DEIF
-power in control

$C \, \epsilon$

DESIGNER'S REFERENCE HANDBOOK

Genset Control Unit, GCU 100
- Functional description
- Additional functions
- Parameter list

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 terminal against static discharges during the installation. Once the unit is installed and connected, these precautions are no longer necessary.

1.1.5 Factory settings

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

1.2 About the 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, information about the PID controller, 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 he needs in order to successfully set up the parameters needed in his specific application.

⚠️ **Please 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, e.g. 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 GCU 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 GCU 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
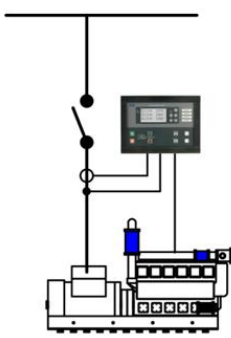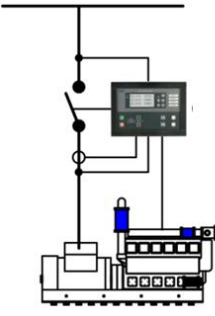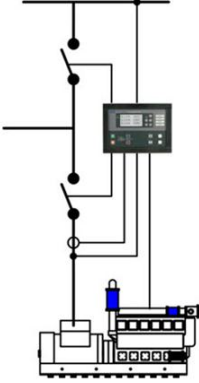
The Generator control unit is a micro-processor based control unit containing all necessary functions for protection and control of a genset.

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

2.3 Option and Variants

2.3.1 Variants
The GCU 100 family consists of different variants to cover applications in a cost-efficient way. The application shown in the single line diagrams relates functionality to GCU 111/112/113 numbering

GCU 111	GCU 112	GCU 113

ⓘ **More detailed list of available variants is included in the data sheet. Please 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 please read the help file in the USW editor.

To interface the GCU 100 from the PC, the option J9 is used. The option J9 is a USB to TTL interface between the PC and the GCU 100. The J9 is 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 and features are listed in the table.

Main functions	GCU 111	GCU 112	GCU 113
Operation modes			
Blackout detection	-	-	X
Island operation	X	X	X
Engine control			
Start/stop sequences	X	X	X
Run and stop coil	X	X	X
Engine protection			
Overspeed	X	X	X
Multi-functional alarm inputs (digital, 4-20 mA or RMI)	X	X	X
Digital alarm inputs	X	X	X
Breaker control			
Generator breaker control	-	X	X
Tie breaker control	-	-	X
Communication			
CANbus engine communication, J1939	X	X	X
Modbus communication, RS485	X	X	X
TTL interface to PC	X	X	X
Additional Operator Panel, AOP-2	X	X	X
Display			
Push-buttons for start and stop	X	X	X
Push-buttons for breaker operations	X	X	X
Status texts	X	X	X
Alarm and Event LOG	X	X	X
M-Logic			
Simple logic configuration tool	X	X	X
Selectable input events	X	X	X
Selectable output commands	X	X	X
Emulation software solution			
Application test before installation	X	X	X

3.1.2 Protection (ANSI)

The following protection functions are included as standard functions in all versions.

Protection function	ANSI	Levels
Generator reverse power	32	2 steps
Generator overcurrent	50	2 steps
Fast overcurrent	51	2 steps
Generator overvoltage	59	2 steps
Generator undervoltage	27	2 steps
Generator overfrequency	81	2 steps
Generator underfrequency	81	2 steps
Busbar overvoltage	59B	2 steps
Busbar undervoltage	27B	2 steps
Busbar overfrequency	81B	2 steps
Busbar underfrequency	81B	2 steps
Generator overload	32	2 steps
Current unbalance	46	
Voltage unbalance	60	
Overexcitation	24	
Loss of excitation	40	

ANSI # as per IEEE Std. C37.2-1996 (R2001)

3.1.3 Display
- Push-Buttons for start and stop
- Push-buttons for breaker operations
- Status texts

3.1.4 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 GCU 100.

3.3 Measurement systems

The GCU 100 is designed for measurement of voltages between 100 and 480V AC. For further reference, the AC wiring diagrams are shown in the Installation Instructions.

In menu 9130, the measurement principle can be changed between three-phase, two-phase and single phase.

⚠️ **Configure the GCU 100 to match the correct measuring system. When in doubt, contact the switchboard manufacturer for information about the required adjustment.**

🛈 **The GCU 100 has two sets of BB transformer settings, which can be enabled individually individually in this measurement systems.**

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

The following adjustments must be made to make the system ready for the single phase measuring (example 230V AC):

Setting	Adjustment	Description	Adjust to value
9130	AC configurator	Setup: 1 phase L1	-
6004	Norm. U1	Phase-neutral voltage of the generator	230V AC
6041	G primary U	Primary voltage of the G voltage transformer (if installed)	U_{NOM} x √3
6042	G secondary U	Secondary voltage of the G voltage transformer (if installed)	U_{NOM} x √3
6051	BB primary U1	Primary voltage of the BB voltage transformer (if installed)	U_{NOM} x √3
6052	BB secondary U1	Secondary voltage of the BB voltage transformer (if installed)	U_{NOM} x √3
6053	BB Nominal U1	Phase-phase voltage of the busbar	U_{NOM} x √3

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

🛈 **The GCU 100 has two sets of BB transformer settings, which can be enabled individually in this measurement system.**

3.3.2 Two-phase system
This is a special application where two phases and neutral are connected to the GCU 100. The GCU 100 shows phases L1 and L3 in the display. The phase angle between L1 and L3 can be in the range of 100 to 200 degrees. Two-phase is possible between L1-L2 and L1-L3.

The following adjustments must be made to make the system ready for the two-phase measuring (example 240/120V AC):

Setting	Adjustment	Description	Adjust to value
9130	AC configuration	Setup: 2 phase L1L2	
6004	Norm. U1	Phase-neutral voltage of the generator	120V AC
6041	G primary U	Primary voltage of the G voltage transformer (if installed)	U_{NOM}
6042	G secondary U	Secondary voltage of the G voltage transformer (if installed)	U_{NOM}
6051	BB primary U1	Primary voltage of the BB voltage transformer (if installed)	U_{NOM}
6052	BB secondary U 1	Secondary voltage of the BB voltage transformer (if installed)	U_{NOM}
6053	BB Nominal U 1	Phase-phase voltage of the busbar	U_{NOM}

ⓘ **The measurement U_{L1L2} shows 240V AC. The voltage alarm set points refer to the nominal voltage 120V AC, and U_{L1L2} does not activate any alarm.**

ⓘ **The GCU 100 has two sets of BB transformer settings, which can be enabled individually in this measurement system.**

3.3.3 Three-phase system

When the GCU 100 is delivered from the factory, the three-phase system is selected. When this principle is used, all three phases must be connected to the GCU-100.

The following adjustments must be made to make the system ready for the three-phase measuring (example 400/230V AC):

Setting	Adjustment	Description	Adjust to value
9130	AC configurator	Setup: 3 phase L1L2L3	
6004	Norm. U1	Phase-neutrak voltage of the generator	400V AC
6041	G primary U	Primary voltage of the G voltage transformer (if installed)	U_{NOM}
6042	G secondary U	Secondary voltage of the G voltage transformer (if installed)	U_{NOM}
6051	BB primary U 1	Primary voltage of the BB voltage transformer (if installed)	U_{NOM}
6052	BB secondary U 1	Secondary voltage of the BB voltage transformer (if installed)	U_{NOM}
6053	BB Norminal U 1	Phase-phase voltage of the busbar	U_{NOM}

ⓘ **The GCU 100 has two sets of BB transformer settings, which can be enabled individually in this measurement system.**

3.4 Running modes and applications

3.4.1 Auto/remote mode

The functionality and application of auto/remote mode relates to current GCU variant.

Application	Island	EDG
GCU 111	X	-
GCU 112	X	-
GCU 113	X	X

(i) **More detailed explanation of available variants is included in the data sheet. Please see www.deif.com**

Island operation
The unit automatically starts the genset and closes the generator breaker at a digital start and close command. When the open and 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.

Emergency Genset operation (only applies to GCU 113)
The unit automatically starts the genset and switches to generator supply at a black-out after an adjustable time delay. It is possible to adjust the unit to change to genset operation in two different ways.
1. The tie breaker will be opened at genset start-up.
2. The tie 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 tie breaker is open.

When the main busbar is restored, the unit will switch back to MBB supply and cool down and stop the genset. The switching back to main busbar supply is done when the adjusted "MBB OK delay" has expired.

(i) **The change-over from generator to main busbar supply is done without synchronisation.**

This functionality is only valid in Auto and Test mode. If test mode is active this will be overruled by any of below situations.

Genset mode	Running mode		
	Auto/remote	Test	Manual/local
Blackout detection	X	X	-

3.4.2 Manual/local mode (only applies to GCU 113)
The unit can be operated in manual/local mode (hand). Manual/local means that the unit will not initiate any sequences automatically, as is the case with the auto/remote mode. It will only initiate sequences, if external signals are given.

An external signal may be given in three ways:

1. Stop and manual push-buttons on the display are used
2. Digital inputs are used
3. Modbus command at service port or RS 485

3.4.3 Manual/local mode (GCU 111 and GCU 112)

The unit can be operated in manual/local mode (hand). Manual/local means that the unit will not initiate any sequences automatically, as is the case with the auto/remote mode. It will only initiate sequences activated by operator on the display unit.

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.	First start: include preheat Second start: cancel preheat Applies to: GCU 111, 112 and 113
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. Applies to GCU 111, 112 and 113
Close GB	The unit will close the generator breaker if the busbar breaker is open	Applies to GCU 112 and 113
Open GB	The unit will open the generator breaker instantly	Applies to GCU 112 and 113
Close TB	The unit will close the busbar breaker if the generator breaker is open	Applies to: GCU 113
Open TB	The unit opens the busbar breaker instantly.	Applies to: GCU 113

3.4.4 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.**

Test parameters	Description
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

(i) **If the timer is set to 0.0 min., the test sequence will be infinite. The test will be cancelled by pushing TEST again.**

3.4.5 Simple test

GCU 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.

3.4.6 Full test (only applies to GCU 113)

The full test will start the genset, open the tie 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 busbar breaker closed, and the generator is stopped after the cool-down time.

ⓘ **During the test it is possible to open and close the generator breaker and the busbar breaker in manual mode.**

3.5 Single-line diagrams

3.5.1 Application illustration

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

3.5.2 Emergency Genset (GCU 113)
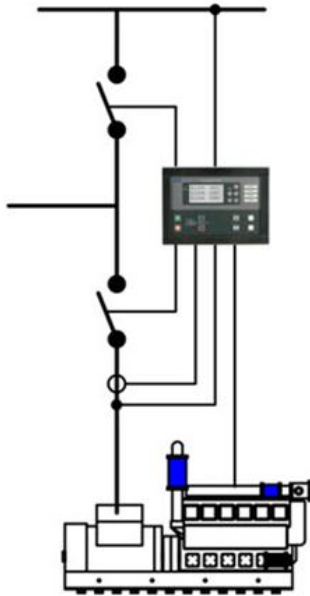
3.5.3 Island operation (GCU 111 and GCU 112)
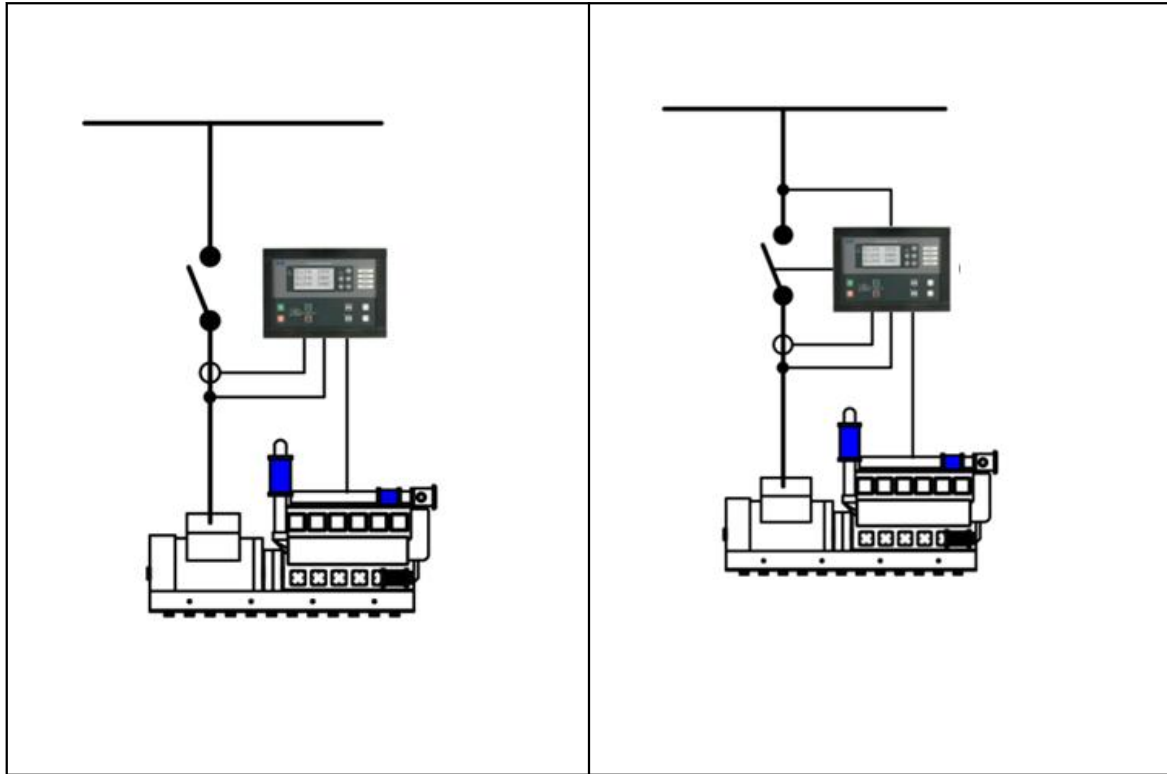
3.6 Flowcharts

3.6.1 Flowcharts

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

- TB open sequence
- GB open sequence
- Stop sequence
- Start sequence
- TB close sequence
- GB close sequence
- Island operation
- Emergency genset sequence
- Test sequence

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

3.6.2 TB open sequence

```
          ┌─────────┐
          │  START  │
          └─────────┘
               │      ◄──── NO
               ▼          │
            ╱ TB ╲────────┘
            ╲ close ╱
               │
              Yes
               ▼
          ┌─────────┐
          │ Open TB │
          └─────────┘
               │
              Yes
               ▼                    ┌──────────────┐
            ╱ TB ╲──── NO ──►        │ Alarm "TB    │
            ╲ open ╱                 │ open fail"   │
               │      ◄──────────────└──────────────┘
              Yes
               ▼
          ┌─────────┐
          │   End   │
          └─────────┘
```

3.6.3 GB open sequence

```
                    ┌──────────┐
                    │  START   │
                    └──────────┘
                         │        ┌── NO
                         ▼        │
                      ╱────────╲  │
                     ╱ GB close ╲─┘
                      ╲────────╱
                         │
                        Yes
                         ▼
                    ┌──────────┐
                    │  Open GB │
                    └──────────┘
                         │
                        Yes
                         ▼
                      ╱────────╲           ┌──────────────┐
                     ╱ GB open  ╲── NO ──> │  Alarm ''GB  │
                      ╲────────╱           │  open fail'' │
                         │                 └──────────────┘
                        Yes
                         ▼
                    ┌──────────┐
                    │   End    │
                    └──────────┘
```

3.6.4 Stop sequence

```
                    ┌──────────┐
                    │  Start   │
                    └────┬─────┘
                         │        ┌─── No
                         ▼        │
                     ╱╲───────────┘
                    ╱  ╲
                   ╱Stop ╲
                   ╲conditions OK
                    ╲    ╱
                     ╲  ╱
                      ╲╱
                  Yes │          ┌─── No
                      ▼          │
                     ╱╲──────────┘
                    ╱  ╲
                   ╱Cool╲
                   ╲down ╱
                   ╲timer╱
                     ╲╱
                  Yes │
                      ▼
                     ╱╲                    ┌──────────┐
                    ╱  ╲──── No ─────────▶ │Stop Coil │
                   ╱ Run ╲                 └────┬─────┘
                   ╲Coil ╱                      │
                     ╲╱                         │
                  Yes │                         │
                      ▼                         ▼
               ┌──────────┐            ┌──────────┐
               │Deactivate│            │ Activate │
               │ RUN coil │            │"stop"relay│
               └────┬─────┘            └────┬─────┘
                    │                       │
                    │◀──────────────────────┘
                    ▼
                   ╱╲                 ┌──────────┐
                  ╱  ╲──── No ──────▶ │  Alarm   │
                 ╱Genset╲             └────┬─────┘
                 ╲stopped╱                 │
                    ╲╱◀───────────────────┘
                 Yes │
                     ▼
               ┌──────────┐
               │   End    │
               └──────────┘
```

3.6.5 Start sequence

```
                    ┌─────────┐
                    │  Start  │
                    └────┬────┘
                         │              No
                         ↓◄──────────────┐
                    ╱────────╲            │
                   ╱  Start   ╲           │
                   ╲conditions╱───────────┘
                    ╲   OK    ╱
                     ╲──┬───╱
                        │ Yes            No
                        ↓◄──────────────┐
                   ╱──────────╲          │
                  ╱   Start    ╲─────────┘
                  ╲  prepare   ╱
                   ╲  timer   ╱
                    ╲───┬───╱
        ┌──────────────┤ Yes
        │              ↓
        │         ┌──────────┐
        │         │Start relay│
        │         │    ON    │
        │         └────┬─────┘
        │              │ Yes
        │              ↓
        │         ╱──────────╲      No   ╱──────────╲   No  ┌─────────┐
   No   │        ╱Start relay ╲─────────╱    Run     ╲──────│  Alarm  │
        │        ╲   timer    ╱         ╲  feedback  ╱      └─────────┘
        │         ╲ timeout  ╱           ╲ detected ╱
        │          ╲───┬───╱              ╲───┬───╱
        │              │ Yes                  │ Yes
        │              ↓                      │
        │         ┌──────────┐                │
        │         │STOP relay │               │
        │         │   OFF    │                │
        │         └────┬─────┘                │
        │              │            No        │
        │              ↓◄──────────┐          │
        │         ╱──────────╲     │          │
        │        ╱ Stop relay ╲────┘          │
        │        ╲   timer    ╱               │
        │         ╲ timed out ╱               │
        │          ╲───┬───╱                  │
        │              │ Yes                  ↓
        │              ↓              ┌──────────┐
        │         ╱──────────╲        │ Running  │
        └────────╱ Max start  ╲       └────┬─────┘
                 ╲  atempts   ╱            │
                  ╲───┬───╱                │
                      │ Yes                ↓
                      ↓              ┌──────────┐
               ┌──────────┐          │   End    │
               │Start failure│       └──────────┘
               │   alarm   │
               └──────────┘
```

3.6.6 TB close sequence

3.6.7 GB close sequence

3.6.8 Emergency Genset sequence

```
                    ┌─────────────┐
                    │    Start    │
                    └──────┬──────┘
                           │        ┌─── No
                           ▼        │
                       ◇ Busbar ◇───┘
                         failure
                           │
                          Yes
                           │
                           ▼
                      ◇ Fail delay ◇
                          timer
                           │
                          Yes
                           │
                           ▼
                    ┌─────────────┐
                    │   Open TB   │
                    └──────┬──────┘
                           │
                           ▼
                    ┌─────────────┐
                    │    Start    │
                    │  sequence   │
                    └──────┬──────┘
                           │
                           ▼
                    ┌─────────────┐
                    │   GB close  │
                    │  sequence   │
                    └──────┬──────┘
                           │        ┌─── No
                           ▼        │
                      ◇ Busbar OK ◇─┘
                           │
                          Yes
                           │
                           ▼
          ┌──────────┐   ┌──────────┐   ┌──────────┐
          │ Time out │──▶│ TB close │──▶│   End    │
          │          │   │ sequense │   │          │
          └──────────┘   └──────────┘   └──────────┘
```

3.6.9 Test sequence

```
                    ┌──────────────┐
                    │    Start     │
                    └──────┬───────┘
                           │
                    ┌──────▼───────┐
                    │ Select test  ├──────────────┐
                    │    mode      │              │
                    └──────┬───────┘              │
                           │                      │
                    ┌──────▼───────┐       ┌──────▼───────┐
                    │ Simple test  │       │  Full test   │
                    └──────┬───────┘       └──────┬───────┘
                           │                      │
                    ┌──────▼───────┐       ┌──────▼───────┐
                    │    Start     │       │    Start     │
                    │   sequence   │       │   sequence   │
                    └──────┬───────┘       └──────┬───────┘
                           │                      │
                    ┌──────▼───────┐       ┌──────▼───────┐     ┌──────────┐     ┌──────────┐
                    │  Test timer  │       │  Test timer  ├────►│ Open TB  ├────►│ Close GB │
                    └──────┬───────┘       └──────────────┘     │ sequence │     │ sequence │
                           │                                    └──────────┘     └────┬─────┘
                      ╱────▼────╲                                                      │
                     ╱ Timer run ╲◄───────────────────────────────────────────────────┘
                     ╲    out    ╱
                      ╲────┬────╱
                           │ Yes
                    ┌──────▼───────┐
                    │    Stop      │
                    │   sequence   │
                    └──────┬───────┘
                           │
             ┌─────────────▼────────────┐
             │   Return to running      │
             │   mode menu 7043         │
             └─────────────┬────────────┘
                           │
                    ┌──────▼───────┐
                    │     End      │
                    └──────────────┘
```
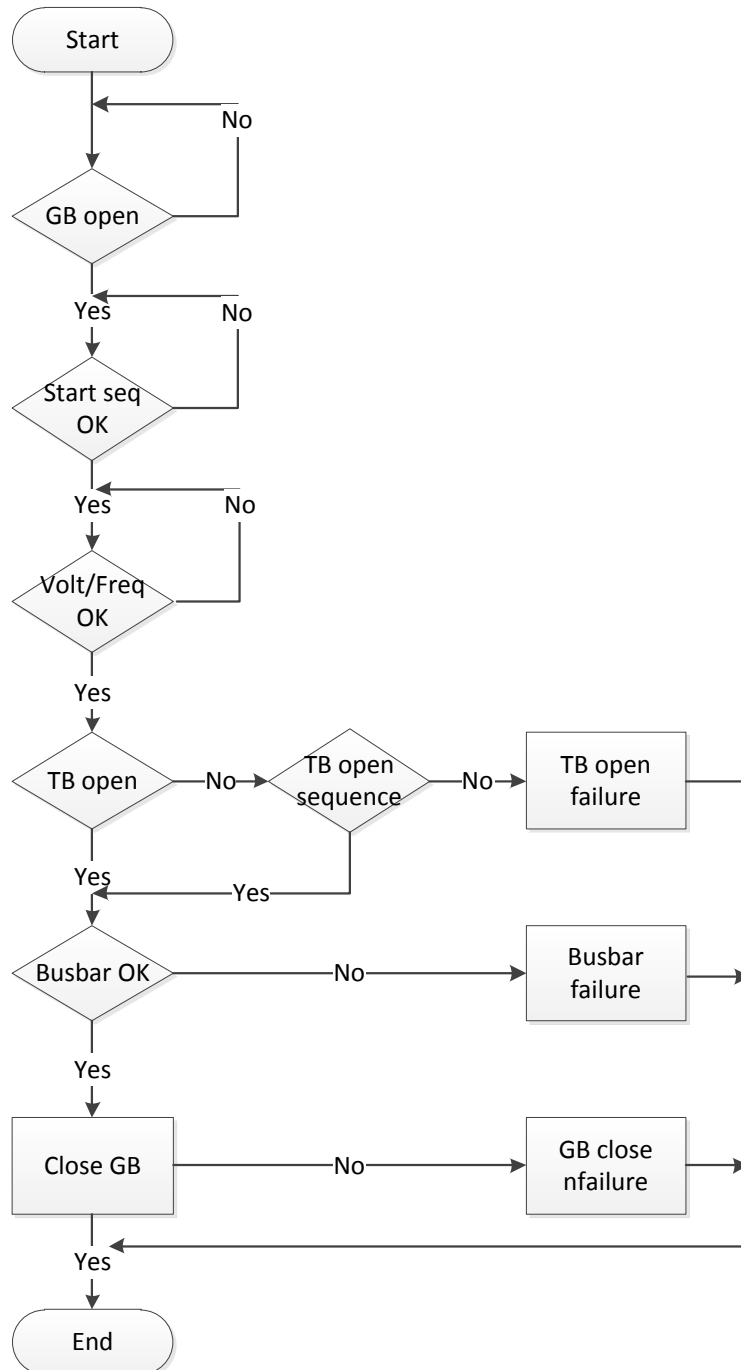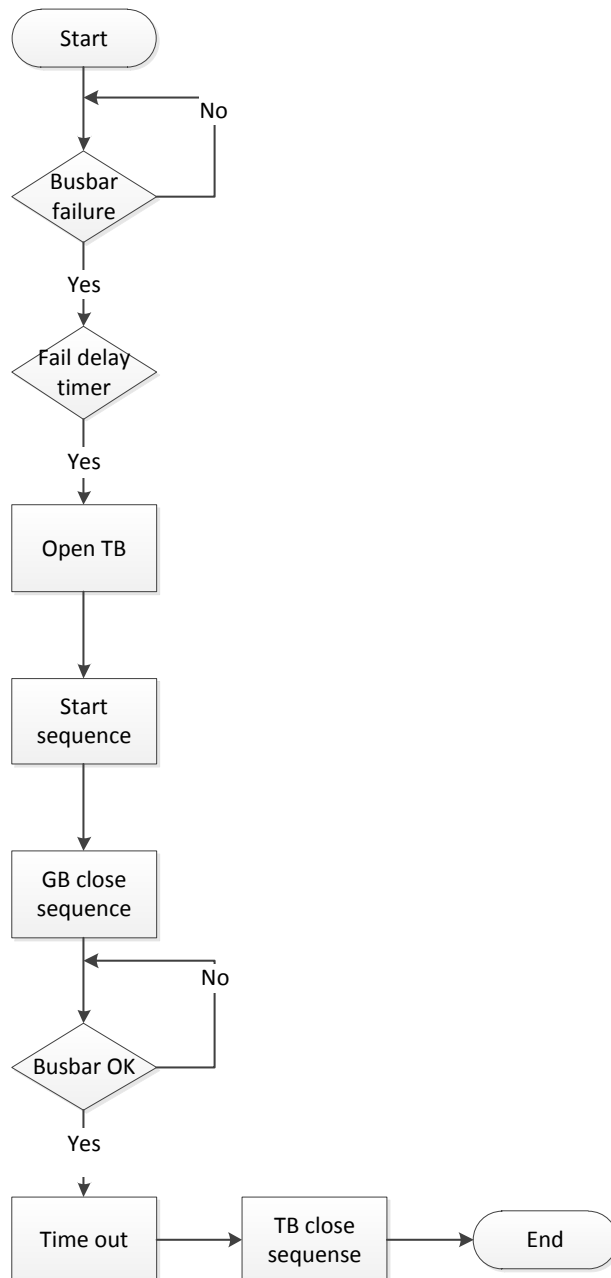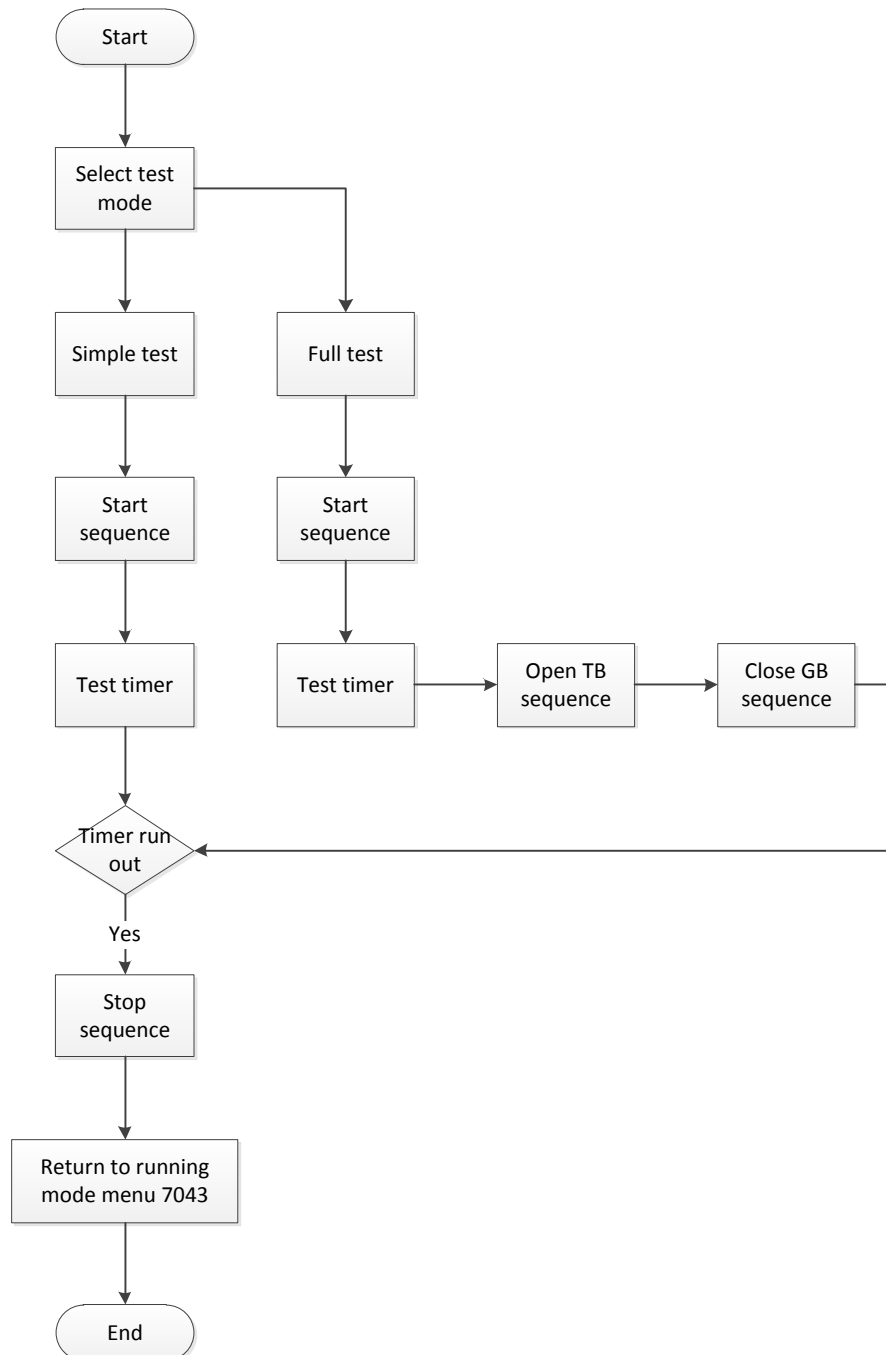
3.7 Sequences

3.7.1 Sequences

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

In manual, the selected sequence is the only sequence initiated (e.g. press the START push-button: the engine will start, but not close the breaker).

The following sequences will be illustrated below:
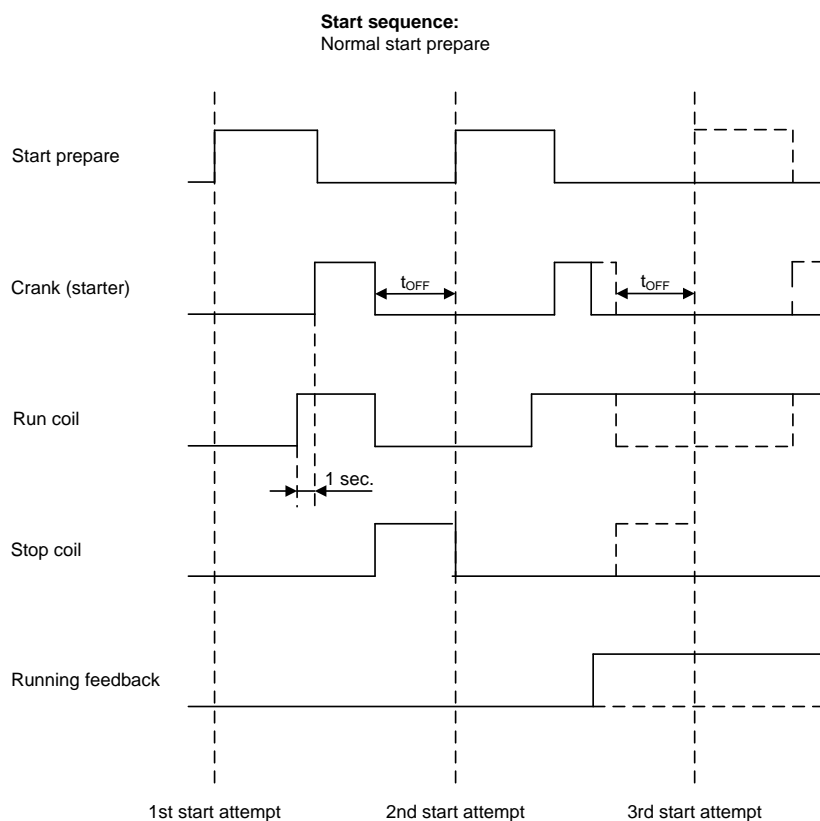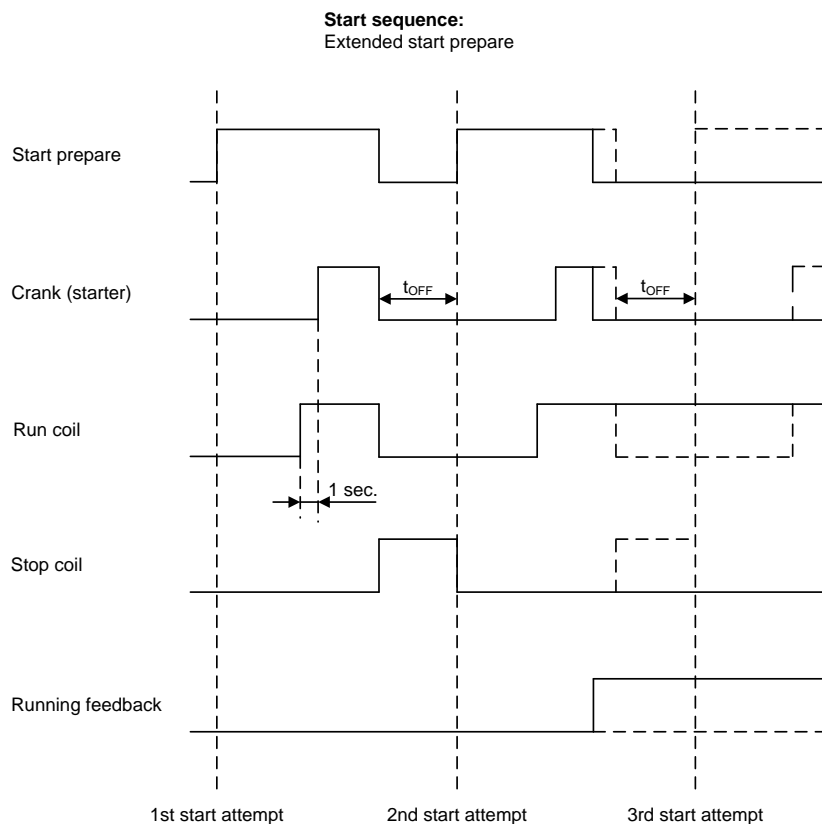● START sequence
● STOP sequence
● Breaker sequences

We recommend not using small relays for stop coil output. If small relays are used, a resistor must be mounted across the relay coil to prevent undesirable closing of the relay. This is caused by the wirebreak function.

3.7.2 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).

Start sequence:
Normal start prepare

Start prepare

Crank (starter) t_{OFF} t_{OFF}

Run coil

                    1 sec.

Stop coil

Running feedback

1st start attempt   2nd start attempt   3rd start attempt

Start sequence:
Extended start prepare

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).**

3.7.3 Start sequence conditions

The start sequence initiation can be controlled by the following conditions:
● RMI 6 (oil pressure)
● RMI 7 (water temperature)
● RMI 8 (fuel level)
This means that if e.g. 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 setpoint 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.

Start sequence
Cranking depends on RMI

Start prepare
(3 start attempts)

Stop relay

Crank relay

Run coil

Running feedback

**RMI
measurement OK**

RMI value

Cranking starts
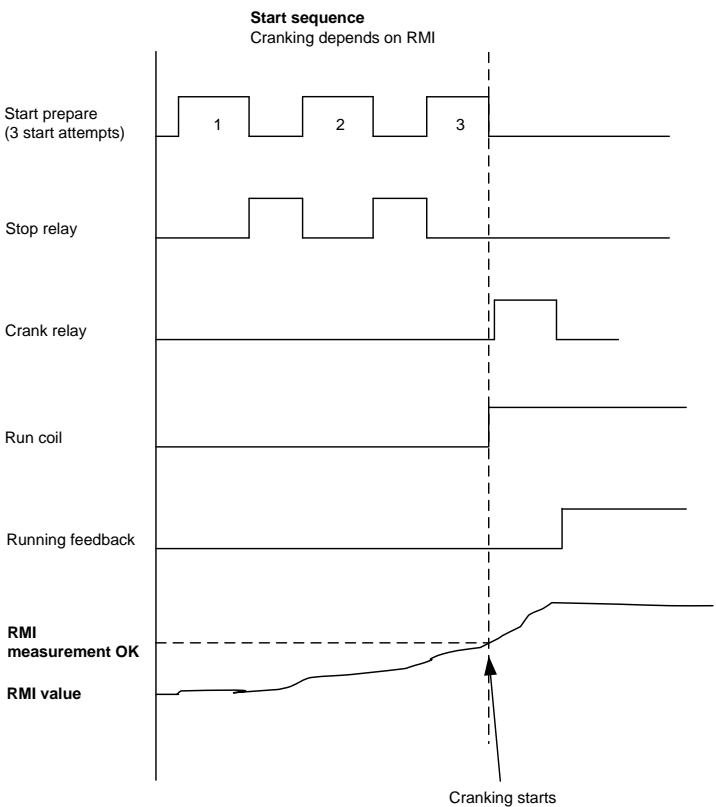
3.7.4 Running feedback

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.

Feedback type
Digital input
MPU input
EIC
Multi-input 6
Multi-input 7
Multi-input 8

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 feed-back, the running detection will be made, based on all available types.

The sequence is shown in the diagram below.
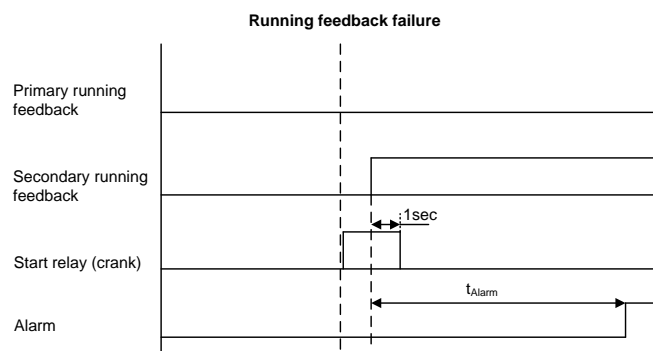
Interruption of start sequence
The start sequence is interrupted in the following situations:

Event	Comment
Stop signal	
Start failure	
Remove starter feedback	Tacho setpoint.
Running feedback	Digital input.
Running feedback	Tacho setpoint.
Running feedback	W terminal
Running feedback	Frequency measurement above 32 Hz. The frequency measurement requires a voltage measurement of 30% of U_{NOM}. The running detection based on the frequency measurement can replace the running feedback based on tacho or digital input or engine communication.
Running feedback	Oil pressure setpoint (menu 6175).
Running feedback	EIC (engine communication).
Emergency stop	
Alarm	Alarms with shutdown" or "trip and stop" fail class.
Stop push-button on display	Manual mode.
Modbus stop command	Manual mode.
Digital stop input	Manual mode.

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

Setpoints 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, e.g. 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, e.g. prelubrication 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.

3.7.5 Stop sequence

The drawings illustrate the stop sequence.

Stop sequence
Run coil

Cooling down time t_{COOL}

Run coil t_{stop}

Running feedback

Sequence initiated

Stop sequence
Stop coil

Cooling down time t_{COOL}

Stop coil t_{stop}

Running feedback

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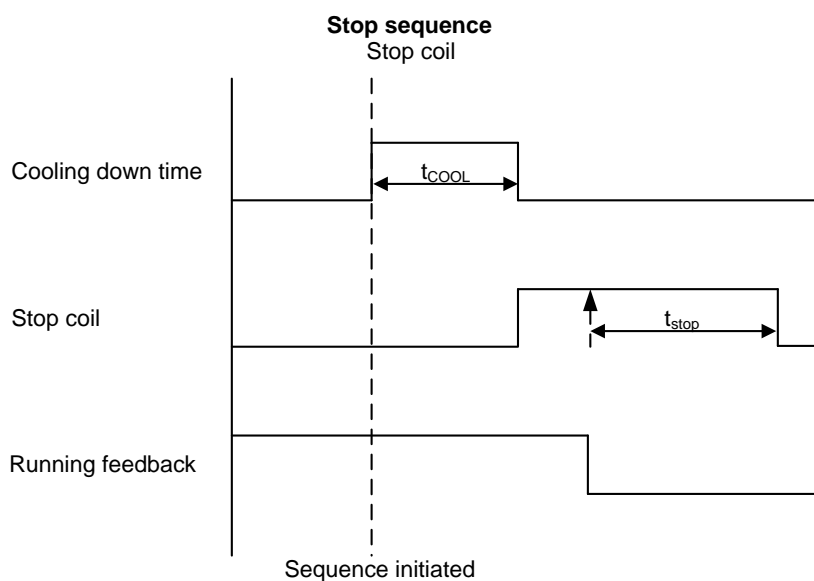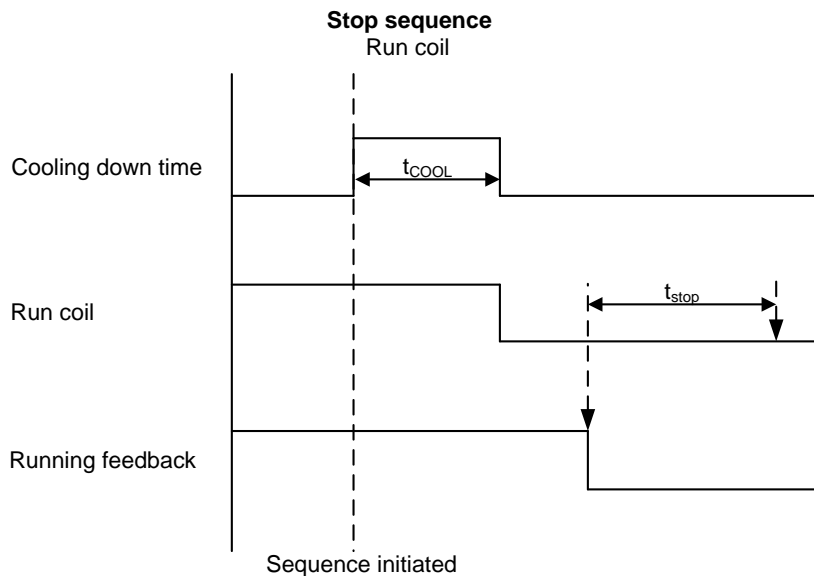
The stop sequence will be activated if a stop command is given. The stop sequence includes the cooling down time if the stop is a normal or controlled stop.

Description	Cooling down	Stop	Comment
Auto mode stop	X	X	
Trip and stop alarm	X	X	
Stop button on display	(X)	X	Manual stop. Cooling down is interrupted if the stop button is activated twice.
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
Black-out detection	Auto mode
Start button is pressed	Manuel mode: engine will run in idle speed
Digital start input	Auto mode
GB close button is pressed	Manual mode

Setpoints 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 setpoint 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 setpoint in menu 6214.

If, for some reason, the engine cannot get the temperature below the temperature setpoint 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.

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

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

3.7.6 Breaker sequences

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

Mode	Variant	Breaker control
Auto	GCU 113	Controlled by the unit
Manual	GCU 113	Push-button, digitagl input, Modbus, M-Logic
Remote	GCU 111, GCU 112	Remote-controlled by digital input, Modbus, M-Logic
Local	GCU 111, GCU 112	Locally controlled by means of the display

Before closing the breakers, it must be checked that the voltage and frequency are OK.

Setpoints related to TB control

7080 TB control

TB close delay	The time from GB OFF to TB ON
Load time	After opening of the breaker, the MB ON sequence will not be initiated before this delay has expired. Please refer to the description of "Breaker spring load time".
Breaker type	Signal description for breaker

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

ⓘ **The GB can only be closed if the busbar breaker is open. The TB can only be closed if the generator breaker is open.**

3.7.7 Blackout sequences

The functionality Blackout detection and handling are controlled by the following parameters (7100 blackout)

Fail delay (tFD)	Timer to delay blackout detection and activation of blackout sequence on MBB.
OK delay (tFOD)	Timer to delay OK status on MBB after initiated blackout sequence.
U<	Voltage limit for blackout detection (% of nominal voltage)

Initiation of blackout sequence and time to restore MBB are influenced by the following timers.

GB close delay (tGBC)	Timer for delay GB close
TB close delay (tTBC)	Timer for delay TB close
Hz/V OK (tFO)	Generator frequency and voltage OK

Handling and timers initiated in blackout sequence can be seen in example 1 start engine and open TB and in example 2 start engine:

Example 1:
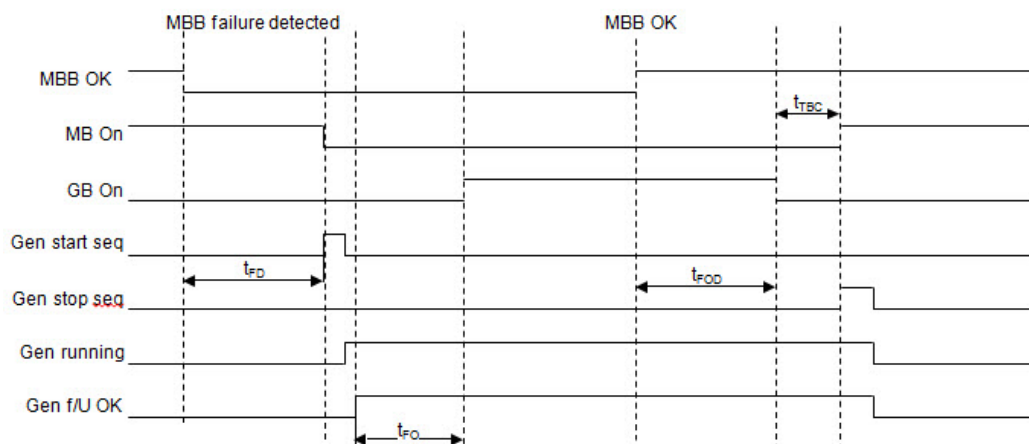
Example 2:
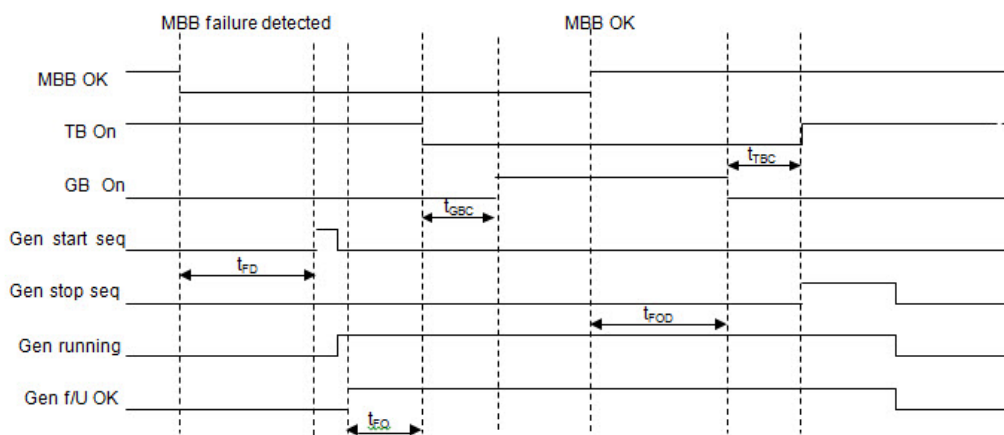
Conditions for breaker operations

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 TB open
TB ON, direct closing	Busbar frequency/voltage OK GB open
GB OFF, direct opening	TB open
TB OFF, direct opening	Alarms with fail classes: Shut down or Trip TB alarms

4. Display and menu structure

4.1 Password and parameter acccess

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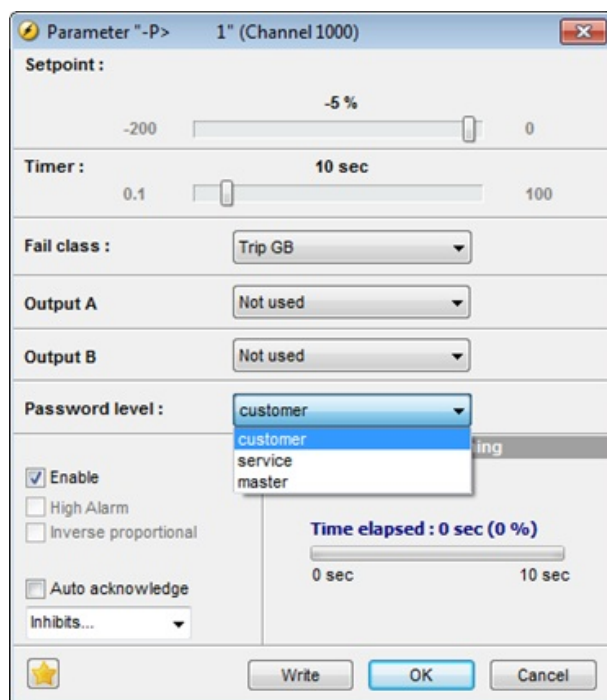
The password level can also be changed from the parameter view in the column "Level".

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 GCU 100.**

5. Engine communication

5.1 Reference to engine communication manual

5.1.1 Engine communication
The GCU 100 is able to communicate with an engine controller through the CAN bus (CAN A).

ⓘ **Information about engine communication can be found in the "Engine communication" manual, which is located on DEIF's homepage under documentation for GCU 100.**

6. Additional functions

6.1 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.
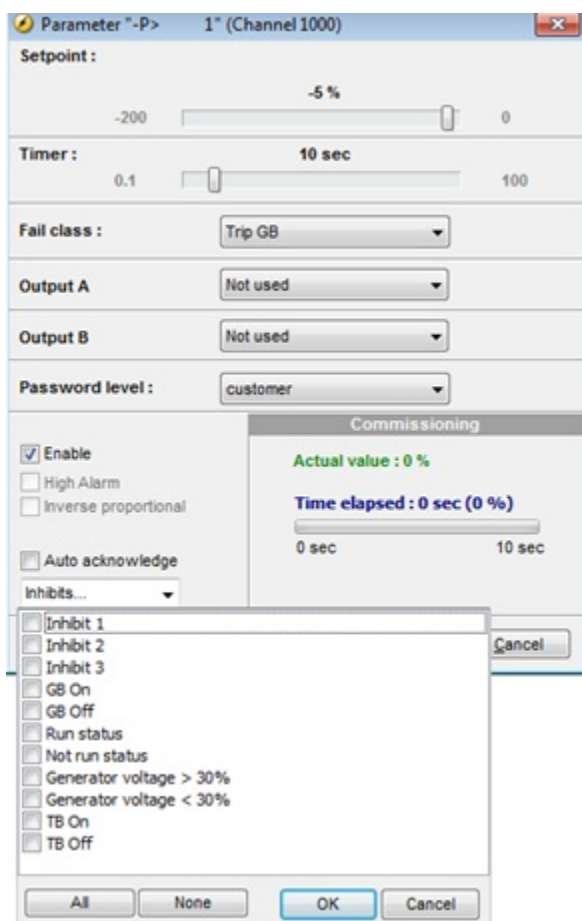
Selections for alarm inhibit:

Function	Description
Inhibit 1	M-Logic outputs: Conditions are programmed in M-Logic
Inhibit 2	
Inhibit 3	
GB ON	Generator breaker is closed
GB OFF	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
TB ON	Tie breaker is closed
TB OFF	Tie 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:
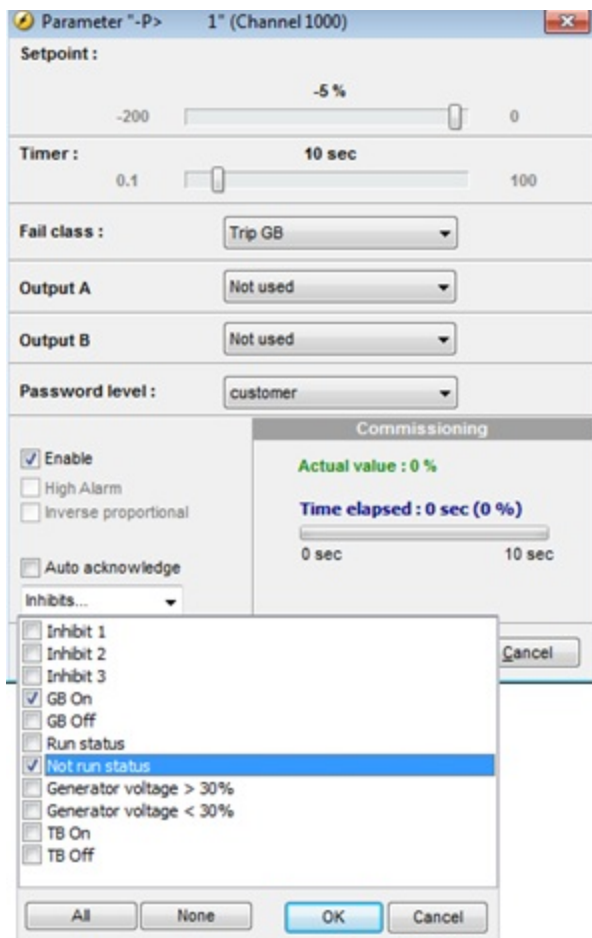
In this example, inhibit is set to *Not run status* and *GB ON*. Here, the alarm will only be active when the generator is running and disabled again when the GB is closed.

6.1.1 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.

Run. feedback

t_{RUN}

t

Alarms active
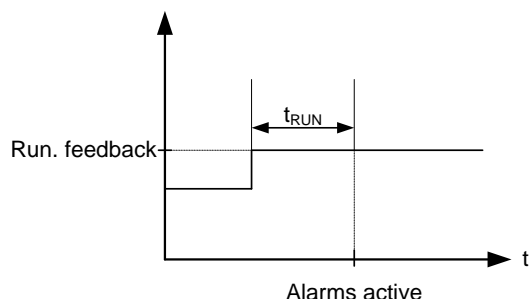
ⓘ **The timer is ignored if digital running feedback is used.**

6.2 Battery test

6.2.1 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 busbar failure occurs during the battery test sequence, the test will automatically be interrupted, and the automatic busbar 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 setpoint.

$U_{BATTERY}$

$t_{BAT\ TEST}$ $t_{BAT\ TEST}$

Alarm

Cancel test

t

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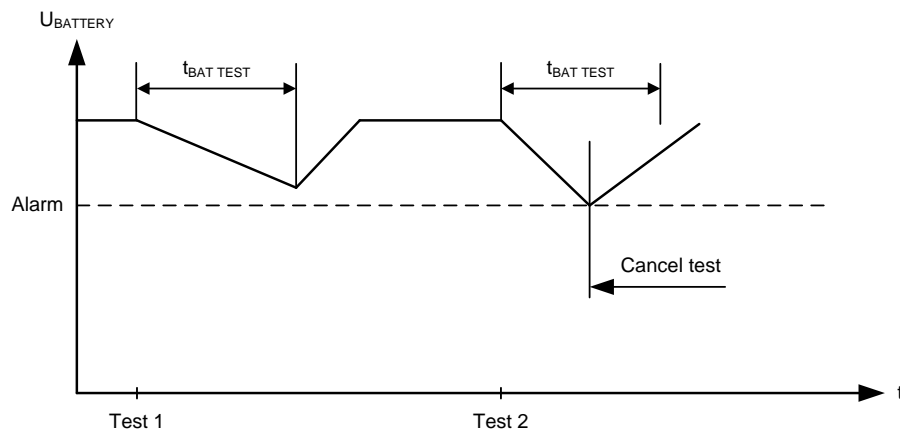
The drawing shows that test #1 is carried out without a large voltage drop of the battery voltage, whereas test #2 reaches the alarm setpoint.

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, e.g. 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.
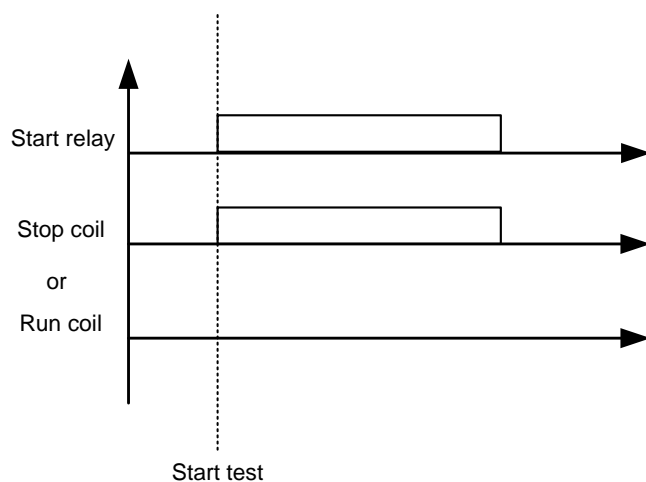
6.2.2 Input configuration
If this function is to be used, it is necessary to configure a digital input that initiates the function. This is done in the dialogue box below:
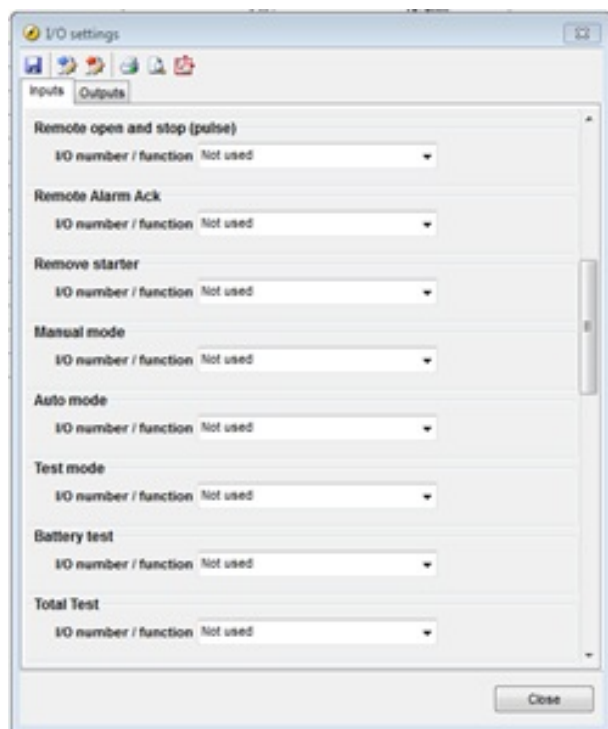
> **(i)** **If AUTO mode is selected, the busbar failure sequence will be initiated if a busbar failure occurs during the battery test.**

6.2.3 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, e.g. once a week. Completed battery tests will be logged in a separate battery test log.

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

6.3 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 and TB.

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 setpoint for the GB and TB 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 setpoints are found in menus 6230 and 7080.

2. Digital input
Two configurable inputs to be used for feedbacks from the breakers: One for GB spring loaded and one for TB 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, then the GCU can take this delay into account. This can be controlled through timers in the GCU or through digital feedbacks from the breaker, depending on the breaker type.

6.3.1 Principle

The diagram shows an example where a single GCU 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, e.g. by the operator through a switch in the switchboard. However, the GCU 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 GCU issues the close signal.
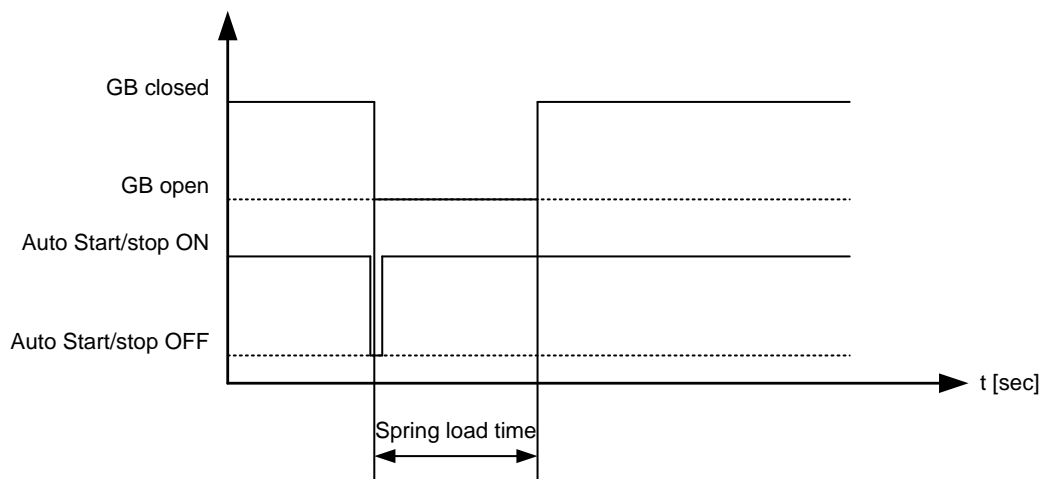
6.4 Breaker types and feedback

6.4.1 Breaker types

There are five possible selections for the setting of breaker type for both busbar breaker and generator breaker. The breaker type is selected in the application configuration 6230.

Continuous NE and Continuous ND
This type of signal is most often used combined with a contactor. When using this type of signal, the GCU will only use the close breaker(e.g. 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 GCU will use the close command(e.g. GB On) and the open command relay (e.g. 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.

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 GCU will need to use both a close command(e.g. GB On) and a open command relay(e.g. GB Off). The close breaker relay will close for a short time for the compact 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.

(i) **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 TB 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.

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

6.5 Busbar voltage unbalance detection

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

6.6 Buzzer

6.6.1 Buzzer
The GCU 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.

(i) **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.**

6.7 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 TB operations	Offset adjustment of the number of busbar breaker operations.	Counting at each TB 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.**

6.8 Differential measurement

6.8.1 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 e.g. fuel filter check, the timer will be activated if the setpoint between PA (analogue A) and PB (analogue B) is exceeded. If the differential value drops below the setpoint value before the timer runs out, then the timer will be stopped and reset.
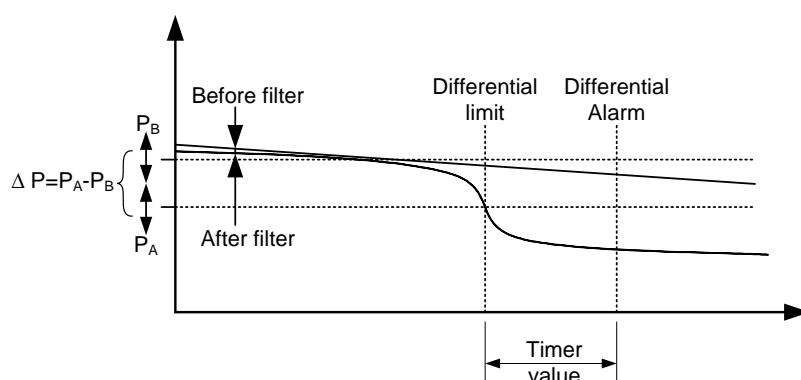
Six different differential measurements between two analogue input values can be configured.

Differential measurements between two sensors can be configured in menus 4600-4606 and 4670-4676. The sensors are selected from the input list as shown below, the list also contains various EIC measurements.
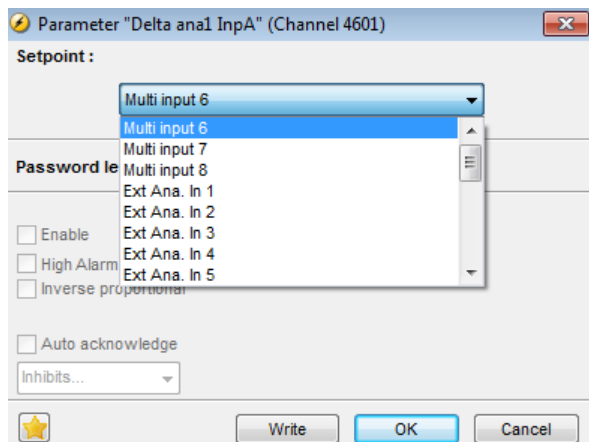
The relevant alarm setpoint is chosen in parameters 4610-4660 and 4680-4730
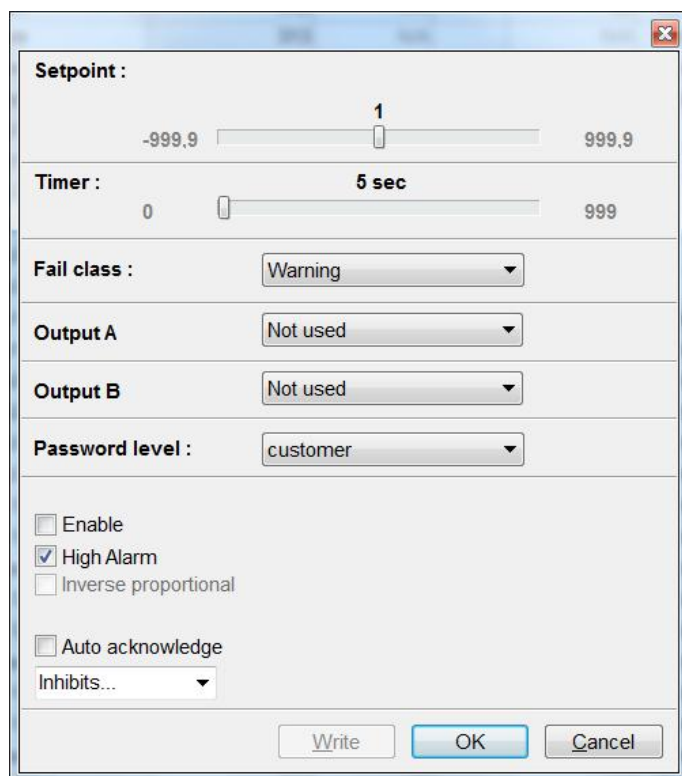
Each alarm can be configured in two alarm levels for each differential measurement between the analogue inputs A and B as follows. The configurations are done in menus 4610-4660 and 4680-4730.
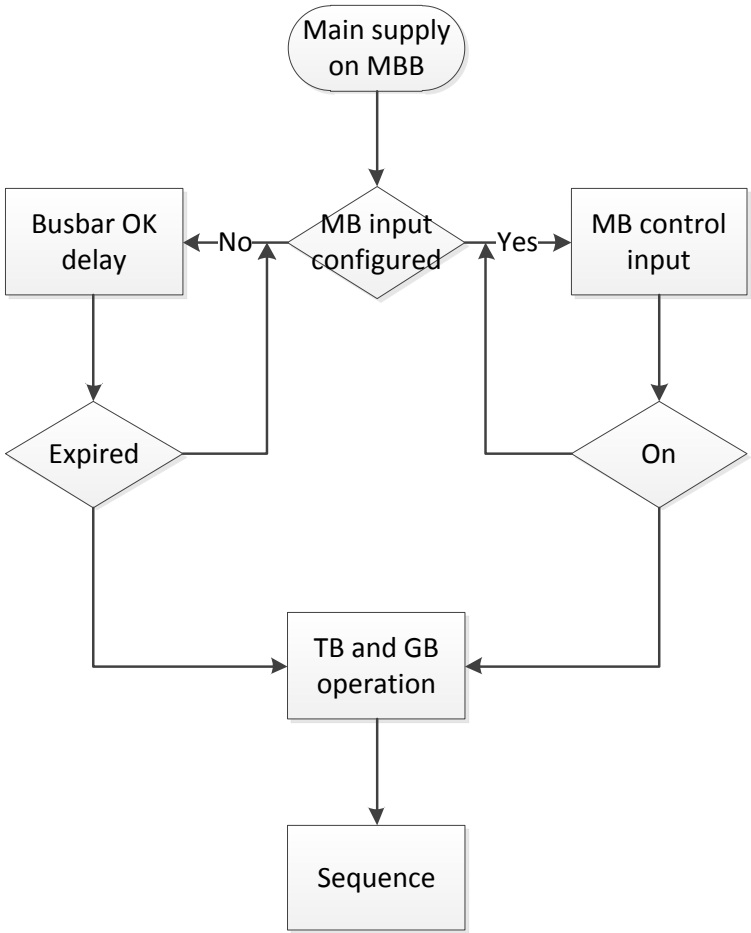
Ain	4601	Delta ana1 InpA	1482	4	
Ain	4602	Delta ana1 InpB	1483	4	
Ain	4603	Delta ana2 InpA	1484	4	
Ain	4604	Delta ana2 InpB	1485	4	
Ain	4605	Delta ana3 InpA	1486	4	
Ain	4606	Delta ana3 InpB	1487	4	
Ain	4610	Delta ana1 1	1488	1	
Ain	4620	Delta ana1 2	1489	1	
Ain	4630	Delta ana2 1	1490	1	
Ain	4640	Delta ana2 2	1491	1	
Ain	4650	Delta ana3 1	1492	1	
Ain	4660	Delta ana3 2	1493	1	

6.9 Digital busbar breaker control

The unit will normally execute the automatic busbar 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 busbar return sequence. This input is the "Main supply on MBB" input. The purpose of this function is to let an external device or an operator control the busbar return sequence. The external device can e.g. 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 busbar return sequence. The load will continue on generator supply if the input is not activated.

The busbar OK delay is not used at all when the "Main supply on MBB" input is configured.

```
                          ┌─────────────┐
                          │ Main supply │
                          │   on MBB    │
                          └─────────────┘
                                 │
                                 ▼
┌───────────┐            ◇               ◇           ┌───────────┐
│ Busbar OK │◄──No──  MB input  ──Yes──►  │ MB control│
│   delay   │         configured          │   input   │
└───────────┘            ◇               ◇           └───────────┘
      │                                                    │
      ▼                                                    ▼
   ◇ Expired ◇                                          ◇ On ◇
      │                                                    │
      └──────────►  ┌──────────────┐  ◄──────────────────┘
                    │  TB and GB   │
                    │  operation   │
                    └──────────────┘
                           │
                           ▼
                    ┌──────────────┐
                    │   Sequence   │
                    └──────────────┘
```

6.10 Digital inputs

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

	Input function	Auto	Test	Man	Configurable	Input type
1	Shutdown override	X	X	X	Configurable	Constant
2	Remote start	X		X*	Configurable	Pulse
3	Remote stop	X		X*	Configurable	Pulse
4	Remote GB ON			X	Configurable	Pulse
5	Remote GB OFF			X	Configurable	Pulse
6	Remote TB ON			X	Configurable	Pulse
7	Remote TB OFF			X	Configurable	Pulse
8	Remote start and close	X			Configurable	Pulse
9	Remote open and stop	X			Configurable	Pulse
10	Remote alarm acknowledge	X	X	X	Configurable	Constant
11	Remote start			X	Configurable	Pulse
12	Manual mode		X		Configurable	Pulse
13	Auto mode		X	X	Configurable	Pulse
14	Battery test	X			Configurable	Pulse
15	Total test	X	X	X	Configurable	Constant
16	GB close inhibit	X		X	Configurable	Constant
17	TB close inhibit	X	X	X	Configurable	Constant
18	Low speed	X	X		Configurable	Constant
19	Digital running detection	X	X	X	Configurable	Constant
20	Start enable	X	X	X	Configurable	Constant
21	GB spring loaded	X	X	X	Configurable	Constant
22	TB spring loaded	X	X	X	Configurable	Constant
23	GB position ON	X	X	X	Configurable	Constant
24	GB position OFF	X	X	X	Configurable	Constant
25	TB position ON	X	X	X	Configurable	Constant
26	TB position OFF	X	X	X	Configurable	Constant
27	Alternative start	X	X	X	Configurable	Constant
28	D+ (digital running feedback)	X	X	X	Configurable	Constant
29	Inhibit Engine alarms	X	X	X	Configurable	Constant
30	Main supply on MBB	X			Configurable	Constant

* Only Availible on GCU113

6.10.1 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 three by default, but it can be configured in **6190 Start**. Also a special cool down timer is used in the stop sequence after an activation of this input.

2. Remote start

This input initiates the start sequence of the genset when manual mode is selected.

3. 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.

4. Remote GB ON

The generator breaker ON sequence will be initiated and the breaker will close if the busbar breaker is opened.

5. Remote GB OFF

The generator breaker OFF sequence will be initiated.

6. Remote TB ON

The busbar breaker ON sequence will be initiated.

7. Remote TB OFF

The busbar breaker OFF sequence will be initiated.

8. Remote start and close

This input initiates the sequence start engine and close the generator breaker

9. Remote open and stop

This input initiates the sequence open the generator breaker and stop engine,

10. Remote alarm acknowledge

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

11. Remove starter

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

12. Manual mode

Changes the present running mode to manual.

13. Auto mode

Changes the present running mode to auto.

14. 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.

15. Total test

This input will be logged in the event log to indicate that a planned busbar failure has been made.

16. 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.

17. TB close inhibit
When this input is activated, then the busbar breaker cannot close.

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

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

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

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

22. TB spring loaded
The GCU will not send a close signal before this feedback is present.

23. 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.

24. 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.

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

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

27. Alternative start
This input is used to simulate an busbar failure and this way run a full emergency generator sequence without a busbar failure actually being present.

28. 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).

29. Inhibit Engine alarms
When this input is active, it will inhibit all engine interface alarms.

30. MBB supply on
Input indicate external feedback for voltage and frequency ok on busbar.

6.11 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 setpoints adjusted in menu 6320 are:

Setpoint: This setpoint +/- the hysteresis is the start and stop points for the engine heater.

Output A: The relay output for the engine heater.

Type: Multi-input to be used for temperature measurement.

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

Enable: Enables the engine heater function.

Principle diagram:
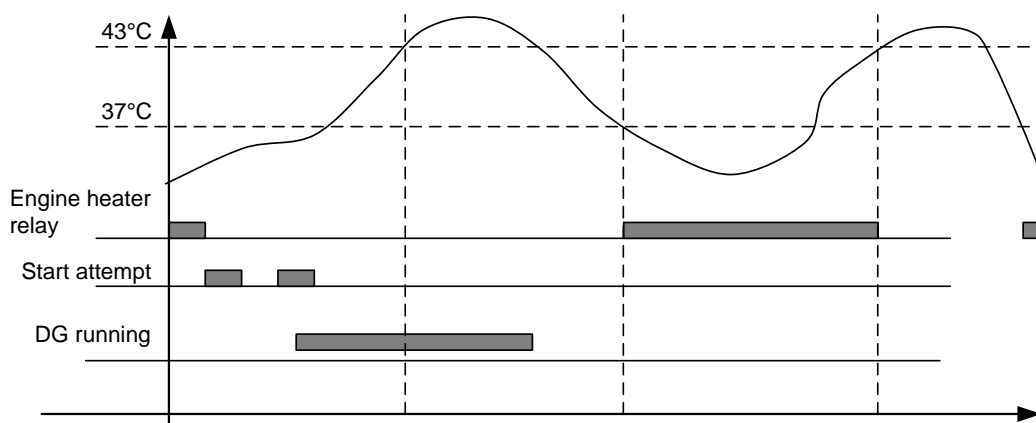
ⓘ **The engine heater function is only active when the engine is stopped.**

6.11.1 Engine heater alarm
If the temperature keeps dropping after the start setpoint has been exceeded, an alarm will be raised if configured in menu 6330.

6.12 Fail class

6.12.1 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.

6.12.2 Engine running

Fail class	Action	Alarm horn relay	Alarm dis-play	Trip of gen. breaker	Trip of bus-bar 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 TB		X	X		X		
7 Trip TB/GB		X	X	X	X		

The table illustrates the action of the fail classes. If, for instance, an alarm has been configured with the "shut-down" 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 TB/GB" will only trip the generator breaker if there is no mains breaker present.**

6.12.3 Engine stopped

Fail class	Action	Block engine start	Block TB 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 TB			X	
7 Trip TB/GB			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.**

6.12.4 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.
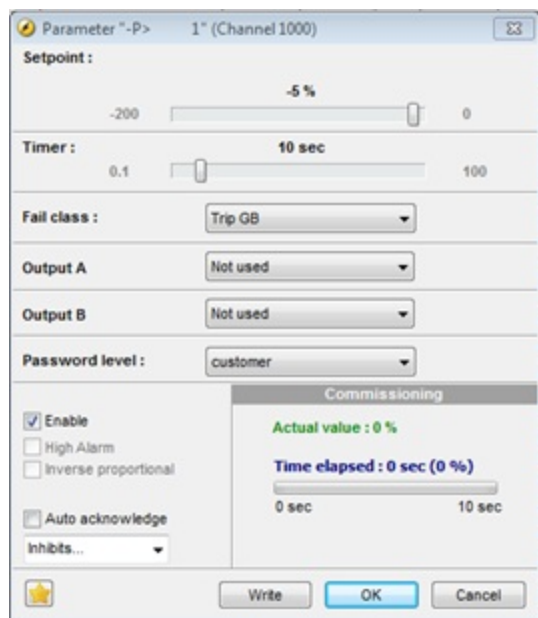
6.13 Fuel pump logic

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

Setpoints available in menu 6550:

Pump start	Start level.
Pump stop	Stop level.
Timer:	If the fuel level has not increased by 2% within this delay, a *Fuel fill alarm* will be raised.
Output A (OA):	The relay to be used for control of the fuel pump. The selected relay activates below the start limit and deactivates above the stop level.
Type:	The multi-input to be used for the fuel level sensor.
Fail class:	The fail class of the *Fuel fill 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 below drawing shows how the fuel pump is activated when the level reaches 20% and stopped again when the level has reached 80%.
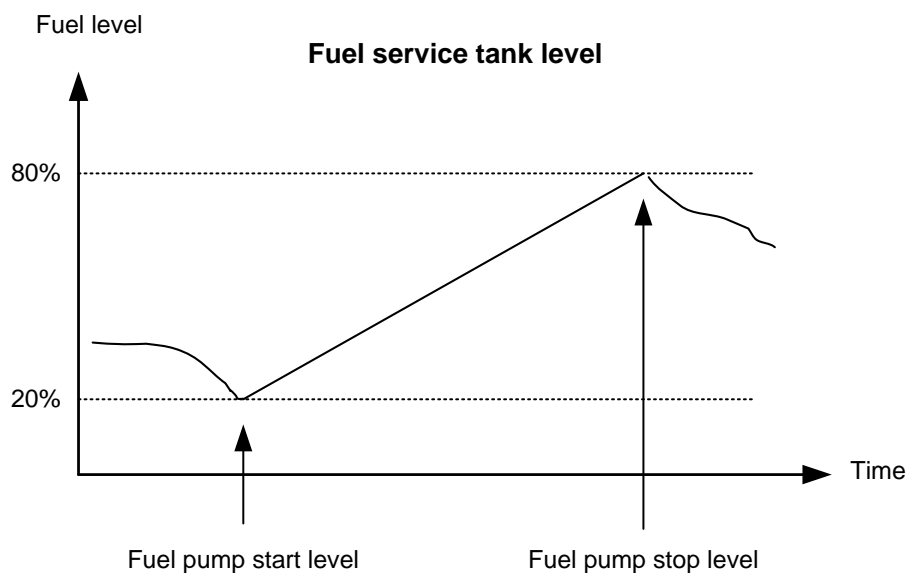
6.13.1 Fuel fill check

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

When the fuel pump is running, the fuel level must increase by 2% within the **fuel fill check** timer set in menu 6553. If the fuel level does not increase by 2% within the adjusted delay time, then the fuel pump relay deactivates and a **Fuel fill alarm** occurs.
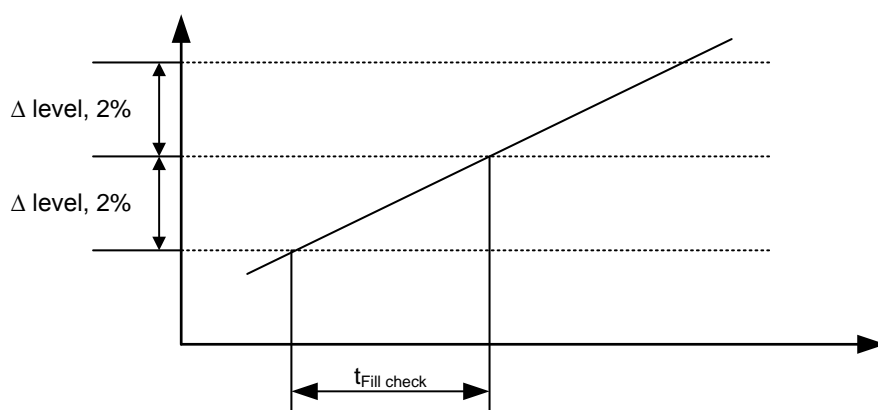
ⓘ **The level of increase is fixed at 2% and cannot be changed.**

6.14 GSM communication

6.14.1 GSM and modem communication

GSM communication can be used for two purposes:

1. Sending SMS alarm messages to up to 5 different mobile phones. The messages will be clear text, repre-
   senting the alarm in question (e.g. "Overspeed") and an ID. The ID represents the total numbers of sent
   SMS.
2. Communicate with the PC utility software.
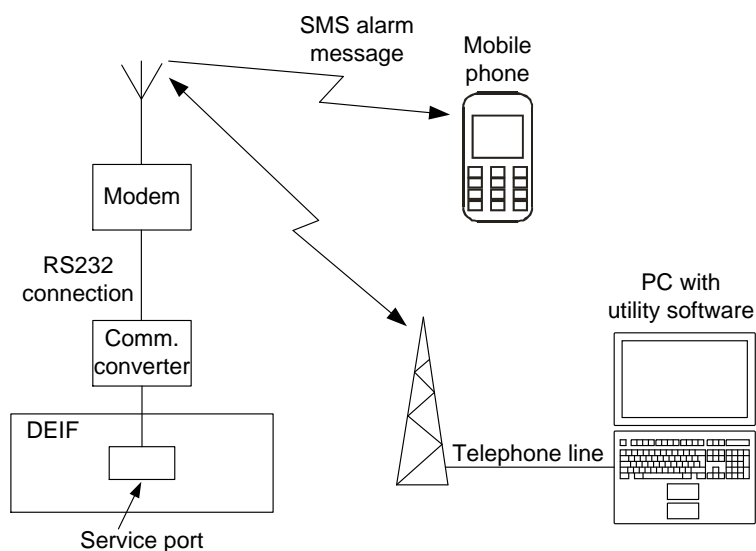
Connection

The connection is based on an RS232 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 con-
vert the signals to RS232. 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 termi-
nals. 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.

PC utility software communication via modem	
Locate the settings for modem communication in the utility software settings (F3).	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.
After this, dial-up can be used. Click the this icon to start modem communication:	
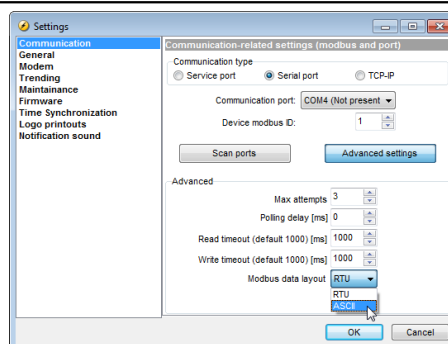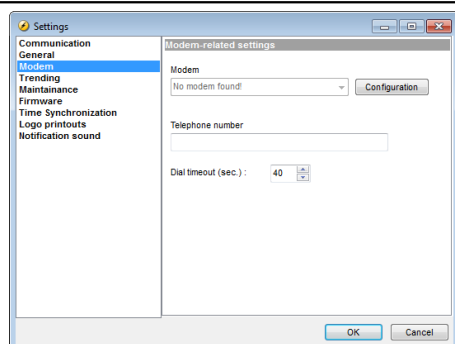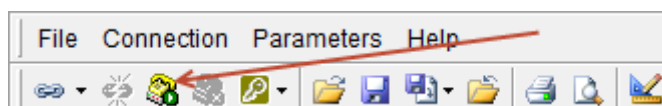
ⓘ   **The modem communication is much slower than the normal direct connection, so please be patient. It is not recommended to download the entire setting list. Use single setting downloads.**

ⓘ   **If a PC utility software connection is required, then 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 e.g. only half of the parameter file has been downloaded when the communication is interrupted, the settings are going to be a mix.

6.15 Idle running

6.15.1 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.

(i)   **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.

6.15.2 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.

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

(i)   **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.**

6.15.3 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.
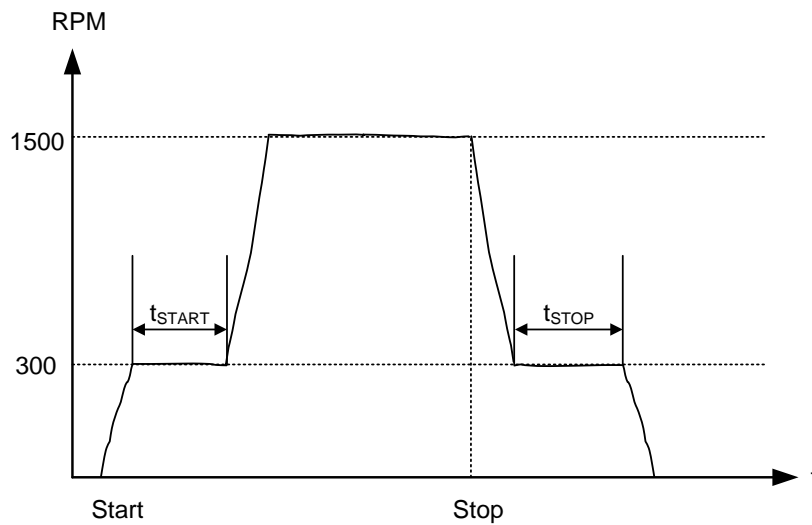
6.15.4 Inhibit

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.
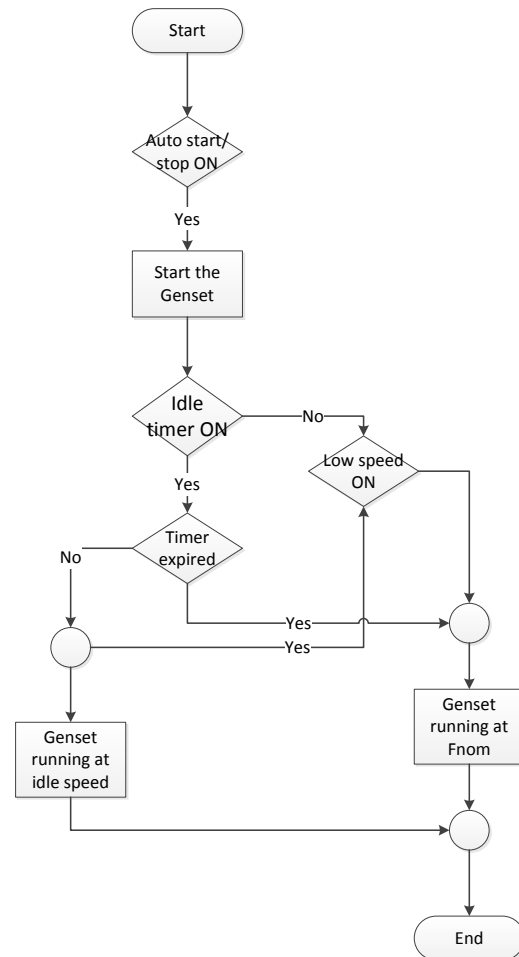
6.15.5 Running signal

The running feedback must be activated when the genset is running in idle mode.
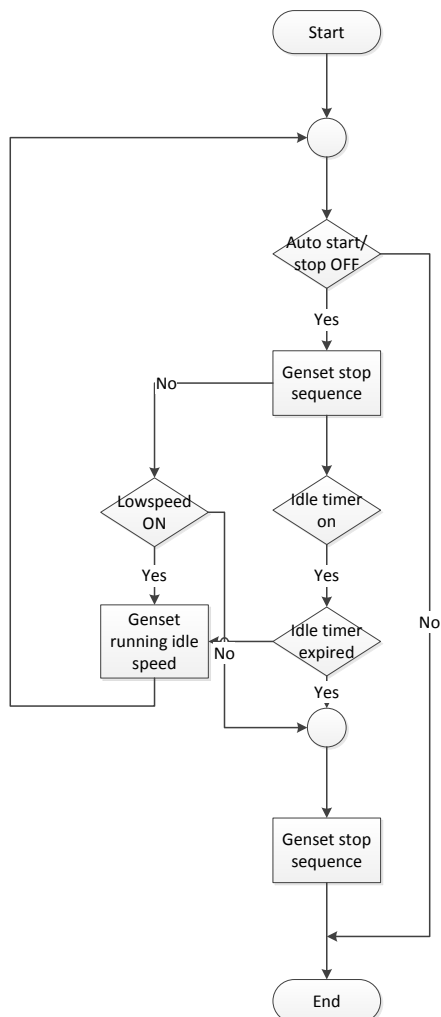
6.15.6 Idle speed flowcharts

The flowcharts illustrate the starting and stopping of the genset by use of the input "low speed".

6.15.7 Start

6.15.8 Stop

6.16 Information and status texts

Information and status texts are displayed to ease operation and indicate the actual status of the unit/engine.

ⓘ **Description of information and status texts can be found in the GCU operator's manual which is available at www.deif.com.**

6.17 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.

+ V DC

Alarm
input

Multi-line 2

Dig in

Relayout

Com
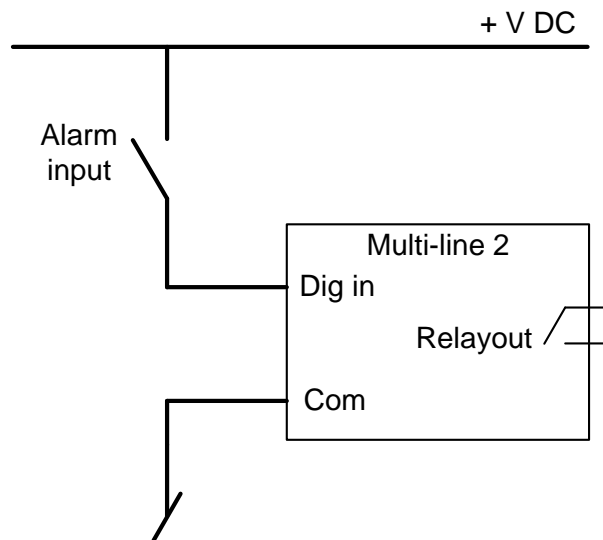
6.18 Relay function selection

Function	Description
Alarm relay NE	The relay is energised until the alarm occurs. From here, the relay stays deactivated until the alarm is acknowledged and gone. The relay will, based on the alarm, send out a signal, or not, depending on its physical setup (normally open or normally closed).
Limit relay	The relay will activate at the limit setpoint. No alarm will appear when both outputs (OA/OB) of the alarm are adjusted to the limit relay. After the condition activating this relay has returned to normal, the relay will deactivate when the "OFF delay" has expired. The OFF delay is adjustable.
Horn relay	The output activates on all alarms. For a detailed description, please refer to the chapter "Horn output".
Siren relay	The output activates on all alarms, like "Horn output". If the relay is ON, and another alarm is active, a short-time reset will be activated.
Alarm relay ND	The relay is deenergised until the alarm occurs. From here, the relay stays activated until the alarm is acknowledged and gone. The relay will, based on the alarm, send out a signal, or not, depending on its physical setup (normally open or normally closed).
Common alarm	The output activates all alarms, like "Horn output" If the relay is ON, and another alarm is active, a short-time reset will be activated. The common alarm output will be activated as long as there is an active alarm - also if the alarm is acknowledged.
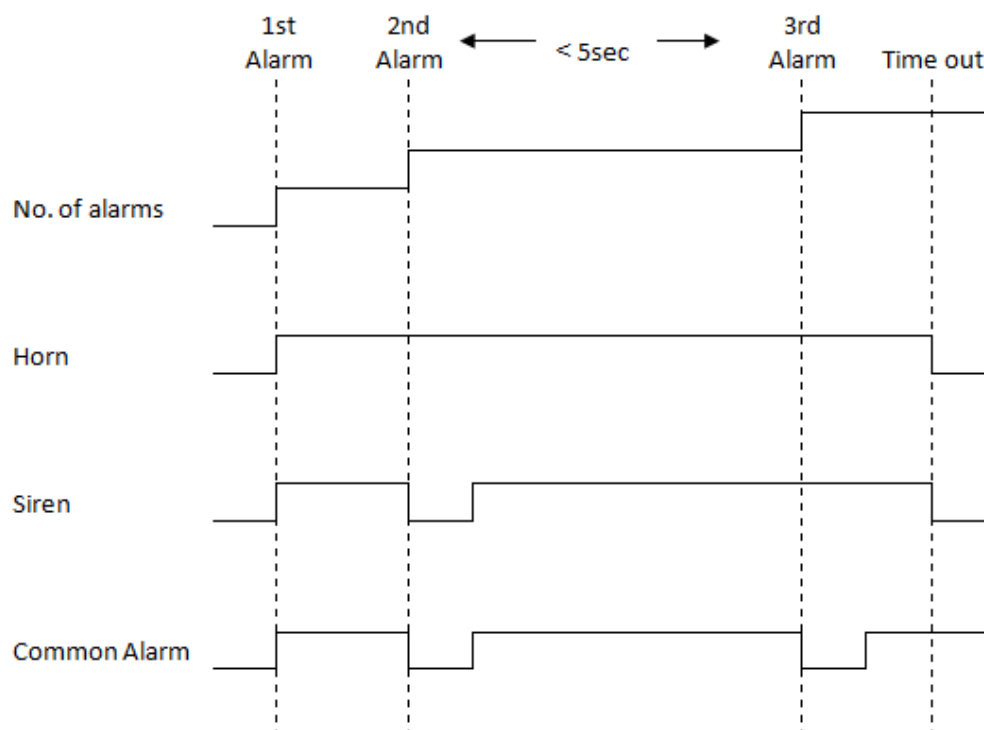
The 1st alarm activates the relay chosen for the horn, siren or common alarm. The 2nd will deactivate the relay and subsequently activate again to tell that another alarm has occured, but only on the siren and the common alarm. The horn alarm will keep the relay activated from the 1st alarm, and until the timer in parameter 6130 runs out. Then the relay is deactivated.

The next alarms will in the same way always on the common alarm de- and activate the relay. On the siren, the time from the 2nd alarm to the next has to be more than 5 seconds; otherwise the relay will stay activated. When the timer runs out (parameter 6130), the siren deactivates the relay, but if a common alarm is chosen, it stays activated until the alarm is acknowledged and gone.

6.19 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.

6.20 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 www.deif.com.

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.

6.21 Multi-inputs

The GCU unit has three multi-inputs which can be configured to be used as the following input types:
1. 4-20 mA
2. RMI oil
3. RMI water
4. RMI fuel
5. Digital

ⓘ **The function of the multi-inputs can only be configured in the PC utility software.**

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
4-20 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

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

6.21.1 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.

6.21.2 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.

6.21.3 RMI oil

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

		RMI sensor type		
Pressure		**Type 1**	**Type 2**	**Type 3**
Bar	**psi**	**Ω**	**Ω**	**Ω**
0	0	10.0	10.0	
0.5	7	27.2		
1.0	15	44.9	31.3	
1.5	22	62.9		
2.0	29	81.0	51.5	
2.5	36	99.2		
3.0	44	117.1	71.0	
3.5	51	134.7		
4.0	58	151.9	89.6	
4.5	65	168.3		
5.0	73	184.0	107.3	
6.0	87		124.3	
7.0	102		140.4	
8.0	116		155.7	
9.0	131		170.2	
10.0	145		184.0	

(i) **The configurable type is configurable with eight points in the range 0-2500 Ω. The resistance as well as the pressure can be adjusted.**

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

6.21.4 RMI water

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

Temperature		RMI sensor type			
		Type 1	Type 2	Type 3	Type 4
°C	°F	Ω	Ω	Ω	Ω
40	104	291.5	480.7	69.3	
50	122	197.3	323.6		
60	140	134.0	222.5	36.0	
70	158	97.1	157.1		
80	176	70.1	113.2	19.8	
90	194	51.2	83.2		
100	212	38.5	62.4	11.7	
110	230	29.1	47.6		
120	248	22.4	36.8	7.4	
130	266		28.9		
140	284		22.8		
150	302		18.2		

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

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

6.21.5 RMI fuel

This RMI input is used for the fuel level sensor.

	RMI sensor type
	Type 1
Value	Resistance
0%	78.8 Ω
100%	1.6 Ω

	RMI sensor type
	Type 2
Value	Resistance
0%	3 Ω
100%	180 Ω

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

	RMI sensor type
Value	**Type configurable**
%	**Resistance**
0	
10	
20	
30	
40	
50	
60	
70	
80	
90	
100	

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

6.21.6 Illustration of configurable inputs
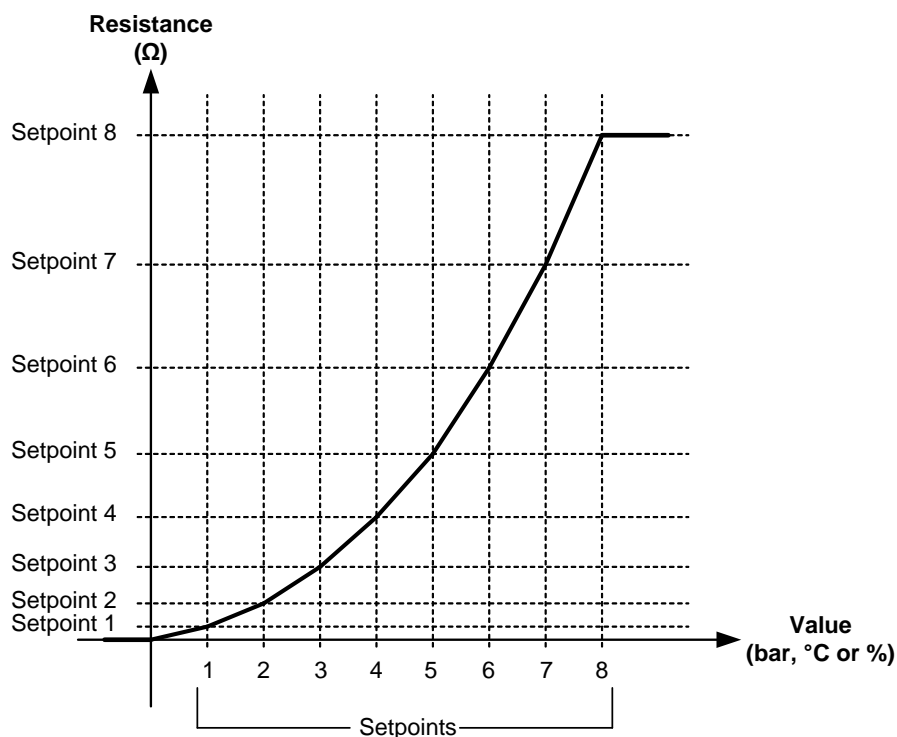
6.21.7 Configuration

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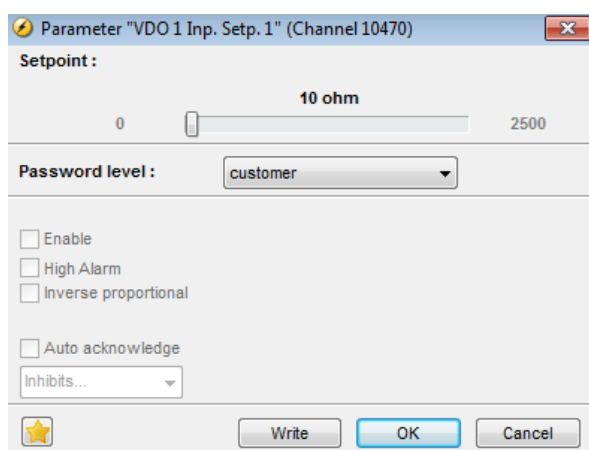
Adjust the resistance of the RMI sensor at the specific measuring value. In the example above the adjustment is 10 Ω at 0.0 bar.

6.21.8 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 fane 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, e.g. 0-5 bar:
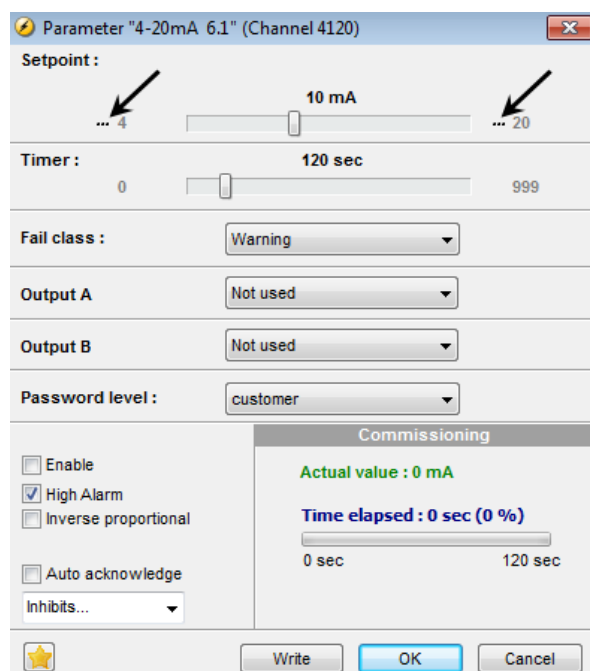
4. Adjust the input as required, e.g. 0-5 bar:
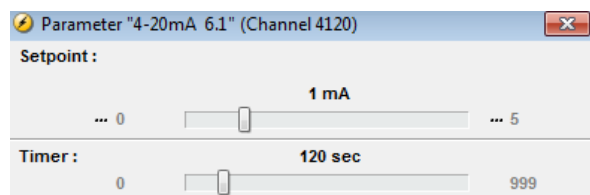
The display will then show 0 at 4 mA.

5. If needed, it is possible to scale the input to fit the sensor (Parameter 11010).
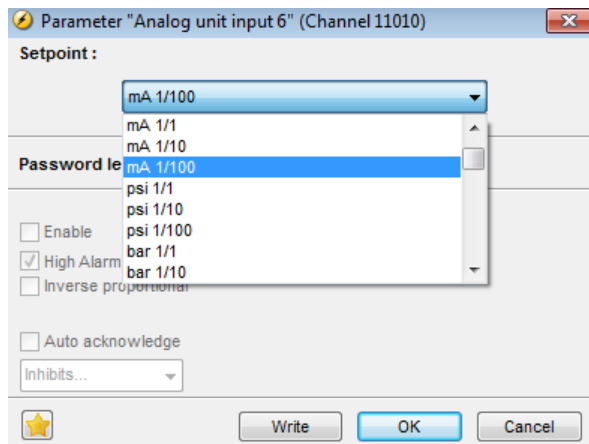
6. It is necessary to read the parameters from the device to the computer after changing the scale (1/1, 1/10 or 1/100) settings. This is in order to refresh the parameter list so the alarm settings present the correct value.
7. After reading the parameters, the alarm has been scaled so it needs to be adjusted (0-5 in this example), and this is also a scaling of the value on the display.
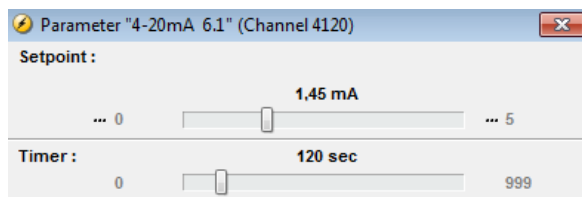
The display will now show the scaled value of multi-input 6.
In the example shown above, the value can be adjusted with two decimals. If the parameters were not refreshed, it would still only be possible to adjust the setpoint without decimals.

Save the parameter file:
After having set up the 4-20 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.

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

6.22 Nominal settings

6.22.1 How to change the nominal settings
The nominal settings can be changed to match different voltages and frequencies. The GCU has four sets of nominal values for the generator, and they are adjusted in menus 6000 to 6010 (Nominal settings 1 to 2).

Menu	Setting		
6001	Frequency	Nom. f 1	Nominal System frequency
6002	Power	Nom. P 1	Rated generator power
6003	Current	Nom. I 1	Rated generator current
6004	Voltage	Nom. U 1	Rated generator voltage

(i) **Nominal settings 2 menu 6010 equals those in settings 1 menu 6000**

There are also two sets of nominal settings for the busbar, they can be adjusted in menus 6050 to 6060.

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

(i) **The possibility to switch between the two sets of nominal setpoints is typically used on rental gensets, where switching between 50 and 60 Hz is required.**

Activation
The switching between the nominal setpoints 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 two 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.

6.23 Not in Auto/Remote

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

6.24 Outputs

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

	Output function	Output type
1	Status OK	Constant
2	Run coil	Constant
3	Stop coil	Constant
4	Prepare	Constant
5	Starter (Crank)	Constant
6	Horn	Constant
7	GB on	Continuous
8	GB off	Continuous
9	TB on	Continuous
10	TB off	Continuous

6.24.1 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. 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.

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

6. Horn
The horn relay is an 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.

7. GB on
The function will close the generator breaker

8. GB off
This function will open the generator breaker

9. TB on
This function will close the busbar breaker

10. TB off
This function will open the busbar breaker

6.25 Phase sequence error

6.25.1 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.

6.26 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.
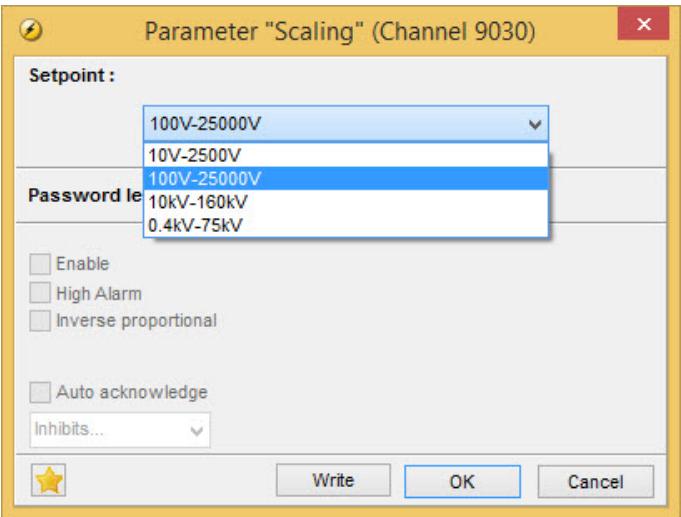
Changing the voltage scaling will also influence the nominal power scaling:

Scaling parameter 9030	Nom. settings 1 and 2 (power) will change according to parameter 9030	Nom. settings 1 and 2 (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
0.4 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

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

6.27 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.

Setpoints available in menus 6110 and 6120:

Enable: Enable/disable the alarm function.

Hours timer: 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.

Days timer: 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.

6.28 Start functions

6.28.1 Start functions

The GCU 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 setpoint before 600 RPM, then 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.
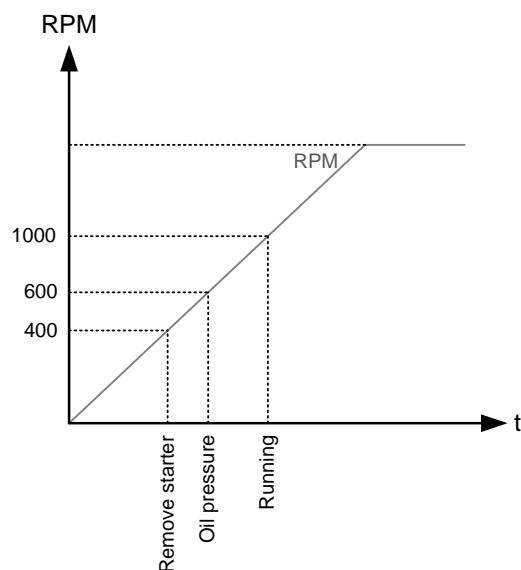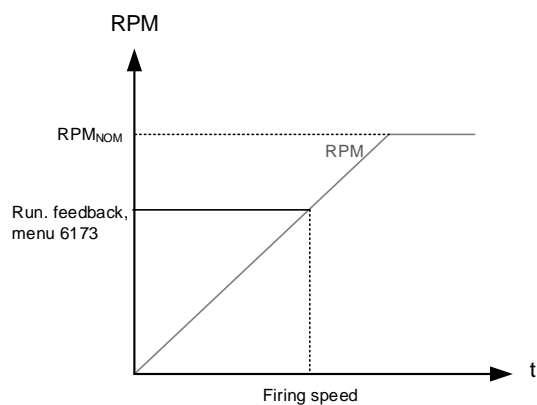
6.28.2 Analogue tacho feedback

When a magnetic pick-up (MPU) is being used, the specific level of revolutions for deactivation of the start relay can be adjusted.
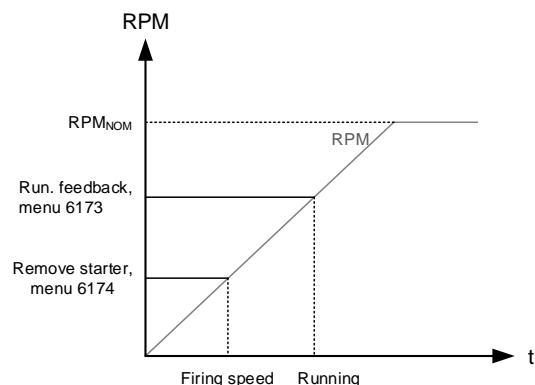
Running feedback
The diagram below shows how the running feedback is detected at the firing speed level. The factory setting is 1000 RPM **(6170 Running detect.).**

⚠️ **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 setpoint 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.**

6.28.3 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.
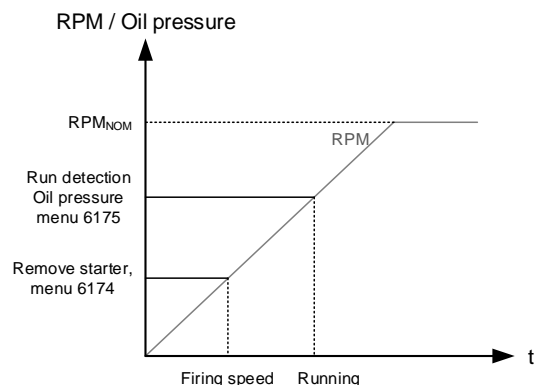
When the oil pressure increases above the adjusted value **(6175 Pressure level),** the running feedback is detected, and the start sequence is ended.

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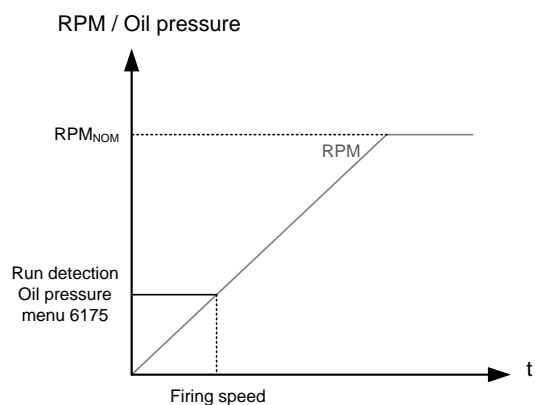
Remove starter input
The drawing below shows how the setpoint of the "remove starter input" is detected at the firing speed level.
The factory setting is 400 RPM **(6170 Running detect.).**

RPM / Oil pressure

RPM$_{NOM}$ --------------------------

RPM

Run detection
Oil pressure
menu 6175

Remove starter,
menu 6174

                                                        t

         Firing speed   Running

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

6.28.4 Digital feedbacks

If an external running relay is installed, the digital control inputs for running detection or remove starter can be used.
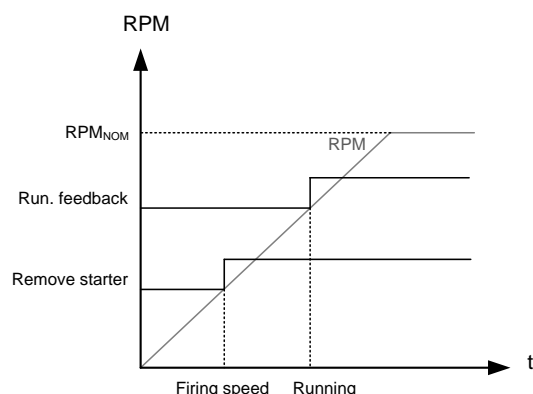
Running feedback
When the digital running feedback is active, the start relay is deactivated, and the starter motor will be disengaged.

RPM

RPM$_{NOM}$ --------------------------

RPM

Run. feedback

                                                        t
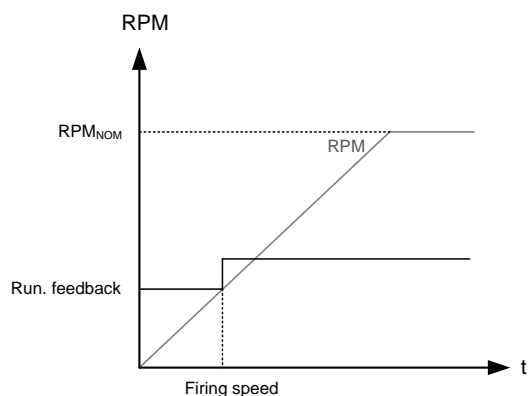
         Firing speed

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 above 32 Hz, RPM measured by magnetic pick-up or EIC (engine communication).**
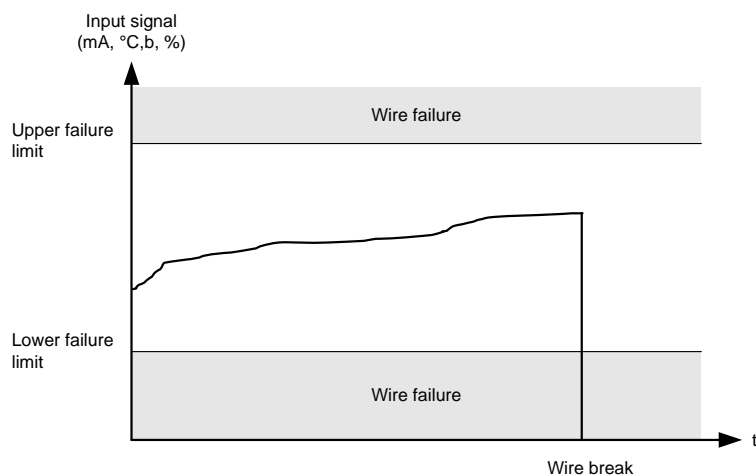
6.29 Wire break fail detection

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
4-20 mA	< 3 mA	4-20 mA	> 21 mA
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.

Input signal
(mA, °C,b, %)

Upper failure
limit

Wire failure

Wire failure

Lower failure
limit

t

Wire break

6.30 Oil Renewal

6.30.1 Oil renewal

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 GCU is only used if the EIC counter is not available.

The function in the GCU 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 GCU 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.

7. Protections

7.1 General

7.1.1 General

The protections are all of the definite time type, i.e. a setpoint and time is selected.

If the function is e.g. overvoltage, the timer will be activated if the setpoint is exceeded. If the voltage value falls below the setpoint value before the timer runs out, then the timer will be stopped and reset.
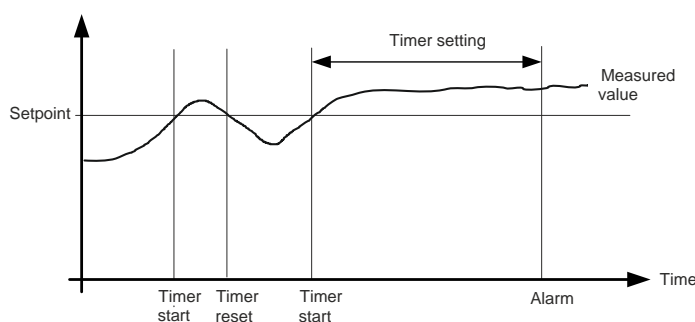
When the timer runs out, the output is activated. The total delay will be the delay setting + the reaction time.

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

An example:
A power generation system must not reconnect to a network when the voltage is 85% of Un +/-0% $\leq$ U $\leq$ 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 1-2% higher/lower than the actual setpoint 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, please 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**
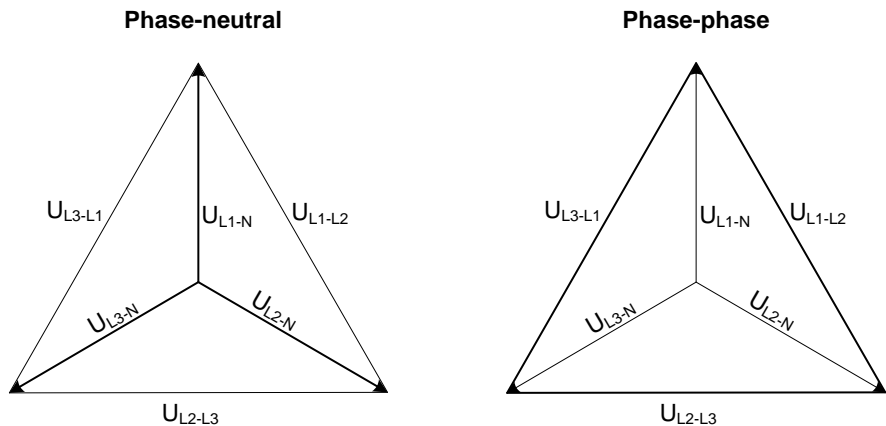
As indicated in the vector diagram, there is a difference in voltage values at an error situation for the phase-neutral voltage and the phase-phase voltage.

The table shows the actual measurements at a 10% undervoltage 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 setpoint is 10% in both cases.

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

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

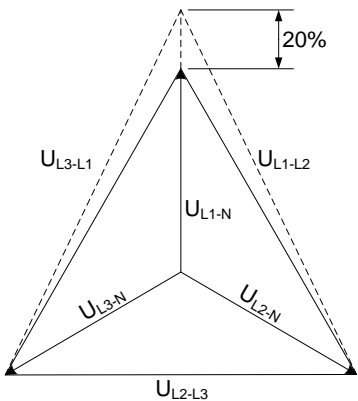**Error situation:**
U_{L1L2} = 360V AC
U_{L3L1} = 360V AC

U_{L1-N} = 185V AC

ΔU_{PH-N} = 20%

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

8. Parameter list

8.1 Related parameters

8.1.1 Related parameters

For further information related to parameters, please see the parameter list, document no. 4189340796.