# GPU 300 APPLICATION NOTES

## Converting GPU-2 to GPU 300

# 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!**
Warnings indicate a potentially dangerous situation, which could result in death, personal injury or damaged equipment, if certain guidelines are not followed.

**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. If there is any doubt about how to install or operate the engine/generator controlled by the Multi-line 2 unit, the company responsible for the installation or the operation of the set must be contacted.

**DANGER!**
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
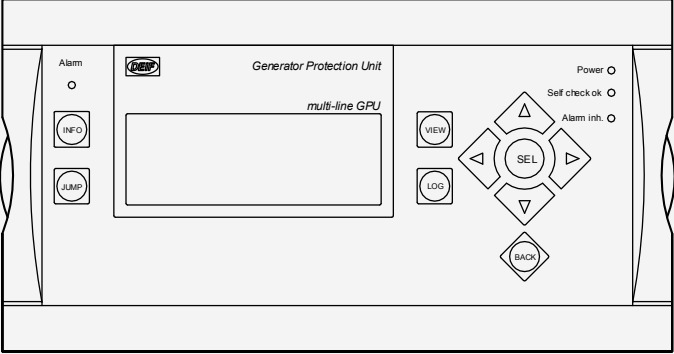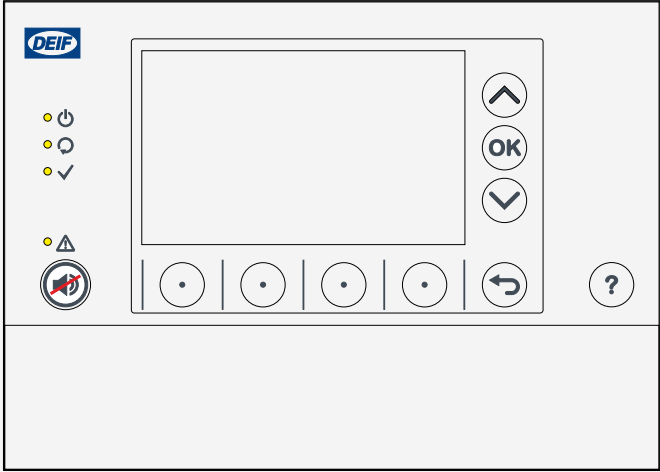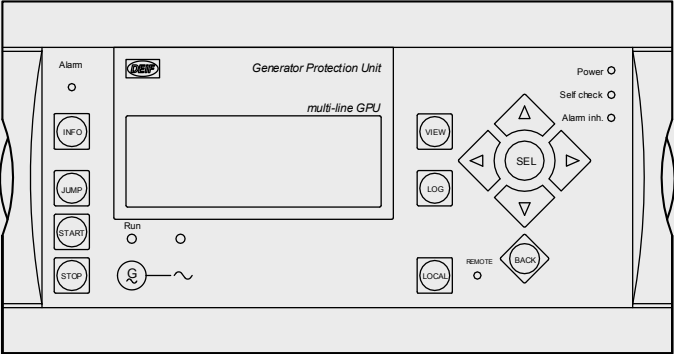
### 2.1.1 General description
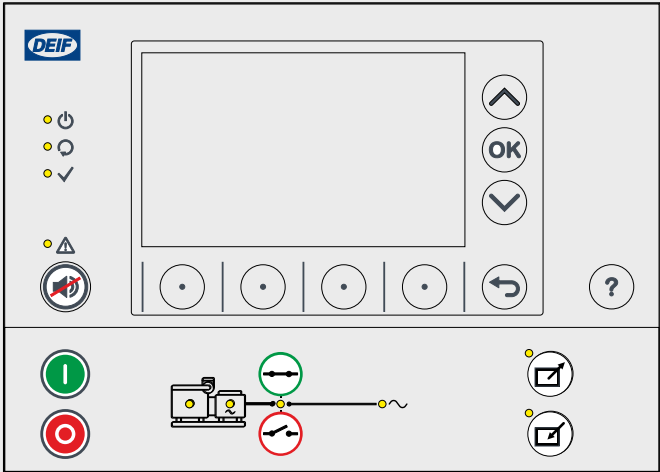
This document includes general information on how to upgrade a standard GPU-2 to a standard GPU 300 system, including mounting instructions and wiring descriptions, parameter and general standard conversions.

The general purpose of this document is to help the user with the first steps of upgrading a standard Generator Protection Unit (GPU) 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.

| GPU-2 | GPU 300 |
|---|---|
| Standard display | Optional display |
|  |  |
| With engine control | With engine and breaker control |
|  |  |

**MORE INFORMATION**
See the **GPU-2 Designer's reference handbook** and the **GPU 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 GPU-2



**Slot #4, term. 65-72**
Governor/AVR outputs

| Option G2/D2: | Four relay outputs |
|---|---|
| Option F2: | 2 x 0(4)-20mA out, transducer out |

**Slot #6, term. 90-97**
Analogue outputs

| Option F1/F2: | 2 x 0(4)-20mA out, transducer |
|---|---|

**Slot #8, term. 126-133**
Comm./In-/outputs

| Option H4: | Engine RS232 CAT CCM |
|---|---|
| Option H5: | CAN bus (J1939) |
| Option H6: | Cummins GCS |

**Slot #2, term. 29-36**
Communication

| Option H1: | CAN-open |
|---|---|
| Option H2: | Modbus RTU (RS485) |
| Option H3: | Profibus DP (RS485) |

| Option M13: | 7 x binary inputs |
|---|---|
| Option M14: | 4 x relay outputs |
| Option M15: | 4 x 4-20mA inputs |

**Slot #1, term. 1-28**
Power supply (std. board)

12/24V DC supply, 8W
1 x status output relay
5 x relay outputs
2 x pulse outputs (kWh, kVArh)
5 x binary inputs

**Slot #7, term. 98-125**
Engine I/F

| Option M1: | 4 x 4-20mA in<br>2 x PT100 in<br>1 x magn. pick-up<br>5 x binary in<br>3 x relay out |
|---|---|
| Option M2: | 3 x 4-20mA in<br>3 x VDO in<br>1 x magn. pick-up<br>9 x binary in<br>3 x relay out |

**Slot #3, term. 37-64**
Synchronising/In-/outputs

Option G2:
Synchronising with GOV control
13 x binary inputs
4 x relay outputs

**Slot #5, term. 73-89**
AC measuring (std.)

3 x generator voltage
3 x generator current
3 x busbar/mains voltage

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

| GPU-2 | Description | GPU 300 | Option type |
|---|---|---|---|
| Option A1 | Vector jump and df/dt (ROCOF)<br>Over-/under-voltage (generator and busbar)<br>Time-dependent under-voltage<br>Reactive power-dependent under-voltage | NA | |
| Option A2 | Df/dt (ROCOF)<br>Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar) | NA | |
| Option A3 | Vector jump<br>Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar) | NA | |
| Option B1 | Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar) | Standard | Software |
| Option C1 | Over-/under-voltage (generator)<br>Over-/under-frequency (generator)<br>Overload<br>Fast over-current (<42 ms, 350 %, 2 levels)<br>Current/voltage unbalance<br>Reactive power import (excitation loss)<br>Reactive power export (over-excitation) | Standard | Software |
| Option C2 | Negative seq. voltage/current<br>Zero Seq. voltage/current<br>Power-dependent reactive power import/export<br>Inverse time over-current | Standard | Software |
| Option D2 | Constant voltage control (stand-alone) | NA | |
| Option F1 | 2 x 0(4) to 20 mA transducer out | NA | Hardware |
| Option F2 (GPU) | 4 x 0(4) to 20 mA transducer out | NA | Hardware |
| Option G1 | Start/stop of next DG outputs | NA | Software |
| Option G2 | Synchronisation with relay speed governor 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 |
| Option H5 | Engine communication - CAN bus J1939 | NA | Hardware |
| Option H6 | Cummins GCS | 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 |
| Option J6 | Display cable, 1 m | NA | Hardware |
| Option K1 | Designer´s Reference Handbook (hard copy) | NA | |
| Option K2 | CD-ROM with complete documentation | NA | |
| Option L | Display gasket for IP54 | Standard (IP65 from front) | |
| Option M1 or M2 | Engine control and protection. Configurable I/O's. 13 inputs, 4 outputs. | NA | Hardware |
| Option M13 | 7 digital inputs in slot #8 | Standard | Hardware |

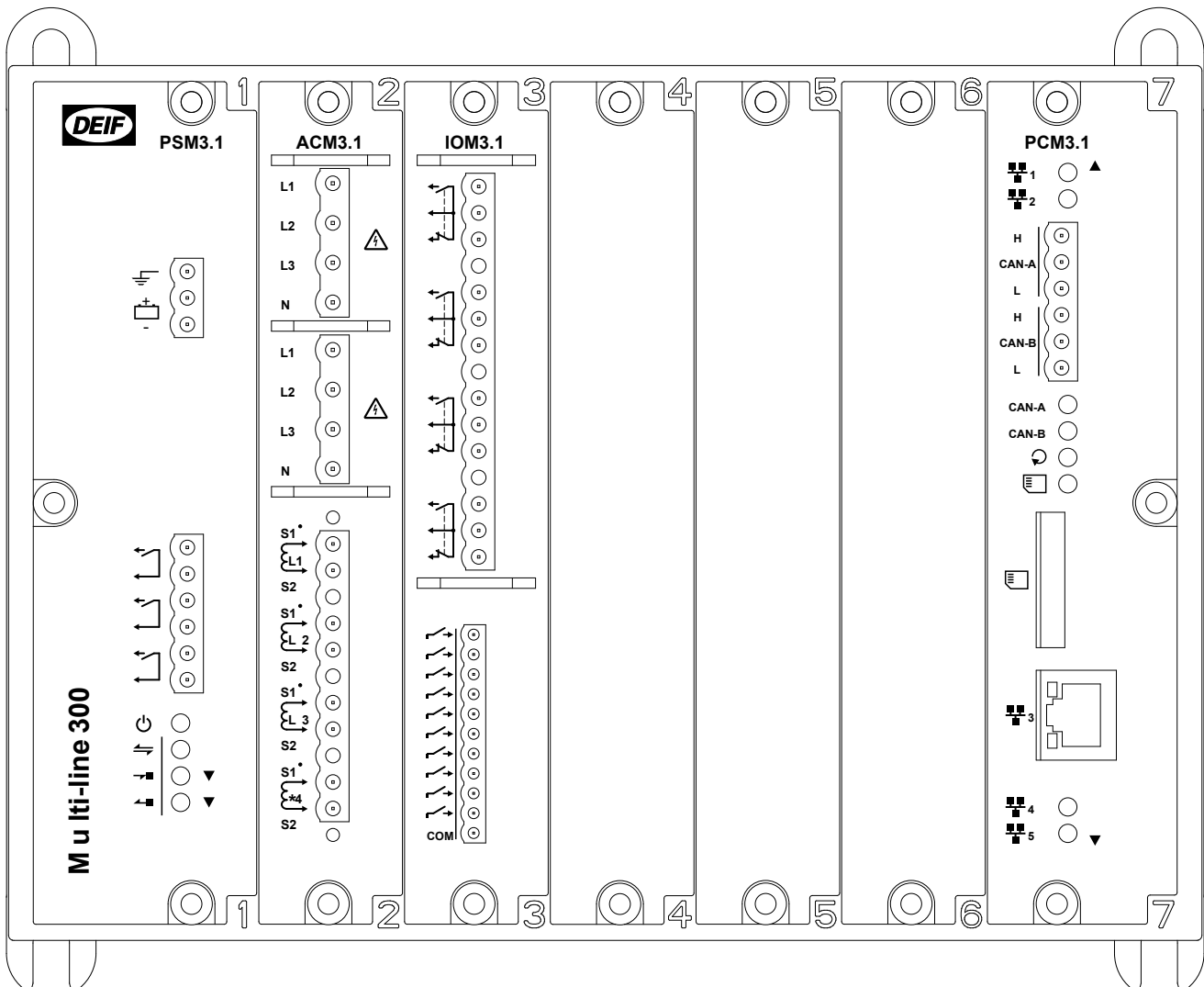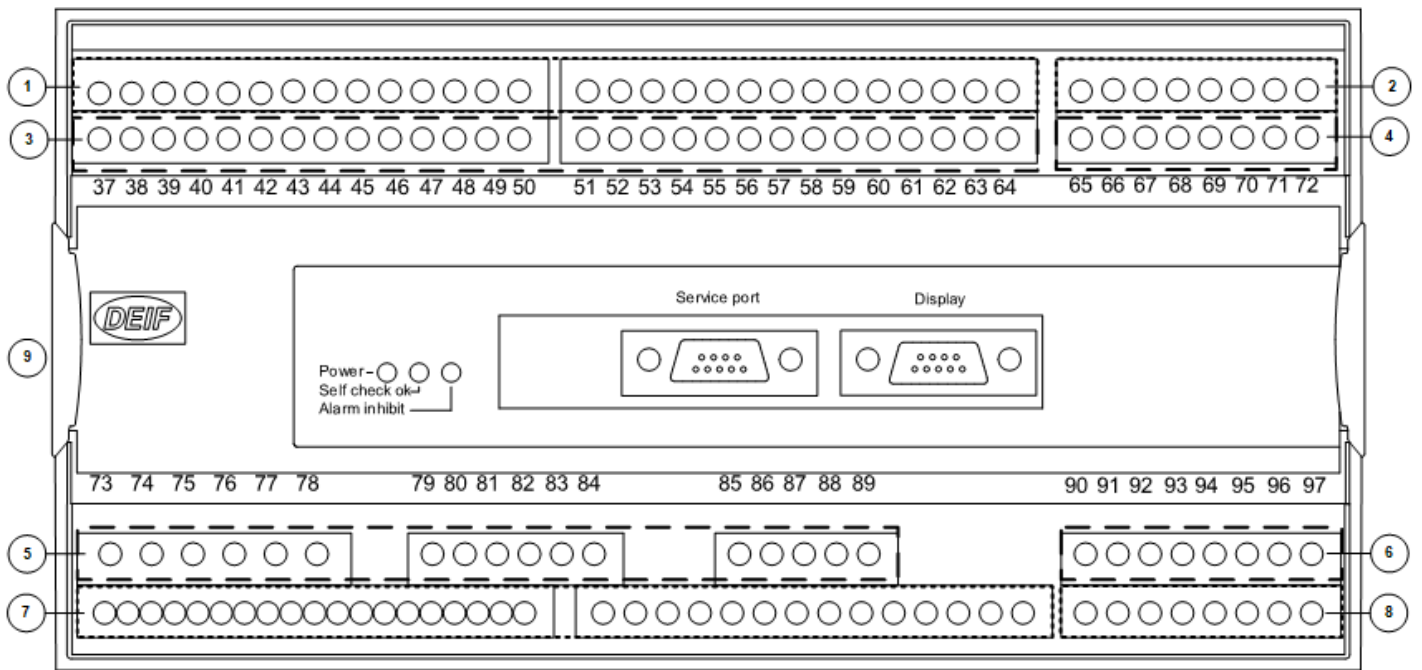| GPU-2 | Description | GPU 300 | Option type |
|-------|-------------|---------|-------------|
| Option M14 | 4 relay outputs in slot #8 | Standard | Hardware |
| Option M15 | 4 analogue inputs in slot #8 | NA | Hardware |
| Option Z1 | Generator nominal power >20MW | NA | |

## 2.2 Installation and parameter setup

### 2.2.1 Wiring installation

The table below shows an overview of the terminals on GPU-2 and GPU 300. Only standard PCBs, Option H2, and G2 are shown below. Contact DEIF support if you have installed other options in the GPU-2, and you need help to wire these. Some inputs and outputs might not be available in GPU 300.

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

**Figure 2.2**     GPU 300 topside overview

**Figure 2.3** GPU-2 topside overview



**Table 2.2** GPU-2 Slot #1, Power supply PCB

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 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<br>4 | Relay (NO)<br>Common | Status relay | PSM 3.1 term 3 + 4 | Relay | Alarm > Status OK |
| 5<br>6<br>7 | NO<br>Common<br>Relay NC | Relay 1 | IOM 3.1 | Configurable Digital output | |
| 8<br>9<br>10 | NO<br>Common<br>NC | Relay 2 | IOM 3.1 | Configurable Digital output | |
| 11<br>12<br>13 | NO<br>Common<br>NC | Relay 3 | IOM 3.1 | Configurable Digital output | |
| 14<br>15<br>16 | NO<br>Common<br>NC | Relay 4 (Open breaker) | IOM 3.1 term. 1+2+3 | Configurable Digital output | [Breaker] > Control > [Open] (Configurable) |
| 17<br>18<br>19 | NO<br>Common<br>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) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 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**       GPU-2 Slot #2, Communication (Option H2)

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

**Table 2.4**       GPU-2 Slot #3, Synchronising/In-/Outputs (Option G2)

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 300 | Note |
|---|---|---|---|---|---|
| 37<br>38<br>39 | | Not used | | | |
| 40<br>41<br>42 | | Not used | | | |
| 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 | |
| 48 | Configurable | Digital input | IOM 3.1 | Configurable Digital Input | |
| 49 | Configurable | Digital input | IOM 3.1 | Configurable Digital Input | |

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 300 | Note |
|---|---|---|---|---|---|
| 50 | Configurable | Digital input | IOM 3.1 | Configurable Digital Input | |
| 51 | Configurable | Digital input | IOM 3.1 | Configurable Digital Input | |
| 52 | Configurable | Digital input | IOM 3.1 | Configurable Digital Input | |
| 53 | Configurable | 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**    GPU-2 Slot #4, GOV/AVR outputs (option G2/D2 (and F2 - not shown))

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 300 | Note |
|---|---|---|---|---|---|
| 65 66 | GOV control | GOV UP | NA | | |
| 67 68 | GOV control | GOV DOWN | NA | | |
| 69 70 | AVR control (Option D2) | AVR UP | NA | | |
| 71 72 | AVR control (Option D2) | AVR DOWN | NA | | |

**Table 2.6**    GPU-2 Slot #5, AC measuring

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 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 |

| Terminal(s) GPU-2 | General description | Terminal description GPU-2 | Terminal GPU 300 | Terminal description GPU 300 | Note |
|---|---|---|---|---|---|
| 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 GPU-2 and PICUS is for GPU 300. The utility software can be downloaded at www.deif.com.

To replace a GPU-2 with a GPU 300, you must back up all the settings from the GPU-2. You must then manually set up the same parameters in the GPU 300 using PICUS (Power In Control Utility Software). See how to back up settings from the GPU-2 in the **ML-2 application notes Getting started USW 1x**, which can be downloaded at www.deif.com.

⚠️ **CAUTION**

Back up the GPU-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 GPU-2 | Description | Address | Unit | Parameter GPU 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 |
| 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 |

| Parameter GPU-2 | Description | Address | Unit | Parameter GPU 300 | Description | Unit |
|---|---|---|---|---|---|---|
| 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 Blackout close

The Blackout close function sets the action the controller takes when a dead busbar Is detected.

The table below shows which parameters to configure for Blackout closing.

**Table 2.8        Blackout close setup**

| Parameter GPU-2 | Description | Address | Parameter GPU 300 | Description |
|---|---|---|---|---|
| 2021 | Blackout dfMax | 44 | Configure> Parameters> Generator> AC setup> Voltage and frequency OK | Minimum OK frequency |
| 2022 | Blackout duMax | 45 | | Maximum OK voltage |
| 2023 | Blackout Enable | 46 | | Sync. blackout enable |

## 2.2.4 Protection setup

In GPU-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 GPU 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 GPU 300 has 2 different actions:

• Warning
• Trip generator breaker

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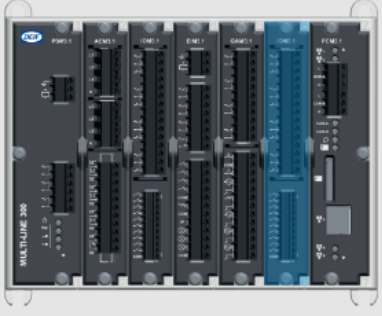
The alarm output is configured in the I/O configuration.

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

> **MORE INFORMATION**
> See the **GPU 300 Designer's handbook** for more information.

## 2.2.5 External communication - Modbus

**GPU-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 GPU-2 and a GPU 300 controller.

**GPU 300**

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

In cases using Modbus RTU in the GPU-2, the GPU 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.

## 2.2.6 CustomLogic in GPU 300

CustomLogic is available in all GPU 300 controllers.

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.