DEIF A/S

Designer's Reference Handbook

Generator Protection Unit/GS Multi-line 2

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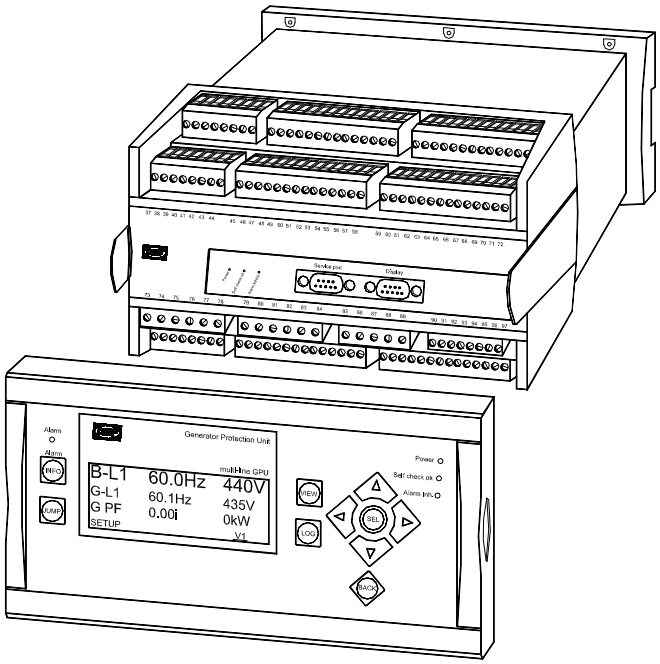

- *Functional description*
- *Display unit and menu structure*
- *Additional functions*
- *Procedure for parameter setup*
- *Parameter setup*

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1. About this document

This chapter includes general user information about this handbook concerning the general purpose, the intended users and the overall contents and structure.

General purpose

This document is the Designer's Reference Handbook for DEIF's Generator Protection Unit, the GPU. The document mainly includes functional descriptions, presentation of display unit and menu structure, information about the PI-controller, the procedure for parameter setup and complete standard parameter lists.

The general purpose of the Designer's Reference Handbook is to provide useful overall information about the functionality of the unit and its applications. This handbook also offers the user the information he needs in order to successfully set up the parameters needed in his specific application.

Please make sure to read this handbook before working with the Multi-line 2 controller and the gen-set to be controlled. Failure to do this could result in human injury or damage to the equipment.

Intended users

The handbook is mainly intended for the person responsible for the unit parameter setup. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in the handbook.

Contents/overall structure

The Designer's Reference Handbook is divided into chapters and in order to make the structure of the document simple and easy to use, each chapter will begin from the top of a new page. The following will outline the contents of each of the chapters.

About this document

This first chapter includes general information about this handbook as a document. It deals with the general purpose and the intended users of the Designer's Reference Handbook. Furthermore, it outlines the overall contents and structure of the document.

Warnings and legal information

The second chapter includes information about general legal issues and safety precautions relevant in the handling of DEIF products. Furthermore, this chapter will introduce note and warning symbols, which will be used throughout the handbook.

General product information

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

Functional descriptions

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

Display unit and menu structure

This chapter deals with the display unit including the push-button and LED functions. In addition, the unit menu structure will be presented. Furthermore, the selection of unit mode and password will be illustrated.

Additional functions

This chapter describes the additional functions of the unit.

Procedure for parameter setup

This chapter deals with the procedure to be followed when the parameters are set up or changed. By means of various illustrations, this chapter will guide the user through the procedure for parameter setup step by step.

Parameter list

This chapter includes a complete standard parameter list for setup. Therefore, this chapter is to be used for reference when information about specific parameters is needed.

2. Warnings and legal information

This chapter includes important information about general legal issues relevant in the handling of DEIF products. Furthermore, some overall safety precautions will be introduced and recommended. Finally, the highlighted notes and warnings, which will be used throughout this handbook, are presented.

Legal information and responsibility

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

The units are not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

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 the unit implies work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

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

Definitions

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

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

Warnings

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

3. General product information

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

Introduction

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

Type of product

The Generator Protection Unit is a micro-processor based control unit containing all necessary functions for protection and control of a generator.

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

Options

The Multi-line 2 product range consists of different basic versions which can be supplemented with the flexible options needed to provide the optimum solution. The options cover e.g. various protections for generator, busbar and mains, voltage/VAr/PF control, various outputs, serial communication etc.

A full options list is included in the data sheet, document no. 4921240312.

PC utility software warning

It is possible to remote control the gen-set from the PC utility software M-Vision or the Proface Display Unit by use of a modem. To avoid personal injury, make sure that it is safe to remote control the gen-set.

4. Functional description

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.

Standard functions

In the following paragraphs the standard functions are listed.

Applications:

- Generator protection

Protections (ANSI)

- Reverse power (32)
- Overcurrent, 2 levels (51)
- Overcurrent, 1 level (51)

Display

- Separate mounting
- Easy readable
- Password protected setup
- Configurable views
- Alarm list
- Event log (150 events)

GSM communication

- SMS messages at all alarms
- Dial up from PC utility software to control unit

Functions

- 2 sets of alarm setpoints
- Alarm inhibit, automatic
- Horn relay
- Language selection
- kWh/kVArh outputs

Measuring system

- 3-phase true RMS
- Galvanically isolated voltage and current inputs
- -/1 or -/5 A AC
- 100 – 25000V AC

Approvals

- Major Marine societies
- Netmanagement
- TÜV Nord
- GOST-R
- UL

Terminal strip overview

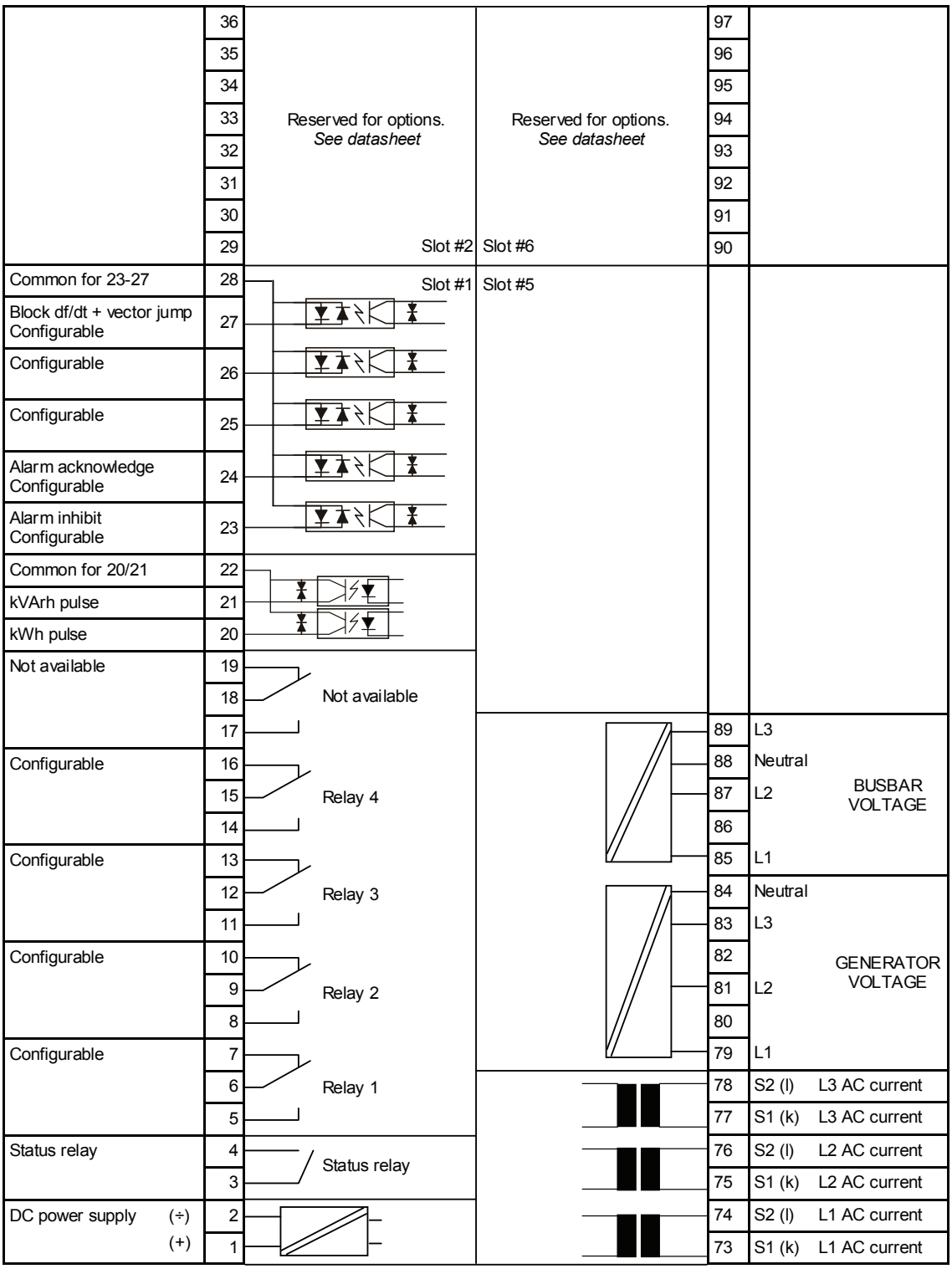
The terminal strip overview shows I/Os for the standard-installed hardware.

Refer to the data sheet for accurate information about possible configurations of the GPU.

Refer to the input/output lists in the installation instructions for detailed information about the I/Os of the specific options.

The terminal strip overview of the standard GPU without options is shown on the next page.

Slots #1, #2, #5 and #6

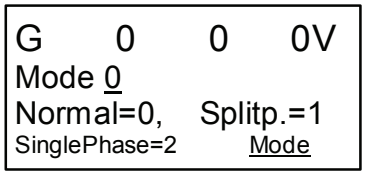


Measurement systems

The GPU is designed for measurement of voltages between 100 and 690V AC. The AC wiring diagrams are shown in the installation instructions for further reference. In menu 6100, the measurement principle can be changed between three-phase, single phase and split phase.

The settings can only be changed using the display. Press the JUMP push-button and go to the menu 6100.

The menu for adjusting the measurement principle looks like this:



Press 'SEL' to change the mode and select '0' for three-phase mode, '1' for split phase mode and '2' for single phase mode.

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

Three-phase

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

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

Setting / Adjustment		Description	Adjust to value
4014	Nom.voltage	Phase-phase voltage	400V AC
4021	Transformer Gen	Primary voltage of the voltage transformer (if installed)	U_{NOM}
4022	Transformer Gen	Secondary voltage of the voltage transformer (if installed)	U_{NOM}
4031	Transformer BUS	Primary voltage of the voltage transformer (if installed)	U_{NOM}
4032	Transformer BUS	Secondary voltage of the voltage transformer (if installed)	U_{NOM}

Split phase

This is a special application where two phases and neutral are connected to the GPU. The GPU shows phases L1 and L3 in the display. The phase angle between L1 and L3 is 180 degrees.

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

Setting / Adjustment		Description	Adjust to value
4014	Nom.voltage	Phase-phase voltage	120
4021	Transformer Gen	Primary voltage of the voltage transformer (if installed)	U_{NOM}
4022	Transformer Gen	Secondary voltage of the voltage transformer (if installed)	U_{NOM}
4031	Transformer BUS	Primary voltage of the voltage transformer (if installed)	U_{NOM}
4032	Transformer BUS	Secondary voltage of the voltage transformer (if installed)	U_{NOM}

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

Single phase

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

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

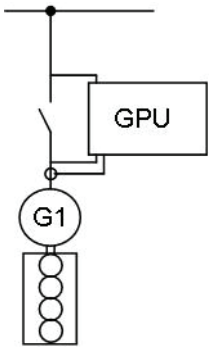
Setting / Adjustment		Description	Adjust to value
4014	Nom.voltage	Phase-phase voltage	230
4021	Transformer Gen	Primary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
4022	Transformer Gen	Secondary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
4031	Transformer BUS	Primary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
4032	Transformer BUS	Secondary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$

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

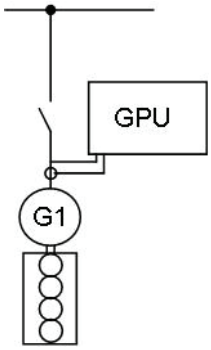
Single line diagrams

The GPU can be used for a numerous applications. Below is shown a few examples but due to the flexibility of the product it is not possible to show all possibilities. The flexibility is one of the great advantages of the GPU controller.

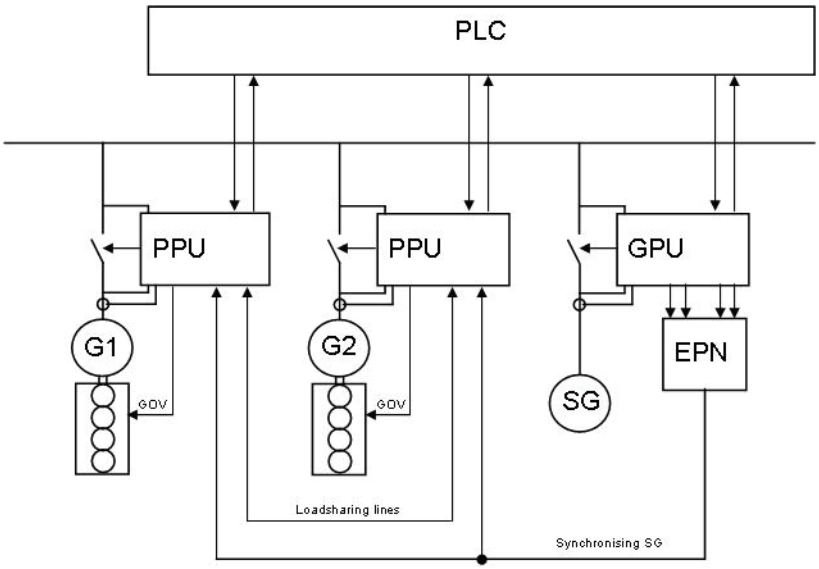
Generator protection



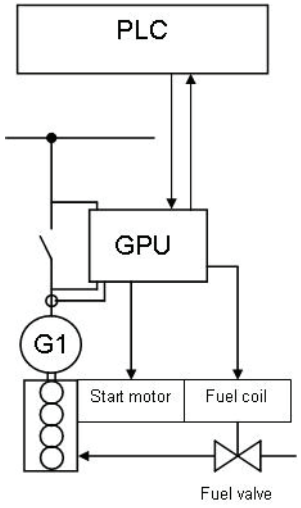
Generator protection



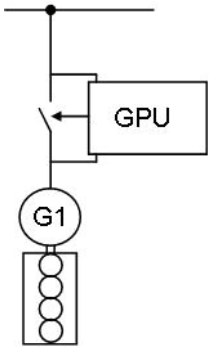
PLC controlled system



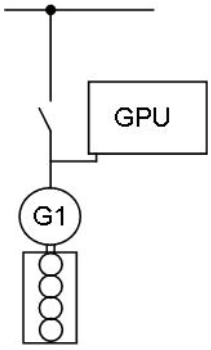
PLC controlled system with start/stop



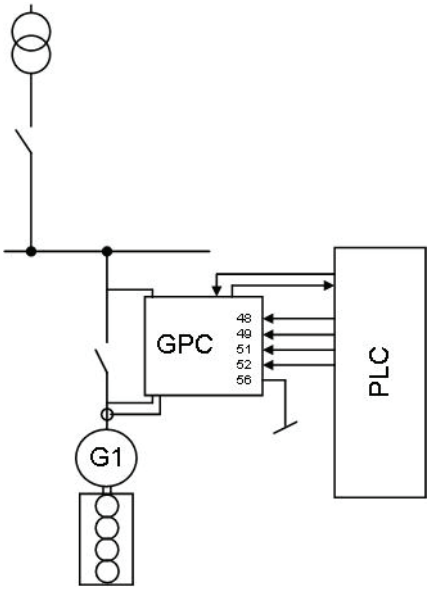
Generator protection/synchronising



Generator protection



Gen-set parallel to mains and AVR control. (PLC controlled)



5. Display unit and menu structure

This chapter deals with the display unit including the push-button and LED functions. In addition, the unit menu structure will be presented.

Display unit

The display has 4 different lines, each with 20 characters, and holds a number of push-button functions.

Display dimensions are H x W = 115 x 220 mm (4.528" x 9.055").

Push-button functions

The display unit holds a number of push-button functions which are presented below.

INFO: Shifts the display 3 lower lines to show the alarm list.

JUMP: Enters a specific menu number selection. All settings have a specific number attached to them. The JUMP button enables the user to select and display any setting without having to navigate through the menus (see later).

VIEW: Shifts the first line displaying in the setup menus.

LOG: Shifts the display 3 lower lines to show the event and alarm list. The list holds 150 events. The events are not deleted when the auxiliary supply is switched off.

 : Moves the cursor left for manoeuvring in the menus.

 : Increases the value of the selected setpoint (in the setup menu). In the daily use display, this button function is used for scrolling the second line displaying of generator values in the setup menu or for scrolling through the view windows (V1).

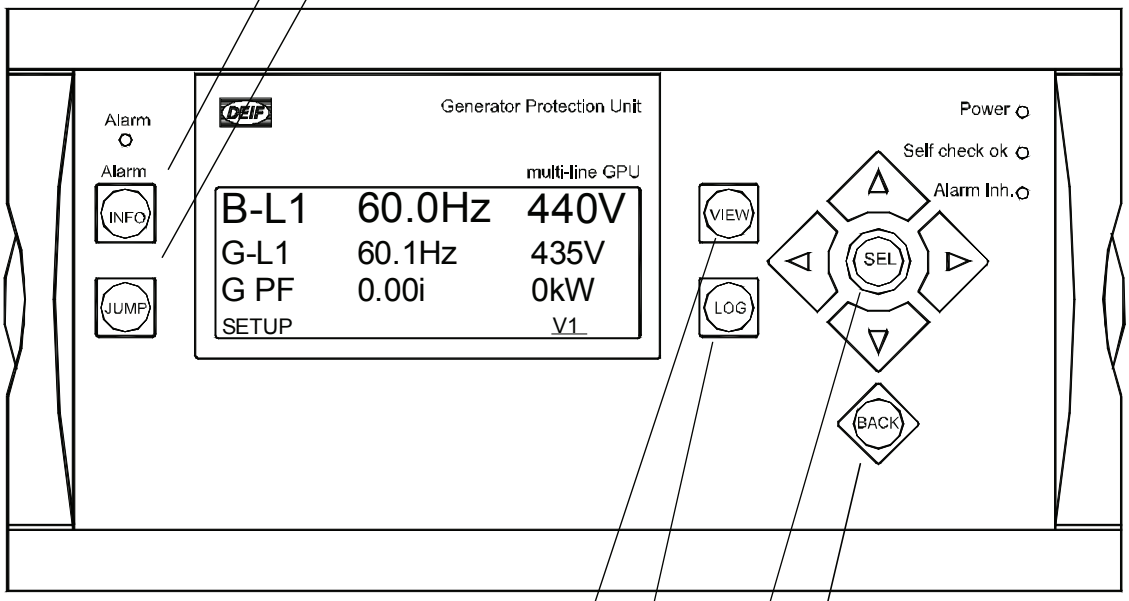
SEL: Is used to select the underscored entry in the fourth line of the display.

 : Decreases the value of the selected setpoint (in the setup menu). In the daily use display, this button function is used for scrolling the second line displaying of generator values in the setup menu or for scrolling through the view windows (V1).

 : Moves the cursor right for manoeuvring in the menus.

BACK: Jumps one step backwards in the menu (to previous display or to the entry window).

The push-buttons are placed as follows:



INFO:
Shifts the display three lower lines to show the alarm list.

JUMP:
Enters a specific menu number selection.

VIEW:
Shifts the first line displaying in the setup menus.

LOG:
Shifts the display three lower lines to show the event and alarm list.

SEL:
Selects the underscored entry in the fourth display line.

BACK:
Jumps one step backwards in the menu.

LED functions

The display unit holds 10 LED functions. The colour is green or red or a combination in different situations.

Alarm: LED flashing indicates that unacknowledged alarms are present.
LED fixed light indicates that ALL alarms are acknowledged.

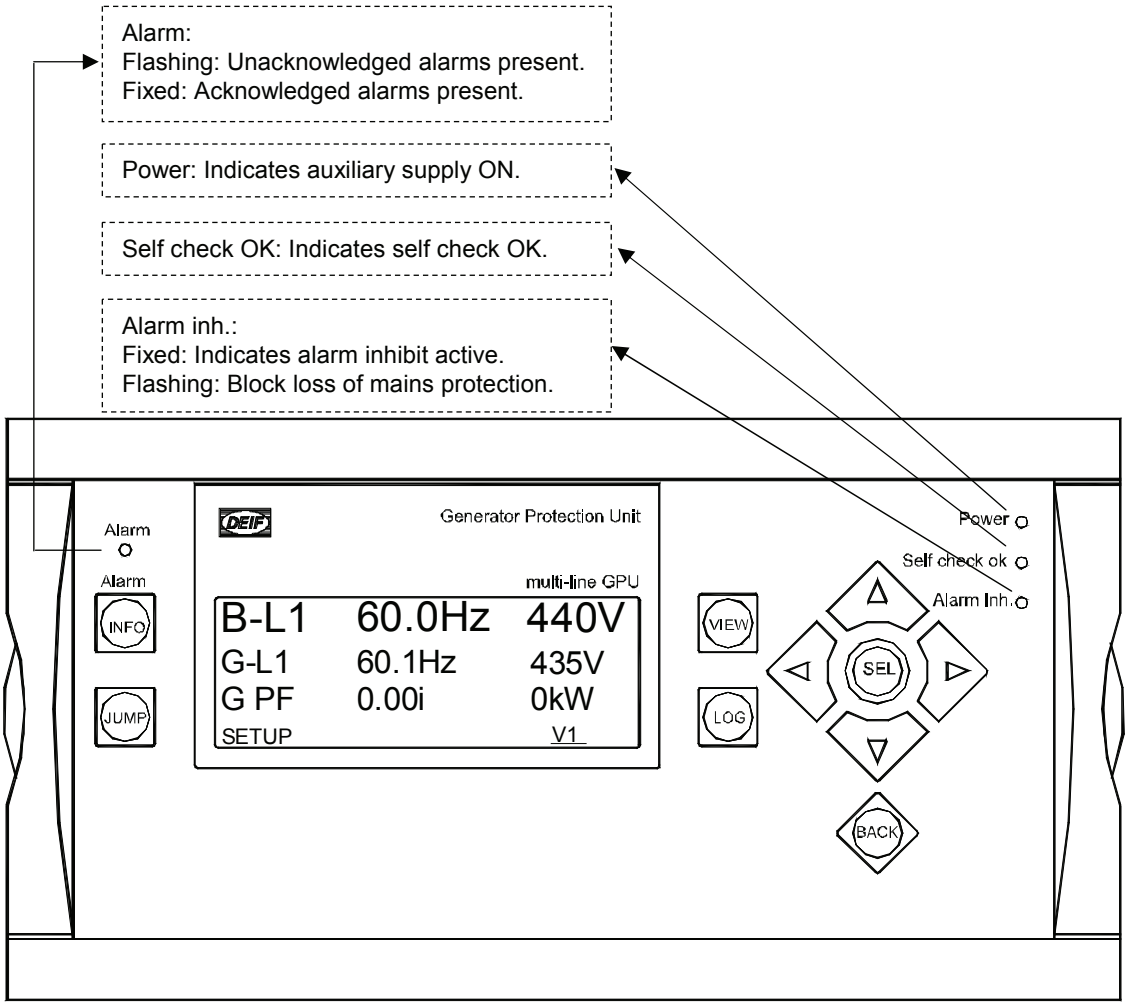
Power: LED indicates that the auxiliary supply is switched on.

Self check OK: LED indicates that the self check is OK.

Alarm inh: LED flashing indicates that the loss of mains protections is inhibited. (Block loss of mains input is ON).
LED fixed light indicates that the inhibit function is ON.

Breaker on: LED green light indicates that the generator breaker is closed.

The display LEDs are indicating as follows:



Menu structure

The display includes two menu systems which can be used without password entry:

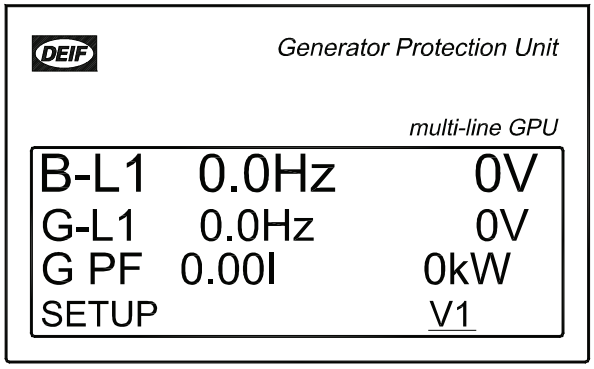
View menu system
This is the commonly used menu system. 15 windows are configurable and can be entered by using the arrow push-buttons.

Setup menu system
This menu system is used for setting up the unit, and if the user needs detailed information that is not available in the view menu system. Changing of parameter settings is password protected.

Entry window

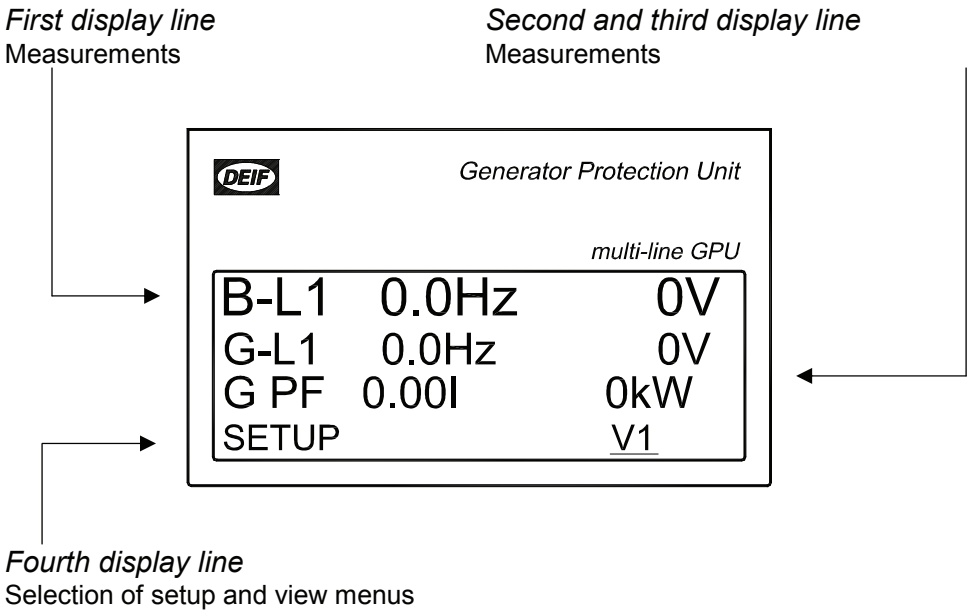
When the unit is powered up, an entry window appears. The entry window is the turning point in the menu structure and as such the gateway to the other menus. It can always be reached by pressing the BACK push-button 3 times.

The alarm list will appear at power up if an alarm is present.



View menu

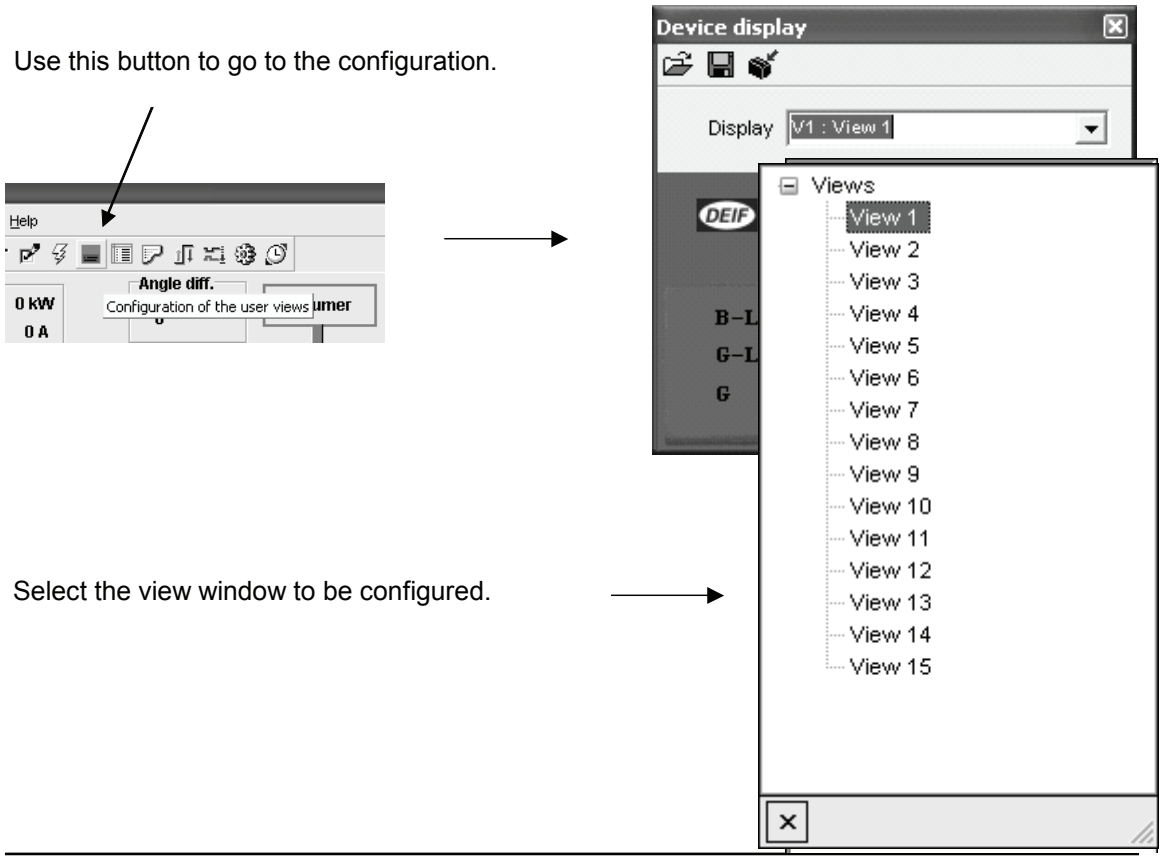
The view menus (V1, V2 and V3) are the most commonly used menus of the unit.



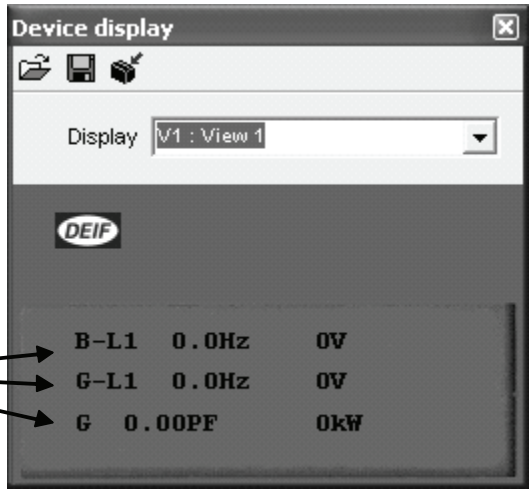
In the view menus various measured values are shown on the display.

View window configuration

The individual view windows need to be configured through the PC software in the dialog box illustrated below.



Click here to change the configuration.



It is only possible to configure the view windows via the PC software – configuration via the display unit is not possible.

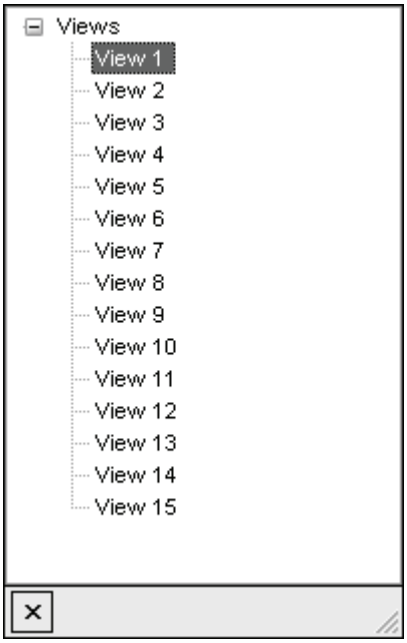
The selectable values and measurements are presented in the table on page 25 in this handbook.

If the text 'no text' is selected in all 3 lines in a window, it will not be displayed. This is to get a continuous displaying, if a window is not to be used.

There is a maximum of 15 configurable view windows in V1.

View window overview

Windows	V1
View 1	Manual selection with key UP or key DOWN push-buttons
View 2	
View 3	
View 4	
View 5	
View 6	
View 7	
View 8	
View 9	
View 10	
View 11	
View 12	
View 13	
View 14	
View 15	

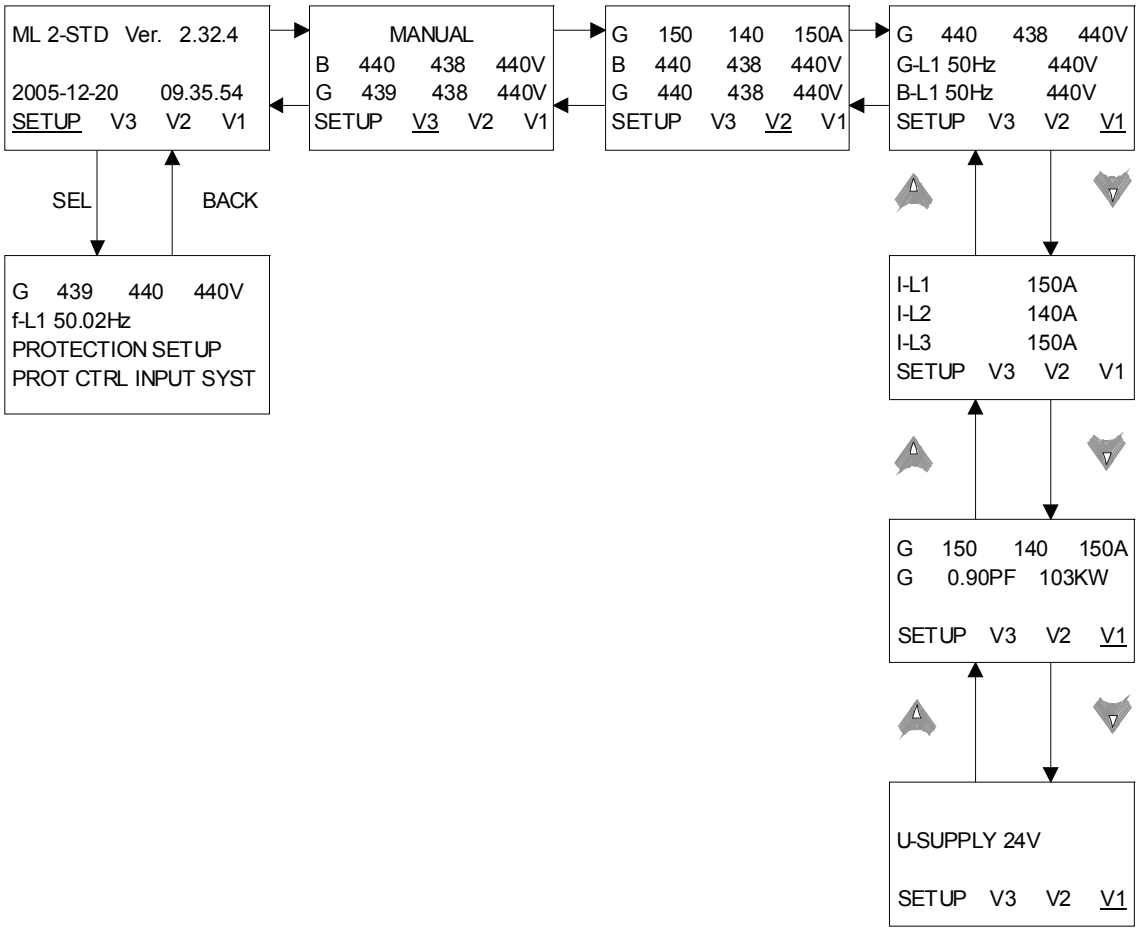


Windows	V 2	V 3
View 1	Changes automatically between the 5 first views: 1. View 1 (Start prepare) 2. View 2 (Sync.) 3. View 3 (Ramp up/down) 4. View 4 5. View 5 (Default*) No manual selection. All three lines show measuring values.	Changes automatically between the 5 first views: 1. View 1 (Start prepare) 2. View 2 (Sync.) 3. View 3 (Ramp up/down) 4. View 4 5. View 5 (Default*) No manual selection. Line 1 shows the text 1…5 (above). Line 2 and line 3 show measurements.
View 2		
View 3		
View 4		
View 5		

** The default window is automatically selected after the generator breaker closure when the gen-set is in normal operation, e.g. fixed power mode after the ramping up.*

View menu example

The following is an example of a configured view menu system. In this example 4 of 15 windows have been configured in view 1.



...Etc. (max. 15)

The menu navigating starts from the fourth display line in the entry window and is carried out using the , , and push-buttons.

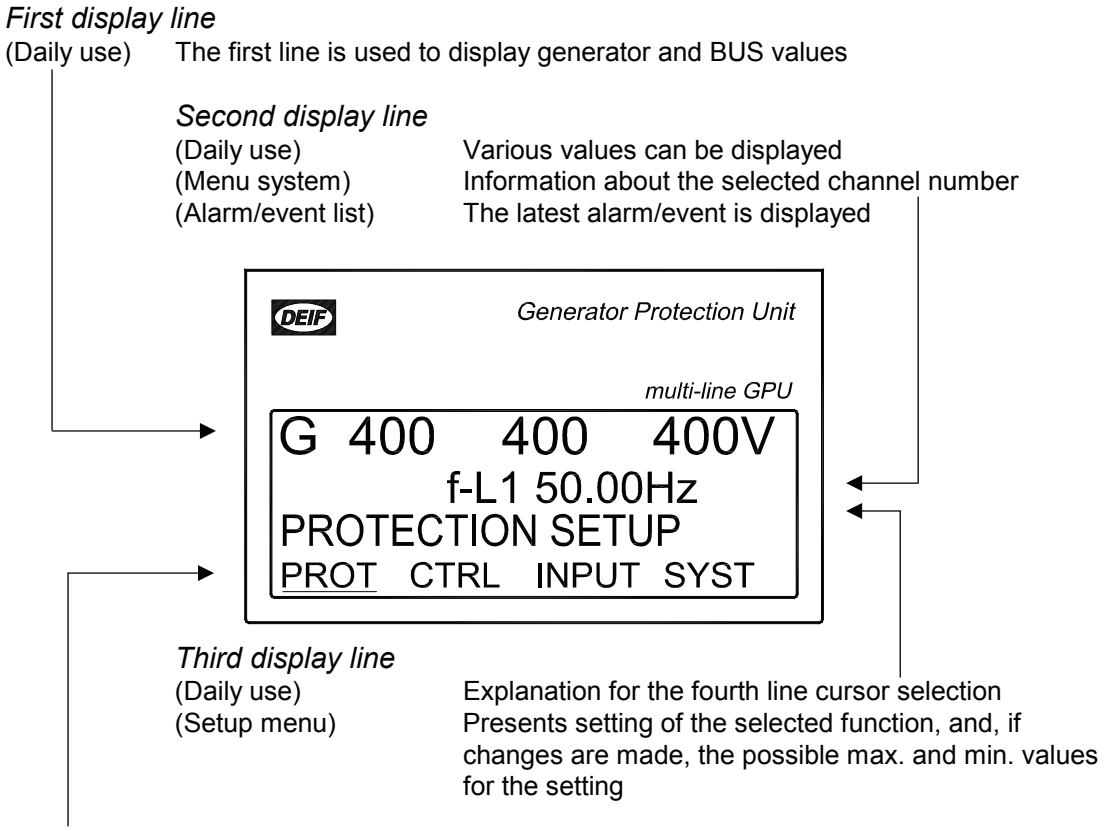
The entry window displays view 3, (in the illustration above, the window where 'manual' is displayed).

Moving the cursor left or right offers the following possibilities.

- Setup menu – access to the following sub-menus:
  - Protection setup
  - Control setup
  - Input setup
  - System setup
- View 3 – window displays operational status and selectable measurements
- View 2 – window displays selectable measurements
- View 1 – access to up to 15 selectable windows displaying selectable measurements

Setup menu

The setup menu system is used for parameter setup of the unit, and if the user needs detailed information that is not available in the view menu system. So, this menu can be used for both daily use and setup purposes. The menu is entered from the entry window by selecting the entry SETUP in the fourth display line.



Possible values in the second display line

View line/second display line configuration			
For generator	**For bus/mains**	**For analogue input**	**Communication/ other**
Date and time	Voltage L1-N (V AC)	Analogue 1	PID value #1.1
Voltage L1-N (V AC)	Voltage L2-N (V AC)	Analogue 2	PID value #1.2
Voltage L2-N (V AC)	Voltage L3-N (V AC)	Analogue 3	PID value #1.3
Voltage L3-N (V AC)	Voltage L1-L2 (V AC)	Analogue 4	PID value #1.4
Voltage L1-L2 (V AC)	Voltage L2-L3 (V AC)	Pt 100 no. 1	PID value #1.5
Voltage L2-L3 (V AC)	Voltage L3-L1 (V AC)	Pt 100 no. 2	PID value #1.6
Voltage L3-L1 (V AC)	Voltage max. (V AC)	Tacho (RPM)	PID value #1.7
Voltage max. (V AC)	Voltage min. (V AC)	VDO no. 1	PID value #1.8
Voltage min. (V AC)	Frequency (Hz)	VDO no. 2	PID value #2.1
Current L1 (A)	Voltage angle between L1-L2 (deg.)	VDO no. 3	PID value #2.2
Current L2 (A)	Frequency deviation	Analogue 5	PID value #2.3

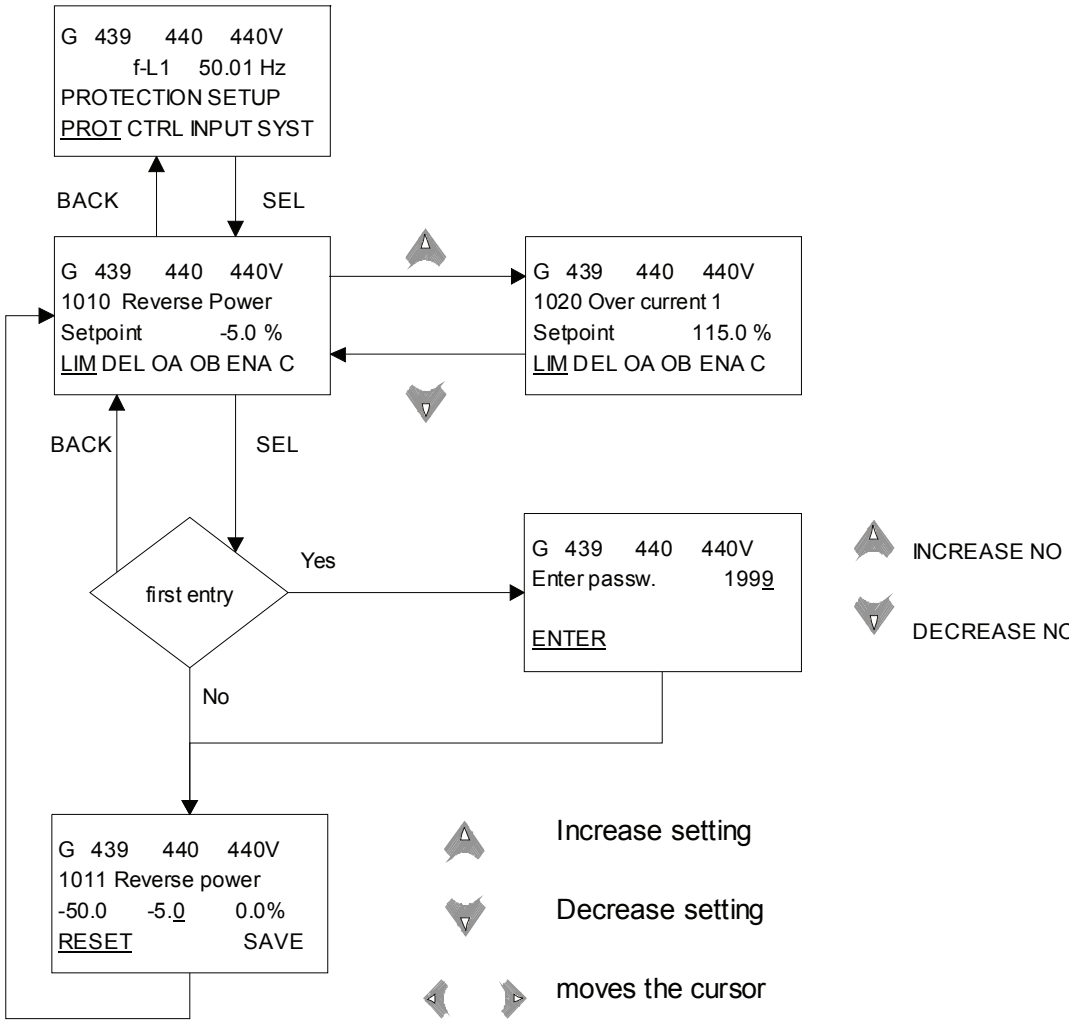
View line/second display line configuration			
For generator	**For bus/mains**	**For analogue input**	**Communication/ other**
	(df/dt) (Hz/sec.)		
Current L3 (A)	Voltage angle between generator voltage and bus voltage (deg.)	Analogue 6	PID value #2.4
Frequency L1 (Hz)	Power supply voltage (VDC)	Analogue 7	PID value #2.5
Frequency L2 (Hz)		Analogue 8	PID value #2.6
Frequency L3 (Hz)			PID value #2.7
Active power (kW)			PID value #2.8
Reactive power (kVAr)			EIC speed
Apparent power (kVA)			EIC Coolant Temp.
Energy counter (kWh)			EIC Oil Pressure
Power factor			EIC Faults
Voltage angle between L1-L2 (deg.)			EIC Oil Temp.
Voltage angle between L2-L3 (deg.)			EIC Fuel Temp.
Voltage angle between L3-L1 (deg.)			EIC Boost Pressure
Run time (h)			EIC Air Inlet Temp.
Number of CB operations			EIC Coolant Level
			EIC Fuel Rate
			EIC Charge Air Pres.
			EIC Charge Air Temp.
			EIC D.D. % Torque
			EIC Actual % torque
			EIC Acc. pedal pos.
			EIC % Load, C. Speed
			EIC Air Inlet Pres.
			EIC Exhaust gas Temp
			EIC Engine Hours
			EIC Oil F. Diff Pres
			EIC Battery voltage
			EIC Fuel Del. Pres.
			EIC Oil level
			EIC Crankcase Pres.
			EIC Coolant Pressure
			EIC Water In Fuel

View line/second display line configuration			
For generator	**For bus/mains**	**For analogue input**	**Communication/ other**
			EIC Blowby Flow
			EIC Fuel Rail Pres.
			EIC Timing Rail Pres
			EIC Aftercooler W.T.

PID values are CAT® CCM communication values, EIC values are CAN J1939 communication values.

Setup example

The following example illustrates how a specific setting is changed in the setup menu. In this case **Reverse power** is the selected parameter.



Password

The unit includes one configurable user password level. However, the device can be accessed by means of two additional password levels, should the configurable user password be lost.

Available password levels:

Password level	Factory setting	Menu for configuration	Access	Log entry
User configurable	2000	4971	All	L2 password
Back up password	4972	4972	All	L1 password
DEIF password	####	None	All	L0 password

Contact DEIF A/S, Customer service (tel. +45 96149614) for details regarding the DEIF back-up password, should the user configurable backup password be lost.

Parameter access

To get access to adjust the parameters from the utility software, the user configurable password (L2 password) must be entered. If the user configurable password (L2 password) is not entered, it is not possible to enter the parameters from the utility software.

The factory passwords must be changed, if the operator of the gen-set is not allowed to change the parameters.

To start using the new password from the utility software it will be necessary to close the programme and open it again.

6. Additional functions

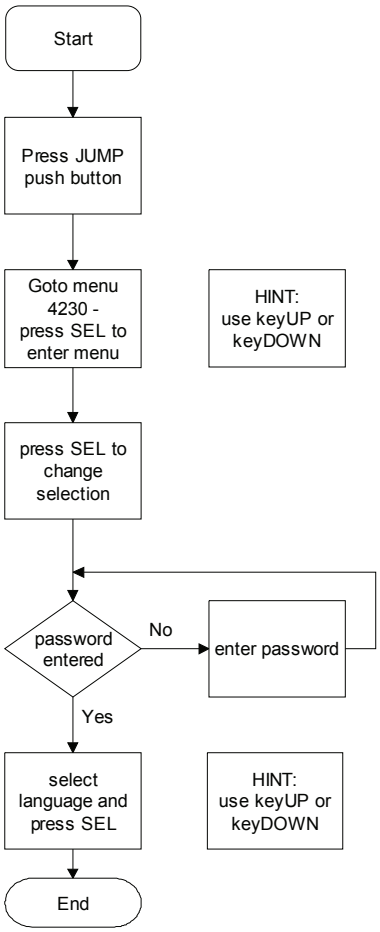
This chapter describes the additional functions.

Language selection

The language of the GPU is adjusted to English from the factory. The following languages can be selected (menu 4230):

Language	English name
English	English
Deutsch	German
Français	French
Español	Spanish

Use the flowchart below to navigate through the display if the language must be changed.



Alarm function

The alarm function of the GPU includes possibility to display the alarm texts, activate relays or displaying alarm texts combined with relay outputs.

Setup

The alarms must typically be setup with setpoint, timer, relay outputs and enabling. The adjustable setpoints of the individual alarms vary in range, e.g. the minimum and maximum settings.

Alarm display

All enabled alarms will be shown in the display unless the Output A as well as the output B are adjusted to a 'limit' relay.

If output A and output B are adjusted to a limit relay then the alarm message will not appear but the limit relay will activate at a given condition.

Definitions

There are three states for an enabled alarm.

1. Alarm is not present:	The display does not show any alarm. The alarm LED is dark.
2. Unacknowledged state:	The alarm has exceeded its setpoint and delay, and the alarm message is displayed. The GPU is in the alarm state and it can only leave the alarm state if the cause of the alarm disappears and the alarm message is acknowledged at the same time. The alarm LED is flashing.
3. Acknowledged state:	The alarm will be in an acknowledged state if the alarm situation is present and the alarm has been acknowledged. The alarm LED is lit with fixed light. Any new alarm will make the LED flash.

Alarm acknowledge

The alarms can be acknowledged in two ways. Either by means of the binary input 'Alarm acknowledge' or the push-buttons on the display.

Binary acknowledge input

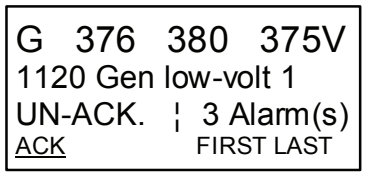
The alarm acknowledge input acknowledges all present alarms and the Alarm LED will change from flashing light to fixed light (alarms still present) or no light (no alarms present).

It is not possible to acknowledge individual alarms with the binary alarm acknowledge input. All alarms will be acknowledged when the input is activated.

Display acknowledge (push-buttons)

The display can be used for alarm acknowledgement when the alarm info window is entered. Pressing the 'INFO' button will open this window.

The alarm information window displays one alarm at a time together with the alarm state (alarm acknowledged or not). If the alarm is unacknowledged, move the cursor to 'ACK' and press select to acknowledge it.



Use keyUP and keyDOWN to step through the alarm list. The alarm list contains all present alarms.

Relay outputs

In addition to the display message of the alarms each alarm can also activate one or two relays if this is required.

Adjust Output A (OA) and/or Output B (OB) to the desired relay(s).

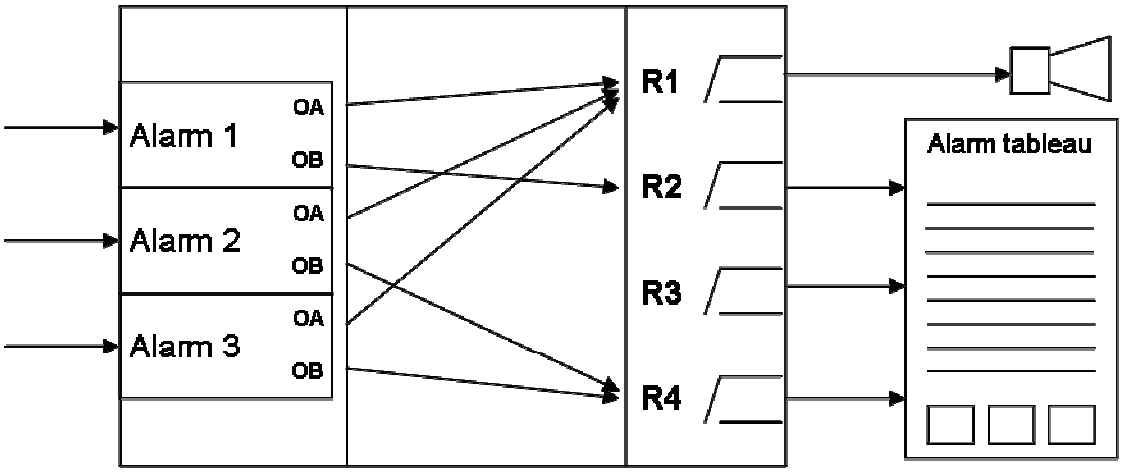
In the example on the drawing below three alarms are configured and relay 1-4 are available as alarm relays.

When alarm 1 appears, output A activates relay 1 (R1) which activates an alarm horn on the diagram. Output B of alarm 1 activates relay 2 (R2). On the diagram, R2 is connected to the alarm panel.

Alarm 2 activates R1 and R4.
Alarm 3 activates R1 and R4.

Several alarms can activate the same relay.

Each alarm can activate none, one or two relays. (None means that only a display message is given).



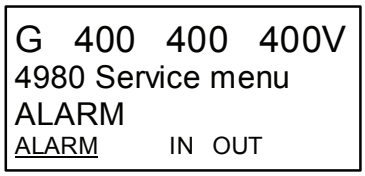
Service menu

The purpose of the service menu is to give information about the present operating condition of the gen-set. The service menu is entered using the 'JUMP' push-button (4920 Service menu).

Use the service menu for easy troubleshooting in connection with the event log (see page 32).

Entry window

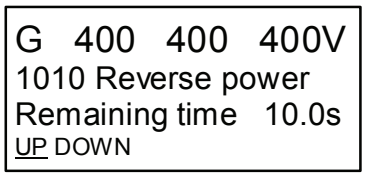
The entry shows the possible selections in the service menu.



Available selections:

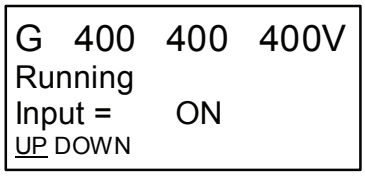
Alarm

Shows the alarm timer and the remaining time. The indicated remaining time is minimum remaining time. The timer will count downwards when the setpoint has been exceeded.



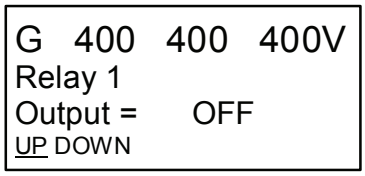
IN (digital input)

Shows the status of the digital inputs.



OUT (digital output)

Shows the status of the digital outputs.

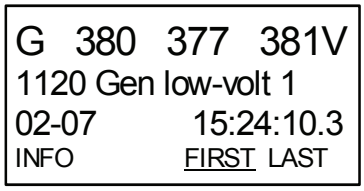


Event log

The event log holds up to 150 events, and they can be viewed in the display or in the PC utility software. When more than 150 events have occurred, each new event will overwrite the oldest event following the 'first in – first out' principle.

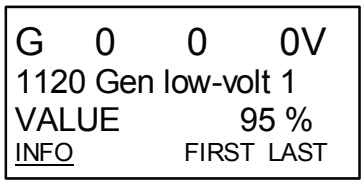
Display

In the display it looks like this when the 'LOG' push-button is pressed (example):



The specific alarm or event is shown in the second line. In the example above, the generator low voltage, level 1 alarm has occurred. The third line shows the time stamp.

If the cursor is moved to 'INFO', the actual value can be read when pressing 'SEL':



The first event in the list will be displayed if the cursor is placed below 'FIRST' and 'SEL' is pressed.

The last event in the list will be displayed if the cursor is placed below 'LAST' and 'SEL' is pressed.

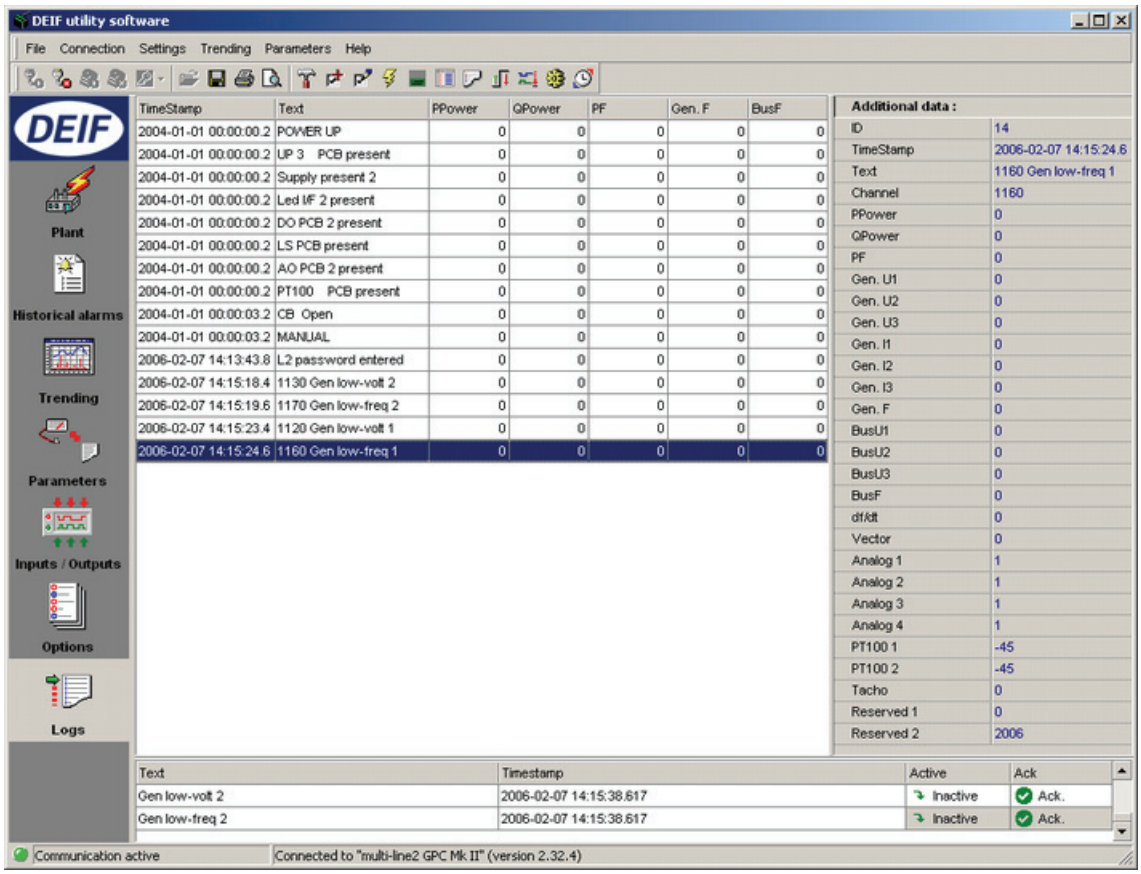
The keyUP and keyDOWN push-buttons are used for navigating in the list.

PC utility software

Using the PC utility software, the entire log stack of the last 150 events can be retrieved by activating the log button on the horizontal toolbar.

The alarms and events are displayed as indicated below. The actual alarms are displayed in the text column together with selected measurements.

In the right side column, additional data is indicated. This is specific data for the most important measurements. The data is logged for each specific event and is used for troubleshooting after each alarm.



The entire log can be saved in Excel format and used in that particular programme.

Counters

Counters for various values are included in the GPU, and two of those can be adjusted if necessary, for instance if the GPU is installed on an existing gen-set (adjust the running hours) or a new circuit breaker has been installed (adjust number of CB operations).

The table shows the adjustable values and their function:

Description	Function	Comment
4121 Running time	Offset adjustment of the total running hours counter.	Counting when the voltage is present.
4122 CB operations	Offset adjustment of the number of circuit breaker operations.	Counting at each CB close command.
4123 kWh reset	Resets the kWh counter.	Automatically resets to OFF after the reset. The reset function cannot be left active.

The menus 4121 and 4122 will automatically change their setting when the run time and CB operations count.

Menu 4122 has no function in the standard GPU. It is only useable if option G2 is selected.

kWh/kVArh counters

The GPU has two transistor outputs each representing a value for the power production. The outputs are pulse outputs, and the pulse length for each of the activations is 1 second.

Term. number	Output
20	kWh
21	kVArh
22	Common terminal

The number of pulses depends on the actual adjusted setting of the nominal power:

Generator power	Value	Number of pulses (kWh)	Number of pulses (kVArh)
P_{NOM}	<100 kW	1 pulse/kWh	1 pulse/kVArh
P_{NOM}	100-1000 kW	1 pulse/10 kWh	1 pulse/10 kVArh
P_{NOM}	>1000 kW	1 pulse/100 kWh	1 pulse/100 kVArh

The kWh measurement is shown in the display as well, but the kVArh measurement is only available through the transistor output.

Be careful – the maximum burden for the transistor outputs is 10mA.

Self check

The GPU has a self check function and a status relay output that responds to this function. The status relay is prepared for 24V DC/1A, and it is normally energised.

The self check is monitoring the programme execution. Should this fail, i.e. in the unlikely event of microprocessor failure, then the self check function deactivates the status relay.

Use the output from the status relay to perform a proper action for the gen-set application. Typically, this would mean a shut down of the gen-set since it is now operating without protection and control.

The protections in the GPU are not functioning when the self check function deactivates the status relay.

There are two 'Self check ok' LEDs on the GPU. One is placed on the display and one on the main unit. The LEDs are lit when the GPU is functioning well.

Digital input configuration

The unit has a number of binary inputs. These inputs can be configured as control inputs as mentioned in the table or they can be configured as alarm inputs.

Control inputs

The list mainly contains inputs available in the standard GPU. Please refer to the option manuals for option dependent inputs, should these not be listed below.

	Input function	Configurable	Input type	Available inputs
1	Alarm inhibit	Configurable	Constant	23, 24, 26, 27
2	Alarm ack.	Configurable	Constant	23, 24, 26, 27
3	Start sync./Control	Configurable	Constant	25
4	External communication	Configurable	Constant	23, 24, 26, 27
5	Block loss of mains protection	Configurable	Constant	23, 24, 26, 27
6	Island mode	Configurable	Constant	23, 24, 26, 27
8	Parameter shift	Configurable	Constant	23, 24, 26, 27
9	Running feedback	Configurable	Constant	116
10	Start enable	Configurable	Constant	115
11	Shut down override	Configurable	Constant	114, 43-53
12	Deflector closed	Configurable	Constant	23, 24, 26, 27
13	Open breaker	Configurable	Constant	43
14	Manual raise speed	Configurable	Constant	44
15	Manual lower speed	Configurable	Constant	45
16	Manual raise voltage	Configurable	Constant	46
17	Manual lower voltage	Configurable	Constant	47

If used as alarm inputs the selected input must be configured to 'Not used' and the alarm setup must be done in the parameter list.

1. Alarm inhibit
Specific alarms are inhibited to prevent the alarms from occurring. Refer to page 43.

Essential protections might also be inhibited, if this input is used.

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

3. Start sync./control
The input starts the regulation and the control of the GOV/(AVR) is performed by the GPU. If the CB is open then synchronising will start and if the CB is closed then the selected method of regulation will depend on the mode input selection.

When the input is selected OFF then the GPU is in manual control mode and the display shows 'MANUAL'.

4. External communication control
When the input is activated then the GPU is controlled from CAN-open, Modbus or Profibus only. When the input is deactivated then the GPU performs the control depending on the other hardwired I/Os namely the control inputs and mode inputs.

When load sharing mode is selected through the communication, the analogue load sharing lines are used.

5. Block loss of mains protection
The alarms vector jump and df/dt are inhibited when the input is activated.

The alarm inhibit LED is flashing yellow when the input is ON.

6. Island mode (option G2)
This input deactivates the busbar measurements during breaker operations. This makes it possible to close the breaker from the GPU even though the generator and busbar are ***not*** synchronised.

The GPU will issue the close breaker signal even though the generator and busbar/mains are NOT synchronised.

If this function is used additional breakers must be installed between the generator and the point from where the busbar measurements are taken for the GPU. Otherwise the generator will close its circuit breaker without synchronism with subsequent damage, injury or death!

Serious personal injury, death and damaged equipment could be the result of using this input without proper safety precautions/testing prior to use. Take precautions that a high degree of safety is implemented in the application before using this function.

The function of the application must be checked and tested carefully during the commissioning when the island mode input is used. This is to ensure that no false breaker closings occur.

8. Parameter shift
Enables the second level of alarm setpoints for selected alarms.

9. Running feedback
Input that indicates the engine is running.

This function only concerns the engine control option M1 and M2.

10. Start enable
The GPU can initiate the start sequence when the 'start enable' input is ON and a start command is given.

This function only concerns the engine control option M1 and M2.

11. Shutdown override
Deactivates the shutdown alarms, i.e. alarms configured to relay 9.

This function only concerns the engine control option M1 and M2.

The gen-set will not shut down in case of serious alarms that would shut down the gen-set under normal operation.

12. Deflector closed
The input indicates whether the jet deflector is in open position or in closed position.

This function only concerns the water turbine control option O1.

13. Open breaker
The input starts the open breaker function of the GPU. The function will either be 'open breaker' or 'prevent synchronising'. (requires option G2).

14. Manual raise speed
Increases the governor output when start sync./control is OFF.

15. Manual lower speed
Decreases the governor output when start sync./control is OFF.

16. Manual raise voltage
Increases the AVR output when start sync./control is OFF.

Requires option D2 – AVR control.

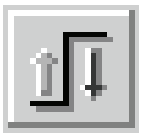
17. Manual lower voltage
Decreases the AVR output when start sync./control is OFF.

Requires option D2 – AVR control.

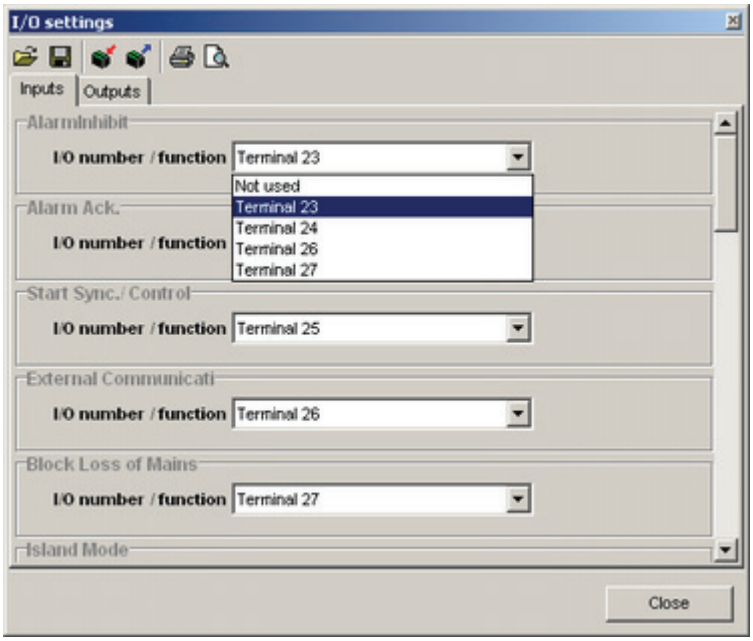
Configuration

The digital inputs are configured via the PC utility software.

Select the input icon in the horizontal toolbar.



The desired input number can now be selected for the individual input function via the roll-down panel.



Dedicated functions such as 'Start enable' can only be configured to one specific input, e.g. terminal 115 for 'Start enable'.

Alarm inputs

If the digital inputs are to be used as alarm inputs they can be connected to e.g. pressure and temperature switches for alarm, trip or shutdown purposes.

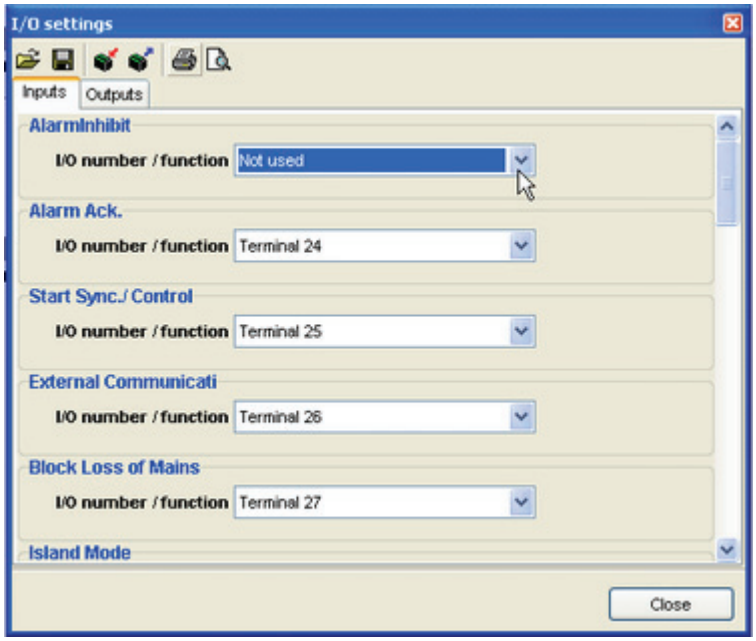
Since the inputs are default-configured as control inputs, it is necessary to reconfigure the inputs to prepare them for the alarm use.

If the alarm input is used without setting the *control function* to not used, then the control function is still active. Therefore, remember unconfiguring the control input.

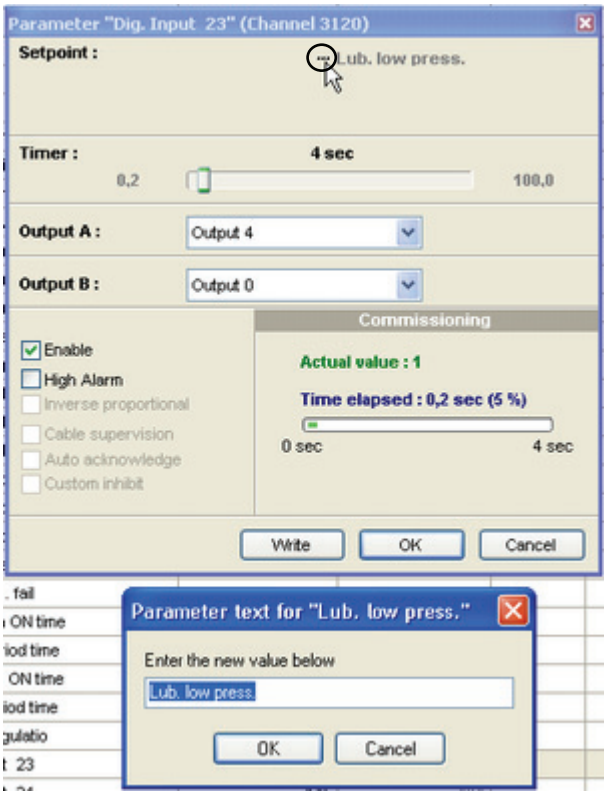
The two possibilities for using the digital inputs are not intended to be combined. Please either use the digital input as an alarm input or as a control input. The settings in the parameter setup for the individual alarms, such as high alarm, enable or delay, do not influence the control functions of the inputs.

The procedure for configuring the digital input as an alarm input is described in the example below where the digital input terminal 23 must be used as a low lubricating oil alarm.

Step 1:
The control function of the digital input is set to 'Not used'.



Step 2:
Make the proper adjustments for the digital input. The name can be changed by pressing the button with the three small dots in front of the name of the input.



Parameter shifting

The function in the GPU for parameter shifting is for shifting the alarm setpoints. This is operated by a digital input.

The nominal settings will not be changed when activating the parameter shift input.

The function is normally used when the generator is applied in island operation as well as in parallel to mains operation. Typically the settings of alarm setpoint and alarm timer must be tighter for parallel to the mains operation than for island mode operation.

The second level of alarms can only be configured through the PC utility software!

Second level alarm list

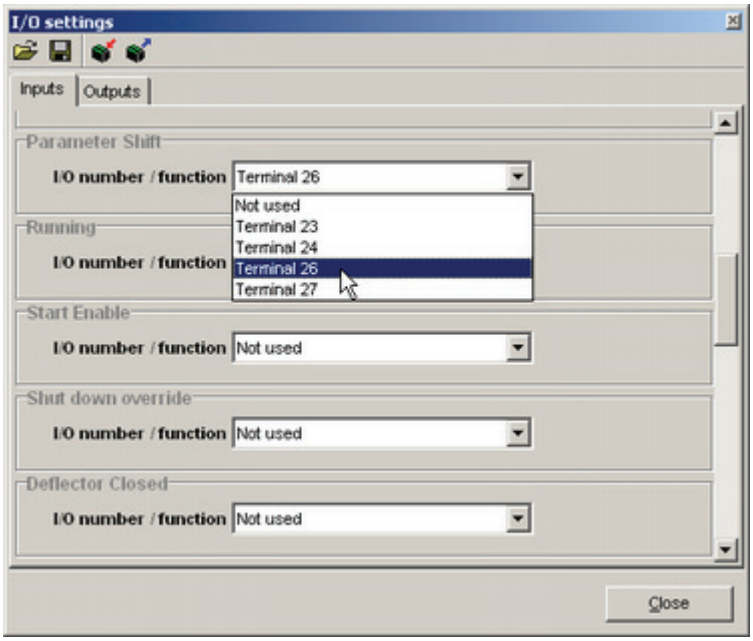
These alarms have two levels of setpoints:

Setpoint / Alarm	Primary	Secondary
Reverse power	1010	1400
Overcurrent 1	1020	1410
Overcurrent 2	1030	1420
Gen high-volt 1	1100	1430
Gen high-volt 2	1110	1440
Gen low-volt 1	1120	1450
Gen low-volt 2	1130	1460
Gen high-freq 1	1140	1470
Gen high-freq 2	1150	1480
Gen low-freq 1	1160	1490
Gen low-freq 2	1170	1500
Bus high-volt 1	1180	1510
Bus high-volt 2	1190	1520
Bus low-volt 1	1200	1530
Bus low-volt 2	1210	1540
Bus high-freq 1	1220	1550
Bus high-freq 2	1230	1560
Bus low-freq 1	1240	1570
Bus low-freq 2	1250	1580
Overload 1	1260	1590
Overload 2	1270	1600
Unbalance current	1280	1610
Unbalance voltage	1290	1620
VAr import	1300	1630
VAr export	1310	1640

The reverse power can be adjusted to ÷110% in the secondary settings. This allows for PTI operation in marine applications.

Input configuration

It is necessary to use a digital input to activate the parameter shift function. This input must be configured through the PC Utility software. Select on the menu bar: Settings/inputs-outputs and the I/O settings box appears.



In this example the parameter shift function is activated by terminal 26.

The inputs 23, 24, 26 or 27 can be used.

When configuring the input, the original function of this input is no longer active. If e.g. input 23 is used for parameter shifting, then the inhibit function configured as default is no longer activated by the same input.

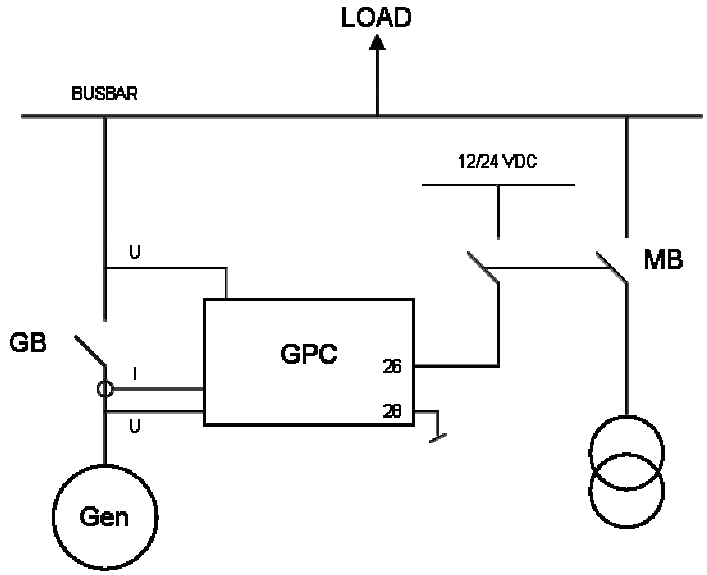
Example

This example shows a generator operating in island mode as well as parallel to the mains. Two levels of busbar alarms are required.

Input 26 is configured to 'Parameter shift'.

Setpoint / Input status	Primary	Secondary
Input 26 = OFF	1200/1210	Not active
Input 26 = ON	Not active	1530/1540

The following simple sketch illustrates that when the MB is open, input 26 is deactivated and when the MB is closed, input 26 is activated. The above table shows when the primary level and the secondary level are activated.



Inhibit

The purpose of the alarm inhibit function is to avoid nuisance alarms when the generator is in a controlled operational state (stop). For example, it is not necessary to have the low voltage alarm displayed when the generator is stopped.

The inhibit function can be configured in the PC utility software or the function can be used with the factory settings. The alarms are divided into five groups to make the function flexible.

Factory settings

The factory setting of each group is as follows:

- BB protections: The alarms are inhibited when the circuit breaker is open
- Gen protections: The alarms are inhibited when the inhibit input is activated
- Engine I/F card: The alarms are inhibited when the inhibit input is activated
- df/dt Vector jump The alarms are inhibited when the input 'block loss of mains protection' is activated
- EIC alarms: The alarms are inhibited when the inhibit input is activated

The factory settings can be changed using the inhibit configurator.

Default input setting for the 'alarm inhibit' input is terminal 23.
Default input setting for the 'block loss of mains protection' input is terminal 27.

Possible alarms to inhibit

Several of the alarms in the GPU unit can be inhibited. The alarms are split up into five groups and each group can be configured differently.

Group 1 (BB protections)

	Alarm	Factory setting		
	1180 BUS high-volt 1	Logic 1	And	CB opened
	1190 BUS high-volt 2			
	1200 BUS low-volt 1			
	1210 BUS low-volt 2			
	1220 BUS high-freq 1			
	1230 BUS high-freq 2			
	1240 BUS low-freq 1			
	1250 BUS low-freq 2			

Low as well as high level alarms can be inhibited.

Group 2 (Gen protections)

	Alarms	Factory setting		
	1120 Gen low-volt 1	Inhibit	And	Logic 1
	1130 Gen low-volt 2			
	1160 Gen low-freq 1			
	1170 Gen low-freq 2			

Low level alarms can be inhibited and not high level alarms.

Group 3 (Engine interface card (I/O extension card))

	Option M1	Option M2	Factory setting		
	3440 1.1 4-20mA	3440 1.1 4-20mA	Inhibit	And	Logic 1
	3450 1.2 4-20mA	3450 1.2 4-20mA			
	3460 2.1 4-20mA	3460 2.1 4-20mA			
	3470 2.2 4-20mA	3470 2.2 4-20mA			
	3480 3.1 4-20mA	3480 3.1 4-20mA			
	3490 3.2 4-20mA	3490 3.2 4-20mA			
	3500 4.1 4-20mA				
	3510 4.2 4-20mA				
	3600 1.1 PT100				
	3610 1.2 PT100				
	3620 2.1 PT100				
	3630 2.2 PT100				
		3660 Oil Pressure 1			
		3670 Oil Pressure 2			
		3680 Cool W. Temp 1			
		3690 Cool W. Temp 2			
		3700 Fuel level 1			
		3710 Fuel level 2			
	3640 Oversp. 1	3640 Oversp. 1			
	3650 Oversp. 2	3650 Oversp. 2			
		3280 Dig. Input 110			
		3290 Dig. Input 111			
		3300 Dig. Input 112			
		3310 Dig. Input 113			
	3320 Dig. Input 114	3320 Dig. Input 114			
	3330 Dig. Input 115	3330 Dig. Input 115			
	3340 Dig. Input 116	3340 Dig. Input 116			
	3350 Dig. Input 117	3350 Dig. Input 117			
	3360 Dig. Input 118	3360 Dig. Input 118			

The oil pressure and over speed alarms are never inhibited.

The digital input 118 can be inhibited when engine logics are switched off.
The digital input 118 cannot be inhibited when engine logics are switched on.
This is because it is used as emergency stop in this case.

Group 4 (df/dt – vector jump)

	Alarm	Factory setting		
	1350 df/dt (ROCOF)	Block loss of mains input	And	Logic 1
	1360 Vector jump			

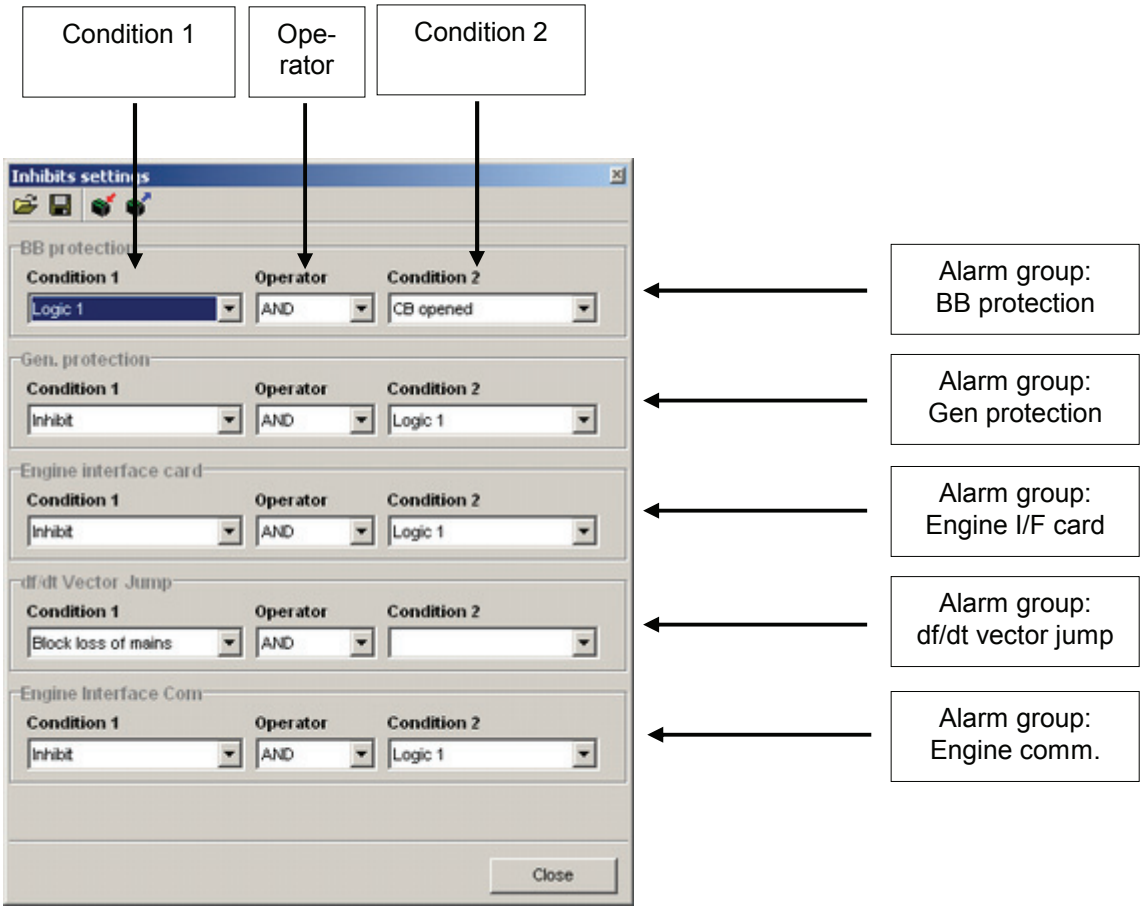
Group 5 (Engine interface communication)

	Alarm	Factory setting		
	4800 EIC Warning	Inhibit	And	Logic 1
	4810 EIC Shutdown			
	4820 EIC Overspeed			
	4830 EIC Coolant T.1			
	4840 EIC Coolant T.2			
	4850 EIC Oil Pres. 1			
	4860 EIC Oil Pres. 2			

Configuration

The configuration of the inhibit function is easily done using the PC utility software. Go to 'Settings/inhibits' to start the configuration or press the inhibit button on the horizontal toolbar.

The dialogue box for inhibit configuration appears:



As illustrated there two conditions and an operator (AND/OR) for each group of alarms. The inhibit function will be activated when one or both of the conditions are met. The operator decides whether one or two of the conditions activate the inhibit function.

Conditions

There are several conditions that can activate or prevent the inhibit function. The conditions can be used in a combination or as a single condition.

Condition	Description for TRUE state	Available in
Logic 0	Defined as a false state. This state cannot activate alarm inhibit but can prevent it	Condition 2
Logic 1	Defined as a true state	Condition 1/2
Inhibit	Alarm inhibit input = ON	Condition 1
Not inhibit	Alarm inhibit input = OFF	Condition 1
CB opened	Circuit breaker is opened	Condition 2
CB closed	Circuit breaker is closed	Condition 2
Not running (U<30%)	Gen-set is stopped (the voltage measurement is below 30%)	Condition 1
Block loss of mains protection	Block input is ON	Condition 1

A true state can activate the inhibit function if the combination of condition 1 and condition 2 is TRUE.

The input to block the loss of mains protection can only be selected for the df/dt and vector jump protections.

Examples

The below three examples show possible configurations of the inhibit function.

As illustrated, when the operator is set to AND the inhibit function will activate only when BOTH conditions are in a true state. When the operator is set to OR the inhibit function will activate when only one of the conditions is in a true state.

Condition 1	Operator	Condition 2	Result
TRUE	AND	TRUE	**ALARM INHIBIT**
FALSE	AND	TRUE	NO INHIBIT
TRUE	AND	FALSE	NO INHIBIT
FALSE	AND	FALSE	NO INHIBIT
TRUE	OR	TRUE	**ALARM INHIBIT**
FALSE	OR	TRUE	**ALARM INHIBIT**
TRUE	OR	FALSE	**ALARM INHIBIT**
FALSE	OR	FALSE	NO INHIBIT

Example 1

In this example, the alarm inhibit must be activated when the digital input 'Alarm inhibit' is activated.

Condition 1	Operator	Condition 2
Inhibit	AND	Logic 1

Example 2

In this example, the alarm inhibit must be activated when the digital input 'Alarm inhibit' is activated or the circuit breaker is opened. Both conditions will activate the input.

Condition 1	Operator	Condition 2
Inhibit	OR	CB opened

Example 3

In this example, the alarms must NEVER be inhibited. The result of the line below will always be FALSE and therefore the inhibit function never activates.

Condition 1	Operator	Condition 2
Logic 1	AND	Logic 0

Relay setup

The GPU has several relay outputs available. Each of these relays can be given a special function depending on the required functionality. This is done in the system setup (menu 4600 - 4760).

Relay functions

There are five functions available. (Please refer to the Horn output chapter for information regarding the horn function as it is not covered in this chapter. See p. 48.)

Function	Description
Alarm	The relay is activated until the alarm that caused the activation is acknowledged and gone. The alarm LED is flashing or constant depending on the acknowledged state.
Alarm + sync. block	The relay is activated until the alarm that caused the activation is acknowledged and gone. When the relay is activated, the synchronising is blocked but the regulation is still active.
Limit	The relay will activate at the limit setpoint. No alarm will appear when both outputs (OA/OB) of the alarm are adjusted to the limit relay. After the condition activating this relay has returned to normal, the relay will deactivate when the "Off delay" has expired. The OFF delay is adjustable.
Alarm/reset	The functionality is similar to 'Alarm', but with a short-time reset if the relay is ON and another alarm tries to activate the same relay.
Alarm sync. block/reset	The functionality is similar to 'Alarm + sync. Block', but with a short-time reset if the relay is ON and another alarm tries to activate the same relay.

Horn output

Relay #3 (terminals 11, 12, 13) can be chosen to be a horn output. This is selected in the menu 4590. This means that the relay can be connected to an alarm annunciator, e.g. a horn. Every time a new alarm occurs, the horn output will activate.

The horn output will activate on all alarms. The output remains activated until:

- The alarm is acknowledged
- The horn relay timer runs out (automatic reset function)

When relay 3 is activated to be the horn relay, it cannot be used by anything else.

The horn output will not activate on limit switch functions.

Automatic reset

The horn relay function has an automatic reset function. When the timer (menu 4591) is adjusted differently from 0 second, then the horn relay output resets itself when the delay has expired. This is also the situation when the alarm is STILL present.

The horn output resets when the alarm is still present. This is the function of the 'Automatic reset'.

Manual reset

If the time is set to 0.0 s, the automatic reset of the horn output is disabled. The horn will remain ON until the alarm is acknowledged by the operator. Now, the status of the alarm changes from unacknowledged (UN-ACK.) to acknowledged (ACK.).

If the alarm condition is gone when the alarm is acknowledged, then the specific alarm message also disappears.

Trip characteristics

The alarms in the GPU controller are typically with definite time characteristics. This means that when the alarm setpoint is exceeded, then the delay will expire and the alarm occurs. For certain alarms the inverse trip characteristic can be selected.

An inverse characteristic means that the alarm delay setpoint is dependent on the specific exceedance of the setpoint. A small exceedance means that a long time will pass until the alarm occurs whereas a bigger exceedance of the setpoint means that a shorter time will pass until the alarm occurs.

Possible alarms

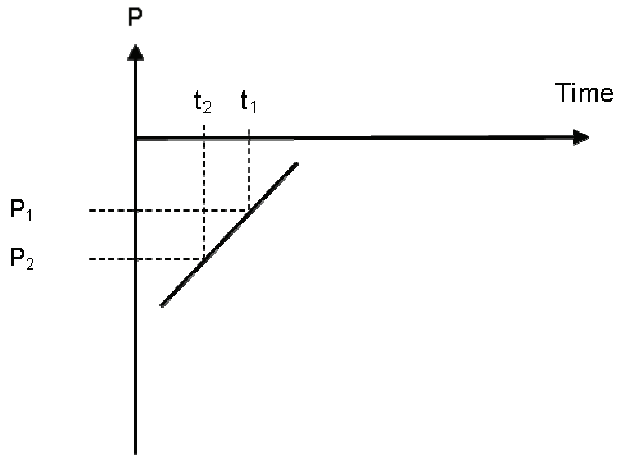
The table shows that the reverse power alarm and one over current alarm can be adjusted with inverse trip characteristic.

Characteristic / Alarm	Definite	Inverse
1010 Reverse power	X	X
1020 Overcurrent 1	X	-
1030 Overcurrent 2	X	-
1060 Overcurr. inv.	X	X

Reverse power

If inverse characteristic is selected, the tripping time is dependent on how much the setpoint is exceeded. The GPU will calculate the exact tripping time depending on the alarm settings. The alarm settings define a certain amount of energy that defines the longest possible tripping time.

When the setpoint is exceeded, the measured energy is calculated according to the setpoint (1011) and the time delay (1012). If this value is exceeded, the alarm occurs. The maximum energy (kWh) will never be exceeded, so if the reverse power increases, the time delay will decrease and vice versa.



The diagram above shows that when the reverse power increases from P1 to P2, the delay will also be shorter.

Overcurrent

The overcurrent alarm with inverse characteristic must be configured with 6 fixed points. These points create a curve that describes the alarm characteristic.

The overcurrent alarm in menu 1060 can be selected with inverse characteristic. The setting of the alarm curve is done in menu 1040 and 1050.

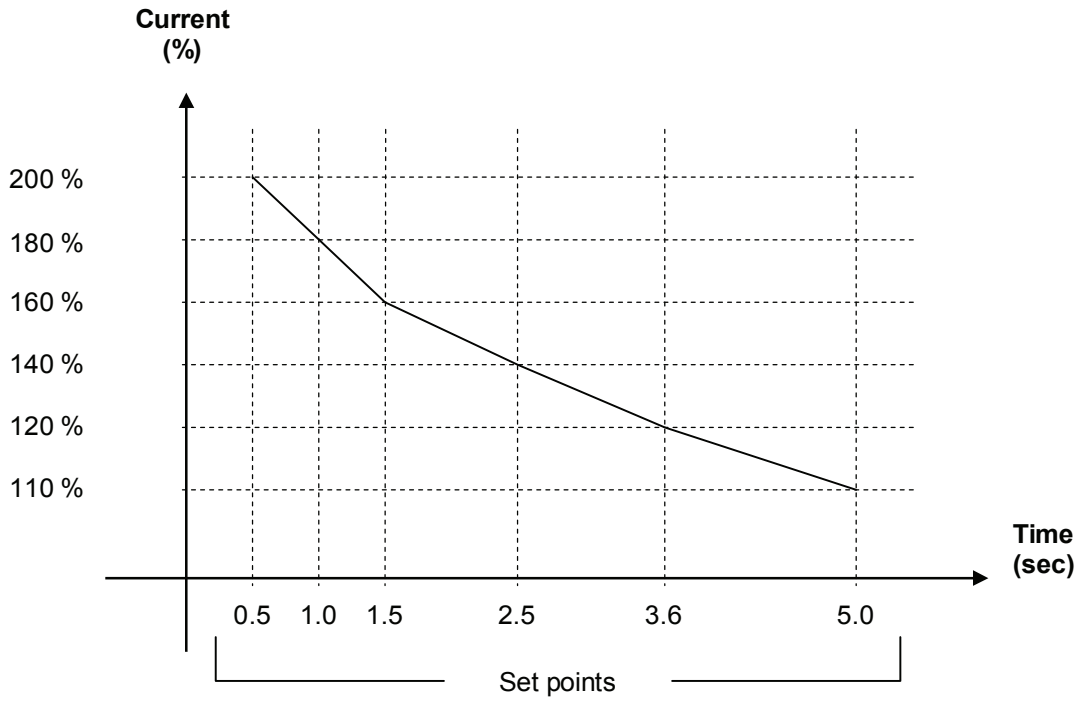
The six fixed points must be programmed so the next current setting has a higher current value than the previous. The time value must be programmed in the same manner but here the timer settings must be decreasing.

If these rules are not followed, the alarm will trigger as an alarm with definite time setting using

the lowest current and the lowest timer settings.

The diagram below is configured with these setpoints:

Setpoint / Value	Setpoint I1/T1	Setpoint I2/T2	Setpoint I3/T3	Setpoint I4/T4	Setpoint I5/T5	Setpoint I6/T6
Current	110 %	120 %	140 %	160 %	180 %	200 %
Timer	5.0 s	3.8 s	2.5 s	1.5 s	1.0 s	0.5 s



The minimum time setting of each of the configurable points is 0.1 second. This will result in the best configuration of the trip curve. Note that the fastest actual response time is 200 ms.

GSM communication

The GSM communication can be used for two purposes.

- SMS service
- Utility software communication

SMS service

With the SMS (Short Message Service) service it is possible to send a SMS message to a mobile telephone when an alarm occurs in the GPU. The message can be send to up to 5 mobile phones. Each message will be sent in clear text, e.g. '1120 Gen low-volt 1'.

The alarms cannot be acknowledged from the mobile phone.

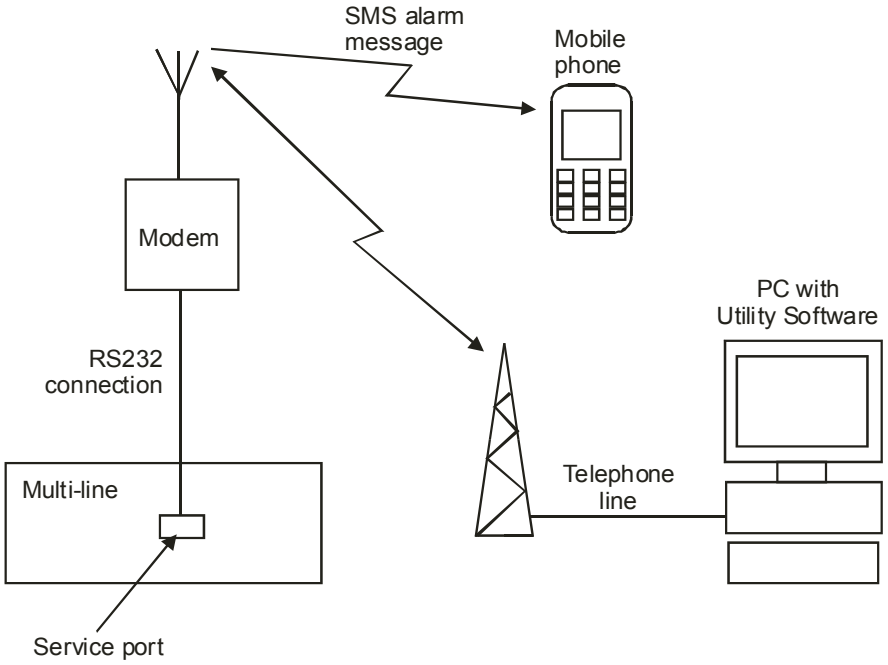
Utility software communication

It is possible to communicate with the GPU via the PC utility software. The purpose is to be able to remotely monitor and control the gen-set application. All functions in the utility software can be used, but please be patient because the speed of the modem communication is slower than the speed of the communication when the GPU is connected directly to the PC.

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

Principle overview

It is possible to use the SMS service or the utility software communication. This is illustrated below.



Wirings and connections

Serial connection

The serial connection to the GSM modem is done via straight cable (option J1) (male/female).

Modem

DEIF A/S recommends using the MOXA OnCell G2150I, Wavecom WMOD2 or Westermo GDW-11 terminal, as the application has been tested with these terminals. The easiest way to get the modem is to purchase it through a local dealer.

A SIM card must be fitted in the modem. The SIM card can be purchased from the local telephone company.

The SIM card must support data transfer for PC utility software communication. This is not necessary if only SMS service is needed.

Setting the PIN code on the SIM card of the modem is done easily by inserting the SIM in a mobile telephone and then by changing the PIN code there.

The PIN code of the SIM card must also be adjusted in parameter file (menu 5116).

Some modem manufacturers recommend a short power interruption (30 seconds) once a day to prevent lock-up of the modem. This is easily done using a 24h watch.

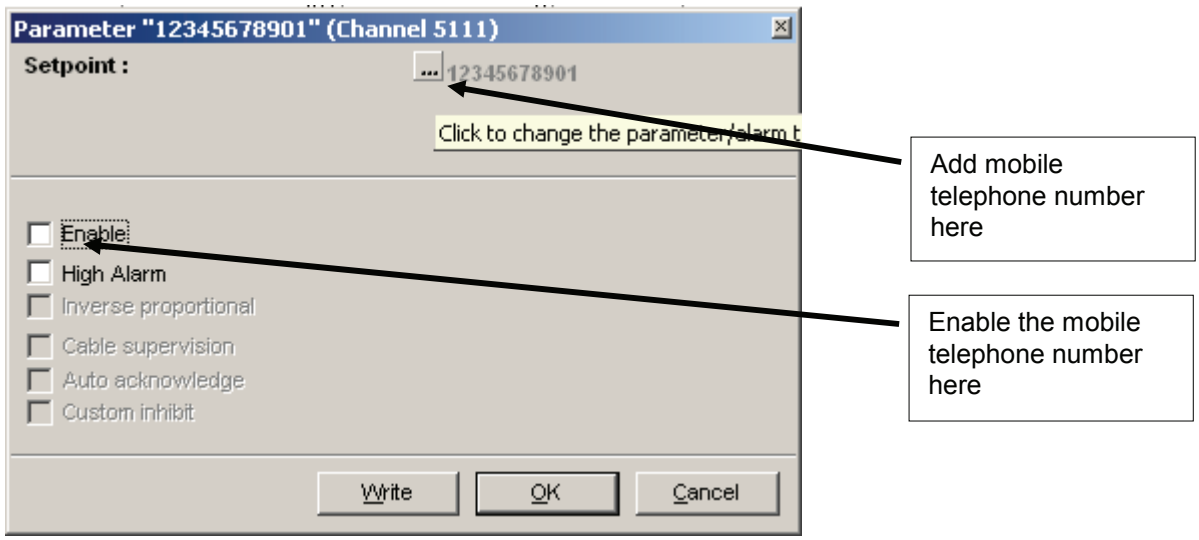
Should an alarm occur during the interruption, the GPU will retransmit the SMS message when the modem starts again. This secures that no messages are lost.

SMS setup

To enable the SMS service, the GPU must be configured in the PC utility software. When the parameter list is uploaded from the GPU, then the telephone number(s) and PIN code can be adjusted. The display cannot be used for this configuration.

Parameter no.	Text	Factory setting
5111	Telephone no. 1	12345678901
5112	Telephone no. 2	12345678902
5113	Telephone no. 3	12345678903
5114	Telephone no. 4	12345678904
5115	Telephone no. 5	12345678905
5116	PIN code	1933

When the parameter file is opened, the configuration can be done by double clicking the specific menu number. In the example below, menu 5111 must be configured.



To call a foreign number type '+ country code' instead of '00', for example dial +45 99999999 for a Danish number.

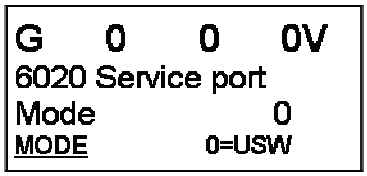
The PIN code is transmitted to the modem when the GPC initialises and again each time an SMS message is transmitted.

Utility software communication setup

The service port is used for the communication between the modem and the GPU. The principle of the communication of the service port must be changed to ASCII mode when the modem communication is used.

Display configuration

Use the 'JUMP' push-button to go to the menu 6020 and change the selection to 1. (default selection is 0)

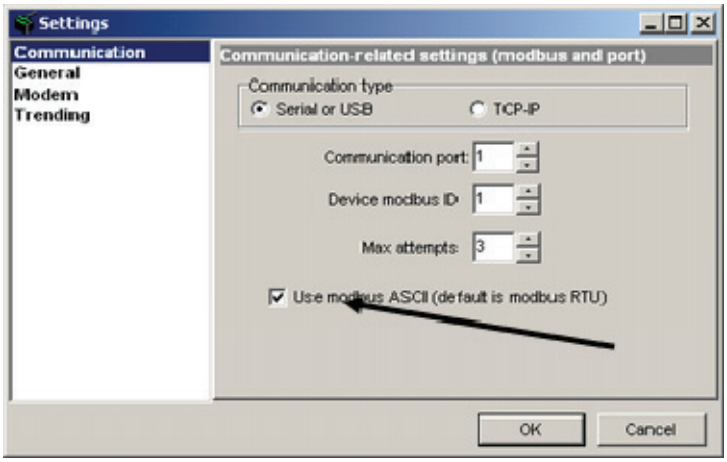


Selection '1' means ASCII communication which is needed for the modem communication.

PC configuration

Press the settings symbol on the horizontal toolbar (the hammer).

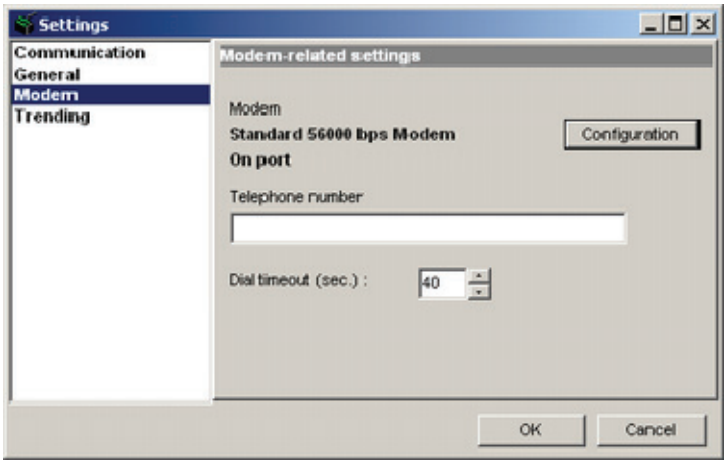
Check off the box as indicated below and press OK. Now ASCII mode is selected.



If the GPU and the USW is adjusted to ASCII mode it is still possible to communicate directly from the PC service port to the GPU.

Modem selection

When 'Modem' is selected in the dialogue box above, the modem configurations can be made.



Select the modem and key in the telephone number of the GSM modem connected to the GPU. Now the PC can connect through the modem when the telephone button on the horizontal toolbar is pressed.

The modem communication is much slower than the normal direct connection so please be patient. It is not recommended to download the entire parameter list. Use the 'Write' function instead.

Download precaution

If the communication fails during parameter download, the Multi-line unit will operate according to the received data. If e.g. only half of the parameter file has been downloaded, when the communication is interrupted, the settings are going to be a mix and the GPU will act accordingly.

Step up transformer

The GPU can be used in applications where the generator is followed by a step up transformer. I.e. the measurement of the generator voltage is on a different level than the measurement of the busbar voltage. The functions available in this application are:

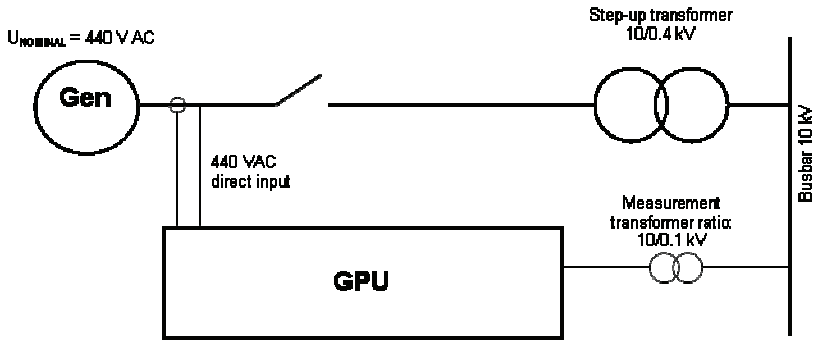
1. Synchronising with or without phase compensation (option G2 only)
2. Voltage measurements displayed
3. Generator protections (option dependent)
4. Busbar protections (option dependent)

The maximum nominal voltage supported by the GPU is 25000V AC.

Applications

Different applications are supported by the GPU when a step up transformer is placed after a generator. Measurement transformers can be installed on the generator side and the busbar side, or direct inputs between 100V AC and 690V AC can be connected.

A typical setup includes a low voltage generator, e.g. 400V AC, and a step up transformer, e.g. 400/10000V AC. In this case, 400V AC would be connected to the generator inputs and 100 or 110 from the measurement transformer connected to the busbar inputs.

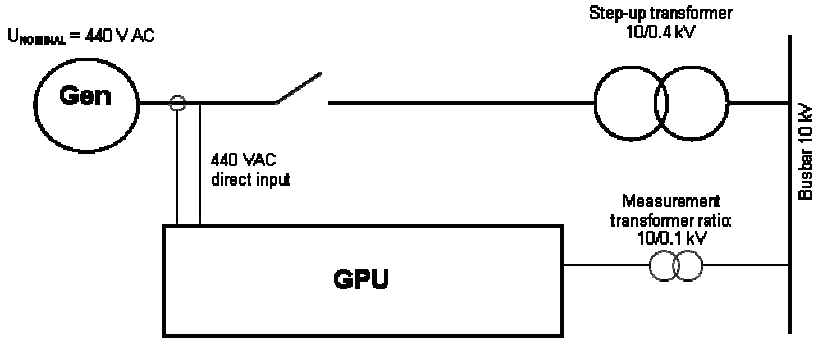


Measurement transformer

The GPU can be adjusted with different measurement transformer ratios. This is adjusted in the system setup (menus 4020/4030). The advantage is a.o. that synchronising of a circuit breaker can be performed even though the voltage measurement points are not placed on the same busbar.

Different measurement inputs

In the GPU it is possible to have different measurement inputs on the generator measurements and the busbar measurements. Schematically it looks e.g. like the diagram below where the generator inputs are 440 volt and the busbar inputs are 100 volt.



The current measurement point must be placed on the generator side of the step-up transformer.

If there is a phase shift in the step up transformer, then please note the chapter regarding synchronising.

Settings

When the GPU is used as described in this chapter, two sets of nominal voltages can be adjusted.

- 4014 generator nominal voltage
- 4033 busbar nominal voltage

Both adjustments are necessary in all cases when the specific ratios of the measurement transformers are adjusted in the GPU. This is the case when the unit must be used for voltage protections and/or the display unit is installed.

The ratio of the nominal voltages of the generator and the busbar must be equal to the ratio of the step up transformer.

For instance, this means that if a 10000/400V AC transformer is installed together with a 380V AC generator then the busbar nominal voltage must be adjusted to 380*10000/400=9500V AC. This is due to the internal calculations regarding the control functions. If the busbar protections are used their alarm levels must be adjusted accordingly.

Use this function only when the transformer has a fixed ratio.

Note that the ratio of the step up transformer must be equal to the ratio of the nominal voltages.

Measurement transformer

If the measurement transformer ratio is adjusted to 110/110 or 100/100, then only the phase angle must be adjusted or checked. (This is typically the case where the display is not installed and the voltage protections are not used).

If it is required to use actual settings of the measurement transformers, then the nominal voltages must be adjusted too. (This is typically the case when the display must be installed in the cabinet door, when the voltage protections must be used or only a measurement transformer is placed on the high voltage side).

Warning

If there is an error in the settings of the nominal voltages vs. the measurement transformers an error will occur. This error occurs when the nominal voltages (4014/4033) are different but the measurement transformers (4020/4030) are equal. The error will appear when the generator is started and the GPU has running feedback or voltage measurements.

Synchronising with or without phase compensation (option G2 only)

The GPU has an adjustment that allows for an offset of the angle measurement when synchronising. With this compensation an offset of +/- 45 deg. can be used when synchronising.

The menu 6200 is used for the adjustment. It can only be accessed through the display using the 'JUMP' push-button.

The function can be used when there is a step up transformer between the generator measurements and the busbar measurements and the specific type is the Yy1, Dy1, Yd1, Yy11, Dy11 and Yd11 type. These transformers have a 30 degree and a 330 degree phase shift between the primary and the secondary side and therefore it is necessary to make an offset during synchronising. (Synchronising is of course also possible for transformer types without angle displacement).

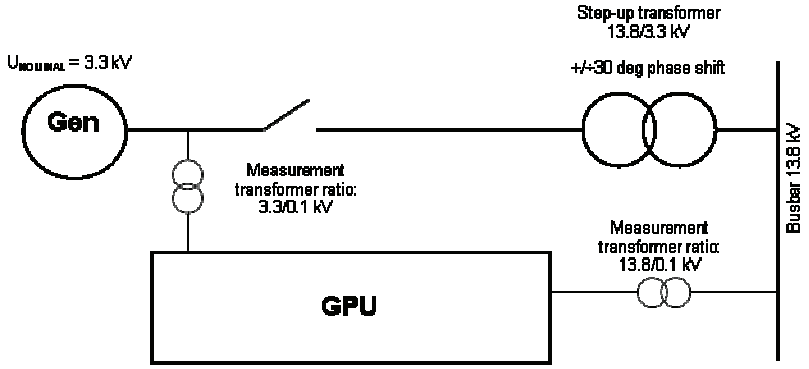
If the transformer has an angle displacement then synchronising can ONLY be used with Yy1, Dy1, Yd1, Yy11, Dy11 and Yd11 transformers. (+/-30 deg. phase shift).

The factory setting is 0 degrees and it has to remain at that value except when one of the six mentioned transformers is installed between the generator and the busbar measurements.

Any error in this setting will cause a false closing of the breaker! Therefore it is *essential* to check the angular precision before allowing the GPU to perform a real breaker closing.

Single line example

The simple diagram below shows a step up transformer with +/- 30 deg. phase shift depending on the type of transformer. In order to be able to synchronise the generator circuit breaker, the GPU must compensate for the 30 degree offset.



When used for synchronising, the GPU uses the ratio of the nominal voltages of the generator and the busbar when calculating the AVR setpoint and the voltage synchronising window (dU_{MAX}).

Example:
A 10000/400V AC step up transformer is installed after a generator with the nominal voltage of 400V AC. The nominal voltage of the busbar is 10000V AC. Now, the voltage of the busbar is 10500V AC. The generator is running 400V AC before the synchronising starts but when attempting to synchronise the AVR setpoint will be changed to $U_{BUS-MEASURED} * U_{GEN-NOM}/U_{BUS-NOM}$:10500*400/10000 = 420V AC.

Protection

The voltage protections refer to the nominal adjusted voltages (menu 4014 and 4033).

Alarm \ Reference U		4014	4033	Option dependency
1100	Gen. high volt. 1	X		A1 A2 A3 B1 C1
1110	Gen. high volt. 2	X		A1 A2 A3 B1 C1
1120	Gen. low volt. 1	X		A1 A2 A3 B1 C1
1130	Gen. low volt. 2	X		A1 A2 A3 B1 C1
1180	Bus high volt. 1		X	A1 A2 A3 B1
1190	Bus high volt. 2		X	A1 A2 A3 B1
1200	Bus low volt. 1		X	A1 A2 A3 B1
1210	Bus low volt. 2		X	A1 A2 A3 B1
1430	Gen h-volt 1 S2	X		A1 A2 A3 B1 C1
1440	Gen h-volt 2 S2	X		A1 A2 A3 B1 C1
1450	Gen l-volt 1 S2	X		A1 A2 A3 B1 C1
1460	Gen l-volt 2 S2	X		A1 A2 A3 B1 C1
1510	Bus h-volt 1 S2		X	A1 A2 A3 B1
1520	Bus h-volt 2 S2		X	A1 A2 A3 B1
1530	Bus l-volt 1 S2		X	A1 A2 A3 B1
1540	Bus l-volt 2 S2		X	A1 A2 A3 B1

The power calculation is based on the generator voltage (menu 4014).

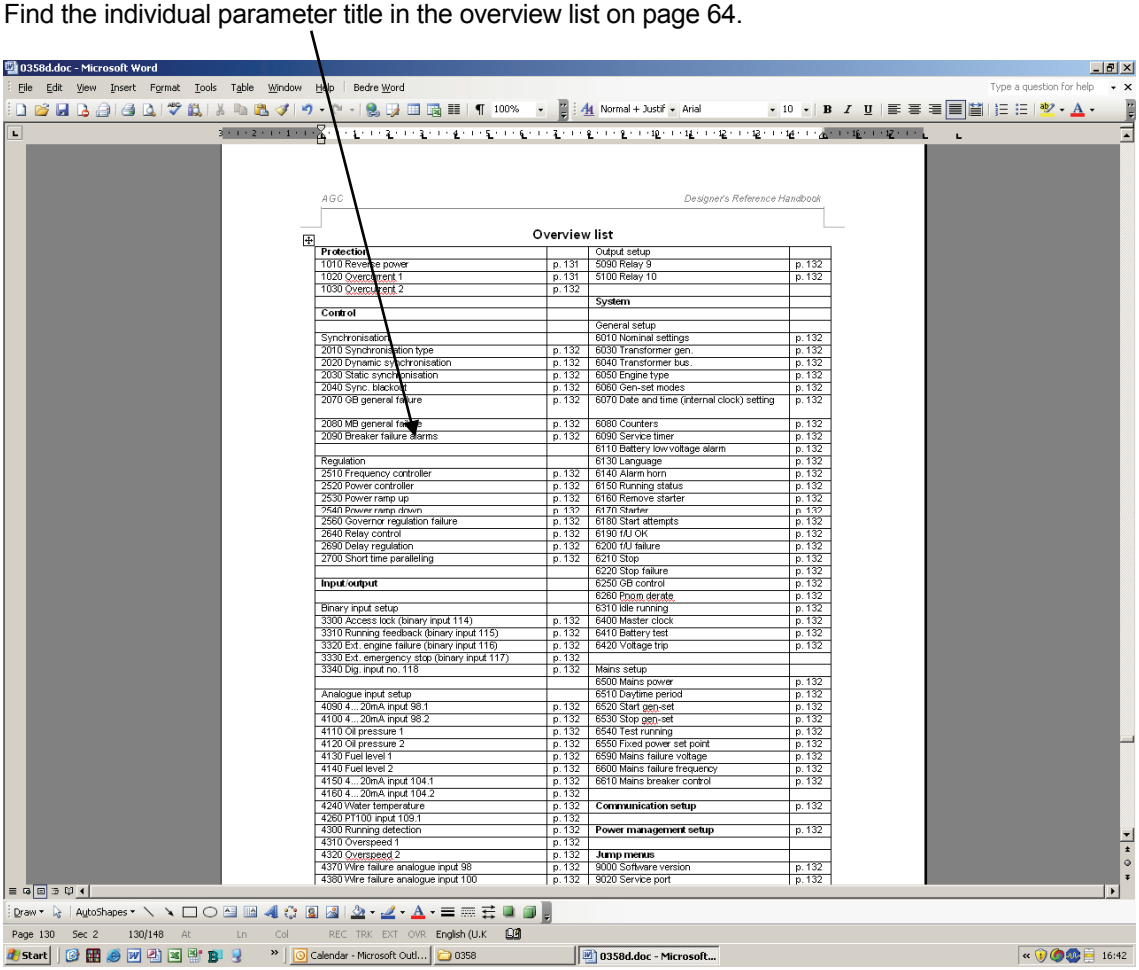
7. Procedure for parameter setup

This chapter deals with the procedure to be followed when the parameters of the unit are set up from the initial point of finding the individual parameter description in this handbook to the actual setup. By use of various illustrations, the following will guide the user through the whole procedure for parameter setup step by step.

Finding the selected parameter

The first step in the parameter setup is finding the correct parameter descriptions. All parameter descriptions are located in chapter 8 'Parameter setup' which is intended for reference purposes. The descriptions are structured according to their parameter titles and the main parameter group to which they belong.

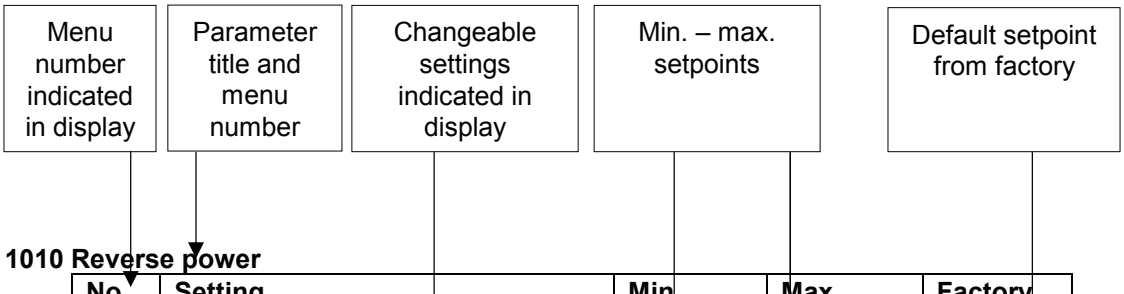
Find the individual parameter title in the overview list on page 64.



In the overview list, you will find the page location of the parameter description you are looking for.

Parameter descriptions

In chapter 8, each parameter description is structured according to the same principles. Under the parameter title heading, the detailed parameter descriptions are illustrated and presented. First, a table indicating the parameter facts related to the individual parameter title is presented:



1010 Reverse power

No.	Setting		Min. setting	Max. setting	Factory setting
1011	Reverse power	Setpoint	-50.0%	0.0%	-5.0%
1012	Reverse power	Timer	0.1 s	100.0 s	10.0 s
1013	Reverse power	Relay output A	R0 (none)	Option dependent	R0 (none)
1014	Reverse power	Relay output B	R0 (none)		R0 (none)
1015	Reverse power	Enable	OFF	ON	ON
1016	Reverse power	Characteristic	Inverse	Definite	Definite

Small differences due to the character of the parameters may exist between the individual tables.

The first column indicates the menu number in the display.

The second column indicates the changeable setting in the display.

The third and fourth columns indicate the minimum/maximum setpoint available for this setting.

The sixth column indicates the default setpoint of the unit from the factory. When necessary, additional information will be supplied after the table in order to make the individual parameter descriptions as informative as possible.

Setup

At this point of the process you will have located the specific parameter description that you were looking for. Now, follow the menu structure presented earlier in this handbook in order to set up the individual parameters. (In this overall example, we have chosen to change the setpoint of the parameter **1010 Reverse power**).

Step 1: Enter the 'setup' menu via SETUP in the fourth display line in the entry window.
Step 2: Enter the 'protection' menu via PROT in the fourth display line in the setup menu.
Step 3: Enter the 'setpoint 1' menu via PROT1 in the fourth display line in the setup menu.
Step 4: Use JUMP or the ▽ and △ push-buttons to locate the selected parameter.
Step 5: Enter the 'setpoint' menu via LIM in the fourth display line.
Step 6: Enter password to change the setpoint.
Step 7: Use the ▽ and △ push-buttons to increase/decrease the setpoint setting.
Step 8: Use the 'underscore' to save the new setpoint setting.

8. Parameter setup

This chapter includes a complete standard parameter list. Therefore, this part of the handbook is to be used for reference when specific information about the individual parameters is needed for the unit setup. An overview list can be seen on the next page.

The parameter lists for the available options are presented in the documents Description of Options describing the individual options in detail.

Parameter table description
The table consists of the following possible adjustments:

Setpoint: The alarm setpoint is adjusted in the setpoint menu. The setting is a percentage of the nominal values.

Timer: The timer setting is the time that must expire from the alarm level is reached until the alarm occurs.

Relay output A: A relay can be activated by output A.

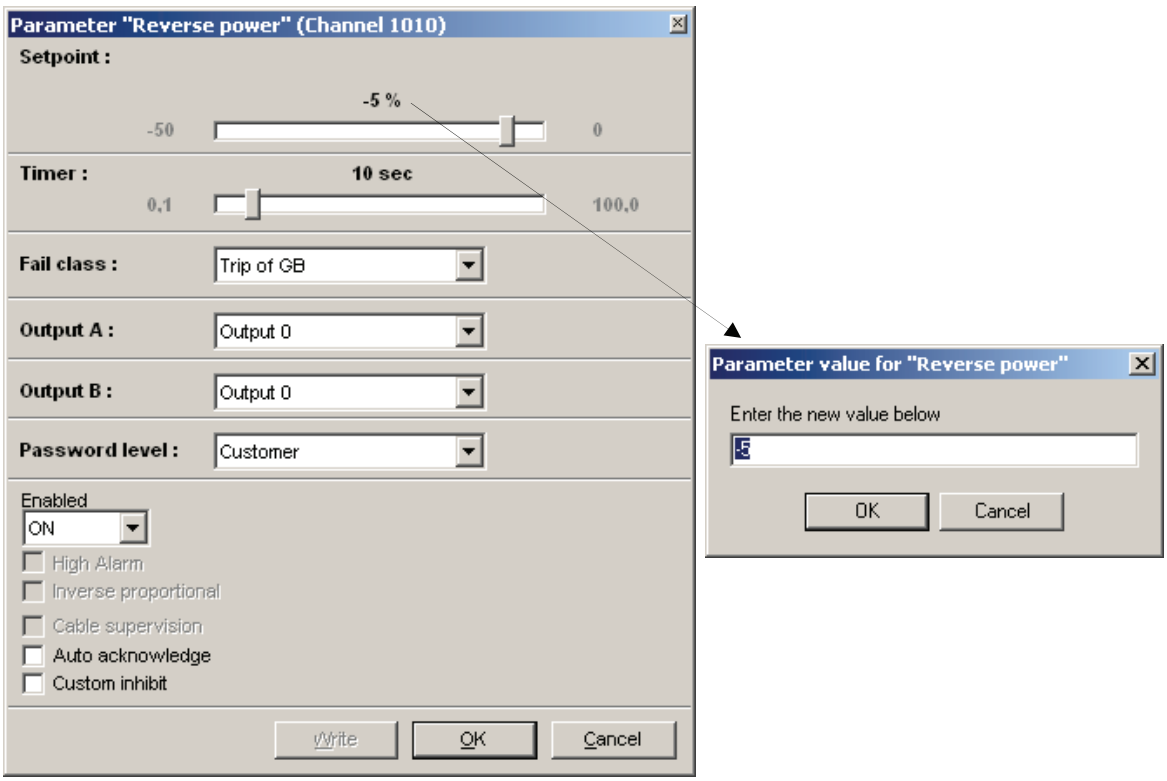
Relay output B: A relay can be activated by output B.

Enable: The alarm can be activated or deactivated.

Small differences due to the character of the parameters may exist between the individual tables.

It is also possible to configure the parameters by using the PC utility software. It will be possible to make the same configurations as described above.

By using the PC utility software some extra functionalities are available. For all the protections it is possible to make an automatic acknowledgement of the alarm. Usually, it is important when the mains protections are used, as the sequences are blocked until the alarm is acknowledged.



Overview list

Protection		4030 Transformer bus	**p. 67**
1010 Reverse power	**p. 65**	4100 Date and time	**p. 67**
1020 Over current 1	**p. 65**	4121 Counters	**p. 67**
1030 Over current 2	**p. 65**	4221 Battery low voltage	**p. 67**
1040 Over current inv.	**p. 65**	4230 Language	**p. 68**
1050 Over current inv.	**p. 65**	4590 Horn	**p. 68**
1060 Over current inverse	**p. 66**	4600 Relay 0 (Virtual)	**p. 68**
		4610 Relay 1	**p. 68**
Input		4620 Relay 2	**p. 68**
3120 Binary input 23	**p. 66**	4630 Relay 3	**p. 68**
3130 Binary input 24	**p. 66**	4640 Relay 4	**p. 68**
3140 Binary input 25	**p. 66**		
3150 Binary input 26	**p. 66**	**Jump button**	
3160 Binary input 27	**p. 66**	4971 User password	**p. 69**
		4972 YYYYY password	**p. 69**
System		4980 Service menu	**p. 69**
4010 Nominal settings	**p. 67**	6100 Application	**p. 69**
4020 Transformer gen.	**p. 67**	6200 Phase compensation	**p. 69**

Protection

This setup menu consists of the protection setup.

1010 Reverse power

No.	Setting		Min. setting	Max. setting	Factory setting
1011	Reverse power	Setpoint	-50.0%	0.0%	-5.0%
1012	Reverse power	Time	0.10 s	100.00 s	10.00 s
1013	Reverse power	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
1014	Reverse power	Relay output B	R0 (none)		R0 (none)
1015	Reverse power	Enable	OFF	ON	ON
1016	Reverse power	Characteristic	Inverse	Definite	Definite

1020 Overcurrent 1

No.	Setting		Min. setting	Max. setting	Factory setting
1021	Overcurrent 1	Setpoint	50.0%	200.0%	115.0%
1022	Overcurrent 1	Time	0.10 s	100.00 s	10.00 s
1023	Overcurrent 1	Relay output A	R0 (none)	Option dependent	R2 (relay 2)
1024	Overcurrent 1	Relay output B	R0 (none)		R0 (none)
1025	Overcurrent 1	Enable	OFF	ON	ON

1030 Overcurrent 2

No.	Setting		Min. setting	Max. setting	Factory setting
1031	Overcurrent 2	Setpoint	50.0%	200.0%	120.0%
1032	Overcurrent 2	Time	0.10 s	100.00 s	5.00 s
1033	Overcurrent 2	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
1034	Overcurrent 2	Relay output B	R0 (none)		R0 (none)
1035	Overcurrent 2	Enable	OFF	ON	ON

1040 Overcurrent inv.

No.	Setting		Min. setting	Max. setting	Factory setting
1041	Overcurr. inverse	Current setpoint 1	100%	200%	110%
1042	Overcurr. inverse	Time setpoint 1	0.1 sec	200.0 sec	5.0 sec
1043	Overcurr. inverse	Current setpoint 2	100%	200%	120%
1044	Overcurr. inverse	Time setpoint 2	0.1 sec	200.0 sec	3.8 sec
1045	Overcurr. inverse	Current setpoint 3	100%	200%	140%
1046	Overcurr. inverse	Time setpoint 3	0.1 sec	200.0 sec	2.5 sec

1050 Overcurrent inv.

No.	Setting		Min. setting	Max. setting	Factory setting
1051	Overcurr. inverse	Current setpoint 4	100%	200%	160%
1052	Overcurr. inverse	Time setpoint 4	0.1 sec	200.0 sec	1.5 sec
1053	Overcurr. inverse	Current setpoint 5	100%	200%	180%
1054	Overcurr. inverse	Time setpoint 5	0.1 sec	200.0 sec	1.0 sec
1055	Overcurr. inverse	Current setpoint 6	100%	200%	200%
1056	Overcurr. inverse	Time setpoint 6	0.1 sec	200.0 sec	0.5 sec

1060 Overcurrent inverse

No.	Setting		Min. setting	Max. setting	Factory setting
1061	Overcurr. inverse	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
1062	Overcurr. inverse	Relay output B	R0 (none)		R1 (relay 1)
1063	Overcurr. inverse	Activate	OFF	ON	ON

Input

This menu consists of parameters for configuration of the inputs.

3120 Binary input 23

No.	Setting		Min. setting	Max. setting	Factory setting
3121	Binary input term. 23	Time	0.10 s	100.00 s	5.00 s
3122	Binary input term. 23	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3123	Binary input term. 23	Relay output B	R0 (none)		R0 (none)
3124	Binary input term. 23	Enable	OFF	ON	OFF

3130 Binary input 24

No.	Setting		Min. setting	Max. setting	Factory setting
3131	Binary input term. 24	Time	0.10 s	100.00 s	5.00 s
3132	Binary input term. 24	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3133	Binary input term. 24	Relay output B	R0 (none)		R0 (none)
3134	Binary input term. 24	Enable	OFF	ON	OFF

3140 Binary input 25

No.	Setting		Min. setting	Max. setting	Factory setting
3141	Binary input term. 25	Time	0.10 s	100.00 s	5.00 s
3142	Binary input term. 25	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3143	Binary input term. 25	Relay output B	R0 (none)		R0 (none)
3144	Binary input term. 25	Enable	OFF	ON	OFF

3150 Binary input 26

No.	Setting		Min. setting	Max. setting	Factory setting
3151	Binary input term. 26	Time	0.10 s	100.00 s	5.00 s
3152	Binary input term. 26	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3153	Binary input term. 26	Relay output B	R0 (none)		R0 (none)
3154	Binary input term. 26	Enable	OFF	ON	OFF

3160 Binary input 27

No.	Setting		Min. setting	Max. setting	Factory setting
3161	Binary input term. 27	Time	0.10 s	100.00 s	5.00 s
3162	Binary input term. 27	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3163	Binary input term. 27	Relay output B	R0 (none)		R0 (none)
3164	Binary input term. 27	Enable	OFF	ON	OFF

System

The menu includes parameters for the system setup.

4010 Nominal settings

No.	Setting		Min. setting	Max. setting	Factory setting
4011	Nominal settings	Frequency	48.0 Hz	62.0 Hz	60.0 Hz
4012	Nominal settings	Generator power	10 kW	99 MW	480 kW
4013	Nominal settings	Generator current	0 A	9000 A	787 A
4014	Nominal settings	Generator volt.	100 V	25000 V	440 V

4020 Transformer gen.

No.	Setting		Min. setting	Max. setting	Factory setting
4021	Transformer gen.	Volt. prim.	100 V	25000 V	440 V
4022	Transformer gen.	Volt. sec.	100 V	690 V	440 V
4023	Transformer gen.	Current prim.	5 A	9000 A	1000 A
4024	Transformer gen.	Current sec.	1 A	5 A	5 A

4030 Transformer bus

No.	Setting		Min. setting	Max. setting	Factory setting
4031	Transformer bus.	Volt. prim.	100 V	25000 V	440 V
4032	Transformer bus.	Volt. sec.	100 V	690 V	440 V
4033	Transformer bus.	U bus nominal	100 V	25000 V	440 V

4100 Date and time

No.	Setting		Min. setting	Max. setting	Factory setting
4101	Date and time	Year	2001	2100	Present year
4102	Date and time	Month	1	12	1
4103	Date and time	Date	1	31	1
4104	Date and time	Hour	0	23	0
4105	Date and time	Minute	0	59	0

4121 Counters

No.	Setting		Min. setting	Max. setting	Factory setting
4121	Counters	Running time	0	20000	0
4122	Counters	CB operations	0	20000	0
4123	Counters	Reset kWh counter	OFF	ON	OFF

4221 Battery low voltage

No.	Setting		Min. setting	Max. setting	Factory setting
4221	Battery low V	Setpoint	8.0 V	32.0 V	18.0 V
4222	Battery low V	Time	0.0 s	10.0 s	1.0 s
4223	Battery low V	Relay output A	R0 (none)	Option dependent	R0 (none)
4224	Battery low V	Relay output B	R0 (none)		R0 (none)
4225	Battery low V	Enable	OFF	ON	ON

4230 Language

No.	Setting		Factory setting
4231	Language	English	English
		Deutsch	-
		Français	-
		Español	-

4590 Horn

No.	Setting		Min. setting	Max. setting	Factory setting
4591	Horn	Time	0.0 s	999.9 s	0.0 s
4592	Horn	Enable	OFF	ON	OFF

Only relay three (R3) can be used as a horn relay output.

4600 Relay 0 (virtual)

No.	Setting		Min. setting	Max. setting	Factory setting
4601	Relay 0 virtual	Function	Alarm	Alarm/sync. Block	Alarm
4602	Relay 0	Off delay	0.0 s	999.9 s	5.0 s

4610 Relay 1

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4611	Relay 1	Function	Alarm	Alarm/sync. Block - reset	Limit	Alarm
4612	Relay 1	Off delay	0.0 s	999.9 s	-	5.0 s

4620 Relay 2

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4621	Relay 2	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4622	Relay 2	Off delay	0.0 s	999.9 s	-	5.0 s

4630 Relay 3

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4631	Relay 3	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4632	Relay 3	Off delay	0.0 s	999.9 s	-	5.0 s

4640 Relay 4

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4641	Relay 4	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4642	Relay 4	Off delay	0.0 s	999.9 s	-	5.0 s

Jump button

A number of menus can only be entered using the jump menu.

4971 User password

No.	Setting		Min. setting	Max. setting	Factory setting
4971	User password	Setting	0	32000	2000

4972 YYYYY password

No.	Setting		Min. setting	Max. setting	Factory setting
4971	YYYYY password	Setting	0	32000	4972

This is the backup password. If it is changed keep the new password in a safe place.

4980 Service menu

No.	Setting		Description
4981	Service menu	Alarm	Shows remaining delay time
4982	Service menu	Digital input	Shows binary input status
4983	Service menu	Digital output	Shows relay output status

6100 Application

No.	Setting		Description	Factory setting
6100	Application	Mode 0	Normal (3-phase)	Normal (3-phase)
6100	Application	Mode 1	Split phase	-
6100	Application	Mode 2	Single phase	-

6200 Phase compensation

No.	Setting		Min. setting	Max. setting	Factory setting
6200	Phase compensation	Setpoint	-45 deg.	45 deg.	0.0 deg.

Requires option G2.

DEIF A/S reserves the right to change any of the above.