DEIF A/S

Designer's Reference Handbook

Paralleling and Protection Unit/GS Multi-line 2

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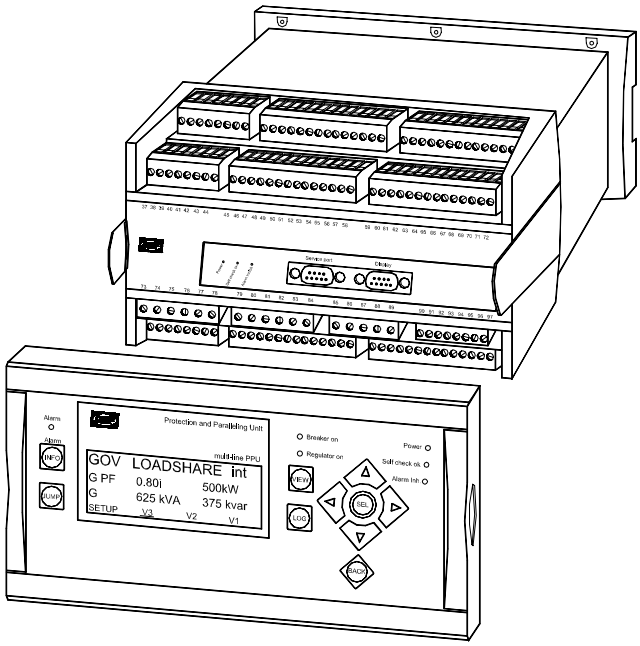

- *Functional description*
- *Display unit and menu structure*
- *PI controller*
- *Procedure for parameter setup*
- *Parameter setup*

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Table of contents

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 Paralleling and Protection Unit, the PPU. 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.

PI-controller

This chapter offers information about the PI-controller in the form of principle drawings and descriptions.

Synchronising

This chapter contains detailed information about the unit's dynamic and static synchronisation.

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 PPU 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 Paralleling and 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. 4921240313.

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:

Stand-alone

- Parallel with other gen-sets
- Parallel with the mains

Control functions

- Synchronising
- Power and frequency controls

Operation modes

- Fixed frequency
- Fixed power (base load)
- Droop
- Load sharing

Protections (ANSI)

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

Separate mounting

- Status texts
- Easy readable
- Programming

Measuring system

- 3-phase true RMS
- Galvanically isolated voltage and current inputs

GSM communication

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

Terminal strip overview

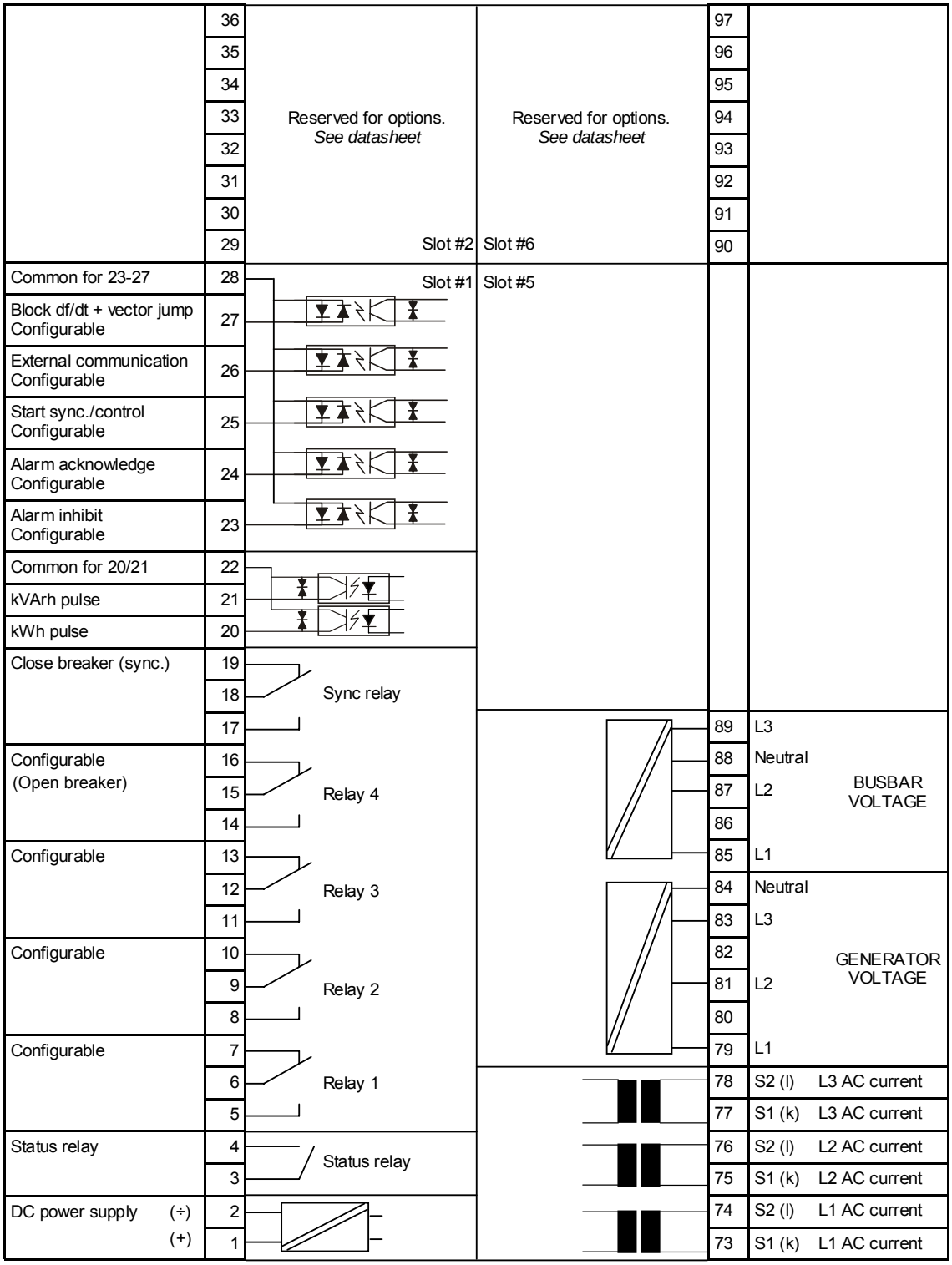
The terminal strip overview shows I/Os for selectable standard and optional hardware.

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

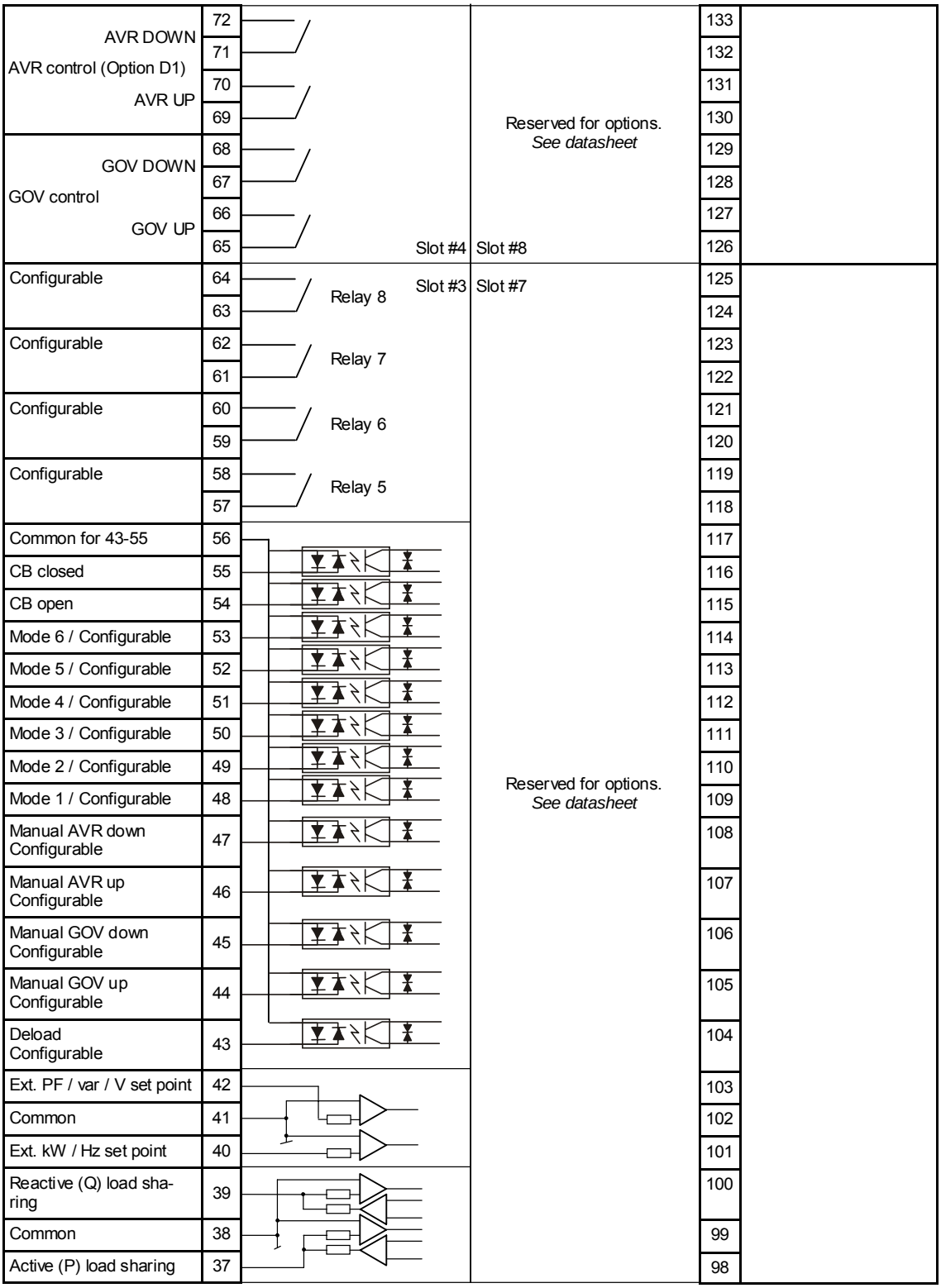
Refer to the input/output lists in the installation instructions for detailed information about the I/Os of the specific options.

The terminal strip overview of the standard PPU with option D1 is shown on the next two pages.

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



Slots #3, #4, #7 and #8



Applications

The unit can be used for the applications listed in the table below. This depends on the selection of the running modes.

Mode selection / Application	Select running mode			
	Fixed frequency	**Fixed power**	**Droop**	**Load sharing**
Island mode, stand-alone	**X**		**X**	
Island mode, load sharing with other gen-sets			**X**	**X**
Fixed power to mains		**X**	**X**	

All combinations of the above applications are possible. The selection is made with the mode inputs called mode 1 (terminal 48) and mode 2 (terminal 49).

Fixed frequency

Select fixed frequency mode by deactivating mode 1 and mode 2.

This mode is always used when the CB is opened regardless of the activation of the mode inputs. When the CB is opened nothing else but the frequency can change as a cause of changed governor regulation and therefore the mode inputs are not used. (Mode 3 (external setpoint) can still be used!)

This running mode is typically used when the generator is running in island operation/stand alone. During island operation/stand alone the load connected to the generator cannot be changed through regulation of the gen-set. If the fuel supply to the engine is increased or decreased then the loading of the gen-set does not change – only the frequency will increase or decrease as a result of changed fuel supply.

Dependency

Fixed frequency mode is active when:

Input / Active mode			Fixed frequency (Sync)	Fixed frequency	Fixed frequency
Control inputs	Start sync./control	25	ON	ON	ON
	Deload	43	OFF	ON	OFF
Breaker feedbacks	CB open	54	ON	ON	OFF
	CB closed	55	OFF	OFF	ON
Mode inputs	Mode 1	48	*Mode inputs are not used when the CB is opened*		OFF
	Mode 2	49			OFF

Regulator

The frequency regulator is active in this mode. During fixed frequency operation the setpoint is typically the nominal frequency. (See page 62 for exact description of the setpoint).

Fixed power

Select fixed power mode by activating mode 1 and deactivating mode 2.

This running mode is typically used when the generator is running parallel to the mains. During

fixed power operation, the gen-set cannot change the frequency because it is maintained by the grid. If the fuel supply to the engine is increased or decreased then the frequency of the gen-set does not change – only the load will increase or decrease as a result of changed fuel supply.

Dependency

Fixed power mode is active when:

Input \ Active mode			Fixed power	Fixed power (ramp down)
Control inputs	Start sync./control	25	ON	ON
	Deload	43	OFF	ON
Breaker feedbacks	CB open	54	OFF	OFF
	CB closed	55	ON	ON
Mode inputs	Mode 1	48	ON	ON
	Mode 2	49	OFF	OFF

Regulator

The power regulator is active in this mode. During fixed power operation, the setpoint is typically the setpoint adjusted in the display (menu 4041). (See page 62 for exact description of the setpoint).

Droop

Select droop mode by deactivating mode 1 and activating mode 2.

This running mode can be used on various occasions where it is required that the generator frequency drops with increasing load.

The droop mode adjusted in the PPU should not be confused with the governor droop:

The *governor droop* has the purpose of applying stability in the regulation of the engine and does not give an actual droop if a controller (PPU) is installed.

The *PPU droop* has the purpose of causing an actual speed droop. With this droop activated, the frequency will actually change with changing load.

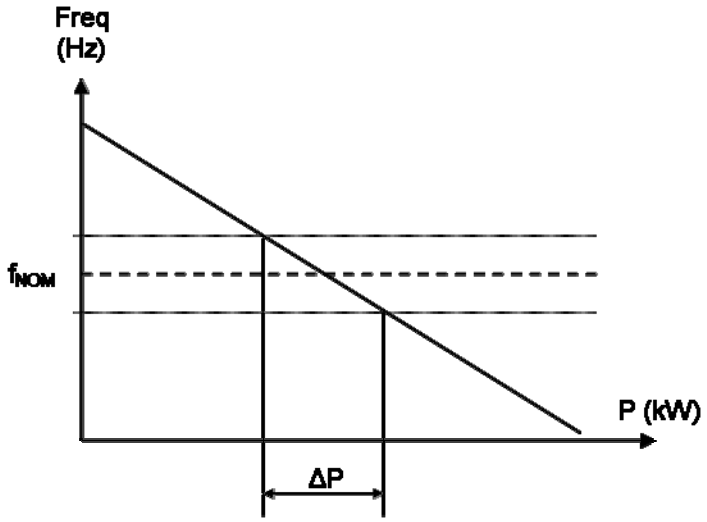
Base loaded operation

When the generator is in parallel operation with the mains it will operate with different loading depending on the frequency. A high droop setting will cause the load to be relatively constant with changed frequency and a lower droop setting will give higher variations in load.

This is shown in the diagrams below:

Diagram A: high droop setting

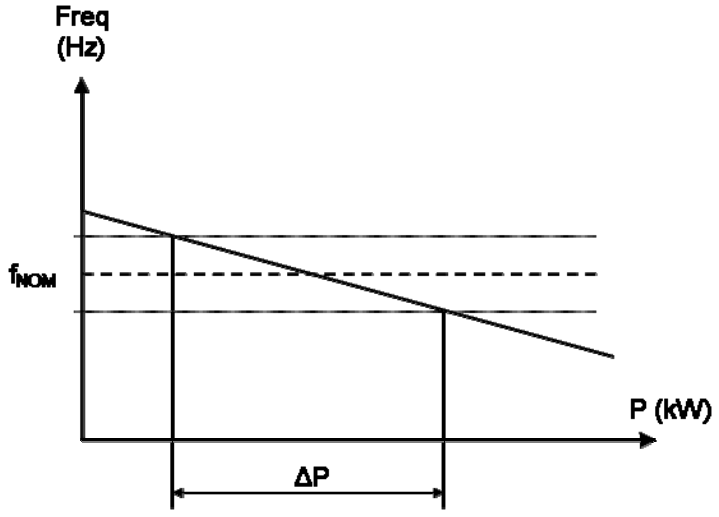
On this diagram, the illustrated frequency variation gives a change in the load. This is marked as ΔP.



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

Diagram B: low droop setting

On this diagram, the load change (ΔP) is larger than before. This means that the generator will vary more in loading than with the higher droop setting.



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

Load sharing with older type gen-sets

Droop mode can be used when a new gen-set is installed in an installation where old gen-sets are installed and they operate in droop mode. Then it can be preferred to install the new gen-set and operate it in droop mode in order to make equal load sharing with the existing gen-sets.

Compensation for isochronous governors

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

Dependency

Droop mode is active when:

Input / Active mode			Droop
Control inputs	Start sync./control	25	ON
	Deload	43	OFF
Breaker feedbacks	CB open	54	OFF
	CB closed	55	ON
Mode inputs	Mode 1	48	OFF
	Mode 2	49	ON

Regulator

The power controller is used in the PPU when operating in droop mode. This means that as long as the power does not match the frequency the governor will be controlled up- or downwards. This way, the power and the frequency will always end up by matching each other according to the adjusted droop curve. (When operating parallel to the mains, the power will be controlled and when operating in island mode, the frequency will be controlled.)

Load sharing

Select load sharing mode by activating mode 1 and mode 2.

This running mode is typically used when paralleling two or more gen-sets. During load sharing operation with other gen-sets the power and frequency of each individual gen-set can be changed. This means that if the fuel supply is changed to the engine, then the power of the gen-set – and subsequently the frequency – will change.

Dependency

Load sharing mode is active when:

Input / Active mode			Load sharing
Control inputs	Start sync./control	25	ON
	Deload	43	OFF
Breaker feedbacks	CB open	54	OFF
	CB closed	55	ON
Mode inputs	Mode 1	48	ON
	Mode 2	49	ON

Regulator

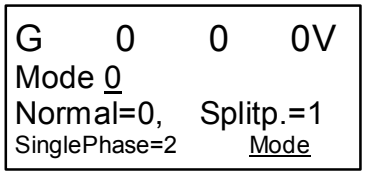
The power and the frequency regulators are active when the load sharing mode is selected. The setpoint is typically a combination of the signal on the load sharing line and the nominal frequency. (See page 62 for exact description of the setpoint).

Measurement systems

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

Three-phase

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

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 PPU. The PPU 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):

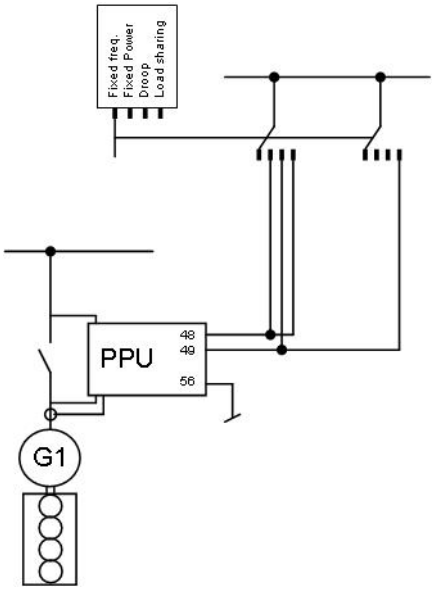
Setting / Adjustment		Description	Adjust to value
4014	Nom.voltage	Phase-phase voltage	230
4021	Transformer Gen	Primary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$
4022	Transformer Gen	Secondary voltage of the voltage transformer (if installed)	$U_{NOM} \times \sqrt{3}$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

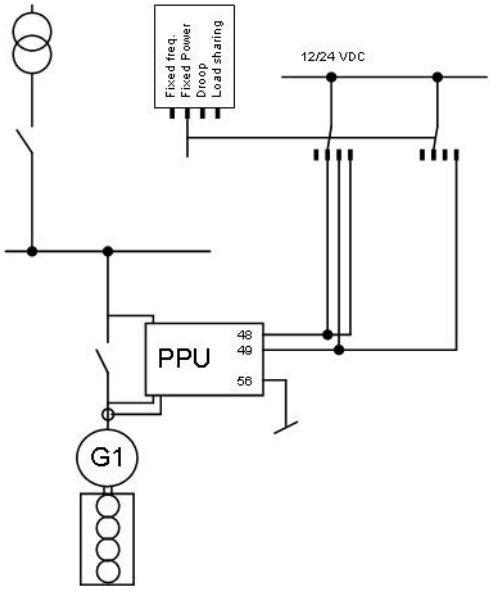
Single diagrams

The PPU 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 PPU controller.

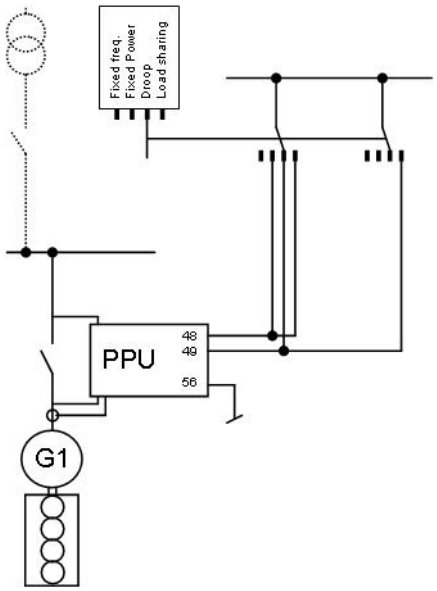
Stand-alone



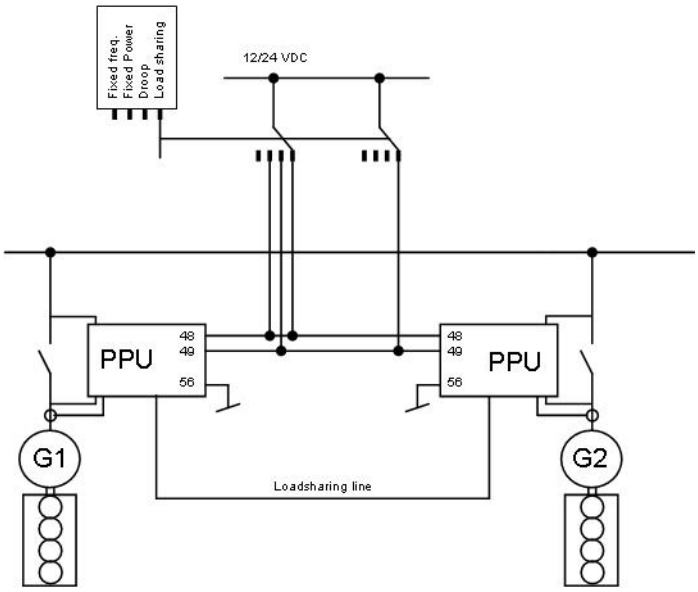
Gen-set parallel to mains



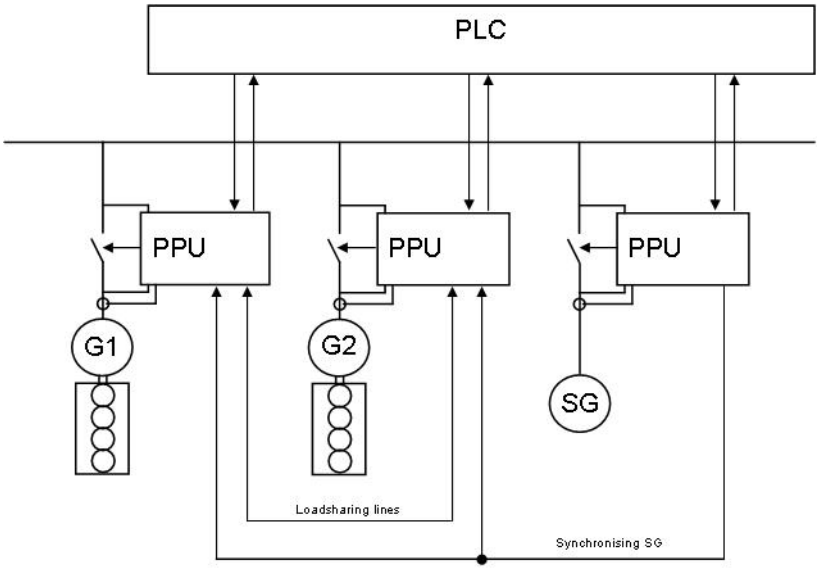
Droop mode



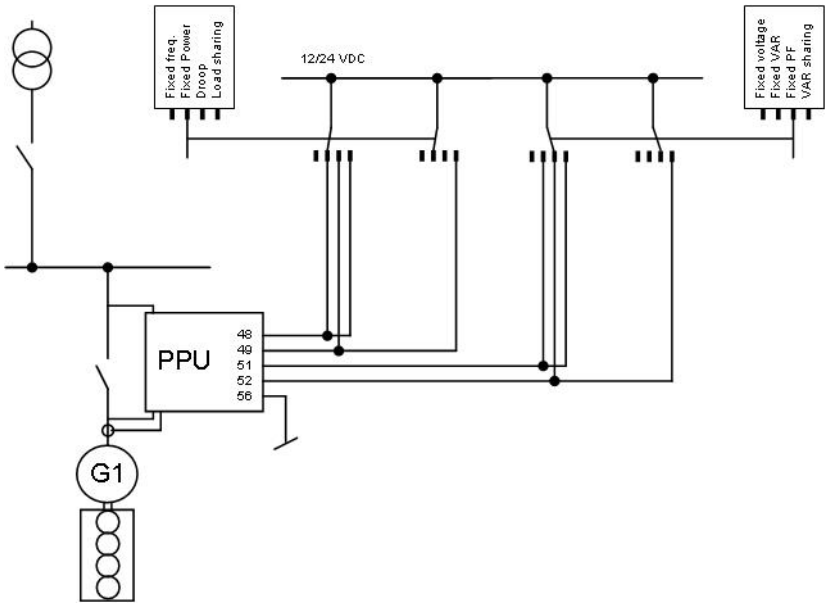
Paralleling gen-sets



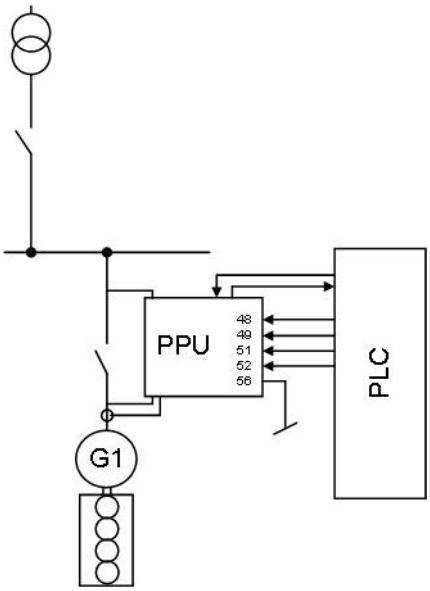
Gen-sets parallel to shaft generator and PLC controlled



Gen-set parallel to mains and AVR control



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



Sequences

The following chapter contains information about the sequences of the PPU.

These sequences will be described:

Sequence	Description
CB ON	Synchronising
CB ON	Black out closing
CB OFF	Open breaker
CB OFF	Deload/open breaker

CB ON sequence/synchronising

The CB ON sequence can be started when the generator is running and the terminal 25 (start sync./control) is activated. The regulation will start and control the gen-set in order to synchronise the breaker.

The busbar voltage must be above 70% x U_{NOM} in order to initiate the synchronising.

Interruption of the CB ON (synchronising) sequence	
Input 25 deactivated	
Input 43 activated	25 = ON at the same time
CB close	
U_{BB} measured below 70%	70% x U_{NOM}
Synchronising failure	
General failure	
Alarm + sync block state	

When the CB opens there is a 10 s delay that prevents it from closing immediately after it has opened. This is to ensure that there is sufficient time to change mode and control inputs.

CB ON sequence/black out closing

In order to make a black out closing, terminal 25 must be activated and the measurements from the busbar must be missing. The breaker will close if the voltage is below 30% x U_{NOM}.

The busbar voltage must be below 30% x U_{NOM} in order to initiate the black busbar closing.

Interruption of the CB ON (black close) sequence	
Input 25 deactivated	
Input 43 activated	25 = ON at the same time
U gen not OK	Limit set in menu 2042
f gen not OK	Limit set in menu 2041
Black closing not enabled	Enabled in menu 2040
CB close	
U_{BB} measured above 30%	
General failure	
Alarm + sync block state	

When the CB opens there is a 10 s delay that prevents it from closing immediately after it has opened. This is to ensure that there is sufficient time to change mode and control inputs.

CB OFF/open breaker

The CB can be opened instantly by the PPU. The sequence is started by this selection of the control inputs:

Terminal	Description	Input state
25	Start sync./control	ON
43	Deload	ON
48	Mode 1	OFF
49	Mode 2	OFF

The CB open signal will be issued immediately when the combination of the control inputs are as mentioned in the table above.

CB OFF/deload

The CB can be opened by the PPU after a smooth deload period where the load has decreased to the breaker open point (menu 2152). The sequence is started by one of the following three combinations of inputs:

Terminal	Description	Input state		
25	Start sync./control	ON	ON	ON
43	Deload	ON	ON	ON
48	Mode 1	ON	ON	OFF
49	Mode 2	ON	OFF	ON

The CB open signal will be issued when the load has been below the breaker open point for 1 second. In order to interrupt the deload sequence the input 43 must be deactivated. Then the PPU will continue the operation according to the present mode selection. (The deload sequence can also be interrupted if the input 'Start sync./control' is deactivated. But then the entire regulation is deactivated).

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).

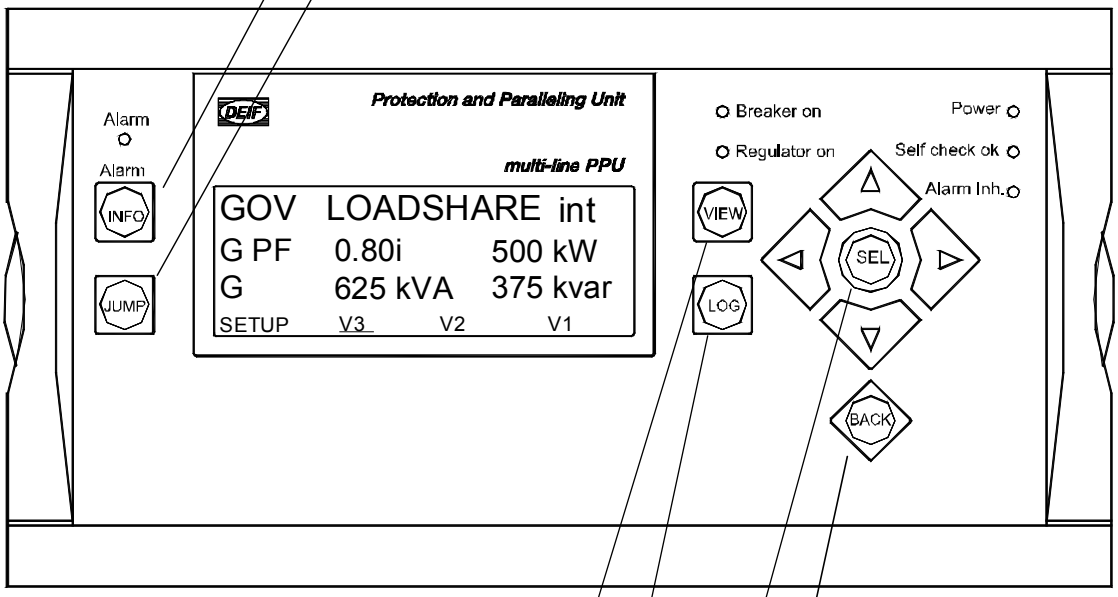
SEL: Is used to select the underscored entry in the fourth line of the display.

 : 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.

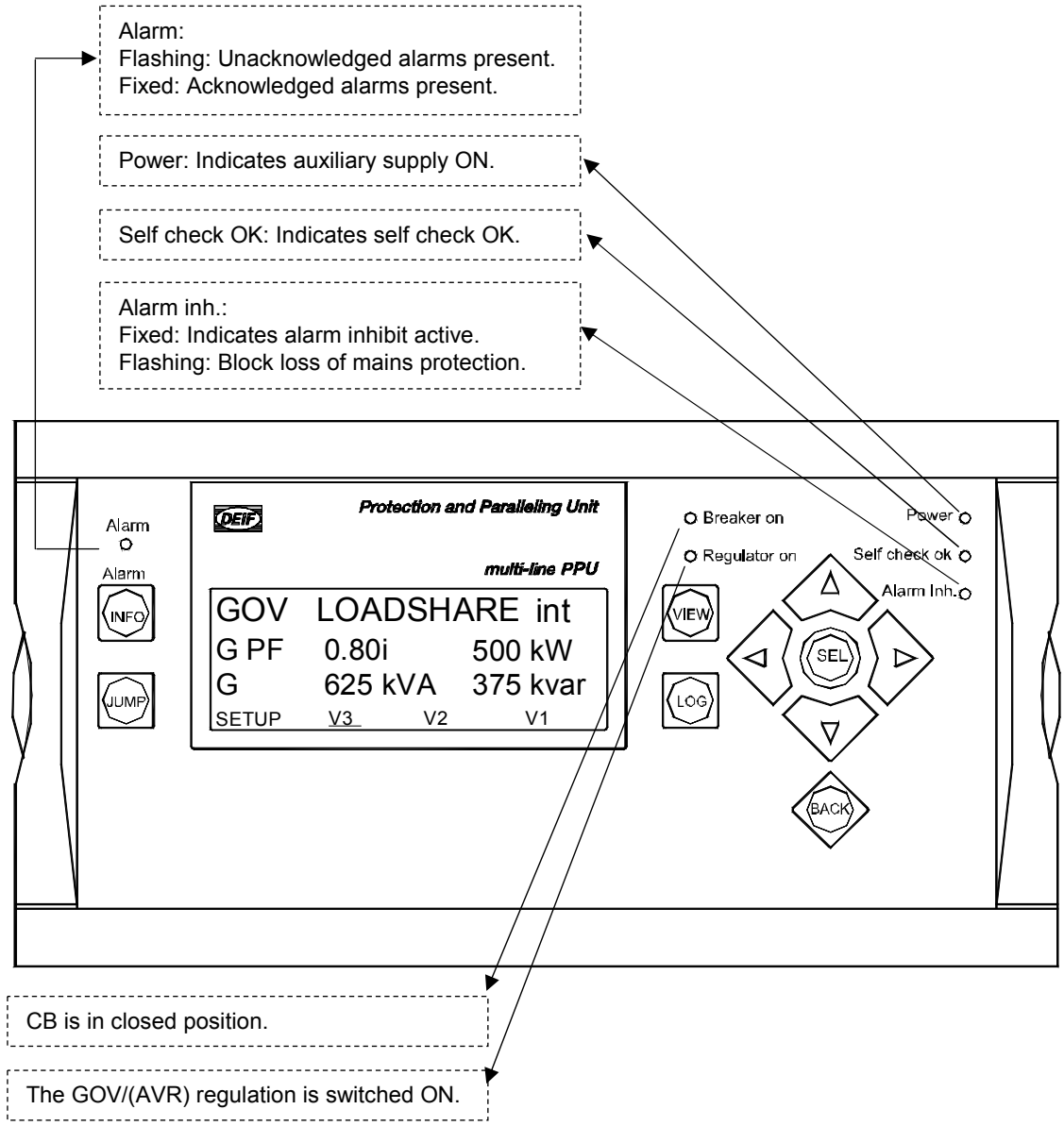
Power: LED indicates that the auxiliary supply is switched on.

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:

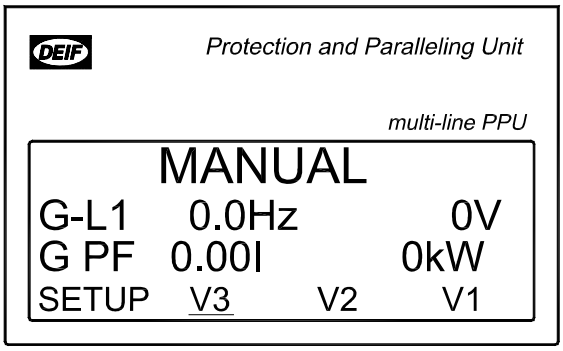
View menu system
This is the commonly used menu system. 15 windows are configurable and can be entered by using the arrow push-buttons.

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

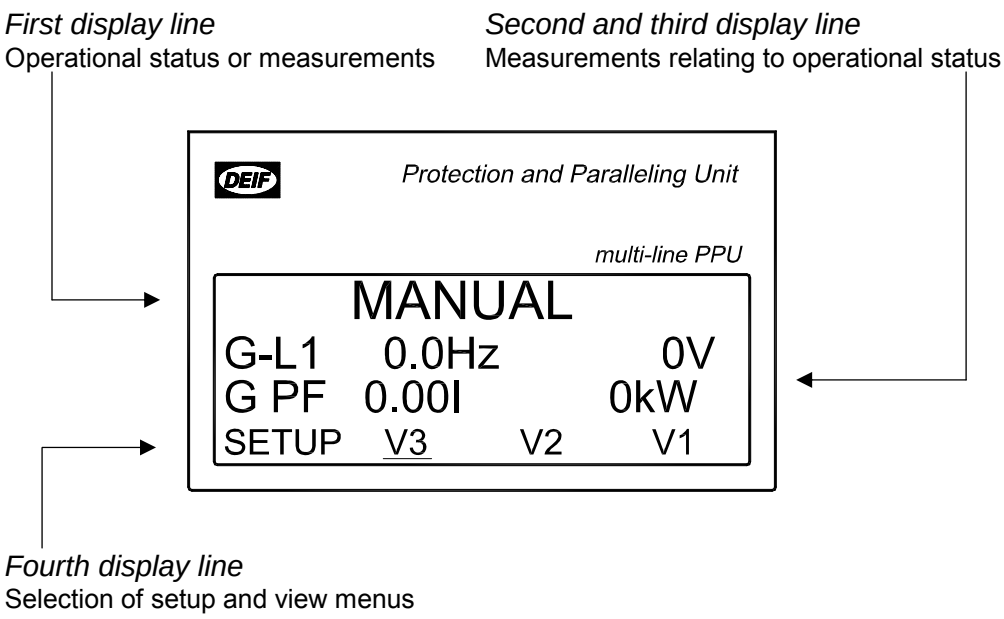
When the unit is powered up, an entry window appears. The entry window is the turning point in the menu structure and as such the gateway to the other menus. It can always be reached by pressing the BACK push-button 3 times.

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



View menu

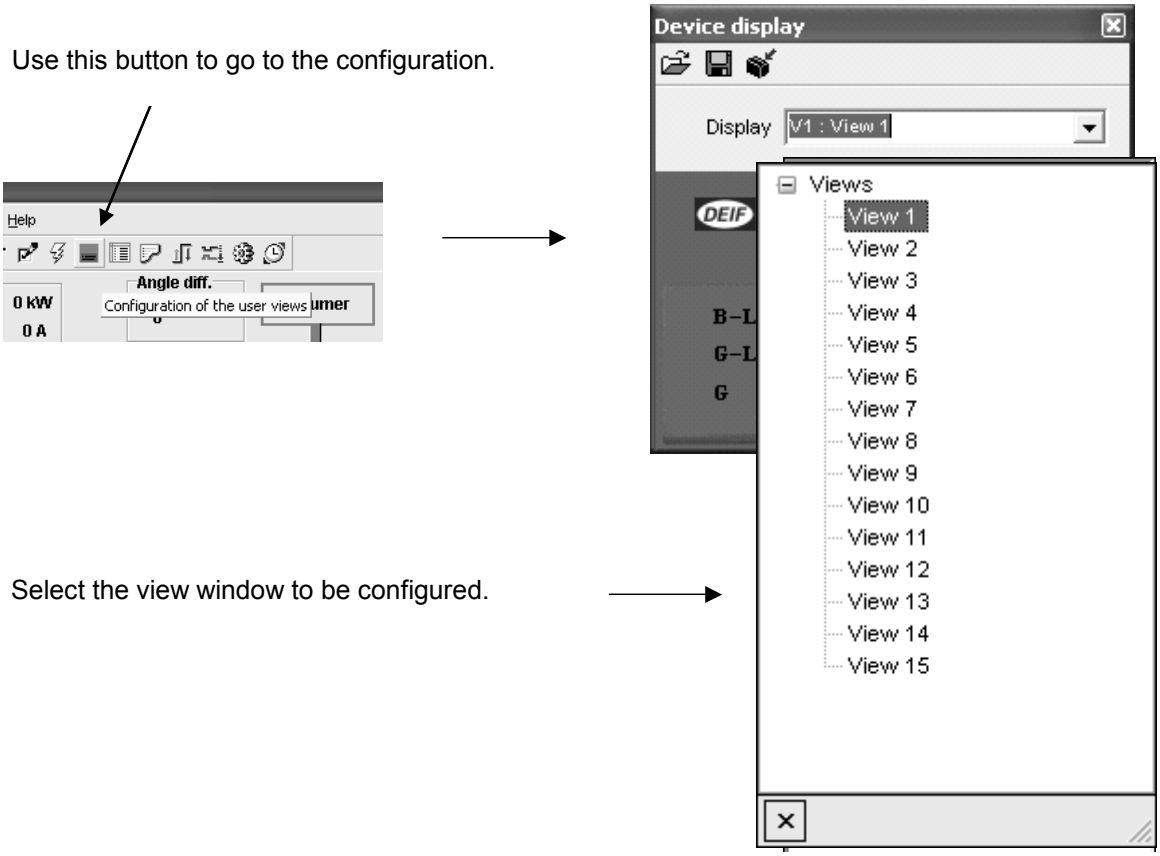
The view menus (V1, V2 and V3) are the most commonly used menus of the unit.



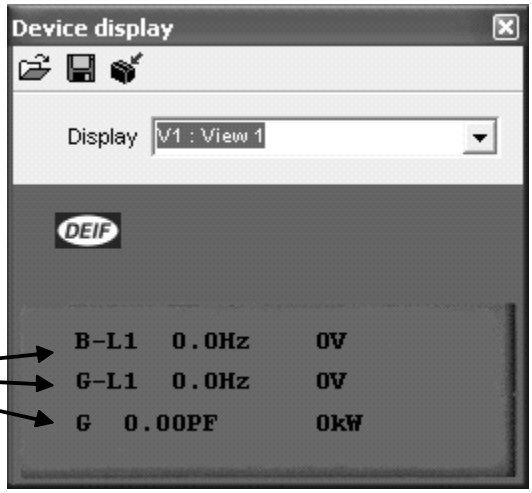
In the view menus various measured values are shown on the display.

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.

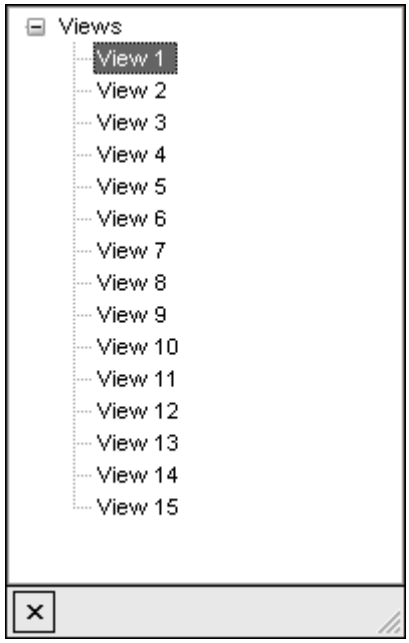
The selectable values and measurements are presented in the table on page 33 in this handbook.

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	

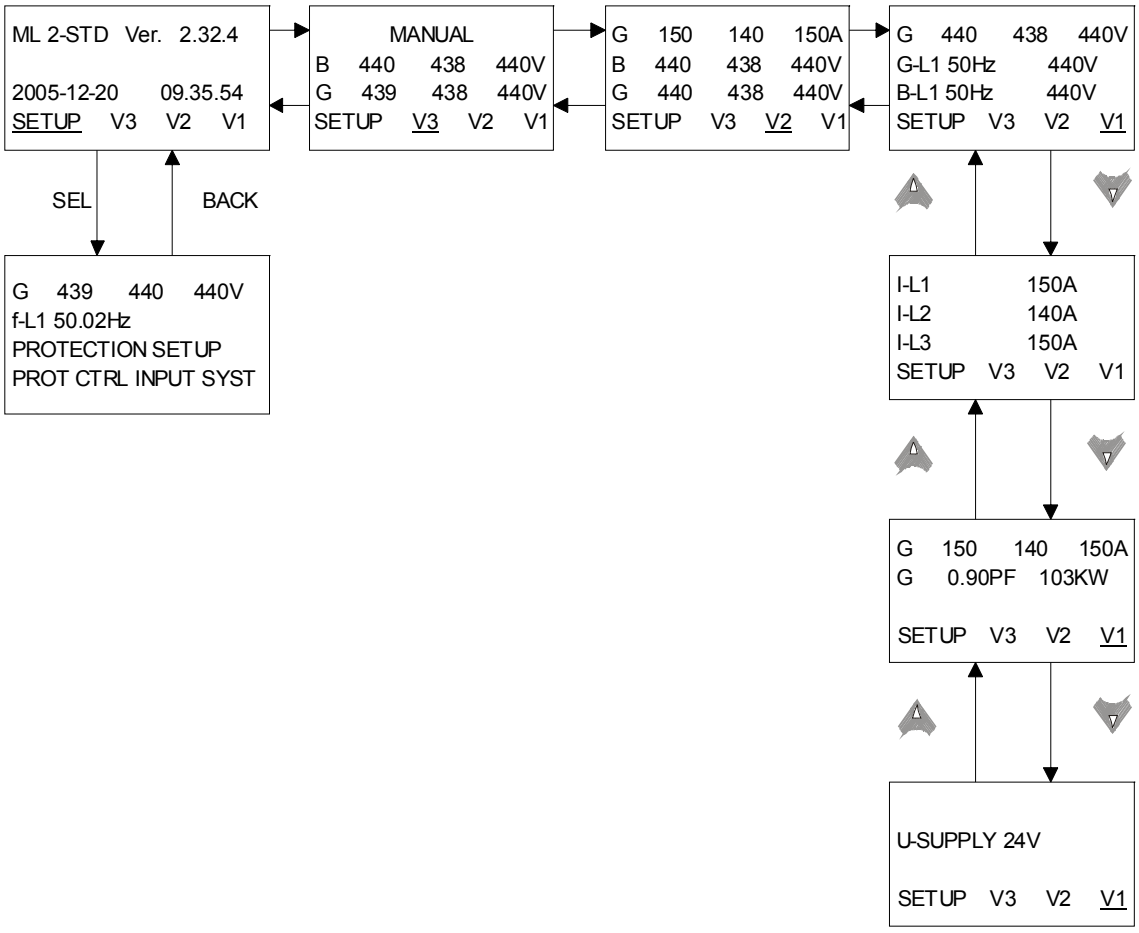


Windows	V 2	V 3
View 1	Changes automatically between the 5 first views: 1. View 1 (Start prepare) 2. View 2 (Sync.) 3. View 3 (Ramp up/down) 4. View 4 5. View 5 (Default*) No manual selection. All three lines show measuring values.	Changes automatically between the 5 first views: 1. View 1 (Start prepare)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

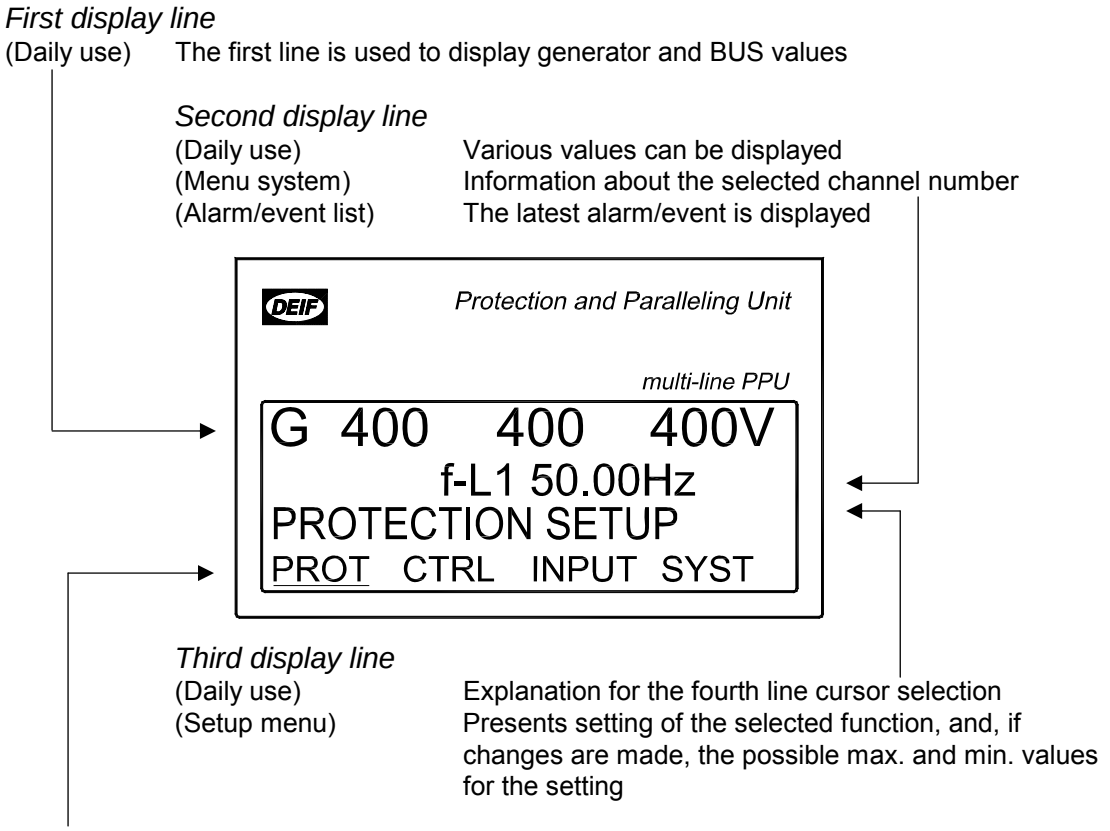
The entry window displays view 3, (in the illustration above, the window where 'manual' is displayed).

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

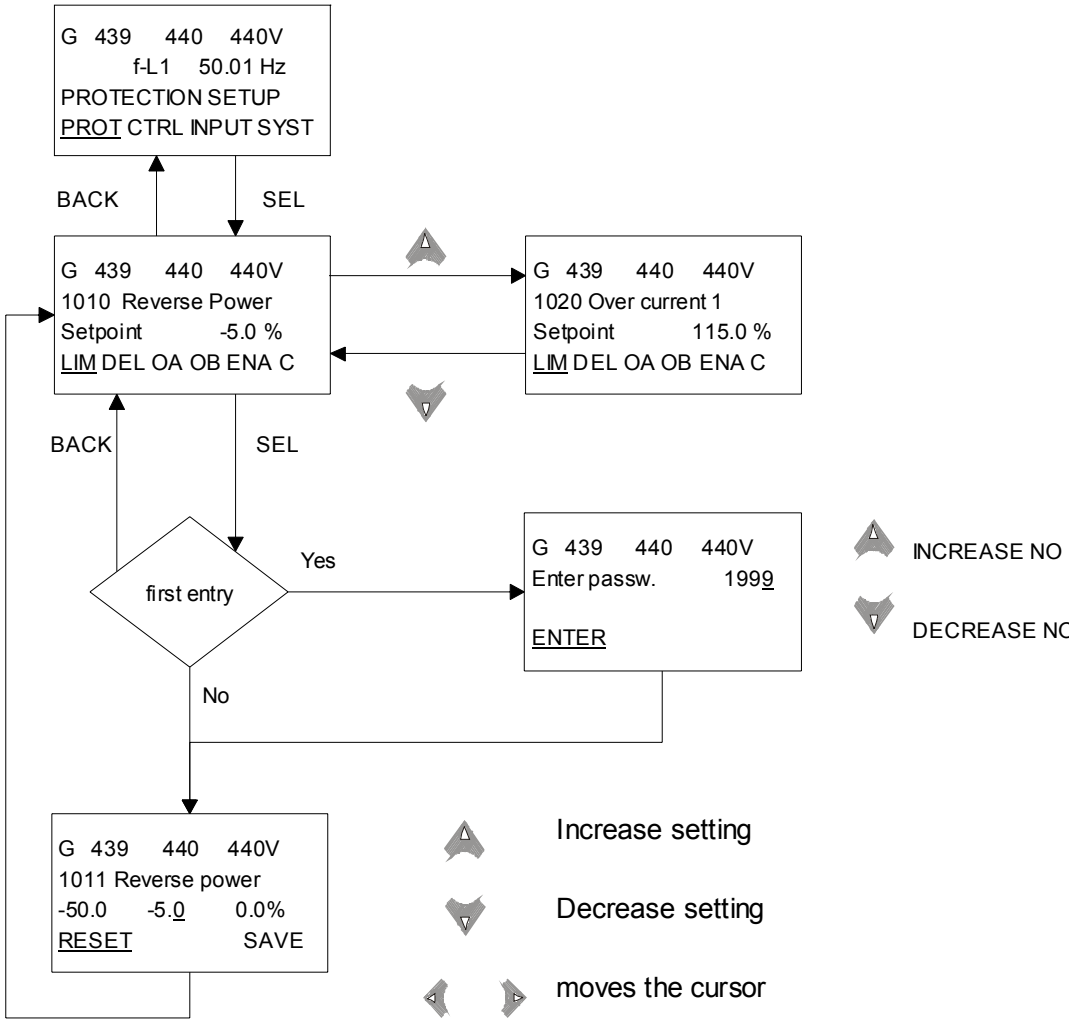
View line/second display line configuration			
For generator	**For bus/mains**	**For analogue input**	**Communication/ other**
	(df/dt) (Hz/sec.)		
Current L3 (A)	Voltage angle between generator voltage and bus voltage (deg.)	Analogue 6	PID value #2.4
Frequency L1 (Hz)	Power supply voltage (V DC)	Analogue 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

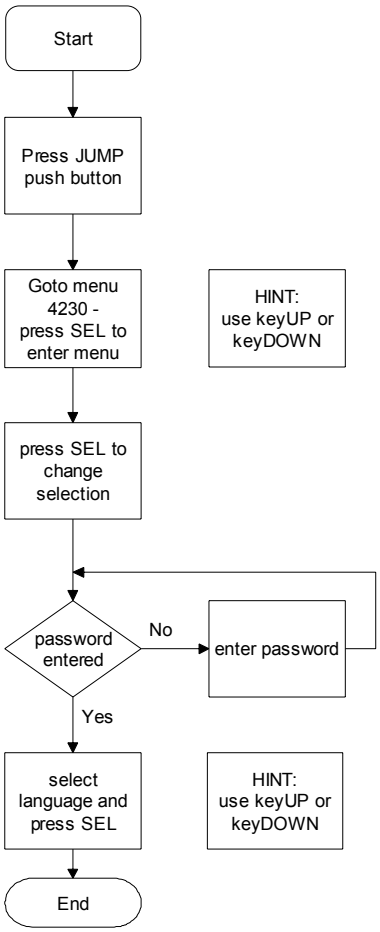
This chapter describes the additional functions.

Language selection

The language of the PPU 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 PPU 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. Un-acknowledged state:	The alarm has exceeded its setpoint and delay, and the alarm message is displayed. The PPU 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.

G 376 380 375V
1120 Gen low-volt 1
UN-ACK. ¦ 3 Alarm(s)
ACK FIRST LAST

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).

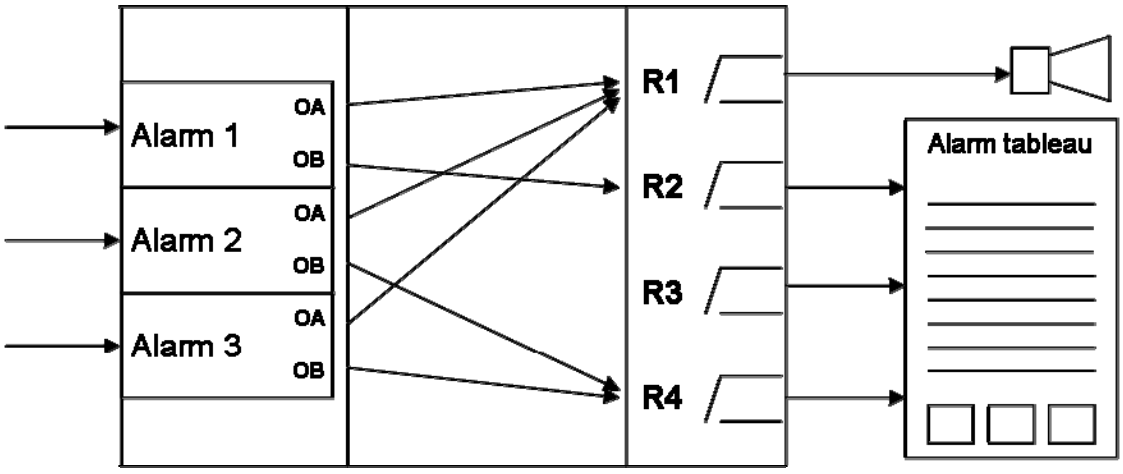
In the example on the drawing below, three alarms are configured and relay 1-4 are available as alarm relays.

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.)



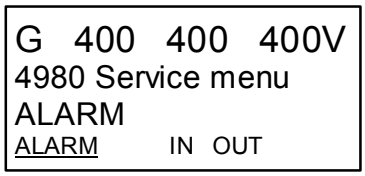
Service menu

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 trouble-shooting in connection with the event log (see page 40).

Entry window

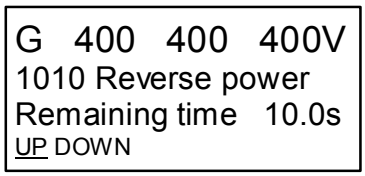
The entry shows the possible selections in the service menu.



Available selections:

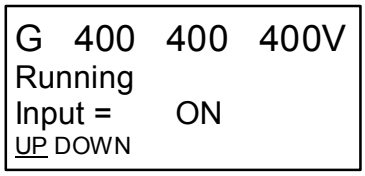
Alarm

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.



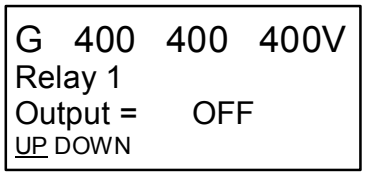
IN (digital input)

Shows the status of the digital inputs.



OUT (digital output)

Shows the status of the digital outputs.

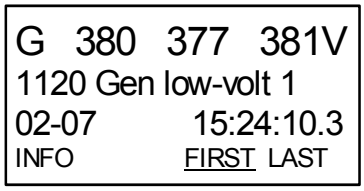


Event log

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.

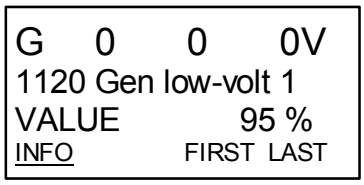
Display

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.

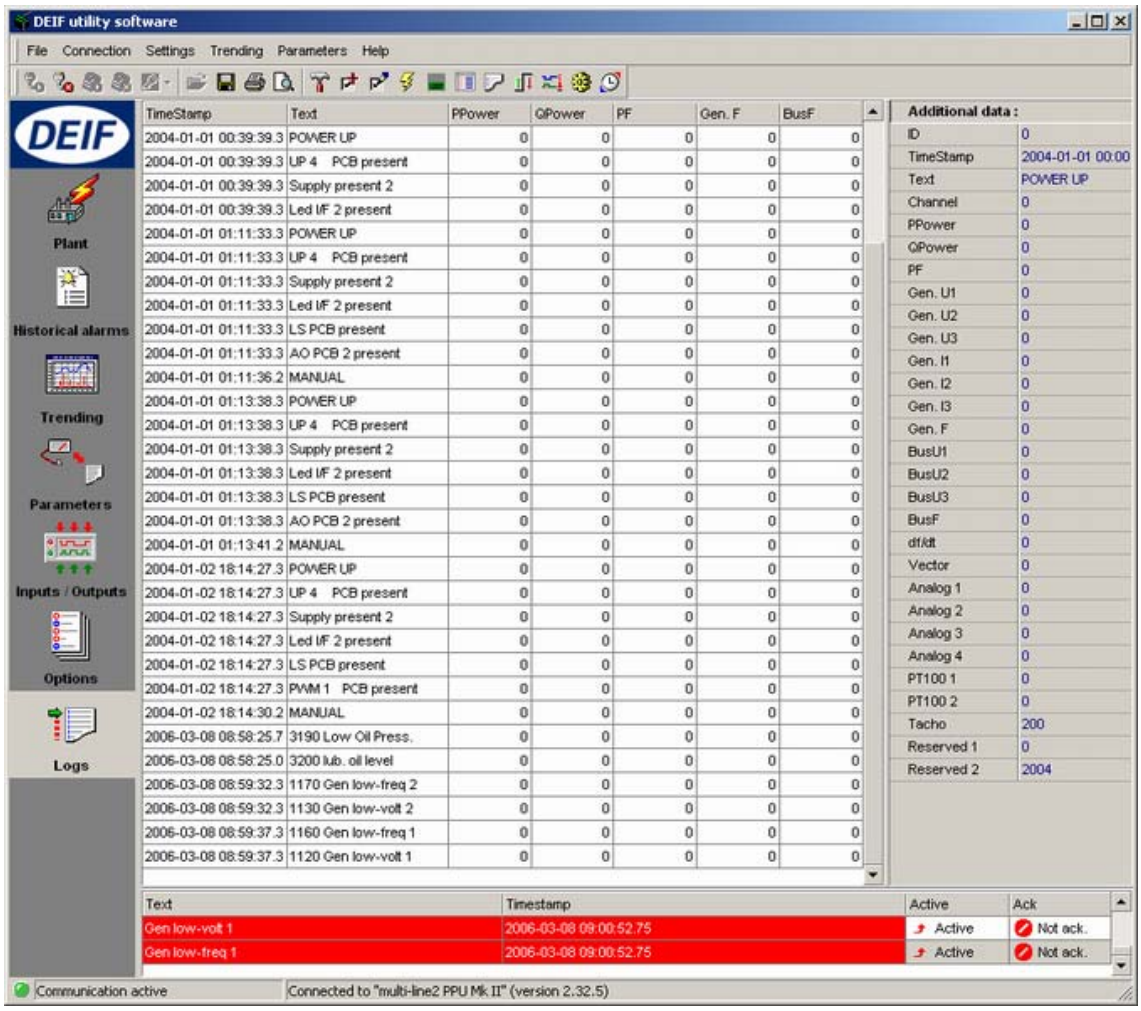
The keyUP and keyDOWN push-buttons are used for navigating in the list.

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 PPU, and two of those can be adjusted if necessary, for instance if the PPU 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 running feedback is present (voltage).
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.

kWh/kVArh counters

The PPU 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 PPU 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 PPU are not functioning when the self check function deactivates the status relay.

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

Text in status line

If the display is installed it will show various messages depending on the running condition. To see these messages, the view menu system must be selected (press 'BACK' three times) and move the cursor to V3. Typically, the messages are self explaining so the operator knows what state the generator is in.

Use the status texts for daily operation as well as for trouble shooting.

The table below indicates the texts in the status line.

The Plant overview in the PC utility software also shows the status message. (Shown beneath the gen-set symbol).

Status text	Condition	Comment
Manual	No regulation	
No regulation	No regulation	The "start sync/reg" input term 25 may be ON, requiring the regulators to operate, but the condition is not fulfilled (e.g. generator not running).
Gov Static Sync	Static synchronisation in progress	Attempting to reach phase angle difference = 0 and frequency difference = 0
Gov Dynamic Sync	Dynamic synchronisation in progress	Attempting to synchronise with generator frequency slightly higher than busbar/ mains
Ramp down	Generator power is being lowered and breaker opens at a pre-set low power value	
Ramp up	Generator power increasing after synchronising of breaker	Only in load sharing and fixed power mode. Ramp up stops when power setpoint is reached.
Gov fixed f int	Fixed frequency running mode	Using internal setpoint (f nom)
Gov fixed f ext	Fixed frequency running mode	Using external setpoint (analogue input)
Gov fixed P int	Fixed Power running mode	Using internal setpoint (P nom)
Gov fixed P ext	Fixed Power running mode	Using external setpoint (analogue input)
Droop int	Speed droop running mode	Using internal setpoint for frequency (f nom)
Droop ext	Speed droop running mode	Using external setpoint for frequency (analogue input)
Load sharing int	Load sharing running mode	Using internal setpoint for frequency (f nom)
Load sharing ext	Load sharing running mode	Using external setpoint for frequency (analogue input)
Water level control	Hydro turbine power production dependent on water level in storage	Option O, hydro turbine control only.
Asynchron sync	Synchronisation of asynchronous generator by using RPM measurement	Requires a magnetic speed pickup
Async. fixed RPM	Fixed speed for asynchronous generator using RPM input	When terminal 25 (start/sync) and 43 (de-load/sync block) are both ON, the speed will go to nominal but breaker remains open
Start Prepare	Pre-start heating or oil pressure build up for engine	Options M1/M2 only

Status text	Condition	Comment
Start relay on	Cranking	Options M1/M2 only
Start relay off	Crank pause	Options M1/M2 only
Cooling down ###.# s	Engine cooling down timer running	Options M1/M2 only
Gen-set stopping	Stop command has been issued but running feedback is still present	Options M1/M2 only
Ext. stop T. ###.#s	Engine has stopped and the extended stop timer is running. During this the stop coil (if selected) will be activated.	Options M1/M2 only. Gen-set cannot be started before the extended stop timer runs out.

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 GPC. 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
7	Reset analogue GOV output	Configurable	Pulse	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	Deload	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
18	Mode 1	Configurable	Constant	48
19	Mode 2	Configurable	Constant	49
20	Mode 3	Configurable	Constant	50
21	Mode 4	Configurable	Constant	51
22	Mode 5	Configurable	Constant	52
23	Mode 6	Configurable	Constant	53

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 54.

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 PPU. 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 PPU is in manual control mode and the display shows 'MANUAL'.

4. External communication control
When the input is activated then the PPU is controlled from CAN-open, Modbus or Profibus only. When the input is deactivated then the PPU 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
This input deactivates the busbar measurements during breaker operations. This makes it possible to close the breaker from the PPU even though the generator and busbar are ***not*** synchronised.

The PPU 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 PPU. 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.

7. Reset analogue governor output
The analogue +/-20mA controller outputs will be reset to 0mA and the PWM output will be reset to the 'INIT' value.

All analogue controller outputs are reset (governor output and AVR output, if option D1 is selected).

If an offset has been adjusted in the control setup, then the reset position will be the specific adjustment.

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 PPU 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. Deload
The input starts the deload function of the PPU. This will either be 'open breaker', 'deload and open breaker' or 'prevent synchronising'.

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 D1 – AVR control.

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

Requires option D1 – AVR control.

18. Mode 1
Input for governor mode selection.

19. Mode 2
Input for governor mode selection.

20. Mode 3
Input for selection between internal or external P/f setpoint

21. Mode 4
Input for AVR mode selection.

Requires option D1 – AVR control.

22. Mode 5
Input for AVR mode selection.

Requires option D1 – AVR control.

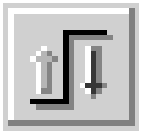
23. Mode 6
Input for selection between internal or external U/Q/PF setpoint.

Requires option D1 – AVR control.

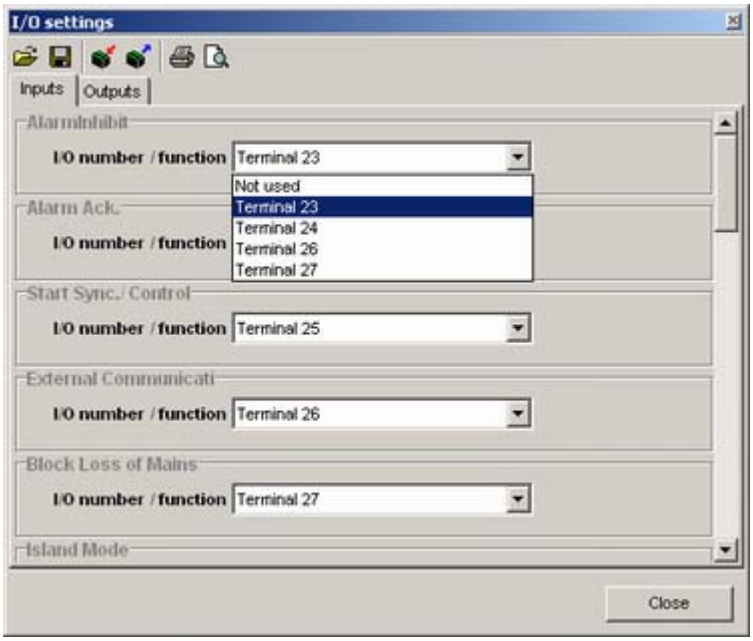
Configuration

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.

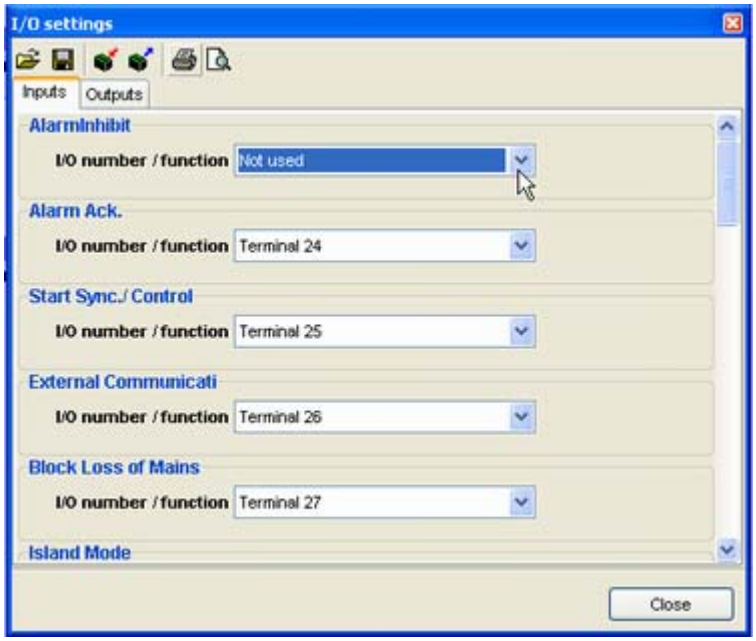
Since the inputs are default-configured as control inputs, it is necessary to re-configure the inputs to prepare them for the alarm use.

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.

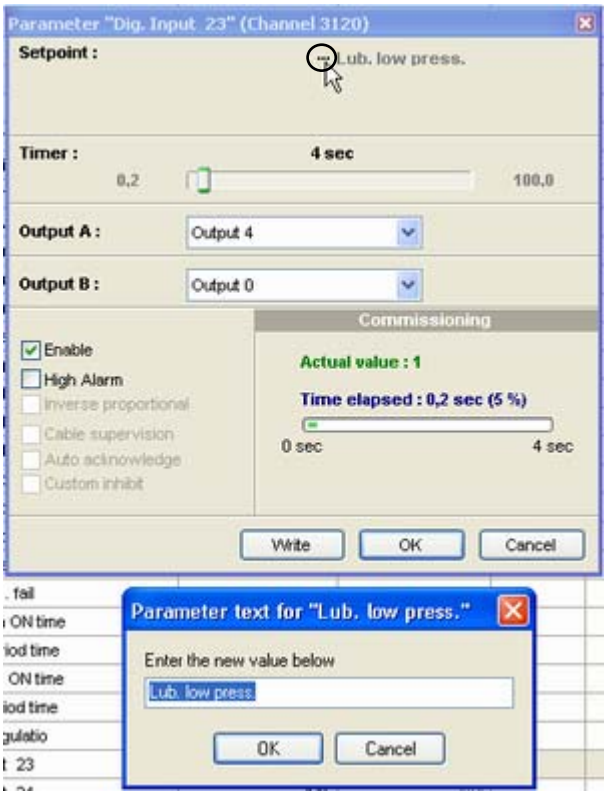
The two possibilities for using the digital inputs are not intended to be combined. Please either use the digital input as an alarm input or as a control input. The settings in the parameter setup for the individual alarms, such as high alarm, enable or delay do not influence the control functions of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

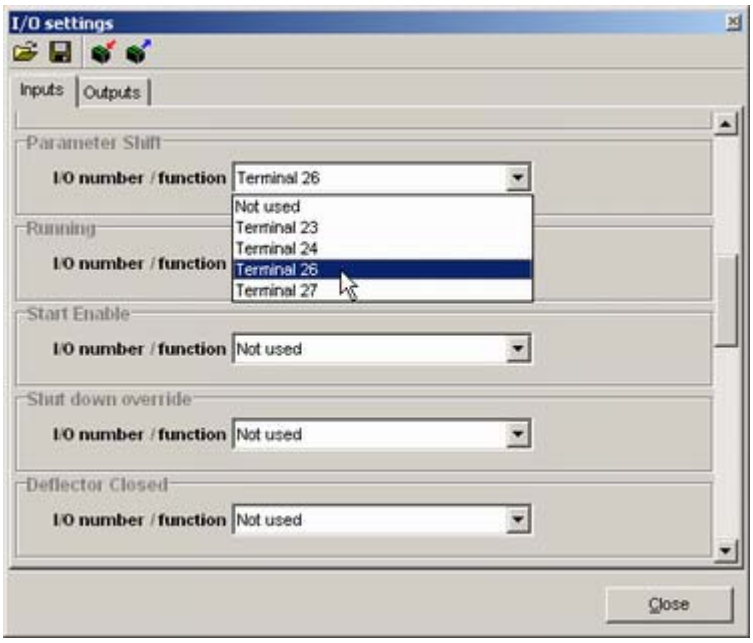
These alarms have two levels of setpoints:

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, the inhibit function configured as default is no longer activated by the same input.

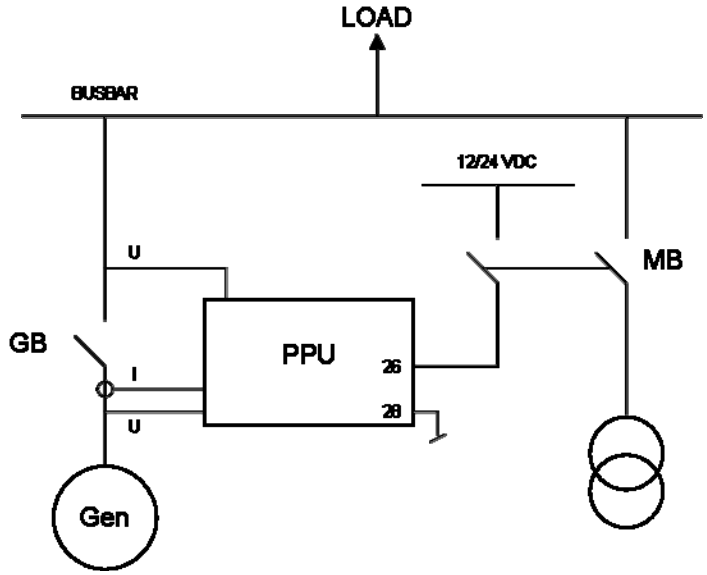
Example

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 simple sketch below 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.



General failure

The general failure alarm (menu 2700) is defined as an alarm that occurs every time a fault is caused by abnormal and unexpected behaviour of the application.

Several items are included in the general failure alarm.

	Description	Displayed alarm text	Delay
Phase sequence error	The phase rotations of the generator measurements and the busbar measurements are opposite.	Phase sequence error	1 sec.
CB open failure	The PPU has issued a CB open signal but the breaker has not opened.	CB open failure	1 sec.
CB close failure	The PPU has issued a CB close signal but the breaker has not closed.	CB close failure	1 sec.
CB position error	The PPU has neither CB open feedback nor CB closed feedback.	CB position error	1 sec.

During general failure alarms, the regulation freezes.

Regulation failure

The PPU has a regulation failure alarm (menu 2180 'GOV reg. fail.') that occurs whenever the specific setpoint is not reached but the regulation is active.

The alarm will appear when the setpoint is reached. The deviation is calculated in percent:

Example:

P_{ACTUAL} = 500 kW
$P_{SETPOINT}$ = 800 kW

Difference in percent: (800-500)/800*100 = 37.5%

The alarm occurs if this calculated value exceeds the alarm setpoint.

AVR regulation failure is available if option D1 is selected.

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 PPU 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 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			

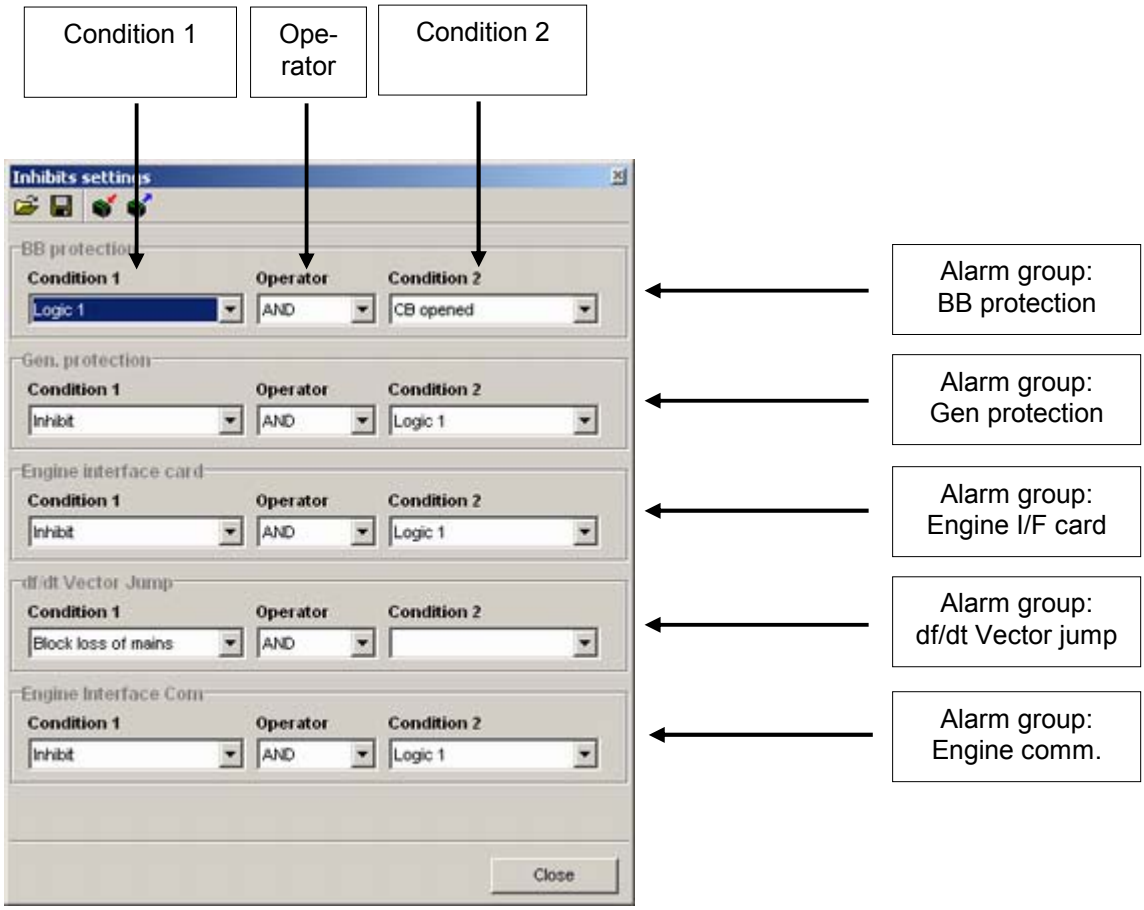
Group 5 (Engine interface communication)

	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 are 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

Start/stop next generator

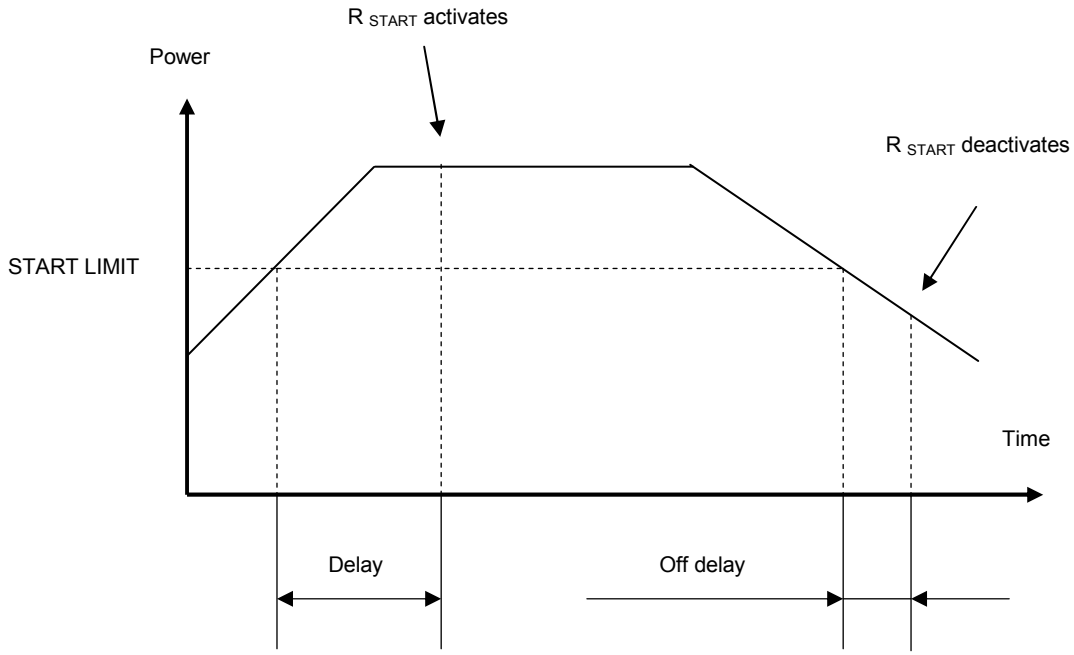
The load dependent start/stop functionality uses one relay for **'start next generator'** and one relay for **'stop next generator'**. It is also possible just to use one of the functions if it is not desired to use both the start and the stop function.

The function load dependent start and stop does not give the possibilities of a power management system such as priority selection and available power calculations. This means that the switchboard manufacturer must take care of starting and stopping the next gen-set(s) and their priority.

The relays can be used as inputs for the power management system as an example.

Start next generator (high load) (menu 4260)

The below diagram shows that the delay for the start relay starts when the load exceeds the adjusted start limit. The relay will deactivate again when the load decreases below the start limit and the off delay has expired.

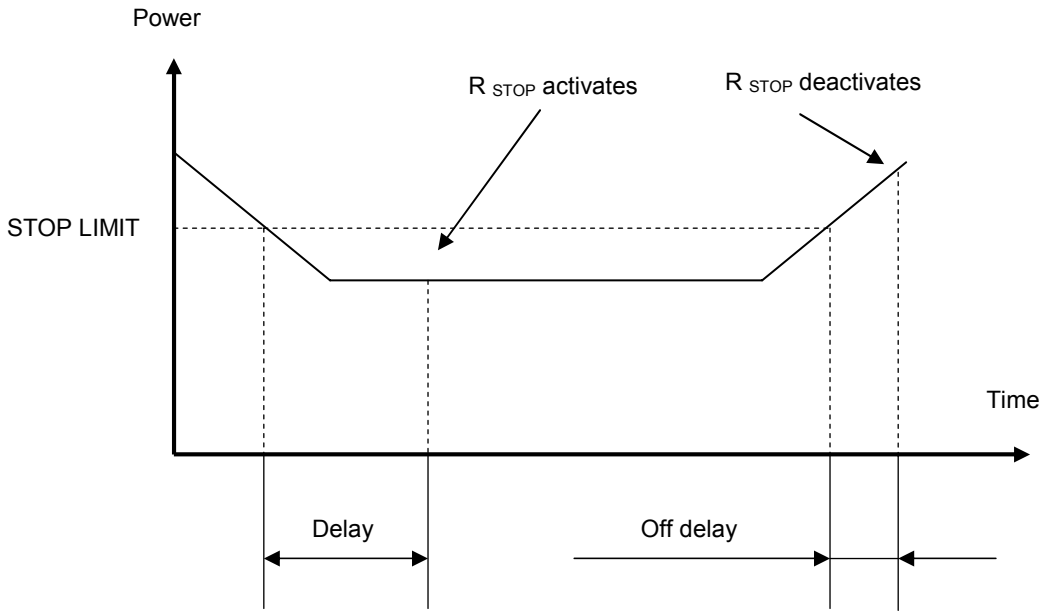


The load dependent start relay reacts based on the power measurement of the PPU together with the breaker closed feedback.

Stop next generator (low load) (menu 4270)

The diagram shows that the stop relay activates after a delay. The timer starts when the load drops below the adjusted stop level, and when the delay has expired the relay activates.

The relay deactivates when the load exceeds the stop level when the off delay has expired. The off delay is adjustable.



The load dependent start relay reacts based on the power measurement of the PPU together with the breaker closed feedback.

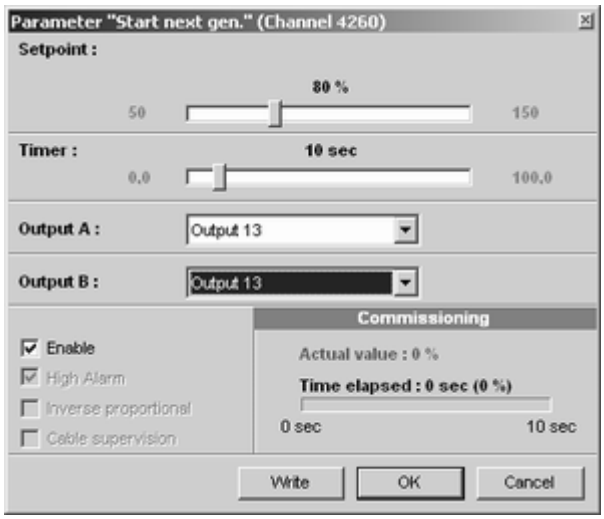
Configuration

The settings are configured through the display or through the PC utility software.

PC utility software configuration

The configuration of the relays is done in 2 steps when the parameter list is uploaded from the PPU to the PC.

Step 1: Configuration of the setpoint

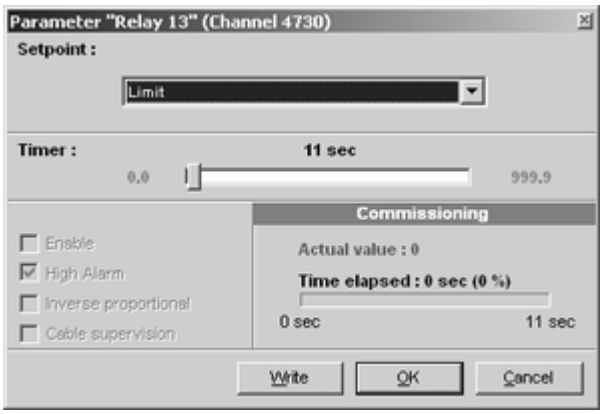


Open menu 4260 in the utility software and adjust the setpoint, timer and relay output.

Output A and output B must be adjusted to the same relay to avoid alarms when the setpoint is reached.

Step 2: Configuration of selected relay

Open the menu of the selected relay – in this example where relay 13 is used you must open menu 4730. Here, the relay function must be set to "Limit". The purpose of this is to avoid an alarm when the relay activates.



This dialog box adjusts the off delay timer which is shown in the drawings above.

Relay allocation

The four relays need to be used as follows:

- 2 relays for alarm relays
- 2 relays for load dependent start/stop

The table shows a possible selection of the relays:

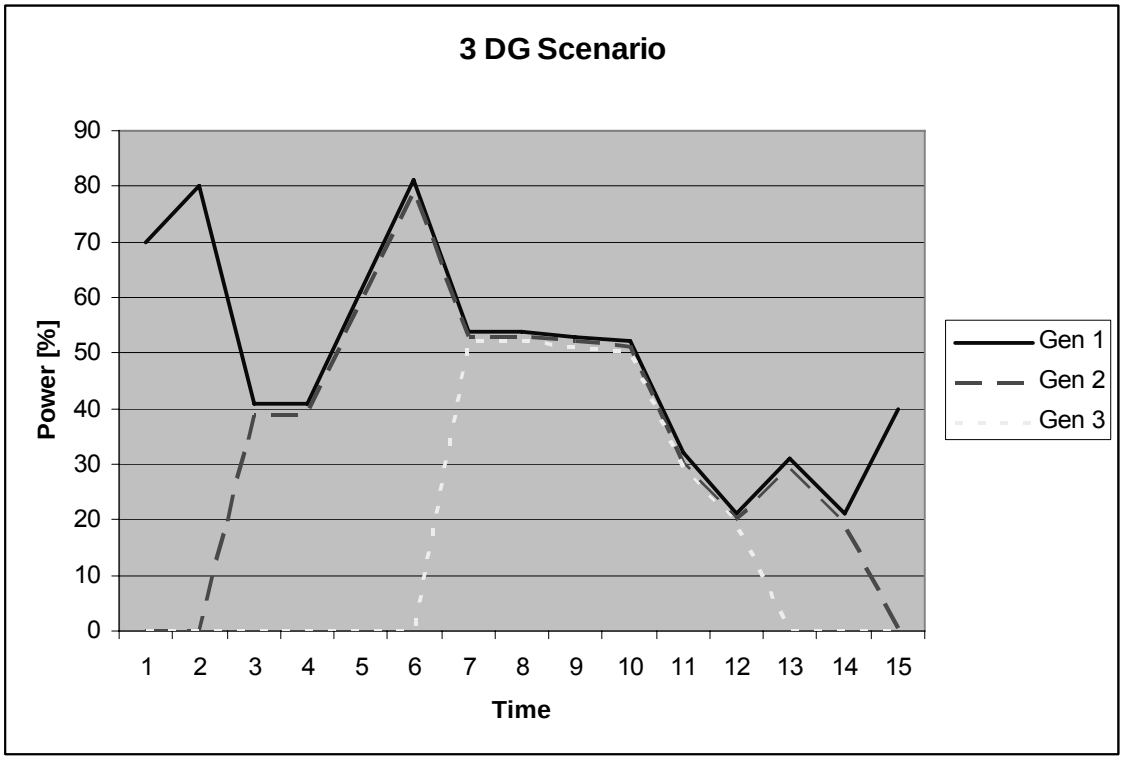
	Relay 5	**Relay 6**	**Relay 7**	**Relay 8**
Load dependent START				X
Load dependent STOP			X	
Alarm relay function		X		
Alarm relay function	X			

Start/stop scenario

This diagram shows a (simplified) scenario where 3 DGs are started and stopped depending on the load dependent start/stop relays.

The scenario shows that gen-set 2 starts when gen-set 1 reaches 80%. The next gen-set to start is DG3 and the three sets load share at 53%.

When the load of all three gen-sets drops to the stop limit, which is 20%, then the load dependent stop relay activates and a gen-set (gen 3 in this example) can be stopped. The load continues to drop and at 20% load the next gen-set to stop is gen-set 2.

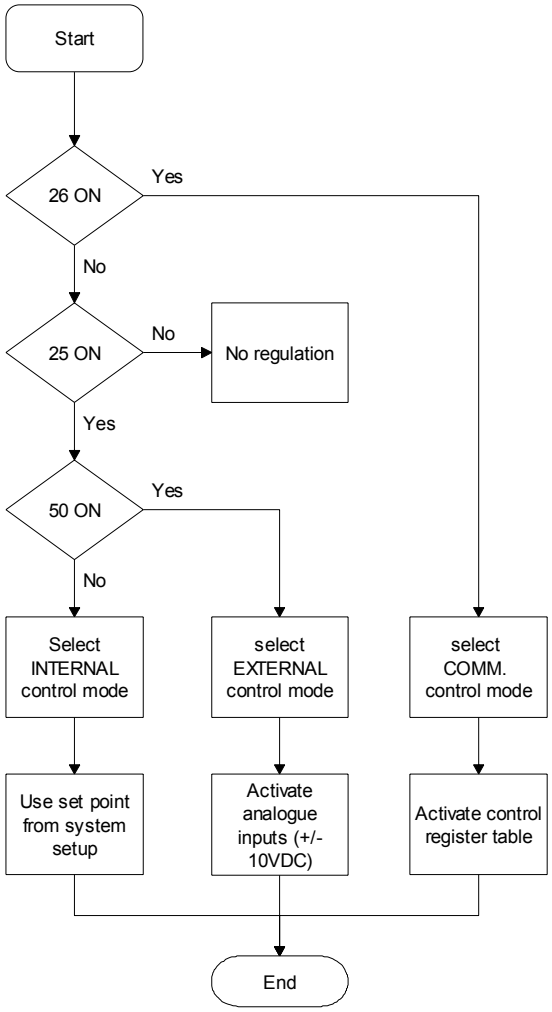


The above is a simplified scenario.

Setpoint selection

There exist various principles for the PPU to control the gen-set through setpoint selection. These are internal or external setpoints or optional control via external communication.

Control via external communication is optional, Modbus (H2), Profibus(H3) or CANopen (H1).



The above flowchart shows that the communication control overrules control through digital inputs. The only condition is that the communication control is activated with a digital input and then commands and setpoints can be transmitted to the PPU.

If the control is done through digital inputs, then the selection between internal and external setpoint is determined by the activation of the input 'mode 3' (terminal 50).

The function 'Start sync./control' must be ON to activate the regulation. This is done through communication if the communication control is used or through digital input (terminal 25) if INTERNAL or EXTERNAL control is used.

Control setpoint

The control setpoints are described in the table below.

Setpoint / Mode	Internal	External	Communication (Ctrl. reg. table)
Fixed frequency	Menu 4011	+/-5Hz	Address 3
Fixed power	Menu 4041	0-100%	Address 1
Droop	P is frequency dependent	+/-5Hz	P is frequency dependent
Load sharing	Analogue lines	+/-5Hz	Analogue lines

When communication control is used the regulation setpoint will be used when the control is enabled in the system setup (menu 4050). (Does not apply for droop or load sharing mode.)

External analogue setpoint

The gen-set can be controlled from internal as well as from external setpoints. The external setpoint is activated with a digital signal but the setpoint itself is analogue.

The input that activates the analogue setpoint is mode 3 (terminal 50).

The table below shows the possible setpoints.

Mode	Input voltage	Description
Fixed frequency	+/-10V DC	f_{NOM} +/-5Hz
Fixed power	+/-10V DC	+/-100% *P_{NOM}
Droop	+/-10V DC	f_{NOM} +/-5Hz
Load sharing	+/-10V DC	f_{NOM} +/-5Hz

The external setpoint can be used when 'Start sync./control' (terminal 25) is ON. When the input is activated, the setpoint immediately changes from internal setpoint to external setpoint and the regulation acts accordingly. This will give a sudden change in the governor control. If a more smooth change of the setpoint is required, then the analogue input on the external setpoint must be changed step wise.

Refer to the manual 'Description of option D1' for information regarding external AVR control.

If option H2 is available in the unit, the external setpoints can be controlled from the control registers in the Modbus protocol. Please refer to the description of option H2 for further information.

Load sharing

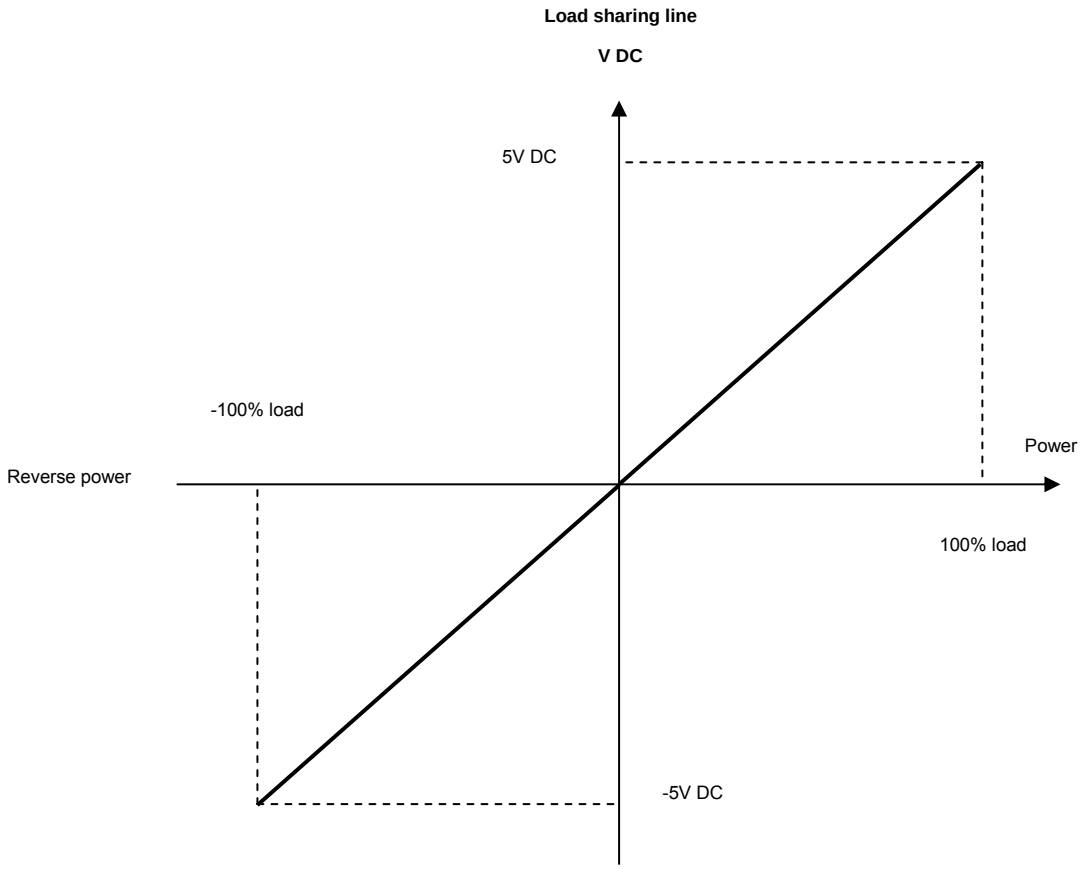
The function of load sharing enables the PPU to share the active load (kW) (and reactive load (kVAr) (option D1)) equally when operating in parallel with other gen-sets. The load sharing is performed so each gen-set takes a portion of the load that is calculated in percent according to the nominal power.

The load sharing is active when the load sharing mode is selected, and the generator breaker is closed.

Principle

A voltage signal equal to the load produced by the gen-set is sent to the load sharing line. When the generator load is 0%, 0V DC is sent to the load share line and when the load is 100% load the voltage will be 5V DC.

This is illustrated in the drawing below where the illustration indicates the characteristic of the active load sharing line. The characteristic of the reactive load sharing line is equivalent to the illustration below.



The PPU will supply a voltage on the load sharing line equal to the actual load. This voltage comes from an internal power transducer in the PPU. At the same time, the actual voltage on the load sharing line will be measured by the PPU.

> *If the measured voltage is higher than the voltage from the internal power transducer, then the PPU will increase its load in order to match the voltage on the load sharing line.*

If the measured voltage is lower than the voltage from the internal power transducer, then the PPU will decrease its load in order to match the voltage on the load sharing line.

The voltage on the load sharing line will only be different from the voltage from the internal power transducer, if two or more Multi-line 2 units are connected to the load share line. For the same reason it is not necessary to change between load sharing mode and fixed frequency mode if the PPU is installed in an island mode application where the operation changes between stand-alone and load sharing mode. Then the mode inputs can be hardwired.

Examples

These examples show that generators will balance their load depending on the signal on the load sharing line.

Example 1:

Two generators are running in parallel. The loads of the generators are:

Generator	Actual load	Voltage on load sharing line
Generator 1	100%	5V DC
Generator 2	0%	0V DC

The voltage level on the load sharing line can be calculated to:

U_{LS}: (5 + 0)/2 = 2.5V DC

Now generator 1 will decrease the load in order to match the voltage on the load sharing line (in this example 2.5V DC). Generator 2 will increase the load in order to match the 2.5V DC.

The new load share situation will be:

Generator	Actual load	Voltage on load sharing line
Generator 1	50%	2.5V DC
Generator 2	50%	2.5V DC

Example 2:

In case of generators of different size, the load sharing will still be carried out on the basis of a percentage of the nominal power.

Two generators supply the busbar. The total load is 550kW.

Generator	Nominal power	Actual load	Voltage on load sharing line
Generator 1	1000kW	500kW	2.5V DC
Generator 2	100kW	50kW	2.5V DC

Both generators are supplying 50% of their nominal power.

Ramp up function

In the menu 2144 it is possible to enable a power ramp up function in the PPU when it is operating in load sharing mode.

When this function is enabled, the PPU will not balance the load immediately when the breaker is closed but will follow the adjusted power ramp up curve (menu 2141). This means that the other generator(s) will carry the majority of the load during the time where the actual generator is in its ramp up sequence.

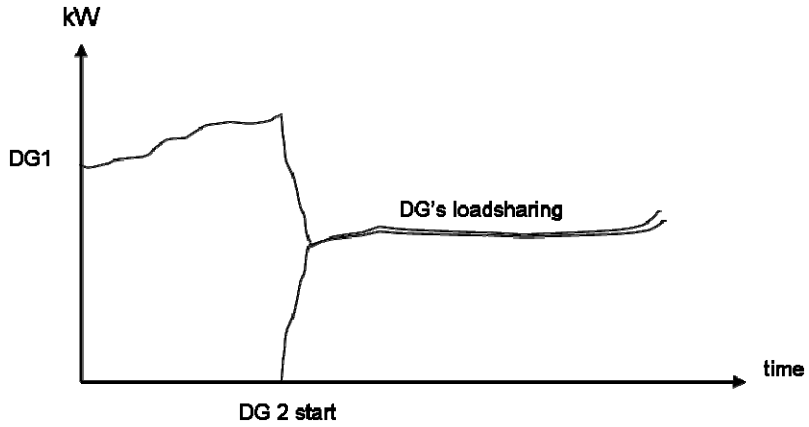
The power setpoint is still reflecting the reference on the load sharing line (0-5V DC ~ 0-100%). When the generator has reached the setpoint, it follows the load without further ramp functions.

The (load sharing mode) ramp function is initiated when LS mode is selected and the CB closes, or when the deload input (43) changes state.

If the ramp up delay point (menu 2142) is used, the actual power production during the delay period (menu 2143) will not match the adjusted value exactly. This is because the regulator setpoint is a mix between the power and frequency controllers when operating in load sharing mode.

Load sharing/NO RAMP

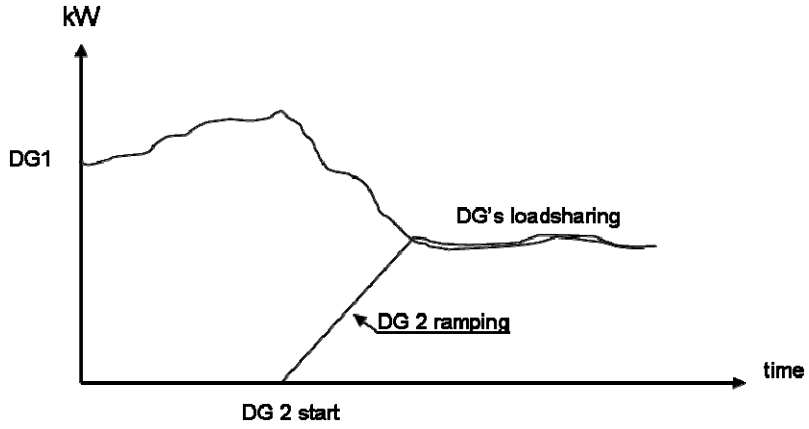
This diagram shows how the load balances after breaker closing when the ramp function (in load sharing mode) is deactivated. The load is balanced immediately, followed by load sharing between the two DGs.



Load sharing/RAMP FUNCTION ON

This picture shows a situation after the breaker closes and where the ramp function is activated. When DG 2 synchronises, it loads up following the ramp curve. Any variations in load will in principle be taken by DG 1, until the ramp sequence has ended.

In this diagram no delay point is used (timer 2143 = 0 sec).



Distance

The inputs on the PPU that are used for load sharing are high impedance inputs (23.5 kOhm) so a cable length of 300 meters is no problem.

Remember to always use screened cable.

Load sharing type

The output from the PPU is by default adjusted to match other Multi-line 2 and Uni-line products from DEIF A/S. This selection enables the load share output to operate in the 5V DC range.

If the load share type is changed to 'adjustable' (menu 4250) then the voltage level can be changed in the range 1.0 – 5.0V DC (menu 4240). The advantage of this is that the load share output can be connected to or compared with other systems.

Careful testing must be carried out when different load sharing systems are interconnected. The reason is that not all systems can be interconnected and still function properly.

If the load share type is changed to 'Selco T4800', the voltage level of the load share line adapts to the required level of the Selco T4800.

Modes active

The PPU is designed to control the generator before, during and after synchronising. However, in rare cases it may become necessary to deactivate the regulation after the synchronising. This can be the case e.g. if other load sharing equipment is installed or if an external power factor controller is installed. Adjust this in menu 2110.

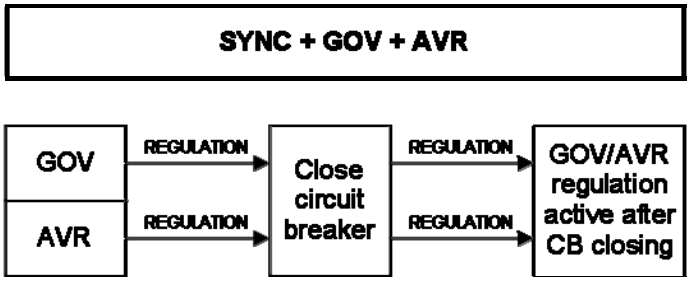
The regulation will always be active when the circuit breaker is open. It is only possible to stop the regulation when the circuit breaker is closed.

The display shows 'No regulation' if the regulation is stopped due to the 'Modes active' function.

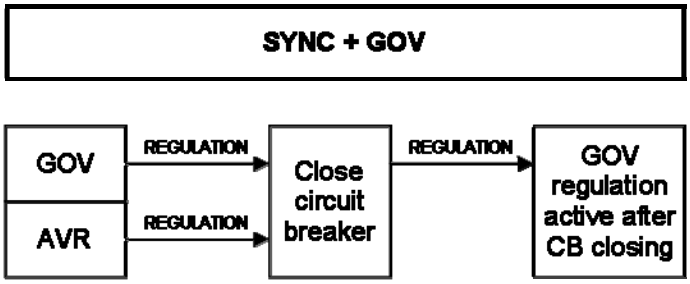
Principle

The diagrams below show that the regulation is active until the circuit breaker closes (during synchronising). When the circuit breaker closes, the regulation will only be active for the selected controller, the governor, the automatic voltage regulator or none of them.

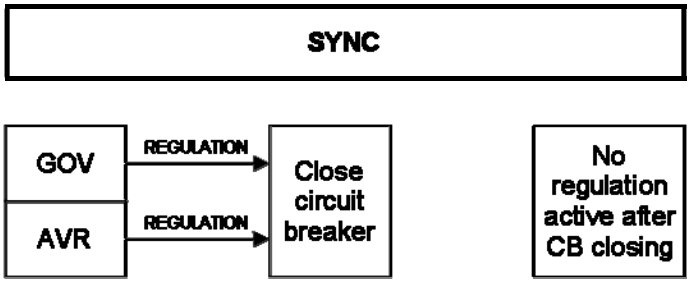
Example 1, menu 2110 is adjusted to 'Sync+GOV+AVR'



Example 2, menu 2110 is adjusted to 'Sync+GOV'



Example 3, menu 2110 is adjusted to 'SYNC'



The same function as 2110 = 'SYNC' can also be achieved by deactivating terminal 25, 'Start sync./Control' when the circuit breaker closes.

Synchronising window

On certain occasions it is necessary to automatically stop the synchronising of the gen-set if the mains voltage changes to unacceptable limits. This can be achieved with the function synchronising window (menu 2050).

The function is typically used when the generator is intended for parallel operation with the mains and the mains is unstable in voltage. E.g. when the generator manufacturer recommends not regulating the voltage beyond certain limits, then the function can be used.

This function is active when the CB is open. The function requires a relay output on the PPU.

Description

When the synchronising is started, the PPU will normally regulate the generator frequency and voltage towards the busbar frequency and voltage. This is necessary because the individual generator controller can only control its own generator and not the other generators/mains connected to the busbar.

On locations where the mains is unstable or not very rigid, the mains voltage will drop from time to time.

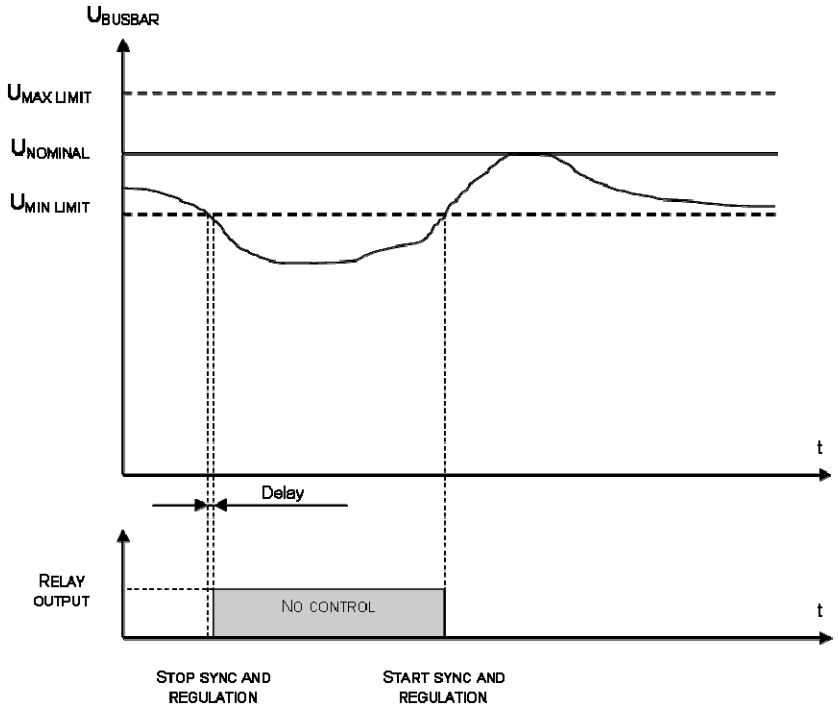
The mains voltage is measured by the PPU on its 'busbar' inputs. In the following, the mains will be referred to as busbar.

When the busbar voltage falls below the limit, the regulation is stopped and the synchronising is temporarily interrupted. The regulation and synchronising will be re-started when the busbar voltage increases above the adjusted setpoint.

Both the frequency and the voltage regulations are stopped when the limit is reached.

Diagram

The diagram below illustrates that the relay output of the PPU activates when the busbar voltage decreases below the setpoint. There is a short timer setting with the purpose of allowing a short voltage dip without interrupting the control.



Adjust output A and output B in the menu settings to a limit relay. This is necessary to avoid an alarm when the busbar voltage is out of the accepted range.

Relay output

It is not necessary to connect the relay output from the PPU to anything. The only purpose of the relay output is to let the function be active without getting an alarm. If an alarm occurs anyway then either output A (menu 2053) or output B (menu 2054) is not configured to a limit relay.

Relay setup

The PPU 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. 71.)

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 un-acknowledged (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 PPU 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 exceeding of the setpoint. A small exceeding means that a long time will pass until the alarm occurs whereas a bigger exceeding of the setpoint means that a shorter time will pass until the alarm occurs.

Possible alarms

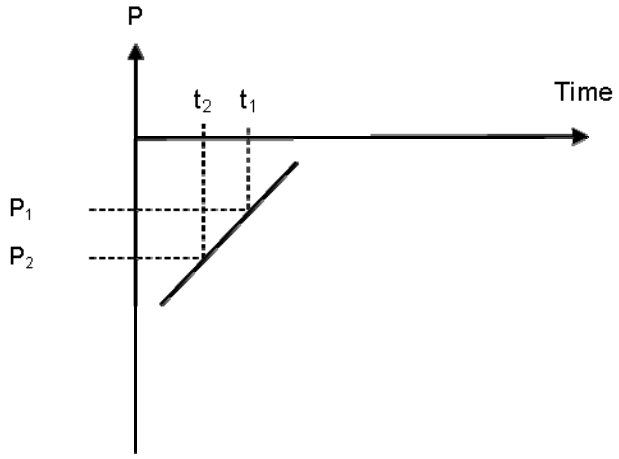
The table shows that the reverse power alarm and one over current alarm can be adjusted with inverse trip characteristic.

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 PPU 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.

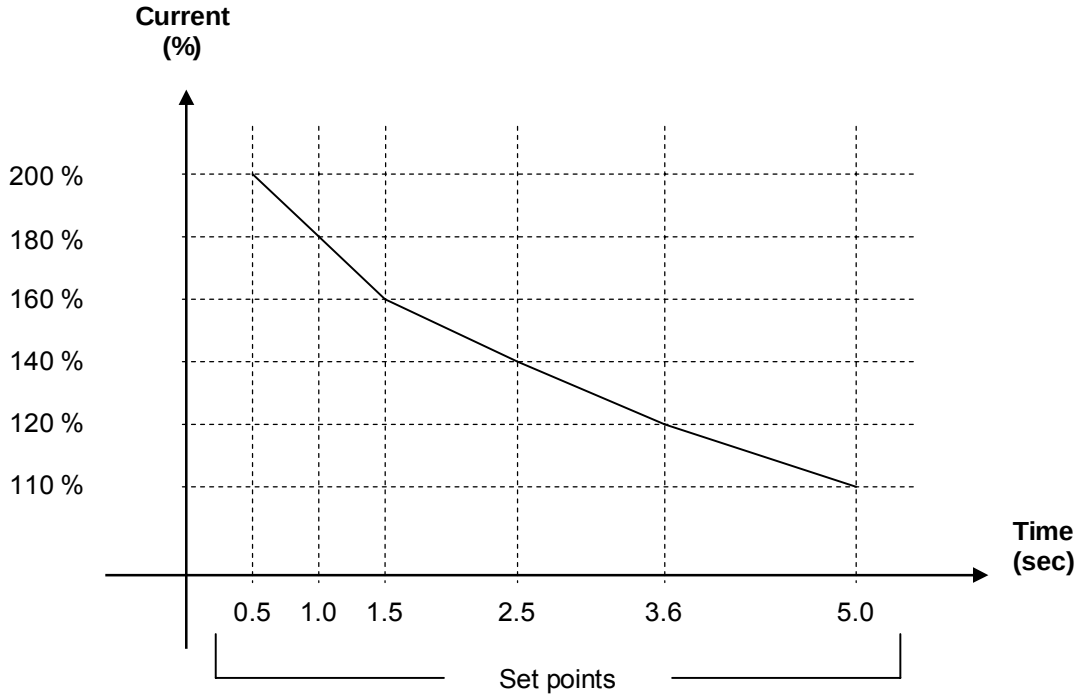
The overcurrent alarm in menu 1060 can be selected with inverse characteristic. The setting of the alarm curve is done in menu 1040 and 1050.

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 PPU. 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.

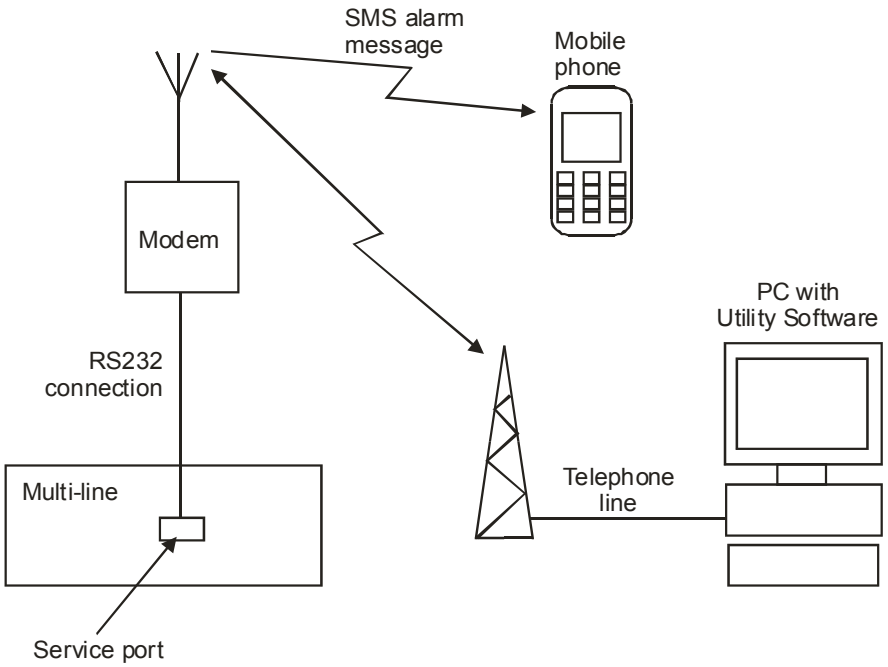
Utility software communication

It is possible to communicate with the PPU 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 PPU 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.

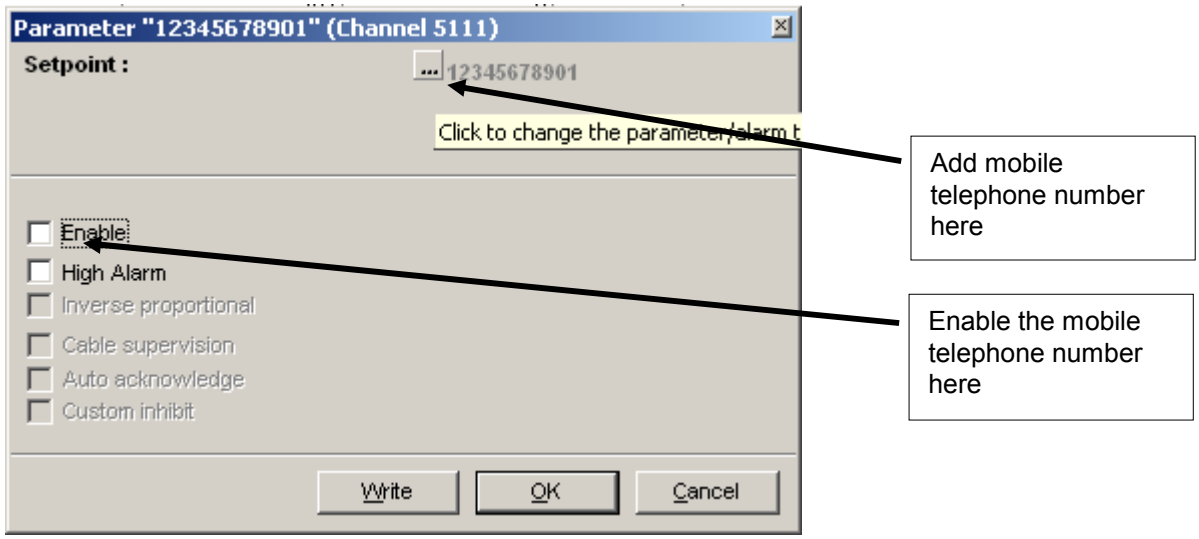
Should an alarm occur during the interruption, the PPU will retransmit the SMS message when the modem starts again. This secures that no messages are lost.

SMS setup

To enable the SMS service, the PPU must be configured in the PC utility software. When the parameter list is uploaded from the PPU, 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.

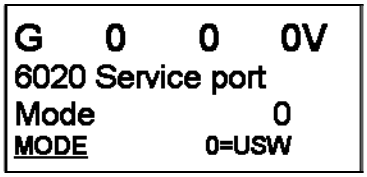
The PIN code is transmitted to the modem when the PPU initialises and again each time an SMS message is transmitted.

Utility software communication setup

The service port is used for the communication between the modem and the PPU. 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)

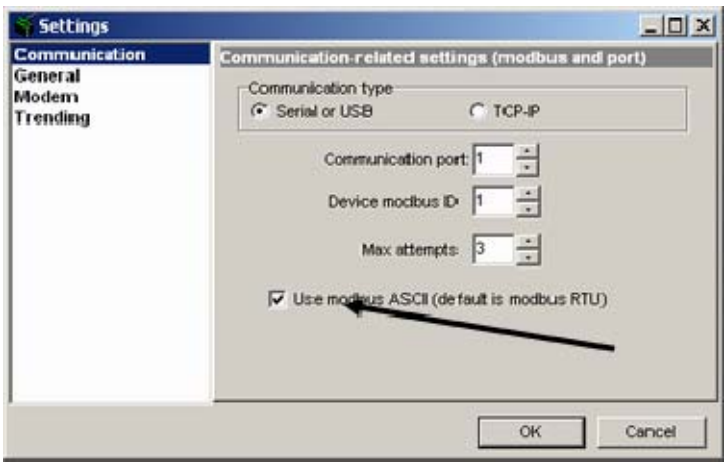


Selection '1' means ASCII communication which is needed for the modem communication.

PC configuration

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

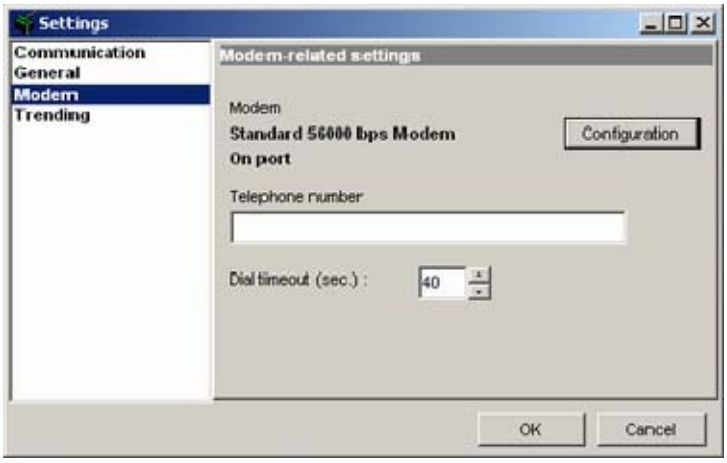
Check off the box as indicated below and press OK. Now ASCII mode is selected.



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

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 PPU. 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 PPU will act accordingly.

Step up transformer

The PPU 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
2. Voltage measurements displayed
3. Generator protections (option dependent)
4. Busbar protections (option dependent)

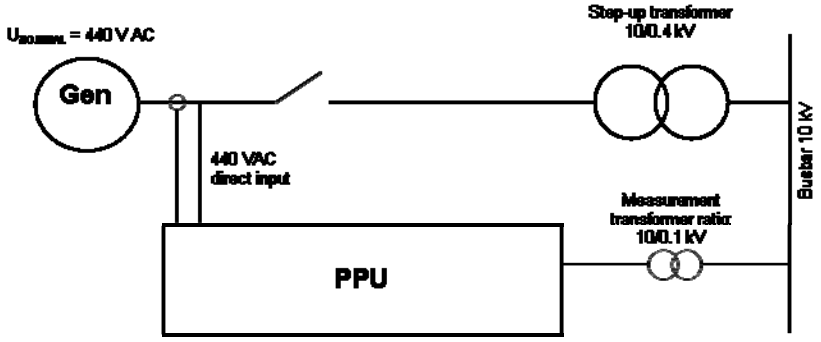
The maximum nominal voltage supported by the PPU is 25000V AC.

Applications

Different applications are supported by the PPU 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.

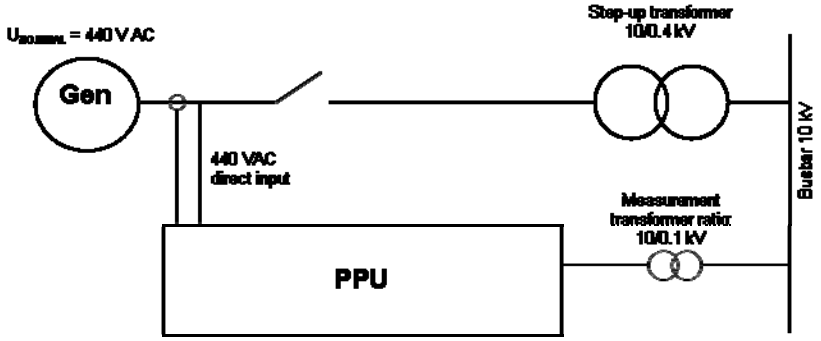


Measurement transformer

The PPU 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 PPU 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 PPU 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 PPU. 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 PPU has running feedback or voltage measurements.

Synchronising with or without phase compensation

The PPU 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).

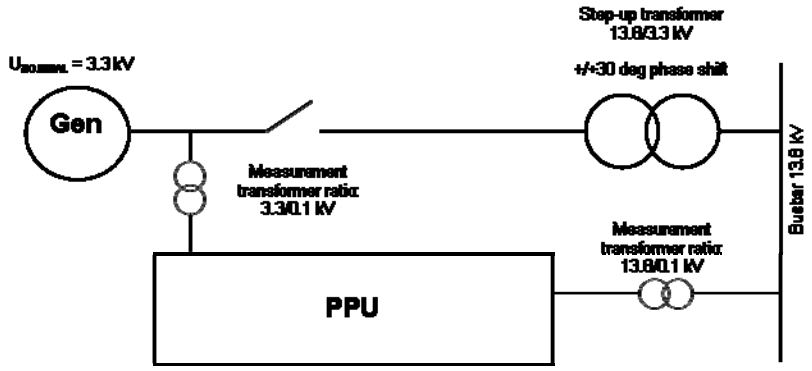
If the transformer has an angle displacement, then synchronising can ONLY be used with Yy1, Dy1, Yd1, Yy11, Dy11 and Yd11 transformers. (+/-30 deg. phase shift).

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 PPU 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 PPU must compensate for the 30 degree offset.



When used for synchronising, the PPU 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. PI controller

The unit controller is a PI controller. It consists of a proportional regulator and an integral regulator. The PI controller is able to eliminate the regulation deviation and can easily be tuned in.

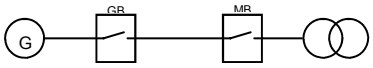
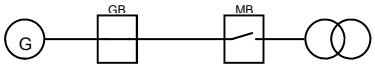
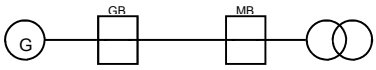
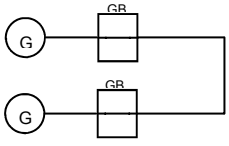
See 'General Guidelines for Commissioning'.

Controllers

There are two controllers for the governor control, and, if option D1 is selected, also two controllers for the AVR control.

Controller	GOV	AVR	Comment
Frequency	X		Controls the frequency
Power	X		Controls the power
Voltage (option D1)		X	Controls the voltage
VAr (option D1)		X	Controls the VAr's or power factor

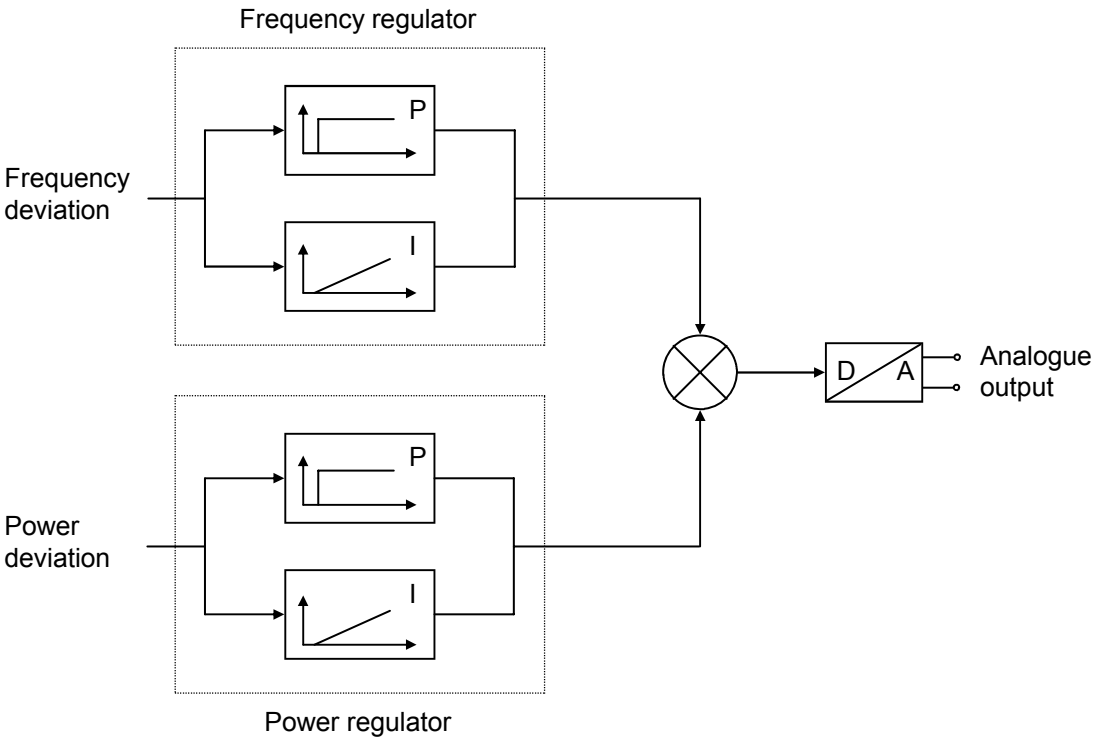
The table below indicates when each of the controllers is active. This means that the controllers can be tuned in when the shown running situations are present.

Governor		AVR (option dependent)		Schematic
Frequency	**Power**	**Voltage**	**VAr**	
X		X		
X		X		
	X		X	
X	X	X	X	

The frequency (and voltage) controller is activated when the gen-set is running in island operation, stand-alone or load sharing mode. The power (and VAr) controller is activated when the gen-set is running parallel to the mains or in load sharing mode.

Principle drawing

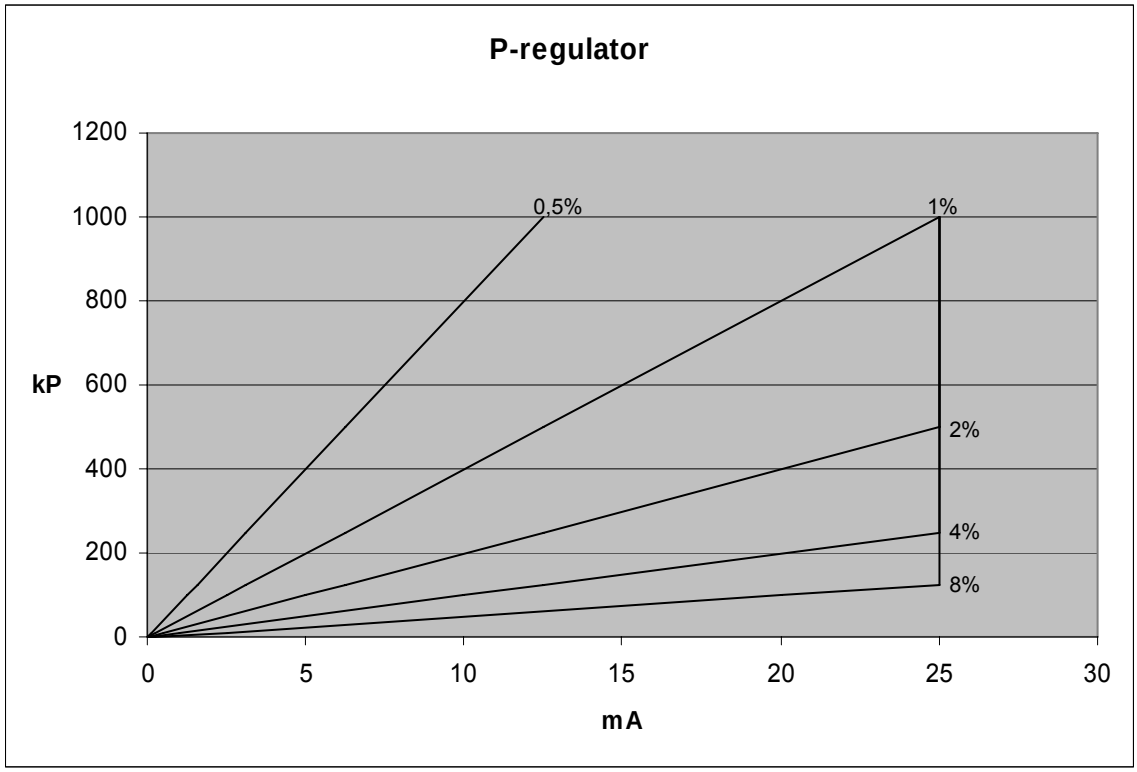
The drawing below shows one PI regulator for the frequency control and one PI regulator for the power control. The output from each regulator is added and converted to the output stage which, in this case, is the analogue output. PWM or relay outputs can also be used.



Proportional regulator

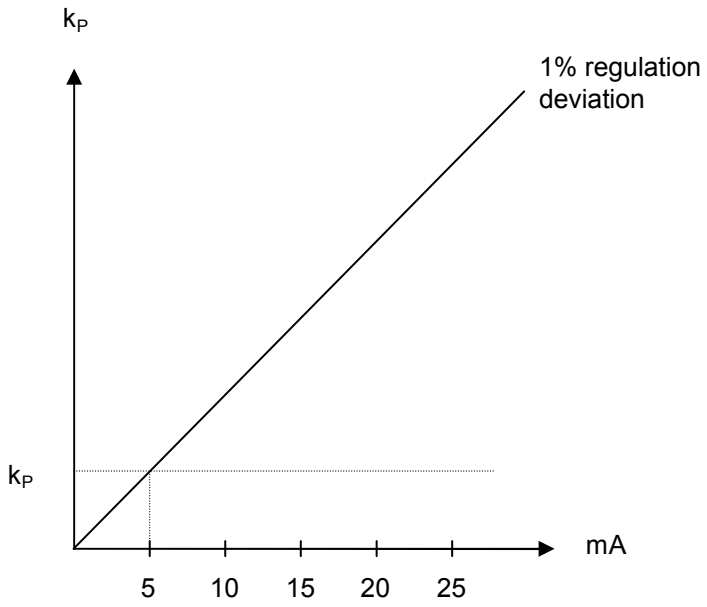
When the regulation deviation occurs, the proportional part will cause an immediate change of the output. The size of the change depends on the proportional action coefficient, KP.

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



Speed range

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

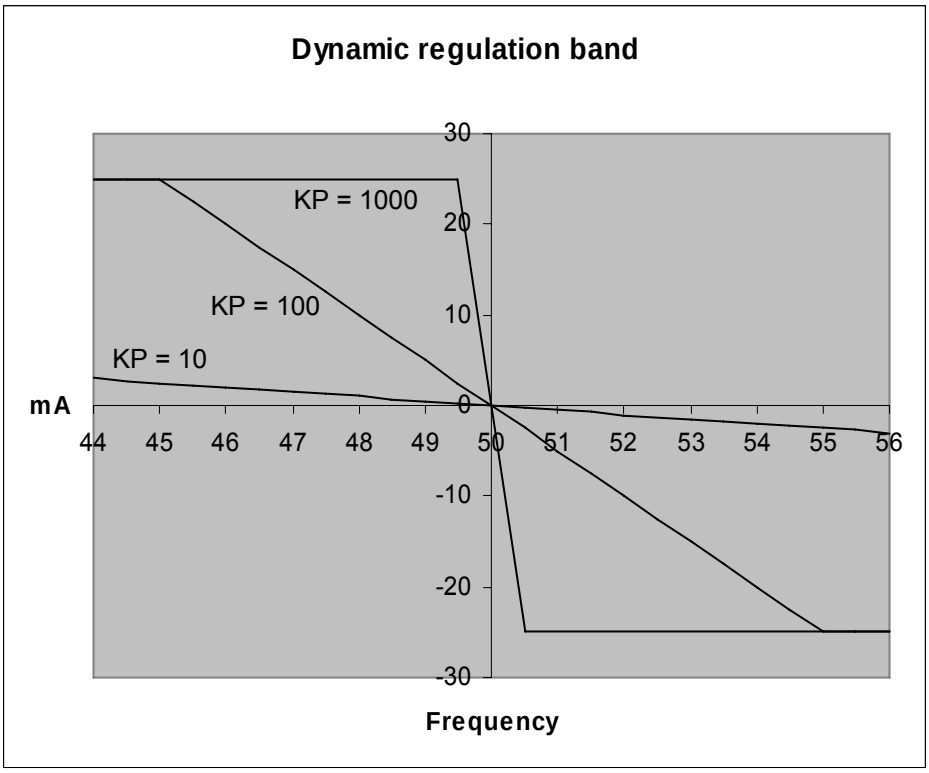


A 1% regulation deviation occurs. With the KP setting adjusted, the deviation causes the output to change 5mA. The table shows that the output of the PPU changes relatively much if the maximum speed range is low.

Max. speed range	Output change		Output change in % of max. speed range
10mA	5mA	5/10*100%	50
20mA	5mA	5/20*100%	25

Dynamic regulation area

The drawing below shows the dynamic regulation area at given values of KP. The dynamic area is reduced if the KP is adjusted to a higher value.

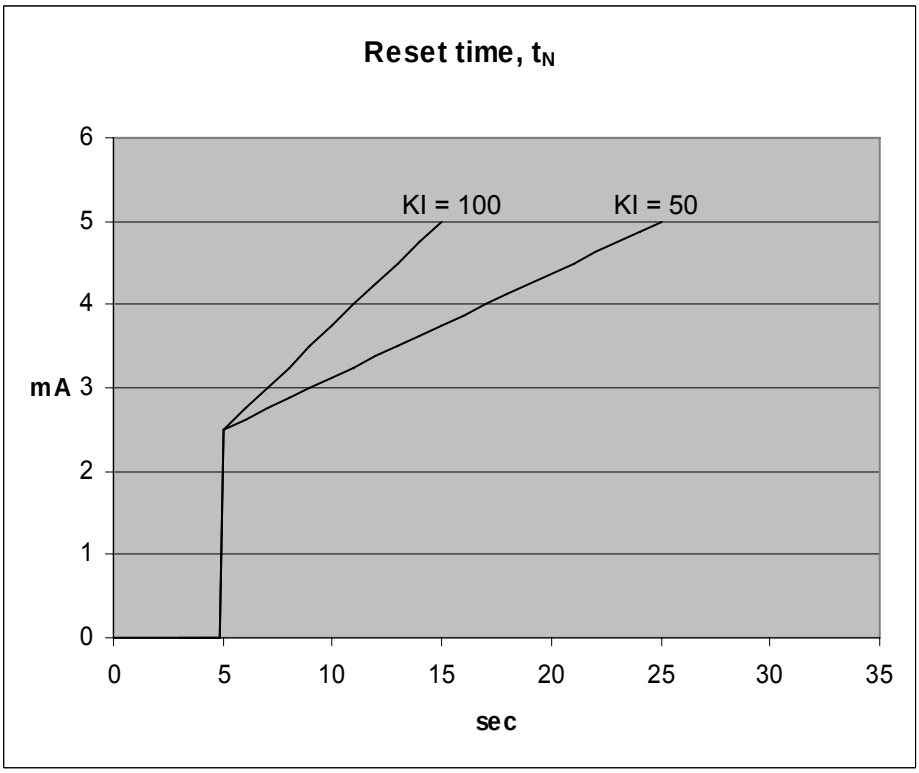


Integral regulator

To illustrate the integral action coefficient, the KI reset time can be used. The reset time is defined as the time the integral regulator uses to replicate the momentary change of the output caused by the proportional regulator.

In the drawing below, the proportional regulator causes an immediate change of 2.5mA. The reset time is then measured when the output reaches 2 x 2.5mA = 5mA.

The drawing shows that when the KI setting is changed to half the value, then the reset time is doubled. The reset time is 10 seconds with a KI setting of 100. With the KI setting adjusted to 50 the reset time will be 20 seconds. The KP setting is 100 in this example.



The reset time of the unit can be calculated at all values of KP and KI with the formula:

$$t_N = k_P * 10 / k_I$$

The table shows theoretical reset times in seconds:

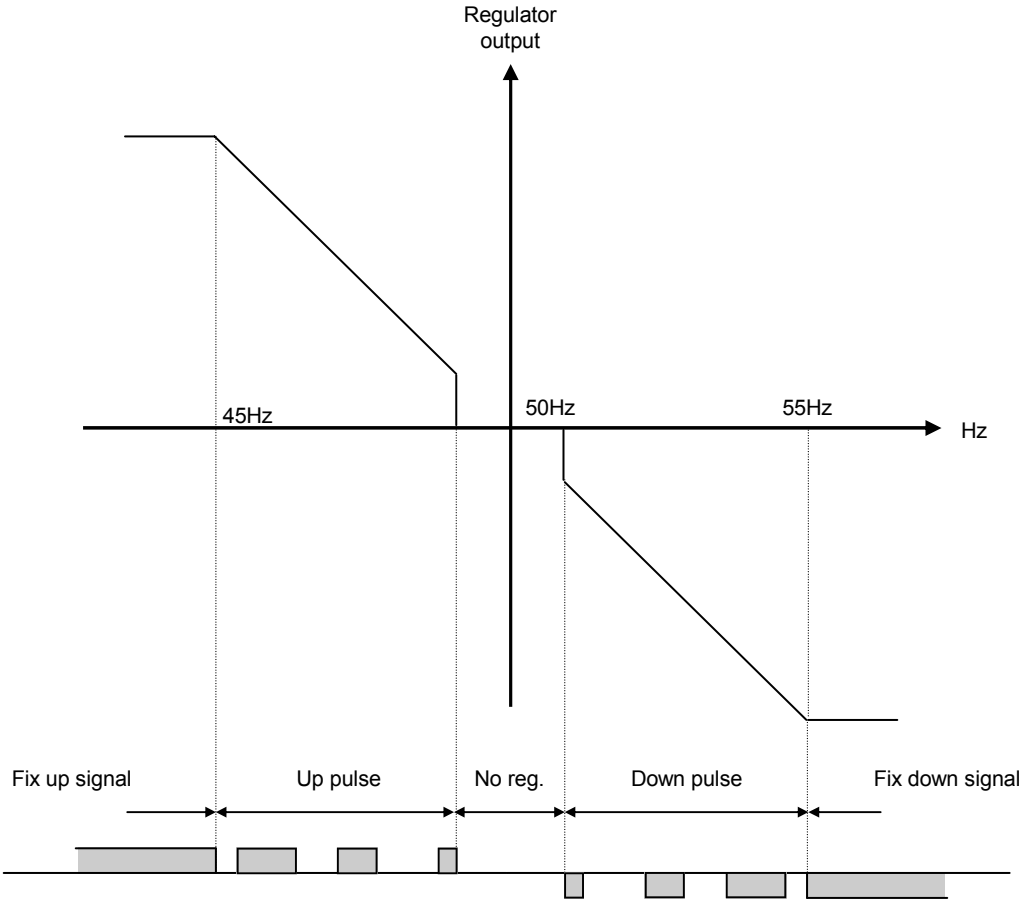
k_P \ k_I	**1**	**10**	**100**	**1000**
1	10	1	0.1	0.01
10	100	10	1	0.1
100	1000	100	10	1
1000	10000	1000	100	10

The integrating function of the I regulator is increased if the integral action coefficient, KI, is increased. This means that the reset time is reduced and a faster I regulation is achieved. If the KI is adjusted to 0 (reset time endless), the I regulator is switched off.

The integral action coefficient, KI, must not be too high. This will make the regulation hunt similar to a too high proportional action factor, KP.

Relay control

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



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

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

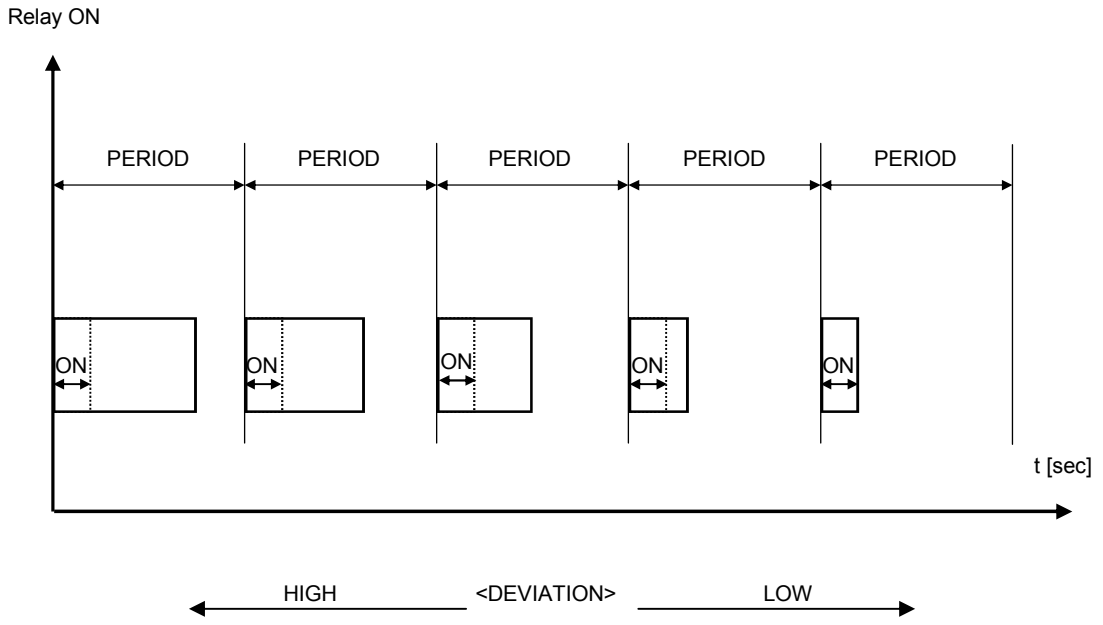
As the drawing indicates, the relays will be fixed on if the regulation deviation is big, and they will be pulsing if it is closer to the setpoint. In the dynamic range, the pulses get shorter and shorter when the regulation deviation gets smaller. Just before the dead band area, the pulse is as short as it can be. This is the adjusted time 'GOV ON time'/('AVR ON time'). The longest pulse will appear at the end of the dynamic range (45Hz in the example above).

Relay adjustments

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

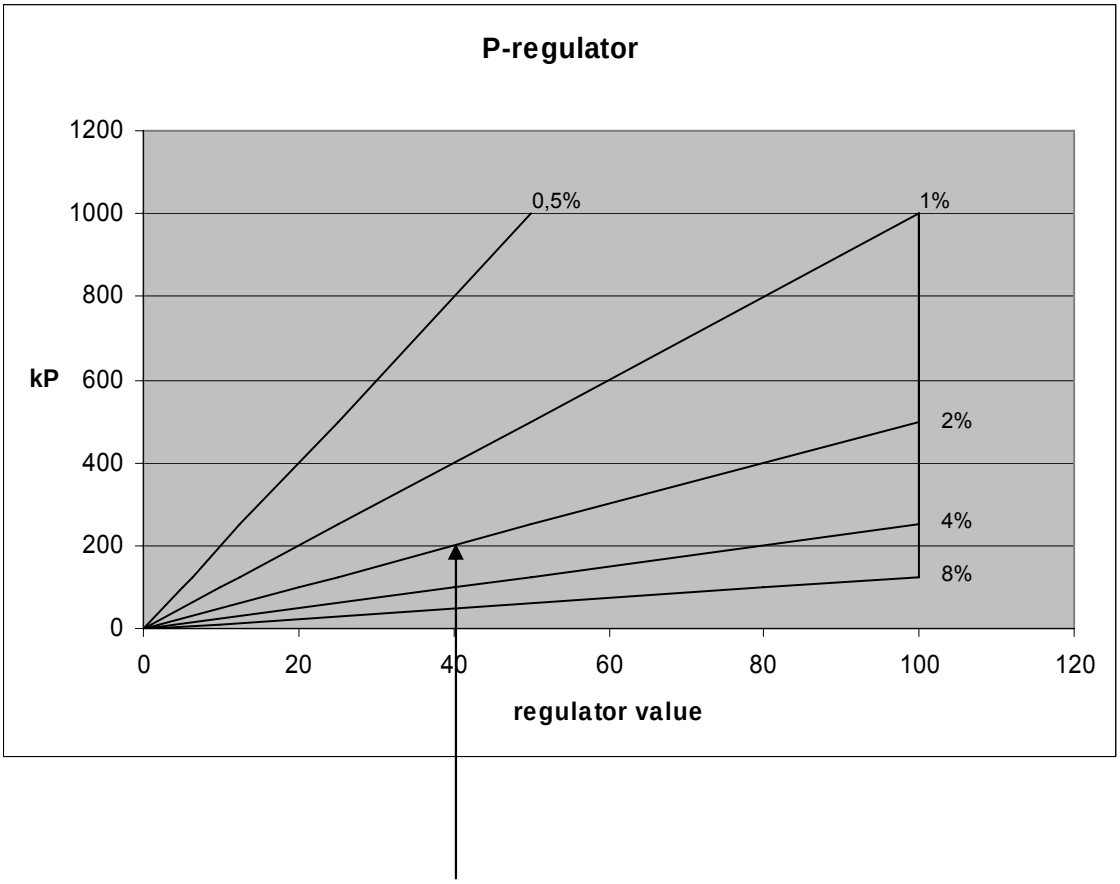
Adjustment	Description	Comment
Period time	Maximum relay time	The time between the beginning of two subsequent relay pulses.
ON time	Minimum relay time	The minimum length of the relay pulse. The relays will never be activated for a shorter time than the ON time.

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



Signal length

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



In this example, we have a 2 percent regulation deviation and an adjusted value of the KP = 200. The calculated regulator value of the unit is 40%. Now, the pulse length can be calculated with a period time = 2500 ms:

$$e_{DEVIATION} / 100 * t_{PERIOD}$$

$$40 / 100 * 2500 = 1000 ms$$

The length of the period time will never be shorter than the adjusted ON time. The P regulator causes the relay output to activate. The I regulator has the same effect on the relay output as described on page 84 concerning the reset time t_N.

8. Synchronisation

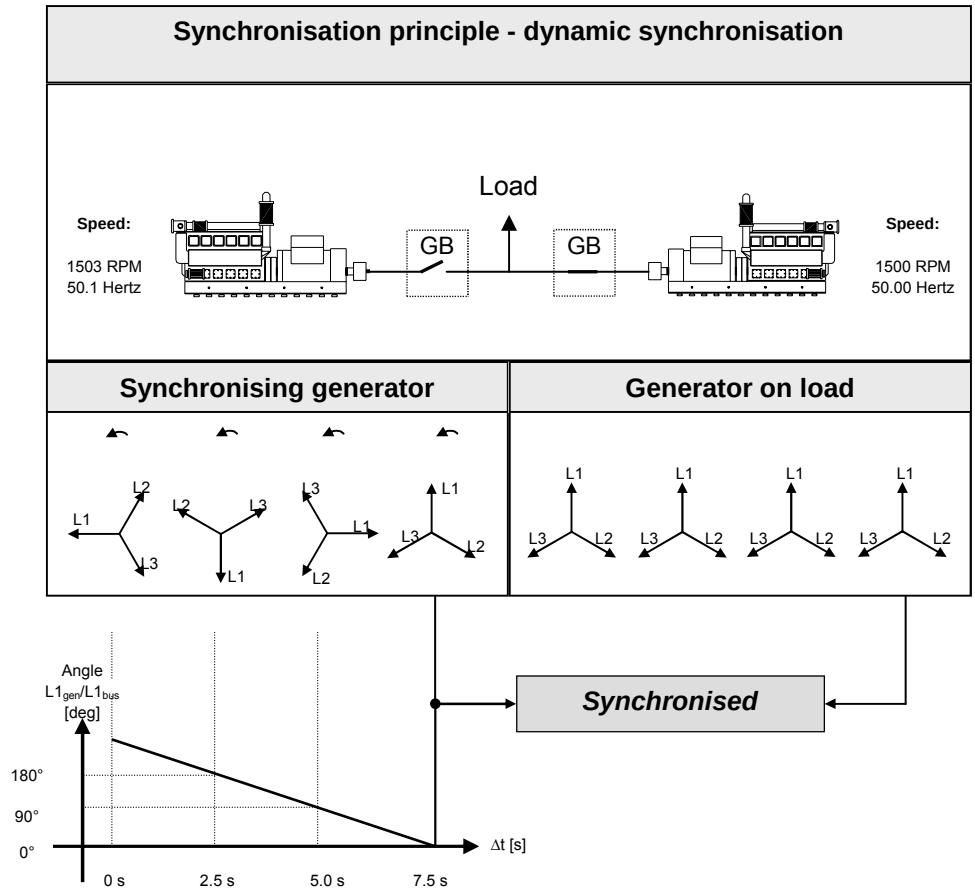
The unit can be used for synchronisation of generator and mains breaker (if installed). Two different synchronisation principles are available, namely static and dynamic synchronisation (dynamic is selected by default). This chapter describes the principles of the synchronisation functions and the adjustment of them.

In the following, the term 'synchronisation' means *'synchronising and closing of the synchronised breaker'*.

Dynamic synchronisation

In dynamic synchronisation, the synchronising gen-set is running at a different speed than the generator on the busbar. This speed difference is called *slip frequency*. Typically, the synchronising gen-set is running with a positive slip frequency. This means that it is running with a higher speed than the generator on the busbar. The objective is to avoid a reverse power trip after the synchronisation.

The dynamic principle is illustrated below.



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

The intention of the synchronising is to decrease the phase angle difference between the two rotating systems. These two systems are the three-phase system of the generator and the three-phase system of the busbar. On the illustration above phase L1 of the busbar is always pointing at 12 o'clock, whereas phase L1 of the synchronising gen-set is pointing in different directions due to the slip frequency.

Of course, both three-phase systems are rotating, but for illustrative purposes the vectors for the generator on load are not shown to be rotating. The reason is that we are only interested in the slip frequency for calculating when to release the synchronisation pulse.

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

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

In the above illustration, the difference in the phase angle between the synchronising set and the busbar gets smaller and will eventually be zero. Then the gen-set is synchronised to the busbar, and the breaker will be closed.

Close signal

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

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

$$\deg_{CLOSE} = 360 * t_{CB} * f_{SLIP}$$
$$\deg_{CLOSE} = 360 * 0.250 * 0.1$$
$$\deg_{CLOSE} = 9\,\deg$$

The synchronisation pulse is always issued, so the closing of the breaker will occur at the 12 o'clock position.

The length of the synchronisation pulse is the response time + 20 ms.

Load picture after synchronising

When the incoming gen-set has closed its breaker, it will take a portion of the load depending on the actual position of the fuel rack. Illustration 1 below indicates that at a given *positive* slip frequency, the incoming gen-set will *export* power to the load. Illustration 2 below shows that at a given *negative* slip frequency, the incoming gen-set will *receive* power from the original gen-set. This phenomenon is called *reverse power*.

To avoid nuisance trips caused by reverse power, the synchronising settings can be set up with a positive slip frequency.

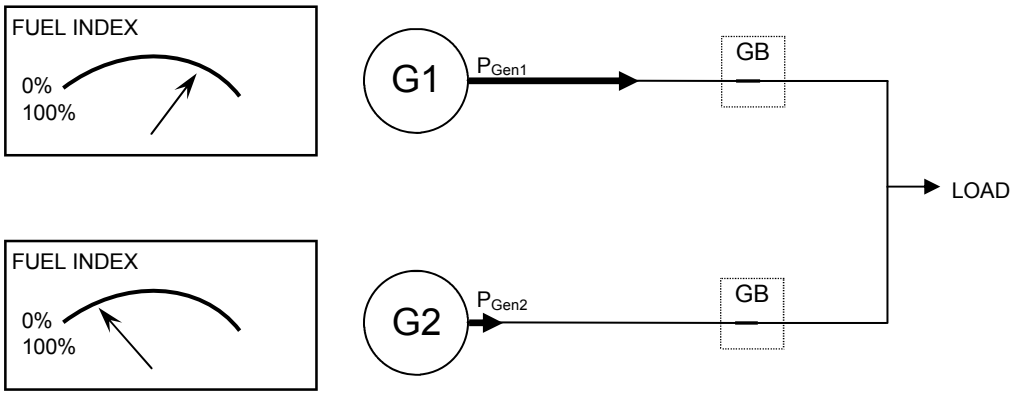


Illustration 1, POSITIVE slip frequency

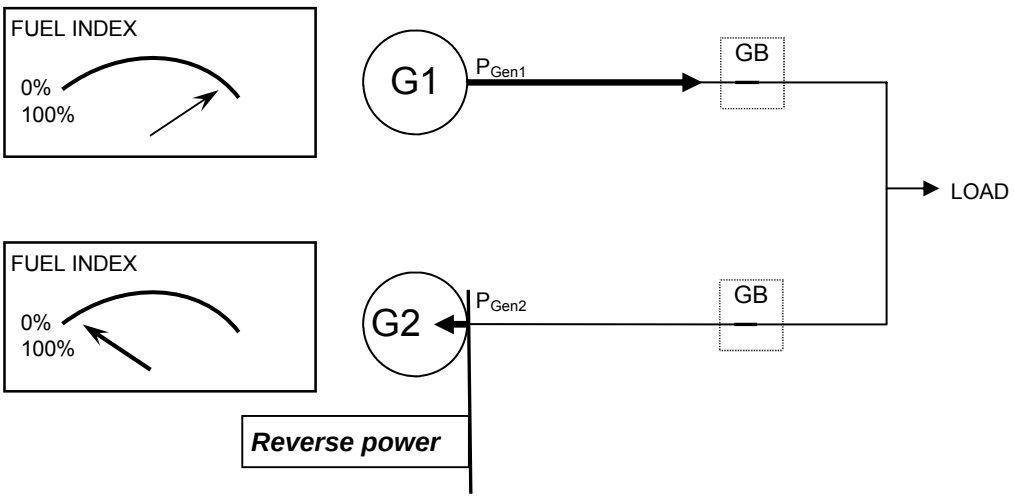


Illustration 2, NEGATIVE slip frequency

Adjustments

The dynamic synchroniser is selected in menu 2010 in the control setup and is adjusted in menu 2020.

Setting	Description	Comment
2021 f_{MAX}	Maximum slip frequency.	Adjust the maximum positive slip frequency where synchronising is allowed.
2022 f_{MIN}	Minimum slip frequency.	Adjust the maximum negative slip frequency where synchronising is allowed.
2023 U_{MAX}	Maximum voltage differ-rence (+/- value).	The maximum allowed voltage difference between the busbar/mains and the generator.
2024 t_{CB}	Circuit breaker closing time.	Adjust the response time of the circuit breaker.

It is obvious that this type of synchronisation is able to synchronise relatively fast because of the adjusted minimum and maximum slip frequencies. This actually means that when the unit is aiming to control the frequency towards its setpoint, synchronising can still occur as long as the frequency is within the limits of the slip frequency adjustments.

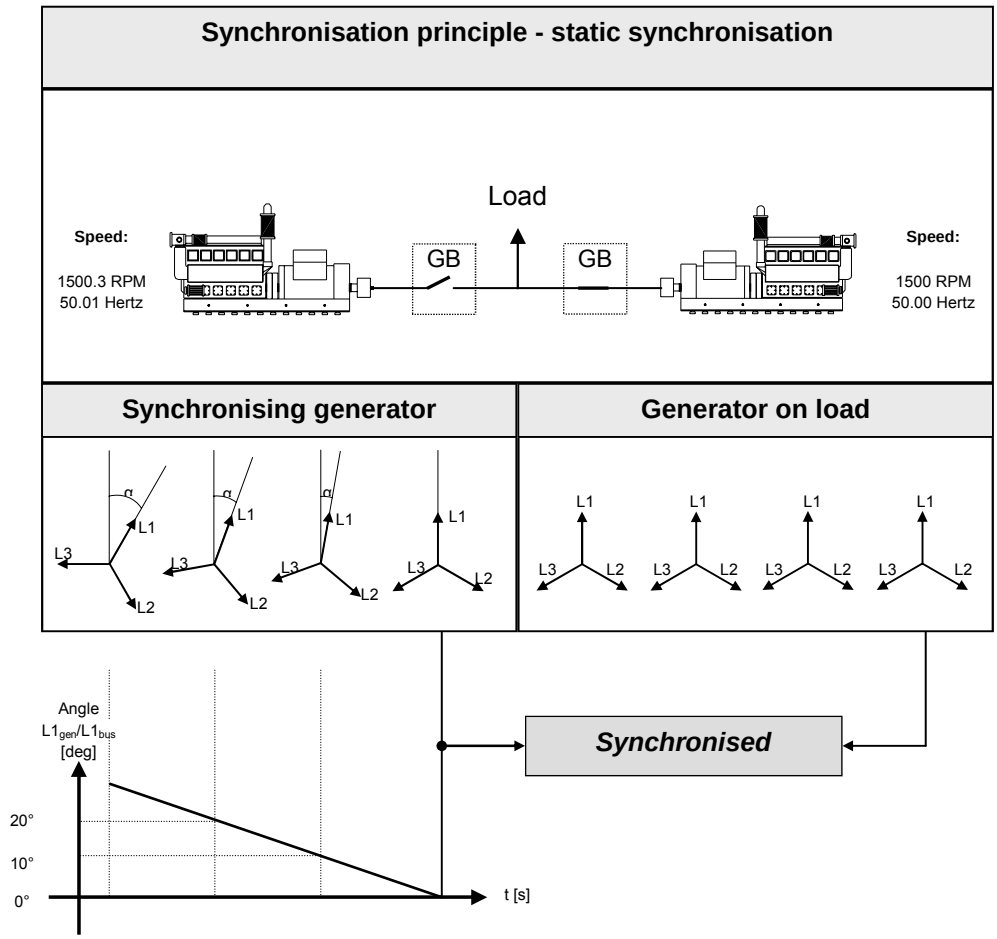
Dynamic synchronisation is recommended where fast synchronisation is required, and where the incoming gen-sets are able to take load just after the breaker has been closed.

Static synchronisation

In static synchronisation, the synchronising gen-set is running very close to the same speed as the generator on the busbar. The aim is to let them run at exactly the same speed and with the phase angles between the three-phase system of the generator and the three-phase system of the busbar matching exactly.

Due to the slower nature of the regulation with relay outputs it is not recommended to use the static synchronisation principle when relay regulation outputs are used.

The static principle is illustrated below.



Phase controller

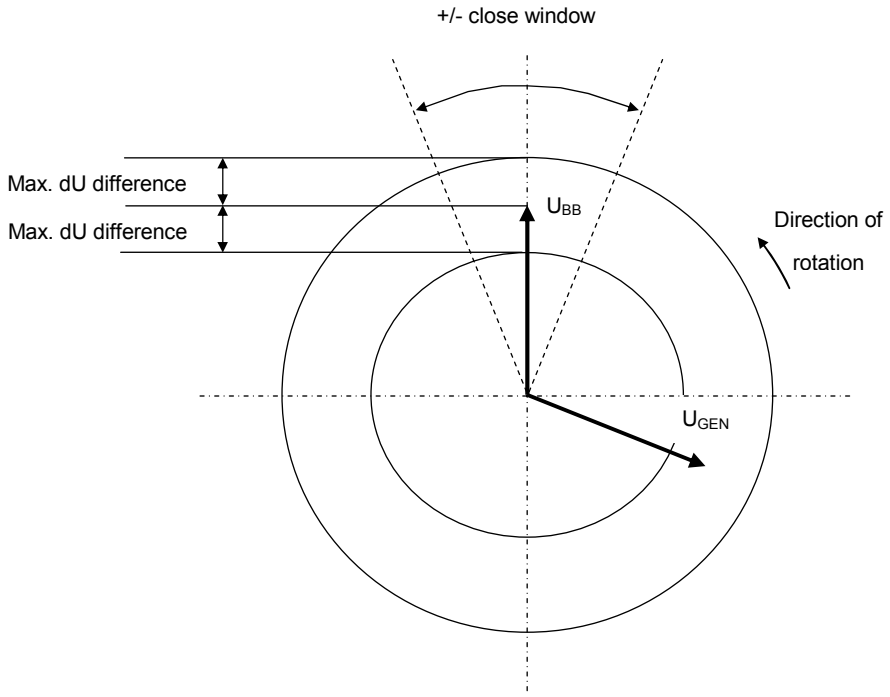
When the static synchronisation is used and the synchronising is activated, the frequency controller will bring the gen-set frequency towards the busbar frequency. When the gen-set frequency is within 50 mHz of the busbar frequency, then the phase controller takes over. This controller uses the angle difference between the generator system and the busbar system as the controlling parameter.

This is illustrated in the example above where the phase controller brings the phase angle from 30 deg. to 0 deg.

Close signal

The close signal will be issued when phase L1 of the synchronising generator is close to the 12 o'clock position compared to the busbar which is also in 12 o'clock position. It is not relevant to use the response time of the circuit breaker when using static synchronisation, because the slip frequency is either very small or non-existing.

To be able to get a faster synchronisation a 'close window' can be adjusted. The close signal can be issued when the phase angle U_{GENL1}-U_{BBL1} is within the adjusted setpoint. The range is +/-0.1-20.0 deg. This is illustrated in the drawing below.



The synchronisation pulse is sent according to the settings in menu 2030 in the control setup.

Load picture after synchronisation

The synchronised gen-set will not be exposed to an immediate load after the breaker closure if the maximum df setting is adjusted to a low value. Since the fuel rack position almost exactly equals what is required to run at the busbar frequency, no load jump will occur.

If the maximum df setting is adjusted to a high value, then the observations in the section about 'dynamic synchronisation' must be observed.

After the synchronising the unit will change the controller setpoint according to the requirements of the selected running mode.

Static synchronisation is recommended where a slip frequency is not accepted, for instance if several gen-sets synchronise to a busbar with no load groups connected.

Settings

The following settings must be adjusted, if the static synchroniser is selected:

Setting	Description	Comment
Maximum df	The maximum allowed frequency difference between the busbar/mains and the generator.	+/- value.
Maximum dU	The maximum allowed voltage difference between the busbar/mains and the generator.	+/- value, related to the nominal generator voltage.
Close window	The size of the window where the synchronisation pulse can be released.	+/- value.
Phase K_P	Adjustment of the proportional factor of the PI phase controller.	Only used during static synchronisation.
Phase K_I	Adjustment of the integral factor of the PI phase controller.	

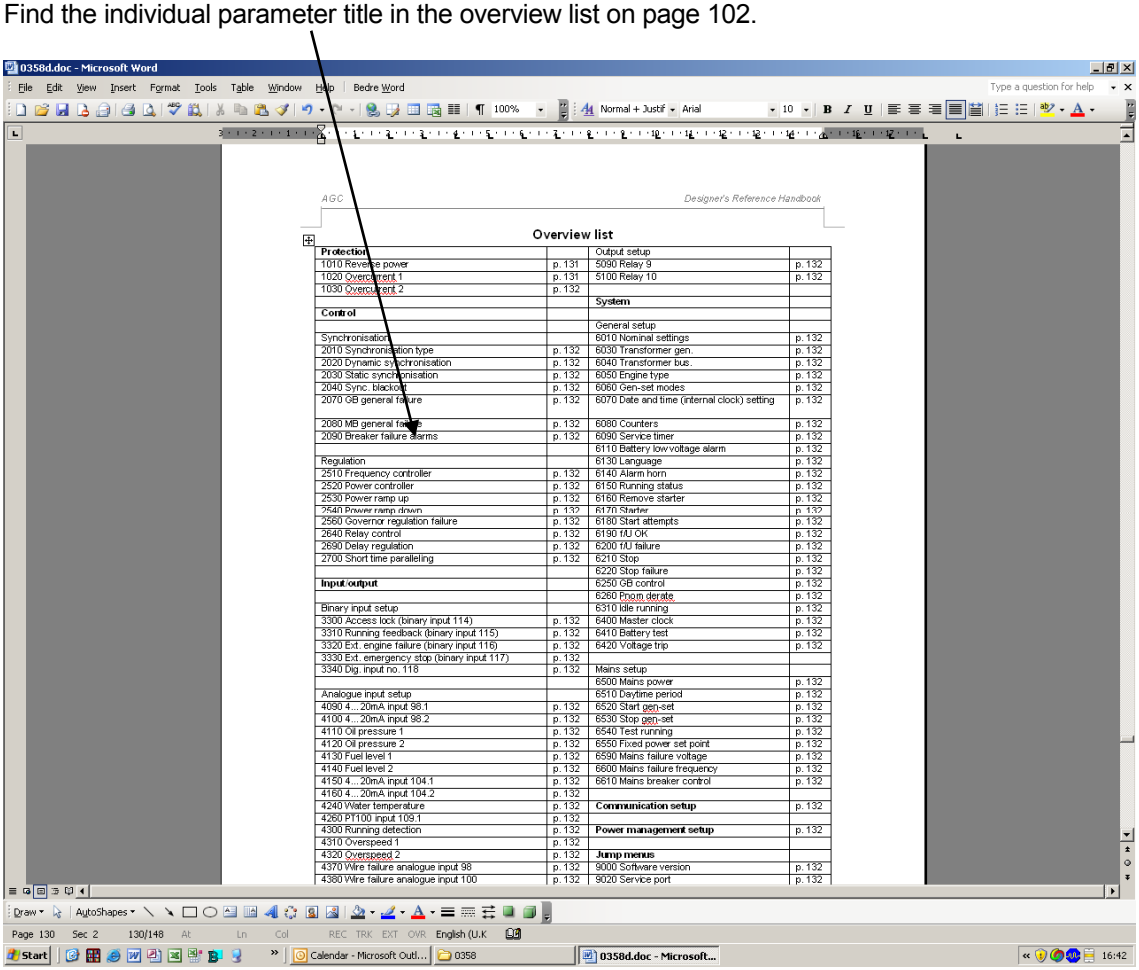
9. Procedure for parameter setup

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 10 '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.

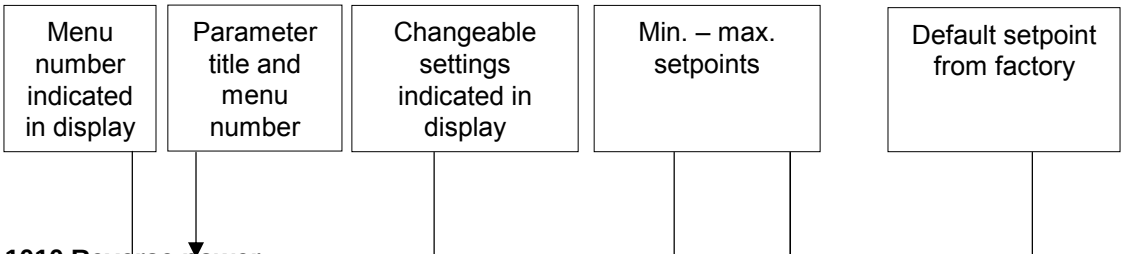
Find the individual parameter title in the overview list on page 102.



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

Parameter descriptions

In chapter 10, 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 it is 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.

10. 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.

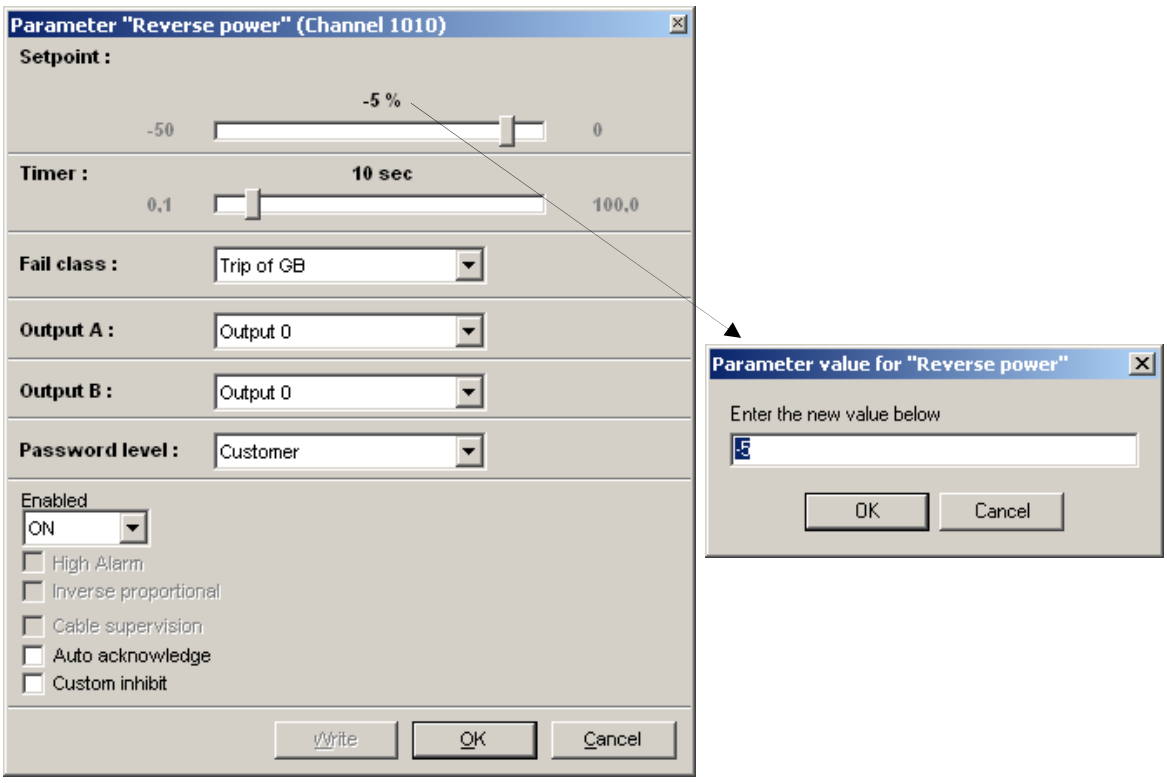
Relay output B: A relay can be activated by output B.

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

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

Control

This setup menu consists of the synchronisation setup and the regulation setup.

2010 Synchronisation type

No.	Setting		First setting	Second setting	Factory setting
2011	Sync. type	Sync. type	Static sync.	Dynamic sync.	Dynamic sync.

2020 Dynamic sync.

No.	Setting		Min. setting	Max. setting	Factory setting
2021	Dynamic sync.	Df max.	0.0Hz	0.5Hz	0.3Hz
2022	Dynamic sync.	Df min.	-0.5Hz	0.5Hz	0.0Hz
2023	Dynamic sync.	DU max.	2%	10%	5%
2024	Dynamic sync.	Breaker delay	40 ms	300 ms	50 ms

2030 Static sync.

No.	Setting		Min. setting	Max. setting	Factory setting
2031	Static sync.	Maximum df	0.00Hz	1.00Hz	0.25Hz
2032	Static sync.	Maximum dU	2%	10%	5%
2033	Static sync.	Close window	0.1 deg.	20.0 deg.	10.0 deg.
2034	Static sync.	Phase K_P	0	1000	10
2035	Static sync.	Phase K_I	0	1000	160

2040 Sync. black out

No.	Setting		Min. setting	Max. setting	Factory setting
2041	Sync. blackout	Df max.	0.0Hz	5.0Hz	3.0Hz
2042	Sync. blackout	DU max.	2%	10%	5%
2043	Sync. blackout	Enable	OFF	ON	OFF

2050 Sync. window

No.	Setting		Min. setting	Max. setting	Factory setting
2051	Sync. window	Setpoint +/-	2.0%	20.0%	15.0%
2052	Sync. window	Delay	0.1 s	2.0 s	0.5 s
2053	Sync. window	Output A	R0 (none)	Option dependent	R0 (none)
2054	Sync. window	Output B	R0 (none)		R0 (none)
2055	Sync. window	Enable	OFF	ON	OFF

2060 Sync. failure

No.	Setting		Min. setting	Max. setting	Factory setting
2061	Sync. failure	Delay	30.0 s	300.0 s	60.0 s
2062	Sync. failure	Relay output A	R0 (none)	Option dependent	R2 (relay 2)
2063	Sync. failure	Relay output B	R0 (none)		R0 (none)
2064	Sync. failure	Activate	OFF	ON	ON

2070 General failure

No.	Setting		Min. setting	Max. setting	Factory setting
2071	General failure	Relay output A	R0 (none)	Option dependent	R2 (relay 2)
2072	General failure	Relay output B	R0 (none)		R0 (none)
2074	General failure	Activate	OFF	ON	ON

2110 Modes active

No.	Setting		Description	Factory setting	PC software setting
2111	Modes active	Sync. + gov. + AVR	All modes	All modes	0
	Modes active	Sync. + gov.	Only gov.		1
	Modes active	Sync. + AVR	Only AVR		2
	Modes active	Sync.	Only sync.		3

AVR control is depending on option D1.

2120 Frequency control

No.	Setting		Min. setting	Max. setting	Factory setting
2121	Freq. control	Dead band	0.2%	10.0%	1.0%
2122	Freq. control	F K_P	0	1000	100
2123	Freq. control	F K_I	0	1000	100
2124	Freq. control	Droop	0.0%	10.0%	4.0%

2130 Power control

No.	Setting		Min. setting	Max. setting	Factory setting
2131	Power control	Dead band	0.2%	10.0%	0.2%
2132	Power control	P K_P	0	1000	100
2133	Power control	P K_I	0	1000	100

2140 Power ramp up

No.	Setting		Min. setting	Max. setting	Factory setting
2141	Power ramp up	Speed	0.1%/s	20.0%/s	2.0%/s
2142	Power ramp up	Delay point	1%	100%	10%
2143	Power ramp up	Delay time	0.0 s	180.0 s	10.0 s
2144	Power ramp up	LS ramp enable	OFF	ON	OFF

2150 Power ramp down

No.	Setting		Min. setting	Max. setting	Factory setting
2150	Power ramp down	Selection display	-	-	-
2151	Power ramp down	Speed	0.1%/s	20.0%/s	10.0%/s
2152	Power ramp down	Breaker open	1%	20%	5%

2180 Governor regulation failure

No.	Setting		Min. setting	Max. setting	Factory setting
2181	Governor reg. failure	Setpoint	1.0%	100.0%	30.0%
2182	Governor reg. failure	Timer	10.0 s	360.0 s	60.0 s
2183	Governor reg. failure	Output A	R0 (none)	Option dependent	R2 (relay 2)
2184	Governor reg. failure	Output B	R0 (none)		R2 (relay 2)
2185	Governor reg. failure	Enable	OFF	ON	ON

2250 Relay control

No.	Setting		Min. setting	Max. setting	Factory setting
2251	Relay control	GOV ON time t_N	10 ms	6500 ms	500 ms
2252	Relay control	GOV per. time t_P	250 ms	32500 ms	2500 ms
2253	Relay control	AVR ON time t_N	10 ms	3000 ms	100 ms
2254	Relay control	AVR per. time t_P	50 ms	15000 ms	500 ms

2290 Delay regulation

No.	Setting		Min. setting	Max. setting	Factory setting
2291	Delay regulation	Delay	0 s	9900 s	0 s
2292	Delay regulation	Output A	R0 (none)	Option dependent	R0 (none)
2293	Delay regulation	Output B	R0 (none)		R0 (none)
2294	Delay regulation	Enable	OFF	ON	OFF

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

3170 Binary input 43

No.	Setting		Min. setting	Max. setting	Factory setting
3171	Binary input term. 43	Time	0.10 s	100.00 s	5.00 s
3172	Binary input term. 43	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3173	Binary input term. 43	Relay output B	R0 (none)		R0 (none)
3174	Binary input term. 43	Enable	OFF	ON	OFF

3180 Binary input 44

No.	Setting		Min. setting	Max. setting	Factory setting
3181	Binary input term. 44	Time	0.10 s	100.00 s	5.00 s
3182	Binary input term. 44	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3183	Binary input term. 44	Relay output B	R0 (none)		R0 (none)
3184	Binary input term. 44	Enable	OFF	ON	OFF

3190 Binary input 45

No.	Setting		Min. setting	Max. setting	Factory setting
3191	Binary input term. 45	Time	0.10 s	100.00 s	5.00 s
3192	Binary input term. 45	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3193	Binary input term. 45	Relay output B	R0 (none)		R0 (none)
3194	Binary input term. 45	Enable	OFF	ON	OFF

3200 Binary input 46

No.	Setting		Min. setting	Max. setting	Factory setting
3201	Binary input term. 46	Time	0.10 s	100.00 s	5.00 s
3202	Binary input term. 46	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3203	Binary input term. 46	Relay output B	R0 (none)		R0 (none)
3104	Binary input term. 46	Enable	OFF	ON	OFF

3210 Binary input 47

No.	Setting		Min. setting	Max. setting	Factory setting
3211	Binary input term. 47	Time	0.10 s	100.00 s	5.00 s
3212	Binary input term. 47	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3213	Binary input term. 47	Relay output B	R0 (none)		R0 (none)
3214	Binary input term. 47	Enable	OFF	ON	OFF

3220 Binary input 48

No.	Setting		Min. setting	Max. setting	Factory setting
3221	Binary input term. 48	Time	0.10 s	100.00 s	5.00 s
3222	Binary input term. 48	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3223	Binary input term. 48	Relay output B	R0 (none)		R0 (none)
3224	Binary input term. 48	Enable	OFF	ON	OFF

3230 Binary input 49

No.	Setting		Min. setting	Max. setting	Factory setting
3231	Binary input term. 49	Time	0.10 s	100.00 s	5.00 s
3232	Binary input term. 49	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3233	Binary input term. 49	Relay output B	R0 (none)		R0 (none)
3234	Binary input term. 49	Enable	OFF	ON	OFF

3240 Binary input 50

No.	Setting		Min. setting	Max. setting	Factory setting
3241	Binary input term. 50	Time	0.10 s	100.00 s	5.00 s
3242	Binary input term. 50	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3243	Binary input term. 50	Relay output B	R0 (none)		R0 (none)
3244	Binary input term. 50	Enable	OFF	ON	OFF

3250 Binary input 51

No.	Setting		Min. setting	Max. setting	Factory setting
3251	Binary input term. 51	Time	0.10 s	100.00 s	5.00 s
3252	Binary input term. 51	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3253	Binary input term. 51	Relay output B	R0 (none)		R0 (none)
3254	Binary input term. 51	Enable	OFF	ON	OFF

3260 Binary input 52

No.	Setting		Min. setting	Max. setting	Factory setting
3261	Binary input term. 52	Time	0.10 s	100.00 s	5.00 s
3262	Binary input term. 52	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3263	Binary input term. 52	Relay output B	R0 (none)		R0 (none)
3264	Binary input term. 52	Enable	OFF	ON	OFF

3270 Binary input 53

No.	Setting		Min. setting	Max. setting	Factory setting
3271	Binary input term. 53	Time	0.10 s	100.00 s	5.00 s
3272	Binary input term. 53	Relay output A	R0 (none)	Option dependent	R1 (relay 1)
3273	Binary input term. 53	Relay output B	R0 (none)		R0 (none)
3274	Binary input term. 53	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	48.0Hz	62.0Hz	60.0Hz
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

4040 Controller

No.	Setting		Min. setting	Max. setting	Factory setting
4041	Controller	Power	-100%	100%	100%
4042	Controller	VAr	-100%	250%	30%
4043	Controller	Power factor (ind.)	0.60	1.00	0.90
4044	Controller	Water level regulation	0%	250%	100%

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	-

4240 Load share out

No.	Setting		Min. setting	Max. setting	Factory setting
4241	Load share out	Load share out	1.0 V	5.0	5.0 V

4250 Load share type

No.	Setting		Type 1	Type 2	Type 3	Factory setting
4251	L. share type	L. share type	DEIF	Selco T4800	Adjustable	DEIF

4260 Start next gen.

No.	Setting		Min. setting	Max. setting	Factory setting
4261	Start next gen.	Start point	50%	150%	80%
4262	Start next gen.	Timer	0 s	100 s	10 s
4263	Start next gen.	Relay output A	R0 (none)	Option dependent	R0 (none)
4264	Start next gen.	Relay output B	R0 (none)		R0 (none)
4265	Start next gen.	Enable	OFF	ON	OFF

4270 Stop next gen.

No.	Setting		Min. setting	Max. setting	Factory setting
4271	Stop next gen.	Stop point	0%	100%	20%
4272	Stop next gen.	Timer	0 s	200 s	30 s
4273	Stop next gen.	Relay output A	R0 (none)	Option dependent	R0 (none)
4274	Stop next gen.	Relay output B	R0 (none)		R0 (none)
4275	Stop next gen.	Enable	OFF	ON	OFF

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

4650 Relay 5

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4651	Relay 5	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4652	Relay 5	Off delay	0.0 s	999.9 s	-	5.0 s

4660 Relay 6

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4661	Relay 6	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4662	Relay 6	Off delay	0.0 s	999.9 s	-	5.0 s

4670 Relay 7

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4671	Relay 7	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4672	Relay 7	Off delay	0.0 s	999.9 s	-	5.0 s

4680 Relay 8

No.	Setting		First/min. setting	Second/max. setting	Third setting	Factory setting
4681	Relay 8	Function	Alarm	Alarm/sync. Block – reset	Limit	Alarm
4682	Relay 8	Off delay	0.0 s	999.9 s	-	5.0 s

4940 Generator type

No.	Setting		Min. setting	Max. setting	Factory setting
4941	Generator type	Asynchronous	OFF	ON	OFF
4942	Generator type	Slip frequency	-10.0%	10.0%	1.0%

'Asynchronous' generator is also known as 'Induction' generator.

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.