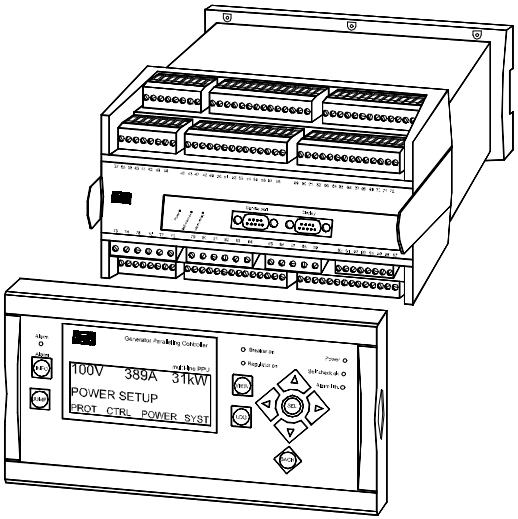
User's manual

Paralleling and Protection Unit Type PPU

multi-line 2

4189340230E

Software ver. 1.4X



- *Compact system in one unit*
  - *dynamic synchronisation*
  - *load sharing*
  - *generator protection*
- *3-phase AC_{RMS} measurements*
- *Calculation of complex AC values*
- *DIN-rail unit with separate display*
- *Easy operator programming via display or PC*
- *Reliable self-monitoring system*

CE

DEIF A/S
Frisenborgvej 33, DK-7800 Skive
Denmark
Tel.: (+45) 9614 9614
Fax: (+45) 9614 9615
E-mail: deif@deif.com

DEIF A/S

This document is the user's manual for the standard Deif Multi-line 2 PPU.

INDEX:

Warnings and legal information

This manual gives guidelines to installation of the DEIF Multi-line 2 generator control and protection units. It is, however, not a complete installation instruction. Therefore, even if terminal numbers are shown in the drawings, the drawings are to be used as guidance only.

Installing and operating the Multi-line 2 products implies work with dangerous currents and voltages, and therefore it should be done by qualified personnel only.

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

DEIF takes no responsibility for operation or installation of the generator set. If there is any doubt about how to install or operate the system on which the Multi-line 2 products are measuring, the company responsible for installation or operation must be contacted.

Standard functions

The PPU is a control and protection unit for a generator driven by a diesel / gas engine or a turbine. The PPU will carry out all necessary tasks to control and protect a generator, regardless of the use of the generator. This means that the PPU can be used for several application types such as:

- Stand-alone generator
- Multiple generator load sharing control
- Fixed load to mains / base load

The PPU measuring system is true RMS 3-phase measurement of generator voltage, generator current and BUS (mains) voltage.

Language

English, German, French or Spanish language may be chosen via the system menu structure.

Control functions

- Dynamic synchronisation
    - o Frequency matching
    - o Voltage check
    - o Breaker delay time compensation
    - o Check phase sequence
- Fixed load (base load) running of the generator
- Fixed frequency running of a stand-alone generator
- Load sharing between generators with power and frequency control
- Relay outputs for speed governor and AVR
- Relay outputs to close / open generator breaker
- Adjustable ramp up/down of generator load

Generator protection functions

- Reverse power
- Over current (2 levels)

Protective functions can be selected to activate one of 4 configurable relays.

Options

Option A and option B cannot be chosen at the same time as some functions are common for both.

			Available for		
Option	**Description**	**Available**	**GPU**	**GPC**	**PPU**
A	**Loss of mains protection package**				
A1	- Over- and under voltage (generator and busbar) - Over- and under frequency (generator and busbar) - Vector jump - Df/dt (ROCOF)	Now	X	X	X
A2	- Over- and under voltage (generator and busbar) - Over- and under frequency (generator and busbar) - Df/dt (ROCOF)	Aug. 2001	X	X	X
A3	- Over- and under voltage (generator and busbar) - Over- and under frequency (generator and busbar) - Vector jump	Aug. 2001	X	X	X
B	**Busbar and generator protection package**				
B1	- Over- and under voltage (generator and busbar) - Over- and under frequency (generator and busbar)	Now	X	X	X
C	**Generator add-on protection package**				
C1	- Overload - Current unbalance - Voltage asymmetry - Reactive power (import (excitation loss)/export)	Now	X		X
D	**Voltage/var/cos ö control**				
D1	Selectable (via binary inputs or (optional) serial interface) functions: - Constant voltage (stand-alone) - Constant reactive power (parallel with mains) - Constant power factor (parallel with mains) - Reactive power sharing (parallel with other generators, island operation)	Now		X	X
D2	- Constant voltage (stand-alone/synchronisation)	Aug. 2001		X	X
E	**Analogue controller outputs**				
E1	- +/-20mA for speed governor - +/-20mA for voltage/var/cos ö control (option D)	Now		X[1]	X[1]
F	**Analogue transducer output**				
F1	- 2 x analogue transducer output - +/-20mA for selectable AC values	Now	X	X	X
F2	- 4 x analogue transducer output - +/-20mA for selectable AC values	Now	X	X[2]	X[2]

[1] Not possible if option F2 is selected.

[2] Not possible if option E is selected.

			Available for		
Option	**Description**	**Available**	**GPU**	**GPC**	**PPU**
G	**Start/stop relay outputs**				
G1	- 2 x relay output for start and stop of other generators, programmable set points and timers	Now	X	Stan-dard	X
H	**Serial communication**				
H1	- CAN-open	June 2001	X	X	X
H2	- Mod-bus	Now	X	X	X
H3	- Profi-bus	Aug. 2001	X	X	X
J	**Cables**				
J1	- Display cable with plugs, 3m. UL94 (V1) approved	Now	X	X	X
J2	- Display cable with plugs, 6m. UL94 (V1) approved	Now	X	X	X
J3	- Serial cable for utility SW com., 3m. UL94 (V1) approv.		X	X	X
K	**User's manual (hard copy)** - The manual is enclosed on a CD-Rom	Now	X	X	X
L	**Display gasket for IP54**	Now	X	X	X
Z	**Nominal power > 20MW (free of charge)**	Now	X	X	X

Hardware

The PPU unit housing is divided into board slot positions, some of which are standard (non-changeable) and some intended for options. The unit is divided like this:

Slot #1: Standard Terminal 1-28
Slot #2: Terminal 29-36
Slot #3: Standard Terminal 37-64
Slot #4: Terminal 65-72
Slot #5: Standard Terminal 73-89
Slot #6: Terminal 90-97
Slot #7: Not used Terminal 98-125
Slot #8: Terminal 126-133

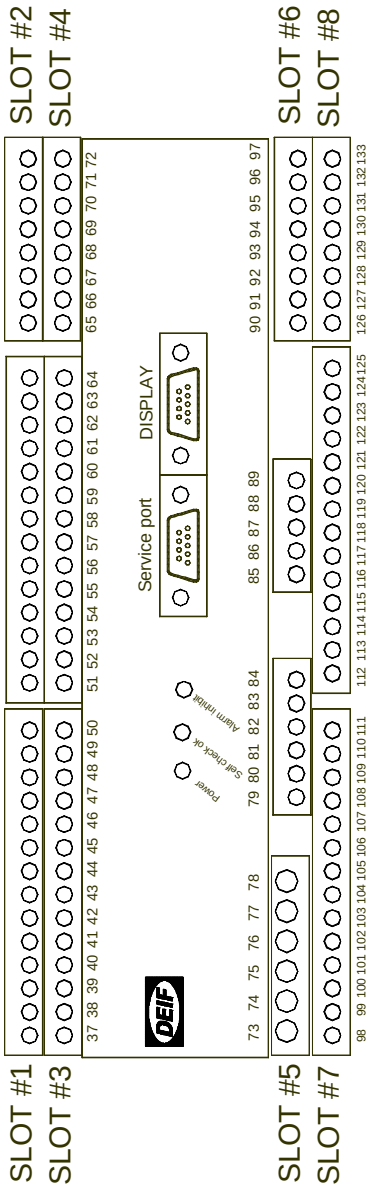
In the standard PPU, the only slots used are as standard slots #1, #3 and #5. Slots #2, #4, #6 and #8 are used for options, slot #7 is not used.

Besides the slots, there is an additional board where the communication ports are placed. I.e. RS232 PC service port for the utility software and the display port.

NOTE:
For slots #1, #3 and #5 only specific boards can be mounted.
For slots #2, #4, #6 and #8 the boards are interchangeable.

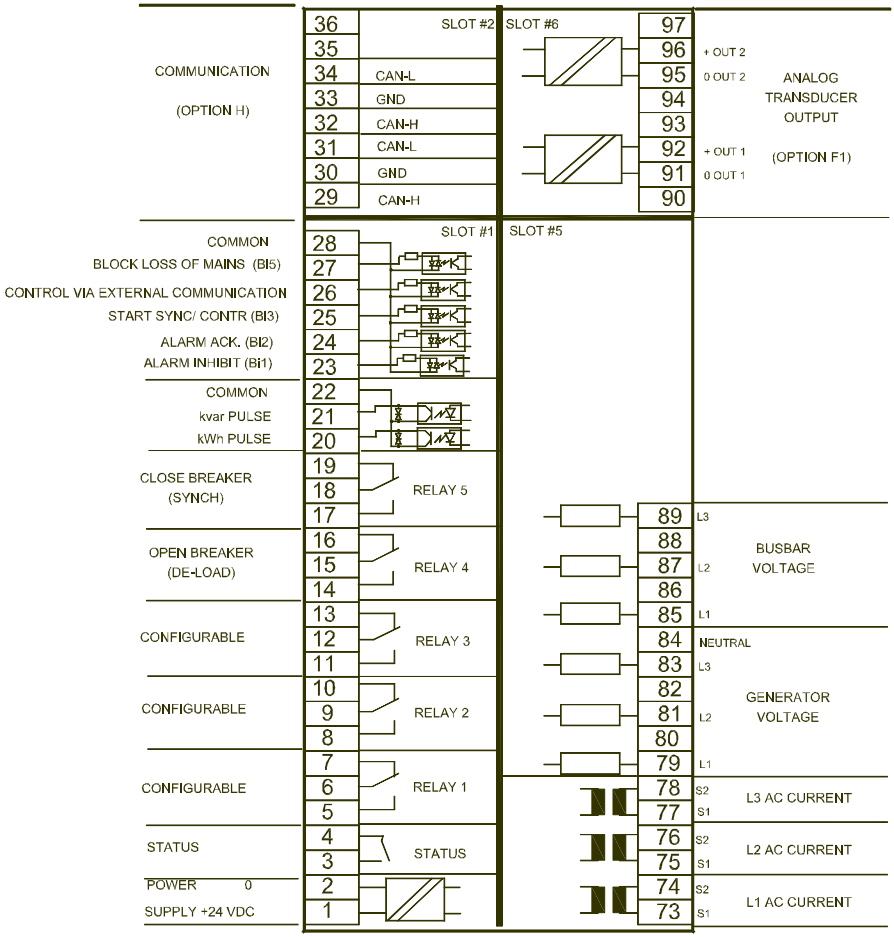
An overview of the terminals can be seen on the next page.

The slots are positioned in the unit as follows (seen from the top of the unit):

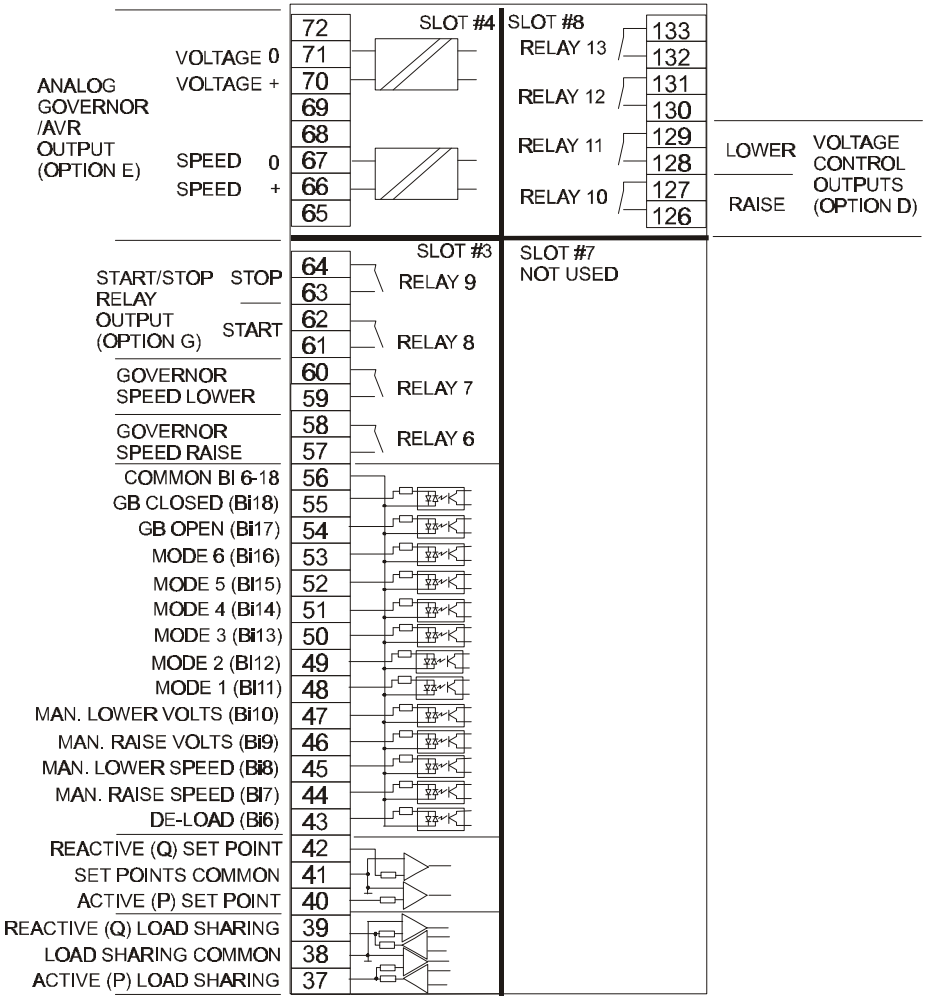


Terminal strip overview

Slots 1,2,5 and 6



Slots 3,4 and 8



Terminal strip, explanation

For the relay outputs, following terms will be used:
NO means **N**ormally **O**pen
NC means **N**ormally **C**losed
Com. means common terminal for the relay in question

Slot #1, power supply and binary I/O

Standard board (always needed):

Term	Function	Technical data	Description
1	+24 VDC	24 VDC +20 / - 30 %	Power supply.
2	0 VDC		
3	NC	Status relay 24V / 1A	Normally closed relay, processor /power supply status supervision
4	Com		
5	NO	Relay 1, 250 VAC / 8A	Configurable
6	Com.		
7	NC		
8	NO	Relay 2, 250 VAC / 8A	Configurable
9	Com.		
10	NC		
11	NO	Relay 3, 250 VAC / 8A	Configurable
12	Com.		
13	NC		
14	NO	Relay 4, 250 VAC / 8A	Open breaker (De-load) Can be configured for tripping also.
15	Com.		
16	NC		
17	NO	Relay 5, 250 VAC / 8A	Close breaker (synchronising)
18	Com.		
19	NC		
20	Open collector 1	Transistor out	Pulse output 1, kWh counter
21	Open collector 2	Transistor out	Pulse output 2, kvarh counter
22	Com.	Common	Common terminal for terminals 21 and 22
23	Digital input 1	Optocoupler	Remote alarm inhibit
24	Digital input 2	Optocoupler	Remote alarm acknowledge
25	Digital input 3	Optocoupler	Start sync. / control functions
26	Digital input 4	Optocoupler	Bus communication control
27	Digital input 5	Optocoupler	Block loss of mains (Vector jump and df/dt (ROCOF) only) (option A)
28	Com	Common	Common for terminals 24 to 27

Inputs

The inputs 23-27 on slot #1 are control inputs. Terminal 28 is the common.

Input 23:
The frequency and voltage alarms can be inhibited according to the table.

Breaker	OFF		ON	
Inhibit	ON	OFF	ON	OFF
Generator low f/U	-	ACT	-	ACT
Generator high f/U	ACT	ACT	ACT	ACT
Bus low f/U	-	-	-	ACT
Bus high f/U	-	-	-	ACT

ACT = Alarm active.

All other alarms are not depending on the breaker status.

The alarm inhibit LED on the display is lit when this input is set.

To avoid the use of the inhibit input the auto detection of running signal can be used. The channel number is 4110. The auto detection of running signal inhibits generator low frequency and low voltage alarms when the measurements are below 30% of the nominal values.

Input 24:
All the alarms are acknowledged when this input is activated. This is used for acknowledging alarms by a PLC or by relay logic. All alarms are acknowledged by this input.

Input 25:
This is the start sync. input. When this is set, the "regulator on" LED on the display is lit, and the multi-line 2 is controlling the speed governor/AVR.

This input must be removed if e.g. an alarm condition activates relay 4 (breaker opening) and the regulation must stop. Otherwise the multi-line 2 will synchronise the generator to the bus bar again. When this input is ON, the selected running modes are active. If the input terminal 25 is OFF, all control functions are disabled and the running situation is frozen. This includes terminal 43, deloading.

If input 25 and the deload input 43 are set, the generator is running at the nominal frequency.

Input 26:
This input is used when external communication e.g. MOD-bus is used. Refer to the bus protocols.

Input 27:
The block loss of mains input is inhibiting the loss of mains protection. This is normally set if closing of generator breakers causes fluctuations and is normally set a few seconds. To indicate that input 27 is set, the alarm inhibit LED on the display is flashing.

Alarm relays

5 relays are mounted in the power supply and binary I/O board in slot #1. Of these 5 relays one is used for closing of the generator breaker (relay 5), and one is used for opening of the generator breaker (relay 4).

The relays 1-4 can be configured as alarm relays. This is done in the protection menu, in the control menu and in the system menu. Each alarm can be configured to two outputs, output A and output B.

If the alarm function is enabled, an alarm will always be displayed on the multi-line 2. Further you can activate a relay which can be used to control your application. The relay can e.g. be used for alarm systems, dropping of unimportant load or as inputs to a PLC.

Since each alarm can be configured to two relays, you can combine the use, e.g. output A to an alarm panel and output B to drop unimportant load.

The PPU is controlling the speed governor output and AVR output in protection alarm conditions. This means that if an alarm has been configured to relay 4 (opening of breaker), it will automatically start synchronising immediately. To avoid this situation, the start/sync. input 25 must be removed.

In general failure conditions (sync. failure) the regulation stops and the running situation is frozen.

Status relay, slot #1

The status relay on the power supply board is a normally closed relay with the purpose of processor and power supply supervision. This relay cannot be configured to any alarms.

kWh and kvarh counter

The PPU monitors the energy production of each unit and it has pulse-outputs for kWh and kVARh measurement. The number of pulses depends on the nominal output of the generator as follows.

P_{nom}	< 100 kW	1 pulse/kW
P_{nom}	100-1000 kW	1 pulse/10 kW
P_{nom}	> 1000 kW	1 pulse/100 kW

The pulse length is 1 s/pulse.

Slot #2, Serial communication (option H)

CAN-open (Option H1):

Term.	Function	Description
29	CAN-H	The CAN is based on CAN-open.
30	GND	
31	CAN-L	
32	CAN-H	
33	GND	
34	CAN-L	
35	Not used	
36	Not used	

MOD-bus (Option H2):

Term.	Function	Description
29	DATA + (A)	
30	GND	
31	DATA - (B)	
32	DATA + (A)	
33	GND	
34	DATA - (B)	
35	Not used	
36	Not used	

The serial communication line should be terminated with a resistor equal to the cable impedance.

Use shielded twisted pair cable.

Slot #3, load sharing control

Term.	Function	Technical data	Description
37	-5…0…5 VDC	Analogue I/O	Active load sharing line
38	Com	Common	Common for load sharing lines
39	-5…0…5 VDC	Analogue I/O	Reactive load sharing
40	-10…0…10 VDC	Analogue input	Frequency / Active load set-point. Passive (requires external power supply)
41	Com	Common	Common for terminals 40 and 42
42	-10…0…10 VDC	Analogue input	Voltage /var/Power factor/Reactive load set-point. Passive (requires external power supply)
43	Binary input 6	Optocoupler	De-load (not possible in freq-control mode)
44	Binary input 7	Optocoupler	Manual raise speed (only active when "start sync. /reg." is OFF)
45	Binary input 8	Optocoupler	Manual lower speed (only active when "start sync. /reg." is OFF)
46	Binary input 9	Optocoupler	Manual raise voltage (only active when "start sync. /reg." is OFF)
47	Binary input 10	Optocoupler	Manual lower voltage (only active when "start sync. /reg." is OFF)
48	Binary input 11	Optocoupler	Mode 1
49	Binary input 12	Optocoupler	Mode 2
50	Binary input 13	Optocoupler	Mode 3
51	Binary input 14	Optocoupler	Mode 4
52	Binary input 15	Optocoupler	Mode 5
53	Binary input 16	Optocoupler	Mode 6
54	Binary input 17	Optocoupler	Generator breaker open
55	Binary input 18	Optocoupler	Generator breaker closed
56	Com	Common	Common for terminals 43 to 55
57	NO	Relay no. 6 250 VAC 8A	Engine speed governor: Raise speed
58	Com		
59	NO	Relay no. 7 250 VAC 8A	Engine speed governor: Lower speed
60	Com		
61	NO	Relay no. 8 250 VAC 8A	Start signal at high generator load = CC (option G)
62	Com		
63	NO	Relay no. 9 250 VAC 8A	Stop signal at low generator load = CC (option G)
64	Com		

Mode 1-6: These controls are only active when the breaker is closed and the start sync. input is ON.

Control selections with mode 1-6 inputs: See page 17.

The manual binary inputs can be used when the start/sync. input 25 is not activated. They respond to both relay and analogue outputs.

Deload input

The PPU has a deload function which is used when the generator breaker has to be opened with no load. The deload function is primarily used when running parallel with generators or the mains.

This function is activated by setting input 43 with a binary signal. Then the deloading is started depending on the running condition.

When running in stand-alone mode, it is not possible to deload the generator as there is no other generator to take the load. If the deload input is set, the breaker will be opened instantly in fixed frequency mode. In base load, droop and loadsharing mode the speed of the generator will be decreased. The breaker will not open.

When running in parallel, the deload input will still open the breaker instantly in fixed frequency mode. In base load, droop and loadsharing mode the load will be decreased and the breaker will open at a configurable set point. The factory setting is 5% of nominal power.

If the deload input is left ON after opening of the breaker, it will prevent resynchronisation.

Power / frequency mode selection	Mode 1	Mode 2
Fixed frequency	OFF	OFF
Base load (Fixed Power)	ON	OFF
Droop	OFF	ON
Load sharing	ON	ON

Power / frequency modes	
Internal set-point	Mode 3 OFF
External (terminals 40(signal) and 41(gnd)) set-point	Mode 3 ON

External set-point values:		
Mode	**Input**	**Value**
Fixed frequency	-10…0…+10 VDC	- 5…0…+5 Hz related to nominal frequency
Base load (Fixed Power)	0…10 VDC	0…100% load related to nominal power
Droop	-10…0…+10 VDC	- 5…0…+5 Hz related to nominal frequency
Load sharing	-10…0…+10 VDC	- 5…0…+ 5Hz related to nominal frequency

Voltage/var/power factor mode selection (option D)	Mode 4	Mode 5
Fixed voltage	OFF	OFF
Fixed var control	ON	OFF
Fixed power factor control	OFF	ON
var sharing	ON	ON

Voltage/var/power factor modes (option D)	
Internal set-point	Mode 6 OFF
External (terminals 42(signal) and 41(gnd)) set-point	Mode 6 ON

External set-point values:		
Mode	**Input**	**Value**
Fixed voltage	-10…0…+10 VDC	- 10…0…+10 % related to nominal voltage
Fixed var control	0…10 VDC	0…100% load related to nominal power
Fixed power factor control	0…+10 VDC	Cos φ 1…0.6 inductive
var sharing	-10…0…+10 VDC	- 10…0…+10 % voltage setting related to nominal voltage

External set-point inputs are passive and require an external power source (+/- 10 VDC)

Slot #4, Analog speed governor / AVR (option E)

These outputs are **active** outputs i.e. they use the internal power supply. The outputs are galvanically separated from each other and the rest of the unit.

The current outputs can if needed be converted to voltage using a resistor across the terminals (250 Ω will convert the +/- 20 mA into +/- 5 VDC).

Term.	Function	Description
65	Not used	
66	+/- 20 mA out	Speed governor set-point output.
67	0	
68	Not used	
69	Not used	
70	+/- 20 mA out	AVR voltage set-point output.[1)]
71	0	
72	Not used	

Note 1: Voltage control set-point to AVR is an option (option D).
If the combination of analogue speed governor signals and relay AVR signals is needed, the analogue speed governor signal is taken from slot #4, and the AVR relay outputs are taken from slot #8 relays 10 and 11.

Slot #5, AC measuring

Term.	Function	Technical description	Description
73	I L1 s1	Generator current L1	1/5 A AC input
74	I L1 s2		
75	I L2 s1	Generator current L2	1/5 A AC input
76	I L2 s2		
77	I L3 s1	Generator current L3	1/5 A AC input
78	I L3 s2		
79	U L1	Generator voltage L1	Max. 690 VAC phase - phase value
80		Not used	
81	U L2	Generator voltage L2	Max. 690 VAC phase - phase value
82		Not used	
83	U L3	Generator voltage L3	Max. 690 VAC phase - phase value
84	U Neutral	Generator voltage neutral	For land-based applications only
85	U L1	BUS voltage L1	Max. 690 VAC phase - phase value
86		Not used	
87	U L2	BUS voltage L2	Max. 690 VAC phase - phase value
88		Not used	
89	U L3	BUS voltage L3	Max. 690 VAC phase - phase value

Note: Current inputs are galvanically separated. Max. 0.3 VA per phase.

Voltage measurements are available in 4 levels:

1) 100 to 110 VAC
2) 200 to 240 VAC
3) 380 to 480 VAC
4) 660 to 690 VAC

The voltage level is to be defined when ordering, but can be changed onsite for the levels 1-3. The voltage level 4 (660-690 VAC) cannot be changed onsite, but must be defined when ordering.

Slot #6, analogue transducer output (option F1)/(slot #4 (option F2))

These outputs are **active** outputs i.e. they use the internal power supply. The outputs are galvanically separated from each other and the rest of the unit. The individual output can be selected (in display or via PC programming software) to represent any AC measuring value and related values (e.g. power, power factor, frequency, etc….).

For actual selection refer to the channel numbers 4500-4560.

Via software selection, the outputs can be selected to be 0…20 mA or 4…20 mA.

The current output can if needed be converted to voltage using a resistor across the terminals (250 Ω will convert the 0 - 20 mA into 0 - 5 VDC).

The outputs can, by moving a jumper on the board, be selected to be +/- 20 mA if needed.

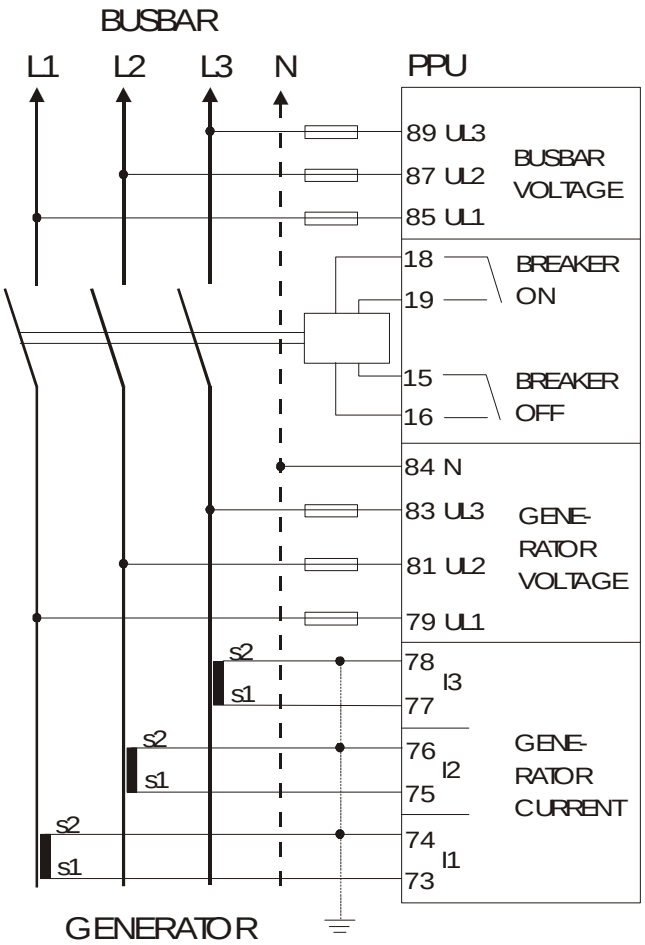
Term. Slot #6	Function	Description
90	Not used	
91	0	Analogue output, selectable
92	0(4) - 20 mA out	
93	Not used	
94	Not used	
95	0	Analogue output, selectable
96	0(4) - 20 mA out	
97	Not used	

Slot #8, AVR voltage control relay outputs (option D)

Term. Slot #8	Function	Technical data	Description
126	NO	Relay 10 250 VAC, 8A	Generator AVR: Raise voltage (Option D only)
127	Com		
128	NO	Relay 11 250 VAC, 8A	Generator AVR: Lower voltage (Option D only)
129	Com		
130	Not used		
131	Not used		
132	Not used		
133	Not used		

Wirings

AC connections



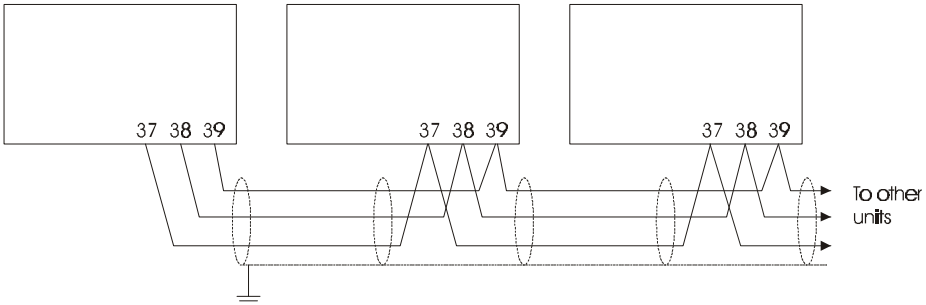
Notes: The neutral line (N) connection is not necessary for correct measurement. 3-phase without neutral is also possible.

The current transformers ground connection can be on s1 or s2 connection, whichever is preferred.

Fuses: 2A slow-blow.

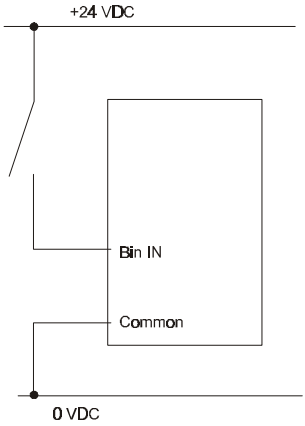
Load sharing lines

Even though screened cable is not needed, it is recommended if the cable run is longer than 5 m between units.



Binary inputs

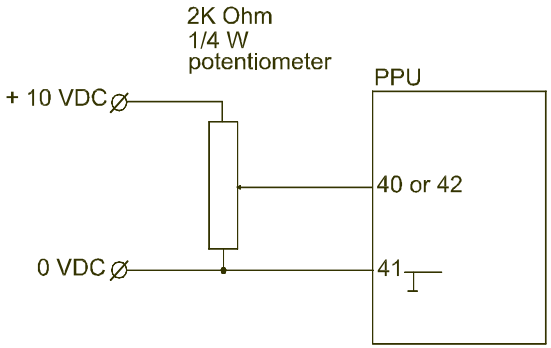
All binary inputs are 24 VDC bi-directional optocoupler. Typical input is:



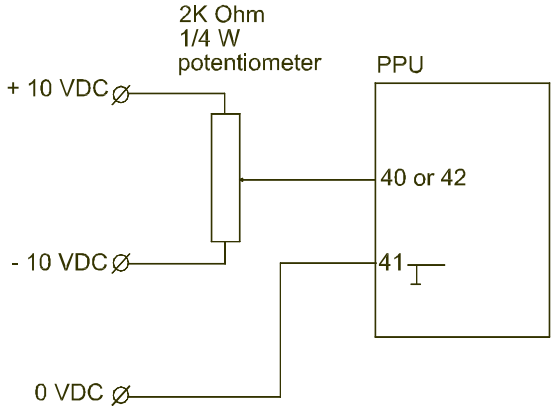
Analogue inputs (external set-points)

The set-point inputs are passive, i.e. an external power source is needed. This can be an active output from e.g. a PLC, or a potentiometer can be used.

0…10 VDC input using potentiometer:

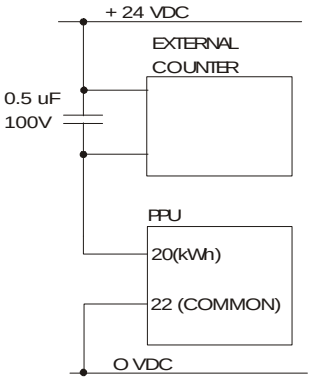


+/- 10 V input using potentiometer:



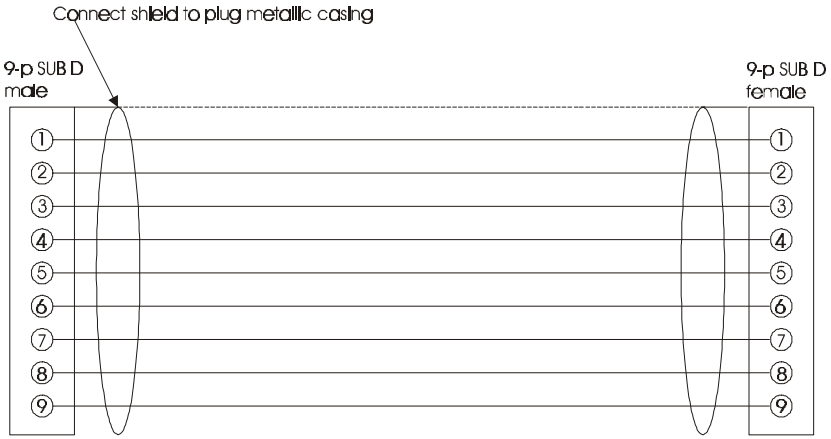
Optocoupler outputs for external counter

The kWh counter (terminals 21-23) and kvarh counter (terminals 21-22) outputs are low-power outputs. For that reason the following circuit must be applied:



Display I/F cable (option J)

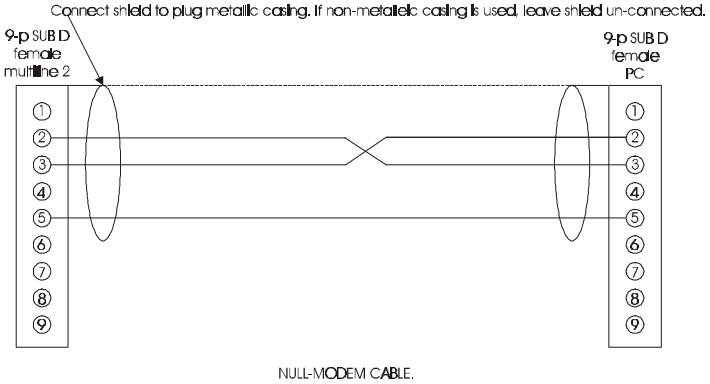
A standard computer extension cable can be used (9-pole SUB-D male / female plugs) or a cable can be tailored:



Wires min 0.22 mm^2. The cable length is 3m. (option J1) or 6m. (option J2).
Cable types: Belden 9540, BICC H8146, Brand Rex BE57540 or equivalent.

PC I/F cable (option J3)

A standard computer null-modem cable can be used (9-pole SUB-D female / female plugs) or a cable can be tailored:



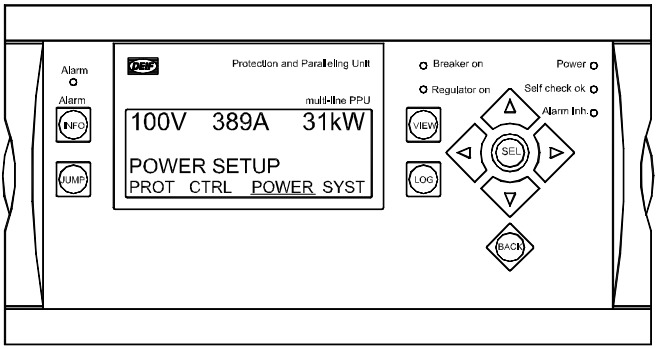
NULL-MODEM CABLE.

The cable length is 3m.

Display unit

The display unit used in multi-line 2 communicates and receives power supply via a 9-pole Sub-D plug. The plug fits directly onto the main unit, so the display can be mounted on the top of the main unit.

If the display is to be used as remote display, a standard computer extension cable with male / female plug can be used for the connection.



Display dimensions HxWxD = 115 x 220 x 20 mm

Push-button functions

There are 10 push-buttons on the display unit with the following functions:

INFO: Shifts the display 3 lower lines to show the alarm list (up to 30 alarms can be in the list).

JUMP: Enters a menu number selection. All settings have a specific number attached to it. Using the JUMP button enables the user to select and display any setting without navigating all the way through the menus (see later).

VIEW: Shifts the upper line displaying. The following values can be shown:
- 3 generator voltages (phase-to-phase)
- 3 BUS voltages (phase-to-phase)
- 3 generator currents
- Generator power factor and produced power (kW)
- Generator apparent power (VA) and reactive power (kvar)
- Generator L1 frequency and voltage
- BUS L1 frequency and voltage

LOG: Shifts the display 3 lower lines to show the event and alarm list

 : Moves the cursor left for manoeuvring in the menus.

 : Increases the value of the selected set-point (in the setting menus). In the daily use display it is used for scrolling the second line displaying of generator values.

SEL: Is used to select the chosen function (underscored selection in the lower line of the display).

 : Decreases the value of the selected set-point (in the setting menus). In the daily use display it is used for scrolling the second line displaying of generator values.

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

 : Moves the cursor right for manoeuvring in the menus.

Display functions

First line in display (daily use display functions)

The first line is used to display generator and BUS values. Typically the line will show 2 or 3 different values at the same time. The following line values can be seen:

- Generator voltage L1 L2 L3 (VAC)
- BUS voltage L1 L2 L3 (VAC)
- Generator current L1 L2 L3 (A)
- Generator Power Factor and active power (kW)
- Generator apparent power (kVA) and reactive power (kvar)
- Generator L1 frequency (Hz) and voltage (VAC)
- BUS L1 frequency (Hz) and voltage (VAC)

Second line in display (daily use display)

The second line is a service line where various values can be shown. Scrolling is done using the  and  keys. The values available are:

For generator:	For BUS:
voltage L1-N (VAC) voltage L2-N (VAC) voltage L3-N (VAC) voltage L1-L2 (VAC) voltage L2-L3 (VAC) voltage L3-L1 (VAC) voltage max. (VAC) voltage min. (VAC) current L1 (A) current L2 (A) current L3 (A) frequency L1 (Hz) frequency L2 (Hz) frequency L3 (Hz) active power (kW) reactive power (kvar) apparent power (kVA) energy counter (kWh) power factor voltage angle between L1-L2 (deg.) voltage angle between L2-L3 (deg.) voltage angle between L3-L1 (deg.)	voltage L1-N (VAC) voltage L2-N (VAC) voltage L3-N (VAC) voltage L1-L2 (VAC) voltage L2-L3 (VAC) voltage L3-L1 (VAC) voltage max. (VAC) voltage min. (VAC) frequency (Hz) voltage angle between L1-L2 (deg.) frequency deviation (df/dt) (Hz / sec.) voltage angle between generator voltage and BUS voltage (deg.) power supply voltage (VDC)

Second line in display (menu system)

When entering the menu system, the second line in the display is used for information about which function (with function identifying number) is chosen.

Using the  and  keys will scroll through the settings.

Second line in display (alarm and event list)

When selecting the alarm (and event) list, the second line will display the latest alarm / event.

Using the  and  keys will scroll through the list.

Third line in display (daily use display)

The third line is an indication line. The third line contains an explanation for the lower line selection of setup.

Third line in display (parameter menu display)

In the parameter menu, the third line indicates the present setting of the function in question, and, if changes are to be made, the max. and min. possible value for the setting.

Fourth line in display (daily use display)

In the daily use display, the fourth line is the entry selection for the parameter menu. If "SEL" is pressed, the selection of menu indicated with an underscore will be entered.

Choices are:

"PROT", protection setup
"CTRL", controls setup
"POWER", power control setup
"SYST", system setup

The settings related to the setup can be seen in the paragraph "Menu overview", where the specific function numbers (related to the "JUMP" function) can be seen.

Fourth line in display (parameter menu display)

When entering the parameter menus, the first (entry) display uses the fourth line to select a sub-function for the parameter. What the selections are is dependent on the function selected.

Examples:

For protective function, the first entry shows the "BUS high volt 1" setting (provided the option is chosen). In this case the fourth line shows:

"LIM", setting of switch point
"DEL", setting of time delay
"OA" and "OB", selection of which relay the function must activate.
"ACT", activate / de-activate the function.

For control functions, the first entry shows the "Synchronisation" function. In this case the fourth line shows:

"fMax", max. allowed positive frequency deviation when synchronising.
"fMin", min allowed negative frequency deviation when synchronising.
"Umax", max. allowed voltage deviation (positive or negative) when synchronising.
"tCB", closing time delay for generator circuit breaker.

For power setup, the first entry shows the "Start next gen." relay output (if the option is chosen). In this case the fourth line shows:

"LIM", setting of load dependent start output activation limit.
"DEL", time delay for activating the relay.
"ACT", activate / de-activate the function.

Note that no relay selection is present. This is due to the fact that the function relates to a pre-determined relay output on slot #3.

For system setup, the first entry shows the "Nominal settings". In this case the fourth line shows:

"F", nominal frequency setting.
"P", nominal generator power setting.
"I", nominal generator current setting.
"U", nominal generator voltage setting.

The above settings are used by the PPU to calculate nominal apparent power and current.

Menu overview

The following is the menu structure when entering settings of the PPU. If no entry has taken place before, the first display to appear is the password display. Enter the factory setting password to gain access to the menus.

If no actions have been taken within 3 minutes, the password entry will be de-activated, and a new password entry will be needed.

The menu overview is divided according to the daily use display selections in the fourth line ("PROT", "CTRL", "POWER", "SYST".)

Password setting

The password setting falls outside the menu structure and can only be entered via the "JUMP" push-button.

Select no. 4976 to enter password setting and select your own password. Use the  and the  buttons to change the setting and the "SEL" button to store the new setting. **Beware:** Write down the new password. If you forget it, entering the menus will not be possible.

Service menu

The service menu falls outside the menu structure and can only be entered via the "JUMP" push-button. Select channel 4980 to enter the service menu.

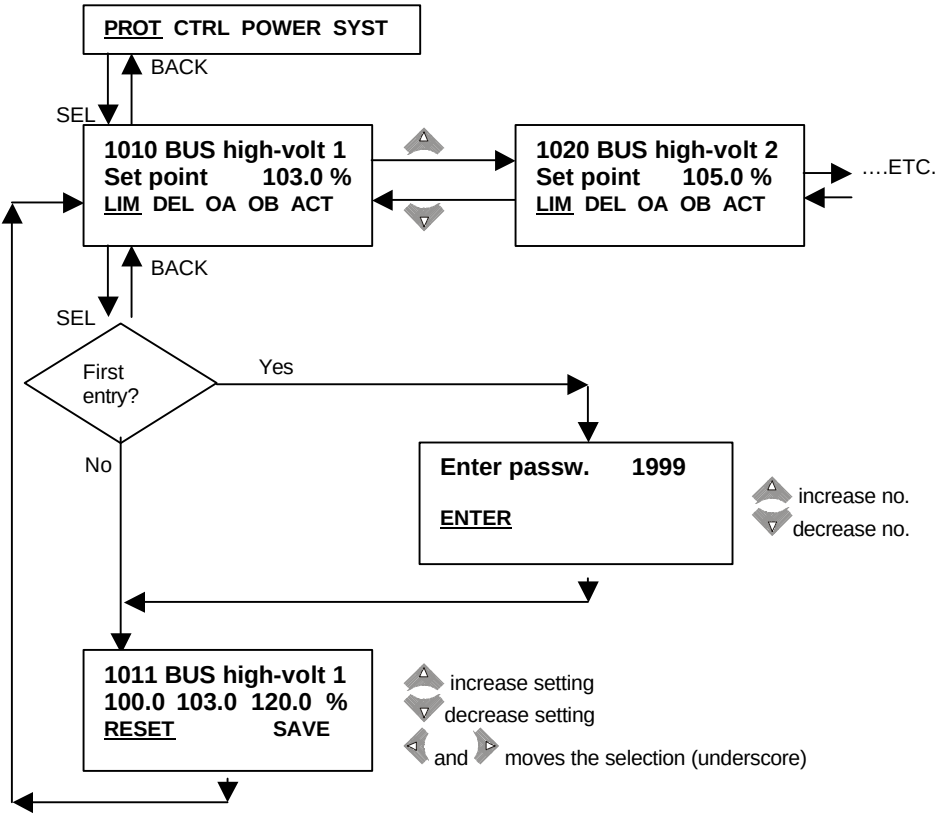
Navigating in the menus

The menu navigating starts from the daily use display fourth line and is carried out from there using the "SEL", , , , and "BACK" push-buttons.

Setup menu system

The following is an example, but all menus operate in the same manner.

Starting from the daily use display fourth line, select the menu indicated with underscore:
(move the underscore with the and pushbuttons)



Menu set-points

The following lists are in numerical order, i.e. the set-points and timers appear according to the given number.

Protection setup

Mains/BUS voltage protection option A or B

Voltage selections relate to nominal phase – to phase voltage

No.	Setting		Min. setting	Max. setting	Factory setting
1010	BUS overvolt 1	Selection display	-	-	-
1011	BUS overvolt 1	Set-point	100.0%	120.0%	103.0%
1012	BUS overvolt 1	Time	0.1 s	100.0 s	10.0 s
1013	BUS overvolt 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1014	BUS overvolt 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1015	BUS overvolt 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1020	BUS overvolt 2	Selection display	-	-	-
1021	BUS overvolt 2	Set-point	100.0%	120.0%	105.0%
1022	BUS overvolt 2	Time	0.0 s	100.0 s	5.0 s
1023	BUS overvolt 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1024	BUS overvolt 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1025	BUS overvolt 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1030	BUS undervolt 1	Selection display	-	-	-
1031	BUS undervolt 1	Set-point	80.0%	100.0%	97.0%
1032	BUS undervolt 1	Time	0.1 s	100.0 s	10.0 s
1033	BUS undervolt 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1034	BUS undervolt 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1035	BUS undervolt 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1040	BUS undervolt 2	Selection display	-	-	-
1041	BUS undervolt 2	Set-point	80.0%	100.0%	95.0%
1042	BUS undervolt 2	Time	0.0 s	100.0 s	5.0 s
1043	BUS undervolt 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1044	BUS undervolt 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1045	BUS undervolt 2	Enable	OFF	ON	OFF

Mains/BUS frequency protection option A or B

Frequency settings relate to nominal frequency setting.

No.	Setting		Min. setting	Max. setting	Factory setting
1050	BUS high freq. 1	Selection display	-	-	-
1051	BUS high freq. 1	Set-point	100.0%	110.0%	103.0%
1052	BUS high freq. 1	Time	0.1 s	100.0 s	10.0 s
1053	BUS high freq. 1	Relay output A	R0 (None)	R4 (relay 4)	R2 relay 2
1054	BUS high freq. 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1055	BUS high freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1060	BUS high freq. 2	Selection display	-	-	-
1061	BUS high freq. 2	Set-point	100.0%	110.0%	105.0%
1062	BUS high freq. 2	Time	0.0 s	100.0 s	5.0 s
1063	BUS high freq. 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1064	BUS high freq. 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1065	BUS high freq. 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1070	BUS low freq. 1	Selection display	-	-	-
1071	BUS low freq. 1	Set-point	90.0%	100.0%	97.0%
1072	BUS low freq. 1	Time	0.1 s	100.0 s	10.0 s
1073	BUS low freq. 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1074	BUS low freq. 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1075	BUS low freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1080	BUS low freq. 2	Selection display	-	-	-
1081	BUS low freq. 2	Set-point	90.0%	100.0%	95.0%
1082	BUS low freq. 2	Time	0.0 s	100.0 s	5.0 s
1083	BUS low freq. 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1084	BUS low freq. 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1085	BUS low freq. 2	Enable	OFF	ON	OFF

Generator voltage protection options A or B

No.	Setting		Min. setting	Max. setting	Factory setting
1310	Gen. high volt 1	Selection display	-	-	-
1311	Gen. high volt 1	Set-point	100.0%	120.0%	103.0%
1312	Gen. high volt 1	Delay	0.1 s	100.0 s	10.0 s
1313	Gen. high volt 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1314	Gen. high volt 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1315	Gen. high volt 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1320	Gen. high volt 2	Selection display	-	-	-
1321	Gen. high volt 2	Set-point	100.0%	120.0%	105.0%
1322	Gen. high volt 2	Delay	0.1 s	100.0 s	5.0 s
1323	Gen. high volt 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1324	Gen. high volt 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1325	Gen. high volt 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1330	Gen. low volt 1	Selection display	-	-	-
1331	Gen. low volt 1	Set-point	80.0%	100.0%	97.0%
1332	Gen. low volt 1	Delay	0.1 s	100.0 s	10.0 s
1333	Gen. low volt 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1334	Gen. low volt 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1335	Gen. low volt 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1340	Gen. low volt 2	Selection display	-	-	-
1341	Gen. low volt 2	Set-point	80.0%	100.0%	95.0%
1342	Gen. low volt 2	Delay	0.1 s	100.0 s	5.0 s
1343	Gen. low volt 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1344	Gen. low volt 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1345	Gen. low volt 2	Enable	OFF	ON	OFF

Generator frequency protection options A and B

No.	Setting		Min. setting	Max. setting	Factory setting
1350	Gen. high freq. 1	Selection display	-	-	-
1351	Gen. high freq. 1	Set-point	100.0%	110.0%	103.0%
1352	Gen. high freq. 1	Delay	0.2 s	100.0 s	10.0 s
1353	Gen. high freq. 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1354	Gen. high freq. 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1355	Gen. high freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1360	Gen. high freq. 2	Selection display	-	-	-
1361	Gen. high freq. 2	Set-point	100.0%	110.0%	105.0%
1362	Gen. high freq. 2	Delay	0.2 s	100.0 s	5.0 s
1363	Gen. high freq. 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1364	Gen. high freq. 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1365	Gen. high freq. 2	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1370	Gen. low freq. 1	Selection display	-	-	-
1371	Gen. low freq. 1	Set-point	90.0%	100.0%	97.0%
1372	Gen. low freq. 1	Delay	0.2 s	100.0 s	10.0 s
1373	Gen. low freq. 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1374	Gen. low freq. 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1375	Gen. low freq. 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1380	Gen. low freq. 2	Selection display	-	-	-
1381	Gen. low freq. 2	Set-point	90.0%	100.0%	95.0%
1382	Gen. low freq. 2	Delay	0.2 s	100.0 s	5.0 s
1383	Gen. low freq. 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1384	Gen. low freq. 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1385	Gen. low freq. 2	Enable	OFF	ON	OFF

Generator reverse power protection (standard function)

Reverse power settings relate to nominal power setting.

No.	Setting		Min. setting	Max. setting	Factory setting
1090	Reverse power	Selection display	-	-	-
1091	Reverse power	Set-point	-50.0%	0.0%	-5.0%
1092	Reverse power	Time	0.1 s	100.0 s	10.0 s
1093	Reverse power	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1094	Reverse power	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1095	Reverse power	Enable	OFF	ON	ON

Generator overcurrent protection (standard function)

Settings relate to nominal generator current.

No.	Setting		Min. setting	Max. setting	Factory setting
1100	Overcurrent 1	Selection display	-	-	-
1101	Overcurrent 1	Set-point	50.0%	200.0%	115.0%
1102	Overcurrent 1	Time	0.1 s	100.0 s	10.0 s
1103	Overcurrent 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1104	Overcurrent 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1105	Overcurrent 1	Enable	OFF	ON	ON

No.	Setting		Min. setting	Max. setting	Factory setting
1110	Overcurrent 2	Selection display	-	-	-
1111	Overcurrent 2	Set-point	50.0%	200.0%	120.0%
1112	Overcurrent 2	Time	0.1 s	100.0 s	5.0 s
1113	Overcurrent 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1114	Overcurrent 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1115	Overcurrent 2	Enable	OFF	ON	ON

Generator overload protection option C

Settings relate to nominal power setting.

No.	Setting		Min. setting	Max. setting	Factory setting
1160	Overload 1	Selection display	-	-	-
1161	Overload 1	Set-point	10.0%	200.0%	100.0%
1162	Overload 1	Time	0.1 s	100.0 s	10.0 s
1163	Overload 1	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1164	Overload 1	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1165	Overload 1	Enable	OFF	ON	OFF

No.	Setting		Min. setting	Max. setting	Factory setting
1170	Overload 2	Selection display	-	-	-
1171	Overload 2	Set-point	10.0%	200.0%	110.0%
1172	Overload 2	Time	0.1 s	100.0 s	5.0 s
1173	Overload 2	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1174	Overload 2	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1175	Overload 2	Enable	OFF	ON	OFF

Generator current unbalance protection option C

Settings relate to nominal generator current.

No.	Setting		Min. setting	Max. setting	Factory setting
1220	Current unbalance	Selection display	-	-	-
1221	Current unbalance	Set-point	0.0%	100.0%	30.0%
1222	Current unbalance	Time	0.1 s	100.0 s	10.0 s
1223	Current unbalance	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1224	Current unbalance	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1225	Current unbalance	Enable	OFF	ON	OFF

Generator voltage unbalance protection option C

Settings relate to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
1230	Voltage unbalance	Selection display	-	-	-
1231	Voltage unbalance	Set-point	0.0%	50.0%	10.0%
1232	Voltage unbalance	Time	0.1 s	100.0 s	10.0 s
1233	Voltage unbalance	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1234	Voltage unbalance	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1235	Voltage unbalance	Enable	OFF	ON	OFF

Generator reactive power import (loss of excitation) protection option C

Settings relate to nominal generator power value (kW).

No.	Setting		Min. setting	Max. setting	Factory setting
1240	var import	Selection display	-	-	-
1241	var import	Set-point	0.0%	150.0%	50.0%
1242	var import	Time	0.1 s	100.0 s	10.0 s
1243	var import	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1244	var import	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1245	var import	Enable	OFF	ON	OFF

Generator reactive power export (overexcitation) protection option C

Settings relate to nominal generator power value (kW).

No.	Setting		Min. setting	Max. setting	Factory setting
1250	var export	Selection display	-	-	-
1251	var export	Set-point	0.0%	100.0%	60.0%
1252	var export	Time	0.1 s	100.0 s	10.0 s
1253	var export	Relay output A	R0 (None)	R4 (relay 4)	R2 (relay 2)
1254	var export	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1255	var export	Enable	OFF	ON	OFF

Loss of mains protection option A

Df/dt (ROCOF) **NOTE:** Time delay is in periods (per)

No.	Setting		Min. setting	Max. setting	Factory setting
1260	Df/dt (ROCOF)	Selection display	-	-	-
1261	Df/dt (ROCOF)	Set-point +/-	0.1 Hz/s	10.0 Hz/s	5.0 Hz/s
1262	Df/dt (ROCOF)	Time	1 per	20 per	6 per
1263	Df/dt (ROCOF)	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1264	Df/dt (ROCOF)	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1265	Df/dt (ROCOF)	Enable	OFF	ON	OFF

Vector Jump

No.	Setting		Min. setting	Max. setting	Factory setting
1270	Vector jump	Selection display	-	-	-
1271	Vector jump	Set-point	1.0 deg.	90.0 deg.	10.0 deg.
1272	Vector jump	Time	No delay (immediate trip)		
1273	Vector jump	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
1274	Vector jump	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
1275	Vector jump	Enable	OFF	ON	OFF

The alarm inhibit lamp is flashing if the block loss of mains input is set.

Control setup

Synchronisation

The "dU max." setting is related to nominal generator voltage. The "dU max." setting is ± nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
2010	Synchronisation	Selection display	-	-	-
2011	Synchronisation	Df max.	0.0 Hz	0.5 Hz	0.3 Hz
2012	Synchronisation	Df min.	-0.5 Hz	0.5 Hz	0.0 Hz
2013	Synchronisation	DU max.	2%	10%	5%
2014	Synchronisation	Breaker delay	40 ms	300 ms	50 ms

The synchronisation pulse is 400 ms.

Blackout closing of breaker

Settings are the accepted limits (generator voltage and frequency) for closing the breaker. The "dU max." setting is related to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
2020	Sync. blackout	Selection display	-	-	-
2021	Sync. blackout	Df max.	0.0 Hz	5.0 Hz	3.0 Hz
2022	Sync. blackout	DU max.	2%	10%	5%
2023	Sync. blackout	Enable	OFF	ON	OFF

If blackout closing of breaker is enabled on more units, external precautions must be taken to avoid two or more generators closing on a black busbar. In that case synchronism will not be present.

General failure (sync. fail)

The general failure covers:

- Synchronisation time
- Breaker ON/OFF feedback fail
- Generator voltage not established
- Generator frequency not established
- Phase sequence error

No.	Setting		Min. setting	Max. setting	Factory setting
2030	General failure	Selection display	-	-	-
2031	General failure	Delay	0.0 s	120.0 s	60.0 s
2032	General failure	Relay output A	R0 (none)	R4 (relay 4)	R2 (relay 2)
2033	General failure	Relay output B	R0 (none)	R4 (relay 4)	R0 (none)

The general failure cannot be disabled.

PI controller

The PPU includes controllers for the different running modes. The controllers control either a relay output (standard slot #3/option D slot #8) or an analogue output (option E slot #4).

The basic principle of the controller is that a calculation is being executed every 5 * ON time (relay output) or 5 * integ. time (analogue output). The result of this calculation indicates whether the actual value (e.g. nominal frequency) is within the deadband. In that case there will be no changes on the output. If the actual value is differing from the deadband, the controller will cause an output signal change.

If the relay output is used, the relay will be set for a certain time depending on the deviation from the actual value to the desired value. The length of the output signal will be up to 5 * ON time.

If the analogue output is used, the analogue signal will change depending on the gain factor and the deviation from the actual value to the desired value. The period the output signal changes will be up to 5 * integral time.

After a period of 5 * ON time or 5 * integral time a new calculation is carried out.

From the table below it appears what controllers are active in the different running modes.

Controllers:

	Controllers					Mix factor	
	Freq.	Power	Voltage	var	PF	f/P mix	U/var mix
Fixed freq.	x						
Fixed power		x					
Droop		x					
Loadsharing	x	x				x	
Fixed voltage			x				
Fixed var				x			
Fixed PF					x		
Loadsharing			x	x			x

The mix factors are not controllers, but they indicate the influence of the two controllers in question.

Example: The generator is running in loadshare mode. The f/P mix factor is set to 50%. Now the frequency controller participates with 50% of the governor control and the power controller participates with: 100 – 50 = 50%.

When running in the generators, the relevant controller must be set in each desired running mode. (Fixed frequency mode set frequency controller).

With the exception of the PF controller the controllers are active in more running modes depending on the application. Regardless of that, the controller values will be the same.

Deadband (+/- value)

The controllers will find a value within the deadband area. If the actual value is within this area the output signals will not change. When the calculation shows an actual value outside the deadband area, the output signals change again.

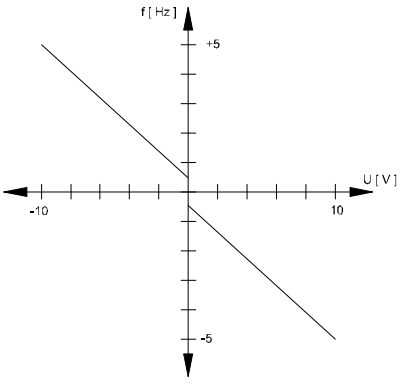
Gain factor

The gain factor indicates with what rate the analogue output signal will change. A higher gain factor will cause a faster regulation, but it might also cause the prime movers to hunt.

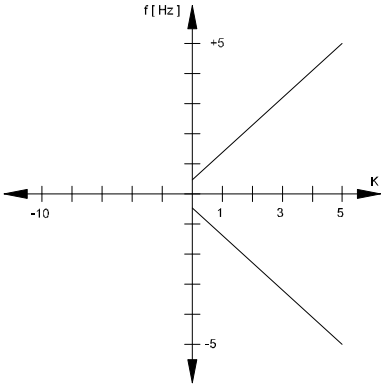
ON-time

The output relay is active for a time of = K * ON time. K is depending on the deviation from nominal value.

Diagrams: Analogue output and output activation time



f = generator frequency
U = analogue output signal



f = generator frequency
K = konstant
The output signal changes:
t = K x integral time [ms]

Frequency controller

The ON / integral time is a combined setting. If relay speed control setting is used, the setting indicates the shortest relay ON time. If the speed control setting is analogue output (option E), the setting is for the PI controller integral time.

Frequency % settings relate to nominal generator frequency.

No.	Setting		Min. setting	Max. setting	Factory setting
2050	Freq. control	Selection display	-	-	-
2051	Freq. control	Droop	0.0%	10.0%	4.0%
2052	Freq. control	Dead band	0.2%	10.0%	1.0%
2053	Freq. control	Gain	1	100	40
2054	Freq. control	ON / Integr. Time	10 ms	3000 ms	100 ms

Power controller

The ON / integral time is a combined setting. If relay speed control setting is used, the setting indicates the shortest relay ON time. If the speed control setting is analogue output (option E), the setting is for the PI controller integral time.

Power % settings relates to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2060	Power control	Selection display	-	-	-
2061	Power control	Dead band	0.2%	10.0%	2.0%
2062	Power control	Gain	1	100	40
2063	Power control	ON / Integr. Time	10 ms	3000 ms	100 ms

Power ramp up

The delay point and – time is the point where the generator stops ramping after closing of breaker to pre-heat the engine before commencing to take load. The time duration of the point is determined by the delay time setting. If the delay function is not needed, set the time to 0.

Power % settings relate to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2070	Power ramp up	Selection display	-	-	-
2071	Power ramp up	Speed	1.0%/s	20.0%/s	2.0%/s
2072	Power ramp up	Delay point	1.0%	100.0%	10.0%
2073	Power ramp up	Delay time	0.0 s	180.0 s	10.0 s

Power ramp down

The breaker open point is where a relay output (relay 4) is activated to open the generator breaker before reaching 0 kW.

Power % settings relate to nominal generator power.

No.	Setting		Min. setting	Max. setting	Factory setting
2080	Power ramp down	Selection display	-	-	-
2081	Power ramp down	Speed	1.0%/s	20.0%/s	10.0%/s
2082	Power ramp down	Breaker open	1.0%	20.0%	5.0%

Power / frequency control mix factor

The mix factor determines the relation between frequency control and power control when running parallel with other generators (load sharing). The reason for the factor is that there is only one power / frequency load sharing line.

Setting the factor to 100% selects power control only, setting it to 0% selects frequency control only.

No.	Setting		Min. setting	Max. setting	Factory setting
2090	P/f contr. mix.	Selection display	-	-	-
2091	P/f contr. mix.	Mix factor	0.0%	100.0%	50.0%

Voltage controller option D

The ON / integral time is a combined setting. If relay voltage control setting is used, the setting indicates the shortest relay ON time. If the voltage control setting is analogue output (option E), the setting is for the PI controller integral time.

Voltage deadband % settings relate to nominal generator voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
2100	Voltage control	Selection display	-	-	-
2101	Voltage control	Deadband	0.0%	10.0%	2.0%
2102	Voltage control	Gain	1	100	40
2103	Voltage control	ON / Integr. time	10 ms	3000 ms	100 ms

var controller option D

The ON / integral time is a combined setting. If relay var control setting is used, the setting indicates the shortest relay ON time. If the var control setting is analogue output (option E), the setting is for the PI controller integral time.

var deadband % settings relate to nominal generator power value, i.e. it is assumed that the generator var value is the same as the kW value. This is not correct but the assumption is made for control purposes only.

No.	Setting		Min. setting	Max. setting	Factory setting
2110	var control	Selection display	-	-	-
2111	var control	Deadband	0.0%	10.0%	2.0%
2112	var control	Gain	1	100	40
2113	var control	ON / Integr. Time	10 ms	3000 ms	100 ms

var / voltage control mix factor

The mix factor determines the relation between voltage control and var control when running parallel with other generators (load sharing). The reason for the factor is that there is only one var / voltage load sharing line.

Setting the factor to 100% selects var control only setting it to 0% selects voltage control only.

No.	Setting		Min. setting	Max. setting	Factory setting
2120	var/U contr. mix.	Selection display	-	-	-
2121	var/U contr. mix.	Mix factor	0.0%	100.0%	50.0%

Power Factor (PF) controller option D

The ON / integral time is a combined setting. If relay PF control setting is used, the setting indicates the shortest relay ON time. If the PF control setting is analogue output (option E), the setting is for the PI controller integral time.

PF deadband is the zone (+/- value) around PF setting value where the relay output does not operate. The value is disregarded if analogue PF control output is used.

No.	Setting		Min. setting	Max. setting	Factory setting
2130	PF control	Selection display	-	-	-
2131	PF control	Deadband	0.00	0.10	0.05
2132	PF control	Gain	1	100	40
2133	PF control	ON / Integr. Time	10 ms	3000 ms	100 ms

Power setup

Load dependent start/stop of next generator option G

The relay outputs for start next and stop next are placed in the loadsharing board in slot #3. The PPU cannot decide what generator to start/stop. This must be handled externally.

Start next generator: Relay 8, terminals 61-62, normally open.

No.	Setting		Min. setting	Max. setting	Factory setting
3010	Start next gen.	Selection display	-	-	-
3011	Start next gen.	Start point	0.0%	150.0%	80.0%
3012	Start next gen.	Timer	0.0 s	100.0 s	10.0 s
3013	Start next gen.	Enable	OFF	ON	ON

Stop next generator: Relay 9, terminals 63-64, normally open.

No.	Setting		Min. setting	Max. setting	Factory setting
3020	Stop next gen.	Selection display	-	-	-
3021	Stop next gen.	Stop point	0.0%	50.0%	20.0%
3022	Stop next gen.	Timer	0.0 s	200.0 s	30.0 s
3023	Stop next gen.	Enable	OFF	ON	ON

System setup

Nominal settings

No.	Setting		Min. setting	Max. setting	Factory setting
4010	Nominal settings	Selection display	-	-	-
4011	Nominal settings	Frequency	48.0 Hz	62.0 Hz	60.0 Hz
4012	Nominal settings	Generator Power	10 kW	99 MW	100 kW
4013	Nominal settings	Generator current	0 A	9000 A	787 A
4014	Nominal settings	Generator volt	100 V	25000 V	110 V

Transformer

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

No.	Setting		Min. setting	Max. setting	Factory setting
4020	Transformer	Selection display	-	-	-
4021	Transformer	Volt prim	100 V	25000 V	110 V
4022	Transformer	Volt sec	100 V	690 V	110 V
4023	Transformer	Current prim	5 A	9000 A	1000 A
4024	Transformer	Current sec	1 A	5 A	5A

Controller settings

The setting values are used if external set-point or serial communication set-point is not chosen.

Power setting relates to generator nominal power (kW).
Var setting is inductive reactive power and relates to generator nominal power (kW ~kvar)
Power factor setting is inductive value.

No.	Setting		Min. setting	Max. setting	Factory setting
4030	Controller	Selection display	-	-	-
4031	Controller	Power	0.0%	100.0%	100.0%
4032	Controller	var	0.0%	100.0%	30.0%
4033	Controller	Power factor (ind)	0.60	1.00	0.90

Communication control enable / disable control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4040	Comm. control	Selection display	-	-	-
4041	Comm. control	Power	OFF	ON	OFF
4042	Comm. control	Frequency	OFF	ON	OFF
4043	Comm. control	Voltage	OFF	ON	OFF
4044	Comm. control	var	OFF	ON	OFF
4045	Comm. control	PF	OFF	ON	OFF
4046	Comm. control	Mode selections	OFF	ON	OFF

Note: Selecting Communication control ON will overrule external and internal settings.

External communication control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4050	External comm.	Selection display	-	-	-
4051	External comm.	ID	1	247	1
4052	External comm.	19200 Baud	OFF	ON	OFF

External communication control (option H)

No.	Setting		Min. setting	Max. setting	Factory setting
4090	External comm. error	Selection display	-	-	-
4091	External comm. error	Delay	1.0 s	100.0 s	10.0 s
4092	External comm. error	Relay output A	R0 (None)	R4 (relay 4)	R1 (relay 1)
4093	External comm. error	Relay output B	R0 (None)	R4 (relay 4)	R0 (None)
4094	External comm. error	Enable	OFF	ON	OFF

Date and time (internal clock) setting

No.	Setting		Min. setting	Max. setting	Factory setting
4100	Date and time	Selection display	-	-	-
4101	Date and time	Year	These settings have no practical limit. Factory settings will be present date and time in Denmark when produced.		
4102	Date and time	Month			
4103	Date and time	Date			
4104	Date and time	Hour			
4105	Date and time	Minute			

Auto detection of running signal

No.	Setting		Min. setting	Max. setting	Factory setting
4110	Auto detection run	Selection display	-	-	-
4111	Auto detection run	Auto det. run	OFF	ON	OFF

The voltage and frequency alarms of the generator are inhibited when the measurements are under 30% of the nominal values.

Battery undervoltage alarm

No.	Setting		Min. setting	Max. setting	Factory setting
4220	Battery low V	Selection display	-	-	-
4221	Battery low V	Set-point	15.0 V	24.0 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)	R4 (relay 4)	R0 (no relay)
4224	Battery low V	Relay output B	R0 (None)	R4 (relay 4)	R0 (no relay)
4225	Battery low V	Enable	OFF	ON	ON

Language

No.	Setting		Setting	Factory setting
4230	Language	Selection display	-	-
4231	Language	English German French Spanish	1 2 3 4	1 1 1 1

Analogue output option F1/F2

The analogue output options each consist of two independent 0(4)…20 mA outputs. Re-configured hardware can enable a –20…0…+20 mA output, but this is special.

Each of the two outputs can be chosen to represent any of the following values.

Power (P kW) output

No.	Setting		Min. setting	Max. setting	Factory setting
4500	Power output	Selection display	-	-	-
4501	Power output	Analogue out no.	0	2	0
4502	Power output	Type	0-20 mA	4-20 mA	4-20 mA
4503	Power output	Max. value	0 kW	99 MW	500 kW
4504	Power output	Min. value	-99 MW	99 MW	0 kW

Apparent Power (S kVA) output

No.	Setting		Min. setting	Max. setting	Factory setting
4510	S output	Selection display	-	-	-
4511	S output	Analogue out no.	0	2	0
4512	S output	Type	0-20 mA	4-20 mA	4-20 mA
4513	S output	Max. value	0 kVA	99 MVA	600 kVA
4514	S output	Min. value	-99 MVA	99 MVA	0 kVA

Reactive Power (Q kvar) output

No.	Setting		Min. setting	Max. setting	Factory setting
4520	React. power output	Selection display	-	-	-
4521	React. power output	Analogue out no.	0	2	0
4522	React. power output	Type	0-20 mA	4-20 mA	4-20 mA
4523	React. power output	Max. value	0 kvar	99 Mvar	400 kvar
4524	React. power output	Min. value	-99 Mvar	99 Mvar	0 kvar

Power factor (PF) output

No.	Setting		Min. setting	Max. setting	Factory setting
4530	Power factor output	Selection display	-	-	-
4531	Power factor output	Analogue out no.	0	2	0
4532	Power factor output	Type	0-20 mA	4-20 mA	4-20 mA
4533	Power factor output	Max. value	0.6	1.0	0.8
4534	Power factor output	Min. value	-0.6	1.0	-0.8

Frequency output

No.	Setting		Min. setting	Max. setting	Factory setting
4540	Frequency output	Selection display	-	-	-
4541	Frequency output	Analogue out no.	0	2	0
4542	Frequency output	Type	0-20 mA	4-20 mA	4-20 mA
4543	Frequency output	Max. value	0 Hz	70 Hz	55 Hz
4544	Frequency output	Min. value	0 Hz	70 Hz	45 Hz

Voltage output

The voltage output represents the L1-L2 voltage.

No.	Setting		Min. setting	Max. setting	Factory setting
4550	Voltage output	Selection display	-	-	-
4551	Voltage output	Analogue out no.	0	2	0
4552	Voltage output	Type	0-20 mA	4-20 mA	4-20 mA
4553	Voltage output	Max. value	0 V	28000 V	500 V
4554	Voltage output	Min. value	0 V	28000 V	0 V

Current output

The current output represents the L1 current

No.	Setting		Min. setting	Max. setting	Factory setting
4560	Current output	Selection display	-	-	-
4561	Current output	Analogue out no.	0	2	0
4562	Current output	Type	0-20 mA	4-20 mA	4-20 mA
4563	Current output	Max. value	0 A	9000 A	1000 A
4564	Current output	Min. value	0 A	9000 A	0 A

User password

The user password can only be entered using the "JUMP" push-button.

No.	Setting		Min. setting	Max. setting	Factory setting
4976	User password	Setting	0	32000	2000

Service menu

The service menu can only be entered using the "JUMP" push-button.

No.	Setting		Description
4980	Service menu	Selection display	
4981	Service menu	Alarm	Shows remaining time
4982	Service menu	Digital input	Shows input status
4983	Service menu	Digital output	Shows output status

General data

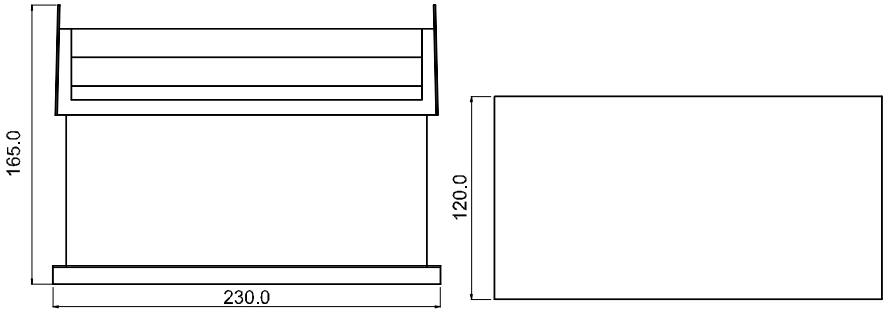
Technical specifications

Accuracy:	Class 1.0 acc. to IEC 688
Operating temp.:	-25…70 °C
Aux. supply:	24 VDC -25 / +30%
Measuring voltage:	100…690 VAC
Frequency:	30…70 Hz
Measuring current:	From current transformers ../1 A or ../5A. Load max. 0.3 VA per phase.
Binary inputs:	Input voltage 12…32 VDC, impedance 2.4 kΩ, bi-directional.
Open collector outputs :	Supply voltage 12…32 VDC. Load max. 10 mA
Load sharing lines:	+/- 5 VDC
Analog inputs:	+/- 10 VDC, impedance 100 kΩ (not galvanically separated).
Relay outputs:	250V/8A or 24VDC/1A. Refer to actual description of I/O's.
Safety:	To EN 61010-1 Installation category (overvoltage category) III, 600V, pollution degree 2.
Galvanic separation:	Between AC voltage, AC current and other I/O's: 3250VAC – 50 Hz – 1 min. Between analogue outputs: 500VDC – 1 min.
EMC / CE:	Acc. to EN-50081-1/2, EN 50082-1/2, SS4361503 (PL4) and IEC 255-3.
Type approval:	DNV, GL, LR and ABS for use in unmanned machinery space.
Material:	All plastic parts are self-extinguishing to UL94 (V1).
Climate:	HSE, to DIN 40040.
Connections:	4 mm^2 multi stranded for AC currents, all others 2.5 mm^2 multi stranded.
Response times:	From the setpoint is reached till the output is activated and the delay set to 0.

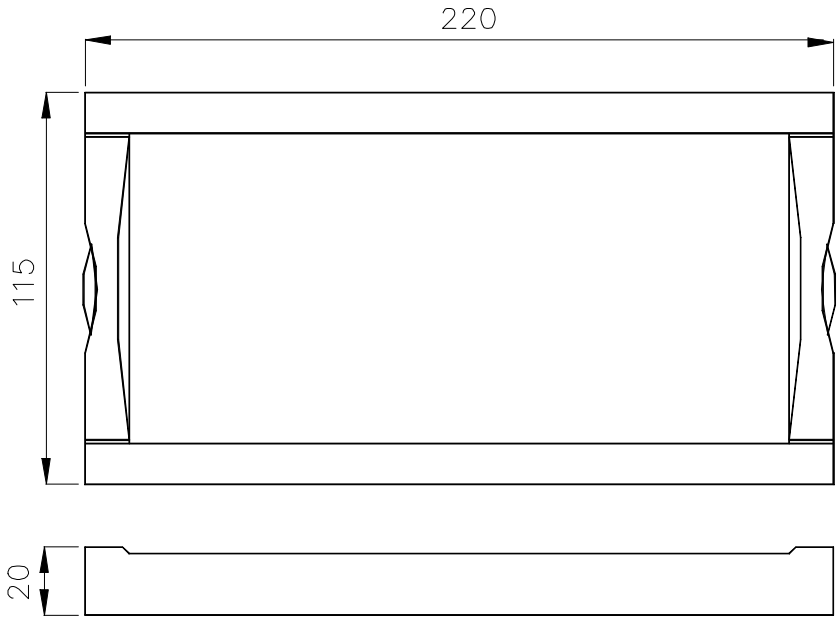
Busbar 1:	Over/under voltage	<20 ms
	Over/under frequency	<20 ms
Generator and busbar 2:	Over/under voltage	70-150 ms
	Over/under frequency	70-150 ms

Response times, cont.:	Current:	100-160 ms
	Rocof:	100 ms (4 periods)
	Vector jump:	30 ms
Protection:	Case: IP40. Terminals: IP20. Operator panel: IP52 (IP54 when mounted with gasket). To IEC 529 and EN 60529.	
Mounting:	Base mounted with six screws or DIN rail mounted. If DIN rail mounted in marine applications, additional means against excessive mechanical vibrations must be used.	

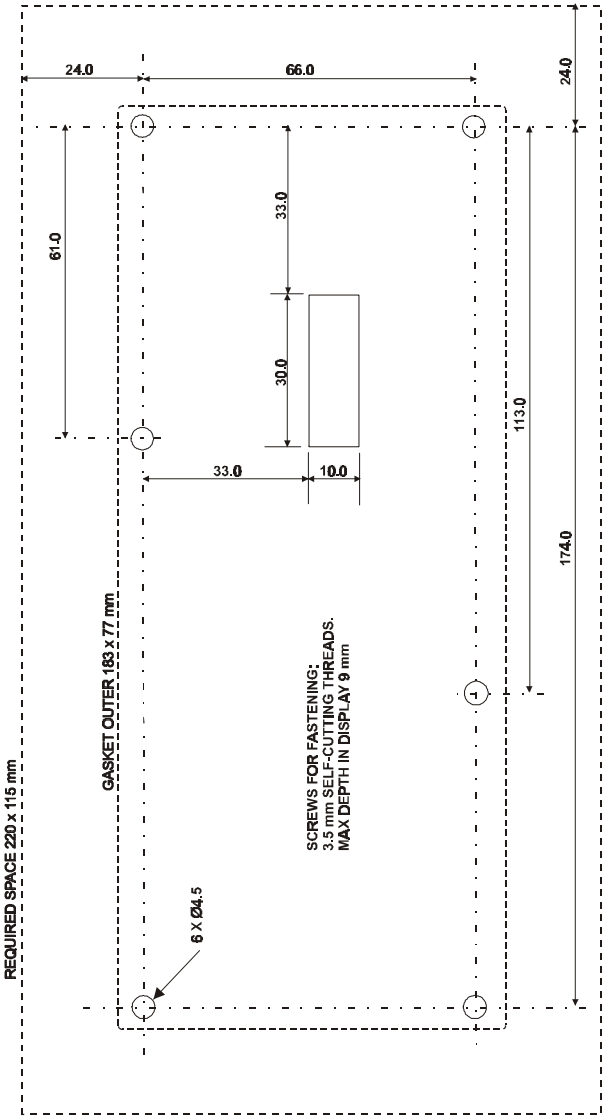
Unit Dimensions



Display dimensions



Panel cutout for display



Errors and changes excepted