On the controller, go to `Service View > PMS Overview` to see an overview of the plant operation information.

Use the *left arrow* and *right arrow* buttons on the controller to change between Power (kW) and Reactive power (kvar).