PPU 300

4189341207B

Converting PPU-2 to PPU 300

Application notes

Improve Tomorrow

1. General information

2. Application and installation

1. General information

1.1 Warnings, legal information and safety

1.1.1 Warnings and notes

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

Warnings

DANGER!
This highlights dangerous situations. If the guidelines are not followed, these situations could result in death, serious personal injury, and equipment damage or destruction.

CAUTION
This highlights potentially dangerous situations. If the guidelines are not followed, these situations could result in personal injury or damaged equipment.

Notes

INFO
Notes provide general information, which will be helpful for the reader to bear in mind.

1.1.2 Legal information and disclaimer

DEIF takes no responsibility for installation or operation of the generator set or switchgear. If there is any doubt about how to install or operate the engine/generator or switchgear controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the equipment must be contacted.

NOTE The Multi-line 2 unit is not to be opened by unauthorised personnel. If opened anyway, the warranty will be lost.

Disclaimer

DEIF A/S reserves the right to change any of the contents of this document without prior notice.

The English version of this document always contains the most recent and up-to-date information about the product. DEIF does not take responsibility for the accuracy of translations, and translations might not be updated at the same time as the English document. If there is a discrepancy, the English version prevails.

1.1.3 Safety issues

Installing and operating the Multi-line 2 unit may imply work with dangerous currents and voltages. Therefore, the installation should only be carried out by authorised personnel who understand the risks involved in working with live electrical equipment.

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

1.1.4 Electrostatic discharge awareness

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

1.1.5 Factory settings

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

1.2 About the Application Notes

1.2.1 General purpose

This document includes application notes for DEIF's Multi-line 2 unit. It mainly includes examples of different applications suitable for the unit.

INFO
For functional descriptions, the procedure for parameter setup, parameter lists, and so on, see the Designer's Reference Handbook.

The general purpose of the application notes is to offer the designer information about suitable applications for the Multi-line 2 unit.

DANGER!
Make sure to read this document before starting to work with the Multi-line 2 unit and the genset to be controlled. Failure to do this could result in human injury or damage to the equipment.

1.2.2 Intended users

The Application Notes are mainly intended for the person responsible for designing Multi-line 2 systems. In most cases, this would be a panel builder designer. Naturally, other users might also find useful information in this document.

2. Application and installation

2.1 About the application

2.1.1 General description

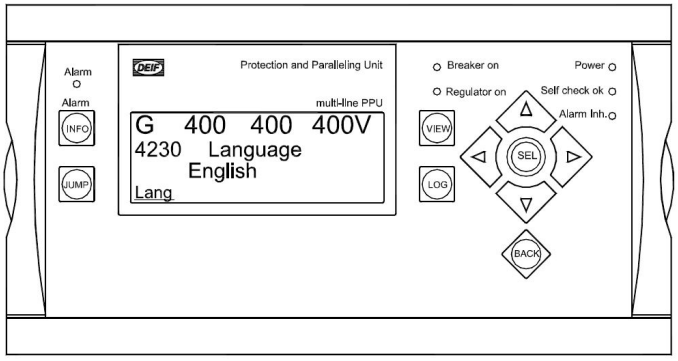
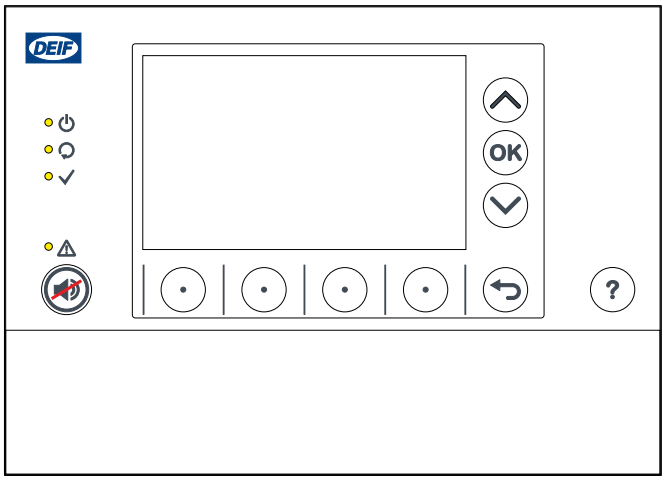
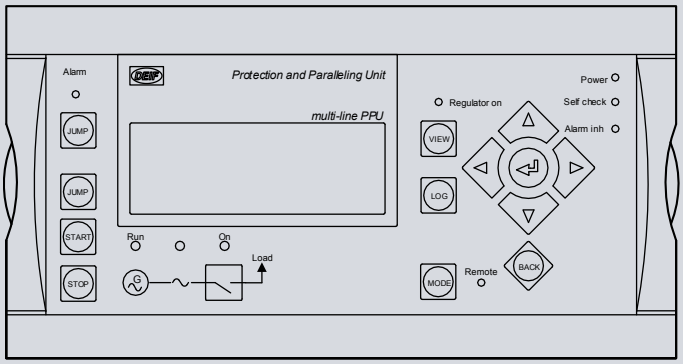
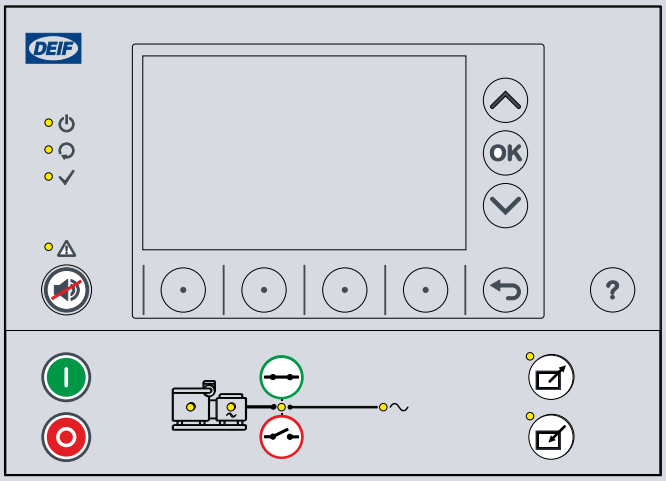
This document includes general information on how to upgrade a standard PPU-2 to a standard PPU 300 system, including mounting instructions and wiring descriptions, parameter and general standard conversions.

The general purpose of this document is to help the user with the first steps of upgrading a standard paralleling & protection unit (PPU) system.

DEIF A/S always recommends to create a full backup parameter file before the old unit is powered down.

2.1.2 Converting the display

The table below shows an overview of standard displays and the options for converting the displays.

PPU-2	PPU 300
Standard display 	Optional display 
With engine control 	With engine and breaker control 

More information
See the **PPU-2 Designer's reference handbook** and the **PPU 300 Designer's handbook** for more information.

2.1.3 Description of options

The unit housing is divided into board slot positions. This means that the unit consists of a number of printed circuit boards (PCB´s) mounted in slots numbered 1 to 8. Some of these board slots are standard and some are intended for options. The board slot positions are arranged as illustrated below.

Figure 2.1 Hardware overview PPU-2

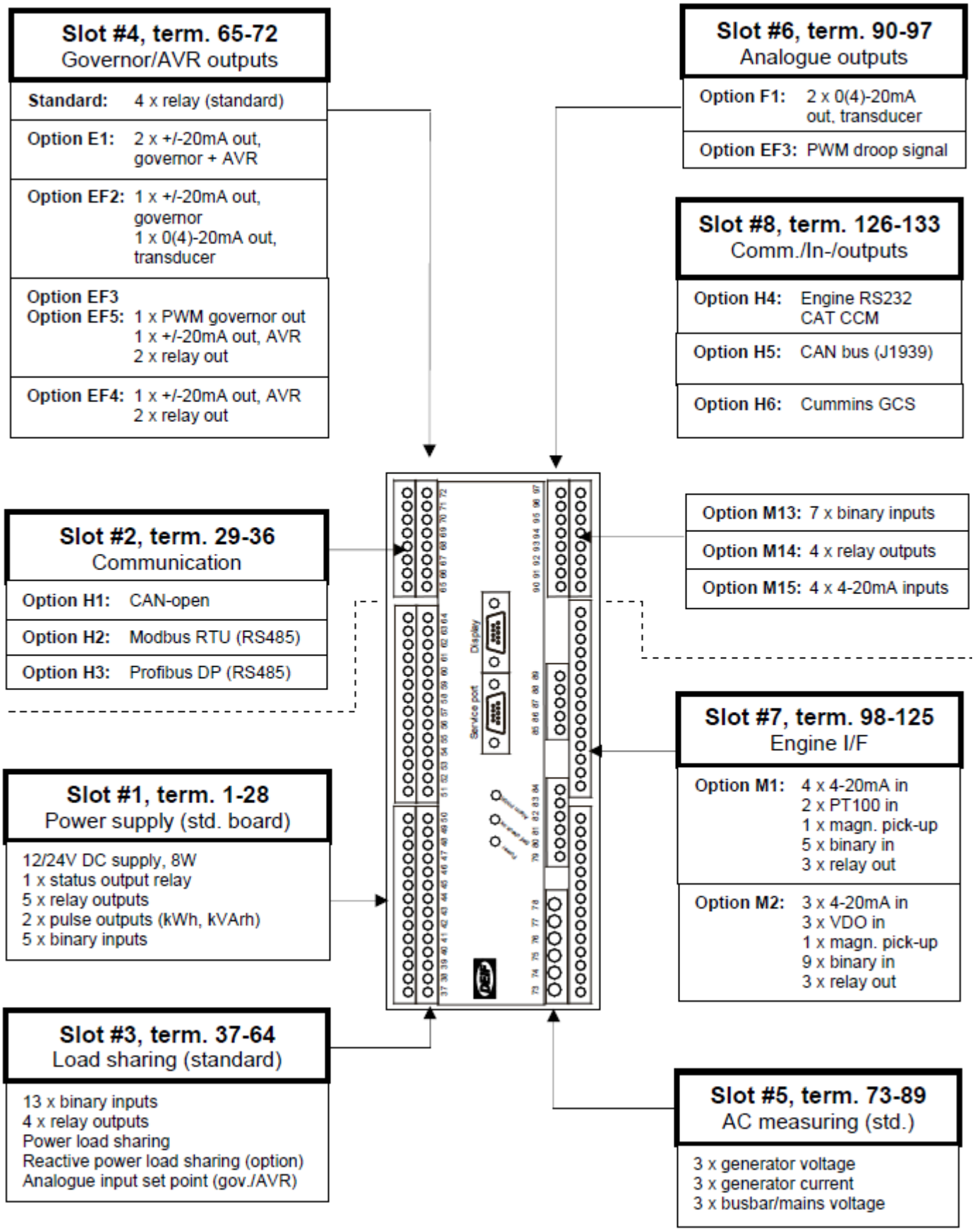


Table 2.1 Overview of the PPU-2 options, and conversion to PPU 300

PPU-2	Description	PPU 300	Option type
Option A1	Vector jump and df/dt (ROCOF) Over-/under-voltage (generator and busbar) Time-dependent under-voltage Reactive power-dependent under-voltage	NA	
Option A2	Df/dt (ROCOF) Over-/under-voltage (generator and busbar) Over-/under-frequency (generator and busbar)	NA	
Option A3	Vector jump Over-/under-voltage (generator and busbar) Over-/under-frequency (generator and busbar)	NA	
Option B1	Over-/under-voltage (generator and busbar) Over-/under-frequency (generator and busbar)	Standard	Software
Option C1	Over-/under-voltage (generator) Over-/under-frequency (generator) Overload Fast over-current (<42 ms, 350 %, 2 levels) Current/voltage unbalance Reactive power import (excitation loss) Reactive power export (over-excitation)	Standard	Software
Option C2	Negative seq. voltage/current Zero Seq. voltage/current Power-dependent reactive power import/export Inverse time over-current	Standard	Software
Option D1	Voltage/VAr/cos phi control / Q-loadsharing	Standard	Software/ Hardware
Option E1	+/-25 mA for speed governor +/-25 mA for AVR	GAM3.1	Hardware
Option EF2	+/-25 mA for speed governor 1 x 0(4) 20 mA transducer output	GAM3.1	Hardware
Option EF3	1 x PWM (Pulse Width Modulated) output for CAT speed governor 1 x PWM (Pulse Width Modulated) output for droop +/-20 mA for speed governor or AVR 2 x relay outputs for speed governor or AVR	GAM3.1	Hardware
Option EF4	+/-25 mA for speed governor or AVR 2 x relay outputs for speed governor or AVR	GAM3.1	Hardware
Option F1	2 x 0(4) to 20 mA transducer out	GAM3.1	Hardware
Option F2 (GPU)	4 x 0(4) to 20 mA transducer out	GAM3.1	Hardware
Option G1	Start/stop of next DG outputs	NA	Software
Option H1	CANopen	N/A	Hardware
Option H2	Modbus	Standard	Hardware
Option H3	Profibus	NA	Hardware
Option H4	CAT CCM	NA	Hardware
N/A	Reading of J1939 values	NA	Hardware
N/A	Cummins GCS	NA	Hardware
N/A	Engine communication - CAN bus J1939	NA	Hardware
N/A	CAN bus interface for external I/O modules (Beckhoff) in slot #2 or slot #8	NA	Hardware

PPU-2	Description	PPU 300	Option type
N/A	Modbus RTU/ASCII (RS-232) and GSM modem connection	NA	Hardware
Option J1	Display cable, 3 m	Standard	Hardware
Option J2	Display cable, 6 m	NA	Hardware
Option J3	PC cable for utility software (RS-232)	NA	Hardware
NA	PC cable for option N-programming	NA	Hardware
NA	Display cable, 1 m	NA	Hardware
NA	PC cable for utility software (USB), 1 m	NA	Hardware
Option M1 or M2	Engine control and protection. Configurable I/O's. 13 inputs, 4 outputs.	EIM3.1	Hardware
Option M13	7 digital inputs in slot #8	Standard	Hardware
Option M14	4 relay outputs in slot #8	Standard	Hardware
Option M15	4 analogue inputs in slot #8	GAM3.1 / EIM3.1	Hardware
N/A	Modbus TCP/IP	Standard	Hardware
N/A	Verified class 0.5	Standard	Hardware
N/A	Additional standard display on CAN bus	NA	Hardware
N/A	Additional Operator Panel (AOP-1)	NA	Hardware
N/A	Additional Operator Panel (AOP-2)	NA	Hardware

2.2 Installation and parameter setup

2.2.1 Wiring installation

The table below shows an overview of the terminals on PPU-2 and PPU 300. Only standard PCBs and Option H2 are shown below. Contact DEIF support if you have installed other options in the PPU-2, and you need help to wire these. Some inputs and outputs might not be available in PPU 300.

Each PPU 300 controller type is delivered with inputs and outputs already configured according the default configuration.

Figure 2.2 PPU 300 topside overview

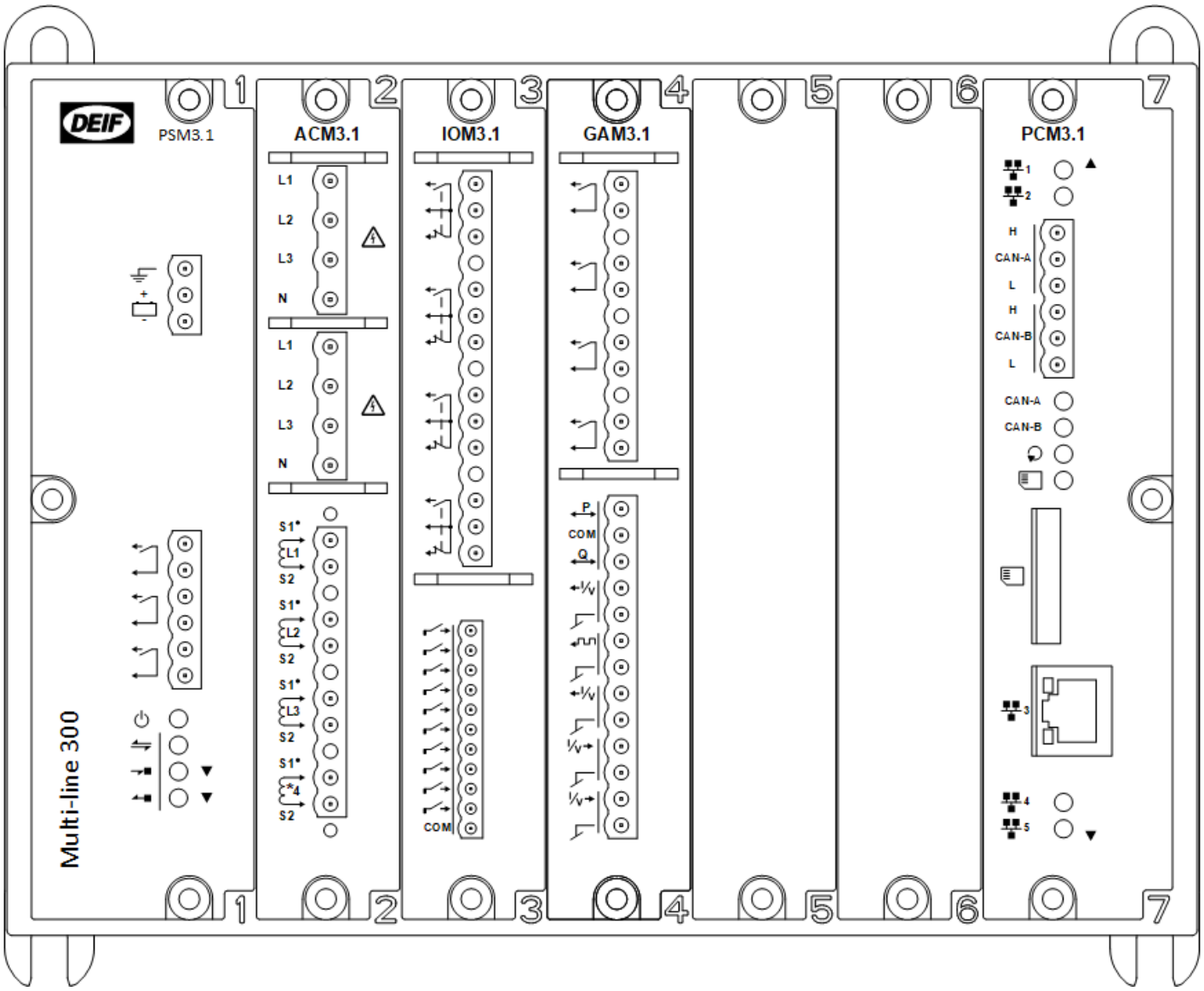


Figure 2.3 PPU-2 topside overview

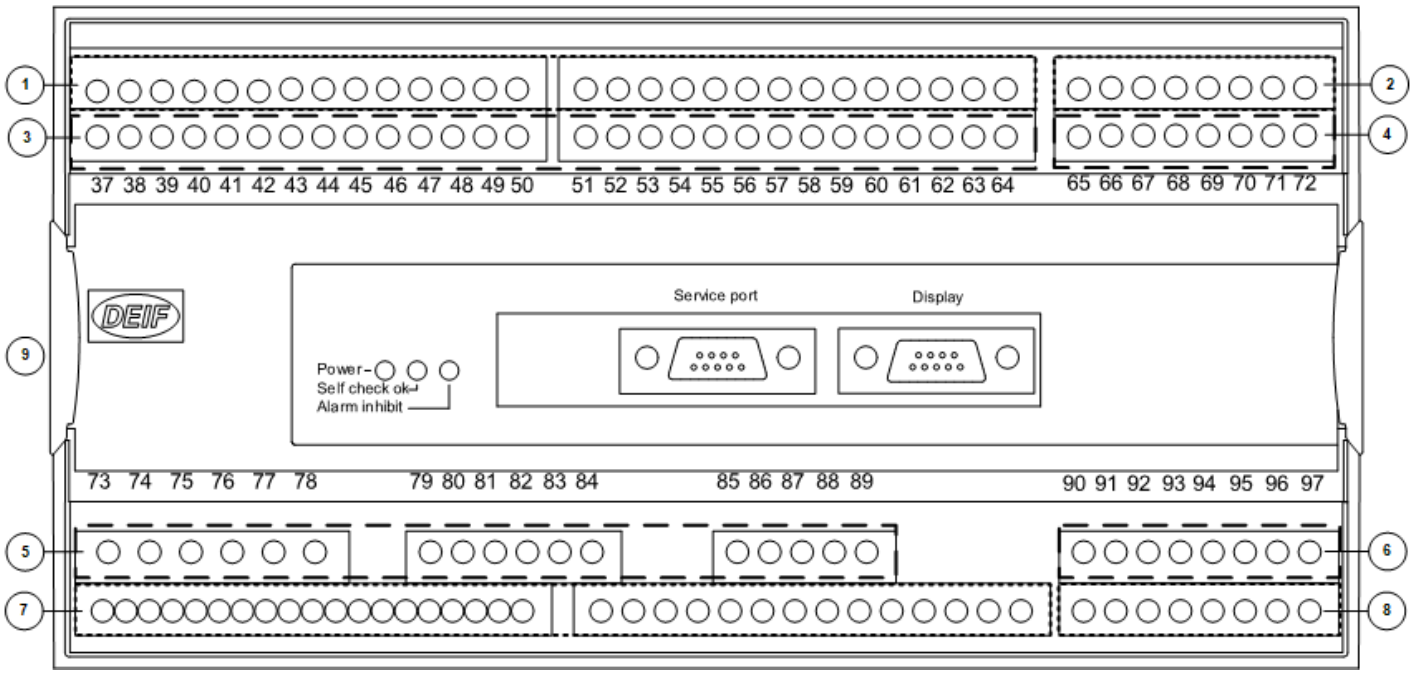


Table 2.2 PPU-2 Slot #1, Power supply PCB

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
1	Power supply	24 V DC (+)	PSM 3.1 term. 1	24 V DC (+)	Power supply module
2	Power supply	0 V DC (-)	PSM 3.1 term. 2	0 V DC (-)	Power supply module
3 4	Relay (NO) Common	Status relay	PSM 3.1 term 3 + 4	Relay	Alarm > Status OK
5 6 7	NO Common Relay NC	Relay 1	IOM 3.1	Configurable Digital output	
8 9 10	NO Common NC	Relay 2	IOM 3.1	Configurable Digital output	
11 12 13	NO Common NC	Relay 3	IOM 3.1	Configurable Digital output	
14 15 16	NO Common NC	Relay 4 (Open breaker)	IOM 3.1 term. 1+2+3	Configurable Digital output	[Breaker] > Control > [Open] (Configurable)
17 18 19	NO Common NC	Sync relay (Close breaker)	IOM 3.1 term. 4+5+6	Configurable Digital output	[Breaker] > Control > [Close] (Configurable)
20	Transistor output	Open collector 1	IOM 3.4	Configurable Digital output	Hardware option
21	Transistor output	Open collector 2	IOM 3.4	Configurable Digital output	Hardware option

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
22	Transistor output	Common for terminals 20 and 22	IOM 3.4 term. 23	COMMON (Term. 13-22)	Hardware option
23	Digital input	Alarm inhibit	IOM 3.1	Configurable Digital Input	
24	Digital input	Remote alarm acknowledge	IOM 3.1	Configurable Digital Input	
25	Digital input	Configurable	IOM 3.1	Configurable Digital Input	
26	Digital input	Configurable	IOM 3.1	Configurable Digital Input	
27	Digital input	Configurable	IOM 3.1	Configurable Digital Input	
28	Common	Common for terminals 23-27	IOM 3.1 term. 23	Common for terminals 23-27	

Table 2.3 PPU-2 Slot #2, Communication (Option H2)

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
29 30 31	Modbus RTU RS-485 (Option H2)	DATA + DATA GND DATA -		NA	Modbus is only available on TCP/IP

Table 2.4 PPU-2 Slot #3, Load sharing

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
37 38 39	Load sharing	Active (P) loadsharing Common Reactive (Q) loadsharing	GAM 3.1 term. 9 (P) term. 10 (Common) term 11 (Q)		
40 41 42	External f/P setpoint	f/P setpoint Common PF/var/V setpoint	IOM 3.1	Configurable Digital Input	
43	Deload	Digital input	IOM 3.1	Configurable Digital Input	
44	Manual GOV up	Digital input	IOM 3.1	Configurable Digital Input	
45	Manual GOV down	Digital input	IOM 3.1	Configurable Digital Input	
46	Manual AVR up	Digital input	IOM 3.1	Configurable Digital Input	
47	Manual AVR down	Digital input	IOM 3.1	Configurable Digital Input	

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
48	Mode 1	Digital input	IOM 3.1	Configurable Digital Input	
49	Mode 2	Digital input	IOM 3.1	Configurable Digital Input	
50	Mode 3	Digital input	IOM 3.1	Configurable Digital Input	
51	Mode 4	Digital input	IOM 3.1	Configurable Digital Input	
52	Mode 5	Digital input	IOM 3.1	Configurable Digital Input	
53	Mode 6	Digital input	IOM 3.1	Configurable Digital Input	
54	CB Open	Digital input	IOM 3.1	Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ)	[Breaker] > Feedback > [Open] (Configurable)
55	CB Closed	Digital input	IOM 3.1	Digital input (OFF: 0 to 2 V DC, ON: 8 to 36 V DC, Impedance: 4.7 kΩ)	[Breaker] > Feedback > [Closed] (Configurable)
56	Common for term. 43-55	Common	IOM 3.1	Common	
57 58	Relay NO	Relay 5	IOM 3.1	Configurable Digital output	
59 60	Relay NO	Relay 6	IOM 3.1	Configurable Digital output	
61 62	Relay NO	Relay 7	IOM 3.1	Configurable Digital output	
63 64	Relay NO	Relay 8	IOM 3.1	Configurable Digital output	

Table 2.5 PPU-2 Slot #4, GOV/AVR outputs

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
65 66	GOV control	GOV UP	GAM 3.1	Configurable	Regulators > Governor > GOV increase (Configurable)
67 68	GOV control	GOV DOWN	GAM 3.1	Configurable	Regulators > Governor > GOV decrease (Configurable)
69 70	AVR control (Option D1)	AVR UP	GAM 3.1	Configurable	
71 72	AVR control (Option D1)	AVR DOWN	GAM 3.1	Configurable	

Table 2.6 PPU-2 Slot #5, AC measuring

Terminal(s) PPU-2	General description	Terminal description PPU-2	Terminal PPU 300	Terminal description PPU 300	Note
73 + 74	I1	Current meas.	ACM 3.1 term. 9 + 10	Current meas.	[Source] L1
75 + 76	I2	Current meas.	ACM 3.1 term. 11 + 12	Current meas.	[Source] L2
77 + 78	I3	Current meas.	ACM 3.1 term. 13 + 14	Current meas.	[Source] L3
79	U1	Volt. meas. Gen	ACM 3.1 term. 5	Volt. meas. Gen	[Source] L1
81	U2	Volt. meas. Gen	ACM 3.1 term. 6	Volt. meas. Gen	[Source] L2
83	U3	Volt. meas. Gen	ACM 3.1 term. 7	Volt. meas. Gen	[Source] L3
85	U1	Volt. meas. BB	ACM 3.1 term. 1	Volt. meas. BB	[Source] L1
87	U2	Volt. meas. BB	ACM 3.1 term. 2	Volt. meas. BB	[Source] L2
89	U3	Volt. meas. BB	ACM 3.1 term. 3	Volt. meas. BB	[Source] L3

2.2.2 Parameter settings - system setup

The PC utility software is used for configuration. Utility Software 1.xx is for PPU-2 and PICUS is for PPU 300. The utility software can be downloaded at www.deif.com.

To replace a PPU-2 with a PPU 300, you must back up all the settings from the PPU-2. You must then manually set up the same parameters in the PPU 300 using the utility software. See how to back up settings from the PPU-2 in the **ML-2 application notes Getting started USW 1x**, which can be downloaded at www.deif.com.

CAUTION
Back up the PPU-2 parameters before powering down the unit. Due to the unit and backup battery age, the parameters could be reset to the factory setup after powering down the controller.

The table below shows a direct conversion of the parameters that include nominal settings.

Table 2.7 Nominal settings

Parameter PPU-2	Description	Address	Unit	Parameter PPU 300	Description	Unit
4010 Nominal Settings						
4011	Nom. frequency	182	Hz	Configure > Parameters > Generator Nominal settings	Nom. f (1)	Hz
4012	Nom. power	183	kW	Configure > Parameters > Generator Nominal settings	Nom. P (1)	kW
4013	Nom. current	184	A	Configure > Parameters > Generator Nominal settings	Nom. I (1)	A
4014	Nom. voltage	185	V	Configure > Parameters > Generator Nominal settings	Nom. U (1)	V

Parameter PPU-2	Description	Address	Unit	Parameter PPU 300	Description	Unit
N/A				Configure > Parameters > Engine > Nominal settings	Nom. RPM (1)	RPM
4020 Transformer generator						
4021	Volt. prim. GEN	186	V	Configure > Parameters > Generator > AC setup	G primary U	V
4022	Volt. sec. GEN	187	V	Configure > Parameters > Generator > AC setup	G secondary U	V
4023	Current prim.	188	A	Configure > Parameters > Generator > AC setup	G primary I	A
4024	Current sec.	189	A	Configure > Parameters > Generator > AC setup	G secondary I	A
4030 Transformer busbar						
4031	Volt. prim. BUS	190	V	Configure > Parameters > Busbar > AC setup	BB primary U1	V
4032	Volt. sec. BUS	191	V	Configure > Parameters > Busbar > AC setup	BB secondary U1	V
4033	Nom. volt. BUS	421	V	Configure > Parameters > Busbar > AC setup	BB nominal U1	V

2.2.3 Parameter setup - regulator governor

The table below illustrates the difference in the regulator parameter setup. In the PPU 300, the possibility to adjust the differential band in the regulator has been added.

Table 2.8 Parameter setup - Digital Governor regulator

Parameter PPU-2	Descriptions	Address	Parameter PPU 300	Description
Parameter setup regulator governor				
2122	Freq. control Kp	92	Configure > Parameters > Regulators > GOV analogue configuration > Frequency synchronisation	f Kp
2123	Freq. control Ki	93	Configure > Parameters > Regulators > GOV analogue configuration > Frequency synchronisation	f Ti
2132	Power control Kp	15	Configure > Parameters > Regulators > GOV analogue configuration > Frequency synchronisation	P kP
2133	Power control Ki	50	Configure > Parameters > Regulators > GOV analogue configuration > Frequency synchronisation	f deadband

2.2.4 Parameter setup - relay or analogue governor

If the PPU-2 uses analogue regulation, it requires an analogue option card (for example, Option E1).

By default, the PPU 300 is set up for relay regulation. It is possible to change between relay and analogue governor setup. You must assign the outputs under **Configure > Input/Output**. Select the hardware module and select a digital (DO) or analogue (AO) output to configure. Most of the controller inputs and outputs can be assigned any function. Most functions are not restricted to specific hardware modules. For example, governor and AVR control functions can use any inputs and outputs, and do not have to use the inputs and outputs on the Governor and AVR module (GAM3.1). The Governor and AVR module has terminals for analogue load sharing. It also has four relay outputs, two analogue outputs, a pulse width modulation output and two analogue inputs.

Table 2.9 Relay or analogue governor setup

Parameter PPU-2	Description	Address	Parameter PPU 300	Description
Relay / Analogue Governor Setup				
NA	NA	NA	Configure > Input/Output	Relay or Analogue

To configure the governor in PPU 300, go to **Configure > Parameters > Regulators > GOV general configuration** and configure the **Output type**.

2.2.5 Parameter setup - governor relay

The PPU-2 standard unit controls the Governor using the relay output terminals 65-68, slot #4. These are not configurable.

The PPU 300 standard unit controls the Governor on relay output GAM3.1, Slot #5, terminals 1-4. These are fully configurable.

The table below shows the differences in the standard parameter settings.

Table 2.10 Parameter setup - Governor relay

Parameter PPU-2	Description	Address	Value	Parameter PPU 300	Description
2251	GOV min ON time	121	ms	Configure > Parameters > Regulators > Gov relay configuration	ms
2252	GOV period time	122	ms	Configure > Parameters > Regulators > Gov relay configuration	ms

2.2.6 Synchronisation setup

The table below shows which parameters to configure for synchronisation.

Table 2.11 Synchronisation setup

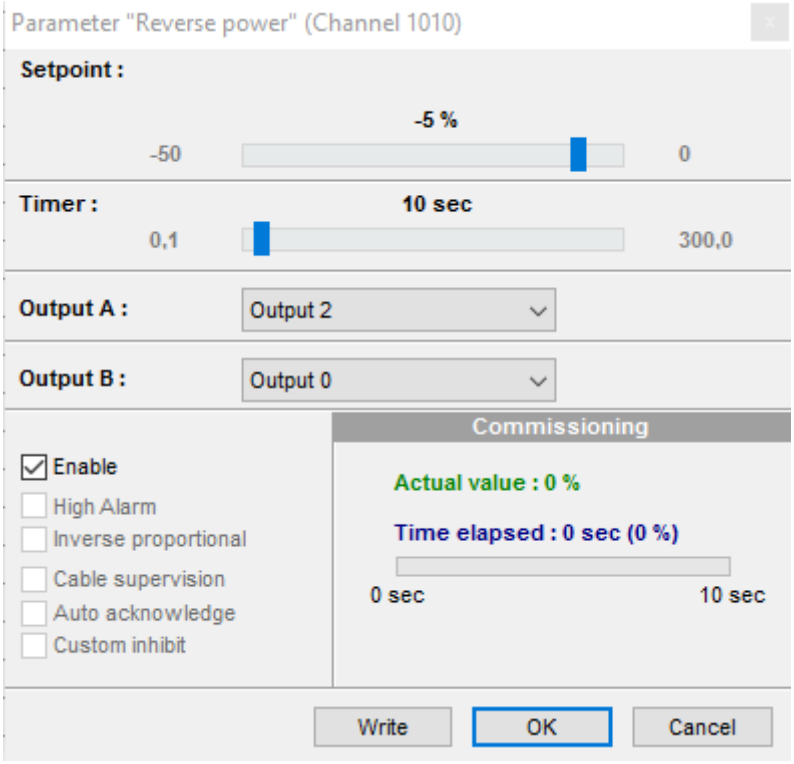
Parameter PPU-2	Description	Address	Parameter PPU 300	Description
2021	Sync. dfMax	71	Configure> Parameters> Breakers> Generator breaker configuration	Delta frequency max.
2022	Sync. dfMin	72	Configure> Parameters> Breakers> Generator breaker configuration	Delta frequency min.

Parameter PPU-2	Description	Address	Parameter PPU 300	Description
2023	Sync. duMax	73	Configure> Parameters> Breakers> Generator breaker configuration	Delta voltage max.
2024	Sync. t CB	74	Configure> Parameters> Breakers> Generator breaker configuration	Breaker close time
2041	Blackout dfMax	80	Configure> Parameters> Generator> AC setup> Voltage and frequency OK	Minimum OK frequency
2042	Blackout duMax	81		Maximum OK voltage
N/A				Sync. blackout enable

2.2.7 Protection setup

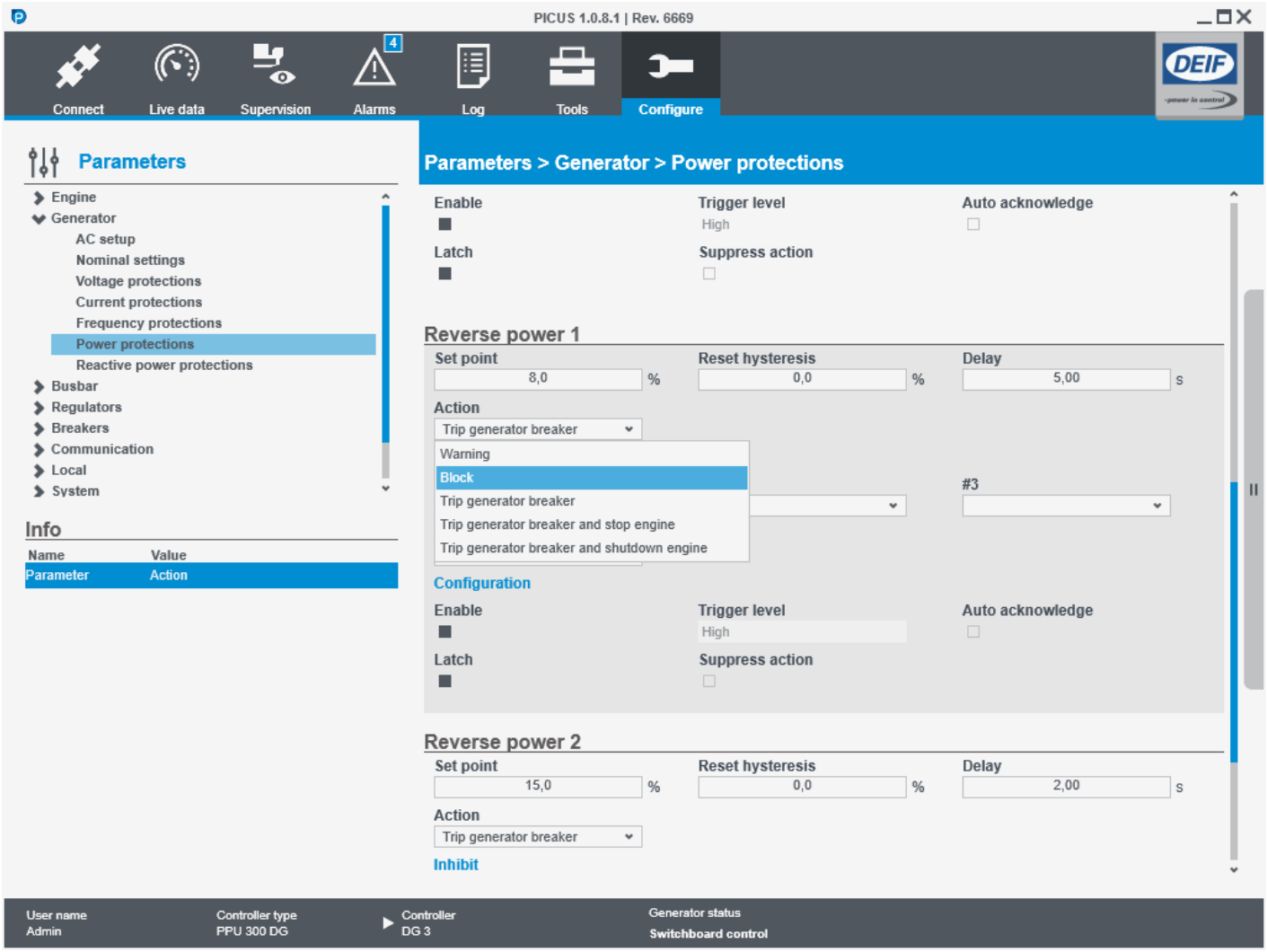
In PPU-2, the following parameters are available: Set points, delay timer, and output A or B.

The protection has a commissioning window where the live status is shown.



Actions

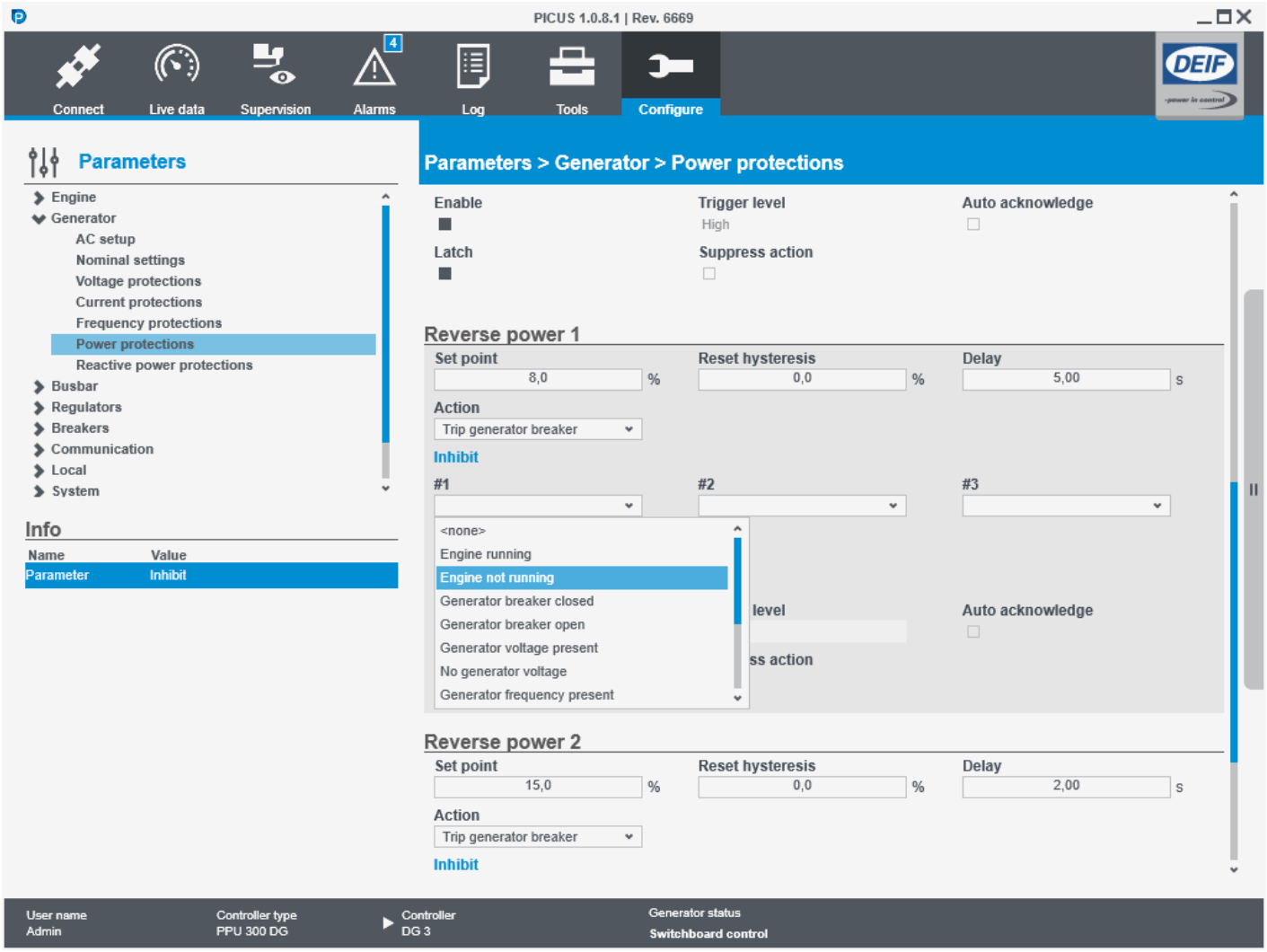
In the PPU 300 the same parameters are present, but an alarm *Action* function has been added. The *Action* defines what happens if the alarm is activated.



The PPU 300 has 5 different actions:

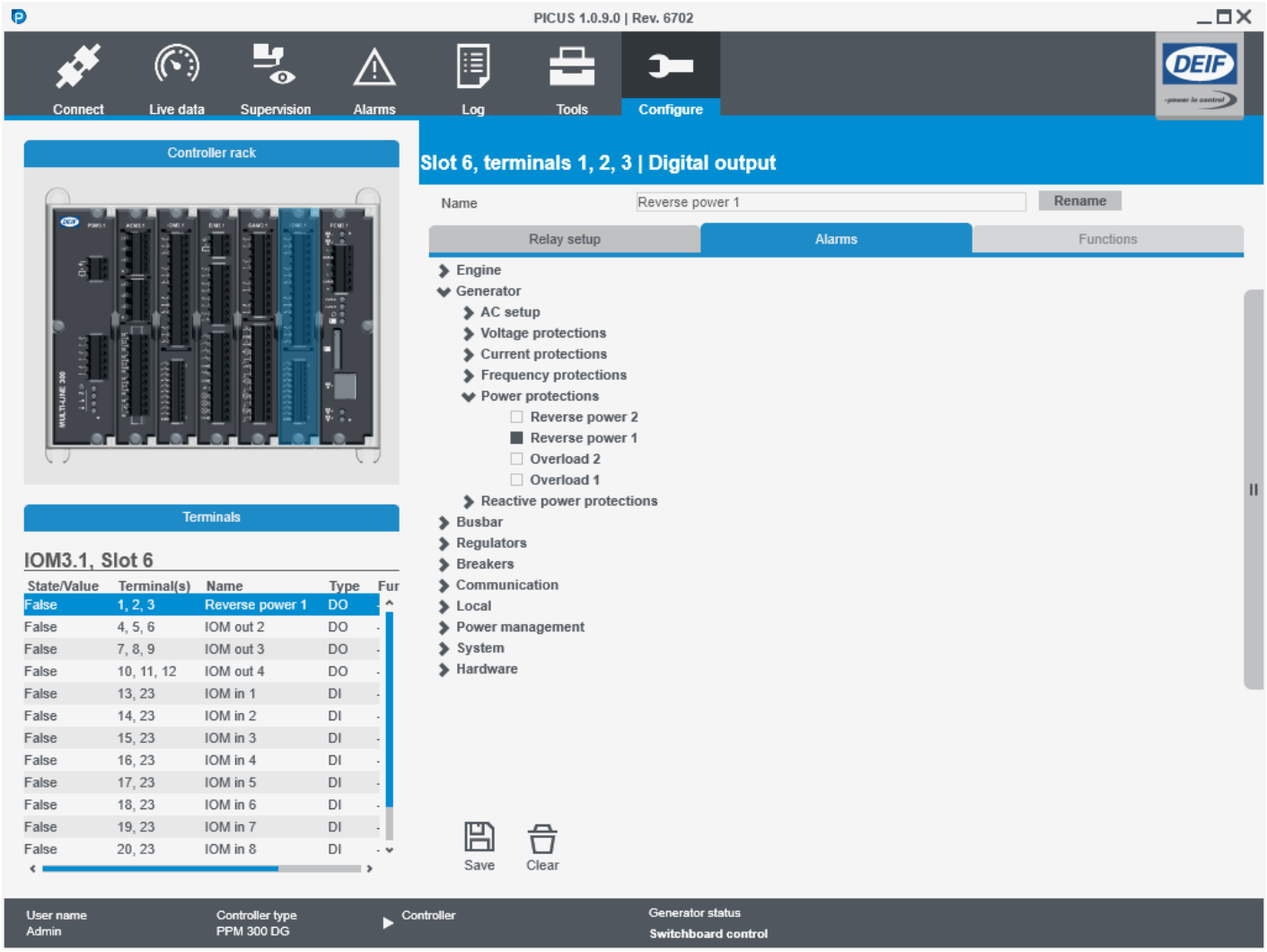
- Warning
- Block
- Trip generator breaker
- Trip generator breaker and stop engine
- Trip generator breaker and shutdown engine

The Inhibit functionality has also been added to this menu.



In order to select when the alarms are to be active, there is a configurable inhibit setting for every alarm. The *Inhibits* are different from the PPU-2 and are only configurable using the PC utility software. Every alarm has a drop-down window, where it is possible to select the conditions that have to be present to inhibit the alarm.

The alarm output is configured in the I/O configuration.



In the example above, an alarm has been configured for *Reverse power*.

More information
See the **PPU 300 Designer's handbook** for more information.

2.2.8 External communication - Modbus

PPU-2

This only applies to external communication board (Options H2 and H3) located in slot #2.

The functions and readings on Modbus/Profibus are not placed on same addresses on a PPU-2 and a PPU 300 controller.

PPU 300

The controller includes a built-in client for Modbus TCP/IP.

In cases using Modbus RTU in the PPU-2, the PPU 300 controller must have an additional Modbus mapping device to meet the needs of a retrofit project.

Contact *DEIF Support* for a complete list of available parameters.

2.2.9 CustomLogic in PPU 300

CustomLogic is available in all PPU 300 controllers. However, if you have CODESYS installed on the controller, CustomLogic is not available.

CustomLogic is used in PICUS to create and configure customised logical operations. These functions are built using ladder logic elements and can include interaction with external equipment, or advanced logic interfaces.

More information
See the **PICUS manual** for more information.

2.2.10 Mode selection

Regulation mode configuration and operation is different in PPU 300.

In a PPU-2 system, a combination of digital inputs determines the selection of running modes (see the table below). In a PPU 300 system, the four modes can be configured in PICUS.

Table 2.12 Mode selection

PPU-2		Description	PPU 300
Digital input (48)	Digital input (49)	Active GOV mode	Input
OFF	OFF	Fixed frequency	Digital input (configurable)
ON	OFF	Fixed power	Digital input (configurable)
OFF	ON	Droop	Digital input (configurable)
ON	ON	Load sharing	Digital input (configurable)
Digital input (51)	Digital input (52)	Active AVR mode	Input
OFF	OFF	Fixed voltage	Digital input (configurable)
ON	OFF	Fixed Q	Digital input (configurable)
OFF	ON	Fixed PF	Digital input (configurable)
ON	ON	Q load sharing	Digital input (configurable)
		Voltage droop	Digital input (configurable)

More information
See the **PPU 300 Designer's handbook** for more information about setting up the modes.