# MULTI-LINE 2

## Converting GPU-2 to GPU-3

- Parameter conversion
- Wiring
- Options
- I/O list

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## 1. General information

**1.1 Warnings, legal information and safety** ..... **3**
1.1.1 Warnings and notes ..... 3
1.1.2 Legal information and disclaimer ..... 3
1.1.3 Safety issues ..... 3
1.1.4 Electrostatic discharge awareness ..... 3
1.1.5 Factory settings ..... 4
**1.2 About the Application Notes** ..... **4**
1.2.1 General purpose ..... 4
1.2.2 Intended users ..... 4
1.2.3 Contents and overall structure ..... 4

## 2. Application and installation

**2.1 About the application** ..... **5**
2.1.1 General description ..... 5
2.1.2 Converting the display ..... 5
2.1.3 Description of options ..... 5
**2.2 Installation and parameter setup** ..... **9**
2.2.1 Wiring installation ..... 9
2.2.2 Parameter settings - system setup ..... 10
2.2.3 Protection setup ..... 11
2.2.4 M-Logic in GPU-3 ..... 12
2.2.5 External communication - Modbus ..... 12

# 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.

### 1.2.3 Contents and overall structure

This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

# 2. Application and installation

## 2.1 About the application

### 2.1.1 General description

This document mainly includes general information (in point form) on how to upgrade a standard GPU-2 to a GPU-3 system, including mounting instructions and wiring descriptions, parameter and general standard conversions.

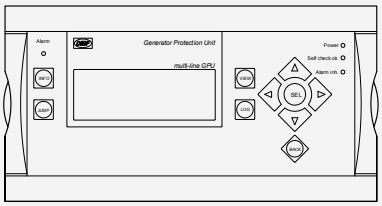
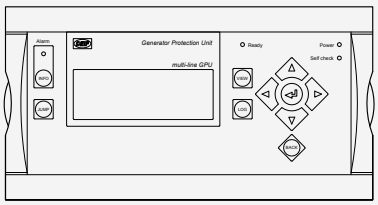
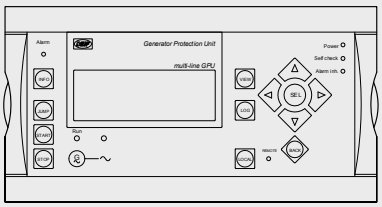
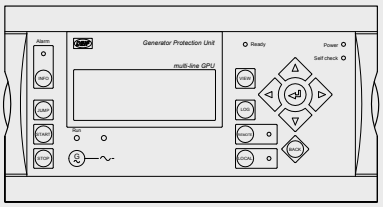
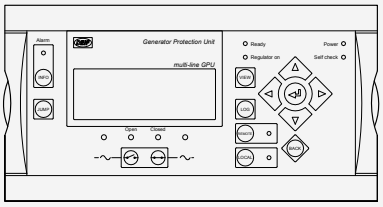
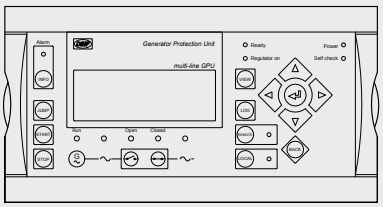
**CAUTION**
This document only cover GPU-2 standard software version 2.xx.x.

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

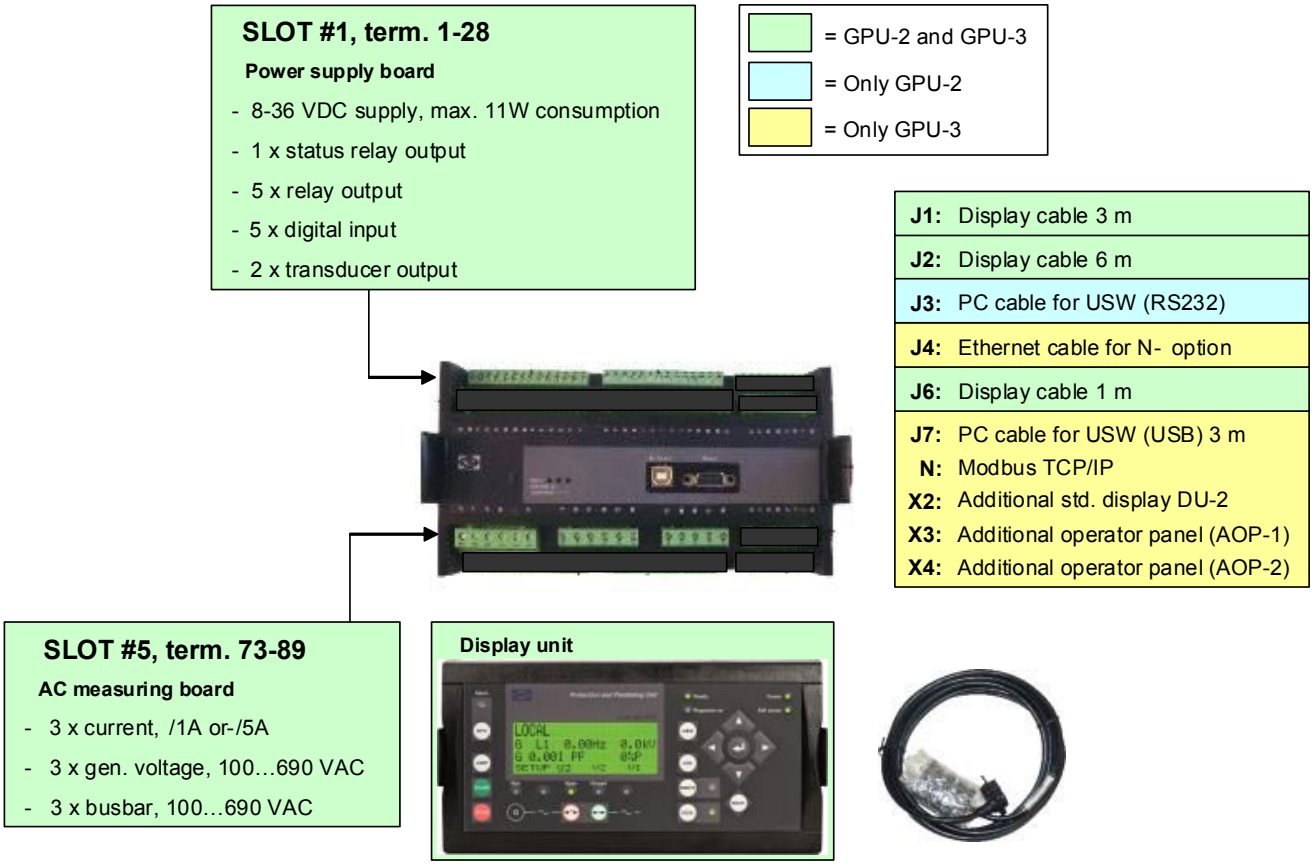
The table below shows an overview of standard displays and the options of converting the displays.

| GPU-2 | GPU-3 | Note |
|---|---|---|
|  |  | Standard |
|  |  | Engine control (option Y7) |
| |  | Breaker control (option Y5) |
| |  | Engine and breaker control (Y1) |

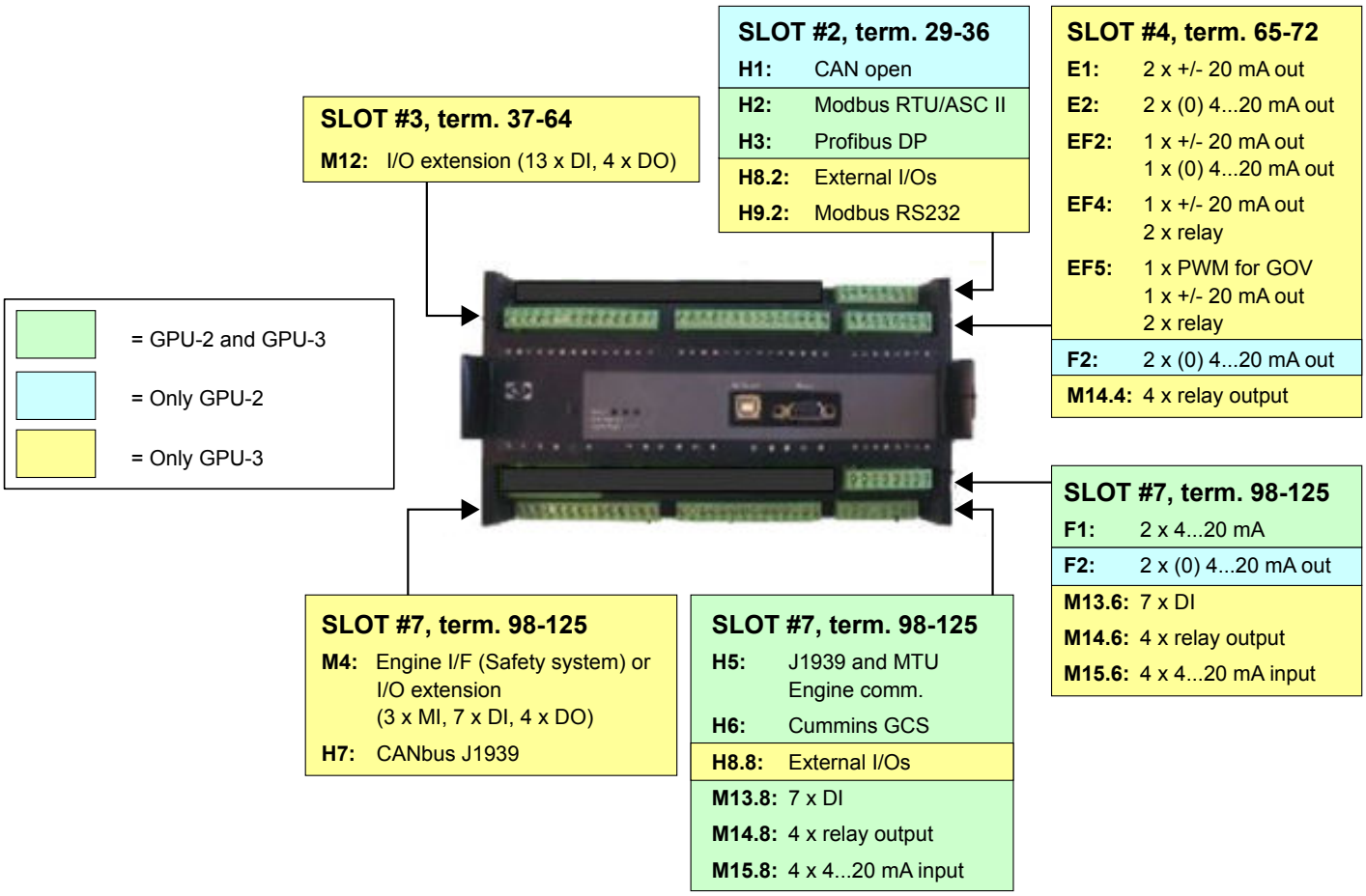
### 2.1.3 Description of options

The unit housing is divided into board slot positions. This means that the unit consists of a number of printed circuit boards (PCBs) mounted in numbered slots - #1-8. 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** Standard PCB's in GPU-2/GPU-3




The illustration below shows the location of the various options.




The table below provides an overview and description of the GPU-2 options and shows which options that can be converted to GPU-3. GPU-2 options B1 and C1 are implemented as standard software in GPU-3.

| GPU-2 | Description | GPU-3 | Option type |
|---|---|---|---|
| Option A1 | Vector jump and df/dt (ROCOF)<br>Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar)<br>Time-dependent under-voltage<br>Reactive power-dependent under-voltage | Option A1 | Software |
| Option A2 | Df/dt (ROCOF)<br>Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar) | Option A1 | Software |
| Option A3 | Vector jump<br>Over-/under-voltage (generator and busbar)<br>Over-/under-frequency (generator and busbar) | Option A1 | Software |
| N/A | Positive sequence voltage low | Option A4 | |
| N/A | Directional over-current | Option A5 | |
| 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 |

| GPU-2 | Description | GPU-3 | Option type |
|---|---|---|---|
| Option C2 | Negative seq. voltage/current<br>Zero Seq. voltage/current | Option C2 | Software |
| | Power-dependent reactive power import/export<br>Inverse time over-current | | |
| Option D1 | Fixed U/Q/PF<br>Q load sharing | Option D1 | Software |
| | Voltage droop<br>GPU: voltage matching (requires option G2) | | |
| Option E1 | +/-20 mA for speed governor<br>+/-20 mA for AVR | Option E1 | Hardware |
| N/A | 0(4)...20 mA for speed governor or transducer<br>0(4)...20 mA for AVR or transducer | Option E2 | Hardware |
| Option EF2 | +/-20 mA for speed governor<br>1 x 0(4) 20 mA transducer output | Option EF2 | Hardware |
| Option EF3 | 1 x PWM (Pulse Width Modulated) output for CAT speed governor<br>1 x PWM (Pulse Width Modulated) output for droop<br>+/-20 mA for speed governor or AVR<br>2 x relay outputs for speed governor or AVR | Option EF5 | Hardware |
| Option EF4 | +/-20 mA for speed governor or AVR<br>2 x relay outputs for speed governor or AVR | Option EF4 | Hardware |
| N/A | 1 x PWM (Pulse Width Modulated) output for CAT speed governor<br>+/-20 mA for speed governor or AVR<br>2 x relay outputs for speed governor or AVR | Option EF5 | Hardware |
| Option F1 | 2 x 0(4) to 20 mA transducer out | Option F1 | Hardware |
| Option F2 | 4 x 0(4) to 20 mA transducer out | Option E2 + F1 | Hardware |
| Option G1 | Start/stop of next DG outputs | Standard | |
| Option G2 | Synchronisation with relay outputs | Option G2 | SW and HW option |
| Option H1 | CANopen | N/A | Hardware |
| Option H2 and H3 | Modbus and Profibus DP | Option H2 and H3 | Hardware |
| Option H4 | CAT CCM | N/A | Hardware |
| N/A | Reading of J1939 values | Option H5 | Hardware |
| | Full J1939 engine | | |
| N/A | Cummins GCS | Option H6 | Hardware |
| N/A | Engine communication - CAN bus J1939 | Option H7 | Hardware |
| N/A | CAN bus interface for external I/O modules (Beckhoff) in slot #2 or slot #8 | Option H8.x | Hardware |
| N/A | Modbus RTU/ASCII (RS-232) and GSM modem connection | Option H9.2 | Hardware |
| Option J1 | Display cable, 3 m | Standard | Hardware |
| Option J2 | Display cable, 6 m | Option J2 | Hardware |
| Option J3 | PC cable for utility software (RS-232) | N/A | Hardware |
| N/A | PC cable for opiton N-programming | Option J4 | Hardware |
| N/A | Display cable, 1 m | Option J6 | Hardware |
| N/A | PC cable for utility software (USB), 1 m | Option J7 | Hardware |
| Option M1 or M2 | Engine control and protection | Option M4 | Hardware |

| GPU-2 | Description | GPU-3 | Option type |
|---|---|---|---|
| | Configurable I/O's. 13 inputs, 4 outputs. | Option M12 | Hardware |
| Option M13 | 7 digital inputs in slot #8 | Option M13.x | Hardware |
| Option M14 | 4 relay outputs in slot #8 | Option M14.x | Hardware |
| Option M15 | 4 analogue inputs in slot #8 | Option M15.x | Hardware |
| Option M20 | Front folio with engine control | Option Y7 (GPU) | Hardware |
| N/A | Modbus TCP/IP and alarms via SMS or email | Option N | Hardware |
| N/A | Verified class 0.5 | Option Q1 | Hardware |
| N/A | Additional standard display on CAN bus | Option X2 | Hardware |
| N/A | Additional Operator Panel (AOP-1) | Option X3 | Hardware |
| N/A | Additional Operator Panel (AOP-2) | Option X4 | Hardware |
| N/A | Front folio with engine and GB control | Option Y1 | Hardware |
| N/A | Front folio with GB control | Option Y5 (GPU) | Hardware |
| Option Z1 | PNOM >20 MW | | |

# 2.2 Installation and parameter setup

## 2.2.1 Wiring installation

The table below shows an overview of the terminals on a standard GPU-2 and GPU-3 without options.

| General description | Terminal GPU-2 | Terminal description GPU-2 | Terminal GPU-3 | Terminal description GPU-3 |
|---|---|---|---|---|
| Power supply | 1 | 24 V DC (+) | 1 | 24 V DC (+) |
| Power supply | 2 | 0 V DC (-) | 2 | 0 V DC (-) |
| Relay (NO) | 3 + 4 | Status relay | 3 + 4 | Status relay |
| Relay (NO + NC) | 5 + 6 + 7 | Relay 1 | 5 + 6 + 7 | Relay 5 |
| Relay (NO + NC) | 8 + 9 + 10 | Relay 2 | 8 + 9 + 10 | Relay 8 |
| Relay (NO + NC) | 11 + 12 + 13 | Relay 3 | 11 + 12 + 13 | Relay 11 |
| Relay (NO + NC) | 14 + 15 + 16 | Relay 4 | 14 + 15 + 16 | Open GB |
| Relay (NO + NC). | | Not used | 17 + 18 + 19 | Relay 17 |
| Transistor output | 20 | Open collector 1 | 20 | Open collector 1 |
| Transistor output | 21 | Open collector 2 | 21 | Open collector 2 |
| Transistor output | 22 | Common for terminals 20 and 22 | 22 | Common for terminals 20 and 22 |
| Digital input | 23 | Alarm inhibit | 23 | Alarm inhibit group 1 |
| Digital input | 24 | Remote alarm acknowledge | 24 | Remote alarm acknowledge |
| Digital input | 25 | Configurable | 25 | Configurable |
| Digital input | 26 | Configurable | 26 | Configurable |
| Digital input | 27 | Configurable | 27 | Configurable |
| Common | 28 | Common for terminals 23-27 | 28 | Common for terminals 23-27 |

| General description | Terminal GPU-2 | Terminal description GPU-2 | Terminal GPU-3 | Terminal description GPU-3 |
|---|---|---|---|---|
| I1 | 73 + 74 | Current meas. | 73 + 74 | Current meas. |
| I2 | 75 + 76 | Current meas. | 75 + 76 | Current meas. |
| I3 | 77 + 78 | Current meas. | 77 + 78 | Current meas. |
| U1 | 79 | Volt. meas. Gen | 79 | Volt. meas. Gen |
| U2 | 81 | Volt. meas. Gen | 81 | Volt. meas. Gen |
| U3 | 83 | Volt. meas. Gen | 83 | Volt. meas. Gen |
| U1 | 85 | Volt. meas. BB | 85 | Volt. meas. BB |
| U2 | 87 | Volt. meas. BB | 87 | Volt. meas. BB |
| U3 | 89 | Volt. meas. BB | 89 | Volt. meas. BB |

**INFO**
Further wiring terminals (if having options added) and wire mounting differences for both units can be seen in manuals *Installation Instructions* and *Description of options* for both GPU-2 and GPU-3 at www.deif.com.

### 2.2.2 Parameter settings - system setup

The PC utility software is a software program used for configurating the Multi-line 2 product. There are two versions, 1.x for GPU-2 and 3.x. for GPU-3.

The utility software can be downloaded at www.deif.com.

Procedure for retrofitting a GPU-2 to a GPU-3 is, besides the physical replacement, in general to retrieve all settings from the GPU-2 and manually setup same parameters in the GPU-3 through the USW. See what settings and how to retrieve them from GPU-2 in the manual *ML-2 application notes Getting started 1x 4189340866* which can be downloaded at www.deif.com.

**CAUTION**
It's very important to take out these GPU-2 parameters before powering down the unit as there are a certain risk (due to unit age) of resetting all parameters back to factory setup.

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

**Nominal settings**

| Parameter GPU-2 | Description | Unit | Parameter GPU-3 | Description | Unit |
|---|---|---|---|---|---|
| 4011 | Nom. frequency | Hz | 6001 | Nom. f (1) | Hz |
| 4012 | Nom. power | kW | 6002 | Nom. P (1) | kW |
| 4013 | Nom. current | A | 6003 | Nom. I (1) | A |
| 4014 | Nom. voltage | V | 6004 | Nom. U (1) | V |
| N/A | | | 6005 | Nom. RPM (1) | RPM |
| 4021 | Volt. prim. GEN | V | 6041 | G primary U | V |
| 4022 | Volt. sec. GEN | V | 6042 | G secondary U | V |
| 4023 | Current prim. | A | 6043 | G primary I | A |
| 4024 | Current sec. | A | 6044 | G secondary I | A |
| 4031 | Volt. prim. BUS | V | 6051 | BB primary U1 | V |
| 4032 | Volt. sec. BUS | V | 6052 | BB secondary U1 | V |

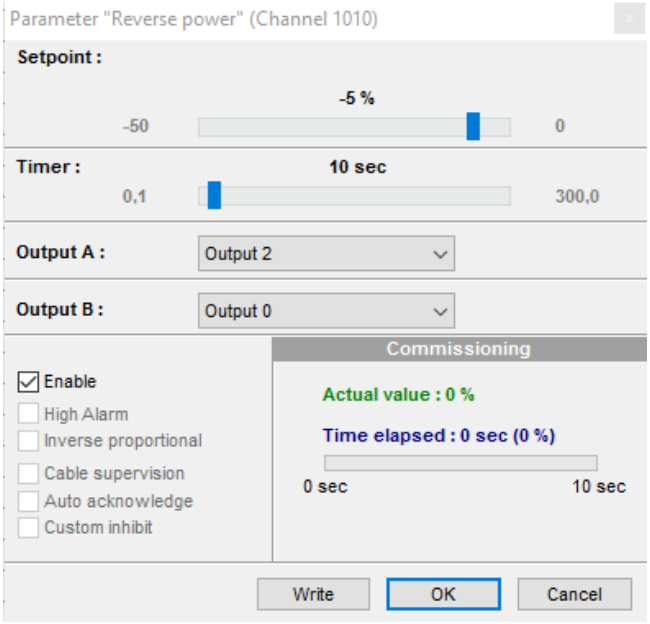
| Parameter GPU-2 | Description | Unit | Parameter GPU-3 | Description | Unit |
|---|---|---|---|---|---|
| 4033 | Nom. volt. BUS | V | 6053 | BB nominal U1 | V |
| 4121 | Running time | Hours | 6101 | Running hours (0-999) | Hours |
| | | | 6102 | Running hours (1.000-999.000) | Hours |
| 4122 | CB operations | | 6103 | GB operations | |

### 2.2.3 Protection setup

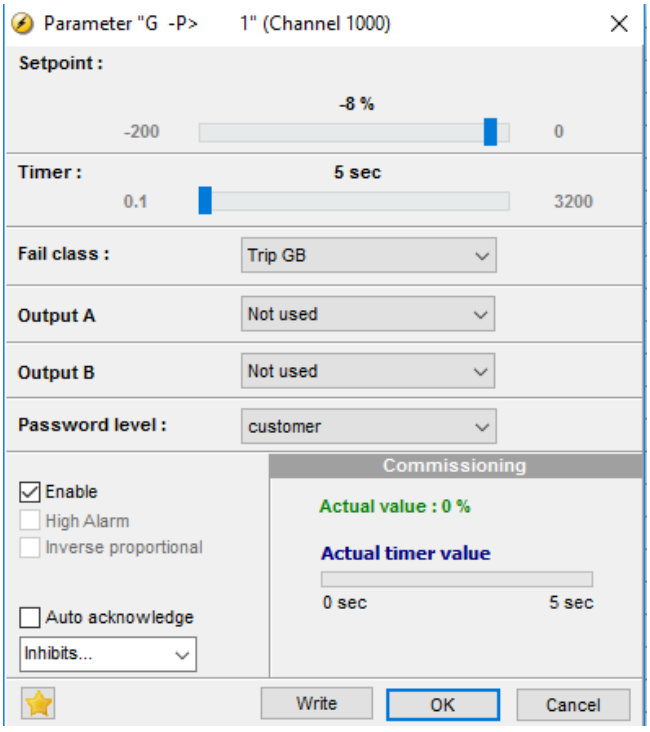
These adjustment points are available in GPU-2:

- Set points
- Delay timer
- Output A
- Output B.

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




In GPU-3, the same adjustment points are available, but "Fail class" is added. Here it is possible to set an alarm action to for example *Trip of GB, Warning, shutdown*, and so on.
Inhibits are also added in the protection parameter window, where one or several conditions can be set to inhibit the specific protection.
It is also possible to attach the protection to an inhibit group, which can be activated from M-Logic. In M-Logic further general inhibits can be set up.

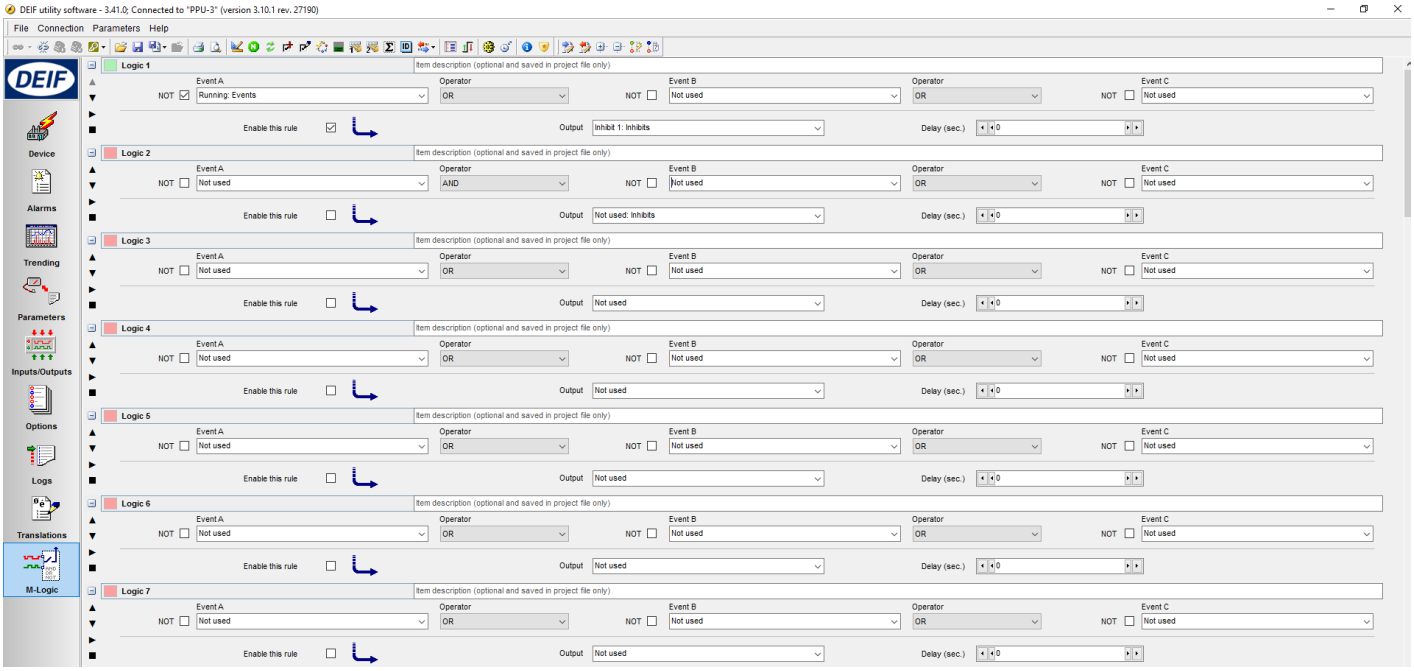


## 2.2.4 M-Logic in GPU-3

The M-Logic functionality is included in the GPU-3 unit and is not an option-dependent function.

M-Logic is used to execute different commands at predefined conditions. M-Logic is not a PLC, but substitutes one if only very simple commands are needed.

M-Logic is a simple tool based on logic events. One or more input conditions are defined, and at the activation of those inputs, the defined output will occur. A great variety of inputs can be selected, such as digital inputs, alarm conditions and running conditions. A variety of the outputs can also be selected, such as relay outputs, controller commands, inhibitations etc.




## 2.2.5 External communication - Modbus

The functions and readings on Modbus/Profibus are not placed on same addresses on a GPU-2 and a GPU-3 controller.

Parameter 7514 allows to enable GPU-2 Modbus protocol in a GPU-3 controller and has three different settings:

1. Standard: Normal GPU/PPU-3 register layout.
2. GPU/PPU-2: GPU/PPU-2 register layout. Only GPU/PPU-2 registers will respond, requests to any other register will result in "ILLEGAL DATA ADDRESS".
3. MIX: GPU/PPU-2 register layout. Requests to GPU/PPU-3 registers that are not occupied by GPU/PPU-2 will respond as in "Standard" mode.

This only applies to the external communication board (options H2 and H3) located in slot #2. The USB service port and Ethernet port (option N) still use the GPU-3 Modbus address list.

Contact DEIF Support for a complete list of available parameters.

**INFO**

The protocol converter is only usable from software version 2.x.x and forward. On units with software below version 2.x.x, alarm bits are not set on same Modbus addresses. In this situation the system communicating with GPU-2 will have to be reprogrammed.