DEIF

-power in control

CE

MULTI-LINE 2
APPLICATION NOTES

Generator Paralleling Controller, GPC-3
Multiple generators parallel to grid

- Application description
- Needed options
- Wiring diagrams
- Functional description

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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

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

Notes

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.

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.

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.

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 terminals 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.

For functional descriptions, the procedure for parameter setup, parameter lists etc., please 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.

Please make sure to read this document before starting to work with the Multi-line 2 unit and the gen-set 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

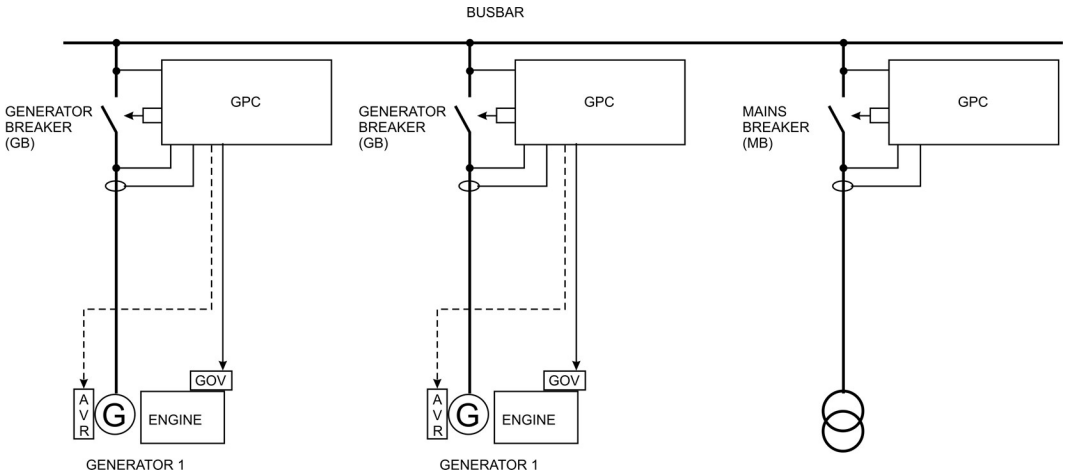
This document is divided into chapters, and in order to make the structure simple and easy to use, each chapter will begin from the top of a new page.

2. Application description

2.1 System overview

2.1.1 Description of basic control system

This document describes the basic control system for a system controlling 2 (or more) generator sets and one mains connection. The system is made with the Multi-line 2 GPC-3 controllers on the generator sets and on the mains connection.



Note that the drawing shows 2 generators, but the system can be used for any number of generators.

This application note describes how to make a system with the following functionality:

1. Start and stop engines
2. Synchronise generators and mains breaker
3. Automatic transfer from generator to mains
4. Automatic transfer from mains to generator
5. Peak shaving operation

The system is one that can be operated manually, semi-automatically or automatically.

Start and stop engines

The GPC will control the start and stop of the engine. This is done automatically or controlled by the operator.

Synchronise generator and shore/shaft breakers

Synchronisation of the breakers is done automatically or it can be controlled by the operator.

Automatic transfer from generator to mains

In automatic mode, the generator(s) will automatically be synchronised to mains, de-loaded and stopped when the selector switch is switched to mains.

Automatic transfer from mains to generator

In automatic mode, the generators will automatically be started, synchronised, and load will be transferred from mains to generators with opening of mains breaker when the selector switch is switched to generator.

Peak shaving operation
When the running mode selector switch is moved to the position "peak shaving", the MB is automatically synchronised. The gensets will change running mode so they use their input for remote setpoint as reference. Then they can be controlled by the GPC installed at the mains breaker side to provide peak shaving (fixed power consumption from mains).

2.2 Needed options

2.2.1 Options needed

The GPCs must be equipped with the following options in order to carry out the controls and protection described in these application notes:

For GPCs carrying out mains breaker control and mains protection:
- Option A1 or A2 or A3 to carry out mains failure protection
- Option D1 to carry out mains power factor and voltage synchronisation control
- Option E1 to make analogue command setpoints for speed, power, voltage and power factor to the generator GCP units.

For generator GCPs:
- Option D1 to carry out power factor and voltage synchronisation control
- Option M4 to carry out engine start/stop and protection

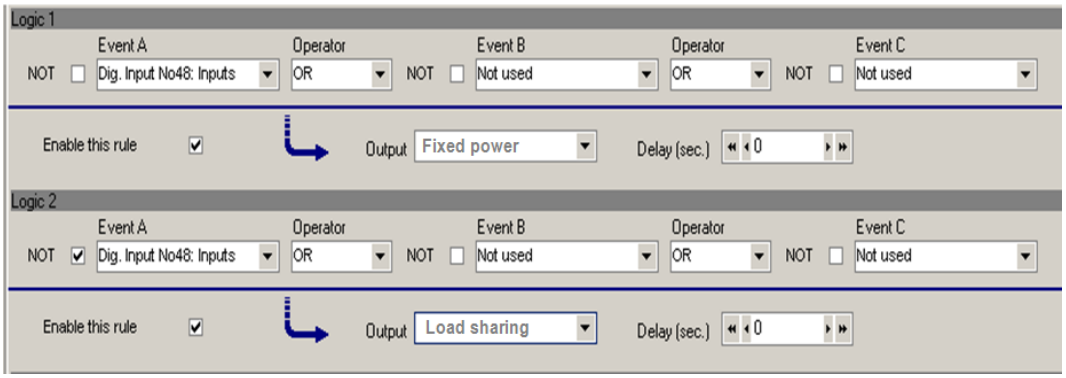
All other available options can be applied as requested. Attention must be paid to governor (AVR) interface and required protections.

Please refer to the data sheet for specific information about the possible options selection.

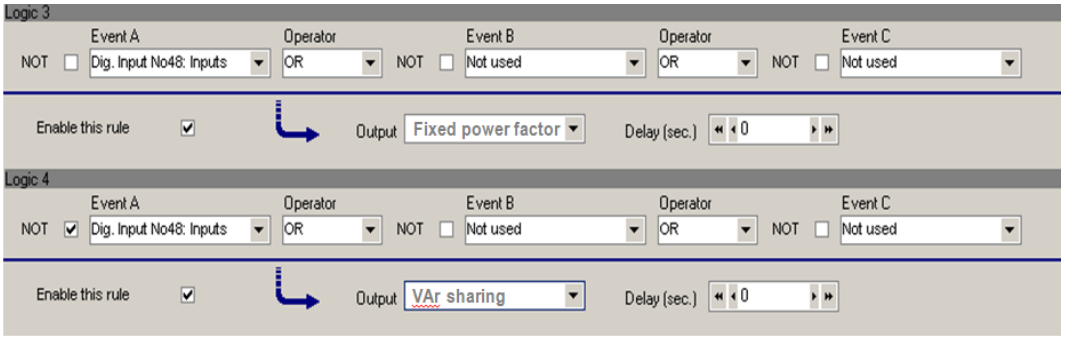
2.3 M-Logic settings

2.3.1 How to set up M-Logic

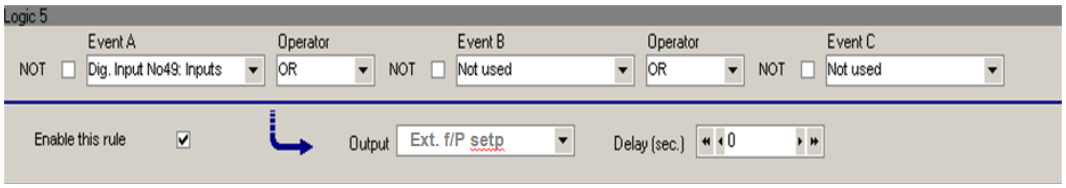
In order to be able to toggle between fixed power mode (parallel with mains) and load sharing mode (long time loadsharing between diesel generators), the terminal 48 digital input is used in this example:



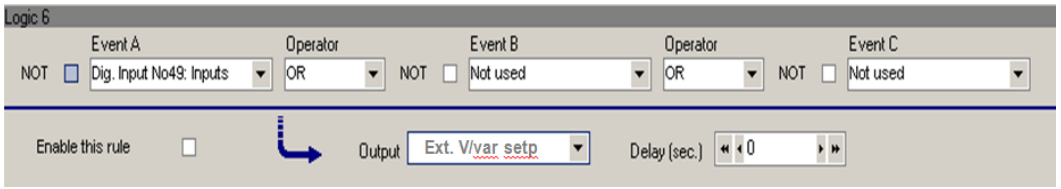
If var sharing is required, the same input is used to toggle between fixed power factor (mains grid parallel) and var sharing (long-time var sharing between diesel generators):



In a similar manner, the selection between internal and external frequency/power setpoint is made, using terminal 49 digital input in this example:



And if var sharing is required, the same for selection between internal and external voltage/var setpoint:



3. Wiring

3.1 Plant control wiring

3.1.1 Abbreviations used

DG: Diesel generator
Mains: Mains connection
GB: Generator breaker
MB: Mains breaker

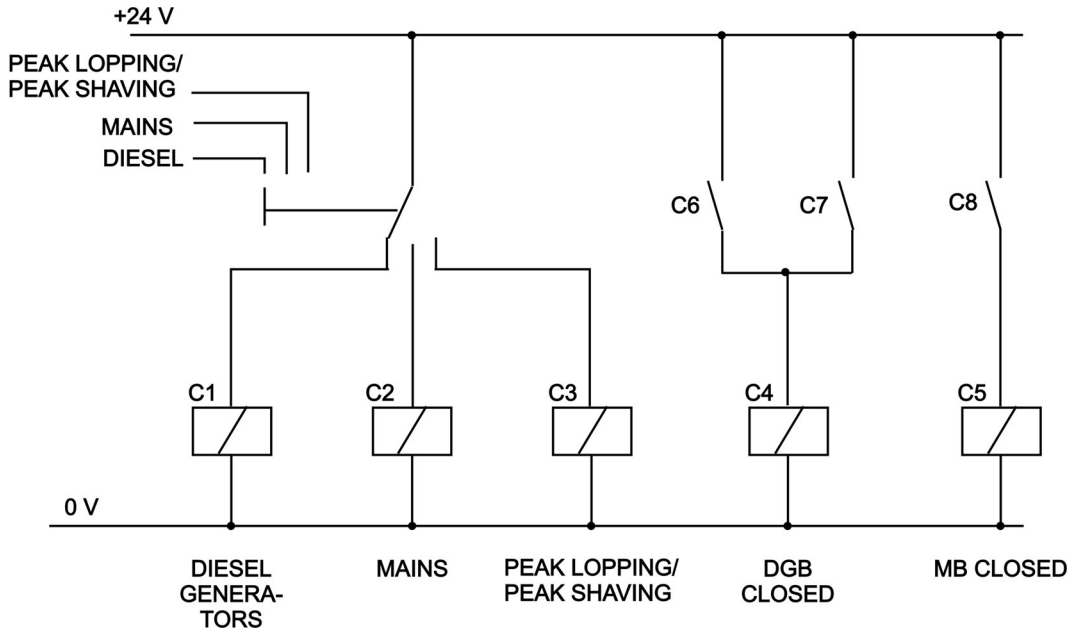
These wirings only comprise the DC lines. The AC lines are described in the GCP-3 Designer's Reference Handbook.

3.2 DC controls

3.2.1 Necessary control circuits

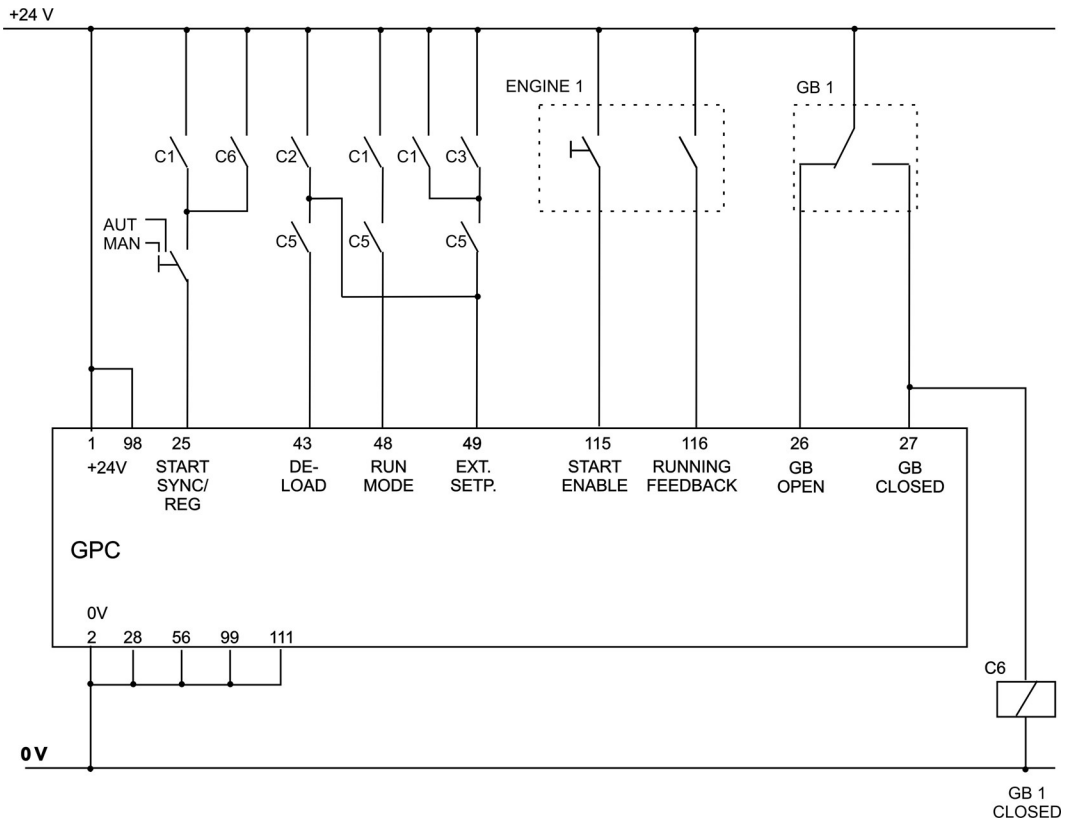
The wiring shows the necessary control circuits to carry out the task. It is assumed that all controls (except breaker commands) are carried out using 24 V_{dc}.

Running mode selector switch

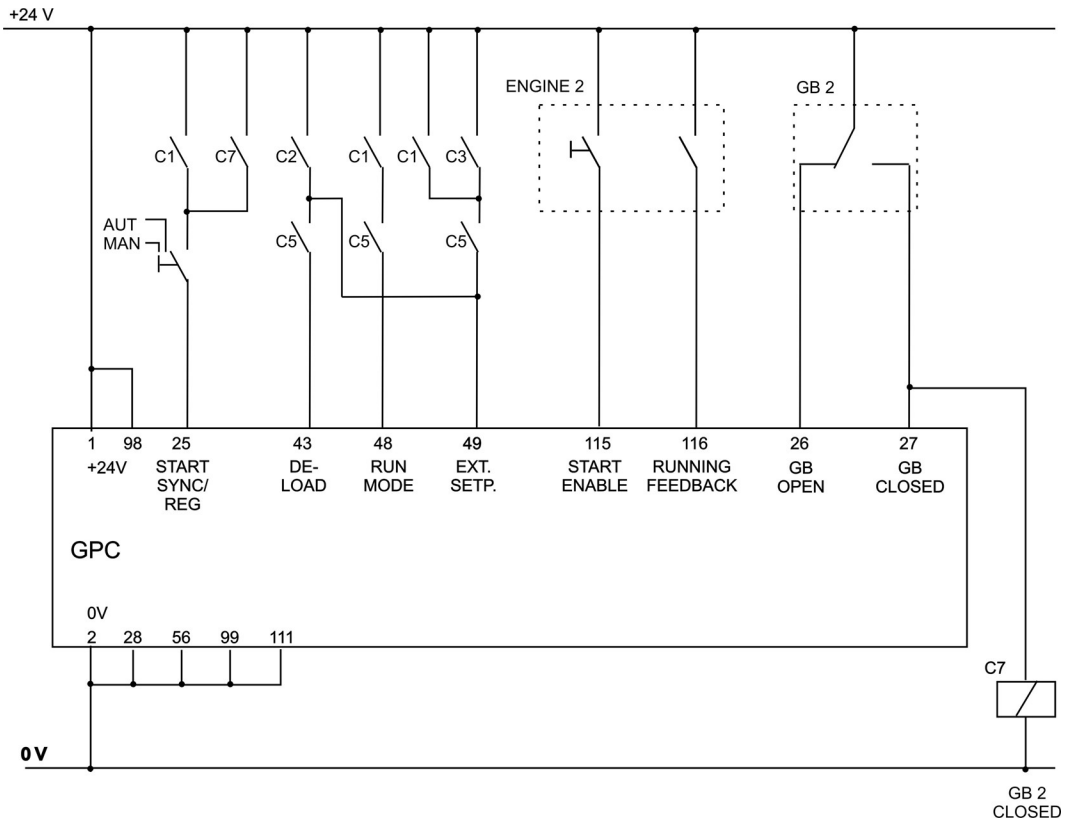


The selector switch is the operator's selector for diesel generator running or shore connection/shaft generator connection. Note that for the switching to take effect, the GPCs must be in "remote" mode (selected on the display).

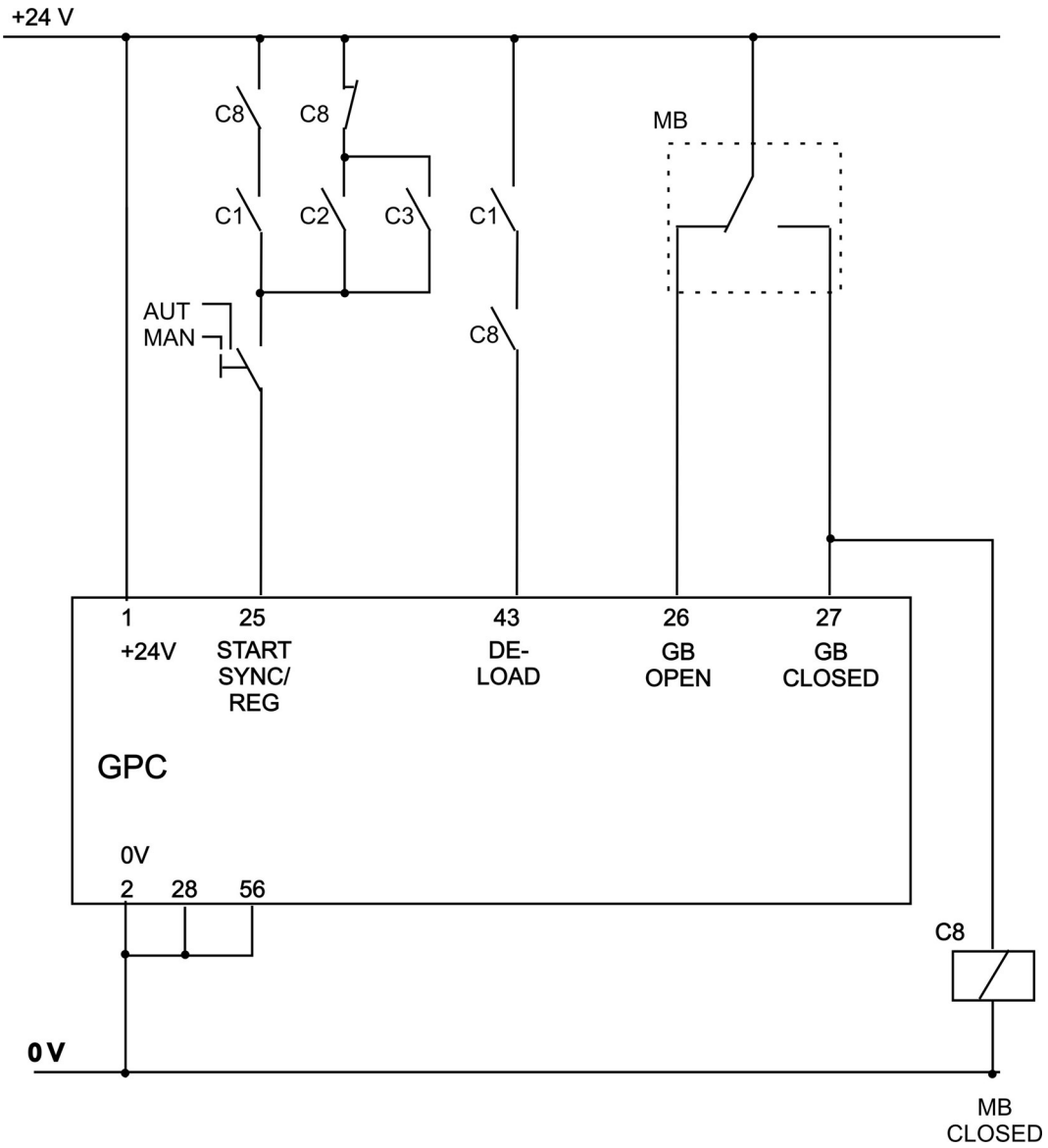
DG1 GPC control



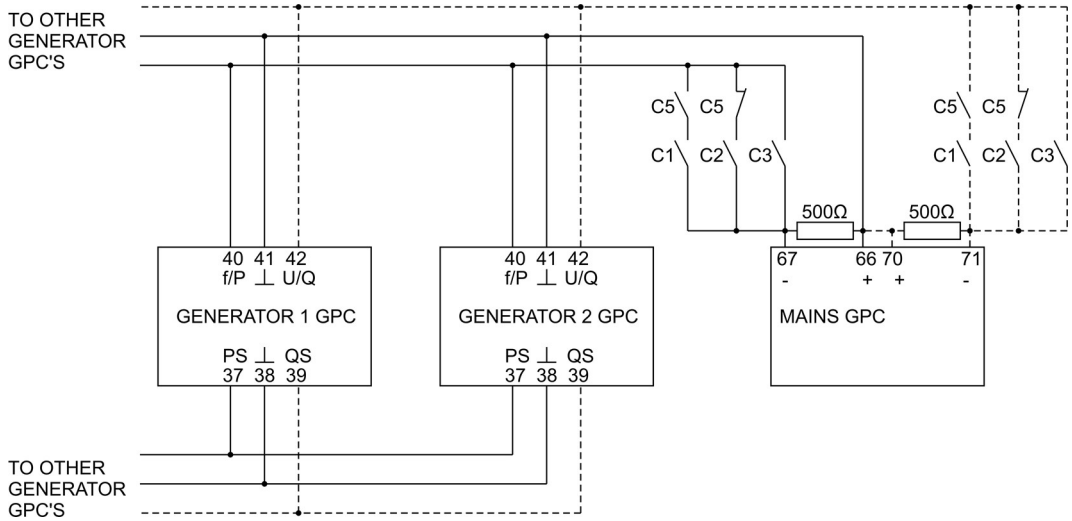
DG 2 GPC controls



Mains GPC controls



DG analogue lines between units



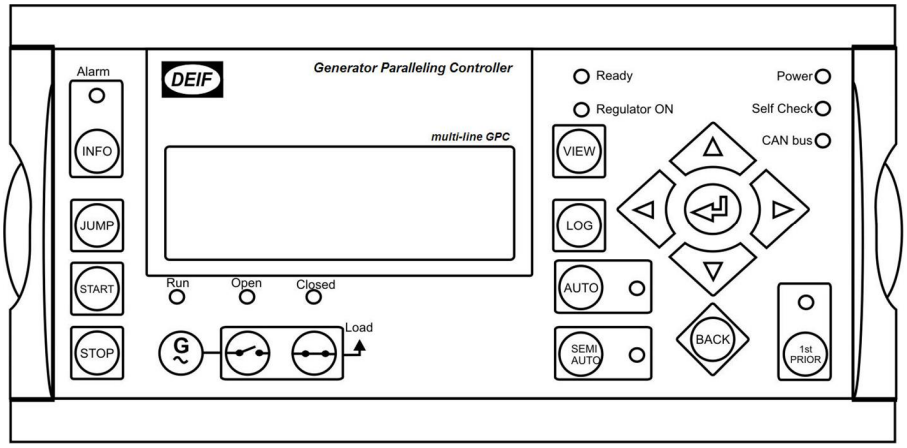
The dotted line connections are only needed if AVR control is included.

4. Functional description

4.1 Display

4.1.1 The GPC display

The display of the GPC used in this application looks like this:



The "Remote" LED is indicating if the generator is controlled locally via the display unit push-buttons (LED = OFF) or remotely (LED = ON). The selection is made on the "REMOTE"/"LOCAL" buttons.

4.2 Selector switches

4.2.1 Installation of switches

On the switchboard, a number of selector switches must be installed. The purpose is to be able to operate the system with the functionality mentioned in chapter "Application description".

Switch/function	Switch functionality
Running mode selector	Selection between diesel generator, mains parallel or mains supply
Gen. auto/manual	Allows DG to be operated in AUTO mode
Gen. start enable	Enables the genset to start

4.3 Running mode selections

4.3.1 Select running mode

The operation of the gensets depends on the selected running mode. The running mode is selected with a selector switch and on the display.

AUTOMATIC

Set switch AUT/MAN on each generator switchboard to position AUTO
Set switch AUT/MAN on the mains switchboard to position AUTO
Set display mode in REMOTE

The remote LED on the display must be ON.

This will enable the automatic generator running, meaning the generators will run constantly when the selector is in the "DIESEL" position.

SEMI-AUTOMATIC
Set switch AUT/MAN on each generator switchboard to position AUTO
Set switch AUT/MAN on the mains switchboard to position AUTO
Set display mode in LOCAL

The remote LED on the display must be OFF.

The generators can now be started and stopped, and the breaker closed (synchronised) and opened (ramp down first) using the display buttons.

MANUAL
Set switch AUT/MAN on each generator switchboard to position MANUAL
Set switch AUT/MAN on the shaft/shore switchboard to position MANUAL
Set display mode in LOCAL
The remote LED on the display must be OFF.
Manual mode will enable the operator to use the START, STOP and generator breaker buttons on the display for start/stop and generator breaker synchronising/open.

REMEMBER: Set the mode on the display back to remote (LED ON) and "Generator AUT/MAN" back in AUTO again when finished with manual operation. If this is not done, the result is that the generator will not participate in the automatic functions.

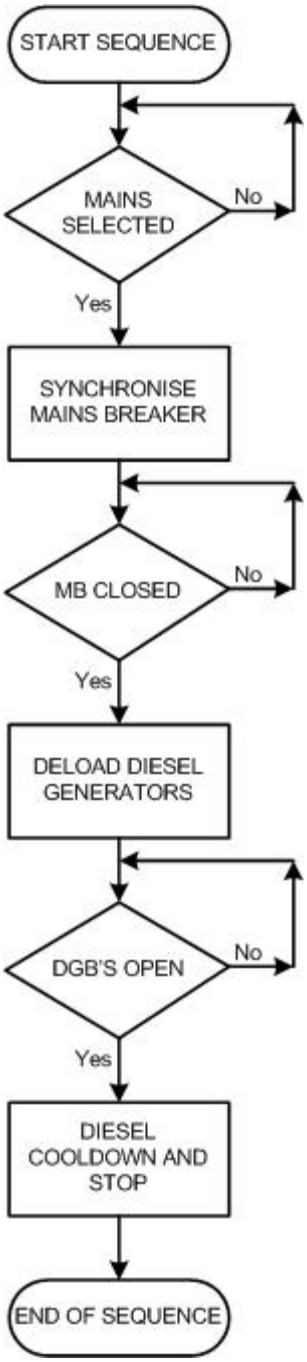
Manual speed control
In manual running mode, to adjust the speed (frequency) up and down, digital command inputs can be used. Any free digital input can be selected for the function.

Breaker operation
If the breaker is open, pressing the breaker button will make the GPC act as a check synchroniser (it will close the breaker when the conditions are OK), but the speed must be controlled with the digital inputs (or by other means).

If the breaker is in closed position and the breaker button is pressed, the breaker will open immediately in the manual running mode.

5. Flowcharts

5.1 Transfer to mains supply



5.2 Transfer to diesel generator supply