MULTI-LINE 2
DESCRIPTION OF OPTIONS



Option T2
Digital AVR: DEIF DVC 310 - Leroy Somer D510C

- Description of option
- Functional description

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SW version: 4.60.x

1. Delimitation

1.1 Scope of option T2

This description of options covers the following products:

AGC-4	SW version 4.60.x or later
AGC 200	SW version 4.60.x or later
GPC-3	SW version 3.21.x or later
DVC 310	SW version 2.30 and HW rev. D or later
DEIF EasyReg	SW version 2.60 or later
Leroy Somer D510C	SW version 2.30 and HW rev. D or later
Leroy Somer EasyReg	SW version 2.60 or later

1.2 Hardware and software relations

The below table shows the connection between DVC 310 hardware and supported softwares:

DVC 310 HW	DVC 310 SW	EasyReg SW
Rev. C	2.20	2.50
Rev. D	2.30	2.60

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.

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.

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 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. Setup of DVC 310

3.1 Setup of DVC 310

3.1.1 Setting up the DVC 310 for the first time

By default, the DVC 310 expects the interfacing to be done via CAN bus. In the following chapters, it is described how to set up the DVC 310 with the Multi-line 2 unit and the present alternator.

Some settings in the DVC 310 can be sent from the Multi-line 2 product, whereas other settings must be made from the DEIF EasyReg software. You can download the EasyReg software at DEIF's website, www.deif.com. The installation of the EasyReg software must be done by an administrator. On some PCs, the EasyReg software must also be run by an administrator, even though it has been installed by an administrator. The first time you set up a DVC 310, the EasyReg software must be used, and the CAN bus communication between the Multi-line 2 unit and the DVC 310 should not be connected.

Always run the EasyReg software before connecting DVC310 to the computer through USB, otherwise a message saying "No firmware loaded" may appear (Win8/10).

You can see the wiring for the DVC 310 in the EasyReg software. The picture/animation will change as the settings are changed.

Always use twisted pairs, shielded cables (120 ohm impedance) of good quality for the CAN bus communication, such as Belden 3105A or Unitronic Bus CAN.

The genset should not be started before this manual states that it is allowed to start. This is to ensure that the proper protections and settings have been made.

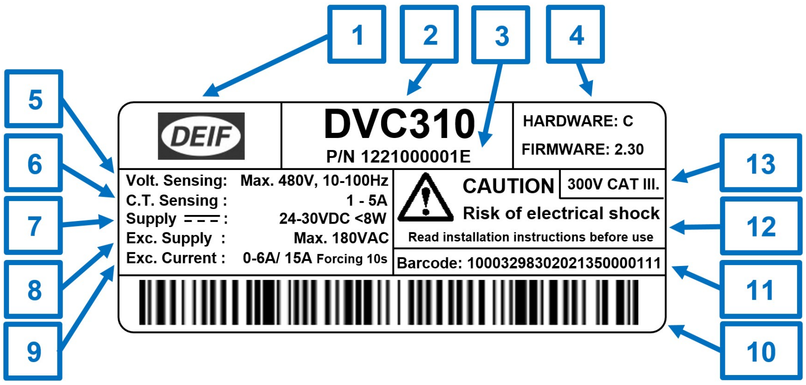
Leroy Somer D510C is compliant with the DVC 310, meaning that whenever a DVC 310 is mentioned in this document, it is also possible to use a Leroy Somer D510C.
To enable this, the Leroy Somer D510C must have the same software version as the DVC 310.This is indicated in the next paragraph.

3.1.2 Software version

This document is based on the following software and P/N revisions:

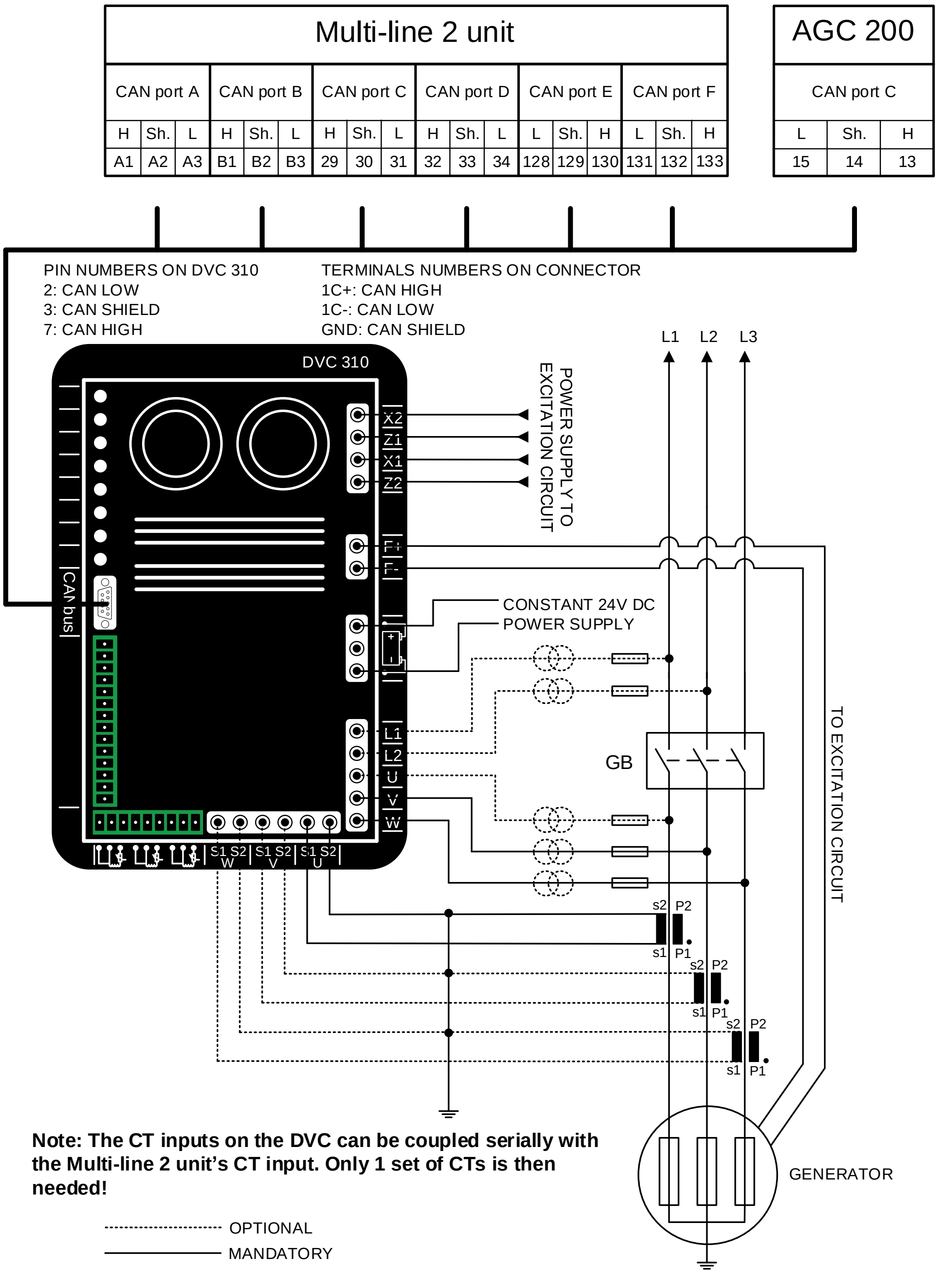
Software type	Software version
DVC 310 firmware	2.30
EasyReg for DEIF	2.60

Hardware identification	Revision
DVC 310 Hardware	Rev. C
DVC 310 Part Number (P/N)	Rev. E

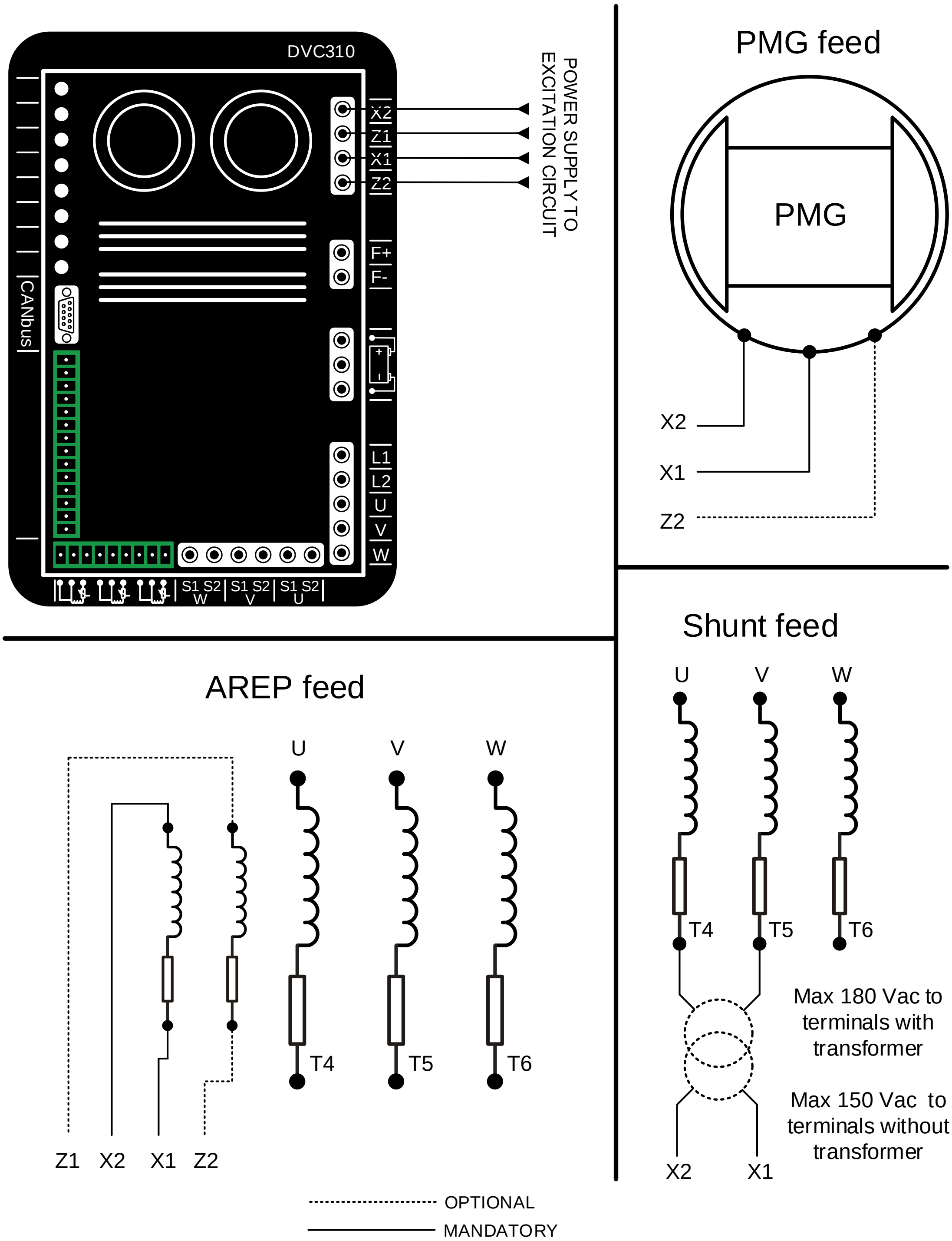

1
2
3
4
5
6
7
8
9
10
11
12
13
DEIF
DVC310
P/N 1221000001E
HARDWARE: C
FIRMWARE: 2.30
Volt. Sensing: Max. 480V, 10-100Hz
C.T. Sensing : 1 - 5A
Supply ⎓ : 24-30VDC <8W
Exc. Supply : Max. 180VAC
Exc. Current : 0-6A/ 15A Forcing 10s
CAUTION
300V CAT III.
Risk of electrical shock
Read installation instructions before use
Barcode: 10003298302021350000111

	Text/ area	Description	Contains
1	DEIF	DEIF logo	DEIF logo printed in black
2	Type name	Product type name	Text: “DVC310”
3	P/N	DEIF part number and revision letter	Text example: “P/N 1221000001E”
4	Hardware, Firmware	Hardware and Firmware versions	Text example: “Hardware: C”, “Firmware: 2.30”
5	Volt. sensing	Electrical specifications	Text: “Volt. Sensing: Max. 480V, 10-100Hz”
6	C.T. Sensing	Electrical specifications	Text: “C.T. Sensing: 1 - 5A”
7	DC Supply	Electrical specifications	Text: “Supply 24-30VDC <8W”
8	Exc. Supply	Electrical specifications	Text: “Exc. Supply: Max. 180VAC”
9	Exc. Current	Electrical specifications	Text: “Exc. Current: 6A/ 15A Forcing 10s.”
10	Barcode	Barcode standard: Code 128	Barcode consisting of (9+3+11 = 23 digits): [Purchase order number] [Order line number] [LS Serial number] Example: PO = 100032983; OL = 020; LS-SN; 21350000111
11	Barcode numbers	Numbers of the barcode	● Text example: “ Barcode: 10003298302021350000111”
12	User information	Warning symbol and text	Risk symbol and text: “CAUTION Risk of electrical shock” “Read installation instructions before use ”
13	Category	Electrical specification	Text: “300V CAT III.”

3.1.3 Wiring to the DVC 310



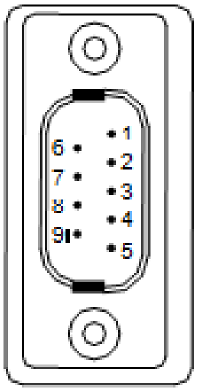
The CT inputs on the DVC 310 can be coupled serially with the Multi-line 2 unit's CT input. In that case, only one set of CTs is needed.


DVC310
X2
Z1
X1
Z2
F+
F-
L1
L2
U
V
W
CANbus
S1 S2 W
S1 S2 V
S1 S2 U
POWER SUPPLY TO EXCITATION CIRCUIT
PMG feed
PMG
X2
X1
Z2
Shunt feed
U
V
W
T4
T5
T6
Max 180 Vac to terminals with transformer
Max 150 Vac to terminals without transformer
X2
X1
AREP feed
U
V
W
T4
T5
T6
Z1
X2
X1
Z2
OPTIONAL
MANDATORY

3.1.4 Communication/wiring between Multi-line 2 unit and DVC 310

Communication between the DVC 310 and a Multi-line 2 unit is established with the engine communication port via J1939 CAN bus. To facilitate the wiring, the terminal numbers are shown below.

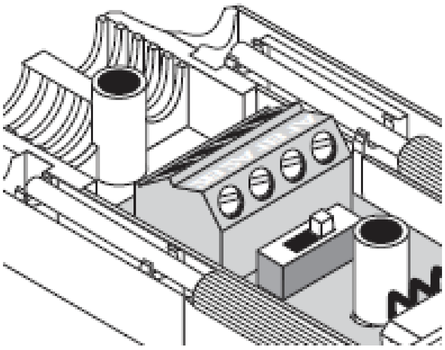
Communication port on DVC 310:



Terminal 2: CAN Low
Terminal 3: CAN Shield
Terminal 7: CAN High

In the included CAN connector, the wiring to the terminals must be as shown in the table below.

Term.	Function
1C+	CAN-H
1C-	CAN-L
GND	CAN-Shield



Check the setting of the terminal resistor when the wiring is done. It can be set to ON or OFF on the switch next to the terminals in the included CAN connector.

The terminal numbers of the Multi-line 2 unit are shown in the diagram in paragraph *Wiring to the DVC 310*.

3.1.5 Setting up communication

The Multi-line 2 unit can hold up to several CAN bus ports, so it is able to communicate with a lot of different components, in different scenarios.
The DVC 310 communicates via CAN bus on a J1939 based protocol. A lot of ECUs also communicate via a J1939 based protocol, which means that the Multi-line 2 unit can communicate to the ECU and DVC 310 via the same CAN bus port. If the Multi-line 2 unit is placed in an application with a DVC 310 and a CAN open-based ECU, the communication will have to be split into two different CAN bus ports on the unit. The CAN open-supported engine interfaces in the Multi-line 2 unit are MTU-MDEC and MTU-ADEC. Furthermore, the application can be a bit more complex, if CIO modules are added into the system.
To give an overview of some of the combinations, the following examples can be helpful:

Description of setup:	**Settings:**
Analogue GOV DVC 310 (Option H5_2)	● 2781 (Regulator output GOV): Analogue ● 2783 (Regulator output AVR): EIC ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): EIC
J1939 based ECU DVC 310 (Option H5_2)	● 2781 (Regulator output GOV): EIC ● 2783 (Regulator output AVR): EIC ● 7561 (Engine Interface): “Relevant J1939 protocol” ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): EIC
J1939 based ECU DVC 310 DEIF CIO modules (Option H5_2)	● 2781 (Regulator output GOV): EIC ● 2783 (Regulator output AVR): EIC ● 7561 (Engine Interface): “Relevant J1939 protocol” ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): EIC ● 7891 (CIO Enable): ON
Analogue GOV DVC 310 DEIF CIO modules (Option H5_2)	● 2781 (Regulator output GOV): Analogue ● 2783 (Regulator output AVR): EIC ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): External modules DEIF ● 7891 (CIO Enable): ON
CAN Open based ECU DVC 310 (Option H12_2) (DVC 310 mounted on CAN port D)	● 2781 (Regulator output GOV): EIC ● 2783 (Regulator output AVR): EIC ● 7561 (Engine Interface): “Relevant CAN Open protocol” ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): EIC ● 7844 (CAN bus port D protocol): External modules DEIF
CAN Open based ECU DVC 310 DEIF CIO modules (Option H12_2) (DVC 310 mounted on CAN port D)	● 2781 (Regulator output GOV): EIC ● 2783 (Regulator output AVR): EIC ● 7561 (Engine Interface): “Relevant CAN Open protocol” ● 7565 (Digital AVR Interface): DEIF DVC 310 ● 7843 (CAN bus port C protocol): EIC ● 7844 (CAN bus port D protocol): External modules DEIF ● 7891 (CIO Enable): ON

The examples above are made where either the option H5 or H12 is mounted in slot #2. The different setups will also work if the H5 or H12 is mounted in slot #8 instead. The parameters regarding the specific CAN port setup will then have to change, so it fits the application.

When performing the initial setup of the DVC 310 with the EasyReg software, it is recommended not to have the CAN bus connected to the DVC 310.

3.1.6 Setting up communication for AGC 200

The AGC 200 unit holds several CAN bus ports, so it is able to communicate with a lot of different components, in different scenarios.

The DVC 310 communicates via CAN bus on a J1939-based protocol. Many ECUs also communicate via a J1939-based protocol, which means that the AGC 200 unit can communicate to the ECU and DVC 310 via the same CAN bus port. If the AGC 200 unit is placed in an application with a DVC 310 and a CANopen-based ECU, the communication will have to be split into two different CAN bus ports on the unit. The CANopen-supported engine interfaces in the AGC 200 unit are MTU-MDEC and MTU-ADEC. Furthermore, the application can be a bit more complex if CIO modules are added into the system.

To give an overview of some of the combinations, the following examples can be helpful:

Description of setup:	**Settings:**
Analogue GOV DVC 310 (IOM 220/230)	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7565 (Digital AVR interface): DEIF DVC 310 • 7843 (CAN bus port C protocol): EIC
J1939-based ECU DVC 310	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7561 (Engine interface): “Relevant J1939 protocol” • 7565 (Digital AVR interface): DEIF DVC 310 • 7843 (CAN bus port C protocol): EIC
J1939-based ECU DVC 310 DEIF CIO modules	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7561 (Engine interface): “Relevant J1939 protocol” • 7565 (Digital AVR interface): DEIF DVC 310 • 7843 (CAN bus port C protocol): EIC • 7891 (CIO enable): ON
Analogue GOV DVC 310 DEIF CIO modules (IOM 220/230)	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7565 (Digital AVR interface): DEIF DVC 310 • 7843 (CAN bus port C protocol): External modules DEIF • 7891 (CIO enable): ON
CANopen-based ECU DVC 310 (DVC 310 mounted on CAN port B)	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7561 (Engine interface): “Relevant CANopen protocol” • 7565 (Digital AVR interface): DEIF DVC 310 • 7842 (CAN bus port B protocol): DEIF DVC 310 • 7843 (CAN bus port C protocol): EIC
CANopen-based ECU DVC 310 DEIF CIO modules (DVC 310 mounted on CAN port B) CIO modules mounted on CAN port C)	• 2781 (Regulator output GOV): EIC • 2783 (Regulator output AVR): EIC • 7561 (Engine interface): “Relevant CANopen protocol” • 7565 (Digital AVR interface): DEIF DVC 310 • 7842 (CAN bus port B protocol): DIGITAL AVR • 7843 (CAN bus port C protocol): EIC • 7891 (CIO enable): ON

When performing the initial setup of the DVC 310 with the EasyReg software, it is recommended not to have the CAN bus connected to the DVC 310.

3.1.7 PID start settings

In the table below, you will find a list of PID settings collected from different sizes of generators. These settings can be used as starting point for the DVC 310 voltage regulation.

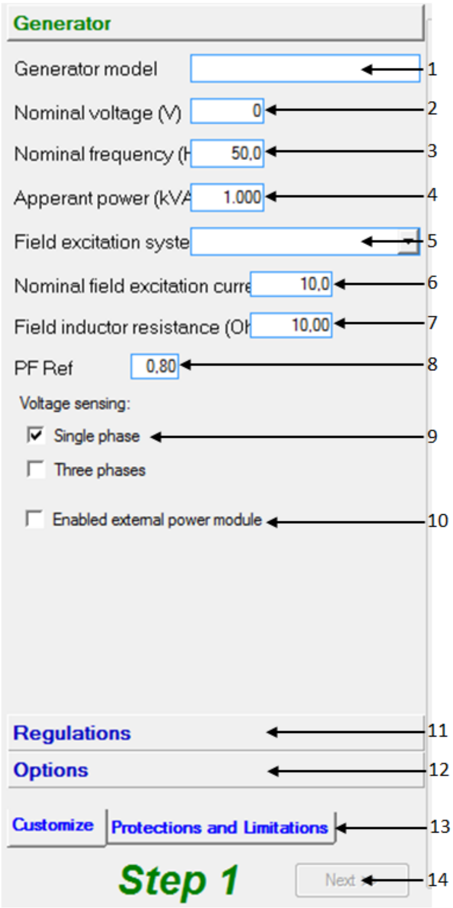
The settings for PID in the DVC 310 must be used shortly after the nominal settings have been made.

Generator size [kVA]	**P**	**I**	**D**	**GAIN**	**Scale**	**Voltage [V]**
15	20	2	150	20	1/1	400
30	25	2	200	20	1/1	400
50	30	2	200	20	1/1	400
70	30	2	200	20	1/1	400
110	40	2	300	20	1/1	400
150	50	2	300	20	1/1	400
240	60	2	400	20	1/1	400
400	60	2	400	20	1/1	400
580	70	2	400	20	1/1	400
820	70	2	500	20	1/1	400
1060	85	2	600	20	1/1	400
1360	85	2	800	20	1/1	400
1860	85	2	1000	20	1/1	400
2250	100	2	1200	20	1/1	400
2500	100	2	1200	20	1/1	400
1300	60	2	1200	20	1/1	6600
1700	60	2	1200	20	1/1	6600
2100	60	2	1200	20	1/1	6600
2800	60	2	1200	20	1/1	6600

The values shown above are not the final settings. These should only be considered as start settings that must be tuned in for the present alternator.

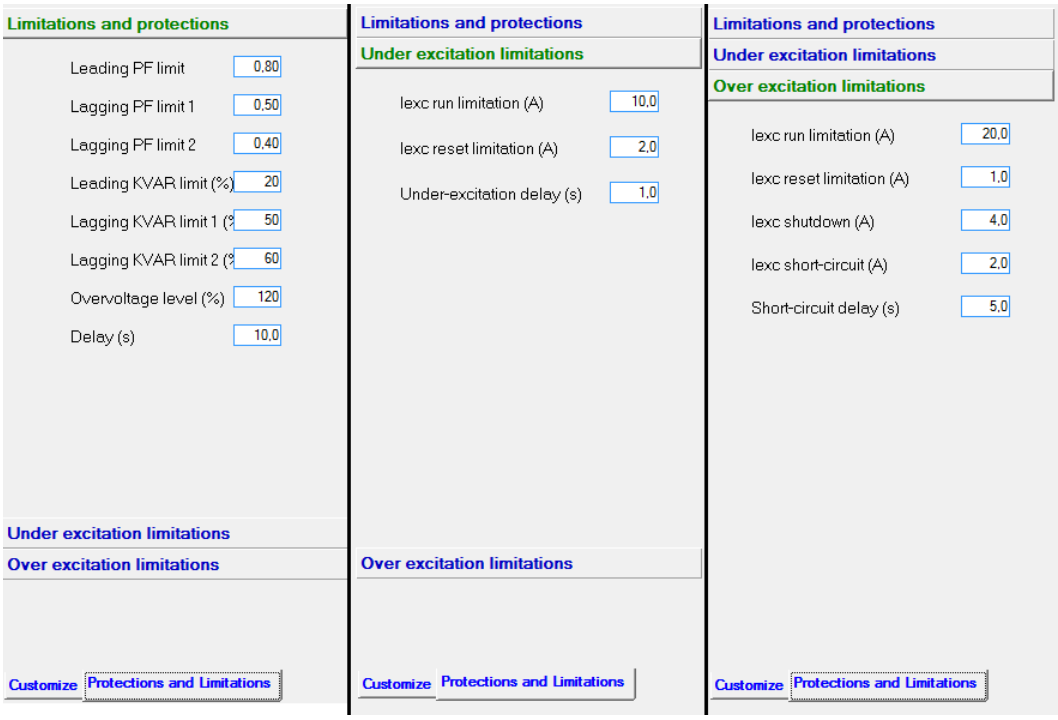
3.1.8 Setup of DVC 310 to match alternator

First, open the EasyReg software and then connect a USB cable between the PC and the DVC 310. Press File at the top of the window and then New Customised Configuration, and the window shown below will appear.



1. A name for the generator can be entered here.
2. The nominal voltage of the generator is set here.
3. The nominal frequency is set here.
4. The apparent power of the alternator is set here.
5. The type of field excitation system is set here.
6. The nominal field excitation is set here.
7. The resistance of the excitation circuit is entered here. This can be measured with a multimeter: Take the F+ and F- wires of the terminals and measure the resistance through the excitation circuit on the alternator.
8. This value indicates at which power factor the alternator can give the apparent power that has been set earlier (no. 4).
9. The voltage sensing for the DVC 310 on the alternator is selected here. (True RMS regulation is only available with single phase measurement).
10. The DVC 310 is not ready for this function yet. If the function is enabled, the excitation supply circuit will be switched off.
11. Some PID settings must be set here. Refer to the paragraph "PID start settings" in this document for a table listing the PID settings collected from different sizes of generators. When the DVC 310 is to be controlled by a Multi-line 2 unit, the DVC 310 will be in voltage regulation. So the PID settings should be made for voltage regulation. Copy the settings into the PF and Iexc. regulators.
12. Temperature sensing and current transformers are set in this menu. It is also set whether a step-up transformer is present in the application. If voltage transformers are present in the application, these can also be set here. If the DVC 310 is to be used at a single phase alternator, it must be set from this window. Refer to the paragraph "Single phase operation".

13. This menu consists of three different windows, as shown below:



The three windows contain different settings. Some of them are used when the DVC 310 is interfaced with a Multi-line 2 unit. In the first window, only over-voltage and delay are used. None of the settings in the second window are used. In the third window, all settings are used. In the settings that are not used, a proper value must be entered. Refer to the chapter "Protections" for a description of all protections.

14. When all the settings above have been made correctly, press the Next button.

Subsequently, the next window in EasyReg will appear, as shown below:

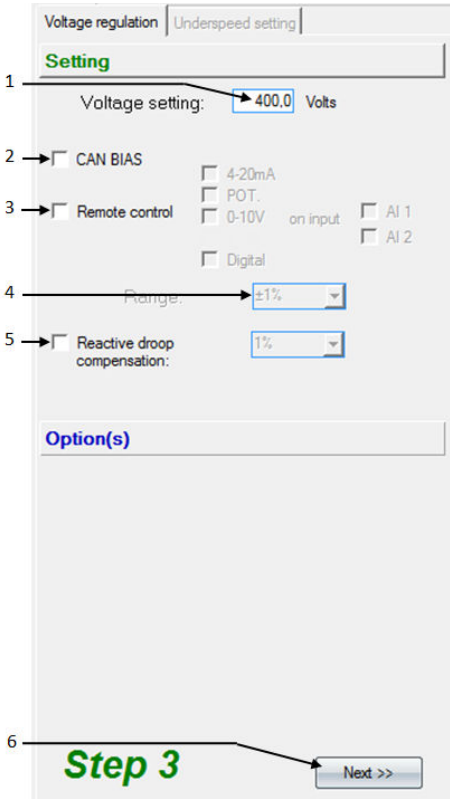
The user can now make four different selections (marked with arrows).

1. If Voltage is selected, settings for voltage regulation are shown. When the DVC 310 is to be controlled by a Multi-line 2 product, the DVC 310 will be in voltage regulation. In this case, the Voltage regulation function should be activated, so the user is trimming the DVC 310 in voltage regulation afterwards. In the Voltage regulation function, different options regarding the start-up and engine aid are also set.
2. If the DVC 310 is to be used in power factor regulation mode, PF should be selected. The power factor regulation mode is very similar to the voltage regulation mode. In PF mode, another tab with settings will appear. This setting determines which power factor reference the DVC 310 should have during parallel

operation. The DVC 310 will need an input to know when it is in parallel to grid. When the DVC 310 is controlled by a Multi-line 2 product, PF will not be used because the cos phi is controlled at the Multi-line 2 controller instead.

3. If the DVC 310 is to be used in fixed kvar regulation mode, "kVAR" must be selected. The fixed kvar regulation mode is very similar to the voltage regulation mode. In kVAR mode, another tab with settings will appear. This setting determines which kvar power reference the DVC 310 should have during parallel operation. The DVC 310 will need an input to know when it is in parallel to grid. When the DVC 310 is controlled by a Multi-line 2 product, kVAR will not be used because the cos phi is controlled at the Multi-line 2 controller instead.
4. If the DVC 310 is to be used in excitation regulation mode, I exc. must be selected. The excitation regulation mode is very similar to the voltage regulation mode. In I exc. mode, another tab with settings will appear. This setting determines which excitation current should be applied by the DVC 310. This functionality can be employed if the user wants to manually apply a fixed excitation, or to control the excitation externally. When the DVC 310 is controlled by a Multi-line 2 product, I exc. will not be used because the bias is controlled at the Multi-line 2 controller instead.

When Voltage has been selected, the window below will appear.



1. The set point for the voltage regulation is entered in this box.

2. This setting determines the origin of the bias signal to the DVC 310, it must come via J1939 CAN bus. When a Multi-line 2 unit is to control the DVC 310, it is recommended to have the DVC 310 set to CAN BIAS.

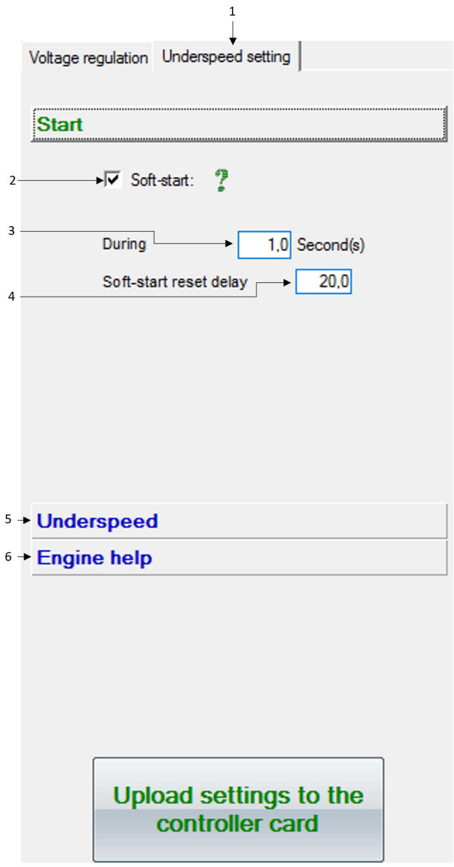
3. This setting determines the origin of the bias signal to the DVC 310, it must come via an analogue input. If analogue bias is to be used, the specific input terminal on the DVC 310 must also be chosen.

4. This setting determines the bias range when analogue regulation is used. This range relates to point 1 in this picture. If the set point of the DVC 310 is 400 V and the bias range is (as an example) +/- 10 %, the external equipment can move the set point of the DVC 310 between 360 V and 440 V.

5. This setting activates the droop in the DVC 310. It is required to have current transformers wired to the DVC 310. Otherwise it is not possible to enable the setting. Furthermore, the droop percentage is set. The droop curve is shown in EasyReg.

6. When the settings above have been made, press the Next button.

Subsequently, the window below will appear:



1. The user should now be at the "Underspeed setting" tab.

2. From here the soft-start ramp during start is enabled. If the soft-start is disabled, the DVC 310 will set the soft-start ramp to 0.1 s. This means that during start-up, the ramp will be controlled by the U/f law instead. This can cause overshoot on faster starting engines.

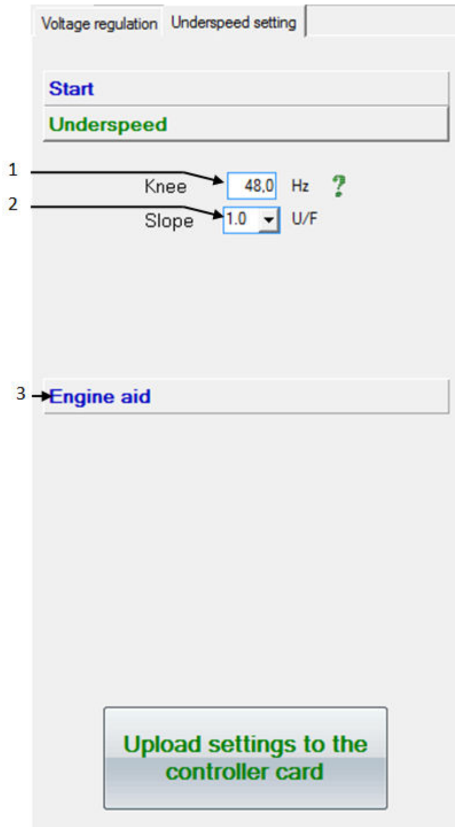
3. This is the timer for the soft-start ramp. Note that the setting is in seconds. This means how long time the DVC 310 should take to ramp up the voltage from 0 to voltage set point. A more detailed description of the soft-start can be found in the section called "Soft-start".

4. This delay secures that soft-start is only activated in the event of a real start. Soft-start will only be activated if this delay has expired before the genset is restarted. Configurable between 5-20 s.

5. When the "Underspeed" tab is pushed, another new window will appear, which will be described below.

6. When the "Engine aid" tab is pushed, another new window will appear, which will also be described below.

When the "Underspeed" tab has been pushed, the window below will appear:

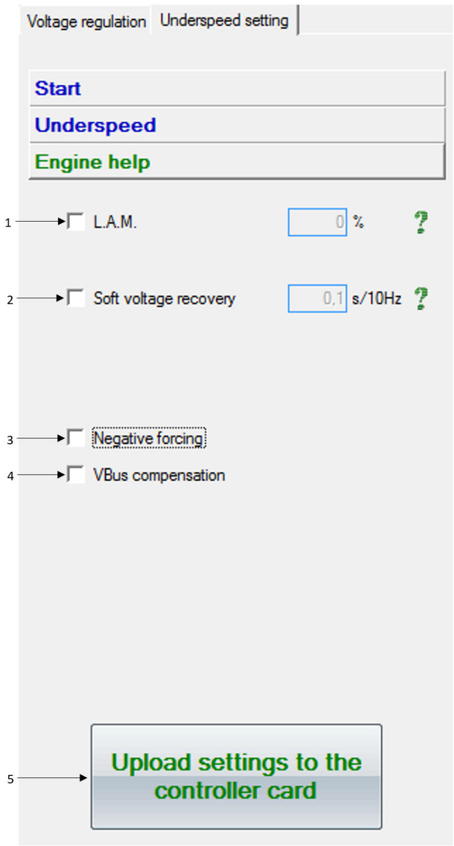


1. This setting determines the upper limit for the U/f slope. If there is a load impact on the genset, and the frequency reaches this set point, the DVC 310 starts slope on the voltage. The knee function is described in the section "U/f (knee function)".

2. From here the slope for the U/f law is set. To see how the calculation for U/f slope is made, see the description in the section "U/f (knee function)". If the soft-start ramp is disabled, the DVC 310 will try to follow this slope during ramp up.

3. When the "Engine aid" tab is pushed, a new window will appear. This window is described below.

After the settings for the "Underspeed" have been made, the settings for the "Engine aid" can be set:



1. Firstly the L.A.M. (Load Acceptance Module) function is set. When the L.A.M. function is enabled, a percentage has to be set. The percentage determines how much the voltage should drop immediately, when the knee set point is reached. The setting is related to the voltage set point. So if the set point is 400 V, and L.A.M. set point is 10 %, and the knee point is reached, the voltage will immediately be dropped 40 V. To read more about the L.A.M. function, please refer to the section "Load acceptance module (LAM)".

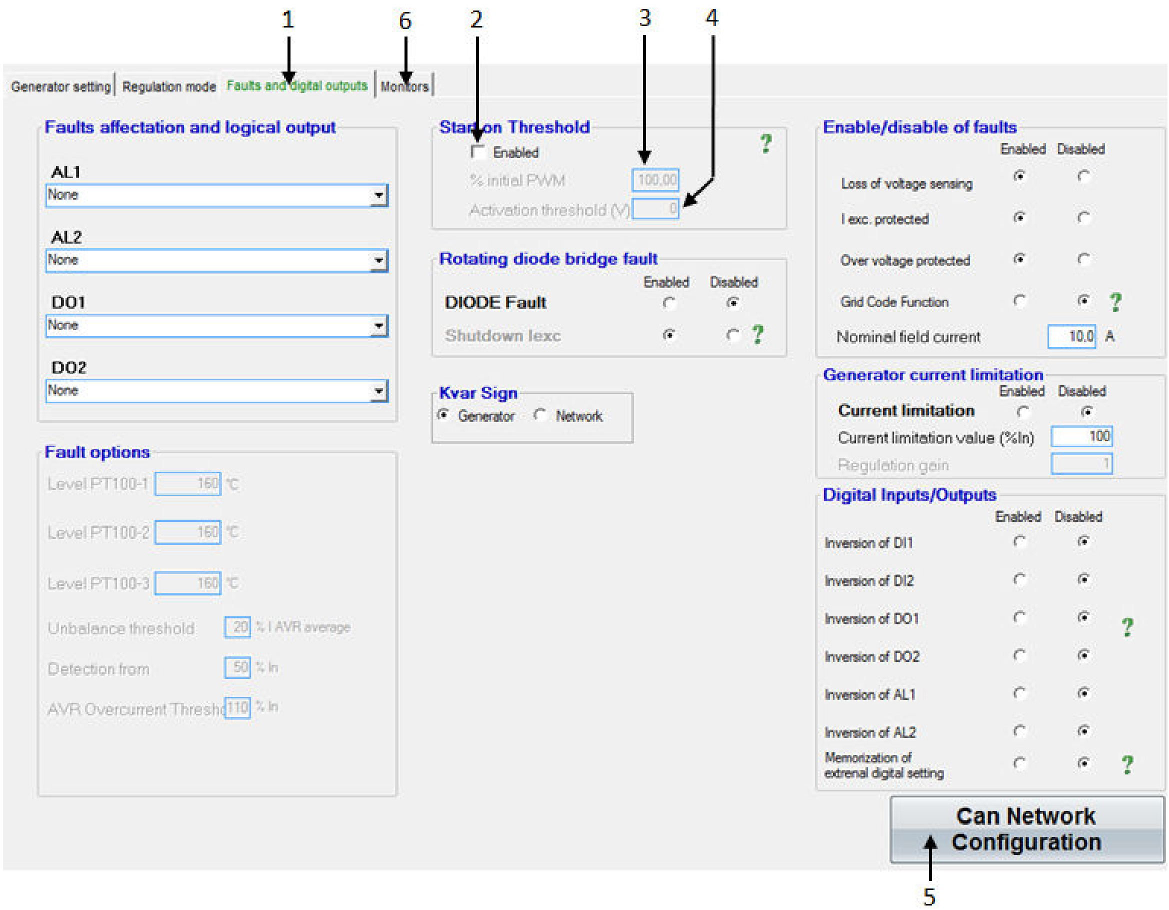
2. From here the SVR (Soft Voltage Recovery) function is enabled. The SVR function determines how fast the DVC 310 is allowed to ramp up the voltage, after the L.A.M. function has been active. For more info about the SVR function, please refer to the section "Soft voltage recovery (SVR)".

3. Activation of "Negative forcing" allows to reverse the excitation voltage to minimise voltage overshoot during load rejection.

4. A tick mark in "VBus compensation" allows to compensate regulation from knowledge of the actual excitation supply voltage potential (VBus measurement).

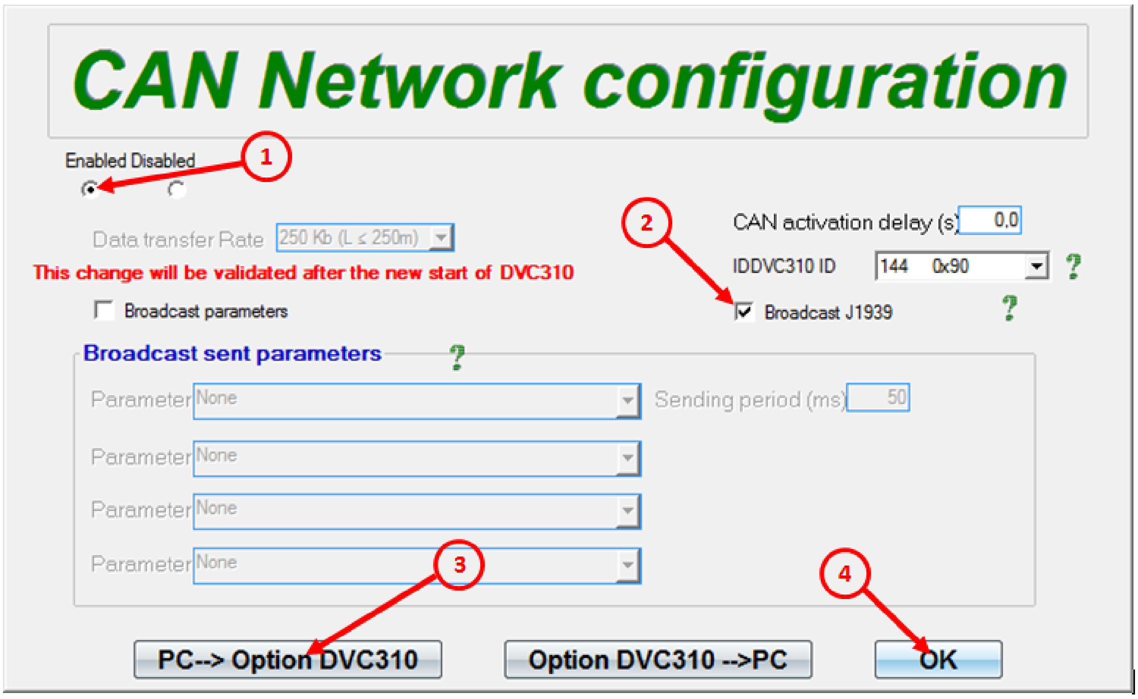
5. When all the desired settings and parameters have been made, all the settings can be uploaded to the DVC 310, by pressing the "Upload settings to the controller card".

When the settings have been uploaded to the DVC 310, the "Fault and digital outputs" tab in the top of the EasyReg software can be pushed to also make some settings.



1. Here the "Fault and digital inputs" tab can be pushed, and then the window should look like above.
2. When this box is ticked, a constant PWM output on the excitation current will be applied on the excitation circuit. The start-on threshold function is activated when the box is ticked, and extra information about this function can be found in the section called "Start-on threshold".
3. The PWM output for the start-on threshold is set in here. Note that this setting should be 0 the first time the genset is about to be started, or a very small percentage.
4. This setting determines when the start-on threshold function should be deactivated, and the DVC 310 should shift over to the soft-start function instead. How the different ramps work during start, is described in the section "Excitation ramp". Values between 5 and 35 % of nominal voltage is a reasonable starting point, which can be tweaked on later. The value must be entered in volt, where the Multi-line 2 unit is set in percentage of nominal voltage.
5. When this button is pushed, a pop-up window will appear, where it is possible to set the CAN bus configuration for the DVC 310. This pop-up window is described shortly hereafter.
6. When the settings have been made, the monitor window will open. The monitor window will be described after the "Can Network Configuration" has been described.

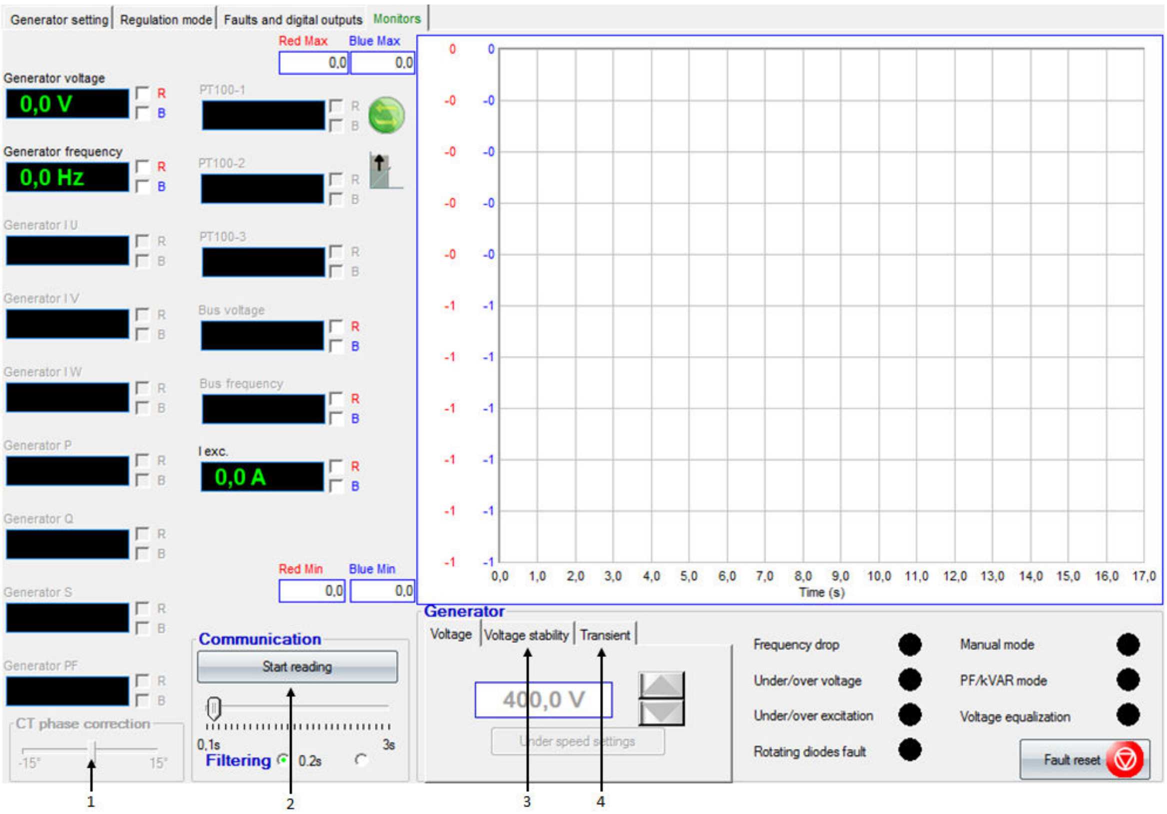
When the "Can Network Configuration" button has been pushed, the pop-up window below will appear.



The buttons and check boxes marked with arrows must be checked.

If J1939 is used as communication IF between the DVC and the controller, the drop down menu IDDVC310 ID is configured to 144 0x90 as shown above.

The monitor window can now be entered.



In this window, it is possible to trend for example the voltage and the frequency at the same time. The monitor is limited to trending max. two different values at a time. To specify which value to be displayed in the trending window, the checkbox to the right of the displayed values will have to be marked. The trending window can be helpful when tuning in the regulators.

1. This "CT phase correction" slider can be used to fine-tune on the power readings of the DVC 310.
2. When the "Start reading" button has been pushed, the EasyReg software will start to read live data from the DVC 310. To start trending, the buttton will also have to be pushed.
3. From here the PID settings are shown for the active regulator. When settings from this window is changed, they are changed on-the-fly (this is the only settings with this behaviour). Because they are changed on-the-fly, some cautiousness must be considered, if settings are changed with a running alternator.
4. From here the steps for the transient test is configured, and also where the transient test is started.

3.1.9 Start up and tuning in DVC 310

To protect against over-voltage and over-current, make a shutdown alarm in the Multi-line 2 unit before tuning in the regulators.

The CAN bus communication between the Multi-line 2 unit and the DVC 310 should not be connected yet. It will be stated later in this document when this should be connected.

Before the first start of the genset with the DVC 310, please make sure that the PWM for start-on threshold is set to 0 % and the "Activation threshold" set point is high, for instance 90 % of nominal voltage. A good idea is also to remove the excitation circuit supply (X1-X2-Z1-Z2) terminal connector. Furthermore, the "Soft-start" ramp should be set slow, for example 10 s to ensure that a slow PID regulation is able to follow the ramp.

When the alarms and start-on threshold + soft-start settings have been made, the genset is ready for the first start.

When the genset is started for the first time, it is presumed that all other equipment is tested, verified and tuned as desired. This manual is only relevant for when the DVC 310 is ready for the first start!

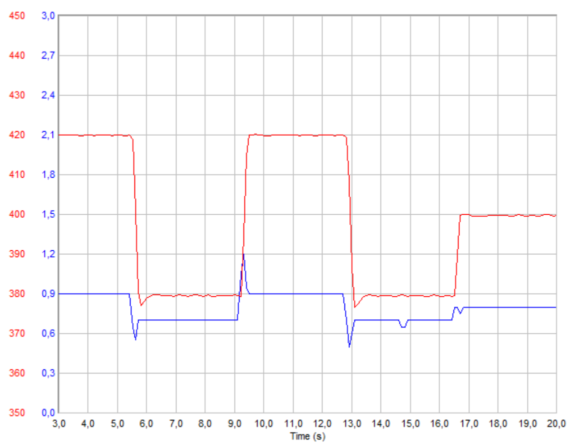
At the first start, only remanence voltage will be present, since the PWM is set to 0 %. This remanence voltage can be used to verify that the DVC 310 is able to measure alternator voltage correctly. This measurement should be compared to the genset controller's measured voltage and/or a multimeter reading.

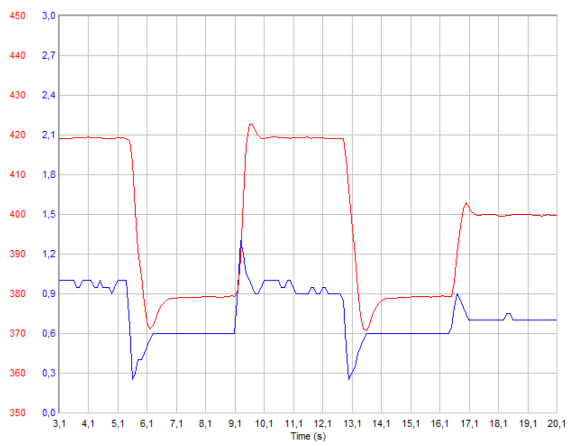
The genset can then be stopped, and the PWM settings can be raised to for example 2 % (small steps), and the "Activation threshold" can be set to for instance 15 % of nominal voltage. The user has to verify that voltage is not shooting upwards, and the PWM can be raised, until the alternator reaches "Activation threshold" voltage.
When the DVC 310 reaches this "Activation threshold", the "Soft-start" ramp will now be used, up till the voltage set point.

When the voltage has reached the set point for the alternator, a transient test can be performed from the "Monitor" window.
For the first transient test, the voltage steps should only deviate about 2 % from the voltage set point.
With the result of the transient test, the regulation of the DVC 310 can now be verified, to see the regulation responds.

It is now possible with the transient test to tune the DVC 310 regulation. When the sufficient responds are acquired, the deviations for the transient test can be raised to +/- 5 % of the voltage set point.

Below is shown transient tests, from two different alternators, which are both considered reasonably tuned. (Red line trends voltage, and the blue line trends excitation current).





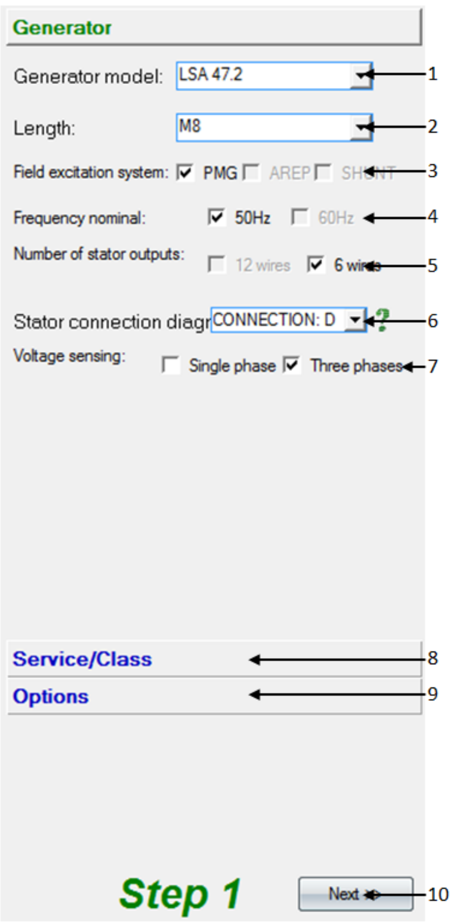
When the regulation has been tuned sufficiently, the "soft-start" ramp can be tuned down until the user finds the start up ramp fast enough.
Furthermore the PWM percentage can be raised, until the first part of the ramp is fast enough for the user. Be aware that the DVC 310's regulation is not active during start-on threshold. The PWM is a constant percentage of voltage that is led directly through the excitation circuit.
When the regulators and functions have been tuned in, the CAN bus cable between the Multi-line 2 unit and the DVC 310 can be connected. Subsequently, it is recommended to go to parameter 7805 and set this to ON. Then the Multi-line 2 unit will be in control of the DVC 310, which makes it possible for example to switch regulation modes.

Before the CAN bus line on the DVC 310 is set, make sure that the gain factor in the EasyReg and the gain factor parameter 7801 are the same.

When the CAN bus cable is connected between the Multi-line 2 unit and the DVC 310, it is necessary that the user reads the table "Overview of shared parameters related to option T2" and sets the desired settings for "soft-start" ramp, "start-on threshold", "PWM" and other settings made during commissioning of DVC 310.

3.1.10 Setup with a Leroy Somer alternator

Connect a USB cable between the PC and the DVC 310. Open the EasyReg software. Press File at the top of the window and then New Configuration, and the window shown below will appear.



1. The Leroy Somer alternator type is set here.
2. The length of the alternator is set in this parameter.
3. The type of field excitation system of the alternator is selected here.
4. The nominal frequency of the alternator is set here.
5. The number of stator outputs is selected here.
6. The stator connection type is selected here. Press the question mark to see a picture of the type selected. This can be helpful if in doubt.
7. The type of voltage measurement on the DVC 310 is selected here.
8. The maximum temperature of the windings is selected in this menu, and also the nominal power.
9. The following is selected in this menu: Temperature sensing - the options are Pt100 sensors or thermo couplers; CTs - be aware of setting the CT ratio correctly; voltage transformers, if these are used - both for alternator and the busbar; step-up transformer, if this is present in the application.

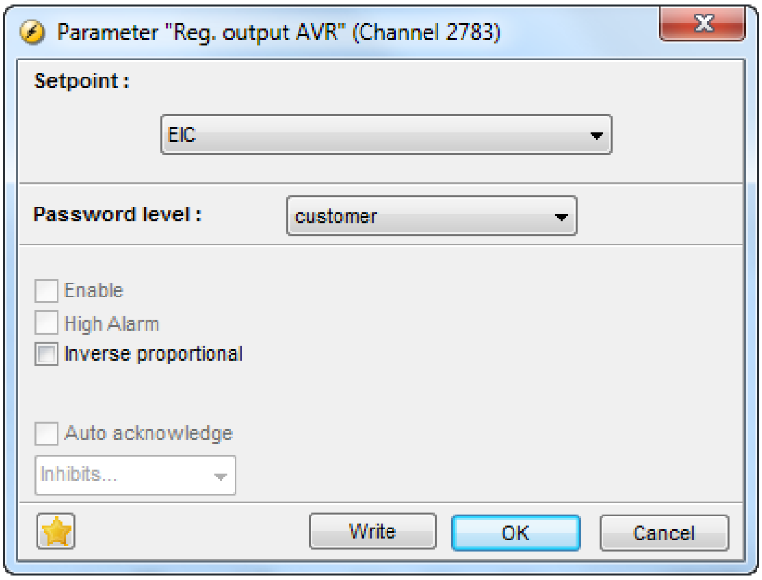
10. When the settings 1 to 9 above have been made, push the Next button.

To set up the DVC 310 for CANbias regulation, and for tuning in the regulator, refer to the section: "Setup of DVC 310 to match alternator".

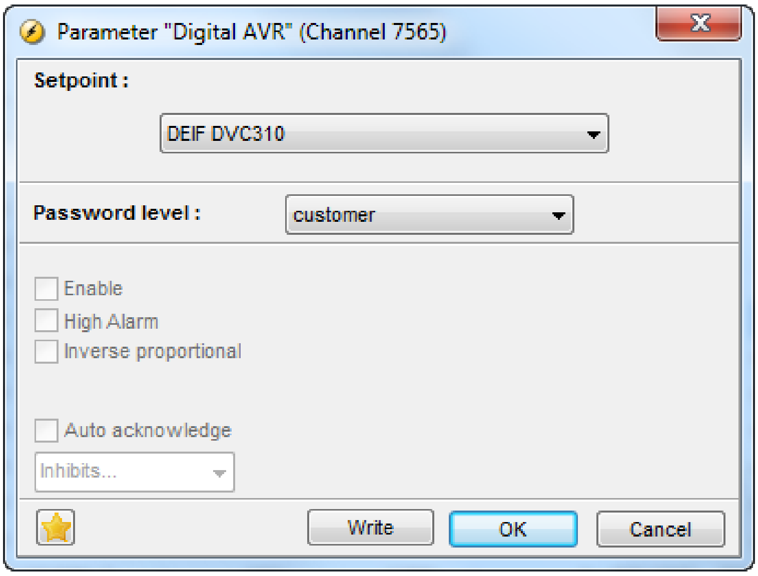
3.1.11 Setting up communication

To be able to communicate with a DVC 310, three settings must be made.

First, select the regulation output AVR to be EIC at parameter 2783.



Then select the AVR type at parameter 7565.



At last, the engine interface must be set; this is done at parameter 7561. It must be set even though relay or analogue regulation is used for governor control, and it must be set to anything else than OFF.

When performing initial setup of the DVC 310 with the EasyReg software, it is recommended not to have the CAN bus connected to the DVC 310.

AGC 200: The "Engine I/F" must be set to anything else than "IOM 220/230" and "OFF"

3.1.12 Voltage transformer settings

The DVC 310 has the possibility to use voltage transformers (VT or PT) for alternator as well as busbar measurements. The nominal voltage input on the DVC 310 may never be below 90 V, see the example below:

$$\frac{VT_{secondary}}{VT_{primary}} \cdot U_{nominal} \geq 90\text{ V}$$

These system values will not be suitable: Voltage transformer values: Primary = 11000 V, secondary = 100 V, Nominal voltage = 9000 V.

$$\frac{100\text{ V}}{11000\text{ V}} \cdot 9000\text{ V} = 81.8\text{ V}$$

If the secondary side of the VT were 115V instead, the values would be suitable for the DVC 310.

$$\frac{115\ V}{11000\ V} \cdot 9000\ V = 94.1\ V$$

The VT ratio is configured in the general settings in the Multi-line 2 unit (parameter 6041-6042 and 6051-6052). The DVC 310 provides the opportunity to have different VTs than those used in the Multi-line 2 (meaning that the range of the DVC 310 VTs is different from the range of the Multi-line 2 unit VTs). If this is the case, parameter 7745 must be enabled and then parameters 7741 to 7744 are used and must be configured for DVC 310 VT ratio.

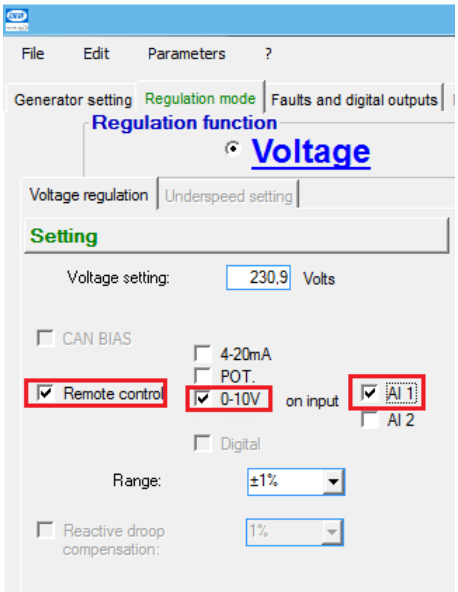
Be aware that when the communication between the Multi-line 2 unit and the DVC 310 is running, multiple settings are sent to the DVC 310. This is for example knee set point, soft-start timers, VT settings. The list of settings is found in the section: "Overview of shared parameters related to option T2".

Parameter	Item	Range	Default	Note
7741	DVC 310 VT's primary setting (side that is in contact with generator voltage).	400 V 32000 V	400 V	Only in genset.
7742	DVC 310 VT's secondary setting (side that is in contact with the DVC 310 voltage input).	50 V 600 V	400 V	Only in genset.
7743	DVC 310 busbar VT's primary setting (side that is in contact with busbar voltage).	400 V 32000 V	400 V	Only in genset.
7744	DVC 310 busbar VT's secondary setting (side that is in contact with the DVC 310 voltage input).	50 V 600 V	400 V	Only in genset.
7745	Activation on VT settings in the DVC 310 (when set to ON, the settings above will be sent).	OFF ON	OFF	Only in genset.

3.1.13 Alternative connection possibility, analogue output from ML-2

It is possible to connect the DVC 310 to the Multi-line 2 unit or any other controller, and to have the voltage regulation made using analogue lines. Using the control way to the DVC 310, digital features will not be available. Only voltage regulation will be effective when using the analogue lines.

In order to use analogue lines, the DVC 310 should be configured to listen to the analogue signals on the analogue input 1 (AI1). This can be made by using EasyReg, and configuring the input as below:



It is also possible to configure analogue regulation from the Multi-line 2 unit, by switching parameter 2783 to analogue instead of EIC. Remember to set the transducer output also at parameter 5991. At parameter 7806, the input type on the DVC type 310 is set, and it will expect it to have the analogue input on AI1. For it to be possible to send all these commands, parameter 7805 has to be enabled. By this, it is possible to send all commands via CAN bus, and control the DVC 310 via analogue bias.

4. Functional description - DVC 310

4.1 Functional description - DVC 310

4.1.1 Start modes

The DVC 310 is able to handle two start modes:

- Normal start
- Close before excitation (CBE)

Normal start:
Excitation is activated at start-up. Normal start is obtained when close before excitation is disabled at parameter 2254. During a normal start, the start-on threshold function will be used, and the soft-start function will also be used.

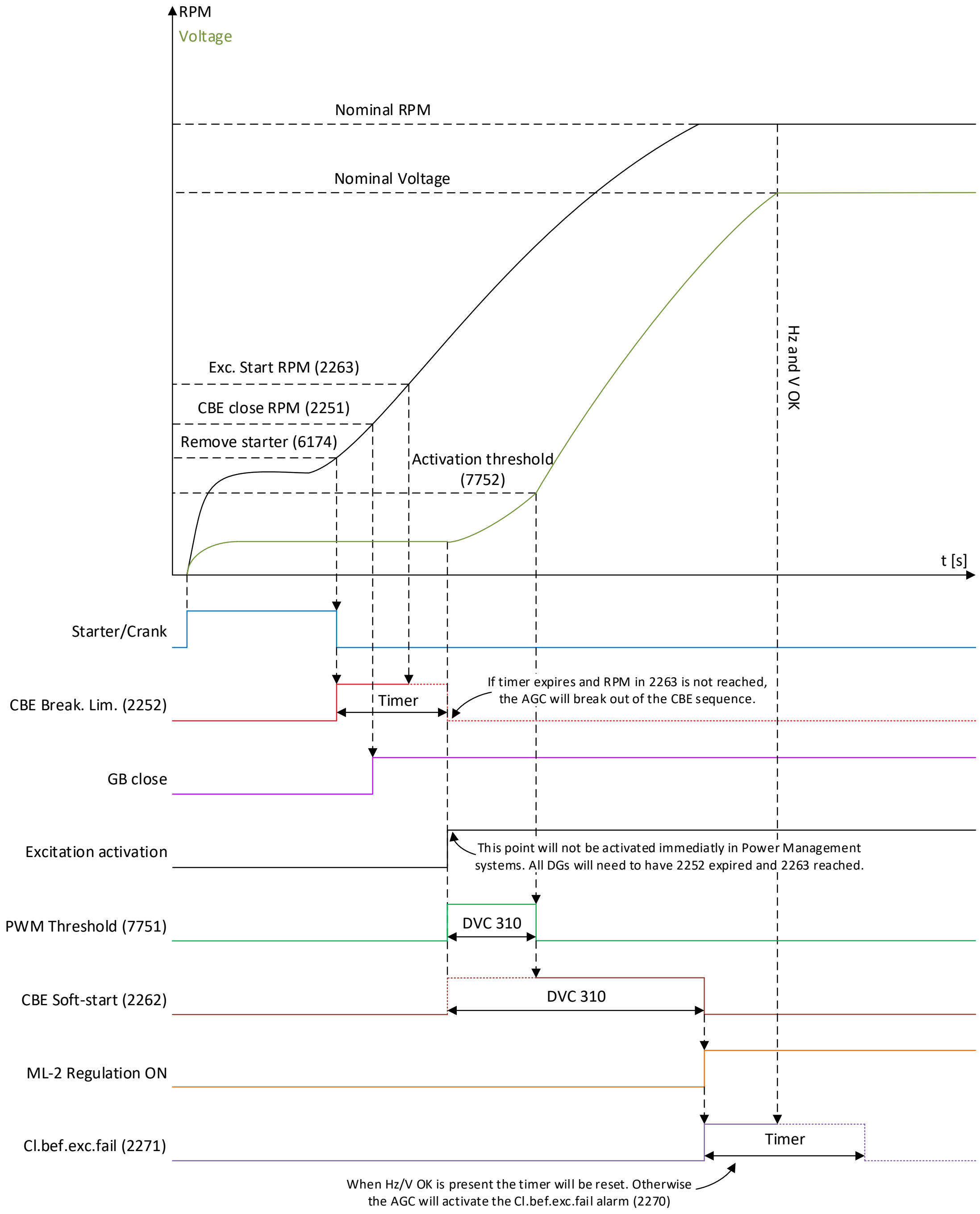
The normal start can be done in two ways. One way is to control the excitation ramp with the start-on threshold and soft-start ramp. In this way, the excitation ramp is controlled during start up. It can also be done, by setting start-on threshold to 100 % (7751), the upper limit for the start-on threshold to 0 % (7752), and set the soft-start ramp to 0.1 sec (7753). In this way, the start up ramp is controlled by the U/f slope, and the DVC 310 will regulate towards this on start up, as the RPMs are ramping up during a start sequence. Not using the soft-start functionality is only recommended on engines that slowly ramps up the RPM, since the U/f law ramp up can give a overshoot.

Close before excitation (CBE):
Excitation is applied after the genset is started and the breaker is closed. Close before excitation is enabled at parameter 2254.

Normally with an analogue AVR, switching on/off the excitation is controlled by a relay output from the AGC to the AVR. When excitation is switched on, the rate of voltage build-up is controlled solely by the AVR. Using the DVC 310 provides the possibility of switching the excitation on/off without the use of a relay output. Furthermore, the rate of voltage build-up is automatically configured via parameter 2262 as part of the existing setup of close before excitation.

The settings for close before excitation are described in the Designers Reference Handbook (AGC-4/AGC 200), or earlier in this document (AGC PM) . When doing close before excitation with the DVC 310, it is possible to apply a little excitation current before voltage build-up. The excitation will be applied after the breaker is closed.

How the different settings are working, when performing close before excitation with the DVC 310, the drawing below can be helpful to give an overview.



Please note, that the soft-start ramp time is started, when the excitation is started. The soft-start timer should be considered as an angle of slope, instead of a specific time.

The purpose of applying the excitation current is to couple the generators tighter together before initiating the voltage build-up. Note that if the excitation current reference is set too high, and voltage generated at that state in the close before excitation sequence exceeds 30 % of nominal voltage, the close before excitation sequence will be aborted. During a CBE sequence, the start-on threshold function will be used and the soft-start function will also be used. The soft-start timer is not the same for the CBE sequence and a normal start. These are two separate timers/angles, which can be adjusted individually.

How to tune the start-on threshold and soft-start ramp, is described later in this manual.

Parameter	Item	Range	Default	Note
7792	Excitation reference at Close before excitation	0.0 A 0.5 A	0.0 A	Only in genset

It is recommended to have zero or a low value in this parameter when doing CBE.

CBE is not possible with GPC-3

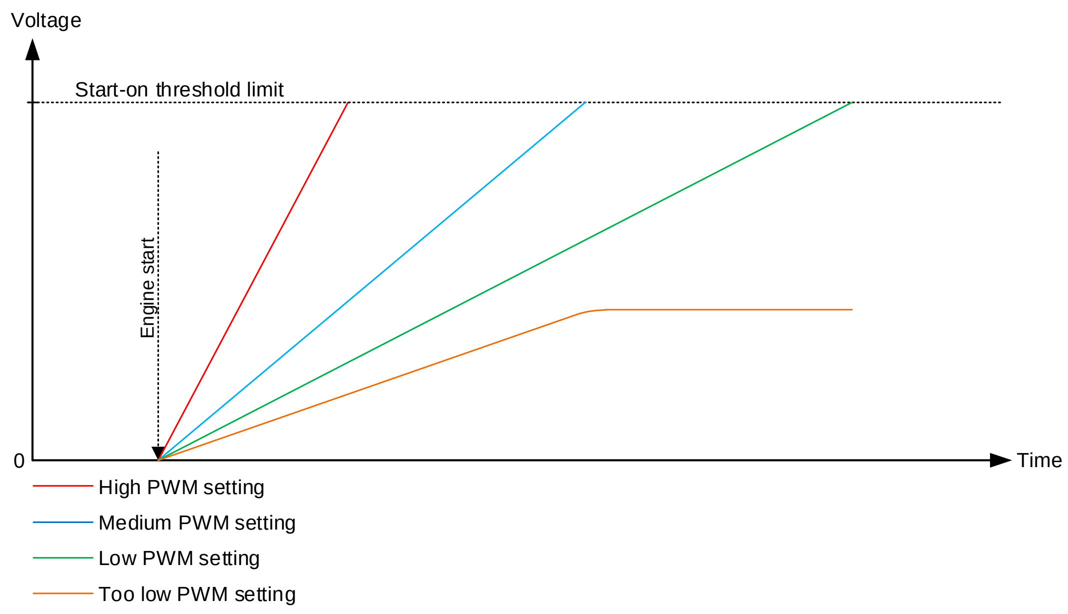
4.1.2 Excitation ramp

During start-up of a generator, the curve can have different characteristics. During each start, the start-on threshold function and the soft-start function will make a part of the characteristic for the excitation. If the generator is used with CBE, the characteristics will be different from a normal start. But in the normal start as well as the CBE start, the start-on threshold and soft-start is used. Be aware that there are different soft-start timers for normal start and for CBE start.

Note that the voltage can never exceed the U/f law, which is described later in this document. This also applies during start-up ramps and soft-starts.

Start-on threshold:

The first part of the excitation ramp is called the start-on threshold. The relevant parameters for start-on threshold are located at parameters 7751 and 7752. Here it is possible to set the upper limit and a PWM output. The upper limit determines when the soft-start function takes over. As a default, this value is set to 35 %, which means 140 V AC for a 400 V alternator. This means that the start-on threshold is the excitation ramp from 0 V AC to default 140 V AC. The PWM output decides how steep the slope for the excitation is. When setting the PWM higher, the excitation slope will be steeper/more aggressive. In the graph below, only the PWM is changed:



When the upper limit for the start-on threshold is changed, the start point for the soft-start is also changed. The upper limit for start-on threshold is always the start point for soft-start.

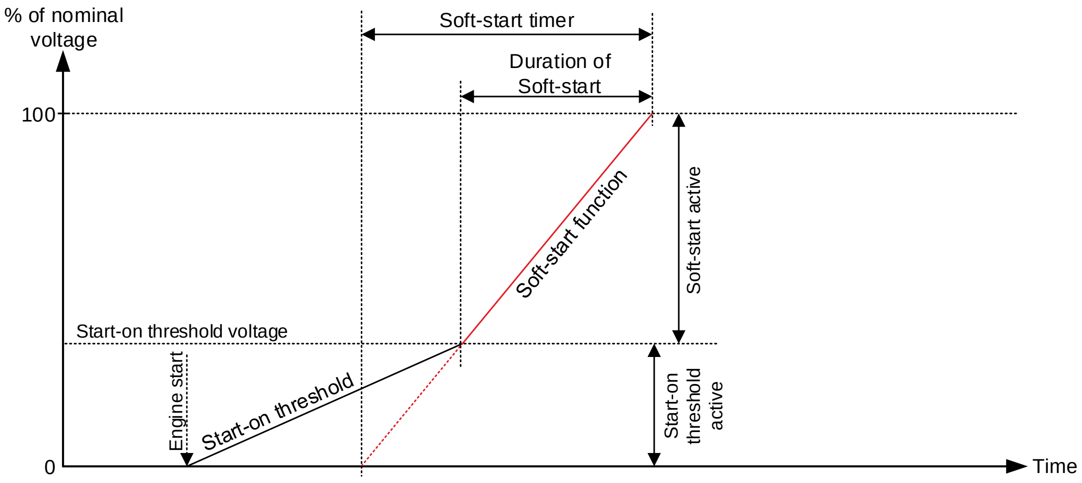
The relevant parameters for start-on threshold are shown in the table below:

Parameter	Item	Range	Default	Note
7751	PWM signal for start-on threshold ramp	0.00 % 100.00 %	10.00 %	Only in genset
7752	Start-on threshold set point	0.0 % 100.0 %	35.0 %	Only in genset

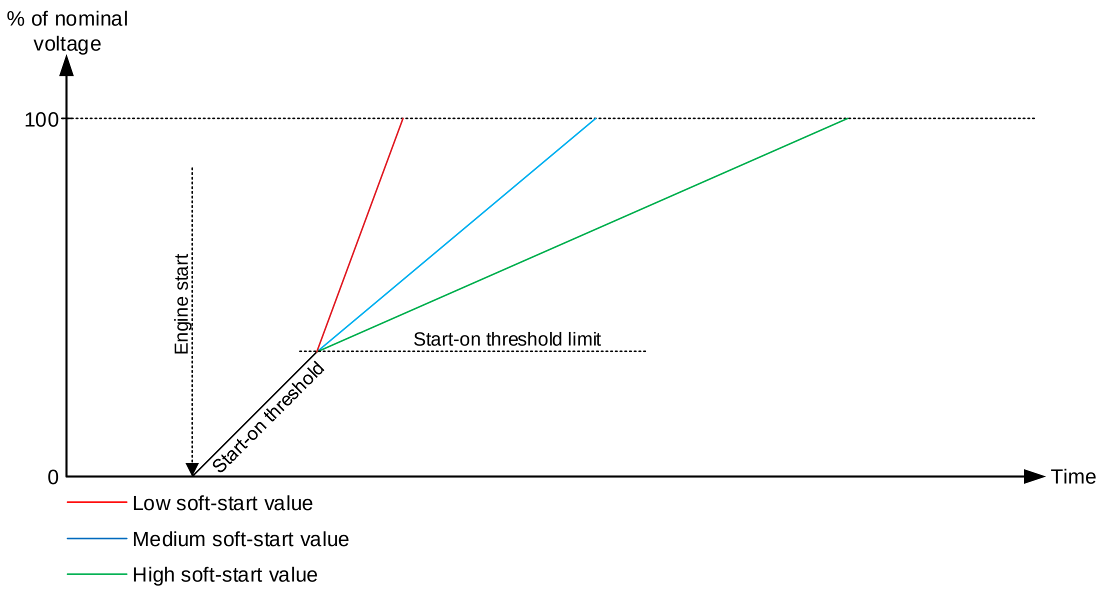
Soft-start:
When the upper limit of the start-on threshold function has been reached, the soft-start function will be initiated. The soft-start is used from the point of the upper limit of start-on threshold until the nominal voltage has been reached. In the soft-start function, only a timer is available; this is found in parameter 7753. The timer defines how long time it should take for the soft-start to increase the voltage from 0 to nominal voltage. So, if the timer is set to 5 seconds, for example, and the start-on threshold is set to 120 V AC and the nominal voltage is 400 V AC, the soft-start will be active for 3.5 seconds. The calculation will be like this:

$$\text{Duration of Soft-start} = \frac{\text{(Nominal voltage)} - \text{(Start-on threshold voltage)}}{\text{Nominal voltage}} \cdot \text{timer for Soft-start}$$

The graph below shows how the different things are placed:



The graph below shows three different settings in the soft-start. The first one has a low timer, the second a medium and the last a high timer. If the DVC 310 has been configured with start-on threshold, the soft-start should not be considered as a timer but instead as an angle.



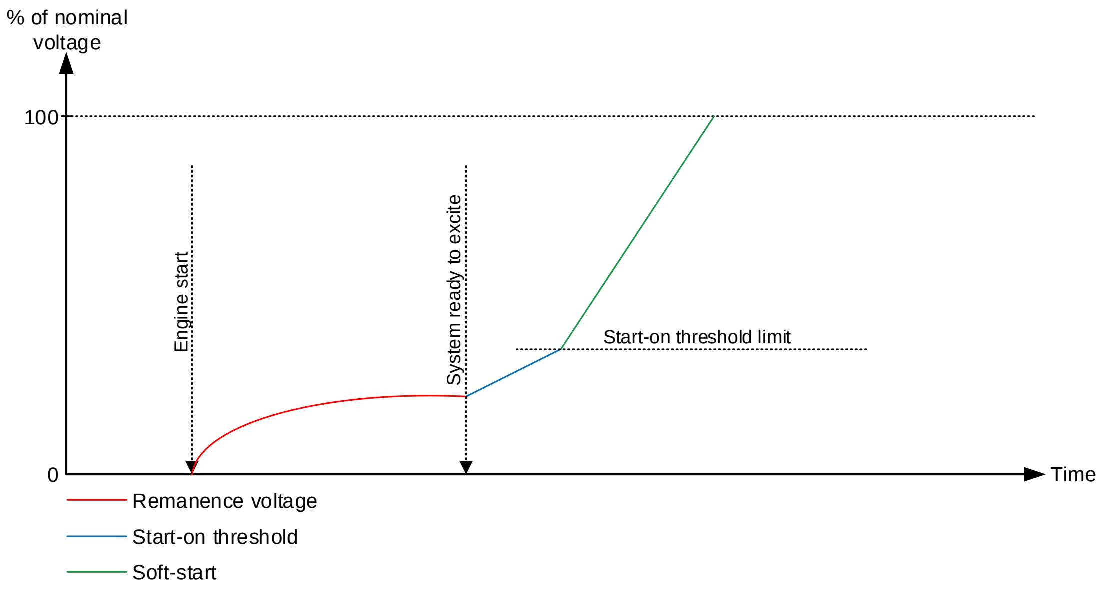
Since the soft-start timer represents how much time it should take to ramp up the voltage from 0 V to nominal, the full timer will not be used if the start-on threshold function is also used. If the wanted duration of the soft-start is known, the timer to set in the parameter can be calculated instead:

$$\text{Timer for Soft-start} = \frac{\text{Nominal voltage}}{(\text{Nominal voltage}) - (\text{Start-on threshold voltage})} \cdot \text{Duration of Soft-start}$$

If the soft-start ramp is set to 0.1 sec, the soft-start function is disabled. The DVC 310 will then use the U/f slope when ramping up the excitation.

Parameter	Item	Range	Default	Note
7753	Softstart ramp timer/angle	0.1 s 120.0 s	2.0 s	Only in genset

Excitation during CBE:
During a CBE sequence, the excitation ramp will look different from the curves in the normal start. The start-on threshold will be inhibited until the timer in parameter 2252 has run out. The timer in 2252 decides how long it should take before the excitation from the DVC 310 begins. The generator is able to build up some voltage because of the remanence in the rotor of the alternator. The CBE excitation curve will have a characteristic as shown below:



The soft-start timer in CBE is not the same as the soft-start timer in normal start, but the start-on threshold parameters are the same as in the normal start. Having different settings for the soft-start gives the possibility to have for example a more aggressive excitation ramp for CBE sequences. The timer for the soft-start in CBE is located in parameter 2262. Note that this timer is different from the one in normal start.

Parameter	Item	Range	Default	Note
2252	Timer for initiation of the start-on threshold	0.1 s 999.0 s	5.0 s	Only in genset
2262	Softstart timer during CBE sequence	0.0 s 999.0 s	5.0 s	Only in genset

4.1.3 Stator current limitation

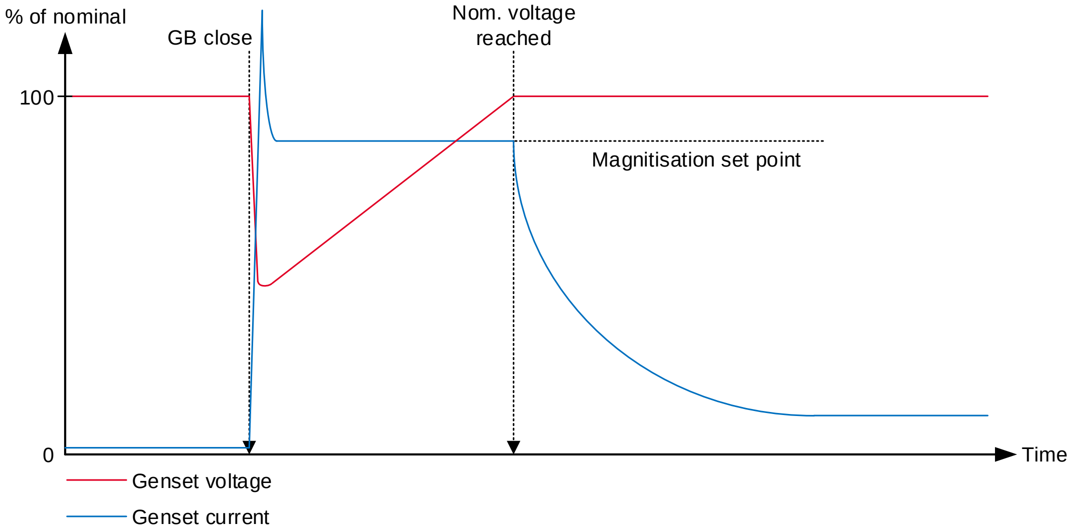
DVC 310 provides the possibility of limiting the stator current. This can be used when applying inductive loads drawing large in-rush currents such as transformers and inductive motors. The function can be controlled through the Multi-line 2 unit. At normal operation, the DVC 310 will have the voltage as set point. When stator current limitation is active, the DVC 310 will instead keep the current as reference and let the voltage drop, until the voltage reaches nominal level again.

Activating current limitation in the Multi-line 2 unit is done at parameter 7795 where you have the following three possibilities:

- Off
- Magnetisation
- Inductive motor

The selection of stator current limitation type is also available through M-Logic. The M-Logic commands related to option T2 can be found later in this manual.

Magnetisation:
The magnetisation function is intended to be used, when a load has to be magnetised up to nominal voltage. The Multi-line 2 unit will firstly rise the voltage to nominal, and then close the generator breaker. Before the breaker is closed, the Multi-line 2 unit will activate the stator current limitation function in the DVC 310, and when the current has decreased, the stator current limitation function will be disabled again. When the current is decreasing after the breaker is closed, the genset will then be able to support a short-circuit, since the stator current limitation is OFF.
If magnetisation is activated, the stator current limitation will be activated every time the generator breaker is opened. When the breaker closes, the current will quickly rise. When the function is enabled, the current will only rise to a point defined in parameter 7793. The DVC 310 will regulate with the current as set point. This parameter indicates a percentage of the nominal current for the genset. The DVC 310 will then let the voltage drop and keep the current at a constant level. The voltage will then start to rise, and when it reaches its nominal voltage, the DVC 310 will instead regulate with the voltage as set point again. The current will then decrease again. When the current has decreased to a level of 5 % below the current limitation, the transformer magnetisation function is not active any more. The transformer magnetisation will not be activated again until the generator breaker has been opened. If the genset is closing the breaker towards a busbar with live voltage, the transformer magnetisation function will be deactivated as soon as the breaker is closed, because then the transformer will already be magnetised. A typical passage with the transformer magnetisation function can look like this:



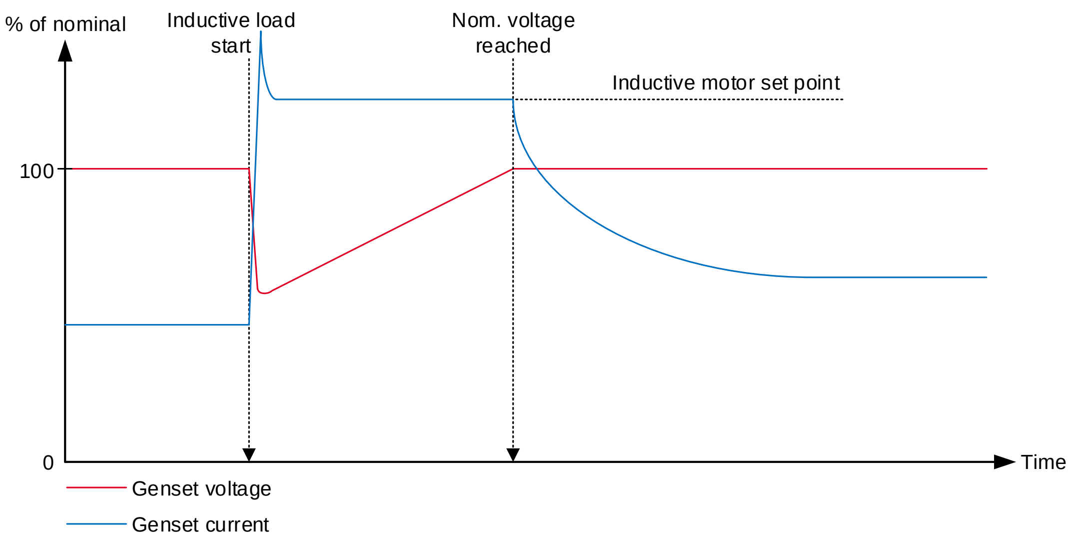
The first dotted line shows when the generator breaker closes. The second dotted line shows when the transformer magnetisation function will be deactivated (5 % below the current limitation set point set at parameter 7793).

Parameter	Item	Range	Default	Note
7793	Current limitation for magnetisation	0.0 % 300.0 %	100.0 %	Only in genset
7795	Enable of current limitation function	OFF Inductive motor	OFF	Only in genset

Settings at parameters 7793 and 7795 are treated as a common set point among the AGC DG units in power management applications.

Inductive motor:
The inductive motor function is very similar to the magnetisation function. The main difference is that the magnetisation function is only active when the generator breaker has just been closed, whereas the inductive motor starting function is active all the time the genset is running and the generator breaker is closed, and the function is enabled. If a heavy inductive load is turned on, the current from the generator will rise, which gives a risk of tripping an over-current protection. To avoid tripping the over-current protection, the DVC 310 is capable of limiting the current by dropping the voltage instead. By lowering the voltage, the power produced from the genset is also reduced, which means a lower risk of tripping from an over-power protection.
Be aware if the "Inductive motor" is active all the time, the genset will drop the reactive power, and by this the short circuit level will not be maintained during a short circuit. The "inductive motor" function can be enabled/disabled via M-Logic, so that it can be controlled by either a digital input or via some custom-made logic.

A typical passage with the inductive motor function is shown below:



When the inductive load is turned on, the current will rise. The inductive motor function will limit the current to the predefined level set in parameter 7794. The DVC 310 will change to have the current as set point and let the voltage drop. When the voltage reaches the nominal value again, the DVC 310 will change to regulate with the voltage as set point again.

Parameter	Item	Range	Default	Note
7794	Current limitation for inductive motor	0.0 % 300.0 %	100.0 %	Only in genset
7795	Enable of current limitation function	OFF ON	OFF	Only in genset

Settings at parameters 7794 and 7795 are treated as a common set point among the AGC DG units in power management applications.

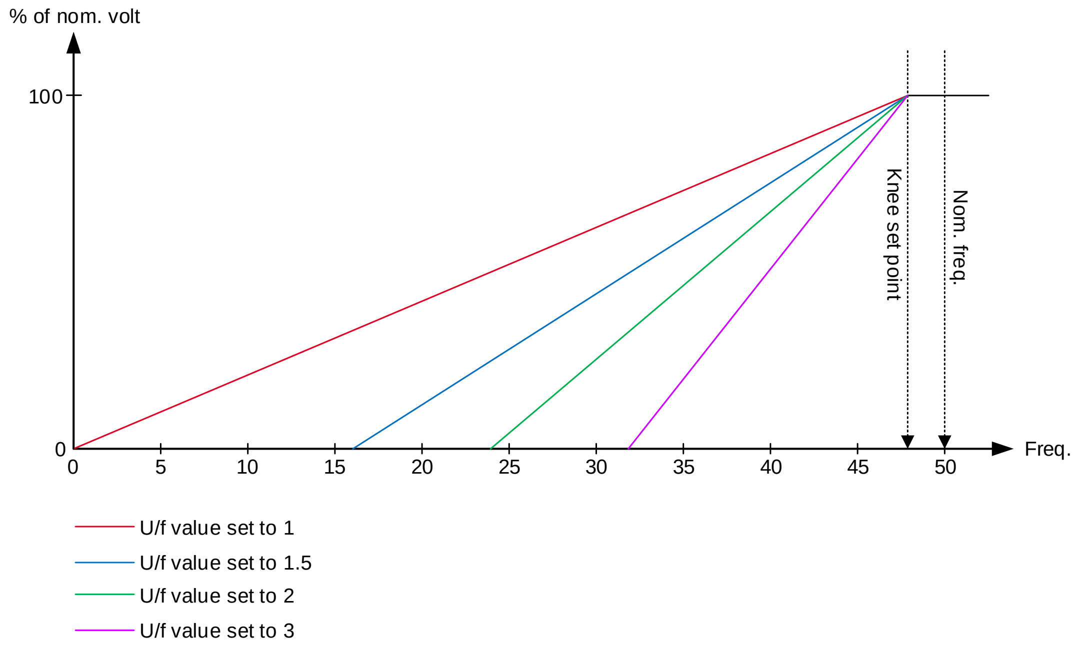
The inductive motor function is not active when the generator is parallel to the mains.

4.1.4 Operation modes

U/f variable slope (knee function):

The U/f variable slope (U/f law) determines the voltage reference/set point used by the DVC 310, depending on the frequency. The U/f law is used to ensure that the genset does not reach its cutout limit. Some gensets are restricted to cut out when reaching 40 Hz, for example. This limit can be reached at heavy loads. If the dive in frequency is below the genset's cutout limit, the genset will be forced to stop. The U/f law allows the voltage to droop and by this reduce the torque on the engine, so the frequency can be kept above the cutout limit. This function will not work with load that determines constant power, such as frequency converters and UPS installations. But it will work with for example electrical motors and electrical heaters where the voltage can be reduced. The U/f law determines how much the DVC 310 should droop the voltage compared to the frequency drop at big loads. It is possible to configure at which frequency the knee set point should be, and this is set in parameter 7771. Below the knee set point, the DVC 310 will let the voltage drop. The slope of how much the voltage should drop compared to the frequency can be set in parameter 7772.

The changes on the U/f law are shown in the graph below. The knee point is held constant in all of them. The graph shows how much the DVC 310 will regulate down in nominal voltage:



The knee set point determines when the U/f law becomes active. When the frequency goes below the knee set point, the U/f law defines a temporary voltage set point for the DVC 310.

The U/f setting can also be calculated instead. This is best explained by an example:

A genset has the nominal voltage of 400 V AC, the knee set point is set to 48 Hz. The genset will cut out at 40 Hz, and the breaker will open at 350 V AC. The calculation for the U/f slope will be like this:

$$U/f = \frac{100 - \left(\frac{\text{Minimum voltage}}{\text{Nominal voltage}} \cdot 100 \right)}{\text{Knee set point} - \text{Cutout limit}}$$

For this example, the calculation will be like this:

$$U/f = \frac{100 - \left(\frac{350}{400} \cdot 100\right)}{48 - 40} = 1.56$$

So the U/f slope can now be set to either 1.5 or 1.6.

The U/f law (knee function) is set up in the parameters shown below:

Parameter	Item	Range	Default	Note
7771	Knee set point	70.0 % 100.0 %	96.0 %	Only in genset
7772	U/f variable slope	1.0 3.0	1.0	Only in genset

The voltage regulator of the Multi-line 2 unit is inhibited in case the frequency drops below knee set point.

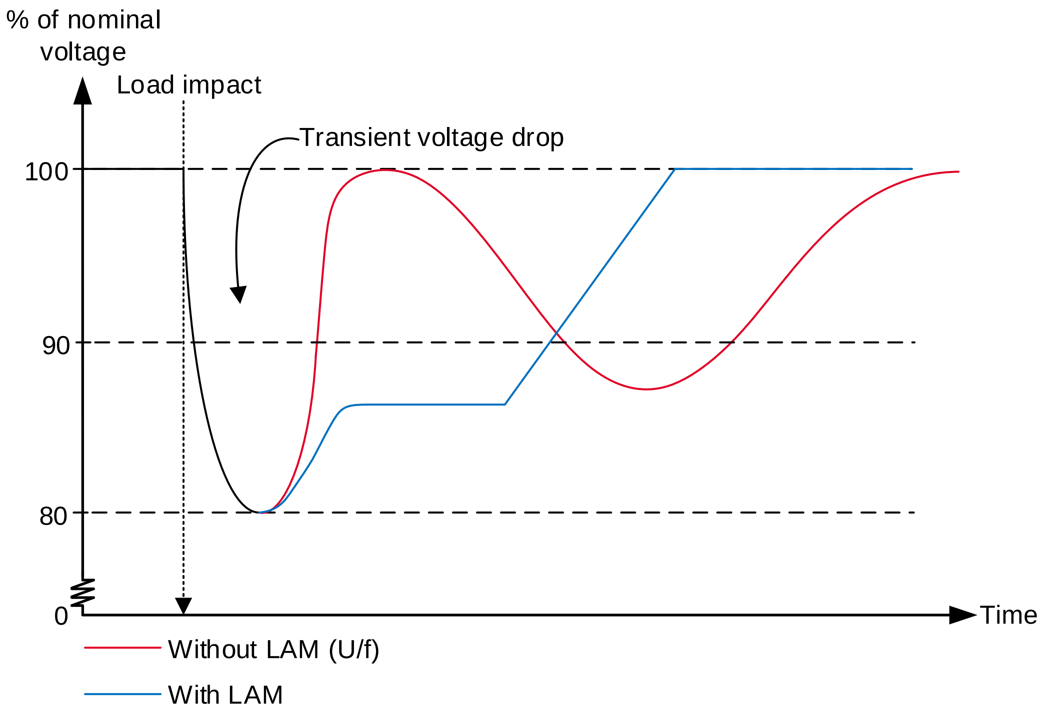
Voltage reference is limited by U/f law at any time.

Settings at parameters 7771 and 7772 are treated as a common set point among the AGC DG units in power management applications.

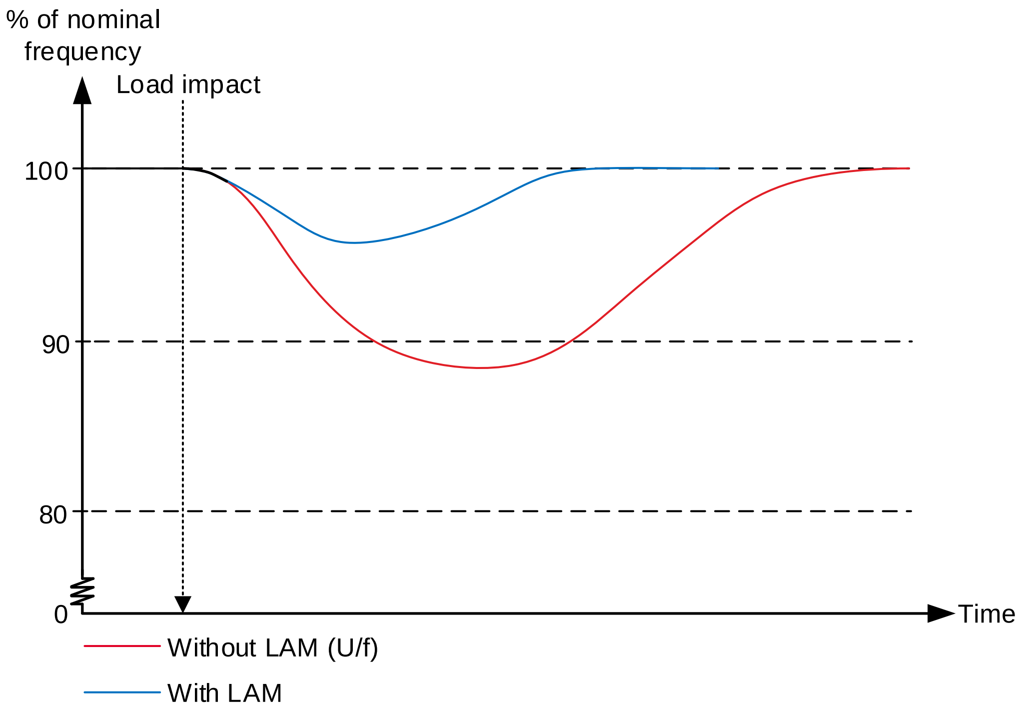
The functionality is automatically disabled by the Multi-line 2 unit when operating parallel to mains.

Load acceptance module (LAM):
The DVC 310 supports LAM, which is a functionality to optimise transient performance of frequency when high load steps are applied. This is achieved by dropping the voltage reference momentarily when the frequency drops below the knee point. In this way, the torque demand on the engine is reduced momentarily. Afterwards, the voltage is raised slowly (according to the soft voltage recovery setting) towards the voltage reference defined by the U/f law. The LAM function can be used to gain more stability in the regulation when a big load impact has been experienced. The percentage set in the LAM function defines how many percent the voltage is allowed to drop, as soon as the knee point is reached.

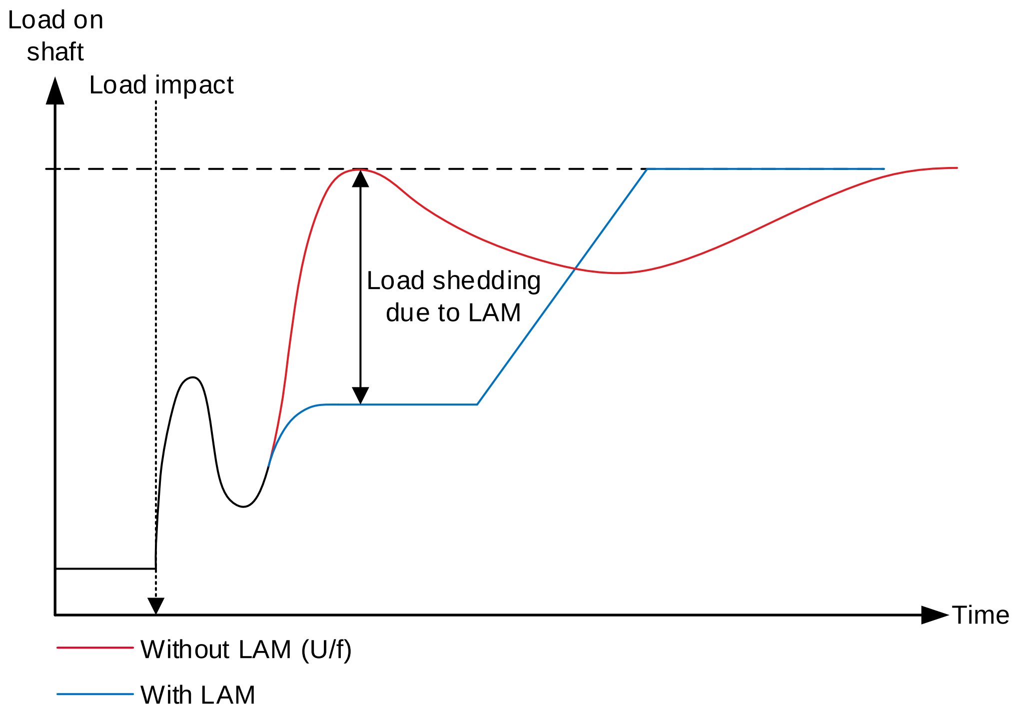
A comparison of U/f and LAM system performance is shown below:



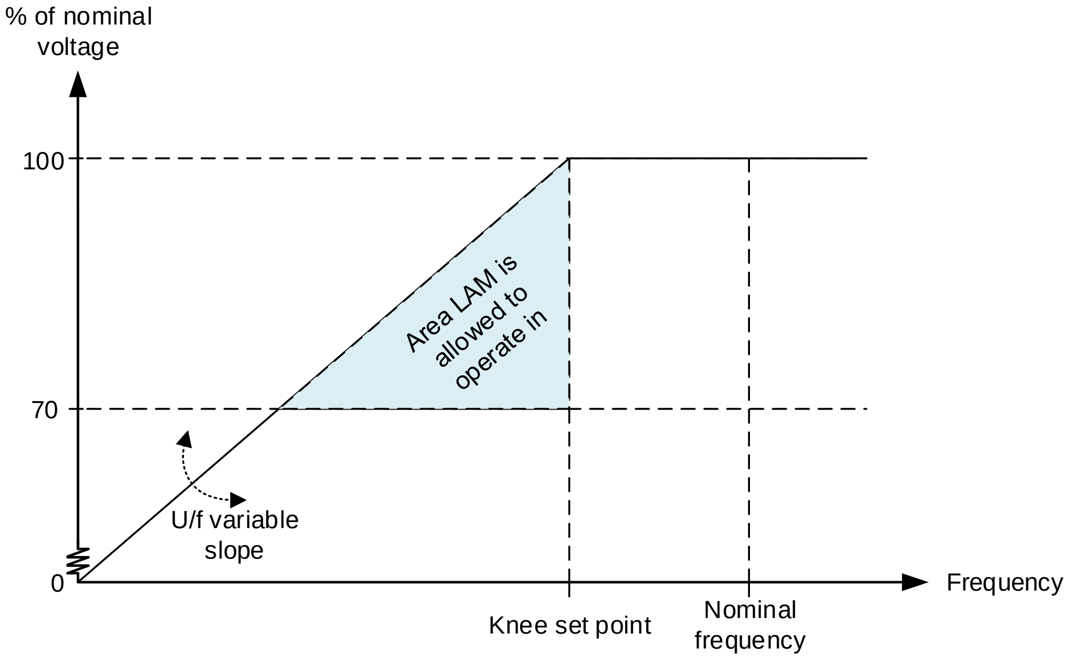
In the graph above, a comparison is made with and without the LAM function. Without the LAM function, the voltage may get unstable at load impacts. Here it is only the U/f law from the knee set point function that determines the voltage set point. With the LAM function, it is allowed to drop the voltage for a short time. The LAM function will start to ramp up the voltage when the frequency is starting to ramp up again. The slope of the ramp up of the voltage is controlled by the soft voltage recovery function, which will be described later.



The graph above shows that with the LAM function, the frequency will rise and stabilise faster after a big load impact. This is because the LAM function will drop the voltage and by this lower the torque on the engine.



The graph above shows a comparison of the load on the shaft of the engine, with the LAM function enabled and disabled. When the LAM function drops the voltage, the torque on the shaft is lightened, which makes it possible for the engine to rise faster in RPM after a load impact. This also gives the possibility to steadily reach nominal values faster after the load impact, since the LAM function will increase system stability.



The graph above is very similar to the U/f law graph. The difference is that a triangle is marked here. When the LAM function is enabled, the genset is allowed to be inside the marked area. When having the U/f law, the DVC 310 will never cross the U/f law line in the graph, but will always seek to be near it. When the genset is above the knee set point, the DVC 310 will regulate up to the nominal voltage instead. But as long as it is in the marked area (triangle), the DVC 310 will have the U/f law to determine the voltage set point.

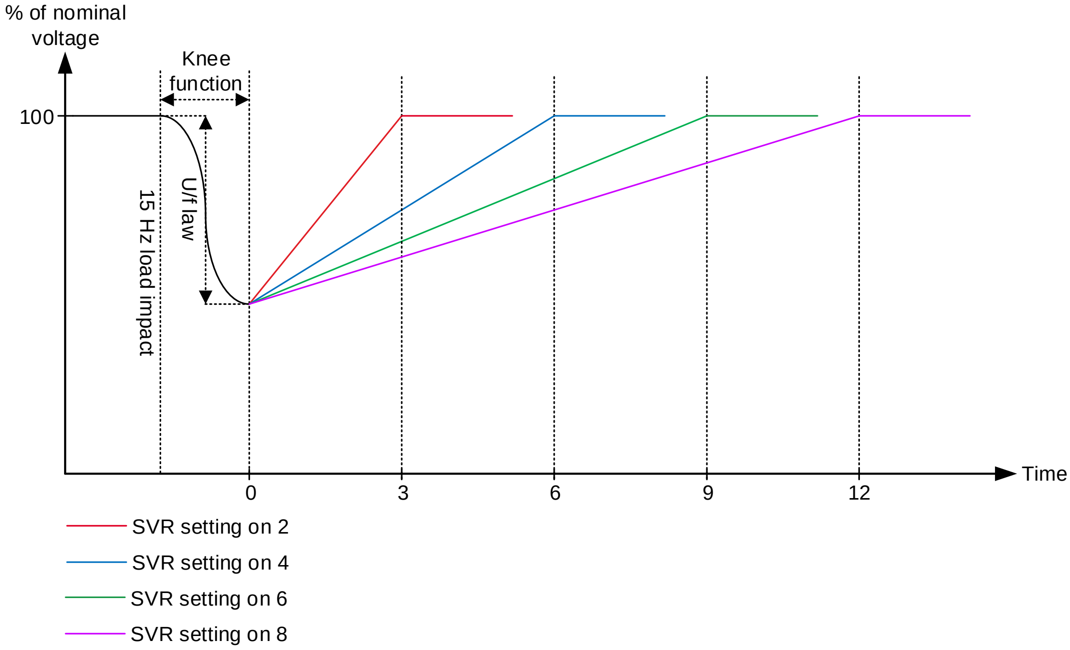
The LAM set point in the DVC 310 is set in percentage of how much it should drop the voltage compared to nominal. So if a set point of 10 % is made, the voltage will drop to 90 % of nominal, when the LAM function is active. In the Multi-line 2 unit, LAM function is set on how much it should drop to when LAM is active. So, if the LAM function in the Multi-line 2 unit is set to 90 %, the DVC 310 will drop the voltage to 90 % of the nominal voltage, when LAM is active.

Parameter	Item	Range	Default	Note
7775	LAM set point	70 % 100 %	90 %	Only in genset. Defines the voltage level, the voltage is dropped to when the knee set point is reached.
7776	Activation of LAM function	OFF ON	OFF	Only in genset

Settings at parameters 7775 and 7776 are treated as a common set point among the AGC DG units in power management applications.

The functionality is automatically disabled by the Multi-line 2 unit when operating parallel to mains.

Soft voltage recovery (SVR):
Soft voltage recovery (SVR) is an add-on to LAM that helps the genset return to its rated speed after experiencing a load impact. This is done by gradually increasing the voltage towards the voltage defined by the U/f law. The SVR is activated when the frequency drops below the knee point and an increase in frequency is detected. The setting for the SVR function defines the slope for the voltage recovery after a load impact. The SVR setting in parameter 7773 defines how many seconds the voltage should take to recover to nominal voltage from a 10 Hz load impact.



In the graph above, different SVR settings are shown at 15 Hz load impact. The dotted line at time point 0 represents where the frequency is starting to recover again. When the frequency starts to recover, the SVR function will be activated. When the genset is exposed to a 15 Hz load impact and the SVR setting is 4 s/10 Hz, the voltage will be recovered in 6 seconds. But the U/f law can still not be passed, which can make the SVR longer than for example 6 seconds. This can happen if the engine is not fast to recover in RPM from a load impact.

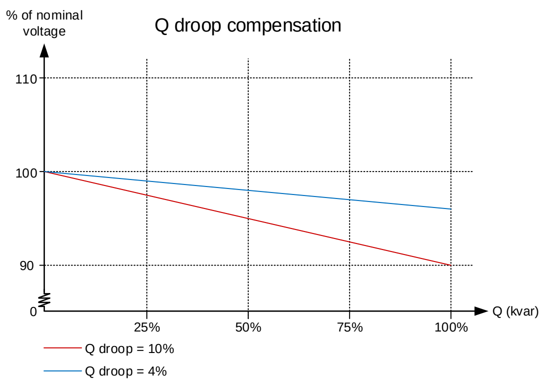
Parameter	Item	Range	Default	Note
7773	Soft voltage recovery timer	0.1 s/10 Hz 30.0 s/10 Hz	2.0 s/10 Hz	Only in genset
7774	Activation of Soft voltage recovery function	OFF ON	OFF	Only in genset

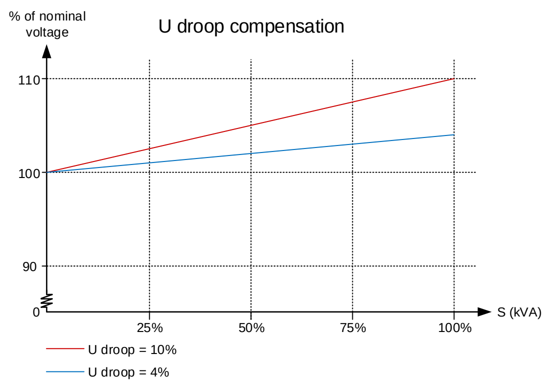
The voltage regulator of the Multi-line 2 unit is inhibited in case the SVR functionality is active. Regulation is activated again when the SVR timer runs out.

Settings at parameters 7773 and 7774 are treated as a common set point among the AGC DG units in power management applications.

The functionality is automatically disabled by the Multi-line 2 unit when operating parallel to mains.

Droop compensation:
Two types of droop compensation are supported by the DVC 310: Reactive droop and voltage line droop. They can be controlled via the Multi-line 2 unit.





The droop compensation decides how much the voltage is allowed to droop if the regulation is turned off in the Multi-line 2 unit. The regulation can be turned off by setting the Multi-line 2 unit into MANUAL. The regulation can also be off if the CAN bus cables should break. With the droop, it is possible to give the DVC 310 a set point for the voltage if an error in the CAN bus lines should occur. This makes it possible for the genset to share the reactive load when no interfacing is available.

It is recommended that the U droop compensation is not turned on when interfacing the DVC 310 with a Multi-line 2 unit. These functions will try to work in opposite directions, which may cause instability.

All settings for droop are found in menu 7780 - Droop compensation.

Parameter	Item	Range	Default	Note
7781	Q droop compensation set point	0.0 % 10.0 %	2.0 %	Only in genset
7782	U droop compensation set point	0.0 % 10.0 %	2.0 %	Only in genset
7783	Activate droop compensation type	Q droop compensation OFF	Q droop compensation	Only in genset

All settings in the menu 7780 are treated as a common set point among the AGC DG units in power management applications.

The functionality is automatically disabled by the Multi-line 2 unit when operating parallel to mains.

Only one of the droop functions can be active.

4.1.5 Genset modes

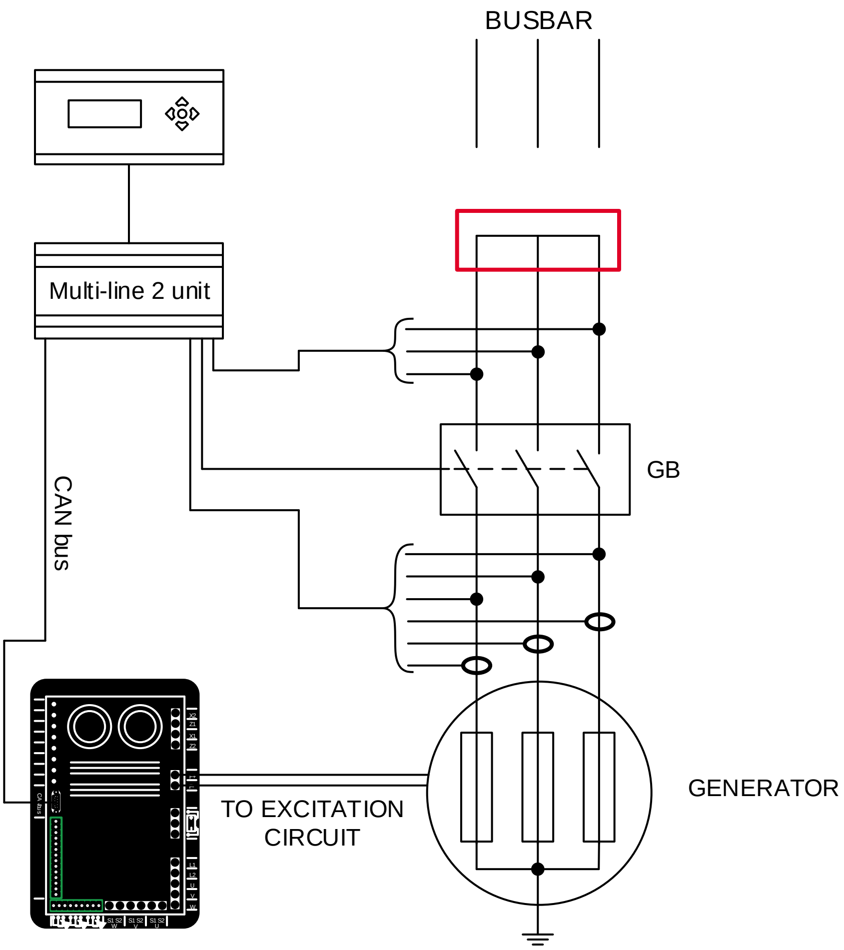
The option T2 and the DVC 310 combined gives two new genset modes, which are available at parameter 6070 - Genset mode:

- Dry alternator
- Ventilation

Dry alternator:

The purpose of the dry alternator is to dry the windings in the generator before use. The reason for drying the windings is to prevent the winding insulation from being degraded due to moisture in the generator and to prevent arc-over in the windings. External heat sources can be used to vaporise the moisture, but the DVC 310 provides the possibility of using the alternator to dry the windings instead. It is done in this way:

1. Make a short circuit of the busbar, meaning that when the GB closes, the generator will supply a short circuit. At parameter 7791, it is possible to type in a set point for excitation current, meaning that if the set point is set to 0.1 A, the DVC 310 will supply 0.1 A excitation current. This will result in much higher current in the stator, and the heating from the stator current will dry the windings.



2. Choose Dry alternator mode at parameter 6071. Start the genset in semi-auto mode and close the GB. When the windings are dried out, open the GB and stop the genset.

3. Now set the Multi-line 2 unit into the desired genset mode at parameter 6071. Start the generator again and close the GB. Now the DVC 310 will slowly raise the excitation current. If the voltage is not raised, the Multi-line 2 unit will make a shutdown, because it means that the short circuit is not removed.

Parameter	Item	Range	Default	Note
7791	Excitation reference for dry alternator	0.0 A 20.0 A	1.5 A	Only in genset

If the excitation supply for the DVC 310 comes from AREP or shunt, an external supply is needed when running dry alternator mode. Only a PMG does not require external supply.

Dry alternator mode is not possible with GPC-3.

Ventilation mode:
The purpose of ventilation is to remove humidity before use. It is done in this way:

1. Select Ventilation mode at parameter 6071.
2. Start the genset in semi-auto mode with open GB, and the generator will be ventilated by fan air. The excitation current will be 0 A.
3. Now set the Multi-line 2 unit into the desired genset mode at parameter 6071.

Ventilation mode is not possible with GPC-3.

5. Protections

5.1 Protections

5.1.1 Enabling and disabling of alarms

The alarm settings parameters 7821 to 7825 enable or disable commands to the equivalent AVR alarms. The setting of alarm parameters can only be done via EasyReg.

The enabling/disabling of alarms is sent to the AVR if:

- one of the parameters is changed and “Write” is pressed
- parameter 7803 is enabled (disables itself again)
- the ML-2 unit is powered up. The transmission takes place one time only after power-up.

5.1.2 Voltage loss detection

The DVC 310 is able to shut down the excitation if a loss of voltage sensing is detected in 1 second. The reason for shutdown of the excitation is that the DVC 310 does not have a voltage reading as regulation feed-back. This is to protect the alternator from overheating the windings, and also to protect the equipment from over-voltage when operating in island mode.

The loss of voltage detection alarm will be triggered when the measured voltage is below 40 % of the set point. Note that the set point may vary, following the U/f rule.

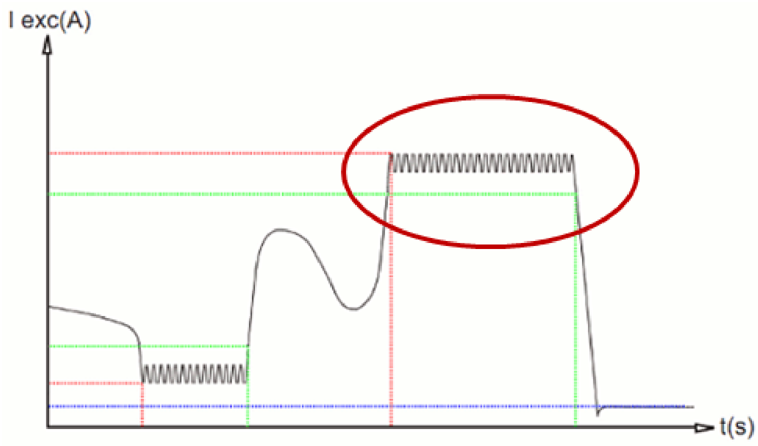
This detection is made in configuration 1ph as well as 3ph. If configured in 3ph, the voltage considered for the alarm is the average global voltage.

The voltage loss detection can be enabled in parameter 7821:

Parameter	Item	Range	Default	Note
7821	Activation of voltage loss detection	OFF ON	OFF	Only in genset

5.1.3 Excitation current run limitation/shutdown excitation

This protection is to ensure that the excitation of the alternator does not exceed the upper limit. The upper limit is shown in the graph below.



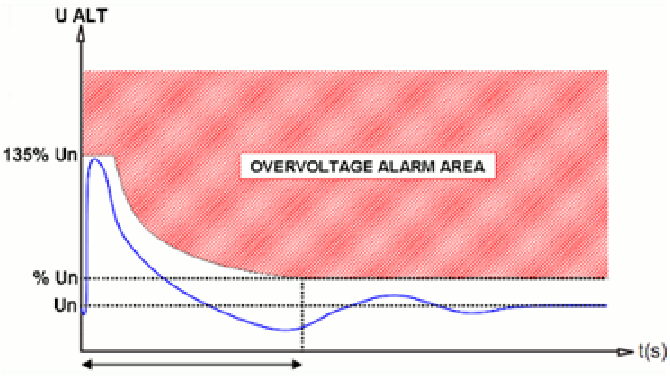
If the genset is supporting a very inductive load, the magnetic flux density in the rotor can be very high, which can cause end-turn burning. This protection contains three parameters, which can all be found in the Easy-Reg software.

The first parameter (Iexc run limitations) determines how much excitation is allowed before a timer starts. The second parameter (Iexc reset limitation) determines how much the excitation has to drop to stop the timer. By default, the timer is 10 seconds and cannot be changed. If the timer expires, the excitation will be turned down to the current set in the third parameter (Iexc shutdown). This protection is used for thermal protection of the windings in the alternator. These settings can all be found in the EasyReg software, which will be described later.
This protection is enabled at parameter 7822:

Parameter	Item	Range	Default	Note
7822	Activation of excitation current protection	OFF ON	OFF	Only in genset

5.1.4 Over-voltage protection

This protection is to prevent the alternator from running with high voltage over a long period of time. The timer and the limit are set in the EasyReg software. The voltage value, to which the over-voltage protection percentage is applied is the, at any time used, voltage regulation set point during voltage regulation. During a soft-start sequence, this means that if the alternator voltage is 210 V AC, but the regulation's set point is 200 V AC, a 5 % deviation is now present. The curve for over-voltage characteristic can only be changed when customised configuration is chosen. The mentioned curve for the over-voltage protection is shown below.



The over-voltage protection in the DVC 310 is enabled in parameter 7823:

Parameter	Item	Range	Default	Note
7823	Activation of over-voltage protection	OFF ON	OFF	Only in genset

5.1.5 Diode fault

The DVC 310 is able to:

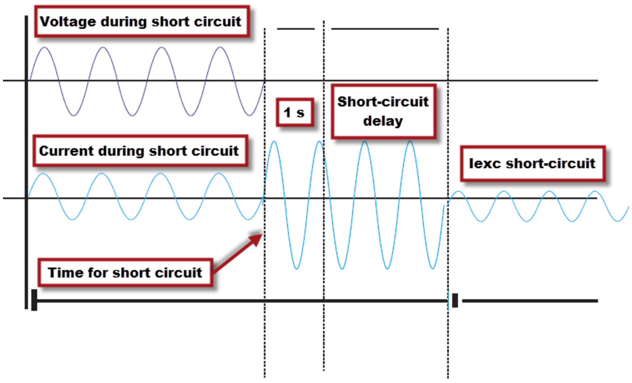
- measure on the excitation circuit in the alternator and thus ensure that all diodes are working normally
- measure the ripples for the excitation and thus detect faulty diodes
- switch off the excitation if it detects a diode fault
- send alarms through the CAN bus communication when it detects a diode fault.

The diode fault detection is enabled in parameter 7824:

Parameter	Item	Range	Default	Note
7824	Activation of diode fault supervision	OFF ON	OFF	Only in genset

5.1.6 Short circuit

If the DVC 310 detects that the voltage disappears and the phase current exceeds two times nominal, the DVC 310 will see this as a short circuit. From the point when the voltage disappears, a one second timer is started. The DVC 310 has a short circuit protection, which uses two parameters. The first parameter (short circuit delay) determines how long a new timer should be active, before the excitation is shut down to a pre-defined level (I-excitation short circuit). The short circuit protection will only be able to activate if 1 or 3 CTs are installed. The short circuit protection is shown in the graph below.



The short circuit protection is activated at parameter 7825:

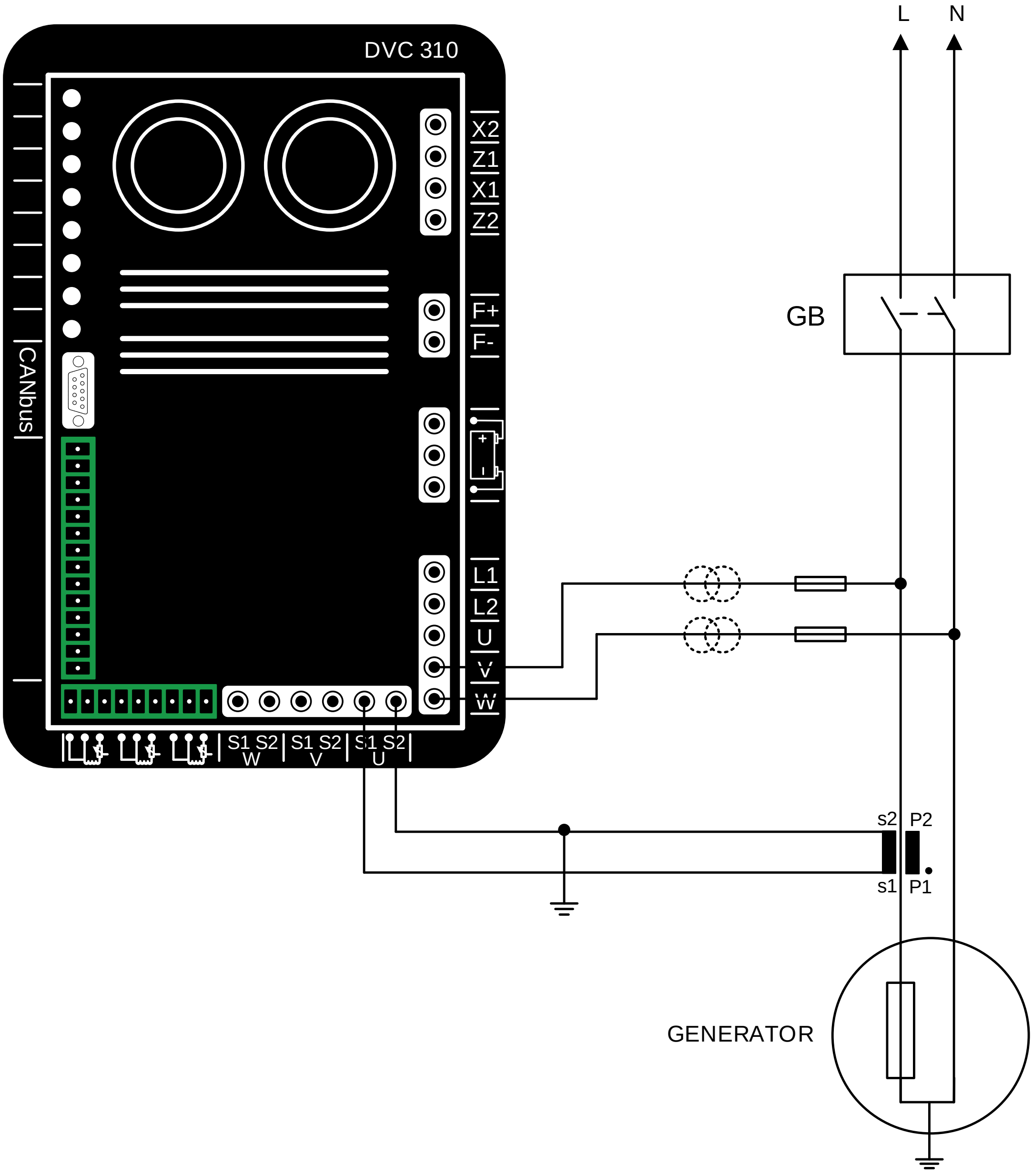
Parameter	**Item**	**Range**	**Default**	**Note**
7825	Activation of shut-down diodes protection	OFF ON	OFF	Only in genset

6. DVC 310 options

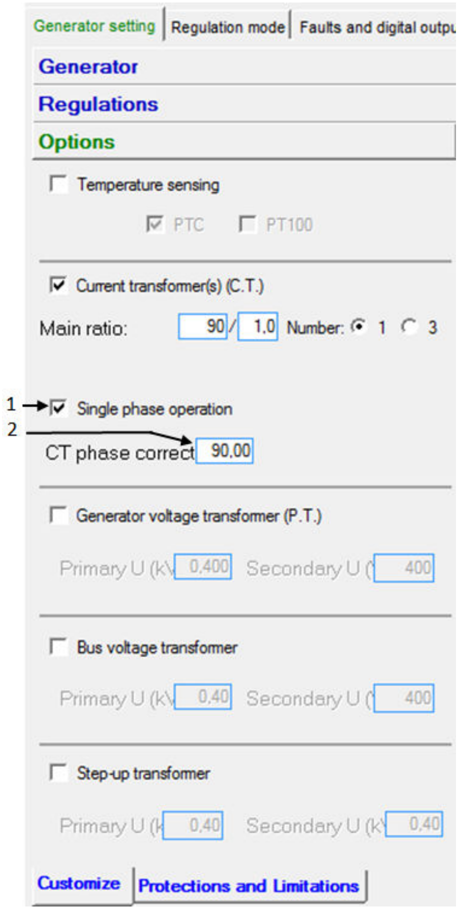
6.1 DVC 310 options

6.1.1 Single phase operation

The DVC 310 is able to perform single phase operation, which means that it is able to measure the voltage on a phase and a neutral. The DVC 310 will need some information to do this. The voltage sensing will have to be done with the phase voltage on V-terminal and the neutral on W-terminal. The current transformer will then have to be mounted to the U-S1 and U-S2 terminals on the DVC 310, with P1 facing the alternator on phase line. The specific things for the installation of a single phase generator is shown below. The other connections are connected in the same way, as on a three-phase generator, which was shown earlier.



For the DVC 310 to measure correctly, the current transformer will need a phase correction, which is set in the EasyReg software. In the EasyReg software, this is configured in the "Generator setting - Options" window.



1. Firstly, the "Single phase operation" setting is enabled. The DVC 310 then expects that the alternator is single-phase.

2. From here, the "CT phase correction" is set. This will have to be set to 90 degrees, when a setup as shown above is used.

The above things are the only things to be aware of when using a single phase generator. The rest of this option description fits three phase as well as single phase generators.

6.1.2 IN, IN/2 or IN/4 sensing

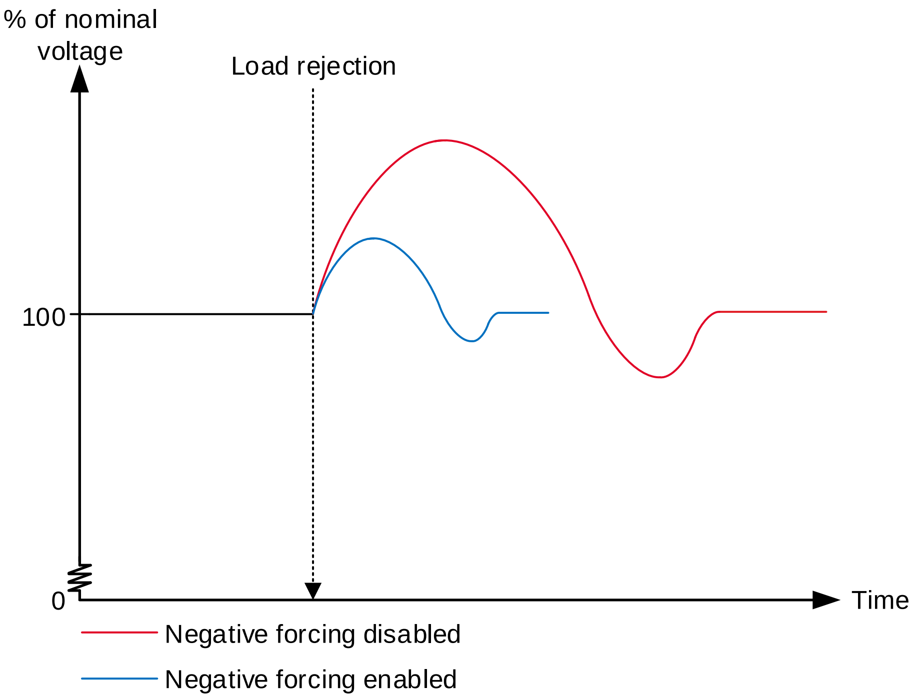
On some alternators, the current transformers can be mounted inside the alternators. The DVC 310 will need to be programmed for this configuration. The DVC 310 can be set to IN, IN/2 or IN/4 sensing from the options menu, in a new configuration. When IN is selected, it means that the CT measures the full current; when IN/2 is selected, it means that the CT measures half of the full current; and when IN/4 is selected, the CT measures one fourth of the full current.

6.1.3 External power module

This function will allow the DVC 310 to regulate on an inverter or a bigger AVR. If the external power module is activated, the excitation power supply circuit will be shut off. This function is not finished yet.

6.1.4 Negative forcing

The negative forcing function enables the DVC 310 to reverse the excitation voltage because of the principle with two transistors instead of one. It allows to have reversed voltage at the output (field excitation), because the two transistors are in parallel and upside down. This function can be useful if the DVC 310 is placed in an application where big loads are turning off. When shutting off a big load, the voltage may increase. By reversing the excitation for a moment, the nominal voltage will be recovered faster. In the graph below, it is shown with the negative forcing function enabled and disabled.



6.1.5 VBus compensation

This function is used to compensate for the deviations in voltage, to which the excitation circuit can be exposed. If the excitation circuit's supply voltage is lower for a moment, the excitation current will also be lower at this time. The PID controller must then be slightly more aggressive to raise the excitation current again. On the other hand, if the excitation circuit's supply voltage is higher than normal, the PID controller must be less aggressive to make sure that the excitation will match the nominal voltage.

7. Regulation related to DVC 310

7.1 Regulation related to DVC 310

7.1.1 Average and true RMS regulation

In the DVC 310, it is possible to make a selection between Average and True RMS regulation. This makes it possible to choose how the DVC 310 should manage the voltage readings. If the DVC 310 is mounted in applications with much harmonic distortion, the regulation should be switched to True RMS regulation. Otherwise, the setting should be Average regulation.

True RMS can only be used with 1-phase measurement.

7.1.2 PID settings

Access to PID settings is added in the Multi-line 2 unit menu 7800.

Parameter	Description	Comment
7801	PID Gain	This is a gain for the PID regulator in the DVC 310
7803	Wr All settings	This parameter sends all settings to the DVC 310 (this is a pulse command, by default the parameter returns to OFF state after use)

The PID regulators can only be changed with the EasyReg software. When the Multi-line 2 unit has the control (7805 to ON, described in the section "DAVR control"), only the voltage regulators are used. The gain for voltage regulator is set from the Multi-line 2 unit at parameter 7801.

Regarding the "Write all settings" (7803), the Multi-line 2 unit is writing the settings on-the-fly, as the settings are made. This parameter can be used, so the user can ensure that all the settings regarding the DVC 310 in the Multi-line 2 unit is written once more.

The ranges and defaults for the parameters are shown below:

Parameter	Item	Range	Default	Note
7801	PID gain in DVC 310	1 100	20	Only in genset
7803	Write all settings to DVC 310	OFF ON	OFF	Only in genset. When set to ON, it will automatically set to OFF.

7.1.3 Bias and control

Bias range:

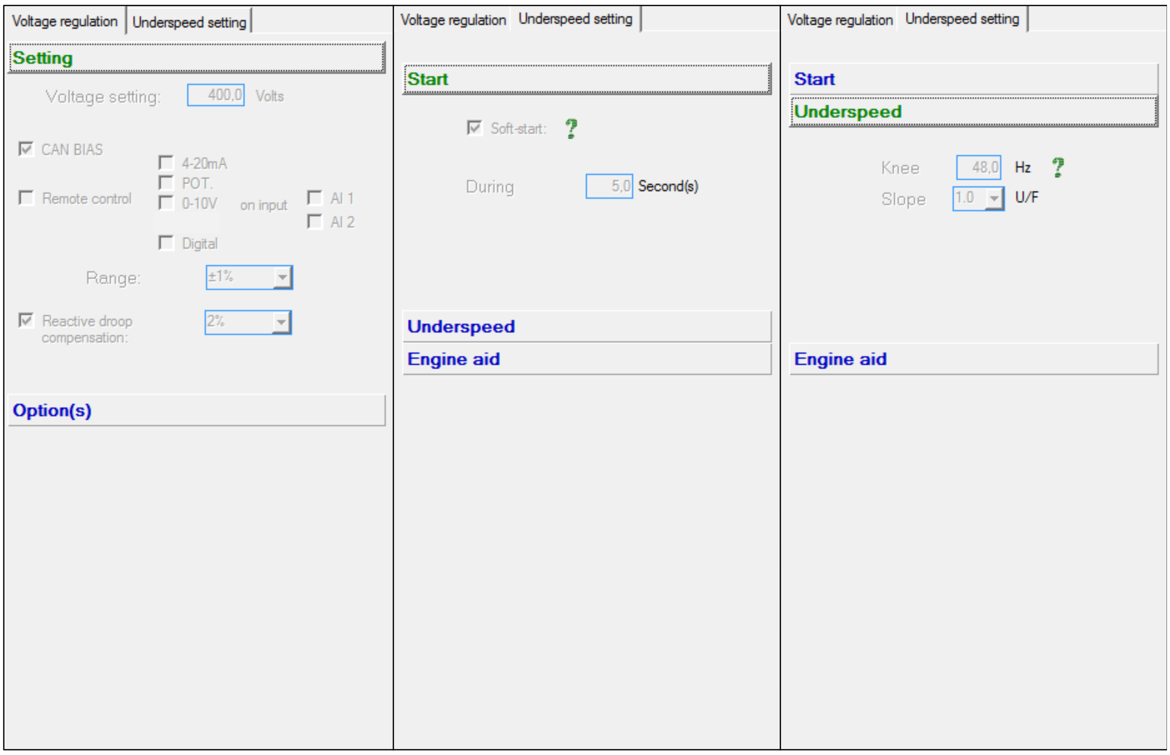
At parameter 7804, the Multi-line 2 unit can control how wide the bias range should allow the Multi-line 2 unit to control the voltage in the DVC 310. By default, it is set to +/- 10 %, which means that the Multi-line 2 unit is allowed to regulate the voltage on a 400 V genset from 360 V to 440 V. The bias range should be wide enough to ensure that the gensets can loadshare the reactive power in both capacitive and inductive situations. By making the bias range wider, the resolution for load sharing between the Multi-line 2 units will be harder, since a small step gives a bigger response. By experience, the +/- 10 % bias range covers most applications.

The bias range is only for CAN bus based bias signal.

Bias for analogue regulation:
At parameter 7806, it can be set which type of input the DVC 310 should expect to receive, if parameter 2783 is set to: Analogue.
To ensure that the DVC 310 is regulated from the Multi-line 2 unit, parameter 5990 has to be set to the correct transducer output that has to give the bias to the DVC 310.

DAVR control:
This parameter is located 7805. It controls whether the Multi-line 2 unit should send commands and information in the CAN bus. This could for example be controlling the DVC 310 in switching regulation mode, and sets the knee set point and other settings/commands to the DVC 310.
It does not matter if the "DAVR control" is set to ON or OFF, regarding the bias signal. The Multi-line 2 unit is still able to regulate on the CAN bus based bias to the DVC 310. Parameter 2783 will then still have to be set to: "EIC", and the engine interface (7561), will have to be set to a J1939 based protocol.

If the Multi-line 2 unit has the control, and the communication is up and running, it can be seen in the Easy-Reg software. A lot of settings are greyed out, so these settings can only be changed from the Multi-line 2 unit. The settings that are greyed out are the ones corresponding to the ones mentioned in the table for "Common settings related to DVC 310". The picture below shows what it looks like when the settings in Easy-Reg are greyed out.



A table for the parameters described above, is shown below:

Parameter	Item	Range	Default	Note
7804	DVC 310 bias range for CAN bus-based regulation	0.1 % 30.0 %	10.0 %	Only in genset
7805	Allow the Multi-line 2 unit to control DVC 310	OFF ON	ON	Only in genset.
7806	DVC 310 analogue bias input type	4-20 mA 0-10 V DC	0-10 V DC	Only in genset.

8. Multi-line 2 and DVC 310 in cooperation

8.1 Multi-line 2 and DVC 310 in cooperation

8.1.1 Nominal settings

When the CAN bus communication is established, and the parameter for “DAVR control” (7805) is enabled, the Multi-line 2 unit is able to control the nominal settings in the DVC 310. This can be helpful, for rental customers, where the gensets are exposed to different scenarios where different nominal settings can be required. By shifting the nominal settings in the DVC 310, it makes sure that the bias range is still the same, even though the nominal voltage is either higher/lower.

The nominal settings that are being sent automatically from the Multi-line 2 unit are the active nominal voltage and frequency. So if the nominal setting is shifted between one of the four possible nominal settings, the active nominal settings will be sent automatically to the DVC 310.

8.1.2 Autoview

If the CAN bus communication between the Multi-line 2 unit and the DVC 310 is established, the Multi-line 2 unit is able to display some values that it receives via the CAN bus. These values will be added to the already 20 present views in the Multi-line 2 unit, so the total number of views will be expanded. It will still only be be possible to configure the first 20 views.

The extra lines will be displayed if parameter 7564 is switched to “ON” and the CAN bus is active. Parameters 7564 will automatically switch to “OFF” again.

Note that if the DVC 310 is mounted on a genset where there is also an ECU, and the ECU also gives information via the CAN bus, the ECU data might not be required to start the genset, before toggling the autoview to “ON”, since some ECUs only give information when the engine is running.

The parameter for the autoview is shown below:

Parameter	**Item**	**Range**	**Default**	**Note**
7564	Autoview - enable	OFF ON	OFF	Only in genset. Note that it automatically switches to OFF again.

8.1.3 Pt100 sensors at the DVC 310

At menu 7810 in the Multi-line 2 unit, it is possible to set the alarm limit for the three Pt100 inputs on the DVC 310. It is not required that a Pt100 sensor is wired to all inputs. The Multi-line 2 unit can then send the limit setting, indicating when the DVC 310 should give an alarm regarding high temperature. The three input limits can be set independently of each other.

The relevant parameters are shown in the table below:

Parameter	Item	Range	Default	Note
7811	Pt100 input no.1 on the DVC 310 - threshold	50 deg. 200 deg.	160 deg.	Only in genset.
7812	Pt100 input no.2 on the DVC 310 - threshold	50 deg. 200 deg.	160 deg.	Only in genset.
7813	Pt100 input no.3 on the DVC 310 - threshold	50 deg. 200 deg.	160 deg.	Only in genset.

8.1.4 Communication error

When the settings regarding communication to the DVC 310 have been set, the Multi-line 2 unit has an alarm for surveillance of the communication lines. If the communication between the Multi-line 2 unit and the DVC 310 suddenly stops, the Multi-line 2 unit will give an alarm called “DAVR Comm. Err”.

The alarm can be configured at menu 7830 where it is also possible to set a failclass to activate if the “DAVR Comm. Err” alarm appears.

The parameters used for the communication alarm error are shown below:

Parameter	Item	Range	Default	Note
7831	Digital AVR communication error - delay	0.0 s 100.0 s	0.0 s	Only in genset
7832	Digital AVR communication error - output A	Not used Option-dependent	Not used	Only in genset.
7833	Digital AVR communication error - output B	Not used Option-dependent	Not used	Only in genset.
7834	Digital AVR communication error - enable	OFF ON	OFF	Only in genset.
7835	Digital AVR communication error - failclass	Block Trip MB/GB	Warning	Only in genset.

8.1.5 DVC 310 alarms on Multi-line 2 unit

The Multi-line 2 unit has the possbility to act on alarms given from the DVC 310 via CAN bus.

The DVC 310 can give two different levels of alarms, where the first level is a "DAVR Warning", and the next level "DAVR Trip". This is enabled at menu 7760, where it is also possible to set a failclass for a "DAVR Warning" and for a "DAVR Trip".

The relevant parameters are shown in the table below:

Parameter	Item	Range	Default	Note
7761	DVC 310 Warning - enable	OFF ON	OFF	Only in genset.
7762	DVC 310 Warning - failclass	Block Trip MB/GB	Warning	Only in genset.
7763	DVC 310 Trip - enable	OFF ON	OFF	Only in genset.
7764	DVC 310 Trip - failclass	Block Trip MB/GB	Warning	Only in genset.

8.1.6 Close before excitation – additional control parameters

If the application has been configured to use “Close Before Excitation” (CBE) during start, the Multi-line 2 unit can do additional things to handle the sequence correctly.

If, for example, the application is made for backup power (AMF), it can be chosen what the Multi-line 2 unit should do during cooldown. The Multi-line 2 unit is able to make a rerun, which means that if a new start request comes during cooldown, the genset(s) can perfom the CBE sequence again without stopping the genset(s). To handle the functionality for the rerun and cooldown, some parameters must be set correctly.

Excitation control during cooldown: At parameter 2266, it is possible to decide how the Multi-line 2 unit should react during cooldown. At this parameter, it is possible to select between three settings:

- Excitation follow busbar
- Excitation constant OFF
- Excitation constant ON

A short description of each selection is made below:

Excitation follow busbar: By default, the parameter is set to “Excitation follow busbar”. This means that if there is voltage on the busbar during cooldown of the specific genset, the excitation is ON. If the voltage on the busbar disappears, the excitation is shut OFF.

Excitation constant OFF: If the parameter is set to “Excitation constant OFF”, the excitation will be switched OFF, as soon as the GB is open during cooldown. This feature can be handy if the genset fans are pulled mechanically by the genset. Then the genset will be able to make a rerun faster.

Excitation constant ON: If the parameter is set to “Excitation constant ON”, the excitation will be ON until the genset stops or a new start request comes. This feature can be handy if the genset fans are driven by the voltage from the genset.

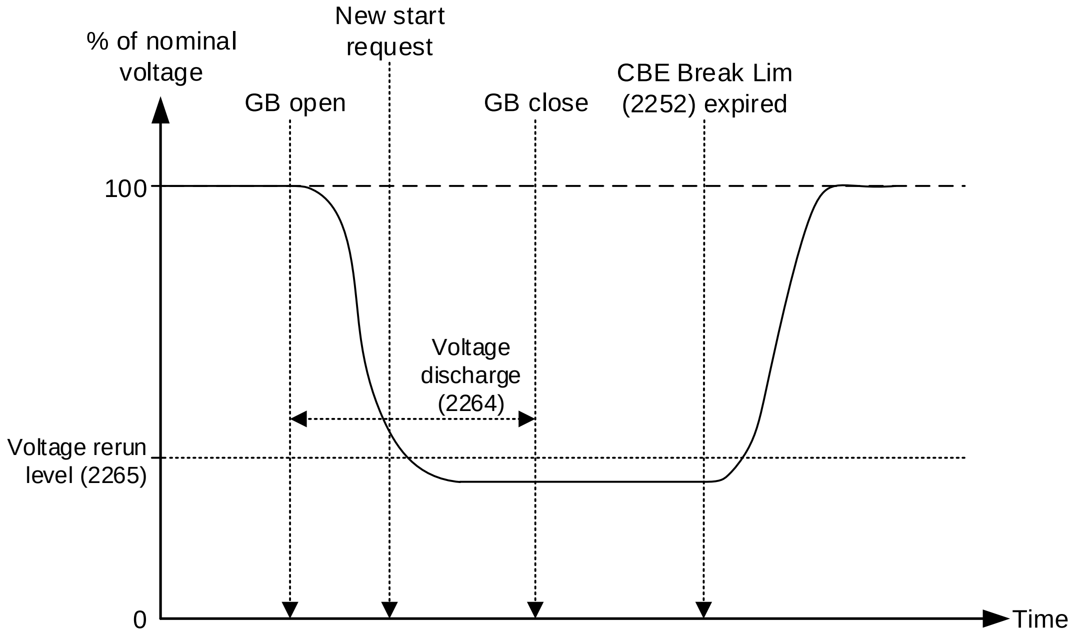
Parameter	Item	Range	Default	Note
2266	Excitation control during cooldown	Excitation follow busbar Excitation constant ON	Excitation follow busbar	Parameter is not shared between gensets!

Voltage rerun level:

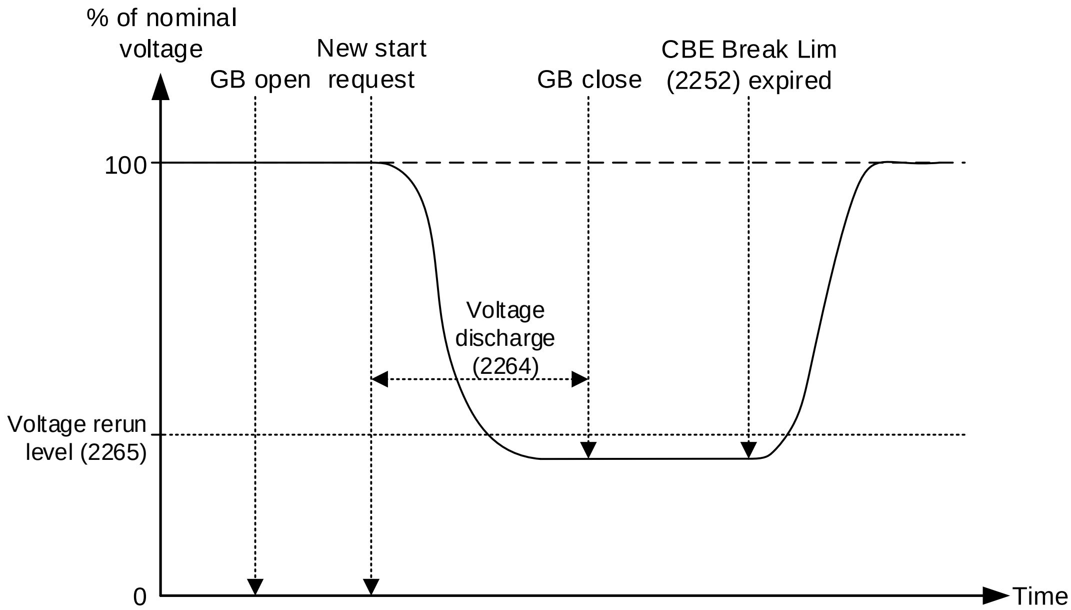
At parameter 2265, it is set how low the voltage must be, before it is allowed to close the breaker during the rerun. If the voltage is not below the “voltage rerun level” before the “voltage discharge timer” has expired, the specific genset will be excluded from the CBE rerun sequence.

Parameter	Item	Range	Default	Note
2265	Voltage rerun level	30 % 100 %	30 %	Parameter is not shared between gensets!

Voltage discharge timer:
The timer can be found at parameter 2264 and represents how long time it takes from the excitation is removed until the voltage is below “voltage rerun level”. The voltage discharge timer can be started either from a new start request or from when the generator breaker opens. The different reactions are dependent on the selection of “excitation control during cooldown”. The two rerun sequences shown below may enhance the understanding:



In the diagram above, the excitation is shut off as soon as the breaker is opened. Shortly after the breaker is opened, a new start request appears. The Multi-line 2 unit will wait with the closing of the GB until the “voltage discharge timer” has expired.



In the diagram above, the excitation is ON during cooldown. Then a new start request is made, which means that the excitation will be shut off. When the excitation is shut off, the voltage discharge timer starts. Comparing the two situations shows that the first example is the fastest. This is because the excitation is already off when the next start request appears. If the new start request had appeared a little later, the voltage discharge timer could already have expired. This means that the generator breaker could have closed very shortly after the new start request.

Parameter	Item	Range	Default	Note
2264	Voltage discharge timer	1.0 s 20.0 s	5.0 s	Parameter is not shared between gensets!

8.1.7 DAVR info menu (jump 9090)

At jump menu 9090, it is possible to access information about DAVR software version and see any active alarms in the DAVR.

Parameter 9093 offers the possibility to restart the DAVR to reset internal alarms.

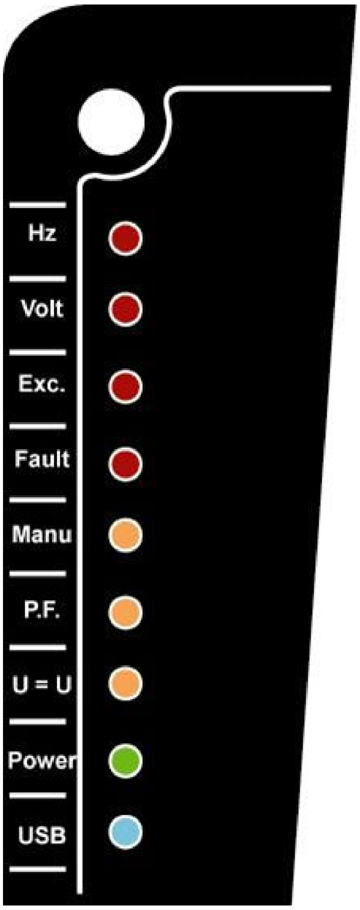
Parameter	Item	Note
9091	DAVR SW version	Display of DAVR software version
9092	DAVR alarms	Display of all active alarms
9093	DAVR trip alarms	Display of active trip alarms (select to restart DAVR)

9. DVC 310 LEDs

9.1 DVC 310 LEDs

9.1.1 DVC 310 LEDs

The DVC 310 has numerous LEDs that can be used for indication and information. The LEDs are placed in the upper left corner, as shown below.



Hz: Glows red if the speed has dropped below the knee set point and the U/f law is active.

Volt: Glows red if the voltage is high or low compared to the nominal voltage.

Exc.: Glows red if the alternator is exposed to either over- or under-excitation.

Fault: Glows red if the DVC 310 has detected a diode fault.

Manu: Glows yellow when a Multi-line 2 unit is ready for a CBE start. Can be used to indicate that all conditions are present for a CBE start.

PF/kVAR: Glows yellow when PF or kvar regulation mode is active. (PF and kvar regulation cannot be activated when interfacing with a Multi-line 2 unit).

U = U: Glows yellow when voltage matching is active. (Not available when interfacing with a Multi-line 2 unit).

Power ON: Glows green when a 24 V DC supply is present on the DC supply terminals of the DVC 310.

USB: Glows blue when the DVC 310 is connected to a PC.

10. M-Logic related to DVC 310

10.1 M-Logic related to DVC 310

10.1.1 M-Logic events, outputs and commands

In M-Logic, there are additional possibilities with the option T2.

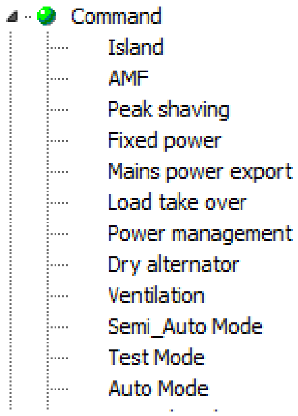
A list of the events is shown below:

- DAVR event
  - LED: Power On
  - LED: U=U
  - LED: PFkVAR
  - LED: Manual
  - LED: Fault
  - LED: Exc.
  - LED: Exc. blink
  - LED: Volt
  - LED: Hz
  - General trip
  - Short circuit
  - Loss of voltage sensing
  - Under excitation
  - Over excitation (level)
  - Over excitation (curve)
  - Over voltage
  - High temperature PT100_1
  - High temperature PT100_2
  - High temperature PT100_3
  - High temperature PTC
  - Stator over current
  - Stator over current U
  - Stator over current V
  - Stator over current W
  - Imbalance Stator current
  - Diode fault
  - Shutdown diodes
  - Stator current limitation off
  - Stator current limitation TM
  - Stator current limitation IM
  - Stator current limitation Active

For outputs, these four are possible:

- DAVR commands
  - Set stator current limitation off
  - Set stator current limitation TM
  - Set stator current limitation IM
  - Reset trip alarms

Furthermore, two lines have been added in the command window in M-Logic: Dry alternator and Ventilation.



11. Common settings related to DVC 310

11.1 Common settings related to DVC 310

11.1.1 Overview of shared parameters related to option T2

This chapter is made to give the user an overview of parameters that are shared between the AGC DG units, and between a Multi-line 2 unit and a DVC 310.

Parameter	Parameter no.	AGC DG to AGC DG	ML-2 unit to DVC 310
CBE set point	2251	X	
CBE delay	2252	X	
CBE enable	2254	X	
CBE breaker sequence	2261	X	
CBE soft-start timer	2262	X	X
CBE RPM excite	2263	X	
Generator nominal voltage - nominal set 1	6004		X
Generator nominal voltage - nominal set 2	6014		X
Generator nominal voltage - nominal set 3	6024		X
Generator nominal voltage - nominal set 4	6034		X
Generator voltage transformer primary side	6041		X
Generator voltage transformer secondary side	6042		X
Busbar voltage transformer primary side - busbar nominal set 1	6051		X
Busbar voltage transformer secondary side - busbar nominal set 1	6052		X
Busbar voltage transformer primary side - busbar nominal set 2	6061		X
Busbar voltage transformer secondary side - busbar nominal set 2	6062		X
DVC 310 generator primary voltage	7741		X
DVC 310 generator secondary voltage	7742		X
DVC 310 busbar primary voltage	7743		X
DVC 310 busbar secondary voltage	7744		X
DVC 310 voltage transformer enable	7745		X
Start-on threshold PWM	7751		X
Start-on threshold voltage limit	7752		X
Soft-start timer (Normal start)	7753		X
Knee set point	7771	X	X
U/f law slope	7772	X	X
Soft voltage recovery timer	7773	X	X

Parameter	**Parameter no.**	**AGC DG to AGC DG**	**ML-2 unit to DVC 310**
Soft voltage recovery enable	7774	X	X
LAM set point	7775	X	X
LAM enable	7776	X	X
Q droop compensation set point	7781	X	X
U droop compensation set point	7782	X	X
Droop compensation type	7783	X	X
Excitation current for dry alternator mode	7791		X
Excitation current for CBE during remanence phase	7792		X
Transformer excitation set point for current	7793		X
Inductive motor starting set point for current	7794		X
Stator current limitations enable	7795		X
PID Gain	7801		X
Write all settings to DVC 310	7803		X
DVC 310 bias range	7804		X
DVC 310 controls	7805		X
DVC 310 bias analogue type	7806		X
Pt100_1 threshold setpoint	7811		X
Pt100_2 threshold setpoint	7812		X
Pt100_3 threshold setpoint	7813		X
Voltage loss detection enable	7821		X
Excitation current protection enable	7822		X
Over-voltage protection enable	7823		X
Diode fault protection enable	7824		X
Shutdown diode protection enable	7825		X

12. Modbus Commmunication

12.1 Additional information for H2/N

This chapter is to be considered as additional information for option H2/N (Modbus RS-485 RTU). If option H2/N is installed, the data can be transmitted to a PLC, a computer, the alarm-and-monitoring system or a Scada system.

Please refer to the option H2/N technical documentation for more information about our standard external Modbus communication.

The data readable by the Modbus communication are converted into the chosen unit in menu 10970.

12.2 Modbus table

Function code 4			
Address	**Bit**	**Content**	**Note**
916		AVR generator AC Voltage [V]	
917		AVR generator frequency [Hz] 1/10	
918		AVR generator AC current [A]	
919		AVR field excitation current [A] 1/10	
920		*Not used*	
921		AVR generator reactive power	
922		AVR generator Power Factor [ ] 1/100	
923		AVR generator Power Factor lagging	00= lagging 01= leading
924		*Not used*	
925		Total Power	
926		*Not used*	
927		AVR generator apparent power	
928		AVR Pt100 1 temperature [deg C/F]	
929		AVR Pt100 2 temperature [deg C/F]	
930		AVR Pt100 3 temperature [deg C/F]	
1056	0	AVR comm. error	
	1	AVR Warning	
	2	AVR Trip	
	3-15	*Not used*	
1365	0	LED: U=U	
	1	LED: PFKVAR	
	2	LED: Manual	
	3	LED: Fault	
	4	LED: Iexc	
	5	LED: Volt	
	6	LED: Hz	
	7	LED: Power ON	
	8	LED: Blink Iexc	
	9-15	*Not used*	
1366	0	General trip	
	1	Short circuit alarm	
	2	Loss of voltage sensing alarm	

Function code 4			
Address	**Bit**	**Content**	**Note**
	3	Under excitation alarm	
	4	Over excitation on level alarm	
	5	Over excitation on curve alarm	
	6	Over voltage alarm	
	7	Over temperature Pt100 1 alarm	
	8	Over temperature PTC alarm	
	9	Over temperature Pt100 2 alarm	
	10	Over temperature Pt100 3 alarm	
	11	Over stator current	
	12	Over stator current U	
	13	Over stator current V	
	14	Over stator current W	
	15	Imbalance stator current	
1367	0	Open diode	
	1	Short circuit diode	
	2-15	*Not used*	