VACON® NX

AC DRIVES

ARFIF106
Grid Converter
with General Grid Codes
Application manual

VACON®

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Document: DPD01978A
Software code: ARFIF106V062
Version release date: 4.9.2018

1. GENERAL

This application is not kept backwards compatible. See chapter Compatibility issues before you update the application. The Grid Converter application is used to make AC grids with a possibility to operate in parallel with other power sources. The Grid Converter application has 3 different operation modes:

- Standard AFE mode.
- Island mode.
- Micro Grid mode.

1.1 AFE CONTROL

AFE function keeps constant DC voltage. AFE mode transfers power between DC and AC. AFE cannot create grid by itself, it needs to be connected to existing grid.

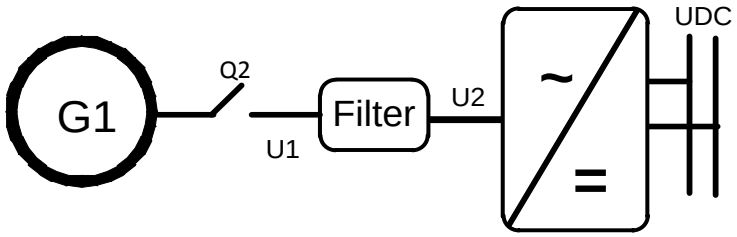


Figure 1.

1.2 ISLAND (STATIC POWER SUPPLY)

Island mode generates constant voltage and frequency. In island mode DC Voltage is not controlled.

Island mode cannot operate in parallel with other power sources in AC side, because the drive will not balance reactive or active power with other power sources.

DC voltage level needs to be considered to have correct voltage on AC side in different load situations, considering voltage losses in LCL filter and in transformer.

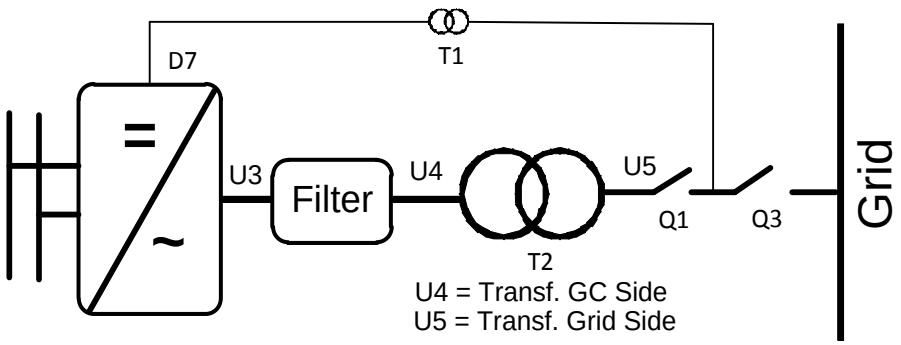


Figure 2.

1.3 MICRO GRID

Micro Grid mode controls the grid voltage and frequency. It functions like an ordinary generator. Micro Grid mode does not control DC Voltage.

With the help of voltage droop and frequency droop, more than one Micro Grid and/or Generators can work together.

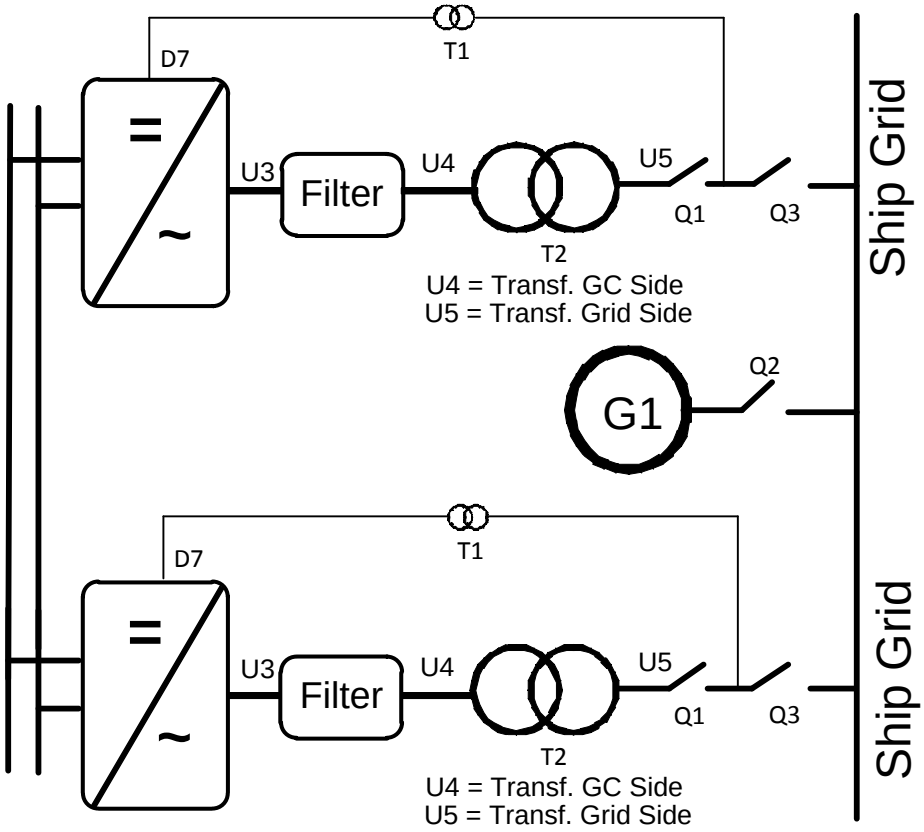


Figure 3.

1.3.1 OPERATION PRINCIPLE: DROOP SPEED CONTROL MODE

When the power demand increases, all generators on the grid allow frequency to droop. This will balance the load between all the generators on the grid. Then the power management system gives all generators a command to increase frequency so that the grid frequency is maintained at its nominal value.
When the load is reducing on the grid, the frequency of the generators will increase, and the power management system gives a command to decrease frequency.

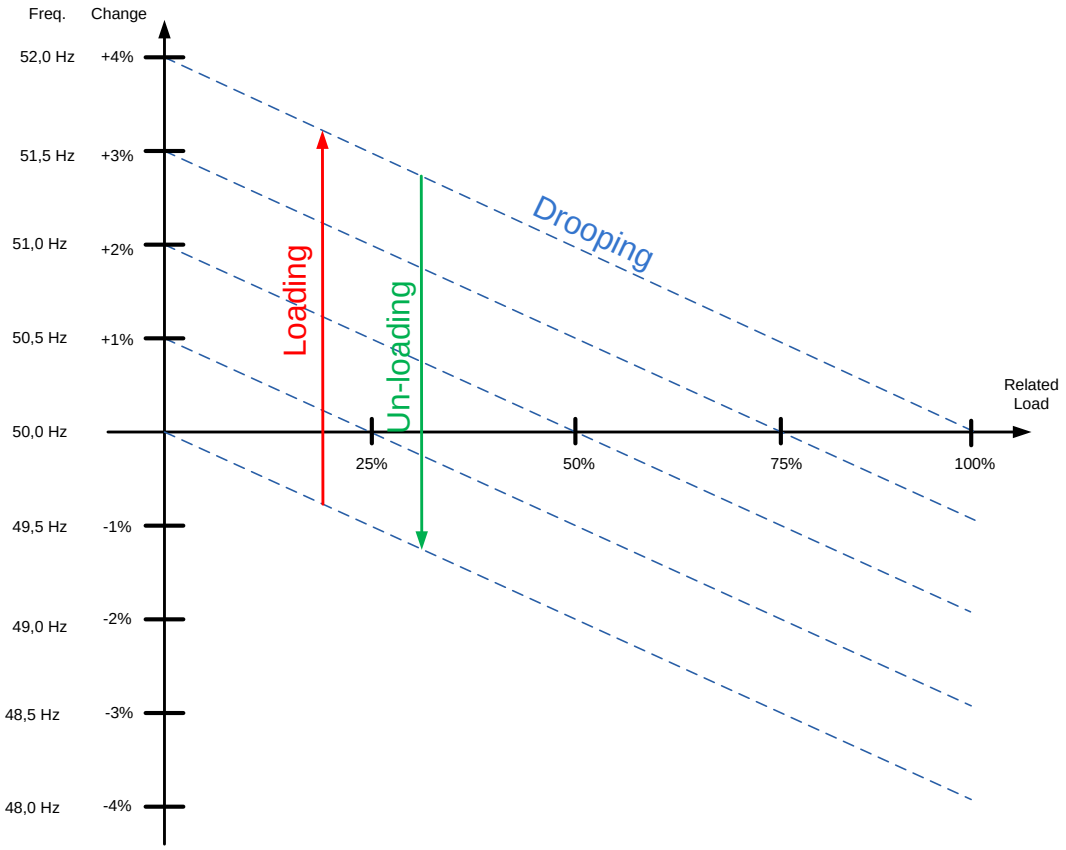


Figure 4.

1.3.2 OPERATION PRINCIPLE: ISOCHRONOUS SPEED CONTROL MODE

In the isochronous speed control mode, the Micro Grid frequency reference is kept the same as the grid frequency with help of OPT-D7. This will keep power at zero regardless of grid frequency. While drive operates in drooping mode, the actual power is controlled by base current reference. This reference needs to be controller by power management system (PMS) that will handle power sharing between different machines on the grid.

1.4 SHAFT GENERATOR

The shaft generator is a system where the generator is connected to the main engine shaft that also runs the main propulsion. The disadvantage is that the main engine must run at nominal speed even if full power to the propeller is not necessary.

With the shaft generator system power goes through the drives. One converts power from the generator to DC link, and the other makes a ship grid with constant 50 Hz or 60 Hz. Thus there is no direct connection to generator. The main engine can run at a more efficient speed without changing grid frequency.

One drive operates as an AFE on the generator side and the other operates on Island mode or Micro Grid mode on the grid side.

- The start command to generator side drive.
- Both drives can make DC charging if powered by +24 Vdc.
- When DC is at an 80% of nominal, the generator side and the grid side breakers close.
- The generator side AFE is started to boost DC first.
- The grid side Grid Converter is started and will synchronise to grid.
- The drives take power from the bypass, and the PMS opens the SG contactor.
- You can decrease the speed of the main diesel engine to be more economical.

NOTE! If it is necessary to have these systems in parallel, the system bus communication is reserved for parallel Micro Grid units on the grid side. The control must be arranged separately for each drive.

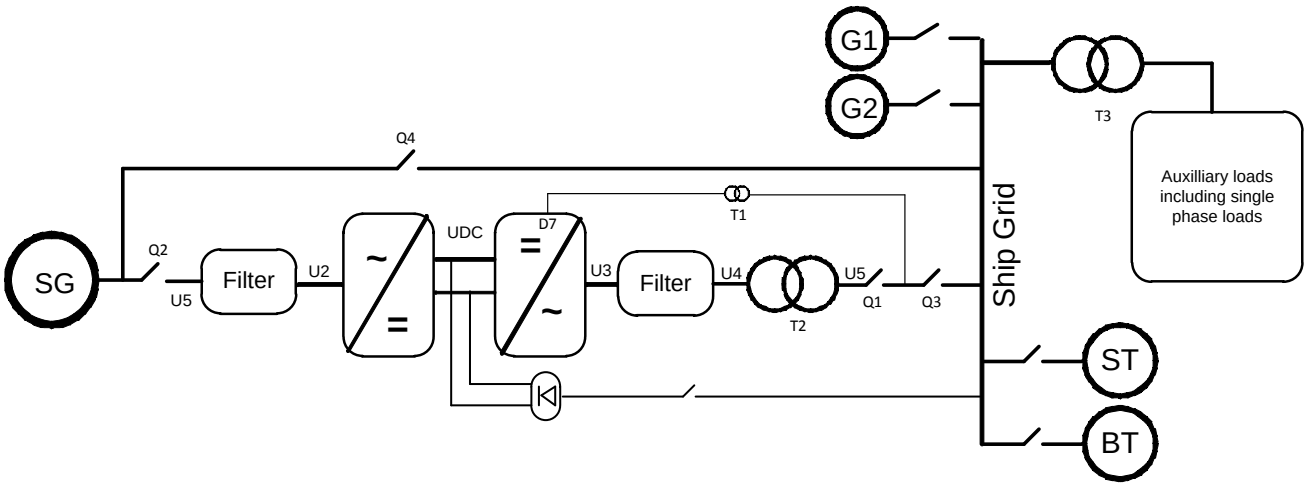


Figure 5.

1.5 COMMISSIONING

NOTE! Before you start the commissioning, read the safety instructions in the user manual of your product.

To use the Island, Micro Grid, or Shaft generator operation, you need a licence key. The AFE mode is available without a licence.

This application requires an NXP3 control board VB761 or newer.

The control place (P3.1) of the Micro Grid drive is Keypad as a default.

The basic I/O configuration of the Micro Grid drive consists of OPT-A1, OPT-A2, and OPT-D7 option boards. The basic I/O configuration is described in Table 1.

OPT-D7 is required when the Micro Grid unit is needed to start with zero power to the grid. If grid frequency is not monitored with OPT-D7, the unit may go generator side or directly to full power because different reference frequency and grid frequency.

The GTC is utilised by using AFE hardware with special software. An external LC(L)-filter and charging circuit is needed. This unit is selected when low harmonics are required. The principle connection of AFE drive has been described in Figure 6.

The external 24 Vdc is recommended for control board(s). It enables the setting of parameters even when the power unit itself is not powered. This is important also when software updates are made. Some default I/O configuration of the application can cause unexpected DO operation. When the control board is powered, the drive can give information from the status of the system if, for example, the drive I/O is used for an overall system monitoring.

The external 24 Vdc is required for the drives in cases where the start command starts the control board-controlled precharging operation.

1.5.1 QUICK START INSTRUCTIONS

1. Connect the unit according to the Figure 6.
2. Power up the control unit with 24 Vdc.
3. Set the basic parameters (G2.1)
4. Check that the digital input parameters (G2.4.2) have been set according to the connections.
5. Change the control place according to the system requirements.
6. Charge the unit.

1.5.2 IN CASE OF PARALLEL AFE:

1. Set P2.1.5 Parallel AFE to *Yes*. This will also set DC Drooping to 3.00% (Default).

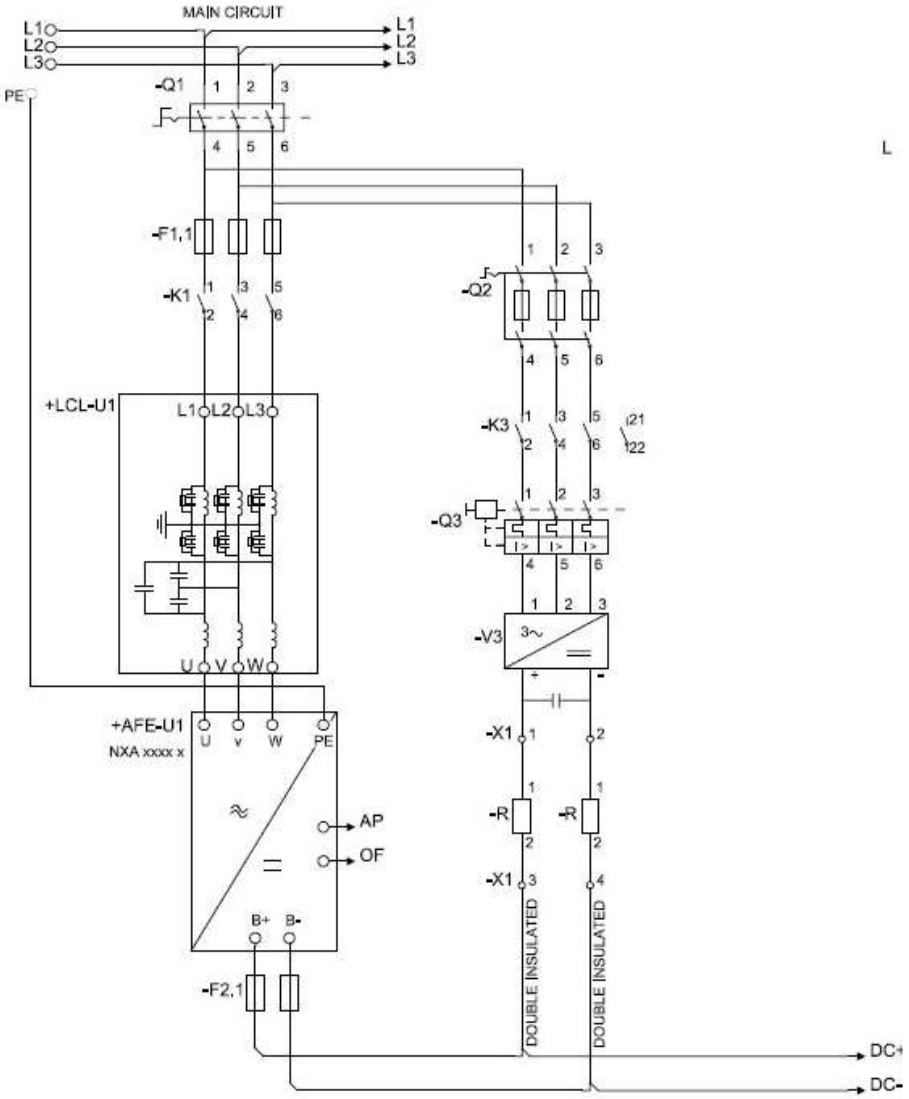


Figure 6. Connection

1.6 CHARTING OF DC

This AFE application has its own charging control, P2.5.1.13 DC Charge (24 Vdc required for control board) and charging protection in case the external charging cannot get DC voltage to required level within set time P2.9.1.6 Charge Max Time (provided that the DC Voltage reaches the under voltage fault level).

The charging function is activated when P2.5.1.13 DC Charge is A.1 or higher. When the control place is IO, Keypad or NCDrive, charging is started from the start command.
Charging is not started if:

- Drive is in fault state.
- P2.4.2.26 Enable CB Close is FALSE
- P2.4.2.8 Run Enable is FALSE
- P2.4.2.19 Quick Stop is FALSE

Charging is also stopped if above conditions occur during charging or if the start command is removed.

For fieldbus control, charging is started with B0 of FB Control Word on the supporting FB profiles. Charging is also stopped if B0 goes low. Also MCB is opened if already closed.

DC Charge (F80) is given if 85 % of DC Nominal is not reached within P2.9.1.6 Charge Max Time and charging is stopped.

DC Charging is stopped when the drive receives feedback from P2.4.2.4 MCB Feedback.

NOTE! Use suitably sized DC Charging resistor. To select the correct size, check Pulse loadability for time duration set in for Max Charge Time parameter.

1.7 MAIN CIRCUIT BREAKER CONTROL (MCB)

The Micro Grid application controls the circuit breaker of the system with the relay output RO2. When the DC bus is charged, the MCB will be closed. The status of the MCB is monitored via a digital input. The digital input used for monitoring is selected with parameter P2.3.1.3. Faults can be set to open the MCB by selecting a response to a fault to be *3=Fault, DC OFF*.

An external charging circuit is necessary to charge the DC bus but drive can control this circuit if 24 Vdc is provided for the control board.

Closing limit is 85% of the nominal DC Voltage.
Opening limit is 75% of the nominal DC Voltage.

*Nominal DC Voltage = Grid Nom Voltage (P2.1.1) * 1.35.*

Over Current (F1), Hardware IGBT (F31) and Software IGBT (F41) faults will open MCB immediately to protect the drive.

NOTE! The MCB feedback is necessary for the correct operation of the Grid Converter application.
NOTE! Only the drive controls its own MCB. If additional interlocks or opening commands are needed, these commands must go through the drive.
NOTE! UPS may be needed during short circuit situation to keep MCB closed if control voltage is taken from the grid where the short circuit occurs.

1.8 START SEQUENCE

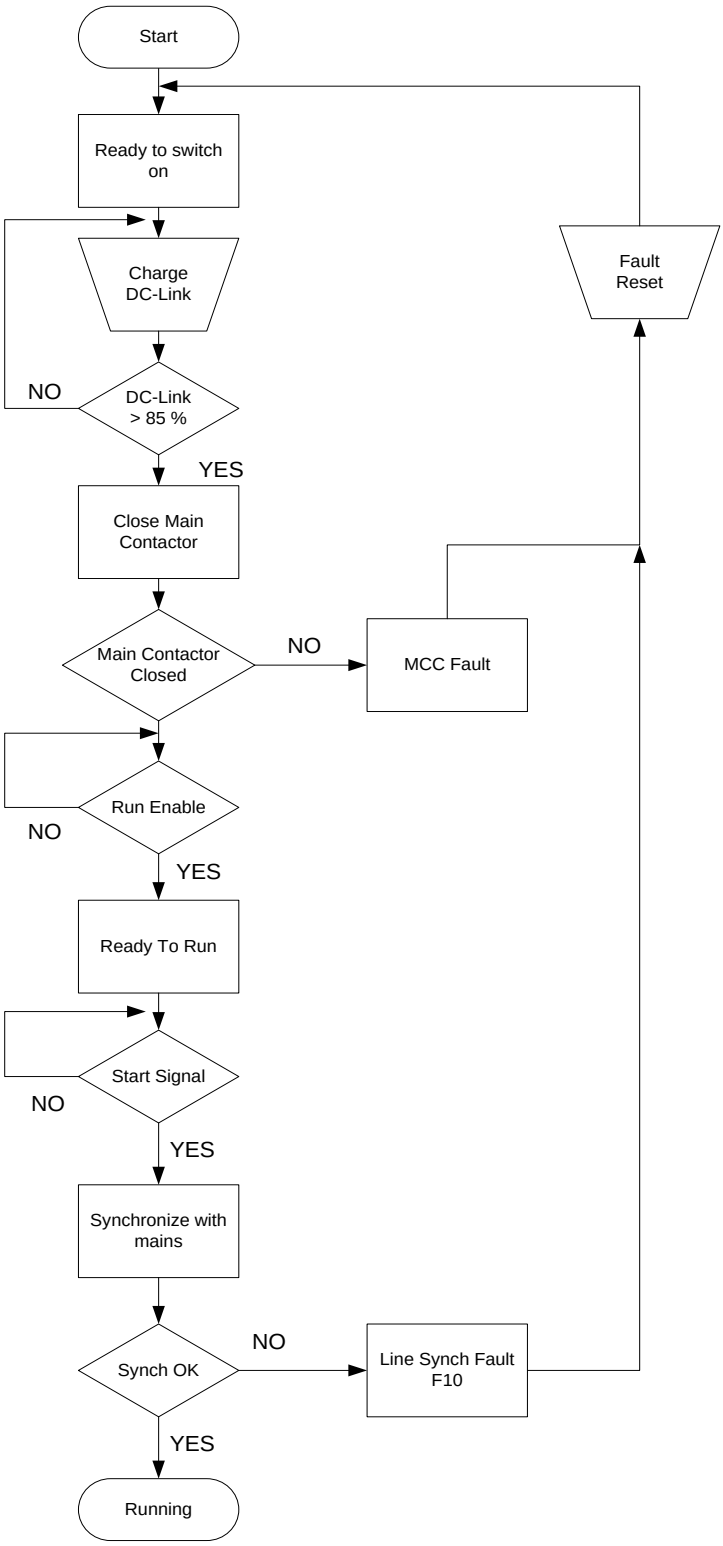


Figure 7. AFE start sequence

1.9 STOP SEQUENCE

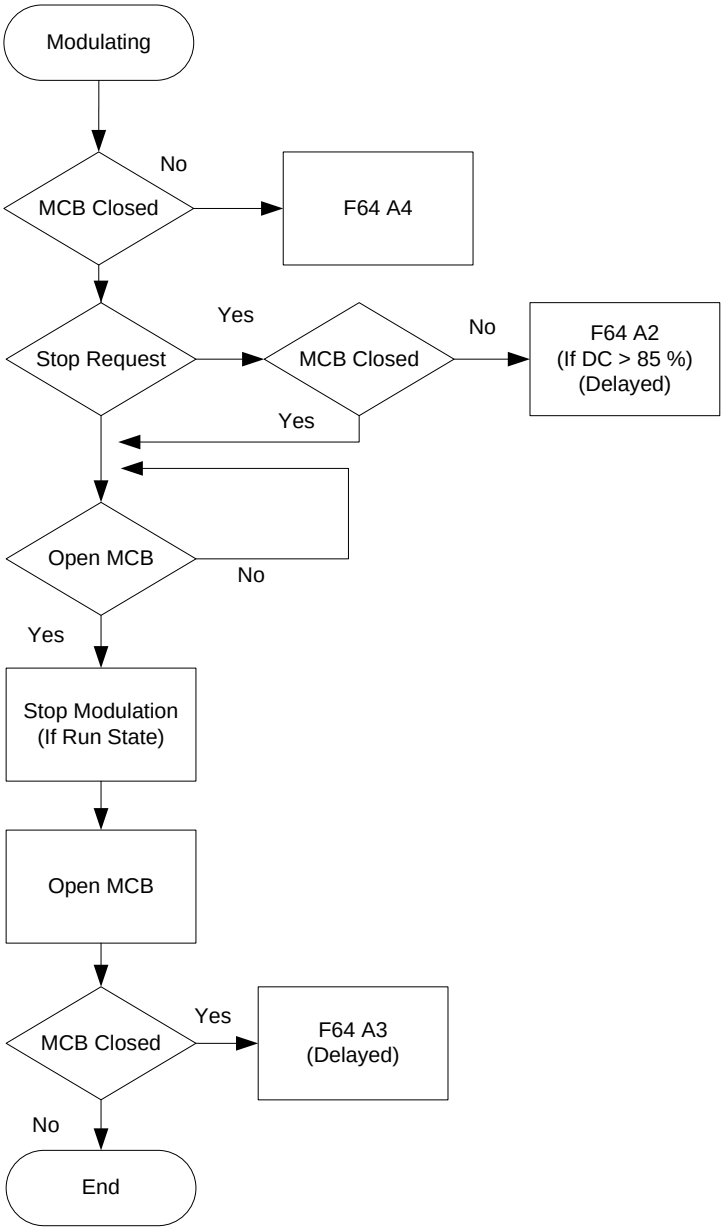


Figure 8. Stop sequence

1.10 VOLTAGE COMPENSATION

Grid Converter system will have voltage losses. Depending on the system, the losses may be more than 50 Vac when operating close to Grid Converter nominal currents with low power factor between points U3 and U5. This voltage loss needs to be compensated so that the grid voltage stays at nominal. This also sets requirements for the needed DC link voltage.

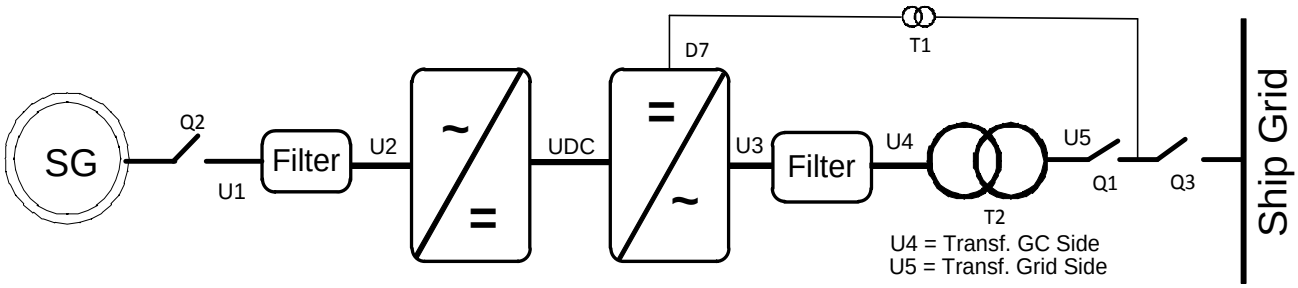


Figure 9. Voltage compensation

The normal operation voltage range in a land-based grid is usually between 80% and 115% of the grid nominal voltage.

The voltage losses compensation is handled separately for Active power (kW) and Reactive power (kVar), the latter being more significant. The Active power voltage losses are compensated with Inductor Losses parameter (P2.2.8.6) and Reactive power voltage losses are compensated with Inductor Size parameter (P2.2.8.5).

Uncompensated system may result in unnecessary reactive power circulation in a grid between the different power sources and wrong grid voltage.

OPT-D7 can be used to compensate the voltage losses (closed loop voltage compensation) but it is recommended to do an open loop voltage compensation tuning in case of OPT-D7 failure. When the OPT-D7 measurements exceed the set limit values, the voltage compensation falls back to open loop control.

Inductor Size and Losses affect

Grid Nom. Voltage: 400 Vac, Reactive Current: 30%, Active Current 50%, Inductor Size: 15%, Inductor Losses: 15%, Voltage Correction: 0 Vac.

Reactive Increase: 400 Vac×30%×15%=18 Vac
Active Increase: 400 VacIncrease::or Losses: 15% 400 Vac×50%×15%×15%=4.5 Vac
Total increase: 18 Vac+4.5 Vac =22.5 Vac

See also document: Voltage Compensation Vxxx.pdf.

1.11 OPT-D7

OPTD7 is an AC sinusoidal voltage measurement board. Using this board, the drive measures the line voltage, the frequency and the voltage angle information.

The drive can compare this information with its output voltage angle when it runs. This feature can be used to make synchronisations to a grid that is measured. For example, for line synchronisation purposes you can use APFIFF44 LineSynch II Application. That will work as a smooth starter.

In Micro Grid application this can be used:

- To synchronise to existing external grid while the drive is running to enable bumpless transfer from a generator operation to a shore powered operation in a ship.
- To control the grid voltage (Voltage losses compensation).
- To enable a zero power connection to an existing grid.
- To help in the commissioning of drive active power and reactive power voltage losses compensation when the actual grid voltage is visible in NCDrive.

The OPT-D7 board is delivered with the transformer which is suitable for a voltage range up to 690 Vac. The transformer cannot be used with a pulse width modulated (PWM) voltage input.

It is possible to use a customised transformer when the input voltage to be measured is not within the OPT-D7 transformer voltage range. The transformation ratio parameter can be adjusted according to the transformer primary to secondary ratio. See details in the OPT-D7 user manual.

Synchronisation to the grid can be made without the OPT-D7 when the drive operates in the AFE or the Micro Grid mode. This requires that the output terminals of the drive are connected to the existing grid when the drive is in the STOP state. When a start command has been given in AFE or Micro Grid mode, the drive will make standard AFE synchronisation. Depending on the operation mode, the drive will start to keep constant DC voltage (AFE) or start to share power based on grid frequency (Micro Grid). Using OPT-D7 for synchronisation will make the start of the drive smoother.

If the drive does not detect an existing line voltage or frequency in Micro Grid mode, the output voltage is raised defined time (VoltageRiseTime). In the Island mode, the detection of the grid is not made and the voltage is raised from zero in the set time (VoltageRiseTime).

NOTE: The OPT-D7 board (in slot C) is mandatory for the Grid Converter unit.

1.12 LICENCES

Using this application requires detailed knowledge and information about the system. The licence key will not be given unless all necessary information has been given in advance to Vacon Finland for approval.

This information includes:

- The single line diagram of the system.
- The voltage range.
- The nominal power and short circuit current requirement.
- The grid and load type (IT, three phase load and single phase load, direct on line motors).
- The generators/motors, PTI or PTO, by-pass, battery backups, etc.

After the details have been approved by Vacon Finland, contact **tech.supportVDF@vacon.com** to get a document for the licence key approval. The licence key has to be approved by your contact person in Vacon Finland.

Enclosure size FR4 will be operational in uGrid and Island mode without a licence key, but this enclosure size is only for testing and demonstration purposes, not for real production.

Air and liquid-cooled drives that are compatible with AFE-II application ARFIFF05 or Grid Converter application ARFIF106 are the only ones that are supported. See details in the GTC Product compatibility note, or for Air Cooled: Vacon NX AFE User Manual, and for Liquid Cooled: Vacon NXP Liquid Cooled Drives User Manual.

Downloading AFE or uGrid application to products other than those listed are considered to be a non-standard product the functionality of which has not been verified or documented. In such cases the user takes full responsibility for possible hardware and software problems. Application support is not available for non-standard products.

1.13 COMPATIBILITY ISSUES IN PARAMETERS BETWEEN VERSIONS

NOTE! This application is not kept backwards compatible. See release notes and this chapter before updating the application.

Update Note 1: When you update the application do not use NCDrive parameter download function. Instead upload parameters from the unit and compare them to the old parameter file. The application is constantly developed, and it includes changing parameter default values. If parameters are directly downloaded to drive, improved default values will be lost.

1.14 GRID CONVERTER UNITS

See full details from AFE unit user manual.
Air Cooled: Vacon NX AFE User Manual
Liquid Cooled: Vacon NXP Liquid Cooled Drives User Manual.

Air and liquid-cooled products listed in this chapter are compatible with Grid Converter application ARFIF106. Hardware and software support for AFE use is only available for these products.

Downloading Grid Converter application to products other than those listed in this chapter is considered to be a non-standard product the functionality of which has not been verified or documented. In such cases, the user takes full responsibility for possible hardware and software problems. Application support is not available for non-standard products.

NOTE: OPT-D7 board is mandatory for Grid Converter unit, placed in C-Slot.

1.14.1 AIR COOLED 500 VAC UNITS, 465-800 VDC

Code + MASG	Frame	IL-cont [A]	IH-cont [A]	Is [A] (2 s)
NXA_0261 5 A0T02SG	1xFI9	261	205	349
NXA_0460 5 A0T02SG	1xFI10	460	385	693
NXA_1300 5 A0T02SG	1xFI13	1300	1150	2070

1.14.2 AIR COOLED 690 VAC UNITS, 640-1100 VDC

Code + MASG	Frame	IL-cont [A]	IH-cont [A]	Is [A] (2 s)
NXA_0170 6 A0T02SG	1xFI9	170	144	245
NXA_0325 6 A0T02SG	1xFI10	325	261	470
NXA_1030 6 A0T02SG	1xFI13	1030	920	1656

1.14.3 LIQUID COOLED 500 VAC UNITS, 465-800 VDC

Code + MASG	Chassis	Ith [A]	Il [A]	Ih [A]	Is [A]
NXA02615A0T02WV	CH5	261	237	174	261
NXA03855A0T02WG	CH61	385	350	257	385
NXA05205A0T02WG	CH62	520	473	347	520
NXA07305A0T02WG	CH62	730	664	487	730
NXA09205A0T02WG	CH63	920	836	613	920
NXA11505A0T02WG	CH63	1150	1045	767	1150
NXA16405A0T02WG	CH64	1640	1491	1093	1640
NXA23005A0T02WG	CH64	2300	2091	1533	2300

1.14.4 LIQUID COOLED 690 VAC UNITS, 640-1100 VDC

Code + MASG	Chassis	Ith [A]	Il [A]	Ih [A]	Is [A]
NXA02616A0T02WG	CH61	261	237	174	261
NXA03856A0T02WG	CH62	385	350	257	385
NXA05026A0T02WG	CH62	502	456	335	502
NXA07506A0T02WG	CH63	750	682	500	750
NXA11806A0T02WG	CH64	1180	1073	787	1180
NXA15006A0T02WG	CH64	1500	1364	1000	1500
NXA17006A0T02WG	CH64	1700	1545	1133	1700

1.14.5 LIQUID COOLED 690 VAC UNITS, 640-1200 VDC

Code + MASG	Chassis	Ith [A]	Il [A]	Ih [A]	Is [A]
NXA02618A0T02WG	CH61	261	237	174	261
NXA03858A0T02WG	CH62	385	350	257	385
NXA05028A0T02WG	CH62	502	456	335	502
NXA07508A0T02WG	CH63	750	682	500	750
NXA11808A0T02WG	CH64	1180	1073	787	1180
NXA15008A0T02WG	CH64	1500	1364	1000	1500
NXA17008A0T02WG	CH64	1700	1545	1133	1700

2. CONTROL I/O

Table 1. Minimum recommended I/O configuration.

OPT-A1			
Terminal		Signal	Description
1	$+10V_{ref}$	Reference voltage output	Voltage for potentiometer, etc.
2	AI1+	Analogue input 1. Range 0-10V, R_i = 200Ω Range 0-20 mA R_i = 250Ω	Input range selected by jumpers. Default range: Voltage 0 – 10 V
3	AI1-	I/O Ground	Ground for reference and controls
4	AI2+	Analogue input 2. Range 0-10V, R_i = 200Ω Range 0-20 mA R_i = 250Ω	Input range selected by jumpers. Default range: Current 0 – 20 mA
5	AI2-		
6	+24V	Control voltage output	Voltage for switches, etc. max 0.1 A
7	GND	I/O ground	Ground for reference and controls
8	DIN1	Programmable G2.2.1	
9	DIN2	Programmable G2.2.1	
10	DIN3	Programmable G2.2.1	
11	CMA	Common for DIN 1– DIN 3	Connect to GND or +24V
12	+24V	Control voltage output	Voltage for switches (see #6)
13	GND	I/O ground	Ground for reference and controls
14	DIN4	MCB Feedback Programmable G2.2.1	0 = MCB open 1 = MCB closed
15	DIN5	Quick Stop Programmable G2.2.1	0 = Quick Stop Active 1 = No Quick Stop
16	DIN6	Programmable G2.2.1	
17	CMB	Common for DIN4– DIN6	Connect to GND or +24V
18	AO1+	Analogue output 1	Programmable Range 0– 20 mA/R_L, max. 500Ω
19	AO1-		
20	DO1	Digital output READY	Programmable P2.3.1.1 Open collector, I≤50mA, U≤48 VDC
OPT-A2			
21	RO1	 Relay output 1 Programmable P2.3.1.2	Switching capacity 24 VDC / 8 A 250 VAC / 8A 125 VDC / 0.4 A
22	RO1		
23	RO1		
24	RO2	 **Relay output 2** **MCB control**	**This RO is not programmable.** **Fixed for MCB Control (Close)**
25	RO2		
26	RO2		

3. MONITORING SIGNALS

The menu M1 (Monitoring) has all the monitoring values. Values are only for monitoring, and cannot be altered on the control panel.

3.1 MONITORING VALUE TABLES

3.1.1 MONITORING VALUES 1 (CONTROL PANEL: MENU M1.1)

Code	Parameter	Unit	Form.	ID	Description
V1.1.1	DC-Link Voltage	V	#	1108	Measured DC Link voltage in volts, filtered.
V1.1.2	DC Voltage Ref.	%	#,##	1200	Used DC voltage reference by the regenerative unit in % of Nominal DC voltage. Nominal DC voltage = 1.35 * supply voltage
V1.1.3	DC Voltage Act.	%	#,##	7	Same scaling as DC Voltage Ref.
V1.1.4	Total Current	A	Varies	1104	Filtered current
V1.1.5	Active Current	%	#,#	1125	> 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.6	Reactive Current	%	#,#	1157	
V1.1.7	Power kW	kW	Varies	1508	> 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.8	Power %	%	#,#	5	> 0 power from AC side to DC side < 0 power from DC side to AC side
V1.1.9	Status Word		#	43	
V1.1.10	Supply Frequency	Hz	#,##	1	Drive output frequency
V1.1.11	Supply Voltage	V	#,#	1107	Drive output voltage
V1.1.12	Line Frequency D7	Hz	#,##	1654	Measured line frequency
V1.1.13	Line Voltage D7	V	#	1650	Measured line voltage
V1.1.14	AC Voltage Reference	V	#	1556	Used AC Voltage Reference
V1.1.15	DC Ref Max Lim	%	#,##	1606	Internal limit for DC Voltage Ref.

3.1.2 MONITORING VALUES 2 (CONTROL PANEL: MENU M1.2)

Code	Parameter	Unit	Form.	ID	Description
V1.2.1	DC Voltage	V	#	44	Measured DC Link voltage in volts, unfiltered.
V1.2.2	Operation Mode		#	1615	0 = AFE 1 = Island 2 = Micro Grid
V1.2.3	Used Current Ref	%	#,#	1704	Used current reference is negated to parameter value. Made to compare values in NCDrive easier to Active current
V1.2.4	D7 Synch. Error		#	1659	Synchronisation error to external grid
V1.2.5	Cos Phi Actual		#,###	1706	
V1.2.6	Unit Temperature	°C	#	1109	
V1.2.7	Freq. Reference	Hz	#,#	1752	Used line frequency reference
V1.2.8	Current	A	Varies	1113	Unfiltered current
V1.2.9	SG Synch Error		#	1658	Synchronisation error to shaft generator side
V1.2.10	Operation Hours	h	#,##	1856	
V1.2.11	Reactive Current Reference	%	#,#	1389	
V1.2.12	Grid State		#	1882	
V1.2.13	Mindex	%	#,#	1858	Modulation Index

3.1.3 FIELDBUS MONITORING VALUES (CONTROL PANEL: MENU M1.3)

Code	Parameter	Unit	Form.	ID	Description
V1.3.1	FB Control Word		#	1160	Control word from fieldbus
V1.3.2	FB Status Word		#	68	Status word to fieldbus
V1.3.3	Fault Word 1		#	1172	
V1.3.4	Fault Word 2		#	1173	
V1.3.5	Warning Word 1		#	1174	
V1.3.6	FB Micro Grid CW1		#	1700	Control for Micro Grid operations
V1.3.7	FB Micro Grid SW1		#	1701	Status of Micro Grid operations
V1.3.8	Last Active Warning		#	74	
V1.3.9	Last Active Fault		#	37	
V1.3.10	MC Status		#	64	

3.1.4 I/O MONITORING VALUES (CONTROL PANEL: MENU M1.4)

Code	Parameter	Unit	Form.	ID	Description
V1.4.1	DIN1, DIN2, DIN3		#	15	
V1.4.2	DIN4, DIN5, DIN6		#	16	
V1.4.3	DIN Status 1		#	56	
V1.4.4	DIN Status 2		#	57	
V1.4.5	Analogue Input 1	%	#,##	13	
V1.4.6	Analogue Input 2	%	#,##	14	
V1.4.7	Analogue input 3	%	#,##	27	AI3, unfiltered.
V1.4.8	Analogue input 4	%	#,##	28	AI4, unfiltered.
V1.4.9	Analogue Out 1	%	#,##	26	
V1.4.10	Analogue Out 2	%	#,##	50	AO2
V1.4.11	Analogue Out 3	%	#,##	51	AO3
V1.4.12	PT100 Temp. 1	°C	#,#	50	
V1.4.13	PT100 Temp. 2	°C	#,#	51	
V1.4.14	PT100 Temp. 3	°C	#,#	52	
V1.4.15	PT100 Temp. 4	°C	#,#	69	
V1.4.16	PT100 Temp. 5	°C	#,#	70	
V1.4.17	PT100 Temp. 6	°C	#,#	71	

3.1.5 LICENCE KEY ACTIVATION

Code	Parameter	Unit	Form.	ID	Description
V1.6.1	Serial Number Key		#	1997	Give this number to the technical support of the manufacturer in case of licence key problems.
V1.6.2	Licence Status		#	1996	

3.1.6 GRID CODE

Code	Parameter	Unit	Form.	ID	Description
V1.7.1	Line State		#	2202	
V1.7.2	Line Voltage GC	%	#,##	1912	Line Voltage used by Grid Code
V1.7.3	Line Frequency GC	%	#,##	1913	Line Frequency used by Grid Code
V1.7.4	Line Voltage L1-L2	%	#,##	2203	
V1.7.5	Line Voltage L2-L3	%	#,##	2204	
V1.7.6	Line Voltage L3-L1	%	#,##	2205	
V1.7.7	Trip State			2206	

3.1.7 PID CONTROLLER

Code	Parameter	Unit	Form.	ID	Description
V1.8.1	PID Reference		#,#	20	
V1.8.2	PID Actual Value		#,#	21	
V1.8.3	PID Output		#,##	23	

3.1.8 ACTIVE LIMITS

Code	Parameter	Unit	Form.	ID	Description
V1.9.1	Output Power Limit	%	#,#	1953	

3.2 DESCRIPTION OF MONITORING VALUES

3.2.1 MONITORING 1 VALUES

V1.1.1 DC-Link Voltage V ID1108

The measured DC voltage, filtered.

V1.1.2 DC Voltage Ref. % ID1200

The DC voltage reference. Compared to given supply voltage.

*DC Voltage = Grid Nom Voltage (P2.1.1) * 1.35 * DC Voltage Ref.*

$1025\ \text{Vdc} = 690\ \text{Vac} * 1{,}35 * 1{,}10$

V1.1.3 DC Voltage Act. % ID7

The actual DC Voltage, measured DC Voltage scaled to % value.

DC Voltage Act. = DC Voltage * 100 / (*Grid Nom Voltage (P2.1.1) * 1.35)*

$110{,}00\ \% = 1025\ \text{Vdc} * 100\ /(690 * 1{,}35)$

V1.1.4 Total Current A ID 1113

The filtered current of the drive.

V1.1.5 Active Current % ID 1125

The active current in % of System Rated Current.
A negative value means that the current is flowing to AC side from DC side.

V1.1.6 Reactive Current % ID 1157

The reactive current of the regenerative drive in % of System Rated Current.

V1.1.7 Power kW kW ID 1508

The output power of the drive in kW.

A negative value means that the current is flowing to AC side from DC side.

V1.1.8 Power % % ID 5

The output power of the drive in %. 100,0 % eguals 100.0 % Active Current and 100.0 % Supply Voltage.

A negative value means that the current is flowing to AC side from DC side.

V1.1.9 Status Word (Application) ID 43

The Application Status Word combines different statuses of the drive to one data word.

	Status Word (Application) ID43	
	FALSE	TRUE
b0		
b1	Not in Ready state	Ready
b2	Not Running	Running
b3	No Fault	Fault
b4	No Start Request	Start Request
b5	Quick stop active	Quick stop not active
b6	Run Disabled	Run Enable
b7	No Warning	Warning
b8	Charging Switch Open	Charging Switch closed (internal)
b9	MCB Control Open	MCB Control
b10		MCB Feedback
b11		
b12	No Run Request	Run Request
b13		At Current Limit
b14		Island Mode Active
b15		uGrid Mode Active

V1.1.10 Supply Frequency Hz ID 1

The drive output frequency. Updated in the STOP state when Regen Option B9 is activated.

V1.1.11 Supply Voltage V ID 1107

The drive output voltage.

V1.1.12 Line Frequency D7 Hz ID 1654

The measured line voltage frequency when using the OPT-D7 option board in slot C.

When the OPT-D7 board is not used, it is possible to use Analogue Input 3 and 4 ID write function to give the grid the Line Frequency and Line Voltage. This enables use of grid PI voltage controller without the OPT-D7 board. Note that both line frequency and line voltages needs to be given. By activating Control Options 2 B2 these analogue inputs can be used also to grid protection.

V1.1.13 Line Voltage D7 V ID 1650

The measured line voltage rms value when using the OPT-D7 option board in slot C.

When the OPT-D7 board is not used, it is possible to use Analogue Input 3 and 4 ID write function to give the grid the Line Frequency and Line Voltage. This enables use of grid PI voltage controller without the OPT-D7 board. Note that both line frequency and line voltages needs to be given. By activating Control Options 2 B2 these analogue inputs can be used also to grid protection.

V1.1.14 AC Voltage Reference V ID1556

The used AC voltage reference.

V1.1.15 DC Voltage Max Limit ID1606

The drive will limit the DC reference to inside drive specification, but allows higher reference if lower supply voltage. This shows the final limit of the DC reference.

3.2.2 MONITORING 2 VALUES

V1.2.1 DC Voltage V ID44

The measured DC voltage, unfiltered.

V1.2.2 Operation Mode ID1615

The active Grid Converter operation mode.

0 = AFE operation

1 = Island operation

2 = Micro Grid Operation

V1.2.3 Used Current Ref % ID 1704

The used current reference. The value is negative to the set parameter to make the monitoring easier in NCDrive.

V1.2.4 D7 Synch. Error ID 1659

An error on voltage angles between the drive and the measurement taken by OPT-D7.

-3072...+3071 = -180...180 degrees.

If the value is not near to zero when running in AFE mode, the phase order may be wrong even if the OPT-D7 frequency is correct (Error about 2047 = 120 degree). If the measurement is after the Dyn11 transformer, the error is usually about 512 (30.0 Degrees).

V1.2.5 CosPhiActual ID 1706

The calculated Cos Phi.

V1.2.6 Unit Temperature °C ID 1109

The heatsink temperature of the drive.

V1.2.7 Frequency Reference Hz ID1752

The used frequency reference. In AFE mode, the frequency reference is determined internally when the synchronisation is made. In Island and Micro Grid mode, the reference is used for a static power supply, and a power drooping in Micro Grid mode.

V1.2.8 Current A ID 1113

The unfiltered current of the drive.

V1.2.9 SG Synch Error ID1658

A synchronisation error to the shaft generator frequency.

V1.2.10 Operation Hours h ID1856

This shows operation hours of the drive. G2.7 Operation Time is used to enter old value if the software is updated.

V1.2.11 Reactive Current Reference % ID1389

The final reactive current reference.

V1.2.12 Grid State ID1882

The Status Word for the grid.

	Grid State ID1882	
b0	Supply frequency or frequency from OPT-D7 below fault limit	
b1	Supply frequency or frequency from OPT-D7 below warning limit	
b2	Supply frequency or frequency from OPT-D7 above warning limit	
b3	Supply frequency or frequency from OPT-D7 above fault limit	
b4	Voltage from OPT-D7 below fault limit	
b5	Voltage from OPT-D7 below warning limit	
b6	Voltage from OPT-D7 above warning limit	
b7	Voltage from OPT-D7 above fault limit	
b8	Supply voltage below fault limit	
b9	Supply voltage below warning limit	
b10	Supply voltage above warning limit	
b11	Supply voltage above fault limit	
b12		
b13		
b14		
b15		

V1.2.13 Mindex % ID1874

This value can be used to recognize low Dc-Link voltage when operating in island and uGrid modes. If the value is above 90%, the drive is in limits to make correct voltage to the AC side.

3.2.3 FIELDBUS MONITORING VALUES

V1.3.1 FB Control Word ID 1160

The control word from fieldbus. The table below is for "2 / Vacon AFE 1" Selection (P2.10.19) in bypass operation for such fieldbus board that natively supports this or can be parameterised to bypass mode. See other profile selections from chapter Status and Control Word.

	FB Control Word ID1160	
	Signal	Comment
b0	DC Charge	**0** = Open MCB. **1** = Close DC charge contactor, MCB closed automatically.
b1		
b2		
b3	Start	**0** = Stop Command **1** = Start Command
b4		
b5		
b6		
b7	Reset	0>1 Reset fault.
b8		
b9		
b10	Fieldbus Control	**0** = No control from fieldbus **1** = Control from fieldbus
b11	Watchdog	0>1>0>1...0.5 s square wave clock. This is used to check data communication between the fieldbus master and the drive.
b12	FB DIN2	Can be used to control RO or the parameter directly by ID number. G2.4.1
b13	FB DIN3	Can be used to control RO or the parameter directly by ID number. G2.4.1
b14	FB DIN4	Can be used to control RO or the parameter directly by ID number. G2.4.1
b15		

V1.3.2 FB Status Word ID 68

This is referred as GeneralStatusWord in the fieldbus manual. See details in the fieldbus manual.

	FB Status Word ID68	
	Signal	Comment
b0	Ready On	0 = Drive not ready to charge 1 = Drive ready to charge
b1	Ready Run	0 = Drive not ready to run 1 = Drive ready to run and MCB is ON
b2	Running	0 = Drive not running 1 = Drive running with regenerative control ON
b3	Fault	0 = No active fault 1 = Fault is active
b4	Run Enabled	0 = Run Disabled by I/O Commands 1 = Run Enabled by I/O Commands
b5	Quick Stop	0 = Quick Stop Active 1 = Quick Stop Not Active
b6	Switch On Inhibit	0 = CB Control OK 1 = CB Requested open but DC is high
b7	Warning	0 = No warning 1 = Warning active
b8	At Reference	0 = DC Voltage Ref and Act DC Voltage are not same. 1 = DC Voltage Ref and Act DC Voltage are same.
b9	Fieldbus Control Active	0 = Fieldbus control not active 1 = Fieldbus control active
b10	Above Limit	0 = DC voltage is below the level specified by P2.5.7.4 1 = The DC voltage is above the level specified by P2.5.7.4
b11	FB_SW_B11	Select bit in G2.10 Fieldbus
b12	FB_SW_B12	Select bit in G2.10 Fieldbus
b13	FB_SW_B13	Select bit in G2.10 Fieldbus
b14	FB_SW_B14	Select bit in G2.10 Fieldbus
b15	Watchdog	

V1.3.3 Fault Word 1 ID 1172

	FALSE	TRUE
b0		F1 Over current, F31 IGBT, F41 IGBT
b1		F2 Over Voltage
b2		F9 Under Voltage
b3		F91 Short Circuit
b4		F3 Earth Fault
b5		
b6		F14 Unit Over temperature
b7		Temperature fault from measurements F56 PT100, F29 Thermistor
b8		F10 Line Synch Fault
b9		
b10		
b11		F52 Keypad or OC communication fault
b12		F53 Fieldbus fault
b13		F59 System bus fault
b14		F54 Slot Communication fault
b15		F50 4mA fault

V1.3.4 Fault Word 2 ID 1173

	FALSE	TRUE
b0		F11 Output Phase Fault
b1		
b2		
b3		
b4		
b5		
b6		F51 External fault
b7		
b8		
b9		F31 IGBT, F41 IGBT
b10		
b11		
b12		
b13		
b14		F64 MCB State fault
b15		

V1.3.5 Warning Word 1 ID 1174

	Warning	Comment
b0	W91 Short Circuit	Triggered when current has reached current limit
b1	W29 Thermistor	Not implemented
b2		
b3		
b4		
b5		
b6	F53_FB_Warning_Slot_D	
b7	F67_FB_Warning_Slot_E	
b8	W14 Unit Temperature	
b9		
b10		
b11		
b12		
b13		
b14		
b15		

V1.3.6 FB Micro Grid CW1 ID 1700

Control for the Micro Grid operations.

	FB Micro Grid CW1 ID1700	
	Signal	Comment
b0	Start As Island	If B11 = False, mode changed in STOP state.
b1	Start As Micro Grid	If B11 = False, mode changed in STOP state.
b2	Start synchronisation D7	Synchronization to external grid with OPT-D7
b3		
b4	Power Down	Same as P2.2.6.2
b5	Power Up	Same as P2.2.6.3
b6		
b7		
b8		
b9		
b10	Enable FB Control Mode	B0 and B1, is controllable from FB otherwise parameter
b11	Live Mode Control	Operation mode is changed in Run State
b12	P2.10.27 uCW B12	
b13	P2.10.28 uCW B12	
b14	P2.10.29 uCW B12	
b15	P2.10.30 uCW B12	

V1.3.7 FB Micro Grid SW1 ID 1701

Status of the Micro Grid operations.

	Micro Grid Status Word	
	Signal	Comment
b0	Charge Control active	Charging
b1	Internal Charging switch status	
b2	MCB control	
b3	MCB status	
b4	Run Enabled	
b5	Drive Ready	
b6	AFE mode active	
b7	Island mode active	
b8	Micro Grid mode active	
b9	Run Request active	
b10	Drive in run state	
b11	Fault Active	
b12	SynchronizedToD7	
b13		
b14	D7 measurements OK	
b15		

V1.3.8 Warning ID74

The number of the last active warning.

V1.3.9 Last Active Fault ID37

The number of the last active fault.

V1.3.10 MC Status ID 64

For the fieldbuses that do not have their own state machine, this value is sent to fieldbus.

	Motor Control Status Word	
	FALSE	TRUE
b0	Not in Ready state	Ready
b1	Not Running	Running
b2	Direction Clockwise	Counter clockwise
b3	No Fault	Fault
b4	No Warning	Warning
b5		At reference speed
b6		At Zero Speed
b7		Flux Ready
b8		TC Speed Limiter Active
b9	Encoder Direction	Counter clockwise
b10		Under Voltage Fast stop
b11	No DC brake	DC Brake is active
b12		
b13		Restart delay active
b14		
b15		

3.2.4 I/O MONITORING VALUES

V1.4.1 DIN1, DIN2, DIN3 ID 15

V1.4.2 DIN4, DIN5, DIN6 ID 16

	DIN1/DIN2/DIN3 status	DIN4/DIN5/DIN6 status
b0	DIN3	DIN6
b1	DIN2	DIN5
b2	DIN1	DIN4

V1.4.3 DIN Status 1 ID 56

V1.4.4 DIN Status 2 ID 57

	DIN StatusWord 1	DIN StatusWord 2
b0	DIN: A.1	DIN: C.5
b1	DIN: A.2	DIN: C.6
b2	DIN: A.3	DIN: D.1
b3	DIN: A.4	DIN: D.2
b4	DIN: A.5	DIN: D.3
b5	DIN: A.6	DIN: D.4
b6	DIN: B.1	DIN: D.5
b7	DIN: B.2	DIN: D.6
b8	DIN: B.3	DIN: E.1
b9	DIN: B.4	DIN: E.2
b10	DIN: B.5	DIN: E.3
b11	DIN: B.6	DIN: E.4
b12	DIN: C.1	DIN: E.5
b13	DIN: C.2	DIN: E.6
b14	DIN: C.3	
b15	DIN: C.4	

V1.4.5 Analogue Input 1 % ID13

V1.4.6 Analogue Input 2 % ID14

V1.4.7 Analogue input 3 % ID 27

V1.4.8 Analogue Input 4 % ID28

The unfiltered analogue input level.
0% = 0 mA / 0 V, -100% = -10 V, 100% = 20 mA / 10 V. Monitoring scaling is determined by the option board parameter. It is possible to adjust this input value from fieldbus when the input terminal selection is 0.1. This way it is possible to adjust the free analogue input from fieldbus and have all the analogue input functions available for fieldbus process data.

V1.4.9 Analogue Out 1 % ID 26

V1.4.10 Analogue Out 2 % ID 50

V1.4.11 Analogue Out 3 % ID 51

Analogue Output value 0% = 0 mA / 0 V, 100% = 20 mA / 10 V

V1.4.12 PT100 Temp. 1 °C ID 50

V1.4.13 PT100 Temp. 2 °C ID 51

V1.4.14 PT100 Temp. 3 °C ID 52

V1.4.15 PT100 Temp. 4 °C ID 69

V1.4.16 PT100 Temp. 5 °C ID 70

V1.4.17 PT100 Temp. 6 °C ID 71

A separate measurement from two PT100 board. The signal has a 4 s filtering time.

3.2.5 ACTIVATION STATUS

V1.6.1 Serial Number Key ID1997

Give this number to the technical support of the manufacturer when there is a problem in the activation of a function. The drive shows a licence fault.

V1.6.2 Licence Status ID1996

This value indicates the status of the licence key activation.

0 / No Function

If PLC receives this number from this ID, it is likely that the Micro Grid application is not loaded on the drive.

1 / No Code

Correct application in the drive, but the licence key has not been given.

2 / Code Given, not possible to verify, no connection to power unit

The licence key has been given, but there is no connection to power unit to verify it.

Charge the DC at least for 20 s.

NOTE! It is possible that the drive gives a licence fault in this state. Power up the power unit, so that the control board can read the drive serial number.

3 / Code Wrong

The code that was entered is wrong.

4 / Licence Key entered too many times

A wrong licence key has been entered three times. Power down the drive before trying to enter a new code.

5 / Code Accepted

The correct key has been entered, and all functions of Micro Grid application are available.

6 / Unknown Error

The licence key calculation has detected an internal error. Take the service information and the parameter file from the drive when the power unit is powered. Send these files to the technical support of the manufacturer (**tech.supportVDF@vacon.com)**.

3.2.6 GRID CODE

V1.7.1 Line State ID2202

Give this number to the technical support of the manufacturer when there is a problem in the activation of a function. The drive shows a licence fault.

	Line State ID2202	
	Signal	
b0	LineVoltageHighFast_Act	
b1	LineVoltageHighSlow_Act	
b2	LineVoltageLowSlow_Act	
b3	LineVoltageLowFast_Act	
b4	LineFreqHighFast_Act	
b5	LineFreqHighSlow_Act	
b6	LineFreqLowSlow_Act	
b7	LineFreqLowFast_Act	
b8	LVRTTimerStart	
b9	LVRTBiTimerStart	
b10	FreqHigh_DL	
b11	LF_OK	
b12	LV_OK	
b13	FALSE	
b14	FALSE	
b15	Trip limit reached	

V1.7.2 Line Voltage GC % #,## 1912

V1.7.3 Line Frequency GC % #,## 1913

V1.7.4 Line Voltage L1-L2 % #,## 2203

V1.7.5 Line Voltage L2-L3 % #,## 2204

V1.7.6 Line Voltage L3-L1 % #,## 2205

V1.7.7 Trip State 2206

3.2.7 PID CONTROLLER

Monitoring values for power controller in AFE mode

V1.8.1 PID Reference 20

Active Current reference

V1.8.2 PID Actual Value 21

Active current

V1.8.3 PID Output 23

PID controller output for DC Voltage reference, gives an offset for DC Voltage Reference.

3.2.8 ACTIVE LIMITS

V1.9.1 Output Power Limit ID1953

4. PARAMETER LIST

In this chapter you will find the lists of parameters that are available in this application.

4.1 BASIC PARAMETERS

Table 2. Basic parameters , G2.1

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.1.1	Grid Nom Voltage	AFE: 500V: 380V 690V: 525V	AFE: 500V: 500V 690V: 690V	Vac	500V:400 690V:690	110	Set the nominal voltage of the grid. Island and uGrid can go down to 100 Vac. Set System Nominal DC P2.1.7
P2.1.2	Grid Nom. Frequency	0	320	Hz	50.00	1532	**Micro Grid and Island mode:** Grid Nominal Frequency **AFE Mode:** Initial start frequency.
P2.1.3	System Rated Current	0.0	Ih	A	Il	113	Used to scale % values.
P2.1.4	System Cos Phi	0.10	1.00		0.80	120	
P2.1.5	System Rated kVA	0	32000	kVA	0	213	
P2.1.6	System Rated kW	0	32000	kW	0	116	
P2.1.7	System Nominal DC	0	1300	Vdc	500V:675 690V:931	1805	Used for DC Voltage reference and for MCB close limit
P2.1.8	Parallel AFE	0	1		0	1501	**0** = Single AFE **1** = Parallel AFE Activation will set DC Drooping to 3%.
P2.1.9	Transformer: Grid Converter Side U	0	3200	Vac	1000	1850	
P2.1.10	Transformer: Grid Side	0	3200	Vac	1000	1851	
P2.1.11	Transformer: Phase Shift	-360	360	Deg	0.0	1852	e.g. Dyn11 = 30.0 Degree
P2.1.12	Identification	0	1		0	631	**0** = No Action **1** = Current Offset

4.2 REFERENCE HANDLING

Table 3. Reference handling

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.2.1	DC Voltage Ref.	500V: 105% 690V: 105%	500V: 797 Vdc 690V: 1099 Vdc	%	110.00	1462	DC Voltage reference as % of Nominal DC voltage = 1.35 * Grid Nominal Voltage.
P2.2.2	Reactive Current Reference	-170	170	%	0	1459	Regenerative reactive current reference 100.0 = Nominal current. Positive =Inductive Negative = Capacitive

4.2.1 DC REFERENCE

Table 4.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.2.3.1	DC Voltage Drooping	0	100	%	0	620	AFE drooping DC-voltage.
P2.2.3.2	DC Voltage Reference Ramp Rate	0	10000	%/s	1000	1199	
P2.2.3.3	DC Voltage Reference Filtering time	0	15.00	s	0.00	1760	
P2.2.3.4	DC Reference Offset	-15	15	%	0,00	1776	

4.2.2 POWER / FREQUENCY REFERENCE

Table 5.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P 2.2.4.1	Freq Droop Offset	-5.00	5.00	Hz	0.00	1791	
P2.2.4.2	Freq. Down	0.1	E.10	DigIn	0.1	417	
P2.2.4.3	Freq. Up	0.1	E.10	DigIn	0.1	418	
P2.2.4.4	Freq. Adjust Rate	0.001	20.000	Hz/s	0.100	331	
P2.2.4.5	Freq. Max Adjust	0.00	25.00	Hz	2.50	1558	
P2.2.4.6	Base Current Ref.	-170.0	170.0	%	0.0	1533	
P2.2.4.7	Base reference increase rate	0	10000	%/s	100	1536	
P2.2.4.8	Base Ref To Zero	0	3		0	1537	**0 =** No Action **1 =** At Stop State **2 =** When AFE **3 =** Stop & AFE
P2.2.4.9	Base Reference At Stop	0	170.0	%	5.0	1538	

4.2.3 PID POWER CONTROLLER FOR AFE

Table 6.

Code	Parameter	Min	Max	Unit	Default	ID	Description
2.2.4.10.1	PID Power Activation	0.1	W.10	DigIN	0.1	1905	
2.2.4.10.2	PID Kp	0,00	1e6	%	100,00	1911	
2.2.4.10.3	PID Ti	0	1e5	ms	1000	1906	
2.2.4.10.4	PID DC Low	-50,00	50,00	%	-5,00	1903	
2.2.4.10.5	PID DC High	-50,00	50,00	%	5,00	1904	
2.2.4.10.6	Reference Down Rate	-1,00	100	%/s	-1,00	1810	
2.2.4.10.6	Reference Up Rate	-1,00	100	%/s	-1,00	1811	

4.2.4 REFERENCE ADJUST

Table 7.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.2.5.1	Reactive Adjust Rate	0.0	1000.0	%/s	1.0	1557	
P2.2.5.2	Reactive Ref Up	0.1	E.10	DigIn	0.1	1553	
P2.2.5.3	Reactive Ref Down	0.1	E.10	DigIn	0.1	1554	
P2.2.5.4	MaxReactiveAdjust	0,0	100,0	%	25,0	1559	

4.2.5 AC VOLTAGE REFERENCE

Table 8.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.2.6.1	Voltage at field weakening point	10.00	200.00	%	100.00	603	
P2.2.6.2	Field weakening point	8.00	320.00	Hz	45.00	602	
P2.2.6.3	Voltage Correction	-50	50	V	0	1790	
P2.2.6.4	Capacitor Size	0.0	100.0		5.0	1460	
P2.2.6.5	Inductor Size	0.0	100.0		15,0	1461	
P2.2.6.6	Inductor Losses	0.0	100.0		15,0	1465	
P2.2.6.7	Voltage Down	0.1	E.10	DigIn	0.1	1551	
P2.2.6.8	Voltage Up	0.1	E.10	DigIn	0.1	1550	
P2.2.6.9	Voltage Adjust Rate	0.0	1000.0	%/s	1.0	1555	
P2.2.6.10	Voltage Maximum Adjust	0	20	%	20	1639	
P2.2.6.11	Start Voltage Mode	0	2		1	1641	**0 =** Zero Q Start **1 =** Drooping **2** = Reactive Ref
P2.2.6.12	Reset Zero Q Delay	0,00	120,00		0,00	1642	**0,00** = No Reset
P2.2.6.13	Capacitor Size 2nd	0,0	100,0	%	0,0	2330	
P2.2.6.14	Capacitor Size 2nd Voltage	0,0	1100,0	%	0,0	2331	

4.3 RAMP CONTROL

Table 9.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.3.1	Ramp Time	0.1	3200.0	s	25.0	103	2.00 Hz/s if Range 50 Hz
P2.3.2	Ramp Range	0.01	100.00	Hz	50.00	1980	

4.4 INPUT SIGNALS

4.4.1 BASIC SETTINGS

Table 10.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.1.1	Start/Stop Logic	0	2		0	300	0 = Start-No Act 1 = RPuls-FPuls 2 = RPuls-RPuls
P2.4.1.2	Input Inversion	0	65535		4	1091	Inversion control of the input I/O signals. B0 = INV Open Contactor B1 = INV Ext. Fault 1 B2 = INV Ext. Fault 2

4.4.2 DIGITAL INPUTS

Table 11. Digital inputs , G2.2.1

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.2.1	Start Signal 1	0	E.10		A.1	403	
P2.4.2.2	Start Signal 2	0	E.10		0.1	404	
P2.4.2.3	Open MCB	0	E.10		0.1	1600	Forced open command
P2.4.2.4	CB Feed Back	0	E.10		0.1	1453	AFE MCB feedback (MCB 1)
P2.4.2.5	Fault Reset	0	E.10		0.1	414	
P2.4.2.6	Ext Fault 1	0	E.10		0.1	405	
P2.4.2.7	Ext Fault 2	0	E.10		0.2	406	
P2.4.2.8	Run Enable	0	E.10		0.2	407	
P2.4.2.9	Synchronisation	0	E.10		0.1	1602	
P2.4.2.10	Connect To Net	0	E.10		0.1	1604	
P2.4.2.11	Forced AFE Mode	0	E.10		0.1	1540	Force mode to AFE
P2.4.2.12	NET Contactor	0	E.10		0.1	1660	
P2.4.2.13	Cooling Monitor	0	E.10		0.2	750	OK input from the cooling unit
P2.4.2.14	Grid Close Enabled	0	E.10		0.1	1705	Interlock for shore connection
P2.4.2.15	Use CB 2	0	E.10		0.1	1708	Second AFE contactor coming from second grid to have 2 different supplies
P2.4.2.16	CB 2 Status	0	E.10		0.1	1710	Feedback signal from second AFE contactor
P2.4.2.17	AFE Mode 2	0	E.10		0.1	1711	Only active when P2.11.1 is in 6/FRee select
P2.4.2.18	AFE Mode 3	0	E.10		0.1	1712	Only active when P2.1.1 is in 6/FRee select
P2.4.2.19	Quick Stop	0	E.10		0.2	1213	Stop and opens MCB
P2.4.2.20	LCL Temperature	0	E.10		0.2	1179	
P2.4.2.21	Synch to SG Grid	0	E.10		0.1	1897	
P2.4.2.22	RR Enable	0	E.10		0.2	1896	Disables final Run Command
P2.4.2.23	I/O Terminal Control	0	E.10		0.1	409	
P2.4.2.24	Keypad Control	0	E.10		0.1	410	
P2.4.2.25	Fieldbus Control	0	E.10		0.1	411	
P2.4.2.26	Enable MCB Close	0	E.10		0.2	1619	

4.4.3 ANALOGUE INPUT 1

Table 12. Analogue Input 1, G2.2.2

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.3.1	AI1 signal selection	0.1	E.10		0.1	377	
P2.4.3.2	AI1 filter time	0.000	32.000	s	0.000	324	
P2.4.3.3	AI1 custom minimum setting	-160.00	160.00	%	0.00	321	
P2.4.3.4	AI1 custom maximum setting	-160.00	160.00	%	100.00	322	
P2.4.3.5	AI1 signal inversion	0	1		0	387	
P2.4.3.6	AI1 reference scaling, minimum value	-32000	32000		0	303	
P2.4.3.7	AI1 reference scaling, maximum value	-32000	32000		0	304	
P2.4.3.8	AI1 Controlled ID	0	10000		0	1507	

4.4.4 ANALOGUE INPUT 2

Table 13. Analogue Input 2, G2.2.3

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.4.1	AI2 signal selection	0.1	E.10		0.1	388	
P2.4.4.2	AI2 filter time	0.000	32.000	s	0.000	329	
P2.4.4.3	AI2 custom minimum setting	-160.00	160.00	%	0.00	326	
P2.4.4.4	AI2 custom maximum setting	-160.00	160.00	%	100.00	327	
P2.4.4.5	AI2 signal inversion	0	1		0	398	
P2.4.4.6	AI2 reference scaling, minimum value	-32000	32000		0	393	
P2.4.3.7	AI2 reference scaling, maximum value	-32000	32000		0	394	
P2.4.4.8	AI2 Controlled ID	0	10000		0	1511	

4.4.5 ANALOGUE INPUT 3

Table 14. Analogue Input 2, G2.2.3

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.5.1	AI3 signal selection	0.1	E.10		0.1	141	
P2.4.5.2	AI3 filter time	0.000	32.000	s	0.000	142	
P2.4.5.3	AI3 custom minimum setting	-160.00	160.00	%	0.00	144	
P2.4.5.4	AI3 custom maximum setting	-160.00	160.00	%	100.00	145	
P2.4.5.5	AI3 signal inversion	0	1		0	151	
P2.4.5.6	AI3 reference scaling, minimum value	-32000	32000		0	1037	
P2.4.5.7	AI3 reference scaling, maximum value	-32000	32000		0	1038	
P2.4.5.8	AI3 Controlled ID	0	10000		0	1509	

4.4.6 ANALOGUE INPUT 4

Table 15. Analogue Input 2, G2.2.3

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.4.6.1	AI4 signal selection	0.1	E.10		0.1	152	
P2.4.6.2	AI4 filter time	0.000	32.000	s	0.000	153	
P2.4.6.3	AI4 custom minimum setting	-160.00	160.00	%	0.00	155	
P2.4.6.4	AI4 custom maximum setting	-160.00	160.00	%	100.00	156	
P2.4.6.5	AI4 signal inversion	0	1		0	162	
P2.4.6.6	AI4 reference scaling, minimum value	-32000	32000		0	1039	
P2.4.6.7	AI4 reference scaling, maximum value	-32000	32000		0	1040	
P2.4.6.8	AI4 Controlled ID	0	10000		0	1510	

4.5 OUTPUT SIGNALS

4.5.1 DIGITAL OUTPUT SIGNALS

Table 16. Digital output signals, G2.3.1

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.1.1	MCB1 Close Control	0.1	E.10		0.1	1218	AFE contactor, fixed to relay output B.2
P2.5.1.2	MCB1 Open Control	0.1	E.10		0.1	1219	
P2.5.1.3	Ready	0.1	E.10		0.1	432	The AC drive is ready to operate.
P2.5.1.4	Run	0.1	E.10		0.1	433	The AC drive operates (the motor is running).
P2.5.1.5	Common Fault	0.1	E.10		0.1	434	A fault trip has occurred.
P2.5.1.6	Fault, Inverted	0.1	E.10		0.1	435	No fault trip has occurred.
P2.5.1.7	At reference	0.1	E.10		0.1	442	
P2.5.1.8	Overtemperature Warn.	0.1	E.10		0.1	439	The heatsink temperature exceeds +70 °C
P2.5.1.9	Warning	0.1	E.10		0.1	436	General warning signal.
P2.5.1.10	CB2 Close Control	0.1	E.10		0.1	1709	Second AFE contactor control
P2.5.1.11	NET Contactor	0.1	E.10		0.1	1605	NET contactor (DC)
P2.5.1.12	D7 Synchronized	0.1	E.10		0.1	1753	Drive is synchronised to D7 card
P2.5.1.13	Charge Control	0.1	E.10		0.1	1568	Charge control from start command
P2.5.1.14	Common Alarm	0.1	E.10		0.1	1684	
P2.5.1.15	Ready For Start	0.1	E.10		0.1	1686	No conditions that could disable starting active
P2.5.1.16	Quick Stop Active	0.1	E.10		0.1	1687	
P2.5.1.17	Fieldbus digital input 1	0.1	0.1		0.1	455	FB CW B11
P2.5.1.18	FB Dig 1 Parameter	ID0	ID0			891	Select parameter to control
P2.5.1.19	Fieldbus digital input 2	0.1	0.1		0.1	456	FB CW B12
P2.5.1.20	FB Dig 2 Parameter	ID0	ID0			892	Select parameter to control
P2.5.1.21	Fieldbus digital input 3	0.1	0.1		0.1	457	FB CW B13
P2.5.1.22	FB Dig 3 Parameter	ID0	ID0			893	Select parameter to control
P2.5.1.23	Fieldbus digital input 4	0.1	0.1		0.1	169	FB CW B14
P2.5.1.24	FB Dig 4 Parameter	ID0	ID0			894	Select parameter to control

4.5.2 DELAYED DO 1

Table 17. Delayed DO 1, G2.3.2

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.2.1	Dig.Out 1 Signal	0.1	E.10		0.1	486	Connect the delayed DO1 signal to the digital output of your choice with this parameter.
P2.5.2.2	DO1 Content	0	10		0	312	0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = FC overheat warning 6 = Ext. fault or warning 7 = Ref. fault or warning 8 = Warning 9 = Reverse 10 = SynchronisedToD7 11 = Start Command given 12 = FB DIN2 13 = FB DIN3 14 = ID.Bit DO
P2.5.2.3	DO1 ON Delay	0.00	320.00	s	0.00	487	0.00 = On delay not in use
P2.5.2.4	DO1 OFF Delay	0.00	320.00	s	0.00	488	0.00 = On delay not in use
P2.5.2.5	ID.Bit Free DO	0.00	2000.00	ID.Bit	0.00	1216	

4.5.3 DELAYED DO 2

Table 18. Delayed DO 2, G2.3.3

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.3.1	Dig.Out 2 Signal	0.1	E.10		0.1	486	Connect the delayed DO2 signal to the digital output of your choice with this parameter.
P2.5.3.2	DO2 Content	0	10		0	312	0 = Not used 1 = Ready 2 = Run 3 = Fault 4 = Fault inverted 5 = FC overheat warning 6 = Ext. fault or warning 7 = Ref. fault or warning 8 = Warning 9 = Reverse 10 = SynchronisedToD7 11 = Start Command given 12 = FB DIN2 13 = FB DIN3 14 = ID.Bit DO
P2.5.3.3	DO2 ON Delay	0.00	320.00	S	0.00	487	0.00 = On delay not in use
P2.5.3.4	DO2 OFF Delay	0.00	320.00	S	0.00	488	0.00 = On delay not in use
P2.5.2.5	ID.Bit Free DO	0.00	2000.00	ID.Bit	0.00	1217	

4.5.4 ANALOGUE OUTPUT 1

Table 19. Analogue output signals, G2.3.4

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.4.1	Iout 1 signal	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1	464	Connect the AO1 signal to the analogue output of your choice with this parameter.
P2.5.4.2	Iout Content	0	11		1 / O/P Freq	307	0 =Not used 1 = DC Voltage 2 = Drive Current 3 = Output Voltage 4 = Active Current 5 = Power 6 = Reactive Current 7 = Power Bidirectional 8 = AI1 9 = AI2 10 = FB Analogue Output 11 = Line Voltage 12 = FreqOut, bidirectional 13 = Value Control Out
P2.5.4.3	Iout Filter Time	0	10	s	1	308	0 = No filtering
P2.5.4.4	Iout Invert	0	1		0 / No Inversion	309	0 = Not inverted 1 = Inverted
P2.5.4.5	Iout Minimum	0	1		0 / 0 mA	310	0 = 0 mA 1 = 4 mA
P2.5.4.6	Iout Scale	10	1000	%	100	311	Percentage multiplier. Defines output when content is in maximum value
P2.5.4.7	Iout Offset	-100	100	%	0	375	Add -1000 to 1000% to the analogue output.

4.5.5 ANALOGUE OUTPUT 2

Table 20. Analogue output signals, G2.3.4

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.5.1	Iout 2 signal	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1	464	Connect the AO1 signal to the analogue output of your choice with this parameter.
P2.5.5.2	Iout Content	0	11		1 / O/P Freq	307	0 = Not used 1 = DC Voltage 2 = Drive Current 3 = Output Voltage 4 = Active Current 5 = Power 6 = Reactive Current 7 = Power Bidirectional 8 = AI1 9 = AI2 10 = FB Analogue Output 11 = Line Voltage 12 = FreqOut, bidirectional 13 = Value Control Out
P2.5.5.3	Iout Filter Time	0	10	s	1	308	0 = No filtering
P2.5.5.4	Iout Invert	0	1		0 / No Inversion	309	0 = Not inverted 1 = Inverted
P2.5.5.5	Iout Minimum	0	1		0 / 0 mA	310	0 = 0 mA 1 = 4 mA
P2.5.5.6	Iout Scale	10	1000	%	100	311	Percentage multiplier. Defines output when content is in maximum value
P2.5.5.7	Iout Offset	-100	100	%	0	375	Add -1000 to 1000% to the analogue output.

4.5.6 ANALOGUE OUTPUT 3

Table 21. Analogue output signals, G2.3.4

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.6.1	Iout 3 signal	AnOUT:0.1	AnOUT:E.10		AnOUT:A.1	464	Connect the AO1 signal to the analogue output of your choice with this parameter.
P2.5.6.2	Iout Content	0	11		1	307	0 = Not used 1 = DC Voltage 2 = Drive Current 3 = Output Voltage 4 = Active Current 5 = Power 6 = Reactive Current 7 = Power Bidirectional 8 = AI1 9 = AI2 10 = FB Analogue Output 11 = Line Voltage 12 = FreqOut, bidirectional 13 = Value Control Out
P2.5.6.3	Iout Filter Time	0	10	s	1	308	0 = No filtering
P2.5.6.4	Iout Invert	0	1		0 / No Inversion	309	0 = Not inverted 1 = Inverted
P2.5.6.5	Iout Minimum	0	1		0 / 0 mA	310	0 = 0 mA 1 = 4 mA
P2.5.6.6	Iout Scale	10	1000	%	100	311	Percentage multiplier. Defines output when content is in maximum value
P2.5.6.7	Iout Offset	-100	100	%	0	375	Add -1000 to 1000% to the analogue output.

4.5.7 OPTIONS

Table 22.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.5.7.1	Output Inversion	0	65535		0	1806	
P2.5.7.2	Freq Scale Min AO	0.00	320.00	Hz	0.00	1809	
P2.5.7.3	Freq Scale Max AO	0.00	320.00	Hz	50.00	1808	
P2.5.7.4	DC Supervision Limit	0	1500	V		1454	
P2.5.7.5	MCB Close Mode	0	2		0	1607	0 = DC Voltage 1 = DC or Start command 2 = Start Command.
P2.5.7.6	MCB At Stop Command	0	1		0	1685	0 = Keep CB Closed 1 = Open CB
P2.5.7.7	MCB Close Delay	0.00	3.00		0.00	1513	Delay to CB RO

4.6 LIMIT SETTINGS

4.6.1 CURRENT LIMIT

Table 23.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.1.1	Current Limit	0	Varies	A	Varies	107	Total current limit
P2.6.1.2	Short Circuit Level	0	800,1	%	800.0	1620	Disabled above 499.0%
P2.6.1.3	Short Circuit Time	0	5000	ms	0	1515	
P2.6.1.4	High Freq. Current Limit	0	1		0	1517	0 = Enabled (FR) 1 = Disabled (INU)
P2.6.1.5	BiPhase fault voltage level	0.00	150.00	%	0.00	1518	
P2.6.1.6	Output Active Current Limit	0	300,0	%	150,0	1290	Generating Active Current limit in AFE mode to grid.
P2.6.1.7	Input Active Current Limit	0	300,0	%	150,0	1289	Motoring active current limit in AFE mode to DC-link.

4.6.2 POWER LIMIT

Table 24.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.2.1	Output PowerLimit	0	300	%	300	1288	Generating Power limit in AFE mode to grid.
P2.6.2.2	Input Power Limit	0	300	%	300	1287	Motoring Power limit in AFE mode to DC.
P2.6.2.3	Limit increase Rate	0	10000	%/s	100	1502	
P2.6.2.4	High Frequency Power Limit	0.00	100.00	Hz	0.00	1703	0.00 = Not Used.
P2.6.2.5	Stop Power Ramp Rate	-1,00	100,00	%/s	-0,01	1812	

4.6.3 FREQUENCY LIMIT

Table 25.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.3.1	Line High Trip Limit	0.00	120.00	Hz	75.00	1716	F10 immediately if above
P2.6.3.2	Line Low Trip Limit	0.00	120.00	Hz	25.00	1717	F10 immediately if below

4.6.4 MICRO GRID

Table 26.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.4.1	Current limit Min	-300.0	0.0	%		1621	Island and uGrid mode
P2.6.4.2	Current limit Max	0.0	300.0	%		1622	Island and uGrid mode
P2.6.4.3	Max Limit Increase rate	0	10000	%/s		1502	
P2.6.4.4	Current limit Kp	0	1000			1623	
P2.6.4.5	Current Limit ti	0	1000	ms		1625	
P2.6.4.6	Current Limit Max Minimum	0.0	10.0	%		1890	
P2.6.4.7	Current Limit To Zero Mode	0	10			1539	0 = No Action 1 = At Stop State

4.6.5 DC VOLTAGE

Table 27.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.5.1	Under Voltage Limit	0.00	320.00	%	65.00	1524	
P2.6.5.2	Over voltage limit	0.00	320.00	%	120.00	1523	

4.7 DRIVE CONTROL

Table 28. Drive control, G2.6

Code	Parameter	Min	Max	Unit	Default	ID	Description
P 2.7.1	Switching Freq	3.6	6	kHz	3.6	601	
P 2.7.2	AFE Options 1	0	65535		544	1463	
P 2.7.3	AFE Options 2	0	65535		0	1464	
P 2.7.4	AFE Options 3	0	65535		0	1466	
P 2.7.5	Start Delay	0.10	3200	s	1.00	1500	
P 2.7.6	Modulator Type	0	4		1	1516	
P 2.7.7	Control Options	0	65535		0	1707	
P2.7.8	Control Options 2	0	65535		0	1798	
P2.7.9	Operation Time	0	2^32		0	1855	

4.7.1 AFE CONTROL

Table 29. AFE Control, G2.7.9

Code	Parameter	Min	Max	Unit	Default	ID	Description
P 2.7.10.1	Dynamic Support Kp	0	32000		0	1797	
P 2.7.10.2	Synch Kp	0	32000		2000	1457	
P 2.7.10.3	Synch Ti	0	1000		50	1458	
P 2.7.10.4	Active Current Kp	0	4000		400	1455	
P 2.7.10.5	Active Current Ti	0,0	100,0		1,5	1456	
P 2.7.10.6	Synch. Kp Start	0	10000		4000	1300	
P 2.7.10.7	Voltage Ctrl Kp	0	32000		200	1451	
P2.7.10.8	Voltage Ctrl Ti	0	1000	ms	50	1452	

4.7.2 IDENTIFICATION

Table 30. Identification

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.7.11.1	IU Offset	-10000	10000		10000	668	
P2.7.11.2	IV Offset	-10000	10000		0	669	
P2.7.11.3	IW Offset	-10000	10000		0	670	

Table 31. DC Compensation

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.7.12.1	DC Ripple Compensation Kp	0	100		0	1900	
P2.7.12.2	DC Ripple Compensation Phase	-360	360		0	1901	
P2.7.12.3	DC Ripple Compensation frequency	0	0		300	1902	

4.8 PROTECTIONS

4.8.1 GENERAL

Table 32. Protections, G2.9

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.1.1	Thermistor Fault Response	0	3		2 / Fault	732	0 = No response 1 = Warning 2 = Fault, stop acc. stop mode 3 = Fault, stop by coasting
P2.9.1.2	Overtemperature Response	2	5		2 / Fault	1757	As Par. P2.9.1.4
P2.9.1.3	Overvoltage Response	2	5		2 / Fault	1755	As Par. P2.9.1.4
P2.9.1.4	Cooling Flt. Delay	0	7	s	2	751	
P2.9.1.5	LCL Overtemperature	0	3		2	1505	
P2.9.1.6	Max Charge Time	0.00	30.00	s	5.00	1522	Charging time limit when drive charging options are used.
P2.9.1.7	MCB At Fault	0	1		0	1699	0 = No Action 1 = Open MCB
P2.9.1.8	Start Fault Delay	0.00	320.00	s	3.00	1512	
P2.9.1.9	Quick Stop Response	1	2		1 / Warning	1758	1 = Warning 2 = Fault
P2.9.1.10	Reactive Error Trip Limit	-300	300	%	7.5	1759	
P2.9.1.11	MCB Fault Delay	0.00	10.00	s	3.50	1521	
P2.9.1.12	Line Phase Supervision	0	2		0 / No Action	702	0 = No Action 1 = Warning 2 = Fault
P2.9.1.13	4 mA Fault Response	0	2		0 / No Action	700	0 = No Action 1 = Warning 2 = Fault
P2.9.1.14	Reactive Current Limit Response	0	2		1 / Warning	1981	0 = No Action 1 = Warning 2 = Fault

4.8.2 PT-100

Table 33.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.2.1	PT100 Numbers	0	5		0	739	0 = Not used (ID Write) 1 = PT100 input 1 2 = PT100 input 1 & 2 3 = PT100 input 1 & 2 & 3 2 = PT100 input 2 & 3 3 = PT100 input 3
P2.9.2.2	PT100 FaultResponse	0	3		2 / Fault	740	0 = No response 1 = Warning 2 = Fault,stop acc. to 2.4.7 3 = Fault,stop by coasting
P2.9.2.3	PT100 Warn.Limit	-30	200	°C	120	741	
P2.9.2.4	PT100 Fault Lim.	-30	200	°C	130	742	
P2.9.2.5	PT100 2 Inputs	0	5		0	743	See ID739
P2.9.2.6	PT100 2 WarnLim	-30	200	°C	120	745	
P2.9.2.7	PT100 2 FaultLim	-30	200	°C	130	746	

4.8.3 EARTH FAULT

Table 34.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.3.1	Earth Fault Response	2	5		2 / Fault	1756	
P2.9.3.2	Earth Fault Level	0	100	%	50	1333	

4.8.4 FIELDBUS FAULT

Table 35.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.4.1	FB Fault response Slot D	0	6		2	733	
P2.9.4.2	FB Fault response Slot E	0	6		2	761	
P2.9.4.3	FB WD Time	0.00	30.00	s	0.00	1354	

4.8.5 EXTERNAL FAULT

Table 36.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.5.1	External Fault 1	0	3		2 / Fault	701	
P2.9.5.2	External Fault 2	0	3		1 / Warning	1504	
P2.9.5.3	External Fault Delay	0.00	320.00	s	0.00	1506	

4.8.6 GRID VOLTAGE D7

Table 37.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.6.1	Voltage D7 Response	0	2		1	1626	
P2.9.6.2	Voltage Low Warning Limit	0.00	320.00	%	90.00	1893	
P2.9.6.3	Voltage Low Trip Limit	0.00	320.00	%	80.00	1899	
P2.9.6.4	Voltage High Warning Limit	0.00	320.00	%	110.00	1895	
P2.9.6.5	Voltage High Trip Limit	0.00	320.00	%	115.00	1799	
P2.9.6.6	Voltage Trip Delay	0.00	320.00	s	0.50	1898	

4.8.7 GRID FREQUENCY

Table 38.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.7.1	Freq. Supply Response	0	2		2	1627	
P2.9.7.2	Freq. D7 Response	0	2		1	1628	
P2.9.7.3	Freq. Low Warning Limit	0.00	320.00	%	95.00	1780	Low limit for e.g. Mot Pot function
P2.9.7.4	Freq. Low Trip Limit	0.00	320.00	%	90.00	1781	
P2.9.7.5	Freq. High Warning Limit	0.00	320.00	%	106.00	1783	High limit for e.g. Mot Pot function.
P2.9.7.6	Freq. High Trip Limit	0.00	320.00	%	110.00	1784	
P2.9.7.7	Freq. Trip Delay	0.00	320.00	s	0.50	1785	

4.8.8 VOLTAGE

Table 39.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.6.8.1	Voltage Supply Response	0	2		2	1629	
P2.6.8.2	Voltage Low Trip Limit	0.00	320.00	%	75.00	1891	
P2.6.8.3	Voltage Low Warning Limit	0.00	320.00	%	90.00	1880	
P2.6.8.5	Voltage High Trip Limit	0.00	320.00	%	130.00	1992	

4.8.9 OVER LOAD

Table 40.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.9.1	Over Load Response	0	2		1	1838	**0**=No response **1**=Warning **2**=Fault
P2.9.9.2	Over Load Signal	0	2		0	1837	**0**=Not Used **1**=Current % **2**=Active Current **3**=Reactive Current
P2.9.9.3	Over Load Maximum Input	0,0	300,0	%	150,0	1839	
P2.9.9.4	Over Load maximum Step	0	10000		200	1840	

4.8.10 EXTRA

Table 41.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.9.10	Fault Simulation	0	65535		0	1569	
P2.9.11	Reset Datalogger	0	1		0	1857	

4.9 FIELDBUS

Table 42. Fieldbus, G2.10

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.10.1	FB Actual Value Sel	0	10000		44	1853	
P2.10.2	FB Data Out1 Sel	0	10000		1104	852	
P2.10.3	FB Data Out2 Sel	0	10000		1508	853	
P2.10.4	FB Data Out3 Sel	0	10000		1172	854	
P2.10.5	FB Data Out4 Sel	0	10000		1173	855	
P2.10.6	FB Data Out5 Sel	0	10000		56	856	
P2.10.7	FB Data Out6 Sel	0	10000		1174	857	
P2.10.8	FB Data Out7 Sel	0	10000		1125	858	
P2.10.9	FB Data Out8 Sel	0	10000		1157	859	
P2.10.10	FB Data Out9 Sel	0	10000		0	558	Data Out 9-16 visible only with correct HW and SW.
P2.10.11	FB Data Out10 Sel	0	10000		0	559	
P2.10.12	FB Data Out11 Sel	0	10000		0	560	
P2.10.13	FB Data Out12 Sel	0	10000		0	561	
P2.10.14	FB Data Out13 Sel	0	10000		0	562	
P2.10.15	FB Data Out14 Sel	0	10000		0	563	
P2.10.16	FB Data Out15 Sel	0	10000		0	564	
P2.10.17	FB Data Out16 Sel	0	10000		0	565	
P2.10.18	FB Data In 1 Sel	0	10000		0	876	
P2.10.19	FB Data In 2 Sel	0	10000		0	877	
P2.10.20	FB Data In 3 Sel	0	10000		0	878	
P2.10.21	FB Data In 4 Sel	0	10000		0	879	
P2.10.22	FB Data In 5 Sel	0	10000		0	880	
P2.10.23	FB Data In 6 Sel	0	10000		0	881	
P2.10.24	FB Data In 7 Sel	0	10000		0	882	
P2.10.25	FB Data In 8 Sel	0	10000		0	883	
P2.10.26	FB Data In 9 Sel	0	10000		0	550	Data In 9-16 visible only with correct HW and SW.
P2.10.27	FB Data In 10 Sel	0	10000		0	551	
P2.10.28	FB Data In 11 Sel	0	10000		0	552	
P2.10.29	FB Data In 12 Sel	0	10000		0	553	
P2.10.30	FB Data In 13 Sel	0	10000		0	554	
P2.10.31	FB Data In 14 Sel	0	10000		0	555	
P2.10.32	FB Data In 15 Sel	0	10000		0	556	
P2.10.33	FB Data In 16 Sel	0	10000		0	557	
P2.10.34	GSW Data	0	10000		68	897	
P2.10.35	State Machine	0	2		2	896	0 = Basic 1 = Standard 2 = Vacon AFE 1
P2.10.36	FB Ref Min	105.00	320.00	%	105.00	850	
P2.10.37	FB Ref Max	105.00	320.00	%	130.00	851	
P2.10.38	Control Slot Selector	0	Varies		0	1440	**0**=Not Sel, **4**=Slot D, **5**=Slot E, **8**=Slot D 16 PD, **9**=Slot E 16 PD Note: Options 8-9 visible only with correct HW and SW.
P2.10.39	SW B11 ID.Bit	0.00	2000.15		0.00	1907	
P2.10.40	SW B12 ID.Bit	0.00	2000.15		0.00	1908	
P2.10.41	SW B13 ID.Bit	0.00	2000.15		0.00	1909	
P2.10.42	SW B14 ID.Bit	0.00	2000.15		0.00	1910	

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.10.43	uCW B12	0	10000		0	1934	
P2.10.44	uCW B13	0	10000		0	1935	
P2.10.45	uCW B14	0	10000		0	1936	
P2.10.46	uCW B15	0	10000		0	1937	

4.10 MICRO GRID

Table 43. Micro Grid, G2.7

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.11.1	Control Mode	0	6		0 / AFE	1531	0 = AFE 1 = Island 2 = Micro Grid 3 = Island-AFE 4 = Island-Micro Grid 5 = Island-Micro Grid (Reserved) 6 = FreeSelect
P2.11.2	Frequency Droop	1	32	Hz	1	1534	
P2.11.3	Voltage Droop	0	320	%	10	1535	Reactive current drooping in percentage of P2.1.
P2.11.4	Start Power Mode	0	2		2	1503	0 = Zero power D7 1 = Zero Power F/O 2 = Drooping 3 = Isochron.Gen
P2.11.5	Voltage Rise Time	0	10000	ms	100	1541	
P2.11.6	Generator Mechanical Time Constant	0	32000	ms	0	1722	0 = Not used 1 >= Active Use 1000 ms as a starting point.
P2.11.7	Generator Speed Control Kp	0,0	3200,0	%/Hz	40,0	1723	
P2.11.8	Generator Speed Control Ti	0	32000	ms	32000	1724	

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.11.9.1	AFE Mode 1	0	6		0 / AFE	1616	
P2.11.9.2	AFE Mode 2	0	6		1 / Island	1617	
P2.11.9.3	AFE Mode 3	0	6		2 / Micro Grid	1713	

4.11 SYNCHRONISATION TO EXTERNAL GRID

Table 44.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.12.1	Synch. Offset	-3172	3171		0	1601	Used to compensate for transformer angle offset. (3172 equals 180 degrees offset).
P2.12.2	Synch Reference	-3170	3170		0	1611	Gives synchronisation point for synch error.
P2.12.3	Synch Kp	0	32000		500	1612	
P2.12.4	Synch Ti	0	32000		0	1613	
P2.12.5	Synch. Hysteresis	-3170	3170		50	1614	
P2.12.6	Contactor Delay	0	1000	ms	0	1624	In case no feedback from shore contactor, this can be used to simulate feedback signal.
P2.12.7	Synch Stop Mode	0	1		0 / Stay Run	1618	When stop is selected, drive will go to stop mode when feedback from shore contactor.

4.12 SYNCHRONISATION TO SHAFT GENERATOR

Table 45.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.13.1	SG Follower Ramp Time	1.0	600.0	s	3.0	1527	
P2.13.2	SG Grid Phase Offset	-3200	3200		0	1586	
P2.13.3	Synch Gain	0	10.00	Hz	0.50	1778	
P2.13.4	Phase Synch Ramp Time	0.00	10.00	S	0.02	1777	
P2.13.5	Max Synch Correct	0	3200		3000	1992	
P2.13.6	Ramp Change Hysteresis	0	3070		3000	1894	

4.13 ID CONTROL FUNCTIONS

4.13.1 VALUE CONTROL

Table 46. Power reference input signal selection, G2.2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.14.1.1	Control Input Signal ID	0	10000	ID	0		1580	
P2.14.1.2	Control Input Off Limit	-32000	32000		0		1581	
P2.14.1.3	Control Input On Limit	-32000	32000		0		1582	
P2.14.1.4	Control Output Off Value	-32000	32000		0		1583	
P2.14.1.5	Control Output On Value	-32000	32000		0		1584	
P2.14.1.6	Control Output Signal ID	0	10000	ID	0		1585	
P2.14.1.7	Control Mode	0	5		0		1586	0 = SR ABS 1 = Scale ABS 2 = Scale INV ABS 3 = SR 4 = Scale 5 = Scale INV
P2.14.1.8	Control Output Filtering rime	0.000	32.000	s	0.000		1721	

4.13.2 DIN ID CONTROL 1

Table 47. DIN ID control parameters, G2.2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.14.2.1	ID Control DIN	0.1	E.10		0.1		1570	Slot Board input No. If 0.1 ID61 can be controlled from FB
P2.14.2.2	Controlled ID	0	10000	ID	0		1571	Select ID that is controlled by digital input
P2.14.2.3	False value	-32000	32000		0		1572	Value when DI is low
P2.14.2.4	True value	-32000	32000		0		1573	Value when DI is high

4.13.3 DIN ID CONTROL 2

Table 48. DIN ID control parameters, G2.2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.14.3.1	ID Control DIN	0.1	E.10		0.1		1590	Slot Board input No. If 0.1 ID61 can be controlled from FB
P2.14.3.2	Controlled ID	0	10000	ID	0		1575	Select ID that is controlled by digital input
P2.14.3.3	False value	-32000	32000		0		1592	Value when DI is low
P2.14.3.4	True value	-32000	32000		0		1593	Value when DI is high

4.13.4 DIN ID CONTROL 3

Table 49. DIN ID control parameters, G2.2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.14.4.1	ID Control DIN	0.1	E.10		0.1		1578	Slot Board input No. If 0.1 ID61 can be controlled from FB
P2.14.4.2	Controlled ID	0	10000	ID	0		1579	Select ID that is controlled by digital input
P2.14.4.3	False value	-32000	32000		0		1594	Value when DI is low
P2.14.4.4	True value	-32000	32000		0		1596	Value when DI is high

4.13.5 DIN ID CONTROL 4

Table 50. DIN ID control parameters, G2.2.8

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.14.5.1	ID Control DIN	0.1	E.10		0.1		1930	Slot Board input No. If 0.1 ID61 can be controlled from FB
P2.14.5.2	Controlled ID	0	10000	ID	0		1931	Select ID that is controlled by digital input
P2.14.5.3	False value	-32000	32000		0		1932	Value when DI is low
P2.14.5.4	True value	-32000	32000		0		1933	Value when DI is high

4.14 AUTO RESET

Table 51.

Code	Parameter	Min	Max	Unit	Default	ID	Description
P2.15.1	Wait Time	0.00	60.00	s	5.00	717	
P2.15.2	Trial Time	0.00	120.00	s	30.00	718	
P2.15.3	Over voltage tries	0	3		0	721	
P2.15.4	Over current tries	0	3		0	722	
P2.15.6	External fault tries	0	10		0	725	

4.15 GRID VOLTAGE PI

Table 52. Grid voltage PI function

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.16.1	PID Activation	0.1	E.10	DigIn	0.1		1807	Digital input to activate PI controller
P2.16.2	PI controller gain	0.0	1000.0	%	200.0		118	PI controller gain
P2.16.3	PI controller I-time	0.00	320.00	s	0.05		119	PI controller I-time
P2.16.4	PI Max Adjust	-32000	32000	%	5.00		360	PI High limit
P2.16.5.1	PI Frequency Low Limit	0.00	320.00	%	95.00		1630	
P2.16.5.2	PI Frequency High Limit	0.00	320.00	%	102.00		1631	
P2.16.5.3	PI Voltage Low Limit	0.00	320.00	%	90.00		1632	
P2.16.5.4	PI Voltage High Limit	0.00	320.00	%	110.00		1633	

4.16 GRID CODE PARAMETERS

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.1	GGC License	0	65535		0		2201	
P2.17.2	EnableGridCode	0	2		0		2254	0 = Disabled 1 = Enabled; No Trip. 2 = Enabled
P2.17.3	Anti-islanding	0	2		0 / Disabled		2250	
P2.17.4	Power RampUp Rate	-1,00	320,00	%/s	-1		2324	Negative value means no limitation in power increase.

4.16.1 FRT

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.5.1	FRT Function	0	3		0 / No		2251	0 = Disabled; Both 1 = Enabled; Limits 2 = Enabled; Curve 3 = Enabled; Neither
P2.17.5.2	ReactivInjection	0	2		0 / Tri:N, Bi:N		2252	
P2.17.5.3	Symmetrical Reactive	0	1		0 / No		2323	

4.16.2 RECONNECTION

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.6.1	ReConnectTime	0	1000	s	2		2253	
P2.17.6.2	ReConnTimeStop	0	1000	s	2		2255	
P2.17.6.3	ReConRampUpRate	-1	320	%/s	-1		2297	

4.16.3 LINE VOLTAGE

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.7.1	LV High 1	0	200	%	115		2256	
P2.17.7.2	LV High 1 Delay	0	60000	ms	0		2257	
P2.17.7.3	LV High 2	0	200	%	0		2258	
P2.17.7.4	LV High 2 Delay	0	120000	ms	0		2259	
P2.17.7.5	LV Low 1	0	200	%	0		2260	
P2.17.7.6	LV Low 1 Delay	0	120000	ms	0		2261	
P2.17.7.7	LV Low 2	0	200	%	80		2262	
P2.17.7.8	LV Low 2 Delay	0	120000	ms	0		2263	

4.16.4 LINE FREQUENCY

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.8.1	LF High 1	0	200	%	103		2264	
P2.17.8.2	LF High 1 Delay	0	120000	ms	0		2265	
P2.17.8.3	LF High 2	0	200	%	0		2266	
P2.17.8.4	LF High 2 Delay	0	120000	ms	0		2267	
P2.17.8.5	LF Low 1	0	200	%	0		2268	
P2.17.8.6	LF Low 1 Delay	0	120000	ms	0		2269	
P2.17.8.7	LF Low 2	0	200	%	95		2270	
P2.17.8.8	LF Low 2 Delay	0	120000	ms	0		2271	
P2.17.8.9	LF MaxChangeRate	0	20	Hz/s	0		2322	

4.16.5 VOLTAGE TIME TRIP

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.9.1	Voltage X0	0	110	%	0		2272	
P2.17.9.2	Time Y0	0	20000	ms	0		2273	
P2.17.9.3	Voltage X1	0	110	%	0		2274	
P2.17.9.4	Time Y1	0	20000	ms	0		2275	
P2.17.9.5	Voltage X2	0	110	%	0		2276	
P2.17.9.6	Time Y2	0	20000	ms	0		2277	
P2.17.9.7	Voltage X3	0	110	%	0		2278	
P2.17.9.8	Time Y3	0	20000	ms	0		2279	
P2.17.9.9	Voltage X4	0	110	%	0		2280	
P2.17.9.10	Time Y4	0	20000	ms	0		2281	
P2.17.9.11	Voltage X5	0	110	%	30		2282	
P2.17.9.12	Time Y5	0	20000	ms	400		2283	
P2.17.9.13	Voltage X6	0	110	%	80		2284	
P2.17.9.14	Time Y6	0	20000	ms	2500		2285	

4.16.6 LINE OK LIMITS

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.10.1	LF OK High	0	200	%	0		2287	
P2.17.10.2	LF OK Low	0	110	%	0		2286	
P2.17.10.3	LV OK High	0	200	%	0		2289	
P2.17.10.4	LV OK Low	0	110	%	0		2288	
P2.17.10.5	Line OK Delay	0	20000	ms	0		2290	

4.16.7 REACTIVE INJECTION

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.11.1	Reactive Mode	0	1		0 / Linear		2314	
Code	**Parameter**	**Min**	**Max**	**Unit**	**Default**	**Cust**	**ID**	**Description**
P2.17.11.2.1	UV High Corner	0	200	%	0		2291	
P2.17.11.2.2	UV Low Corner	0	200	%	0		2292	
P2.17.11.2.3	UV Reac. Ref	0	150	%	0		2293	
P2.17.11.2.4	UV Bi Reac. Ref	0	150	%	0		2294	
P2.17.11.2.5	OV Low Corner	0	150	%	0		2300	
P2.17.11.2.6	OV Max Reactiv	0	150	%	0		2301	
P2.17.11.2.7	OV React Slope	0	150	%	0		2302	
P2.17.11.2.8	OV React PLim In	0	150	%	0		2303	
P2.17.11.2.9	OV React PLim Out	0	150	%	0		2329	
Code	**Parameter**	**Min**	**Max**	**Unit**	**Default**	**Cust**	**ID**	**Description**
P2.17.11.3.1	PowerLockIn	0	200	%	0		2315	
P2.17.11.3.2	PowerLockOut	0	200	%	0		2316	
P2.17.11.3.3	UV High Corner	0	200	%	0		2291	
P2.17.11.3.4	UV Low Corner	0	200	%	0		2292	
P2.17.11.3.5	UV LockOutVoltag	0	200	%	0		2317	
P2.17.11.3.6	UVReacRefHighCor	0	200	%	0		2318	
P2.17.11.3.7	UV Reac. Ref	0	150	%	0		2293	
P2.17.11.3.8	UV Bi Reac. Ref	0	150	%	0		2294	
P2.17.11.3.9	OV Low Corner	0	150	%	0		2300	
P2.17.11.3.10	OV High Corner	0	200	%	0		2320	
P2.17.11.3.11	OVReacRefLowCorn	0	200	%	0		2321	
P2.17.11.3.12	OV Max Reactiv	0	150	%	0		2301	
P2.17.11.3.13	OV LockOutVoltag	0	200	%	0		2319	

4.16.8 POWER LIMIT

4.16.8.1 High Frequency

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.12.1.1	HighFreqModes	0	1		0		2307	
P2.17.12.1.2	HighFreqLowCornr	0	200	%	0		2295	
P2.17.12.1.3	HighFreqHigCornr	0	200	%	0		2296	
P2.17.12.1.4	HighFreqLockOut	0	150	%	0		2308	
P2.17.12.1.5	HighFreqPowRatio	0	100	%	0		2309	
P2.17.12.1.6	HighFreqPLimRamp	-1	320	%	-1		2298	
P2.17.12.1.7	HighFreqPReleDel	0	1000000	ms	50		2299	

4.16.8.2 High Voltage

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.12.2.1	Log In Voltage	0,00	320,00	%	0		2325	
P2.17.12.2.2	Log Out Voltage	0,00	320,00	%	0		2326	
P2.17.12.2.3	Limit Slope	-1,0	3200,0	%/%	0,0		2327	

4.16.9 COS PHII CONTROL

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.13.1	CosPhiiRef	-1	1		0		2304	
P2.17.13.2	LockInVoltage	0	150	%	0		2305	
P2.17.13.3	LockOutVoltage	0	150	%	0		2306	

4.16.10 External Input

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.14.1	Ext GC Trip In	0.1	E.10	DI	0.1		2310	
P2.17.14.2	SeparateFLimMon	0.1	E.10	DI	0.1		2311	
P2.17.14.3	SepFreqHighLim	0	150	%	0		2312	
P2.17.14.4	SepFreqLowLim	0	150	%	0		2313	

4.16.11 Low Frequency Power

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.15.1	Power Increase High Frequency	0,00	150,00	%	0,00		2334	
P2.17.15.2	Power Increase Slope	0,0	200,0	%/%	15,0		2335	
P2.17.15.3	Power Increase Max	0,0	200,0	%	200,0		2336	

4.16.12 Options

Code	Parameter	Min	Max	Unit	Default	Cust	ID	Description
P2.17.16.1	GC Options 1	0	65535		0		2328	
P2.17.16.2	Voltage Filt. TC	0	10000	ms	20		2332	
P2.17.16.3	Frequency Filt. TC	0	10000	ms	35		2333	
P2.17.16.4	FRT Options	0	65535		0		2400	
P2.17.16.5	Vac Stop Offset	-10,00	10,00	%	1,50		2337	
P2.17.16.6	Vac Run Offset	-10,00	10,00	%	0,00		2338	
P2.17.16.7	Power Follower Hysteresis	0,0	100,0	%	3,0		1529	

4.17 KEYPAD CONTROL (CONTROL PANEL: MENU M3)

Table 53. Keypad control parameters M3

Code	Parameter	Default	Min	Max	Unit	ID	Description
P3.1	Control Place	2	0	2		1403	0 = PC Control 1 = I/O terminal 2 = Keypad (Default) 3 = Fieldbus 4 = SystemBus
P3.2	Licence Key	0	0			1995	

4.18 SYSTEM MENU (CONTROL PANEL: MENU M6)

For the parameters and functions related to the general use of the AC drive, such as application and language selection, customised parameter sets or information about the hardware and software, see the Vacon NX User Manual.

4.19 EXPANDER BOARDS (CONTROL PANEL: MENU M7)

The M7 menu shows the expander and option boards attached to the control board, and the board-related information. For more information, see the Vacon NX User Manual and the Vacon I/O option board manual.

5. DESCRIPTION OF PARAMETERS

5.1 BASIC PARAMETERS

2.1.1 Grid Nominal Voltage V ID110

This parameter sets the incoming line voltage for the regenerative drive. Set this parameter to the nominal line voltage at the installation site. Used also as a reference point for grid voltage protection functions. Use G2.2.8 Voltage Correction for static voltage correction.

When transformer parameters are given, this parameter will be voltage reference of grid when operating in Island and uGrid modes. When transformer rating is different than 1:1 System Rated DC parameter must be given so that AFE operation will work correctly and MCB is closed at correct voltage level.

2.1.2 Grid Nominal Frequency Hz ID1532

Micro Grid and Island mode frequency set point. In Micro Grid mode used as a reference point for the Base Current reference and drooping. In AFE mode used as a reference point for frequency protection functions. Use G2.11 FreqDroopOffset for static frequency adjustment.

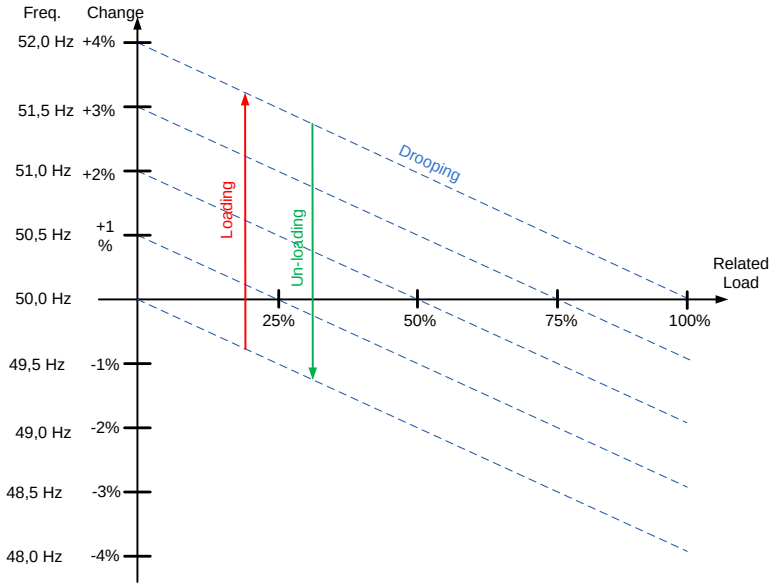


Figure 10.

2.1.3 System Rated Current A ID113

The rated current capacity of the supply or the transformer. It can be necessary to set it if AFE is overdesigned compared to the supply or feeding transformer capacity.

The active current and the reactive current are scaled to this parameter as is the current cutter level.

For testing purposes (FAT) feeding transformer should not be less than 20% of the unit nominal current or following breakers or fuses.

2.1.4 System Rated Cos Phi ID120

Enter the system rated Cos Phi.

2.1.5 System Rated kVA ID213

Enter the system rated kVA.

2.1.6 System Rated kW kW ID116

Set the the rated active power of the system.

2.1.7 Nominal DC ID1805

This value is used as a reference point for DC Voltage reference instead of Grid Nominal Voltage.

Recommended to set to highest DC Source voltage of the system.

Based on:

Grid voltage: Grid Nominal Voltage * 1.35

Generator Voltage: Motor/Generator nominal voltage * 1.35

DC-DC Converter: Maximum battery DC voltage.

2.1.8 Parallel AFE ID1501

Set this to 1 if more than one unit is connected to same DC bus.

0 = Single AFE

1 = Parallel AFE

When you select parallel AFE, DC drooping is set to 3.00% and modulation is synchronised to reduce circulating current if the drives are in a common DC bus.

5.1.1 TRANSFORMER PARAMETERS

These parameters are used to scale voltage so that the parameter P2.1.1 Grid Nominal Voltage can be given a value as actual grid voltage. The drive will calculate the actual drive terminal voltage based on these values.

NOTE: When ration is different than 1:1 also P2.1.7 System Nominal DC parameter must be given so that MCB is closed at correct voltage level and AFE mode DC Voltage reference will give correct DC-Link Voltage.

2.1.9 Transformer GC Side Voltage ID1850

Set the transformer nominal voltage on Grid Converter side (U4).

2.1.10 Transformer Grid Side Voltage ID1851

Set the transformer nominal voltage on Grid side (U5).

2.1.11 Transformer Phase Shift ID1852

Set the transformer phase shift. Difference in angle, between U3 and U5. When OPT-D7 measurement is connected to U5 (i.e. to ship grid). This information is used if OPT-D7 assisted AFE start synchronization is activated. Usually Dyn11 transformer has 30.0 degree phase shift.

NOTE: Synchronization to external grid will use different set of parameters for phase shifts.

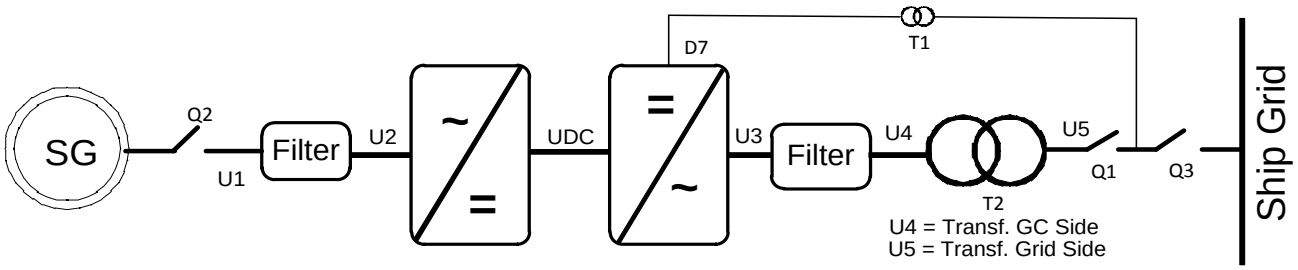


Figure 11.

P2.1.7 Identification ID631

Identification function will calibrate current measurement.

0 = No Action

1 = Current measurement offset

5.2 REFERENCE HANDLING

2.2.1 DC Voltage Reference ID1462

This parameter sets the DC Voltage reference in % of the Nominal DC voltage.

If P2.1.5 System Nominal DC is zero then

Nominal DC voltage = 1.35 * Grid Nom. Voltage (P2.1.1).

Final DC Voltage Ref (V1.1.2) = Nominal DC Voltage * DC Voltage Reference

The DC Voltage will be maintained at this level when the regenerative unit is running.

There is internal limitation to reference: For 500V units the maximum limit is 797 Vdc and for 690V units the maximum limit 1099 Vdc.

The maximum limit can be monitored from V1.1.15 DC Ref Max Lim.

NOTE! If DC voltage exceeds the values below in STOP state, the drive will lose READY state:

- 797 Vdc for 500V unit, trip limit 911 Vdc
- 1099 Vdc for 690V unit, immediate trip limit 1200 Vdc, U2t protection above 1100 Vdc.
- 1136 Vdc for LC 690V voltage class 8 (Order code example: NXA1500**8**_ _ _ _ _**W**)

NOTE! When transformer ration is different than 1:1 also P2.1.7 System Nominal DC parameter must be given so that MCB is closed at correct voltage level and AFE mode DC Voltage reference is giving correct DC-Link Voltage.

By default the internal DC voltage reference is kept the same as the actual DC voltage when the drive is in STOP state, or the operation mode is Island or Micro Grid. This is to make the change to the AFE mode smoother when the change is done on the fly.

2.2.2 Reactive Current Reference ID1459

This parameter sets the reference for the reactive current in % of the nominal current.

This can be used for power factor correction of AFE system or reactive power compensation. Positive value gives inductive compensation whereas negative value gives capacitive compensation.

In uGrid mode 100.0 % reactive reference will decrease voltage by set voltage drooping value.

NOTE: Reactive Current reference does not affect voltage in island mode operation.

5.2.1 DC REFERENCE TUNING

2.2.3.1 DC Drooping ID620

When AFEs are used in parallel in independent mode, drooping can be used for current balancing. The DCV voltage reference drooping is set as % of the active current reference.

For example, if drooping is 3.00% and active current is 50%, the DC voltage reference is reduced by 1.5%. With drooping, paralleled units can be balanced by adjusting the DCVoltReference to slightly different values.

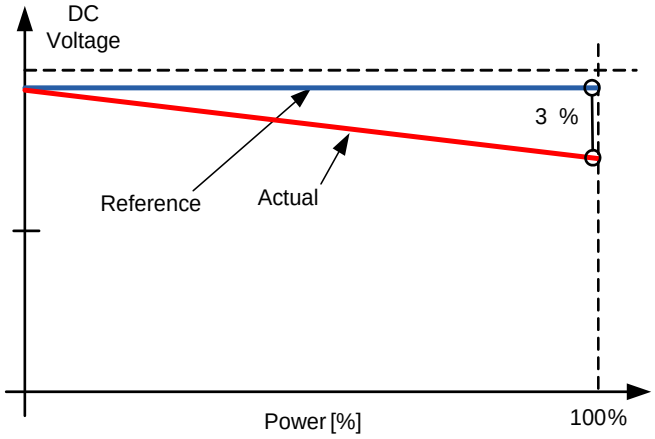


Figure 12.

2.2.3.2 DC Voltage Ramp Rate ID1199

This parameter defines the ramp rate for the DC voltage reference change. The rate is defined as %/s.

By default the internal DC voltage reference is kept the same as the actual DC voltage when the drive is in STOP state, or the operation mode is Island or Micro Grid. This is to make the change to the AFE mode smoother when the change is done on the fly.

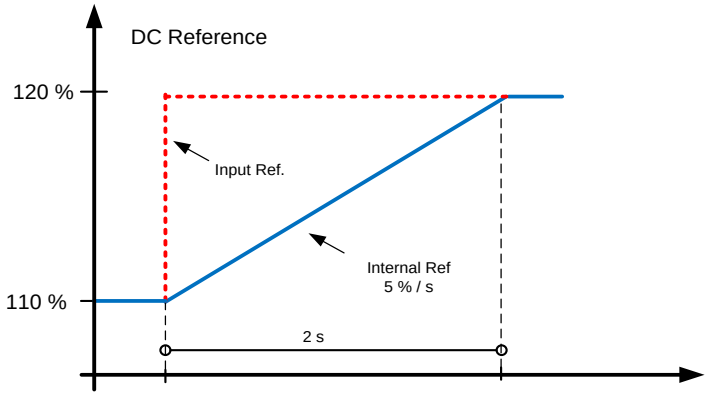


Figure 13.

2.2.3.3 DC Voltage Reference Filter TC ID1760

By default the internal DC voltage reference is kept the same as the actual DC voltage when the drive is in STOP state, or the operation mode is Island or Micro Grid. This is to make the change to the AFE mode smoother when the change is done on the fly.

This will prevent over current and current spikes when the control mode is changed.

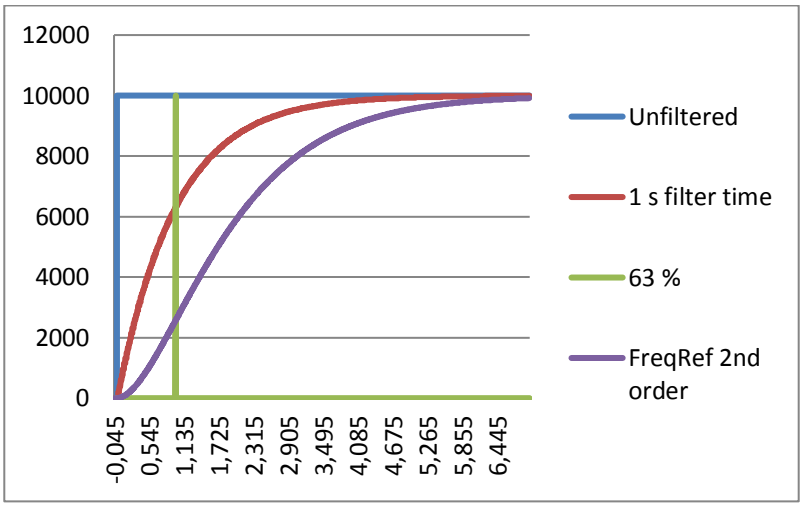


Figure 14.

2.2.3.4 DC Reference Offset

Offset for DC Reference, used to balance parallel unit active current while using same DC Reference P2.2.1. in all units.

5.2.2 POWER /FREQUENCY REFERENCE

2.2.4.1 Frequency Drooping Offset

This parameter is used to adjust the base frequency for drooping purposes. For example, if drooping is set to 2 Hz this parameters can be set to 1 Hz so that when the load is 50%, the frequency will be at the nominal point. The offset can also be set by the supply frequency parameters. However, in that case the grid frequency protection function will also use this increased value as a reference point and makes the protection function activate at the wrong frequency.

When you use this parameter for drooping purposes, the supply frequency can be left to the nominal value.

Final frequency reference is also limited by G2.9.7 frequency warning limits.

2.2.4.2 Frequency Down (DigIn) ID417

Select a digital input to decrease the base frequency with a set ramp rate.

See also ID1700 FB Micro Grid CW1 Bit 4 Power Down

2.2.4.3 *Frequency Up (DigIn)* *ID418*

Select a digital input to increase the base frequency with a set ramp rate. Frequency change is also limited by G2.3 Ramp Time and Ramp Range.

See also ID1700 FB Micro Grid CW1 Bit 5 Power Up

2.2.4.6 *Base Current Reference* *ID1533*

The Base Current Reference determines offset for frequency reference within Frequency Drooping. For example, if frequency drooping is set to 2.000 Hz and grid frequency is constant 50 Hz with very small or nonexistent changes (isochronous or strong grid), and if 100% of Base Current Reference is given, the drive will feed 100% power to the grid. The situation is the same with the frequency reference set to 52 Hz and with 2.000 Hz drooping.

Base current reference can be used together with selection *3* of P2.11.5 StartPowerMode: Isochron.Gen. This selection will keep the drive frequency reference same as the grid frequency, and the power that is fed or taken from the drive is solely defined by the Base Current Reference parameter.

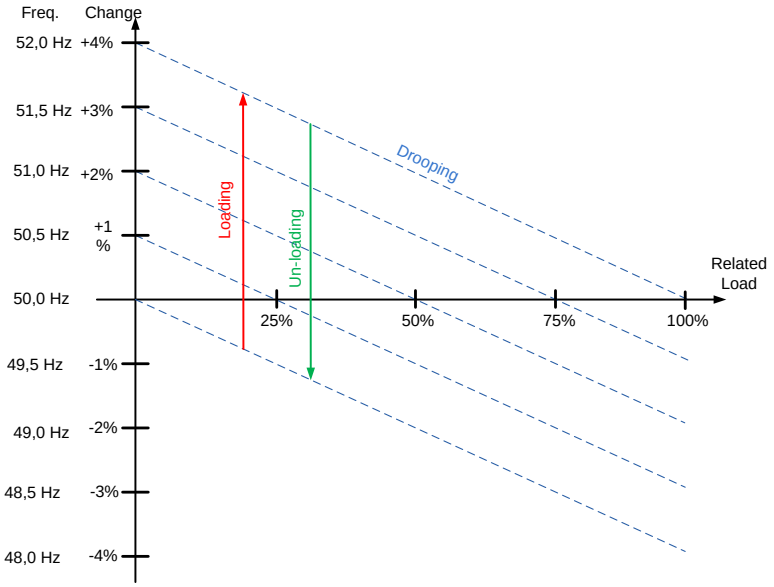


Figure 15.

2.2.4.7 *Base Reference Ramp Rate ID1536*

This parameter defines the increase rate of the base current reference when the reference is changed or the drive is started.

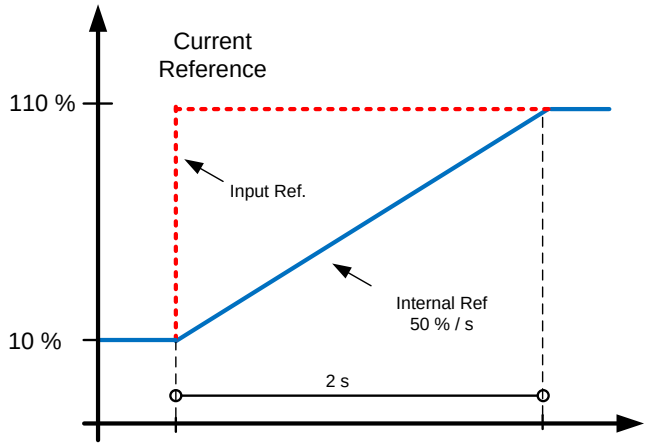


Figure 16.

2.2.4.8 *Base Reference to Zero ID1537*

This parameter defines in which situations Base Current Reference is set to the value of P2.2.6.8 BaseRefAtStop.

0 = No action.

1 = Reference set to P2.2.6.4 when at STOP state.

2 = Reference set to P2.2.6.4 when AFE mode is active.

3 = Reference set to P2.2.6.4 when AFE mode is active or drive in STOP state.

2.2.4.9 *Base Reference at Stop State ID1538*

Base reference on situation selected by P2.2.6.7 Base Reference to Zero. Reference is ramped after start command to P2.2.6.5. This parameter defines power level that is injected to grid right after synchronisation.

NOTE! The actual power will be determined by the set supply frequency, drooping and the start power mode.

5.2.3 PID POWER CONTROLLER

This function is mend be control drive power when operating in AFE mode. P2.2.4.6 Base Current Reference is used as reference input and V1.1.5 Active Current is used as actual value.
PID Controller is forced to zero when DI: PID Power Activation is low or drive is in stop state or drive is not operating in AFE mode. PID Controller will adjust power flow by giving offset to given DC Voltage Reference. It's recommended to use some drooping to make controller smoother.

2.2.4.10.1 PID Power Activation ID1905

Select digital input to activate PID Power control function. This signal can be controlled from fieldbus with FB Control Word by assailing e.g. P2.5.1.20 to ID1905.

2.2.4.10.2 PID Kp ID1911

Gain for PID controller.

2.2.4.10.3 PID Ti ID1906

Integration time for PID controller.

2.2.4.10.4 PID DC Low

This parameter defined how low PID controller can adjust DC Voltage Reference from P2.2.1 DC Voltage Ref.

2.2.4.10.5 PID DC High

This parameter defined how high PID controller can adjust DC Voltage Reference from P2.2.1 DC Voltage Ref.

2.2.4.10.6 Reference Down Rate %/s 1810

Power reference ramp rate when increasing the reference

2.2.4.10.6 Reference Up Rate %/s 1811

Power reference ramp rate when decreasing the reference

5.2.4 REFERENCE ADJUST FUNCTIONS

5.2.4.1 Reactive Current Reference

2.2.5.1 Reactive Adjust Rate ID1557

Defines the rate that is used to change the reactive current reference when Up and Down inputs are used.

2.2.5.2 Reactive Ref Up (DigIn) ID1553

Select a digital input to increase the reactive reference with a set ramp rate.

2.2.5.3 Reactive Ref Down (DigIn) ID1554

Select a digital input to increase the reactive reference with a set ramp rate.

2.2.5.4 Maximum Reactive Adjust ID1559

Maximum reference change that Reactive MotPot function can make to main reference.

5.2.5 AC VOLTAGE REFERENCE

P2.2.6.1 Voltage at field weakening point ID603

Above the field weakening point, the output voltage remains at the set value. Below the field weakening point, the output voltage depends on the setting of the U/f curve parameters.

P2.2.6.2 Field weakening point ID602

The field weakening point is the output frequency at which the output voltage reaches the field weakening point voltage. Set this to level where generator's AVR starts to decrease voltage as a function of generator speed.

P2.2.6.3 Voltage Correction ID1790

This parameter is used to compensate the zero load voltage drop in grid side when running in Micro Grid or island mode. The supply voltage parameter can also be used for this purpose, but Grid Voltage D7 protection uses this increased value for reference too. When using this parameter for compensation, the supply voltage can be left to nominal value.

NOTE! Some cases when inductor size and losses are compensated, the zero load voltage may need to decrease.

P2.2.6.4 Capacitor Size [%] (ID1460)

AFE: This parameter defines the reactive current going to the LCL filter capacitor. It compensates the LCL effect to the reactive current by adjusting the reactive current reference internally. The inductor size is also added to compensation. If set correctly, the power factor on the grid side will be 1.

Island and Micro Grid: Not used.

P2.2.6.5 Inductor Size [%] (ID1461)

AFE:

This parameter defines voltage losses in percentage of the nominal voltage at 100% active current. This value is internally added to the reactive current reference thus giving power factor 1 on the grid side, if set correctly together with Capacitor Size. The transformer and feeding cables can be compensated by increasing this value.

Island and Micro Grid:

This parameter defines the voltage increase in percentage of the nominal voltage at 100% reactive current.

- Supply Voltage: 400 Vac
- Inductor Size: 15.0 %
- Inductor losses: 15.0 %
- Reactive Current: 30.0 %
- Active Current: 50.0 %

$400\ Vac * 30{,}0\ \% *\ 15.0\ \% = 18\ Vac$. Increase of voltage from reactive current.

Voltage drooping will decrease the final voltage if it is used.

P2.2.6.6 Inductor Losses [%] (ID1465)

AFE: Not used.

Island and Micro Grid: This parameter defined voltage increase in percentage from Inductor size at nominal voltage at 100% active current.

- Supply Voltage: 400 Vac
- Inductor Size: 15.0 %
- Inductor losses: 15.,0 %
- Reactive Current: 30.0%
- Active Current: 50.0 %

$400\ Vac * 50{,}0\ \% *\ 15{,}0\ \% *\ 15{,}0\ \% = 4{,}5\ Vac$. Increase of voltage from active current.

Voltage drooping will decrease the final voltage if it is used.

Together with inductor size and inductor losses voltage will be increased

18 Vac + 4,5 Vac = 22,5 Vac from Supply Voltage parameter -> 422,5 Vac.

2.2.6.7 Voltage Down (DigIn) ID1551

Select a digital input to decrease the supply voltage with a set ramp rate.

2.2.6.8 Voltage Up (DigIn) ID1550

Select a digital input to increase the supply voltage with a set ramp rate.

2.2.6.9 Voltage Adjust Rate ID1555

Defines the rate that is used to change the base voltage when Up and Down inputs are used.

2.2.6.10 Voltage Maximum Adjust ID1639

The maximum adjustment to the voltage when controlling reactive power.

2.2.6.11 Start Voltage Mode ID1641

This parameter select how internal voltage reference is used in Micro Grid mode. Change that this function can do to Field Weakening Point voltage is limited by ID1880 and ID1881, Supply Voltage warning limits.

0 = Start Zero Reactive Power OPT-D7

The option board D7 is used to monitor the grid voltage and uses this as a starting point for reactive power drooping control.

1 = Drooping

The drive does not control the power to zero but goes directly to the drooping control with set parameters.

3 = Keep Reactive Reference

The drive will follow the line voltage exactly while reactive reference is zero, so the voltage change will not change the reactive power of the Micro Grid application. In this mode, reactive power is controlled by the reactive current reference assuming drive is not single power source for the grid.

2.2.6.12 Reset Zero Q Delay ID1642

This parameter defines delay when Zero Reactive Power is reset, returning internal voltage compensation back to zero. Setting this value to zero will keep function active.

P2.2.6.13 Capacitor Size 2nd ID2330

Capacitor size can be adjusted based on voltage level. Set here the capacitor size at voltage level defined by ID2331

P2.2.6.14 Capacitor Size 2nd Voltage ID2331

Set here the voltage level where Capacitor Size 2nd is used ID2330

5.3 RAMP CONTROL

P2.3.1 Ramp Time ID103

This parameter defines the time required for the frequency to increase and decrease between zero frequency and P2.3.2 Ramp Range.

P2.3.2 Ramp Range ID232

This parameter defines the frequency range where the ramp time is related. Starting from zero frequency.

5.4 INPUT SIGNALS

5.4.1 BASIC SETTINGS

P2.4.1.1 Start/Stop Logic Selection ID300 Start/Stop Logic

This parameter defines the start/stop logic when using I/O control.

0 **Start – No Act – Start Drive – No Action**

Start 1: closed contact = start command DI "Start 1"

1 **StartP-StopP – Start Pulse – Stop Pulse**

3-wire connection (pulse control):

DIN1: closed contact = start pulse

DIN2: open contact = stop pulse, falling edge.

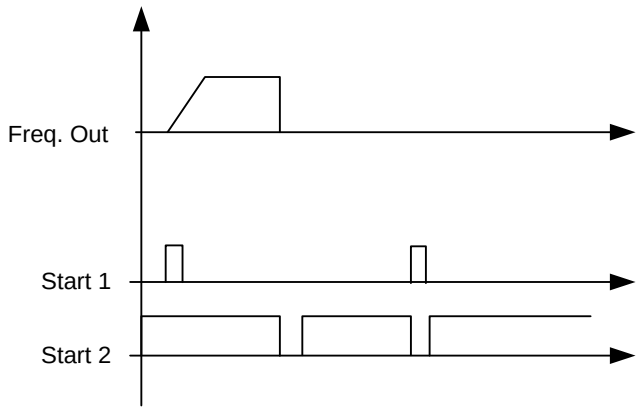


Figure 17. Start pulse/ Stop pulse.

The selections including the text *Rising edge required to start* is be used to exclude the possibility of an unintentional start when, for example, power is connected, re-connected after a power failure, after a fault reset, after the drive is stopped by Run Enable (Run Enable = False) or when the control place is changed. The Start/Stop contact must be opened before the motor can be started.

2 **RPuls – RPuls – Rising pulse start – Rising pulse stop**

Start 1: closed contact = Start command DI "Start 1"

Start 2: closed contact = Stop command DI "Start 1"

2.4.1.2 Input Inversion ID1091

Bit selection to invert input signal logic.

B00 = INV Open Contactor

B01 = INV Ext. Fault 1

B02 = INV Ext. Fault 2

5.4.2 DIGITAL INPUT SIGNALS

2.4.2.1 Start Signal 1 ID403

Signal selection 1 for the start/stop logic. This parameter is used to select the input for Run Request signal

2.4.2.2 Start Signal 2 ID404

Signal selection 1 for the start/stop logic. This parameter is used to select the input for Stop Request signal.

2.4.2.3 Open MCB ID1600

This parameter is used to select the input for the Open Contactor signal. The signal is used to force the main circuit breaker open (MCB or MCB2) and to stop the modulating.

When this input is used to stop AFE and open a main circuit breaker, the DC link must be discharged and recharged to close the main circuit breaker again and to continue modulation.

If the Force Main circuit breaker Open signal is not used the option *0.1* = FALSE must be selected.

When the control is on the keypad, pressing the Stop button more than a 2 second opens the MCB.

2.4.2.4 MCB Feed Back ID1453

This parameter defines which digital input is used to the monitor circuit breaker status. The drive monitors the status and does not start if the state of the contactor does not correspond to the required status, that is, is open when it should be closed.

If the status of the main circuit breaker is not monitored, there will be a 3 s forced delay before drive starts.

2.4.2.5 Fault Reset ID414

Contact closed: all faults are reset. Rising edge.

2.4.2.6 Ext Fault 1 ID405

Contact closed: the fault is displayed and the motor stopped. Fault 51. Can be inverted by the input inversion control.

2.4.2.7 Ext Fault 2 ID406

Contact open: the fault is displayed and the motor stopped. Fault 51. Can be inverted by the input inversion control.

2.4.2.8 Run Enable ID407

When the signal is low, the drive will lose READY status.

Contact open: the start of drive disabled.

Contact closed: the start of drive enabled.

2.4.2.9 *Synchronisation ID1602*

This input is used to the synchronisation of the external network when the drive is already generating network but in a different phase. It can be used only when OPT-D7 board is installed and measurements are on the external network side.

When the input is activated, the drive uses line frequency as a frequency reference and adjusts the voltage angle to correspond with the line voltage angle with given hysteresis.

2.4.2.10 *Connect to Net ID1604*

A command to close NET (shore) contactor. The closing will take place only when the drive is synchronised to the grid (shore).

This function is needed when the drive is already making a grid and needs to be synchronised to another grid that cannot be synchronised to the grid that the drive is making.

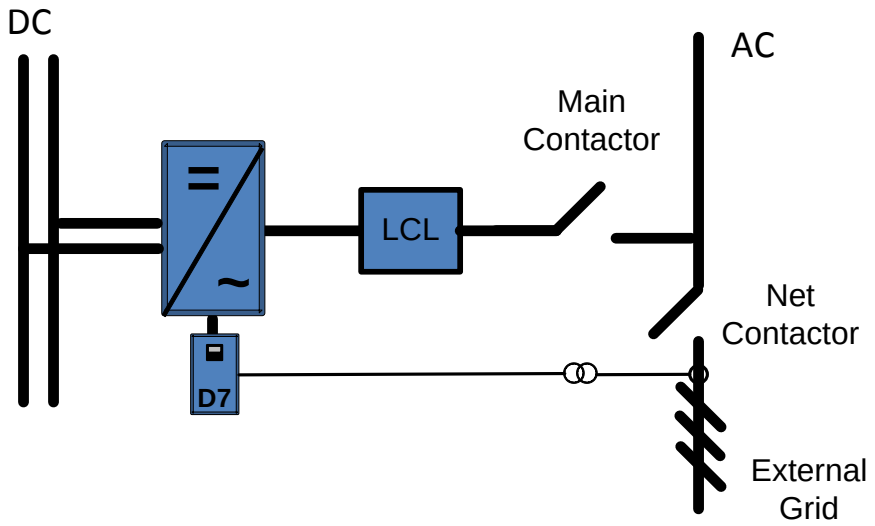


Figure 18.

2.4.2.11 *Forced AFE Mode ID1540*

Forces the drive control mode to 0 = AFE mode.

2.4.2.12 *NET Contactor ID1660*

This parameter determines if the drive monitors the status of the NET contactor (shore) of the unit. The drive will switch from Island mode to Micro Grid mode if the control mode 4 / Island – Micro Grid is used.

If the status of the NET contactor is not monitored in the system, the option *0.1* = FALSE must be selected.

2.4.2.13 *Cooling Monitor ID750*

OK input from the cooling unit.

If the status is not monitored in the system, the option *0.2* = TRUE must be selected.

2.4.2.14 Grid Close Enabled ID1705

An interlock for the NET contactor (shore).

If the interlock is not used in the system, the option *0.1* = FALSE must be selected.

2.4.2.15 Use MCB 2 Control ID1708

This parameter is useful if 2 different supply networks are used. With this input, it is possible to select which one is used.

When the input is HIGH, MCB 1 is opened immediately.

2.4.2.16 MCB 2 Feedback ID1710

This parameter determines if the drive monitors the status of the main circuit breaker (MCB 2) of the unit. If the monitoring function is used, the unit monitors the status and will not start if the state of the contactor does not correspond to the required status, that is, is open when it should be closed.

If the status of the main circuit breaker 2 is not monitored in the system, the option *0.1* = FALSE must be selected.

2.4.2.17 AFE Mode 2 ID1711

Forces mode to P2.11.8 (MODE2). Only active when P2.1.1 is in 6/Free select.

2.4.2.18 AFE Mode 3 ID1712

When both 2.4.2.17 and 2.4.2.17 are true then P2.11.9 (Mode3) is selected. When 2.4.2.17 LOW and 2.4.2.17 HIGH, the AFE mode 1 selected. Only active when P2.11.1 is in 6/Free select.

2.4.2.19 Quick Stop ID1213

The drive stops the modulation immediately and opens the main circuit breaker.

2.4.2.20 LCL Temperature ID1179

The digital input from the LCL temperature monitoring.

2.4.2.21 Synch to SG Grid

Activates the synchronisation to the shaft generator side. This option is available only if back to back AFE system is used with the system bus.

2.4.2.22 RR Enable

Enables the final run request command. Used for testing purposes when precharge control is started directly from the start command and when you do not want the system to go the RUN state.

5.4.2.1 Forced control place

The digital inputs can be used to bypass parameter P3.1 Control Place, for example, in an emergency situation when PLC is not able to send command to the drive.

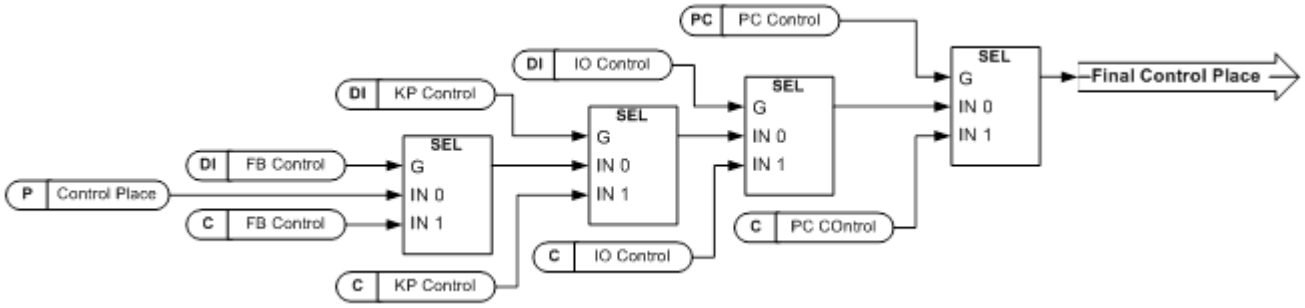


Figure 19. Control place selection priority order

P2.4.2.23 Control from I/O terminal ID409 "I/O Term Control"

Contact closed: force the control place to I/O terminal.

P2.4.2.24 Control from Keypad ID410 "Keypad Control"

Contact closed: force the control place to keypad.

P2.4.2.25 Control from Fieldbus ID411 "Keypad Control"

Contact closed: force the control place to fieldbus.

NOTE! When the control place is forced to change, the values of Start/Stop, Direction and Reference that are valid in the control place in question are used. The value of parameter ID125 (Keypad Control Place) does not change. When the input opens, the control place is selected according to keypad control parameter P3.1 Control Place.

P2.4.2.26 Enable CB Close ID1619 "Enable CB Close"

This input enables CB closing when the DC voltage is at a required level. It can be used on a battery system where drive DC is charged but it is not necessary for CB to close at this point. When the input goes high and DC is at required level, CB will close immediately.

5.4.3 ANALOGUE INPUTS 1-4

2.4.3.1 AI1 signal selection ID377 "AI1 Signal Sel"

2.4.4.1 AI2 signal selection ID388 "AI2 Signal Sel"

2.4.5.1 AI3 signal selection ID141 "AI3 Signal Sel"

2.4.6.1 AI4 signal selection ID152 "AI4 Signal Sel"

Connect the AI3/AI4 signal to the analogue input of your choice with this parameter.

When the analogue input selection parameter is set to *0.1*, you can control the analogue input monitoring variable from fieldbus by assigning a process data input ID number to the monitoring signal. This allows the scaling function on the drive side to PLC input signals.

2.4.3.2 Analogue input 1 signal filtering time ID324 "AI1 Filter Time"

2.4.4.2 Analogue input 2 signal filtering time ID329 "AI2 Filter Time"

2.4.5.2 Analogue input 3 signal filtering time ID142 "AI3 Filter Time"

2.4.6.2 Analogue input 4 signal filtering time ID153 "AI3 Filter Time"

First order filtering is used for the analogue input signals 3 and 4.

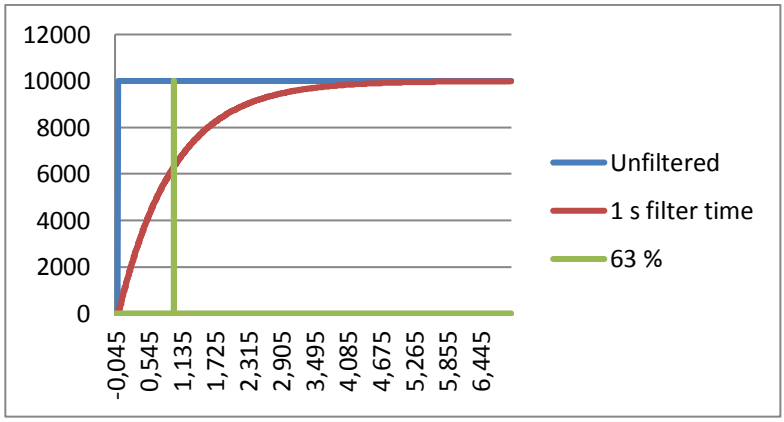


Figure 20.

2.4.3.3 AI1 custom setting minimum ID321 "AI1 Custom Min"
2.4.3.4 AI1 custom setting maximum ID322 "AI1 Custom Max"

2.4.4.3 AI2 custom setting minimum ID326 "AI2 Custom Min"
2.4.4.4 AI2 custom setting maximum ID327 "AI2 Custom Max"

2.4.5.3 AI3 custom setting minimum ID144 "AI3 Custom Min"
2.4.5.4 AI3 custom setting maximum ID145 "AI3 Custom Max"

2.4.6.3 AI4 custom setting minimum ID155 "AI4 Custom Min"
2.4.6.4 AI4 custom setting maximum ID156 "AI4 Custom Max"

Set the custom minimum and maximum input level for the AI3 signal within -160...160%.

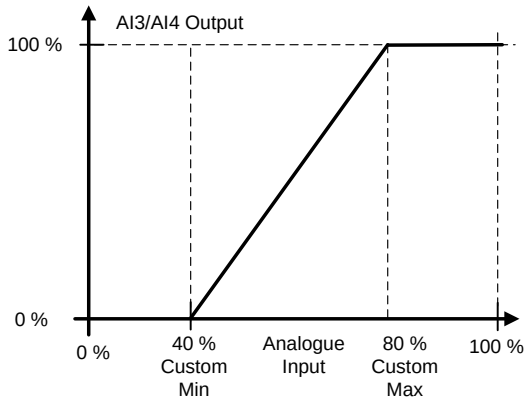


Figure 21.

2.4.3.5 AI1 signal inversion ID387 "AI1 Signal Inv"

2.4.4.5 AI2 signal inversion ID398 "AI2 Signal Inv"

2.4.5.5 AI3 signal inversion ID151 "AI3 Signal Inv"

2.4.6.5 AI4 signal inversion ID162 "AI3 Signal Inv"

The signal inversion function is useful for example in a situation where PLC sends power limit to the drive by using analogue inputs. If PLC is unable to communicate to the drive, the power limit is normally zero. When an inverted signal logic is used, a zero value from PLC means maximum power limit. This allows you to run the drive, for example, from the keypad without changing the power limit parameters.

0 = No inversion

1 = Signal inverted

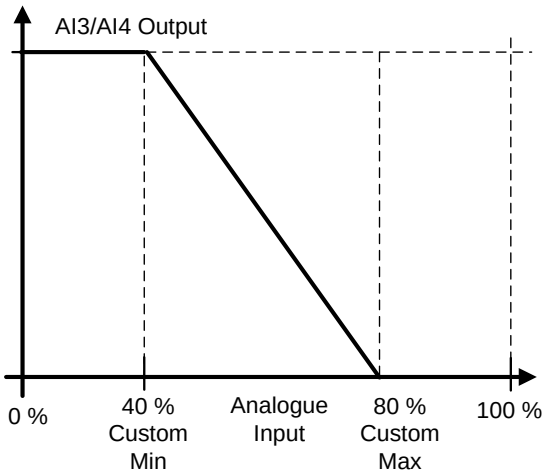


Figure 22.

5.4.3.1 Analogue input to any parameter

This function allows you to control any parameter by using an analogue input. Use a parameter to select the range of the control area and the ID number for the parameter that is controlled.

2.4.3.6	*Analogue input 1, minimum value*	*ID303 "AI1 Scale Min"*
2.4.3.7	*Analogue input 1, maximum value*	*ID304 "AI1 Scale Max"*
2.4.4.6	*Analogue input 2, minimum value*	*ID393 "AI2 Scale Min"*
2.4.4.7	*Analogue input 2, maximum value*	*ID394 "AI2 Scale Max"*
2.4.5.6	*Analogue input 3, minimum value*	*ID1037 "AI3 Scale Min"*
2.4.5.7	*Analogue input 3, maximum value*	*ID1038 "AI3 Scale Max"*
2.4.6.6	*Analogue input 4, minimum value*	*ID1039 "AI4 Scale Min"*
2.4.6.7	*Analogue input 4, maximum value*	*ID1040 "AI4 Scale Max"*

These parameters define the range for the controlled parameter. All the values are considered to be integers, so when you are controlling FWP as in the example, you also need to set numbers for the decimals. For example, FWP 100.00 must be set as *10000*.

2.4.3.8	*AI1 Controlled ID*	*ID1507*	*"AI1 Control. ID"*
2.4.4.8	*AI2 Controlled ID*	*ID1511*	*"AI2 Control. ID"*
2.4.5.8	*AI3 Controlled ID*	*ID1509*	*"AI3 Control. ID"*
2.4.6.8	*AI4 Controlled ID*	*ID1510*	*"AI4 Control. ID"*

These parameters define which parameter is controlled.

Example:

You want to control Motor Field Weakening Point Voltage by an analogue input from 70.00% to 130.00%.

Set Scale min to 7000 = 70.00%.

Set Scale max to 13000 = 130.00%.

Set Controlled ID to 603 Voltage at field weakening point.

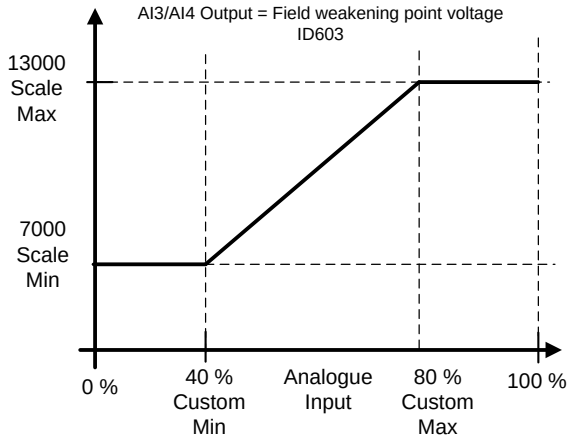


Figure 23.

The analogue input 3 signal 0 V to 10 V (0 mA to 20 mA) will control the field weakening point voltage between 70.00% and 130.00%. When setting a value, decimals are handled as integers.

5.5 OUTPUT SIGNALS

5.5.1 DIGITAL OUTPUT SIGNALS

2.5.1.1 Main Circuit Breaker 1 Close Control ID1218 "MCB1 Close Cont"

AFE contactor, fixed to the relay output B.2.

When P2.5.1.2 is not activated, this output will stay high as long as MCB must be closed. When the signal goes low, MCB must be open.

When P2.5.1.2 is activated, this gives only a closing command with a 2 s pulse.

2.5.1.2 Main Circuit Breaker 1 Open Control ID1219 "MCB1 Open Cont"

When this output is selected above 0.9, the drive will use pulse control for the MCB breaker. P2.5.1.1 is used to close the breaker with a 2 s pulse.

The opening command is given by P2.5.1.2 with a 2 s pulse.

2.5.1.3 Ready ID432

The AC drive is ready to operate.

2.5.1.4 Run ID433

The AC drive operates (the drive is modulating).

2.5.1.5 Common Fault ID434

A fault trip has occurred.

2.5.1.6 Fault, Inverted

No fault trip has occurred.

2.5.1.7 At Reference

The output frequency has reached the set reference. In AFE mode, when DC voltage level is on setpoint.

2.5.1.8 Overtemperature Warning

The heatsink temperature exceeds unit temperature warning limit.

2.5.1.9 Warning

A general warning signal. The warning will go low when the reset command is given.

2.5.1.10 Circuit Breaker 2 Close Control ID1709 "CB2 Close Cont"

A second AFE contactor control. The drive can connect to two different networks. This will control the main circuit breaker of the second network.

2.5.1.11 NET Contactor Control

The NET contactor control. Contactor control for Grid where the drive will be synchronised. This grid is usually the shore supply. When P2.4.2.12 NET Contactor feedback is received, the drive will change the operation mode to AFE mode.

2.5.1.12 D7 Synchronized

The drive is synchronised to the D7 card. Information is sent, for example, to PLC that the drive is synchronised to an external network (where D7 is connected). This output cannot be used to control the NET contactor. There is a separate output signal for that purpose.

2.5.1.13 Charge control

When this is activated, the drive will start charging of DC from the start command and go directly to RUN state. The charging starts from the start command.

2.5.1.14 Common alarm

Drive has a warning active. This indication needs to be reset separately even if the situation is over.

2.5.1.15 Ready For Start

The drive has no interlock for starting the charging and going to RUN state.

2.5.1.16 Quick Stop Active

The drive has received a quick stop command.

5.5.1.1 Fieldbus digital inputs connection

P2.5.1.17 Fieldbus input data 1 ID455 "FB Dig Input 1"
P2.5.1.19 Fieldbus input data 2 ID456 "FB Dig Input 2"
P2.5.1.21 Fieldbus input data 3 ID457 "FB Dig Input 3"
P2.5.1.23 Fieldbus input data 4 ID169 "FB Dig Input 4"

The data from the fieldbus main control word can be led to the digital outputs of the drive. See the fieldbus board manual for the location of these bits.

P2.5.1.18 Fieldbus digital input 1 parameter ID891 "FB Dig 1 Par ID"
P2.5.1.20 Fieldbus digital input 2 parameter ID892 "FB Dig 2 Par ID"
P2.5.1.22 Fieldbus digital input 3 parameter ID893 "FB Dig 3 Par ID"
P2.5.1.24 Fieldbus digital input 4 parameter ID894 "FB Dig 4 Par ID"

With these parameters you can define the parameter to be controlled by using FB digital input.

Example:

All option board inputs are already in use, but you want to give a DI: DC Brake Command (ID416). You also have a fieldbus board in the drive.

Set parameter ID891 (Fieldbus Digital Input 1) to *416*. Now you are able to control DC braking command from the fieldbus by Profibus control word (bit 11).

It is possible to control any parameter in the same way if values 0 = FALSE and 1 = TRUE are significant for that parameter. For example, P2.6.5.3 Brake Chopper (ID504) can be switched on and off using this function (Brake Chopper: 0 = Not Used, 1 = On, Run).

5.5.2 DELAYED DIGITAL OUTPUT 1 & 2

2.5.2.1 Dig.Out 1 Signal

2.5.3.1 Dig.Out 2 Signal

Connect the delayed DO1 signal to the digital output of your choice with this parameter.

2.5.2.2 DO1 Content

2.5.3.2 DO2 Content

0 = Not used
1 = Ready
2 = Run
3 = Fault
4 = Fault inverted
5 = FC overheat warning
6 = Ext. fault or warning
7 = Ref. fault or warning
8 = Warning
9 = Reverse
10 = SynchronisedToD7
11 = Start Command given
12 = FB DIN2
13 = FB DIN3
14 = ID.Bit DO, See P2.4.x.5

2.5.2.3 DO1 ON Delay

2.5.3.3 DO2 ON Delay

2.5.2.4 DO1 OFF Delay

2.5.3.4 DO2 OFF Delay

With these parameters you can set the on and off delays to digital outputs.

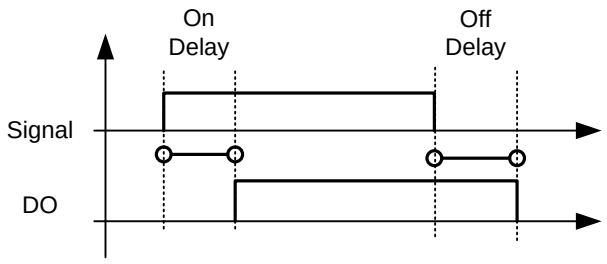


Figure 24. Digital outputs 1 and 2, on- and off-delays

2.5.2.5 ID.Bit Free DO

2.5.3.5 ID.Bit Free DO

Select the signal for controlling the DO. The parameter must be set in the format xxxx.yy where xxxx is the ID number of a signal and yy is the bit number. For example, the value for DO control is *1174.02*. 1174 is the ID number of Warning Word 1. So the digital output is ON when the bit number 02 of the warning word (ID no. 1174), that is, *Motor underload* is high.

5.5.3 ANALOGUE OUTPUT 1 & 2 & 3

2.5.4.1 Iout 1 signal

2.5.5.1 Iout 2 signal

2.5.6.1 Iout 3 signal

Connect the AO signal to the analogue output of your choice with this parameter.

2.5.4.2 Iout 1 Content

2.5.5.2 Iout 2 Content

2.5.6.2 Iout 3 Content

0 = Not used
1 = DC Voltage
Scaling: 500 Vac Unit 0-1000 Vac, 690 Vac Unit 0-1317 Vdc
2 = Drive Current
Scaled to Nominal Current
3 = Output Voltage
Scaled to Nominal Voltage
4 = Active Current
Scaled to 100 %.
5 = Power
Scaled to 100 %
6 = Reactive Current
Scaled to 100 %
7 = Power Bidirectional
Scaled to -200 % to 200 %
8 = AI1
9 = AI2
10 = FB Analogue Output
11 = LineVoltage
Scaled to Nominal Voltage.
12 = FreqOut, bidirectional
13 = Control Value output

2.5.4.3 Iout 1 Filter Time

2.5.5.3 Iout 2 Filter Time

2.5.6.3 Iout 3 Filter Time

Defines the filtering time of the analogue output signal. Setting this parameter value 0 will deactivate the filtering. First order filtering is used for the analogue output signals.

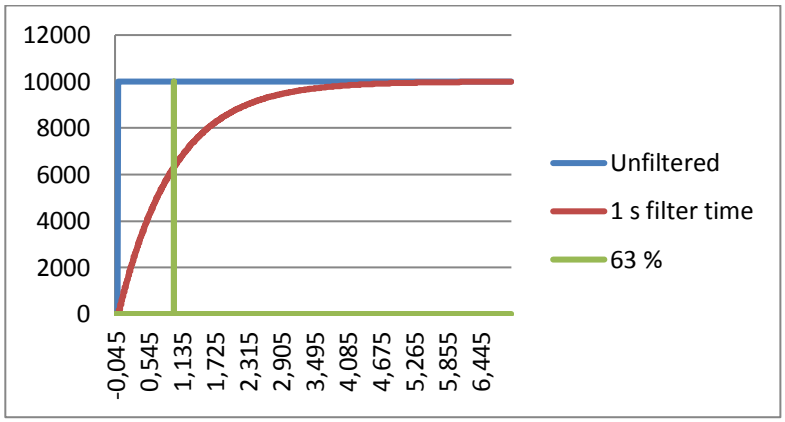


Figure 25.

2.5.4.4 Iout 1 Invert

2.5.5.4 Iout 2 Invert

2.5.6.4 Iout 3 Invert

Inverts the analogue output signal:

- Maximum output signal = Minimum set value.
- Minimum output signal = Maximum set value.

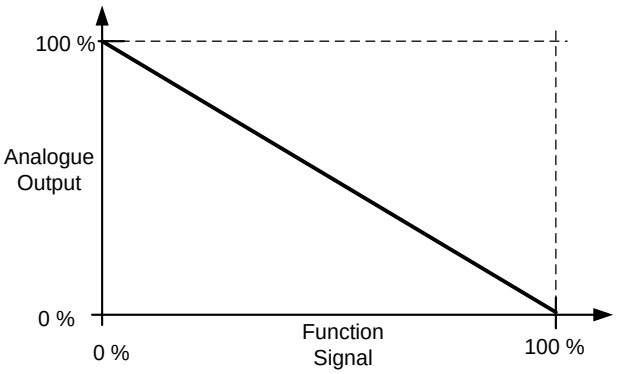


Figure 26.

2.5.4.5 Iout 1 Minimum

2.5.5.5 Iout 2 Minimum

2.5.6.5 Iout 3 Minimum

0 = Set minimum value to 0 mA (0%)

1 = Set minimum value to 4 mA (20%)

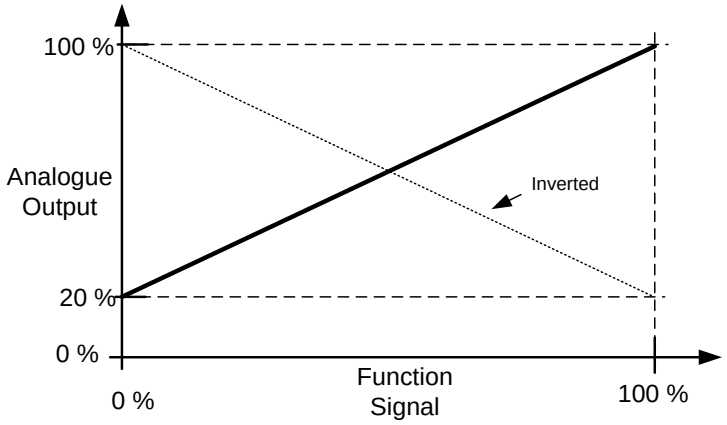


Figure 27.

2.5.4.6 Iout 1 Scale

2.5.5.6 Iout 3 Scale

2.5.6.6 Iout 4 Scale

A scaling factor for an analogue output.

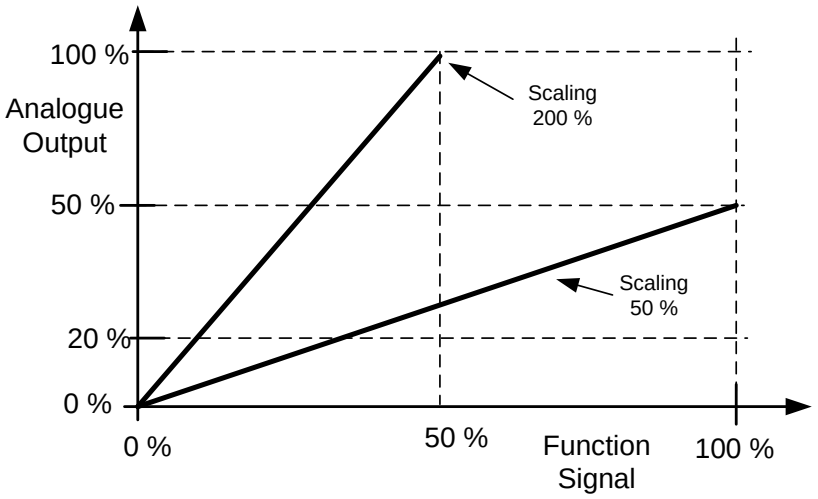


Figure 28.

2.5.4.7 Iout 1 Offset

2.5.5.7 Iout 2 Offset

2.5.6.7 Iout 3 Offset

Add –100.0 to 100.0% to the analogue output.

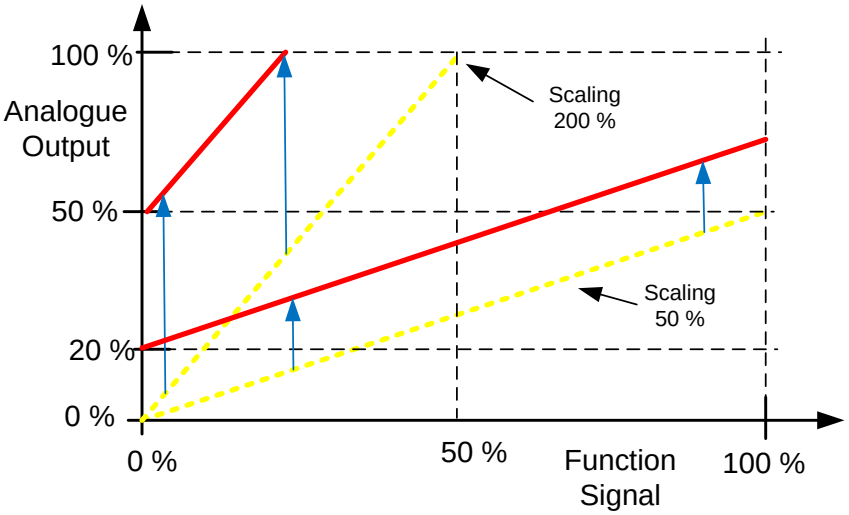


Figure 29.

5.5.4 OPTIONS

P2.5.7.1 Output Inversion ID1806

With this parameter it is possible to select which output signals are inverted.

B00 = +1 = Inver Common Alarm

B01 = +2 = Invert Common Warning

B02 = +4 = Invert delayed output 1

B03 = +8 = Invert delayed output 2

P2.5.7.2 Freq Scale Min AO ID1807

This parameter is used to scale the analogue output function **12** / FreqOut, bidirectional. This parameter defines the frequency where the analogue output is at the minimum. For example, when it is set to 45.00 Hz, the analogue output is 0 V, 0 mA, or 4 mA depending on signal selections.

P2.5.7.3 Freq Scale Max AO ID1808

This parameter is used to scale the analogue output function **12** / FreqOut, bidirectional. This parameter defines the frequency where the analogue output is at the maximum. For example, when it is set to 55.00 Hz, the analogue output is 10 V or 20 mA depending on signal selections.

P2.5.7.4 DC Supervision Limit ID1454

This parameter defines when FB Status Word B10 is high (ID68). The Bit is high when DC voltage is above the value set by this parameter.

P2.5.7.5 CB Close Mode

This parameter defines how the closing of circuit breaker is handled.

0 = DC Voltage

Normal AFE operation type circuit breaker control. The circuit breaker is closed when DC voltage is at a required level.

1 = DC Voltage or Start Command

The circuit breaker is closed when DC voltage is at the required level, or from a start command if DC is at a required level. This can be used when the breaker is opened, for example, by a stop command but DC remains high. It is useful when used in a battery system.

2 = Start Command

The circuit breaker is closed from a start command if DC is at a required level.

P2.5.7.6 MCB At Stop Command

The parameter defines the action for MCB when a stop command has been given.

0 = Keep closed

1 = Open CB when drive has stopped

P2.5.7.7 MCB close delay

The parameter defines the delay when RO2 is closed after the drive has determined that MCB can be closed.

5.6 LIMIT SETTINGS

5.6.1 CURRENT LIMITS

2.6.1.1 Current Limit

The parameter sets the current limit for the Grid Converter unit. Set the value to correspond to the maximum peak overload for the unit or if needed, to required short circuit current (I_{SCC}).

The maximum value for air cooled unit is I_s and liquid cooled unit I_{th}. For air cooled units I_s is available when short circuit functionality is activated. See available current values from "GTC Product compatibility note" column I_s.

The drive can operate against the current limit if P2.6.1.3 Short Circuit time has been set to zero, and P2.6.1.4 High Frequency Current limit has been enabled. Otherwise the drive will trip to a short circuit fault immediately, or after a set time delay.

NOTE! The internal protections of the drive can trip the drive before the time limit or the current level is reached.

NOTE! Set the current limit high enough so that limit is not reached in normal operation.

2.6.1.2 Short Circuit Level

This parameter defines the current level when the drive will start to feed reactive current to the short circuit, i.e. this is short circuit current detection level.

This is instantaneous value, related to P2.1.3 System Rated Current. ($P2.1.3 * \sqrt{2}$)

This value should be above the set current limit of the drive but below the (F1) over current trip limit (3,2-4 * I_h, depending on unit).

The recommendation is to set Short Circuit Level about 25 % higher than the value of the current limit. This will eliminate short circuit operation while already operating against current limit due current spikes that goes to short circuit detection level.

Example LC AFE unit 730 A 500 Vac :

System Rated Current (I_{SRC}): 487 A (I_h)

Current Limit (I_{SCC}) : 730 A (I_{th})

Short Circuit Detection Level (I_{SCD}) : $\frac{730\ A}{487\ A} * \sqrt{2} * 1{,}25 = 256\ \%$

In this case Short Circuit Level 212% would be equal to Current Limit in rms. The recommended value for the Short Circuit Level in the case above is 265 %. The function will be disabled if a value above 499% is given. If it is possible, adjust System Rated current to have values below 499%.

NOTE! The function requires a uGrid Licence (P3.2 uGrid Licence)

NOTE! During the short circuit grid voltage will be low; it may require that UPS is used for auxiliary voltage that MCB is kept closed during short circuit.

Example Air Cooled AFE unit 460 A 500 Vac :

System Rated Current (I_{SRC}): 385 A (I_h)

Current Limit (I_{SCC}): 693 A (I_s)

Short Circuit Detection Level (I_{SCD}) : $\frac{693\ A}{385\ A} \times \sqrt{2} \times 1.25 = 319\ \%$

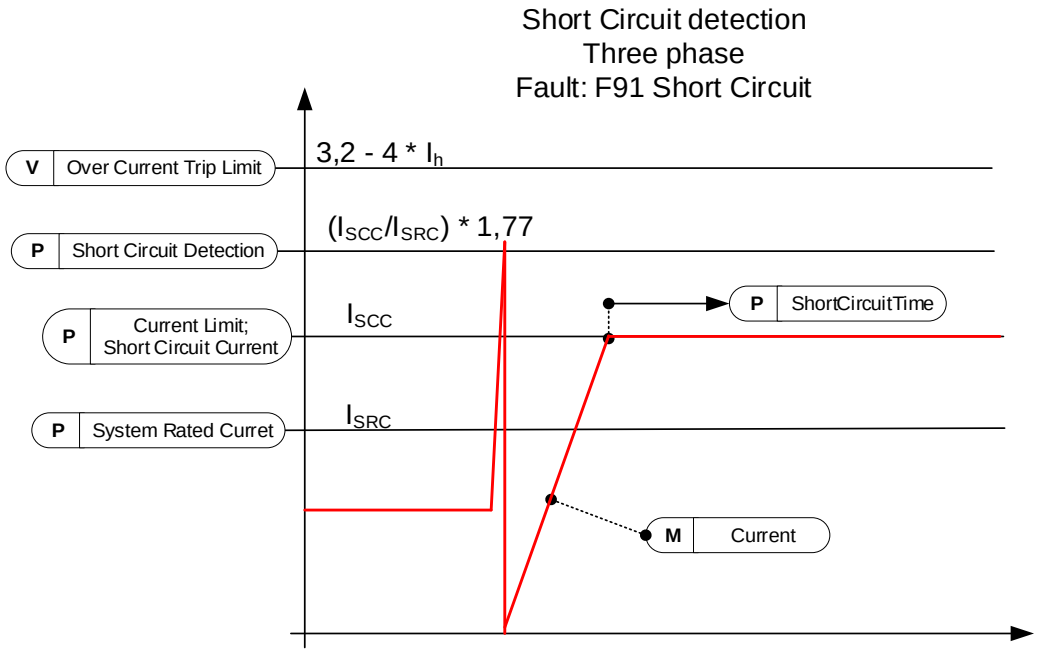


Figure 30.

2.6.1.3 Short Circuit Time

The maximum time that the drive can operate against the current limit.

NOTE! The function requires a uGrid Licence (P3.2 uGrid Licence)

2.6.1.4 High Frequency Current Limit

In normal motoring drives I_s is for starting current. In Grid Converter case I_s must be enabled separately for short circuit current if current levels above I_h 50 % over load currents are needed for air cooled units. Liquid cooled units I_{th} is always the maximum limit.

The parameter can be disabled when a licence key has been given and the drive is connected to DC (INU unit). If connected to AC grid (FC unit), this parameter must be kept at 0 / Enable.

NOTE! The function requires a uGrid Licence (P3.2 uGrid Licence)

2.6.1.5 *BiPhase Fault Voltage Level.*

The BiPhase fault is detected by monitoring the supply voltage. Set this value lower than the supply voltage would be in normal operation.

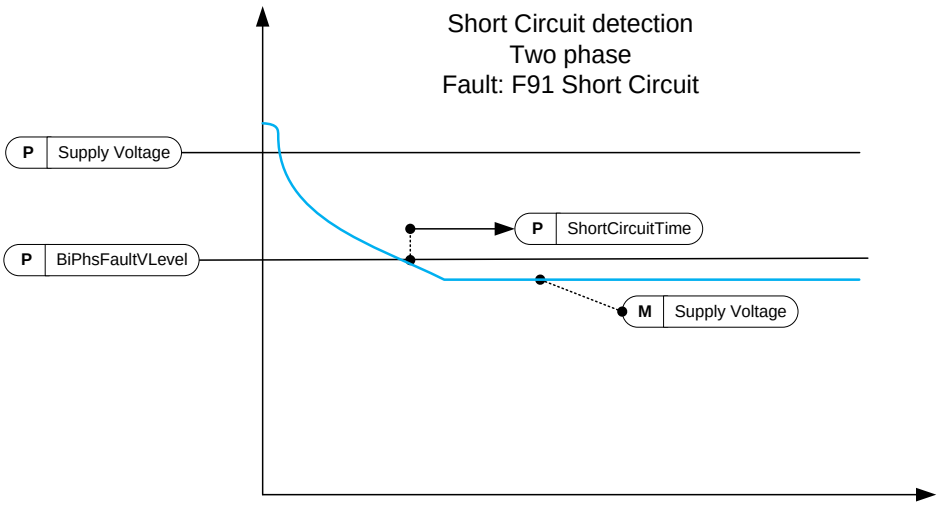


Figure 31.

P2.6.1.6 *Output Active Current Limit [%] ID1290 "OutputActCurLim"*

This parameter sets the active current limit for the generator side operation of the regenerative unit. 100.0% is equal to nominal current. Generator Side operations is when power flows from DC side to AC side. Setting too low value may lead to over voltage fault even on situation when power is not mend to regenerate to grid side.

P2.6.1.7 *Input Active Current Limit [%] ID1289 "InputActCurrLim"*

This parameter sets the active current limit for the motor side operation of the regenerative unit. 100.0% is equal to nominal current. Motoring Side operations is when power flows from AC side to DC side.

5.6.2 POWER LIMITS

2.6.2.1 Output Power Limit ID1288

This parameter sets the power limit for the generator side operation of the regenerative unit. 100.0% is equal to nominal current at nominal voltage. Generator Side operations is when power flows from DC side to AC side. Setting too low value may lead to over voltage fault even on situation when power is not mend to regenerate to grid side.

2.6.2.2 Input Power Limit ID1287

This parameter sets the power limit for the motor side operation of the regenerative unit. 100.0% is equal to nominal current at nominal voltage. Motoring Side operations is when power flows from AC side to DC side.

2.6.2.3 Power Limit Increase Rate ID1502 "Limit.Inc.Rate"

This parameter defines the limit increase rate. The limit will start to decrease immediately.

P2.6.2.4 High Frequency Power Limit Function ID1703

This parameter provides a high frequency power limit function for AFE. When the frequency exceeds this value, power is limited with 1 Hz slope. The value 0 = Not in use.

P2.6.2.5 Stop Power Ramp Rate ID1812

Defines ramp rate for power when stopping. Ramping disabled when negative value selected.

5.6.3 FREQUENCY LIMITS

NOTE: This functionality is not Grid Code functionality even if functionality may be similar.

2.6.3.1 Line Low Frequency Trip Limit

If the drive output frequency goes below this level, the drive will trip to a line synch fault.

Use this limit as a final and immediate protection function for the grid or generator. In the protection group there are protection functions that will use OPT-D7 information.

The common tripping limit of the land based grid code standard is 47.5 Hz within 200 ms.

2.6.3.2 Line High Frequency Trip Limit

If the drive output frequency goes above this level, the drive will trip to a line synch fault.

Use this limit as a final and immediate protection function for the grid or generator. In the protection group there are protection functions that will use OPT-D7 information.

The common tripping limit of the land based grid code standard is 50.2-51.5 Hz within 200 ms.

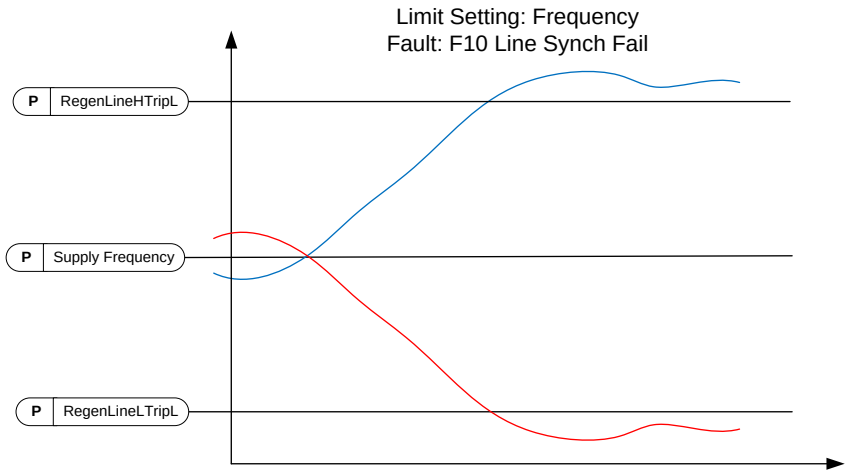


Figure 32.

5.6.4 MICRO GRID LIMITS

2.6.4.1 Current Limit Minimum

An active current limit from AC to DC direction. This limit affects the Island and uGrid operation modes but not the AFE operation mode.

2.6.4.2 Current Limit Maximum

An active current limit from DC to AC direction. This limit affects the Island and uGrid operation modes but not the AFE operation mode.

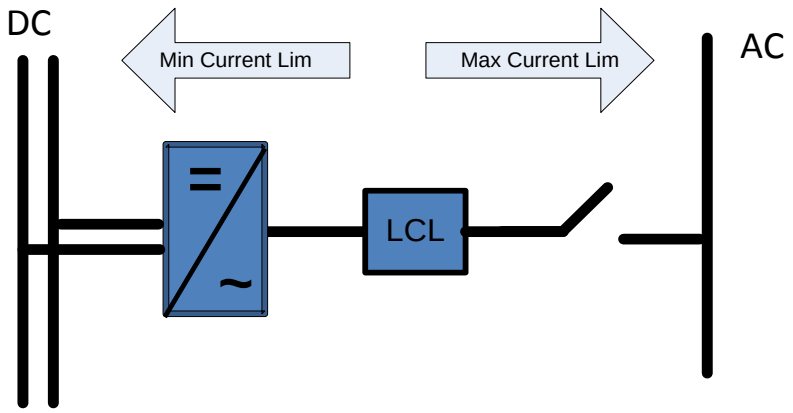


Figure 33.

2.6.4.3 Maximum Limit Increase Rate

This parameter defines the increase rate for the current limit from DC to AC direction.

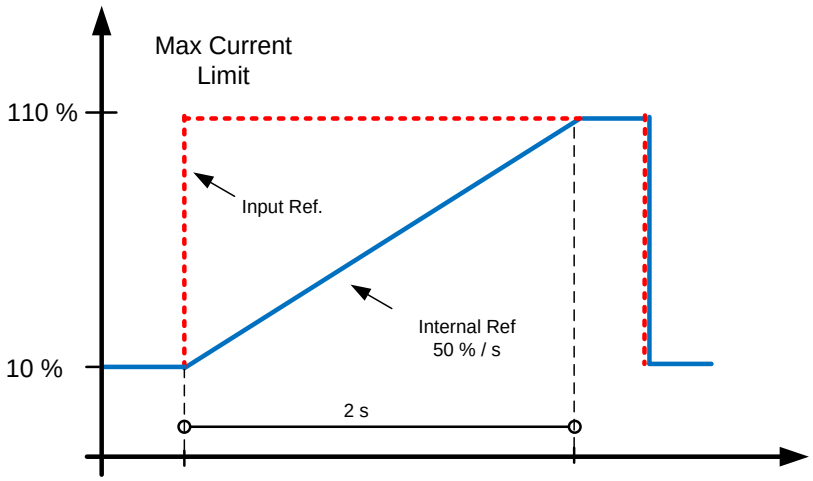


Figure 34.

2.6.4.4 Current Limit Kp

The gain for the current limit operation.

2.6.4.5 Current Limit Ti

The integration time for the current limit operation.

2.6.4.6 Current Limit Max Minimum

This parameter defines the minimum limit for the maximum current limit.

Use this function to limit minimum when PLC control value to zero. The value zero will cause instability in the control. Depending on the system, the value is usually between 1% and 5%.

2.6.4.7 Current limit to Zero Mode

Defines how the maximum current limit is handled in the STOP state.

In a starting situation, the current can increase above the reference when the grid frequency is below the base frequency. This function will decrease the starting current in starting situations.

0 = Current limit is kept at parameter level in STOP state.

1 = Current limit is set to minimum level in STOP state.

5.6.5 DC VOLTAGE REGULATORS

P2.6.5.1 Under Voltage Limit ID1524

This parameter provides the under voltage regulator limit for Island and Micro Grid operation. A percentage value related to the nominal AC voltage of the drive.

$$DC\ Under\ Voltage\ Limit = Unit\ Nom\ AC\ Voltage * 1{,}35 * Under\ Voltage\ Limit$$

500 Vac unit: $439\ Vdc = 500\ Vac * 1{,}35 * 65{,}00\ \%$

690 Vac unit: $605\ Vdc = 690\ Vac * 1{,}35 * 65{,}00\ \%$

P2.6.5.2 Over Voltage limit ID1523

This parameter provides the over voltage regulator limit for Island and Micro Grid operation. A percentage value related to the nominal AC voltage of the drive.

$$DC\ Under\ Voltage\ Limit = Unit\ Nom\ AC\ Voltage * 1{,}35 * Over\ Voltage\ Limit$$

500 Vac unit:$810\ Vdc = 500\ Vac * 1{,}35 * 120{,}00\ \%$

690 Vac unit:$1117\ Vdc = 690\ Vac * 1{,}35 * 120{,}00\ \%$

5.7 DRIVE CONTROL

2.7.1 Switching Frequency

The switching frequency of the IGBT Bridge in kHz. Changing the default value can have an impact on the LCL filter operation.

2.7.2 AFE Options 1

This packed bit word is made for enabling/disabling different control options for the regeneration control.

B0 = Disable DCV reduction with a reactive reference generation with high line voltage.

B1 = Disable LCL reactive power compensation.

B5 = Disable all harmonic elimination compensation.

This is active by default. When activated, this function will reduce little 5^{th} and 7^{th} harmonics. This will not reduce harmonics of the grid, only the harmonics of the drive.

B8 = Enable double pulse synchronisation.

This option will generate two synchronisation pulses instead of one. It can help the synchronisation on a weak grid.

B9 = Enable soft synchronisation (>= FI9).

This function enables zero crossing detection on drives that are FI9 or bigger. When this is active and there is a connection to the grid when the drive is in the STOP state, Supply Frequency is updated by the detected frequency.

B12 = Enable floating DC reference. DC-link voltage will follow the line voltage.

When the drive is in the RUN state, it can detect the Supply Voltage. If the supply voltage changes, also the internal DC Reference is changed so that DC voltage is:

$$DC\ Voltage = \ Estimated\ Supply\ Voltage * 1{,}35 * DC\ Reference$$

B13 = Enable use of D7 board for start synchronisation.

When an OPT-D7 board is installed, this bit will activate the synchronisation by using a voltage angle and frequency information from the D7 board. The phase order must be same in both the OPT-D7 and input phases. It is also necessary to keep the frequency on the positive side. The frequency of the D7 board can be the same as a Supply Frequency but the phase order can be still wrong.

2.7.3 AFE Options 2

This packed bit word is made for enabling/disabling different control options for the regeneration control.

2.7.4 AFE Options 3

This packed bit word is made for enabling/disabling different control options for the regeneration control.

2.7.5 *Start Delay*

This parameter defines a starting delay when a run command is given. When programming different delays to parallel units, the units will start in sequence. This is necessary in parallel units to make sure that the synchronisation does not happen simultaneously in all the drives. A simultaneous start can lead to a failed synchronisation. The recommended value between the drives is 500 ms.

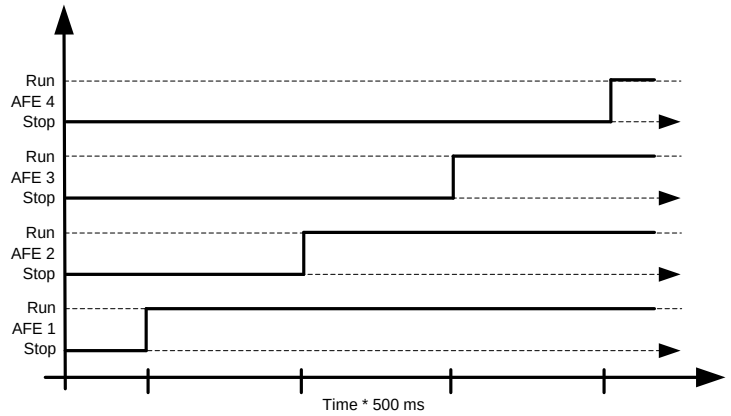


Figure 35.

2.7.6 *Modulator Type (ID1516)*

With this parameter you can change the modulator type. With an ASIC (HW) modulator, the current distortion is lower, but losses are higher compared to a software modulator. It is recommended to use Software modulator 1 as a default option.

0 = Hardware modulator: an ASIC modulator, with a classical third harmonic injection. The spectrum is slightly better compared to Software 1 modulator.

1 = Software modulator 1: A symmetric vector modulator with symmetrical zero vectors. The current distortion is smaller than with Software modulator 2 if boosting is used.

2 = Software modulator 2: A symmetric BusClamb, in which one switch always conducts 60 degrees either to a negative or a positive DC-rail. Switching losses are reduced without different heating of upper and lower switches. The spectrum is narrow. Not recommended for parallel units.

3 = Software modulator 3: An unsymmetric BusClamb, in which one switch always conducts 120 degrees to a negative DC-rail to reduce switching losses. The upper and lower switches are unevenly loaded and the spectrum is wide. Not recommended for parallel units.

4 = Software modulator 4: A pure sine wave, sinusoidal modulator without harmonic injection. It is dedicated to be used, for example, in back-to-back test benches to avoid a circulating third harmonic current. The required DC voltage is 15% higher compared to other modulator types.

2.7.7 Control Options 1 ID1707

B03 = +8 = Disable D7 frequency monitoring for diagnostic. Used for testing purposes.

B04 = +16 = Disable D7 voltage monitoring for diagnostic. Used for testing purposes.

B05 = +32 = Keep frequency drooping while synchronising to external grid.

B06 = +64 = Enable external grid contactor closing in STOP state.

B07 = +128 = Enable changing (temporally) MCB Control output. Used to disable MCB close for testing purposes.

B08 = +256 = Disable floating DC reference, Island and Micro Grid modes will follow actual DC.

B10 = +1024= Bypass normal DC-Link voltage reference level for 500 Vac unit.

B11 = +2048= Enable drive stop when OPT-D7 voltage is below P2.9.6.2 VoltLowWarnLim
This function is used to keep AFE-INU system operational during short circuit on grid side given that inertia of INU side will keep DC high enough for long enough.

B12 = +4096= Reserved.

B13 = +8192= Use angle information of the drive for SG synchronisation.

2.7.8 Control Options 2

B00 = +1 = Reserved.

B02 = +4 = OPT-D7 simulation. When OPT-D7 board is not used, it is possible to use Analogue Input 3 and 4 ID write function to give the grid the Line Frequency D7 (ID1654) and Line Voltage D7 (ID1650). This enables use of grid protection functions without OPT-D7 board. Note that both line frequency and line voltages needs to be given.

B04+ B05 = +48 = DCV-ripple compensation

2.7.9 Operation Time ID1855

This parameter stores the operation time. When the application is reloaded, operation hours will go to zero if this parameter is not updated.

The unit of the monitoring signal is h with two decimals.

Parameter is in this format:

XX (Years) XX (Months) XX (Days) XX (Hours) XX Minutes

1211292359 -> 12 years, 11 months, 29 days, 23 hours and 59 minutes.

5.7.1 AFE CONTROL

P2.7.10.1 Dynamic Support Kp ID1797

P2.7.10.2 Synch Kp ID1457

This parameter sets the gain of the synchronisation controller used to synchronise the switching to the supply.

P2.7.10.3 Synch Ti ID1458

This parameter sets the time constant of the controller used to synchronise the switching to the supply (15 equals 7ms).

P2.7.10.4 Active Current Kp ID1455

This parameter sets the gain of the controller for the active current of the regenerative unit.

P2.7.10.5 Active Currnt Ti ID1456

This parameter sets the time constant of the controller for the active current of the regenerative unit (15 equals 1.5ms).

P2.7.10.6 Synch. Kp Start ID1300

P2.7.10.7 Voltage Control Kp ID1451

This parameter sets the gain for the DC link PI voltage controller.

P2.7.10.8 Voltage Control Ti ID1452

This parameter sets the time constant in ms of the DC link PI controller.

5.7.2 IDENTIFICATION

P2.7.11.1 IU Offset ID668

Identified U phase current measurement offset, identified during identification run.

P2.7.11.2 IV Offset ID669

Identified U phase current measurement offset, identified during identification run.

P2.7.11.3 IW Offset ID670

Identified W phase current measurement offset, identified during identification run.

5.7.3 DC-LINK COMPENSATION

P2.7.12.1 DC Ripple Compensation Kp ID1897

Gain for DC-Link ripple compensation.

P2.7.12.2 DC Ripple Compensation Phase ID1898

Phase for DC-Ripple compensation.

P2.7.12.3 DC Ripple Compensation Frequency ID1899

Frequency for DC-Link ripple compensation.

5.8 PROTECTIONS

5.8.1 GENERAL SETTINGS

2.9.1.1 Thermistor Fault Response

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to ID506
3 = Fault, stop mode after fault always by coasting

Setting the parameter to *0* will deactivate the protection.

2.9.1.2 OverTemp Response

2= Fault
3= Fault, Open MCB
4= Fault, Open NET CB
5 = Fault, Open Main & NET CB

2.9.1.3 Overvoltage Response

2= Fault
3= Fault, Open MAIN CB
4= Fault, Open NET CB
5 = Fault, Open Main & NET CB

2.9.1.4 CoolingFlt.Delay

Protection for liquid-cooled units. An external sensor is connected to the drive (DI: Cooling Monitor) to indicate if cooling liquid is circulating. If the drive is in STOP state this is only a warning. In RUN state, the drive will issue a fault with a coast stop. This parameter defines the delay after which the drive goes to FAULT state when *Cooling OK* signal is missing.

2.9.1.5 LCL Temperature input monitor

This parameter defines a response to the input filter overtemperature fault. The fault is monitored through a digital input.

2.9.1.6 Max Charge Time

When the drive charging options are used, this parameter defines the maximum time limit for charging.

2.9.1.7 MCB at Fault

Defines action for the main circuit breaker when the drive has a fault.

F1 Over Current, F31 Hardware IGBT and F41 Software IGBT will open MCB immediately regardless of the setting of this parameter.

0 = Keep closed

1 = Open at any fault situation

2.9.1.8 Start Fault Delay

When using the master-follower system for example for a shaft generator, this parameter defines the fault delay if both drives are not started.

P2.9.1.9 Quick Stop Response ID1758

This function will stop the drive at any case. This parameter is used to select which action is shown on keypad.

1 = Warning
2 = Fault

P2.9.1.10 Reactive Error Trip Limit ID1759

Limit for the reactive current for the line fault detection, when the reactive current is less than the value of parameter Line Synch fault.

P2.9.1.11 MCB Fault Delay ID1521

The delay for the main circuit breaker open fault. The delay between the control relay close command of the main circuit breaker and the acknowledge signal of the main circuit breaker. If the acknowledge signal is not received within this time, a fault F64 will be generated.

P2.9.1.12 Line Phase Supervision ID702

Defines the response when the drive notices that one of the input phases is missing.

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to Stop Function
3 = Fault, stop mode after fault always by coasting

P2.9.1.13 Response to the 4mA reference fault ID700

The 4 mA protection monitors the analogue input signal level from Analogue Input 1 and Analogue Input 2. The monitoring function is active when the signal Custom Minimum is bigger than 16.00%. A fault or warning is generated when the signal goes below 3.5 mA for 5 seconds or below 0.5 mA for 0.5 seconds.

0 = No response
1 = Warning
2 = Fault

P2.9.1.14 Reactive Current Limit Response ID1981

This function can be used to generate a fault or a warning when the reactive current exceeds 110% value.

0 = No response
1 = Warning
2 = Fault

5.8.2 PT-100

The PT100 protection function is used to measure the temperature and give a warning and/or a fault when the set limits are exceeded. The marine application supports two PT100 boards. One can be used for the motor winding and the other for the motor bearings.

2.9.2.1 Number of PT100 inputs in use ID739 "PT100 Numbers"

If you have a PT100 input board installed in your AC drive, you can select the number of PT100 inputs in use. See also the Vacon I/O boards manual.

0 = Not used (ID Write, value of maximum temperature can be written from fieldbus)
1 = PT100 input 1
2 = PT100 input 1 & 2
3 = PT100 input 1 & 2 & 3
4 = PT100 input 2 & 3
5 = PT100 input 3

NOTE! If the selected input is not connected, the display will show the value 200ºC. If the input is short-circuited, the value is –30ºC.

2.9.2.2 Response to PT100 fault ID740 "PT100 FaultRespo"

0 = No response
1 = Warning
2 = Fault, stop mode after fault according to Stop Function
3 = Fault, stop mode after fault always by coasting

2.9.2.3 PT100 warning limit ID741 "PT100 Warn.Limit"

Set the limit at which the PT100 warning will be activated.

2.9.2.4 PT100 fault limit ID742 "PT100 Fault Lim."

Set the limit at which the PT100 fault (F56) will be activated.

2.9.2.5 *Number of PT100 2 inputs in use* *ID743* *"PT100 2 Numbers"*

If you have a two PT100 input boards installed in your AC drive, you can select the number of PT100 inputs in use on the second board. See also the Vacon I/O boards manual.

0 = Not used (ID Write, value of maximum temperature can be written from fieldbus)
1 = PT100 input 1
2 = PT100 input 1 & 2
3 = PT100 input 1 & 2 & 3
4 = PT100 input 2 & 3
5 = PT100 input 3

2.9.2.6 *PT100 2 Warning Limit* *ID745* *"PT100 2 Warn. Lim"*

Set the limit at which the second PT100 warning will be activated.

2.9.2.7 *PT100 2 Fault Limit* *ID746* *"PT100 2 FaultLim"*

Set the limit at which the second PT100 fault (F61) will be activated.

5.8.3 EARTH FAULT

2.9.3.1 *EarthFlt Response*

2= Fault

3= Fault, Open MCB

4= Fault, Open NET CB

5 = Fault, Open Main & NET CB

2.9.3.2 *EarthFaultLevel*

This parameter defines the maximum level of earth current in % of the unit current.

5.8.4 FIELDBUS

2.9.4.1 *Fieldbus Fault Slot D Response* *ID733*

2.9.4.2 *Fieldbus Fault Slot E Response* *ID761*

Set the response for a fieldbus fault if the active control place is fieldbus. For more information, see the relevant Fieldbus Board Manual.

0 = No response

1 = Warning

2 = Fault, stop mode after fault according to Stop Function

2.9.4.3 *FB WD Time*

Delay time to a fieldbus fault when the pulse from PLC is missing. Setting the time to zero will disable the monitoring function.

5.8.5 EXTERNAL FAULT

2.9.5.1 Response to External Fault 1 ID701 "External Fault 1"

2.9.5.2 Response to External Fault 2 ID1504 "External Fault 1"

Defines response when a digital input signal is used to give signal about an external condition to which the drive needs to react. The external warning/fault indication can be connected to a digital output.

0 = No response
1 = Warning
2 = Fault

2.9.5.3 External fault delay

Defines the delay for an external fault, and affects both external fault inputs.

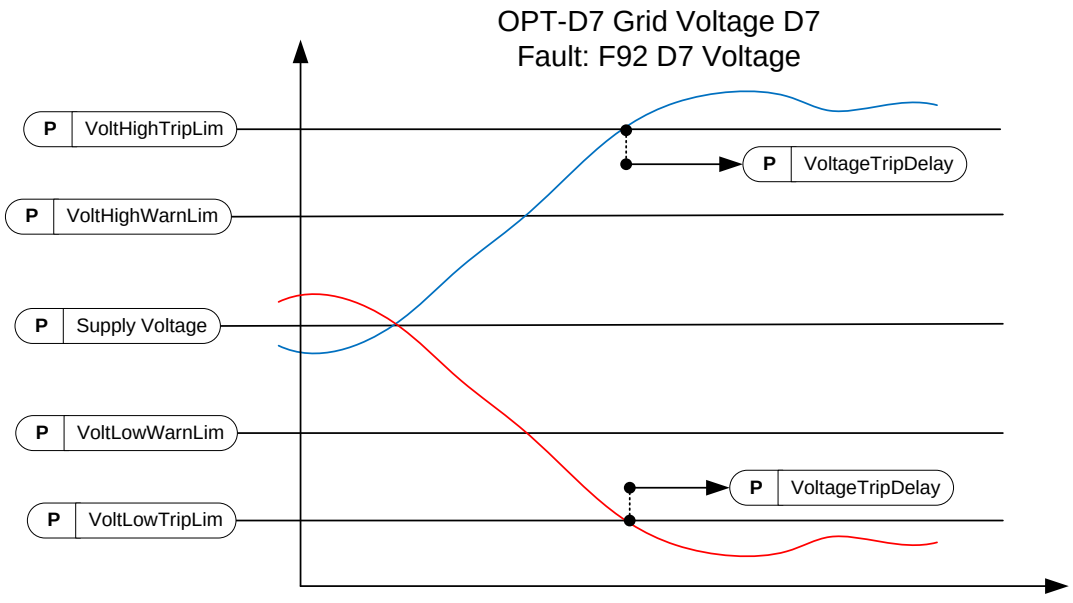
5.8.6 GRID VOLTAGE D7

This function monitors the grid voltage by using measurement from the OPT-D7 board.

NOTE: This functionality is not Grid Code functionality even if functionality may be similar.

P2.9.6.1 Voltage D7 Response ID1626

0 = No response
1 = Warning
2 = Fault



Note: Low Voltage trip from D7 board is disabled if drive has detected Short Circuit

Figure 36.

P2.9.6.2 Voltage Low Warning Limit ID1893

Low limit for a warning indication. A percentage value from a set supply voltage parameter.

P2.9.6.3 Voltage Low Trip Limit ID1899

Low limit for a fault indication. A percentage value from a set supply voltage parameter.

The common tripping limit of the land based grid code standard is 80 % of Un within 200 ms.

P2.9.6.4 Voltage High Warning Limit ID1895

High limit for a warning indication. A percentage value from a set supply voltage parameter.

P2.9.6.5 Voltage High Trip Limit ID1799

High limit for a fault indication. A percentage value from a set supply voltage parameter.

The common tripping limit of the land based grid code standard is 115 % of Un within 200 ms.

P2.9.6.6 Voltage Trip Delay ID1898

Delay to a fault when the voltage has exceeded the fault levels.

5.8.7 GRID FREQUENCY

A monitoring function for the drive output frequency and the measured frequency from OPT-D7. Will also trip this when operating in pure AFE mode.

NOTE: This functionality is not Grid Code functionality even if functionality may be similar.

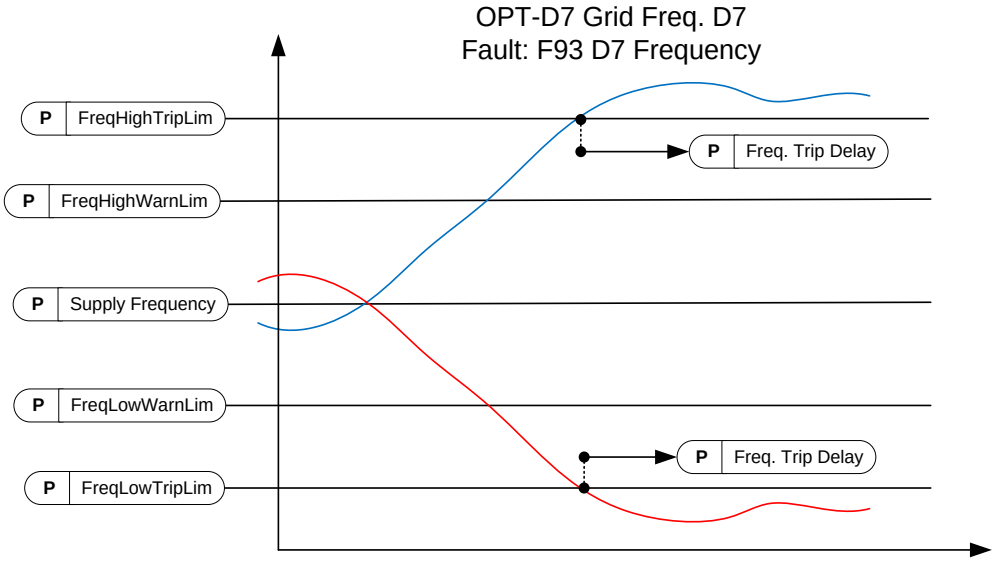


Figure 37.

P2.9.7.1 Freq. Supply Response ID1627

0 = No response
1 = Warning
2 = Fault

P2.9.7.2 Freq. D7 Response ID1628

0 = No response
1 = Warning
2 = Fault

P2.9.7.3 Freq. Low Warning Limit ID1780

Low limit for a warning indication. A percentage value from a set supply frequency parameter. This also limits the adjusted frequency references.

P2.9.7.4 Freq. Low Trip Limit ID1781

Low limit for a fault indication. A percentage value from a set supply frequency parameter. Use G2.6.3 Frequency limits for final and immediate protection.

The common tripping limit of the land based grid code standard is 47.5 Hz within 200 ms.

P2.9.7.5 Freq. High Warning Limit ID1783

High limit for a warning indication. A percentage value from a set supply frequency parameter. This also limits the adjusted frequency references.

P2.9.7.6 Freq. High Trip Limit ID1784

High limit for a fault indication. A percentage value from a set supply frequency parameter. Use G2.6.3 Frequency limits for final and immediate protection.

The common tripping limit of the land based grid code standard is 50.2-51.5 Hz within 200 ms.

P2.9.7.7 Freq. Trip Delay ID1785

Delay to a fault when the frequency has exceeded the fault levels.

5.8.8 SUPPLY VOLTAGE

There is a tripping function for the drive output voltage. It is possible that the drive output voltage is higher (or lower) than the grid voltage, depending on the voltage compensation for LCL and transformer.

P2.9.8.1 Voltage, Supply response ID1629

0 = No response
1 = Warning

2 = Fault

P2.9.8.2 Voltage Low Trip Limit ID1891

When the supply voltage drops below this limit, the drive will trip to an F70 Supply voltage fault. If the drive is already at the current limit, this low voltage trip limit is not active.

NOTE! OPT-D7 is not used for detection.

Use this function for the final protection function for the grid or the generator. Delay to trip is 150 ms.The protection group has functions that use OPT-D7 for voltage level protection.

P2.9.8.3 Voltage Low Warning Limit ID1880

When the supply voltage drops below this limit, the drive will give a warning. If the drive is already at the current limit, this low voltage trip limit is not active.

NOTE! OPT-D7 is not used for detection.

P2.9.8.4 Voltage Low Warning Limit ID1881

When the supply voltage increases above this limit, the drive will give a warning.

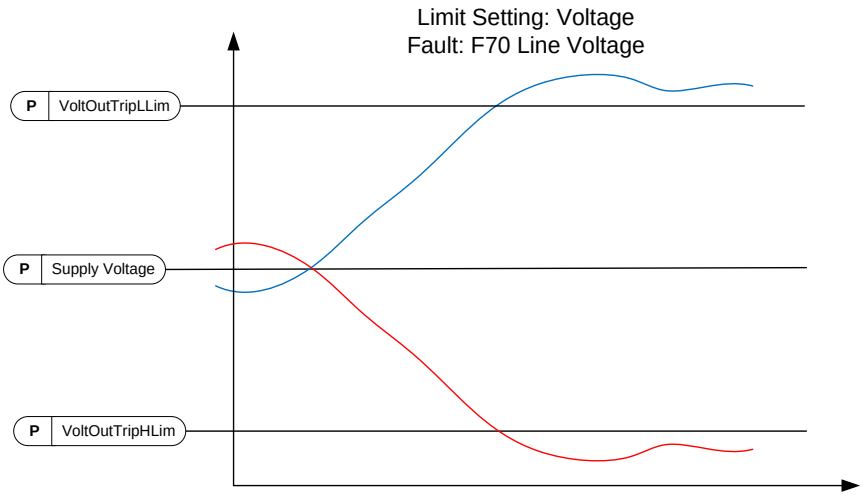
NOTE! OPT-D7 is not used for detection.

P2.9.8.5 Voltage High Trip Limit D1992

When the supply voltage increases above this limit, the drive will trip to an F70 Supply voltage fault.

NOTE! OPT-D7 is not used for detection.

Use this function for the final protection function for the grid or the generator. Delay to trip is 150 ms.The protection group has functions that use OPT-D7 for voltage level protection.



Note: This monitor voltage at drive terminal. When compensating LCL termianal voltage, Output voltage may be considerable higher on full load situations than given Supply Voltage

Note: Low Voltage trip from output voltage is disabled if drive has detected Short Circuit

Figure 38.

5.8.9 OVER LOAD PROTECTION

With this function it is possible to select if Current %, Active Current or Reactive Current is used for over load protection. Over Load is based on internal counter that is increased when input value is above 105 % level and decreased when below 105 % level. The increase and decrease occurs every 100 ms.

Tripping is made when over load counter value is over 10 000.

With parameters you can define the increase (Over load maximum step) at maximum defined input level (Over Load Maximum Input). These points define the slope for the function. For example, if the input value is in the middle of 105 % and Over Load Maximum Input values, the counter is increased by a half of the Over Load Maximum step.

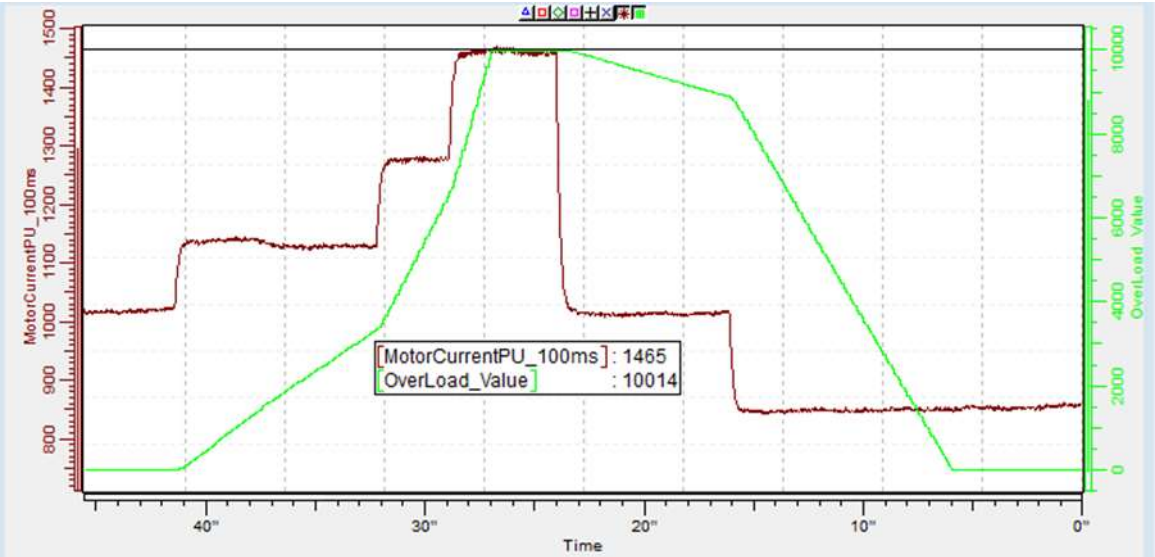


Figure 39.

2.9.9.1 Response to over load ID1838 "OverLoadResponse"

0 = No response
1 = Warning
2 = Fault

2.9.9.2 Over Load Signal ID1837 "OverLoadSignal"

0 = Not Used
1 = Total Current [%] (FW: MotorCurrentPU_100ms)
2 = Active Current
3 = Reactive Current

2.9.9.3 Over Load Maximum Input ID1839 "OverLoadMaxIN"

Input value level where the over load counter is increased with maximum step defined by P2.9.9.4

2.9.9.4 Over Load Maximum Step ID1840 "OverLoadMaxStep"

Step in the over load counter when the input value is at maximum input level defined by P2.9.9.3.

2.9.10 Fault Simulation ID1569 "Fault Simulation"

With this parameter it is possible to simulate different faults without actually making, for example, an over current situation. In the point of view of the drive interface, the operation is identical to actual fault situation.

B00 = +1 = Simulates an over current fault (F1)

B01 = +2 = Simulates an over voltage fault (F2)

B02 = +4 = Simulates an under voltage fault (F9)

B03 = +8 = Simulates an output phase supervision fault (F11)

B04 = +16 = Simulates an earth fault (F3)

B05 = +32 = Simulates a system fault (F8)

This fault simulation covers a wide range of different faults in drive. See the fault description for details.

B06 = +64 = Free

B07 = +128 = Simulates an over temperature warning (W14)

B08 = +256 = Simulates an over temperature fault (F14)

The warning bit must be active for a fault to appear in simulation. If the fault bit is left active, the drive will go FAULT state at warning limit when the drive temperature rises to the warning level.

B09 = +512 = Reserved

2.9.11 Reset Datalogger ID1857

Resets datalogger setting back to factory defaults.

5.9 FIELDBUS

2.10.1 FB Actual Value Sel ID 1853

Enter the ID of the parameter you wish to use as the Fieldbus Actual -control variable.

2.10.2 to

2.10.9 FB Data Out 1-8 Sel ID 852-859

Using these parameters, you can monitor any monitoring or parameter value from the fieldbus. Enter the ID number of the item you wish to monitor as the value of these parameters

2.10.10 to

2.10.17 FB Data Out 9-16 Sel ID 558-565

These parameters are the same as parameters *P2.10.2-9*, but they are only available if a fieldbus board with hardware and software support for 16 process data variables is inserted in option board slot D or E.

2.10.18 to

2.10.25 FB Data In 1-8 Sel ID 876-883

Using these parameters, you can control any parameter value from the fieldbus. Enter the ID number of the item you wish to control as the value of these parameters.

2.10.26 to

2.10.33 FB Data In 9-16 Sel ID 550-557

These parameters are the same as parameters *P2.10.18-25*, but they are only available if a fieldbus board with hardware and software support for 16 process data variables is inserted in option board slot D or E.

2.10.18 GSW Data ID 897

With this parameter it is possible to select which data is sent in FBGeneralStatusWord.

2.10.19 State Machine ID 896

The application provides a possibility to select what kind of state machine is used.

0: Basic

This mode makes fieldbus control behave as is explained in the fieldbus board manual.

1: Standard

A simple control word that is used in modes where the control word from fieldbus is used as such. For some fieldbus boards this requires a bypass operation.

2: Vacon AFE 1

This mode uses a ProfiDrive type state machine in the application level. You can use this mode on fieldbus boards that do not have a state machine or have a possibility to bypass the state machine function in the option board.

2.10.20 FB Ref Min ID 850

2.10.21 FB Ref Max ID 851

The minimum and maximum limits for fieldbus DC Voltage Reference.

2.10.22 Control Slot selector ID 1440

This parameter defines which slot is used as the main control place when fieldbus boards have been inserted into the drive. When values 8-9 are selected the drive can use the Extended fieldbus mode if a fieldbus board with support for that mode is inserted in slot D or E. For more information refer to the fieldbus board manual.

0 = No Sel. Control signals are monitored from every fieldbus board.

4 = Slot D Control signals are monitored from Slot D (8 process data variables).

5 = Slot E Control signals are monitored from Slot E. (8 process data variables).

8 = Slot D with Extended fieldbus mode (16 process data variables).

9 = Slot E with Extended fieldbus mode (16 process data variables).

2.10.23 SW ID.Bit selection B11 ID 1907

2.10.24 SW ID.Bit selection B12 ID 1908

2.10.25 SW ID.Bit selection B13 ID 1909

2.10.26 SW ID.Bit selection B14 ID 1910

Select the bit that used in FB Status Word Bit 11, 12, 13 and 14.

2.10.27	*uGrid CW B12 parameter*	*ID 891 "uCW B12"*
2.10.28	*uGrid CW B13 parameter*	*ID 892 "uCW B13"*
2.10.29	*uGrid CW B14 parameter*	*ID 893 "uCW B14"*
2.10.30	*uGrid CW B15 parameter*	*ID 894 "uCW B15"*

With these parameters you can define the parameter to be controlled by using Micro Grid Control Word bits 12-15.

5.10 MICRO GRID

2.11.1 Control Mode

Select the AFE operation mode.

0 = AFE

Standard AFE functionality, no license key required. Keeps fixed DC-Link Voltage.

1 = Island

Island operation mode, cannot operate parallel with other power sources. Makes fixed voltage and frequency, i.e. no voltage or frequency drooping. Also low DC-Link Voltage limitation function is disabled. Reacts only to set DC Under Voltage limit.

2 = Micro Grid

uGrid operation mode, can operate parallel with other power sources. Parallel operation is achieved by voltage and frequency drooping. Start to reduce output frequency when not sufficient DC-Link Voltage, this will prevent reactive current generation in case of low power in DC-Link side.

3 = Island-AFE

The drive changes the control mode automatically when feedback from the external net contactor has been received.

4 = Island-Micro Grid

The drive changes the control mode automatically when feedback from the external net contactor has been received.

5 = (Reserved)

6 = Free Select

The operation mode is selected by digital inputs and AFE mode 1-3 selections.

NOTE! A licence is necessary for other than the standard AFE mode.

2.11.2 Frequency Droop

Drooping related to the active current in Hz. Set to the same value as all other power sources drooping. Used in uGrid operation mode.

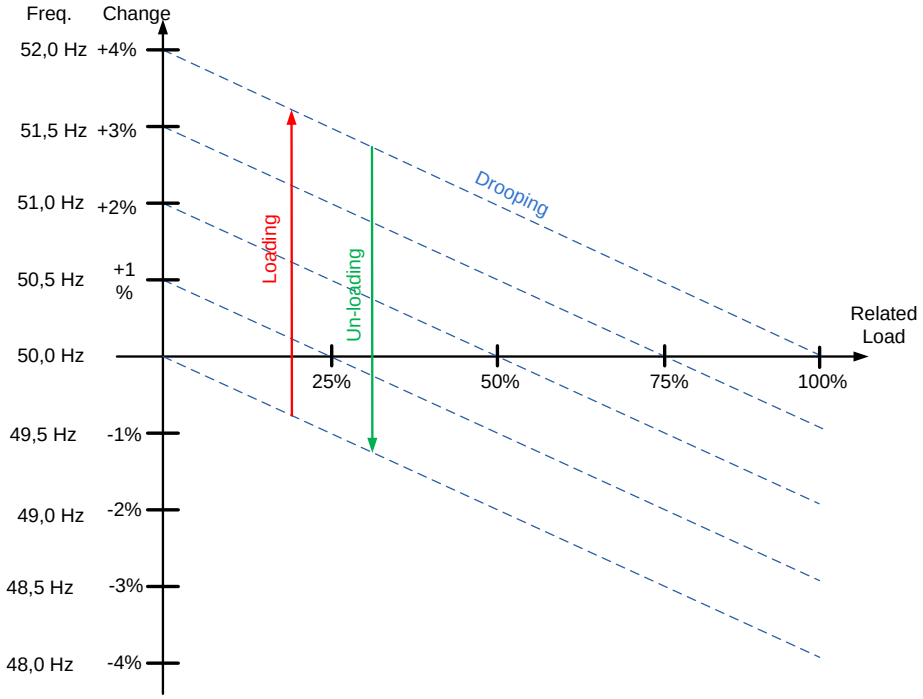


Figure 40.

2.11.3 Voltage Droop

This parameter defines the voltage droop at 100% reactive current. The reactive current drooping in percentage of P2.1.1. Used in uGrid operation mode.

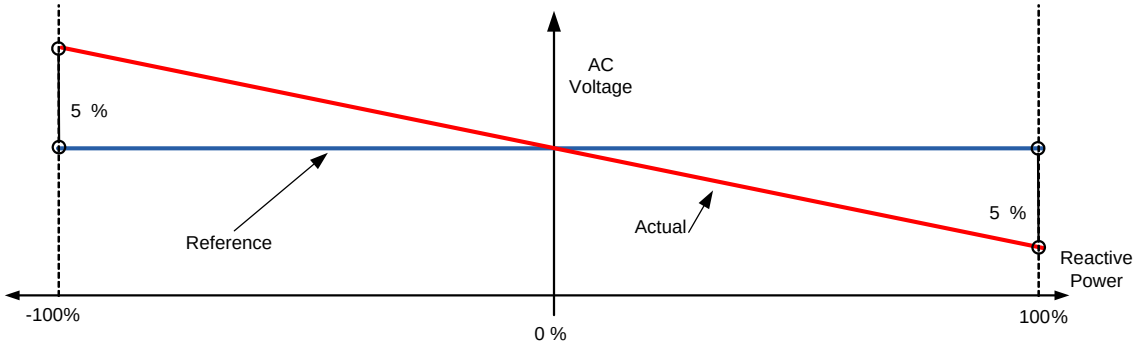


Figure 41.

2.11.4 Start Power Mode

Defines how power is controlled to zero in Micro Grid mode.

0 = Zero Power OPT-D7

The option board D7 is used to monitor the grid frequency and uses this as a starting point for power drooping control.

1 = Zero Power from Supply Frequency

This selection is only possible with unit FI9 and bigger.

The drive monitors the supply frequency by itself and uses this as a starting point for power drooping control.

2 = Drooping

The drive does not control the power to zero but goes directly to the drooping control with set parameters.

3 = Isochron Generator

The drive will follow the line frequency exactly, so the frequency change will not change the power of the Micro Grid application. In this mode, power is controlled by the base current reference.

2.11.5 Voltage Rise Time ID1541

This parameter defines the time until the voltage is at nominal when the drive is started in Island mode or when in Micro Grid mode without an existing grid. Voltage Rise Time is used to minimize inrush current e.g. when Grid Converter needs to magnetize transformer on start.

5.10.1.1 Generator Simulation

These parameters are used to make drive operate more like diesel generator set.

P2.11.6 Generator Mechanical Time Constant ID1722

Simulated diesel generator mechanical time constant.

Values above zero will enable diesel generator simulation function. Use 1000 ms as a starting point if actual mechanical time constant is not known.

P2.11.7 Generator Speed Control Kp ID1723

Simulated diesel generator speed control gain.

P2.11.8 Generator Speed Control Ti ID1724

Simulated diesel generator speed control Ti.

5.10.1.2 AFE operation mode selection

When using digital input P2.4.2.17 AFE Mode 2 and P2.4.2.18 AFE Mode 3 with the parameters below, it is possible to select the operation independently for both the digital inputs.

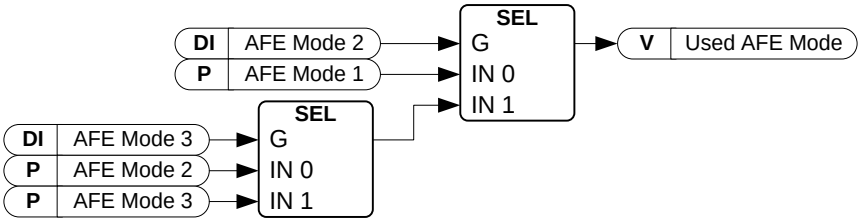


Figure 42.

2.11.10.1 AFE Mode 1

Only active when P2.11.1 is 6/Free select.

0= AFE

1= Island

2= Micro Grid

2.11.10.2 AFE Mode 2

Only active when P2.11.1 is 6/Free select.

0= AFE

1= Island

2= Micro Grid

2.11.10.3 AFE Mode 3

Only active when P2.11.1 is 6/Free select.

0= AFE

1= Island

2= Micro Grid

5.11 SYNCH TO EXTERNAL GRID

This function is used to synchronise to an external grid. Measurements with OPT-D7 are necessary for the use of this function.

2.12.1 Synch. Offset

Used to compensate angle offset between the drive output terminals and OPT-D7 measurement point. E.g. with Dyn11, the transformer angle offset is usually 30.0 degree. This equals as 512 for this parameter. (3072 equals 180 degrees offset). If possible, run in AFE mode and see monitoring variable "D7 Synch. Error" to see what is needed for the offset.

$$\frac{x\ degree * 3071}{180\ degree} = Synch.Offset$$

2.12.2 Synch Reference

Use of P:Synch. Offset do not affect the error value that is shown in monitoring variable "D7 Synch. Error". Therefore you must give the reference for synchronization; usually this reference is roughly the same as P:"Synch. Offset" value, depending on the system. (3072 equals 180 degrees offset).

2.12.3 Synch Kp

Island mode line sync gain. Init = 500.

2.12.4 Synch Ti

Reserved (not in use)

2.12.5 Synch.Hysteresis

Window for closing the net circuit breaker. (3172 equals 180 degrees).

2.12.6 Contactor Delay

In case no feedback is received from the shore contactor, this can be used to simulate a feedback signal. That means that the control mode is changed after this time delay, after the command to close NET contactor has been given.

2.12.7 Synch Stop Mode

Select operation after the drive has synchronised and received feedback from the shore contactor.

0 = Stay Run

1 = Stop

5.12 SYNCH TO SHAFT GENERATOR GRID

P2.13.1 SG follower Ramp Time 103

This is the ramp time when the grid side AFE follows the frequency of the shaft generator. This ramp time is activated when the frequency difference is below 0.10 Hz between the shaft generator and the drive.

P2.13.2 SG Grid Phase Offset 1586

Gives offset to the shaft generator angle when the phase synchronisation is activated.

P2.13.3 Synch Gain 1778

The phase synchronisation gain. The frequency reference at 180 degree difference.

P2.13.4 Phase Synch Ramp Time 1777

The ramp time for the synchronisation function. When the synchronisation mode is after the ramp, this time is active all the time.

If the synchronisation mode is before ramp, this time is activated when the angle difference is less than the value of Ramp Change Hyst.

P2.13.5 Max Synch Correction 1992

This parameter defines how much correction the phase synchronisation can make. The value 3070 equals to Synch Gain value.

P2.13.6 Ramp Change Hysteresis. 1894

This parameter defines the limit when the phase synchronisation starts to use the ramp time defined by P2.13.4. Before this, ramp time P2.3.1 is used.

5.13 ID FUNCTIONS

Here you will find the functions that use the parameter ID number to control and monitor the signal.

5.13.1 VALUE CONTROL

The value control parameters are used to control an input signal parameter.

P2.14.1.1 Control Input Signal ID ID1580 "ContrInSignal ID"

With this parameter you can select which signal is used to control the selected parameter.

P2.14.1.2 Control Off Limit ID1581 "Contrl Off Limit"

This parameter defines the limit when the selected parameter value is forced to Off value.

P2.14.1.3 Control On Limit ID1582 "Contrl On Limit"

This parameter defines the limit when the selected parameter value is forced to On value.

P2.14.1.4 Control Off Value ID1583 "Contrl Off Value"

This parameter defines the value that is used when the used input signal is below Off limit.

P2.14.1.5 Control On Value ID1584 "Contrl On Value"

This parameter defines the value that is used when the used input signal is above On limit.

P2.14.1.6 Control Output Signal ID ID1585 "ContrlOutSignID"

This parameter defines which parameter is forced to On and Off values when selected input signal exceeds the set limits.

P2.14.1.7 Control Mode ID1586 "Control Mode"

This parameter defines how the value control output behaves.

0 = SR ABS

Absolute input value is used to make a step change in the output between On and Off values.

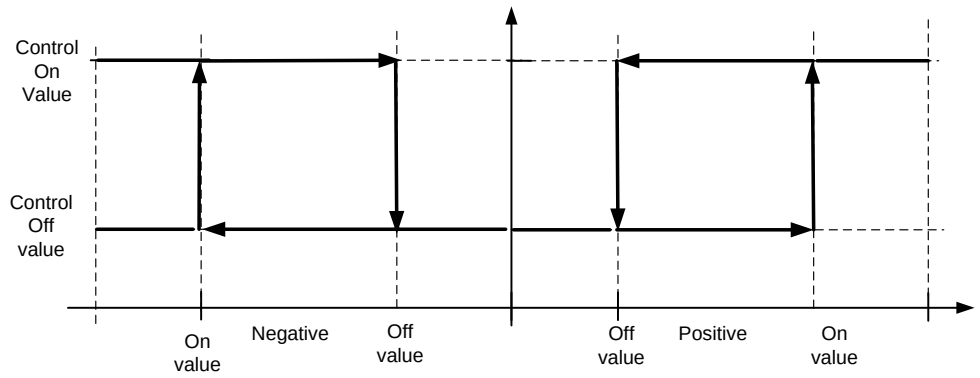


Figure 43.

1 = Scale ABS

Absolute input value is scaled linearly between On and Off values.

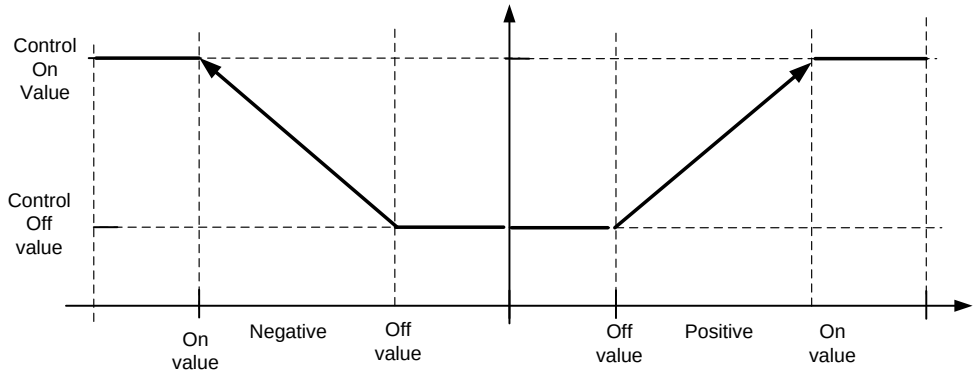


Figure 44.

2 = Scale ABS Inverted

Inverted absolute value is scaled linearly between On and Off values.

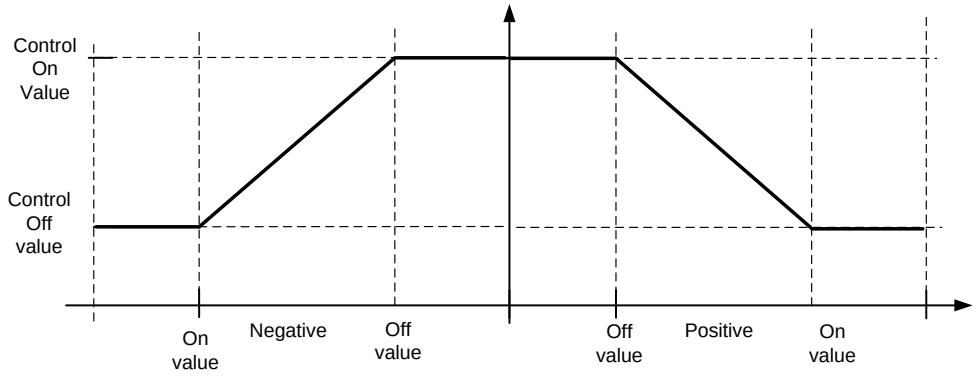


Figure 45.

3 = SR

Input value is used to make a step change in the output between On and Off values.

4 = Scale ABS

Input values is scaled linearly between On and Off values.

5 = Scale Inverted

Inverted value is scaled linearly between On and Off values

P2.14.1.8 Control Signal Filtering TC ID1586 "Control Filt TC"

This parameter is used to filter the scaling function output. This can be used, for example, when unfiltered torque is used to control a parameter that needs stabilisation.

5.13.2 DIN ID CONTROL

This function is used to control any parameter between two different values with a digital input. Different values are given for DI LOW and DI HIGH.

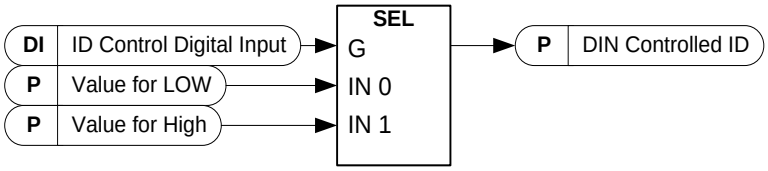


Figure 46.

P2.14.2.1	*ID Control Digital Input*	*ID1570*	*"ID Control DIN"*
P2.14.3.1	*ID Control Digital Input*	*ID1590*	*"ID Control DIN"*
P2.14.4.1	*ID Control Digital Input*	*ID1578*	*"ID Control DIN"*

Select a digital input to be used for controlling the parameter selected by ID1571.

P2.14.2.2	*DIN Controlled ID*	*ID1571*	*"Controlled ID"*
P2.14.3.2	*DIN Controlled ID*	*ID1575*	*"Controlled ID"*
P2.14.4.2	*DIN Controlled ID*	*ID15719*	*"Controlled ID"*

Select a parameter ID controlled by ID1570.

P2.14.2.3	*Value for Low digital input (FALSE)*	*ID1572*	*"FALSE Value"*
P2.14.3.3	*Value for Low digital input (FALSE)*	*ID1592*	*"FALSE Value"*
P2.14.4.3	*Value for Low digital input (FALSE)*	*ID15794*	*"FALSE Value"*

Set the controlled parameter value when the digital input (ID1570) is LOW for the parameter selected by ID1571. The function does not recognise decimals. For example, give the value 10.00 Hz as *1000*.

P2.14.2.4	*Value for High digital input (TRUE)*	*ID1573*	*"TRUE Value"*
P2.14.3.4	*Value for High digital input (TRUE)*	*ID1593*	*"TRUE Value"*
P2.14.4.4	*Value for High digital input (TRUE)*	*ID1596*	*"TRUE Value"*

Set the controlled parameter value when the digital input (ID1570) is HIGH for the parameter selected by ID1571. The function does not recognise decimals. For example, give the value 10.00 Hz as *1000*.

5.14 GRID VOLTAGE PI CONTROLLER

The PI controller is meant to help keep the line voltage constant when the load changes in Island mode. The OPT-D7 option board is necessary. The PI controller controls the field weakening voltage point to keep a constant voltage on the line.

In uGrid mode controller is I type controller and considers set Voltage Drooping.

When OPT-D7 board is not used, it is possible to use Analogue Input 3 and 4 ID write function to give the grid the Line Frequency D7 (ID1654) and Line Voltage D7 (ID1650). This enables use of grid PI voltage controller without the OPT-D7 board. Note that both line frequency and line voltages needs to be given. When Line Voltage is given without OPT-D7 board this mode can be used only in Island mode.

P2.15.1 PI Activation ID1807

Select the digital input that will activate the PI controller. Set selection to 0.2 and the PI controller is activated without an external wiring.

P2.15.2 PI Controller Gain ID118

This parameter defines the gain of the PID controller. If the value of the parameter is set to 100%, a change of 10% in the error value causes the controller output to change by 10%. If the parameter value is set to *0*, the PID controller operates as an I controller.

P2.15.3 PI Controller I-time ID119

The parameter ID119 defines the integration time of the PID controller. If this parameter is set to 1.00 second, a change of 10% in the error value causes the controller output to change by 10.00%/s. If the parameter value is set to *0.00 s*, the PID controller will operate as a P controller.

P2.15.4 PI Max Adjust ID360

This parameter defines maximum adjustment that PI controller can made to voltage.

5.14.1 GRID VOLTAGE PI OPT-D7 LIMITS

These parameters define the limits within which the OPT-D7 measurements must remain in order for the PI controller to remain active. This is a protection function is case of a measurement loss. When a measurement loss is detected, the drive will not stop, but instead it continues to operate by using open loop voltage compensation (Inductor Size and Losses).

P2.16.5.1 PI Frequency Low Limit ID1630

P2.16.5.2 PI Frequency High Limit ID1631

P2.16.5.3 PI Voltage Low Limit ID1632

P2.16.5.4 PI Voltage High Limit ID1633

5.15 GRID CODES

This application Grid Codes are not certified, but on functionality level below tables Grid Code functions are implemented in a general way. Meaning that with correct parameter setting compliance should be achieved provided that system itself where this application is used comply with the Grid Code requirements. Certification itself is a system level process and this application can't be certified itself.

5.15.1 GRID CODES; CERTIFIED IN A DIFFERENT PRODUCT

Compliance	Grid Code	Countries	Low/medium voltage
Yes	VDE 0126-1-1	Germany	Low
Yes	VDE AR-N-4105	Germany	Low
Yes	BDEW 2008	Germany	Medium
Yes	EN 50438	France	Low
Yes	Decret Arrete 23.4.2008	France	Medium
Yes	CEI 0-21	Italy	Low
Yes	CEI 11-20	Italy	Low
Yes	R.D. 1663/2000	Spain	Low
Yes	EN 50438	Czech	Low
Yes	EN 50438	UK	Low
Yes	EN 50438	Belgium	Low
Yes	AS 4777.3	Australia	Low
Yes	IEC 62116		Low
Yes	CEI 0-16 / 17. TERNA	Italy	Medium
Yes	CEI 0-16 + A70	Italy	Medium
Yes	P.O. 12.2/12.3	Spain	Medium
Yes	CGC/GF 001:2010	China	Medium
Yes	G59	UK	Low
Yes	IEEE 1547	USA	Low
Yes	NT30	Romanian	Low
Yes	GB/T 19964-2012	China	Medium

5.15.2 GRID CODES; FUNCTIONALITY IMPLEMENTATION

Compliance	Grid Code	Countries	Low/medium voltage
		Denmark	

5.15.3 GRID CODES; NOT IMPLEMENTED

Compliance	Grid Code	Countries	Low/medium voltage
No	FERC 661A	USA	Medium
No	PRC-024-1	USA	Medium

5.16 GRID CODE PARAMETERS

P 2.17.1 GGC License ID 2201

Enter here license code to activate General Grid Code functionality.

P 2.17.2 EnableGridCode ID 2254

Parameter to enable Grid Codes if correct license is given.

0 = Disabled

Grid Code functions are disabled.

1 = Enabled; No Trip.

Grid Code functions are active but do not cause drive to trip.

2 = Enabled

Grid Code functions are active, and drive will stop modulating if trip conditions are met.

P 2.17.3 Anti-islanding ID 2250

Enables or disables anti-islanding functions.

0 = Disabled

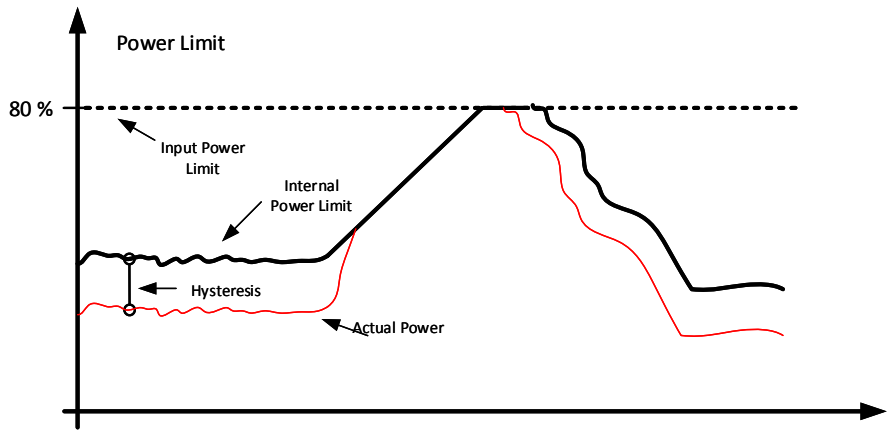
In islanding situation frequency may stay inside acceptable operation.

1 = Active

In islanding situation frequency will change rapidly and frequency limit will trip the drive.

P 2.17.4 Power Ramp Up Rate ID2324

Limit power increase rated when using positive values. Negative value will disable power increase rate limiter.



5.16.1 FRT

P2.17.5.1 FRT Function ID 2251

Enables FRT functionality.

0 = Disabled; Both

FRT is disabled but voltage level and curve are active at the same time.

1 = Enabled; Limits

FRT is enabled, voltage levels make the trip but not curve.

2 = Enabled; Curve

FRT is enabled, curve makes the trip but not voltage levels.

3 = Enabled; Neither

FRT is enabled, but neither curve or voltage levels are not making trip.

P2.17.5.2 ReactivInjection ID 2252

Select the grid fault types when reactive current is injected.

0 = Tri:N, Bi:N

Reactive current is not injected.

1 = Tri:Y, Bi:Y

Reactive current is injected

2 = Tri:Y, Bi:N

Reactive current is injected to three phase faults but not to bi-phase faults.

P2.17.5.3 Symmetrical Reactive ID2323

Select if unsymmetrical fault will be few by symmetrical current.

5.16.2 RECONNECTION

P 2.17.6.1 ReConnectTime s ID 2253

Reconnection time when fault happens on run state.

P 2.17.6.2 ReConnTimeStop s ID 2255

Reconnection time when fault happens in stop state. Disables drive starting when start command is given if Stop State reconnection time has not passed.

P 2.17.6.3 ReConRampUpRate %/s ID 2297

Power ramp up rate on reconnection.

5.16.3 LINE VOLTAGE

Line voltage trip levels and times to tripping.
Reference voltage is P2.1.1 Grid Nom. Voltage

P 2.17.7.1 LV High 1 % ID 2256

Line Voltage High Limit 1 [%] of Grid Nominal Voltage. Trip after delay defined by ID2257.

P 2.17.7.2 LV High 1 Delay ms ID 2257

Delay to trip when voltage above ID2256.

P 2.17.7.3 LV High 2 % ID 2258

P 2.17.7.4 LV High 2 Delay ms ID 2259

P 2.17.7.5 LV Low 1 % ID 2260

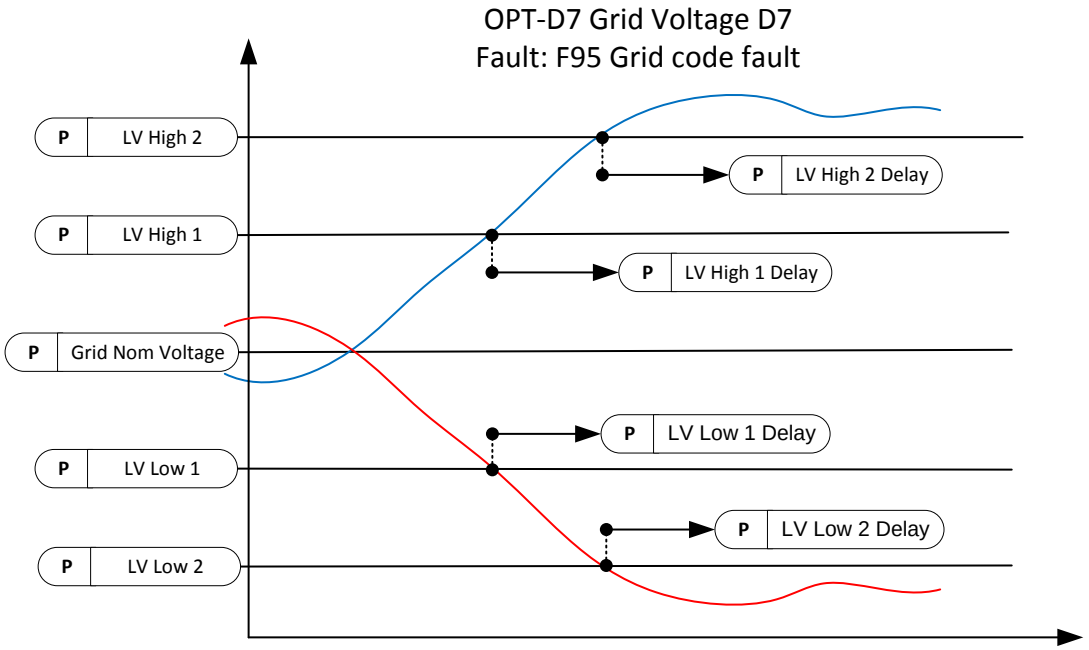
Line Voltage Low Limit 1 [%] of Grid Nominal Voltage. Trip after delay defined by ID2261.

P 2.17.7.6 LV Low 1 Delay ms ID 2261

Delay to trip when voltage below ID2260.

P 2.17.7.7 LV Low 2 % ID 2262

P 2.17.7.8 LV Low 2 Delay ms ID 2263



5.16.4 LINE FREQUENCY

Line frequency trip levels and times to tripping.
Reference frequency is P2.1.2 Grid Nom Freq.

P 2.17.8.1 LF High 1 % ID 2264

Line Frequency High Limit 1 [%] of Grid Nominal Frequency.

P 2.17.8.2 LF High 1 Delay ms ID 2265

Delay to trip when frequency above ID2264.

P 2.17.8.3 LF High 2 % ID 2266

P 2.17.8.4 LF High 2 Delay ms ID 2267

P 2.17.8.5 LF Low 1 % ID 2268

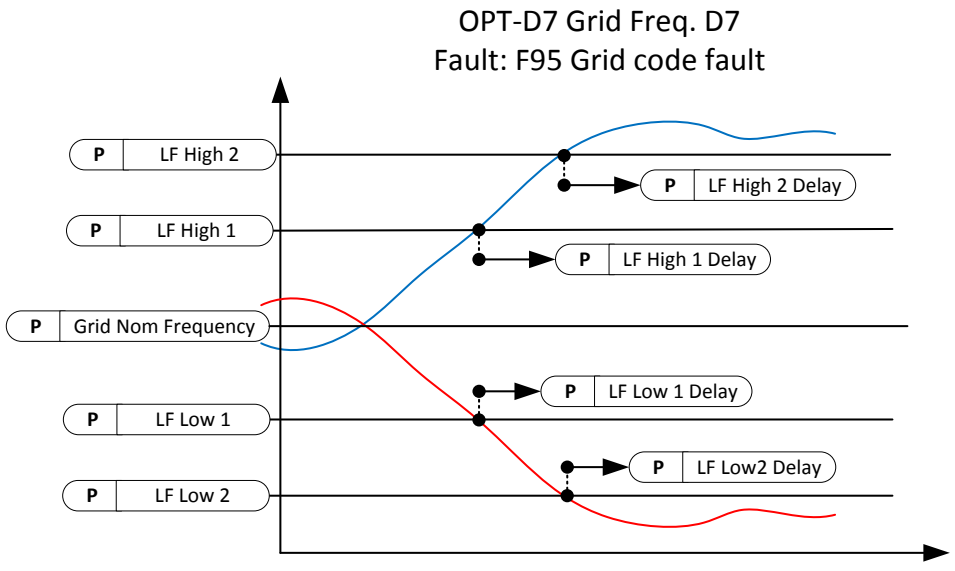
Line Frequency Low Limit 1 [%] of Grid Nominal Frequency.

P 2.17.8.6 LF Low 1 Delay ms ID 2269

Delay to trip when frequency below ID2268.

P 2.17.8.7 LF Low 2 % ID 2270

P 2.17.8.8 LF Low 2 Delay ms ID 2271

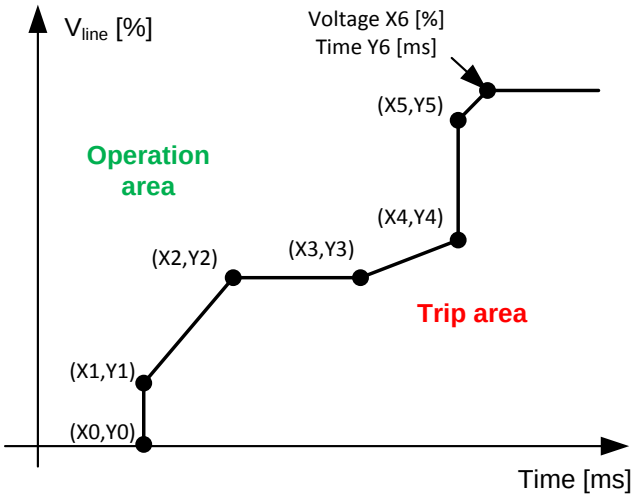


P 2.17.8.9 LF MaxChangeRate Hz/s ID 2322

Tripping if line frequency has changed more than set value inside one (1) second.

5.16.5 VOLTAGE TIME TRIP

Define voltage drop curve, drive will trip if curve is exceeded. Timer start when Voltage is below Voltage X6 point.



P 2.17.9.1	*Voltage X0*	*%*	*ID*	*2272*

Lowest voltage level.

P 2.17.9.2	*Time Y0*	*ms*	*ID*	*2273*
P 2.17.9.3	*Voltage X1*	*%*	*ID*	*2274*
P 2.17.9.4	*Time Y1*	*ms*	*ID*	*2275*
P 2.17.9.5	*Voltage X2*	*%*	*ID*	*2276*
P 2.17.9.6	*Time Y2*	*ms*	*ID*	*2277*
P 2.17.9.7	*Voltage X3*	*%*	*ID*	*2278*
P 2.17.9.8	*Time Y3*	*ms*	*ID*	*2279*
P 2.17.9.9	*Voltage X4*	*%*	*ID*	*2280*
P 2.17.9.10	*Time Y4*	*ms*	*ID*	*2281*
P 2.17.9.11	*Voltage X5*	*%*	*ID*	*2282*
P 2.17.9.12	*Time Y5*	*ms*	*ID*	*2283*
P 2.17.9.13	*Voltage X6*	*%*	*ID*	*2284*

Highest voltage level. Below this level timer is started.

P 2.17.9.14	*Time Y6*	*ms*	*ID*	*2285*

Time to trip when voltage is below X6 point and above X5 point.

Trip time is scaled between X6 and X5 points.

5.16.6 LINE OK LIMITS

Separate Grid OK levels when reconnection is allowed. If these values are zero tripping limits for voltage and frequency are used also as a OK limit.

P 2.17.10.1	*LF OK High*	*%*	*ID*	*2287*
P 2.17.10.2	*LF OK Low*	*%*	*ID*	*2286*
P 2.17.10.3	*LV OK High*	*%*	*ID*	*2289*
P 2.17.10.4	*LV OK Low*	*%*	*ID*	*2288*
P 2.17.10.5	*Line OK Delay*	*ms*	*ID*	*2290*

Minimum time that line needs to be inside acceptable limits before reconnection counter is started.

5.16.7 REACTIVE INJECTION

Reactive current injection is activated by ID2252.

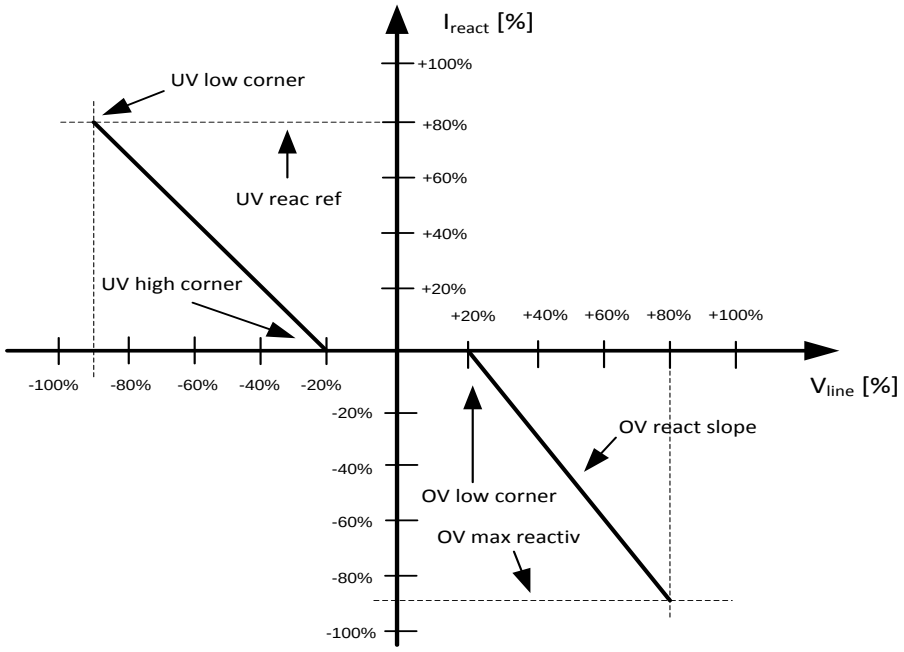
P 2.17.11.1 Reactive Mode ID 2314

Select the operation mode for reactive reference handling.

1. Linear
2. Power Lock In and Lock Out.

5.16.7.1 Linear reference under voltage

Injected reactive current is changing linearly between high and low voltage corners.



P 2.17.11.2.1 UV High Corner % ID 2291

Defines voltage level where reactive current injection is started.

P 2.17.11.2.2 UV Low Corner % ID 2292

Defines voltage level where full Reactive Current, specified in ID2293, is injected to the grid.

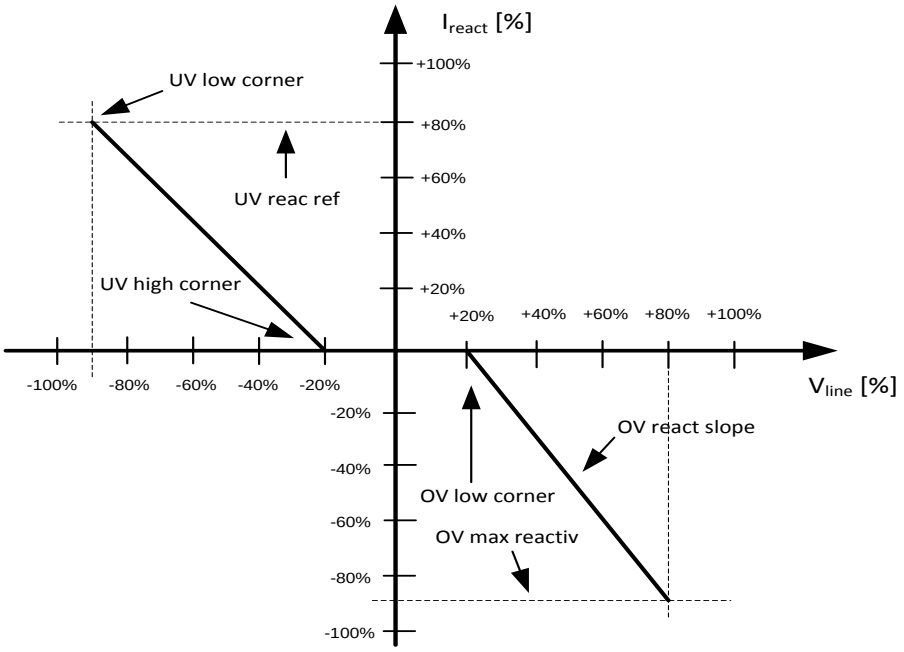
P 2.17.11.2.3 UV Reac. Ref % ID 2293

Reactive current reference at low voltage corner.

P 2.17.11.2.4 UV Bi Reac. Ref % ID 2294

Reactive current reference at low voltage corner on bi phase fault situation.

5.16.7.2 Linear reference over voltage



P 2.17.11.2.5 OV Low Corner % ID 2300

Voltage corner where reactive current injection is started on line over voltage situation.

P 2.17.11.2.6 OV Max Reactiv % ID 2301

Maximum reactive current reference on over voltage situation.

P 2.17.11.2.7 OV React Slope %/% ID 2302

Slope for reactive current reference, started at ID2300.

100 %/% means that reactive current is increase 100 % by 1 % voltage increase.

P 2.17.11.2.8 OV React PLim In % ID 2303

If drive output power is below this reactive current injection is not started on over voltage.

P 2.17.11.2.9 OV React PLim Out % ID 2329

When drive output power falls below this level reactive injection is stoped.

5.16.7.3 Power Lock In and Out Reference under voltage.

P 2.17.11.3.1 PowerLockIn % ID 2315

Power level where reactive current injection is started if Line Voltage is below ID2291.

P 2.17.11.3.2 PowerLockOut % ID 2316

Reactive current injection is stopped if power is below this value.

P 2.17.11.3.3 UV High Corner % ID 2291

If power is above ID2315 and voltage below this value but above ID2292 reactive current set by ID2318 is injected to grid.

P 2.17.11.3.4 UV Low Corner % ID 2292

If power is above ID2315 and voltage below this value, reactive current set by ID2293 is injected to grid.

P 2.17.11.3.5 UV LockOutVoltag % ID 2317

Voltage limit for disabling the reactive current injection in overvoltage situation

P 2.17.11.3.6 UVReacRefHighCor % ID 2318

Reactive current injected to grid when power is above ID2315 and Line voltage below ID2291 but above ID2292.

P 2.17.11.3.7 UV Reac. Ref % ID 2293

Reactive current injected to grid when power is above ID2315 and voltage below ID2292. This level is kept until voltage is above ID2311.

P 2.17.11.3.8 UV Bi Reac. Ref % ID 2294

Reactive reference used when Bi-phase fault, in both voltage levels.

5.16.7.4 Power Lock In and Out Reference over voltage.

P 2.17.11.3.1 PowerLockIn % ID 2315

Power level where reactive current injection is started if Line Voltage is above ID2300.

P 2.17.11.3.2 PowerLockOut % ID 2316

Reactive current injection is stopped if power is below this value.

P 2.17.11.3.9 OV Low Corner % ID 2300

If power is above ID2315 and voltage above this value but below ID2320 reactive current set by ID2321 is injected to grid.

P 2.17.11.3.10 OV High Corner % ID 2320

If power is above ID2315 and voltage above this value, reactive current set by ID2301 is injected to grid.

P 2.17.11.3.11 OVReacRefLowCorn % ID 2321

Reactive current injected to grid when power is above ID2315 and Line voltage above ID2300 but below ID2320.

P 2.17.11.3.12 OV Max Reactiv % ID 2301

Reactive current injected to grid when power is above ID2315 and voltage above ID2320. This level is kept until voltage is below ID2319.

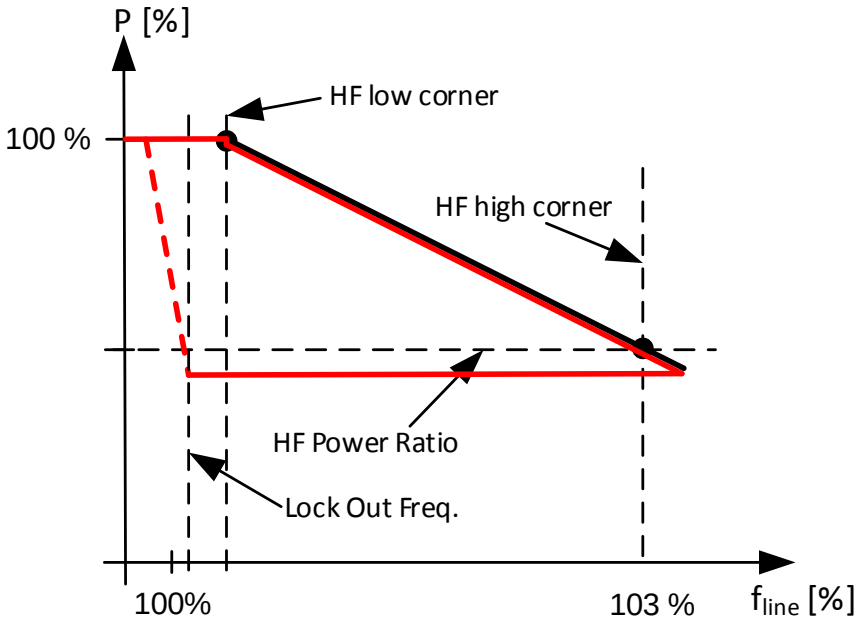
P 2.17.11.3.13 OV LockOutVoltag % ID 2319

Reactive current injection is stopped if voltage is below this value.

5.16.8 POWER LIMIT

5.16.8.1 High Frequency Power Limit

Select power limit behavior on high line frequency.



P2.17.12.1.1 *HighFreqModes* *ID* *2307*

Parameter select how minimum power limit is handled.

0 = High Limit

Power limit will fallow set scaled line.

1 = Minimum

Power limit is kept at minum level set by scaled line.

P2.17.12.1.2 *HighFreqLowCornr* *%* *ID* *2295*

Corner where power limiting is started on high line frequency.

P2.17.12.1.3 *HighFreqHigCornr* *%* *ID* *2296*

Freqyency corner where minimum power limit is used.

P2.17.12.1.4 *HighFreqLockOut* *%* *ID* *2308*

Below this limit power limitation is stopped.

P2.17.12.1.5 *HighFreqPowRatio* *%* *ID* *2309*

Power level in relation to actual power when ID2295 was exceeded to be used at ID2296 corner.

P2.17.12.1.6 HighFreqPLimRamp % ID 2298

Power limit increase ramp rate.

P2.17.12.1.7 HighFreqPReleDel ms ID 2299

Delay how long limit is kept after frequency is below ID2308.

5.16.8.2 High Voltage Power Limit

P2.17.12.2.1 Log In Voltage [%] ID2325

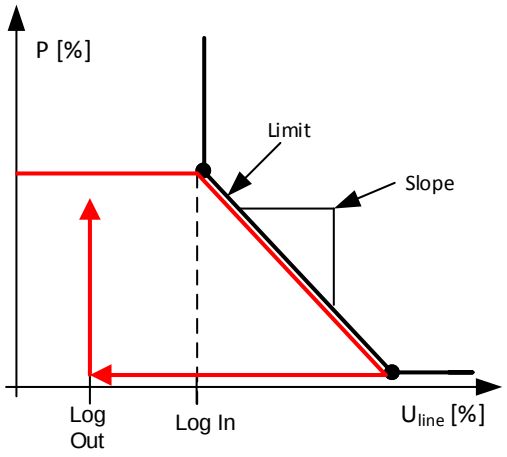
High voltage level when power will be started to limit by the defined slope. Power limit will not increase until voltage has gone below Log Out Voltage Level.

P2.17.12.2.2 Log Out Voltage [%] ID2326

Low Voltage Level where power limit is released if line voltage has increased above Log In Voltage Level

P2.17.12.2.3 Limit Slope [%/%] ID2327

Defines slope for the power limit when voltage goes above Log In Voltage. Function is disabled when this parameter is zero.



5.16.9 COS PHII CONTROL

P 2.17.13.1 CosPhiiRef ID 2304

Direct Cos Phii reference. If Lock In and Out is used this function is not active.
1000=unity, 100=min, neg=capacitive

5.16.9.1 Lock In and Out control

Cos Phii control is used at over voltage situations. Controller is activated when voltage is above Lock In Voltage and Active Current is more than 50 %. 1,0 ref at 50 % power and 0,9 ref at 100 % power.

P 2.17.13.2 LockInVoltage % ID 2305

Voltage level when Cos Phii control is started.

P 2.17.13.3 LockOutVoltage % ID 2306

Voltage level when Cos Phii control is stopped.

5.16.10 EXTERNAL INPUT

External input to make a trip and/or to activate separate frequency limits for tripping.

P 2.17.14.1 Ext GC Trip In ID 2310

Direct digital input to activate Grid Code trip function.

P 2.17.14.2 SeparateFLimMon ID 2311

Digital input to active more strict frequency trip limits.

P 2.17.14.3 SepFreqHighLim % ID 2313

Frequency high limit used to Grid Code trip when digital input defined by ID2311 is active.

P 2.17.14.4 SepFreqLowLim % ID 2313

Frequency low limit used to Grid Code trip when digital input defined by ID2311 is active.

5.16.11 LOW FREQUENCY POWER

Power increase function when frequency decreases. When activated and frequency goes low, drive will activate Power PI controller and start to increase power.

P2.17.15.1 Power Increase High Frequency 2334

Frequency when power is started to increased.

P2.17.15.2 Power Increase Slope 2335

Slope how steeply power is increased.

P2.17.15.3 Power Increase Max 2336

Limit for increased power.

5.16.12 GRID CODE OPTIONS

P 2.17.15 Grid Code Options

B00 = +1 = Activate this bit for Grid Code: GB/T 19964-2012.
B01 = +2 = For voltage level trips minimum of phase voltages is used.

P2.17.16.2 Voltage Filt. TC ms 2332

Filtering time constant for voltage that is used Grid Code monitoring.

P2.17.16.3 Frequency Filt. TC ms 2333

Filtering time constant for frequency that is used Grid Code monitoring.

P2.17.16.4 FRT Options 2400

P2.17.16.5 Vac Stop Offset % 2337

With this is possible to give offset for Grid Code voltage in stop state.

P2.17.16.6 Vac Run Offset % 2338

With this is possible to give offset for Grid Code voltage in run state.

P2.17.16.7 Power Follower Hysteresis ID1529

Power follower hysteresis.

6. KEYPAD CONTROL PARAMETERS

Unlike the parameters listed above, these parameters are located in the M3 menu of the control panel. The reference parameters do not have an ID number.

P3.1 Control Place ID125 "Control Place"

The active control place can be changed with this parameter. PC Control place can be only activated when from NCDrive when this parameter is set 2 / Keypad.

0 = PC Control, Activated by NCDrive

1 = I/O terminal

2 = Keypad

3 = Fieldbus

4 = SystemBus

On keypad control pressing Stop button more than a 2 second will open the MCB.

P3.2 License Key ID1995 "License Key"

Enter the licence key.

The standard AFE functions are available without a licence key. A licence key is not necessary for the frame FR4.

7. FB STATUS AND CONTROL IN DETAIL

P2.10.19 State machine	
1 / Basic	This mode makes fieldbus control operate as is explained in the fieldbus board manual.
2 / Standard	Simple control word that is used in modes where the control word from fieldbus is used as such. For some fieldbus boards this requires bypass operation.
3 / Vacon AFE 1	This mode uses a ProfiDrive type state machine in the application level. It is possible to use this mode on fieldbus boards that do not have a state machine or have a possibility to bypass the state machine function on the option board.

7.1 FB DC REFERENCE

Fieldbus DC reference is available when the Grid Converter is in fieldbus control.The format is the same as in panel references. (11000 = 110 %). If reference is not used from fieldbus, set the "FBSpeedReference" to zero. When FB reference is zero, the drive will use DC Voltage Reference from keypad parameter.

7.2 STATE MACHINE: BASIC

7.2.1 FB CONTROL WORD BASIC

Table 54.

	FB Control Word: Basic		
	FALSE	TRUE	Comment
b0	Stop Request	Start Request	Use this for start and stop command
b1			
b2	No Action	Fault Reset 0 > 1	Use this for fault reset
b3	Fieldbus DIN1=OFF	Fieldbus DIN1=ON	See P2.5.1.17 -18
b4	Fieldbus DIN2=OFF	Fieldbus DIN2=ON	See P2.5.1.19 -20
b5	Fieldbus DIN3=OFF	Fieldbus DIN3=ON	See P2.5.1.21 -22
b6	Fieldbus DIN4=OFF	Fieldbus DIN4=ON	See P2.5.1.23 -24
b7			
b8			
b9			
b10			
b11			
b12			
b13			
b14			
b15			

B00: FALSE = Stop Request, TRUE = Start Request
Stop Request: Drive will stop modulating
Start Request: Drive will start modulating, rising edge needed after fault situation.

B02: FALSE = No Action, TRUE = Fault Reset
Fault Reset: Resets active faults.

7.3 STATE MACHINE: STANDARD

7.3.1 CONTROL WORD: STANDARD

Table 55.

	FB Control Word Standard		
	FALSE	TRUE	Comment
b0	Open CB	Charge DC	
b1			
b2			
b3	Stop Request	Run Request	Use this for start and stop command
b4			
b5			
b6			
b7	No Action	Fault Reset 0 > 1	Use this for fault reset
b8			
b9			
b10			
b11	Fieldbus DIN1=OFF	Fieldbus DIN1=ON	See P2.5.1.17 -18 also WD Pulse
b12	Fieldbus DIN2=OFF	Fieldbus DIN2=ON	See P2.5.1.19 -20
b13	Fieldbus DIN3=OFF	Fieldbus DIN3=ON	See P2.5.1.21 -22
b14	Fieldbus DIN4=OFF	Fieldbus DIN4=ON	See P2.5.1.23 -24
b15			

B00: FALSE = Open CB, TRUE = Charge DC
Open CB: The drive will stop modulating and open main circuit breaker.
Charge DC: The drive will start to precharge if the function is activated by a digital output and the control place is fieldbus. When charging is ready, the main circuit breaker is closed depending on "CB Close Mode" and "Enable CB Close" status.
When the control place is not fieldbus, precharge is started at a normal start command.

B03: FALSE = Stop Request, TRUE = Start Request
Stop Request: The drive will stop.
Start Request: Start Command to the drive.

B07: FALSE = No Action, TRUE = Fault Reset
Fault Reset: Resets active faults.

7.4 STATE MACHINE: VACON AFE 1

7.4.1 CONTROL WORD: VACON AFE 1

	FB Control Word Vacon AFE 1		
	FALSE	TRUE	Comment
b0	Open CB	Charge DC	
b1			
b2			
b3	Stop Request	Run Request	Use this for start and stop command
b4			
b5			
b6			
b7	No Action	Fault Reset 0 > 1	Use this for fault reset
b8			
b9			
b10	Field Bus Control Disable	Fieldbus Control Enable	
b11	Watchdog pulse FALSE	Watchdog pulse TRUE	0>1>0>1...0.5 sec square wave clock. This is used to check data communication between fieldbus master and the drive.
b12	Fieldbus DIN2=OFF	Fieldbus DIN2=ON	See P2.5.1.19 -20
b13	Fieldbus DIN3=OFF	Fieldbus DIN3=ON	See P2.5.1.21 -22
b14	Fieldbus DIN4=OFF	Fieldbus DIN4=ON	See P2.5.1.23 -24
b15			

B00: FALSE = Open CB, TRUE = Charge DC
Open CB: The drive will stop modulating and open main circuit breaker.
Charge DC: The drive will start to precharge if the function is activated by a digital output and the control place is fieldbus. When charging is ready, the main circuit breaker is closed depending on "CB Close Mode" and "Enable CB Close" status.
When the control place is not fieldbus, precharge is started at a normal start command.

B03: FALSE = Stop Request, TRUE = Start Request
Stop Request: The drive will stop.
Start Request: Start Command to the drive.

B07: FALSE = No Action, TRUE = Fault Reset
Fault Reset: Resets active faults.

B10: FALSE = FB Control disabled TRUE = FB Control Enabled

FB Control Disabled: The drive will not follow the main control word from fieldbus. If removed while running, the drive will stop.
FB Control Enabled: The drive follows the control word from fieldbus.

B11: FALSE = FB WD Pulse Low, TRUE = FB WD Pulse High

Watchdog pulse: This pulse is used to monitor that PLC is alive. If the pulse is missing, the drive will go to FAULT state. This function is activated by P2.9.4.3 FB WD Delay. When the value is zero, the pulse is not monitored.

7.5 FB STATUS WORD

	FB Status Word ID68		
	FALSE	TRUE	Comment
b0	DC Charge Disabled	Ready to DC Charge	Drive own DC charge function disabled if FALSE
b1	Not ready to operate	Ready to operate	DC Charged and main CB closed.
b2	Not Running	Running	Drive in Run state
b3	No Fault	Fault	Fault Active
b4	Run Disabled	Run Enabled	Run Enable
b5	Quick stop active	Quick stop not active	Quick stop active
b6	CB Control OK	CB Control NOT OK	CB Requested open but DC stays high
b7	No Warning	Warning	Warning Active
b8	DC Act. <> DC Ref.	DC Act. = DC Ref.	DC at reference
b9	No FB Control request	FB Control Active	FB Control request accepted
b10	DC Below Limit	DC Above Limit	DC above set limit
b11	SW ID.Bit selection B11	P2.13.22 SW B11 ID.Bit	SW ID.Bit selection B11
b12	SW ID.Bit selection B12	P2.13.23 SW B12 ID.Bit	SW ID.Bit selection B12
b13	SW ID.Bit selection B13	P2.13.24 SW B13 ID.Bit	SW ID.Bit selection B13
b14	SW ID.Bit selection B14	P2.13.25 SW B14 ID.Bit	SW ID.Bit selection B14
b15	Watchdog feedback	Watchdog feedback	WD Feedback pulse

SM = Profibus board State Machine

B00: FALSE = DC Charge Disabled, TRUE = Ready to DC Charge
DC Charge Disabled: Fault active, CB requested open, for example, by "Open CB" Command or Quick Stop.
DC Charge Enabled: No fault active and no request to open CB.

B01: FALSE = Not Ready To Operate, TRUE = Ready To Operate
Not Ready To Operate: CB not closed or not allowed to close.
Ready To Operate: CB closed.

B02: FALSE = Drive is not operating, TRUE = Drive is operational
Drive is not operating: The drive is not in RUN state (not modulating)
Drive is operational: The drive is in RUN state and modulating.

B03: FALSE = No Fault, TRUE = Fault Present
No Fault: The drive is not on FAULT state.
Fault Present: The drive is in FAULT state.

B04: FALSE = Run Disabled, TRUE = Run Enabled
Run Disabled: The drive does not receive Run Enable command, for example from the Run Enable digital input.
Run Enabled: Run Command is enabled.

B05: FALSE = Quick Stop Activated, TRUE = Quick Stop Not Activated
Quick Stop Activated: Quick Stop command is active.
Quick Stop Not Activated: Quick stop command is not active.

B06: FALSE = CB Control OK, TRUE = CB Control Not OK
CB Control OK: CB control and the drive internal status are the same.
CB Control Not OK: The drive internal status to close the circuit breaker is high but the application logic requests for the circuit breaker to open. This can be the case when CB has been opened but DC is connected to battery system. DC must be discharged, or CB must close.

B07: FALSE = No Warning, TRUE = Warning Present
No Warning: There is no warning, or the warning has disappeared again.
Warning Present: The drive operates, but there is an active warning.

B08: FALSE = DC Voltage out of tolerance TRUE = DC Voltage within tolerance
DC Error Out Of Tolerance Range
DC Error Within Tolerance Range

B09: FALSE = No Control Requested, TRUE = Control Requested
No Control Requested: Control by the automation system is not possible, only possible at the device or by another interface.
Control Requested: The automation system is requested to assume control.

B10: FALSE = DC Not Reached, TRUE = DC Reached Or Exceeded
DC Not Reached: DC is below P2.5.7.4 DC Voltage Supervision Limit.
DC Reached Or Exceeded: DC is above P2.5.7.4 DC Voltage Supervision Limit.

B11: FALSE = SW ID.Bit selection B11, TRUE = SW ID.Bit selection B11
SW ID.Bit selection B11 Low: Selected bit is low.
SW ID.Bit selection B11 High: Selected bit is high.

B12: FALSE = SW ID.Bit selection B12, TRUE = SW ID.Bit selection B12
SW ID.Bit selection B12 Low: Selected bit is low.
SW ID.Bit selection B12 High: Selected bit is high.

B13: FALSE = SW ID.Bit selection B13, TRUE = SW ID.Bit selection B13
SW ID.Bit selection B13 Low: Selected bit is low.
SW ID.Bit selection B13 High: Selected bit is high.

B14: FALSE = SW ID.Bit selection B14, TRUE = SW ID.Bit selection B14
SW ID.Bit selection B14 Low: Selected bit is low.
SW ID.Bit selection B14 High: Selected bit is high.

B15: FALSE = FB DW Feedback Low, TRUE = FB DW Feedback High
FB DW Feedback: FB Control Word B11 is echoed back to the fieldbus. Can be used to monitor the communication status from the drive.

8. PROBLEM SOLVING

While proper information is needed form the problem, it is also recommended to try with latest application- and system software versions available. Software is continuously developed, and default settings are improved (See Chapter 1.13 Compatibility issues in parameters between versions).

Type	Signal Name	Actual	Unit	Mi
Value	Status Word	1890		0
Value	DC Voltage Act.	119,81		
Value	Active Current	0,3		
Value	Reactive Current	0		
Value	Line Voltage GC	100,42		80,00
Value	Line Freq. GC	100		80,00
Value	Line State	38912		0
Value	Mindex	99,5	%	0,0

Decimal
Bina

Figure 47. The recommended signals for NCDrive

Use the fastest communication speed (Baudrate: 57 600) and a 50 ms update interval for signals for the RS232 communication.

For the CAN communication, use a 1 Mbit communication speed and a 7 ms update interval for signals.

When you contact the support, send the *.trn, *.par and Service info (*.txt) files with a description of the situation. If the situation is caused by a fault, take also the Datalogger data from the drive.

Note that Datalogger settings can be changed to catch correct situation and it is also possible to make manual force trig for Datalogger.

Before storing the parameter file, upload the parameters from the drive and save when NCDrive is in the ON-LINE state. If it is possible, do this while the problem is active.

It is also helpful to have a single line diagram from the system where problem is faced.

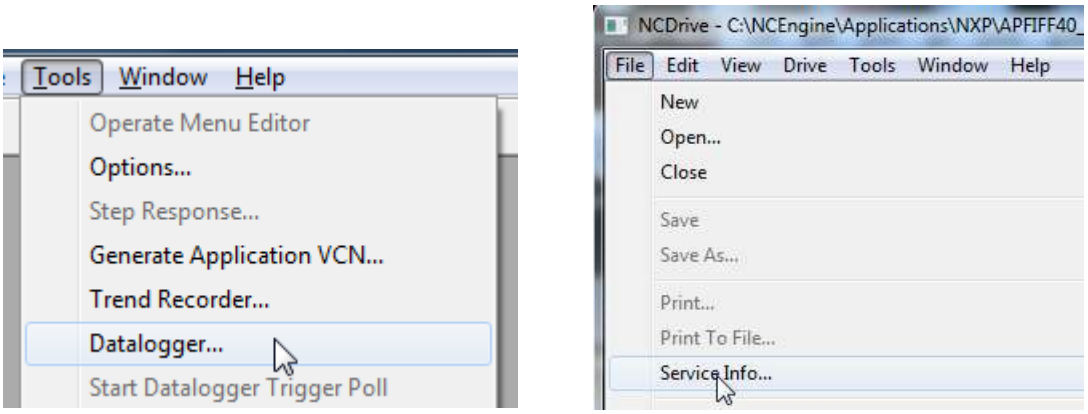


Figure 48. Datalogger window opening and Service Info upload.

9. FAULT CODES

This chapter includes all the fault codes. However, some faults are not possible in the AFE mode. With other faults, the description can be different when compared to a standard AC drive.

F1 Over current fault

The drive has detected a high current in the output phase.

S1 = Hardware trip.

Current above 4*Ih

S3 = Current controller supervision.

Current limit too low or current peak value too high.

Possible cause

- Sudden change in grid frequency.
- Sudden change in grid voltage.
- Short circuit in grid while Short Circuit function is not active.

Correcting measures

- Check grid conditions load.
- Activate Short Circuit function.

F2 Overvoltage fault

DC link voltage has exceeded the drive protection limits.

S1 = Hardware trip.

500 Vac unit DC voltage above 911 Vdc

690 Vac unit DC voltage above 1200 Vdc

S2 = Overvoltage control supervision (only 690 Vac unit).

DC voltage has been above 1100 Vdc for too long.

Possible cause and solutions

- Sudden change in supply voltage or frequency.
- Unstable DC power source in uGrid mode.
- Wrong Grid frequency.

Correcting measures

- Check supply voltage.
- Check DC source.
- Check grid conditions.

F3 Earth fault

Earth fault protection makes sure that the sum of the motor phase currents is 0. The over current protection is always working and protects the AC drive from earth faults with high currents.

S1 = Sum of output phase current is not zero.

Possible cause

- No transformer on the input/output side.
- Insulation failure.

Correcting measures

- Contact factory.

F5 Charge switch

Charge switch status is not correct when the start command is given.

S1 = Charge switch was open when the start command was given.

Possible cause

- Charge switch was open when the start command was given.
- Reset the fault and restart.

Correcting measures

- Check the connection of the feedback from charging relay
- If the fault re-occurs, contact your local distributor.

F6 Emergency stop

Emergency stop command has been given by using a special option board.

F7 Saturation fault

S1 = Hardware failure.

Possible cause and solutions

Correcting measures

- Check the isolation resistance and the resistance on the brake resistor.
- Check the capacitors.

F8 System Fault

A system fault indicates that there are several different fault situations in the drive operation.

S1 = Reserved

- Disturbance. Reset the unit and try again.
- If there is star coupler in the unit, check the fibre connections and phase order.
- Driver board or IGBT is broken.
- FR9 and the bigger drives, which includes not star coupler, ASIC board (VB00451), is broken.
- FR8 and smaller drives: control board is broken.
- FR8 and smaller drives: if there are boardsVB00449 / VB00450, the fault can be there.

S2 = Reserved

S3 = Reserved

S4 = Reserved

S5 = Reserved

S6 = Reserved

S7 = Charge switch

S8 = No power to driver card

S9 = Power unit communication (TX)

S10 = Power unit communication (Trip)

S11 = Power unit comm. (Measurement)

S12 = SystemBus synchronisation has failed in DriveSynch operation

S30 = Safe disable inputs are in different state (OPT-AF)

S31 = Thermistor short circuit detected (OPT-AF)

S32 = OPT-AF board has been removed

S33 = OPT-AF board EEPROM error

Possible cause and solutions

Correcting measures

F9 Undervoltage fault

DC link voltage is below the fault voltage limit of the drive.

S1 = DC link too low during the run.

S2 = No data from the power unit.

S3 = Undervoltage control supervision.

Possible cause

- Too low a supply voltage.
- AC drive internal fault.
- One of the input fuses is broken.
- External charge switch has not been closed.

Correcting measures

- In case of temporary supply voltage break, reset the fault and restart the AC drive.
- Check supply voltage.
- Check the operation of the DC charge.
- Contact your local distributor.

F10 Line Synchronization Fault

S1 = Phase supervision diode supply.

S2 = Phase supervision active front end.

S3 = Grid Converter operation, frequency outside frequency limits (G2.6.3).

Possible cause:

- Input line phase is missing.
- No grid to be synchronized
- Slow power increase in a grid and limit controllers has activated.
- Power or current limits too low for the active load.

Correcting measures

- Check supply voltage, fuses and cable.
- Check drive dimensioning against grid power requirements.
- Check that power or current limits are sufficient.

F11 Line phase supervision

Possible cause:

- Current measurement has detected that there is no current in one phase, or one phase current is considerably different from other phases.

Correcting measures

- Check the motor cable and the motor.

F12 Brake chopper supervision

Brake chopper supervision generates pulses to the brake resistor for response. If no response is received within set limits, a fault is generated.

Possible cause:

- No brake resistor is installed.
- The brake resistor is broken.
- Brake chopper failure.

Correcting measures:

- Check the brake resistor and the cabling.
- If these are ok, the chopper is faulty. Contact your local distributor.

F13 Drive undertemperature fault

Possible cause:

- Heatsink temperature is under −10°C

Correcting measures:

- Add cabinet heater to prevent too cold temperatures and condensation.

F14 Drive overtemperature fault

Possible cause:

- Heatsink temperature is above the acceptable limits. See the user manual for the temperature limit. Overtemperature warning is issued before the actual trip limit is reached.

Correcting measures

- Check correct amount and flow of cooling air.
- Check the heatsink for dust.
- Check ambient temperature.
- Make sure that switching frequency is not too high in relation to ambient temperature and motor load.

F22 EEPROM checksum fault

Possible cause:

- Parameter save fault.
- Faulty operation.
- Component failure.

Correcting measures:

- If the fault re-occurs, contact your local distributor.

F24 Counter fault

Possible cause:

- Values displayed on the counters are incorrect.

Correcting measures:

- Have a critical attitude towards values shown on the counters.

F25 Microprosessor watchdog fault

Possible cause:

- Start-up of the drive has been prevented.
- Run request is ON when a new application is loaded to the drive.

Correcting measures:

- Reset the fault and restart.
- If the fault re-occurs, contact your local distributor.

F26 Start-Up prevention

Possible cause:

- Start-up of the drive has been prevented.
- Run request is ON when a new application is loaded to drive

Correcting measures:

- Cancel the prevention of the start-up if this can be done safely.
- Remove Run Request.

F29 Thermistor fault

The thermistor input of the option board has detected too high a motor temperature.

Possible cause:

- LCL is overheated.
- Thermistor cable is broken.

Correcting measures:

- Check LCL cooling and load.
- Check thermistor connection (If thermistor input of the option board is not in use it has to be short circuited).

F31 IGBT temperature

IGBT Inverter Bridge overtemperature protection has detected too high a short term overload current.

Possible cause:

- Too high a load.
- Identification run has not been made, which causes the motor to start undermagnetised.

Correcting measures:

- Check the load.
- Check the motor size.
- Make an Identification Run.

F32 Fan cooling

Possible cause:

- Cooling fan of the AC drive does not start when ON command is given.

Correcting measures:

- Contact your local distributor.

F37 Device change

Option board or power unit is changed.

Possible cause:

- New device of same type and rating.

Correcting measures:

- Reset. The device is ready for use.

F38 Device added

Option board is added.

Correcting measures:

- Reset. The device is ready for use. Old board settings will be used.

F39 Device removed

Possible cause:

- Option board is removed.

Correcting measures:

- Reset. The device is no longer available.

F40 Device unknown

An unknown option board or drive.

S1 = Unknown device.

S2 = Power1 not same type as Power2.

Correcting measures:

- Contact your local distributor.

F41 IGBT temperature

IGBT inverter bridge overtemperature protection has detected too high a short term overload current.

Correcting measures:

- Check the load.
- Check the motor size.
- Make an Identification Run.

F42 Brake resistor overtemperature

S1: Brake resistor high temperature.

Calculation for an internal brake resistor has exceeded the tripping limit. If the internal brake resistor is not in use, set the brake chopper parameter in System menu to *Not connected*.

S2: Brake resistor resistance is too high.

S3: Brake resistor resistance is too low.

S4: No brake resistor detected.

F44 Device changed (Default param.)

Possible cause:

- Option board or power unit is changed.
- New device of different type or different rating from the previous one.

Correcting measures:

- Reset.
- Set the option board parameters again if option board was changed. Set the drive parameters again if the power unit was changed.

F45 Device added (default param.)

Possible cause:

- Option board of different type added.

Correcting measures:

- Reset.
- Set the option board parameters again.

F50 4mA supervision

Possible cause:

- Current at the analogue input is below 4mA.
- Signal source has failed.
- Control cable is broken or loose.

Correcting measures:

- Check the current loop circuitry.

F51 External fault

Possible cause:

- Digital input fault.

Correcting measures:

- Remove fault situation from the external device.

F52 Keypad communication

Possible cause:

- The connection between the control panel (Keypad) or NCDrive and the AC drive is broken.

Correcting measures:

- Check control panel connection and possible control panel cable.

F53 Fieldbus communication fault on slot D

Possible cause:

- The data connection between the fieldbus Master and the fieldbus board is broken.
- Watchdog pulse is missing from PLC, if Control Slot selector is 0, or set for slot D.

Correcting measures:

- Check installation.
- If installation is correct, contact your local distributor.

F54 Slot fault

Possible cause:

- Defective option board or slot.

Correcting measures:

- Check the board and the slot.
- Contact your local distributor.

F56 PT100 temperature fault

The PT100 protection function is used to measure temperature and give a warning and/or a fault when the set limits are exceeded. The marine application supports two PT100 boards. One can be used for the motor winding and the other for the motor bearings.

Possible cause:

- Temperature limit values set for the PT100 board parameters have been exceeded.

Correcting measures:

- Find the cause of temperature rise.

F57 Identification (Not implemented)

Identification run has failed.

Possible cause:

- There was load on the motor shaft when making the identification run with a rotating motor.
- Motoring or generator side torque/power limits are too low to achieve a stable run.

Correcting measures:

- Run command was removed before the identification was ready.
- Motor is not connected to the AC drive.
- There is load on the motor shaft.

F58 Mechanical brake (Not implemented)

This fault is generated when the acknowledge signal from the brake is used. If the status of the signal is opposite from the control signal for a longer period of time than the delay defined with P2.15.11 *Brake Fault Delay*, a fault is generated.

Correcting measures:

- Check the condition and connections of the mechanical brake.

F59 SystemBus communication

The master drive sends pulses to all follower drives. If the pulses are missing, a system bus communication fault is generated. The master drive also receives pulses back from the follower drives (max. four drives) and generates warnings if pulses are missing.

SystemBus communication is broken between master and follower.

Correcting measures:

- Check expander board parameters.
- Check optical fibre.
- Check option board jumpers.

F60 Cooling

Protection for the liquid-cooled units. An external sensor is connected to the drive (DI: Cooling Monitor) to indicate if cooling liquid is circulating. If the drive is in STOP state, only a warning is issued. In RUN state a fault is issued and the drive makes a coast stop.

Possible cause:

- The cooling circulation of a liquid-cooled drive has failed.

Correcting measures:

- Check reason for cooling failure from the external system.

F62 Run Disabled

A Run Disable warning signal is issued when a Run Enable signal has been removed from the I/O.

F63 Quick stop

Possible cause:

- A command has been given from a digital input or the fieldbus to make a quick stop.

Correcting measures:

- A new run command is accepted after the quick stop is reset.

F64 MCB State Fault

This function monitors the MCB status. Feedback status should correspond to the control signal. The delay to fault is defined by P2.9.1.13 MCB Fault Delay for A2 and A3. A4 is immediately.

A1: Code given by V084 and older versions.

A2: MCB open while request is to close.

A3: MCB closed while request is to open.

A4: MCB opened externally while AFE unit was in run state.

Possible cause:

- Main circuit breaker has opened while drive controls it to close.
- Main circuit breaker has closed while drive controls it to be open.

Correcting measures:

- Check the main circuit breaker function.

F65 PT100 board 2

The PT100 protection function is used to measure temperature and give a warning and/or a fault when the set limits are exceeded. The marine application supports two PT100 boards. One can be used for the motor winding and the other for the motor bearings.

Possible cause:

- The temperature limit values set for the PT100 board parameters have been exceeded.
- The number of inputs selected is higher than what is actually connected.
- PT100 cable is broken.

F67 Fieldbus communication fault on slot E

Possible cause:

- The data connection between the fieldbus Master and the fieldbus board is broken.
- Watchdog pulse is missing from PLC, if Control Slot Selector is 0, or set for slot E.

Correcting measures:

- Check installation.
- If installation is correct contact your local distributor.

F68 D7 Voltage or frequency fault

This monitors Grid frequency and voltage for synchronization function.

Possible cause:

- OPT-D7 measurements are not within limits.

F69 OPT-D7 Missing

OPT-D7 board is not present for the function that is requested.

Possible cause:
Correcting measures:

F70 Supply Voltage

Supply voltage is not inside of set hysteresis. Not to be confused with OPT-D7 protections.

F71 LCL Temperature

LCL Temperature has reached the warning limit.
Possible cause:
Correcting measures:

F72 License

Licence has not been given or licence key is wrong
Possible cause:
Correcting measures:

F73 Supply Frequency

Supply frequency is not inside of set hysteresis, set in G2.9.7. Not to be confused with OPT-D7 protections that will give F93 D7 Frequency.

Possible cause:

- Slow power increase in a grid and limit controllers activated.
- Power or current limits too low for the active load.
- Not sufficient DC voltage to keep grid voltage, compensated by lowering Supply Frequency to avoid reactive current.

Correcting measures

- Check drive dimensioning against grid power requirements.
- Check that power or current limits are sufficient.
- Check that sufficient DC voltage is available for the unit.

F80 Charging Fault

The drive has not reached the required DC voltage at time set to MCB.

Possible cause:

- Charging circuit not operational.
- High load in DC link.
- Low voltage in supply for charging circuit.

Correcting measures:

- Check charging current

F81 External Fault 2

Digital input fault.

Possible cause:

Correcting measures:

- Remove fault situation from external device.

F82 Start Failed

MF mode second drive has not stared within set time.
Possible cause:
Correcting measures:

F83 Over Load

Over Load protection has reached tripping limit. See Chapter 5.9.9 Over Load Protection.

F89 Grid Side Fault

In Master-Follower Mode Grid side drive has an active fault that is shown in master drive as a fault.
Possible cause:
Correcting measures:

F91 Short Circuit

Drive has operated against current limit for more than short circuit time.
By phase fault detection has seen low voltage for more than short circuit time.
Warning comes immediately when current is at current limit, fault comes after the short circuit time.

A1: Code given by V089 and older versions.

A2: Bi Phase

A3: Three Phase

Possible cause:

- There is a short circuit in the grid.

Correcting measures:

F92 D7 Voltage

Measured voltage is not within limits set in the protection group Grid Voltage D7

Possible cause:

- Voltage reference is below set limit.
- Supply Voltage is below set limit.
- There is a short circuit in the grid.
- OPT-D7 is installed but not connected.
    - Monitoring can be disabled with Control Options.

F93 D7 Frequency

Measured frequency is not within limits set in protection group Grid Frequency.

Possible cause:

- OPT-D7 is installed but measurements are not connected.
    - Monitoring can be disabled with Control Options.
- Grid frequency has gone outside the set limits.

F95 Grid Code

Grid Code tripping limit has been reached.

A1: Grid Code license wrong or not give.
A2: Line Voltage High Level 1
A3: Line Voltage High Level 2
A4: Line Voltage Low Level 1
A5: Line Voltage Low Level 2
A6: Line Frequency High Level 1
A7: Line Frequency High Level 2
A8: Line Frequency Low Level 1
A9: Line Frequency Low Level 2
A10: LVRT Three Phase trip.
A11: LVRT Bi-Phase trip
A12: Separate limits or forded trip
A13: Line Frequency change rate trip.

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Document ID:
DPD01978A
Rev. A

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