MULTI-LINE 2
DESCRIPTION OF OPTIONS



Option G3
Load sharing

- Description of option
- Functional description

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SW version:

1. Delimitation

1.1 Scope of option G3

This description of options covers the following product:

AGC-3	SW version 3.4x.x or later
AGC-4	SW version 4.0x.x or later

2. General information

2.1 Warnings, legal information and safety

2.1.1 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.

2.1.2 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.

2.1.3 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.

2.1.4 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.

2.1.5 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.

3. Description of option

3.1 ANSI numbers

Function	ANSI no.
Load sharing between gensets	90

3.2 Option G3

3.2.1 AGC

Option G3 is a hardware option, and therefore a separate PCB is installed in slot #3 in addition to the standard-installed hardware. If option M12 is already installed in the unit, option G3 is a software upgrade.

3.3 Terminal description

Term.	Function	Technical data	Description	Comment
37	-5/+5V DC	Analogue I/O	Active load sharing line	Requires option G3
38	Com.	Common	Common	
39	-5/+5V DC	Analogue I/O	Reactive load sharing	Requires option D1/G3
40	-10/+10V DC	Analogue I/O	f/P setpoint	Requires option G3
41	Com.	Common	Common	
42	-10/+10V DC	Analogue I/O	U/Q setpoint	Requires option D1/G3

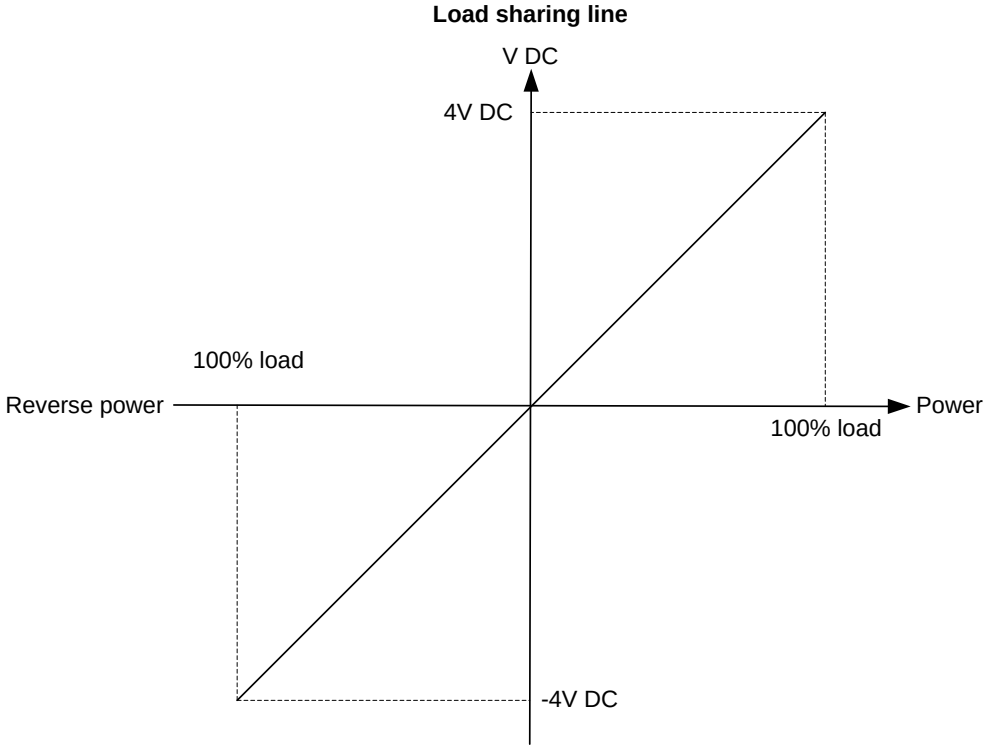
4. Functional description

4.1 Load sharing

Option G3 is an option that enables the unit to share the active load (and reactive load (option D1)) equally in percentage of the nominal power. The load sharing is active when the genset is running in island mode and the generator breaker is closed.

A voltage signal equal to the load produced by the genset is sent to the load sharing line. When the generator load is 0%, 0V DC is sent to the load share line. When the load is 100%, the voltage will be 4V DC.

This is illustrated in the drawing below.



The active load sharing line is illustrated above, and the characteristics of the reactive load sharing line are equivalent to it.

4.1.1 Working principle

The controller unit will supply a voltage on the load sharing line equal to the actual load. This voltage comes from an internal power transducer. At the same time, the actual voltage on the load sharing line will be measured.

If the measured voltage is higher than the voltage from the internal power transducer, the unit will increase its load in order to match the voltage on the load sharing line.
If the measured voltage is lower than the voltage from the internal power transducer, the unit will decrease its load in order to match the voltage on the load sharing line.

The voltage on the load sharing line will only be different from the voltage from the internal power transducer, if two or more controller units are connected to the load share line.

When the option G3 is activated, the load share line will be active at all times no matter if one generator is running in a single application, or a number of generators are actually sharing the load. In case a generator is running alone, it is recommended to disable the load share line to keep the frequency regulator active.

To disable the load share line, use the M-Logic category output/inhibits in the PC utility software.

To improve the handling of several generators in the same application, the option G3 is working as backup system for the power management AGC; option G5. This means that if both option G3 and power management are available in the same unit, the load sharing will be done by the CANbus communication as the primary choice, but if a CANbus error occurs, the load sharing will continue on the analogue load sharing line. The generators will stay stable even though the power management is lost.

AGC only: please refer to the description of option G5 for further information about the power management.

Example 1:
Two generators are running in parallel. The loads of the generators are:

Generator	Actual load	Voltage on load sharing line
Generator 1	100%	4V DC
Generator 2	0%	0V DC

The voltage level on the load sharing line can be calculated to:

U_{LS}: (4 + 0) / 2 = 2.0V DC

Now generator 1 will decrease the load in order to match the voltage on the load sharing line (in this example 2.0V DC). Generator 2 will increase the load in order to match the 2.0V DC.

The new load share situation will be:

Generator	Actual load	Voltage on load sharing line
Generator 1	50%	2.0V DC
Generator 2	50%	2.0V DC

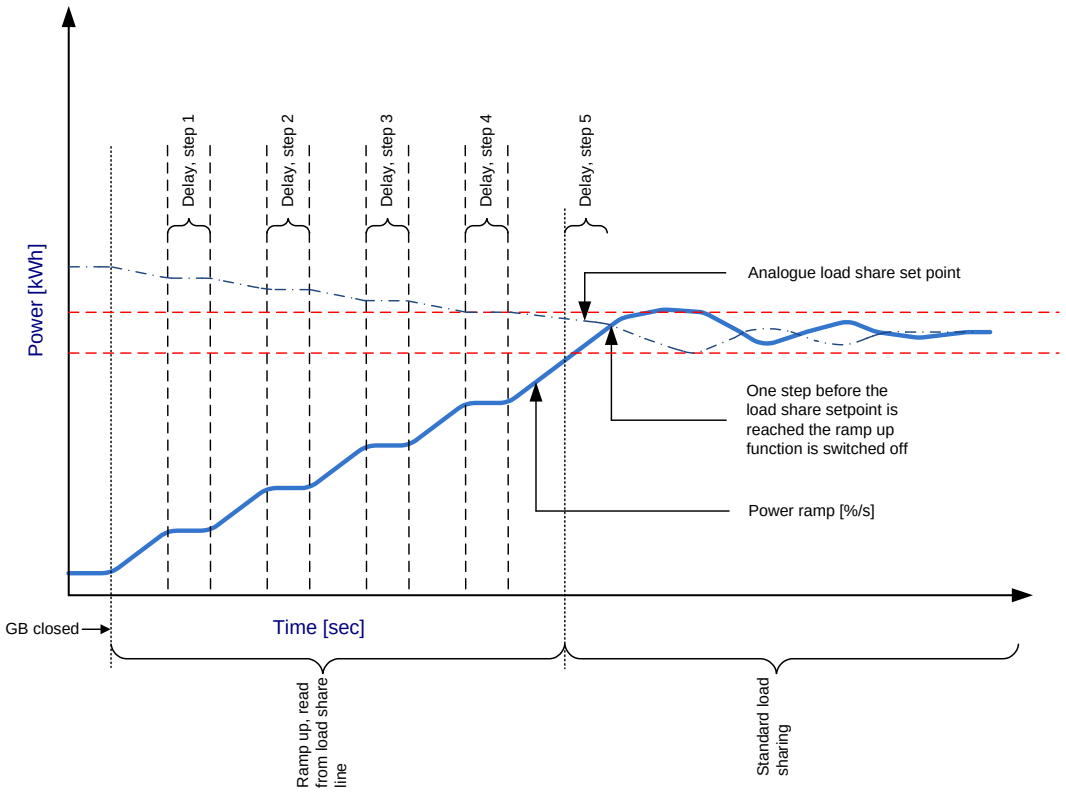
Example 2:
If the size of the generators differs, the load sharing will still be carried out on the basis of a percentage of the nominal power.

Two generators supply the busbar. The total load is 550 kW.

Generator	Nominal power	Actual load	Voltage on load sharing line
Generator 1	1000 kW	500 kW	2.0V DC
Generator 2	100 kW	50 kW	2.0V DC

Both generators are supplying 50% of their nominal power.

4.2 Island ramp up with load steps



When menu 2614 is enabled, the power setpoint continues to rise in ramp up steps, determined by menu 2615, towards the load sharing setpoint. The delay time between each ramp up step will be determined by menu 2613. The ramp up will continue until the load sharing setpoint is reached, and then the regulator will be switched to standard load sharing mode.

If the delay point is set to 20% and the number of load steps is set to 3, the genset will ramp to 20%, wait the configured delay time, ramp to 40%, wait, ramp to 60%, wait and then ramp to the system setpoint. If theset point is at 50%, the ramp will stop at 50%.

4.3 Freeze power ramp

A way to define the ramp up steps is to use the freeze power ramp command in M-Logic.

Freeze power ramp active:

1. The power ramp will stop at any point of the power ramp, and this setpoint will be maintained as long as the function is active.
2. If the function is activated while ramping from one delay point to another, the ramp will be fixed until the function is deactivated again.
3. If the function is activated while the delay timer is timing out, the timer will be stopped and will not continue until the function is deactivated again.

4.4 External analogue setpoints

The genset can be controlled from internal as well as from external set points. The external set points are activated with a digital input.

The inputs are only available, if option G3 is selected.

Five different inputs can be selected by using the ML-2 PC utility software (USW):

Input	Ext. setpoint active condition	Comment
Ext. frequency ctrl	Stand-alone generator or GB opened	
Ext. power ctrl	Parallel to mains (AGC)	
Ext. voltage ctrl	Stand-alone generator or GB opened	Requires option D1.
Ext. PF ctrl	Parallel to mains (AGC)	
Ext. VAr ctrl	Parallel to mains (AGC)	

The controller setpoints will be ignored if the running condition is not present. It is for instance not possible to use the frequency controller when paralleling to the mains.

The table below shows the possible setpoints.

Controller	Input voltage	Description	Comment
Frequency	+/-10V DC	f_{NOM} +/-10%	AGC only: active when MB is OFF
Power	+/-10V DC	P_{NOM} +/-100%	
Voltage	+/-10V DC	U_{NOM} +/-10%	AGC only: active when GB is OFF
Reactive power	+/-10V DC	Q_{NOM} +/-100%	
Power factor	÷10 V…0…10V DC	0.6 capacitive…1.0…0.6 inductive	

The external setpoints can be used in all genset modes, when auto or semi-auto mode is selected.

Only a limited number of digital inputs are available in the standard unit. The unit should be installed with the sufficient number of options to get the desired digital inputs.

If the option H2 (Modbus RS 485 RTU) is available in the unit, the external setpoints can be controlled from the control registers in the Modbus protocol. Please refer to the description of option H2 for further information.

4.5 Load sharing type

The AGC can be adjusted to work with different types of load sharing modules and ranges of the load sharing signal. This is controlled by two menus: menu 6380 (signal level) and 6390 (load sharing type). The signal level is used to adjust the maximum output of the LS lines. The default range is 0-4V DC, and therefore 4V DC is the voltage applied to the load sharing line at 100% load. If the AGC is interfacing to another product where the max. range is different, then it can be changed in this menu.

To be able to adjust the max. range, it is necessary to adjust the menu 6391 to "adjustable". The AGC is able to provide between 1.0 and 5.0V DC as 100% load. Load sharing interfacing to DEIF Uni-line LSU (load sharing unit) and Multi-line 2 version 1 and version 2 might require a 0-5V DC range, depending on configuration. If the load sharing is unequal, please check this.

Menu 6390 holds the following possibilities:
- Adjustable
- Selco T4800
- Cummins PCC

When either "Selco T4800" or "Cummins PCC" is selected, then the adjustable range is ignored. The selection causes the AGC to modify the signal level of the LS lines to adapt to the specific brand of controller/load share unit.

4.5.1 Load sharing modules

If interfacing is performed to the load sharing modules of unspecified brands, it might be necessary to provide galvanic separation of the load sharing lines. The input impedance of such isolation amplifiers should be high impedance for proper function.

4.5.2 Selco T4800 load sharer

The signal level is +/-1V DC, so the AGC adapts automatically to this level. The terminals of the T4800 are 12 (com) and 13 (+). When interfacing to the Selco T4800, the frequency difference of the measured compared to generator nominal is taken into account in order to prevent unequal load sharing (not user-configurable). T4800 is for kW sharing only and not kVAr sharing.

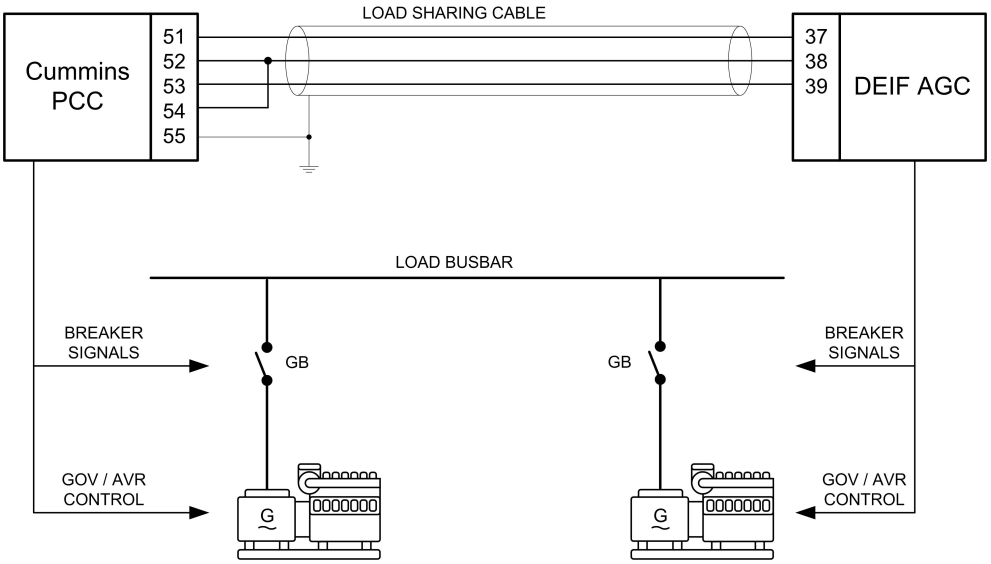
4.5.3 Cummins PCC 3100

The signal level is 0.3-2.1V DC, so the AGC adapts automatically to this level. The terminals (TB3) of the PCC3100 are placed on connector 8, and the terminals are 51 (kW), 53 (kVAr), 52 and 54 (common). Terminal 55 is a dedicated terminal for the shield of the load sharing cable. (Notice that kVAr sharing is option-dependent in some DEIF products (option D1)).

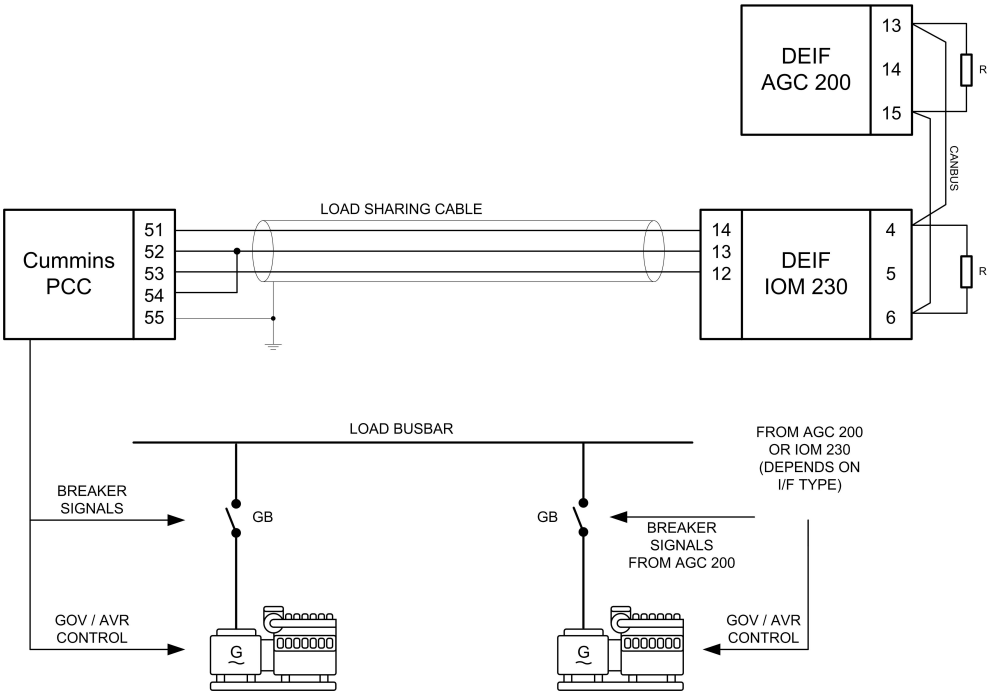
Cummins PCC applications

When the DEIF AGC-3, AGC-4 or AGC 200/IOM230 is being used, then it is possible to interface directly with the PCC using the terminal numbers as mentioned above.

PCC interface to DEIF AGC

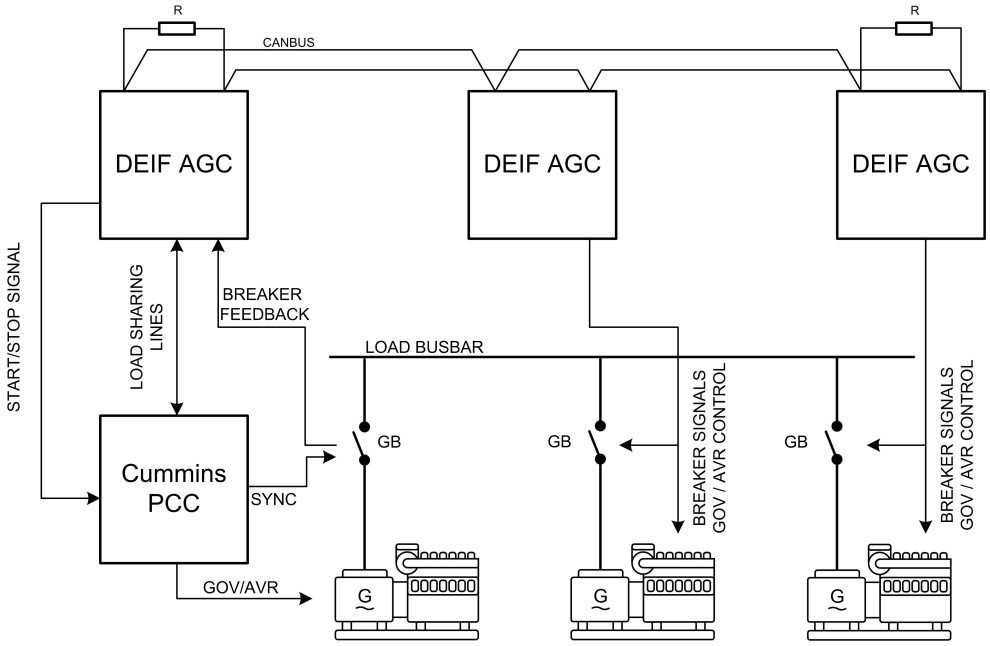


PCC Interface to AGC-200/IOM-230



PCC in DEIF power management system

Notice that if the AGC is part of a power management system, then it is possible to enable the analogue load sharing lines. This is done in M-logic by activating the command "Use Ana LS instead of CAN". If the CANbus communication is used for load sharing, the analogue LS line of the AGC-3 and AGC-4 is still updated so the Cummins PCC will be able to adjust the load level according to the load level of the AGCs. This is useful if the AGC is placed on all gensets only sending start and stop commands to the PCC. This means that the Cummins ILSI unit is not necessary.


R
CANBUS
R
DEIF AGC
DEIF AGC
DEIF AGC
START/STOP SIGNAL
LOAD SHARING LINES
BREAKER FEEDBACK
LOAD BUSBAR
GB
GB
GB
BREAKER SIGNALS GOV / AVR CONTROL
BREAKER SIGNALS GOV / AVR CONTROL
Cummins PCC
SYNC
GOV/AVR
G
G
G

5. Parameters

5.1 Further information

The option G3 relates to the parameters 2610 and 6380-6390.

For further information, please see the separate parameter list for the Multi-line unit in question:

AGC-3	Document number 4189340705
AGC-4	Document number 4189340688