



## MULTI-LINE 2



# General guidelines for commissioning

## 1. Delimitation

## 2. General information

<b>2.1 Warnings, legal information and safety</b> .....	<b>5</b>
2.1.1 Warnings and notes.....	5
2.1.2 Legal information and disclaimer.....	5
2.1.3 Safety issues.....	5
2.1.4 Electrostatic discharge awareness.....	5
2.1.5 Factory settings.....	5
<b>2.2 About the guidelines</b> .....	<b>6</b>
2.2.1 General purpose.....	6
2.2.2 Intended users.....	6

## 3. Commissioning of the Multi-line 2

<b>3.1 Step by step</b> .....	<b>7</b>
-------------------------------	----------

## 4. Settings

<b>4.1 Settings check</b> .....	<b>8</b>
4.1.1 Nominal values.....	8
4.1.2 Alarm settings.....	9
4.1.3 Function control settings.....	10
4.1.4 Synchronisation settings.....	11
4.1.5 Speed controller settings.....	11
4.1.6 Voltage controller settings.....	12

## 5. Governor check

<b>5.1 Instructions</b> .....	<b>14</b>
<b>5.2 Speed setting</b> .....	<b>14</b>
5.2.1 Relay output.....	14
5.2.2 Analogue output.....	14
5.2.3 EIC, J1939.....	14
<b>5.3 Speed droop</b> .....	<b>14</b>
<b>5.4 Speed range</b> .....	<b>15</b>
<b>5.5 Terminals</b> .....	<b>15</b>
5.5.1 Digital interfacing.....	15
5.5.2 Analogue interfacing.....	15
5.5.3 EIC, J1939.....	16

## 6. AVR check

<b>6.1 Instructions</b> .....	<b>17</b>
<b>6.2 Voltage setting</b> .....	<b>17</b>
6.2.1 Relay output.....	17
6.2.2 Analogue output.....	17
<b>6.3 Voltage droop</b> .....	<b>17</b>
<b>6.4 Voltage range</b> .....	<b>18</b>
<b>6.5 Terminals</b> .....	<b>18</b>

## 7. Protections

<b>7.1 Protections check</b> .....	<b>19</b>
7.1.1 Considerations.....	19
7.1.2 Configuration of the protections.....	19

## 8. Adjustment

<b>8.1 Overview</b> .....	<b>21</b>
<b>8.2 Adjusting the PID controller(s)</b> .....	<b>21</b>
8.2.1 Step 1, adjustment of the KP.....	21
8.2.2 Step 2, adjustment of the Ti.....	21
8.2.3 Step 3, adjustment of the Td.....	21
8.2.4 Step 4, readjustment of controller settings.....	21
8.2.5 Manual governor and AVR control.....	22
8.2.6 Manual mode/switchboard control.....	22
8.2.7 Semi-auto mode (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 only).....	22
8.2.8 Auto and test mode (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 only).....	23
<b>8.3 Relay output adjustments</b> .....	<b>23</b>
<b>8.4 Resulting speed/voltage curve upon load change</b> .....	<b>23</b>

## 9. Troubleshooting

# 1. Delimitation

This document covers the following products:

AGC-4 Mk II	SW version 6.0x.x or later
AGC-4	SW version 4.0x.x or later
AGC 200 series	SW version 3.5x.x or later
AGC-3	SW version 3.3x.x or later
AGC PM	SW version 5.03.x or later
GPC-3/GPU-3 Hydro	SW version 3.0x.x or later
GPU-3/PPU-3	SW version 3.0x.x or later
PPM-3	SW version 3.0x.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



##### **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.

#### 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.

**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.

#### 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.



##### **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.

#### 2.1.4 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.

#### 2.1.5 Factory settings

The Multi-line 2 unit is delivered from the factory with default settings. These are not necessarily correct for the engine/generator set. Check all the settings before running the engine/generator set.

## **2.2 About the guidelines**

### **2.2.1 General purpose**

This document includes general guidelines for commissioning of DEIF's Multi-line 2 units. It mainly includes instructions for settings, governor, AVR and protections check and unit adjustment. The general purpose of the document is to supply general guidelines to be used in the commissioning of the Multi-line 2.



#### **DANGER!**

Please 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.

### **2.2.2 Intended users**

These guidelines are mainly intended for the person responsible for the commissioning of the unit. In most cases, this would be a commissioning engineer.

## 3. Commissioning of the Multi-line 2

### 3.1 Step by step

The illustration below indicates the overall steps to be followed in order to carry out a successful commissioning of the Multi-line 2 unit.

<i>Step 1</i>	<b>Settings check</b>
<i>Step 2</i>	<b>Governor check</b>
<i>Step 3</i>	<b>AVR check</b>
<i>Step 4</i>	<b>Protections check</b>
<i>Step 5</i>	<b>Adjustment</b>

In addition, the generic troubleshooting in the chapter "Troubleshooting" can be used.

## 4. Settings

### 4.1 Settings check

It is necessary to perform a settings check. This is done by following these steps:

1. Check and adjust the nominal settings.
2. Check and adjust the alarm settings.
3. Check and adjust the function control settings.
4. Check and adjust the speed controller settings.
5. Check and adjust the voltage controller settings.

The above-mentioned settings must be checked and adjusted prior to the initial starting of the genset.



#### INFO

The settings can be adjusted using either the display or the PC utility software. For navigating in the menus, see the **Operator's Manual**.

#### 4.1.1 Nominal values

The nominal values of the Multi-line 2 are adjusted in the general part of the system setup menu.



File Connection Parameters Help

View mode:  Tree  List

All groups  Protection  Synchronisation  Regulation  Digital In  Analogue In  Outputs  General  Mains  Communicatio

Drag a column header here to group by that column

Category	Channel	Text	Address	Value	Unit
General	6001	Nom. f 1	407	50	Hz
General	6002	Nom. P 1	408	480	kW
General	6003	Nom. I 1	409	867	A
General	6004	Nom. U 1	410	400	V
General	6005	Nom. rpm 1	411	1500	RPM
General	6006	Enable nom. set	412	0	
General	6011	Nom. f 2	413	50	Hz
General	6012	Nom. P 2	414	230	kW
General	6013	Nom. I 2	415	345	A
General	6014	Nom. U 2	416	480	V
General	6015	Nom. rpm 2	417	1500	RPM
General	6016	Block nom chang	1229	0	
General	6021	Nom. f 3	418	60	Hz
General	6022	Nom. P 3	419	230	kW
General	6023	Nom. I 3	420	345	A
General	6024	Nom. U 3	421	480	V
General	6025	Nom. rpm 3	422	1800	RPM
General	6031	Nom. f 4	423	60	Hz
General	6032	Nom. P 4	424	230	kW
General	6033	Nom. I 4	425	345	A
General	6034	Nom. U 4	426	480	V
General	6035	Nom. rpm 4	427	1800	RPM
General	6041	G primary U	428	400	V
General	6042	G secondary U	429	400	V
General	6043	G Primary I	430	1000	A
General	6044	G Secondary I	431	1	A
General	6051	BB primary U 1	432	400	V
General	6052	BB second. U 1	433	400	V
General	6053	BB Nominal U 1	1326	400	V
General	6054	Bus nom. set	1582	0	
General	6061	BB primary U 2	1579	400	V
General	6062	BB second. U 2	1580	400	V
General	6063	BB Nominal U 2	1578	400	V
General	6070	Genset Mode	435	6	

In the PC utility software, these parameters are presented as shown on the above screen dump. The correct values are supplied by the switchboard manufacturer.

## 4.1.2 Alarm settings

The alarm settings are adjusted in the protection setup menu.

Category	Channel	Text	Address	Value	Unit
Protection	1000	-P> 1		1	-5 %
Protection	1010	-P> 2		2	-5 %
Protection	1030	> 1		4	115 %
Protection	1040	> 2		5	120 %
Protection	1050	> 3		6	115 %
Protection	1060	> 4		7	120 %

In the PC utility software, these parameters are presented as shown on the screen dump above or similar. The number of alarms depends on the options selection of the individual unit. The actual alarm parameters are adjusted according to customer and application requirements.

### 4.1.3 Function control settings

The function control settings are adjusted in the general part of the system setup menu.

Category	Channel	Text	Address	Value	Unit
General	6130	Alarm horn		449	N/A
General	6151	Run coil setup		1455	N/A
General	6152	Run coil setup		1456	0
General	6160	Run status		452	N/A
General	6165	Freq. Det. Lvl		83	32 Hz
General	6171	Number of teeth		453	0
General	6172	Run detect type		454	2
General	6173	Running detect.		455	1000 RPM
General	6174	Remove starter		456	400 RPM
General	6175	Pressure level		1101	0
General	6181	Start Prepare		458	N/A
General	6182	Ext. Start Prepare		459	N/A
General	6183	Start On Time		460	N/A
General	6184	Start Off Time		461	N/A
General	6185	Start threshold type		1102	0
General	6186	Start threshold		1103	0
General	6191	Start attempts		462	3
General	6192	Double attempts		1373	0
General	6201	Shutdown overr.		463	7
General	6202	Shutdown overr.		464	N/A
General	6203	Shutdown overr.		465	N/A
General	6211	Cooldown Time		466	N/A
General	6212	Extended Stop Time		467	N/A

In the screen shot above, only some of the settings are shown. Since the function control settings include parameters for all the Multi-line 2 unit functions, they must be worked through carefully. The function control settings are adjusted according to the desired unit control.



**INFO**

If you need more information about the requirements, contact the switchboard manufacturer.

### 4.1.4 Synchronisation settings

The ML-2 synchronisation settings are adjusted in the synchronisation part of the control setup menu.

DEIF utility software - 3.47.1; Connected to "AGC-4 Mk II Genset" (version 6.00.0 rev. 1353)

File Connection Parameters Help

View mode:  Tree  List

All groups: Protection Synchronisation Regulation Digital In Analogue In Outputs General Mains Communicatio

Drag a column header here to group by that column

Category	Channel	Text	Address	Value	Unit
Synchronisation	2000	Static sync	63		N/A
Synchronisation	2021	Sync. dfMax	65		0,3 Hz
Synchronisation	2022	Sync. dfMin	66		0 Hz
Synchronisation	2023	Sync. dUMax	67		5 %
Synchronisation	2024	Sync. dUMin	1615		-5 %
Synchronisation	2025	Sync. t GB	68		50 ms
Synchronisation	2026	Sync. t MB	69		50 ms
Synchronisation	2031	Maximum df	70		0,1 Hz
Synchronisation	2032	Maximum dU	71		5 %
Synchronisation	2033	Closing window	72		10 deg
Synchronisation	2034	Static sync	73		N/A s
Synchronisation	2035	Static type	1533		1
Synchronisation	2036	Static type	1562		1
Synchronisation	2041	f sync. Kp	74		2,5
Synchronisation	2042	f sync. Ti	75		1,5 s
Synchronisation	2043	f sync. Td	76		0 s
Synchronisation	2050	f sync Kp relay	77		10



**INFO**

GPU/GPU Hydro: Synchronisation requires option G2.

### 4.1.5 Speed controller settings

The Multi-line 2 speed controller settings are adjusted in the regulation part of the control setup menu.

The screen shot below shows the controller settings related to the speed governor. As an initial setting before the first start up, the  $K_p$  of the frequency and power controllers are set to a low value giving a slow regulation.

File Connection Parameters Help

View mode:  Tree  List

All groups  Protection  Synchronisation  Regulation  Digital In  Analogue In  Outputs  General  Mains  Communicatio

Drag a column header here to group by that column

Category	Channel	Text	Address	Value	Unit
Regulation	2511	f Kp	122	2,5	
Regulation	2512	f Ti	123	1,5	s
Regulation	2513	f Td	124	0	s
Regulation	2514	f Droop	125	4	%
Regulation	2531	P Kp	126	2,5	
Regulation	2532	P Ti	127	1,5	s
Regulation	2533	P Td	128	0	s
Regulation	2541	P loadsh. f Kp	129	2,5	
Regulation	2542	P loadsh. f Ti	130	1,5	s
Regulation	2543	P loadsh. f Td	131	0	s
Regulation	2544	P LS P weight	132	10	%
Regulation	2550	GOV outp offset	133	50	%
Regulation	2551	GOV outp offset	1633	50	%
Regulation	2552	GOV outp offset	1634	50	%
Regulation	2553	GOV outp offset	1635	50	%
Regulation	2560	GOV reg. fail	134	30	%
Regulation	2571	f deadband	135	1	%
Regulation	2572	f Kp relay	136	10	
Regulation	2573	f Droop relay	1375	4	%
Regulation	2581	P deadband	137	2	%
Regulation	2582	P Kp relay	138	10	
Regulation	2591	P LS f deadband	139	1	%
Regulation	2592	P ls. f Kp rel.	140	10	
Regulation	2593	P LS P deadband	141	2	%
Regulation	2594	P LS P weight	142	10	%
Regulation	2601	GOV ON time	143	500	ms
Regulation	2602	GOV period time	144	2500	ms

## Analogue controller or EIC, J1939

As an initial setting before the first start up, the  $K_p$ ,  $T_i$  and  $T_d$  of the frequency and power controllers are set to a value giving a slow regulation. This means that  $K_p$  and  $T_d$  should be set to a low value, and  $T_i$  should be set to a high value.

### 4.1.6 Voltage controller settings

The voltage controller settings are adjusted in the regulation part of the control setup menu.

View mode:  Tree  List

Drag a column header here to group by that column

Category	Channel	Text	Address	Value	Unit
Regulation	2641	U Kp		151	2,5
Regulation	2642	U Ti		152	1,5 s
Regulation	2643	U Td		153	0 s
Regulation	2644	U Droop		1374	4 %
Regulation	2651	Q Kp		154	2,5
Regulation	2652	Q Ti		155	1,5 s
Regulation	2653	Q Td		156	0 s
Regulation	2661	Q loadsh. U Kp		157	2,5
Regulation	2662	Q loadsh. U Ti		158	1,5 s
Regulation	2663	Q loadsh. U Td		159	0 s
Regulation	2664	Q LS Q weight		160	10 %
Regulation	2670	AVR outp offset		161	50 %
Regulation	2671	AVR outp offset		1636	50 %
Regulation	2672	AVR outp offset		1637	50 %
Regulation	2673	AVR outp offset		1638	50 %
Regulation	2680	AVR reg. fail		162	30 %
Regulation	2691	U deadband		163	2 %
Regulation	2692	U Kp relay		164	10
Regulation	2693	U Droop relay		1376	4 %
Regulation	2701	Q deadband		165	2 %
Regulation	2702	Q Kp relay		166	10
Regulation	2711	Q LS U deadband		167	1 %
Regulation	2712	Q Is. U Kp rel.		168	10
Regulation	2713	Q LS Q deadband		169	2 %
Regulation	2714	Q LS Q weight		170	10 %
Regulation	2721	AVR ON time		171	100 ms
Regulation	2722	AVR period time		172	500 ms

The screen shot above shows the controller settings of the voltage and reactive power controller. As an initial setting before the first start up, the  $K_p$  of the voltage and reactive power controllers are set to a low value giving a slow regulation.

### Analogue controller or J1939

As an initial setting before the first start up, the  $K_p$ ,  $T_i$  and  $T_d$  of the frequency and power controllers are set to a value giving a slow regulation. This means that  $K_p$  and  $T_d$  should be set to a low value, and  $T_i$  should be set to a high value.

## 5. Governor check

### 5.1 Instructions

Even if the engine manufacturer has adjusted the governor, it is necessary to carry out the following adjustments to be sure that the Multi-line 2 can successfully operate with the speed governor.

The governor should be tuned in according to the governor/engine manufacturer's instructions. It is important that the engine is able to run smoothly and without hunting, before the control function of the Multi-line 2 is activated.

### 5.2 Speed setting

An initial speed setting must be made.



#### INFO

The speed setting procedure is depending on the interfacing.

#### 5.2.1 Relay output

- Disable the outputs from the Multi-line 2.
- Run the generator with no load (open generator breaker).
- Adjust the frequency (on the speed governor) to be base frequency (50 or 60 Hz).

#### 5.2.2 Analogue output

The analogue output is a  $\pm 25$  mA or 0-20 mA (depending on option) signal which in most cases must be converted into a voltage using a resistor across the terminals (150  $\Omega$  gives 3 V DC at 20 mA, and so on).

The AGC 200 series has no analogue outputs. If analogue outputs are needed, the IOM 200 series external interface unit must be used.

Given the fact that especially the governors are sensitive to the external circuit impedance, it is essential to carry out the initial setting of speed governor while the Multi-line 2 is connected and the control function disabled.

Putting the Multi-line 2 in manual operation, (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 = MAN, PPM = switchboard control) disables the control function. This will "disable" the control outputs, but the generator protection is still active. If you fail to do this, you may experience control problems later on.

- Set the unit in manual operation/switchboard control.
- Reboot the unit or activate the input "reset analogue controller outputs".
- Run the generator with no load (open generator breaker).
- Set the frequency (on the speed governor) to be base frequency (50 or 60 Hz).

#### 5.2.3 EIC, J1939

The speed setting is not possible to adjust because the proper rpm is adjusted in the ECU from the factory side.

### 5.3 Speed droop

The speed governor must have a speed droop of 3 to 4 % (speed dropping 3 to 4 % from no load to full load, when the Multi-line 2 is **not** in control). In order to ensure equal load sharing on parallel running machines, all governors must have the same droop setting.

**INFO**

DEIF recommends adjusting the speed droop on the speed governor for stability purposes. It is necessary in all cases when relay outputs for governor control is used.

When analogue interfacing is used, it is possible to operate with a speed droop adjustment of 0 %, but for safety reasons it is recommended to use the speed droop adjustment.

## 5.4 Speed range

When using the analogue interfacing, the resistor installed across the output terminals is selected to obtain the necessary speed range. When finding the correct resistor, several aspects must be considered.

The necessary speed range must be selected, so it is possible to operate at full load. Typically, this is  $f_{NOM} + 3$  Hz. If the speed range is too high, the resistor size must be decreased. If the speed range is too low, the resistor size must be increased.

**INFO**

The speed range must allow for the full load of the genset. If full load cannot be reached, then the resistor size must be increased.

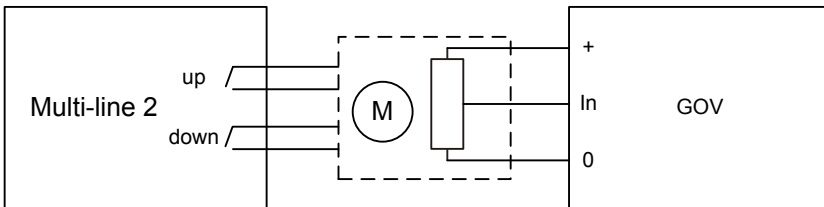
## 5.5 Terminals

The governor can either be prepared for analogue interfacing or digital interfacing. When analogue interfacing is used, a +/-25 mA or 0-20 mA signal from the Multi-line 2 is applied. This signal can be converted to the necessary voltage level. When digital interfacing is used, two relays are used as increase/decrease outputs.

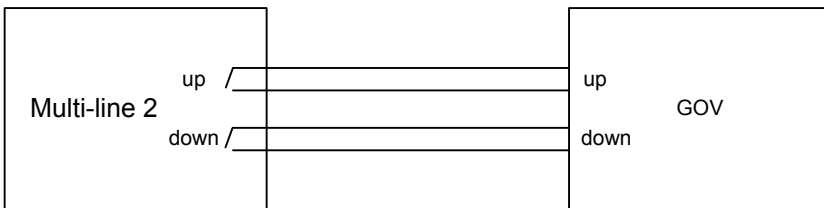
The terminals must be identified depending on the necessary interfacing. Some general examples are shown in the following illustrations.

### 5.5.1 Digital interfacing

#### Motor potmeter

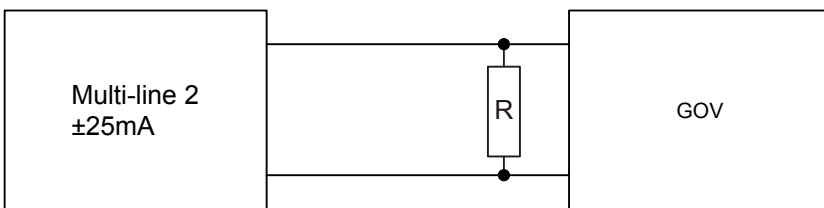


#### Direct digital signals

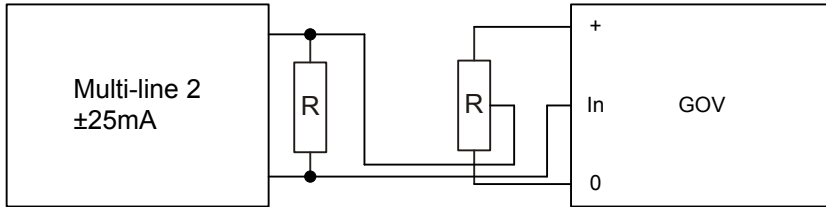


### 5.5.2 Analogue interfacing

#### Direct analogue signal

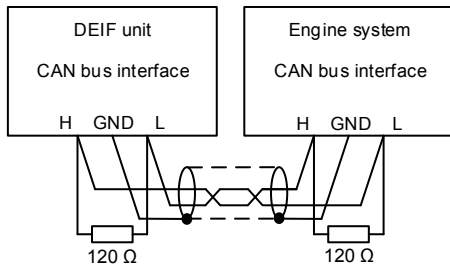


## External potmeter



## 5.5.3 EIC, J1939

The interface is between CAN L and CAN H.



### INFO

For additional information about interfaces, see **Interfacing DEIF Equipment, application notes 4189340670 UK** (available on [www.deif.com](http://www.deif.com)).



## 6. AVR check

### 6.1 Instructions

Even if the AVR is adjusted by the genset manufacturer, it is necessary to go through the following adjustments in order to be sure that the Multi-line 2 can operate with the AVR.

The AVR should be tuned in according to the AVR/generator manufacturer's instructions. It is imperative that the genset is able to operate smoothly, before the control function of the Multi-line 2 is activated.

### 6.2 Voltage setting

An initial voltage level setting must be made.



#### INFO

The voltage level setting procedure is depending on the interfacing.

#### 6.2.1 Relay output

- Disable the outputs from the Multi-line 2.
- Run the generator with no load (open generator breaker).
- Adjust the voltage (on the AVR) to be nominal voltage.

#### 6.2.2 Analogue output

The analogue output is a  $\pm 25$  mA or 0-20 mA (depending on option) signal which in most cases has to be converted into a voltage using a resistor across the terminals (150  $\Omega$  gives 3 V DC at 20 mA, and so on).

The AGC 200 series has no analogue outputs. If analogue outputs are needed, the IOM 200 series external interface unit must be used.

Given the fact that especially the AVRs are sensitive to the external circuit impedance, it is essential to carry out the initial setting of the AVR while the Multi-line 2 is connected and the control function disabled.

Putting the Multi-line 2 in manual operation, (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 = MAN, PPM = switchboard control) disables the control function. This will 'disable' the control outputs, but the generator protection is still active. If you fail to do this, you may experience control problems later on.

- Set the unit in manual operation/switchboard control.
- Reboot the unit or activate the input "reset analogue controller outputs".
- Run the generator with no load (open generator breaker).
- Set the voltage (on the AVR) to be nominal voltage.

### 6.3 Voltage droop

The AVR controls the generator voltage in a way which is comparable to the speed governor controlling the prime mover speed.

This means that the generator AVR must have a voltage droop of 3-4% (voltage dropping 3-4% from no load to full reactive load when the Multi-line 2 has no control). In order to ensure equal VAR sharing on parallel running generators, all generators must have the same voltage droop setting.

## 6.4 Voltage range

When using the analogue interfacing, the resistor installed across the output terminals is selected to obtain the necessary speed range. The voltage range must be defined similar to the speed range for the governor.

The voltage range must be wide enough for the voltage droop and for the full loading of the genset. A typical value is  $\pm 10\% \cdot U_{\text{NOM}}$ . The necessary control signal level is often specified depending on the AVR type.

## 6.5 Terminals

The AVR can either be prepared for analogue interfacing or digital interfacing. When analogue interfacing is used, a  $\pm 25$  mA or 0-20 mA signal from the Multi-line 2 is applied. This signal can be converted to the necessary voltage level. When the digital interfacing is used, two relays are used as increase/decrease outputs.

The AGC 200 series has no analogue outputs. If analogue outputs are needed, the IOM 200 series external interface unit must be used.

The terminals must be identified depending on the necessary interfacing. Some general examples are shown in the illustrations in the chapter "Governor check".

# 7. Protections

## 7.1 Protections check

As a part of the commissioning, the protections should be checked.

The following points must be considered for each alarm:

- Alarm set point
- Alarm delay
- Relay output
- Activation
- Fail class
- Inhibits



### INFO

For further information, see the **Designer's Handbook**.

### 7.1.1 Considerations

Several issues must be taken into consideration when doing the configuration of the alarms. These are e.g. national rules and requirements, additionally installed protection equipment, required use of the protections (trip of non-essential load, breaker tripping and engine stopping).

**The switchboard manufacturer and the end customer must take these considerations.**

### 7.1.2 Configuration of the protections

The dialogue box shows a typical alarm.

Parameter "-P> 1" (Channel 1000)

**Set point :**  
-200      -5 %      0

**Timer :**  
0,1      10 sec      100

**Fail class :** Trip GB

**Output A** Not used

**Output B** Not used

**Password level :** customer

Enable  
 High Alarm  
 Inverse proportional

Auto acknowledge  
 Inhibits...

**Commissioning**  
 Actual value : 0 %  
 Actual timer value  
 0 sec      10 sec

★ Write OK Cancel



**INFO**

In the *Commissioning* field above, the horizontal line with the blue heading shows the elapsed time since the alarm set point was exceeded. In this example, the generator reverse power set point is -5 %. If the commissioning is done without the PC utility software, the timers can be seen in service menu 9120.

## 8. Adjustment

### 8.1 Overview

The adjustment of the unit can be carried out when the initial settings of the governor and the AVR are made.

The controller of the unit is a PID controller.

The unit includes different controllers which must be tuned in at the correct running situations (see the table below):

Controller	Purpose	Tune in conditions
Frequency controller	Controls the frequency when the Multi-line 2 is in island mode (stand-alone).	Tune in when the generator is running with the generator breaker open.
Power controller	Controls the power when the Multi-line 2 is running with fixed power/base load.	Tune in when the generator is running parallel to the mains.
P load share controller	Controls the power when the Multi-line 2 is running in load sharing mode.	Tune in when the generator is running in load sharing mode.
Voltage controller	Controls the voltage when the Multi-line 2 is in island mode (stand-alone).	Tune in when the generator is running with the generator breaker open.
Reactive power controller	Controls the VAr when the Multi-line 2 is running with fixed VAr load.	Tune in when the generator is running parallel to the mains or in load sharing mode.
Q load share controller	Controls the reactive power when the Multi-line 2 is running in load sharing mode.	Tune in when the generator is running in reactive load sharing mode.

### 8.2 Adjusting the PID controller(s)

Before the PID controllers of the Multi-line 2 are tuned in, the values of the  $K_p$ ,  $T_i$  and  $T_d$  of all controllers must be decreased to a low value.

Start by tuning in the  $K_p$  factor, and then tune in the  $T_d$  and  $T_i$ . Normally, the controllers are tuned in following a few general rules as given below.

#### 8.2.1 Step 1, adjustment of the $K_p$

Only the P regulator is to be active ( $T_d$  and  $T_i$  set to 0 s), and the operation of the genset must be stable. Now increase the  $K_p$  factor step by step, until the genset becomes unstable. Adjust the  $K_p$  factor to 50% of the value found above.

#### 8.2.2 Step 2, adjustment of the $T_i$

With the  $K_p$  setting set to the value found in step 1, raise the  $T_i$  to a high value, e.g. 30 s, and decrease  $T_i$  step by step, until the genset becomes unstable. Adjust the  $T_i$  to approx. 1.5-1.7 times the value where instability begins.

#### 8.2.3 Step 3, adjustment of the $T_d$

Step by step increase the  $T_d$  until the genset becomes unstable. Adjust the  $T_d$  to 50...70% of the value.

#### 8.2.4 Step 4, readjustment of controller settings

It can be necessary to make a readjustment of the controller settings, if during testing the genset turns out to be unstable to some extent. If this is the case, then adjust the  $K_p$ ,  $T_d$  and  $T_i$  until the operation is satisfactory.

**INFO**


The Ti and Td settings are only available when analogue controller output is used.

**INFO**

To see the effect of the new adjustments when tuning in the Multi-line 2, remember to make a regulation deviation, e.g. by applying a load jump.

## 8.2.5 Manual governor and AVR control

In many cases, it is difficult to tune in the controller using load jumps (no load bank available). When this is the situation, the manual control can be used as an easy way to make regulation deviations during the commissioning.

This function can be activated by pressing  more than 2 seconds, or by activating the digital inputs or AOP buttons for governor or AVR control in semi-auto mode. The intention of this function is to give the commissioning engineer a helpful tool for adjustment of the regulation.

The function of the regulation window depends on the selected mode:

<b>G</b>	<b>0</b>	<b>0</b>	<b>0V</b>
f-U Setp	100%	100%	
f-U Setp	50%	50%	
	<u>GOV</u>		AVR



## 8.2.6 Manual mode/switchboard control



In manual mode or switchboard control, the regulation is deactivated. When activating the up or down arrows, the output value to GOV or AVR is changed, this is the Reg. value in the display. The up and down arrows have the same function as the digital inputs or AOP buttons for governor and AVR control when the window is open. To exit the regulation window, press "back".

**INFO**

GPC/GPU/GPU Hydro/PPU: Manual GOV/AVR control inputs are not active in SWBD control.

## 8.2.7 Semi-auto mode (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 only)

As in manual mode, the  and  arrows have the same function as the digital inputs or AOP buttons for governor or AVR control when the window is open.

The value *setp* can be changed by pressing the arrow  or . When GOV is underlined, the governor set point will be changed, and vice versa when the AVR is underlined. When changing the *setp* value, an offset will be added to or subtracted from the nominal value. The *reg.* value is the output value from the regulator. If the genset is running in parallel, the active or reactive nominal power set point value will be changed. If it is a stand-alone genset not parallel to the mains, the nominal frequency or voltage set point will be changed and also displayed. When the *back* button is activated, the regulation set point returns to nominal.

**INFO**

If the digital inputs or AOP buttons are activated in semi-auto, the regulation window is automatically opened.

## 8.2.8 Auto and test mode (AGC-4 Mk II/AGC-4/AGC-3/AGC 200 only)

Similar to semi-auto except from the fact that activating the digital inputs or AOP buttons for governor or AVR control will change the regulation set point but not open the regulation window. When the digital inputs or AOP buttons are deactivated, the regulation set point returns to nominal.



### INFO

PPM: Test mode is only available for an emergency generator.



### INFO

AVR set point manipulation requires option D1. Option D1 is included in the standard AGC-4 Mk II.



### INFO

Regarding AOP setup, please refer to *Help* in the PC utility software.

## 8.3 Relay output adjustments

If the relay outputs are used for the speed governor/AVR, it will be necessary to adjust the relay minimum pulse time and the period time.

There are two settings: ON time, which is the shortest relay ON signal time.  
PER time, which is the period time.

The shortest acceptable pulse time is depending on the reaction of the governor/AVR and connection type. Slow reaction requires a long time pulse.

As a starting point, use the following settings for the relay ON time and relay period time:

Governor ON time	Menu 2601	500...1000 ms	
Governor period time	Menu 2602	2500...5000 ms	It is recommended that the period time is approximately 5xON time.
AVR ON time	Menu 2721	100 ms	
AVR period time	Menu 2722	500 ms	It is recommended that the period time is approximately 5xON time.



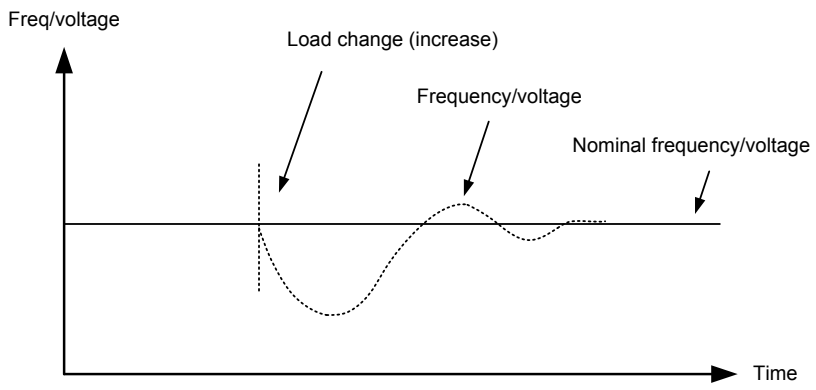
### INFO

It is still necessary to tune in the P controllers.

## 8.4 Resulting speed/voltage curve upon load change

Testing is easily done by using (if possible) a load bank applying "jumps" in the generator load, hereby testing the speed/voltage control.

The optimum result is indicated by this curve:



As indicated, 2-3 "overshoots" before stabilising after a sudden change is OK. If more "overshoots" are present, decrease the  $K_p$  factor and try again.



## 9. Troubleshooting

The troubleshooting table can be used for the Uni-line and the Multi-line 2 products.

Problem indication	Problem cause	Remedy
Load sharing or fixed power control (base load) unstable. Synchronisation OK. Single generator running frequency control OK.	No speed droop on generators.	Apply 3-4% speed drop on prime mover governor.
Load sharing or fixed power voltage (VAR) control unstable. Synchronisation OK. Single generator running frequency control OK.	No voltage droop on generators.	Apply 3-4% voltage drop on generator AVR.
Generator not able to take load to 100%.	Initial setting of speed governor not correct.	See chapters regarding governor/AVR checks.
Generator not able to take load to 100%.	Analogue output from DEIF equipment has too low output range.	Increase the full scale value. This is mostly a case when using electronic potentiometers.
Speed decreases when increase was expected (relay outputs).	Relay outputs "up" and "down" reversed.	Swap connections.
Speed decreases when increase was expected (analogue output).	Outputs "+" and "-" reversed.	Swap connections.
Engine overspeeds when starting up.	Regulator output is too high.	Decrease the analogue output signal by decreasing the resistor.