MURPHY®

by ENOVATION CONTROLS


# Genset Controller Unit
# Model EMS -GC10

*Operator's Manual*

**00-02-0878**
**Section 75**
**2013-03-07**

In order to consistently bring you the highest quality, full featured products, we reserve the right to change our specifications and designs at any time. The latest version of this manual can be found at www.fwmurphy.com.


**BEFORE BEGINNING INSTALLATION OF THIS MURPHY PRODUCT:**

- Read and follow all installation instructions.
- Please contact your Murphy Master Distributor immediately if you have any questions.
- A visual inspection of this product for damage during shipping is recommended before installation.
- It is your responsibility to ensure that qualified mechanical and electrical technicians install this product.

To locate your local distributor, go to
http://www.fwmurphy.com/dealer_search/

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# About This Document

## General Purpose

This document is the Operator's Manual for Murphy's Automatic Genset Controller, the EMS-GC10.

The general purpose of the Installation Manual is to provide the information needed to operate the unit.

> WARNING: Please make sure to read this document before working with the EMS-GC10 controller and the Genset to be controlled. Failure to do this could result in human injury or damage to the equipment.

You may visit the Murphy website at http://www.fwmurphy.com/emsgc10 to download the latest version of the configuration tool software and the EMS-GC10 Operator's Manual part number 00-02-0878.

You will need to purchase the TTL to USB cable (75000277) in order to use the Utility Software (USW).

## Intended Users

The document is intended for the person responsible for setup and operating the EMS-GC10 unit.

## Address, Menu, Setting, Parameter

To promote consistently with the PC Configuration Tool called Utility Software (USW), this document uses the word Parameter, where in some instances, may also be thought of as an address, menu, or setting.

# Warnings and Legal Information

## Legal Information and Responsibility

FW Murphy 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 EMS-GC10 unit, the company responsible for the installation or the operation of the set must be contacted.

IMPORTANT: The EMS-GC10 unit is not to be opened by unauthorized personnel. If this occurs, the warranty will be void.

## Disclaimer

FW Murphy reserves the right to change any of the contents of this document without prior notice.

## Electrostatic Discharge Awareness

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

## Safety Issues

Installing and operating the EMS-GC10 unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorized personnel who understand the risks involved in working with live electrical equipment.

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

## Factory Settings

The EMS-GC10 unit is delivered from the 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.

**NOTE:** When the controller unit operates for the first time after it has been received from the factory, both mains and generator breakers alarms will be activated to warn the user (shown as fault), until they are connected to the power system and reset accordingly.

## Warnings and Notes

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

### Notes

> **NOTE**: The notes provide general information which will be helpful for the reader to bear in mind.

### Warnings

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

# Introduction

This Operator's Manual includes general product information, display readings, push-button, LED functions, alarm handling descriptions, and presentation of the log list. This manual is intended to help optimize the operator s daily use. On the basis of this document, the operator will be able to carry out simple procedures such as start/stop and control of the generator set.

**As a Reference point: Please note that the "U" symbol is also used as an indication for the voltage.**

**EMS-GC10** delivers field-adjustable operating parameters but may require further configuration using the Utility Software. It can support both mechanical and J1939 electronic engines.

The **EMS-GC10** is ideal for use with a remote modem or in a SCADA system offering Modbus® RTU protocol on the RS485 port.

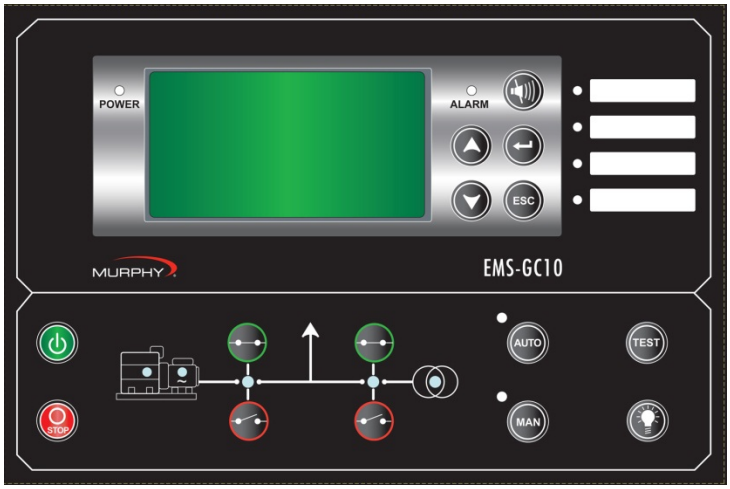
## Product Description

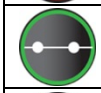
The EMS-GC10 Genset Controller provides flexible control and monitoring for industrial genset applications. Typical applications include backup power, power supply for remote locations without a connection to power grid, and mobile power for remote locations. The controller supports programmable logic, up to 40 expressions, and can be configured for specific predefined functions unique to your application.

The EMS-GC10 supports Automatic Mains Failure (AMF) and generator breaker control.

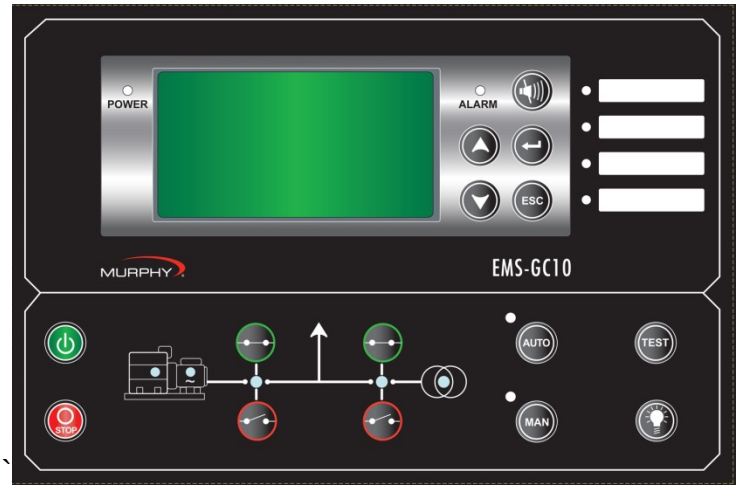
The EMS-GC10 offers field-adjustable operating parameters that can be changed through the controller or an easy to use PC configuration tool called Utility Software

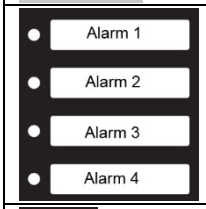
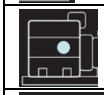
## Push-Buttons




| | |
|---|---|
|  | Normal display: Scrolls the display down once. Programming: Decreases setpoint value. |
|  | Normal display: Scrolls the display up once. Programming: Increases setpoint value. |
|  | Resets horn relay. Extra function: Press and hold button 2 seconds to see alarm list. |
|  | Enter menus/enter value/acknowledges alarm. |
|  | Jumps from parameter settings to display. Removes pop-up messages. |
|  | Initiates the test sequence. |
|  | Lamp test. One push will illuminate all LEDs for 3 seconds. |
|  | Manual/Block running mode selector. Press MAN twice to activate Block mode. |
|  | AUTO running mode selector. |
|  | Open breaker. |
|  | Closed breaker. |
|  | Stop engine (Manual, not auto) running mode. |
|  | Start engine (Manual, not auto) running mode. |

## LED Indicators




| | |
|---|---|
|   | Power OK indicator. |
|   | Alarm LED: Flashing: active, non-acknowledged alarm(s) present. Steady: active, acknowledged alarm(s) present. |
|   | Additional alarm indication LEDs: Flashing: active, non-acknowledged alarm(s) where output A or B is configured to LED 1, 2, 3 or 4. Steady: active, acknowledged alarm(s) where output A or B is configured to LED 1, 2, 3 or 4. |
|   | ON in Manual Mode. Flashing when in Block mode. |
|   | ON in AUTO Mode. |
|  | Generator breaker ON/Mains. |
|  | U/f OK, generator voltage/frequency. |
|  | Running feedback present. |
|  | Power comes from utilities/grid (Mains ok). |

## Menu

The Menu can be viewed without password entry.

| | | |
|---|---|---|
| | **View Menu** | The measured values are displayed from this view. |
|  | **Log Menu** | This menu displays the Event, Alarm, and Battery Logs. |
|  | **Setup Menu** | Used for setting up the unit, and detailed information. Changing of parameter settings is password-protected. |
|  | **Alarm List** | This list shows active acknowledged and unacknowledged alarms. In addition, while in this list the alarms can be acknowledged by pressing the ENTER  button. |
|  | **Service Menu** | This menu contains input, output, M-Logic status, and data about the unit |

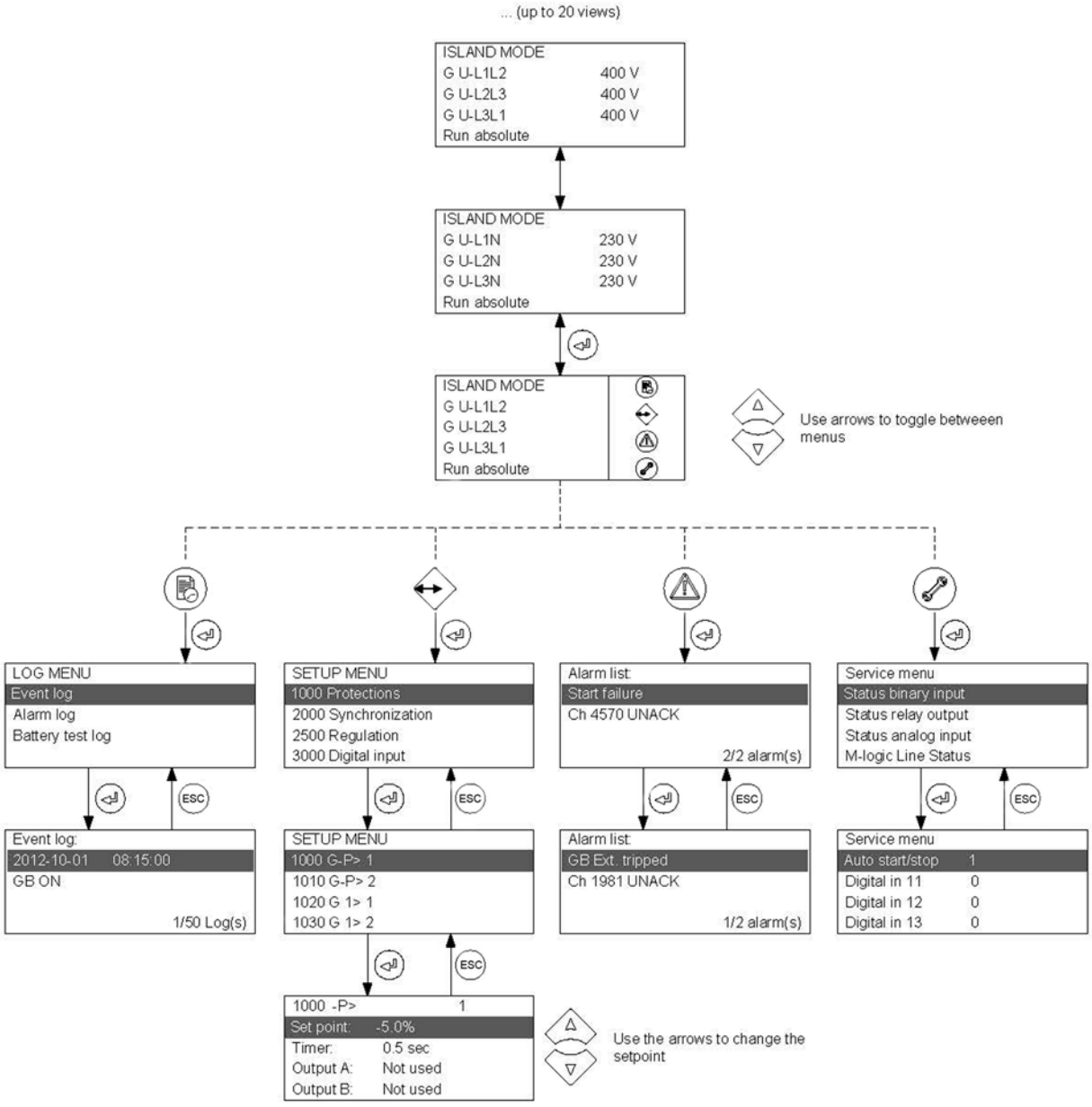
## View Menu

The View Menu is used daily by the operator. There are up to 20 configurable display views, with up to three configurable display lines in each view. View configuration is done through the PC utility software (USW).

In the View Menu, various measured values are on the display.

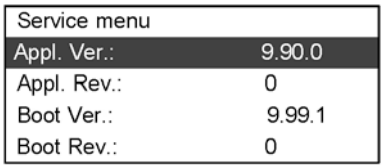
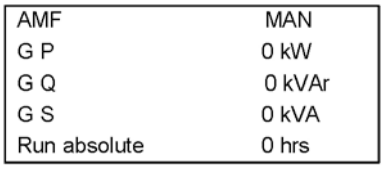
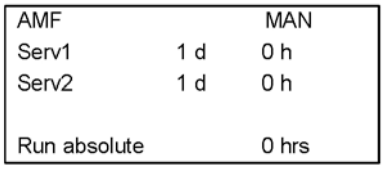
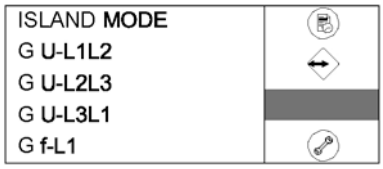
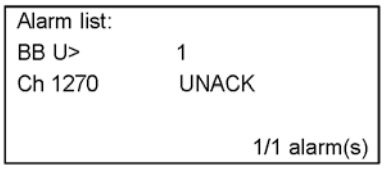
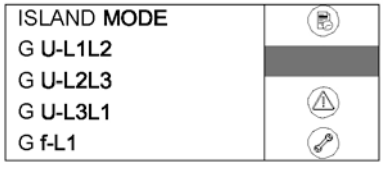
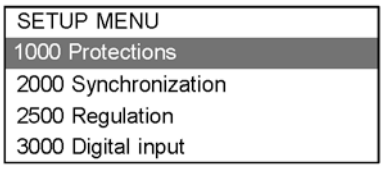
| | |
|---|---|
| AMF MAN<br>G P 0 kW<br>G Q 0 kVAr<br>G S 0 kVA<br>Run absolute 0 hrs | First display line: Genset mode and running mode<br>Second display line: Measurements relating to operational status<br>Third display line: Measurements relating to operational status<br>Fourth display line: Measurements relating to operational status<br>Fifth display line: Running hours |

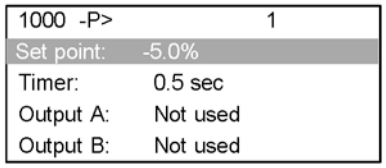
## Menu Structure Diagram



## Display

The display indicates readings and alarms. Below are some examples of the display views.

| Display View | Description and Notes |
|---|---|
| **View Menu** | |
|  | The software version can be found in the Service Menu |
|  | Status of Generator P, Generator Q, Generator S, and Run Hours |
|  | Status of Service Timer 1, Service Timer 2, and Run Hours |
| **Alarm Acknowledge** | |
|  | Press ENTER button to enter the list of active alarms |
|  | The alarm list shows the active alarms. Press ENTER button to acknowledge alarm |
| **Parameter Settings** | |
|  | Press the ENTER button to enter the Parameter Settings |
|  | Select menu group, press ENTER button to edit |

| Display View | Description and Notes |
|---|---|
|  | Edit value with the UP and DOWN buttons and save the value by pressing the ENTER button |

> **NOTE:** The available parameters depend on the set options. Some parameters can only be changed using the PC utility software (USW) for EMS-GC10.

## Status Line Text

Below is a list of standard conditions with comments.

| Condition | Comment | Note |
|---|---|---|
| Block | Block mode is activated | |
| Simple Test | Test mode is activated | |
| Full Test | | |
| Simple Test ###.#Min | Test mode activated and test timer counting down | |
| Full Test ###.#Min | | |
| Island Man | Genset stopped or running and no other action taking place | |
| Island Semi | | |
| Ready Island Auto | Genset stopped in Auto | |
| Island Active | Genset running in Auto | |
| AMF Man | Genset stopped or running and no other action taking place (AMF mode) | |
| AMF Semi | | |
| Ready AMF Auto | Genset stopped in Auto (AMF mode) | |
| AMF Active | Genset running in Auto (AMF mode) | |
| Load Takeover Man | Genset stopped or running and no other action taking place (LTO mode) | |
| Load Takeover Semi | | |
| Ready LTO Auto | Genset stopped in Auto (LTO mode) | |
| LTO Active | Genset running in Auto (LTO mode) | |
| DG Blocked For Start | Generator stopped and active alarm(s) on the generator | |
| GB On Blocked | Generator running, GB open and an active "Trip GB" alarm | |
| Shutdown Override | The configurable input is active | |
| Access Lock | The configurable input is activated, and the operator tries to activate one of the blocked keys | |

| Condition | Comment | Note |
|---|---|---|
| GB Trip Externally | Some external equipment has tripped the breaker | An external trip is logged in the event log |
| MB Trip Externally | | |
| Idle Run | The "Idle run" function is active. The genset will not stop until a timer has expired | |
| Idle Run ###.#Min | The timer in the "Idle run"' function is active | |
| Aux. Test ##.#V ####S | Battery test activated | |
| Start Prepare | The start prepare relay is activated | Prepare, close, plus delay |
| Start Relay On | The start relay is activated | |
| Start Relay Off | The start relay is deactivated during the start sequence | |
| Mains Failure | Mains failure and mains failure timer expired | |
| Mains Failure In ###S | Frequency or voltage measurement is outside the limits | The timer shown is the Mains failure delay. Text in mains units with time in seconds |
| MAINS U OK DEL ####S | Mains voltage is OK after a mains failure | The timer shown is the Mains OK delay |
| MAINS F OK DEL ####S | Mains frequency is OK after a mains failure | The timer shown is the Mains OK delay |
| Hz/V OK IN ###S | The voltage and frequency on the genset is OK | When the timer runs out it is allowed to operate the generator breaker |
| COOLING DOWN ###S | Cooling-down period is activated | |
| Cooling Down | Cooling-down period is activated and infinite | Cooling down timer is set to 0.0 s |
| Genset Stopping | This info is shown when cooling down has finished | |
| Ext. Stop Time ###S | | |
| Ext. Start Order | A planned AMF sequence is activated | There is no failure on the mains during this sequence |

## Running Modes

The unit has four different running modes and one block mode. The different running modes are four to three via the display or the PC utility software.

| | |
|---|---|
| **Auto** | In auto mode, the unit will operate automatically, and the operator cannot initiate any sequences manually. |
| **Test** | The test sequence will start when the test mode is selected. |
| **Manual** | Manual means that the unit will not initiate any sequences automatically, as is the case with the auto mode. It will only initiate sequences, if external signals are given. |
| **Block** | When the block mode is selected, the unit is not able to initiate any sequences, for example, the start sequence. |

> **NOTE:** Block mode must be selected when maintenance work is carried out on the Genset.
>
> **NOTE:** The Genset will shut down if block mode is selected while the Genset is running
>
> **NOTE:** If the auto button is pressed twice, the controller will be in the semi-auto mode. This mode is not supported, and is the same as the manual mode. Press either the auto or manual button once to resume normal operation

## Alarm and Logs

When an alarm occurs, the alarm is displayed and saved in the Alarm Log.

Press the ESC  button to hide the alarm from the display.

Press the ENTER  button to acknowledge the alarm.

> **NOTE:** When you acknowledge an alarm, and the alarm condition is no longer present, the alarm will no longer be displayed in the Alarm Log.

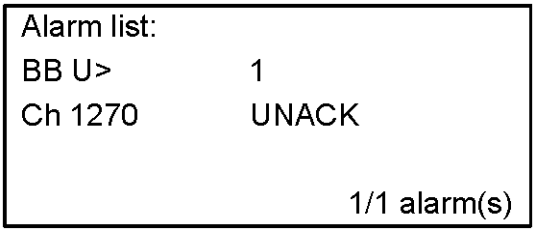
Press the HORN  button for 2 seconds to view the list of alarms stored in the alarm log. Press the UP  and Down  Buttons to view the list.

> **NOTE:** The display will show one alarm at a time.

The alarm log contains both acknowledged and unacknowledged alarms provided that they are still active (i.e. the alarm condition is still present).

If there are no alarms, the Alarm List (Log) will be empty.

The display example below indicates an unacknowledged alarm. This means: Bus Bar U > Settings Group 1




## Log List

The log is divided into three different lists:

- Event Log – closing of breaker and starting of engine
- Alarm Log – overcurrent or high cooling water temperature
- Battery Test Log – test OK or test failed

The event log contains up to 50 events, the alarm log contains up to 30 historical alarms and the battery test log contains up to 52 historical battery tests.

## Parameters—Only Available With USW

Parameters need to be configured through the Utility Software (USW) and not locally available to be configured from EMS-GC10 unit.

| Parameter | Description |
|---|---|
| 1340 | Busbar voltage trip. |
| 2774 | EIC speed ramp. |
| 4220 | RMI fuel level multi input 6. |
| 4230 | RMI fuel level multi input 6. |
| 4250 | 4-20ma. multi input 7. |
| 4260 | 4-20ma. Multi input 7. |
| 4350 | RMI fuel level multi input 7. |
| 4360 | RMI fuel level multi input 7. |
| 4380 | 4-20ma. multi input 8. |
| 4390 | 4-20ma. multi input 8. |
| 4440 | RMI oil psi multi input 8. |
| 4450 | RMI oil psi multi input 8. |
| 4460 | RMI water temp. Multi input 8. |
| 4470 | RMI water temp. multi input 8. |
| 4550 | Magnetic pickup wire break. |
| 4601 | Delta analog 1, 2, 3. |
| 5000 | Relay 03. |

| Parameter | Description |
|---|---|
| 5010 | Relay 21. |
| 5020 | Relay 22. |
| 5030 | Relay 23. |
| 5040 | Relay 24. |
| 5060 | Relay 45. |
| 5070 | Relay 47. |
| 6200 | Shutdown override. |
| 7000 | Mains power. |
| 7010 | Daytime period. |
| 7020 | Start Generator. (peak shaving) |
| 7030 | Stop Generator. (peak shaving) |
| 7530 | Internal communication ID. |
| 8180 | Mains configuration. |
| 8190 | Tie breaker. |
| 9120 | Service menu. |
| 9180 | Quick setup mains. |
| 9190 | Application broadcast. |
| GSM Settings | Calling phone numbers. |
| 10390 | Password language. |
| 10400 | Password log page. |
| 10410 | Password control page. |
| 10460-10620 | RMI configurable curves. |
| 10970 | Engineering units. (metric/English) |
| 10980 | Configuration multi input 6. |
| 10990 | Configuration multi input 7. |
| 11000 | Configuration multi input 8. |
| 11010-1110 | 4-20ma. input scale. |
| 12790-12940 | External digital outputs |
| 12950-12983 | External module status |

## Functional Descriptions

### Standard Functions

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

The standard functions are listed in the following paragraphs.

### Operation Modes

- Automatic Mains Failure (AMF)
- Island operation (Island)
- Load takeover (LTO)

### Engine Control

- Start/stop sequences
- Run and stop coil
- Multi-inputs (binary, 4-20 mA or VDO)
- Digital inputs

### Generator Protection (ANSI)

- Reverse power (32)
- Overload (32)
- Overcurrent (50/51)
- Overvoltage (59)
- Undervoltage (27)
- Over-/underfrequency (81)
- Current/voltage unbalance (60)

### Busbar Protection (ANSI)

- Overvoltage (59)
- Undervoltage (27)
- Overfrequency (81)

Underfrequency (81)

Voltage unbalance (60)

### Display

Push-buttons for start and stop

Push-buttons for breaker operations

Status texts

### M-Logic

Simple logic configuration tool

Selectable input events

Selectable output commands

## Terminal Strip Overview

### 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 FW Murphy website under documentation for EMS-GC10.

## Measurement Systems

EMS-GC10 unit is designed for measurement of voltages between 100 and 690Vpp AC. For further reference, the AC wiring diagrams are shown in the Installation Instructions. In parameters 9130, 9131 the measurement principle can be changed between three-phase, single phase and split phase.

IMPORTANT: Configure EMS-GC10 to match the correct measuring system. When there is a doubt, contact the switchboard manufacturer for information about the required adjustment.

**NOTE:** EMS-GC10 unit has four sets of nominal generator settings, which can be enabled individually in the different measurement systems.

## 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):

| Parameter | Adjustment | Description | Adjust to value |
|---|---|---|---|
| 6004 | G nom. voltage | Phase-neutral voltage of the generator | 230V AC |
| 6041 | G transformer | Primary voltage of the G voltage transformer (if installed) | UNOM x √3 |
| 6042 | G transformer | Secondary voltage of the G voltage transformer (if installed) | UNOM x √3 |
| 6051 | BB transformer | Primary voltage of the BB voltage transformer (if installed) | UNOM x √3 |
| 6052 | BB transformer | Secondary voltage of the BB voltage transformer (if installed) | UNOM x √3 |
| 6053 | BB nom. voltage | Phase-phase voltage of the busbar | UNOM x √3 |

> **NOTE:** The voltage alarms refer to UNOM (230V AC).
>
> **NOTE:** EMS-GC10 unit has two sets of BB transformer settings, which can be enabled individually in this measurement system.

## Split Phase System

When EMS-GC10 unit is delivered from the factory, the three-phase system is selected. When this principle is used, all three phases must be connected to the EMS-GC10 controller unit.

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 |
|---|---|---|---|
| 6004 | G nom. voltage | Phase-phase voltage of the generator | 400V AC |
| 6041 | G transformer | Primary voltage of the G voltage transformer (if installed) | UNOM |
| 6042 | G transformer | Secondary voltage of the G voltage transformer (if installed) | UNOM |
| 6051 | BB transformer | Primary voltage of the BB voltage transformer (if installed) | UNOM |
| 6052 | BB transformer | Secondary voltage of the BB voltage transformer (if installed) | UNOM |
| 6053 | BB nom. voltage | Phase-phase voltage of the busbar | UNOM |

> **NOTE:** EMS-GC10 has two sets of BB transformer settings, which can be enabled individually in this measurement system.

# Applications

## Applications and Genset Modes

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

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

| Application |
|---|
| Engine Control |
| Automatic Mains Failure (no back sync.) |
| Island operation |
| Load takeover |

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

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

## AMF (No Back Synchronization)

### Auto Mode Description:

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

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

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

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

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

## Island Operation

### Auto Mode Description:

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

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

## Load Takeover

### Auto Mode Description:

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

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

## Running Mode Description

### Manual Mode

The unit can be operated in manual mode (MAN). Manual means that the unit will not initiate any sequences automatically, as is the case with the auto mode. It will only initiate sequences, if external signals are given.

An external signal may be given in three ways:

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

> **NOTE:** The standard EMS-GC10 is only equipped with a limited number of digital inputs, please see "Digital inputs" in this document for additional information about availability.

The following sequences can be activated in manual mode:

| Command | Description | Comment |
|---|---|---|
| Start | The start sequence is initiated and continues until the genset starts or the maximum number of start attempts has been reached. | First start: include preheat<br>Second start: cancel preheat |
| Stop | The genset will be stopped. After disappearance of the running signal, the stop sequence will continue to be active in the '"extended stop time" period. The genset is stopped with cooling down time. | The cooling down time is cancelled if the stop button is activated twice. |
| Close GB | The unit will close the generator breaker if the mains breaker is open | |
| Open GB | The unit will open the generator breaker instantly | |
| Close MB | The unit will close the mains breaker if the generator breaker is open | |
| Open MB | The unit opens the mains breaker instantly. | |

## 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 parameter 7040 Test. Use the USW to view the USW settings.

1. Timer: Period starts when U/f is ok. Engine stops when time runs out.
2. Return: When the test is completed, the unit will return to the selected mode (manual or auto).
3. Type: Selection of one of the two types of tests: simple or full.

> **NOTE:** If the timer is set to 0.0 min., the test sequence will be infinite. The test will be cancelled by pushing TEST again.
>
> **NOTE:** Test mode is not available in an island application

## Simple Test

EMS-GC10 controller unit will go through the start sequence and run the engine for the time set in parameter 7041 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 7040 is set to 0, the test is infinite. The test will be interrupted if the mode is changed to: manual, semi-auto, or auto.

## Full Test

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

> **NOTE:** To run the full test, it is required that EMS-GC10 is in AMF or LTO mode.
>
> **NOTE:** It is possible to open and close the generator breaker and the mains breaker in manual mode.

## Block Mode

Block mode can be enabled by pressing the MAN button on the EMS-GC10 twice and hold for 2 seconds, with M-Logic or a digital input. When block mode is selected, the controller unit will be locked for certain actions. This means that it cannot start the genset or perform any breaker operations from the buttons.

The purpose of the block mode is to make sure that the genset does not start for instance during maintenance work.

WARNING: You should take care to follow OSHA equipment lockout requirements and any other company safety regulations, procedures, or requirements by authorities with local jurisdiction.

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

When EMS-GC10 unit goes into block mode, it will:

- Open GB, shut down the engine, show "BLOCK" in the display and flash the MAN LED
- GB ON, GB OFF, MB ON, MB OFF and START buttons are locked
- Parameter 7065 set to Start Engine+Open MB: MB will switch on every time voltage/frequency is within the limits and open when not OK (used when the breaker is a contactor)
- Parameter 7065 set to Start Engine: MB will switch ON one time if the voltage/frequency is within the limits and OFF otherwise. It respects the "MB close delay" in 7082.

If block mode is selected using the display after the digital block input is activated, the EMS-GC10 will stay in block mode after the block input is deactivated. The block mode must now be changed using the push-buttons AUTO or MAN. The block mode can only be changed locally by push-button or a digital input.

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

**NOTE:** Alarms are not influenced by block mode selection.

WARNING: You should take care to follow OSHA equipment lockout requirements and any other company safety regulations, procedures, or requirements by authorities with local jurisdiction.

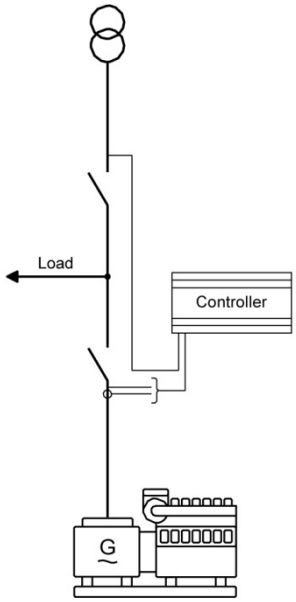
IMPORTANT: The genset will shut down if block mode is selected while the genset is running.

## Single-Line Diagrams

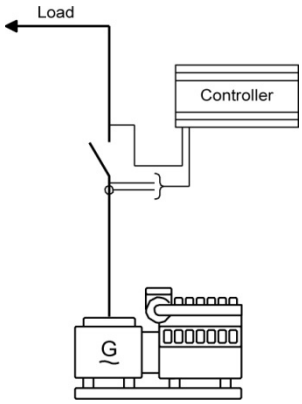
### Application Illustration

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

### Automatic Mains Failure (AMF)

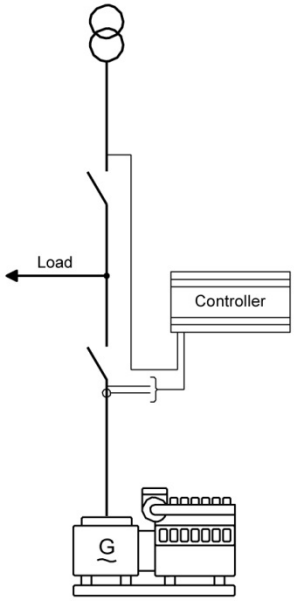


## Island Operation




Island Mode without breaker is possible.

## Load Takeover




**NOTE:** Synchronization is not supported by EMS-GC10

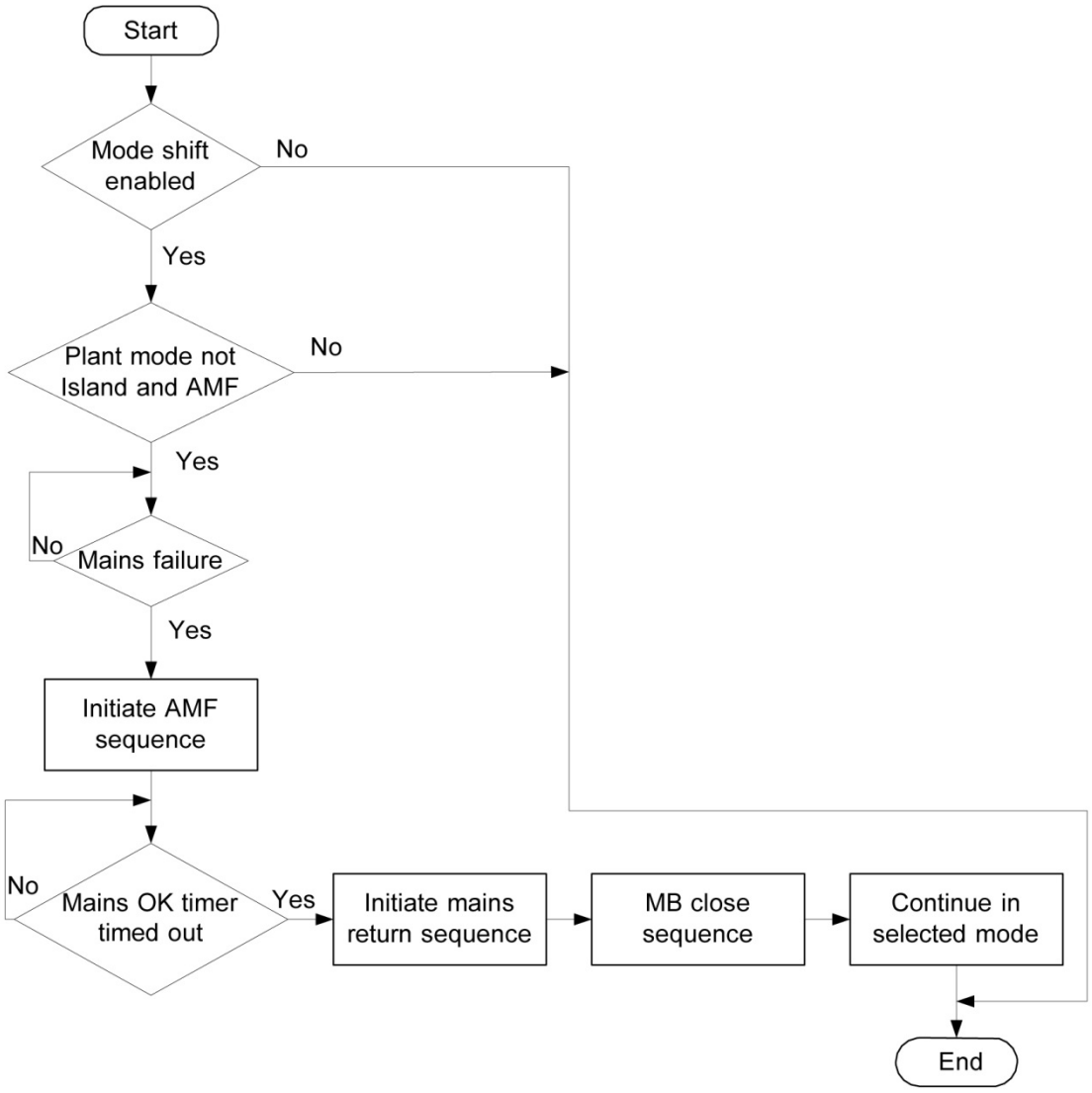
## Flowcharts

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

- Mode shift
- MB open sequence
- GB open sequence
- Stop sequence
- Start sequence
- MB close sequence
- GB close sequence
- Load takeover (without synchronizing)
- Island operation
- Automatic Mains Failure
- Test sequence

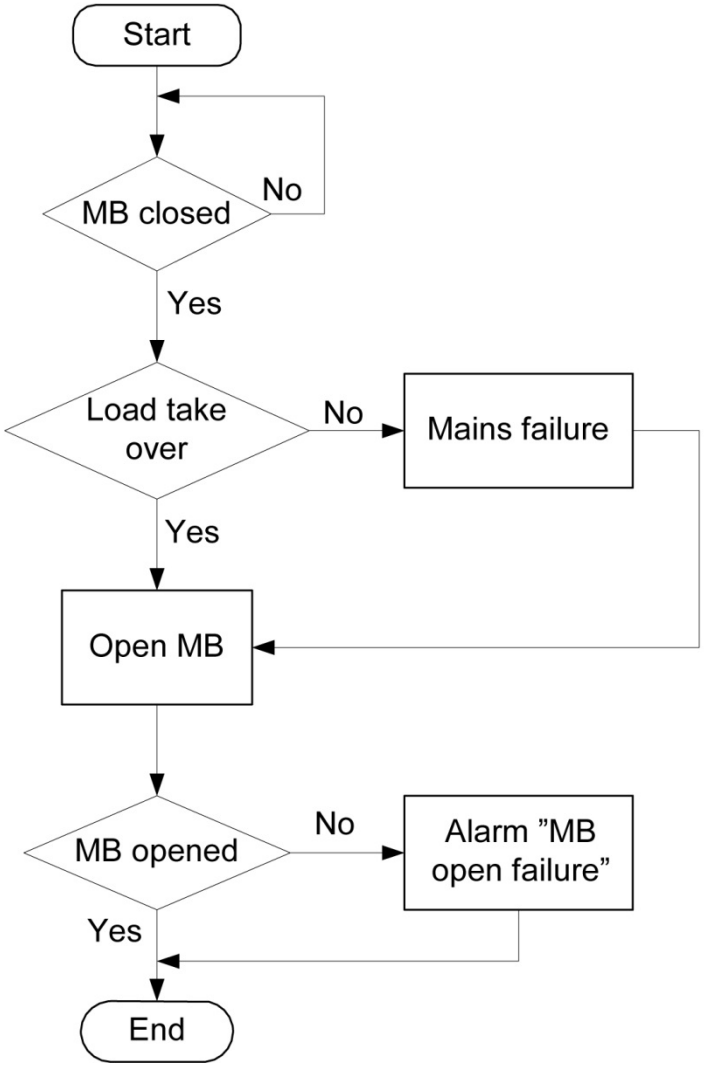
> **NOTE:** The flowcharts on the following pages are for guidance only. For illustrative purposes, the flowcharts are simplified in some extent.

## Mode Shift

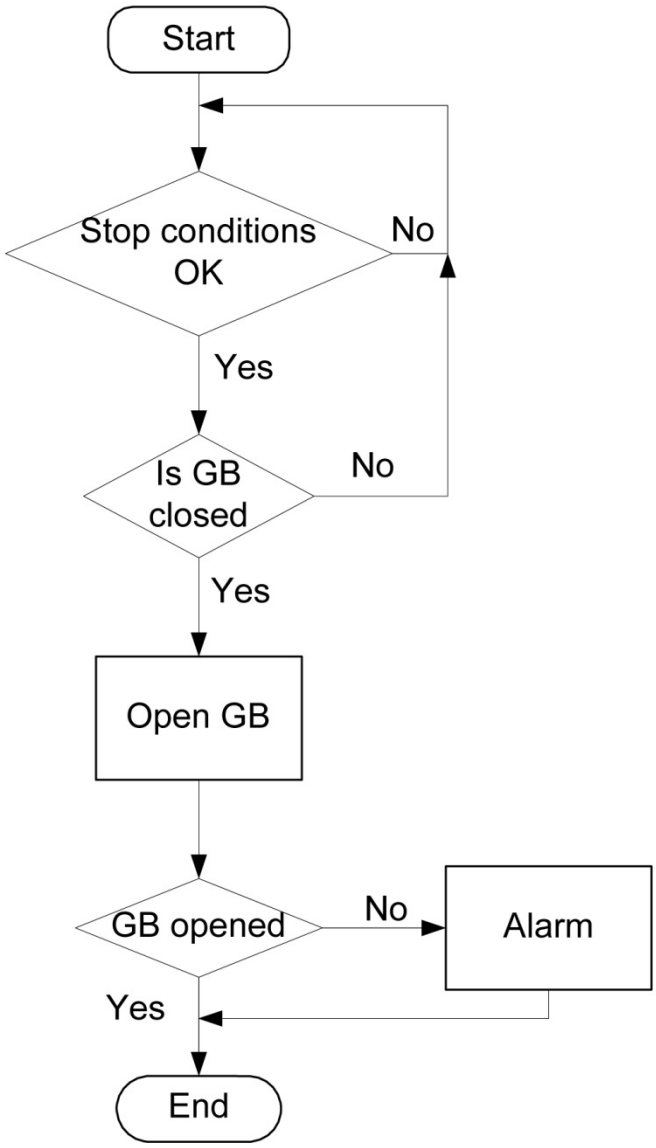



**NOTE:** To enable mode shift, a digital input has to be set up.

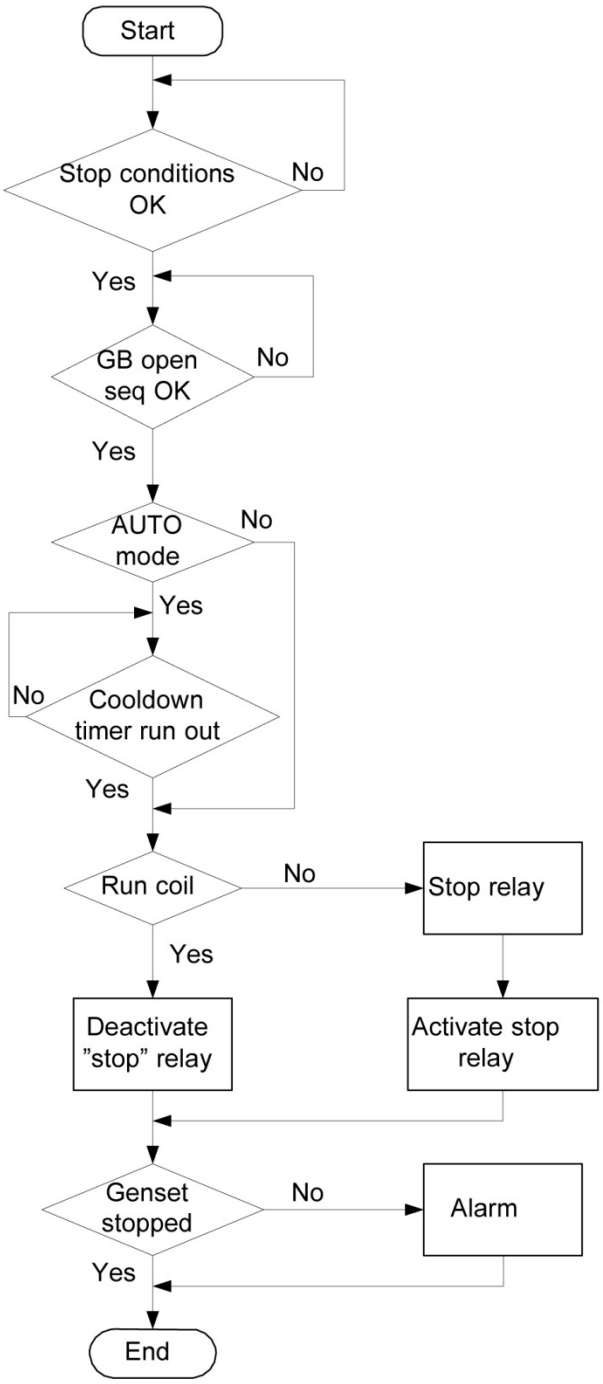
## MB Open Sequence



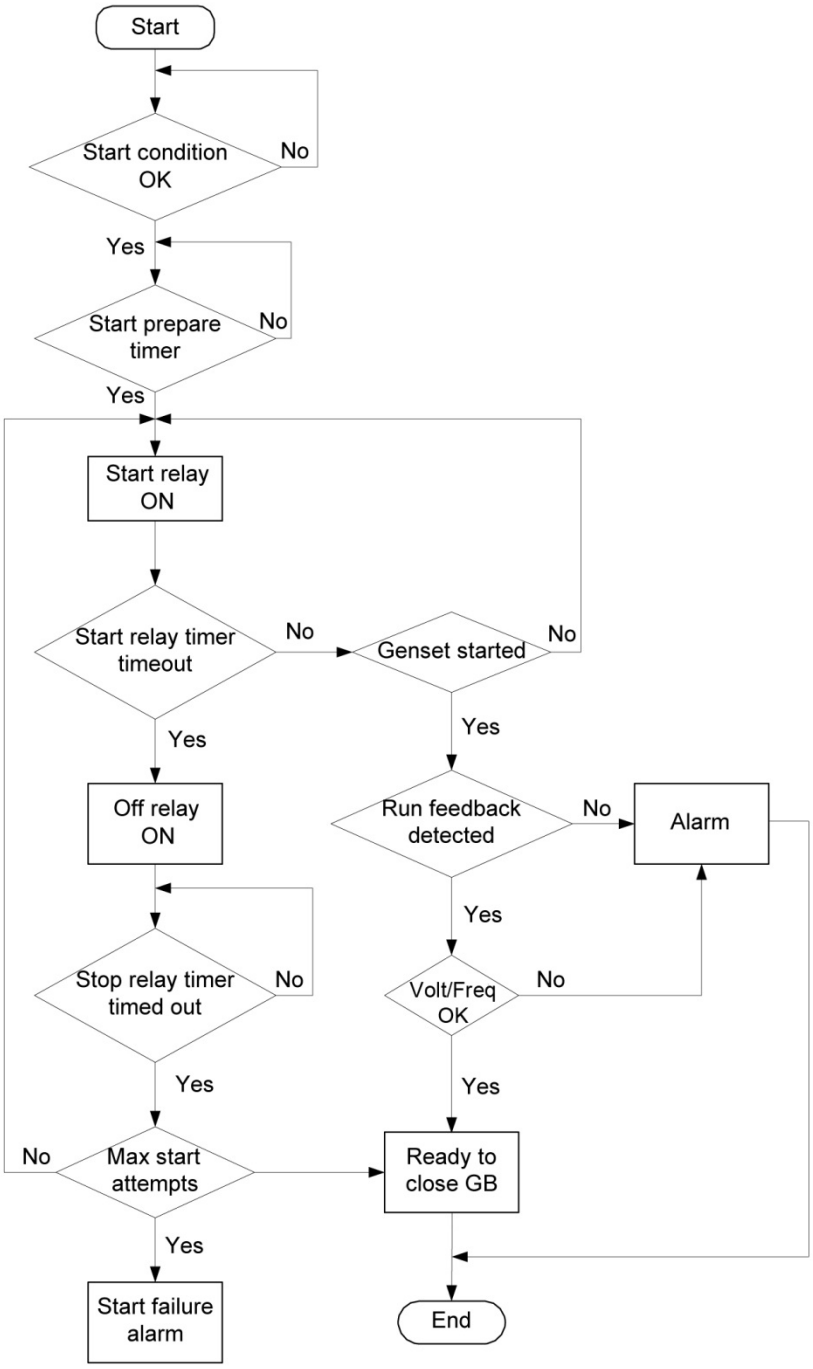
## GB Open Sequence



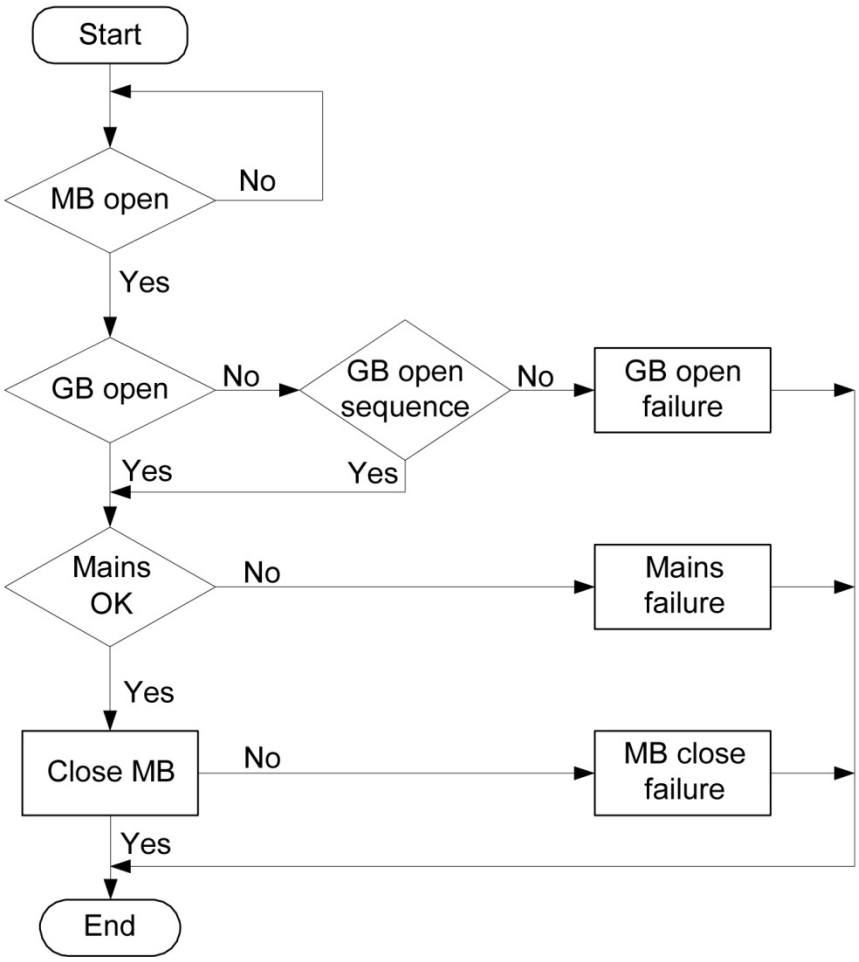
## Stop Sequence



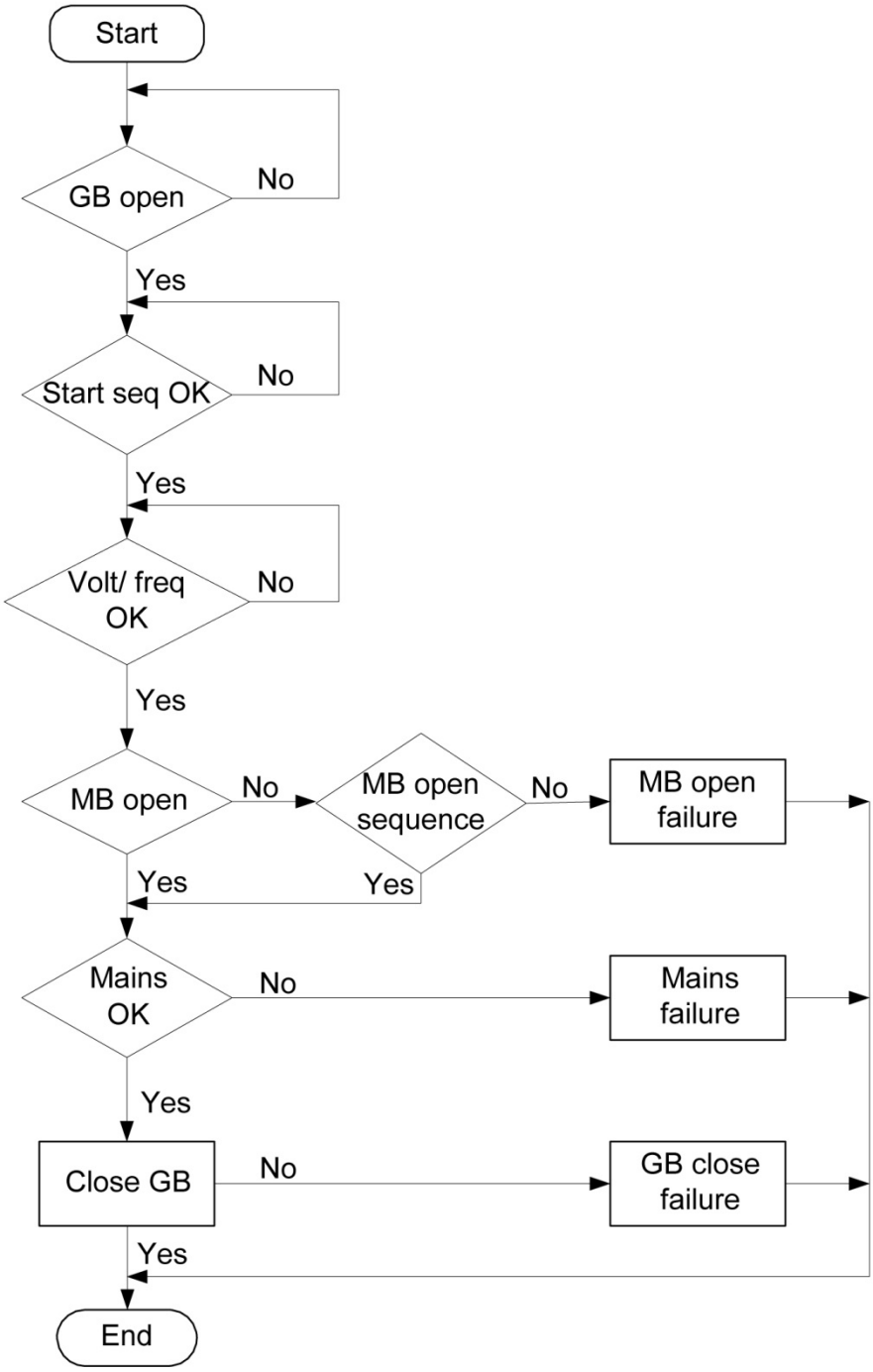
## Start Sequence



## MB Close Sequence

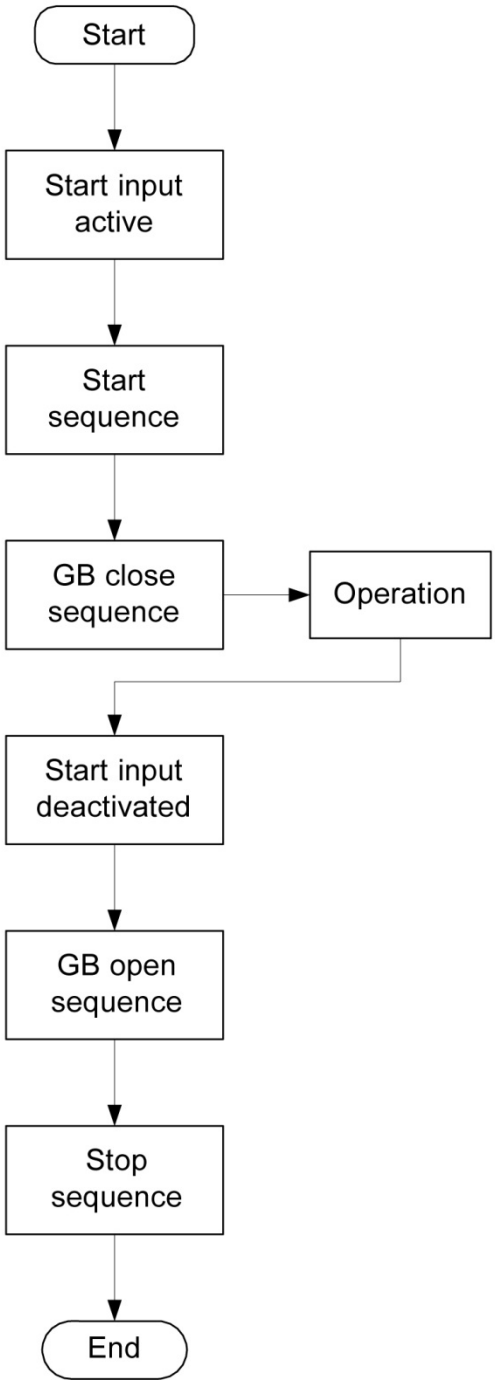


## GB Close Sequence

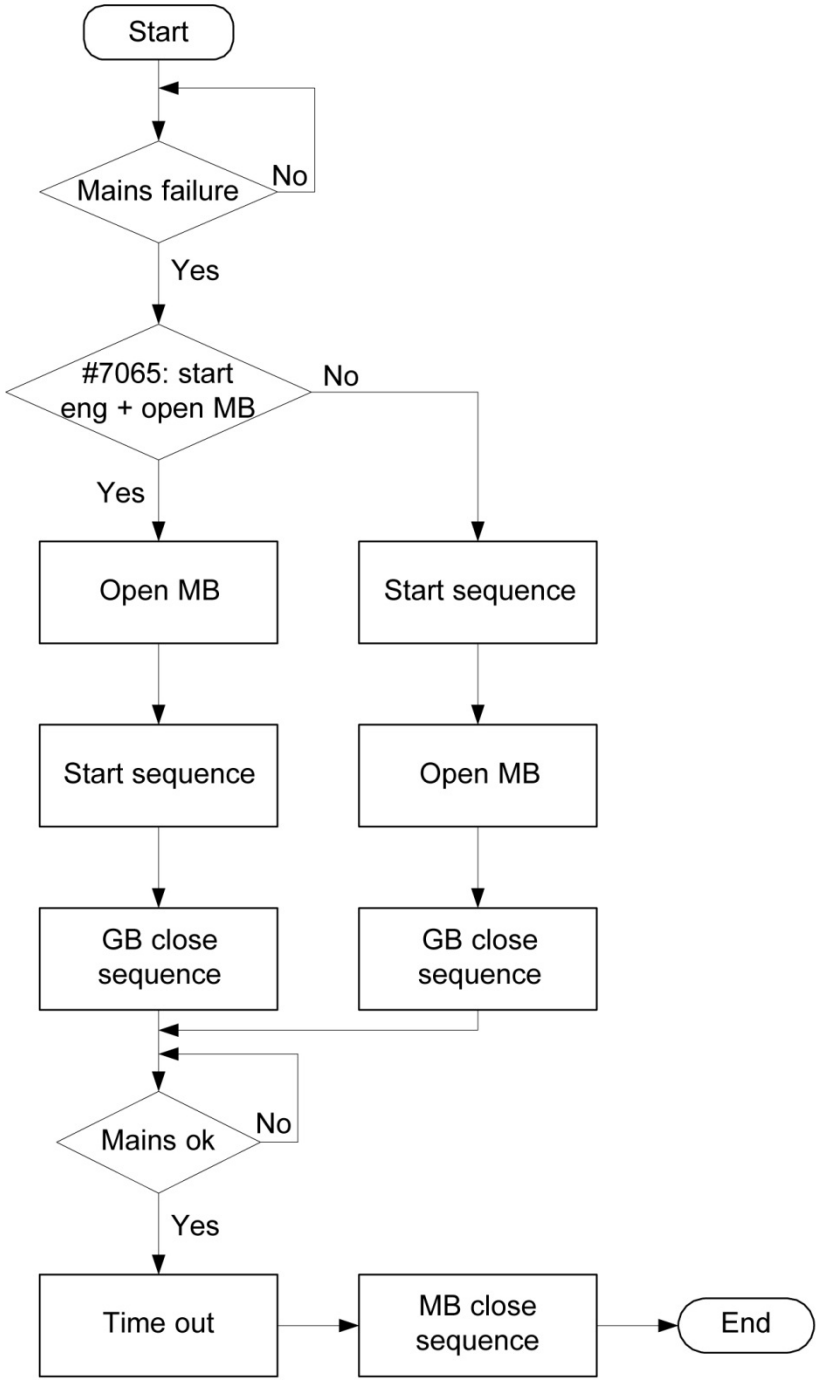


## Load Takeover (LTO)

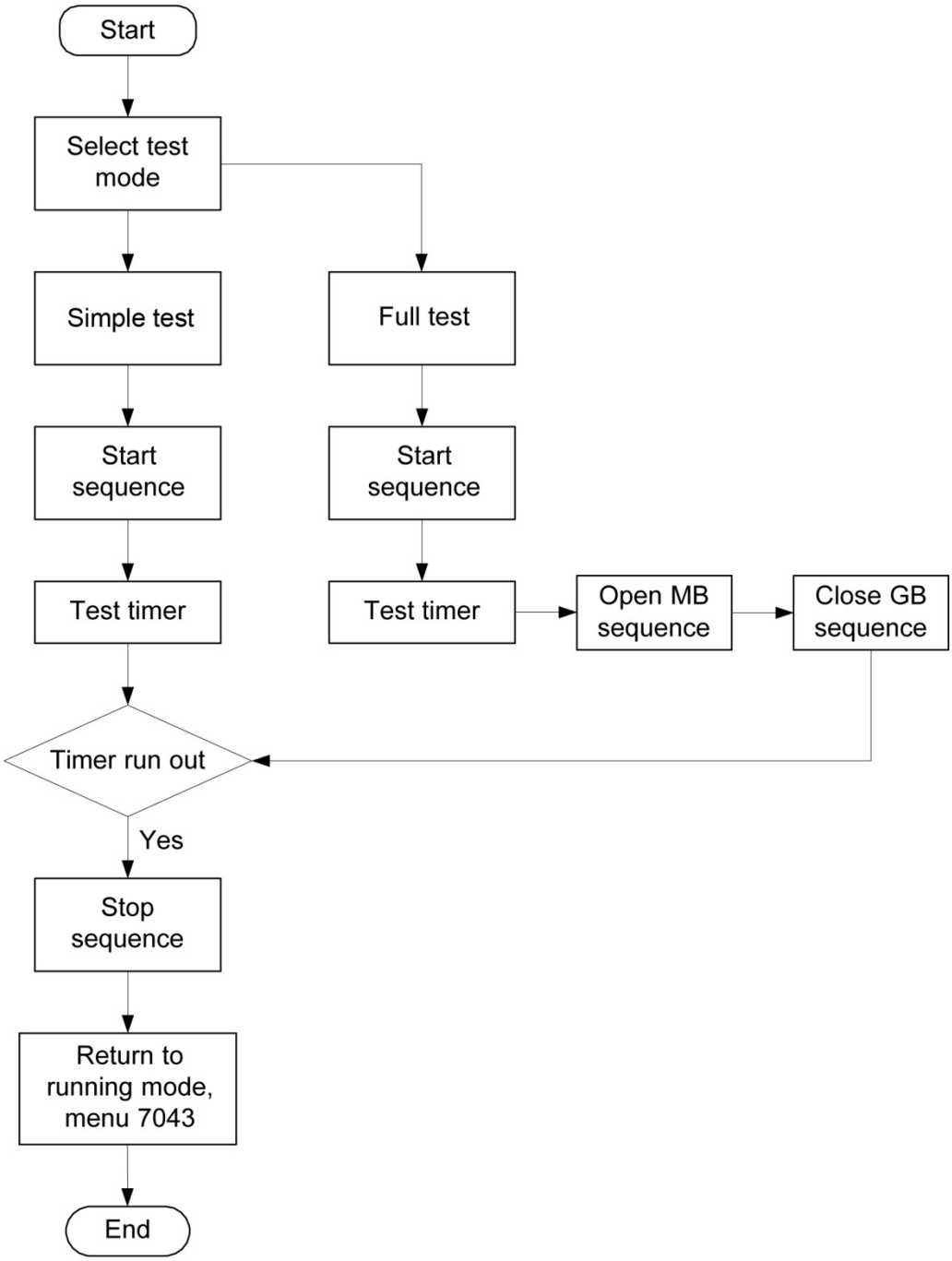
## Island Operation



## Automatic Mains Failure (AMF)



## Test Sequence



## Sequences

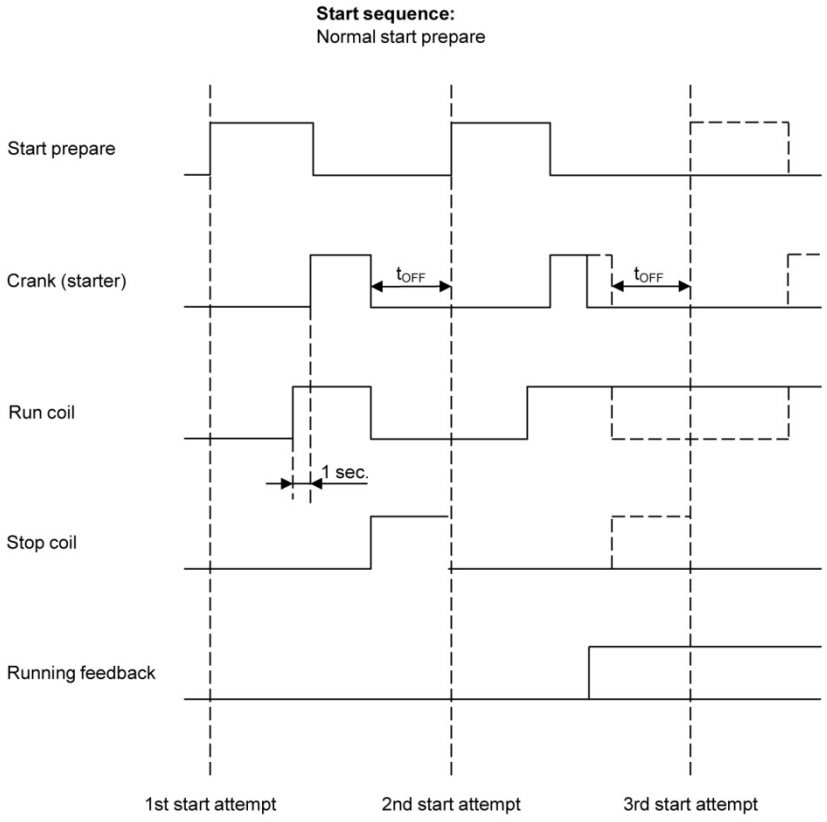
The following contains information about the sequences of the engine, the generator breaker, and the mains breaker.

In the manual or semi-auto mode, 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

## Start Sequence




**NOTE:** 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. (parameter 6151).

## Start Sequence Conditions

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

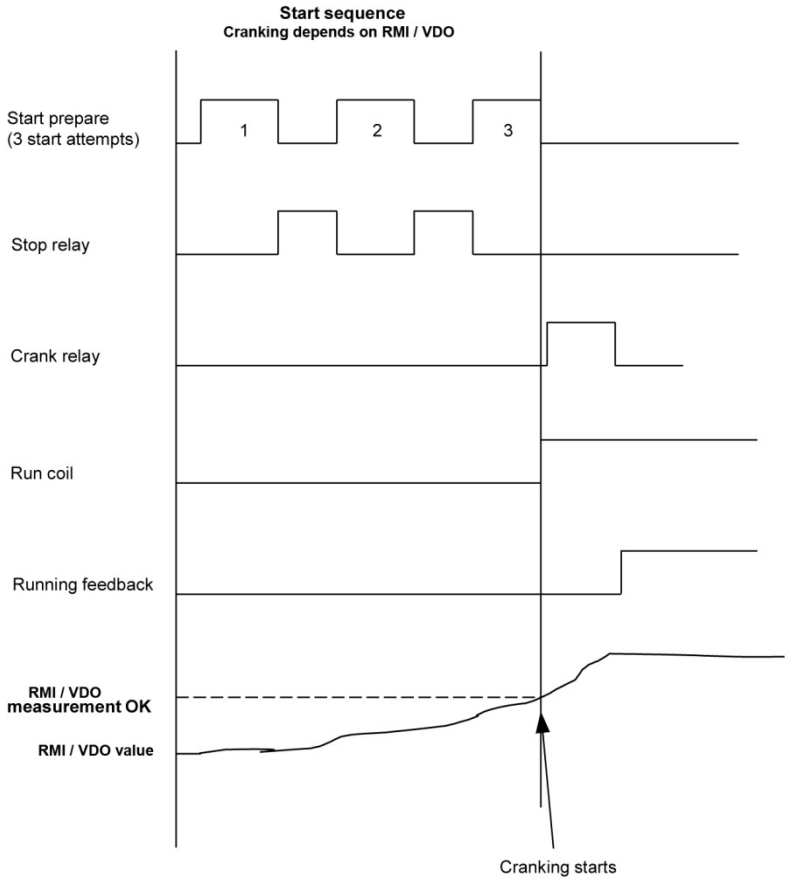
- (oil pressure)
- (water temperature)
- (fuel level)

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

The selection is made in parameter 6185. For each of the Analog Input 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.

> **NOTE:** If the value in parameter 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 analog input signal builds up slowly, and starting is initiated at the end of the third start attempt.



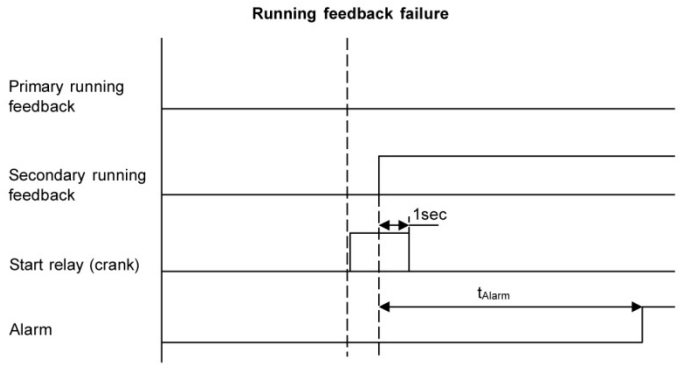
## Running Feedback

Different types of running feedback can be used to detect if the motor is running. Refer to parameters 6170, 6171, 6175 for selection of the running feedback type.

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

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

The sequence is shown in the diagram below.




### Interruption of Start Sequence

The start sequence is interrupted in the following situations:

| Event | Comment |
|---|---|
| Stop signal | |
| Start failure | |
| Remove starter feedback | Tacho setpoint. |
| Running feedback | Digital input. |
| Running feedback | Tacho setpoint. |
| Running feedback | W terminal |
| Running feedback | Frequency measurement above 32 Hz.<br>The frequency measurement requires a voltage measurement of 30% of UNOM (normal voltage).<br>The running detection based on the frequency measurement can replace the running feedback based on speedo signal (MPU alternator) or digital input or engine communication (J1939). |

| | |
|---|---|
| Running feedback | Oil pressure setpoint (parameter 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. |
| Binary stop input | Manual mode. |
| Deactivate the "auto start/stop" | Auto mode in the following genset modes: Island operation or load takeover mode. |

> **NOTE:** If the MPU input is to be used to remove the starter, it has to be set up in parameters 6171, 6172, 6173, 6174.

**Parameter Setpoints Related To The Start Sequence:**

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

- Hz/V failure (parameter 4560 Hz/V failure)
If the frequency and voltage are not within the limits set in parameters 2110, 2111, 2112 after the running feedback is received, this alarm is raised when the delay has expired.

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

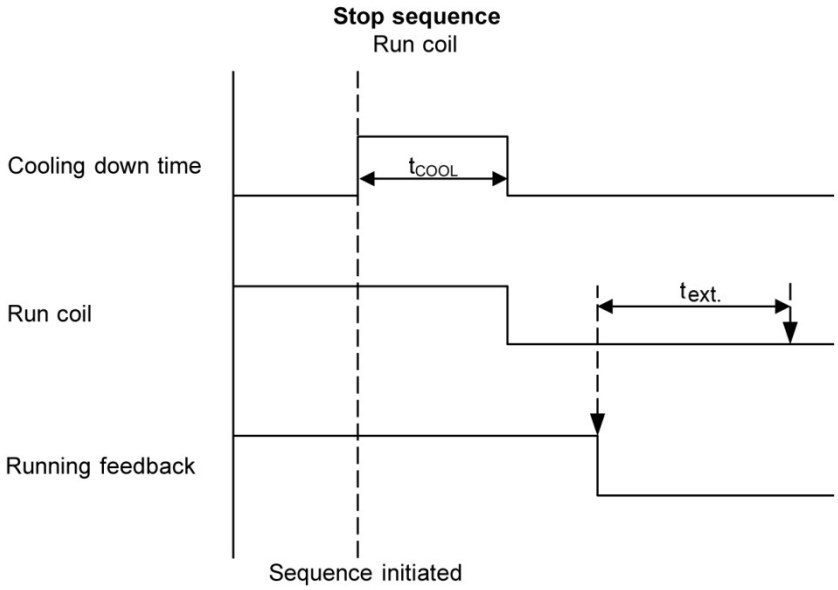
- Start prepare (parameters 6180, 6181, 6182, 6183, 6184, 6185, 6186 Starter)
Normal prepare: the start prepare timer can be used for start preparation purposes, for example, pre-lubrication or pre-glowing (glowing before start). The start prepare relay is activated when the start sequence is initiated and deactivated when the start relay is activated. If the timer is set to 0.0 s, the start prepare function is deactivated.

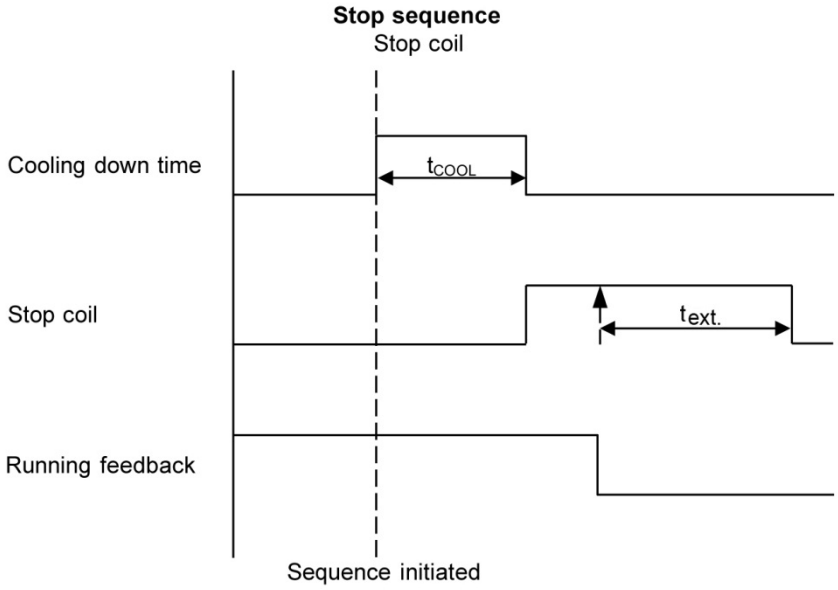
Extended prepare: the extended prepare will activate the start prepare relay when the start sequence is initiated and keep it activated when the start relay activates until the specified time has expired. If the extended prepare time exceeds the start ON time, the start prepare relay is deactivated when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

Start ON time: the starter will be activated for this period when cranking. Start OFF time: the pause between two start attempts.

## Stop Sequence

The drawings illustrate the stop sequence.



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

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

The stop sequence can only be interrupted (to go back to running) during the cooling down period. Interruptions can occur in these situations:

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

### Setpoints Related To The Stop Sequence

- Stop failure (parameter 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 parameter has expired.

- Stop (parameter 6210, 6211, 6212, 6213, 6214, 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 parameter 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 parameter 6214.

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

> **NOTE:** If the cooling-down timer is set to 0.0 s, the cooling-down sequence will be infinite.
>
> **NOTE:** If the cooling-down temperature is set to 0 deg., the cooling-down sequence will be entirely controlled by the timer.

## Breaker Sequences

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

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

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

### Setpoints Related To MB Control

Parameter 7080 MB control.

Parameter 7081 Mode shift: When enabled, the EMS-GC10 will perform the AMF sequence in case of a mains failure in load takeover or TEST mode

Parameter 7082 MB close delay: The time from GB OFF to MB ON

Parameter 7085 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".

> **NOTE:** If no MB is configured and used, the relays and inputs normally used for MB control become configurable.
>
> **NOTE:** The GB can only be closed if the mains breaker is open. The MB can only be closed if the generator breaker is open.

### AMF MB Opening (Parameters 7060–7066 U Mains Failure)

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

The possibilities are:

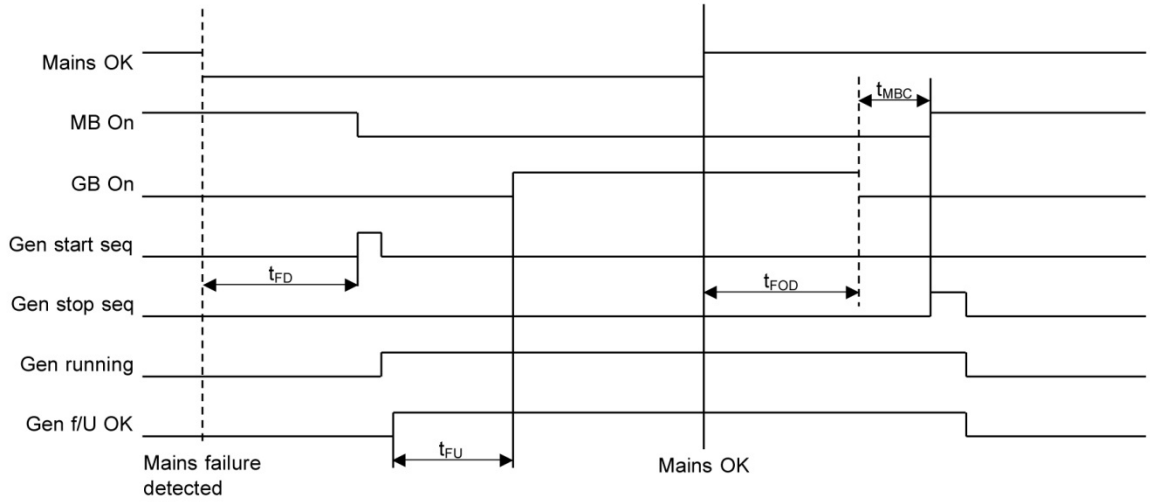
| Selection | Description |
|---|---|
| Start engine and open mains breaker | When a mains failure occurs, the mains breaker opens, and the engine starts at the same time. |
| Start engine | When a mains failure occurs, the engine starts. When the generator is running and the frequency and voltage are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

## AMF Timers

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

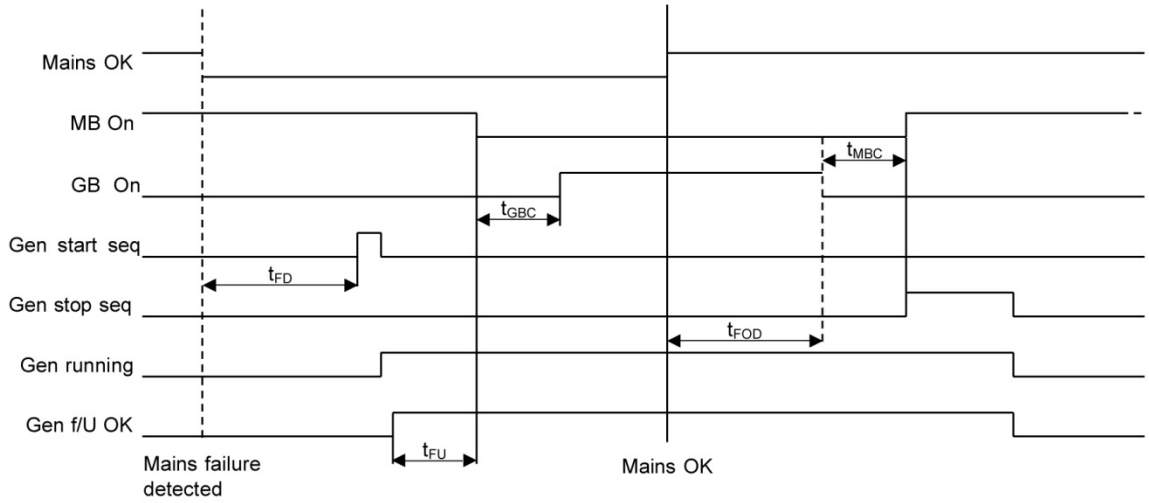
| Timer | Description | Parameter Number |
|---|---|---|
| $^{t}$FD | Mains failure delay | 7070–7074 f mains failure<br>7060–7066 U mains failure |
| $^{t}$F/U | Frequency / Voltage OK<br>($^{t}$V/F, Voltage / Frequency/ OK) | 6220 Hz/V OK |
| $^{t}$FOD | Mains failure OK delay | 7070–7074 f mains failure<br>7060–7066 U mains failure |
| $^{t}$GBC | GB ON delay | 6230–6232 GB control |
| $^{t}$MBC | MB ON delay | 7080–7085 MB control |

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




> **NOTE:** The Terms: $^{t}$F/U (Frequency / Voltage) and $^{t}$V/F (Voltage / Frequency) represent the same value.

Example 2:
Parameter 7065 Mains fail control: Start engine




> **NOTE:** The Terms: $^{t}$F/U (Frequency / Voltage) and $^{t}$V/F (Voltage / Frequency) represent the same value.

## Conditions for Breaker Operations

The breaker sequences react depending on the breaker positions and the voltage/frequency 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<br>Generator voltage/frequency OK MB open |
| MB ON, direct closing | Mains voltage/frequency OK GB open |
| GB OFF, direct opening | MB open |
| MB OFF, direct opening | Alarms with fail classes:<br>Shut down or Trip MB alarms |

# Display and Menu Structure

## Passwords and Parameter Access

## Passwords

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

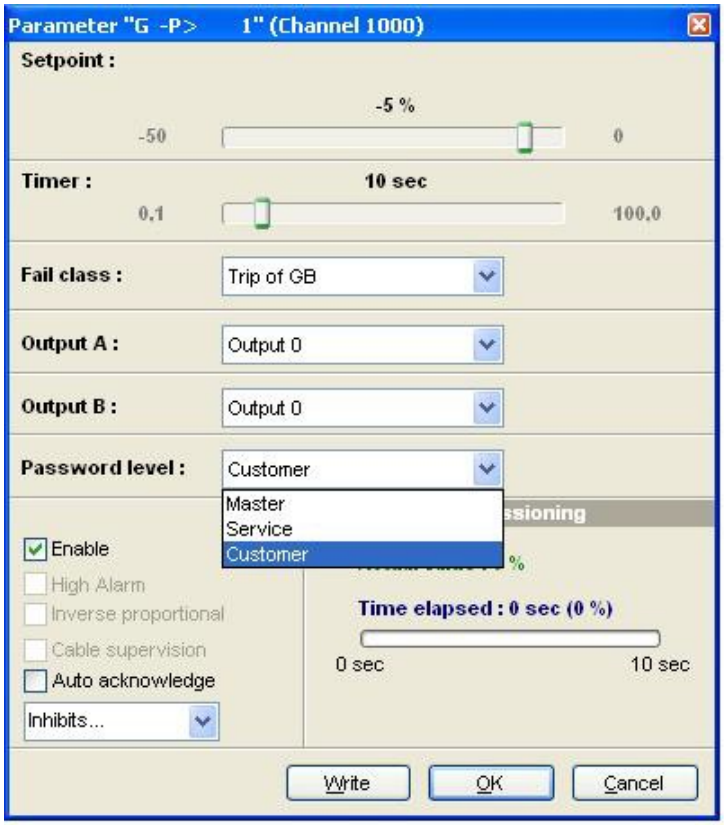
Available password levels:

| 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.

Example of pop-up window in USW for parameter 1000.




The password level can also be changed from the parameter view in the column "Level". This is a snapshot of part of the USW parameters list.

### 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.

> **NOTE:** 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.
>
> **NOTE:** The factory passwords must be changed if the operator of the genset is not allowed to change the parameters.
>
> **NOTE:** It is not possible to change the password at a higher level than the password entered.

## Engine Communication

### EMS-GC10 Unit and Engine Controller

The EMS-GC10 unit is able to communicate with an engine controller through the CAN bus (CAN A).

> **NOTE:** Information about engine communication can be found in this manual Appendix I.

# Additional Functions

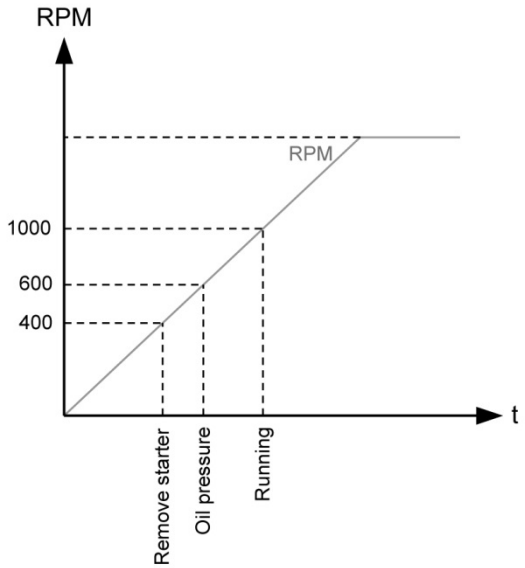
## Start Functions

The controller unit 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.

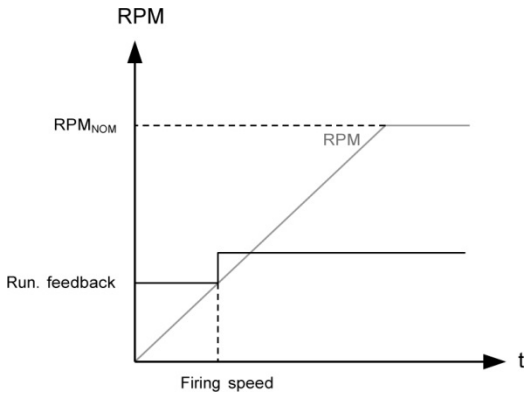


## Digital Feedbacks

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

### Running Feedback

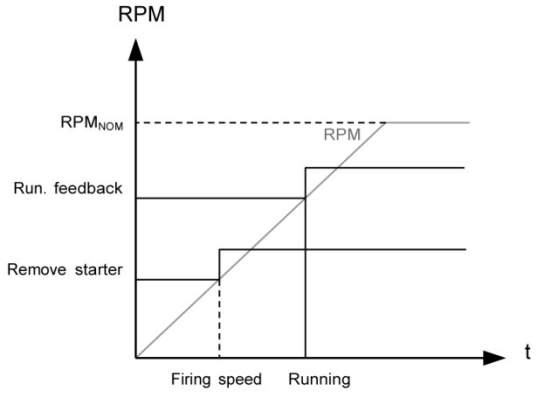
When the digital running feedback is active, the start relay is deactivated, and the starter motor will be disengaged.




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

### Remove Starter

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




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

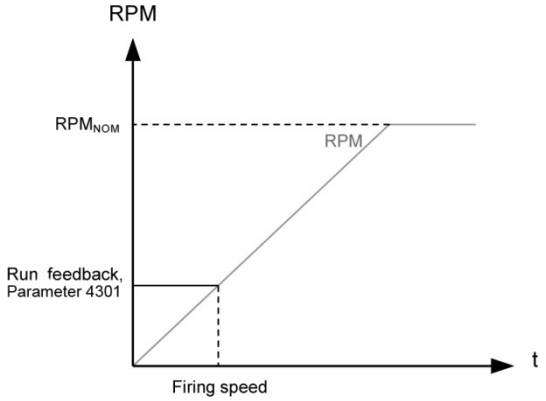
> **NOTE:** The remove starter input must be configured from a number of available digital inputs.
>
> **NOTE:** The running feedback is detected by either the digital input (see diagram above), frequency measurement above 32 Hz, RPM measured by magnetic pick-up or Engine Interface communication.

## Analog Tach 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

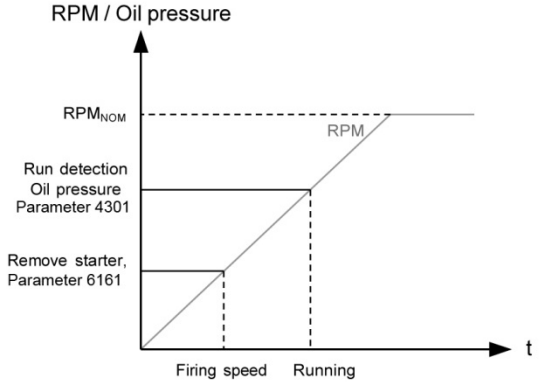
The diagram below shows how the running feedback is detected at the firing speed level. The factory setting is 1000 RPM (parameter 6173 Running detect.).




IMPORTANT: 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 (parameter 6174 Running detect).



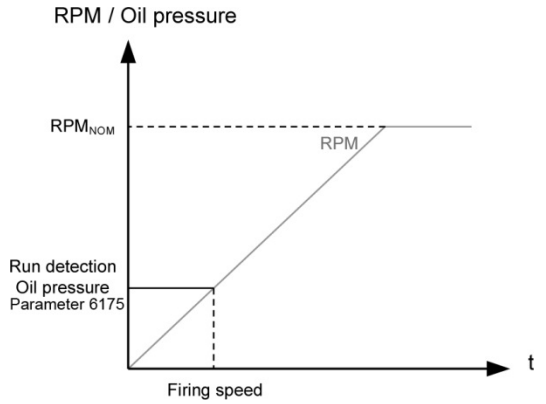

**NOTE:** The number of teeth on the flywheel must be adjusted in parameter 6171 when the MPU input is used.

## 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 an analog input for oil pressure measurement.

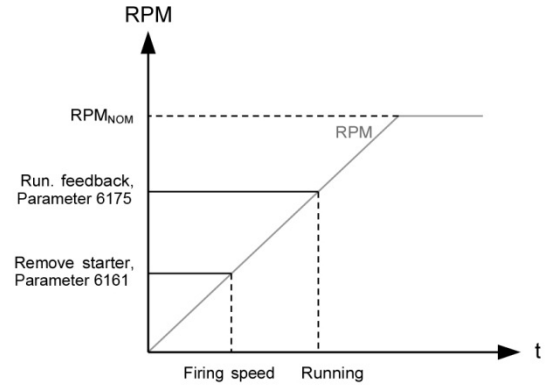
When the oil pressure increases above the adjusted value, (parameter 6175 Pressure level), the running feedback is detected, and the start sequence is ended.

### 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 (parameter 6170 Running detect).




> **NOTE:** The remove starter function can use the MPU or a digital input.

## Mains Voltage Unbalance Detection

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

## Phase Sequence Error

## 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, and the breaker's LED will flash red.

## Breaker Types and Feedback

## Breaker Types

There are five possible selections for the setting of breaker type for both mains breaker and generator breaker.

Continuous NE and Continuous ND
This type of signal is most often used combined with a contactor. When using this type of signal, the genset controller unit will only use the close breaker 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 energized signal, and continuous ND is a normally de-energized signal.

Pulse
This type of signal is most often used combined with circuit breaker. With the setting pulse, EMS-GC10 unit will use the close command and the open command relay. 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 EMS-GC10 controller unit will need to use both a close command and a open command relay. 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.

> **NOTE:** If compact breaker is selected, the length of breaker open signal can be adjusted. This can be done in parameters 2160, 2170, 2180, 2200, 2210, 2220 (GB open fail and MB open fail).

## 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.

## 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 MB.

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

- The genset is in auto mode, the auto start/stop input is active, the genset is running and the GB is closed.
- The auto start/stop input is deactivated, the stop sequence is executed and the GB is opened.
- 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:

Timer-Controlled
A load time setpoint for the GB and MB control for breakers with no feedback indicating that the spring is loaded. After the breaker has been opened it will not be allowed to close again before the delay has expired. The setpoints are found in parameters listed:

| | | |
|---|---|---|
| Parameter | GB | 6231, 6232 |
| | MB | 7082, 7085 |

Digital Input
Two configurable inputs to be used for feedbacks from the breakers: One for GB spring loaded and one for MB spring loaded. After the breaker has been opened it will not be allowed to close again before the configured inputs are active. The inputs are configured in the 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**

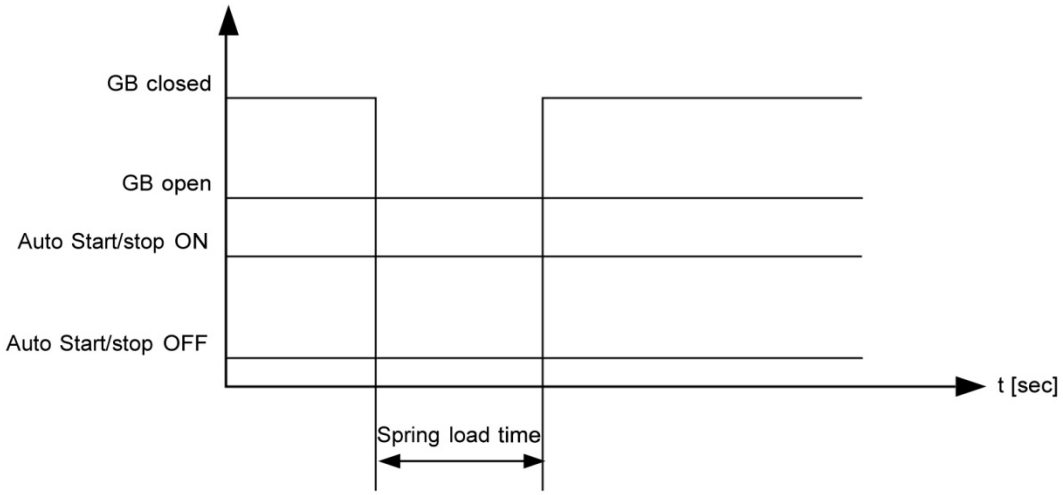
To alert the user that the breaker close sequence has been initiated but is waiting for permission to give the close command, the LED indication for the breaker will be flashing yellow in this case.

If the breaker needs time to reload the spring after it has opened, then the controller unit can take this delay into account. This can be controlled through timers in EMS-GC10 or through digital feedbacks from the breaker, depending on the breaker type.

## Island Mode Condition

The diagram shows an example where a single EMS-GC10 in Island Mode is controlled by the AUTO start/stop input.

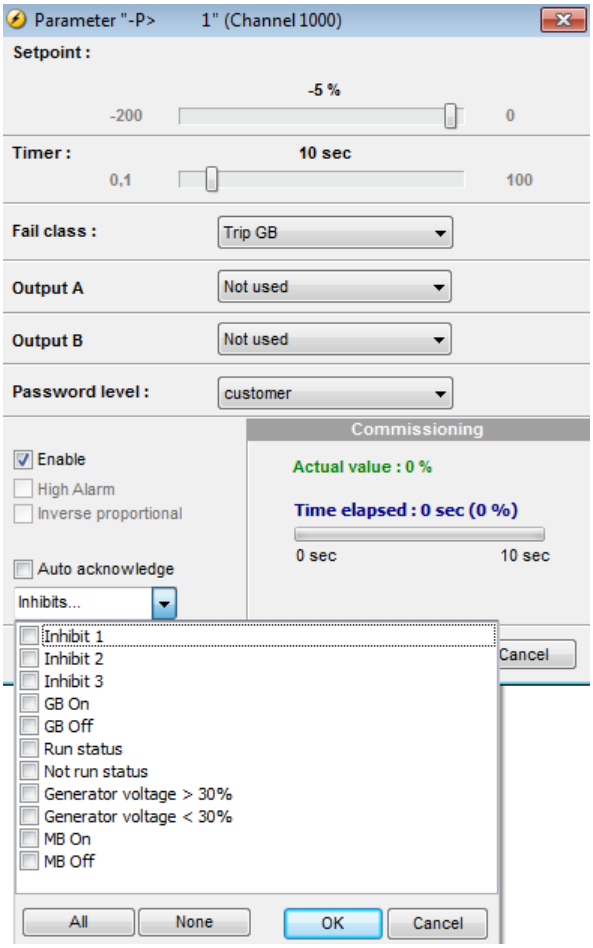
This is what happens: When the AUTO start/stop input deactivates, the GB opens. The AUTO start/stop is reactivated immediately after the GB has opened, for example, by the operator through a switch in the switchboard. However, the EMS-GC10 unit waits a while before it issues the close signal again, because the spring load time must expire (or the digital input must be activated - not shown in this example). Then EMS-GC10 unit issues the close signal.



## 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 only available via the PC utility software (USW). 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.

Example of the USW parameter 1000.



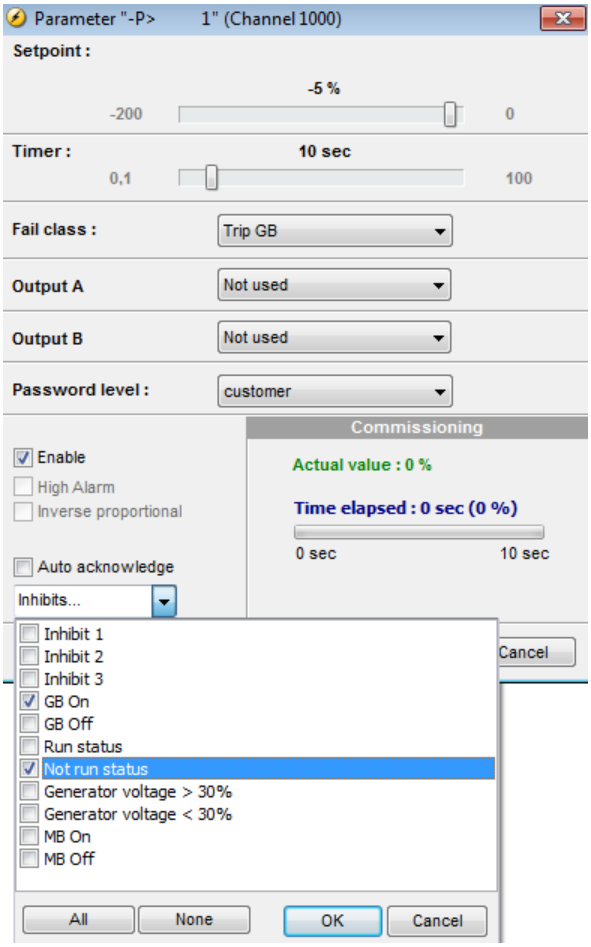
Selections for Alarm Inhibit:

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

**NOTE:** The timer in parameter 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 of the USW parameter 1000.

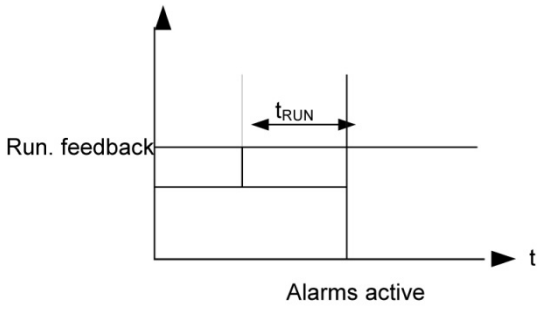



In this example, inhibit is set to Not run status and GB ON. Here, the alarm will be active when the generator has started and disabled again when the GB is closed.

## Run Status (parameter 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.



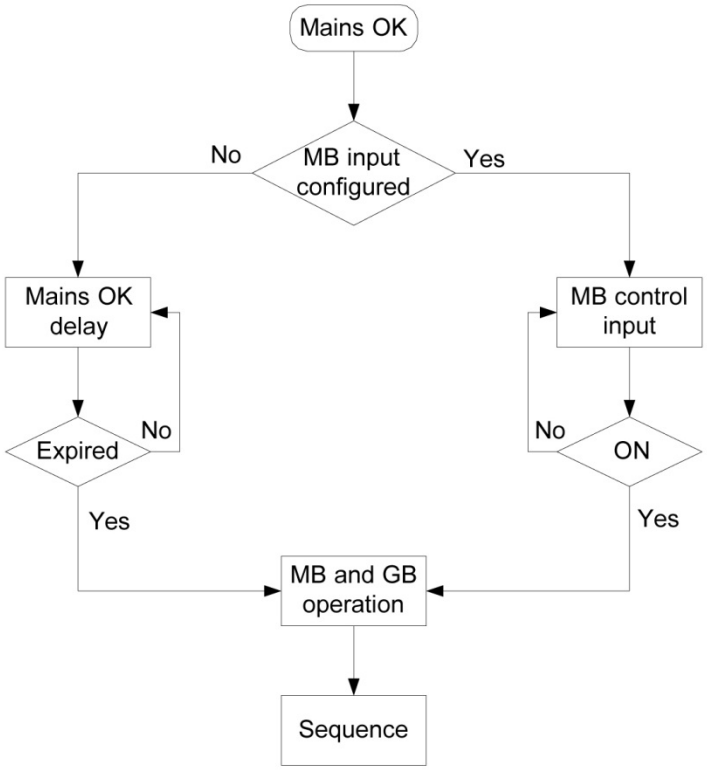

**NOTE:** The timer is ignored if binary running feedback is used.

## Digital Mains Breaker Control

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

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

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



## Command Timers

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

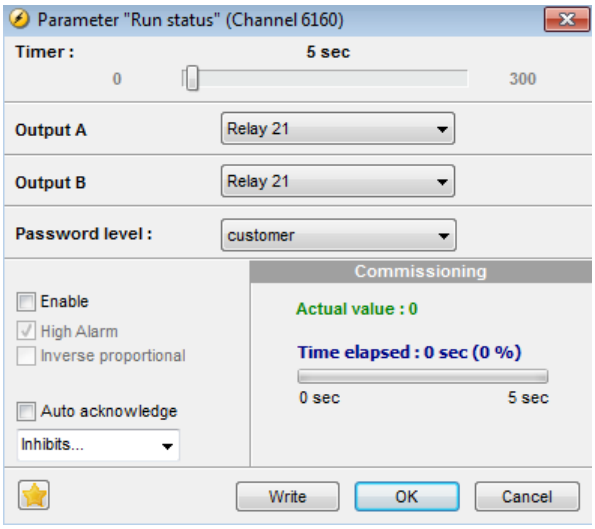
- Individual days (MO, TU, WE, TH, FR, SA, SU)
- Or the following group of days
    - MO, TU, WE, TH
    - MO, TU, WE, TH, FR
    - MO, TU, WE, TH, FR, SA, SU
    - SA, SU

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

## Running Output

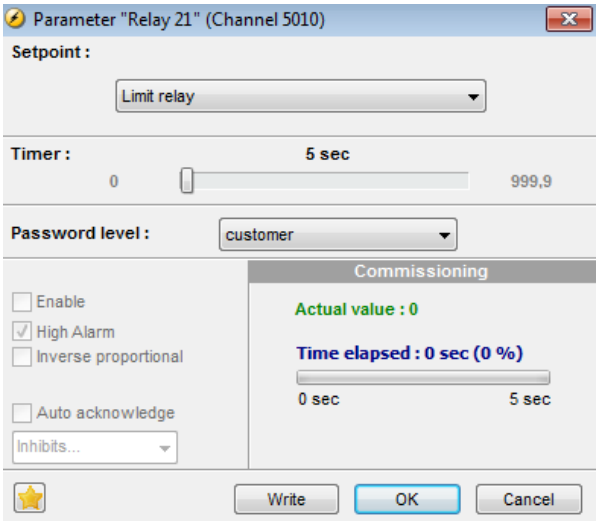
Parameter 6160 Run status can be adjusted to give a digital output when the genset is running.

Example of the USW parameter 6160 setup window.




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

Example of the USW parameter 5010 setup window.




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

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

> **NOTE:** 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.

## Description

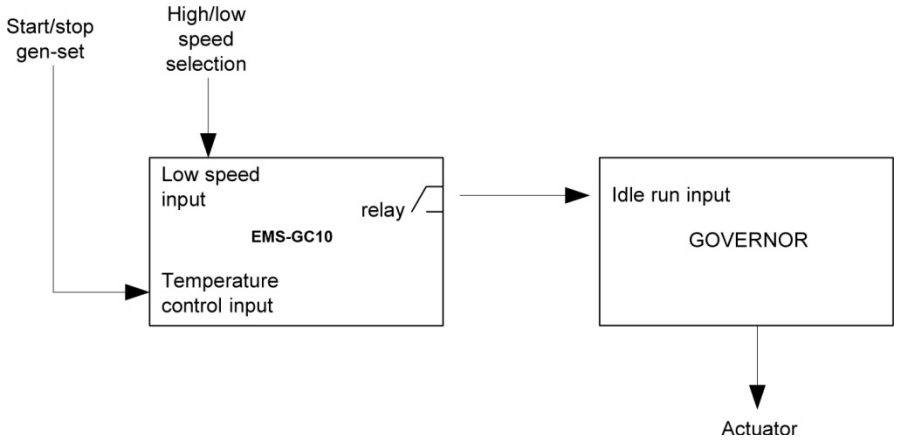
The function is enabled and configured in parameters 6290–6295 Idle running. It has to be noted that the governor itself must handle the idle speed based on a digital signal from the unit (see the principle diagram below).

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

| 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 or ratio speed. |
| 2 | Temperature control input | When this input is activated, the genset will start. It will not be able to stop as long as this input is activated. |

> **NOTE:** If the idle run function is selected by means of the timer, the low speed input is overruled.
>
> **NOTE:** The input must be configured through the PC software (USW) at commissioning.

**NOTE:** 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.

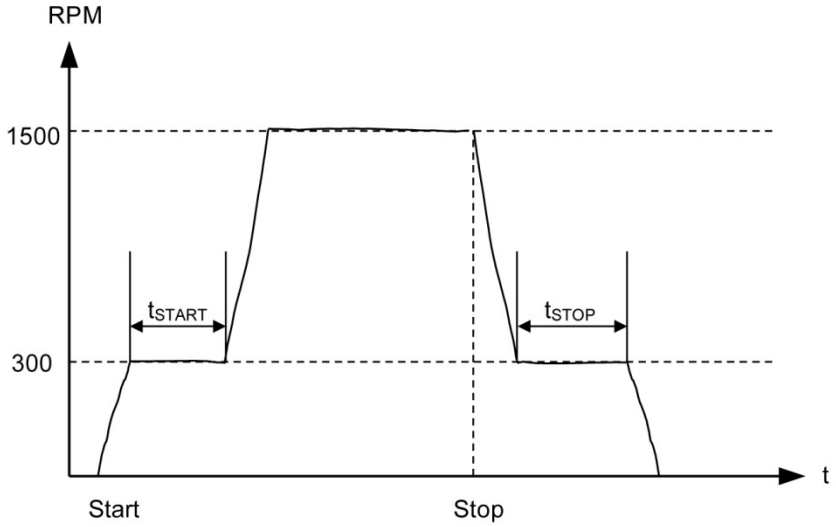



## Examples

### Idle Speed During Starting And Stopping

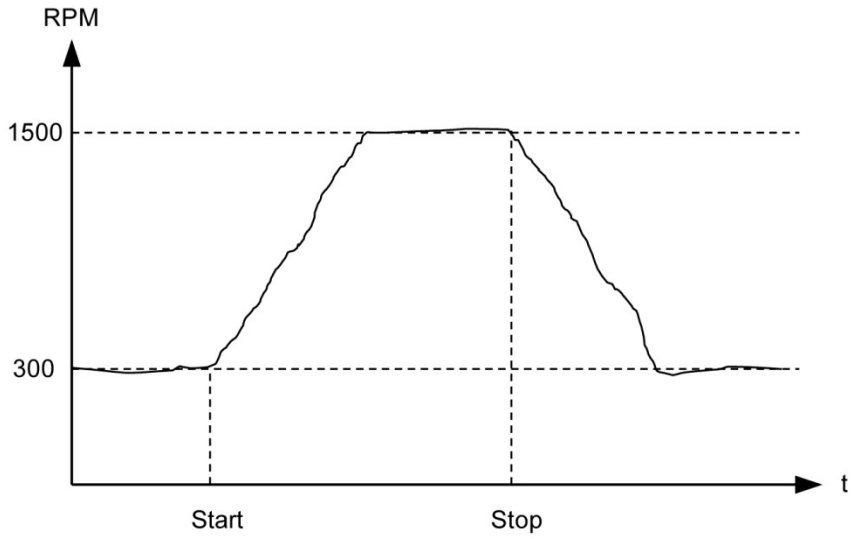
In this example both the start and the stop timers are activated.

The start and stop sequences are changed in order to let the genset stay at the idle level before speeding up. It also decreases the speed to the idle level for a specified delay time before stopping.



**Idle Speed, No Stopping**
In this example both timers are deactivated.

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




> **NOTE:** The oil pressure alarm (analog input for oil) will be enabled during idle run if set to "ON".

## Inhibit

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

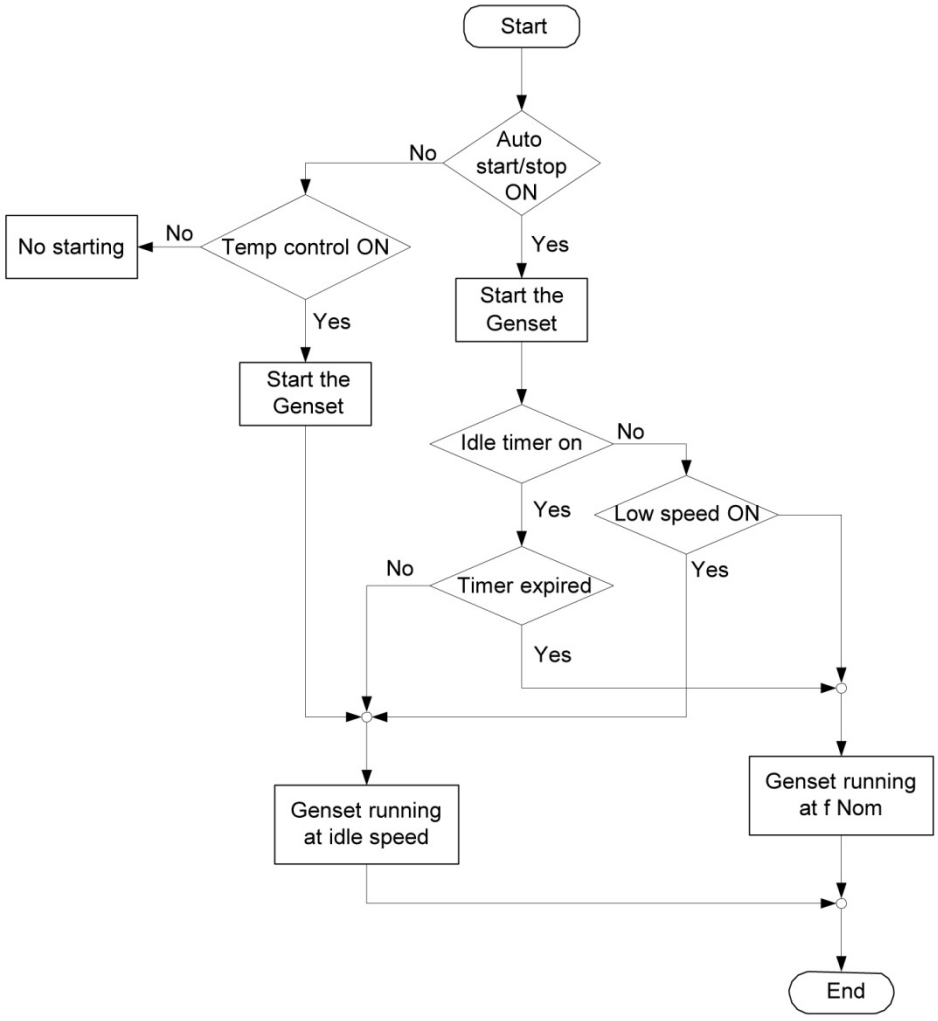
## Running Signal

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

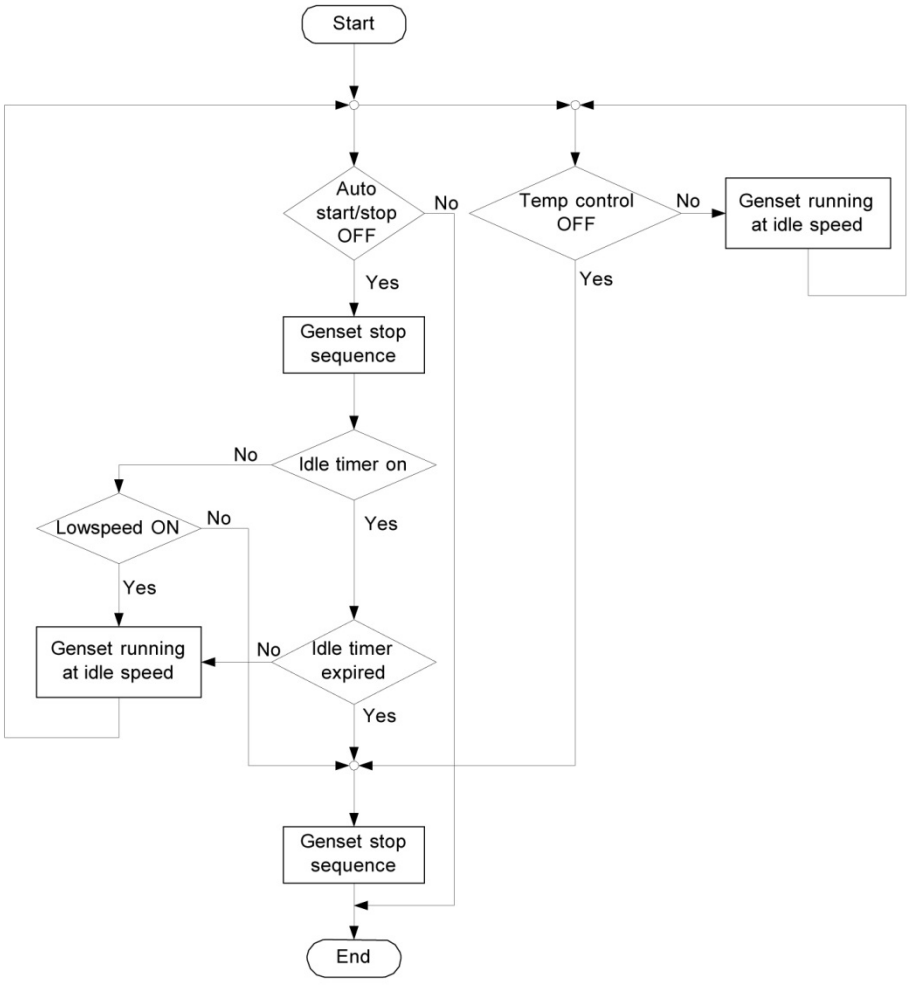
## Idle speed flowcharts

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

## Start


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

## Stop


Start
Auto start/stop OFF
No
Temp control OFF
No
Genset running at idle speed
Yes
Yes
Genset stop sequence
No
Idle timer on
Yes
Lowspeed ON
No
Yes
Genset running at idle speed
No
Idle timer expired
Yes
Genset stop sequence
End

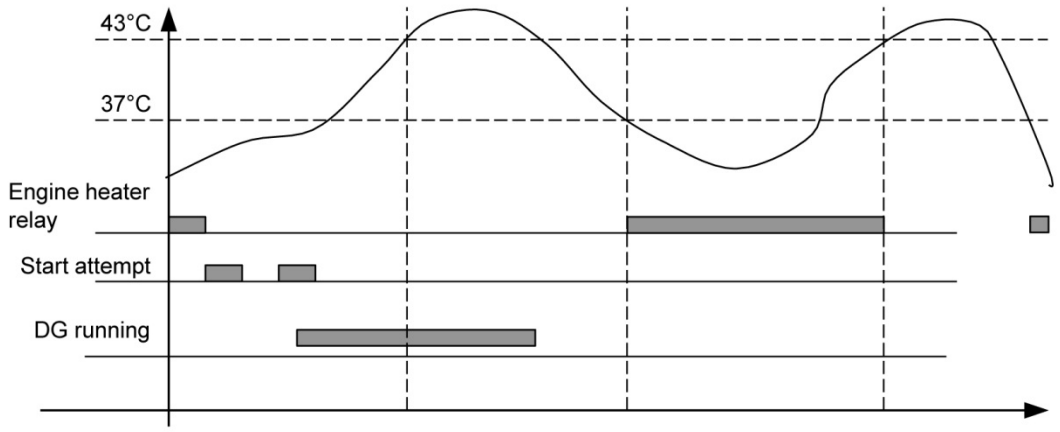
## Engine Heater

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 parameter 6320–6324, 6330 are:

| | |
|---|---|
| Parameter 6321 setpoint | This setpoint +/- the hysteresis is the start and stop points for the engine heater. |
| Output A | The relay output for the engine heater. |
| Input type | Multi-input to be used for temperature measurement. |
| Hysteresis | This decides how big a deviation from the setpoint is needed to activate/deactivate the engine heater |
| Enables | Enables the engine heater function. |

Principle Diagram:




**NOTE:** The engine heater function is only active when the engine is stopped.

## Engine Heater Alarm

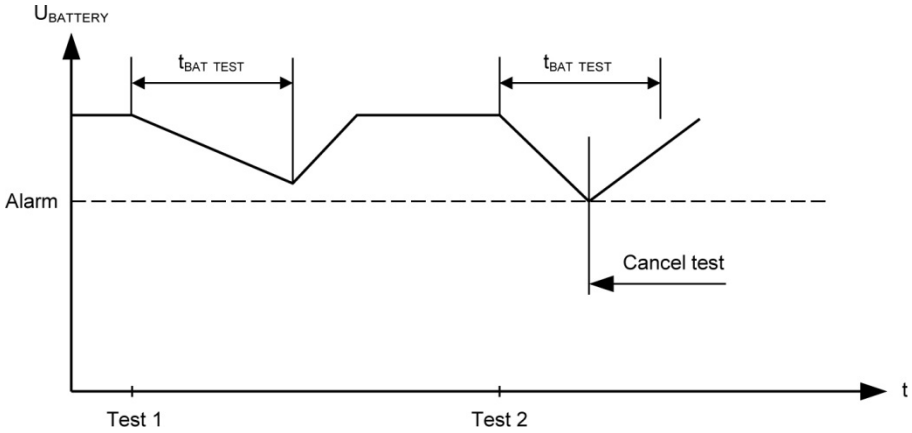
If the temperature keeps dropping after the start setpoint has been exceeded, an alarm will be raised if configured in parameter 6330.

## 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 auto mode.

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

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




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

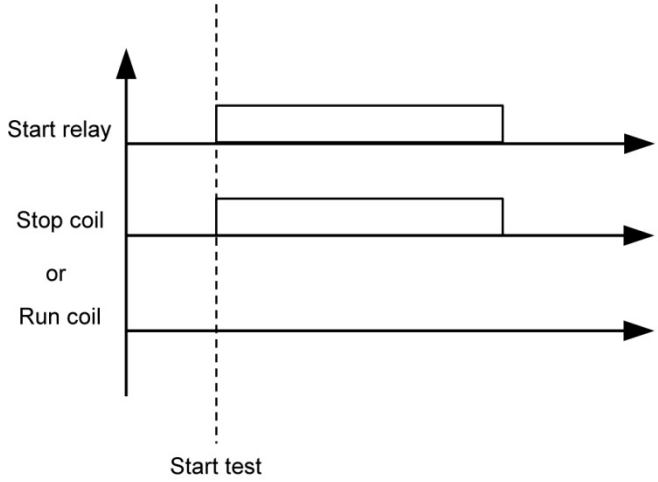
As there is no reason to wear the battery down even more, the test stops when the battery test alarm occurs.

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

The stop relay will act depending on the coil type:

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

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




## Input Configuration

If this function is to be used, it is necessary to configure a digital input that initiates the function. Using the PC software (USW), this is done in the `dialogue box below:


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

## Auto Configuration

If the automatic battery test is used, the function has to be enabled in parameters 6420, 6421, 6423–6425. When the function is enabled, the battery test will be carried out with a specified interval, for example, once a week. Completed battery tests will be logged in a separate battery test log.

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

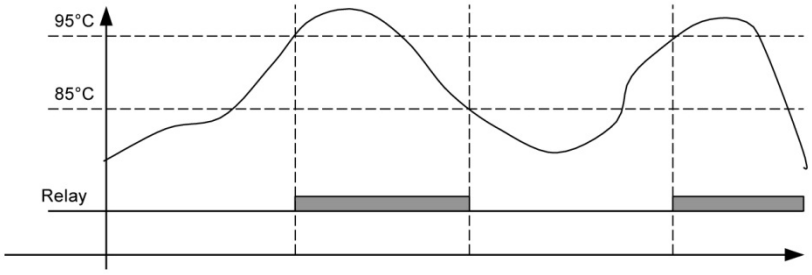
## Ventilation

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

Setpoint available (parameter 6460 Max ventilation):

| | |
|---|---|
| Setpoint | The limit for activation of the relay set in OA. |
| Output A (OA) | The relay activated when the setpoint is exceeded. |
| Hysteresis | The number of degrees the temperature has to be below the setpoint in order to deactivate the relay set in OA. |
| Enable | Enable/disable the ventilation function. |

> The type of input to use [RMI, Analog, or EIC (J1939)] for the temperature measurement is selected in parameter 6323 Engine heater.




## Max. Ventilation Alarm

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

## Not in Auto

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

## Fuel Pump Logic

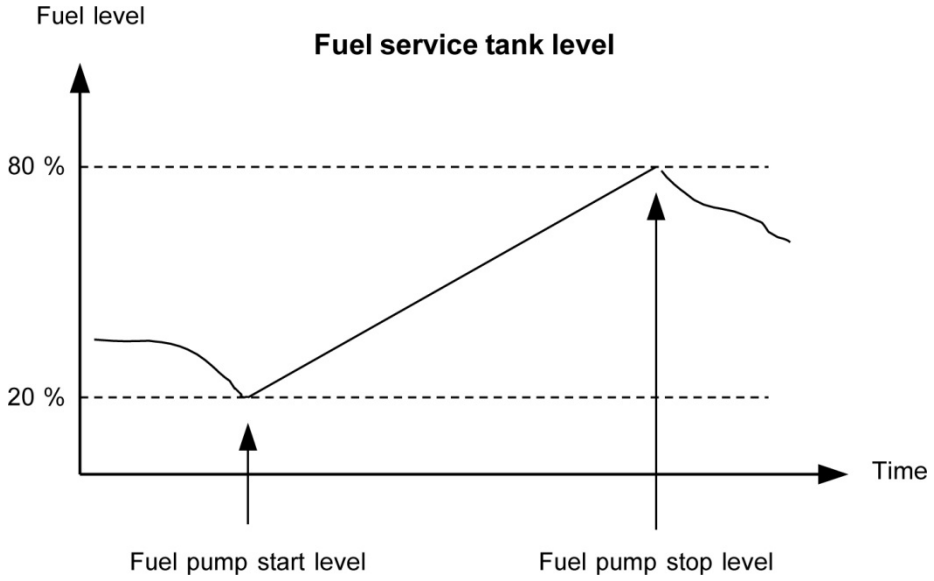
The fuel pump logic is used to start and stop the fuel supply pump to maintain the fuel level in the service tank at predefined levels. The start and stop limits are detected from one of the three multi-inputs.

Set points available in parameter 6550–6554:
Setpoint 1: Start level.
Setpoint 2: Stop level.

| | |
|---|---|
| Delay | 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 (RMI) to be used for the fuel level sensor. |
| Fail Class | The fail class of the Fuel fill alarm. |

> **NOTE:** The fuel pump relay can be activated via M-logic.
>
> **NOTE:** The output relay should be configured as a limit relay, otherwise, an alarm will be raised whenever the output is activated.

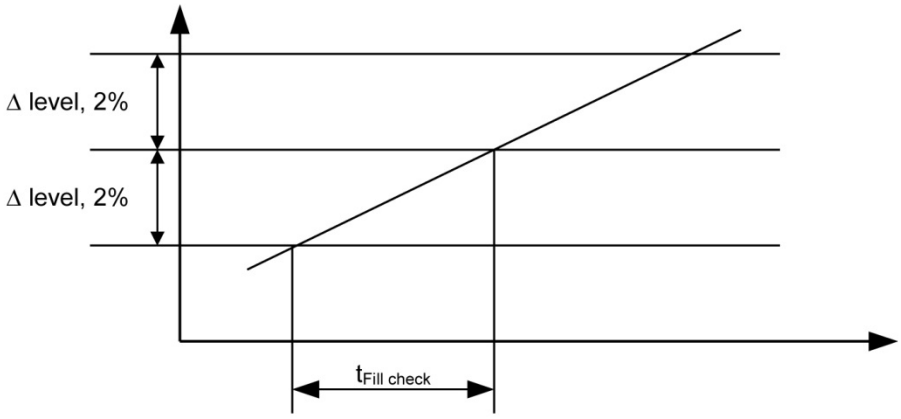
The following drawing shows how the fuel pump is activated when the level reaches 20% and stopped again when the level has reached 80%.



## Full to 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 parameter 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.




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

## 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.

## Engine Running

| Fail Class | Action | Alarm Horn Relay | Alarm Display | Trip Of Gen. Breaker | Trip Of Mains Breaker | Cooling-Down Genset | Stop Genset |
|---|---|---|---|---|---|---|---|
| 1 Block | | X | X | | | | |
| 2 Warning | | X | X | | | | |
| 3 Trip GB | | X | X | X | | | |
| 4 Trip + stop | | X | X | X | | X | X |
| 5 Shutdown | | X | X | X | | | X |
| 6 Trip MB | | X | X | | X | | |
| 7 Trip MB/GB | | X | X | (X) | X | | |

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

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

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

## Engine Stopped

| Fail Class | Action | Block Engine Start | Block MB Sequence | Block GB Sequence |
|---|---|---|---|---|
| 1 Block | | X | | |
| 2 Warning | | | | |
| 3 Trip GB | | X | | X |
| 4 Trip + stop | | X | | X |
| 5 Shutdown | | X | | X |
| 6 Trip MB | | | X | |
| 7 Trip MB/GB | | (X) | X | (X) |

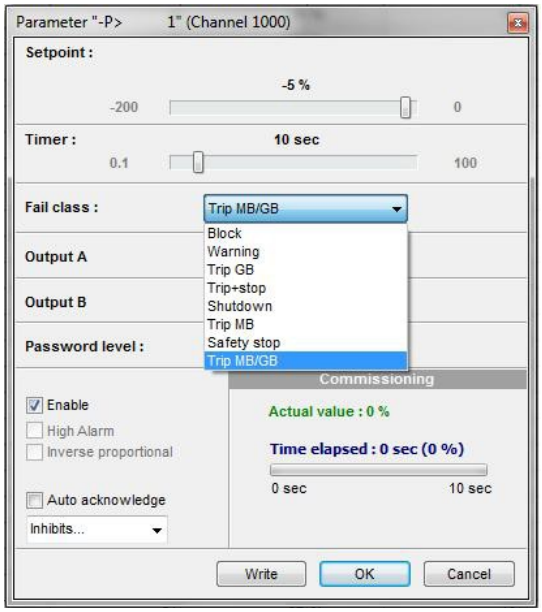
> **NOTE:** In addition to the actions defined by the fail classes, it is possible to activate one or two relay outputs if additional relays are available in the unit.
>
> **NOTE:** The fail class "Trip MB/GB" will only block engine start and GB sequence if no mains breaker is present.

## 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 (USW), the alarm function to be configured must be selected. Select the desired fail class in the fail class roll-down panel.

Example of pop-up window in USW for parameter 1000.



## 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 parameters 6110, 6113, 6114, 6116, and 6120, 6121, 6123, 6126.

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 parameters 6110, 6111, 6113, 6116, and 6120, 6121, 6123, 6126:

| | |
|---|---|
| **Enable** | Enable/disable the alarm function. |
| **Running hours** | The number of running hours to activate the alarm. The service timer alarm will be activated as soon as the running hours have been reached. |
| **Day** | The number of days to activate the alarm – if the running hours are not reached before this number of days, the alarm will still be activated. The service timer alarm will be activated at 8:00 AM on the day the alarm expires. |
| **Fail class** | The fail class of the alarm. |
| **Output A**: | Relay to be activated when the alarm is activated. |
| **Reset** | Enabling this will reset the service timer to zero. This must be done when the alarm is activated. |

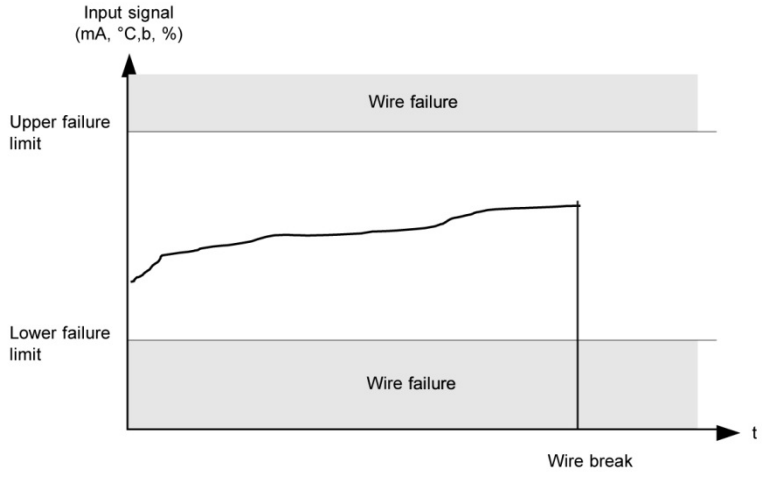
## Wire Fail Detection

If it is necessary to supervise the sensors/wires connected to the multi-inputs and analog 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/VDO 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.



## Digital Inputs

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

| | Input Function | Auto | Semi | Test | Man | Block | Configurable | Input Type |
|---|---|---|---|---|---|---|---|---|
| 1 | Shutdown override | X | X | X | X | X | Configurable | Constant |
| 2 | Access lock | X | X | X | X | X | Configurable | Constant |
| 3 | Binary running detection | X | X | X | X | X | Configurable | Constant |
| 4 | Remote start | | X | | X | | Configurable | Pulse |
| 5 | Remote stop | | X | | X | | Configurable | Pulse |
| 6 | Test | X | X | | X | X | Configurable | Pulse |
| 7 | Auto | | X | X | X | X | Configurable | Pulse |
| 8 | Manual | | X | X | | X | Configurable | Pulse |
| 9 | Block | X | X | X | X | | Configurable | Constant |
| 10 | Remote GB ON | | X | | X | | Configurable | Pulse |
| 11 | Remote GB OFF | | X | | X | | Configurable | Pulse |
| 12 | Remote MB ON | | X | | X | | Configurable | Pulse |
| 13 | Remote MB OFF | | X | | X | | Configurable | Pulse |
| 14 | Remote alarm acknowledge | X | X | X | X | X | Configurable | Constant |
| 15 | Auto start/stop | X | | | | | Configurable | Constant |
| 16 | Remove starter | X | X | X | X | | Configurable | Constant |
| 17 | GB position ON | X | X | X | X | X | Configurable | Constant |
| 18 | GB position OFF | X | X | X | X | X | Configurable | Constant |
| 19 | MB position ON | X | X | X | X | X | Configurable | Constant |
| 20 | MB position OFF | X | X | X | X | X | Configurable | Constant |
| 21 | Emergency stop | X | X | X | X | X | Not configurable | Constant |
| 22 | Low speed | X | X | X | | | Configurable | Constant |
| 23 | Temperature control | X | X | X | | | Configurable | Constant |
| 24 | Battery test | X | X | | | | Configurable | Pulse |
| 25 | Mains Okay | X | X | X | X | X | Configurable | Pulse |
| 26 | GB close inhibit | X | X | | X | X | Configurable | Constant |
| 27 | MB close inhibit | X | X | X | X | X | Configurable | Constant |
| 28 | Enable mode shift | X | X | X | X | X | Configurable | Constant |
| 29 | Start enable | X | X | X | X | | Configurable | Constant |
| 30 | Alternative start | X | X | X | X | X | Configurable | Constant |
| 31 | Switchboard error | X | X | X | X | X | Configurable | Constant |
| 32 | Total test | X | X | X | X | X | Configurable | Constant |
| 33 | GB spring loaded | X | X | X | X | X | Configurable | Constant |
| 34 | MB spring loaded | X | X | X | X | X | Configurable | Constant |
| 35 | D+ (digital running feedback) | X | X | X | X | X | Configurable | Constant |
| 36 | Inhibit Engine alarms | X | X | X | X | X | Configurable | Constant |

## Functional Description—Input

**1. Shutdown override**
This input deactivates all protections except the over speed protection and the emergency stop input. The number of start attempts is seven by default, but it can be configured in parameter 6201. Also a special cool down timer is used in the stop sequence after an activation of this input.

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

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

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

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

**6. Test**
Changes the present running mode to test.

**7. Auto**
Changes the present running mode to auto.

**8. Manual**
Changes the present running mode to manual.

**9. Block**
Changes the present running mode to block.

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

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

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

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

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

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

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

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

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

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

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

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

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

> **NOTE:** The shutdown fail class must be selected.

**22. Low speed**
Keeps the genset running at a low RPM.

> **NOTE:** The governor must be prepared for this function.

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

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

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

**26. GB close inhibit**
When this input is activated, then the generator breaker cannot close. This input is used where an external PLC or other equipment controls when load is put on the genset.

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

**28. Enable mode shift**
The input activates the mode shift function, and the EMS-GC10 will perform the AMF sequence in case of a mains failure. When the input is configured, the setting in parameter 7081 (mode shift ON/OFF) is disregarded.

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

> **NOTE:** When the genset is started, the input can be removed.

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

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

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

**33. GB spring loaded**
EMS-GC10 genset controller unit will not send a close signal before this feedback is present.

**34. MB spring loaded**
EMS-GC10 genset controller unit will not send a close signal before this feedback is present.

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

**36. Inhibit EI alarms**
When this input is active, it will inhibit all engine interface [(Engine Interface Communication, (EIC) (J1939)] alarms.

> **NOTE:** The input functions are set up with the PC utility software (USW), please refer to "Help" in the USW for this.

## Outputs

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

| | Output Function | Auto | Semi | Test | Man | Block | Configurable | Output Type |
|---|---|---|---|---|---|---|---|---|
| 1 | Status OK | X | X | X | X | X | Configurable | Constant |
| 2 | Run coil | X | X | X | X | X | Configurable | Constant |
| 3 | Stop coil | X | X | X | X | X | Configurable | Constant |
| 4 | Prepare | X | X | X | X | X | Configurable | Constant |
| 5 | Starter (Crank) | X | X | X | X | X | Configurable | Constant |
| 6 | Horn | X | X | X | X | X | Configurable | Constant |
| 7 | GB on | X | X | X | X | X | Configurable | Continuous |
| 8 | GB off | X | X | X | X | X | Configurable | Continuous |
| 9 | MB on | X | X | X | X | X | Configurable | Continuous |
| 10 | MB off | X | X | X | X | X | Configurable | Continuous |

## Functional Description—Output

**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 external 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 pre-lubrication.

**5. Starter (Crank)**
The relay configured to starter will be closed for the time selected in parameter 6183 in the start sequence.

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

**7. GB on**
The function will close the generator breaker

**8. GB off**
This function will open the generator breaker

**9. MB on**
This function will close the mains breaker.

**10. MB off**
This function will open the mains breaker.

## Multi-Inputs

The EMS-GC10 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. Binary

> **NOTE:** The function of the multi-inputs can only be configured in the PC utility software (USW).

For each input, two alarm levels are available; the parameter 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 |

> **NOTE:** Only one alarm level is available for the digital input type.

## 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 (USW) in order to get the correct reading in the display.

## RMI (Analog) Inputs

The unit can contain up to three RMI inputs. The inputs have different functions, as the hardware design allows for several RMI types.

These various types of RMI inputs 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 input, it is possible to select between different characteristics including a configurable one.

## RMI Oil

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

| Pressure | | RMI Sensor Type | | |
|---|---|---|---|---|
| | | 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 | |

**NOTE:** The configurable type is configurable with eight points in the range 0-480 Ω. The resistance as well as the pressure can be adjusted.

**NOTE:** 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.

## 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 | | |

**NOTE:** The configurable type is configurable with eight points in the range 0-480 Ω. The temperature as well as the resistance can be adjusted.

**NOTE:** 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 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 |

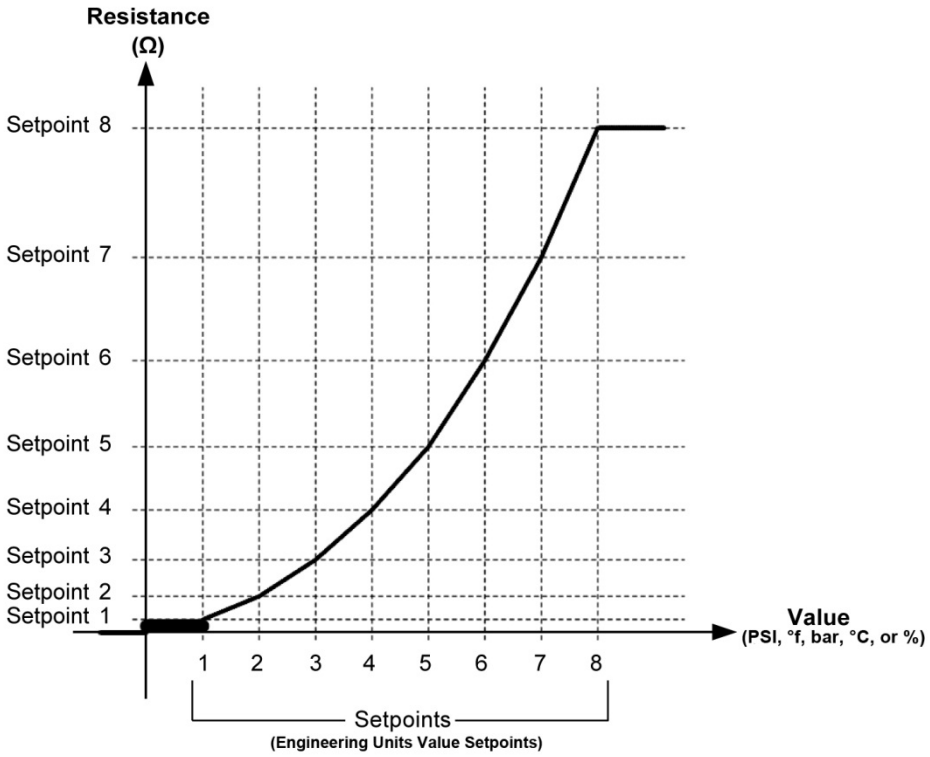
| | RMI Sensor Type |
|---|---|
| | Type 2 |
| Value | Resistance |
| 0% | 3 Ω |
| 100% | 180 Ω |

> **NOTE:** 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 | |

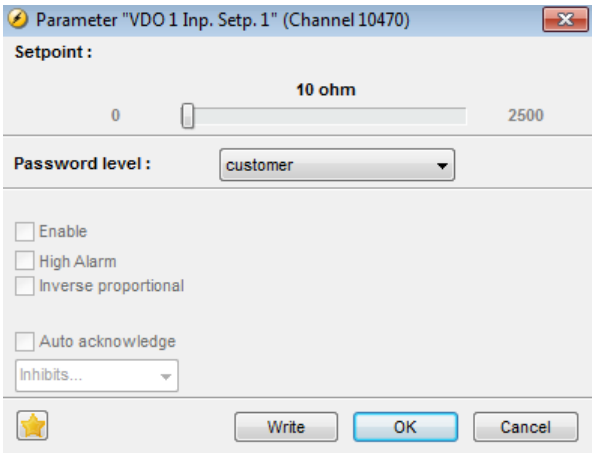
> **NOTE:** The configurable type is configurable with eight points in the range 0-480 Ω. The value as well as the resistance can be adjusted.

## Illustration of Configurable Inputs




## Configuration

The eight curve settings (data point or pairs) for the configurable RMI inputs cannot be changed in the display, but only in the PC utility software (USW). In the USW 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 the engineering units minimum scale value.

## Scaling Of 4-20 Ma Inputs

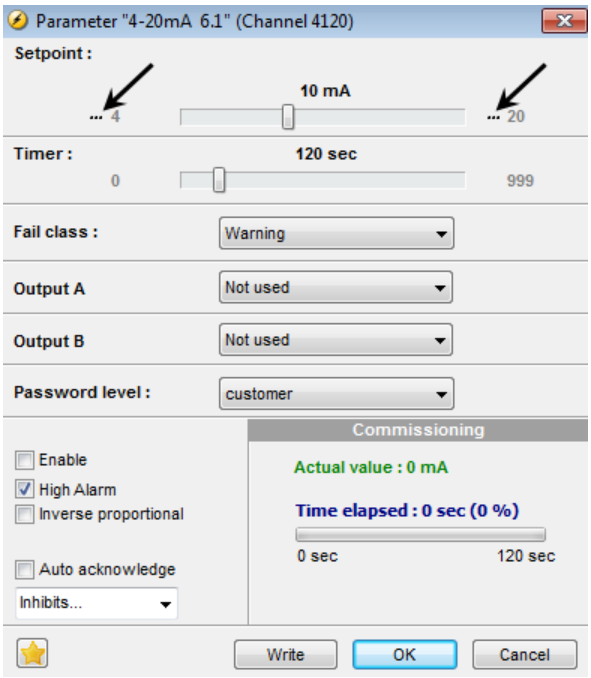
The scaling of the analog inputs is made to ensure that the readout of the inputs is made with a resolution that fits the connected sensor. It is recommended to follow the guide below when changing the scaling of the analog inputs.

**Scaling Example:**
1. Use the PC utility software (USW) to configure a multi input to be 4-20mA, in this example multi input 6 (parameter 10980).

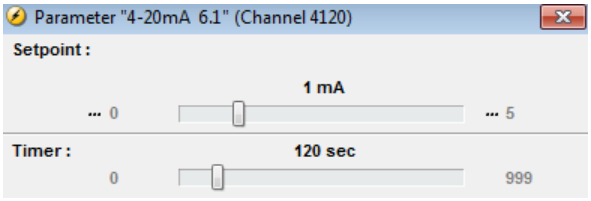
> **NOTE:** Multi input 7 (parameter 10980) and Multi input 8 (parameter 11000)

2. Read the parameters from the device

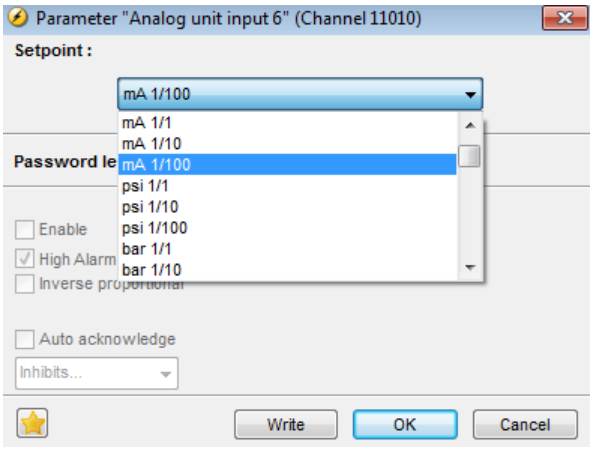
3. After reading the parameters the 4-20mA alarm appears under the analog window pane in the USW. The example below shows how to adjust the analog input alarm. The three dots to the left of the figures, marked with arrows, are buttons. Adjust the input as required, for example, 0-5 bar:



4. Adjust the input as required, for example, 0-5 bar. The display will then show 0 at 4 mA.



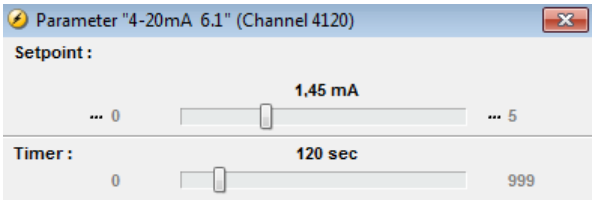

5. If needed, it is possible to scale the input to fit the sensor (Parameter 11010).




> **NOTE:** Multi input 7 (parameter 11020) and Multi input 8 (parameter 11030)
>
> **NOTE:** Analog Units listed as 1/1 = xxx units, 1/10 = xx.x units, 1/100 = x.xx units.

6. It is necessary to write to the device/controller, then, 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 (hardware, wiring, and transducer/transmitter 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.

## Binary

If the multi-inputs are configured to "Binary", they become available as binary inputs which means a switch function input.Input Function Selection

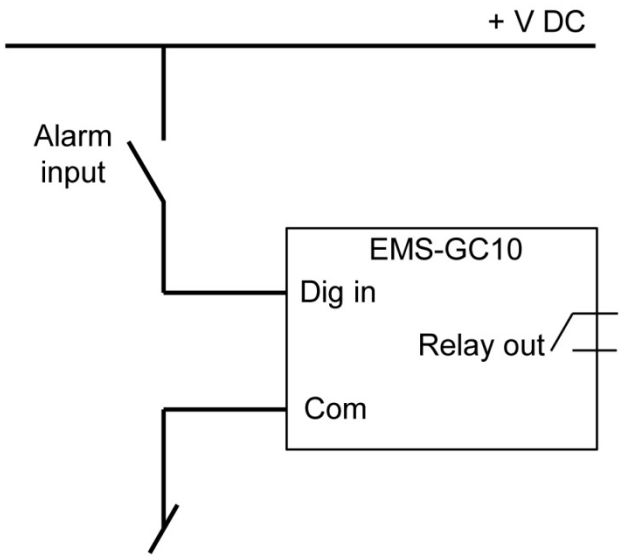
Digital input alarms can be configured with a possibility to select when the alarms are to be activated. The possible selections of the input function are normally open or normally closed.

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 (contact opens).

2. Digital input alarm configured to NO, normally open:
This will initiate an alarm when the signal on the digital input appears (contact closes).

> **NOTE:** The relay output function can be selected to be ND (Normally De-energized), NE (Normally Energized), Limit or Horn.



## Text in Status Line

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

| Condition | Comment | Note |
|---|---|---|
| BLOCK | Block mode is activated | |
| SIMPLE TEST | Test mode is activated | |
| FULL TEST | | |
| SIMPLE TEST ###.#min | Test mode activated and test timer counting down | |
| FULL TEST ###.#min | | |
| ISLAND MAN | Genset stopped or running and no other action taking place | |
| ISLAND SEMI | | |
| READY ISLAND AUTO | Genset stopped in Auto | |
| ISLAND ACTIVE | Genset running in Auto | |
| AMF MAN | Genset stopped or running and no other action taking place | |
| AMF SEMI | | |
| READY AMF AUTO | Genset stopped in Auto | |
| AMF ACTIVE | Genset running in Auto | |
| LOAD TAKEOVER MAN | Genset stopped or running and no other action taking place | |
| LOAD TAKEOVER SEMI | | |
| READY LTO AUTO | Genset stopped in Auto in load takeover operation mode | |
| LTO ACTIVE | Genset running in Auto in load takeover operation mode | |
| DG BLOCKED FOR START | Generator stopped and active alarm(s) on the generator | |
| GB ON BLOCKED | Generator running, GB open and an active "Trip GB" alarm | |
| SHUTDOWN OVERRIDE | The configurable input is active | |
| ACCESS LOCK | The configurable input is activated, and the operator tries to activate one of the blocked keys | |
| GB TRIP EXTERNALLY | Some external equipment has tripped the breaker | An external trip is logged in the event log |
| MB TRIP EXTERNALLY | Some external equipment has tripped the breaker | An external trip is logged in the event log |
| IDLE RUN | The "Idle run" function is active. The genset will not stop until a timer has expired | |
| IDLE RUN ###.#min | The timer in the "Idle run"' function is active | |
| Aux. test ##.#V ####s | Battery test activated | |
| START PREPARE | The start prepare relay is activated | |
| START RELAY ON | The start relay is activated | |
| START RELAY OFF | Start relay is deactivated during the start sequence | |
| MAINS FAILURE | Mains failure and mains failure timer expired | |

| Condition | Comment | Note |
|---|---|---|
| MAINS FAILURE IN ###s | Frequency or voltage measurement is outside the limits | The timer shown is the Mains failure delay. Text in mains units |
| MAINS U OK DEL ####s | Mains voltage is OK after a mains failure | The timer shown is the Mains OK delay |
| MAINS f OK DEL ####s | Mains frequency is OK after a mains failure | The timer shown is the Mains OK delay |
| Hz/V OK IN ###s | The voltage and frequency on the genset is OK | When the timer runs out it is allowed to operate the generator breaker |
| COOLING DOWN ###s | Cooling-down period is activated | |
| COOLING DOWN | Cooling-down period is activated and infinite | Cooling down timer is set to 0.0 s |
| GENSET STOPPING | This info is shown when cooling down has finished | |
| EXT. STOP TIME ###s | | |
| EXT. START ORDER | A planned AMF sequence is activated | There is no failure on the mains during this sequence |
| QUICK SETUP ERROR | Quick setup of the application failed | |
| MOUNT CAN CONNECTOR | Connect the power management CAN line | |
| ADAPT IN PROGRESS | The EMS-GC10 is receiving the application that it has just been connected to | |
| SETUP IN PROGRESS | The new EMS-GC10 is being added to the existing application | |
| SETUP COMPLETED | Successful update of the application in all EMS-GC10 units | |
| REMOVE CAN CONNECTOR | Remove the power management CAN lines | |
| PREPARING ENGINE IF | Preparing engine IF | |
| PROGRAMMING M-LOGIC | Downloading M-Logic to the unit | |

## 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 parameter 6100:

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

> **NOTE:** Additional counters for "Running hours" and "Energy" can be read out from the PC utility software (USW).

## 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.

> **NOTE:** The M-Logic is part of the PC utility software (USW), and as such, it can only be configured in the PC utility software and not via the display.

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

> **NOTE:** Please refer to appendix for more details about this tool available in the PC Utility Software (USW).

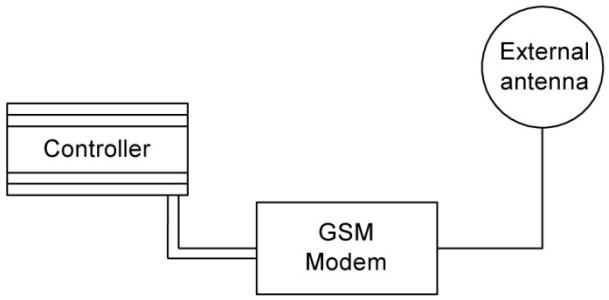
## Buzzer

EMS-GC10 unit 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.

## GSM Communication

The GSM modem communication is used to send a GSM message to up to five cellular telephones when an alarm appears on the display.

System single-line diagram




> **NOTE:** MOXA OnCell G2150I, Wavecom WMOD2 or Westermo GDW-11 terminal are recommended as Modems, as the application has been tested with these terminals.

Basic Parameter Settings

| Parameter | Name | Function | Set To |
|---|---|---|---|
| 10320 | GSM PIN code | Set PIN code for GSM modem | None |
| 10330 | 12345678901 | Set phone no. for SMS to cellular phone 1 | None |
| 10340 | 12345678901 | Set phone no. for SMS to cellular phone 2 | None |
| 10350 | 12345678901 | Set phone no. for SMS to cellular phone 3 | None |
| 10360 | 12345678901 | Set phone no. for SMS to cellular phone 4 | None |
| 10370 | 12345678901 | Set phone no. for SMS to cellular phone 5 | None |

> **NOTE:** For calling a foreign number type "+" and country code instead of "00", for example dial +45 99999999 for a Danish number.
>
> **NOTE:** The phone number can only be entered using the PC utility software (USW).
>
> **NOTE:** The SIM card used in the cellular telephone must support data transfer.

**PIN Code Configuration**
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 (USW).

## USW Remote Communication

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

> **NOTE:** It is possible to remotely control the genset from the PC utility software (USW) if a modem is used. Take precautions that it is safe to remotely operate the genset to avoid personal injury or death.

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

**Application settings**
Please refer to the PC utility software help file.

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

## How to Change the Nominal Settings

The nominal settings can be changed to match different voltages and frequencies. The EMS-GC10 has four sets of nominal values for the generator, and they are adjusted in parameters.

| EMS-GC10 Nominal Settings | Parameters |
|---|---|
| 1 | 6001–6005 |
| 2 | 6011–6015 |
| 3 | 6021–6025 |
| 4 | 6031–6035 |

There are also two sets of nominal settings for the busbar, they can be adjusted in parameters.

| Busbar Nominal Settings | Parameters |
|---|---|
| 1 | 6051–6053 |
| 2 | 6061–6063 |

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

**NOTE:** The possibility to switch between the four sets of nominal set points is typically used on rental gensets, where switching between 50 and 60 Hz is required, or switching between different generator tapping or steering (single phase, three phase, 208/120, 480, ect.

### Activation

The switching between the nominal set points, for the generator, can be done in two ways; digital input & parameter 6006. Switching between busbar parameters sets is done in parameter 6054.

### 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:

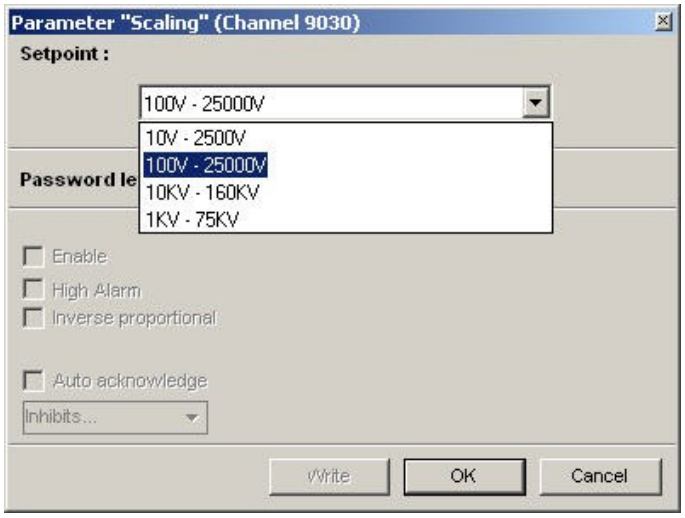
| Event A | | Event B | | Event C | Output |
|---|---|---|---|---|---|
| Dig. input no. 10 | or | Not used | or | Not used | Set nom. parameter settings 1 |
| Not Dig. input no. 10 | or | Not used | or | Not used | Set nom. parameter settings 2 |

**Parameter Settings**
In parameter 6006 the switching is made between settings 1 to 4, for the generator, simply by choosing the desired nominal setting, just as it is for the Busbar group choice in parameter 6054.

## AC Voltage Scaling

Default AC voltage scaling is set to range 100 V-25000 V (parameter 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 parameter 9030 from the display window shown in the following illustration.




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

| Scaling Parameter 9030 | Nom. Settings 1 To 4 (Power) Will Change According To Parameter 9030 | Nom. Settings 1 To 4 (Voltage) Will Change According To Parameter 9030 | Transformer Ratio Settings Parameter 6041, 6051 And 6053 |
|---|---|---|---|
| 10 V-2500 V | 1.0-900.0 kW | 10.0 V-2500.0 V | 10.0 V-2500.0 V |
| 100 V-25000 V | 10-20000 kW | 100 V-25000 V | 100 V-25000 V |
| 1 kV-75 kV | 0.10-90.00 MW | 1.00 kV-75.00 kV | 1.00 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 |

> **NOTE:** All nominal values and the Primary Transformer (PT) settings must be corrected after the scaling has been changed in parameter 9030.

## Fan Logic

EMS-GC10 is able to control four different fans. This could for example, be air supply fans for supplying air to a genset in a closed enclosure, or radiator fans for switching on and off cooling fans for air coolers.

There are two features in the fan control of EMS-GC10.

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

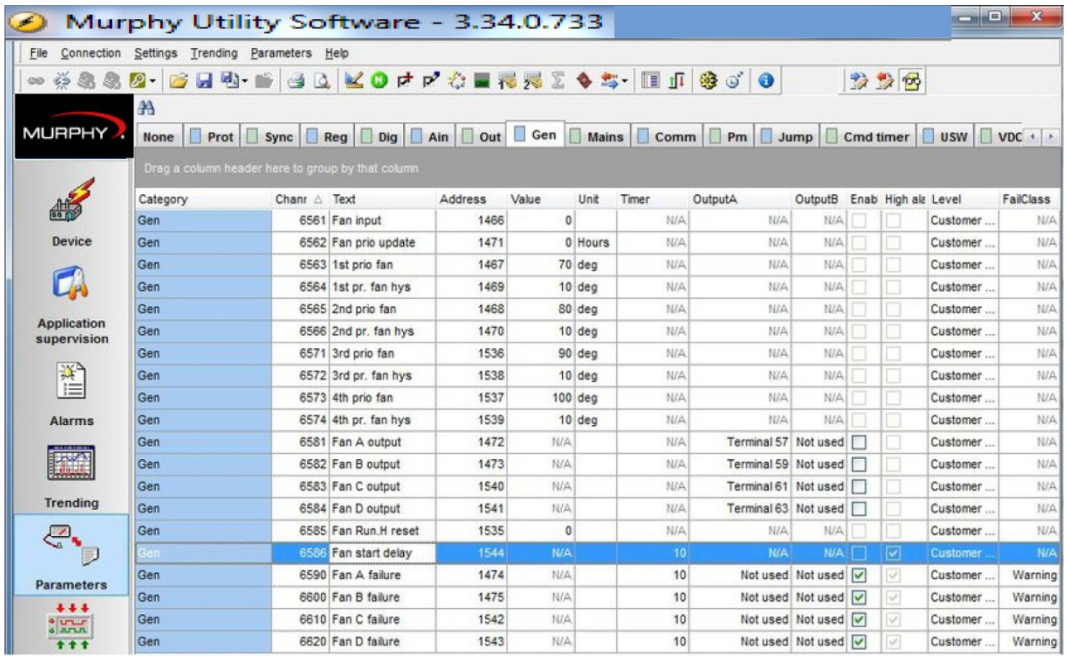
A priority routine ensures that the running hours of the available fans are evened out and the priority shifts between them.

The functionality behind the temperature-dependent start/stop is that the EMS-GC10 unit measures a temperature for example, cooling water temperature, and based on this temperature it switches on and off relays that must be used for engaging the fan(s).

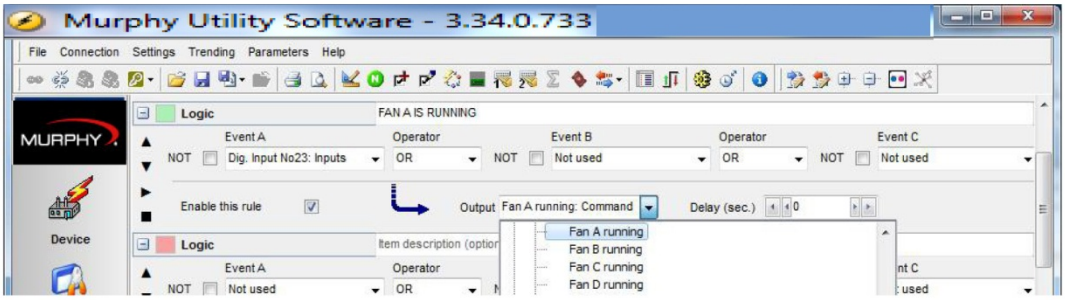
## Fan Parameters

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

**Parameters:**



**M-logic:**




## Input for Fan Control

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

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

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

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

## Fan Start/Stop

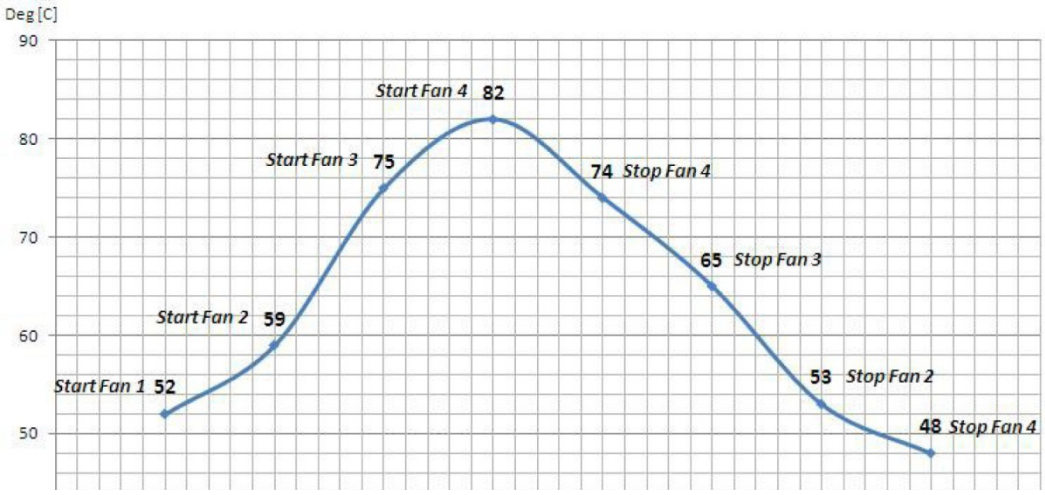
The start and stop settings of the fan(s) are set up in parameters 6563 to 6574. With the settings in the table below, the illustrative curve can be observed.

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

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

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

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



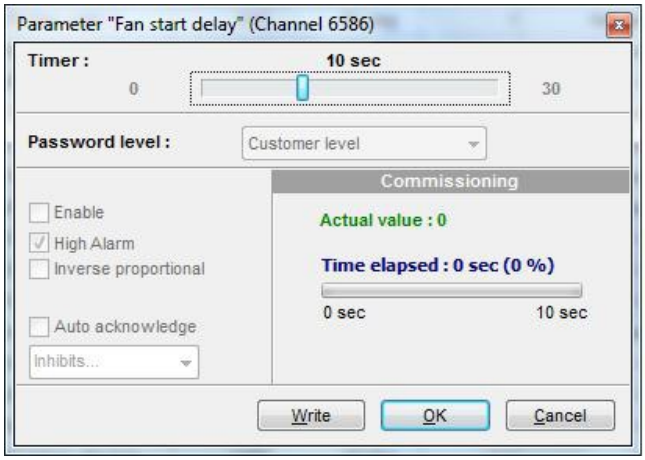

## Fan Output

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

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

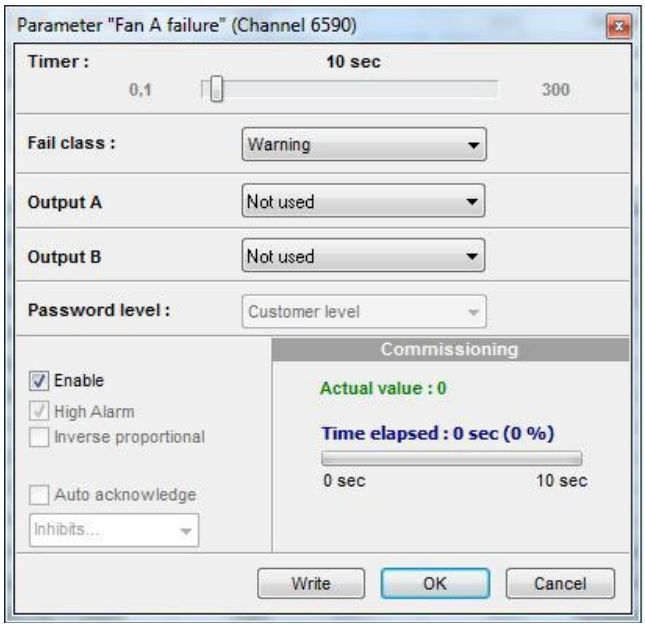
## Fan Start Delay

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



## Fan Failure

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



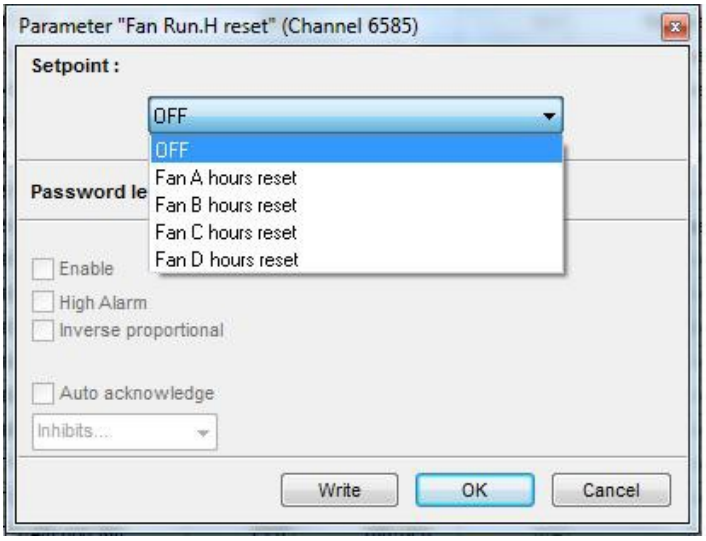

## Fan Priority (Running Hours)

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

M-Logic setup:
If the fan unit is raising a signal that is led to a digital input on the EMS-GC10 unit when it is running, then the following M-Logic must be programmed:


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

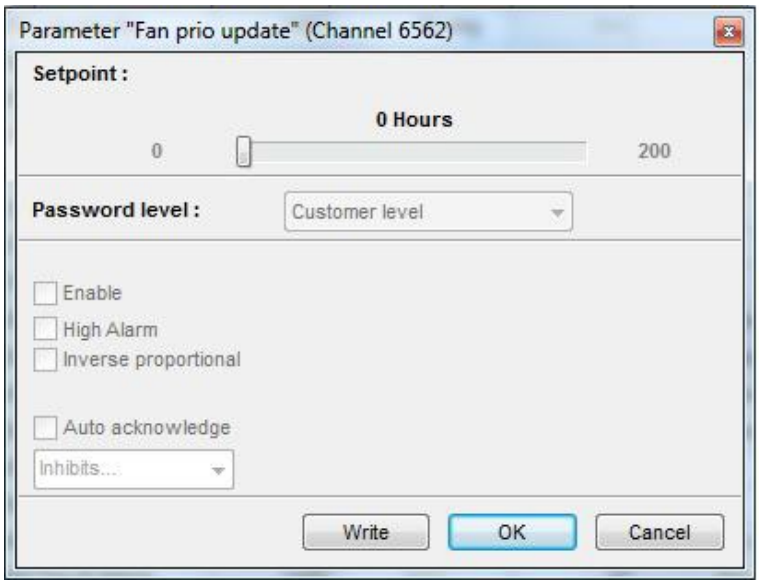
The running hour can be reset by entering parameter 6585 and then selecting the desired fan hours to be reset.




> **NOTE:** Only reset is possible. It is not possible to add an offset to the run hour counter.

## Fan Priority Update

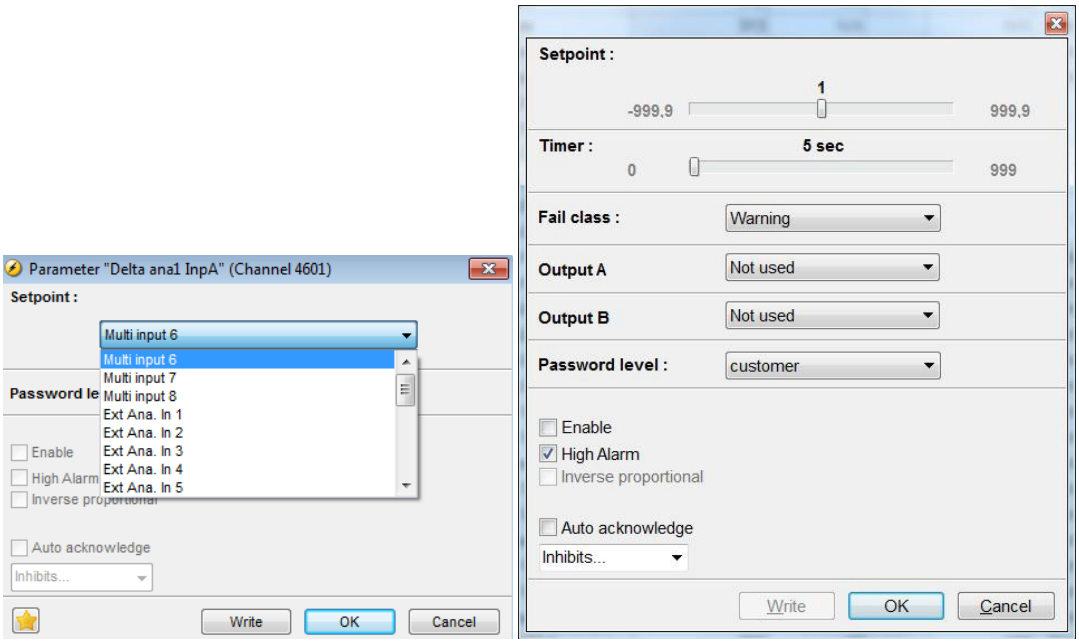
In parameter 6562 the priority update rate (hours between priority rearrange) is selected:




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

## Differential Measurement

Differential measurements between two sensors can be configured in parameters 4600-4606. The sensors can be selected from the input list shown, the list also contains various EIC measurements:




Two levels of alarms can be made of each differential measurement between sensor A and B.

| | | | | |
|---|---|---|---|---|
| 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 |

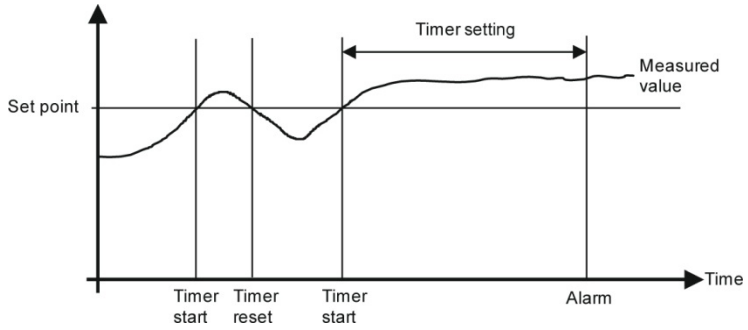
Analog settings for differential measurements.

# Protections

## General

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

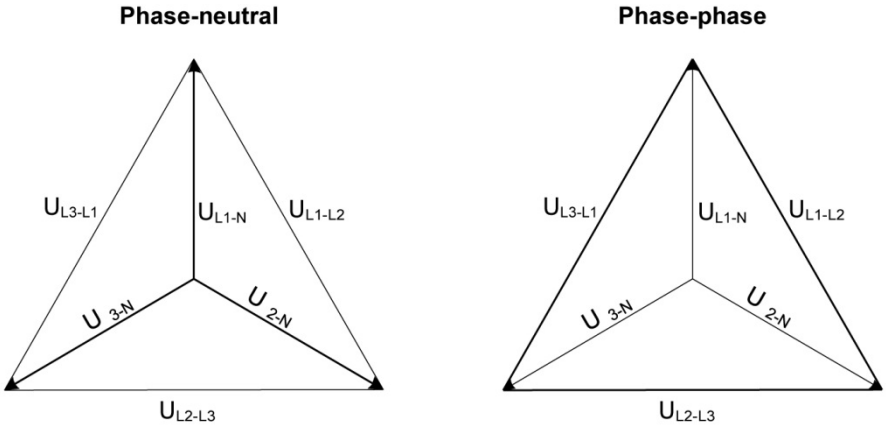
If the function is, for example, Overvoltage, the timer will be activated if the setpoint is exceeded. If the voltage value falls below the setpoint value before the timer runs out, then the timer will be stopped and reset.




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

## Phase-Neutral Voltage Trip

If the voltage alarms are to work based on phase-neutral measurements, please adjust parameters 1200 and ph–ph or ph–N accordingly. Depending on the selections, either phase-phase voltages or phase-neutral voltages will be used for the alarm monitoring.




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

The table shows the actual measurements at a 10% under voltage situation in a 400/230 volt system.

| | Phase-Neutral | Phase-Phase |
|---|---|---|
| **Nominal Voltage** | **400/230** | **400/230** |
| **Voltage, 10% Error** | 380/**207** | **360**/185 |

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

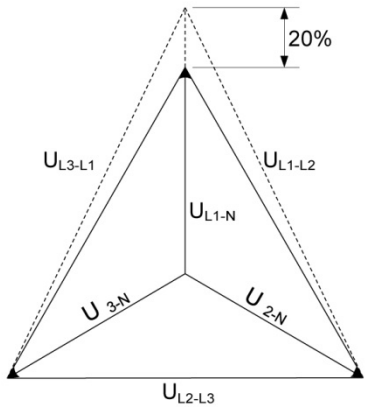
Example
The below 400V AC system shows that the phase-neutral voltage must change 20%, when the phase-phase voltage changes 40 volts (10%).

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

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

$U_{L1-N}$ = 185V AC

$\Delta U_{PH-N}$ = 20%




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

# Appendix I —Can Bus Engine Interface Communication

## Terminal Description for EMS-GC10

| Term. | Function | Description |
|---|---|---|
| 53 | CAN-H | CAN A |
| 54 | CAN-GND | |
| 55 | CAN-L | |

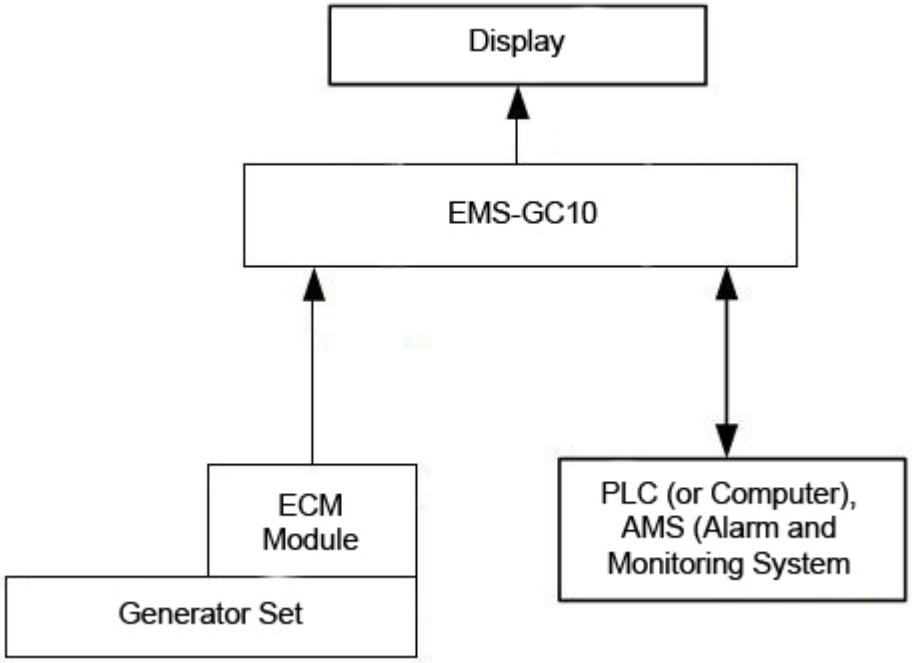
## Modbus Communication

If option H2 is present in the EMS-GC10 unit, it is possible to read engine data over the Modbus.

## Terminals

> **NOTE**: For terminal details, please refer to the document “Installation Manual”.

## Principle Diagram



# Functional Description

## Electronic Control Module (ECM)

### ECM

This communication extracts information from the Electronic Control Module (ECM) of an engine equipped with an ECM module with CANbus interface. The values can be used as display values, alarms/shutdown alarms and values to be transmitted through Modbus.

## Engine Types

Data can be transmitted between the EMS-GC10 units and the following engine controllers/types:

| Engine Manufacturer | Engine Controller/Type | Comment |
|---|---|---|
| Caterpillar | ADEM III and A4/C4.4, C6.6, C9, C15, C18, C32 | Read/Write |
| Cummins | CM570 and CM850/QSL, QSB5 and 7, QSM11, QSK19, 50 and 60 | Read/Write |
| Detroit Diesel | DDEC III and IV/Series 50, 60 and 2000 | Read/Write |
| Deutz | EMR3, EMR 2 (EMR)/912, 913, 914 and L2011 | Read/Write |
| - | Generic J1939 | Read/Write |
| Iveco | EDC7 (Bosch MS6.2) / Series NEF, CURSOR and VECTOR 8 | Read/Write |
| John Deere | JDEC/PowerTech M, E and Plus | Read/Write |
| MTU | MDEC, module M.302 or M.303/ISeries 2000 and 4000 | Read Only |
| MTU | MDEC, module M.201 or M.304/Series 2000 and 4000 | Read Only<br>Select M.303 |
| MTU | ADEC/Series 2000 and 4000 (ECU7) | Read/Write |
| MTU | J1939 Smart Connect/Series 1600 (ECU8) | Read/Write |
| Perkins | Series 1100, 1300, 2300, 2500 and 2800 | Read/Write |
| Scania | EMS | Read Only |
| Volvo Penta | EDC4 | Read Only<br>Select EMR 2 |
| Volvo Penta | EMS | Read Only |
| Volvo Penta | EMS 2 and EDCIII/D6 D7, D9, D12 and D16 (GE and AUX variants only) | Read/Write |

**NOTE:** Read/Write: Please go to the section “Specific Engine Type Descriptions” for details of data read and write.

**NOTE:** The engine type is selected in parameter 7561.

**NOTE:** For support of controller/engine types not listed, please contact FW Murphy

## Communication System

All these protocols are based on a CANbus communication system. Except for the MDEC and ADEC communication, all are based on the J1939. The MDEC and ADEC protocols are MTU-designed protocols based on CANopen.

The Baud rate is fixed by the engine manufacturer at:

| MDEC, ADEC | Caterpillar, Cummins, Detroit Diesel, Deutz, Iveco, John Deere, Perkins, MTU J1939 Smart Connect, Scania and Volvo Penta |
|---|---|
| 125 kb/s | 250 kb/s |

## EIC Unit

The selection of the EIC unit (parameter 10970) determines whether bar/PSI and Celsius/Fahrenheit is used. The selection affects display readings, values used for alarm evaluation (parameter 76xx) and data readable by Modbus communication.

## Common for all Alarm Functions

A number of alarms can be configured. The following items can be configured to an alarm:

| Parameter | Alarm | Comment |
|---|---|---|
| 7570 | El comm. Error | Communication error |
| 7580 | EIC warning | Any alarm listed as warning for the selected engine type in the section “Specific Engine Type Descriptions”. |
| 7590 | EIC shutdown | Any alarm listed as shutdown for the selected engine type in the section “Specific Engine Type Descriptions”. |
| 7600 | EIC overspeed | Actual RPM |
| 7610/7620 | EIC coolant t. (2 levels) | Actual temperature |
| 7630/7640 | EIC oil press. (2 levels) | Actual pressure |
| 7650/7660 | EIC oil temp. (2 levels) | Actual temperature |
| 7670/7680 | EIC coolant level (2 levels) | Actual cooling water level |

## J1939 Measurement Table

This is the common J1939 measurement overview showing which measurements are available. Note that not all measurements are supported by the individual engines; please refer to the specific engine description.

The table below shows which values can be displayed in the view parameter that is in V1, V2 and V3.

The display values corresponding to the engine communication have a description beginning with “EIC”.

## Error Messages

The following error messages can occur:

| Message | Description |
|---|---|
| Engine I. value N.A. | The view is not selectable for the present engine type. |
| Value selected error | The value cannot be read due to the sensor error, sub-system or module error. |
| “N.A.” | The value is not supported by the engine, or due to a communication error. |

## Object Selection, J1939

The view lines can be configured with these available values.

> **NOTE:** For Modbus scaling, please see the chapter “Modbus Communication”.
>
> **NOTE:** The engine is expected to use source address 0.

| Object | PGN No. | Pri-Ority | Start Posi-Tion Of 1st Data Byte | Length (Bytes) | SPN No. | Unit | J1939-71 Scaling |
|---|---|---|---|---|---|---|---|
| EIC speed | 61444 | 3/6 | 4 | 2 | 190 | RPM | 0.125 rpm/bit, offset 0 |
| EIC coolant temp. (1) | 65262 | 3/6 | 1 | 1 | 110 | °C | 1 deg C/bit, offset -40°C |
| EIC oil pressure (2) | 65263 | 6 | 4 | 1 | 100 | Kpa | 4 kpa/bit, offset 0 |
| EIC faults (4) | 65230 | 6 | 1 | 1 | 1218 | | 1/bit, offset 0 |
| EIC oil temp. (3) | 65262 | 3/6 | 3 | 2 | 175 | °C | 0.03125°C/bit, offset -273°C |
| EIC fuel temp. | 65262 | 3/6 | 2 | 1 | 174 | °C | 1°C/bit, offset -40°C |
| EIC intake manifold #1 P. (also called EIC bootst P.) | 65270 | 6 | 2 | 1 | 102 | kpa | 2 kpa/bit, offset 0 |
| EIC air inlet temp. | 65269 | 6 | 6 | 1 | 172 | °C | 1°C/bit, offset -40°C |
| EIC coolant level | 65263 | 6 | 8 | 1 | 111 | % | 0.4%/bit, offset 0 |
| EIC fuel rate | 65266 | 6 | 1 | 2 | 183 | l/h | 0.05 l/h per bit, offset 0 |
| EIC intake manifold 1 temp. (also called EIC charge air temp.) | 65270 | 6 | 3 | 1 | 105 | °C | 1°C/bit, offset -40°C |
| EIC d.d. % torque | 61444 | 3/6 | 2 | 1 | 512 | % | 1%/bit, offset -125% |
| EIC actual % torque | 61444 | 3/6 | 3 | 1 | 513 | % | 1%/bit, offset -125% |
| EIC acc. pedal pos. | 61443 | 3/6 | 2 | 1 | 91 | % | 0.4%/bit, offset 0 |

| Object | PGN No. | Pri-Ority | Start Posi-Tion Of 1st Data Byte | Length (Bytes) | SPN No. | Unit | J1939-71 Scaling |
|---|---|---|---|---|---|---|---|
| EIC % load, c. speed | 61443 | 3/6 | 3 | 1 | 92 | % | 1%/bit, offset 0 |
| EIC air inlet pressure | 65270 | 6 | 4 | 1 | 106 | kpa | 2 kpa/bit, offset 0 |
| EIC exhaust gas temp. | 65270 | 6 | 6 | 2 | 173 | °C | 0.03125°C/bit, offset -273°C |
| EIC engine hours | 65253 | 6 | 1 | 4 | 247 | h | 0.05 hr/bit, offset 0, max: 32767 hrs |
| EIC oil filter diff. press. | 65276 | 3/6 | 4 | 1 | 99 | kpa | 0.5 kpa/bit, offset 0 |
| EIC key switch battery potential | 65271 | 6 | 7 | 2 | 158 | V DC | 0.05V DC/bit, offset 0 |
| EIC fuel del. press. | 65263 | 6 | 1 | 1 | 94 | kpa | 4 kpa/bit, offset 0 |
| EIC oil level | 65263 | 6 | 3 | 1 | 98 | % | 0.4%/bit, offset 0 |
| EIC crankcase press. | 65263 | 6 | 5 | 2 | 101 | kpa | 1/128 kpa/bit, offset -250 kpa |
| EIC coolant pressure | 65263 | 6 | 7 | 1 | 109 | kpa | 2 kpa/bit, offset 0 |
| EIC water in. fuel | 65279 | 6 | 1 | 2 bit | 97 | | 00: No, 01: Yes, 10: Error, 11: Not available |
| EIC turbo oil temp. | 65262 | 3/6 | 5 | 2 | 176 | °C | 0.03125°C/bit, offset -273°C |
| EIC particulate trap inlet | 65270 | 6 | 1 | 1 | 81 | kpa | 0.5 kpa/bit, offset 0 |
| EIC air filter diff. | 65270 | 6 | 5 | 1 | 107 | kpa | 0.05 kpa/bit, offset 0 |
| EIC coolant filter diff. | 65270 | 6 | 8 | 1 | 112 | kpa | 0.5 kpa/bit, offset 0 |
| EIC atmospheric press. | 65269 | 6 | 1 | 1 | 108 | kpa | 0.5 kpa/bit, offset 0 |
| EIC ambient air temp. | 65269 | 6 | 4 | 2 | 171 | °C | 0.03125°C/bit, offset -273°C |
| EIC trip fuel_gaseous | 65199 | 6 | 1 | 4 | 1039 | kg | 0.5 kg//bit, offset 0 |
| EIC total fuel used_gaseous | 65199 | 6 | 5 | 4 | 1040 | kg | 0.5 kg//bit, offset 0 |
| EIC engine trip fuel | 65257 | 6 | 1 | 4 | 182 | L | 0.5 L//bit, offset 0 |
| EIC engine total fuel used | 65257 | 6 | 5 | 4 | 250 | L | 0.5 L//bit, offset 0 |
| EIC Nominal Power | 65214 | 7 | 1 | 2 | 166 | kW | 0.5 kW/bit |
| EIC Mean trip fuel consumption | 65203 | 7 | 5 | 2 | 1029 | l/h | 0.05 [l/h]/bit |
| EIC intake manifold #1 absolute pressure | 64976 | 6 | 5 | 1 | 3563 | Bar or psi | 2 kPa/bit |
| EIC Air filter diff. pressure | 64976 | 6 | 1 | 1 | 2809 | kPa | 0.05 kPa offset 0 |
| EIC Fuel supply pump inlet pressure | 65130 | 6 | 2 | 1 | 1381 | kPa | 2 kPa/bit offset 0 |
| EIC Fuel filter (suction side) diff. pressure | 65130 | 6 | 3 | 1 | 1382 | kPa | 2 kPa/bit offset 0 |

## For the Iveco Vector 8 Type Only:

(1): EIC coolant temp.: PGN=65282, priority=6, start at byte 5, length=1 byte, SPN=110, same scale
(2): EIC oil temp.: PGN=65282, priority =6, start at byte 6, length=1 byte, SPN=175, same scale
(3): EIC oil pressure. PGN=65282, priority=6, start at byte 7, length=1 byte, 8kPa/bit gain, 0kPa offset, data range: 0 to +2000 kPa.

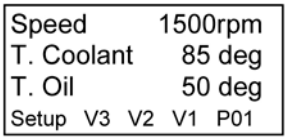
## For the MTU Smart Connect Type Only:

(4): EIC Faults: PGN=65284, priority=6, start at byte 1, length=2 byte

> **NOTE:** The objects are not supported by all engines. Please refer to the specific engine type manual for information about the specific engine.

## Showing Engine Values in Display

It is possible to parameterise the EMS-GC10 so all values from the engine CAN bus is shown in the display unit. This is an example where speed, coolant and air inlet temperature is shown. The number of available views is 20. The number can be increased with the Autoview function.




**The EMS-GC10 can be setup in two ways:**

1. Using the function of the PC Utility Software (USW) “Configuration of the User Views”. This way the 20 three-line views can be configured to show the desired. A total of 20 views is displayed (unless fewer is set up).
2. Using the Autoview function in the communication setup (parameter number 7564). This way the 20 three-line views are kept with their present setup and all engine values are added to the list of the 20 three line views. A total of 20 + 14 three-line views are available. The 20 lines are user configurable (as mentioned above) but the additional 14 three-line views are dedicated to EIC and cannot be modified by the user.

The first option is useful when a few EIC values need to be shown and if all of the 20 user configurable views are not already used to display requested values.

The second option is useful if it is requested to read **all available** EIC data from the ECU. It must be noted that all available data is shown when using this method until the additional 14 three-line views are used. The number of extra display views depends on the available data from the specific engine controller connected to the EMS-GC10.

## Configuration of the User View

This configuration is done in the PC Utility Software (USW) by pressing the User View icon in the horizontal toolbar.

## Activation of Auto Views

The extra view lines are displayed if the parameter 7564 is switched to “ON” and the engine CAN bus is active. Note that it might be necessary to start the engine before switching 7564 to “ON”. The setting automatically returns to “OFF”.

To deactivate the Auto View function, please follow the steps below:

1. Adjust Engine I/F type to “OFF” (parameter 7561).
2. Adjust EIC AUTOVIEW to “ON” (parameter 7564).
3. Adjust EIC AUTOVIEW to “OFF” (parameter 7564).
   (The parameter is not reset automatically when no engine is selected).

## Verification of J1939 Objects

To verify the communication, various CAN PC tools can be used. Common for these are that they must be connected to the CANbus between the EMS-GC10 unit and the engine controller. When the tool is connected, it is possible to monitor the communication between the two units. For use of the CAN tool, please refer to the manual for the product used.

As an example, you may see the following telegram:

**0xcf00400 ff 7d 7d e0 15 ff f0 ff**
DATA BYTE: 1 2 3 4 5 6 7 8

-0xc is the priority
-f004 is the PGN number (61444 in decimal value)
-The 8 bytes following the CAN ID (Oxcf00400) are data, starting with byte 1

The priority needs to be converted to decimal. Note that the 3 priority bits in this case are displayed in the CAN id (You see Oxcf00400 instead of 0x0cf00400). In other cases you may read (e.g., 0x18fef200 [PGN 65266]).

The formula to find the priority number (P) is to divide by 4: **0xc = 12 (Dec) => Priority 3**

| Priority | DecID | DecID |
|---|---|---|
| 1 | 4d | 0x4 |
| 2 | 8d | 0x8 |
| 3 | 12d | 0xc |
| 4 | 16d | 0x10 |
| 5 | 20d | 0x14 |
| 6 | 24d | 0x18 |

Normally in SAE J1939, only priority 3 and 6 are used.

Hereafter the data can be read (PGN 61444): **0xcf00400 xD ff 7d 7d e0 15 ff f0 ff**

| | | | |
|---|---|---|---|
| Engine torque | (Data byte 1) | ff | Not available |
| Driver demand torque | (Data byte 2) | 7d | |
| Actual engine torque | (Data byte 3) | 7d | |
| Engine speed | (Data byte 4) | e0 | |
| Engine speed | (Data byte 5) | 15 | |
| Source address | (Data byte 6) | ff | Not available |
| Engine starter mode | (Data byte 7) | f0 | |
| Engine Demand | (Data byte 8) | ff | Not available |

Calculation example:

RPM resolution is 0.125 RPM/bit, offset 0.

The result is then 15e0 (Hex) or 5600 (dec) 0.125 = 700 RPM.

## Displaying Alarms - J1939 DM1/DM2, Scania KWP2000, Caterpillar/Perkins

Besides some engine –specific alarms which are shown in the standard alarm list, the J1939 Diagnostic messages DM1 (active alarms) and DM2 (hirtoric alarm log list as well as the Scania KWP 20000 alarms can all be shown on the display.

### J1939

Press the LOG button for 2 seconds. That will display the alarm log.

Example:

```
SPN  100  FMI15  oc34
Oil pressure
Slightly above range
CLRALL     DM1    DM2
```

The alarm log always shows the DM1 (active alarms) as default. By selecting DM2 (move the cursor under DM2 and press ENTER), the historical alarm list can be shown.

Use the up △ and down ▽ buttons to scroll through the list.

oc: This indicates how many times a specific alarm has occurred.

CLRALL: By pressing ENTER, the entire alarm log list will be cleared. For safety reasons this requires the master password. Refer to “Passwords and Parameter Access” for details.

> **NOTE:** If the controller has no translation text of an SPN diagnostic number, “Text N/A.” will be shown. For information about particular SPN numbers, please consult the engine manufacturer’s documentation or SAE J1939-71 for a general description.

## Scania KWP 2000

Press the LOG button for 2 seconds. That will display the alarm log. The top line shows readings of AC values and is not used by the alarm list.

Example:

```
BB  0  0   0V
1105 Speed sendor 1
Active alarms: 6
CLRALL  First  Last
```

The Scania KWP 2000 log shows active and passive alarms in a mix.

Use the up △ and down ▽ buttons to scroll through the list.

CLRALL: By pressing ENTER, the entire alarm log list will be cleared. For safety reasons, this requires the master password. Refer to “Passwords and Parameter Access” for details.

## Caterpillar/Perkins

Press the LOG button for 2 seconds. That will display the alarm log. Caterpillar and Perkins have a secondary DM1 log as well as one DM2 log.

Example:

```
SPN 100 FMI15  oc34
Oil pressure
Slightly above range
CLRALL DM1se DM2
```

The secondary DM1 log shows alarms from the EMCP 3.x gen-set controller. Similar to the J1939 protocol, the DM2 log shows the historical alarms. Use the up △ and down ▽ buttons to scroll through the list.

0c: This indicates how many times a specific alarm has occurred.

CLRALL: By pressing ENTER the entire alarm log list will be cleared. For safety reasons this requires the master password. Refer to “Passwords and Parameter Access” for details.

## J1939

Use the up △ and ▽ buttons until the DM1 or DM2 is shown in the display and press Enter. The alarm log will be shown in the display.

Example:

```
DM1  LOG  DDEC
Oil pressure
Low level warning
SPN          100
FMI          17
```

The alarm log in DM1 shows the active alarms, the DM2 shows the historical alarms.

Use the up △ and down ▽ buttons to scroll through the list.

## Scania KWP 2000

Use the up △ or down ▽ button until the engine log is shown in the display and press enter. The alarm log will be shown in the display.

Example:

```
Scania KW2000 LOG
1105 Speed sensor 1
Active alarms: 6
```

The Scania KWP 2000 log shows active and passive alarms in a mix.

Use the up △ and down ▽ buttons to scroll through the list.

## Caterpillar/Perkins

Caterpillar and Perkins have a primary and a secondary DM1 log as well as one DM2 log. Use the up △ or down ▽ buttons until the "2nd DM1 log" is shown and press enter. The second alarm log will be shown in the display.

Example:

```
2nd  DM1    Caterpillar
Oil pressure
SlightlyAboveRange
SPN   100
FMI   15
```

The primary DM1 log shows alarms from the ADEM III/IV engine controllers. The secondary DM1 log shows alarms from the EMCP 3.x gen-set controller. Similar to the J1939 protocol the DM2 log shows the historical alarms. Use the up △ and down ▽ buttons to scroll through the list.

> **NOTE:** The display of Caterpillar/Perkins secondary DM 1 log only applies to EMS-GC10 100 and GC-1F/2.

## Control Commands Sent to the Engine

Engine types with the possibility to send commands to the ECM via the CANbus communication line:

| Engine Type / Command | Detroit Diesel DDEC | John Deere JDEC | Caterpillar | Perkins | Cummins | Generic J1939 | Deutz EMR | Iveco | Iveco Vector 8 |
|---|---|---|---|---|---|---|---|---|---|
| Preheat | - | - | - | - | - | - | - | - | - |
| Start/Stop | - | - | X | X | - | - | - | - | - |
| Engine Speed | X | X | X | X | X/ | X | X | X | X |
| Nominal Frequency | - | - | - | - | X | - | - | - | - |
| Governor gain | - | - | - | - | X | - | - | - | - |
| Idle speed | X | X | X | X | X | X | X | X | - |
| Droop | - | - | X | X | X | - | - | - | - |
| Shutdown override | - | - | - | - | X | - | - | - | - |
| Engine overspeed test | - | - | - | - | - | - | - | - | - |
| Enable cylinder cut out | - | - | - | - | - | - | - | - | - |
| Intermittent oil priming | - | - | - | - | - | - | - | - | - |
| Engine operating mode | - | - | - | - | - | - | - | - | - |
| Demand switch | - | - | - | - | - | - | - | - | - |
| Trip counter reset | - | - | - | - | - | - | - | - | - |
| Engine speed GOV parameter command | - | - | - | - | - | - | - | - | - |

| Engine Type / Command | MTU MDEC | MTU ADEC | MTU J1939Smart Connect | Scania EMS | Scania EMS S6 | Volvo Penta | Volvo Penta EMS2 |
|---|---|---|---|---|---|---|---|
| Preheat | - | - | - | - | - | - | X |
| Start/Stop | - | X | X | - | X | - | X |
| Engine Speed | - | X | X | - | X | - | X |
| Nominal Frequency | - | X | X | - | X | - | X |
| Governor gain | - | - | - | - | - | - | - |
| Idle speed | - | X | X | - | X | - | X |
| Droop | - | X | X | - | X | - | X |
| Shutdown override | - | - | X | - | X | - | X |
| Engine overspeed test | - | - | X | - | - | - | - |
| Enable cylinder cut out | - | X | X | - | - | - | - |
| Intermittent oil priming | - | - | X | - | - | - | - |
| Engine operating mode | - | - | X | - | - | - | - |
| Demand switch | - | X | X | - | - | - | - |
| Trip counter reset | - | X | X | - | - | - | - |
| Engine speed GOV parameter command | - | - | X | - | - | - | - |

**NOTE:** For engine types not mentioned, CANbus control is not supported. In these cases, start/stop etc. must be sent to the controller using hardwired connections.

**NOTE:** The parameter number 7563 has to be used for enabling or disabling the transmission of all the EMS-GC10 unit EIC control frames listed in the above table.

## EIC 50 Hz – 60 Hz Switch

If the set point f nominal is changed in the EMS-GC10 between 50 and 60 Hz then the change is made with a frequency ramp of 2 Hz per second. This frequency ramp is used when switching between nominal settings 1-4 or if the parameter of the nominal frequency is changed between 50 and 60 Hz.

## EIC Droop

There are two ways of obtaining a speed droop:

For engines where the droop command or set point can be sent to the engine controller the droop setting in parameter 2771 is the actual droop that is being used and this set point is sent to the ECU. This method is referred to as “EIC droop”.

For engines where the droop command or set point cannot be sent to the engine controller, the droop setting in parameter 2771 is used for droop emulation in the EMS-GC10. This method is referred to as “EIC droop emulation”.

In both cases the droop function is activated in the M-logic (EIC droop/EIC droop eumulation) command output.

Please refer to the specific engine type to determine if droop is supported or whether emulated droop has to be used.

## EIC Inhibit

The EIC alarms can be inhibited through M-Logic. This would typically be necessary during stopping of the engine. The following alarms can be inhibited:

- EIC red alarm
- EIC yellow alarm
- EIC malfunction
- EIC protection

## EIC Idle

The “Idle” function of the EMS-GC10 is activated in parameter 6290. If this is used with engines with speed control from CANbus communication, the speed is defined to be 700 rpm.

# Specific Engine Type Descriptions

## About Type Descriptions

> **NOTE:** The J1939 warnings/shutdowns with corresponding SPN and FMI numbers in this chapter refer to those that will automatically appear in the alarm list. The alarms can be acknowledged from the display.
>
> **NOTE:** The available alarms vary from engine type to engine type. Besides these, the entire log list can be read in the engine controller by holding the “LOG” button for 3 seconds.

## Caterpillar/Perkins (J1939)

## Warnings and Shutdowns

| Warning/shutdown list | J1939 Codes | | |
|---|---|---|---|
| | SPN | FMI Warning | FMI Shutdown |
| Low oil pressure | 100 | 17 | 1 |
| Intake manifold #1 P | 102 | 15 | - |
| Coolant temperature | 110 | 15 | 1 |
| High inlet air temp. | 172 | 15 | - |
| Fuel temperature | 174 | 15 | - |
| Overspeed | 190 | 15 | 0 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | X | - |
| EIC protection | - | X | - |

> **NOTE:** FMI Indication “-“ means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine speed
  CANbus ID for speed control: 0x0c000000. J1939 TSC1.
- M-Logic commands are available to enable/disable start/stop and speed controls.
  - EIC start/stop enable
  - EIC speed control inhibit

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

# Cummins CM850-CM570 (J1939)

## Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | 18 | 1 |
| Coolant temperature | 110 | 16 | 0 |
| Oil temperature | 175 | 16 | 0 |
| Intake manifold temp | 105 | 16 | 0 |
| Fuel temperature | 174 | 16 | 0 |
| Coolant level low | 111 | 18 | 1 |
| Overspeed | 190 | - | 16 |
| Crankcase pressure high | 101 | - | 0 |
| Coolant pressure low | 109 | - | 1 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | x | - |
| EIC protection | - | x | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine Controls

  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).

  M-Logic commands are available to enable/disable speed controls:

  - EIC Speed Control Inhibit.
- Engine Speed

  CANbus ID for speed control: 0x00FF69DC. For Cummins proprietary “Engine governing” EG telegram, the source address of the EMS-GC10 controller is 0xDC/220 dec).
- Frequency Selection

  Nominal frequency is written automatically based on the frequency nominal parameter.

  50 Hz is written if: fNOM is < 55 Hz.

  60 Hz is written if: fNOM is > 55 Hz.
- Gain setting

  Gain is set in parameter 2773.
- Shutdown Override

  This command can be used in order to prevent shut down actions from the ECU. The function follows the standard EMS-GC10 function “shutdown override” (digital input on the EMS-GC10).

## Cummins After Treatment

If Cummins After Treatment equipment is installed in the exhaust line and the system is connected to the ECU then indicators from the treatment system can be read over the J1939 link and some regeneration can be controlled.

The table shows lamps and status indicators from the after treatment. The states can be reached through M-logic and can be shown on a FW Murphy display unit.

| Status indicator<br>State | Diesel particulate filter regeneration status | Diesel particulate filter status | Particulate filter lamp | High exhaust system temp. | Regenera - tion disabled |
|---|---|---|---|---|---|
| OFF | - | - | x | x | - |
| ON solid | - | - | x | x | - |
| ON fast blink | - | - | x | - | - |
| Inhibited | - | - | - | - | x |
| Not inhibited | - | - | - | - | x |
| Not Active | x | - | - | - | - |
| Active | x | - | - | - | - |
| Regeneration needed | x | - | - | - | - |
| Regeneration not needed | - | x | - | - | - |
| Regeneration lowest level | - | x | - | - | - |
| Regeneration moderate level | - | x | - | - | - |
| Regeneration highest level | - | x | - | - | - |

Besides the lamp and status indicators two after treatment switches for control of the regeneration are available. These can be reached through M-logic in the command group.

1. Cummins particulate filter manual (non-mission) regeneration initiate.
2. Cummins particulate filter regeneration.

## Detroit Diesel DDEC (J1939)

### Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | x | - |
| EIC protection | - | x | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

### Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000000. J1939 TSC1.
  M-Logic commands are available to enable/disable start/stop and speed controls.
  - EIC Speed Control Inhibit

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

## Deutz EMR 2 – EMR 3 (J1939)

### Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | - | 1 |
| Coolant temperature | 110 | - | 0 |
| Overspeed | 190 | - | 0 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | x | - |
| EIC protection | - | x | - |

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000003. For J1939 TSC1, the source address of the EMS-GC10 controller is 3.
  - EIC Speed Control Inhibit

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

# Generic J1939 (J1939)

## Warnings and Shutdowns

| Warning/shutdown list | J1939 | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC Malfunction | - | X | - |
| EIC Protection | - | X | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000000. J1939 TSC1.
  M-Logic commands are available to enable/disable start/stop and speed controls.
  - EIC Speed Control Inhibit

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

## Iveco (J1939)

## Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | 17 | 1 |
| Intake manifold #1 P | 102 | 15 | - |
| Coolant temperature | 110 | 15 | 0 |
| High inlet air temp. | 172 | 15 | - |
| Fuel temperature | 174 | 15 | - |
| Overspeed | 190 | 15 | 0 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | X | - |
| EIC protection | - | X | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000003.
  For J1939 TSC1, the source address of the EMS-GC10 controller is 3.
  For the Iveco Vector 8 type only: CANbus ID for speed control: 0xcFF0027.
  M-Logic commands are available to enable/disable start/stop and speed controls:
  - EIC Speed Control Inhibit

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

## John Deere JDEC (1939)

## Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | 18 | 1 |
| Intake manifold | 105 | 16 | - |
| Coolant temperature | 110 | 16 | 0 |
| Fuel injection pump | 1076 | 10 | 6 |
| Fuel temperature | 174 | - | 16 |
| ECU failure | 2000 | - | 6 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | X | - |
| EIC protection | - | X | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000000. J1939 TSC1.
  M-Logic commands are available to enable/disable start/stop and speed controls.
  - EIC Speed Control Inhibit

> **NOTE:** The speed regulation is enabled in parameters 2781 (Reg. output) and 7563 (EIC Controls).

## Smart Connect

This protocol is available with MTU series 1600 With ECU8/Smart Connect.

## Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | x | - |
| EIC protection | - | x | - |

> **NOTE:** FMI indication "-" means that the alarm in question is not supported.

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x0c000000. J1939 TSC1.
  M-Logic commands are available to enable/disable start/stop and speed controls:
  - EIC Start/Stop Enable
  - EIC Speed Control Inhibit

  > **NOTE:** The speed regulation is enabled in parameters 2781 (Reg. output) and 7563 (EIC Controls).

- Frequency Selection
  Nominal frequency is written automatically based on the frequency nominal parameter. 50 Hz is written if $f_{nominal}$ <55Hz, 60 Hz is written if $f_{nominal}$ is >55 Hz.
- Shut down Override
  This command can be used with a digital input in order to override shut down actions from the ECU.
- Engine Overspeed Test
  The command is activated through M-Logic. Testing of the overspeed function at any given rpm.
- Enable Cylinder Cutout
  The command can be used to engage all cylinders if the engine is running with one bank only. The command is activated through M-logic.

- Intermittent Oil Priming
  Engage the pre-lubrication oil pump if installed. The command is activated through M-Logic.
- Engine Operating Mode
  Switches the operating mode of the engine. The command is activated through M-Logic (EIC Engine opr mode command).
- Demand Switch
  Set method of speed control between digital (“Up/down ECLU” with relay controls), analog (“Analog ECU Relative” for analog VDC control) or from J1939 commands (“Analog CAN”). This is selected in parameter 2790. Please refer to the MTU documentation for the ECU8 for further information about switching between normal and emergency operation in local or remote.
- Speed Gov. Param Command
  Parameter switch for selection between: Default and Variant 1. M-Logic is used to select variant 1 parameters.
- Trip Counter Reset
  This command resets the trip fuel consumption counter. The command is activated through M-Logic.

## MTU ADEC (CANopen)

The MTU ADEC is not a part of the J1939, therefore the reading of values, alarms and shutdowns are different.

## Display Readings

| Object | Object |
|---|---|
| EIC speed | EIC ambient air temp |
| EIC coolant temp. | EIC exch. temp. A |
| EIC oil pressure | EIC exch. temp. B |
| EIC faults | EIC temp. winding 1 |
| EIC oil temp. | EIC temp. winding 2 |
| EIC fuel temp. | EIC temp. winding 3 |
| EIC Coolant level | EIC turbo 1 outlet temp. |
| EIC charge air pressure | EIC engine intercooler temp. |
| EIC charge air temp. (or EIC intake manifold 1 temp.) | EIC fuel rate |
| EIC air inlet press. | EIC engine trip fuel |
| EIC running hours | EIC trip average fuel rate |
| EIC ECU power supp. | EIC Mean trip fuel consumption |
| EIC oil level | EIC Nominal power |
| EIC after cooler water inlet temp. | EIC Engine power |
| EIC atmospheric press. | |

The Modbus addresses are read-only (function code 04h).

## Warning

Below is a list of warnings that can be shown on the display. The warnings will be shown as an alarm in the alarm window. The alarms can be acknowledged from the display, but they will be visible until the alarm disappears in the ECM module.

| Warning list | Warning list |
|---|---|
| Coolant temp. high | ECU power supply high |
| Charge air temp. high | ECU power supply low |
| Intercooler coolant temp. high | Generator temp. high |
| Lube oil temp. high | Holding tank high level |
| ECU temp. high | Holding tank low level |
| Engine speed too low | Generator winding 1 high temp. |
| Prelube fail. | Generator winding 2 high temp. |
| Start speed not reached | Generator winding 3 high temp. |
| Common alarm (yellow) | Ambient temp. high |
| Lube oil pressure low | Water in fuel 1 |
| Coolant level low | Water in fuel 2 |
| Intercooler coolant level low | Fuel temp. high |
| ECU defect | Exhaust bank A high temp. |
| Speed demand failure | Exhaust bank B high temp. |
| Power supply low voltage | Fuel high pressure 1 |
| Power supply high voltage | Fuel high pressure 2 |
| Overspeed | Day tank high level |
| Lube oil press. low | Day tank low level |
| Coolant temp. high | Run-up speed not reached |
| Lube oil temp. high | Idle speed not reached |
| Charge air temp. high | |

## Shutdown

Below is a shutdown value that can be shown on the display. It is possible to configure “EIC Shutdown” in the system setup to put the unit in a shutdown state and/or to activate relay outputs if necessary. The shutdown state is present, until it disappears in the ECM module.

| Shutdown List |
| --- |
| AL Com. Alarm Red |

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls).
- Engine Speed
  CANbus ID for speed control: 0x300+ADEC ID – speed demand telegram (ADEC ID is selected in parameter 7562, default ID is 6: 0x306).
  M-Logic commands are available to enable/disable start/stop and speed controls:
  - EIC Start/Stop Enable

    > **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

- Start/Stop command
- Frequency Selection
  Nominal frequency is written automatically based on the frequency nominal parameter. 50 Hz is written if fNOM <55Hz, 60 Hz is written if fNOM is >55 Hz.

  > **NOTE:** The CANopen node ID no is selected in parameter 7562. The default value (6) usually matches the ADEC parameter.

- Demand switch
  Set method of speed control between digital (Up/down ECU with relay controls), analog (“Analog ECU Relative” for analog VDC control) or from J1939 commands (“Analog CAN”). This is selected in parameter 2790. Please refer to the MTU documentation for the ECU8 for further information about switching between normal and emergency operation in local or remote.
- Trip counter
  This command resets the trip fuel consumtion counter. The command is activated through M-Logic.
- Enable Cylinder Cutout
  The command can be used to engage all cylinders if the engine is running with one bank only. The command is activated through M-Logic.

## MTU MDEC Module 302/303 (MTU)

**NOTE:** The MTU MDEC is not a part of the J1939, therefore the reading of values, alarms and shutdowns are different.

| Object |
|---|
| EIC speed |
| EIC coolant temp. |
| EIC oil pressure |
| EIC faults |
| EIC oil temp. |
| EIC fuel temp. |
| EIC charge air pressure |
| EIC charge air temp.<br>(or EIC intake manifold 1 temp.) |

**NOTE:** The Modbus addresses are read-only (function code 04h).

## Alarms

Below is a list of alarms that can be shown on the display. The alarms will be shown in the alarm window. The alarms can be acknowledged from the display, but they will be visible until the alarm disappears in the ECM module.

| Alarm List | Warning | Shutdown |
|---|---|---|
| MDEC yellow alarm | X | - |
| MDEC red alarm | - | X |
| Overspeed | - | X |
| Low oil pressure | X | X |
| High coolant temp. | X | X |
| High oil temp | - | X |
| High intercooler temp. | X | - |
| Defective cool. level switch | X | - |
| Low coolant level | - | X |
| MDEC ECU failure | - | X |

**NOTE:** MDEC indication “-“ means that the alarm in question is not supported.

## Write Commands to Engine Controller

None.

## Scania EMS (J1939)

## Warning/Shutdown

None.

## Write Commands to Engine Controller

None.

## Scania EMS 2 S6 (J1939)

## Scania EMS 2 S6 (J1939)

> **NOTE:** Scania EMS 2 S6 does not use the J1939 SPN/FMI (Suspect parameter Number/Failure Mode Indicator) system for alarm handling. Instead the DNL2 system is used. For this reason, the alarm handling is also different.

## Warnings and Shutdowns (DNL2 Alarms)

Below is a list of warnings and shutdowns that can be shown on the display. They will be shown as an alarm in the alarm window. The alarms can be acknowledged from the display, but they will be visible until the alarm disappears in the ECM module.

| Warning/shutdown list | DNL2 warning | DNL2 shutdown |
|---|---|---|
| EMS warning | X | - |
| Low oil pressure | X | - |
| High coolant temp | X | - |
| Stop limit exceeded | - | X |
| Charge 61 | X | - |
| EIC yellow lamp | X | - |
| EIC red lamp | - | X |
| EIC malfunction | X | - |
| EIC protection | X | - |

> **NOTE:** DNL2 indication "-" means that the alarm in question is not supported.
>
> **NOTE:** Handling of alarms is only active when the engine is running.

## Error Log

It is possible to retrieve and acknowledge alarms in the error log of the Scania EMS S6 (KWP 2000).

The alarms available are the same alarms which can be read by the flash combination of the diagnostics lamp on the EMS S6 (please refer to the engine documentation).

> **NOTE:** The EMS S6 software version and engine number is automatically retrieved when CANbus communication is established.

| Flash Code | EMS-GC10 Displayed Text | Description |
|---|---|---|
| 11 | Overreving | One or both engine speed sensors have indicated above 3000 rpm |
| 12 | Speed sensor 1 | Engine sensor 1 |
| 13 | Speed sensor 2 | Engine sensor 2 |
| 14 | Water T sen. | Engine coolant temperature sensor |
| 15 | Char. air T sen | Charge air temperature sensor |
| 16 | Char. air P sen | Charge air pressure sensor |
| 17 | Oil temp. sen. | Oil temperature sensor |
| 18 | Oil pres. sen. | Oil pressure sensor |
| 23 | Fault in cor. | Fault in coordinator |
| 25 | Throttle pedal | CAN message for fine tune nominal speed out of range |
| 27 | Emerg. stop o.r | Engine stop overridden |
| 31 | Oil pres. prot | Oil pressure protection activated |
| 32 | Wrong parameter | Wrong parameter setting for defect CAN communication |
| 33 | Battery voltage | Battery voltage out of range |
| 37 | Emerg. stop cor | Emergency stop switch activated |
| 43 | CAN cir. defect | CAN circuit defect |
| 48 | CAN mess. DLN1 | CAN message from the coordinator missing or not correct |
| 49 | Wrong CAN ver. | Non-matching CAN version in EMS and coordinator |
| 51 | Un. inj. cyl. 1 | Unit injector cylinder 1 |
| 52 | Un. inj. cyl. 2 | Unit injector cylinder 2 |
| 53 | Un. inj. cyl. 3 | Unit injector cylinder 3 |
| 54 | Un. inj. cyl. 4 | Unit injector cylinder 4 |
| 55 | Un. inj. cyl. 5 | Unit injector cylinder 5 |
| 56 | Un. inj. cyl. 6 | Unit injector cylinder 6 |
| 57 | Un. inj. cyl. 7 | Unit injector cylinder 7 |
| 58 | Un. inj. cyl. 8 | Unit injector cylinder 8 |
| 59 | Extra ana. inp. | Voltage out of range on extra analogue input pin |
| 61 | System shutdown | System shut down incorrectly |

| Flash Code | EMS-GC10 Displayed Text | Description |
|---|---|---|
| 66 | Coola. l. prot. | Low engine coolant level |
| 86 | HW watchdog | Hardware watchdog |
| 87 | Fault in RAM | The EMS has detected that the fault code memory is not functioning correctly |
| 89 | Seal | The programme in the EMS has been altered in a prohibited manner |
| 94 | Coola. shut off | Engine coolant temperature/oil pressure shutdown |
| 96 | Overheat prot. | Overheat protection activated |
| 99 | Fault in TPU | Error in TPU Timer Processor Unit |

## Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls)
- Droop
- Engine Speed
  CANbus ID: Offset: 0xcfff727
  Speed 0x0cff8027
  M-Logic commands are available to enable/disable start/stop and speed controls:
  - EIC start/stop enable
  - EIC speed control inhibit
- Frequency selection
  Nominal speed/frequency is selected in parameter 2772. If “user” is selected, nominal speed/frequency is written automatically, based on the frequency nominal parameter.
- Start/stop command

> **NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).
>
> **NOTE:** It is only possible to write commands to the engine when the Scania Coordinator is NOT mounted.

## Control

In the parameter 2770, it is possible to configure the droop parameter and the initial speed setting.

## Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | 5 | - |
| Intake manifold #1 P | 102 | - | - |
| Coolant temperature | 110 | 5 | - |
| High inlet air temp. | 172 | 5 | - |
| Fuel temperature | 174 | - | - |
| Fuel pressure | 94 | 5 | - |
| Oil level | 98 | 5 | - |
| Overspeed | 190 | - | 0 |
| Coolant level low | 111 | - | 1 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | X | - |
| EIC protection | - | X | - |

## Write Commands to Engine Controller

None

## Volvo Penta EMS 2 (J1939)

EMS 2 and EDCIII/D6, D7, D9, D12 and D16 (GE and AUX variants only).

### Warnings and Shutdowns

| Warning/shutdown list | J1939 codes | | |
|---|---|---|---|
| | SPN | FMI warning | FMI shutdown |
| Low oil pressure | 100 | 5 | - |
| Intake manifold #1 P | 102 | - | - |
| Coolant temperature | 110 | 5 | - |
| High inlet air temp. | 172 | 5 | - |
| Fuel temperature | 174 | - | - |
| Fuel pressure | 94 | 5 | - |
| Oil level | 98 | 5 | - |
| Overspeed | 190 | - | 0 |
| Coolant level low | 111 | - | 1 |
| EIC yellow lamp | - | X | - |
| EIC red lamp | - | - | X |
| EIC malfunction | - | X | - |
| EIC protection | - | X | - |

**NOTE:** FMI indication "-" means that the alarm in question is not supported.

### Write Commands to Engine Controller

- Engine Controls
  All the write commands to the engine controller (ex: speed, start/stop, etc.) are enabled in parameter 7563 (EIC Controls)
- Engine Speed
  CANbus ID for speed control: 0x0cff4611 – Volvo Penta proprietary telegram
  M-Logic commands are available to enable/disable start/stop and speed controls:
    - EIC start/stop enable
    - EIC speed control inhibit
- Preheat
- Start/Stop

### Readable States - Preheat and Running

**NOTE:** The speed regulation is enabled in parameter 2781 (Reg. output) and 7563 (EIC Controls).

**NOTE:** Selection of primary or secondary speed is selected in parameter 2774.

# Modbus Communication

## Additional Information

This is to be considered as additional information for Modbus RS 485 RTU. Please refer to the ECM (Engine Communication Module) user manuals for more information about the ECM protocol technical description and the details of each communication value. The data can be transmitted to a PLC, a computer, the alarm-and-monitoring system or a Scada system.

A certain amount of engine data can be transmitted from the engine communication module to the controller unit. They can be transmitted through Modbus.

The available values depend on the selected type of engine communication.

The data readable by the Modbus communication are converted into the chosen unit in parameter 10970.

## Readings

## Analog Values

The reading of values is independent of engine type, so all readings below are available in the Modbus protocol.

The availability of data from the individual engine types is dependent on the specific engine. Please refer to the engine manual in question.

The data refers to the common J1939 display reading list as well as the overview of readings in the MTU ADEC (CANopen) and MTU MDEC (MTU protocol).

| Measurement Table (Read Only) Function Code 04h. | | | | | | |
|---|---|---|---|---|---|---|
| Addr | Content | Unit | Scaling | | | Description |
| | | | J1939 | ADEC | MDEC | |
| 593 | EIC speed | [RPM] | 1/1 | 1/1 | 1/1 | Speed |
| 594 | EIC coolant temp. | [deg] [F] | 1/1 | 1/10 | 1/10 | Coolant temperature |
| 595 | EIC oil pressure | [bar] [psi] | 1/100 | 1/100 | 1/100 | Engine oil pressure |
| 596 | EIC no of faults | [Faults] | 1/1 | 1/1 | 1/1 | Number of faults |
| 597 | EIC oil temp. | [deg] [F] | 1/10 | 1/10 | 1/10 | Engine oil temperature |
| 598 | EIC fuel temp. | [deg] [F] | 1/1 | 1/10 | 1/10 | Fuel temperature |
| 599 | EIC intake manifold #1 P | [bar] [psi] | 1/100 | 1/100 | - | Intake manifold #1 P |
| 600 | EIC air inlet temp. | [deg] [F] | 1/1 | - | - | Air inlet temperature |
| 601 | EIC coolant level | [%] | 1/10 | - | - | Coolant level |
| 602 | EIC fuel rate | [L/h] | 1/10 | 1/1 | - | Fuel rate |
| 603 | EIC charge air press | [bar] [psi] | - | - | 1/100 | Charge air press |
| 604 | EIC intake manifold 1 T (or EIC charge air T) | [deg] [F] | 1/1 | - | 1/10 | Intake manifold 1 temperature |
| 605 | EIC d.d. % torque | [%] | 1/1 | - | - | Driver's demand engine - percent torque |
| 606 | EIC actual % torque | [%] | 1/1 | - | - | Actual engine - percent torque |
| 607 | EIC acc. pedal pos. | [%] | 1/1 | - | - | Accelerator pedal position |
| 608 | EIC % load, c. speed | [%] | 1/1 | - | - | Percent load at current speed |
| 609 | EIC air inlet pressure | [bar] [psi] | 1/100 | - | - | Air inlet pressure |
| 610 | EIC exhaust gas temp. | [deg] [F] | 1/10 | - | - | Exhaust gas temperature |
| 611 | EIC engine hours | [H] | 1/1 | 1/1 | - | ENGINE HOURS |
| 612 | EIC oil filter diff. press. | [bar] [psi] | 1/100 | - | - | Oil filter diff press |
| 613 | EIC battery voltage | [V] | 1/10 | 1/10 | - | Keyswitch battery potential |
| 614 | EIC fuel del. press. | [bar] [psi] | 1/100 | 1/100 | - | Fuel delivery pressure |
| 615 | EIC oil level | [%] | 1/10 | - | - | Engine oil level |
| 616 | EIC crankcase press. | [bar] [psi] | 1/100 | - | - | Crankcase pressure |
| 617 | EIC coolant pressure | [bar] [psi] | 1/100 | - | - | Coolant pressure |
| 618 | EIC water in fuel | [2 bits] | 1/1 | - | - | Water in fuel (1 = Yes, 0 =NO) |
| 619 | Reserved | - | - | - | - | - |
| 620 | Reserved | - | - | - | - | - |
| 621 | Reserved | - | - | - | - | - |
| 622 | Reserved | - | - | - | - | - |
| 623 | EIC turbo oil temp. | [deg] [F] | 1/10 | - | - | Turbo oil temp. |

| Measurement Table (Read Only) Function Code 04h. | | | | | | |
|---|---|---|---|---|---|---|
| Addr | Content | Unit | Scaling | | | Description |
| | | | J1939 | ADEC | MDEC | |
| 624 | EIC trap inlet | [bar] [psi] | 1/100 | - | - | Trap inlet |
| 625 | EIC Air filter diff press | [bar] [psi] | 1/1000 | - | - | Air filter diff press |
| 626 | EIC Cool filter diff press | [bar] [psi] | 1/100 | - | - | Cool filter diff press |
| 627 | EIC Atm press | [bar] [psi] | 1/100 | - | - | Atmospheric pressure |
| 628 | EIC Ambient air temp | [deg] [F] | 1/10 | - | - | Ambient air temp [F/10] |
| 629 | EIC exch. temp A | [deg] [F] | 1/10 | 1/10 | - | Exh. temp bank A |
| 630 | EIC exch. temp B | [deg] [F] | 1/10 | 1/10 | - | Exch. temp bank B |
| 631 | EIC Winding 1 temp | [deg] [F] | - | 1/1 | - | Gen winding 1 temp |
| 632 | EIC Winding 2 temp | [deg] [F] | - | 1/1 | - | Gen winding 2 temp |
| 633 | EIC Winding 3 temp | [deg] [F] | - | 1/1 | - | Gen winding 3 temp |
| 634 | Reserved | - | - | - | - | - |
| 635 | Reserved | - | - | - | - | - |
| 636 | EIC Turbo 1 comproutlet press | [bar] [psi] | - | 1/10 | - | Turbo 1 compr outlet press |
| 637 | EIC Intercooler temp | [deg][F] | - | 1/10 | - | Intercooler temp |
| 638 | EIC trip fuel_gaseous | [kg] | 1/1 | - | - | Trip fuel, gaseous |
| 639 | EIC total fuel used_gaseous | [ton] | 1/10 | - | - | Total fuel used, gaseous |
| 640 | EIC engine trip fuel | [L] | 1/1 | 1/1 | - | Engine trip fuel |
| 641 | EIC engine total fuel used | [kL] | 1/10 | - | - | Engine total fuel used |
| 900 | EIC trip average fuel rate | [L/h] | - | 1/10 | - | Average fuel rate (trip) |
| 901 | EIC nominal power | [Kwm] | 1/1 | 1/1 | - | Nominal power of the engine |
| 902 | EIC trip fuel liquid | [L] | 1/2 | 1/10 | - | High word |
| 903 | EIC trip fuel liquid | [L] | 1/2 | 1/10 | - | Low word |
| 904 | EIC total fuel liquid | [L] | 1/2 | 1/10 | - | High word |
| 905 | EIC total fuel liquid | [L] | 1/2 | 1/10 | - | Low word |
| 906 | EIC mean trip fuel consumption | [L/h] | - | 1/1000 | - | High word |
| 907 | EIC mean trip fuel consumption | [L/h] | - | 1/1000 | - | Low word |
| 908 | EIC engine power | [Kwm] | - | 1/1 | - | Nominal power of the engine (ADEC) |
| 911 | EIC intake manifold #1 absolute pressure | Bar or psi | 1/100 | - | - | Only MTU J1939 Smart Connect |
| 912 | EIC Air filter diff. pressure | Bar or psi | 1/100 | - | - | - |
| 913 | EIC Fuel supply pump inlet pressure | Bar or psi | 1/100 | - | - | - |
| 914 | EIC Fuel filter (suction side) diff. pressure | Bar or psi | 1/100 | - | - | - |

## Diagnostic Codes

To interpret an SPN and/or FMI number, refer to the documentation of the engine manufacturer.

SPN means "Suspect Parameter Number", for example, if the coolant water temperature becomes too high, the SPN code "110" will be shown.

FMI means "Failure Mode Indicator", for example, if the temperature in the above example is at shutdown level, the FMI code "0" will be shown.

Oc means "occurrence counter" and it indicates how many times a specific alarm has occurred., for example, if the specific alarm in the above example (SPN 100, FMI 0) has occurred 2 times, the oc code "2" will be shown.

> **NOTE:** In the table below a specific SPN number is linked to the same FMI and oc number.

| Active Diagnostic Code (DM1/SPN) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1370 | SPN diagnostic no. 1 | Lo word |
| 1371 | SPN diagnostic no. 2 | Lo word |
| 1372 | SPN diagnostic no. 3 | Lo word |
| 1373 | SPN diagnostic no. 4 | Lo word |
| 1374 | SPN diagnostic no. 5 | Lo word |
| 1375 | SPN diagnostic no. 6 | Lo word |
| 1376 | SPN diagnostic no. 7 | Lo word |
| 1377 | SPN diagnostic no. 8 | Lo word |
| 1378 | SPN diagnostic no. 9 | Lo word |
| 1379 | SPN diagnostic no. 10 | Lo word |
| 1380 | SPN diagnostic no. 1 | Hi word |
| 1381 | SPN diagnostic no. 2 | Hi word |
| 1382 | SPN diagnostic no. 3 | Hi word |
| 1383 | SPN diagnostic no. 4 | Hi word |
| 1384 | SPN diagnostic no. 5 | Hi word |
| 1385 | SPN diagnostic no. 6 | Hi word |
| 1386 | SPN diagnostic no. 7 | Hi word |
| 1387 | SPN diagnostic no. 8 | Hi word |
| 1388 | SPN diagnostic no. 9 | Hi word |
| 1389 | SPN diagnostic no. 10 | Hi word |
| 1390-1401 | Not used | Reserved |

| Active Fail Mode Identifier (DM1/FMI) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1402 | FMI diagnostic no. 1 | - |
| 1403 | FMI diagnostic no. 2 | - |
| 1404 | FMI diagnostic no. 3 | - |
| 1405 | FMI diagnostic no. 4 | - |
| 1406 | FMI diagnostic no. 5 | - |
| 1407 | FMI diagnostic no. 6 | - |
| 1408 | FMI diagnostic no. 7 | - |
| 1409 | FMI diagnostic no. 8 | - |
| 1410 | FMI diagnostic no. 9 | - |
| 1411 | FMI diagnostic no. 10 | - |
| 1412-1417 | Not used | Reserved |

| Active Occurrence Counter (DM1/OC) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1418 | Occurrence counter diagnostic no. 1 | - |
| 1419 | Occurrence counter diagnostic no. 2 | - |
| 1420 | Occurrence counter diagnostic no. 3 | - |
| 1421 | Occurrence counter diagnostic no. 4 | - |
| 1422 | Occurrence counter diagnostic no. 5 | - |
| 1423 | Occurrence counter diagnostic no. 6 | - |
| 1424 | Occurrence counter diagnostic no. 7 | - |
| 1425 | Occurrence counter diagnostic no. 8 | - |
| 1426 | Occurrence counter diagnostic no. 9 | - |
| 1427 | Occurrence counter diagnostic no. 10 | - |
| 1428-1433 | Not used | Reserved |

| Active Diagnostic Codes (DM2/SPN) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1434 | SPN diagnostic no. 1 | Lo word |
| 1435 | SPN diagnostic no. 2 | Lo word |
| 1436 | SPN diagnostic no. 3 | Lo word |
| 1437 | SPN diagnostic no. 4 | Lo word |
| 1438 | SPN diagnostic no. 5 | Lo word |
| 1439 | SPN diagnostic no. 6 | Lo word |
| 1440 | SPN diagnostic no. 7 | Lo word |
| 1441 | SPN diagnostic no. 8 | Lo word |
| 1442 | SPN diagnostic no. 9 | Lo word |
| 1443 | SPN diagnostic no. 10 | Lo word |
| 1444 | SPN diagnostic no. 1 | Hi word |
| 1445 | SPN diagnostic no. 2 | Hi word |
| 1446 | SPN diagnostic no. 3 | Hi word |
| 1447 | SPN diagnostic no. 4 | Hi word |
| 1448 | SPN diagnostic no. 5 | Hi word |
| 1449 | SPN diagnostic no. 6 | Hi word |
| 1450 | SPN diagnostic no. 7 | Hi word |
| 1451 | SPN diagnostic no. 8 | Hi word |
| 1452 | SPN diagnostic no. 9 | Hi word |
| 1453 | SPN diagnostic no. 10 | Hi word |
| 1454-1465 | Not used | Reserved |

| Active Fail Mode Identifier (DM2/FMI) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1466 | FMI diagnostic no. 1 | - |
| 1467 | FMI diagnostic no. 2 | - |
| 1468 | FMI diagnostic no. 3 | - |
| 1469 | FMI diagnostic no. 4 | - |
| 1470 | FMI diagnostic no. 5 | - |
| 1471 | FMI diagnostic no. 6 | - |
| 1472 | FMI diagnostic no. 7 | - |
| 1473 | FMI diagnostic no. 8 | - |
| 1474 | FMI diagnostic no. 9 | - |
| 1475 | FMI diagnostic no. 10 | - |
| 1476-1481 | Not used | Reserved |

| Active Occurrence Counter (DM2/OC) | | |
|---|---|---|
| **Addr.** | **Content** | **Description** |
| 1482 | Occurrence counter diagnostic no. 1 | - |
| 1483 | Occurrence counter diagnostic no. 2 | - |
| 1484 | Occurrence counter diagnostic no. 3 | - |
| 1485 | Occurrence counter diagnostic no. 4 | - |
| 1486 | Occurrence counter diagnostic no. 5 | - |
| 1487 | Occurrence counter diagnostic no. 6 | - |
| 1488 | Occurrence counter diagnostic no. 7 | - |
| 1489 | Occurrence counter diagnostic no. 8 | - |
| 1490 | Occurrence counter diagnostic no. 9 | - |
| 1491 | Occurrence counter diagnostic no. 10 | - |
| 1492-1499 | Not used | Reserved |

# Alarms

## Caterpillar/Perkins

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 1 EIC low oil pressure, warning |
| | | Bit 2 EIC low oil pressure, shutdown |
| | | Bit 3 EIC boost pressure, warning |
| | | Bit 4 EIC high coolant temperature, warning |
| | | Bit 5 EIC low coolant level, shutdown |
| | | Bit 6 EIC high inlet air temperature, warning |
| | | Bit 7 EIC fuel temperature, warning |
| | | Bit 8 EIC ECM yellow lamp, warning |
| | | Bit 9 EIC ECM red lamp, shutdown |
| | | Bit 10 EIC overspeed, warning |
| | | Bit 11 EIC overspeed, shutdown |
| | | Bit 12 EIC protection |
| | | Bit 13 EIC malfunction |

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1023 | EIC alarms, engine controller (DM1) | Bit 0 EIC yellow |
| | | Bit 1 Red |
| | | Bit 2 EIC protection |
| | | Bit 3 EIC malfunction |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC DEC communication error |
| | | Bit 1 EIC low oil pressure, warning |
| | | Bit 2 EIC low oil pressure, shutdown |
| | | Bit 3 EIC high coolant temp, warning |
| | | Bit 4 EIC high coolant temperature, shutdown |
| | | Bit 5 EIC low coolant level, warning |
| | | Bit 6 EIC low coolant level, shutdown |
| | | Bit 7 EIC intake manifold temp, warning |
| | | Bit 8 EIC intake manifold, shutdown |
| | | Bit 9 EIC fuel temp., warning |
| | | Bit 10 EIC fuel temp, shutdown |
| | | Bit 11 EIC coolant pressure, shutdown |
| | | Bit 12 EIC oil temp., warning |
| | | Bit 13 EIC oil temp., warning |
| | | Bit 14 EIC overspeed shutdown |
| | | Bit 15 EIC crankcase press., shutdown |

## DDEC – Detroit Engines

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | BIt 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC communication error, warning |
| | | Bit 1 EIC warning |
| | | Bit 2 EIC shutdown |
| | | Bit 3 EIC protection |
| | | Bit 4 EIC malfunction |

## EMR 2 – EMR 3 - Deutz Engines

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC high coolant temperature, shutdown |
| | | Bit 1 EIC low oil pressure, shutdown |
| | | Bit 2 EIC overspeed, shutdown |
| | | Bit 3 EIC EMR shutdown (LS: lamp status) |
| | | Bit 4 EIC EMR warning (LS: lamp status) |
| | | Bit 5 EIC communication error |
| | | Bit 6 EIC protection |
| | | Bit 7 EIC malfunction |

## Generic J1939

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC communication error |
| | | Bit 1 EIC yellow |
| | | Bit 2 EIC red |
| | | Bit 3 EIC protection |
| | | Bit 4 EIC malfunction |

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC communication error |
| | | Bit 1 EIC low oil pressure, warning |
| | | Bit 2 EIC low oil pressure, shutdown |
| | | Bit 3 EIC boost pressure, warning |
| | | Bit 4 EIC high coolant temperature, warning |
| | | Bit 5 EIC low coolant level, shutdown |
| | | Bit 6 EIC high inlet air temperature, warning |
| | | Bit 7 EIC fuel temperature, warning |
| | | Bit 8 EIC ECM yellow lamp, warning |
| | | Bit 9 EIC ECM red lamp, shutdown |
| | | Bit 10 EIC overspeed, warning |
| | | Bit 11 EIC overspeed, shutdown |
| | | Bit 12 EIC protection |
| | | Bit 13 EIC malfunction |

## JDEC – John Deere Engines

Alarm, status and measurement table (read-only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC high coolant temperature, shutdown |
| | | Bit 1 EIC low oil pressure, shutdown |
| | | Bit 2 EIC fuel temperature, shutdown |
| | | Bit 3 EIC fuel control valve, shutdown |
| | | Bit 4 EIC ECU failure, shutdown |
| | | Bit 5 EIC oil pressure, warning |
| | | Bit 6 EIC intake manifold, warning |
| | | Bit 7 EIC coolant temperature, warning |
| | | Bit 8 EIC fuel injection pump, warning |
| | | Bit 9 EIC JDEC shutdown (LS: lamp status) |
| | | Bit 10 EIC JDEC warning (LS: lamp status) |
| | | Bit 11 EIC communication error |
| | | Bit 12 EIC protection |
| | | Bit 13 EIC malfunction |

Alarms, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIc alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temp. 1 |
| | | Bit 5 7620 EIC coolant water temp. 2 |
| | | Bit 6 7630 EIC oil pressure level 1 |
| | | Bit 7 7640 EIC oil pressure level 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms, engine controller (DM1) | Bit 0 EIC communication error |
| | | Bit 1 EIC yellow |
| | | Bit 2 EIC red |
| | | Bit 3 EIC protection |
| | | Bit 4 EIC malfunction |

Alarm, status and measurement table (read only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 EIC 7570 communication error |
| | | Bit 2 EIC 7590 shutdown |
| | | Bit 3 EIC 7600 overspeed |
| | | Bit 4 EIC 7610 coolant water temperature 1 |
| | | Bit 5 EIC 7620 coolant water temperature 2 |
| | | Bit 6 EIC oil pressure 1 |
| | | Bit 7 EIC 7640 oil pressure 2 |
| | | Bit 8 EIC 7650 oil temp. 1 |
| | | Bit 9 EIC 7660 oil temp. 2 |
| | | Bit 10 EIC 7670 coolant level 1 |
| | | Bit 11 EIC 7680 coolant level 2 |
| 1022 | EIC alarms, engine controller | Bit 0 EIC ECU power supp voltage LoLo |
| | | Bit 1 EIC Fuel high temp |
| | | Bit 2 EIC Exhaust A high temp |
| | | Bit 3 EIC Exhaust B high temp |
| | | Bit 4 EIC Pressure 1 high (Aux 1) |
| | | Bit 5 EIC Pressure 2 high (Aux 2) |
| | | Bit 6 EIC Day tank high level |
| | | Bit 7 EIC Day tank low level |
| | | Bit 8 EIC Run-up speed not reached |
| | | Bit 9 EIC Idle speed not reached |

| Addr. | Content | Type |
|---|---|---|
| 1023 | EIC alarms, engine controller | Bit 0 EIC Common alarm red |
| | | Bit 1 EIC Overspeed |
| | | Bit 2 EIC Lube oil press LowLow |
| | | Bit 3 EIC Coolant temperature HiHi |
| | | Bit 4 EIC Lube oil temp HiHi |
| | | Bit 5 EIC Charge air temp HiHi |
| | | Bit 6 EIC ECU power supp voltage HiHi |
| | | Bit 7 EIC Generator temp high warning |
| | | Bit 8 EIC Holding tank high level |
| | | Bit 9 EIC Holding tank low level |
| | | Bit 10 EIC Winding 1 temp high |
| | | Bit 11 EIC Winding 2 temp high |
| | | Bit 12 EIC Winding 3 temp high |
| | | Bit 13 EIC Ambient temp high |
| | | Bit 14 EIC Water in fuel 1 |
| | | Bit 15 EIC Water in fuel 2 |
| 1024 | EIC alarms, engine controller | Bit 0 EIC Coolant high temp |
| | | Bit 1 EIC Charge air high temp |
| | | Bit 2 EIC Intercooler coolant high temp |
| | | Bit 3 EIC Lube oil high temp |
| | | Bit 4 EIC ECU high temp |
| | | Bit 5 EIC Engine speed low |
| | | Bit 6 EIC Prelube fail |
| | | Bit 7 EIC Start speed not reached Common alarm |
| | | Bit 8 EIC yellow |
| | | Bit 9 EIC Lube oil pressure low |
| | | Bit 10 EIC Coolant level low |
| | | Bit 11 EIC Intercooler coolant level low |
| | | Bit 12 EIC ECU defect |
| | | Bit 13 EIC Speed demand defect |
| | | Bit 14 EIC Power supply low voltage |
| | | Bit 15 EIC Power supply high voltage |

Alarm, status and measurement table (read-only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 EIC communication error |
| | | Bit 2 EIC shutdown |
| | | Bit 3 EIC overspeed |
| | | Bit 4 EIC coolant water temperature 1 |
| | | Bit 5 EIC coolant water temperature 2 |
| | | Bit 6 EIC oil pressure 1 |
| | | Bit 7 EIC oil pressure 2 |
| 1024 | EIC alarms, engine controller | Bit 0 EIC overspeed, shutdown |
| | | Bit 1 EIC low oil pressure, warning |
| | | Bit 2 EIC low oil pressure, shutdown |
| | | Bit 3 EIC low coolant level, shutdown |
| | | Bit 4 EIC MDEC ECU failure, shutdown |
| | | Bit 5 EIC high coolant temperature, warning |
| | | Bit 6 EIC high coolant temperature, shutdown |
| | | Bit 7 EIC high intercooler coolant temp, warning |
| | | Bit 8 EIC high oil temperature, shutdown |
| | | Bit 9 EIC high charge air temperature, shutdown |
| | | Bit 10 EIC defect coolant level switch, warning |
| | | Bit 11 EIC MDEC yellow alarm, warning |
| | | Bit 12 EIC MDEC red alarm, shutdown |

Alarm, status and measurement table (read-only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1026 | EIC alarms (KWP 2000) | Bit 0 EIC overreving |
| | | Bit 1 EIC speed sensor 1 |
| | | Bit 2 EIC speed sensor 2 |
| | | Bit 3 EIC water temp. sensor |
| | | Bit 4 EIC charge air temp. sensor |
| | | Bit 5 EIC charge air pressure sensor |
| | | Bit 6 EIC oil temp. sensor |
| | | Bit 7 EIC oil pressure sensor |
| | | Bit 8 EIC fault in cor. |
| | | Bit 9 EIC throttle pedal |
| | | Bit 10 EIC emergency stop override |
| | | Bit 11 EIC oil pressure prot. |
| | | Bit 12 EIC wrong parameter |
| | | Bit 13 EIC battery voltage |
| | | Bit 14 EIC oil pressure prot. |
| | | Bit 15 EIC emergency stop cor. |
| 1027 | EIC alarms (KWP 2000) | Bit 0 EIC CAN cir. defect |
| | | Bit 1 EIC CAN mess. DLN1 |
| | | Bit 2 EIC Wrong CAN version |
| | | Bit 3 EIC un. inj. cyl. 1 |
| | | Bit 4 EIC un. inj. cyl. 2 |
| | | Bit 5 EIC un. inj. cyl. 3 |
| | | Bit 6 EIC un. inj. cyl. 4 |
| | | Bit 7 EIC un. inj. cyl. 5 |
| | | Bit 8 EIC un. inj. cyl. 6 |
| | | Bit 9 EIC un. inj. cyl. 7 |
| | | Bit 10 EIC un. inj. cyl. 8 |
| | | Bit 11 EIC extra ana. inp. |
| | | Bit 12 EIC system shutdown |
| | | Bit 13 EIC coola. L. prot. |
| | | Bit 14 EIC HW watchdog |
| | | Bit 15 EIC fault in RAM |

| Addr. | Content | Type |
|---|---|---|
| 1028 | EIC alarms (KWP 2000) | Bit 0 EIC seal |
| | | Bit 1 EIC coola. shut OFF |
| | | Bit 2 EIC overheat prot. |
| | | Bit 3 Fault in TPU |
| | | Bit 4 Not used |
| | | Bit 5 Not used |
| | | Bit 6 Not used |
| | | Bit 7 Not used |
| | | Bit 8 Not used |
| | | Bit 9 Not used |
| | | Bit 10 Not used |
| | | Bit 11 Not used |
| | | Bit 12 Not used |

Alarm, status and measurement table (read-only) function code 04h.

| Addr. | Content | Type |
|---|---|---|
| 1020 | EIC alarms | Bit 0 7570 EIC communication error |
| | | Bit 1 7580 EIC warning |
| | | Bit 2 7590 EIC shutdown |
| | | Bit 3 7600 EIC overspeed |
| | | Bit 4 7610 EIC coolant water temperature 1 |
| | | Bit 5 7620 EIC coolant water temperature 2 |
| | | Bit 6 7630 EIC oil pressure 1 |
| | | Bit 7 7640 EIC oil pressure 2 |
| | | Bit 8 7650 EIC oil temp. 1 |
| | | Bit 9 7660 EIC oil temp. 2 |
| | | Bit 10 7670 EIC coolant level 1 |
| | | Bit 11 7680 EIC coolant level 2 |
| 1024 | EIC alarms (DM 1) | Bit 0 EIC overspeed, warning |
| | | Bit 1 EIC oil pressure, warning |
| | | Bit 2 EIC oil temperature, warning |
| | | Bit 3 EIC high coolant temperature, warning |
| | | Bit 4 EIC low coolant level, warning |
| | | Bit 5 EIC fuel pressure, warning |
| | | Bit 6 EIC ECM yellow lamp, warning |
| | | Bit 7 EIC ECM red lamp, shutdown |
| | | Bit 8 EIC high inlet air temperature, warning |
| | | Bit 10 EIC battery voltage, warning |
| | | Bit 11 EIC low oil level, warning |
| | | Bit 12 EIC protection |
| | | Bit 13 EIC malfunction |

# Appendix II —M-Logic

## Introduction to M-Logic

The M-Logic is a small logic controller incorporated in the EMS-GC10 unit. Even though it is a logic controller, it must not be confused with a PLC. The M-Logic can be compared with a PLC limited in functionality and can only be used for uncomplicated tasks.

The M-Logic can carry out binary control functions only; there are no possibilities for analog reading and/or control functions.

The M-Logic can be programmed from the free PC tool called Utility Software (USW version 3). The USW can be downloaded from: www.FWMurphy.com.

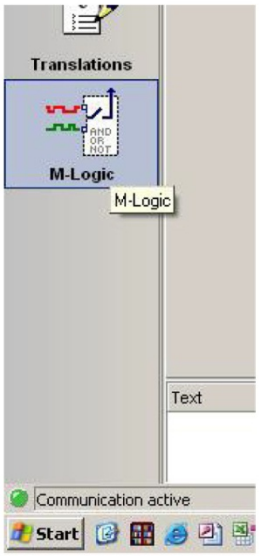
M-Logic setting is done in command lines. There are 40 lines, and each line contains 3 events, 2 operators and one output with a possibility to make a time delay.

If 3 operators are not enough, a number of virtual events can be used to pass the control on to another line and carry on there. This makes it possible to build larger event-based controls.

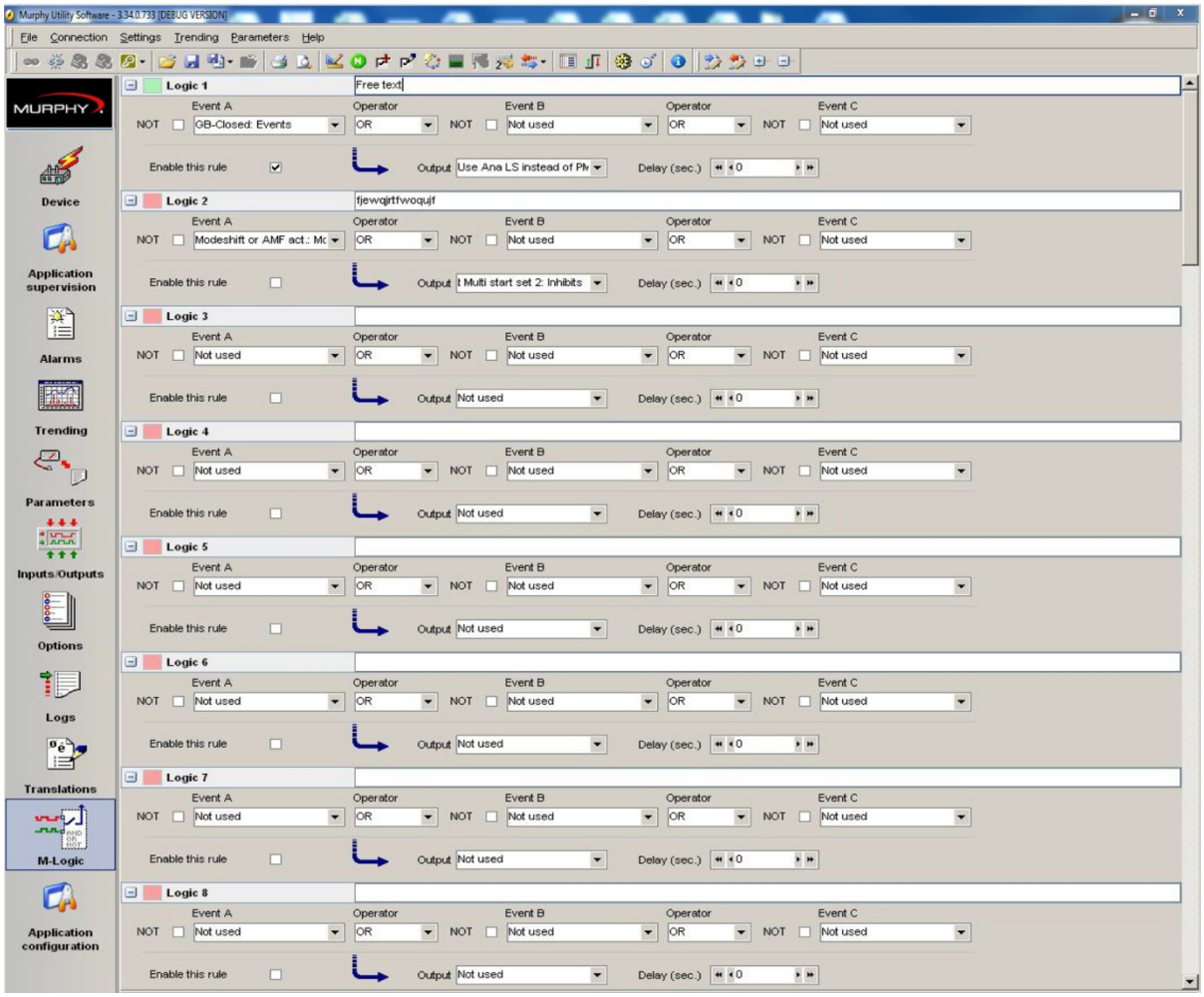
# Configuration

## Starting the M-Logic

Once the USW has been started, there will be an icon on the lower left-hand side to activate M-Logic



Click the icon, and the following screen appears:

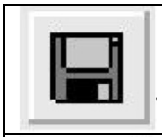



## Read/Write and Save/Open

When the M-Logic screen is shown, the M-Logic toolbar appears at the top of the screen. The toolbar has two buttons which are used to write and read the M-Logic configuration to and from the unit.

| | |
|---|---|
|  | Read: Activating this button will read all M-Logic settings from the unit to the USW. |
|  | Write: Activating this button will write the M-Logic settings from the USW to the unit. |

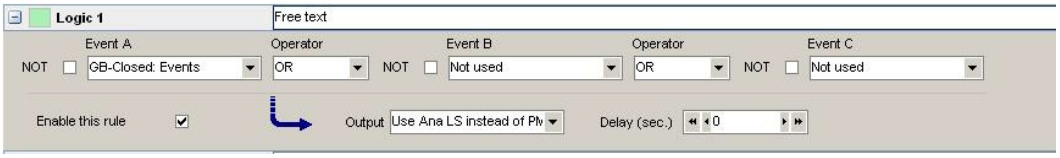
The M-Logic configuration can also be saved/opened to/from a file using the default save/open buttons.

| | |
|---|---|
|  | Save: Activating this button makes it possible to save the M-Logic configuration to file (part of the general EMS-GC10 configuration file ".USW"). |
|  | Open: Activating this button makes it possible to open a previously saved logics file. |

## Basic Functions

The M-Logic consists of a number of "lines", Logic 1, Logic 2 and so on. Each of these lines have three event settings, two operator settings, one enable tick box and one output setting.

The Logic line can be collapsed or expanded using this button. The free text will still be shown.



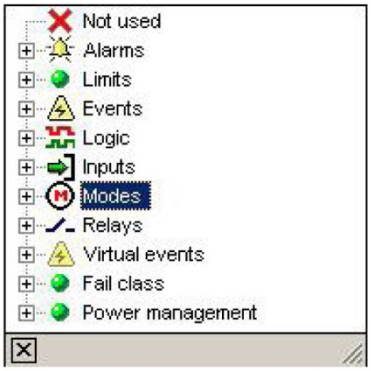

> **NOTE:** The free text is stored in the .usw file, but not in the product itself.

The available functions are Events A, B, and C. These are used to trigger the logic.

## Events A, B, and C

> **Note:** For each event, the function “NOT” can be selected to get an inverted function.

When opening the roll-down window of the events, this window appears.




| | |
|---|---|
| **Alarm** | Use an alarm to activate. |
| **Limits** | Same as alarms, only with no time delay on binary inputs. |
| **Events** | Events that are not alarms, for example, "Engine Running". |
| **Static Sync. Type** | Selected static sync. Functionality. |
| **Command Timers** | If the activating (triggering) event is required to be a pulse, these can be used (1 sec. pulse). |
| **CAN inputs** | Status of M-logic functions broadcasted on the power management CAN line. |
| **Logic** | Can be TRUE or FALSE. TRUE means always, FALSE means never. |
| **Inputs** | Direct activation of a binary input. The availability of binary inputs is option-dependent. |
| **Modes** | Running modes and plant modes, e.g. "AUTO". |
| **Relays** | Activation when a relay activates. The availability of relay outputs is option-dependent. |
| **Virtual Events** | A number of internal (virtual) events that can be activated from another logic line. By using these virtual events, the number of activating (triggering) events can be expanded from the three available in each logic line to, in theory, an unlimited number of events. |
| **Fail Class** | The event activates upon activation of any alarm with the chosen fail class, for example, "Shut-down". |
| **EIC Events** | Events that are related to engine communication. |

## Operators

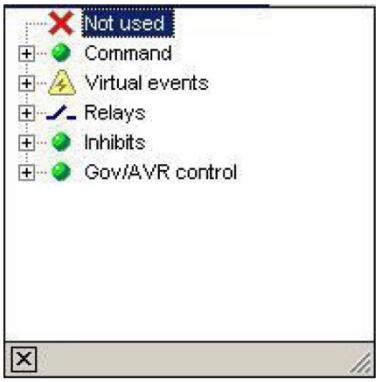
Two operators are available, and they can be: “OR” (any operator activates the function output), “AND” (all activated operators must have status ON to activate the function output).

## Enable the Rule

If this tick box is not ticked, the logic in question will not operate.

## Output

This is the selection of the reaction of the system upon activation of the function. Note that the output has a delay function. If set to 0 s (default), there is no delay.




| | |
|---|---|
| **Commands** | Command to the EMS-GC10 unit, for example,, select AUTO running mode. |
| **Virtual events** | A number of internal (virtual) events that can be activated and used in another logic line. By using these virtual events, the number of activating (triggering) events can be expanded from the three available in each logic line to, in theory, an unlimited number of events. Virtual events can also be trigged from Modbus. |
| **Relays** | Selection of a relay output. The selection of these is option-dependent. |
| **Inhibits** | A selection of inhibit functions for the alarms. Static sync. type: Selection between static sync. functionalities. |
| **Gov/AVR control** | Possibility to force the speed/voltage control up or down for 5 sec. |
| **Alarm LED** | The availability of the alarm LEDs is dependent on the module in question. There are (4) LED’s mounted on the display front. |
| **EIC commands** | Commands that are related to engine communication. |
| **Buzzer** | Incorporated buzzer. Control of activation and deactivation of the buzzer (e.g., with alarms). |
| **CAN cmd** | Command to EMS-GC10 unit connected to the power management CAN line, for example, select AUTO running mode. |

> **NOTE:** If a relay output is chosen, the relay in question must be set up to be a limit relay output. This is done in the parameter list under "OUTPUTS".
>
> **NOTE:** If a relay output is chosen, the relay in question must be set up to be an alarm/limit output (input/output settings, icon in the top of the USW).

## Definitions

The TRUE and FALSE states are explained below.

A TRUE state of an input/event will be detected, if the condition defined in the input/event is met.

**Examples given:**

Digital input is TRUE when activated (12/24V DC applied).

Alarm condition is TRUE when the alarm is present.

Mode condition is TRUE when the mode is selected.

A FALSE state of an input event will be detected, if the condition defined in the input event is not met.

**Examples given:**

Digital input is FALSE when deactivated (12/24V DC not applied).

Alarm condition is FALSE when the alarm is not present.

Mode condition is FALSE when the mode is not selected.

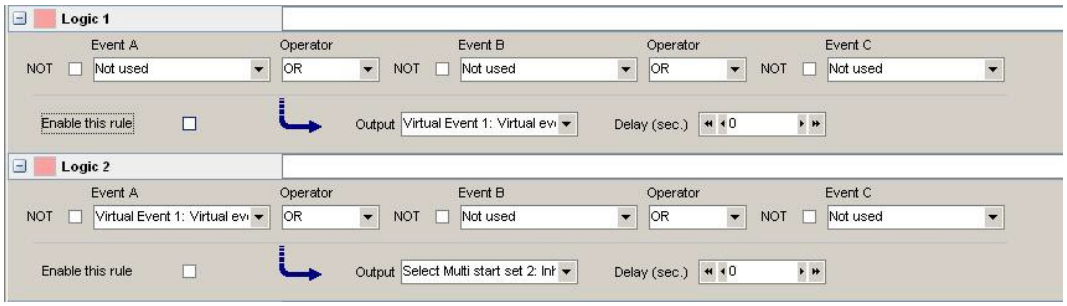
## Examples

By using the events, rules can be made for the use of the M-Logic.

### Virtual Events

Virtual events are used to expand the number of events in a logic sequence.

The following shows how the output of Logic 1 is used to continue the sequence in Logic 2.




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

This gives a total of five events that can be used in this logic sequence (A + B + C in Logic 1 and B + C in Logic 2).

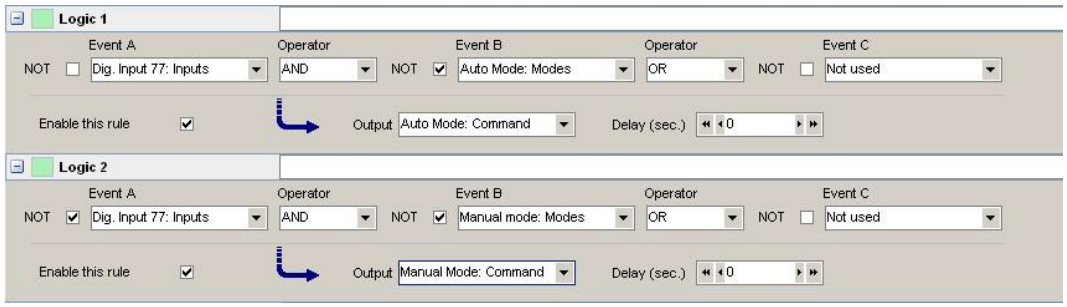
### Set/Reset Function

If you use a single binary input for, for example, selection of AUTO/MANUAL, you need a SET/RESET function, since two binary inputs are normally required for this.

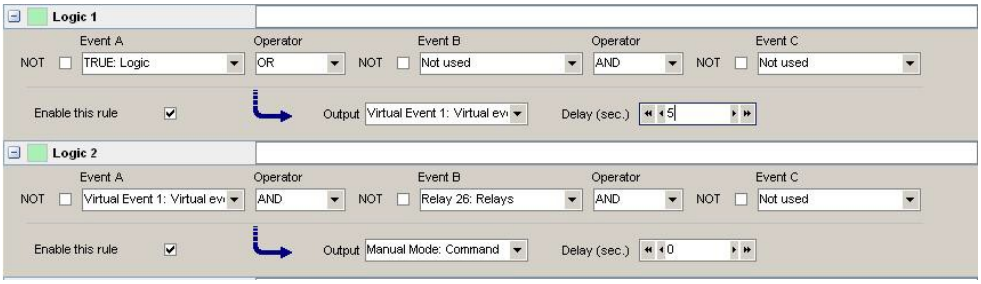
In the following example, binary input no. 10 is used to switch between AUTO (input ON) and MANUAL (input OFF).

| | |
|---|---|
| First line | If input 10 = ON and AUTO = OFF (NOT Auto operation mode), then set AUTO mode command. |
| Second line | If input 10 = OFF and MANUAL = OFF (NOT Manual operation), then set MANUAL mode command. |

In M-Logic, it looks like this:



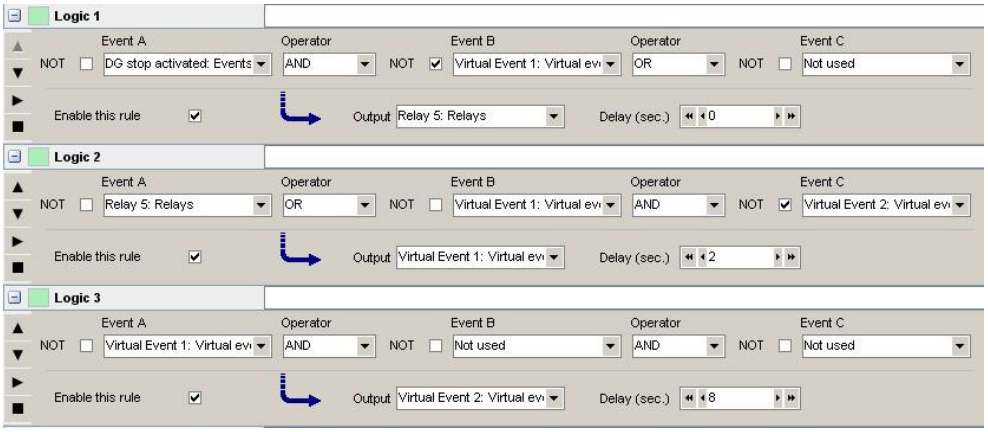
## Power Up In a Specific Mode




In the above example, the unit will always power up in manual mode. The timer in Logic 1 sets the output for 5 s, and this is used to set manual mode in event 2. When the timer expires, you can freely select any mode since the virtual event 1 turns ON and the Logic 2 says NOT virtual event 1.

## Flip-Flop Function

If a flip-flop (periodical relay output ON/OFF) function is required, the following example can be used:




The example shows how to configure relay 5 as an output for a flashing light (or similar) during engine stop-ping sequence.

The event "DG Stop activated" triggers the function.

Logic 1: DG stop activated event triggers the function. The relay output resets if the virtual event (VE) 1 is active.

Logic-2: Relay 5 triggers VE 1 or VE 1 holds itself ON provided VE 2 is NOT active. The time delay of VE 1 is the relay 5 ON time.

Logic 3: VE 1 triggers VE 2. The time delay of VE 2 is the relay 5 OFF time. This time has to be longer than the time delay of VE 1.

The relay 5 (parameter) has to be set to "Limit".

# List of Events and Commands

| Events | Description | Notes |
|---|---|---|
| Alarms | All alarms are available as events in the alarm category. Note that the list will show all alarms, also those that are not available in the present configuration of basic unit and options. | |
| Limits | Like the alarm list it represents the alarms. | If the outputs A and B of the alarm in question (e.g. BB < 1) are set to "limit", the alarm message will not appear, but the function will still trigger in the M-Logic limits section. |
| Events | Main fail | Main failure condition (single generator set). |
| | MB closed | Mains breaker (single generator set). |
| | MB opened | |
| | GB opened | Generator breaker (generator set). |
| | GB closed | |
| | G volt/freq OK delay expired | Diesel generator V/Hz OK (generator set). |
| | GB direct in | Generator breaker is being closed on a dead busbar (generator set). |
| | GB black close request | Generator breaker direct close on request to dead busbar. |
| | Running | Engine is running (generator set). |
| | Access lock | Binary input access lock activated. |
| | Emergency stop | Emergency stop activated. |
| | DG ready for auto start | All is normal, no alarms. |
| | Cranking | Crank output activated. |
| | Start activated | Start sequence activated. |
| | Lamp test | Lamp test in progress. |
| | Battery test activated | Battery test in progress. |
| | Cool down active | Cool down sequence in progress. |
| | Engine heater in manual control | Force/release block of engine heater (toggle function) |
| | Alternative start activated | Alternative start is a full AMF sequence test of the plant. |
| | Parameter set 1 used | The parameter sets can be selected internally or with binary input. |
| | Parameter set 2 used | |
| | Parameter set 3 used | |
| | Parameter set 4 used | |
| | DG in quarantine | The diesel generator cannot be used. |
| | Test mode simple selected | Selection of test mode. |
| | Test mode full selected | |
| | BB voltage OK | Busbar voltage |
| | Application 1 activated | The applications are the choices of the plant layout. Four different layouts can be stored at the same time. |
| | Application 2 activated | |
| | Application 3 activated | |
| | Application 4 activated | |
| | Single DG selected | Application selection. |
| | Multi-mains selected | |
| | Dynamic section equal static section | |
| | G volt/freq OK | Generator frequency and voltage are within range. |
| | Update mode local selected | Update of setting on local |
| | Update mode on all selected | Update of setting |
| | Ack. all alarms active | Acknowledge all active alarms. |
| | Mode shift activated | Mode shift between a running mode and |

| Events | Description | Notes |
|---|---|---|
| Events | Mode shift deactivated | AMF (Automatic Mains Failure). |
| | 3-phase system | AC configuration. |
| | Split L1L3-phase system | |
| | Split L1L2-phase system | |
| | Single phase system | |
| | Test application selected with output cmd enabled | Emulation with engine and breaker relay reaction. |
| | Test application selected with output cmd disabled | Emulation without engine and breaker relay reactions. |
| | BB Parameter set 1 used | Nominal busbar settings 1 and 2. |
| | BB Parameter set 2 used | |
| | 60 Hz system | The event becomes true if the nominal frequency is higher than 55 Hz. |
| Logic | Not used | - |
| | TRUE | “Always”. |
| | FALSE | “Never”. |
| Command Timers | Cmd timer 01 active | The command timers will operate in pairs of two to activate and deactivate a flop-flop function. |
| | Cmd timer 02 active | |
| | Cmd timer 03 active | |
| | Cmd timer 04 active | |
| | Any Cmd timers active | |
| Can Inputs | CAN inputs 01-16 active (expansion I/O) | The CAN inputs are handled as binary inputs |
| Inputs | Binary input activated (digital input or external I/O) | The number of binary inputs selectable is hardware option dependent. The number indicates the terminal number for the input in question. |
| | Emergency stop | Emergency stop input activated (note that this is normal state for emer.). |
| Modes | Island | Island is one or several generators running in an island NOT connected to mains grid. |
| | AMF | Automatic mains failure. |
| | Peak shaving | Peak shaving cuts the peak of the mains consumption by paralleling the generator to the mains. |
| | Fixed power | Mains grid parallel fixed generator power. |
| | Mains power export | Export of power to the mains grid. |
| | Load takeover | Load is transferred from mains to generator, and mains is disconnected. |
| | Auto mode | |
| | Test mode | |
| | Manual mode | |
| | Block mode | |

In the following section, EMS-GC10 Genset Controller Unit module CANbus addresses. These are divided into:

DG (diesel generator unit): Address 1-16

Mains (Mains breaker unit with or without tie breaker):Address 17-32

BTB (bus tie breaker unit): Address 33-40

| Event | Description | Notes |
|---|---|---|
| | Unit has command status | This unit is in command. |
| | DG X GB closed | Diesel generator breaker closed. |
| | Mains X TB closed | Tie breaker controlled by mains unit closed. |
| | DG X GB opened | Diesel generator breaker closed. |
| | Mains X TB opened | Tie breaker controlled by mains units open. |
| | DG X volt/freq OK | Diesel generator voltage and frequency OK. |
| | Mains X mains volt/freq OK | Mains grid voltage and frequency OK. |
| | DG X ready to auto start | Diesel generator ready to auto start. |
| | Mains X in auto or test | Mains unit in auto or test running mode. |
| | DG X has any alarm present | Diesel generator unit has an alarm. |
| | Mains X has any alarm present | Mains unit has an alarm. |
| | DG X running | Diesel engine running. |
| | Mains X MB closed | Mains breaker closed. |
| | Mains X MB opened | Mains breaker open. |
| | DG X synchronizing | Diesel generator breaker is being synchronized. |
| | Mains X synchronising | Mains breaker is being synchronised. |
| | Mains X TB synchronising | Tie breaker is being synchronised. |
| | BTB X BTB closed | Bus tie breaker is closed. |
| | BTB X BTB opened | Bus tie breaker is open. |
| | BTB X BTB synchronising | Bus tie breaker is being synchronised. |
| | Mains X mains failure | Mains failure detected. |
| | Any BTB deloading | Any bus tie breaker is deloading. |
| | First priority | Indicates number of priority. |
| | First standby | Indicates number of priority. |
| | Second standby | Indicates number of priority. |
| | Third standby | Indicates number of priority. |
| | Any mains on busbar | Do any of the mains connections supply voltage to the busbar? |
| | Any MB synchronizing | Are any of the mains breakers in the process of synchronizing? |
| | Any TB synchronizing | Are any of the tie breakers in the process of synchronizing? |
| | Any TB de-loading | Are any of the tie breakers in the process of being de-loaded? |
| | Asymmetric LS enabled | Asymmetric LS enabled |
| | Asymmetric LS active | Asymmetric LS active |

| Event | Description | Notes |
|---|---|---|
| Eic Event | DPF Lamp OFF | Particulate filter is OK. |
| | DPF Lamp ON (solid) | Indicates initial need for regeneration. |
| | DPF Lamp ON (blink) | Regeneration is necessary<br>(after regeneration the lamp turns OFF). |
| | DPF Active Regeneration not activated (status) | Regeneration status. |
| | DPF Active Regeneration activated (status) | Regeneration status. |
| | DPF Active Regeneration needed (status) | Regeneration status. |
| | DPF Regen not needed (status) | Level of needed regeneration. |
| | DPF Regen needed lowest level (status) | Level of needed regeneration. |
| | DPF Regen needed moderate level (status) | Level of needed regeneration. |
| | DPF Regen needed highest level (status) | Level of needed regeneration. |
| | DPF Regen not inhibited (lamp) | Regeneration switch is disabled. |
| | DPF Regen inhibited (lamp) | Regeneration disable switch is active.<br>Automatic and manual regeneration cannot occur. |
| | High Exh Syst Temp OFF (lamp) | Exhaust temp. below. |
| | High Exh Syst Temp ON (lamp) | Exhaust temp. above. |

## Operators

| Operator | Description | Notes |
|---|---|---|
| OR | Using OR between 2 events means that the output will activate when one of these activates. | |
| AND | Using AND between 2 operators means that the output will only activate if both events are activated. | |

## Outputs

| Output | Description | Notes |
|---|---|---|
| Commands | Island | Function modes. |
| | AMF | |
| | Peak shaving | |
| | Fixed power | |
| | Mains power export | |
| | Load takeover | |
| | Semi-auto | Running modes. |
| | Test mode | |
| | Manual mode | |
| | Block mode | |
| | Lamp test | Activate lamp test (LED's on display). |
| | Ack. all alarms | Acknowledge all alarms. |
| | Battery test | Activate battery test |
| | Engine heater manual ctrl. | Force/release block of engine heater (this will disable/enable the engine heater function). |
| | Set to local start | Select local start in a power management application. |
| | Set to remote start | Select remote start in a power management application. |
| | Set clock to 4 am | Set the device clock to 4 am/<br>04.00. |
| | Set parameter 1 | Choose a parameter set (nominal settings). |

| Output | Description | Notes |
|---|---|---|
| | Set parameter 2 | |
| | Set parameter 3 | |
| | Set parameter 4 | |
| | Select test type to simple | Test sequence selection. |
| | Select test type to full | |
| | Block GB sequence | Block the operation of the genset breaker. |
| | Select application 1 | Power management: Four different applications can be stored at the same time in the units. Here the selection between them can be made. |
| | Select application 2 | |
| | Select application 3 | |
| | Select application 4 | |
| | Run my ID | Runs the connected mains |
| | Run one mains | Run one mains only |
| | Run all mains | Run all mains in application |
| | Update mode local | Running mode update. |
| | Update mode on all | Running mode update |
| | Store common settings | Broadcast the common settings to all units. |
| | Open GB | Generator breaker. |
| | Close GB | |
| | Open MB | Mains breaker. |
| | Close MB | |
| | Start and close GB | Start the engine and close the breaker/open the breaker and stop engine. |
| | GB open and stop | |
| | Auto start/stop | ON = Start, OFF = Stop. |
| | Remote start | Pulse signal. |
| | Remote stop | Pulse signal. |
| | Deactivate base load | Disables the base load function. |
| | First priority | Forces this unit to have the first priority in a power management system. |
| | Select 3-phase system | Selects to measure AC voltage on a 3-phase system. |
| | Select split L1 L3 phase system | Selects to measure AC voltage on a 2-phase system. |
| | Select split L1 L2-phase system | Selects to measure AC voltage on a 2-phase system. |
| | Select single phase system | Selects to measure AC voltage on a 1-phase system. |
| | Idle run low speed | Idle speed constant low speed. |
| | Idle run temp control | Idle speed temperature-dependent. |
| | Cool down threshold | Interrupt cool down sequence. |
| | Activate all AOP-2 buzzers | All AOP-2 buzzers. |
| | Activate all AOP-2 relays | All AOP-2 relays. |
| | Activate relay on AOP-2 ID1 | Single AOP-2 relays. |
| | Activate relay on AOP-2 ID2 | |
| | Activate relay on AOP-2 ID3 | |
| | Activate relay on AOP-2 ID4 | |

| Output | Description | Notes |
|---|---|---|
| | Activate relay on AOP-2 ID5 | |
| | Activate buzzer on AOP-2 ID1 | Single AOP-2 buzzer. |
| | Activate buzzer on AOP-2 ID2 | |
| | Activate buzzer on AOP-2 ID3 | |
| | Activate buzzer on AOP-2 ID4 | |
| | Activate buzzer on AOP-2 ID5 | |
| | Fan A running | Running feedback for cooling fans. |
| | Fan B running | |
| | Fan C running | |
| | Fan D running | |
| | MB close inhibit | Inhibit the closing of MB. |
| | Reset horn | Reset the horn relay. |
| | Activate buzzer on controller | Activates the controllers internal buzzer |
| | Deactivate buzzer on controller | Deactivates the controllers internal buzzer |
| | Reset rel. counter | |
| | Set parameter 1 | Select between parameter set 1 and 2 for BB nominal settings. |
| | Set parameter 2 | |
| | M-Logic alarm 1 | These are virtual alarms that can be used to trigger M-Logic events. The alarms can also be set in the digital inputs. |
| | M-Logic alarm 2 | |
| | M-Logic alarm 3 | |
| | M-Logic alarm 4 | |
| | M-Logic alarm 5 | |
| | Act. Max ventilation | Activates max Ventilation. |
| | De-act. Max ventilation | Deactivates max ventilation |
| | Shutdown override | Activates shutdown override |
| Virtual Event | Virtual event 1-32 | These are used as interconnection between multiple logics to enhance the possible number of events in one sequence. |
| Relays | Selectable no. of relays are option-dependent | The list will show all relays possible, including optional ones. Make sure that a selected relay is actually present. |
| Inhibits | Not used | - |
| | Deactivate mode button | Mode button on display front. |
| | Inhabit acknowledge in AUTO | If in AUTO mode, the alarm acknowledge is not possible. |
| | Inhabit Modbus commands | Modbus commands are ignored. |
| | Inhibit 1 | Alarm inhibits. |
| | Inhibit 2 | |
| | Inhibit 3 | |
| | Activate mode shift | Shift from a running mode to AMF in case of mains failure. |
| | Deactivate mode shift | |
| | Inh. BTB close request | Bus tie breaker closing not allowed. |
| | Block request for section | Use of section not allowed. |
| | Inh. AOP1 buttons | All command buttons on AOP are ignored. |
| | Inh. start button | - |
| | Inh. stop button | - |
| | Inh. GB button | - |
| | Inh. MB button | - |

| Output | Description | Notes |
|---|---|---|
| CAN Command | CAN command 01-16 active | |
| Alarm Ind. Leds | LED X Red + blink | X = ID number (01-04). |
| | LED X Red | |
| | LED X Yellow +blink | |
| | LED X Yellow | |
| | LED X Green + blink | |
| | LED X Green | |
| | Activate view 1-20 on display 1 | Activate a specific view on display 1. |
| Quick SetUp | Off | Quick setup for application configuration. |
| | Setup stand alone | |
| | Setup plant | |
| EIC Command | EIC droop | Activate ECU droop. |
| | EIC droop emulation | Activate droop in the ML-2 (reference setpoint still nominal frequency/power but regulation loop is with added droop for stability). |
| | EIC reset trip fuel | Reset fuel counter in the ECU. |
| | EIC enable cylinder cutout | Allows cylinder cutout. |
| | EIC engine over-speed test | Initiate over-speed test. |
| | EIC intermittent oil priming | Activate oil priming pump. |
| | EIC Engine opr mode command | Set the operating mode of the engine. |
| | EIC Engine speed gov param command | Select default or variant 1 governor parameter setting. |
| | EIC DPF regeneration inhibit | The Regeneration Disabled (Inhibit) switch disallows any automatic or manual (non-mission) regeneration of the diesel particulate filter.<br>This may be used by the operator to prevent regeneration when the machine is operating in a hazardous environment and the OEM is concerned about high temperature. |
| | EIC DPF regeneration force | The Regeneration Initiate switch initiates a manual (non-mission) regeneration of the particulate filter when the machine is in non-mission condition and DPF soot levels are high enough to allow regeneration.<br>This switch is for use in forcing a regeneration event to occur to troubleshoot the system. During a non-mission regeneration the engine speed will increase to an optimum speed for regeneration. |
| | Inh EIC alarms | Inhibit of EIC alarms; red/yellow/ protection/malfunction. |
| | EIC Select Cummins PCC1301 | Enable speed control for PCC 1301. |
| | EIC Start/stop enable | Switch ON/OFF the start and stop commands. |
| | EIC Speed control inhibit | Disable the EIC speed control. |

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