-power in control

CE

DESIGNER´S REFERENCE HANDBOOK



Advanced Genset Controller, AGC 100

- Functional description
- Additional functions
- Power management (non sync)

DEIF A/S · Frisenborgvej 33 · DK-7800 Skive
Tel.: +45 9614 9614 · Fax: +45 9614 9615
info@deif.com · www.deif.com

Document no.: 4189340766G
SW version: 4.02.0 or later

1. General information

2. General product information

3. Functional descriptions

1. General information

1.1 Warnings, legal information and safety

1.1.1 Warnings and notes

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

Warnings

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

Notes

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

1.1.2 Legal information and disclaimer

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

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

Disclaimer

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

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

1.1.3 Safety issues

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

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

1.1.4 Electrostatic discharge awareness

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

1.1.5 Factory settings

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

1.2 About the Designer's Reference Handbook

1.2.1 General purpose

This Designer's Reference Handbook mainly includes functional descriptions, presentation of display unit and menu structure, the procedure for parameter setup and reference to parameter lists.

The general purpose of this document is to provide useful overall information about the functionality of the unit and its applications. This document also offers the user the information needed in order to successfully set up the parameters needed in his specific application.

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

1.2.2 Intended users

This Designer's Reference Handbook is mainly intended for the panel builder designer in charge. On the basis of this document, the panel builder designer will give the electrician the information he needs in order to install the Multi-line 2 unit, for example detailed electrical drawings. In some cases, the electrician may use these installation instructions himself.

1.2.3 Contents and overall structure

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

2. General product information

2.1 Introduction

2.1.1 Introduction

This chapter will deal with the unit in general and its place in the DEIF product range.

The AGC is part of the DEIF Multi-line 2 product family. Multi-line 2 is a complete range of multi-function generator protection and control products integrating all the functions you need into one compact and attractive solution.

The concept of the AGC is to offer a cost-effective solution to genset builders, who need a flexible generator protection and control unit for small single to medium and large genset applications. Being part of the Multi-line product family, the standard functions can be supplemented with a variety of optional functions.

2.2 Type of product

The Advanced Genset Controller is a micro-processor based control unit containing all necessary functions for protection and control of a genset.

It contains all necessary 3-phase measuring circuits, and all values and alarms are presented on the LCD display.

2.3 Options and variants

2.3.1 Options and variants

The AGC 100 family consists of different variants to cover applications in a cost-efficient way. Options cover, for example, protections for generator, busbar and mains, power management (non sync.), serial communication, external input or output, additional operator display, emulation, and so on.

A complete list of available variants and options is included in the data sheet. See www.deif.com

2.4 Setup of the controller

2.4.1 Setup of the controller

The parameter settings and M-Logic programming can easily be done via a PC Windows®-based utility software (USW). The USW is password-protected - for further information, read the help file in the USW editor.

To interface the AGC 100 from the PC, there are two possibilities. One is option J5, which is RS-232 with an interface box between the PC and the AGC 100. The other option is J9, which is USB to TTL interface between the PC and the AGC 100. Both cable options J5 and J9 are galvanically isolated and will protect your PC if it is connected during genset operation.

The PC utility software offers additional features such as monitoring of all relevant information during commissioning, saving and downloading of settings and downloading of software updates.

2.5 PC utility software warning

2.5.1 PC utility software warning

It is possible to remote-control the genset from the PC utility software or by use of a modem. To avoid personal injury, make sure that it is safe to remote-control the genset.

2.6 UL applications

2.6.1 UL applications

These flat surface panel-mounted controllers are intended to be used in Listed Generator Assemblies, where the suitability of the combination has been determined by Underwriters Laboratories.
These devices have been evaluated for fire and shock only. They have no voltage-regulating function.

3. Functional descriptions

3.1 Standard functions

3.1.1 Standard functions

This chapter includes functional descriptions of standard functions as well as illustrations of the relevant application types. Flowcharts and single-line diagrams will be used in order to simplify the information.

The standard functions are listed in the following paragraphs.

3.1.2 Operation modes

- Automatic Mains Failure
- Island operation
- Load takeover

3.1.3 Engine control

- Start/stop sequences
- Run and stop coil

3.1.4 Generator protection (ANSI)

- 2 x reverse power (32)
- 5 x overload (32)
- 6 x over-current (50/51)
- 2 x over-voltage (59)
- 3 x under-voltage (27)
- 3 x over-/under-frequency (81)
- Current/voltage unbalance (60)
- Multi-inputs (binary, 4 to 20 mA, RMI or Pt1000)
- Digital inputs

3.1.5 Busbar protection (ANSI)

- 3 x over-voltage (59)
- 4 x under-voltage (27)
- 3 x over-frequency (81)
- 4 x under-frequency (81)
- Voltage unbalance (60)

3.1.6 Display

- Push-buttons for start and stop
- Push-buttons for breaker operations
- Status texts

3.1.7 M-Logic

- Simple logic configuration tool
- Selectable input events
- Selectable output commands

3.2 Terminal strip overview

3.2.1 Reference to Installation Instructions

Information about terminal strip overview and rear side controller view can be found in the "Installation Instructions", which is located on DEIF's homepage under documentation for AGC 100.

3.3 Measurement systems

The AGC is designed for measurement of voltages between 100 and 690 V AC on the terminals. If the voltage is higher, voltage transformers are required. For further reference, the AC wiring diagrams are shown in the Installation Instructions.

In menu 9130, the measurement principle can be changed; the options are three-phase, single phase and split phase.

Configure the AGC to match the correct measuring system. When in doubt, contact the switchboard manufacturer for information about the required adjustment.

3.3.1 Three-phase system

When the AGC is delivered from the factory, the three-phase system is selected. When this principle is used, all three phases must be connected to the AGC.

The table below contains the parameters to make the system ready for split phase measuring.
The example below is with 230/400 V AC, which can be connected directly to the AGC's terminals without the use of a voltage transformer. If a voltage transformer is necessary, the nominal values of the transformer should be used instead.

Setting	Adjustment	Description	Adjust to value
6004	G nom. voltage	Phase-phase voltage of the generator	400 V AC
6041	G transformer	Primary voltage of the G voltage transformer (if installed)	400 V AC
6042	G transformer	Secondary voltage of the G voltage transformer (if installed)	400 V AC
6051	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	400 V AC
6052	BB transformer set 1	Secondary voltage of the BB voltage transformer (if installed)	400 V AC
6053	BB nom. voltage set 1	Phase-phase voltage of the busbar	400 V AC

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

3.3.2 Single phase system

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

The table below contains the parameters to make the system ready for single phase measuring.

The example below is with 230 V AC, which can be connected directly to the AGC's terminals without the use of a voltage transformer. If a voltage transformer is necessary, the nominal values of the transformer should be used instead.

Setting	Adjustment	Description	Adjust to value
6004	G nom. voltage	Phase-neutral voltage of the generator	230 V AC
6041	G transformer	Primary voltage of the G voltage transformer (if installed)	230 V AC
6042	G transformer	Secondary voltage of the G voltage transformer (if installed)	230 V AC
6051	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	230 V AC
6052	BB transformer set 1	Secondary voltage of the BB voltage transformer (if installed)	230 V AC
6053	BB nom. voltage set 1	Phase-neutral voltage of the busbar	230 V AC

The voltage alarms refer to U_{NOM} (230 V AC).

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

3.3.3 Split phase system

This is a special application where two phases and neutral are connected to the AGC. The AGC shows phases L1 and L3 in the display. The phase angle between L1 and L3 is 180 degrees. Split phase is possible between L1-L2 or L1-L3.

The table below contains the parameters to make the system ready for split phase measuring.
The example below is with 240/120 V AC, which can be connected directly to the AGC's terminals without the use of a voltage transformer. If a voltage transformer is necessary, the nominal values of the transformer should be used instead.

Setting	Adjustment	Description	Adjust to value
6004	G nom. voltage	Phase-neutral voltage of the generator	120 V AC
6041	G transformer	Primary voltage of the G voltage transformer (if installed)	120 V AC
6042	G transformer	Secondary voltage of the G voltage transformer (if installed)	120 V AC
6051	BB transformer set 1	Primary voltage of the BB voltage transformer (if installed)	120 V AC
6052	BB transformer set 1	Secondary voltage of the BB voltage transformer (if installed)	120 V AC
6053	BB nom. voltage set 1	Phase-neutral voltage of the busbar	120 V AC

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.

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

3.4 Applications

3.4.1 Applications and genset modes

This section about applications is to be used for reference using the particular genset mode as starting point. It is not suitable for reading from beginning to end.

The unit can be used for the applications listed in the table below.

Application	Comment
Engine Control	AGC 110/111/112/113
Automatic Mains Failure (no back sync.)	AGC 113/145/146
Island operation	AGC 111/112/113
Load takeover	AGC 113/145/146
Power management	AGC 145/146

Genset mode	Running mode				
	Auto	Semi	Test	Man	Block
Automatic Mains Failure (no back sync.)	X	X	X	X	X
Island operation	X	X	X	X	X
Load takeover	X	X	X	X	X

For a general description of the available running modes, please refer to the chapter "Running mode description".

3.4.2 AMF (no back synchronisation)

Auto mode description

The unit automatically starts the genset and switches to generator supply at a mains failure after an adjustable delay time. It is possible to adjust the unit to change to genset operation in two different ways:

1. The mains breaker will be opened at genset start-up.
2. The mains breaker will remain closed until the genset is running, and the genset voltage and frequency is OK.

In both cases, the generator breaker will be closed when the generator voltage and frequency is OK, and the mains breaker is open.

When the mains returns, the unit will switch back to mains supply and cool down and stop the genset. The switching back to mains supply is done when the adjusted "Mains OK delay" has expired.

For a general description of the available running modes, please refer to the chapter "Running mode description".

3.4.3 Island operation

Auto mode description

The unit automatically starts the genset and closes the generator breaker at a digital start command. When the stop command is given, the generator breaker is tripped, and the genset will be stopped after a cooling down period. The start and stop commands are used by activating and deactivating a digital input or with the time-dependent start/stop commands. If the *time-dependent start/stop* commands are to be used, the auto mode must also be used.

For a general description of the available running modes, please refer to the chapter "Running mode description".

3.4.4 Load takeover

Auto mode description

The purpose of the load takeover mode is to transfer the load imported from the mains to the genset for operation on generator supply

The unit automatically starts the genset and closes the generator breaker at a digital start command. When the stop command is given, the generator breaker is tripped, and the genset will be stopped after a cooling-down period. The start and stop commands are used by activating and deactivating a digital input or with the time-dependent start/stop commands. If the time-dependent start/stop commands are to be used, then the auto mode must also be used.

3.5 Running mode description

3.5.1 Manual mode

The unit can be operated in manual mode (MAN). Manual means that the unit will not initiate any 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. Stop and MAN push-buttons on the display are used
2. Digital inputs are used
3. Modbus command at service port or RS 485

The standard controller is only equipped with a limited number of digital inputs, please refer to "Digital inputs" in this document and the data sheet for additional information about availability.

The following sequences can be activated in manual mode:

Command	Description	Comment
Start	The start sequence is initiated and continues until the genset starts or the maximum number of start attempts has been reached.	
Stop	The genset will be stopped. After disappearance of the running signal, the stop sequence will continue 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 unit will close the generator breaker if the mains breaker is open.	
Open GB	The unit will open the generator breaker instantly.	
Close MB	The unit will close the mains breaker if the generator breaker is open.	
Open MB	The unit opens the mains breaker instantly.	

3.5.2 Semi-auto mode

Semi-auto mode can be activated by pushing either the AUT button twice or with the utility software. Semi-auto has the same function as manual mode in systems without power management.

Semi-auto mode is only relevant in a power management system where AGC 14x is able to change mode on other controllers in the power management system.

3.5.3 Test mode

The test mode function is activated by the TEST push-button on the display, the Modbus USW or by activating a digital input.

The settings for the test function are set up in menu

7040 Test

- Set point: Load set point (can only be set in AGC 145 and 146).
- Timer: Period starts when U/f is OK. Engine stops when time runs out.
- Return: When the test is completed, the unit will return to the selected mode (manual or auto).
- Type: Selection of one of the two types of tests: simple or full.

If the timer in parameter 7042 is set to 0, the test is infinite. The test will be interrupted if the mode is changed to either manual, semi-auto or auto.

Test mode is not available in an island application

3.5.4 Simple test

AGC 100 will go through the start sequence and run the engine for the time set in parameter 7042 without any breaker operation. This sequence is initiated by a digital input or the TEST push-button on the front. The test will run until the timer expires. When the timer runs out, the stop sequence including cooling down will be carried out.
If the timer in parameter 7042 is set to 0, the test is infinite. The test will be interrupted if the mode is changed to either manual, semi-auto or auto.

3.5.5 Full test

The full test will start the genset, open the mains breaker and close the generator breaker. When the test timer expires or the test is cancelled by mode change, the generator breaker is opened, the mains breaker closed, and the generator is stopped after the cool-down time.

To run the full test, it is required that AGC 100 is in AMF or load takeover mode.

It is possible to open and close the generator breaker and the mains breaker in manual mode.

3.5.6 Block mode

Block mode can be enabled by pressing the MAN button twice, with M-Logic or a digital input. When block mode is selected, the controller will be locked for certain actions. This means that it cannot start the genset or perform any breaker operations from the buttons.
The purpose of the block mode is to make sure that the genset does not start for instance during maintenance work.

It is important to know that the digital input configured to block mode is a constant signal. So, when it is ON, the unit is in a blocked state, and when it is OFF, it returns to the mode it was in before block mode was selected.

When controller goes into block mode, it will:

- Open GB, shut down the engine, show "BLOCK" in the display and flash the MAN LED
- GB ON, GB OFF, MB ON, MB OFF and START buttons are locked

If block mode is selected using the display, the block mode can only be deactivated from the display. If block mode is selected using the digital input, the block mode can only be deactivated by setting the digital input to OFF.

Before the running mode is changed, it is important to check that persons are clear of the genset and that the genset is ready for operation.

Alarms are not influenced by block mode selection.

The genset can be started from the local engine control panel, if such is installed. Therefore, DEIF recommends avoiding local cranking and starting of the genset.

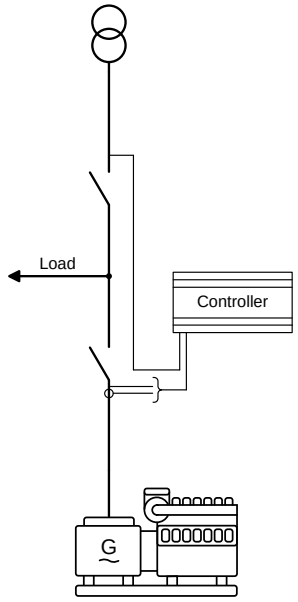
The genset will shut down if block mode is selected while the genset is running.

3.6 Single-line diagrams

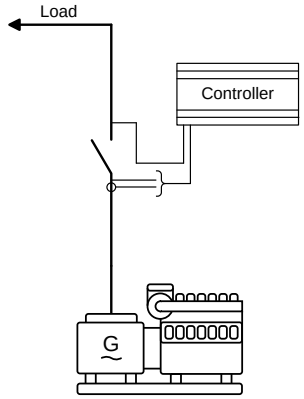
3.6.1 Application illustration

In the following, the various applications are illustrated in single-line diagrams.

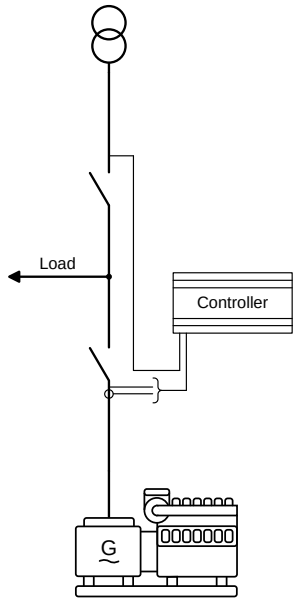
3.6.2 Automatic Mains Failure



3.6.3 Island operation



3.6.4 Load takeover



3.7 Flowcharts

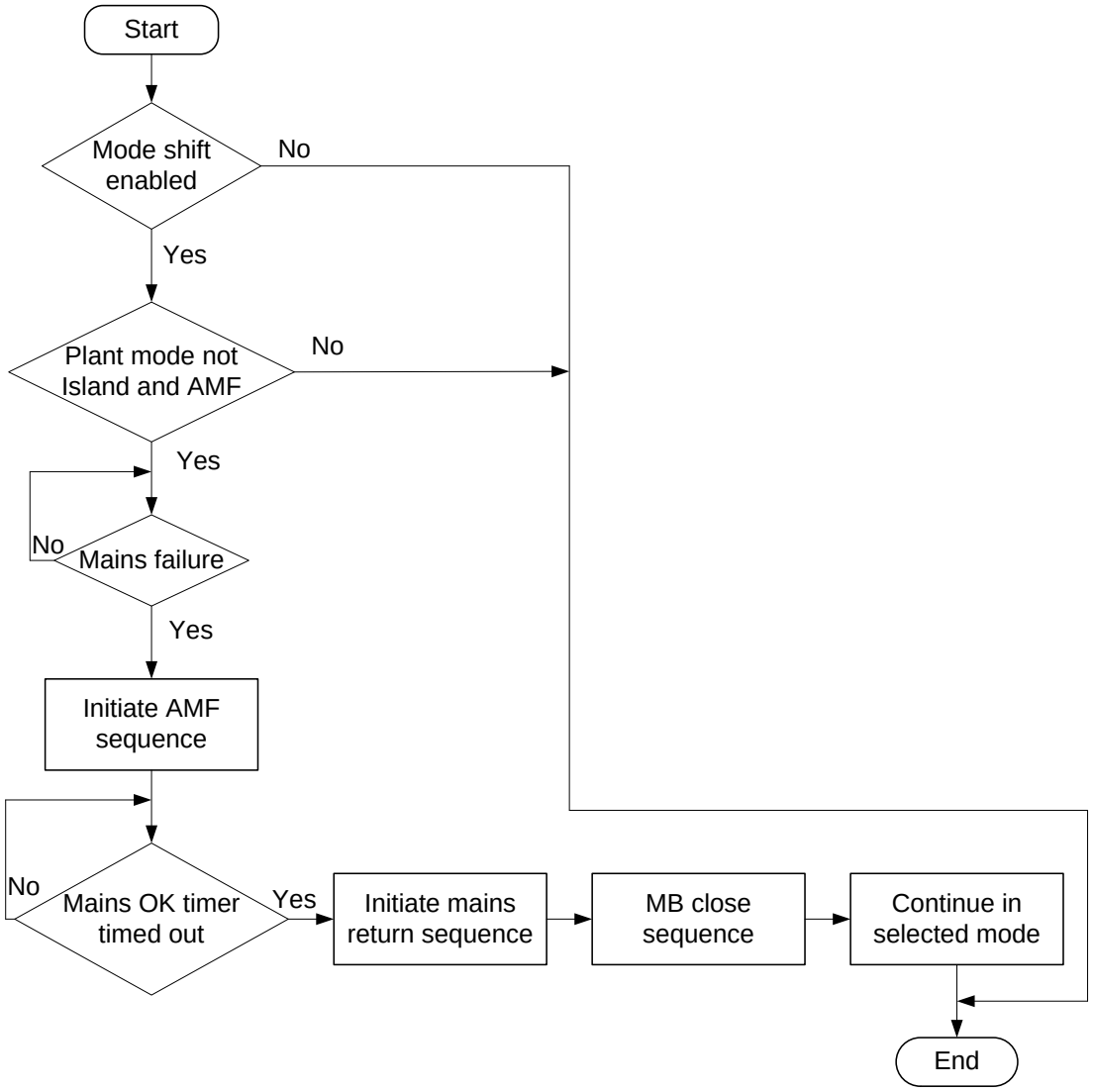
3.7.1 Flowcharts

Using flowcharts, the principles of the most important functions will be illustrated in the next sections. The functions included are:

- Mode shift
- MB open sequence
- GB open sequence
- Stop sequence
- Start sequence
- MB close sequence
- GB close sequence
- Load takeover
- Island operation
- Automatic Mains Failure
- Test sequence

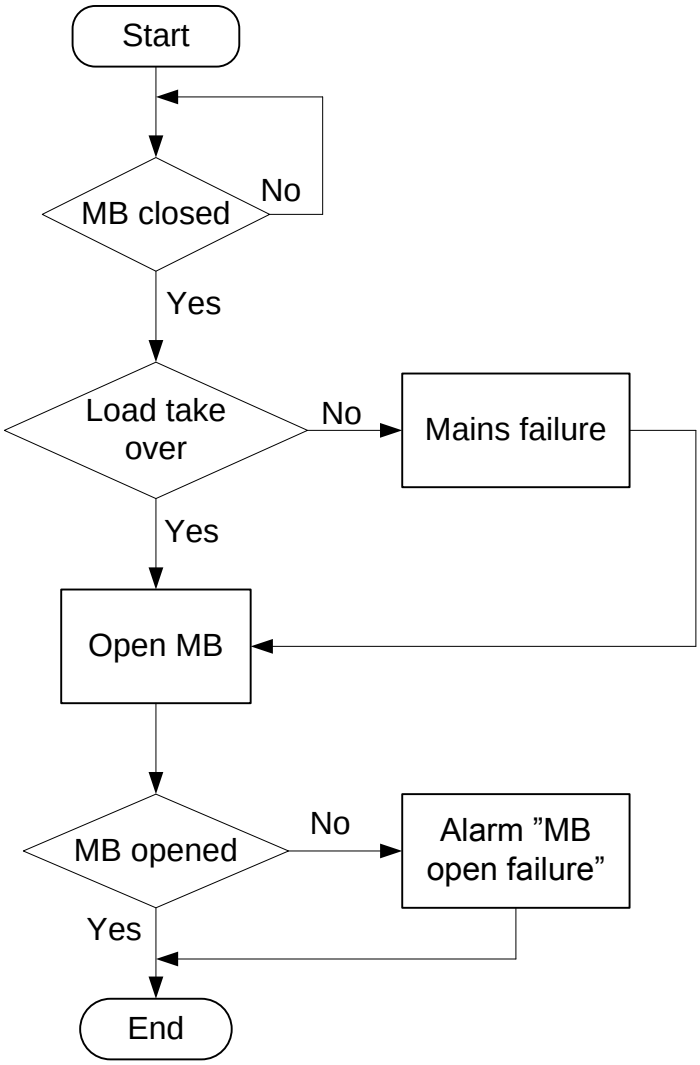
The flowcharts on the following pages are for guidance only. For illustrative purposes, the flowcharts are simplified in some extent.

3.7.2 Mode shift

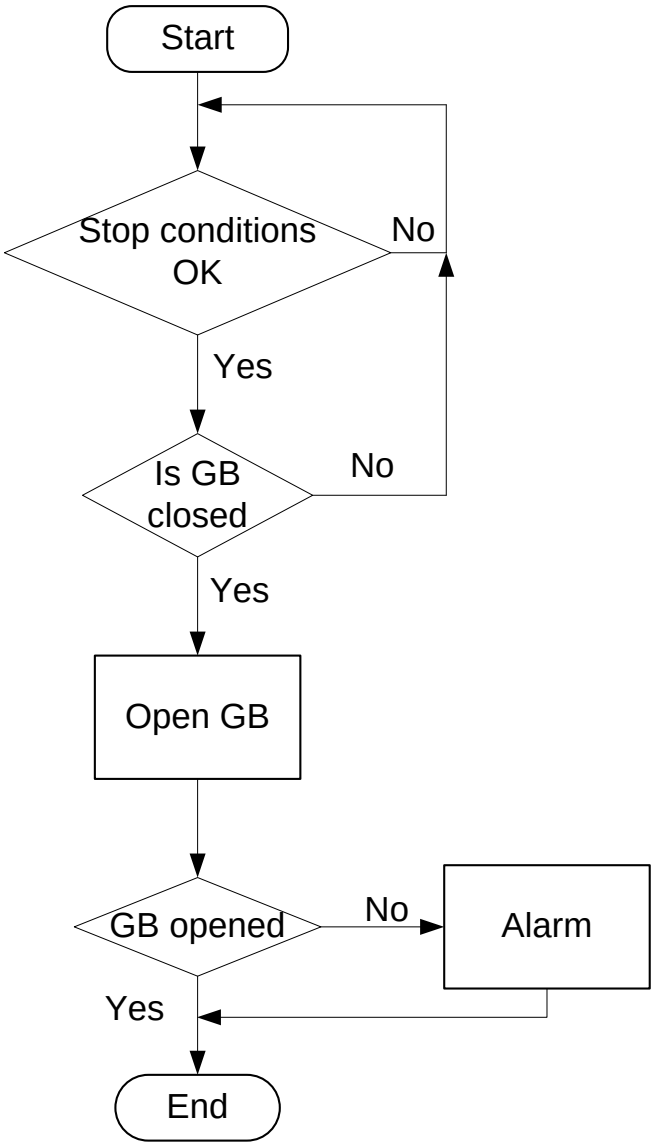


To enable mode shift, a digital input has to be set up.

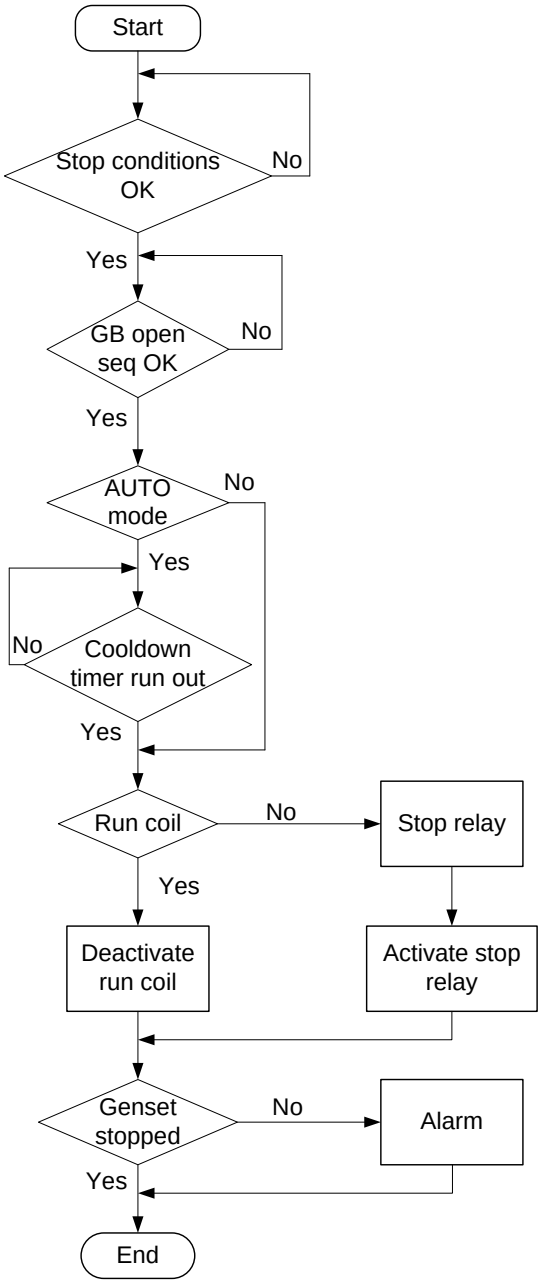
3.7.3 MB open sequence



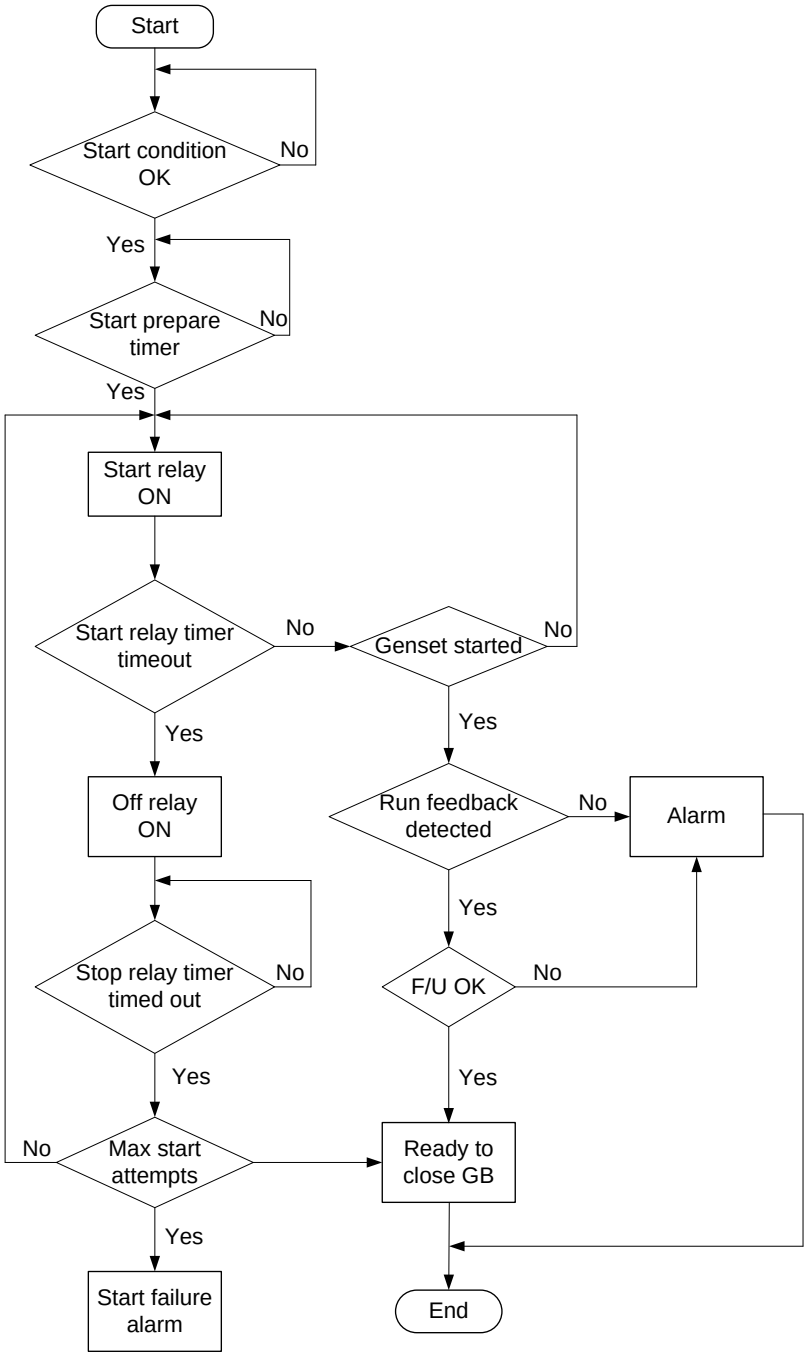
3.7.4 GB open sequence



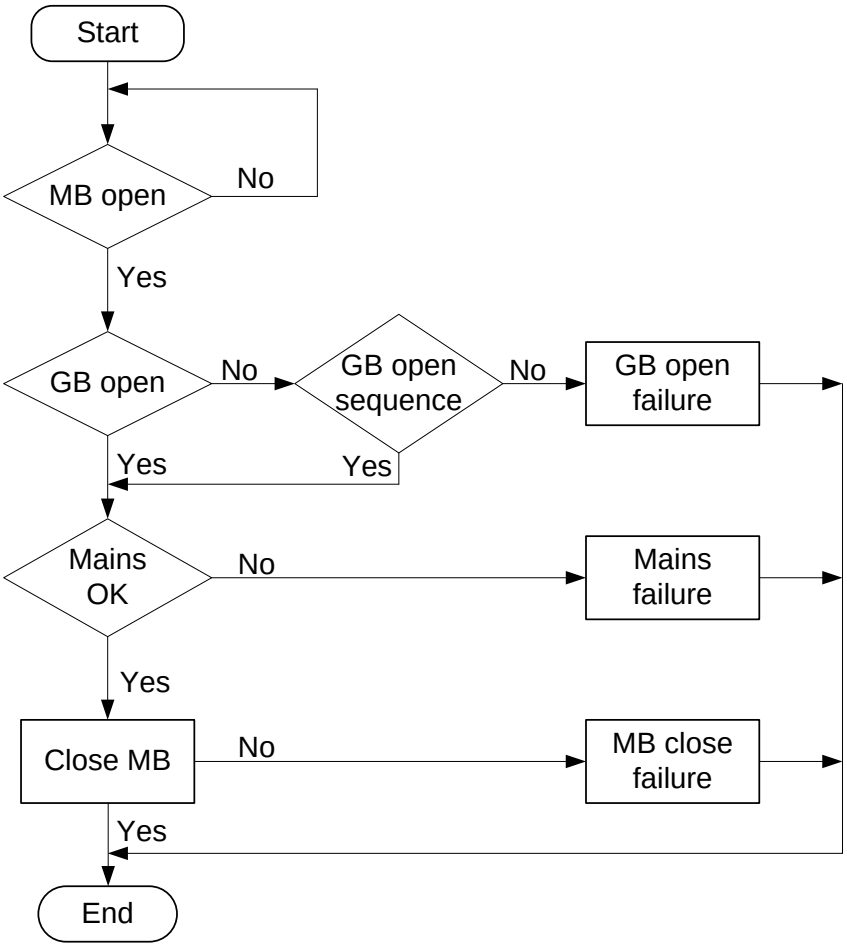
3.7.5 Stop sequence



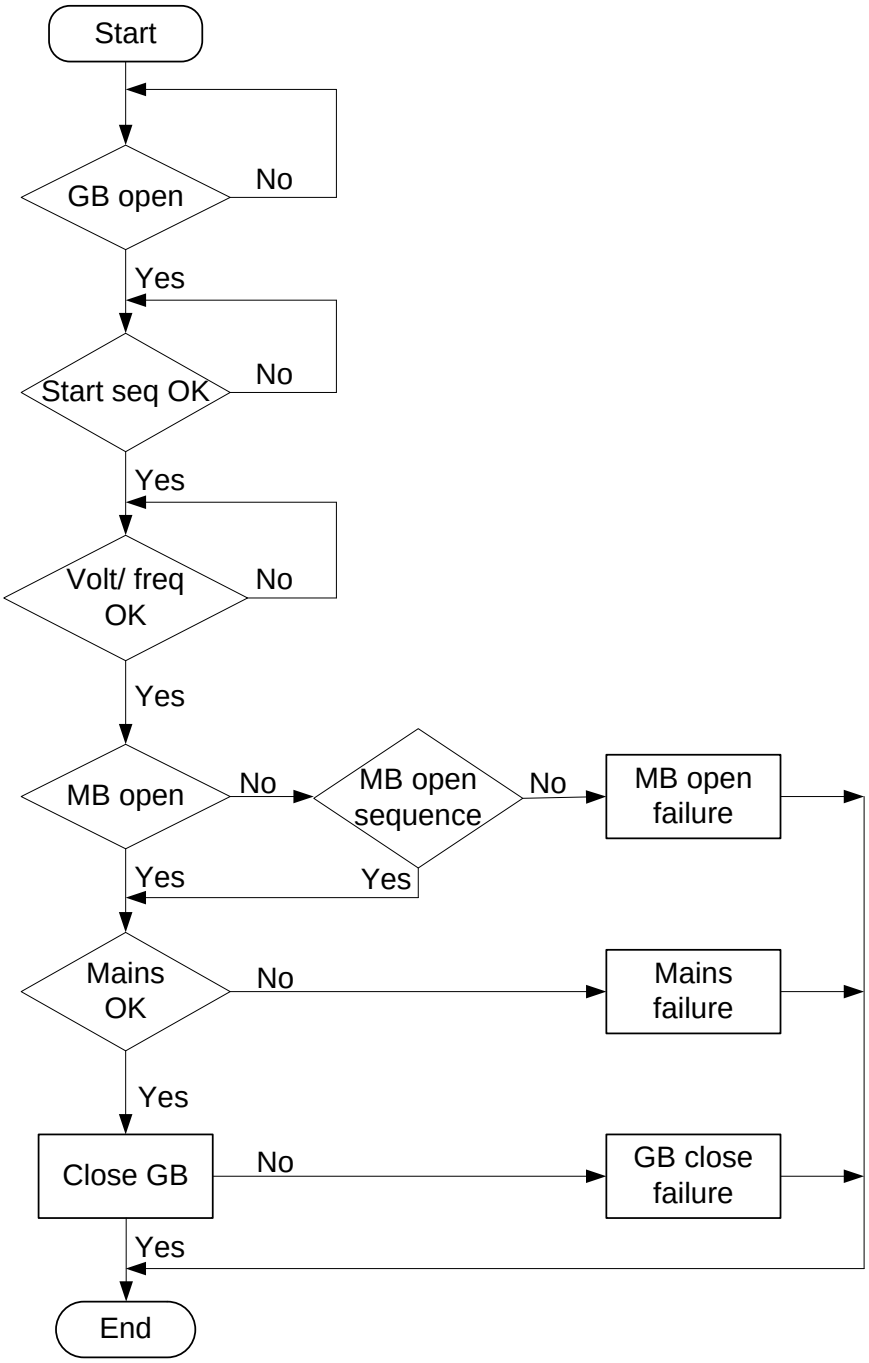
3.7.6 Start sequence



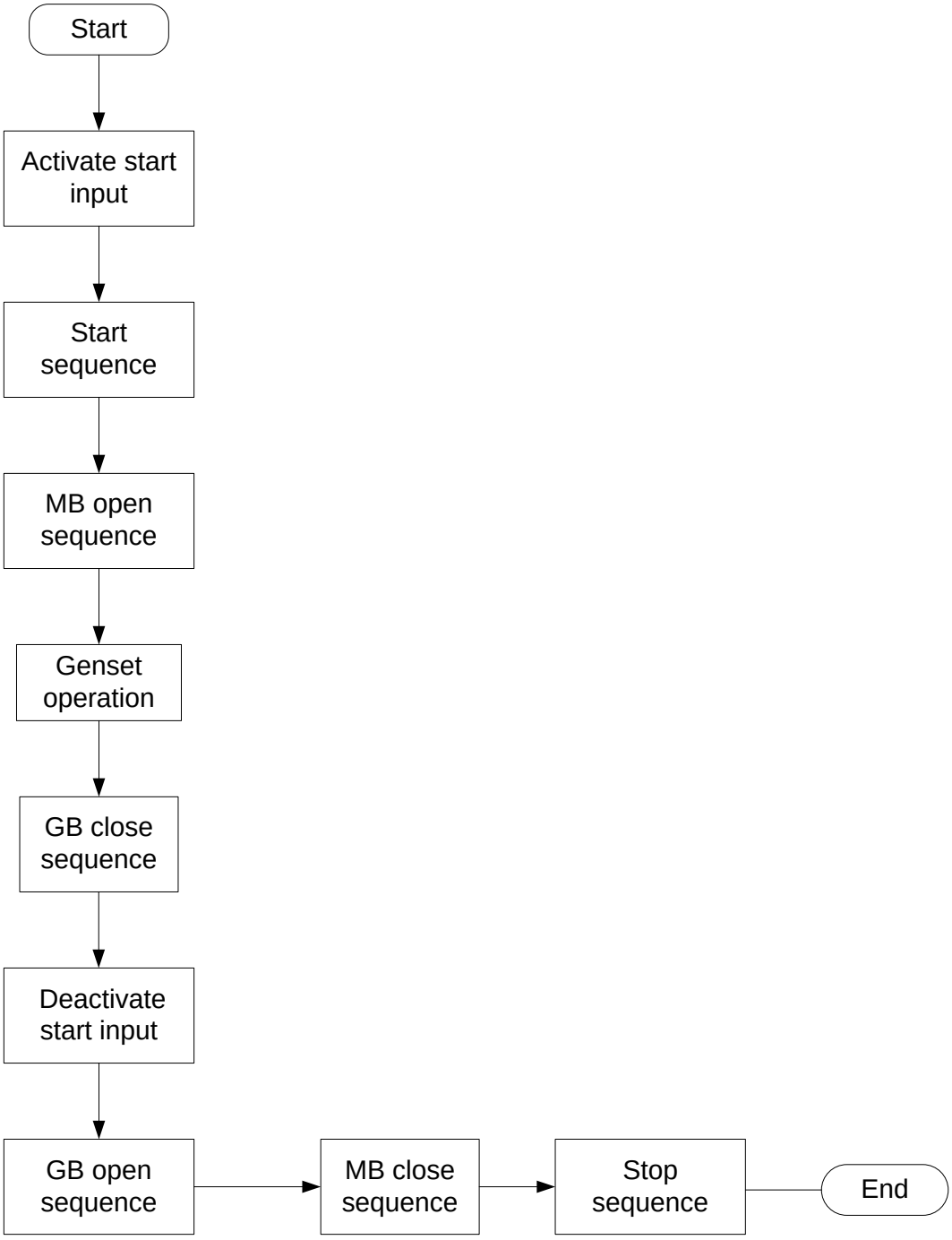
3.7.7 MB close sequence



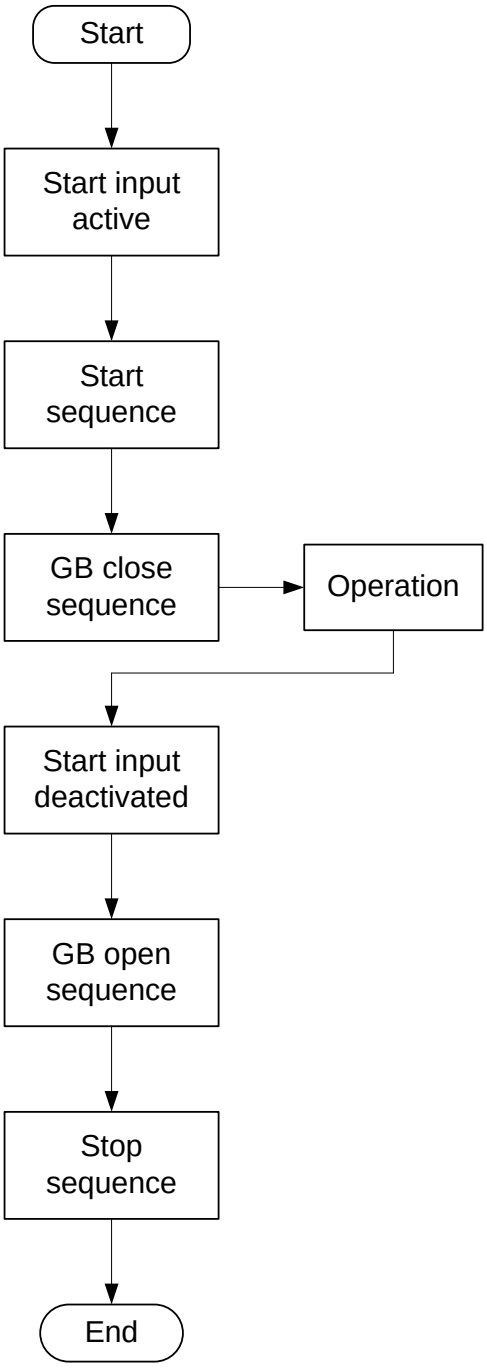
3.7.8 GB close sequence



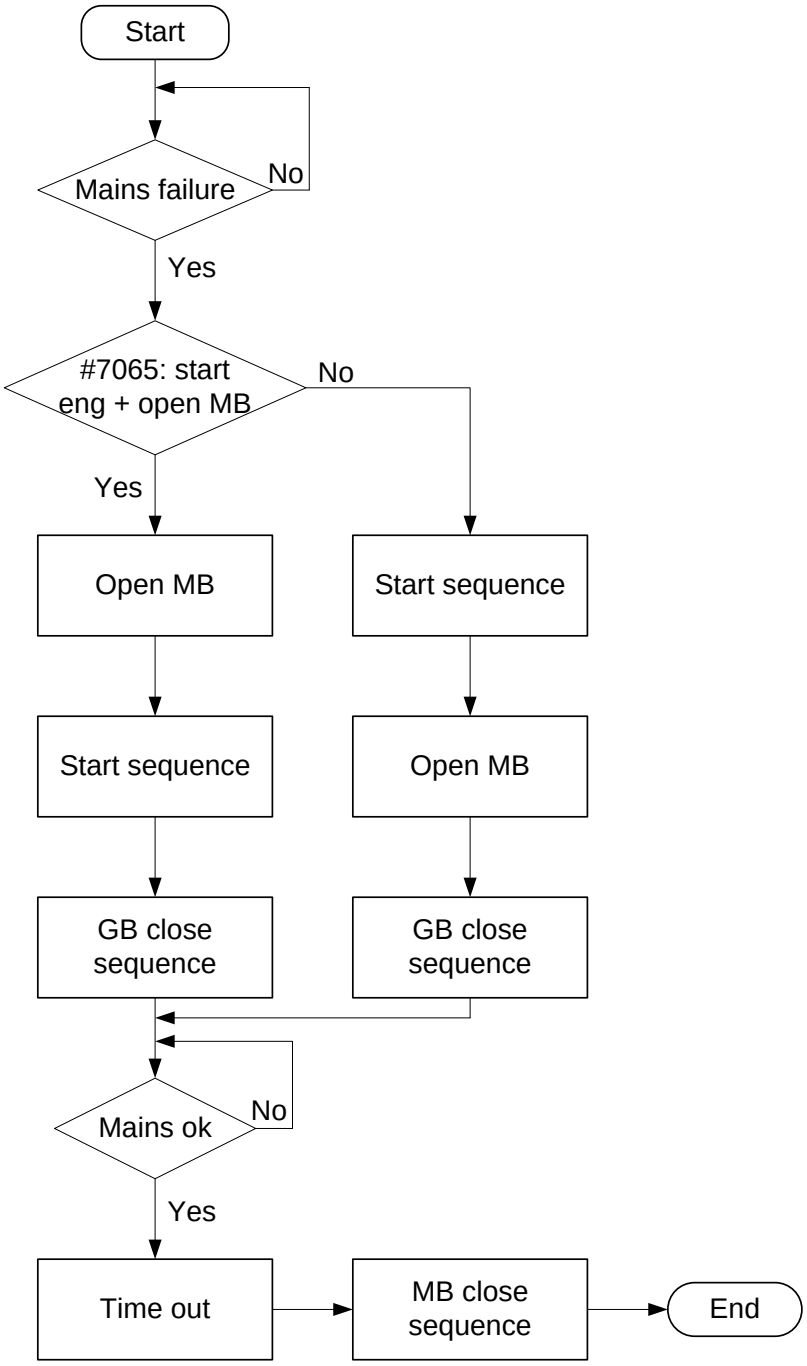
3.7.9 Load takeover



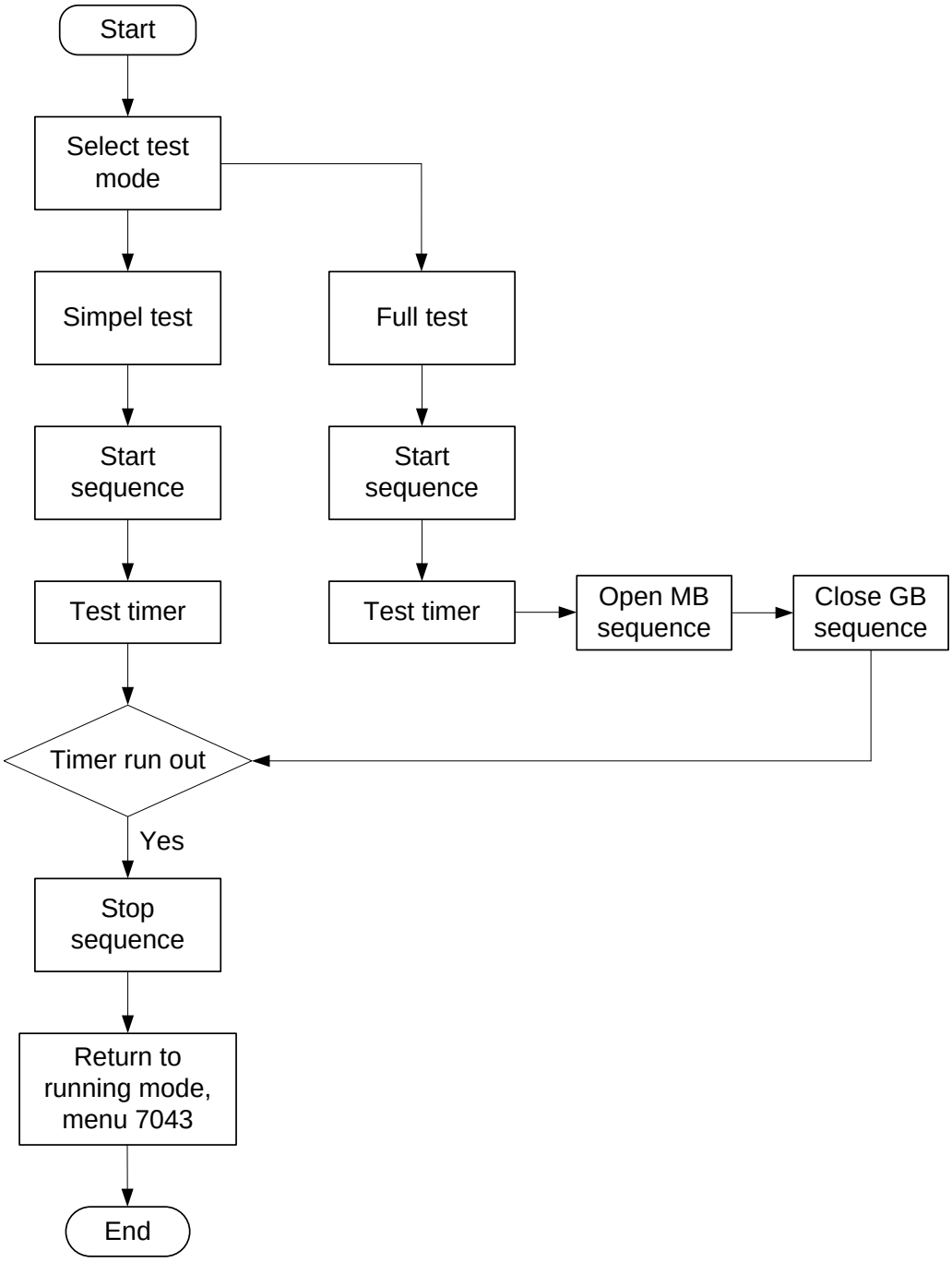
3.7.10 Island operation



3.7.11 Automatic Mains Failure, AMF



3.7.12 Test sequence



3.8 Sequences

3.8.1 Sequences

The following contains information about the sequences of the engine, the generator breaker, and the mains breaker. These sequences are automatically initiated if the auto mode is selected.

In the manual or semi-auto mode, the selected sequence is the only sequence initiated (for example press the START push-button: the engine will start, but not close the breaker).

The following sequences will be illustrated below:

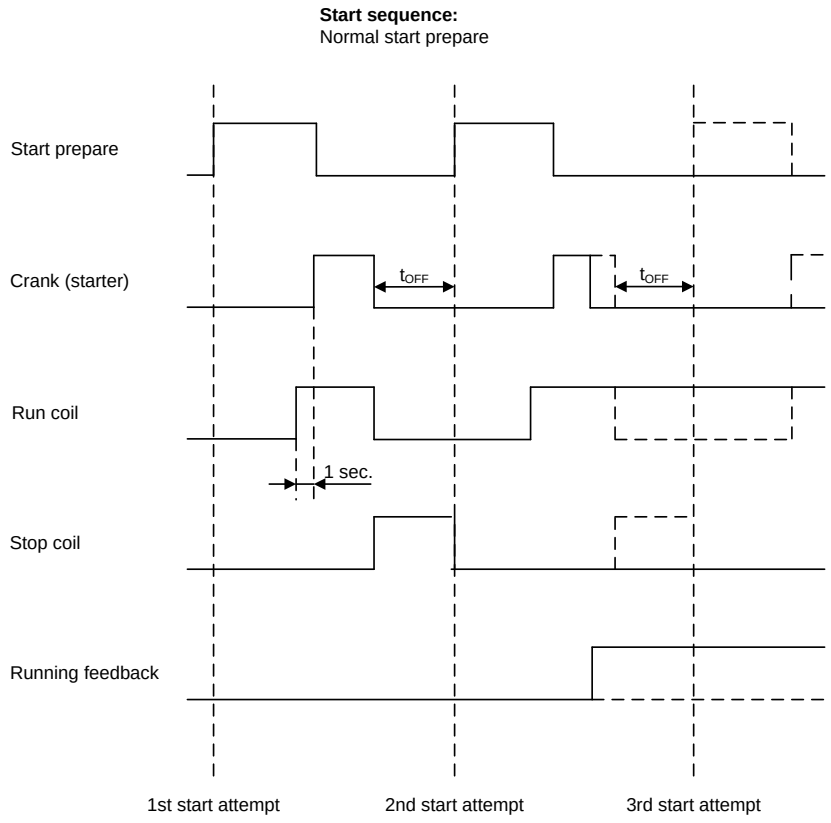
- START sequence
- STOP sequence
- Breaker sequences

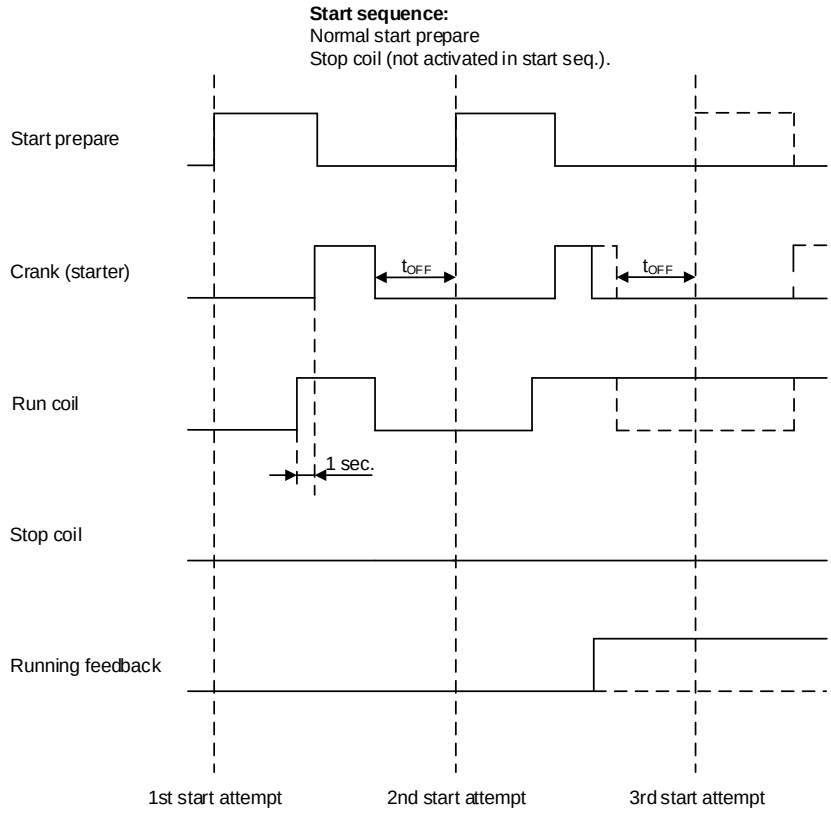
3.8.2 Start sequence

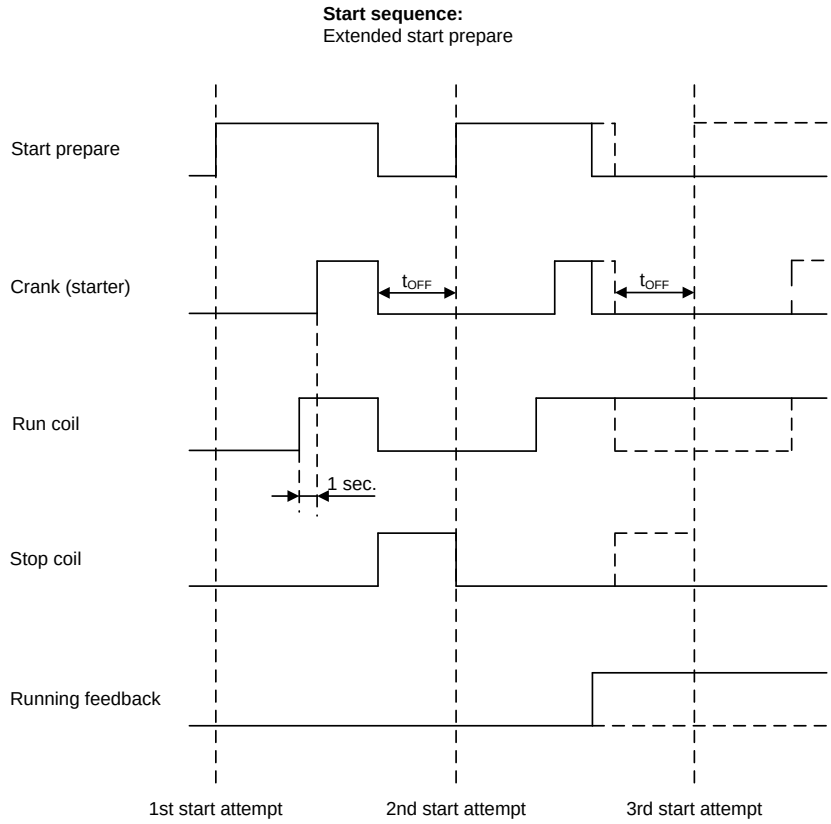
The following drawings illustrate the start sequences of the genset with normal start prepare and extended start prepare.

No matter the choice of start prepare function, the running coil is activated 1 sec. before the start relay (starter).

Note that the three illustrations are different. Be sure to read them carefully to understand them correctly.




Start sequence:
Normal start prepare
Stop coil (not activated in start seq.).
Start prepare
Crank (starter)
tOFF
tOFF
Run coil
1 sec.
Stop coil
Running feedback
1st start attempt
2nd start attempt
3rd start attempt



Run coil can be activated from 1...600 sec. before crank (starter) will be executed. In the above example, the timer is set to 1 sec. (menu 6150).

3.8.3 Start sequence conditions

The start sequence initiation can be controlled by the following conditions:

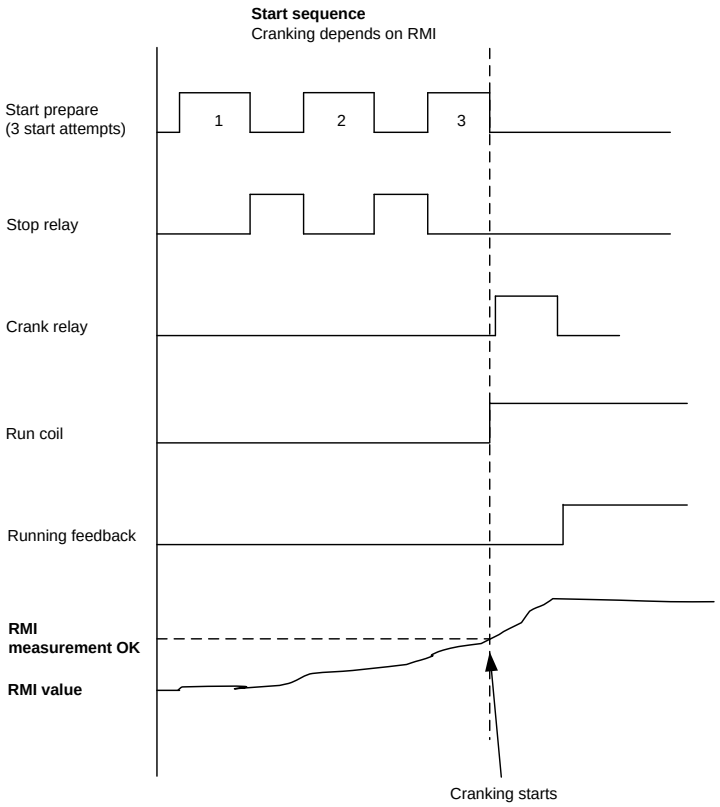
- Oil pressure (RMI 6,7 or 8)
- Water temperature (RMI 6,7 or 8)
- Fuel level (RMI 6, 7 or 8)

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

The selection is made in setting 6185. For each of the RMI settings, the rule is that the value (oil pressure, fuel level or water temperature) must exceed the set point of setting 6186 before starting is initiated.

If the value in 6186 is set to 0.0, the start sequence is initiated as soon as it is requested.

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



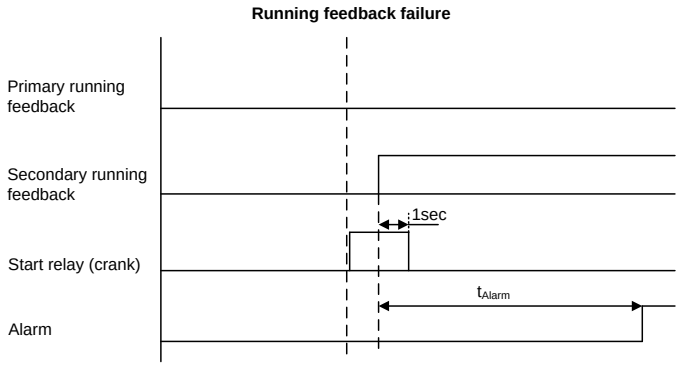
3.8.4 Running feedback

Different types of running feedback can be used to detect if the motor is running. Refer to menu 6170 for selection of the running feedback type.

The running detection is made with a built-in safety routine. The running feedback selected is the primary feedback. At all times, all the types of running feedback is used for running detection. If, for some reason, the primary choice is not detecting any running feedback, the starter relay will stay activated for 1 additional second. If a running feedback is detected based on one of the secondary choices, the genset will start. This way, the genset will still be functional even though a tacho sensor is damaged or dirty.

As soon as the genset is running, no matter if the genset is started based on the primary or secondary feedback, the running detection will be made, based on all available types.

The sequence is shown in the diagram below.



Interruption of start sequence
The start sequence is interrupted in the following situations:

Event	Comment
Stop signal	
Start failure	
Remove starter feedback	Tacho set point.
Running feedback	Digital input.
Running feedback	Tacho set point.
Running feedback	W terminal
Running feedback	As soon as voltage is detected with a frequency above the set point in parameter 6165 (default 32 Hz). 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 (menu 6175).
Running feedback	EIC (engine communication).
Emergency stop	
Alarm	Alarms with shutdown" or "trip and stop" fail class.
Stop push-button on display	Semi-auto or manual mode.
Modbus stop command	Semi-auto or manual mode.
Binary stop input	Semi-auto or manual mode.
Deactivate the "auto start/stop"	Auto mode in the following genset modes: Island operation or load takeover mode.

If the MPU input is to be used to remove the starter, it has to be set up in menu 6174.

Set points related to the start sequence
- Crank failure alarm **(4530 Crank failure)**
If MPU is chosen as the primary running feedback, this alarm will be raised if the specified rpm is not reached before the delay has expired.

- Run feedback failure **(4540 Run feedb. fail)**
If running is detected on the frequency (secondary), but the primary running feedback, for example digital input, has not detected running, this alarm will be raised. The delay to be set is the time from the secondary running detection and until the alarm is raised.

- Hz/V failure **(4560 Hz/V failure)**
If the frequency and voltage are not within the limits set in menu 2110 after the running feedback is received, this alarm is raised when the delay has expired.

- Start failure alarm **(4570 Start failure)**
The start failure alarm occurs, if the genset has not started after the number of start attempts set in menu 6190.

- Start prepare **(6180 Starter)**
Normal prepare: the start prepare timer can be used for start preparation purposes, 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.

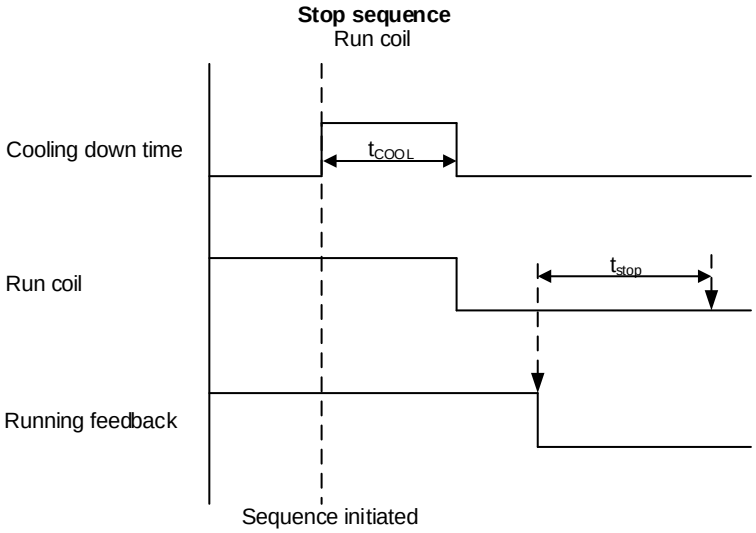
Extended prepare: the extended prepare will activate the start prepare relay when the start sequence is initiated and keep it activated when the start relay activates until the specified time has expired. If the ext. prepare time exceeds the start ON time, the start prepare relay is deactivated when the start relay deactivates. If the timer is set to 0.0 s, the extended prepare function is deactivated.

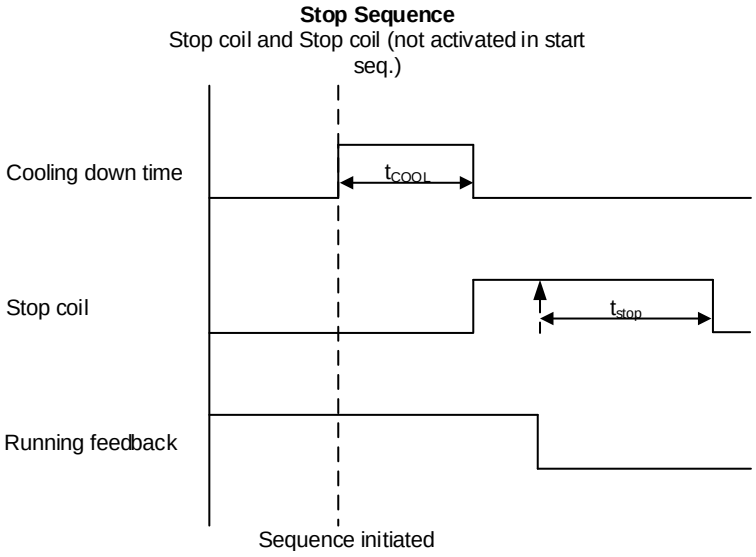
Start ON time: the starter will be activated for this period when cranking.

Start OFF time: the pause between two start attempts.

3.8.5 Stop sequence

The drawings illustrate the stop sequence.





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

Description	Cooling down	Stop	Comment
Auto mode stop	X	X	
Trip and stop alarm	X	X	
Stop button on display	(X)	X	Semi-auto or manual. Cooling down is interrupted if the stop button is activated twice.
Remove "auto start/stop"	X	X	Auto mode: island operation and load takeover.
Emergency stop		X	Engine shuts down and GB opens.

The stop sequence can only be interrupted during the cooling down period. Interruptions can occur in these situations:

Event	Comment
Mains failure	AMF mode selected (or mode shift selected ON) and auto mode selected.
Start button is pressed	Auto mode: engine will run in idle speed.
Binary start input	Auto mode: island operation and load takeover.
GB close button is pressed	Semi-auto and manual mode.

Set points related to the stop sequence

- Stop failure **(4580 Stop failure)**
A stop failure alarm will appear if the primary running feedback or the generator voltage and frequency are still present after the delay in this menu has expired.

- Stop **(6210 Stop)**
Cooling-down:
The length of the cooling-down period.

Extended stop:
The delay after the running feedback has disappeared until a new start sequence is allowed. The extended stop sequence is activated any time the stop button is pressed.

Cool down controlled by engine temperature:
The engine temperature-controlled cool-down is to ensure that the engine is cooled down below the set point in menu 6214 "Cool down temperature" before the engine is stopped. This is particularly beneficial if the engine has been running for a short period of time and therefore not reached normal cooling water temperature, as the cool-down period will be very short or none at all. If the engine has been running for a long period, it will have reached normal running temperature, and the cool-down period will be the exact time it takes to get the temperature below the temperature set point in menu 6214.

If, for some reason, the engine cannot get the temperature below the temperature set point in 6214 within the time limit in parameter 6211, the engine will be shut down by this timer. The reason for this could be high ambient temperature.

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

If the cooling-down temperature is set to 0 deg., the cooling-down sequence will be entirely controlled by the timer.

3.8.6 Breaker sequences

The breaker sequences will be activated depending on the selected mode:

Mode	Genset mode	Breaker control
Auto	All	Controlled by the unit
Semi-auto	All	Push-button, M-Logic, Modbus, Digital input
Manual	All	Push-button, M-Logic, Modbus, Digital input
Block	All	Controlled by the unit

Before closing the breakers, it must be checked that the voltage and frequency are OK. The limits are adjusted in menu 2110 Sync. blackout.

Set points related to MB control

7080 MB control

Mode shift: When enabled, the AGC will perform the AMF sequence in case of a mains failure in load takeover or TEST mode

MB close delay: The time from GB OFF to MB ON

Load time: After opening of the breaker, the MB ON sequence will not be initiated before this delay has expired. Refer to the description of "Breaker spring load time".

If no MB is represented, the relays and inputs normally used for MB control become configurable.

The GB can only be closed if the mains breaker is open. The MB can only be closed if the generator breaker is open.

- AMF MB opening **(7060 U mains failure)**

It is possible to select the functionality of the mains breaker closing function. This is necessary if the unit operates in Automatic Mains Failure (AMF).

The possibilities are:

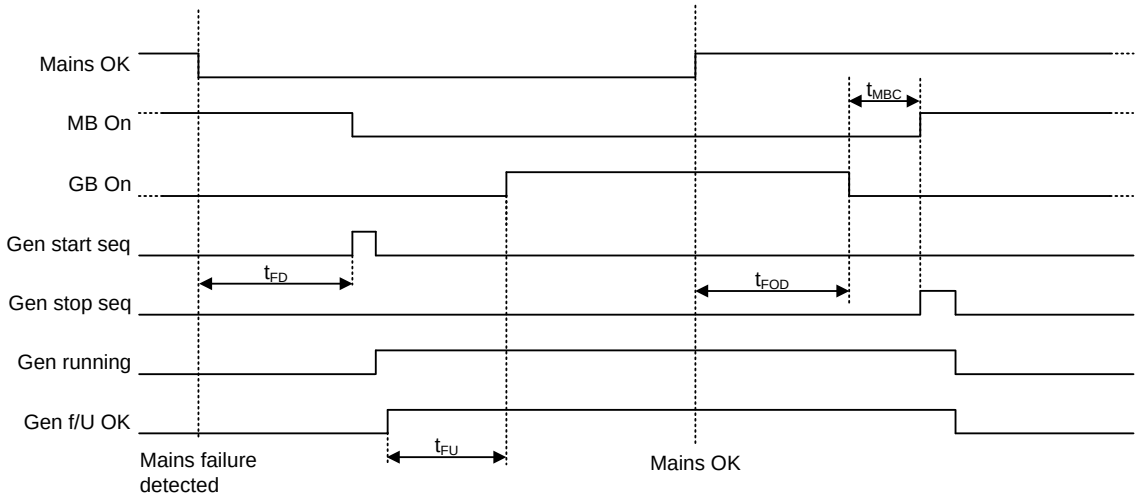
Selection	Description
Start engine and open mains breaker	When a mains failure occurs, the mains breaker opens, and the engine starts at the same time.
Start engine	When a mains failure occurs, the engine starts. When the generator is running and the frequency and voltage are OK, the MB opens and the GB closes.

3.8.7 AMF timers

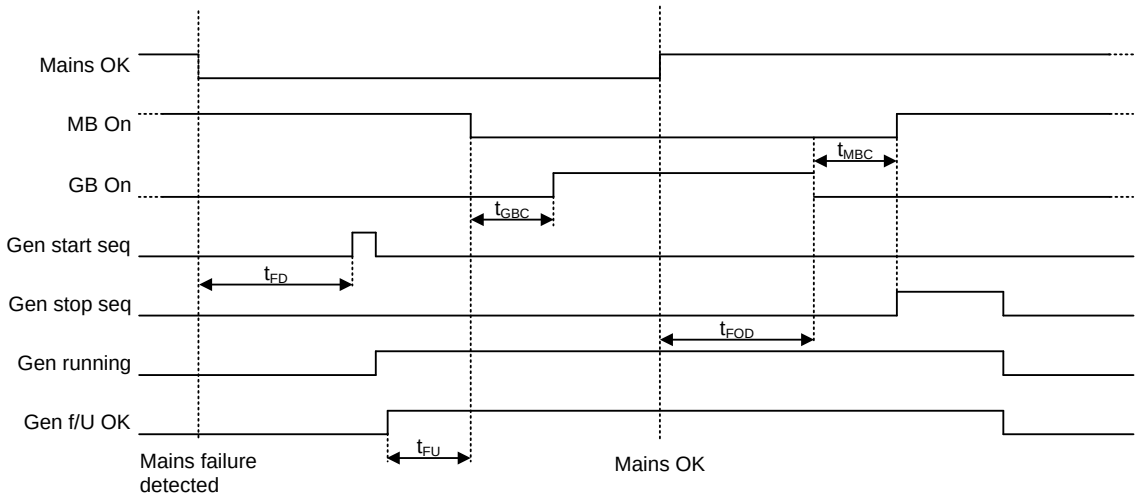
The time charts describe the functionality at a mains failure and at mains return. The timers used by the AMF function are indicated in the table below:

Timer	Description	Menu number
t_{FD}	Mains failure delay	**7070 f mains failure** **7060 U mains failure**
t_{FU}	Frequency/voltage OK	**6220 Hz/V OK**
t_{FOD}	Mains failure OK delay	**7070 f mains failure** **7060 U mains failure**
t_{GBC}	GB ON delay	**6230 GB control**
t_{MBC}	MB ON delay	**7080 MB control**

Example 1:
7065 Mains fail control: Start engine and open MB



Example 2:
7065 Mains fail control: Start engine



Conditions for breaker operations
The breaker sequences react depending on the breaker positions and the frequency/voltage measurements.

The conditions for the ON and OFF sequences are described in the table below:

Conditions for breaker operations	
Sequence	**Condition**
GB ON, direct closing	Running feedback Generator frequency/voltage OK MB open
MB ON, direct closing	Mains frequency/voltage OK GB open
GB OFF, direct opening	MB open
MB OFF, direct opening	Alarms with fail classes: Shut down or Trip MB alarms

4. Display and menu structure

4.1 Passwords and parameter access

4.1.1 Passwords

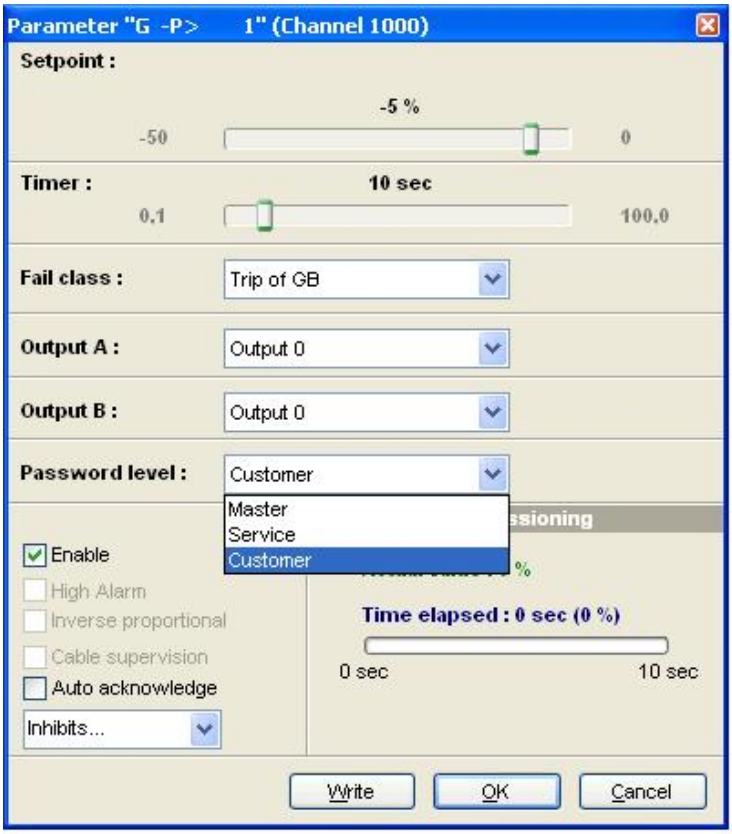
The unit includes three password levels. All levels can be adjusted in the PC software.

Available password levels:

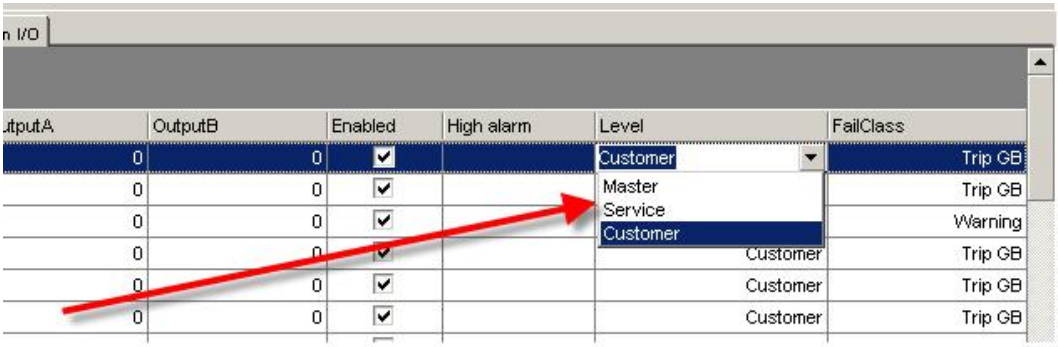
Password level	Factory setting	Access		
		Customer	Service	Master
Customer	2000	X		
Service	2001	X	X	
Master	2002	X	X	X

A parameter cannot be entered with a password that is ranking too low. But the settings can be displayed without password entry.

Each parameter can be protected by a specific password level. To do so, the PC utility software must be used. Enter the parameter to be configured and select the correct password level.



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



4.1.2 Parameter access

To gain access to adjust the parameters, the password level must be entered:

If the password level is not entered, it is not possible to enter the parameters.

The customer password can be changed in parameter 9111. The service password can be changed in parameter 9112. The master password can be changed in parameter 9113.

The factory passwords must be changed if the operator of the genset is not allowed to change the parameters.

It is not possible to change the password at a higher level than the password entered.

4.2 Reference to Operator's manual

Information about display and menu structure can be found in the "Operator's manual", which is located on DEIF's homepage under documentation for AGC 100.

5. Engine communication

5.1 Reference to H5 manual

5.1.1 Engine communication

The AGC 100 is able to communicate with an engine controller through the CAN bus (CAN A).

Information about engine communication can be found in the "Option H5 and H7" manual, which is located on DEIF's homepage under documentation for AGC 100.

6. Additional functions

6.1 Start functions

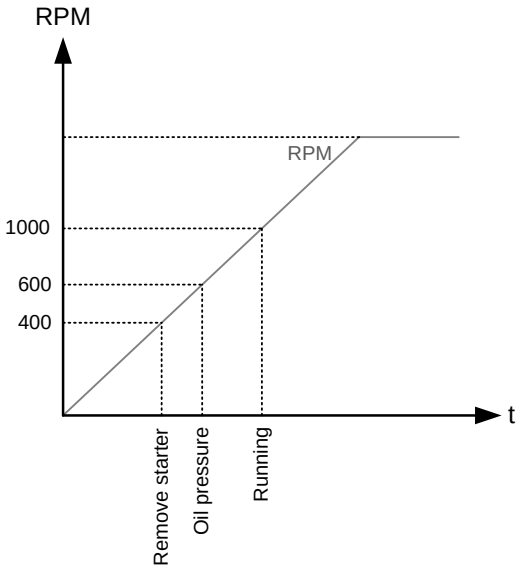
6.1.1 Start functions

The AGC will start the genset 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.

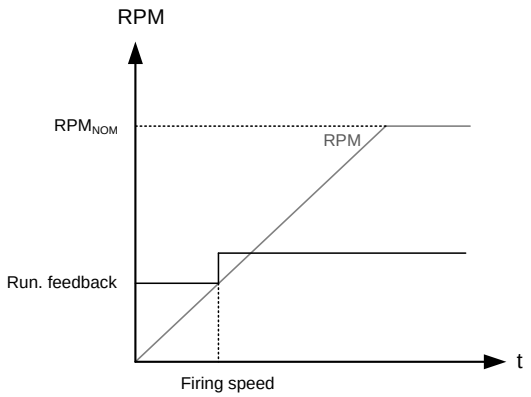
An example of a critical alarm is the oil pressure alarm. Normally, it is configured according to the shutdown fail class. But if the starter motor has to disengage at 400 RPM, and the oil pressure does not reach a level above the shutdown set point before 600 RPM, the genset would shut down if the specific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



6.1.2 Digital feedbacks

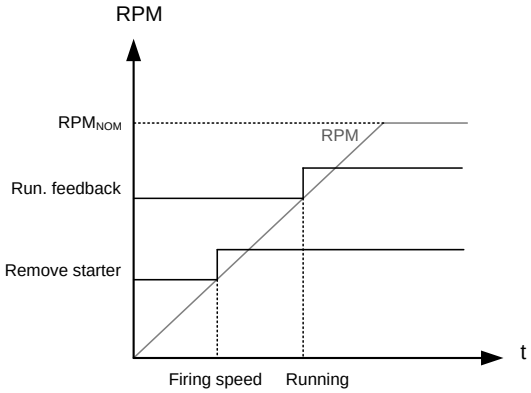
If an external running relay is installed, the digital control inputs for running detection or remove starter can be used.

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



The diagram illustrates 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 illustrates 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.

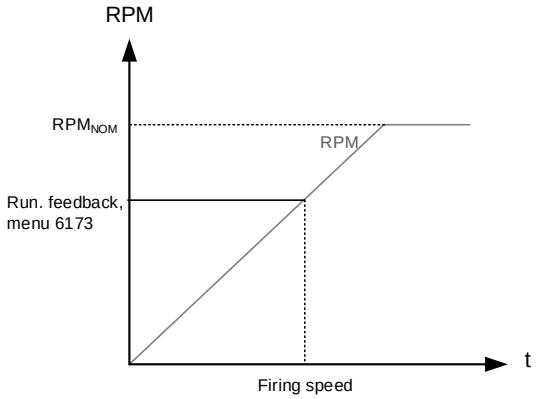
The remove starter input must be configured from a number of available digital inputs.

The running feedback is detected by either the digital input (see diagram above), frequency measurement (frequency level is adjustable in parameter 6165), RPM measured by magnetic pickup or EIC (engine communication).

6.1.3 Analogue tacho feedback

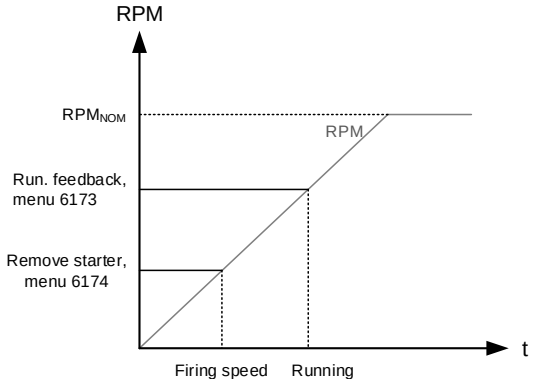
When a magnetic pickup (MPU) is being used, the specific level of revolutions for deactivation of the start relay can be adjusted.

Running feedback
The diagram below shows how the running feedback is detected at the firing speed level. The factory setting is 1000 RPM **(6170 Running detect.).**



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

Remove starter input
The drawing below shows how the set point of the remove starter is detected at the firing speed level. The factory setting is 400 RPM **(6170 Running detect.).**



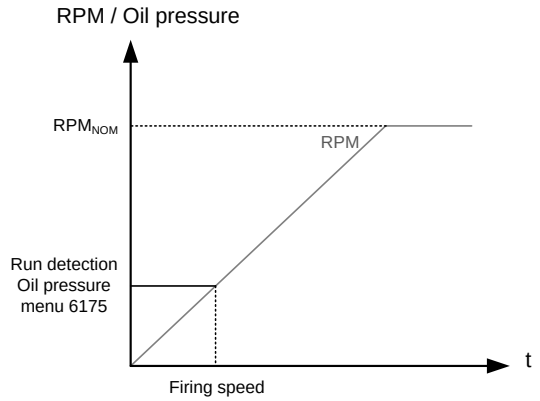
The number of teeth on the flywheel must be adjusted in menu 6170 when the MPU input is used.

6.1.4 Oil pressure

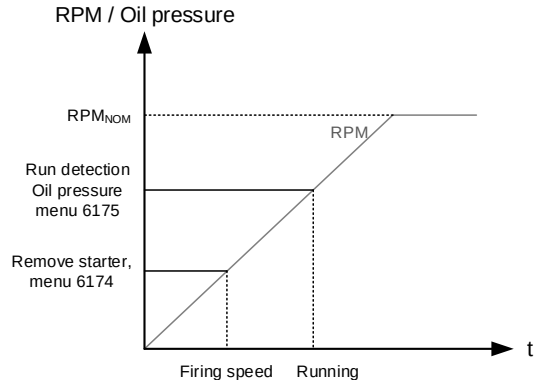
The multi-inputs on terminals 6, 7 and 8 can be used for the detection of running feedback. The terminal in question must be configured as a RMI input for oil pressure measurement.

When the oil pressure increases above the adjusted value **(6175 Pressure level),** the running feedback is detected, and the start sequence is ended.

Running feedback



Remove starter input
The drawing below shows how the set point of the "remove starter input" is detected at the firing speed level. The factory setting is 400 RPM **(6170 Running detect.).**

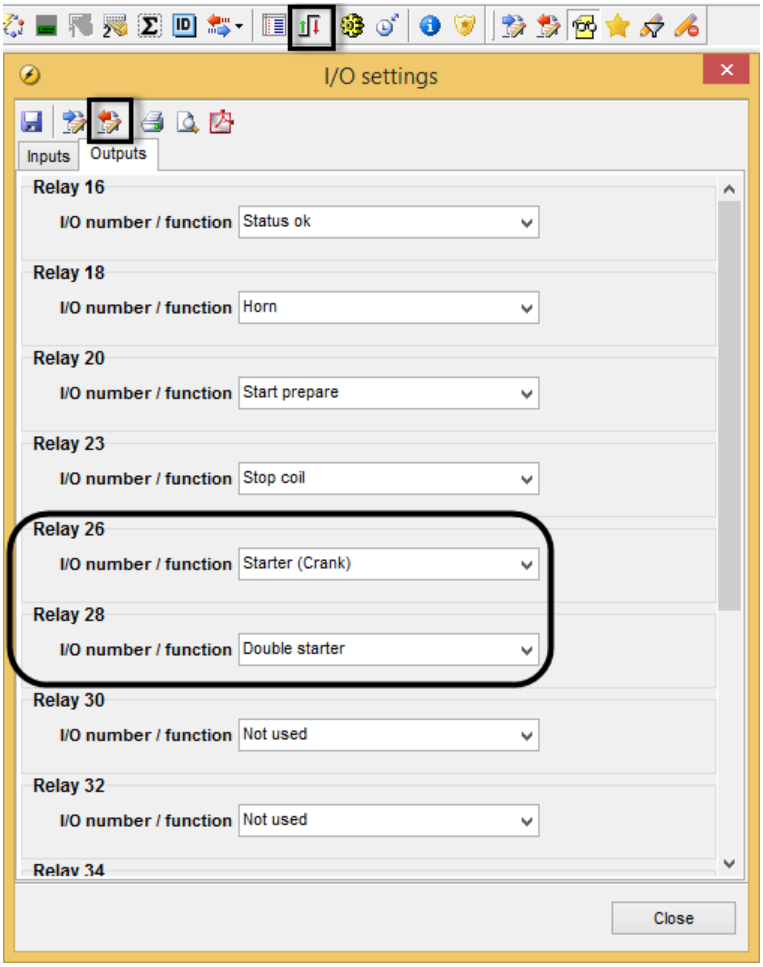


The remove starter function can use the MPU or a digital input.

6.1.5 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 "Double starter" function is set up in channel 6191-6192, and a relay for cranking with the alternative starter is chosen in the configuration of inputs/outputs.



Remember to write the settings when changing the I/O configuration.

Channel	Menu text	Explanation
6191	Standard attempts	Accepted total number of start attempts before a "start failure" alarm is activated
6192	Double attempts	The number of start attempts before redirecting the start signal

The "Double starter" function is enabled by choosing a value higher than zero in channel 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, defined in channel 6191, is reached, the start attempts stop and the alarm "Start failure" appears.

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

Examples:

6191 Std attempts	6192 Dbl attempts	1st attempt	2nd attempt	3rd attempt	4th attempt	5th attempt
3	1	Standard	Double	Standard	Alarm	-
5	1	Standard	Double	Standard	Double	Standard
5	2	Standard	Standard	Double	Double	Standard
4	5	Standard	Standard	Standard	Standard	Alarm

6.2 Mains voltage unbalance detection

6.2.1 Mains voltage unbalance detection

The formula for mains voltage unbalance is: (Most deviating line-to-line voltage - average voltage)*100/average voltage (nominal value in %)

6.3 Phase sequence error

6.3.1 Description of phase sequence error

Prior to closing a breaker, the unit checks that the phase sequence is correct, depending on the chosen phase direction in parameter 2154: "phase rotation". If it is incorrect (reversed), an alarm will be issued, and the breaker in question will not be closed.

6.4 Breaker types and feedback

6.4.1 Breaker types

There are five possible selections for the setting of breaker type for both mains breaker and generator breaker. The breaker type is selected in the application configuration.

Continuous NE and Continuous ND

This type of signal is most often used combined with a contactor. When using this type of signal, the AGC will only use the close breaker (for example GB On) relays. The relay will be closed for closing of the contactor and will be opened for opening of the contactor. Continuous NE is a normally energised signal, and continuous ND is a normally deenergised signal.

Pulse

This type of signal is most often used combined with circuit breaker. With the setting pulse, the AGC will use the close command (for example GB On) and the open command relay (for example GB Off). The close breaker relay will close for a short time for closing of the circuit breaker. The open breaker relay will close for a short time for opening of the breaker.

External/ATS no control (only applies to AGC 145/146 as mains breaker)

This type of signal is used to indicate the position of the breaker, but the breaker is not controlled by the AGC.

Compact

This type of signal will most often be used combined with a compact breaker, a direct controlled motor-driven breaker. With the setting compact, the AGC will need to use both a close command (for example GB On) and a open command relay (for example GB Off). The close breaker relay will close for a short time for the com-

pact breaker to close. The breaker off relay will close for the compact breaker to open and hold it closed long enough for the motor in the breaker to recharge the breaker. If the compact breaker is tripped externally, it is recharged automatically before next closing.

If compact breaker is selected, the length of breaker open signal can be adjusted. This can be done in menu 2160/2200 (GB open fail and MB open fail).

6.4.2 Breaker feedback

Whether breaker feedbacks are necessary or not depends on which type of breaker is selected in the application configuration of the utility software (USW) .

Continuous NE and Continuous ND
This type of breaker does not require feedback.

Pulse
Because of the pulse signal, it is required that at least one feedback is configured for each breaker.

External/ATS no control (only applies to AGC 145/146 as mains breaker)
With this type of breaker signal, it is required that both breaker on and off inputs are configured.

Compact
This type of breaker signal requires that at least one feedback is configured for each breaker.

6.5 Breaker spring load time

To avoid breaker close failures in situations where breaker ON command is given before the breaker spring has been loaded, the spring load time can be adjusted for GB/TB and MB.

The following describes a situation where you risk getting a close failure:

1. The 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 GB will give a GB close failure as the GB needs time to load the spring before it is ready to close.

Different breaker types are used, and therefore there are two available solutions:

1. Timer-controlled
A load time set point for the GB/TB and MB control 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. The set points are found in menus 6230, 7080 and 8190.

On AGC mains controllers (AGC 145/146) , the spring load feedback from the tie breaker can be connected instead of the GB spring load feedback.

2. Digital input
Two configurable inputs to be used for feedbacks from the breakers: One for GB/TB spring loaded and one for MB spring loaded. After the breaker has been opened it will not be allowed to close again before the configured inputs are active. The inputs are configured in the ML-2 utility software. When the timers are counting, the remaining time is shown in the display.

If the two solutions are used together, both requirements are to be met before closing of the breaker is allowed.

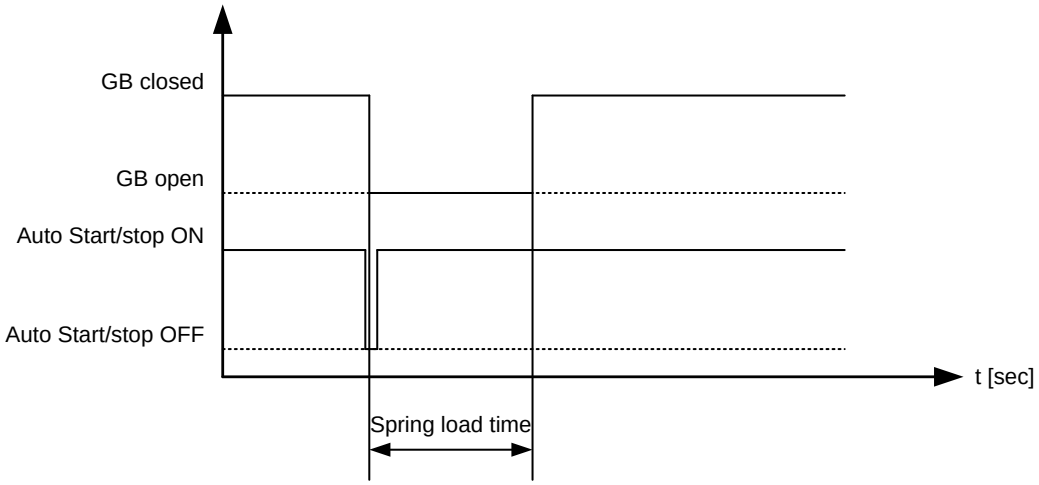
Breaker LED indication
To alert the user that the breaker close sequence has been initiated but is waiting for permission to give the close command, the LED indication for the breaker will be flashing yellow in this case.

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

6.5.1 Principle

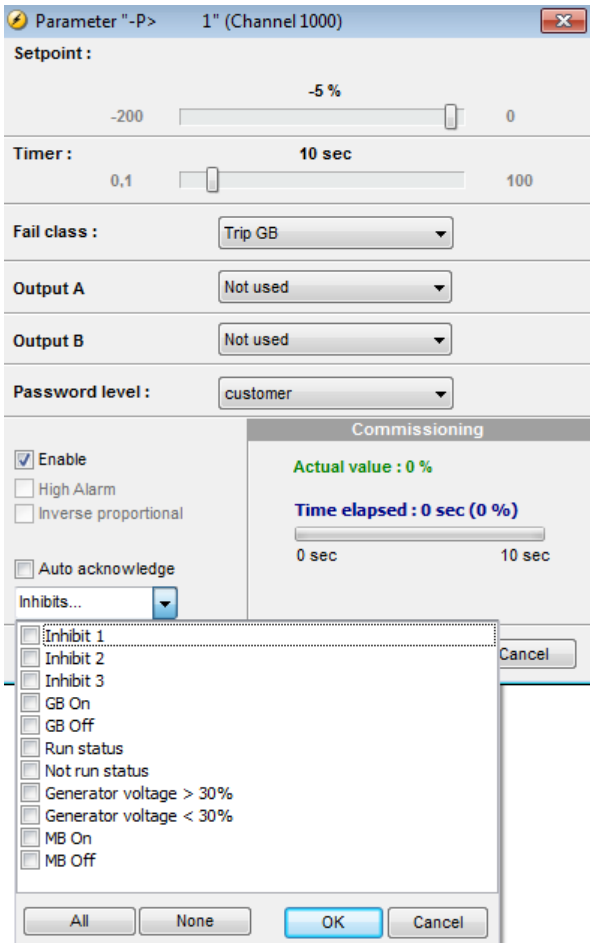
The diagram shows an example where a single AGC in island mode is controlled by the AUTO start/stop input.

This is what happens: When the AUTO start/stop input deactivates, the GB opens. The AUTO start/stop is reactivated immediately after the GB has opened, for example by the operator through a switch in the switchboard. However, the AGC waits a while before it issues the close signal again, because the spring load time must expire (or the digital input must be activated - not shown in this example). Then the AGC issues the close signal.



6.6 Alarm inhibit

In order to select when the alarms are to be active, a configurable inhibit setting for each alarm has been made. The inhibit functionality is a way to make an alarm inactive when the events, chosen in the menu below, are active. The inhibit functionality is only available via the PC utility software. For each alarm, there is a drop-down window where it is possible to select which signals have to be present in order to inhibit the alarm.



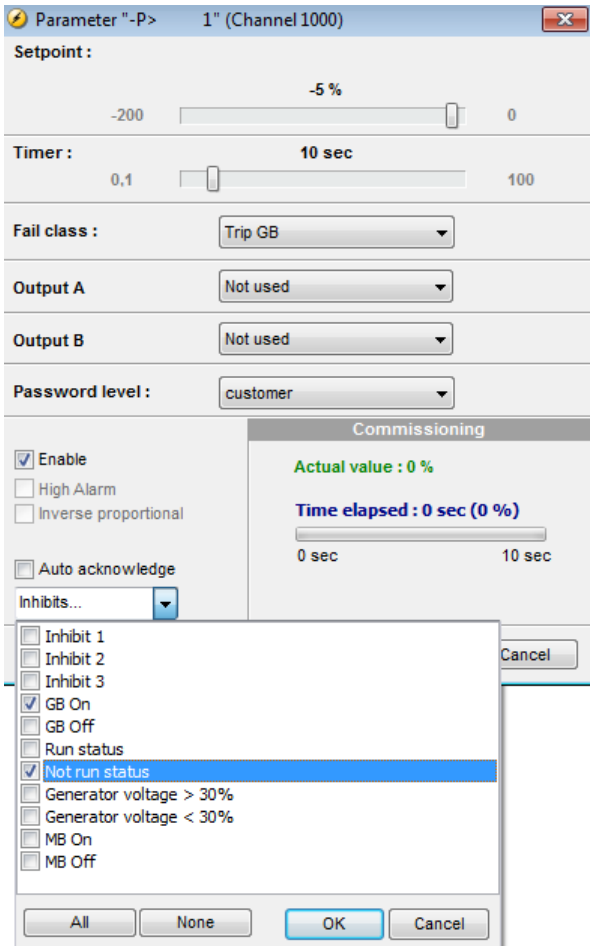
Selections for alarm inhibit:

Function	Description
Inhibit 1	M-Logic outputs: Conditions are programmed in M-Logic
Inhibit 2	
Inhibit 3	
GB ON (TB ON)	The generator breaker is closed
GB OFF (TB ON)	The generator breaker is open
Run status	Running detected and the timer in menu 6160 expired
Not run status	Running not detected or the timer in menu 6160 not expired
Generator voltage > 30%	Generator voltage is above 30% of nominal
Generator voltage < 30%	Generator voltage is below 30% of nominal
MB ON	The mains breaker is closed
MB OFF	The mains breaker is open

The timer in 6160 is not used if binary running feedback is used.

Inhibit of the alarm is active as long as one of the selected inhibit functions is active.

Example:

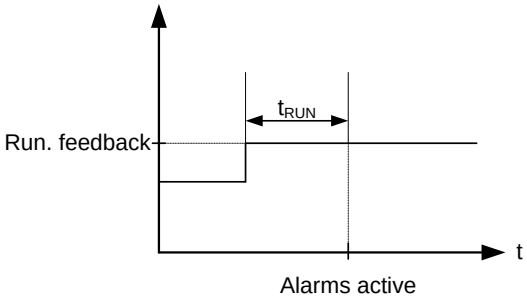


In this example, inhibit is set to *Not run status* and *GB ON*. Here, the alarm will only be active when the generator is running and disabled again when the GB is closed.

6.6.1 Run status (6160)

Alarms can be adjusted to activate only when the running feedback is active and a specific time delay has expired.

The diagram below illustrates that after activation of the running feedback, a run status delay will expire. When the delay expires, alarms with *Run status* will be activated.



The timer is ignored if digital running feedback is used.

6.7 Access lock

The purpose of access lock is to deny the operator the possibility to configure the unit parameters and change the running modes from the display and digital inputs. When activated the display will read "Access lock" when pushing the display buttons affected by the access lock, please see the table below.

The input to be used for the access lock function is defined in the PC utility software (USW).

Access lock will typically be activated from a key switch installed behind the door of the switchboard cabinet.

Display Button	Button icon	Button status	Comment
START		Not active	
STOP		Not active	
GB ON		Not active	
GB OFF		Not active	
MB ON		Not active	
MB OFF		Not active	
TEST		Not active	
AUTO		Not active	
MANUAL		Not active	
LED TEST		Active	
HORN		Active	
UP		Active	
SELECT		Active	If the access lock is activated when the view menu system is displayed, it is not possible to access the setup menu. If the access lock is activated when the setup menu system is displayed, this button is not active.
DOWN		Active	
ESC		Active	

After three minutes, the display returns to the view menu system. The setup menu system can only be entered again if the access lock is deactivated.

The following digital input functions are affected when access lock is activated:

Digital input name	Input status
Remote Start	Not active
Remote Stop	Not active
Remote GB ON	Not active
Remote GB OFF	Not active
Remote MB ON	Not active
Remote MB OFF	Not active
Test mode	Not active
Auto mode	Not active
Manual mode	Not active
Block	Not active

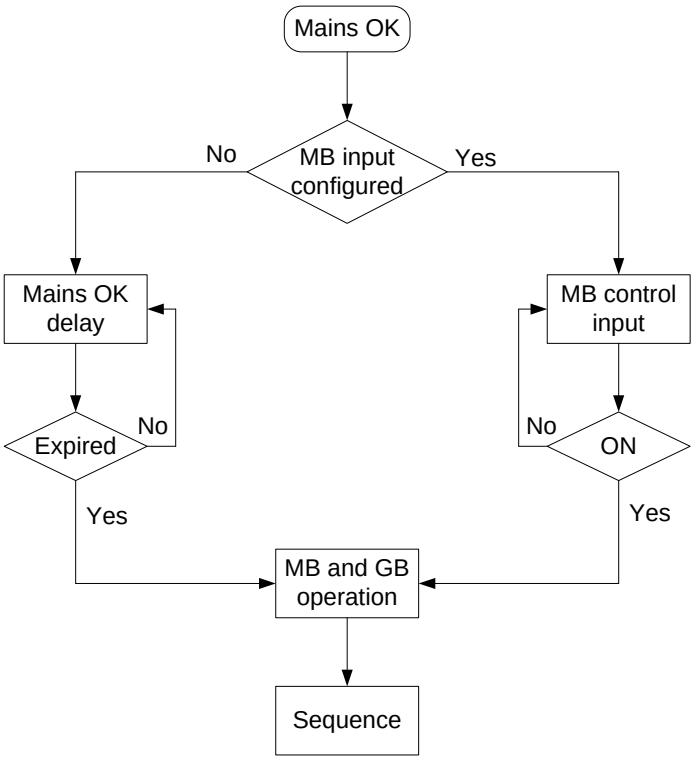
AOP buttons are not locked when access lock is activated.

6.8 Digital mains breaker control

The unit will normally execute the automatic mains failure sequence based on the settings adjusted in the system setup. Besides these settings it is possible to configure a digital input that can be used to control the mains return sequence. This input is the "Mains Okay" input. The purpose of this function is to let an external device or an operator control the mains return sequence. The external device can for example be a PLC.

The flowchart below shows that if the input is configured, it needs to be activated (by a pulse) in order to initiate the mains return sequence. The load will continue on generator supply if the input is not activated.

The mains OK delay is not used at all when the "Mains Okay" input is configured.



6.9 Command timers

The purpose of the command timers is, for example, to be able to start and stop the genset automatically at specific times each weekday or certain weekdays. If auto mode is activated, this function is available in island operation and load takeover operation. Up to four command timers can, for example, be used for start and stop. The command timers are available in M-Logic and can be used for other purposes than starting and stopping the genset automatically. The settings can either be set up through the PC utility software or the display. Each command timer can be set for the following time periods:

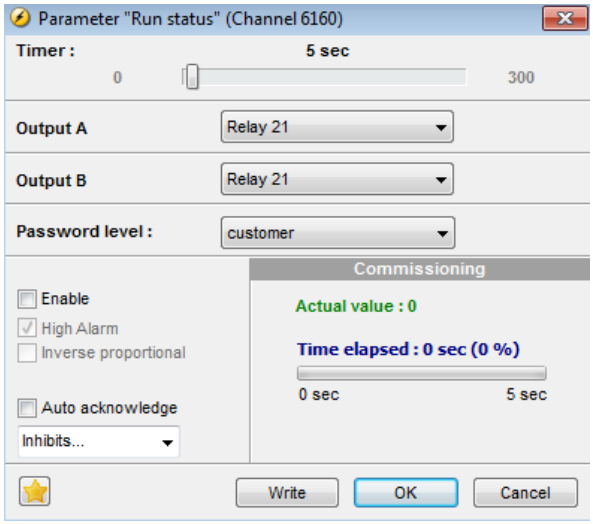
- Individual days (MO, TU, WE, TH, FR, SA, SU)
- MO, TU, WE, TH
- MO, TU, WE, TH, FR
- MO, TU, WE, TH, FR, SA, SU
- SA, SU

To start in AUTO mode, the "Auto start/stop" command can be programmed in M-Logic or in the input settings.

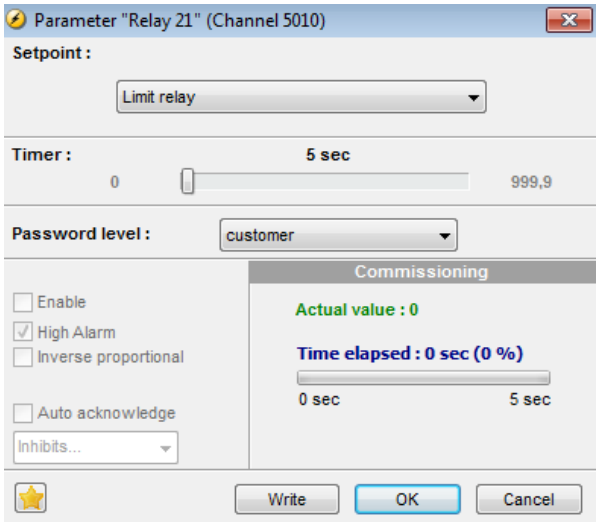
The time-dependent commands are flags that are raised when the command timer is in the active period.

6.10 Running output

6160 Run status can be adjusted to give a digital output when the genset is running.



Select the correct relay number in output A and output B and enable the function. Change the relay function to limit in the I/O menu. Then the relay will activate, but no alarm will appear.



If the relay function is not changed to "limit" function, an alarm will appear at every running situation.

6.11 Idle running

6.11.1 Idle running

The purpose of the idle run function is to change the start and stop sequences to allow the genset to operate under low temperature conditions.

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 main purpose of the function is to prevent the genset from stopping. The timers are available to make the function flexible.

The speed governor must be prepared for the idle run function if this function is to be used.

The function is typically used in installations where the genset is exposed to low temperatures which could generate starting problems or damage the genset.

6.11.2 Description

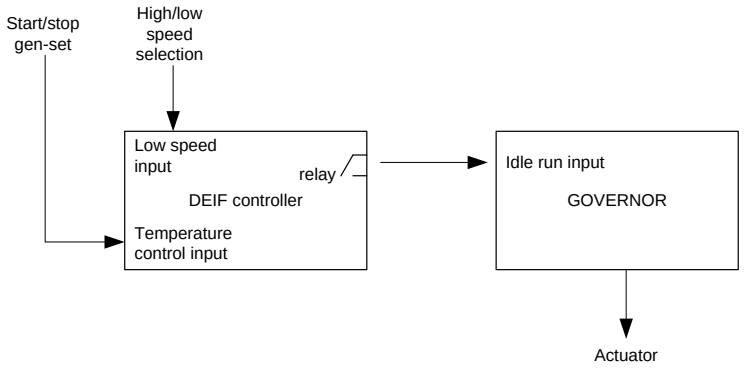
The function is enabled and configured in 6290 Idle running. It has to be noted that the governor itself must handle the idle speed based on a digital signal from the unit (see the principle diagram below).

When the function is enabled, two digital inputs are used for control purposes. These inputs must be configured through the Utility software:

No.	Input	Description
1	Low speed input	This input is used to change between idle speed and nominal speed. This input does not prevent the genset from stopping - it is only a selection between idle and nominal speed.
2	Temperature control input	When this input is activated, the genset will start. It will not be able to stop as long as this input is activated. To use temperature control it is necessary to enable idle speed in parameter 6295.

If the idle run function is selected by means of the timer, the low speed input is overruled.

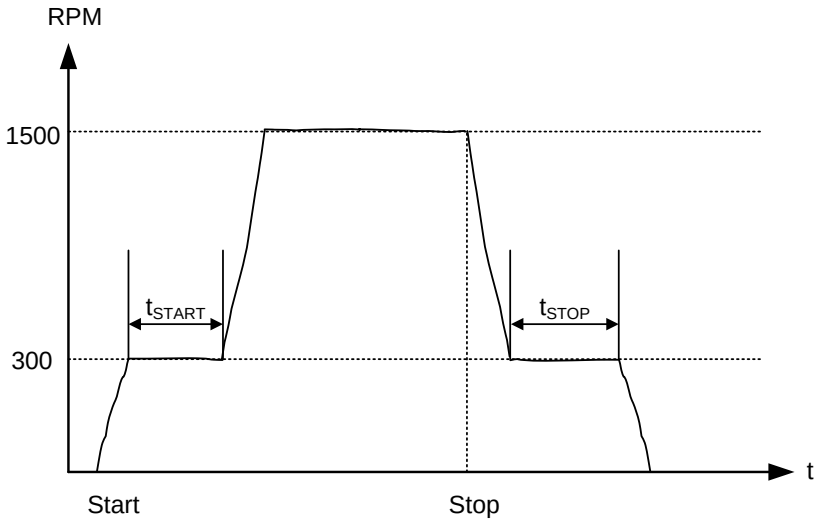
Turbo chargers not originally prepared for operating in the low speed area can be damaged if the genset is running in "idle run" for too long.



6.11.3 Examples

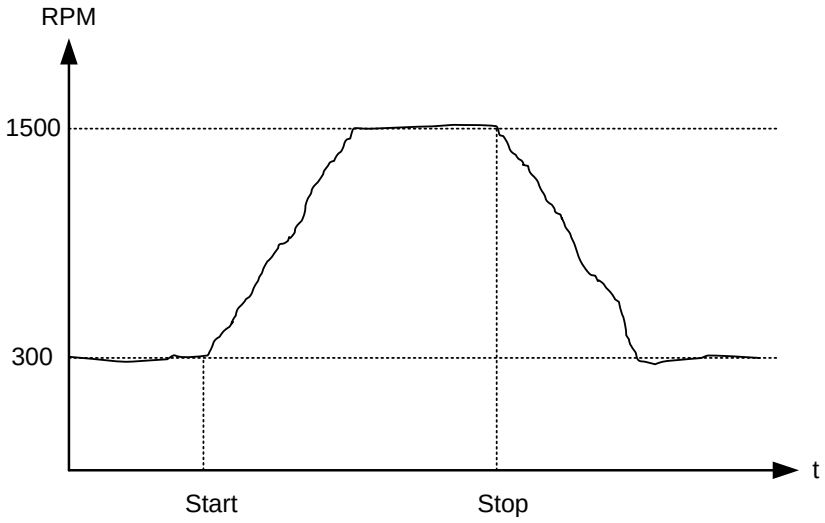
Idle speed during starting and stopping
In this example both the start and the stop timers are activated.

The start and stop sequences are changed in order to let the genset 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, no stopping
In this example both timers are deactivated.

If the genset is to be prevented from stopping, then the digital input "temp control" must be left ON at all times. In that case the characteristic looks like this:



The oil pressure alarm (RMI oil) will be enabled during idle run if set to "ON".

6.11.4 Inhibit

The alarms that are deactivated by the inhibit function are inhibited in the usual manner, except for the oil pressure alarms; RMI oil 6,7 and 8 which are active during "idle run" as well.

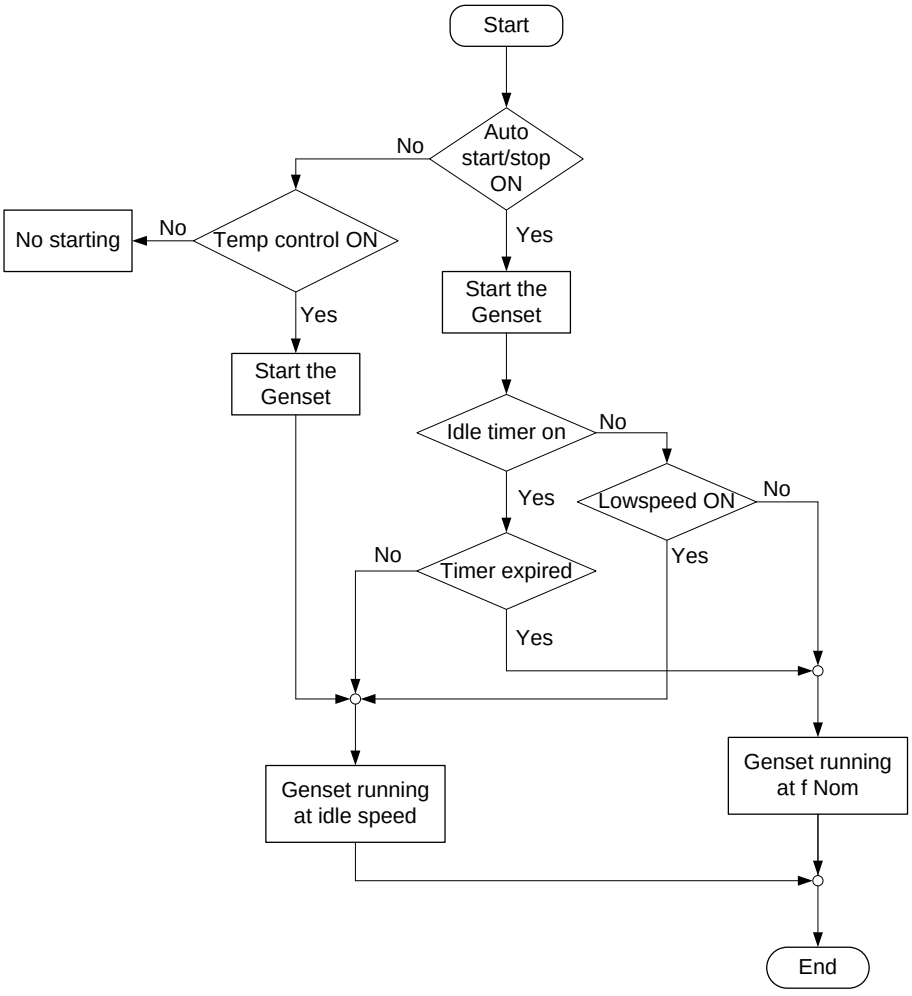
6.11.5 Running signal

The running feedback must be activated when the genset is running in idle mode.

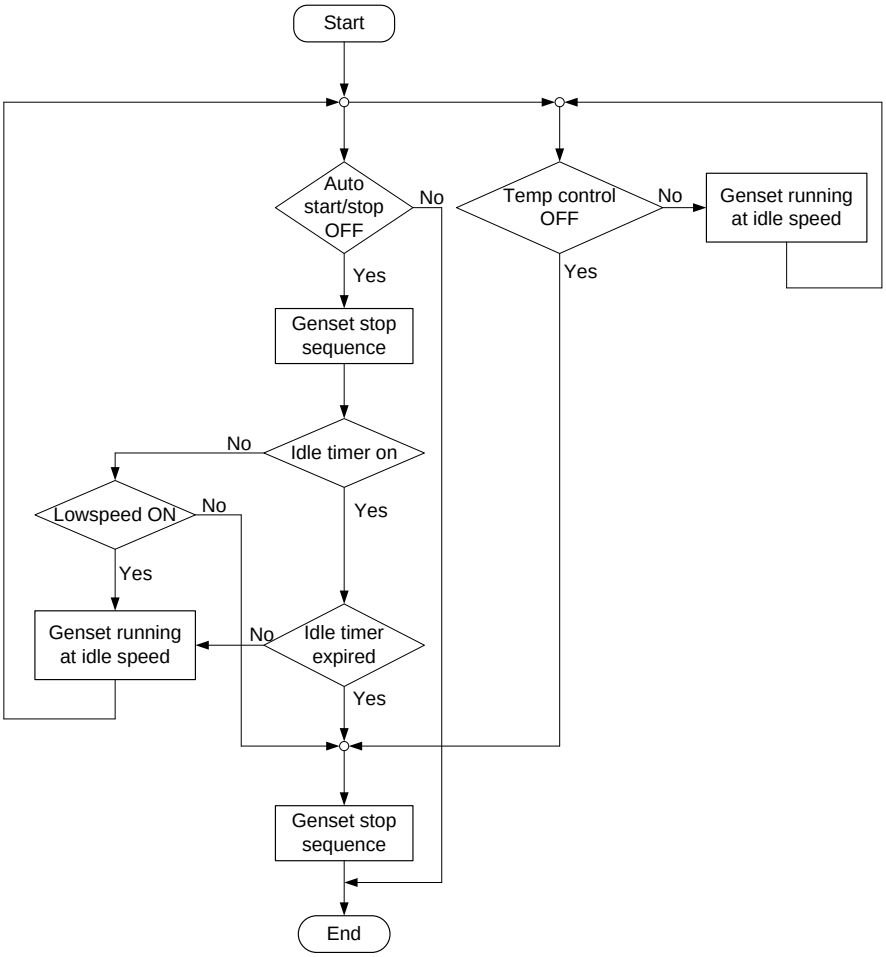
6.11.6 Idle speed flowcharts

The flowcharts illustrate the starting and stopping of the genset by use of the inputs "temp control" and "low speed".

6.11.7 Start


Start
Auto start/stop ON
No
Yes
Temp control ON
No
No starting
Yes
Start the Genset
Start the Genset
Idle timer on
No
Yes
Lowspeed ON
No
Yes
Timer expired
No
Yes
Genset running at idle speed
Genset running at f Nom
End

6.11.8 Stop



6.12 Engine heater

This function is used to control the temperature of the engine. A sensor measuring the cooling water temperature is used to activate an external heating system to keep the engine at a minimum temperature.

The set points adjusted in menu 6320 are:

Set point: This set point +/- the hysteresis is the start and stop points for the engine heater.

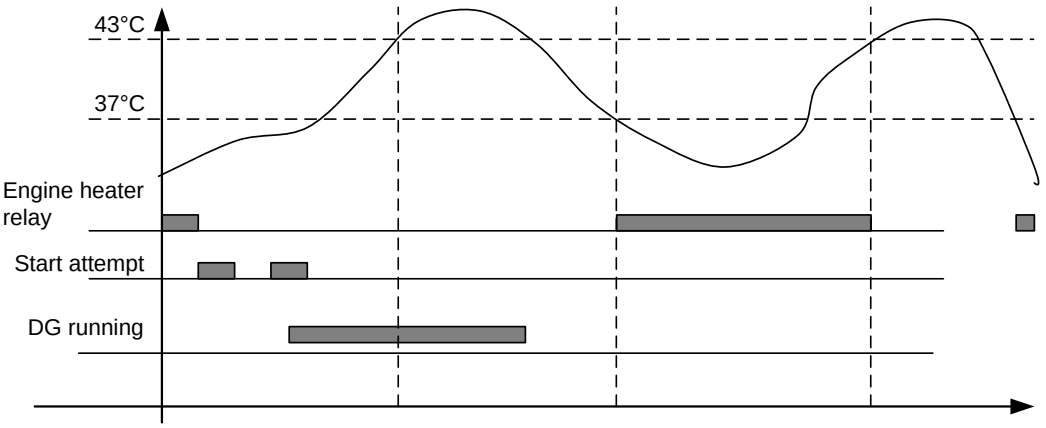
Output A: The relay output for the engine heater.

Input type: Multi-input to be used for temperature measurement.

Hysteresis: This decides how big a deviation from the set point is needed to activate/deactivate the engine heater.

Enable: Enables the engine heater function.

Principle diagram:



The engine heater function is only active when the engine is stopped.

6.12.1 Engine heater alarm

If the temperature keeps dropping after the start set point has been exceeded, an alarm will be raised if configured in menu 6330.

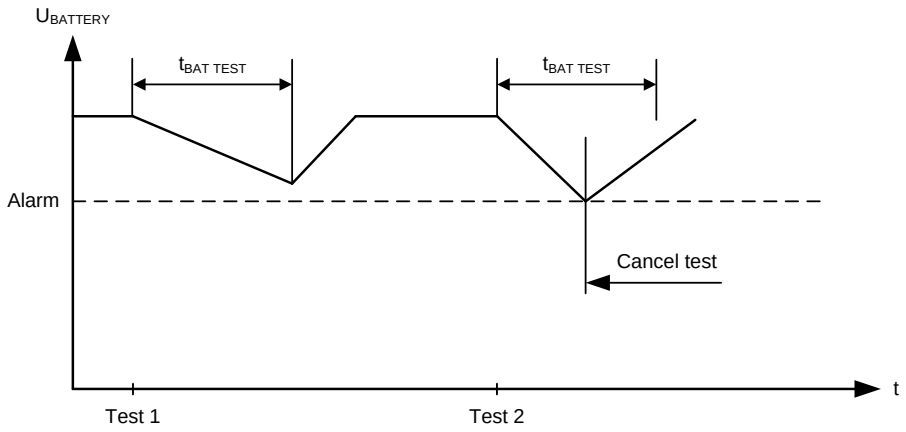
6.13 Battery test

6.13.1 Battery test

This function gives the possibility to test the condition of the battery. The battery test can be initiated with a digital input and is available when the genset is in semi-auto and auto mode.

If a mains failure occurs during the battery test sequence, the test will automatically be interrupted, and the automatic mains failure start up sequence will be activated.

During the test, the battery voltage will decrease, and an alarm will occur if it drops to the set point.



The drawing shows that test #1 is carried out without a large voltage drop of the battery voltage, whereas test #2 reaches the alarm set point.

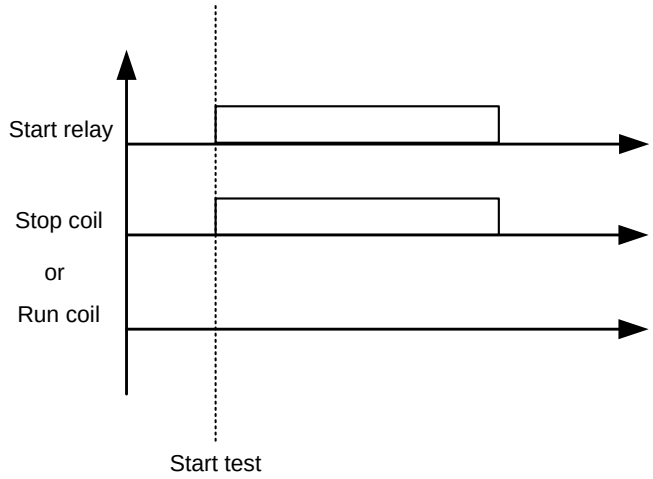
As there is no reason to wear the battery down even more, the test stops when the battery test alarm occurs.

The test is typically used at periodical intervals, for example once every week. The engine must be at a standstill when the test is started. Otherwise, the test command will be ignored.

The stop relay will act depending on the coil type:

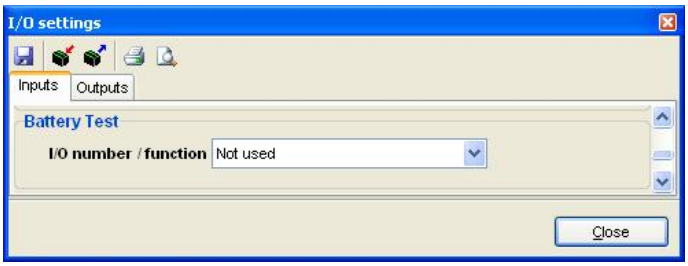
Stop coil: *The stop relay activates during the test.*
Run coil: *The stop relay stays deactivated during the test.*

The drawing below shows that when the test is started, the start relay activates making the engine turn.



6.13.2 Input configuration

If this function is to be used, it is necessary to configure a digital input that initiates the function. This is done in the dialogue box below:



If AUTO mode is selected, the mains failure sequence will be initiated if a mains failure occurs during the battery test.

6.13.3 Auto configuration

If the automatic battery test is used, the function has to be enabled in menu 6420. When the function is enabled, the battery test will be carried out with a specified interval, for example once a week. Completed battery tests will be logged in a separate battery test log.

The factory setting in menu 6424 is 52 weeks. This means, that the automatic battery test will be executed once a year.

6.14 Ventilation

This function can be used to control the cooling of the engine. The purpose is to use a multi-input for measuring the cooling water temperature and that way activate an external ventilation system to keep the engine below a maximum temperature. The functionality is shown in the below diagram.

Set points available **(6460 Max ventilation):**

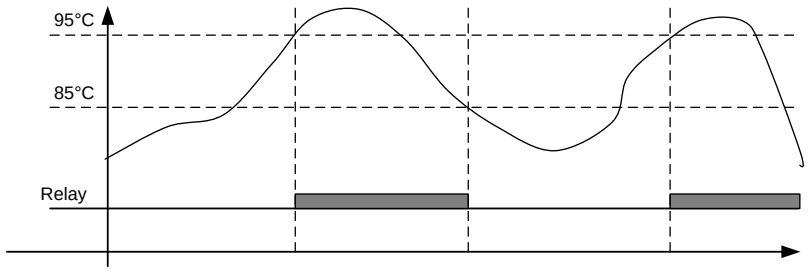
Set point: The limit for activation of the relay set in OA.

Output A (OA): The relay activated when the set point is exceeded.

Hysteresis: The number of degrees the temperature has to be below the set point in order to deactivate the relay set in OA.

Enable: Enable/disable the ventilation function.

The type of input to use for the temperature measurement is selected in menu 6323 Engine heater.



6.14.1 Max. ventilation alarm

Two alarms can be set up in menu 6470 and menu 6480 to activate if the temperature keeps rising after the start set point has been reached.

6.15 Not in auto

This function can be used for indication or to raise an alarm in case the system is not in Auto. The function is set up in menu 6540.

6.16 Fuel pump logic

The fuel pump logic is used to start and stop the fuel supply pump to maintain the fuel level in the service tank at pre-defined levels. The start and stop limits are detected from one of the three multi-inputs.

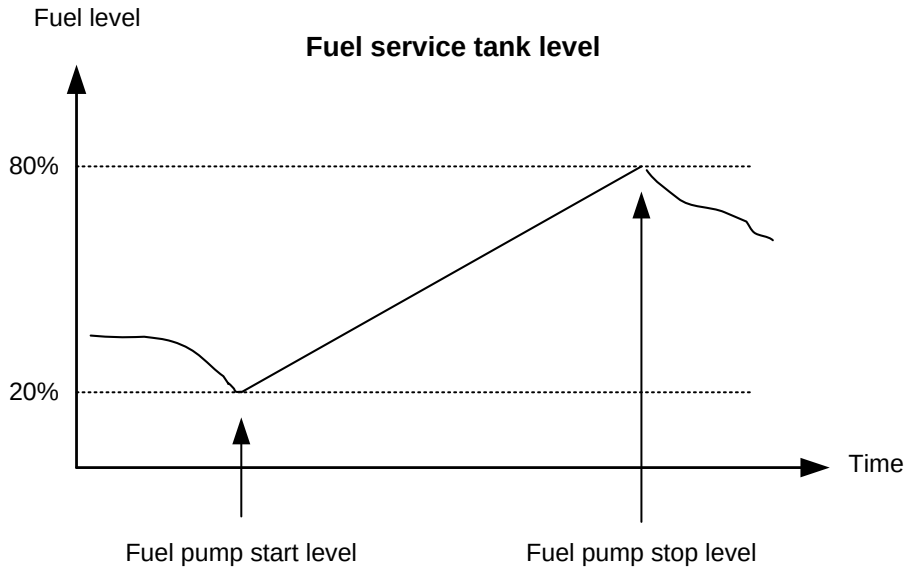
Set points available in menu 6550:

Parame-ter	Name	Function
6551	Fuel pump log. start	Fuel transfer pump starting point in percentage.
6552	Fuel pump log. stop	Fuel transfer pump stopping point in percentage.
6553	Fuel fill check	Delay timer before fuel fill check alarm is activated.
6554	Output A	The output relay to be used for control of the fuel pump. The selected relay activates below the start limit and deactivates above the stop level.
6555	Type	The multi-input or external analogue input to be used for the fuel level sensor. **Choose multi-input if 4 to 20 mA is used.** **Choose "auto detection" if an RMI is used.**
6556	Fail class	The fail class of the fuel fill alarm.
6557	Fuel fill check slope	This parameter defines the slope for the fuel fill check alarm.

The fuel pump relay can be activated via M-Logic.

The output relay should be configured as a limit relay. Otherwise, an alarm will be raised whenever the output is activated.

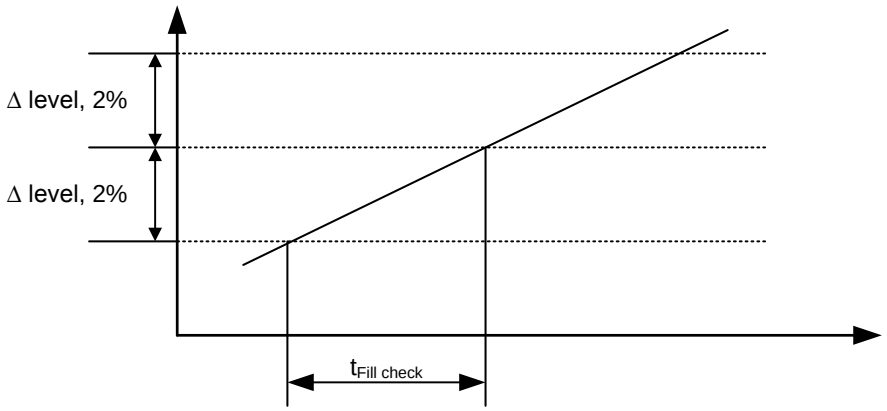
The drawing below shows how the fuel pump is activated when the level reaches 20 % and stopped again when the level has reached 80 %.



6.16.1 Fuel fill check

The fuel pump logic includes a **fuel fill check** function.

When the fuel pump is running, the fuel level must increase by at least the percentage value in menu 6557 **fuel fill slope** within the **fuel fill check** timer set in menu 6553. If the fuel level does not increase as the slope defines within the adjusted delay time, then the fuel pump relay deactivates and a **fuel fill alarm** occurs. The **fuel fill alarm** can be enabled/disabled in menu 6553.



The level of increase of 2 % that is shown above is just an example and can be changed in parameter 6557 (fuel fill slope).

6.17 Fail class

6.17.1 Fail class

All activated alarms must be configured with a fail class. The fail classes define the category of the alarms and the subsequent alarm action.

Seven different fail classes can be used. The tables below illustrate the action of each fail class when the engine is running or stopped.

6.17.2 Engine running

Fail class	Action	Alarm horn relay	Alarm display	Trip of gen. breaker	Trip of mains breaker	Cooling-down genset	Stop genset
1 Block		X	X				
2 Warning		X	X				
3 Trip GB		X	X	X			
4 Trip + stop		X	X	X		X	X
5 Shutdown		X	X	X			X
6 Trip MB		X	X		X		
7 Trip MB/GB		X	X	(X)	X		

The table illustrates the action of the fail classes. If, for instance, an alarm has been configured with the "shutdown" fail class, the following actions occur.

- The alarm horn relay will activate
- The alarm will be displayed in the alarm info screen
- The generator breaker will open instantly
- The genset is stopped instantly
- The genset cannot be started from the unit (see next table)

The fail class "Trip MB/GB" will only trip the generator breaker if there is no mains breaker present.

6.17.3 Engine stopped

Fail class	Action	Block engine start	Block MB sequence	Block GB sequence
1 Block		X		
2 Warning				
3 Trip GB		X		X
4 Trip + stop		X		X
5 Shutdown		X		X
6 Trip MB			X	
7 Trip MB/GB		(X)	X	(X)

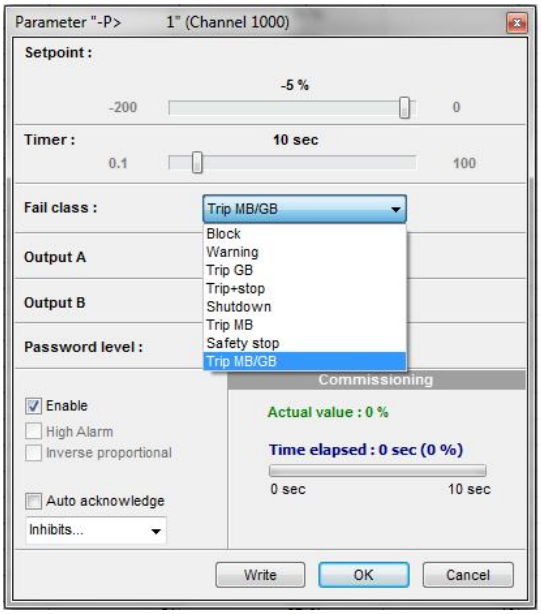
In addition to the actions defined by the fail classes, it is possible to activate one or two relay outputs if additional relays are available in the unit.

The fail class "Trip MB/GB" will only block engine start and GB sequence if no mains breaker is present.

6.17.4 Fail class configuration

The fail class can be selected for each alarm function either via the display or the PC software.

To change the fail class via the PC software, the alarm function to be configured must be selected. Select the desired fail class in the fail class roll-down panel.



6.18 Service timers

The unit is able to monitor the maintenance intervals. Two service timers are available to cover different intervals. The service timers are set up in menus 6110 and 6120.

The function is based on running hours. When the adjusted time expires, the unit will display an alarm. The running hours is counting when the running feedback is present.

Set points available in menus 6110 and 6120:

Enable: Enable/disable the alarm function.

Running hours: The number of running hours to activate the alarm. The service timer alarm will be activated as soon as the running hours have been reached.

Day: The number of days to activate the alarm – if the running hours are not reached before this number of days, the alarm will still be activated. The service timer alarm will be activated at 8:00 AM on the day the alarm expires.

Fail class: The fail class of the alarm.

Output A: Relay to be activated when the alarm is activated.

Reset: Enabling this will reset the service timer to zero. This must be done when the alarm is activated.

6.19 Digital inputs

The unit has a number of binary inputs, some of which are configurable and some are not.

	Input function	Auto	Semi	Test	Man	Block	Configurable	Input type
1	Shutdown override	X	X	X	X	X	Configurable	Constant
2	Access lock	X	X	X	X	X	Configurable	Constant
3	Binary running detection	X	X	X	X	X	Configurable	Constant
4	Remote start		X		X		Configurable	Pulse
5	Remote stop		X		X		Configurable	Pulse
6	Test	X	X		X	X	Configurable	Pulse
7	Auto		X	X	X	X	Configurable	Pulse
8	Manual		X	X		X	Configurable	Pulse
9	Block	X	X	X	X		Configurable	Constant
10	Remote GB ON		X		X		Configurable	Pulse
11	Remote GB OFF		X		X		Configurable	Pulse
12	Remote MB ON		X		X		Configurable	Pulse
13	Remote MB OFF		X		X		Configurable	Pulse
14	Remote alarm acknowledge	X	X	X	X	X	Configurable	Constant
15	Auto start/stop	X					Configurable	Constant
16	Remove starter	X	X	X	X		Configurable	Constant
17	GB position ON	X	X	X	X	X	Configurable	Constant
18	GB position OFF	X	X	X	X	X	Configurable	Constant
19	MB position ON	X	X	X	X	X	Configurable	Constant
20	MB position OFF	X	X	X	X	X	Configurable	Constant
21	Emergency stop	X	X	X	X	X	Not configurable	Constant
22	Low speed	X	X	X			Configurable	Constant
23	Temperature control	X	X	X			Configurable	Constant
24	Battery test	X	X				Configurable	Pulse
25	Mains Okay	X	X	X	X	X	Configurable	Pulse
26	GB close inhibit	X	X		X	X	Configurable	Constant
27	MB close inhibit	X	X	X	X	X	Configurable	Constant
28	Enable mode shift	X	X	X	X	X	Configurable	Constant
29	Start enable	X	X	X	X		Configurable	Constant
30	Alternative start	X	X	X	X	X	Configurable	Constant
31	Switchboard error	X	X	X	X	X	Configurable	Constant
32	Total test	X	X	X	X	X	Configurable	Constant
33	GB spring loaded	X	X	X	X	X	Configurable	Constant
34	MB spring loaded	X	X	X	X	X	Configurable	Constant

	Input function	Auto	Semi	Test	Man	Block	Configurable	Input type
35	D+ (digital running feedback)	X	X	X	X	X	Configurable	Constant
36	Inhibit Engine alarms	X	X	X	X	X	Configurable	Constant

6.19.1 Functional description

1. Shutdown override
This input deactivates all protections except the overspeed protection and the emergency stop input. The number of start attempts is seven by default, but it can be configured in **6180 Start**. Also a special cool down timer is used in the stop sequence after an activation of this input.

2. Access lock
Activating the access lock input deactivates the control display push-buttons. It will only be possible to view measurements, alarms and the log.

3. Binary running detection
The input is used as a running indication of the engine. When the input is activated, the start relay is deactivated.

4. Remote start
This input initiates the start sequence of the genset when semi-auto or manual mode is selected.

5. Remote stop
This input initiates the stop sequence of the genset when semi-auto or manual mode is selected. The genset will stop without cooling down.

6. Test
Changes the present running mode to test.

7. Auto
Changes the present running mode to auto.

. Manual
Changes the present running mode to manual.

9. Block
Changes the present running mode to block.

When block mode is selected, the running mode cannot be changed by activating the digital inputs.

10. Remote GB ON
The generator breaker ON sequence will be initiated and the breaker will close if the mains breaker is opened.

11. Remote GB OFF
The generator breaker OFF sequence will be initiated.

12. Remote MB ON
The mains breaker ON sequence will be initiated.

13. Remote MB OFF
The mains breaker OFF sequence will be initiated.

14. Remote alarm acknowledge
Acknowledges all present alarms, and the alarm LED on the display stops flashing.

15. Auto start/stop
The genset will start when this input is activated. The genset will be stopped if the input is deactivated. The input can be used when the unit is in island operation, load takeover and the AUTO running mode is selected.

16. Remove starter
The start sequence is deactivated. This means the start relay deactivates, and the starter motor will disengage.

17. Generator breaker closed feedback (GB position ON)
The input function is used as an indication of the generator breaker position. The unit requires this feedback when the breaker is closed or a position failure alarm occurs.

18. Generator breaker open feedback (GB position OFF)
Th input function is used as an indication of the generator breaker position. The unit requires this feedback when the breaker is opened or a position failure alarm occurs.

19. Mains breaker closed feedback (MB position ON)
The input function is used as an indication of the mains breaker position. The unit requires this feedback when the breaker is closed or a position failure alarm occurs.

20. Mains breaker open feedback (MB position OFF)
The input function is used as an indication of the mains breaker position. The unit requires this feedback when the breaker is opened or a position failure alarm occurs.

21. Emergency stop
The input shuts down the engine immediately. At the same time it opens the generator breaker.

The shutdown fail class must be selected.

22. Low speed
Disables the regulators and keeps the genset running at a low RPM.

The governor must be prepared for this function.

23. Temperature control
This input is part of the idle mode function. When the input is high, then the genset starts. It starts at high or low speed, depending on the activation of the low speed input. When the input is deactivated, then the genset goes to idle mode (low speed = ON), or it stops (low speed = OFF).

24. Battery test
Activates the starter without starting the genset. If the battery is weak, the test will cause the battery voltage to drop more than acceptable, and an alarm will occur.

25. Mains Okay
Disables the "mains OK delay" timer. The MB close sequence will begin when the input is activated.

26. GB close inhibit
When this input is activated, then the generator breaker cannot close. Inhibit used for GB, where ext. PLC or other equipment controls when load is on gen-set.

27. MB close inhibit
When this input is activated, then the mains breaker cannot close.

28. Enable mode shift
The input activates the mode shift function, and the AGC will perform the AMF sequence in case of a mains failure. When the input is configured, the setting in menu 7081 (mode shift ON/OFF) is disregarded.

29. Start enable
The input must be activated to be able to start the engine.

When the genset is started, the input can be removed.

30. Alternative start
This input is used to simulate an AMF failure and this way run a full AMF sequence without a mains failure actually being present.

31. Switchboard error
The input will stop or block the genset depending on running status.

32. Total test
This input will be logged in the event log to indicate that a planned mains failure has been made.

33. GB spring loaded
The AGC will not send a close signal before this feedback is present.

34. MB spring loaded
The AGC will not send a close signal before this feedback is present.

35. D+ (digital running feedback)
This input is used as a running indication of the engine. When the input is activated, the startrelay is deactivated. Input for running feedback from charge generator +D terminal. (Runs when charger U > battery voltage).

36. Inhibit EI alarms
When this input is active, it will inhibit all engine interface (option H5) alarms.

The input functions are set up with the PC utility software, please refer to "Help" in this.

6.20 Outputs

The unit has a number of output functions which can be configured to any available relay.

	Output function	Auto	Semi	Test	Man	Block	Configurable	Output type
1	Status OK	X	X	X	X	X	Configurable	Constant
2	Run coil	X	X	X	X	X	Configurable	Constant
3	Stop coil	X	X	X	X	X	Configurable	Constant
4	Stop coil (not activated in start seq.)	X	X	X	X	X	Configurable	Constant
5	Prepare	X	X	X	X	X	Configurable	Constant
6	Starter (Crank)	X	X	X	X	X	Configurable	Constant
7	Horn	X	X	X	X	X	Configurable	Constant
8	GB on	X	X	X	X	X	Configurable	Continuous
9	GB off	X	X	X	X	X	Configurable	Continuous
10	MB on	X	X	X	X	X	Configurable	Continuous
11	MB off	X	X	X	X	X	Configurable	Continuous

6.20.1 Functional description

1. Status OK

2. Run coil
The relay configured to Run coil will be closed the entire time the engine is supposed to run.

3. Stop coil
This relay will close to stop the engine, and when no running feedback is present, it will stay closed in the ext. stop time (parameter 6212).

4. Stop coil (not activated in start seq.)
The relay configured to this function will do the same as the normal stop coil, with one exception: It will not close between the start attempts.

5. Prepare
This function will close the relay as the first thing in the start sequence. The relay will be closed for the time programmed in parameter 6181. This function is used for preheating the engine or for prelubrication.

6. Starter (Crank)
The relay configured to starter will be closed for the time selected in parameter 6184 in the start sequence.

7. Horn
The horn relay is a common alarm output. This means that every time an alarm state appears, the horn relay will close for the time configured in the parameter 6130 Alarm horn regardless of fail class. If 6130 is set to 0 seconds, it will be on until the reset horn push-button is activated or the alarm(s) has (have) been acknowledged.

8. GB on
The function will close the generator breaker

9. GB off
This function will open the generator breaker

10. MB on
This function will close the mains breaker

11. MB off
This function vil open the mains breaker

6.21 Limit relay

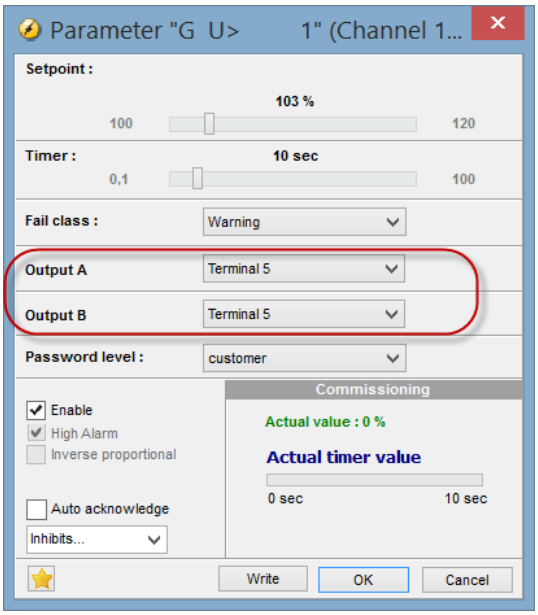
6.21.1 Limit relay

For all alarm functions, it is possible to activate one or two output relays as shown below. This paragraph explains how to use an alarm function to activate an output without any indication of alarm. ON and OFF delay timers are described as well.

If no alarm is needed, it is possible to do one of the following things:

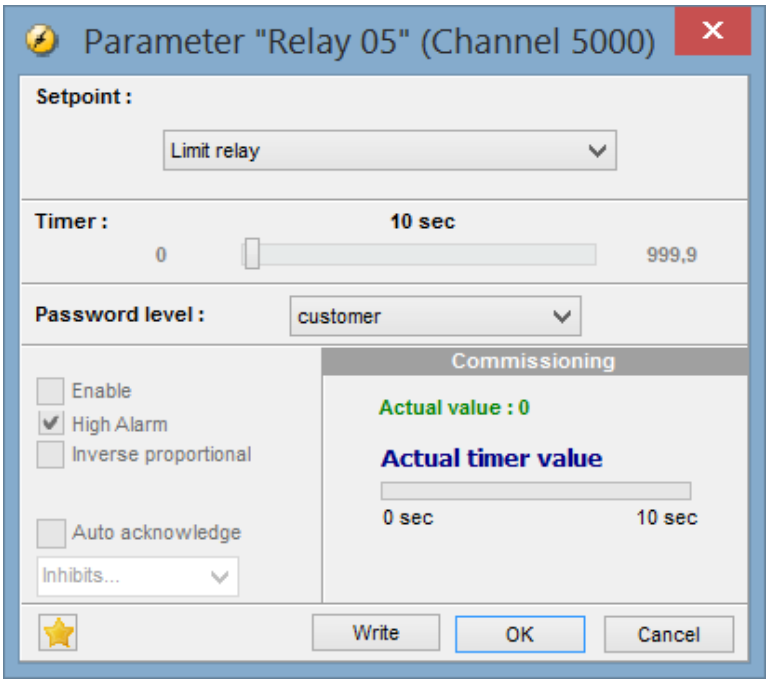
1. Set both output A and output B to Limit.
2. Set both output A and output B to the same specific terminal. If terminal alarm is not required, the set point in the specific relay is set to Limit relay.

In the example below, the relay will close when the generator voltage is above 103 % for 10 seconds, and no alarm will appear on the screen because both output A and output B are configured to relay 5, which is configured as "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.



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 "Limit relay". If it is configured to any "Alarm relay", the relay is deactivated instantly when the alarm conditions disappear and it is acknowledged.

6.22 Multi-inputs

The AGC unit has three multi-inputs which can be configured to be used as the following input types:

1. 4 to 20 mA
2. RMI oil
3. RMI water
4. RMI fuel
5. Binary
6. Pt1000

The function of the multi-inputs can only be configured in the PC utility software. The parameters to change the configuration of the multi-inputs are 10980, 10990 and 11000.

For each input, two alarm levels are available, the menu numbers of the alarm settings for each multi-input is controlled by the configured input type as seen in the following table.

Input type	Multi-input 6	Multi-input 7	Multi-input 8
4 to 20 mA	4120/4130	4250/4260	4380/4390
RMI oil	4180/4190	4310/4320	4440/4450
RMI water	4200/4210	4330/4340	4460/4470
RMI fuel	4220/4230	4350/4360	4480/4490
Binary	3400	3410	3420
Pt1000	4160/4170	4290/4300	N/A

Only one alarm level is available for the digital input type.

The USW only shows the parameter from the selected multi-input. The multi-input is by default set to binary, which means that the only alarm parameters available are 3400, 3410 and 3420. If you want to read the alarms from RMI oil 6, you have to change parameter 10980 to RMI oil 6, when reading the parameters from the device, before you get access to the alarm parameters.

6.22.1 4-20 mA

If one of the multi-inputs has been configured as 4-20 mA, the unit and range of the measured value corresponding to 4-20 mA can be changed in the PC utility software in order to get the correct reading in the display.

6.22.2 RMI inputs

The unit can contain up to three RMI (resistance measurement input). The inputs have different functions, as the hardware design allows for several RMI types.
RMI is a resistance measurement input which can be used together with a resistance dependant sensor. These various types of RMI are available for all multi-inputs:

RMI oil:	Oil pressure
RMI water:	Cooling water temperature
RMI fuel:	Fuel level sensor

For each type of RMI, it is possible to select between different characteristics including a configurable one.

6.22.3 RMI oil

This RMI input is used for measuring the lubricating oil pressure.

- Sensor type 1 = RMI
- Sensor type 2 = RMI
- Sensor type 4 = ESP-100

		RMI sensor type				
Pressure		**Type 1**	**Type 2**	**Type 3**	**Type 4**	**Configurable RMI**
Bar	**psi**	**Ω**	**Ω**	Not used	**Ω**	**Ω**
0	0	10.0	10.0		240	
0.5	7	27.2				
0.7	10				200	
1.0	15	44.9	31.3			
1.4	20				165	
1.5	22	62.9				
2.0	29	81.0	51.5			
2.1	30				135	
2.5	36	99.2				
2.8	40				123	
3.0	44	117.1	71.0			
3.4	50				103	
3.5	51	134.7				
4.0	58	151.9	89.6			
4.1	60				88	
4.5	65	168.3				
4.8	70				74	
5.0	73	184.0	107.3			
5.5	80				60	
6.0	87		124.3			
6.2	90				47	
6.9	100				33	
7.0	102		140.4			
8.0	116		155.7			
9.0	131		170.2			
10.0	145		184.0			

The configurable type is configurable with eight points in the range 0 to 2500 Ω. The resistance as well as the pressure can be adjusted.

If the RMI input is used as a level switch, be aware that no voltage must be connected to the input. If any voltage is applied to the RMI inputs, it will be damaged. Refer to the Application Notes for further wiring information.

6.22.4 RMI water

This RMI input is used for measuring the cooling water temperature.

- Sensor type 1 = RMI
- Sensor type 2 = RMI

- Sensor type 3 = RMI
- Sensor type 4 = EST-250

		RMI sensor type				
Temperature		Type 1	Type 2	Type 3	Type 4	Configurable RMI
°C	°F	Ω	Ω	Ω	Ω	Ω
20.3	68.4				2500	
30	86				1594	
40	104	291.5	480.7	69.3	1029	
50	122	197.3	323.6		680	
60	140	134.0	222.5	36.0	460	
70	158	97.1	157.1		321	
80	176	70.1	113.2	19.8	227	
90	194	51.2	83.2		164	
100	212	38.5	62.4	11.7	120	
110	230	29.1	47.6		89	
120	248	22.4	36.8	7.4	74	
130	266		28.9		52	
140	284		22.8		40	
150	302		18.2			

The configurable type is configurable with eight points in the range 0 to 2500 Ω. The temperature as well as the resistance can be adjusted.

If the RMI input is used as a level switch, be aware that no voltage must be connected to the input. If any voltage is applied to the RMI inputs, it will be damaged. Refer to the Application Notes for further wiring information.

6.22.5 RMI fuel

This RMI input is used for the fuel level sensor.

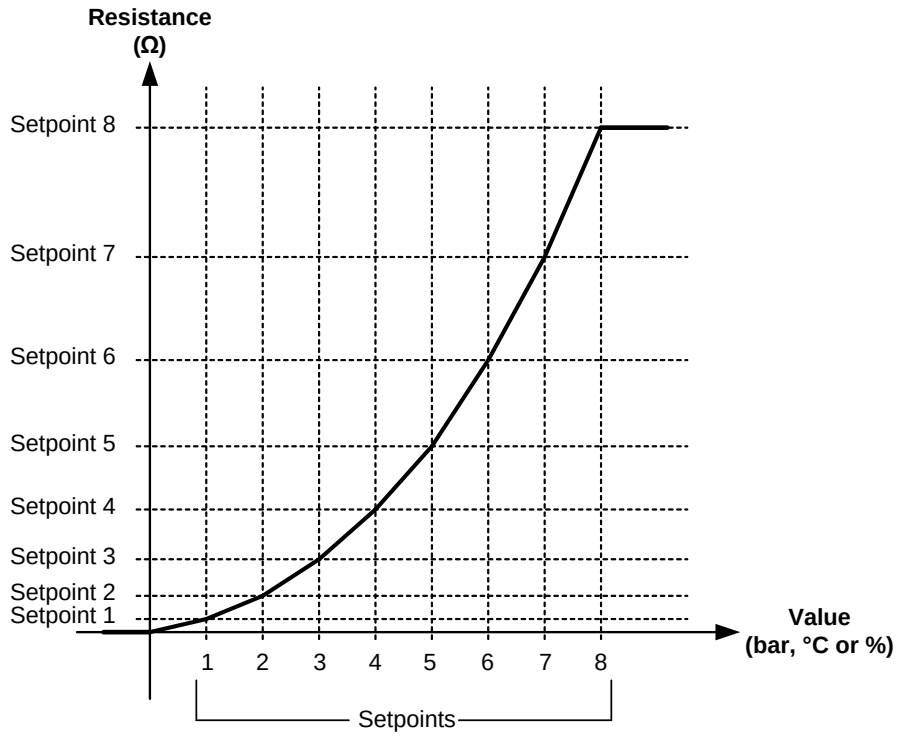
- Sensor type 1 = RMI
- Sensor type 2 = RMI
- Sensor type 4 = ESF

	RMI sensor type				
Fuel level	Type 1	Type 2	Type 3	Type 4	Configurable RMI
%	Ω	Ω	Not used	Ω	
0	78.8	3		240	
25				147	
50				103	
75				60	
100	1.6	180		33	

If the RMI input is used as a level switch, be aware that no voltage must be connected to the input. If any voltage is applied to the RMI inputs, it will be damaged. Refer to the Application Notes for further wiring information.

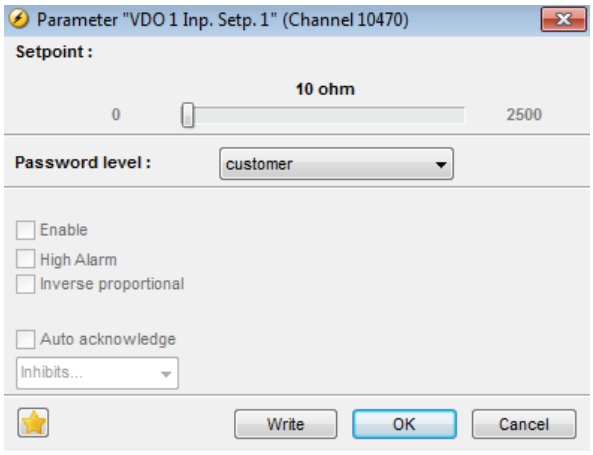
The configurable type is configurable with eight points in the range 0 to 2500 Ω. The value as well as the resistance can be adjusted.

6.22.6 Illustration of configurable inputs



6.22.7 Configuration

The eight curve settings for the configurable RMI inputs cannot be changed in the display, but **only** in the PC utility software. In the PC utility software the configurable inputs are adjusted in this dialogue box:



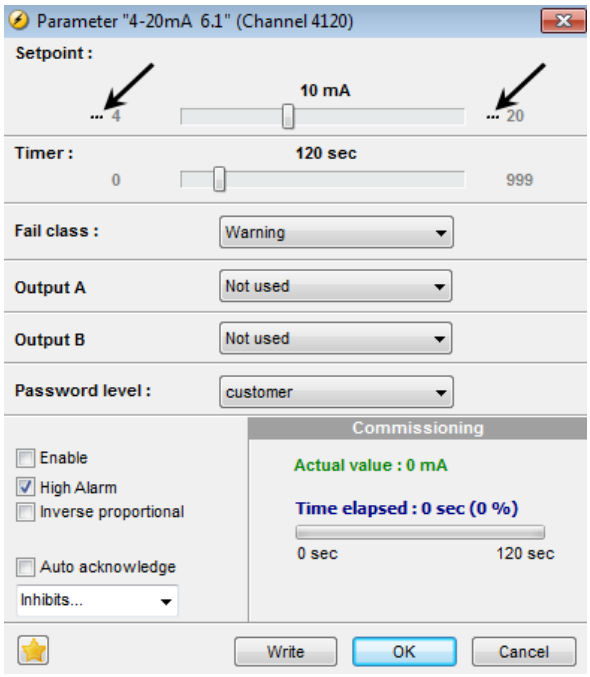
Adjust the resistance of the RMI sensor at the specific measuring value. In the example above the adjustment is 10 Ω at 0.0 bar.

6.22.8 Scaling of 4-20 mA inputs

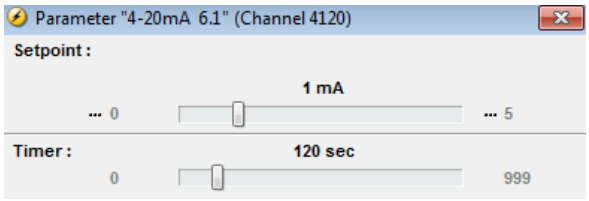
The scaling of the analogue inputs is made to ensure that the readout of the inputs is made with a resolution that fits the connected sensor. It is recommended to follow the guide below when changing the scaling of the analogue inputs.

Scaling example:

1. Use the utility software to configure a multi-input to be 4-20 mA, in this example multi-input 6 (parameter 10980)
2. Read the parameters from the device
3. After reading the parameters, the 4-20 mA alarm appears under the analogue tab in the USW. The example below shows how to adjust the analogue input alarm.
   The three dots to the left of the figures, marked with arrows, are buttons. Adjust the input as required, for example 0-5 bar:

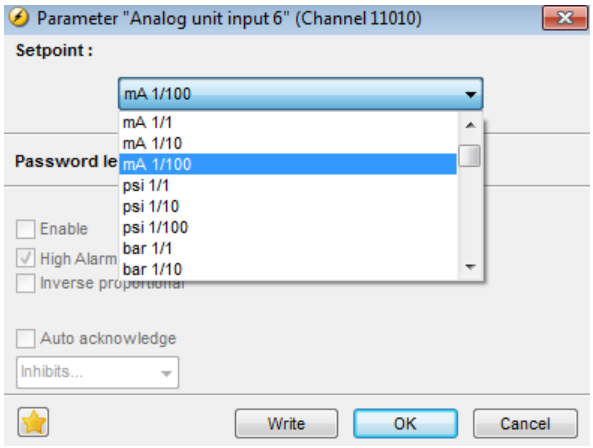


4. Adjust the input as required, for example 0-5 bar:

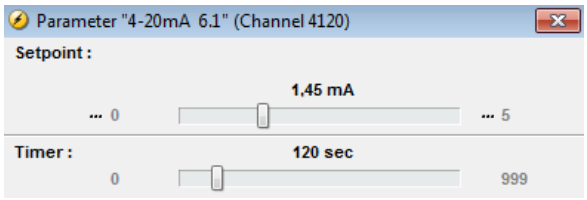


The display will then show 0 at 4 mA.

5. If needed, it is possible to scale the input to fit the sensor (parameter 11010).



6. It is necessary to read the parameters from the device to the computer after changing the scale (1/1, 1/10 or 1/100) settings. This is in order to refresh the parameter list so the alarm settings present the correct value.
7. After reading the parameters, the alarm has been scaled so it needs to be adjusted (0-5 in this example), and this is also a scaling of the value on the display.



The display will now show the scaled value of multi-input 6.
In the example shown above, the value can be adjusted with two decimals. If the parameters were not refreshed, it would still only be possible to adjust the set point without decimals.

Save the parameter file:
After having set up the 4 to 20 mA inputs (HW as well as alarms), the parameter file should be uploaded from the device to the PC and then saved. In this way, the settings will not be modified again if the parameters are reloaded to the device.

6.22.9 Digital

If the multi-inputs are configured to "Digital", they become available as digital inputs which means a switch function input.

6.22.10 Pt1000

This input type can be used for heat sensor, for example cooling water temperature. The unit of the measured value can be changed from Celcius to Fahrenheit in the PC utility software in order to get the desired reading in the display. The setting is located in parameter 10970 and is only accessible from the utility software.
An offset parameter is used for compensation of wire resistance in a 2-wire setup.
Pt1000 offset can be configured in the following parameters:

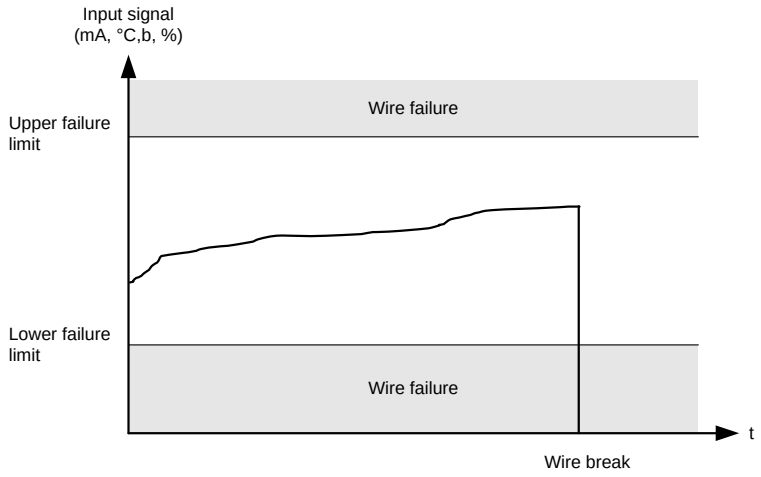
- Multi-input 6: 4167
- Multi-input 7: 4297

6.23 Wire fail detection

If it is necessary to supervise the sensors/wires connected to the multi-inputs and analogue inputs, then it is possible to 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 will be detected as if the wire has made a short-circuit or a break. An alarm with a configurable fail class will be activated.

Input	Wire failure area	Normal range	Wire failure area
4 to 20 mA	< 3 mA	4 to 20 mA	> 21 mA
Pt1000	< 823 ohm	-	> 1941 ohm
RMI Oil, type 1	< 1.0 ohm	-	> 195.0 ohm
RMI Oil, type 2	< 1.0 ohm	-	> 195.0 ohm
RMI Temp, type 1	< 4.0 ohm	-	> 488.0 ohm
RMI Temp, type 2	< 4.0 ohm	-	> 488.0 ohm
RMI Temp, type 3	< 0.6 ohm	-	> 97.0 ohm
RMI Fuel, type 1	< 0.6 ohm	-	> 97.0 ohm
RMI Fuel, type 2	< 1.0 ohm	-	> 195.0 ohm
RMI configurable	< lowest resistance	-	> highest resistance
Level switch	Only active if the switch is open		

Principle
The illustration below shows that when the wire of the input breaks, the measured value will drop to zero. Then the alarm will occur.



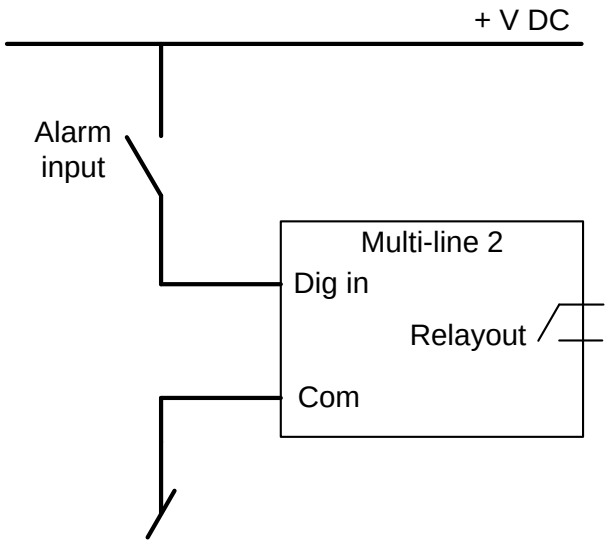
6.24 Input function selection

Digital input alarms can be configured with a possibility to select when the alarms are to be activated. The possible selections of the input function are normally open or normally closed.

The drawing below illustrates a digital input used as an alarm input.

1. Digital input alarm configured to NC, normally closed
   This will initiate an alarm when the signal on the digital input disappears.
2. Digital input alarm configured to NO, normally open
   This will initiate an alarm when the signal on the digital input appears.

The relay output function can be selected to be ND (Normally Deenergised), NE (Normally Energised), Limit or Horn.



6.25 Language selection

The unit has the possibility to display different languages. It is delivered with one master language which is English. This is the default language, and it cannot be changed. In addition to the master language 11 different languages can be configured. This is done via the PC utility software.

The languages are selected in the system setup **menu 6080**. The language can be changed when connected to the PC utility software. It is not possible to make language configuration from the display, but the already configured languages can be selected.

6.26 Text in status line

This table explains the different messages in the status line text.

6.26.1 Standard texts

Condition	Comment	
BLOCK	Block mode is activated	
SIMPLE TEST	Test mode is activated	
FULL TEST		
SIMPLE TEST ###.#min	Test mode activated and test timer counting down	
FULL TEST ###.#min		
ISLAND MAN	Genset stopped or running and no other action taking place	
ISLAND SEMI		
READY ISLAND AUTO	Genset stopped in Auto	
ISLAND ACTIVE	Genset running in Auto	
AMF MAN	Genset stopped or running and no other action taking place	
AMF SEMI		
READY AMF AUTO	Genset stopped in Auto	
AMF ACTIVE	Genset running in Auto	
LOAD TAKEOVER MAN	Genset stopped or running and no other action taking place	
LOAD TAKEOVER SEMI		
READY LTO AUTO	Genset stopped in Auto	
LTO ACTIVE	Genset running in Auto	
DG BLOCKED FOR START	Generator stopped and active alarm(s) on the generator	*Relevant for all variants, except for AGC 110.
BLOCKED FOR START	Engine stopped and active alarm(s) on the engine	*Only for AGC 110.
GB ON BLOCKED	Generator running, GB open and an active "Trip GB" alarm	
SHUTDOWN OVERRIDE	The configurable input is active	
ACCESS LOCK	The configurable input is activated, and the operator tries to activate one of the blocked keys	
GB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
MB TRIP EXTERNALLY	Some external equipment has tripped the breaker	An external trip is logged in the event log
IDLE RUN	The "Idle run" function is active. The genset will not stop until a timer has expired	
IDLE RUN ###.#min	The timer in the "Idle run"' function is active	
Aux. test ##.#V ####s	Battery test activated	
START PREPARE	The start prepare relay is activated	

Condition	Comment	
START RELAY ON	The start relay is activated	
START RELAY OFF	The start relay is deactivated during the start sequence	
MAINS FAILURE	Mains failure and mains failure timer expired	
MAINS FAILURE IN ###s	Frequency or voltage measurement is outside the limits	The timer shown is the Mains failure delay.Text in mains units
MAINS U OK DEL ####s	Mains voltage is OK after a mains failure	The timer shown is the Mains OK delay
MAINS f OK DEL ####s	Mains frequency is OK after a mains failure	The timer shown is the Mains OK delay
Hz/V OK IN ###s	The voltage and frequency on the genset is OK	When the timer runs out it is allowed to operate the generator breaker
COOLING DOWN ###s	Cooling-down period is activated	
COOLING DOWN	Cooling-down period is activated and infinite	Cooling down timer is set to 0.0 s
GENSET STOPPING	This info is shown when cooling down has finished	
EXT. STOP TIME ###s		
EXT. START ORDER	A planned AMF sequence is activated	There is no failure on the mains during this sequence
UNEXPECTED GB ON BB	Another generator breaker is closed onto the busbar (due to a GB position failure) while no voltage is present on the busbar	This indicates that other breakers cannot close to the busbar because of position failure on one or more GBs

6.26.2 Texts only related to power management (AGC 14x)

Status text	Condition	Comment
Mains unit		
UNIT STANDBY	If redundant mains units are present, this message is shown on the redundant unit.	
TB TRIP EXTERNALLY	Some external equipment has tripped the breaker.	An external trip is logged in the event log.
MOUNT CAN CONNECTOR	Connect the power management CAN line	
ADAPT IN PROGRESS	The AGC is receiving the application that it has just been connected to	
SETUP IN PROGRESS	The new AGC is being added to the existing application	
SETUP COMPLETED	Successful update of the application in all AGC units	
REMOVE CAN CONNECTOR	Remove the power management CAN lines.	
All units		
BROADCASTING APPL. #	Broadcast an application through the CAN line.	Broadcasts one of the four applications from one unit to the rest of the AGCs in the power management system.
RECEIVING APPL. #	AGC receiving an application.	
BROADCAST COMPLETED	Successful broadcast of an application.	
RECEIVE COMPLETED	Application received successfully.	
BROADCAST ABORTED	Broadcast terminated.	
RECEIVE ERROR	Application is not received correctly.	

6.27 Counters

Counters for various values are included, and some of these can be adjusted if necessary, for instance if the unit is installed on an existing genset or a new circuit breaker has been installed.

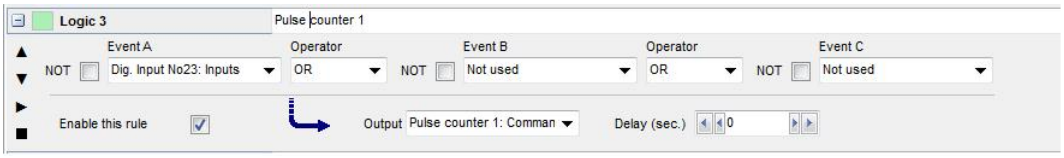
The table shows the adjustable values and their function in menu 6100:

Description	Function	Comment
6101 Running time	Offset adjustment of the total running hours counter.	Counting when the running feedback is present.
6102 Running time	Offset adjustment of the total running thousand hours counter.	Counting when the running feedback is present.
6103 GB operations	Offset adjustment of the number of generator breaker operations.	Counting at each GB close command.
6104 MB operations	Offset adjustment of the number of mains breaker operations.	Counting at each MB close command.
6105 kWh reset	Resets the kWh counter.	Automatically resets to OFF after the reset. The reset function cannot be left active.
6106 Start attempts	Offset adjustment of the number of start attempts.	Counting at each start attempt.

Additional counters for "Running hours" and "Energy" can be read out from the PC utility software.

6.28 Pulse input counters

Two configurable digital inputs can be used for counter input. The two counters can, for example, be used for fuel consumption or heat flow. The two digital inputs can ONLY be configured for pulse inputs via M-Logic, as shown in the example below.



Scaling of pulse input can be set in menu 6851/6861. It is possible to determine the scale value to be pulse/unit or unit/pulse.

Counter values can be read out in display, and the number of decimals can be adjusted in menu 6853/6863.

6.29 M-Logic

The M-Logic functionality is included in the unit and is not an option-dependent function.

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 genset modes and change of running modes.

The M-Logic is part of the PC utility software, and as such, it can only be configured in the PC utility software and not via the display. Please see the M-Logic manual which is available at .

The main purpose of M-Logic is to give the operator/designer more flexible possibilities of operating the generator control system.

Please refer to the "Help" function in the PC utility software for a full description of this configuration tool.

6.30 Buzzer

6.30.1 Buzzer

The AGC 100 has a built-in buzzer. The buzzer is configured in M-Logic. This means that if the buzzer is going to be used as a horn annunciator, the input must be set to "Horn" and the output must be set to "Buzzer". The buzzer will act concurrently to the horn output timer. If the delay timer in M-Logic is used, the buzzer will be active after this time delay.

If an AOP-2 is connected, the buzzer in the AOP-2 must be configured under the AOP-2 setup. But the configuration of the AOP-2 buzzer is similar to the description above.

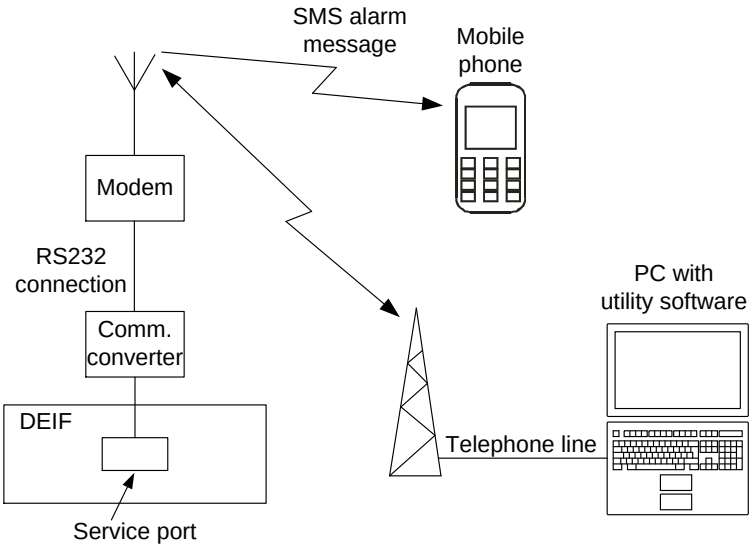
6.31 GSM communication

6.31.1 GSM and modem communication

GSM communication can be used for two purposes:

1. Sending SMS alarm messages to up to five different mobile phones. The messages will be clear text, representing the alarm in question (for example “Overspeed”) and an ID. The ID represents the total numbers of sent SMS.
2. Communicate with the PC utility software.

Connection



The connection is based on an RS-232 connection to a GSM modem via the service port on the unit. Since the connection on the controller is a TTL communication, the interface box PI-1 (option J5) is needed to convert the signals to RS-232. The PI-1 connects via a cable with SUB-D 9-pin female connector on the modem side (see illustration above).

Modem type

DEIF recommends using a Westermo GDW-11 modem, as the application has been tested with these terminals. The SIM card needed must support data transfer. Contact your GSM provider for details. The easiest way to set the PIN code in the modem itself is to mount the SIM card in a mobile phone and change the PIN code there. The SIM card will remember the PIN code when it is installed in the modem.

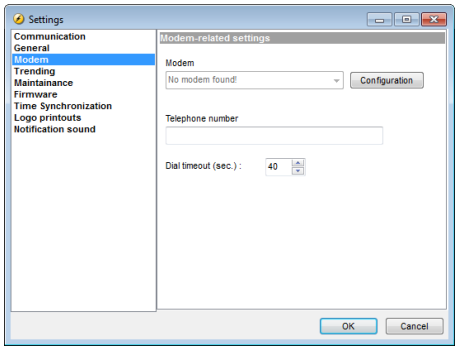
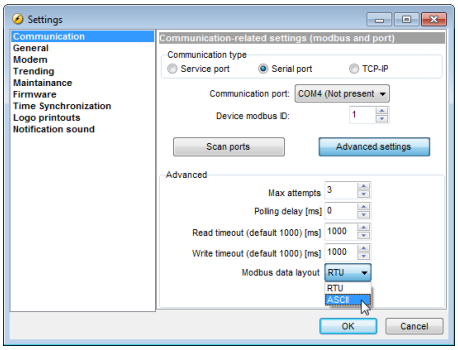
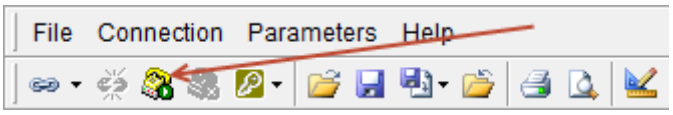
SMS alarm settings

Parameter no.	Name	Function	Set to
10320	GSM PIN code	Set PIN code for GSM modem*	None
10330	12345678901	GSM phone number 1	None
10340	12345678901	GSM phone number 2	None
10350	12345678901	GSM phone number 3	None
10360	12345678901	GSM phone number 4	None
10370	12345678901	GSM phone number 5	None

*After each auxiliary supply power up, the unit will send the required PIN code to the modem if this is necessary. The PIN code is adjusted in the PC utility software.
For calling a foreign number, type "+" and country code instead of "00", for example dial +45 99999999 for a Danish number.

Alarm during operation

Should an alarm occur during the interruption, the controller unit will re-transmit it when the modem starts again, so no messages are lost.

<table>
<tr><th colspan="2">PC utility software communication via modem</th></tr>
<tr><td>Locate the settings for modem communication in the utility software settings (F3).</td><td>Select modem and enter the telephone number of your GSM modem connected to the unit.
When using modem dial-up, the PC utility software must also be set to run ASCII data communication.</td></tr>
<tr><td> 
</td><td> 
</td></tr>
<tr><td colspan="2">After this, dial-up can be used.
Click the this icon to start modem communication:
 
</td></tr>
</table>

The modem communication is much slower than the normal direct connection, so please be patient. It is not recommended to download the entire setting list. Use single setting downloads.

If a PC utility software connection is required, the SIM card must support data transfer. Contact your GSM provider for details.

PC utility software communication safety
If the communication fails, the controller will operate according to the received data. If, for example, only half of the parameter file has been downloaded when the communication is interrupted, the settings are going to be a mix.

6.32 USW communication

It is possible to communicate with the unit via the PC utility software. The purpose is to be able to remote monitor and control the genset application.

It is possible to remote control the genset from the PC utility software if a modem is used. Take precautions that it is safe to remote operate the genset to avoid personal injury or death.

Serial connection
The serial connection to the GSM modem is via the null-modem cable (option J3).

Setup
The Modbus protocol type can be changed from RTU to ASCII. When set to ASCII protocol, the unit will allow for the slower modem communication.

Application settings
Refer to the PC utility software help file.

Safety
If communication fails, the unit will operate according to the received data. If, for example, only half of the parameter file has been downloaded when the communication is interrupted, the unit will use this actual data.

6.33 Nominal settings

6.33.1 How to change the nominal settings

The nominal settings can be changed to match different voltages and frequencies. The AGC has four sets of nominal values for the generator, and they are adjusted in menus 6000 to 6030 (Nominal settings 1 to 4). There are also two sets of nominal settings for the busbar, they can be adjusted in menus 6050 to 6060.

If no busbar voltage transformer is present, the primary and secondary side values are set to generator nominal value.

The possibility to switch between the four sets of nominal set points is typically used on rental gensets, where switching between 50 and 60 Hz is required.

Activation
The switching between the nominal set points can be done in three ways; digital input, AOP or menu 6006.

Digital input
M-Logic is used when a digital input is needed for switching between the four sets of nominal settings. Select the required input among the input events, and select the nominal settings in the outputs.

Example:

Event A		Event B		Event C	Output
Dig. input no. 10	or	Not used	or	Not used	Set nom. parameter settings 1
Not Dig. input no. 10	or	Not used	or	Not used	Set nom. parameter settings 2

AOP
M-Logic is used when the AOP is used for switching between the four sets of nominal settings. Select the required AOP push-button among the input events, and select the nominal settings in the outputs.

Example:

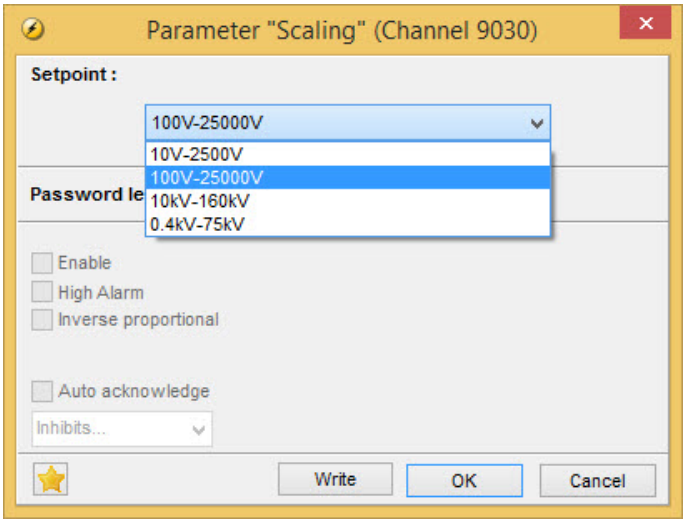
Event A		Event B		Event C	Output
Button07	or	Not used	or	Not used	Set nom. parameter settings 1
Button08	or	Not used	or	Not used	Set nom. parameter settings 2

Menu settings
In menu 6006 the switching is made between settings 1 to 4 simply by choosing the desired nominal setting.

6.34 Scaling

Default voltage scaling is set to range 100 V-25000 V (menu 9030). To be able to handle applications above 25000 V and below 100 V, it is necessary to adjust the input range so it matches the actual value of the primary voltage transformer. This makes it possible to support a wide range of voltage and power values.

Setup of the scaling can be done in menu 9030 from the display.



Changing the voltage scaling will also influence the nominal power scaling:

Scaling parameter 9030	Nom. settings 1 to 4 (power) will change according to parameter 9030	Nom. settings 1 to 4 (voltage) will change according to parameter 9030	Transformer ratio settings parameter 6041, 6051 and 6053
10 V-2500 V	1.0-900.0 kW	10.0 V-2500.0 V	10.0 V-2500.0 V
100 V-25000 V	10-20000 kW	100 V-25000 V	100 V-25000 V
1 kV-75 kV	0.10-90.00 MW	0.4 kV-75.00 kV	0.4 kV-75.00 kV
10 kV-160 kV	1.0-900.0 MW	10.0 kV-160.0 kV	10.0 kV-160.0 kV

All nominal values and the primary VT settings must be corrected after the scaling has been changed in menu 9030.

6.35 Fan logic

The AGC is able to control four different fans. This could for example be air supply fans for supplying air to a genset in a closed enclosure, or radiator fans for switching on and off cooling fans for air coolers.

There are two features in the fan control of the AGC.

1. Priority rearranging depending on running hours of the fans
2. Temperature-dependent start and stop

A priority routine ensures that the running hours of the available fans are evened out and the priority shifts between them.

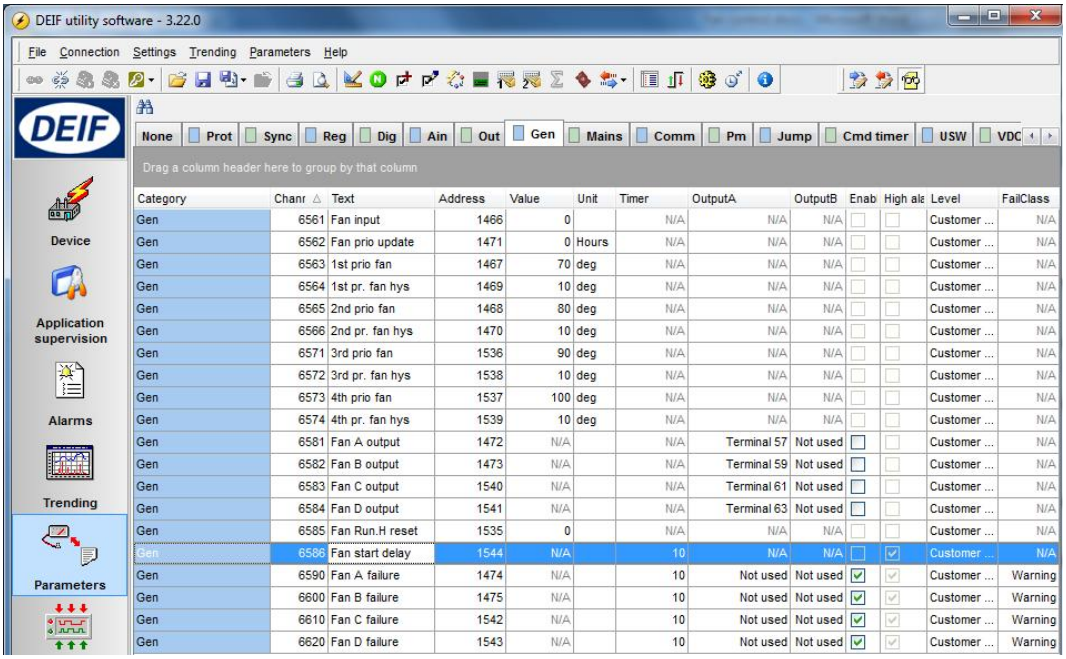
The functionality behind the temperature-dependent start/stop is that the AGC measures a temperature, for example cooling water temperature, and based on this temperature it switches on and off relays that must be used for engaging the fan(s) itself.

The fan control function is active as long as running feedback is detected.

6.35.1 Fan parameters

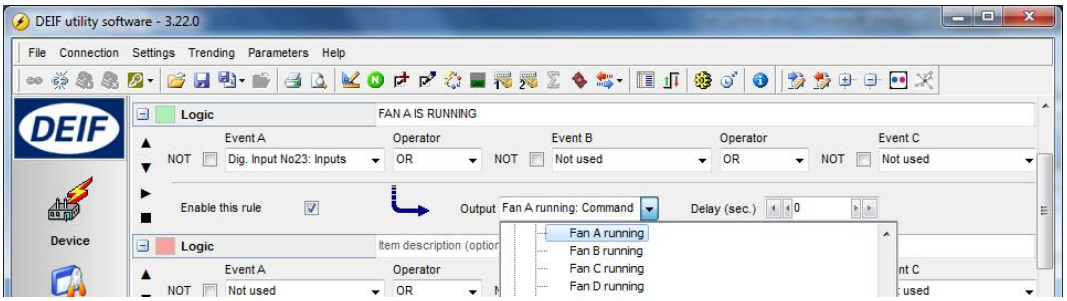
Each fan has a group of parameters that defines their scheme of operation. It is recommended to use the PC utility SW for the setup, because then it is possible to see all parameters. The setup of the fan control is done in the menus 6561-6620 and by using M-Logic in the PC utility SW.

Parameters:



Category	Chanr	Text	Address	Value	Unit	Timer	OutputA	OutputB	Enab	High ala	Level	FailClass
Gen	6561	Fan input	1466	0		N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6562	Fan prio update	1471	0	Hours	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6563	1st prio fan	1467	70	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6564	1st pr. fan hys	1469	10	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6565	2nd prio fan	1468	80	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6566	2nd pr. fan hys	1470	10	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6571	3rd prio fan	1536	90	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6572	3rd pr. fan hys	1538	10	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6573	4th prio fan	1537	100	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6574	4th pr. fan hys	1539	10	deg	N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6581	Fan A output	1472	N/A		N/A	Terminal 57	Not used	☐	☐	Customer ...	N/A
Gen	6582	Fan B output	1473	N/A		N/A	Terminal 59	Not used	☐	☐	Customer ...	N/A
Gen	6583	Fan C output	1540	N/A		N/A	Terminal 61	Not used	☐	☐	Customer ...	N/A
Gen	6584	Fan D output	1541	N/A		N/A	Terminal 63	Not used	☐	☐	Customer ...	N/A
Gen	6585	Fan Run.H reset	1535	0		N/A	N/A	N/A	☐	☐	Customer ...	N/A
Gen	6586	Fan start delay	1544	N/A		10	N/A	N/A	☐	☑	Customer ...	N/A
Gen	6590	Fan A failure	1474	N/A		10	Not used	Not used	☑	☑	Customer ...	Warning
Gen	6600	Fan B failure	1475	N/A		10	Not used	Not used	☑	☑	Customer ...	Warning
Gen	6610	Fan C failure	1542	N/A		10	Not used	Not used	☑	☑	Customer ...	Warning
Gen	6620	Fan D failure	1543	N/A		10	Not used	Not used	☑	☑	Customer ...	Warning

M-Logic:



6.35.2 Input for fan control

The fan control requires a temperature input in order to start and stop the fans based on a temperature measurement.

Fan temperature input is set up in parameter 6561, and this input can be selected between the multi-configurable inputs: Multi-input 6, 7, 8.

The multi-inputs can be configured to measure an engine- or ambient temperature.

Based on the measurement of the selected input, the fan(s) is (are) started and stopped.

6.35.3 Fan start/stop

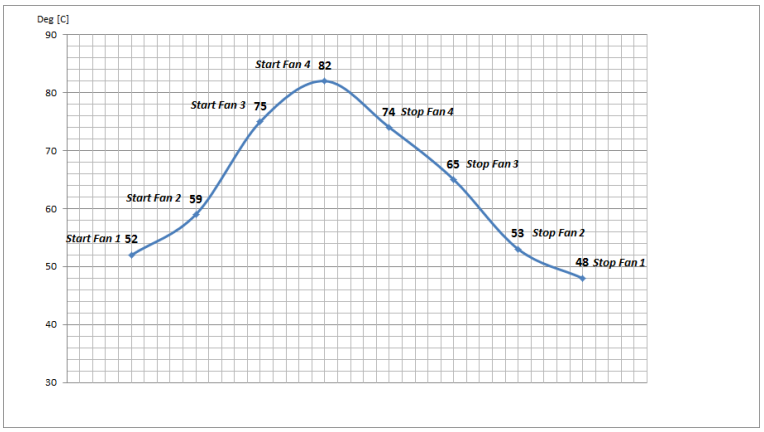
The start and stop settings of the fan(s) are set up in parameters 6563 to 6574. With the settings in the table below, the illustrative curve can be observed.

A hysteresis (abbreviation: hyst.) ensures that there is a range between the start and stop.

6563	1st level fan setp.	50	deg
6564	1st level fan hyst.	2	deg
6565	2nd level fan setp.	56	deg
6566	2nd level fan hyst.	3	deg
6571	3rd level fan setp.	70	deg
6572	3rd level fan hyst.	5	deg
6573	4th level fan setp.	78	deg
6574	4th level fan hyst.	4	deg

Fan	Setp.	hys.	Start	Stop
1	50	2	52	
2	56	3	59	
3	70	5	75	
4	78	4	82	
4	78	4		74
3	70	5		65
2	56	3		53
1	50	2		48

The following start/stop curve will be generated if a bow setting is used:



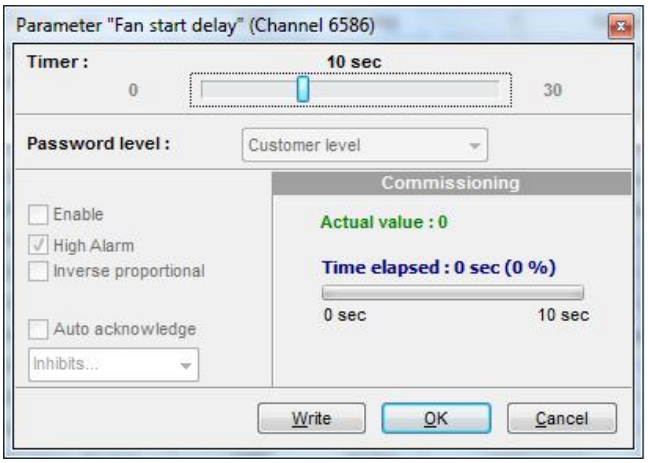
6.35.4 Fan output

At parameter 6581 to 6584, the output relays for fans A to D are selected. The purpose of these relays is to issue a signal to the fan starter cabinet. The relay must be energised for the fan to run.

Gen	6581	Fan A output	1472	N/A		N/A	Terminal 57
Gen	6582	Fan B output	1473	N/A		N/A	Terminal 59
Gen	6583	Fan C output	1540	N/A		N/A	Terminal 61
Gen	6584	Fan D output	1541	N/A		N/A	Terminal 63

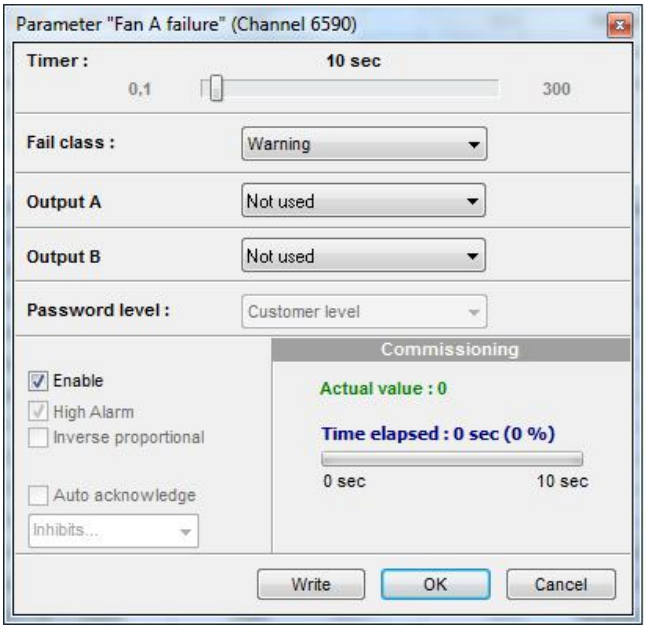
6.35.5 Fan start delay

If two or more fans are requested to be started at the same time, it is possible to add a start delay between each fan start. The reason for this is to limit the peak start current, so all fans will not contribute with a start current at the same time. This delay is adjusted in the menu 6586.



6.35.6 Fan failure

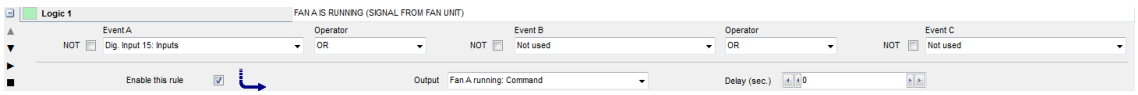
It is possible to activate an alarm if the fan does not start. The fan failure alarm appears if the running feedback from the fan does not appear. In parameters 6590 to 6620, the fan failure alarms are set up for fans A to D.



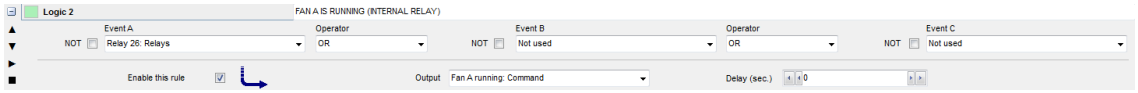
6.35.7 Fan priority (running hours)

The priority of the fans A to D rotates automatically from 1st to 4th priority. This is done automatically, because the running hours of the fans are detected and are used for the rearranging.

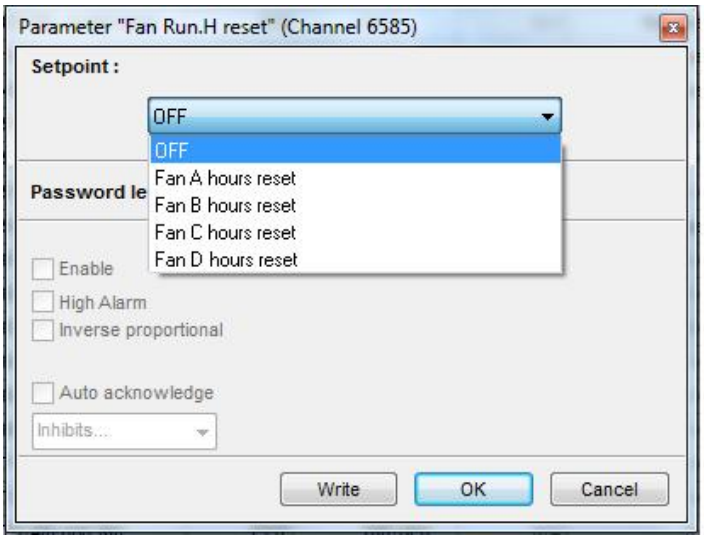
M-Logic setup:
If the fan unit is raising a signal that is led to a digital input on the AGC when it is running, then the following M-Logic must be programmed:



When it is not possible to get a running feedback from the fan unit, the internal relay of the AGC must be used to indicate that the fan is running. If, for example, R26 is the relay for FAN A, the following M-Logic must be programmed:



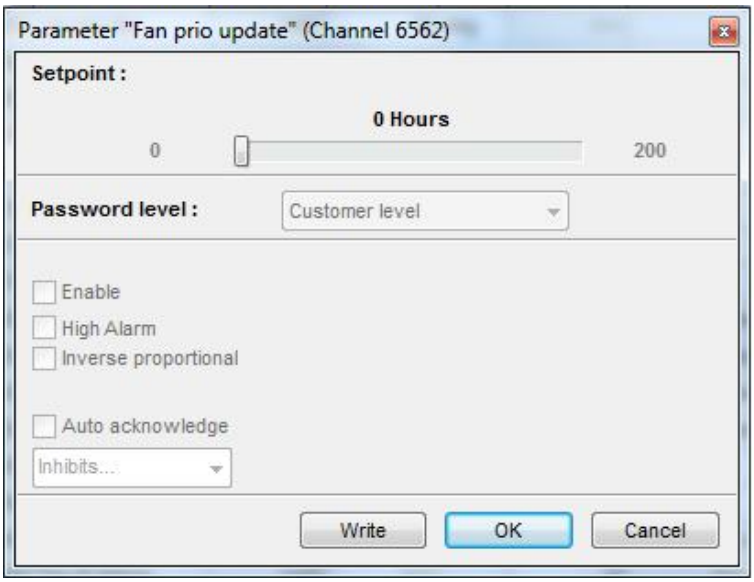
The running hour can be reset by entering parameter 6585 and then selecting the desired fan hours to be reset.



Only reset is possible. It is not possible to add an offset to the run hour counter.

6.35.8 Fan priority update

In parameter 6562, the priority update rate (hours between priority rearrange) is selected:

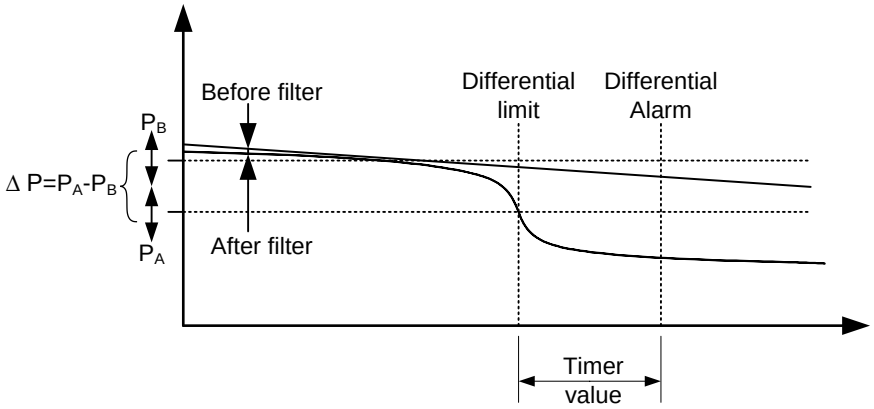


If the fan priority update is set to 0 hours, the order of priority will be fixed at: Fan A, fan B, fan C and fan D.

6.36 Differential measurement

6.36.1 Differential measurement

With the differential measurement function, it is possible to compare two analogue inputs and trigger on the difference between the two values.
If the differential function is for example air filter check, the timer will be activated if the set point between PA (analogue A) and PB (analogue B) is exceeded. If the differential value drops below the set point value before the timer runs out, then the timer will be stopped and reset.



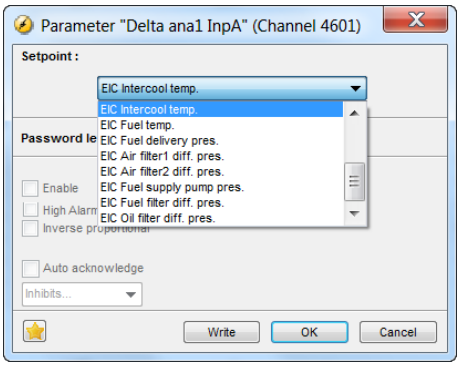
Six different differential measurements between two analogue input values can be configured.

Differential measurements between two sensors can be configured in menus 4600-4606 and 4670-4676. As an example, the figure below shows the two parameters for input selection for differential measurement 1.

Ain	4601	Delta ana1 InpA	1482	4	
Ain	4602	Delta ana1 InpB	1483	4	

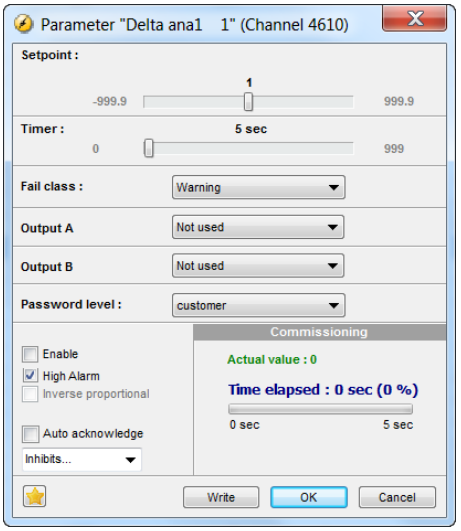
Inputs are selected from the input list as shown below, avaible inputs are:

- Multi-inputs
- EIC measurements
- External inputs (option H8)
- Analogue input (M15.X, only AGC-4)
- Multi-input (M16.X, only AGC-4)



The relevant alarm set point is chosen in parameters 4610-4660 and 4680-4730. Each alarm can be configured in two alarm levels for each differential measurement between analogue input A and input B. The figure below shows the two parameters to configure alarm level 1 and 2, for differential measurement 1.

Ain	4610	Delta ana1	1	1488	1
Ain	4620	Delta ana1	2	1489	1



6.37 Sleep mode

6.37.1 Sleep mode

The sleep mode is a standstill power-saving mode. If the engine is stopped and nothing has happened within the time setting, the unit will enter sleep mode, meaning that the most power consuming functions (for example display) are turned off. As soon as an event occurs, the sleep mode is ended. An event could be one of the following:

- A button is pressed on the unit or on an AOP
- Auto start/stop signal is sent, also as a Modbus command

- Digital input is triggered
- The number of alarms increases

The sleep mode can be deactivated and configured in channel 9150. If any unacknowledged alarms are present, the controller will not enter sleep mode.

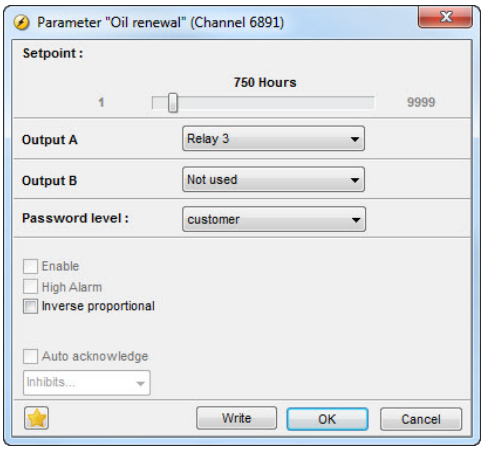
6.38 Oil renewal

6.38.1 Oil renewal function

The purpose of the oil renewal function is to make it possible to exchange a small portion of the lubricating oil of the engine with fresh or new oil. This means that the quality of the oil is kept at a satisfactory level without significant deterioration of the oil quality in the entire period between oil changes.

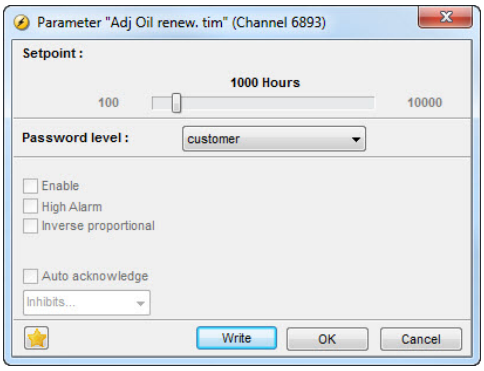
The time interval between oil changes is assumed to be 1000 hours (default set point) of operation; this set point can be changed in menu 6893. The renewal function will read the engine hours from the engine interface communication (EIC). The running hours counter in the AGC is only used if the EIC counter is not available.

The function in the AGC is to activate a relay under defined conditions. Then the relay must be used for the oil renewal system (not part of the DEIF scope of supply), where lubricating oil is removed and added to the engine. Any freely configurable relay is available for this feature. In parameter 6891, a set point is available, which can be set between 1 and 9999 hours to define when the relay should close, and it is possible to select which relay is to be used. Furthermore, this parameter can be inversed, meaning that the relay will close from 0 hours until the set point is reached.



If menu 6893 is set to 1000 hours, the AGC will reset the hours just for the oil renewal function when the running hours counter has reached 1000 hours. If for example menu 6891 has been set to 750 hours and inverse is not enabled, the relay will close at 750 hours and remain closed until 1000 hours is reached, and then the hours counter starts from 0 hours again.

Below it is shown for menu 6893.



6.39 Demand of peak currents

6.39.1 I thermal demand

This measurement is used to simulate a bimetallic system, known from the Maximum Demand ammeter, which is specifically suited for indication of thermal loads in conjunction with cables, transformers, and so on.

It is possible to have two different readouts shown in the display. The first readout is called I thermal demand. This readout shows the average **maximum** peak current over an adjustable time interval.

Be aware that 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 6 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 in parameter 6840. The value can also be reset. If the value is reset, it will be logged in the event log and the readout in the display is reset to 0.

6.39.2 I max. demand

The second readout is called I maximum demand, and shortened in the unit, I max. demand. The readout displays the newest maximum peak current value. When a new maximum peak current is detected, the value is saved in the display. The value can be reset in menu 6843. If the value is reset, it will be logged in the event log.

The two reset functions will also be available as commands through M-Logic.

Display readout is updated with an interval of 6 seconds.

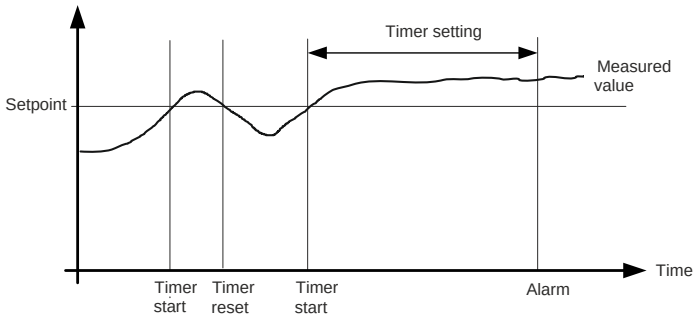
7. Protections

7.1 General

7.1.1 General

The protections are all of the definite time type, that is a set point and time is selected.

If, for example, the function is over-voltage, the timer will be activated if the set point is exceeded. If the voltage value falls below the set point value before the timer runs out, the timer will be stopped and reset.



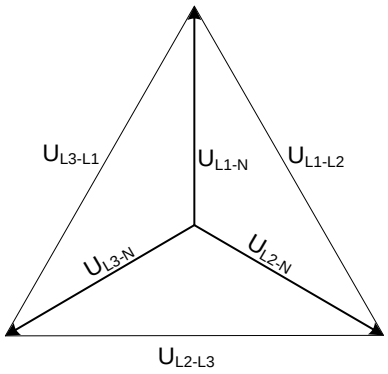
When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

When parameterising the DEIF controller, the measuring class of the controller and an adequate "safety" margin must be taken into consideration.

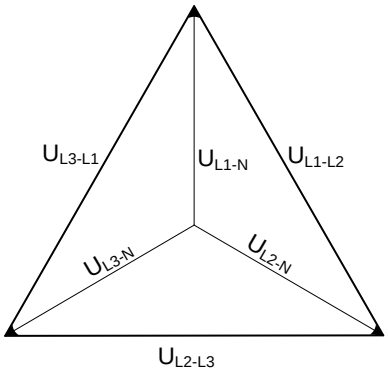
An example:
A power generation system must not reconnect to a network when the voltage is 85 % of Un +/-0 % ≤U ≤110 % +/-0 %. In order to ensure reconnection within this interval, a control unit's tolerance/accuracy (Class 1 of the measuring range) has to be taken into consideration. It is recommended to set a control unit's setting range 1 to 2 % higher/lower than the actual set point, if the tolerance of the interval is +/-0 %, to ensure that the power system does not reconnect outside the interval.

Phase-neutral voltage trip
If the voltage alarms are to work based on phase-neutral measurements, you must adjust menus 1200 and 1340 accordingly. Depending on the selections, either phase-phase voltages or phase-neutral voltages will be used for the alarm monitoring.

Phase-neutral



Phase-phase



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

The table shows the 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.

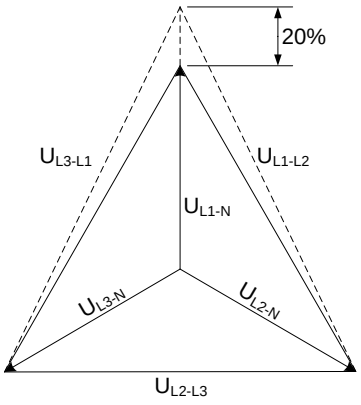
Example
The below 400 V AC system shows that the phase-neutral voltage must change 20 %, when the phase-phase voltage changes 40 volts (10 %).

Example:
U_{NOM} = 400/230 V AC

Error situation:
U_{L1L2} = 360 V AC
U_{L3L1} = 360 V AC

U_{L1-N} = 185 V AC

ΔU_{PH-N} = 20 %



Phase-neutral or phase-phase: both the generator protections and the busbar/mains protections use the selected voltage.

8. Power management (AGC 14x only)

8.1 About AGC 14x power management

8.1.1 About AGC 14x power management

Both AGC 145 and 146 are designed to work as main controllers and/or tie breaker controllers in applications with other Multi-line 2 products such as AGC-4 or AGC 200. Since the AGC 14x variants are not able to synchronise, they are meant to be used in applictions where synchronising of the mains breaker and/or the tie breaker is not necessary. Even though it is not possible to synchronise the mains/tie breaker with AGC 145 or 146 equipped, it is still possible for the generators to synchronise onto busbar. This means that the generators are able to synchronise to the busbar with the tie breaker and the mains breaker already closed, but it is not possible to back synchronise the mains- or tie breaker.
The table below shows the differences in the AGC 14x variants:

AGC 14x variant	Power management	MB control and protection	TB control and protection
AGC 145	X	X	
AGC 146	X	X	X

8.1.2 Description of functions

In the following chapter, the power management functions of the AGC 14x are listed.

Plant modes:
- Island mode (no mains unit)
- Automatic Mains Failure (needs mains unit)
- Fixed power (needs mains unit)
- Peak shaving (needs mains unit)
- Load takeover (needs mains unit)
- Mains power export (needs mains unit)

Display:
- Mains unit display showing mains breaker and tie breaker

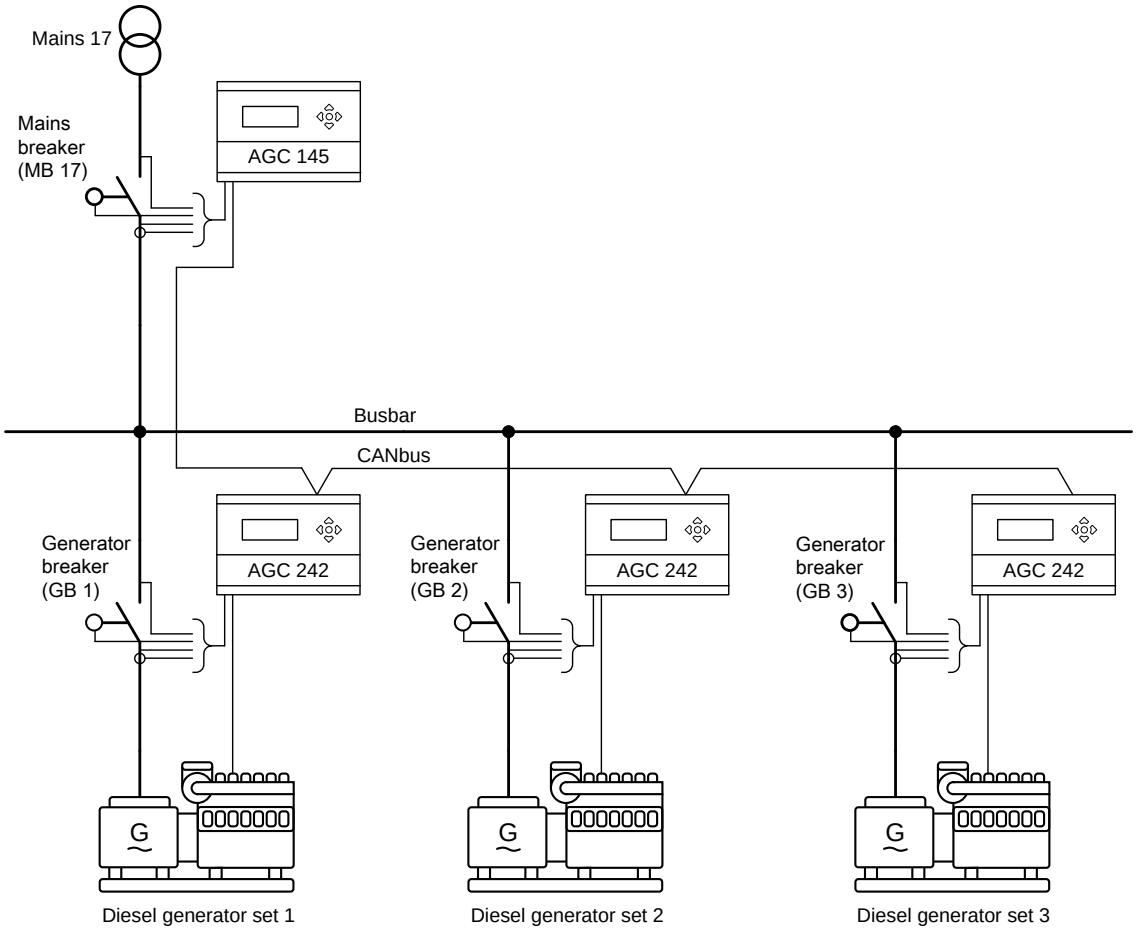
Power management functions:
- Multiple mains support
- Quick setup/broadcast
- CAN flags

When the AGC 14x is used in an application with other products like AGC-3, AGC-4 or AGC 200, please see the power management documentation for these products to see which functions are available.

8.2 Single line diagrams

8.2.1 AGC 145

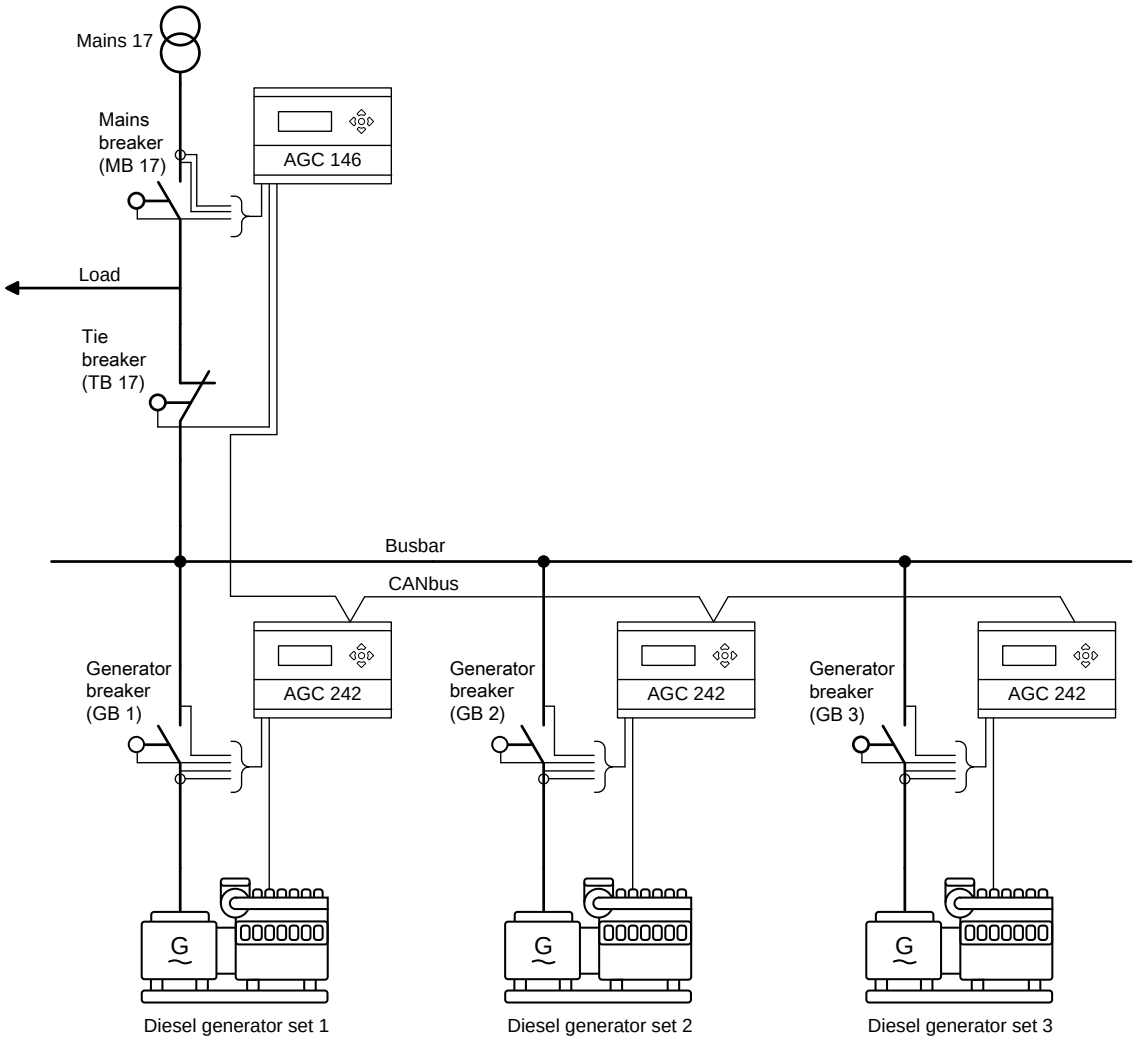
The diagram below shows an example of an application setup where an AGC 145 controls the mains breaker and communicates over the CAN bus with three AGC 242 on the generators. The diesel generators are able to synchronise onto the busbar, but the mains breaker is not.



It is also possible to use AGC-3 and AGC-4 in a power management system with AGC 145/146.

8.2.2 AGC 146

The diagram below shows an example of an application setup where an AGC 146 controls the mains breaker and the tie breaker, while communicating with AGC 242 on the generators.



The tie breaker has to be normally closed (NC) if the plant is to be used for fixed power, mains power export or peak shaving.

It is also possible to use AGC-3 and AGC-4 in a power management system with AGC 145/146.

8.3 Power management setup

8.3.1 How to set up

The AGC is set up using the display and the PC utility software. The quick setup is used to set up with the display.

8.3.2 PC software setup

The communication ID must be adjusted in the utility software for each of the AGC units. In the screenshot below, the internal communication ID is set to 17.

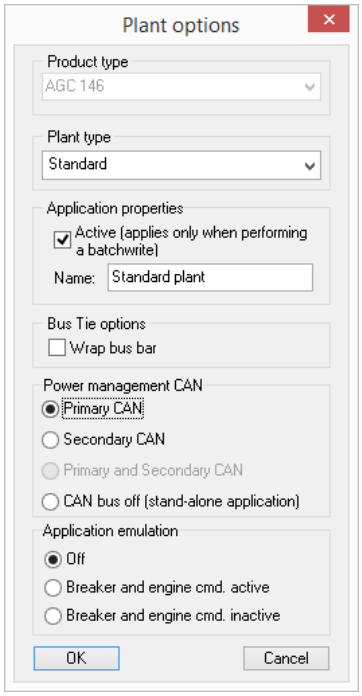
Category	Channel	Text	Address	Value
Comm	7531	Int. comm. ID	566	1
Comm	7533	Miss. all units	568	N/A
Comm	7534	Fatal CAN error	569	N/A
Comm	7535	Any DG missing	570	N/A
Comm	7536	Any mains miss.	571	N/A
Comm	7881	Any BTB miss.	1183	N/A

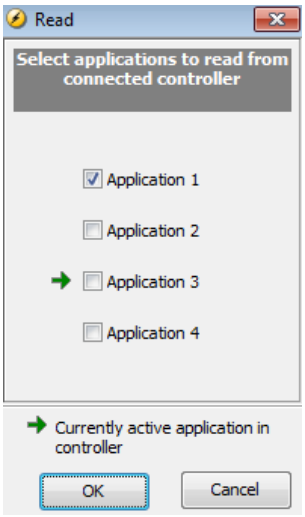
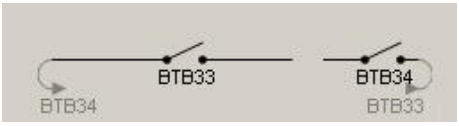
The numbering of the communication IDs must always start from the lowest number, so an application always includes a DG with ID 1. The principle also applies to the AGC mains where the numbering starts from ID 17.

8.3.3 Application design

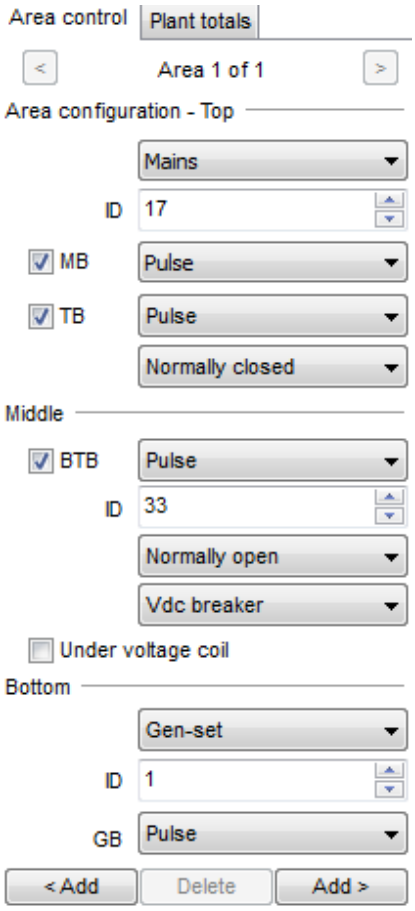
The application is designed through the utility software. Please select configuration.

Select a new application and adjust the settings in this dialogue box.



	Description	Comments
Product type	Select AGC.	
Plant type	Select between • Single DG • Standard	Use "single DG" if power management is not present (or if single functionality is needed for an AGC 14x). Use "standard" if a power management application is needed, where more than one AGC is present.
Configuration selection	The AGC is able to include four applications. One of these can be active. Write a proper name of your application.	Click "Yes" in the pop-up window to set the application to active when downloading it to the AGC. It is possible to see which application is active when the USW is connected to the AGC. The green arrow in the picture below shows which application is active. 
Bus tie options	Select "Wrap busbar" if the BTBs are connected in a ring.	
Power management CAN	Primary CAN Secondary CAN CAN bus off: Disable CAN bus A and B	These settings do not impact whether CAN terminal A or B is used. This must be set up in menu 7840.
Application emulation	Used to enable emulation and to choose whether breaker and engine command is active or not during emulation.	This selection is only available if the option I1 (emulation) is active in the unit.

Now the application can be designed using the area configuration control panel.



For each area, it is defined whether a generator and a mains are present, and the number and type of breakers.

Configurable CAN IDs

Can IDs can be configured as desired, as a mix of DG, mains and BTB units:

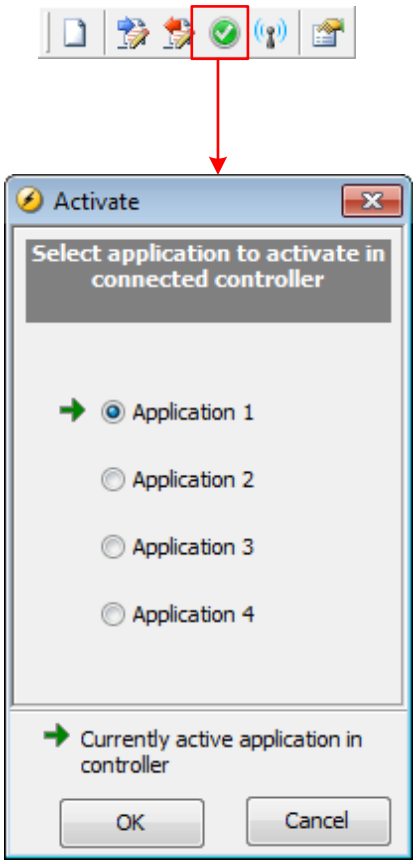
16 gensets	IDs 1-16
16 mains	IDs 17-32
8 bus tie breakers	IDs 33-40

This makes a total of 40 CAN IDs.

Breaker options	Description	Comments
Mains breaker options	Select between: ● Pulse ● Ext/ATS control ● Continuous NE ● Compact ● Continuous ND	Depending on the application, select either "Continuous NE" or "Continuous ND" if mains breaker closure is desired even if AGC power is removed
Tie breaker options	Select between: ● Pulse ● Continuous NE ● Compact	
	● Normally open ● Normally closed	⚠ **In applications with tie breaker control, it is necessary to use a normally closed (NC) breaker if fixed power, mains power export or peak shaving is used.**

When the application has been configured write the drawing(s) to the device using the  icon.

To activate an application through the utility software, press the icon shown in the picture below and select which application to activate. The green arrow shows the currently active application.



For more information about how to set up the plant application drawing, please see the help section of the utility software.

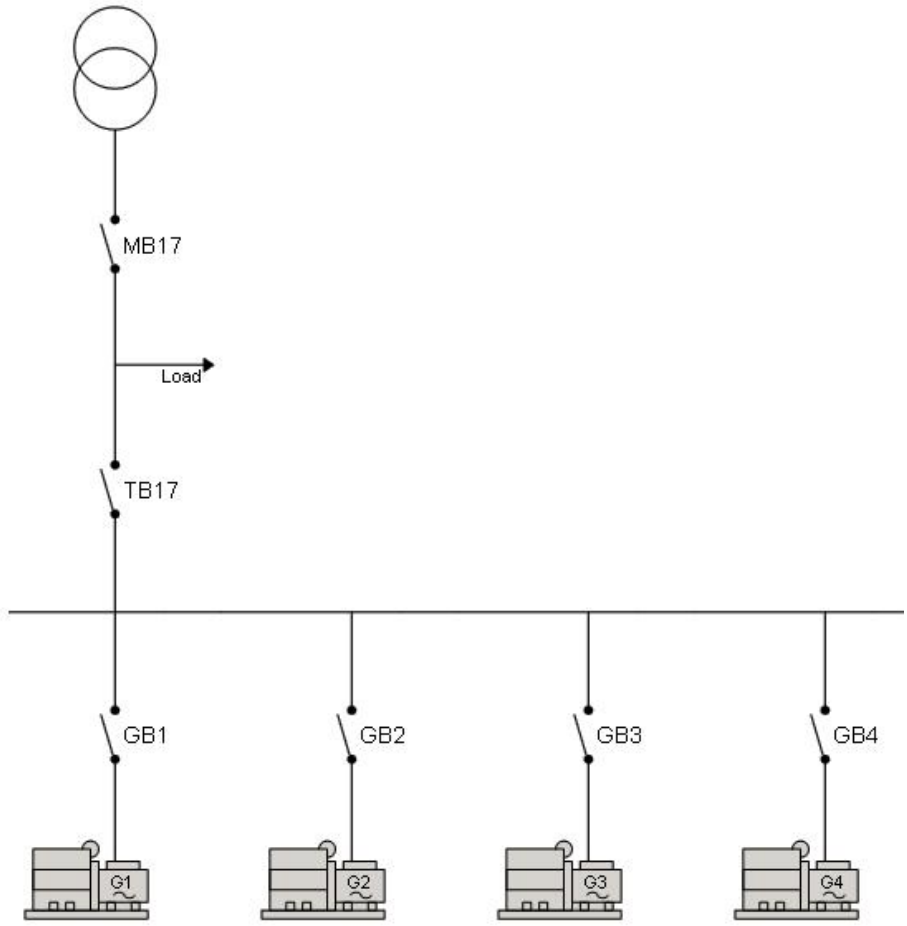
8.3.4 Quick setup

This function is made to provide an easy user interface for applications where it is vital for the end-user to be able to change the application quickly and easily.

It is often applications for the rental market that need this flexibility, and therefore there are some limitations as to which applications can be handled through the quick setup menu.

The following applications can be handled through the quick setup menu.

Simple applications with connection to one mains:



8.3.5 9180 Quick setup

9181 Mode

OFF: When the mode menu is set to "OFF", the existing application that is about to have this genset included will not look for this new genset. This will give the operator time to connect all wiring and to do the basic setup of the genset.

Setup Plant: When the mode menu is set to "Setup Plant", the new AGC will receive the application configuration from the other units in the plant. The new AGC will then notify the rest of the application that a new ID is available on the line. If the ID of the new AGC already exists, the new AGC will – based on the ID numbers in the application configuration – have the highest ID + 1 assigned. This new ID will then be included in the application configuration in all the other AGCs. During this process, the existing application will be able to continue running and will not be affected by the upgrade of the system.

The new AGC will automatically go to block mode to ensure that it is in a safe mode. When the setup is done, the end-user must decide in which running mode the added genset is to run.

If there are already 16 gensets on the CAN line and a new AGC tries to connect to the plant, an alarm text, "No IDs available", will appear.

Setup Stand-alone: When the mode menu is set to "Setup Stand-alone", the AGC will change the application configuration, so it will no longer be a part of the application. When the ID is removed from the application, the new application will be broadcasted to the other AGCs. The IDs of the existing gensets in the application will maintain their ID, as a rearrangement could lead to unnecessary starting and stopping of the gensets.

If the genset that is to be removed is running, it will not be possible/allowed to continue the process until the genset has stopped. If it is attempted to disconnect, an info text, "Quick set-up error", will appear.

If "Setup Stand-alone" is activated when the genset is running, an info text, "Quick setup error", will appear.

If an AGC BTB is detected in the application, an indicating alarm, "Appl. not possible", will appear.

Change of setup from standard to single DG unit: When disconnecting a standard AGC unit in a system, it is important to change the menu 9181, plant setup. After disconnecting, the AGC unit will become a single DG.

8.3.6 9190 Application broadcast

This function makes it possible to broadcast an application over the CAN line from one AGC to all units present in the application. It can either be done from the display or through the utility software. There are two ways to broadcast an application:

1. By sending the application.
2. By sending the application and activating it.

Menu 9191: Broadcast application

OFF: When it is set to OFF, no broadcast will be made.

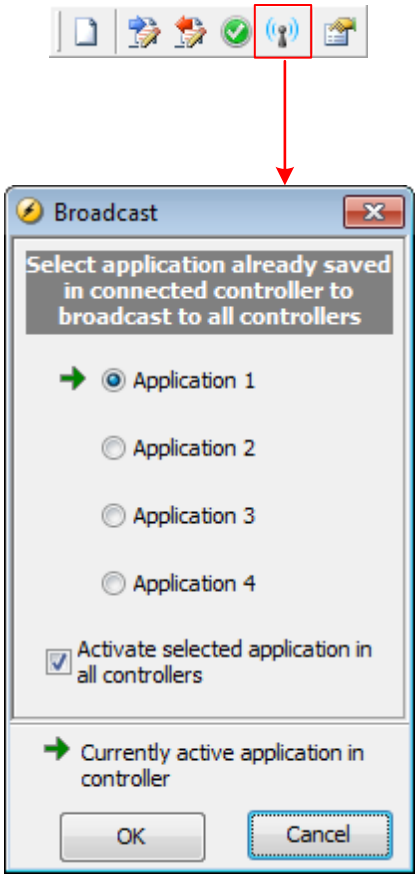
Broadcast: Broadcast of the selected application in menu 9192 will be sent to the units in the application.

Broadcast + Activate: Broadcast is activated and the application in menu 9192 will be broadcasted and activated in all units.

Menu 9192: Select which application to be broadcasted

Applications 1-4 can be configured in the utility software.

Through the utility software, it is possible to broadcast and activate the application. Press the broadcast icon as shown below and mark if the application is to be activated in all controllers. In the broadcast window, the green arrow shows which application is active.



8.3.7 Possibilities

If one or more units have to be taken out of the power management system, the following possibilities exist depending on the situation.

8.3.8 Auxiliary supply OFF

The auxiliary supply must be removed from the AGC. This means that a CAN bus alarm occurs on the other AGCs. These alarms appear in a 2 DG plant where ID 2 is powered down:

Alarms	Functioning unit (ID 1)
System alarm	Failed CAN tx line
System alarm	CAN ID 2P/S MISSING (P = Primary CAN, S = Secondary CAN)
Menu 7533	Miss. all units
Menu 7535	Any DG missing

The alarms will be present at all times during the failure. A reconfiguration of the power plant is required to remove the alarms.

8.3.9 Auxiliary supply ON

If a failure appears on the CAN bus lines of an AGC, the following alarms appear in the example where a failure appears at ID 2:

Alarms	Defective unit	Functioning unit
System alarm	Failed CAN tx line	Failed CAN tx line
System alarm	CAN ID 1P/S MISSING	CAN ID 2P/S MISSING
Menu 7533	Miss. all units	Miss. all units
Menu 7535	Any DG missing	Any DG missing

If the auxiliary supply of the unit where the CAN bus is not functioning is connected, the AGC can be adjusted to another mode than AUTO. In that case, the genset will not take part in the power management routines.

Semi-automatic start or automatic start is possible if the mode is changed to SEMI or AUTO mode. The only exception to this is when BLOCK mode is selected on a genset AGC. In this situation, the GB can be closed without allowance from the power management system.

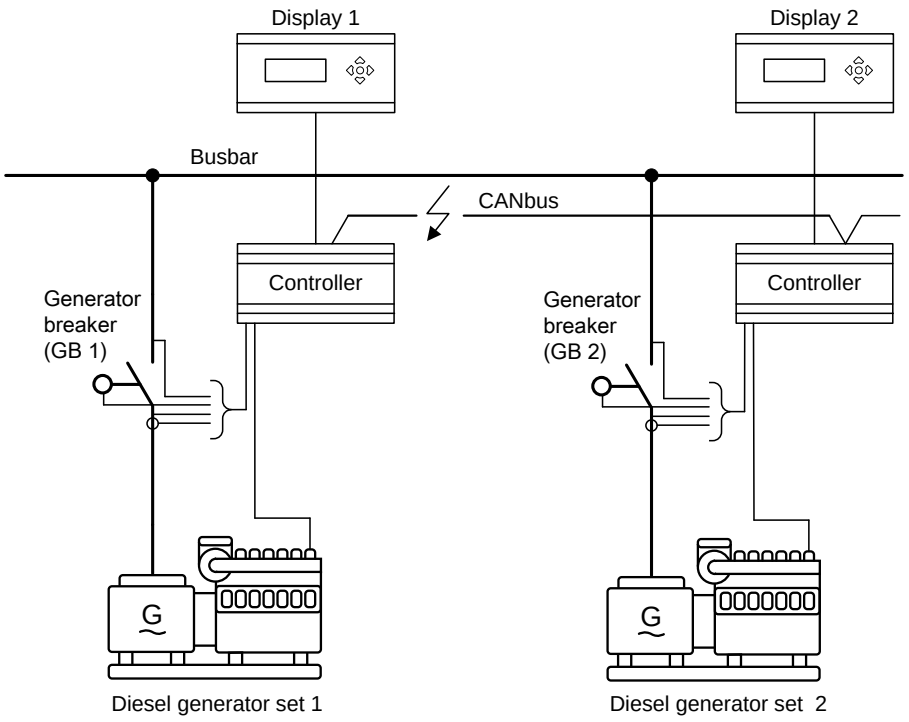
8.3.10 CAN failure mode

In case of a CAN failure on the internal CAN controlling the power management, the system can be set up in different ways. In menu 7530, it is decided how the power management system will react in case of a CAN failure.

Example 1:

- A break on the CAN line is made between ID1 and ID2 shown below.
- Both gensets are running and all breakers are closed.

1. If "SEMI-AUTO" is selected, all AGC units will change mode to semi-auto mode, and in this way the regulators will continue to regulate the load on the gensets which are still "visible" on the internal CAN communication. This means that in the example with six gensets, the load sharing will continue between the units which are still connected (ID1-ID3 and ID4-ID6).



If the CAN error happens when no gensets are running, it will not block the whole system, and it will be possible to start all the gensets in SEMI-AUTO mode, even though the CAN error has not been fixed.

A message will be shown in the status line "BLACKOUT ENABLE" on the display.

If the CAN bus error is present and no generator breakers are closed, it will be possible to close two breakers on the same busbar, which may result in fatal damage to the whole system.

It is recommended to use the analogue load sharing (option G3) and an interlock system to prevent this situation.

2. If "No mode change" is selected, all AGC units will stay in the mode they were in before the failure appeared.

This setting makes it possible to keep the system in auto mode in case of a CAN failure, however, the faulty unit will not be a part of the power management, since it cannot send or receive status and commands on the CAN bus.

If this selection is used, it is recommended to use the CAN bus fail class settings to disconnect the faulty units (refer to the "CAN bus fail class" in this chapter).

8.3.11 CAN bus alarm

The following alarms can be displayed on an AGC unit in case of CAN bus communication failures:

- CAN ID X(P/S) MISSING
  The AGC unit has lost CAN bus communication to one or more CAN IDs on CAN bus I/F.

- CAN MAINS X(P/S) MISSING
  The AGC unit has lost CAN bus communication to the AGC mains unit on CAN bus I/F.

- CAN ID X(P/S) MISSING
  The AGC unit has lost CAN bus communication to one or more CAN IDs on CAN bus I/F.

- CAN MAINS X(P/S) MISSING
  The AGC unit has lost CAN bus communication to the AGC mains unit on CAN bus I/F.

- MISSING ALL UNITS
  The AGC unit has lost the CAN bus communication to all the other units. The fail class set in menu 7533 will be executed.

- FATAL CAN ERROR
  The AGC unit has lost CAN bus communication to more than one CAN ID on the CAN bus line. The fail class set in menu 7534 will be executed.

- ANY DG MISSING
  The AGC unit has lost CAN bus communication to one of the generator CAN IDs on the CAN bus line. The fail class set in menu 7535 will be executed.

- ANY MAINS MISSING
  The AGC unit has lost CAN bus communication to one of the mains CAN IDs on the CAN bus line. The fail class set in menu 7536 will be executed.

- ANY BTB MISSING
  The AGC unit has lost CAN bus communication to one of the BTB CAN IDs on the CAN bus line(s). The fail class set in menu 7536 will be executed.

8.3.12 CAN bus fail class

In menu 7530, it is possible to set a fail class for the following CAN bus alarms:

- Missing all units
- Fatal CAN error
- Any DG missing
- Any mains missing

By using these settings, it is possible to disconnect the faulty units and in this way keep the system running in auto mode (if parameter 7532 is set to "No mode change").

For a general description of "Fail class", refer to the chapter Additional functions in this document.

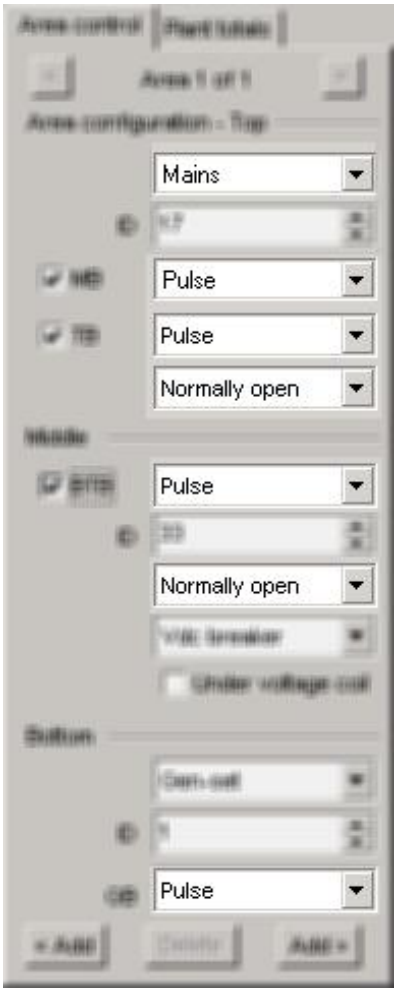
8.3.13 Limitations

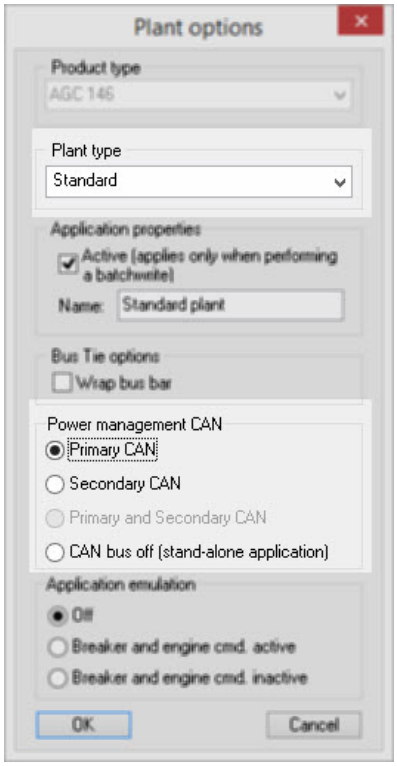
In most cases, the rental applications are very simple applications, and therefore there are some limitations that have to be considered when using the quick setup menu:

- It will not be possible to have any AGC bus tie units in the application.

This function is made to facilitate change of a plant configuration without AGC BTB units. Entering the quick setup menu 9180 via the display makes it possible to add or remove a genset without the use of utility software. It is only possible to do the same basic setup as through the "application configuration" in the utility software.

The functions marked with clear text in the screenshots below can be accessed through the quick setup menu.





8.4 Functional description

8.4.1 Command unit

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

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

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

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

8.4.2 Fail class

The fail classes described in the Designer's Reference Handbook are still valid when the power management option is selected. In addition to these fail classes, the safety stop can be used in the AGC units with power management.

This means that when a trip + stop alarm occurs, the faulty genset will stay on the busbar until the next priority genset is started and synchronised to the bus. When the incoming genset has taken the load, the faulty genset will ramp down the power, followed by trip of the breaker, cooling down of the engine and finally stop.

If the faulty genset has the last priority, or no standby gensets are available, then it will stay on the busbar and will not trip.

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

8.4.3 Local/remote/timer operation

The plant can be adjusted to local, remote or timer operation (menu 8021). This selection is done in the command unit, that is one of the generator units.

The setting defines how the plant is started while it is in AUTO mode.

The settings can be changed in M-Logic and via display or PC utility software.

	Display	**Utility SW (Parameter setup)**	**M-Logic**
Local	X	X	X
Remote start	X	X	X
Timer start	X	X	-

The purpose of the selection is to decide whether the plant can be started from the display (local operator), from remote (for example PLC) or by an internal timer. Remote means that the control can be carried out by activating the digital input or through Modbus/Profibus communication.

8.4.4 Local selection

All operation is carried out on the display. In island operation any generator unit display can be used, and in load takeover, mains power export and fixed power the mains unit display must be used. The plant mode must be AUTO.

8.4.5 Remote selection

The plant is started using the digital input "auto start/stop" when "remote" is selected.

Island mode
In island mode the "auto start/stop" input on any of the generator AGCs can be used for starting the plant. However, DEIF recommends to wire up the "auto start/stop" input to all of the AGCs to be sure that the automatic operation is able to continue even though one of the DGs is taken out for service (power supply disconnected to the AGC).

In island mode any running mode (MAN, AUTO, SEMI, BLOCK) can be selected on the generator units, and the remote start signal is still working for the remaining AGC which is still in AUTO mode.

Parallel to mains mode
In load takeover, mains power export and fixed power mode the "auto start/stop" input on the mains unit must be used for starting the plant.

8.4.6 Plant operation

The table shows how the plant is started:

Plant mode	Selection	Local	Remote
Island mode		Display on generator units	Auto start/stop on gen. units
Fixed power mode		Display on mains unit	Auto start/stop on mains unit
Mains power export		Display on mains unit	Auto start/stop on mains unit
Load takeover		Display on mains unit	Auto start/stop on mains unit

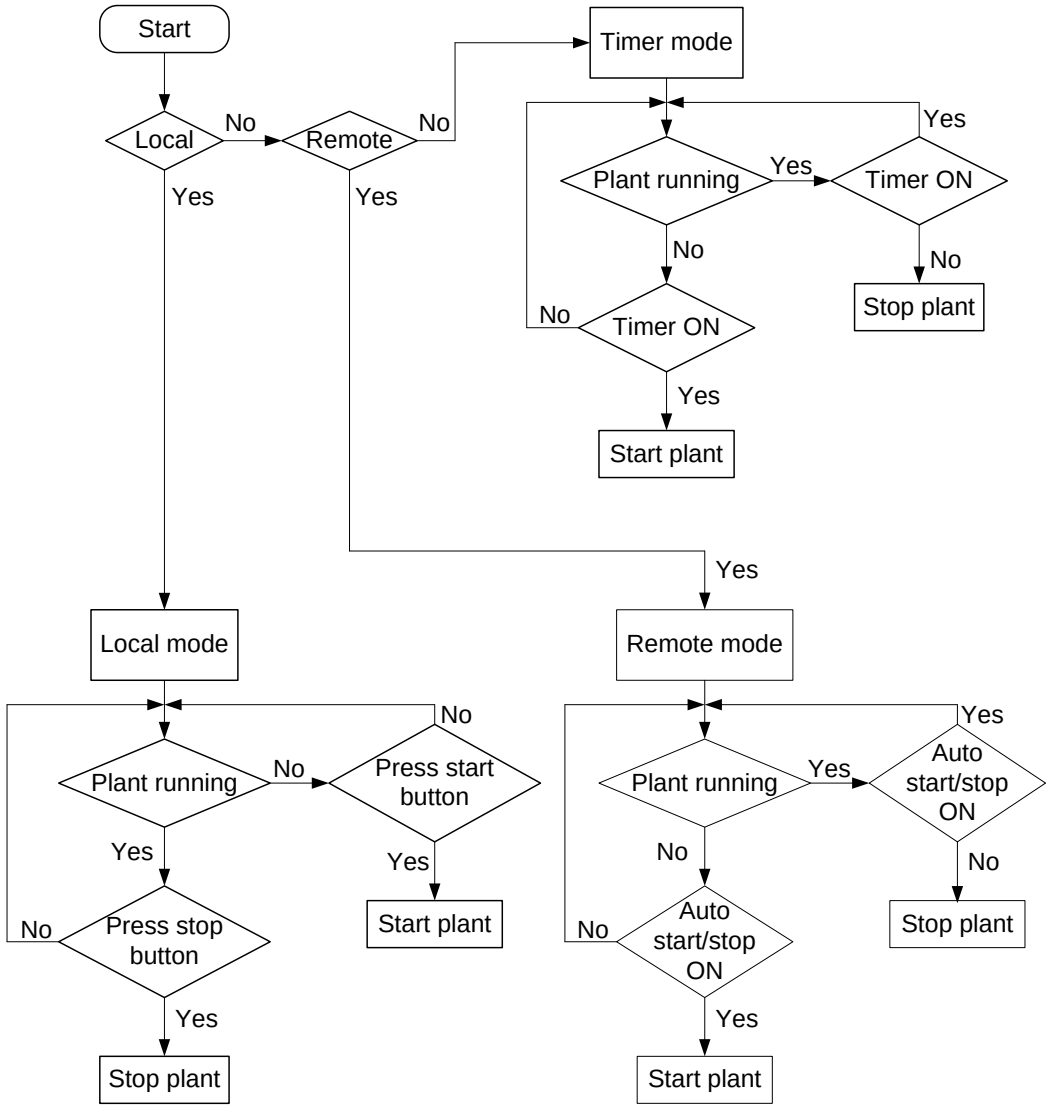
In peak shaving and AMF the automatic operation starts automatically depending on the imported power (peak shaving) or mains failures (AMF).

8.4.7 Timer selection

The operation of the plant is controlled by up to eight internal command timers which are programmed using the PC utility software (USW).

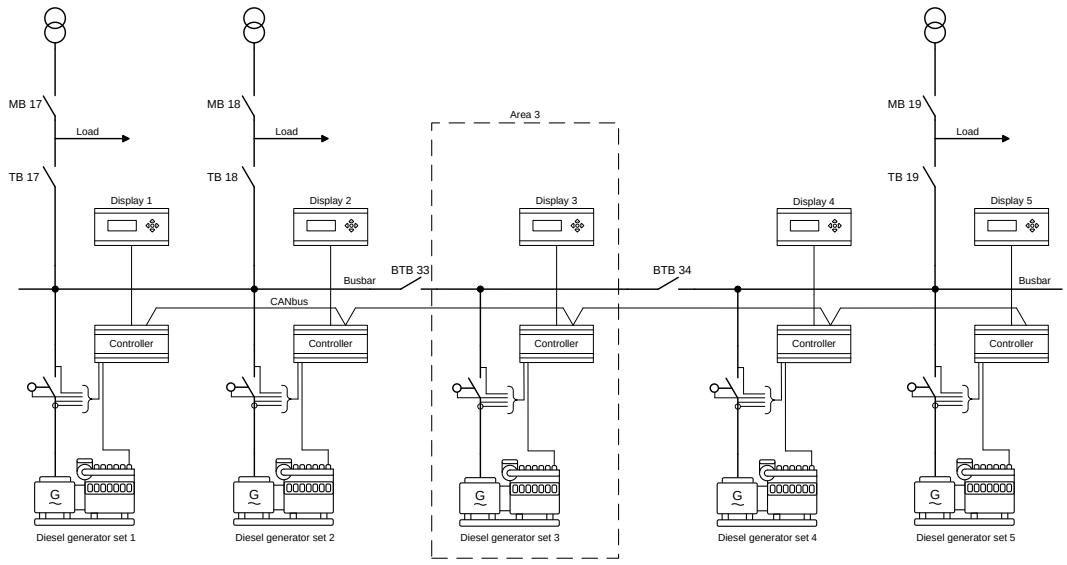
The function can be used in load takeover, mains power export and fixed power, and the mains unit has to be in auto.

8.4.8 Principle



8.4.9 Multiple mains

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



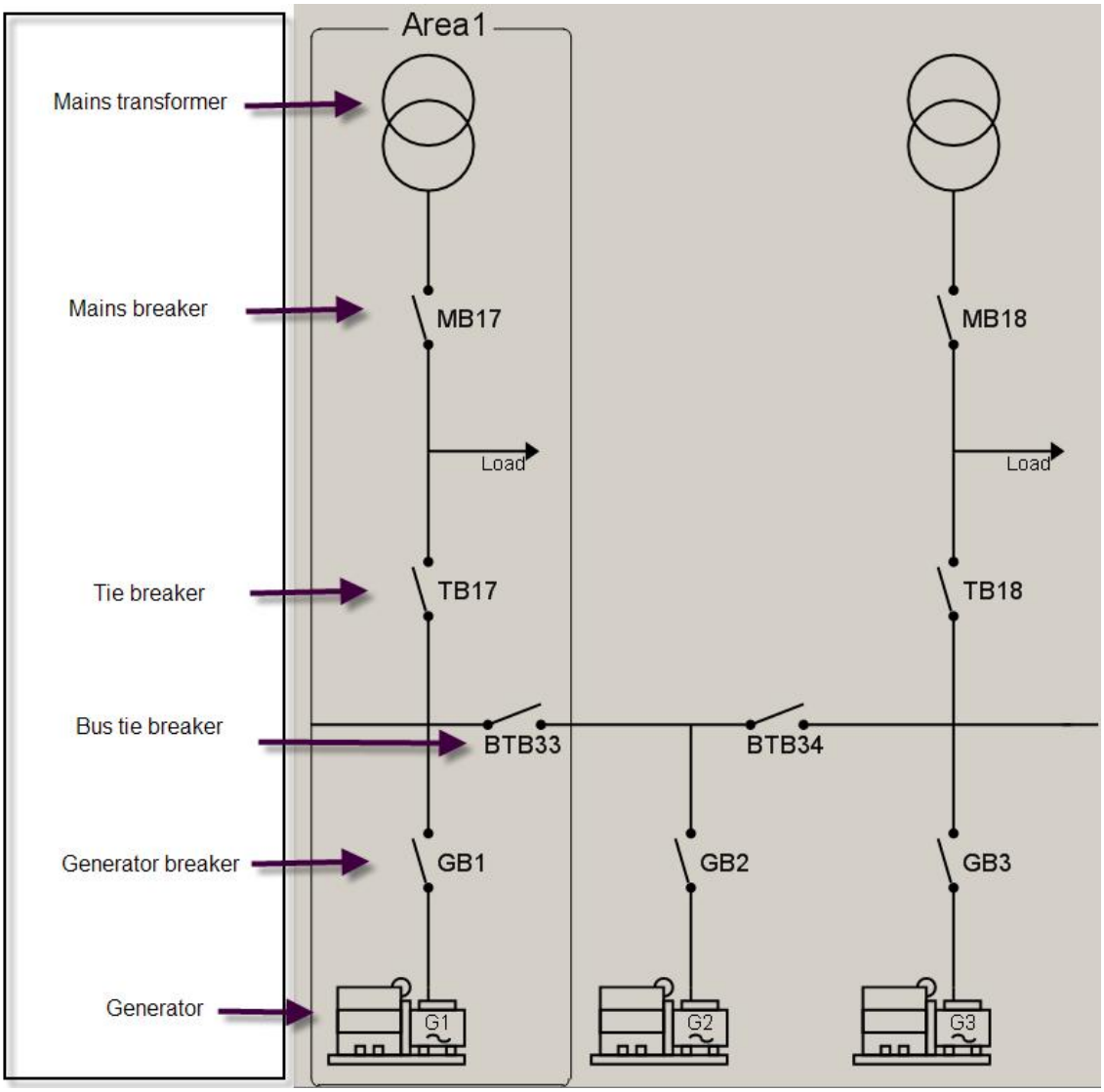
Each application can handle:

- 0-16 mains feeders in the same application
- 0-16 gensets in the same application
- 8 bus tie breakers

The multiple mains functionality covers a great variety of different applications. Please contact DEIF support (support@deif.com) for questions concerning the functionality.

8.4.10 Definitions

A multiple mains application consists of feeders and generators + a number of GBs, TBs, BTBs and MBs.



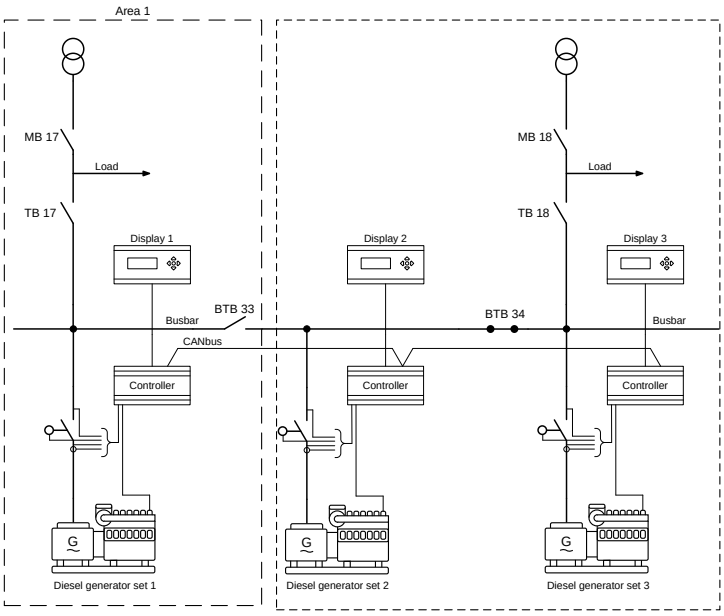
Sections

The application consists of static and dynamic sections if one or more BTBs are installed. The definition of a section is mentioned in the table below.

Section	Definition
Static section	Part of the total application which is separated by one or two open BTBs. There will be no closed BTBs within this section. A static section can also be a dynamic section, but not vice versa.
Dynamic section	Part of the total application which is separated by one or two open BTBs. There may be one or more closed BTBs within this section.

If no BTBs are installed, the application consists of a static section only.

Only use remote start signal in island application with BTB units.



The area on the left of BTB 33 is a static section because it is separated by the open BTB 33. The BTB 34 is in closed position. Therefore the indicated section is a dynamic section.

Please see "Application design" earlier in this document about how to setup applications with more than one AGC.

8.4.11 Plant mode handling

Basically, six menus are available for setting up the functionality of the application.

No.	Setting		Min. setting		Max. setting		Factory setting
8181	MB failure start	Enable	OFF		ON		OFF
8182	Parallel	Enable	OFF		ON		OFF
8183	No break transfer	Enable	OFF		ON		OFF
8184	Auto switch	Enable	OFF	Static	Dynamic	All	OFF
8185	Run type	Run one/all mains	Run all mains		Run one mains		Run one mains
8186	Run type	ID to run	17		32		17

MB close failure start:
This setting determines whether a start of the DGs should be executed if an MB close failure occurs.

If "MB close failure start" is activated, the mode shift functionality will automatically be enabled.

In peak shaving, fixed power, mains power export and load takeover, the function is only active when menu 7081 Mode shift is set to ON.

MB parallel:
This setting determines whether the mains connections (MBs) should be able to run in parallel or not.

The setting of "MB parallel" affects the function of the "Auto switch" setting.

No break transfer:
This setting determines whether switching between the mains connections (MBs) should be executed as a black coupling or a synchronised coupling.

If the TBs in a section are adjusted to normally closed and "MB parallel" is switched OFF, then only one of the TBs can be closed at the time.

The system will try to keep the ID selected in menu 8186 ("My ID to Run") to keep its TB closed. If, however, the selected ID does not have a TB configured as a normally closed breaker, or if it fails to close it, it will be the mains unit holding the lowest ID without TB failures present that will close.

If "My ID to Run" is changed during operation, then the MB parallel setting will decide whether a black or a synchronised change-over will take place.

If "MB parallel" is activated, the "No break transfer" will automatically be enabled.

Auto switch:
This setting determines whether a mains unit detecting a mains failure will try to get the connected load supplied by another mains or by the available DGs.

	Description
OFF	The auto switch functionality is switched OFF.
Static section	The backup power is recovered within its own static section.
Dynamic section	The backup power is recovered within its own dynamic section. The application will never try to synchronise/close a BTB to get help in an AMF situation.
All sections	The backup power is recovered within all available sections.

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

If dynamic is selected, then be aware that one mains unit will be requested to carry all load from the dynamic section without any help from the DGs.

Therefore the remaining mains feeders must be able to carry the load from the entire section.

Run type:
This setting determines how the system in a dynamic section reacts in all the plant modes except island and AMF.

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

This setting can be handled from M-Logic.

8.4.12 Tie breaker configuration

Some of the possible applications of the AGC with option G5 can be used with a tie breaker, that is a breaker connected between the gensets and the load bus.

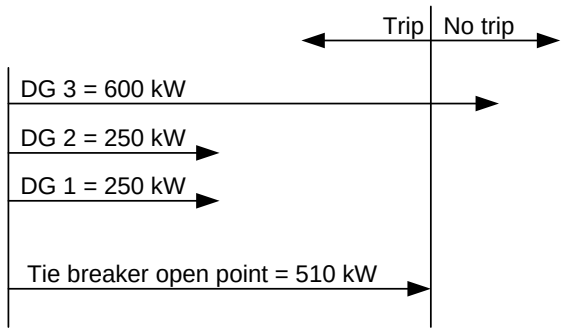
8.4.13 Tie breaker open point

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

This depends on the total nominal power of the running gensets. If the gensets cannot supply the amount of load which is adjusted in the "tie breaker open point" menu 8192, then the tie breaker will open. It will close again when the power capacity set point menu 8193 is reached.

This delay time can be used to trip non-essential load groups.

Example
In the example illustrated below, it can be seen that the tie breaker will trip if DG1 or DG2 is connected to the load, because they are smaller than 510 kW. If DG1 and DG2 are running together, the tie breaker will also trip, because the total nominal power is still below 510 kW. If, however, DG3 is running alone or together with one of the two smaller DGs, the tie breaker will not trip, because the total nominal power will be higher than 510 kW.



The powers mentioned above are nominal powers of the gensets in the application.

8.4.14 Power capacity

The power capacity setting in menu 8193 is used in AMF applications to determine how much power must be available, before the tie breaker can close. When the gensets are started, the generator breakers will close, and when sufficient power is available, the tie breaker will be closed.

Power capacity overrule:
In case some of the generators fail starting and the power capacity set point is not reached, the tie breaker will never be closed. Because of this, it is possible to overrule the power capacity set point after a period of time set in menu 8194. The function "power capacity overrule" is enabled in menu 8195.

8.4.15 Available power

The function is used to activate a relay when a specific amount of power is available. The purpose of this function is to be able to connect load groups when the gensets of the emergency power plant are running.

Five levels of available power can be adjusted (menus 8220-8260):
- Available power 1
- Available power 2
- Available power 3
- Available power 4
- Available power 5

These set points can activate a relay when the specific amount of available power is reached. The relay output can be used for connecting load groups when sufficient power is available. The relays will activate when the available power is higher than the set point, but be aware that when the load groups are being connected, the available power will decrease and the relay(s) deactivate again if the available power is below the set point. So it is necessary to make an external holding circuit.

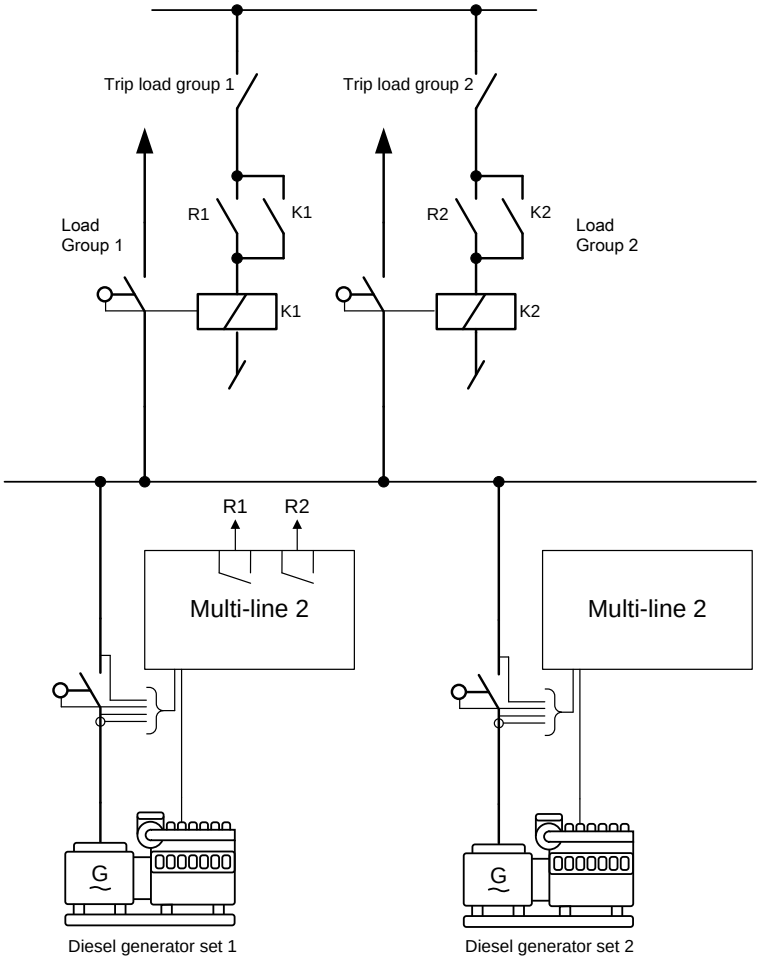
The number of available relays is option-dependent.

The function is not dependent on the running modes. The relays will activate in all modes including block. To avoid activation, for example when the genset is stopped, the inhibit function should be used.

Regarding the inhibit function, refer to the chapter Additional functions in this document.

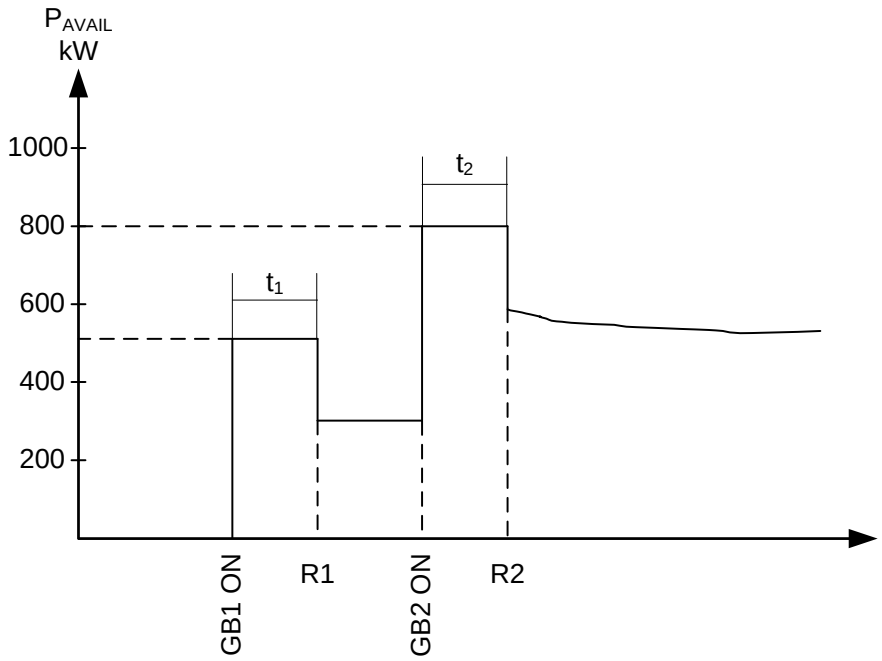
It is possible to adjust different levels of available power in all gensets. This gives the possibility to use several load groups if this is necessary.

Example:
In the example below, generator no. 1 is started, followed by generator no. 2. The simplified diagram shows the two gensets and two load groups that are being connected by the available power relays R1 and R2 on the AGC.



8.4.16 Available power functionality

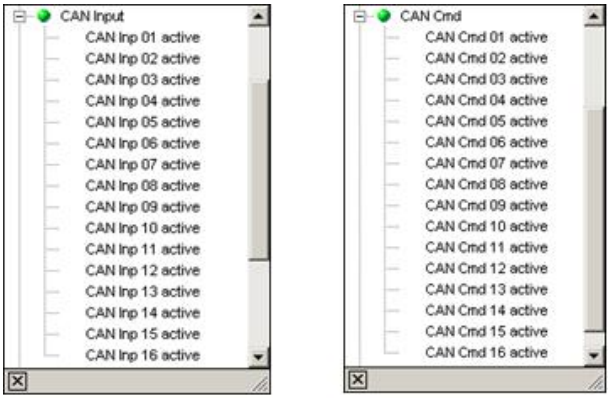
The generator no. 1 is started, and the timer t1 starts running when the GB1 closes. When the t1 is expired, the selected relay activates (R1), and in the example a 200 kW load group is connected. Now the available power falls to 300 kW. After some time, the generator no. 2 is started and its generator breaker is synchronised. When the GB2 closes, the timer t2 runs. When the timer t2 expires, the selected relay activates (R2), and the second load group of 200 kW is connected. Now the available power falls to 600 kW.

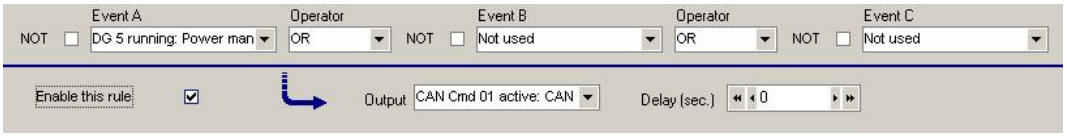


To connect the load groups, individual relays can be selected on each AGC or on one of the AGC units only.

8.4.17 CAN flags

16 CAN flags can be accessed in M-Logic. They can be used in the same way as digital inputs. CAN flags can be set active when a CAN command is sent from one unit to another. The benefit is that no wire is needed, as the CAN flags are activated via the CAN bus.





Example: CAN cmd 01 will be active when DG 5 is running. All units in the power management system will receive "CAN input 01 active" and then be able to act on this information.

Only use of constant signals from digital inputs or AOP buttons can activate the CAN inputs. AOP buttons are pulse inputs, so a latch function must be made to make similar functionality as constant signals.

8.5 AGC 145/146 digital inputs

8.5.1 AGC 145/146 digital inputs

The table below shows the available digital input for AGC 145 and AGC 146. Input selections for the generators are descriped earlier in this document in the chapter "Additional functions" and "Digital inputs".

	Input function	Auto	Semi	Test	Man	Block	Configurable	Input type
1	Access lock	X	X	X	X	X	Configurable	Constant
2	Remote start		X		X		Configurable	Pulse
3	Remote stop		X		X		Configurable	Pulse
4	Test	X	X		X	X	Configurable	Pulse
5	Auto		X	X	X	X	Configurable	Pulse
6	Remote TB ON (Only AGC 146)		X		X		Configurable	Pulse
7	Remote TB OFF (only AGC 146)		X		X		Configurable	Pulse
8	Remote MB ON		X		X		Configurable	Pulse
9	Remote MB OFF		X		X		Configurable	Pulse
10	Remote alarm acknowledge	X	X	X	X	X	Configurable	Constant
11	Auto start/stop	X					Configurable	Constant
12	TB position ON (only AGC 146)	X	X	X	X	X	Configurable	Constant
13	TB position OFF (Only AGC 146)	X	X	X	X	X	Configurable	Constant
14	MB position ON	X	X	X	X	X	Configurable	Constant
15	MB position OFF	X	X	X	X	X	Configurable	Constant
16	Emergency stop	X	X	X	X	X	Not configurable	Constant
17	Mains Okay	X	X	X	X	X	Configurable	Pulse
18	TB close inhibit (Only AGC 146)	X	X		X	X	Configurable	Constant
19	MB close inhibit	X	X	X	X	X	Configurable	Constant
20	Enable mode shift	X	X	X	X	X	Configurable	Constant
21	Alternative start	X	X	X	X	X	Configurable	Constant
22	Switchboard error	X	X	X	X	X	Configurable	Constant
23	Total test	X	X	X	X	X	Configurable	Constant
24	TB spring loaded (Only AGC 146)	X	X	X	X	X	Configurable	Constant
25	MB spring loaded	X	X	X	X	X	Configurable	Constant

8.5.2 Functional description

1. Access lock

Activating the access lock input deactivates the control display push-buttons. It will only be possible to view measurements, alarms and the log.

2. Remote start
This input initiates the start sequence or plant mode of the gensets from the mains unit, when parameter 8021 is set to remote

3. Remote stop
This input initiates the stop sequence or plant mode of the gensets from the mains unit, when parameter 8021 is set to remote.

4. Test mode
Changes the present running mode to test.

5. Auto mode
Changes the present running mode to auto.

6. Remote TB ON
The tie breaker ON sequence will be initiated and the breaker will close if the mains breaker is opened.

7. Remote TB OFF
The tie breaker OFF sequence will be initiated.

8. Remote MB ON
The mains breaker ON sequence will be initiated.

9. Remote MB OFF
The mains breaker OFF sequence will be initiated.

10. Remote alarm acknowledge
Acknowledges all present alarms, and the alarm LED on the display stops flashing.

11. Auto start/stop
The genset will start when this input is activated. The genset will be stopped if the input is deactivated. The input can be used when the unit is in island operation, load takeover and the AUTO running mode is selected.

12. Tie breaker closed feedback (TB position ON)
The input function is used as an indication of the tie breaker position. The unit requires this feedback when the breaker is closed or a position failure alarm occurs.

13. Tie breaker open feedback (TB position OFF)
The input function is used as an indication of the tie breaker position. The unit requires this feedback when the breaker is opened or a position failure alarm occurs.

14. Mains breaker closed feedback (MB position ON)
The input function is used as an indication of the mains breaker position. The unit requires this feedback when the breaker is closed or a position failure alarm occurs.

15. Mains breaker open feedback (MB position OFF)
The input function is used as an indication of the mains breaker position. The unit requires this feedback when the breaker is opened or a position failure alarm occurs.

16. Emergency stop
The input will open the mains breaker in all plant modes. If the generator breaker(s) and the tie/mains breaker is closed at the same time, the emergency stop will open the mains, tie and generator breaker(s) and shut down the generator(s) immediately.

The shutdown fail class must be selected.

24. Battery test
Activates the starter without starting the genset. If the battery is weak, the test will cause the battery voltage to drop more than acceptably, and an alarm will occur.

25. Mains Okay
Disables the "mains OK delay" timer. The MB close sequence will begin when the input is activated.

26. GB close inhibit
When this input is activated, the generator breaker cannot close. Inhibit used for GB, where ext. PLC or other equipment controls when load is on genset.

27. MB close inhibit
When this input is activated, the mains breaker cannot close.

28. Enable mode shift
The input activates the mode shift function, and the AGC will perform the AMF sequence in case of a mains failure. When the input is configured, the setting in menu 7081 (mode shift ON/OFF) is disregarded.

29. Start enable
The input must be activated to be able to start the engine.

When the genset is started, the input can be removed.

30. Alternative start
This input is used to simulate an AMF failure and this way run a full AMF sequence without a mains failure actually being present.

31. Switchboard error
The input will stop or block the genset depending on running status.

32. Total test
This input will be logged in the event log to indicate that a planned mains failure has been made.

33. GB spring loaded
The AGC will not send a close signal before this feedback is present.

34. MB spring loaded
The AGC will not send a close signal before this feedback is present.

35. D+ (digital running feedback)
This input is used as a running indication of the engine. When the input is activated, the start relay is deactivated. Input for running feedback from charge generator +D terminal. (Runs when charger U > battery voltage).

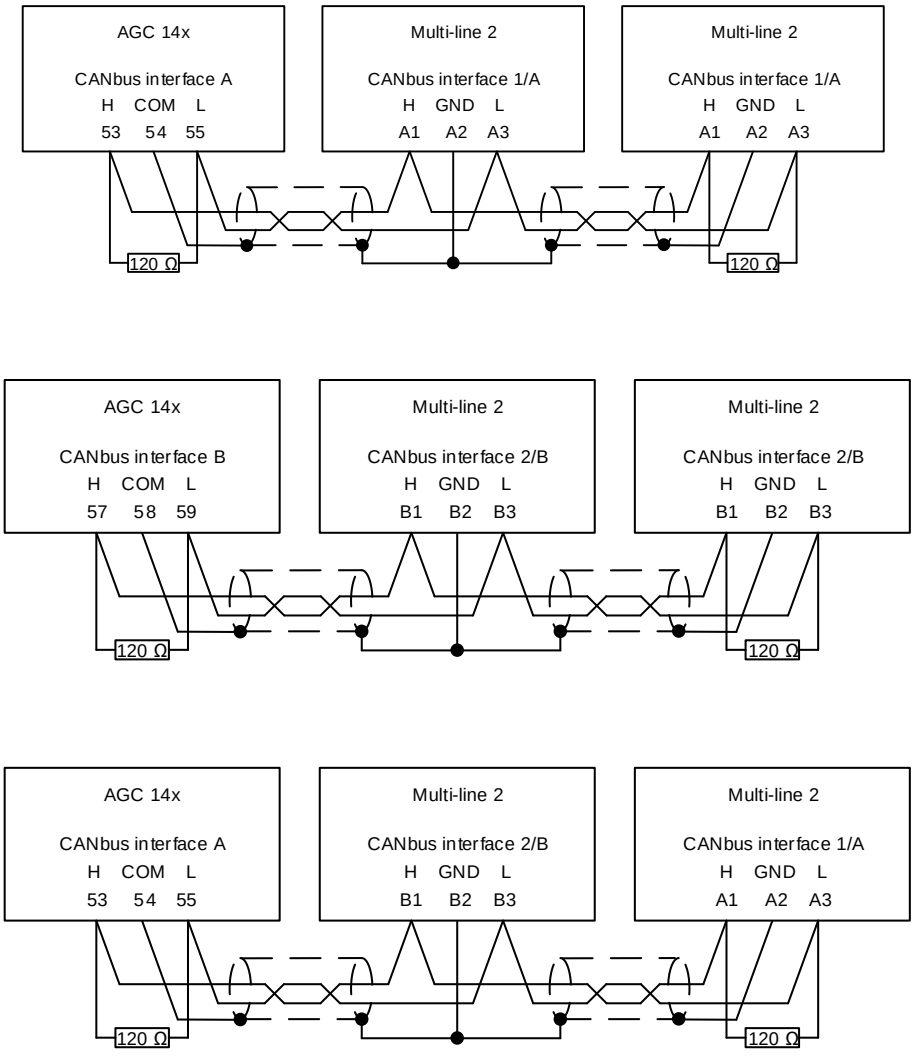
36. Inhibit Ei alarms
When this input is active, it will inhibit all engine interface (option H5) alarms.

The input functions are set up with the PC utility software, please refer to "Help" in this.

8.6 Wiring diagram

8.6.1 CAN bus wiring

The following diagrams show examples with three AGC units connected, for example one AGC 14x and two generator AGC units.



As you can see from the last example, it is possible to mix CAN bus interface 1 and 2 (or A and B).

For distances above 300 metres, we recommend to use a CAN to fibre converter.

Do not connect the cable shield to the GND/COM terminal of the AGC units.

For AGC 100, there are two CAN bus outputs, CAN A + B.

8.7 Breaker feedbacks

8.7.1 Mains breaker (MB) feedback

The required feedback from the breaker depends on which type of breaker is used.

MB present:	See "Additional functions" chapter about breaker feedback in this document
MB not present:	Selected in the application configuration (USW).

When no MB is represented, the MB open and close relays together with the inputs for MB open and close feedbacks will be configurable.

8.7.2 Tie breaker (TB)

The required feedback from the breaker depends on which type of breaker is used.

TB present:	See "Additional functions" chapter about breaker feedback in this document.
TB not present:	Selected in the application configuration (USW)

When no TB is represented, the TB open and close relays together with the inputs for TB open and close feedbacks will be configurable.

9. PID controller (AGC 110 only)

9.1 General purpose of PID regulators (AGC 110 only)

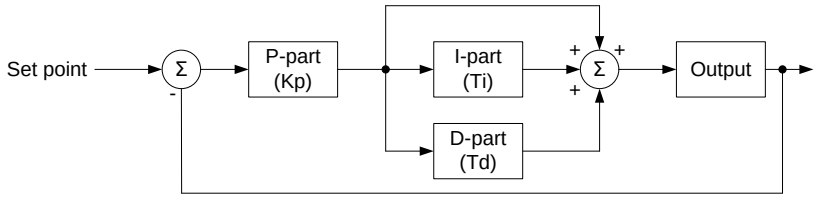
9.1.1 Introduction

The controller in the AGC 110 is a PID controller. It consists of a proportional regulator, an integral regulator and a differential regulator. The PID regulators have been designed to be as close as possible to the PID regulators known from the AGC-4 and the AGC 200. However, the PID regulators in the AGC 110 do not have as quick a response as the PID regulators found in the AGC-4 and AGC 200. It is therefore recommended that the PID regulators in the AGC 110 are used in applications that in general have a slow closed loop only.

All three regulators are 100 % identical. Only parameters and M-Logic inputs/outputs are different. However, note that only PID1 is able to run the engine in idle mode.

9.1.2 Principle drawing

The drawing below shows the basic principle of the PID controller.



$$\mathrm{PID}(s) = Kp \cdot \left(1 + \frac{1}{Ti \cdot s} + Td \cdot s\right)$$

As illustrated in the drawing and the equation above, each regulator (P, I and D) gives an output which is summarised to the total controller output.

The adjustable settings for the PID controllers in the AGC 110 unit are:

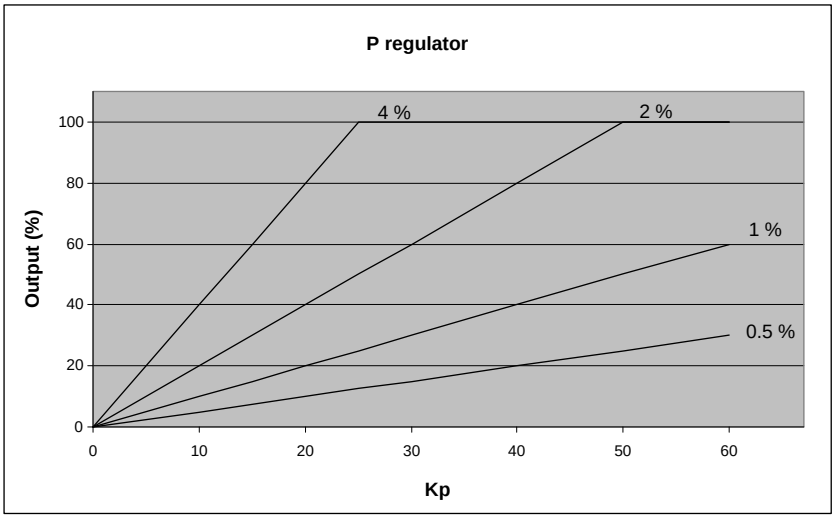
Kp :	The gain for the proportional part.
Ti :	The integral action time for the integral part.
Td :	The differential action time for the differential part.

The function of each part is described in the following.

9.1.3 Proportional regulator

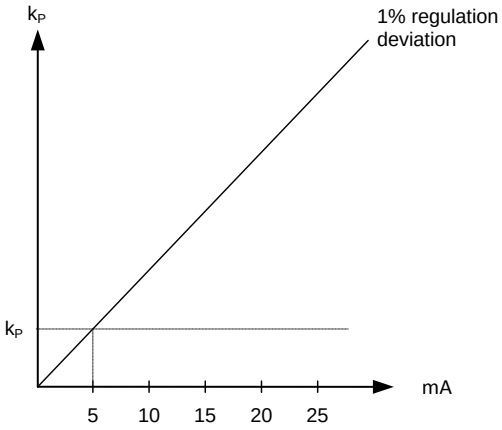
When the regulation deviation occurs, the proportional part will cause an immediate change of the output. The size of the change depends on the gain Kp.

The diagram shows how the output of the P regulator depends on the Kp setting. The change of the output at a given Kp setting will be doubled, if the regulation deviation doubles.



Speed range

Because of the characteristic above, it is recommended to use the full range of the output to avoid an unstable regulation. If the output range used is too small, a small regulation deviation will cause a rather big output change. This is shown in the diagram below.

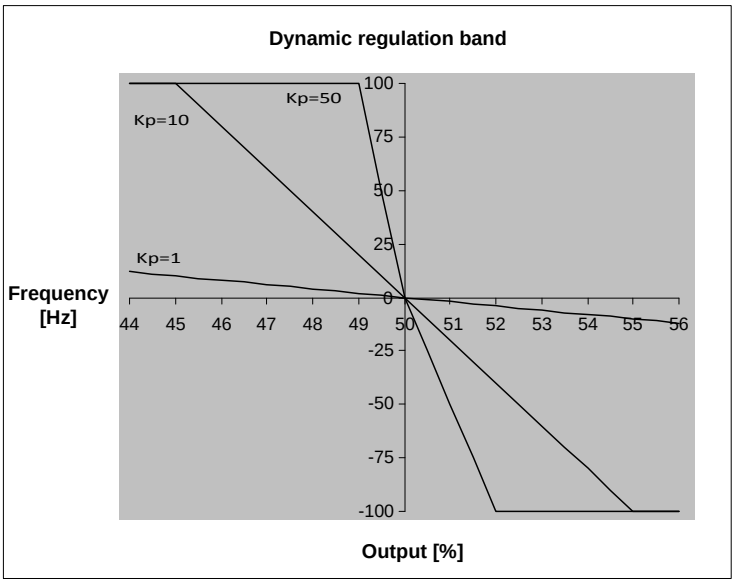


A 1 % regulation deviation occurs. With the Kp setting adjusted, the deviation causes the output to change 20 %. The table shows that the output of the AGC 110 changes relatively much if the maximum speed range is low.

Max. speed range	Output change		Output change in % of max. speed range
50 %	20 %	20/50*100 %	40
100 %	20 %	20/100*10 %	20

Dynamic regulation area

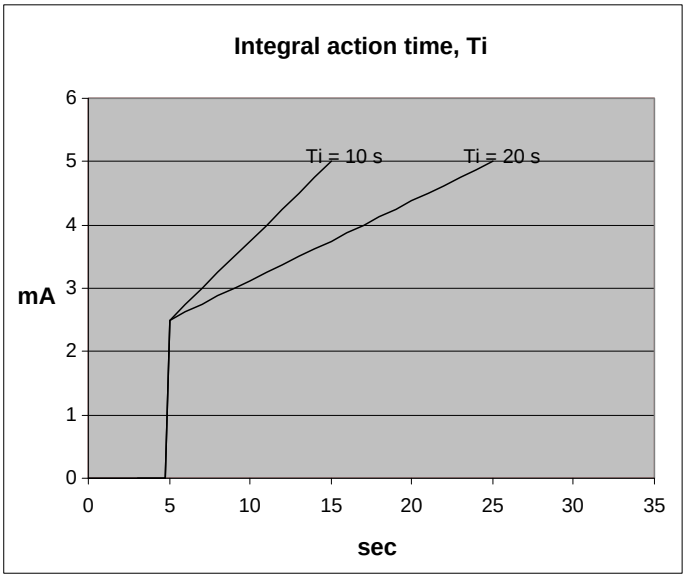
The diagram below shows the dynamic regulation area at given values of Kp. The dynamic area will be smaller if the Kp is adjusted to a higher value.



Integral regulator

The main function of the integral regulator is to eliminate offset. The integral action time Ti is defined as the time the integral regulator uses to replicate the momentary change of the output caused by the proportional regulator.

In the diagram below, the proportional regulator causes an immediate change of 10 %. The integral action time is then measured when the output reaches 2 × 10 = 20 %.



As shown in the diagram, the output reaches 20 % twice as fast at a Ti setting of 10 s than with a setting of 20 s.

The integrating function of the I regulator is increased if the integral action time is decreased. This means that a lower setting of the integral action time Ti results in a faster regulation.

If the Ti is adjusted to 0 s, the I regulator is switched OFF.

The integral action time Ti must not be too low. This will make the regulation hunt, similar to a too high proportional action factor Kp.

Differential regulator

The main purpose of the differential regulator (D regulator) is to stabilise the regulation, thus making it possible to set a higher gain and a lower integral action time Ti. This will make the overall regulation eliminate deviations much faster.

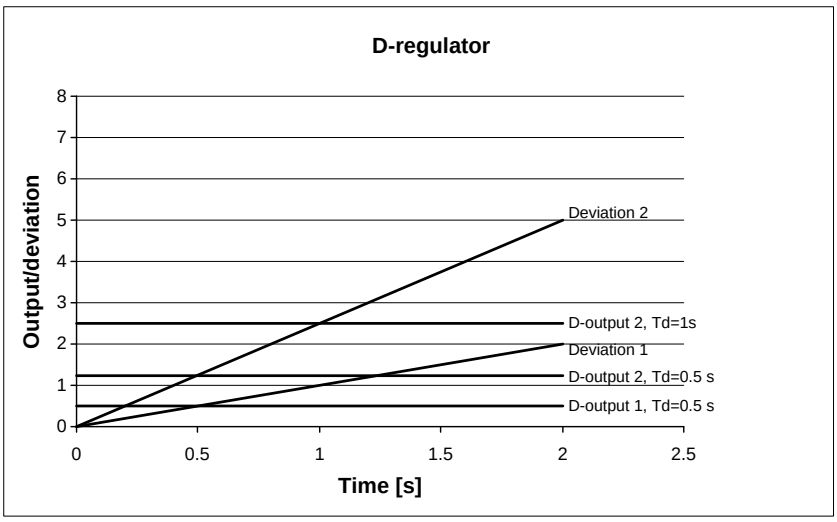
In most cases, the differential regulator is not needed; however, in case of very precise regulation situations, for example static synchronisation, it can be very useful.

The output from the D regulator can be explained with the equation: $D = Td \cdot Kp \cdot \frac{de}{dt}$

D = Regulator output
Kp = Gain
de/dt = Slope of the deviation (how fast the deviation occurs)

This means that the D regulator output depends on the slope of the deviation, the Kp and the Td setting.

Example: In the following example, it is assumed that Kp = 1.



Deviation 1:	A deviation with a slope of 1
Deviation 2:	A deviation with a slope of 2.5 (2.5 times bigger than deviation 1
D output 1, Td=0.5 s:	Output from the D regulator when Td=0.5 s and the deviation is according to Deviation 1.
D output 2, Td=0.5 s:	Output from the D regulator when Td=0.5 s and the deviation is according to Deviation 2.
D output 2, Td=1 s:	Output from the D regulator when Td=1 s and the deviation is according to Deviation 2.

The example shows that the bigger the deviation and the higher the Td setting is, the bigger is the output from the D regulator. Since the D regulator is responding to the slope of the deviation, it also means that when there is no change, the D output will be zero.

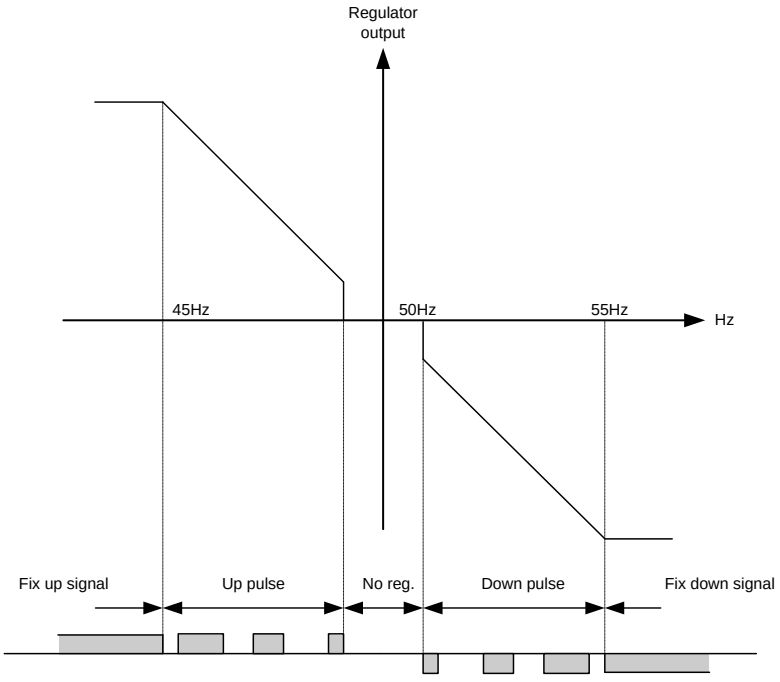
When commissioning, keep in mind that the Kp setting has influence on the D regulator output.

If the Td is adjusted to 0 s, the D regulator is switched OFF.

The differential action time Td must not be too high. This will make the regulation hunt similar to a too high proportional action factor Kp

9.1.4 Relay control

When the relay outputs are used for control purposes, the regulation works like this:



The regulation with relays can be split up into five steps.

#	Range	Description	Comment
1	Static range	Fix up signal	The regulation is active, but the increase relay will be constantly activated because of the size of the regulation deviation.
2	Dynamic range	Up pulse	The regulation is active, and the increase relay will be pulsing in order to eliminate the regulation deviation.
3	Deadband area	No reg.	In this particular range, no regulation takes place. The regulation accepts a predefined deadband area in order to increase the lifetime of the relays.
4	Dynamic range	Down pulse	The regulation is active, and the decrease relay will be pulsing in order to eliminate the regulation deviation.
5	Static range	Fix down signal	The regulation is active, but the decrease relay will be constantly activated because of the size of the regulation deviation.

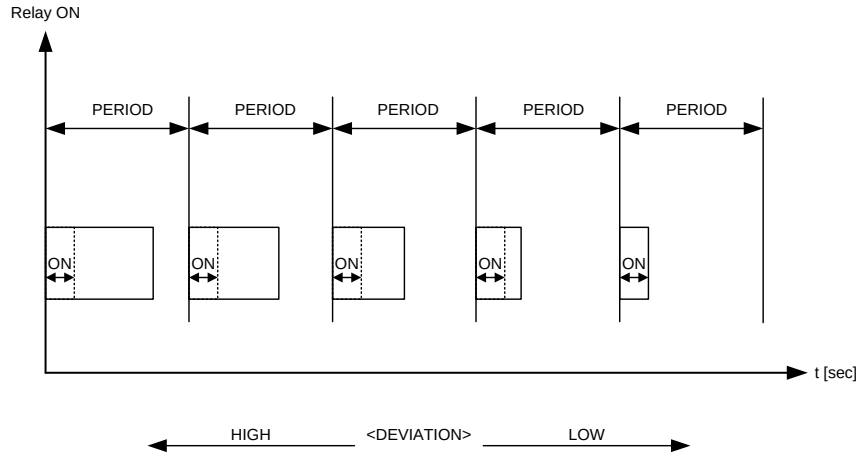
As the drawing indicates, the relays will be fixed ON if the regulation deviation is big, and they will be pulsing if it is closer to the set point. In the dynamic range, the pulses get shorter and shorter when the regulation deviation gets smaller. Just before the deadband area, the pulse is as short as it can get. This is the adjusted time "PID1 ON time"/"PID2 ON time"/"PID3 ON time". The longest pulse will appear at the end of the dynamic range (45 Hz in the example above).

Relay adjustments

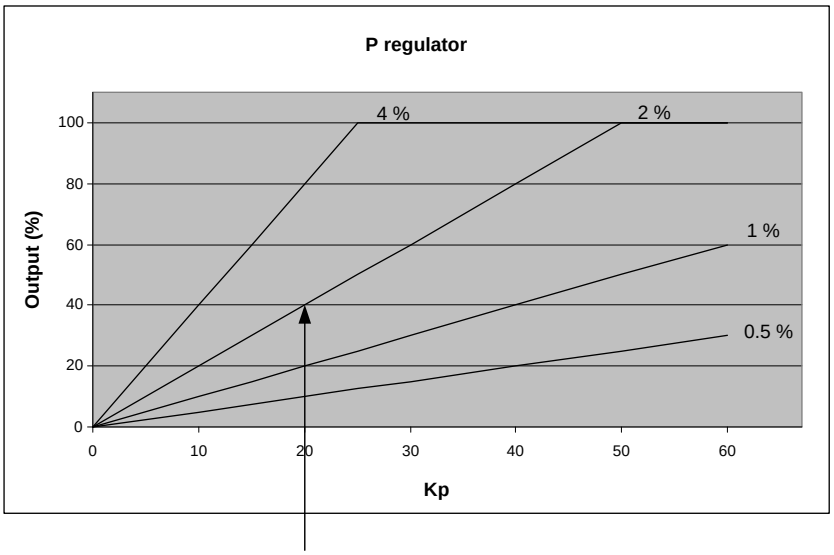
The time settings for the regulation relays can be adjusted in the control setup. It is possible to adjust the "period time" and the "ON time". They are shown in the drawing below.

Adjustment	Description	Comment
Period time	Maximum relay time	The time between the beginnings of two subsequent relay pulses.
ON time	Minimum relay time	The minimum length of the relay pulse. The relays will never be activated for a shorter time than the ON time.

As it is indicated in the drawing below, the length of the relay pulse will depend on the actual regulation deviation. If the deviation is big, then the pulses will be long (or a continued signal). If the deviation is small, then the pulses will be short.



Signal length
The signal length is calculated compared to the adjusted period time. In the drawing below, the effect of the proportional regulator is indicated.



In this example, we have a 2 percent regulation deviation and an adjusted value of the Kp = 20. The calculated regulator value of the unit is 40 %. Now, the pulse length can be calculated with a period time = 2500 ms:

$$e_{DEVIATION} / 100 * t_{PERIOD}$$
$$40 / 100 * 2500 = 1000\ ms$$

The length of the period time will never be shorter than the adjusted ON time.

9.1.5 Regulator modes

The PID regulators in the AGC 110 can function in three different modes. In the sections below, the three different modes will be explained. Note that all modes are controlled entirely from M-Logic. The M-Logic interface for controlling the regulator modes is explained in the document "ML-2 application notes M-Logic".

Auto regulation mode
The auto regulation mode looks at the chosen input for the regulator and tries to regulate towards the chosen reference set point. If the input was a temperature sensor, and the wanted temperature was 50 °C, the reference set point should be 50 °C. The regulator would then try to achieve and hold a temperature of 50 °C.

Manual regulation mode
When a regulator is in manual regulation mode, the regulator goes into a resting position. The chosen reference set point in the parameter list is no longer used. Instead the actual value is chosen as a reference set point for the regulator. The reference set point is then manually changed through two M-Logic increase/ decrease commands. If an increase or decrease command is given to the regulator, it suddenly sees an error (error = reference - actual value). The regulator then tries to diminish that error by increasing or decreasing the output. It can be set by the parameter Man Err Scaling (Manual Error Scaling) how much the increase or decrease pulse changes the error.

Off regulation mode
If off regulation mode is selected, the regulator is not able to do anything. This mode is the default mode. If this mode is chosen while manual or auto regulation mode is functioning, the output of the regulator will be frozen and will stay like that after the off regulation mode is not used anymore.

The frozen output can be reset through the following three M-Logic commands:

- PID Reg set out to Offset
- PID Reg set out to Min
- PID Reg set out to Max

These commands are explained in the document "ML-2 application notes M-Logic".

9.1.6 Regulator inputs

It is possible to choose different kinds of inputs for the regulator. The input is scaled to a value between -100 % and 100 %. In this way, the regulator is able to handle many different inputs. The value shown in the display is always compared to the chosen reference value and is scaled in the same way as the input. In the table below the different inputs are listed.

Input type	Notes
Multi-inputs 6, 7 and 8	**Binary mode:** If the input is shown as ON in the display, the input for the regulator will be 100 %, otherwise 0 %. **4 to 20 mA:** The input is always scaled in the range 4 mA to 20 mA. If a different range is chosen in the 4 to 20 mA alarm parameters, the value shown in the display is scaled in relation to the chosen range. **RMI Fuel level/RMI Water temperature/RMI Oil pressure:** The input is scaled in relation to the selected curve for the selected RMI mode, either a predefined curve or the configurable curve. **Pt1000 (multi-inputs 6 and 7 only):** The input is scaled in the range -51 to 265 °C.
MPU input (RPM measurement)	Here the input is scaled in relation to the nominal rpm range 100 to 4000 rpm.
EIC Speed	PGN 61444, SPN 190 Engine Speed* If the input telegram does not contain a valid value, the used input value will be the last known valid value. The last valid value is zero if no valid values have been received since power-up. The input from the EIC is being scaled in the rpm range 100 to 4000 rpm.
EIC Ambient Air Temperature	PGN 65269, SPN 171 Ambient Air Temperature* If the input telegram does not contain a valid value, the used input value will be the last known valid value. The last valid value is zero if no valid values have been received since power-up. The input from the EIC is being scaled in the temperature range -40 to 210 °C.
EIC Coolant Temperature	PGN 65262, SPN 110 Engine Coolant Temperature* If the input telegram does not contain a valid value, the used input value will be the last known valid value. The last valid value is zero if no valid values have been received since power-up. The input from the EIC is being scaled in the temperature range -40 to 210 °C.
EIC Oil Temperature	PGN 65262, SPN 175 Engine Oil Temperature 1* If the input telegram does not contain a valid value, the used input value will be the last known valid value. The last valid value is zero if no valid values have been received since power-up. The input from the EIC is being scaled in the temperature range -40 to 210 °C.

*The telegrams specified here are part of the J1939 standard. For communication protocols that do not use J1939, consult the document "Option H5, H7 and H13 MTU MDEC, ADEC, J1939 CAN bus engine interface".

9.1.7 Regulator outputs

It is possible to choose three types of outputs for the regulator. If the same output is selected for two or more regulators, the regulator with the lowest number will be the one with the highest priority. An example would be for PID2 and PID3 to have the same output, PID2 would then be the one with the highest priority.

Relay control

If relay control is chosen as the output for a regulator, the regulator requires two unused relays. The relays can be configured in the parameters 2830, 2870 and 2910 for the different regulators.

The relay regulation is controlled with a proportional gain, Kp, and a deadband. By selecting a higher Kp, the regulator will be more aggressive. The deadband is like a deadzone. If the deadband is 5 % and the reference value is 50, the regulator will not do anything when the actual value is in the range of 47.5 to 52.5. A deadband under 0.2 % is not recommended for use with relay regulation.

Analogue control (IOM 220/230 box)
Analogue control can be selected by configuring the regulator type to IOM term. 7, 9, 12 or 14. Analogue regulation requires an IOM 220 or an IOM 230. To configure the IOM 2xx box, the CAN bus must use option H5, Engine Interface Communication, and the IOM 220/230 interface or an engine interface must be chosen in parameter 7561, Engine I/F.

The analogue regulation is controlled with a proportional gain, Kp, an integral action time, Ti, and a differential action time, Td. If needed, a deadband can also be configured. Deadband is a percentage of the reference value and the regulator will rest if the actual value is inside the deadband. If the deadband is set to zero, the deadband is not used.

In manual regulation mode, the Kp and Ti values are used. If both values are zero, the Kp is equal to 1.00 and Ti is equal to 10.00 s. Td is always equal to zero.

An IOM 2xx communication error alarm can be found in parameter 7576. If no PID regulators are configured to use an IOM 2xx box, the alarm will not be active.

The full-scale regulator output will correspond to the full-scale output selected on the IOM 2xx box. Possible output types and terminals are listed in the table below.

Type/terminal	IOM term. 7	IOM term. 9	IOM term. 12	IOM term. 14
IOM 220	+/-25 mA 0 to 20 mA +/-12 V 0 to 10 V	+/-25 mA 0 to 20 mA +/-12 V 0 to 10 V	Not available in IOM 220	Not available in IOM 220
IOM 230	+/-25 mA 0 to 20 mA +/-12 V 0 to 10 V	+/-25 mA 0 to 20 mA +/-12 V 0 to 10 V	+/-5 V	+/-5 V

It is required that all equipment that is connected to the four terminals on the IOM 2xx box have high impedance inputs.

EIC (EIC Speed TSC1 telegram)
EIC speed regulation uses the same parameters and setup as the analogue regulation. If no EIC speed is chosen in any regulator, the EIC speed output (TSC1) on the CAN bus is just signalling the nominal rpm.

In this setting the regulator output is scaled in relation to the nominal rpm range 100 to 4000 rpm. On the Scania interface "Scania EMS" and "Scania EMS 2 S6", the output is limited to 3000 rpm, but the scaling is still 100 to 4000 rpm. On all other engine interfaces the range is limited to 3275 rpm, the scaling is still the same, 100 to 4000 rpm.

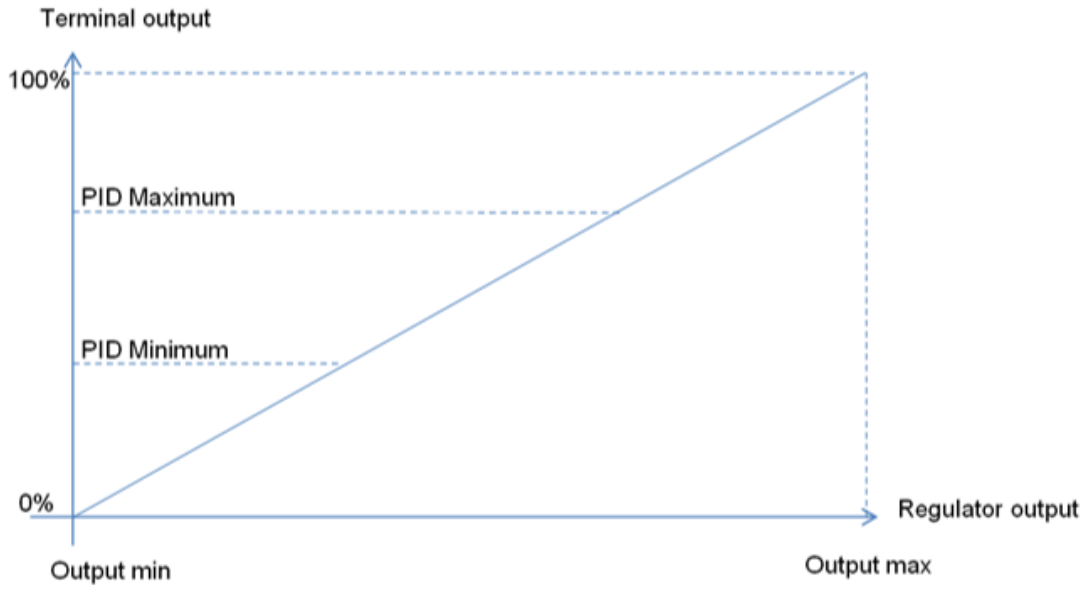
The regulator output is also limited by the nominal rpm set point. This has been done to make it possible to use the overspeed alarm.

9.1.8 Minimum/Maximum/Inverse

If the full range of the regulator output is not to be used, it is possible to limit the output by two parameters. For PID1 these parameters are called 2802 PID1 Minimum and 2803 PID1 Maximum. Similar parameters can be found for PID2 and PID3.

If the range is limited by these parameters, note that the resolution of the limited scale is not improved. The output resolution will remain unchanged and will only work inside the limited range.

It is not possible for the regulator to output a value outside the limited range.



Inverse functionality is used if the hardware is wired up in reverse or if for example an engine has to speed up, to make a lower pressure of some kind. The functionality of the maximum-minimum range is still the same when the inverse functionality is used.

The inverse functionality can only be found in M-Logic as an M-Logic command. For PID1 the command is called PID1 Temporary Inverse. Similar commands exist for PID2 and PID3.

9.1.9 Idle run

If the AGC 110 is used to regulate an engine and it is desired to use idle run for the engine, PID1 can be useful.

For the idle run to work, the closed loop must be set up, an MPU or a CAN bus between the governor and CAN bus H5 EIC must be connected. Next, the idle run rpm must be set up in parameter 6173. Parameter 6173 is the running detection level, and idle run will use the running detection level + 20 % as the temporary reference set point.

The M-Logic command, PID1 Idle Run Speed Control, must be set as long as the engine is in idle run. This will cause the regulator (Auto regulation mode) to aim for the running detection level + 20 % as long as the idle run mode is active. The M-Logic command is explained in the document "ML-2 application notes M-Logic".

10. Parameter list

10.1 Related parameters

The Designer’s Reference Handbook relates to the parameters 1000-1990, 2000-2790, 3000-3490, 4120-4990, 5000-5070, 6000-6990 and 7000-7970.

For further information, please see the separate parameter list, document number 4189340764.