



Emotron AFR/AFG 2.0

AFR - Low harmonic/Regenerative Active Front End

AFG - Active Front End for renewable generation



Instruction manual

English

2019-10-14

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Instruction manual - English

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Safety Instructions

Instruction manual

Read this instruction manual before using the system.

The following symbols can appear in this manual. Always read these first before continuing:

NOTE:

Additional information as an aid to avoid problems.

**CAUTION!**

Failure to follow these instructions can result in malfunction or damage to the active front end or motor inverter.

**WARNING!**

Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the active front end or motor inverter.

**HOT SURFACE!**

Failure to follow these instructions can result in injury to the user.

Handling the Active front end unit

Installation, commissioning, demounting, taking measurements, etc, of or on the active front end may only be carried out by personnel technically qualified for the task. The installation must be carried out in accordance with local standards.

Opening the Active front end unit

**WARNING!**

Always switch off the mains voltage before opening the drive unit and wait at least 7 minutes to allow the buffer capacitors to discharge.

Always take adequate precautions before opening the active front end. Although the connections for the control signals and the switches are isolated from the main voltage, do not touch the control board when the active front end is switched on.

Precautions to be taken with a connected load (motor)

If work must be carried out on a connected load (motor) or on the driven machine, the mains voltage must always be disconnected from the active front end first. Wait at least 7 minutes before starting work.

Earthing

The active front end must always be earthed via the mains safety earth connection.

Earth leakage current

**CAUTION!**

This active front end has an earth leakage current which does exceed 3.5 mA AC.

Therefore the minimum size of the protective earth conductor must comply with the local safety regulations for high leakage current equipment which means that according to the standard IEC61800-5-1 the protective earth connection must be assured by one of following conditions:

PE conductor cross-sectional area shall for phase cable size $\leq 16 \text{ mm}^2$ (6 AWG) be $>10 \text{ mm}^2$ Cu (16 mm^2 Al) or use a second PE conductor with same area as original PE conductor.

For cable size above 16 mm^2 (6 AWG) but smaller or equal to 35 mm^2 (2 AWG) the PE conductor cross-sectional area shall be at least 16 mm^2 (6 AWG).

For cables $>35 \text{ mm}^2$ (2 AWG) the PE conductor cross-sectional area should be at least 50 % of the used phase conductor.

When the PE conductor in the used cable type is not in accordance with the above mentioned cross-sectional area requirements, a separate PE conductor should be used to establish this.

Residual current device (RCD) compatibility

This product cause a DC current in the protective conductor. Where a residual current device (RCD) is used for protection in case of direct or indirect contact, only a Type B RCD is allowed on the supply side of this product. Use RCD of 300 mA minimum.

EMC Regulations

In order to comply with the EMC Directive, it is absolutely necessary to follow the installation instructions. All installation descriptions in this manual follow the EMC Directive.

Mains voltage selection

The active front end may be ordered for use with the mains voltage range listed below.

VFXR/FDUL/AFR46: 380-460 V

VFXR/FDUL/AFR69: 480-690 V

VFXG/FDUG/AFG46: 380-460 V

VFXG/FDUG/AFG69: 480-690 V

Voltage tests (Megger)

Do not carry out voltage tests (Megger) on the motor, before all the motor cables have been disconnected from the active front end and variable speed drive.

Condensation

If the active front end or motor inverter is moved from a cold (storage) room to a room where it will be installed, condensation can occur. This can result in sensitive components becoming damp. Do not connect the mains voltage until all visible dampness has evaporated.

Incorrect connection

The Active front end or motor inverter drive is not protected against incorrect connection of the mains voltage, and in particular against connection of the mains voltage to the motor outputs U, V and W. The Active front end or motor inverter can be damaged in this way.

Power factor capacitors for improving $\cos\phi$

Remove all capacitors from the motor and the motor outputs.

Precautions during Auto-reset

When the automatic reset is active, the motor will restart automatically provided that the cause of the trip has been removed. If necessary take the appropriate precautions.

Transport

To avoid damage, keep the active front end and motor inverter in its original packaging during transport. This packaging is specially designed to absorb shocks during transport.

IT Mains supply

The Active front end can be modified for an IT mains supply, (non-earthed neutral), please contact your supplier for details.

Heat warning



Be aware of specific parts on the Active front end and motor inverter having high temperature.

DC-link residual voltage



WARNING!

After switching off the mains supply, dangerous voltage can still be present in the Active front end-AFR/AFG or motor inverter-AC drive. When opening the equipment for installing and/or commissioning activities wait at least 7 minutes. In case of malfunction a qualified technician should check the DC-link or wait for one hour before dismantling the AFR/AFG or AC drive for repair.

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1. Introduction

NOTE:

Read this instruction manual carefully before starting installation, connection or working with the active front end or motor inverter.

Users

This instruction manual is intended for:

- installation engineers
- maintenance engineers
- operators
- service engineers

Active front end loads

Active front end is suitable for connecting to three phase electrical networks where it allows bi-directional power flow to DC load or from DC power source.

Motors

Motor inverter (VSI) is suitable for use with standard 3-phase asynchronous motors. Under certain conditions it is possible to use other types of motors. Contact your supplier for details.

1.1 Delivery and unpacking

Check for any visible signs of damage. Inform your supplier immediately of any damage found. Do not install the active front end or motor inverter if damage is found.

1.2 Using of the instruction manual

Within this instruction manual the abbreviation "AFR" and "AFG" is used in the following sense:

AFR: To indicate the complete active front end for low harmonic and regenerative applications with no grid code support.

AFG: To indicate the complete active front end for generation applications with full/advanced grid code functionality.

For detail see section 2.1 page 12.

Check that the software version number on the first page of this manual matches the software version in the active front end. See section 11.10.1 page 120 for more information

With help of the Index and the Table of contents in this manual, it is easy to track individual functions and to find out how to use and set them.

1.3 Type code number

Fig. 1 gives an example of the type code numbering used on all active front ends. With this code number the exact type of the drive can be determined. This identification will be required for type specific information when mounting and installing. The code number is located on the product label, on the front of the unit.

AFG46-175-20 C E B S – A – N N N N N - A																	
Position number:																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18

Fig. 1 Type code number

Position	Configuration	
1	AFE type	AFR = "AFR" AFG = "AFG"
2	Supply voltage	46=400 V mains 69=690 V mains
3	Rated current (A) continuous	-175=175 A - -1K5=1500 A
4	Protection class	20=IP20 54=IP54
5	Control panel	--=Blank panel C=2-line panel D=4-line panel E=4-line panel + BLE
6	EMC option	E=Standard EMC (Category C3) F=Extended EMC (Category C2) I=IT-Net
7	Brake chopper option	- =No chopper B=Chopper built in
8	Stand-by power supply option	--=No SBS S=SBS included
9	Safe stop option	- =No safe stop T=Safe stop incl.
10	Brand label	A=Standard
11	Coated boards, option	- =Standard boards V=Coated boards
12	Option position 1	N=No option P=PTC/PT100 I=Extended I/O
13	Option position 2	
14	Option position 3	

Position	Configuration	
15	Option position, Communication	N=No option D=DeviceNet P=Profibus S=RS232/485 M=Modbus/TCP E= EtherCAT A=Profinet IO 1-port B=Profinet IO 2-port G= EtherNet/IP 2-port
16	Software type	A=Standard AFR/AFG
17	CE Approved	-
18	Cooling type	L=Liquid cooled A=Air cooled

1.4 Standards

The active front ends and variable speed drives described in this instruction manual comply with the standards listed in Table 1. For the declarations of conformity and manufacturer's certificate, contact your supplier for more information or visit www.cgglobal.com or www.emotron.com.

1.4.1 Product standard for EMC

Product standard EN(IEC)61800-3, second edition of 2004 defines the:

First Environment (Extended EMC) as environment that includes domestic premises. It also includes establishments directly connected without intermediate transformers to a low voltage power supply network that supplies buildings used for domestic purposes.

Category C2: Power Drive System (PDS) of rated voltage <1.000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by a professional.

Second environment (Standard EMC) includes all other establishments.

Category C3: PDS of rated voltage <1.000 V, intended for use in the second environment and not intended for use in the first environment.

Category C4: PDS or rated voltage equal or above 1.000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

The active front end complies with the product standard EN(IEC) 61800-3:2004 (Any kind of metal screened cable may be used). The active front end is designed to meet the requirements according to category C3.

By using the optional "Extended EMC" filter the active front end fulfils the requirements according to category C2.

For the distributive regeneration applications, Emotron AFG also complies with TR-61000-3-15.



WARNING!

In a domestic environment this product may cause radio interference, in which case it may be necessary to take adequate additional measures.



WARNING!

The AC drive, complying with category C3, is not intended to be used on a low-voltage public network which supplies domestic premises; radio interference is expected if used in such a network. Contact your supplier if you need additional measures.

Table 1 Standards

Market	Standard	Description
European	EMC Directive	2014/30/EU
	Low Voltage Directive	2014/35/EU
	WEEE Directive	2012/19/EU
	Grid connection of generators	2016/631/EC
All	EN 60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements.
	EN(IEC) 61000-6-2 EN(IEC) 61000-6-4	Electromagnetic compatibility (EMC) Part 6-2: Generic standards - Immunity standard for industrial environments. Part 6-4: Generic standards - Emission standard for industrial environments.
	EN(IEC)61800-3:2004	Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods. EMC Directive: Declaration of Conformity and CE marking
	IEC/TR 61000-3-15	Electromagnetic compatibility (EMC) - Part 3-15: Limits assessment of low frequency electromagnetic immunity and emission requirements for dispersed generation system in LV network.
	EN(IEC)61800-5-1 Ed. 2.0	Adjustable speed electrical power drive systems Part 5-1. Safety requirements - Electrical, thermal and energy. Low Voltage Directive: Declaration of Conformity and CE marking
	IEC 60721-3-3	Classification of environmental conditions. Air quality chemical vapours, unit in operation. Chemical gases 3C2, Solid particles 3S2. Optional with coated boards Unit in operation. Chemical gases Class 3C3, Solid particles 3S2.
	IEC-50549	IEC-50549-1 Requirements for generating plants to be connected in parallel with distribution networks Part 1: Connection to a LV distribution network above 16 A. IEC-50549-2 Requirements for generating plants to be connected in parallel with distribution networks Part 2: Connection to a MV distribution network.
	IEC-62116	IEC 62116:2014 Utility-interconnected photovoltaic inverters - Test procedures of islanding prevention measures.

1.5 Dismantling and scrapping

The enclosures of the drives are made from recyclable material as aluminum, iron and plastic. Each drive contains a number of components demanding special treatment, for example electrolytic capacitors. The circuit boards contain small amounts of tin and lead. Any local or national regulations in force for the disposal and recycling of these materials must be complied with.

1.5.1 Disposal of old electrical and electronic equipment

This information is applicable in the European Union and other European countries with separate collection systems.



This symbol on the product or on its packaging indicates that this product shall be taken to the applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potentially negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. The recycling of materials will help to conserve natural resources. For more detailed information about recycling this product, please contact the local distributor of the product.

1.6 Glossary


1.6.1 Abbreviations and symbols

In this manual the following abbreviations are used:

Table 2 Abbreviations

Abbreviation/ symbol	Description
AC drive	Frequency converter
AFE	Active front end (electronics, control board and power module part)
AFG	Active front end for generation with full/advanced grid code functionality
AFR	Low harmonic/regenerative front end with no grid support
AID	Anti-Islanding detection
BLE	Blue tooth
Comm	Command sourced from serial communication
CP	Control panel, the programming and presentation unit on the AC drive
DFE	Diode front end
DPF	Displacement power factor
EInt	Communication format
FDUG	Complete power drive train, including AFG and VSI (FDU)
FDUL	Low harmonic FDU drive, including AFR and VSI (FDU)
FRT	Fault-ride through
GC	Grid Code
Int	Communication format (Integer)
Keyb	Command sourced from keyboard
LCL-filter	Inductance - Capacitance - Inductance type filter
LFSM-O	Limited frequency sensitivity mode - over-frequency
Long	Communication format (4 byte integer)
OFRT	Over-frequency ride-through
OVRT	Over-voltage ride-through
PLL	Phase locked loop
ROCOF	Rate of change of frequency
SVMB	Supply voltage measurement board
THD	Total harmonic distortion
UFRT	Under-frequency ride-through
UInt	Communication format (Unsigned integer)
UVRT	Under-voltage ride-through

Table 2 Abbreviations

Abbreviation/ symbol	Description
VFXG	Complete power drive train, including AFG and VSI (VFX)
VFXR	Regenerative VFX drive, including AFR and VSI (VFX)
VSI	Voltage source inverter (motor inverter)
	The function cannot be changed in run mode

1.6.2 Definitions

In this manual the following definitions for current, torque and frequency are used:

Table 3 Definitions

Name	Description	Quantity
I_{IN}	Nominal input current of AFR/AFG	A_{RMS}
I_{NOM}	Nominal output current of VSI	A_{RMS}
I_{MOT}	Nominal motor current	A_{RMS}
P_{NOM}	Nominal power of VSI	kW
P_{MOT}	Motor power	kW
T_{NOM}	Nominal torque of motor	Nm
T_{MOT}	Motor torque	Nm
f_{OUT}	Output frequency of VSI	Hz
f_{MOT}	Nominal frequency of motor	Hz
n_{MOT}	Nominal speed of motor	rpm
I_{CL}	Maximum output current	A_{RMS}
Speed	Actual motor speed	rpm
Torque	Actual motor torque	Nm

2. General description

The Emotron active front end (AFE) is a regenerative active front end unit designed to be used either in combination with Emotron motor inverter (VSIs) i.e. VFX/FDU or without Emotron motor inverter (VSIs). The main objective of the Emotron AFE is to rectify the supply AC voltage into DC voltage to be fed to or regenerated from the VSIs. This is achieved with the minimal impact on the supply by the control of the active rectifier module which provides sinusoidal input currents with a very low harmonic content, typically a THD(I) below 5%. Different variants of Emotron active front end drives are:

- AFR: Regenerative, low harmonic active front end without Emotron motor inverter.
- AFG: Regenerative, low harmonic active front end without Emotron motor inverter. AFG offers full/advance grid support functionality.
- FDUL: Non-regenerative, low harmonic drive including active front end (AFR) together with Emotron motor inverter FDU.
- VFXR: Regenerative, low harmonic drive including active front end (AFR) together with Emotron motor inverter VFX.
- FDUG: Regenerative, low harmonic drive including active front end for generation (AFG) together with Emotron motor inverter FDU. FDUG offers full/advance grid support functionality.
- VFXG: Regenerative, low harmonic drive including active front end for generation (AFG) together with Emotron motor inverter VFX. VFXG offers full/advance grid support functionality.



CAUTION!
Always consult CG Drives & Automation
before connecting an Emotron AFR/AFG to a
standard VSI.

2.1 AC drive types

2.1.1 Standard AC drive (as comparison)

A standard AC drive consists of a rectifier module and an inverter module. The rectifier module (front-end) consists of a 6-pulse diode bridge, i.e. diode front-end (DFE) while the inverter module (VSI) consists of IGBTs with anti-parallel free wheeling diodes, see Figure 2. The main advantages of DFEs are the simple and robust design together with their high efficiency, i.e. low losses. The main disadvantages are unidirectional power flow and the high harmonic content in the line current, typically THD 30- 40%.

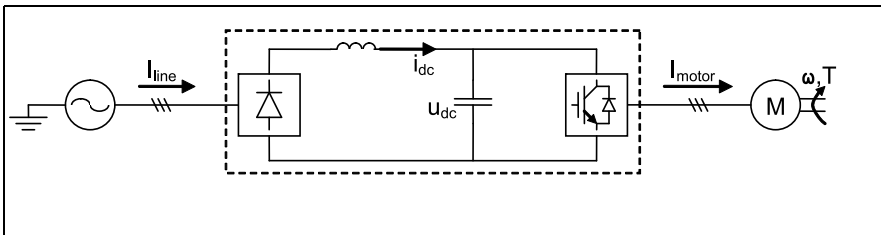


Fig. 2 Standard AC drive.

2.1.2 AC drive with AFR or AFG (FDUL/VFXR/FDUG/VFXG)

An AFE unit is basically a VSI towards the supply (via a filter) where the IGBTs are used as an active rectifier, see Figure 3. The main advantages are inherent 4Q-operation, i.e. bi-directional power flow, and sinusoidal supply currents, i.e. low harmonics, regeneration and improved power factor.

The AFE unit is controlled in such a way to keep the energy between motor and supply in balance. This is achieved by controlling the DC-link voltage (U_{dc}). Other features are the possibility for reactive power compensation and boosted DC-link voltage.

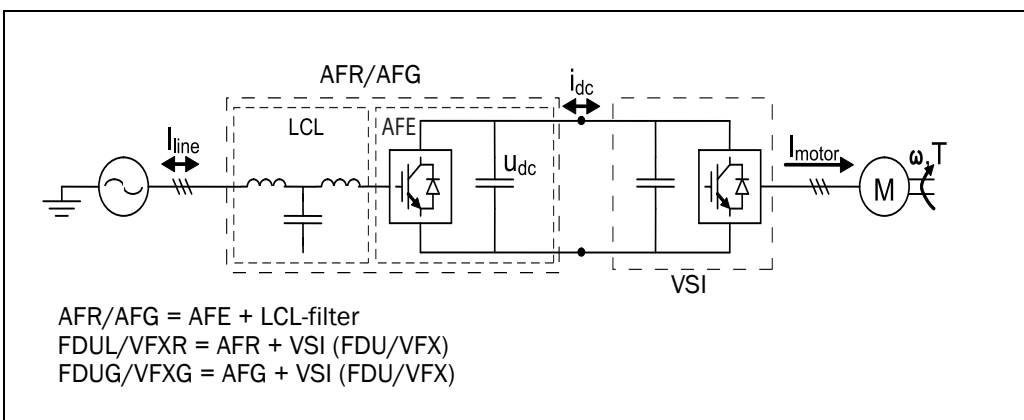


Fig. 3 VSI with AFR/AFG.

2.1.3 AFR

AFR consists of Emotron power electronic module (AFE) connected to grid through LCL filter as shown in Figure 4. The main objective of the Emotron AFR is to rectify the supply AC voltage into the DC voltage to be fed to or regenerated from the VSIs (motor inverter). It also keeps the harmonic content of the current exchanged with grid at low level, maintaining the THD(I) below 5%. AFR offers standard AFE functionality such as:

- Active power control.
- Reactive power control.
- Low harmonic operation.

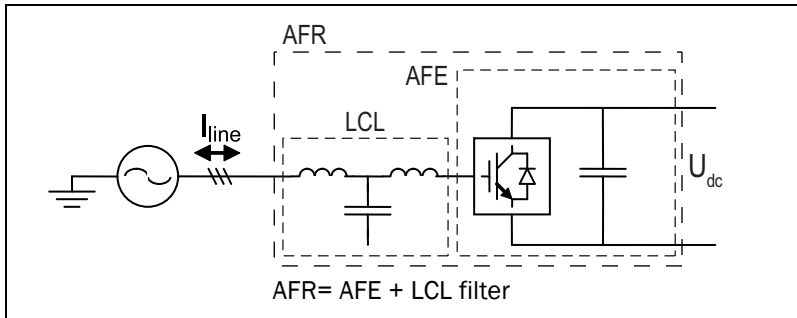


Fig. 4 AFR

2.1.4 AFG

AFG is an AFE variant that offers full/advance grid code functionality. This variant (AFG) is dedicated for generation applications where generated energy (through DC-link) is fed into the utility grid. AFG consists of Emotron power electronic module (AFE) including voltage measurement board and brake chopper switch (optional) connected to grid through LCL filter as shown in Figure 5. Main objective of AFG is to feed in generated power from DC-link to utility grid fulfilling the grid code requirements. AFG offers standard AFE functionality along with full grid support features such as:

- Grid voltage and frequency (U, F) protection.
- Reactive power (Q) control.
- Anti-islanding protection.
- Grid fault ride through (FRT) capability.

NOTE:

Supply voltage measurement board is mandatory requirement for fulfilling the basic and advanced grid code functionality. AFG has internal supply voltage measurement board (SVMB) connected to K2.

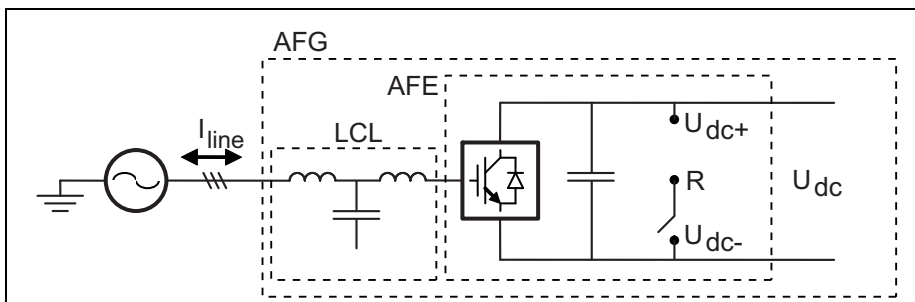


Fig. 5 AFG

2.2 Emotron single drive cabinet concept

2.2.1 FDUL/VFXR/FDUG/VFXG (single drive) applications

The Emotron low harmonic and regenerative AC drive i.e. FDUL/VFXR/FDUG/VFXG is comprised by an AFR or AFG unit i.e. AFE and filters and a VSI, i.e. Emotron VFX or FDU. The concept is designed as a cabinet solution, see Figure 6.

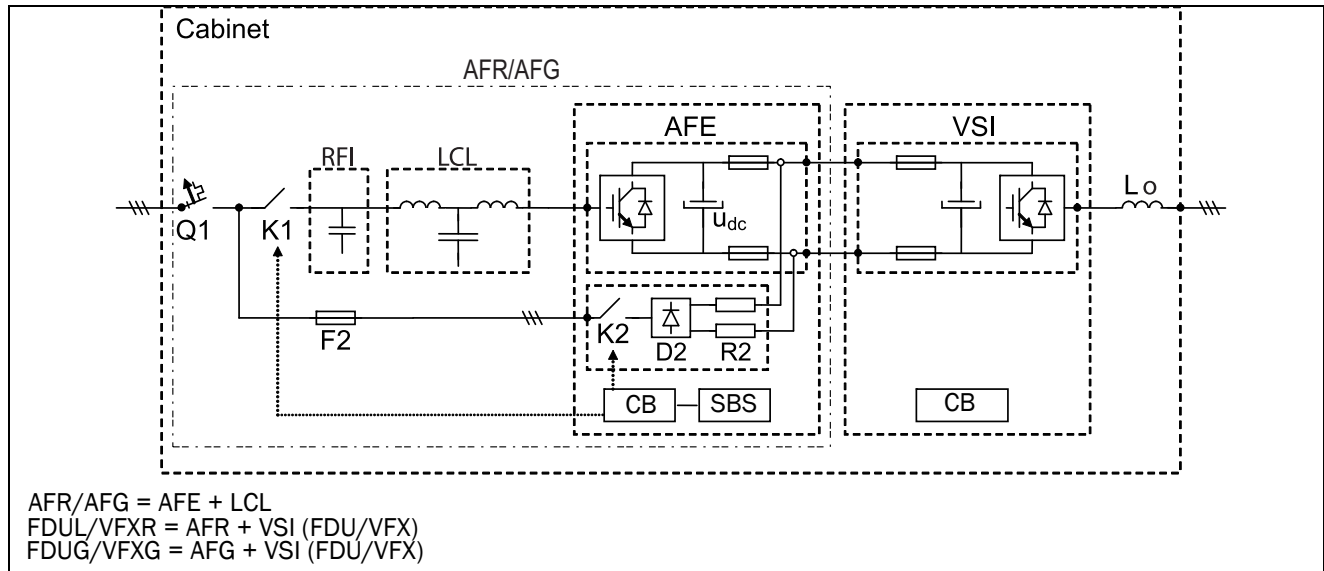


Fig. 6 Single drive in cabinet

where

- Cabinet - IP54 cabinet with door fans
- Q1 - Main switch *
- K1 - Main contactor *
- RFI - EMC filter
- LCL - LCL filter
- F2 - MCB (Miniature circuit breaker) for pre-charge circuit
- AFE - Emotron AFE module with 24V standby supply board, voltage measurement board (optional), brake chopper switch (optional) and integrated pre-charge circuit (K2,D2,R2)
- AFR/AFG - Emotron AFE and filters
- VSI - DC-voltage fed VSI module, i.e. Emotron VFX or FDU
- CB - Control board
- SBS - Standby supply board
- Lo - Output coil

* For larger units, Q1 Main switch and K1 Main contact are replaced by Q1 Motorized circuit breaker.

NOTE:

For AFG/FDUG/VFXG, supply voltage measurement board (SVMB) is mandatory. It is mounted and connected internally to K2.

2.2.2 Common DC-bus applications

For common DC-bus applications, the cabinet will contain only the AFR/AFG part of Figure 6, i.e. all except the VSI & Lo.

2.3 Emotron AFR/AFG concept

Emotron also offers only AFR/AFG solution for the applications where complete FDUL/VFXR/FDUG/VFXG drive train is not required. In this concept, the DC power load/source is connected to the DC-terminals of AFR/AFG. AFR/AFG consists of AFE power electronic module and LCL filters as main components along with other necessary components. AFR/AFG concept is shown in Figure 7.

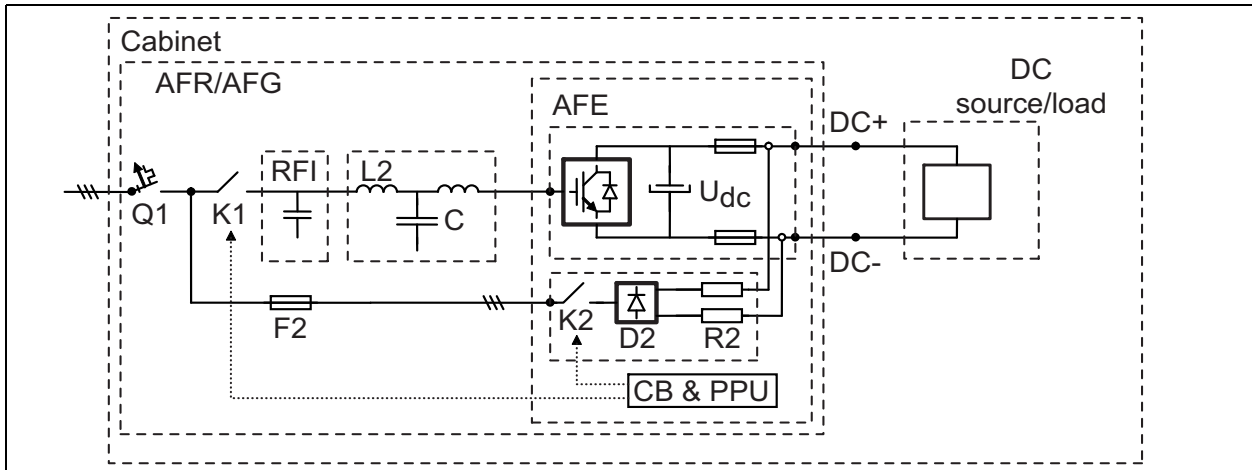


Fig. 7 AFR/AFG concept

where

- Cabinet - outer cabinet (for example IP54)
- Q1 - Main switch *
- K1 - Main contactor *
- RFI - EMC filter
- LCL - LCL filter
- F2 - MCB (Miniature circuit breaker) for pre-charge circuit
- AFE - Emotron AFE module with 24V standby supply board, voltage measurement board (optional for AFR and mandatory for AFG), optional brake chopper switch and integrated pre-charge circuit (K2, D2, R2)
- AFR/AFG - Emotron AFE and filters
- DC source/load - External DC power source or load based on the application.
- CB - Control board
- SBS - Standby supply board

* For larger units, Q1 Main switch and K1 Main contact are replaced by Q1 Motorized circuit breaker.

NOTE:

For AFG/FDUG/VFXG, supply voltage measurement board (SVMB) is mandatory. It is mounted and connected internally to K2.

3. Mounting

This chapter describes how to mount the AC drive. Before mounting it is recommended that the installation is planned first.

- Be sure that the AC drive suits the mounting location.
- The mounting site must support the weight of the AC drive.
- The AC drive shall be mounted in vertical position.
- Will the AC drive continuously withstand vibrations and/or shocks?
- Check ambient conditions, ratings, required cooling air flow, compatibility of the motor, etc.
- Know how the AC drive will be lifted and transported.

3.1 Lifting instructions

The easiest way to move or lift the equipment is to use the lifting eyes on top of the cabinet, see Fig. 8.

When lifting, be careful not to damage the air outlets.

Note:

To prevent personal risks and any damage to the unit during lifting, it is advised to use the lifting eyes on top of the equipment.

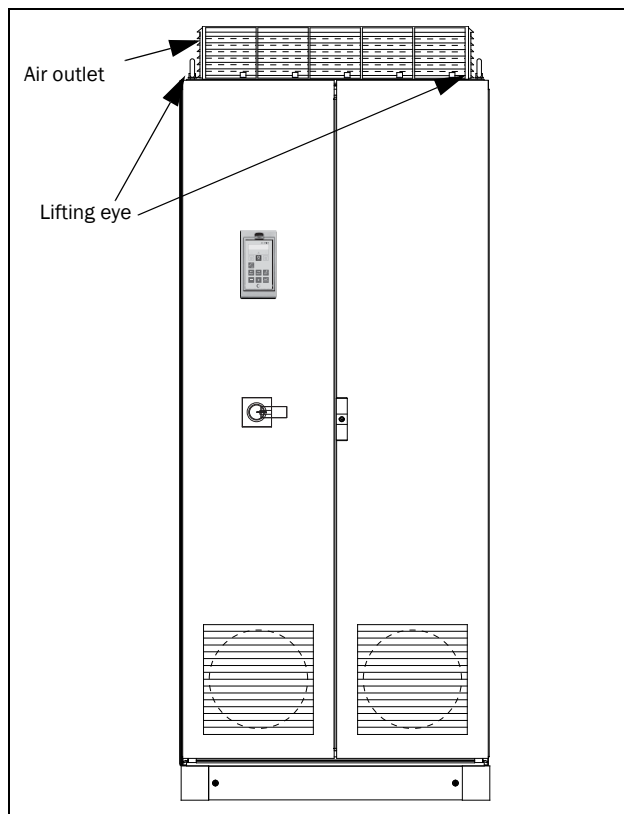


Fig. 8 Use the lifting eyes.

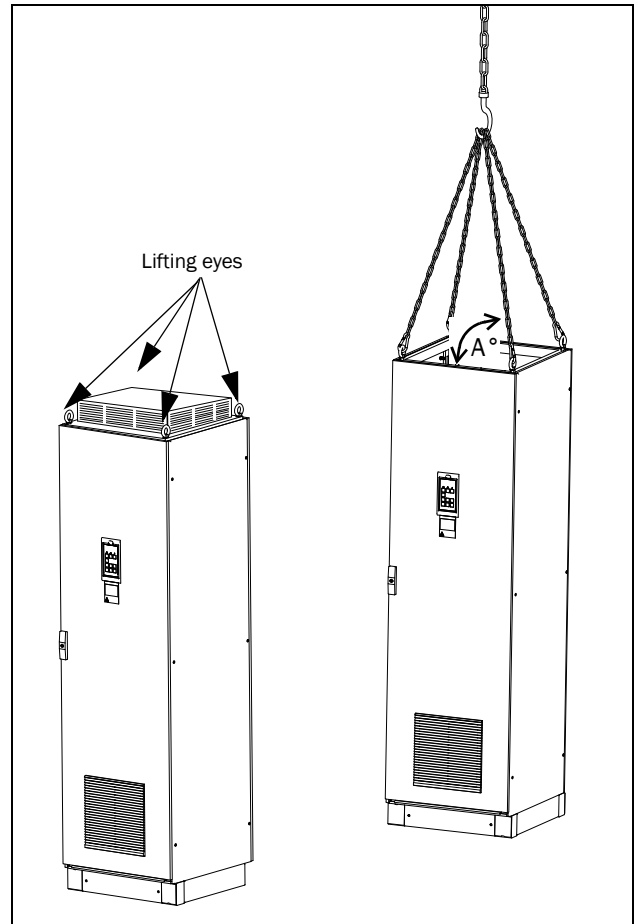


Fig. 9 Remove the roof unit and use the lifting eyes to lift single unit 600 mm and 900 mm.

Single cabinet drives can be lifted/transported safely using the eyebolts supplied and lifting cables/chains as in illustration Fig. 9 above.

Depending on the cable/chain angle A (in Fig. 9), following loads are permitted:

Cable/chain angle A	Permitted load
45 °	4 800 N
60 °	6 400 N
90 °	13 600 N

Regarding lifting instructions for other cabinet sizes, please contact Emotron.

3.1.1 Cooling

Fig. 10 below shows the minimum free space required above the AFR/AFG or VSI cabinets in order to guarantee adequate cooling. Normally the cabinet can be placed close to a wall or another cabinet, however 65 mm space to the wall is required in order to open the cabinet door with main switch handle at least 90 for maintenance.

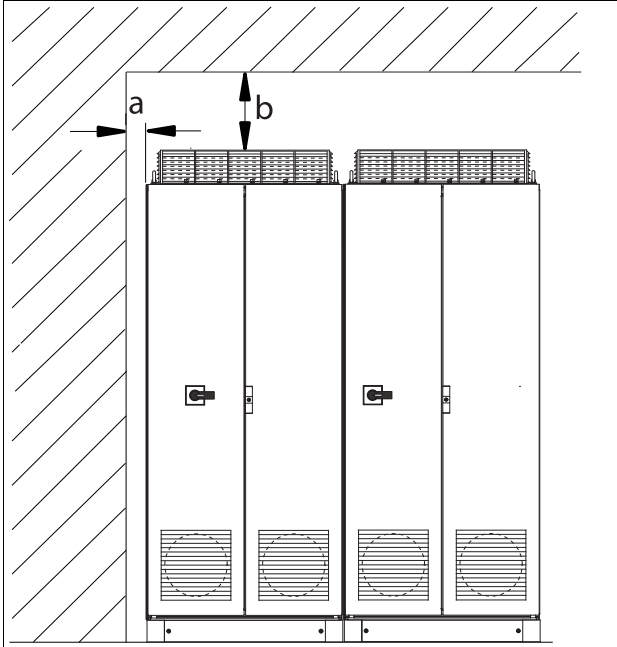


Fig. 10 Required free space around cabinet

Position	Free space
a	65 mm (2.6 in)
b	200 mm (7.9 in)

NOTE:

When a cabinet is placed between two walls, a minimum distance at each side of 200 mm (7.9 in) must be maintained.

3.2 Cabinet mounting

3.2.1 Cooling

If the AFR/AFG or VSI is installed in a cabinet, the rate of airflow supplied by the cooling fans must be taken into consideration. Frame sizes are listed in chapter 14.1 page 159.

Table 4 Flow rate cooling fans

Frame	AFR/AFG Model	Flow rate m ³ /hour (ft ³ /min)
E46	175/175	510 (300)
F46	250/250	800 (471)
F69	175/146	
G46	375/350	1020 (600)
H46	500/500	1600 (942)
H69	350/292	
I46	750/750	2400 (1413)
I69	525/438	
J46	1K0/1K0	3200 (1883)
J69	700/584	
K46	1K5/1K5	4800 (2825)
K69	1K05/876	

NOTE:

For the models 1K0 to 1K5 the mentioned amount of air flow should be divided equally over the two cabinets.

3.2.2 Mounting schemes

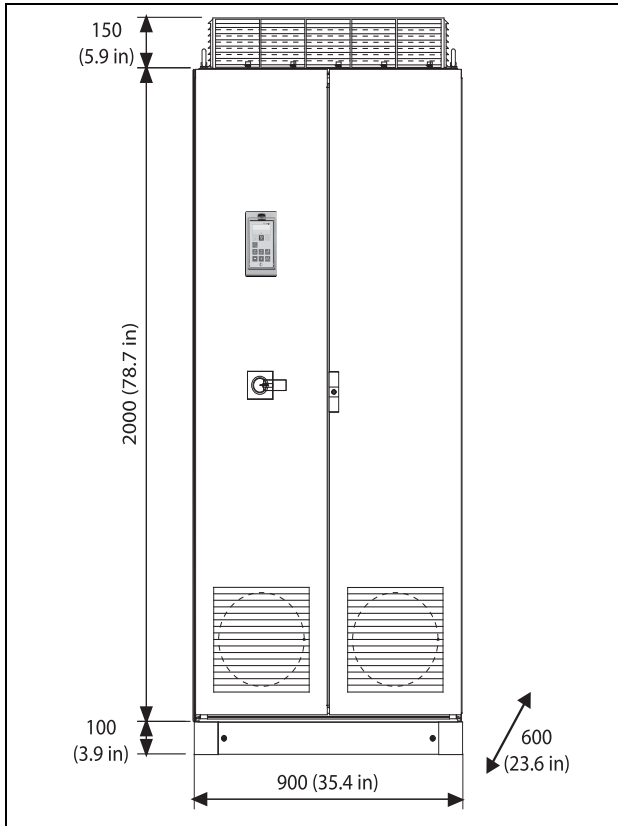


Fig. 11 FDUL/VFXR46, FDUG/VFXG46: Model 175 to 250

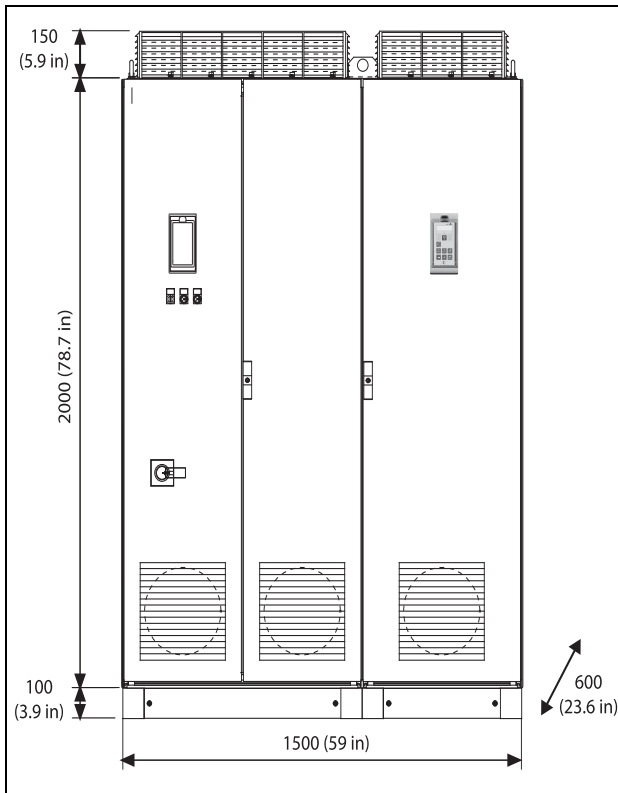


Fig. 12 FDUL/VFXR46, FDUG/VFXG46: Model 375 to 500

3.2.3 Recommended free space in front of cabinet

The cabinet mounted AC drives are designed in modules, so called PEBBs. These PEBBs can be folded out to be replaced. To be able to remove a PEBB in the future, we recommend 1.30 meter (39.4 in) free space in front of the cabinet, see Fig. 13.

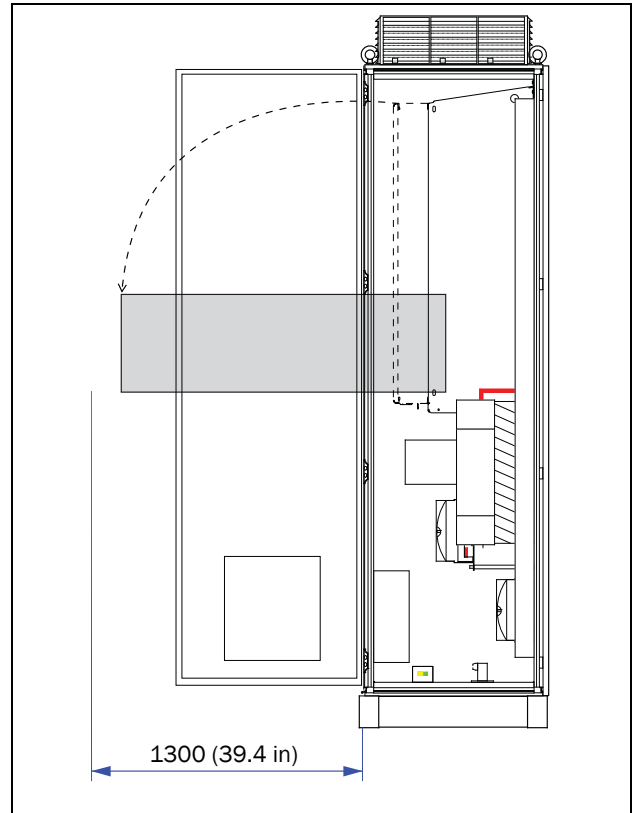


Fig. 13 Recommended free space in front of the cabinet.

3.3 Mounting AFR/AFG/VSI power modules (inside the cabinet)

Following figures provide mounting guidelines when mounting AFR/AFG/VSI power modules inside the cabinet.

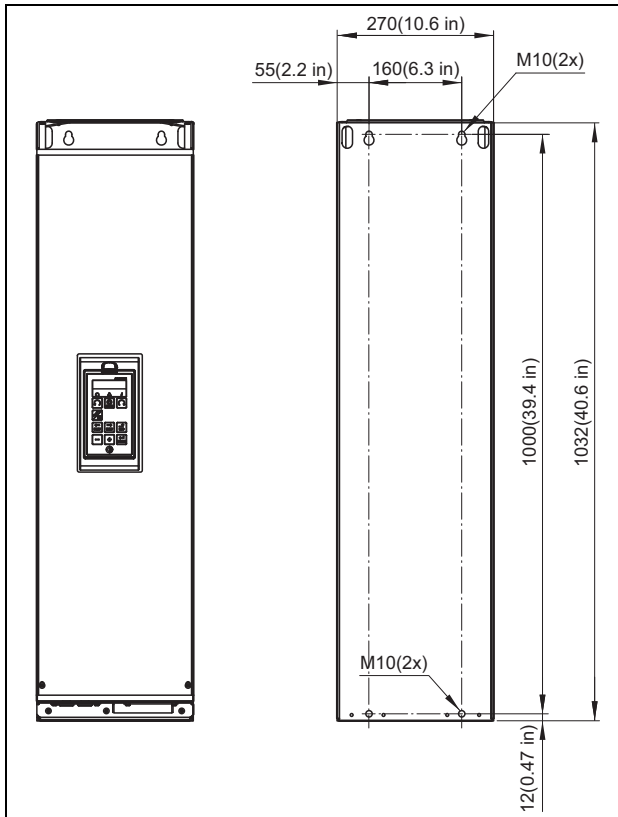


Fig. 14 Single PEBB frame (frame size FS), models AFR/AFG46-175 to AFR/AFG46-250

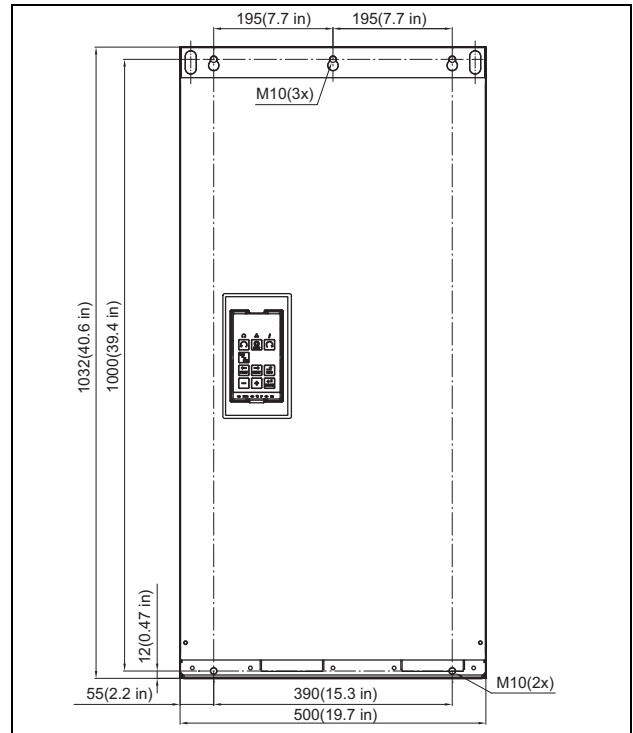


Fig. 15 Dual PEBB frame (frame size H), models AFR/AFG46-275 to AFR/AFG46-500

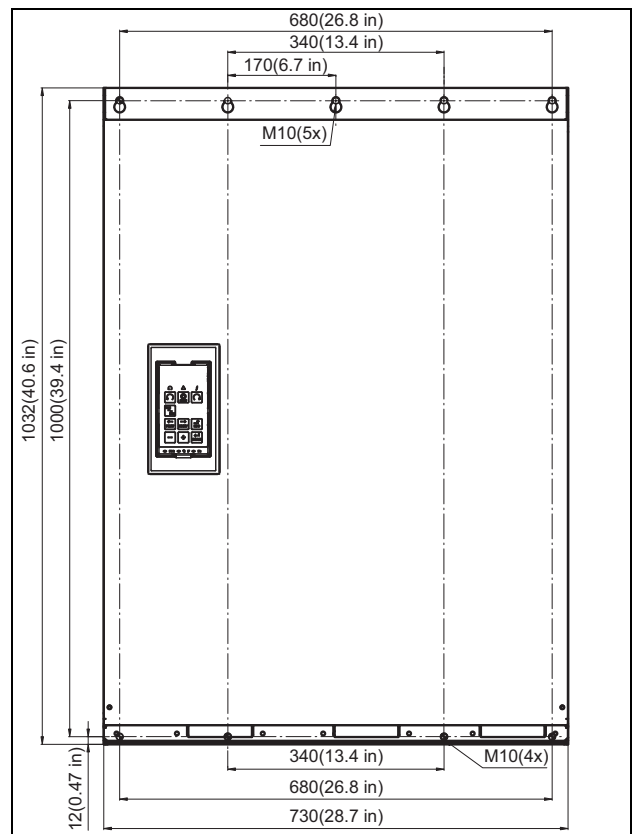


Fig. 16 Three PEBB frame (frame size I), models AFR/AFG46-750

For the higher model dimensions, contact your supplier for more information or visit www.cgglobal.com or www.emotron.com.

4. Installation

The description of installation in this chapter complies with the EMC standards and the Machine Directive.

Select cable type and screening according to the EMC requirements valid for the environment where the AFR/AFG and VSI is installed.



CAUTION!
Always consult CG Drives & Automation
before connecting an AFR/AFG to a standard
AC drive.

4.1 Before installation

Read the following checklist and prepare for your application before installation.

- Local or remote control.
- Functions used.
- Suitable AFR/AFG and VSI size in proportion to the motor/application.
- Mount separately supplied option boards according to the instructions in the appropriate option manual.

If the AFR/AFG and AC drive is temporarily stored before being connected, please check the technical data for environmental conditions. If the AFR/AFG and VSI is moved from a cold storage room to the room where it is to be installed, condensation can occur on it. Allow the AFR/AFG and VSI to become fully acclimatised and wait until any visible condensation has evaporated before connecting the mains voltage.

4.2 Connect motor and mains

4.2.1 Single drives

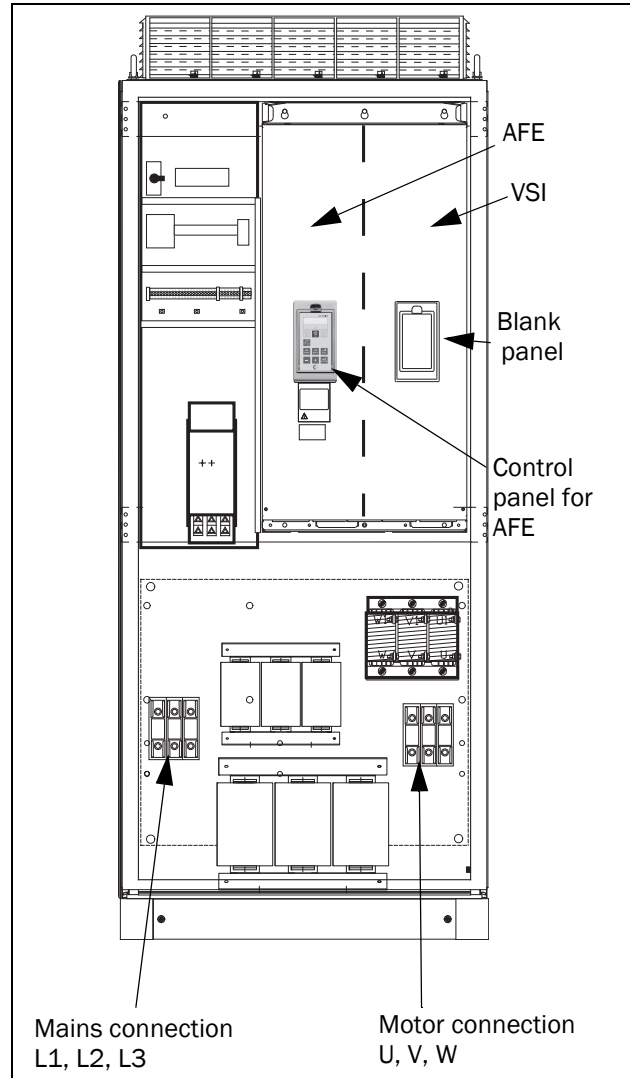



Fig. 17 Connecting motor and mains cables for FDUL/VFXR46-109 to 250 and FDUG/VFXG46-109 to 250

Table 5 Mains and motor connection

L1,L2,L3 PE	Mains supply, 3 -phase Safety earth (protective earth)
 U, V, W	Motor earth Motor output, 3-phase
DC-,DC+	DC-link connections (optional)

4.3 Cable specifications

Table 6 Cable specifications

Cable	Cable specification
Mains	Power cable suitable for fixed installation for the voltage used.
Motor	Symmetrical three conductor cable with concentric protection (PE) wire or a four conductor cable with compact low-impedance concentric shield for the voltage used.
Control	Control cable with low-impedance shield, screened.

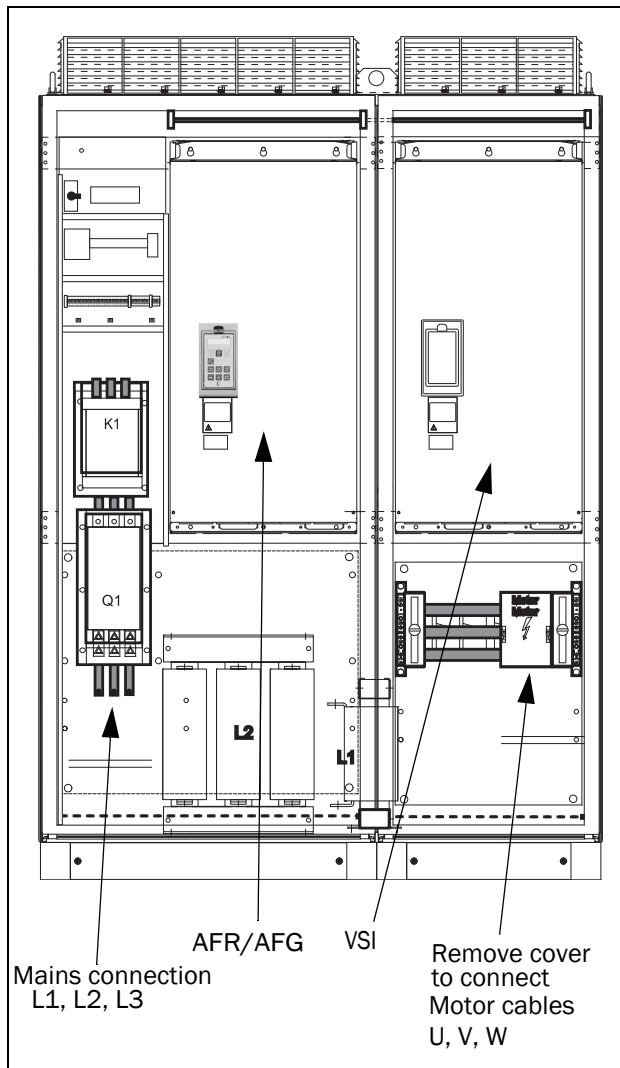


Fig. 18 Connecting motor and mains cables for FDUL/VFXR46-375 to 500 and FDUG/VFXG46-350-500

4.2.2 Common DC-bus

For common DC-bus applications, the cabinet will contain only the AFR/AFG part.

4.2.3 AFR/AFG

For the AFR/AFG deliveries, the cabinet only contains AFR/AFG parts.

5. Control connections

5.1 Control board

Fig. 19 shows the layout of the control board which is where the parts most important to the user are located. Although the control board is galvanically isolated from the mains, for safety reasons do not make changes while the mains supply is on!



WARNING!
Always switch off the mains voltage and wait at least **7 minutes** to allow the DC capacitors to discharge before connecting the control signals or changing position of any switches. If the option External supply is used, switch of the mains to the option. This is done to prevent damage on the control board.

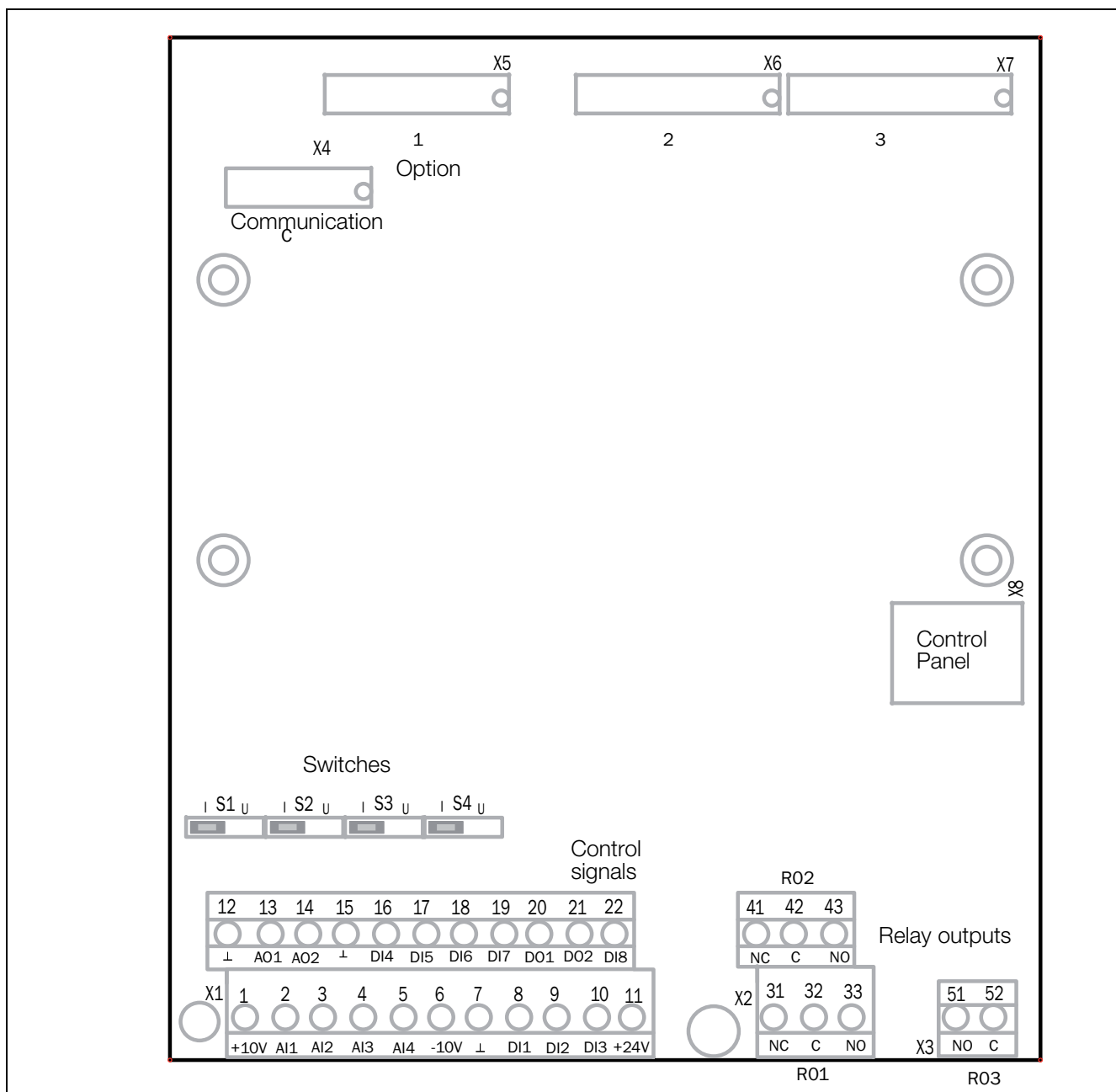


Fig. 19 Control board layout

NOTE:

AnIn switches (S1 to S4) should be in U position when any particular AnIn is used for supply voltage measurement board (SVMB).

5.2 Terminal connections for AFR/AFG

The terminal strip for connecting the control signals is accessible after opening the front door. The table describes the default functions for the signals. The inputs and outputs are programmable for other functions as described in chapter 11, page 69. For signal specifications refer to chapter 14, page 159.

For VSI, refer to instruction manual for Emotron FDU or VFX.

NOTE:

The maximum total combined current available for outputs 11, 20 and 21 is 100 mA. Supply voltage measurement board (SVMB) when connected (for example in AFG) takes 50 mA out of that total available (100 mA) current.

Table 7 Control signals for AFR/AFG

Terminal	Name	Function (Default)
Outputs		
1	+10 V	+10 VDC supply voltage
6	-10 V	-10 VDC supply voltage
7	Common	Signal ground
11	+24 V	+24 VDC supply voltage
12	Common	Signal ground
15	Common	Signal ground
Digital inputs		
8	DigIn 1	RunL (reverse)
9	DigIn 2	RunR (forward)
10	DigIn 3	Enable
16	DigIn 4	Off
17	DigIn 5	Off
18	DigIn 6	Off
19	DigIn 7	Off
22	DigIn 8	RESET
Digital outputs		
20	DigOut 1	LY (logic Y) Active when AFE not running or DC-link voltage has not reached reference value
21	DigOut 2	LZ (Trip pulse of 1s)
Analogue inputs		
2	AnIn 1	Process Ref
3	AnIn 2	AFR: Off AFG: U(L1)
4	AnIn 3	AFR: Off AFG: U(L2)
5	AnIn 4	AFR: Off AFG: U(L3)

Table 7 Control signals for AFR/AFG

Terminal	Name	Function (Default)
Analogue outputs		
13	AnOut 1	0 to nominal current
14	AnOut 2	0 to max torque
Relay outputs		
31	N/C 1	Relay 1 output Dedicated for Charge contactor K2.
32	COM 1	
33	N/O 1	
41	N/C 2	Relay 2 LY (logic Y) Active when AFE not running or DC-link voltage has not reached reference value
42	COM 2	
43	N/O 2	
51	COM 3	Relay 3 output Dedicated for Main contactor K1
52	N/O 3	

NOTE:









N/C is opened when the relay is active and N/O is closed when the relay is active.

5.3 Inputs configuration with the switches

The switches S1 to S4 are used to set the input configuration for the 4 analogue inputs AnIn1, AnIn2, AnIn3 and AnIn4 as described in Table 8.

The switches on the Control board are accessible after opening the door and removing the PPU cover plate.

Table 8 Switch settings

Input	Signal type	Switch
AnIn1	Voltage	S1 
	Current (default)	S1 
AnIn2	Voltage	S2 
	Current (default)	S2 
AnIn3	Voltage	S3 
	Current (default)	S3 
AnIn4	Voltage	S4 
	Current (default)	S4 

NOTE:

Scaling and offset of AnIn1 - AnIn4 can be configured using the software. See menus [512], [515], [518] and [51B].

NOTE:

Switches for AnIn2 to AnIn4 must be in U (Voltage position) when using Voltage measurement board. Switches must be in I (Current) position if current source is used for analogue input.

5.4 Control connections for Emotron FDUL/VFXR/FDUG/VFXG

Fig. 30 shows typical control signal connections required for basic functionality. For more detailed information, see drawings in cabinet and instruction manual for the Emotron VFX, chapter “Control connections”.



WARNING!
Always switch off the mains voltage and wait at least 7 minutes to allow the DC capacitors to discharge before connecting the control signals or changing position of any switches. If the option External supply is used, switch of the mains to the option. This is done to prevent damage on the control board.

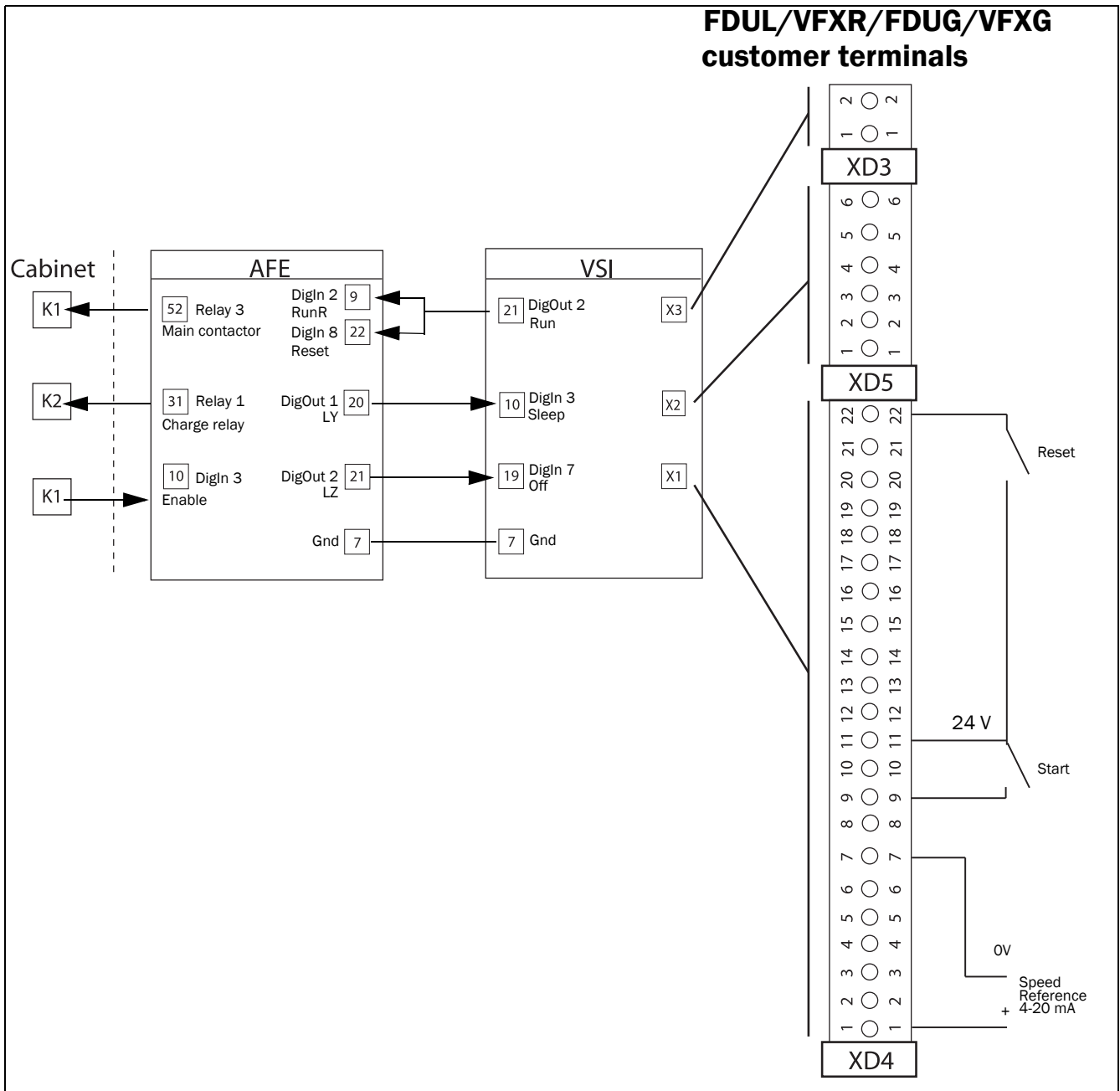


Fig. 20 Recommended control signals

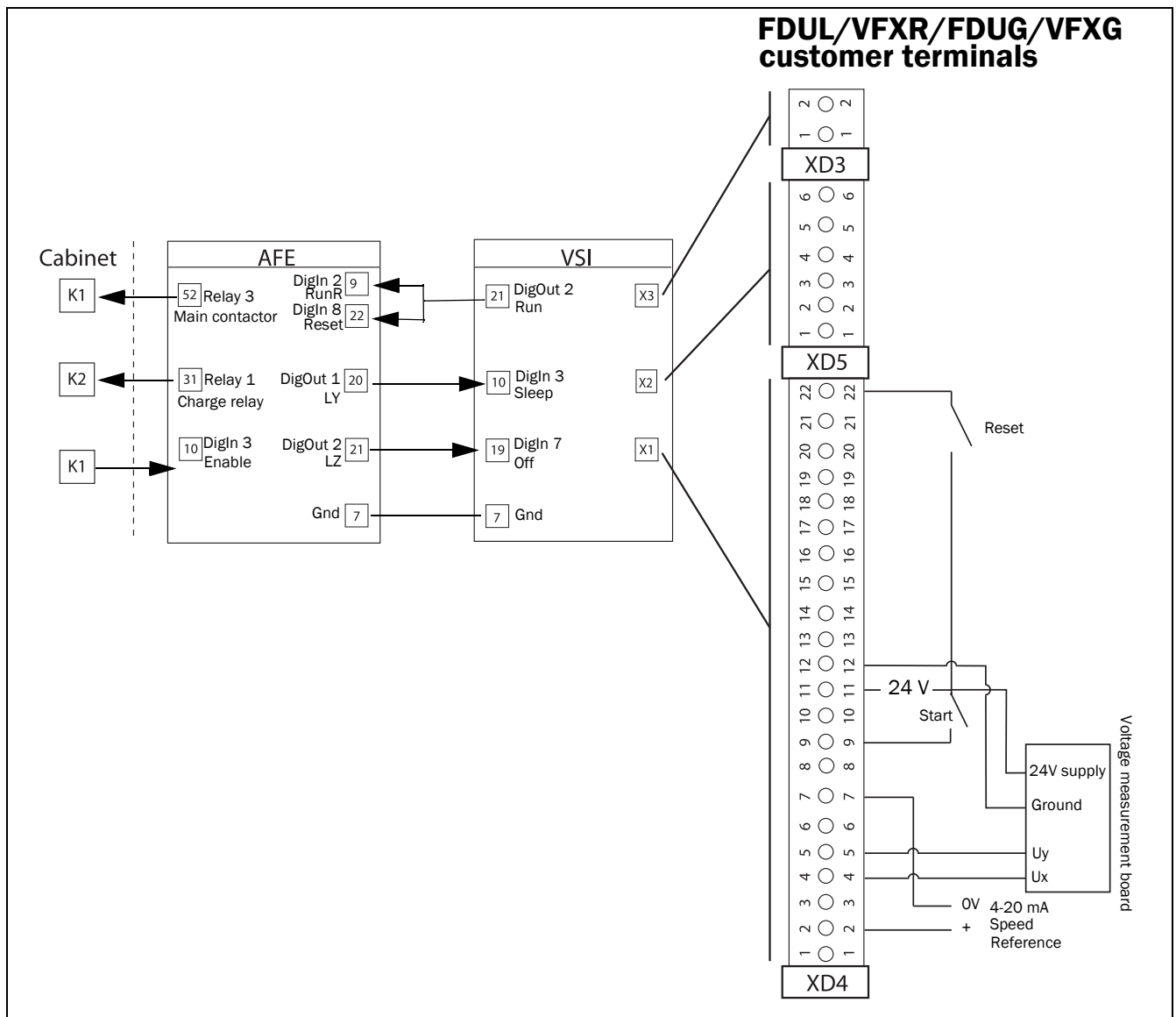


Fig. 21 Alternative wiring scheme with Voltage measurement board.

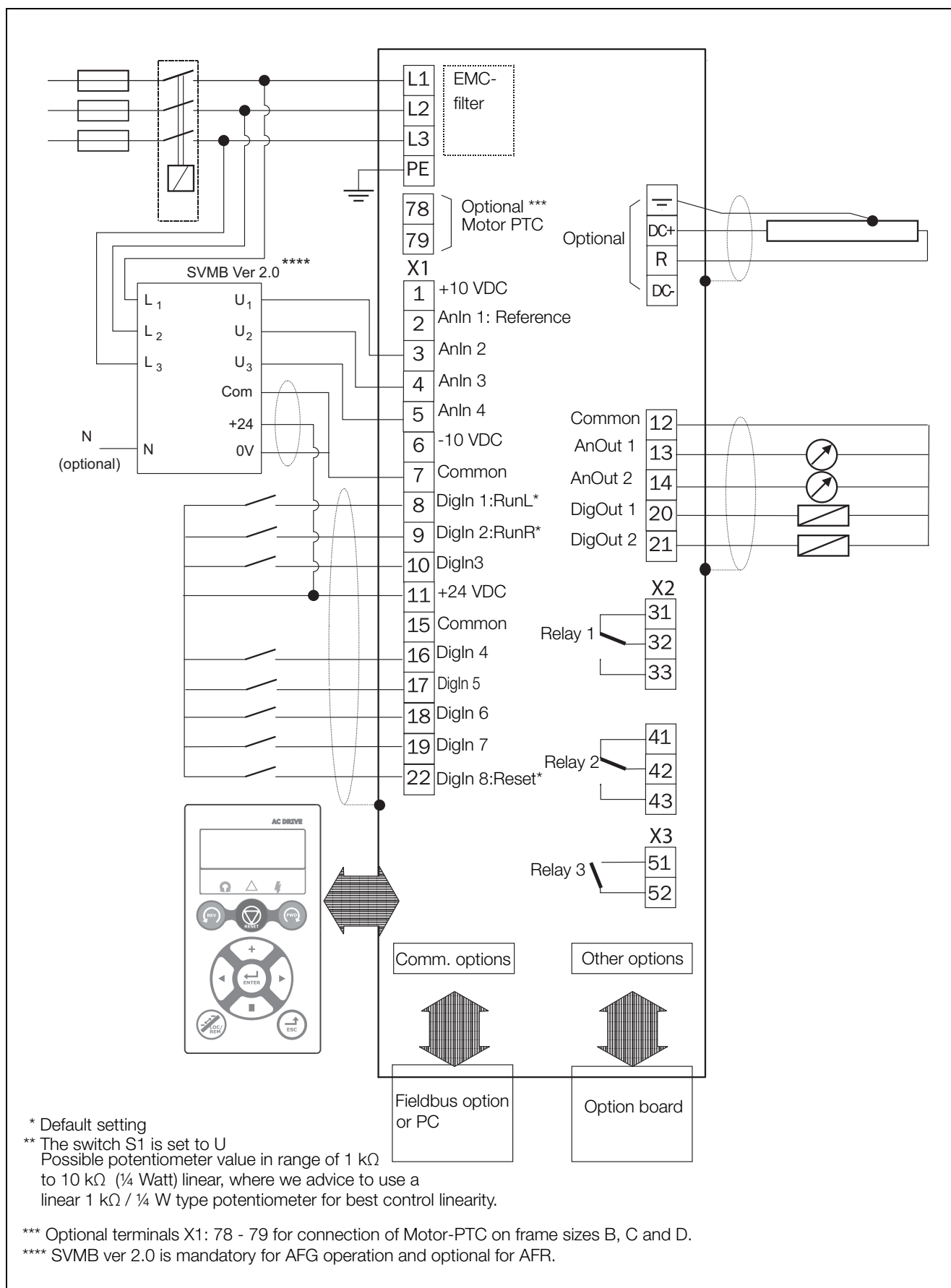


Fig. 22 AFR/AFG drive connection example

5.5 Connecting the control signals

5.5.1 Cables

The standard control signal connections are suitable for stranded flexible wire up to 1.5 mm² and for solid wire up to 2.5 mm².

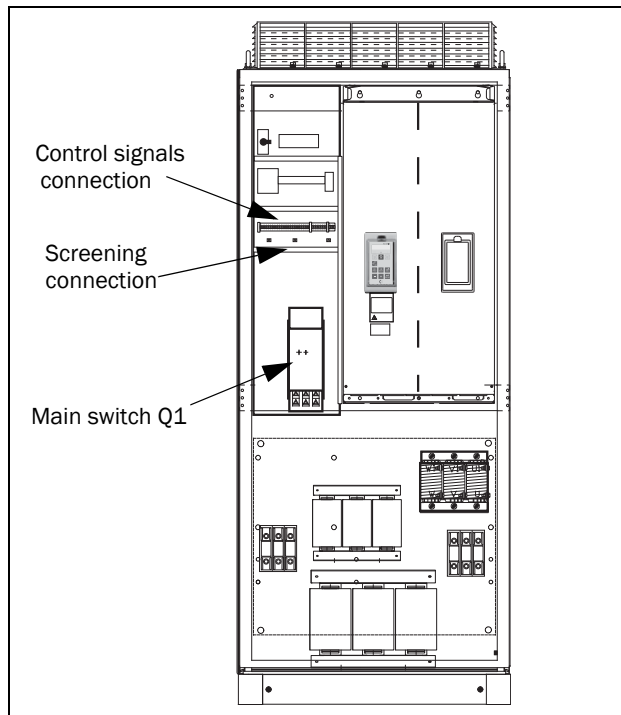


Fig. 23 Connecting the control signals FDUL/VFXR46 - 109 to 250 and FDUG/VFXG46 - 109 to 250.

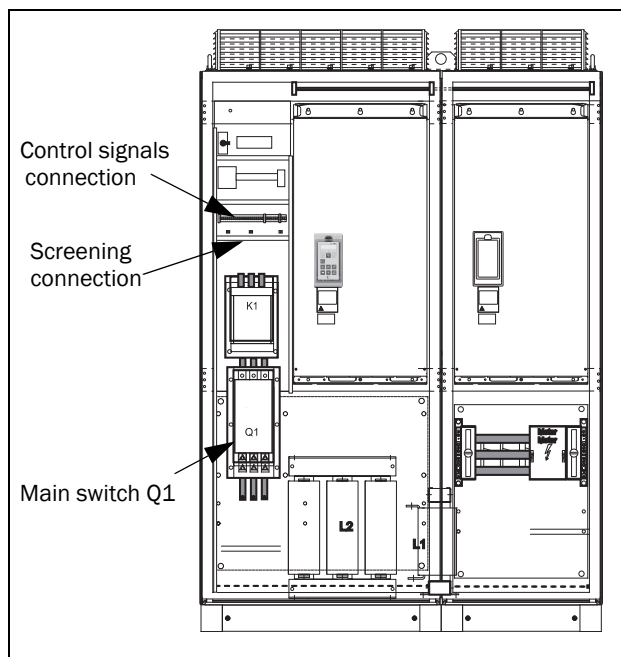


Fig. 24 Connecting control signal FDUL/VFXR46-375 to 500 and FDUG/VFXG46-350 to 500.

NOTE:

The screening of control signal cables is necessary to comply with the immunity levels given in the EMC Directive (it reduces the noise level).

NOTE:

Control cables must be separated from motor and mains cables.

5.5.2 Types of control signals

Always make a distinction between the different types of signals. Because the different types of signals can adversely affect each other, use a separate cable for each type. This is often more practical because, for example, the cable from a pressure sensor may be connected directly to the motor inverter.

We can distinguish between the following types of control signals:

Analogue inputs

Voltage or current signals, (0-10 V, 0/4-20 mA) normally used as control signals for speed, torque and PID feedback signals.

Analogue outputs

Voltage or current signals, (0-10 V, 0/4-20 mA) which change slowly or only occasionally in value. In general, these are control or measurement signals.

Digital

Voltage or current signals (0-10 V, 0-24 V, 0/4-20 mA) which can have only two values (high or low) and only occasionally change in value.

Data

Usually voltage signals (0-5 V, 0-10 V) which change rapidly and at a high frequency, generally data signals such as RS232, RS485, Profibus, etc.

Relay

Relay contacts (0-250 VAC) can switch highly inductive loads (auxiliary relay, lamp, valve, brake, etc.).

Signal type	Maximum wire size	Tightening torque	Cable type
Analogue	Solid wire: 0.14-2.5 mm ² (AWG 26 - 14)	0.5 Nm (4.4 LB-in)	Screened
Digital			Screened
Data			Screened
Relay	Flexible wire: 0.14-1.5 mm ² (AWG 26 - 16) Wire with ferrule: 0.25-1.5 mm ² (AWG 24 - 16)		Not screened

Example:

The relay output from a motor inverter which controls an auxiliary relay can, at the moment of switching, form a source of interference (emission) for a measurement signal from, for example, a pressure sensor. Therefore it is advised to separate wiring and screening to reduce disturbances.

5.5.3 Screening

For all signal cables the best results are obtained if the screening is connected to both ends: the VSI side and at the source (e.g. PLC, or computer). See Fig. 35.

It is strongly recommended that the signal cables be allowed to cross mains and motor cables at a 90° angle. Do not let the signal cable go in parallel with the mains and motor cable.

5.5.4 Single-ended or double-ended connection?

In principle, the same measures applied to motor cables must be applied to all control signal cables, in accordance with the EMC-Directives.

For all signal cables as mentioned in section 5.5.2 the best results are obtained if the screening is connected to both ends. See Fig. 35.

NOTE:

Each installation must be examined carefully before applying the proper EMC measurements.

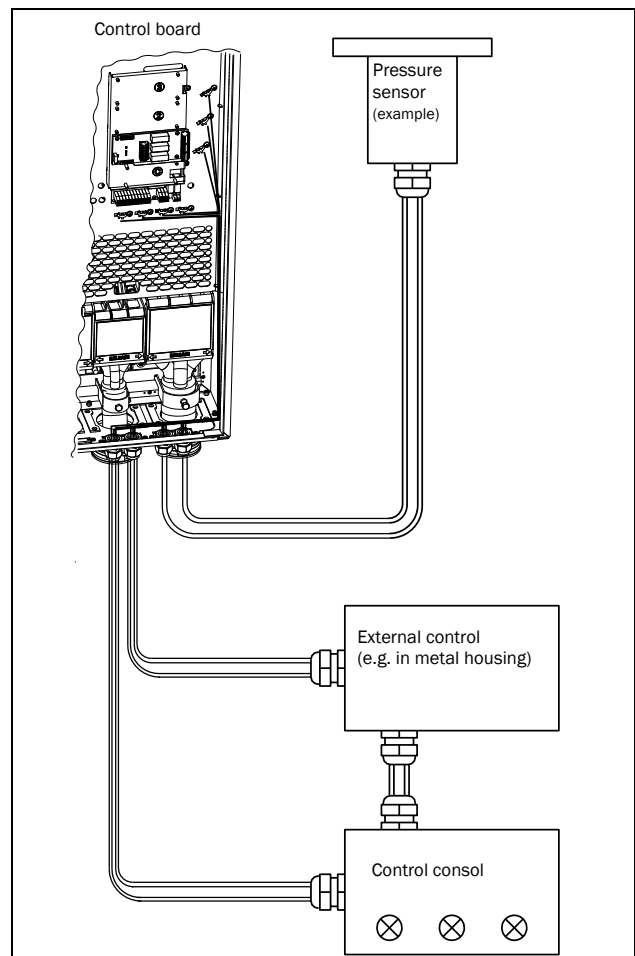


Fig. 25 Electro Magnetic (EM) screening of control signal cables.

5.5.5 Current signals ((0)4-20 mA)

A current signal like (0)4-20 mA is less sensitive to disturbances than a 0-10 V signal, because it is connected to an input which has a lower impedance (250 Ω) than a voltage signal (20 k Ω). It is therefore strongly advised to use current control signals if the cables are longer than a few metres.

5.5.6 Twisted cables

Analogue and digital signals are less sensitive to interference if the cables carrying them are “twisted”. This is certainly to be recommended if screening cannot be used. By twisting the wires the exposed areas are minimised. This means that in the current circuit for any possible High Frequency (HF) interference fields, no voltage can be induced. For a PLC it is therefore important that the return wire remains in proximity to the signal wire. It is important that the pair of wires is fully twisted over 360°.

5.6 Connecting options

The option cards are connected by the optional connectors X4 or X5 on the control board see Fig. 19, page 23 and mounted above the control board. The inputs and outputs of the option cards are connected in the same way as other control signals.

6. Getting Started

This chapter is a step by step guide that will show you the quickest way to get the AFR/AFG running and motor shaft turning in case of FDUL/VFXR/FDUG/VFXG. We will show you setup with remote control.

We assume that the AFR/AFG and VSI is mounted in a cabinet as in the chapter 3. page 17.

First there is general information of how to connect mains, motor and control cables. The next section describes how to use the function keys on the control panel. The subsequent remote control example describe how to program/set the motor data and run the AFR/AFG, the VSI and motor.

6.1 Connect the mains and motor cables

Dimension the mains and motor cables according to local regulations. The cables must be able to carry the AFR/AFG and VSI load current.
Connect mains cables and motor cables according to chapter 4.2 page 21.



CAUTION!
Always switch off the main voltage before opening the drive.

6.2 Using the function keys

For more information regarding the control panel and menu system, see chapter 9. page 53.

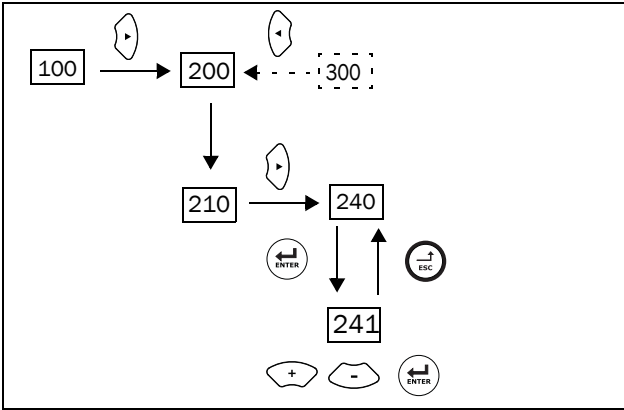


Fig. 26 Example of menu navigation when entering motor voltage

	step to lower menu level or confirm changed setting
	step to higher menu level or ignore changed setting
	step to next menu on the same level
	step to previous menu on the same level
	increase value or change selection
	decrease value or change selection

6.3 Remote control

In this example external signals, an external start button and an analogue reference, are used to control the VSI and motor. The AFR/AFG is controlled from the VSI in case of FDUL/VFXR/FDUG/VFXG.

In order to perform the setup examples, you will use the control panels for the AFR/AFG (inside cabinet) and VSI (cabinet door), see Fig. 51, page 53. For further information about the control panel (CP) and menu structure, see chapter 9, page 53.

6.3.1 Set up AFR/AFG



WARNING!

Always switch off the mains voltage before opening the drive unit and wait at least 7 minutes to allow the buffer capacitors to discharge.

Make sure that the main supply is switched off and open the AFR/AFG or FDUL/VFXR/FDUG/VFXG door. For FDUL/VFXR/FDUG/VFXG case check wiring according to Fig. 20, page 26.

NOTE: Wiring is pre-made from factory.

In this case, wiring is made for Charge method [O21] "Supply-NC" via NC terminal (31) on CB Relay 1.

1. If other Charge method [O21] than default "Supply-NC" = Charge at power supply via NC terminal on Relay 1 is to be used then
 - a) Connect Charge Relay control signal to NO terminal (33)
 - b) Connect external 24V supply. Required for all Charge methods [O21] using NO terminal (33).
 - c) Setup required Charge method [O21].
2. Switch on the power supply. Once the mains is switched on, the internal fans of the AFR/AFG and VSI will run for 5 seconds. Menu [100] Preferred view is displayed in CP after power up.



WARNING!

While power is supplied to the inverter, do not touch any terminal or internal part of the inverter. Do not connect or disconnect any wire or connector. Otherwise, you run the risk of electric shock resulting in serious injury!

In addition this could cause serious damage to the active front end or motor inverter.

3. Perform a supply ID-run [O15]
 - a) [Set [O15] Supply ID run to On, confirm with
 - b) Give start command
 - c) The AFE will now measure and setup supply parameters
 - * [O11] Supply voltage
 - * [O13] Supply frequency

* [O14] Supply phase sequence

- d) After successful ID-run ("Test Run OK" is displayed)
- e) Verify the new settings for [O11]-[O14].
- f) Mains supply voltage [O11] can preferably be manually set back to the average mains supply voltage value after ID-run. This is recommended if the mains supply voltage fluctuates much over time.

4. For 1st run, setup AFE to start from CP.
 - a) Set Reference control [214] to "Keyboard"
 - b) Set Run/Stop control [215] to "Keyboard"
 - c) Set Reset control [216] to "Keyboard"
 - d) Set Process Ref [310] to 0%.
 - e) Disable reactive power compensation by setting Q max [O41] to 0%.
 - f) Start AFR/AFG by pressing or . Note that the both run directions, i.e. RunR and RunL, are accepted independent of the actual phase sequence.
 - g) Verify operation via menus [710].
 - h) Stop AFR/AFG by pressing Stop/Reset.

Set up AFR/AFG to be controlled from VSI

After validating the AFR/AFG operation (following steps in 6.3.1), follow the below given steps to setup the AFR/AFG to be controlled from VSI.

5. Setup AFR/AFG to start from VSI command via I/O.
 - a) Change Ref control [214] to "Remote"
 - b) Change Run/Stop control [215] to "Remote"
 - c) Change Reset control [216] to "Remote" or "Remote+Keyb"
 - d) Verify parameter setup according to Table 9 below.

Table 9 Parameter setup for AFR/AFG to controlled from VSI

Parameter	Setup	Comment
[214] Ref Control	Remote	AFE command setup Q (cos φ) reference
[215] Run/Stp Ctrl	Remote	
[216] Reset Ctrl	Remote	
[310] Set/View ref	0%	
[522] DigIn 2	RunR	AFE/VSI command/ feedback
[528] DigIn 8	Reset	
[541] DigOut 1	LY	
[542] DigOut 2	LZ	
[523] DigIn 3	Enable	Cabinet hardware control/feedback
[551] Relay 1	Charge K2	
[552] Relay 2	LY	
[553] Relay 3	Main K1	



Table 9 Parameter setup for AFR/AFG to controlled from VSI

Parameter	Setup	Comment
[6151] CD1	Trip	AFE 1s trip pulse
[6152] CD2	T2Q	
[630] Logic Z	CD1 & !D2	
[651] Timer2 Trig	Trip	
[652] Timer2 Mode	Delay	
[653] Timer2 Delay	00:00:01	
[6153] CD3	UDC_OK	Feedback signal to VSI that AFE is running or not.
[621] Y Comp1	!D3	
[622] Y Operator 1	&	
[623] Y Comp 2	!D3	
[624] Y Operator 2	.	

6. Now the AFR/AFG is set to be controlled from the VSI.
7. Close the AFR/AFG cabinet door.

6.3.2 Set up VSI

Menu [100], Preferred View is displayed when started.

1. Enter correct motor data for the connected motor. The motor data is used in the calculation of complete operational data in the VSI.
 - a) Set motor voltage [221]
 - b) Set motor frequency [222]
 - c) Set motor power [223]
 - d) Set motor current [224]
 - e) Set motor speed [225]
 - f) Set motor power factor ($\cos \varphi$) [227]
 - g) Select supply voltage level used [21B]
 - h) [229] Motor ID run: Choose Short, confirm with  and give start command .


The VSI will now measure some motor parameters. The motor makes some beeping sounds but the shaft does not rotate. When the ID run is finished after about one minute ("Test Run OK!" is displayed), press  to continue.
2. Use AnIn1 as input for the reference value. The default range is 4-20 mA. If you need a 0-10 V reference value, change switch (S1) on control board and set [512] AnIn 1 Set-up to 0-10V.
3. Setup VSI to control the AFR/AFG via I/O, see Table 10.
 - a) Set digital output 2 [542] to "Run". Gives start command to AFR/AFG from VSI.
 - b) Set digital input 3 [523] to "Sleep". Feedback to VSI that AFR/AFG is running.
 - c) Adapt AFR/AFG trip pulse polarity for VSI Extern Trip polarity.
 - * Set digital input 7 [527] to "Off". Feedback to VSI that AFR/AFG is tripped (pulse if 1s).
 - * Set digital comparator 1 [6151] to "DigIn7".
 - * Set virtual I/O 1 Source [562] to "ID1".
 - * Set virtual I/O 1 Destination [561] to "Ext Trip". see Table 10.

Table 10 Default parameter setup for VSI (VFX/FDU 2.0)

Parameter	Setup	Comment
[523] DigIn 3	Sleep	Feedback signal to VSI that AFE is running or not.
[542] DigOut 2	Run	Command AFE run
[527] DigIn 7	Off	Feedback AFE trip via Ext Trip
[561] VIO 1 Dest	External trip	
[562] VIO 1 Source	ID1	
[6151] CD 1	DigIn 7	

4. Switch off power supply.



WARNING!

Always switch off the mains voltage before opening the drive unit and wait at least 7 minutes to allow the buffer capacitors to discharge.

5. Connect digital and analogue inputs/outputs as in Fig. 27.
 - a) Connect a reference value between terminals 7 (Common) and 2 (AnIn 1).
 - b) Connect an external start button between terminal 11(+24 VDC) and 9 (DigIn2, RUNR).
 - c) Connect a reset signal between terminal 11 (+24 VDC) and 22 Reset.

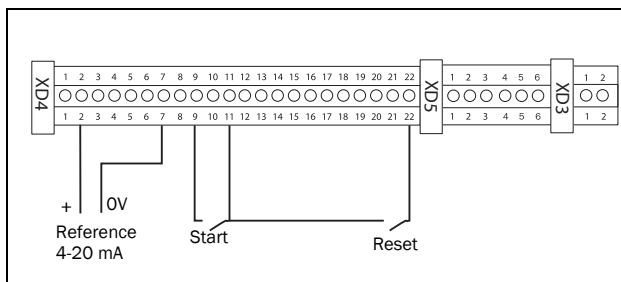


Fig. 27 Wiring

6. Close the door and switch on the power supply. Once the mains is switched on, the internal fans of the AFR/AFG and VSI will run for 5 seconds. Menu [100] Preferred view, is displayed in the Control panel after power up.

6.3.3 Run the VSI

Now the installation is finished, and you can press the external start button to start the motor.

When the AFR/AFG, VSI and motor are running the main connections are OK.

7. FDUL/VFXR/FDUG/VFXG/AFR/AFG Main features

This chapter contains descriptions of the main features of the AFR/AFG drive.

7.1 Autoreset at trip

For several non-critical application-related failure conditions, it is possible to automatically generate a reset command to overcome the fault condition. The selection can be made in menu [250]. In this menu the maximum number of automatically generated restarts allowed can be set, see menu [251], after this the AC drive will stay in fault condition because external assistance is required.

Example

The motor is protected by an internal protection for thermal overload. When this protection is activated, the AC drive should wait until the motor is cooled down enough before resuming normal operation. When this problem occurs three times in a short period of time, external assistance is required.

The following settings should be applied:

- Insert maximum number of restarts; set menu [251] to 3.
- Activate Over temp to be automatically reset; set menu [252] to 300 s.
- Set relay 2, menu [552] to “AutoRst Trip”; a signal will be available when the maximum number of restarts is reached and the AC drive stays in fault condition.
- The reset input must be constantly activated.

7.2 Power-up and DC-link charging

Power up and charge control of the Emotron AFR/AFG and DC-link (U_{dc}) is handled via the dedicated control board (CB) relays 1 and 3, where Charge contactor (K2) control is fixed to CB Relay1 and Main contactor (K1) is fixed to CB Relay3.

Typical charge time is 3-5 s and an additional delay after K1 activation of 1s is added before Run (or Auto ID) command is acknowledged.

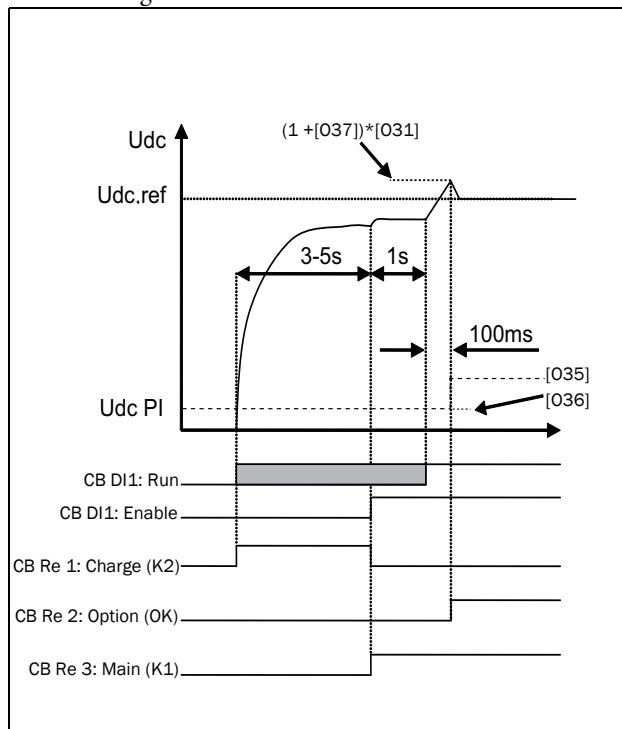


Fig. 28 DC-link voltage (U_{dc}) charge control.

Signal Running OK, i.e. U_{dc} under control can be signalled via digital output or CB Relay2 selection “UDC_Ok”.

If Auto ID mode[O16] is used an additional delay of 1s is inserted before Run command is acknowledged.

Table 11 I/O connection for AFR/AFG charge operation

AFR/AFG I/O	Contactor K1/K2	Comment
Re1='Charge contactor' {NC/NO}	K2.A1 (coil/ctrl)	
Re3='Main contactor' {NO}	K1.A1 (coil/ctrl)	
DI3='Enable'	K1.NO (aux)	Enable AFR/AFG only if K1 OK. Preferably used also for “Emergency Stop” input.

7.3 Automatic power supply parameter detection

The AFR/AFG can automatically detect power supply parameters voltage [O11], frequency [O12] and phase sequence [O14] by separately activated function either manually [O15] or automatically at every power up [O16].

The power supply parameters are detected by running a network measurement routine. See chapter AFE Option [O00] for detailed information about AFR/AFG parameters.

7.4 Power supply synchronisation

The AFR/AFG synchronises to the power supply when starting by making test measurement. Synchronisation during operation is handled via the U_{dc} [O30], Q [O40] and frequency [O50] controllers. See chapter AFE Option [O00] for detailed information about AFR/AFG parameters.

Synchronisation methods

- Standard sync (Default), extended sync routine. This routine also verifies supply network. Takes approx. 50 ms.
- Voltage sync, i.e. via supply voltage measurement.
- Fast sync (fast measurement).

Fast sync method can be enabled via a service menu. Voltage sync requires supply voltage measurement option and is enabled via [O25].

7.5 Start command

The AFR/AFG can be started from digital I/O, control panel (CP) or via serial communication options. Typically the AFR/AFG is started via digital I/O either automatically at power up or by the VSI when the VSI have a run command.

In order to avoid unnecessary losses it is preferred only to run the AFR/AFG when needed, i.e. when the VSI has a run command. Fig. 20, page 26.

NOTE:

To protect AFE against damage an internal protection has been added so that it does not allow AFE to start if DC-link is already loaded. Sending start command generates "Start_Denied" warning if there exists load on DC-link. It is based on current measurement of AFR/AFG.

If required, customer can turn this protection off with the help of service/commissioning engineer.

If starting is required with loaded DC-link then it is recommended to use voltage measurement board (bypass/sync) option for starting/synchronization of AFE.

7.6 Start on regeneration demand

The AFR/AFG can be started on regeneration demand [O22], i.e. when the DC-link voltage increases due to generated power from the VSIs. In motoring operation the AFR/AFG modulation is deactivated and the free wheeling diodes operates as a DFE and in regenerating operation the AFR/AFG is activated and regenerates the energy back to the supply.

Regeneration start/stop operation

- The AFR/AFG will start (DFE stop) when DC-link voltage rises due to energy flow from load towards DC-link.
- The AFR/AFG will stop (DFE start) when energy flow from supply is positive (into the AFR/AFG) during stop delay time [O23].

NOTE:

Requires supply voltage measurement.

7.7 Under voltage ride through for AFR/FDUL/VFXR

AFR/FDUL/VFXR running with voltage measurement board, can withstand momentary power dips. The time to which the system (drive) can stay alive depends on the inertia of the application (load). If the system stays alive based on the energy stored in the inertia, the system (AFR/FDUL/VFXR) can continue its operation smoothly on returning of the supply.

NOTE: During the momentary dip, AFR/FDUL/VFXR unit will not be able to maintain THDI below 5%. However on returning the supply and during smooth operation the low harmonic or low THDI operation will be restored.

NOTE: For staying alive, corresponding settings must be done on the VSI control board. Contact your local supplier for assistance.

NOTE: For under voltage ride through function of AFR/FDUL/VFXR, menus [O25] and [O51] must be set to 'Sensor' and [O24] must be set 'ON'.

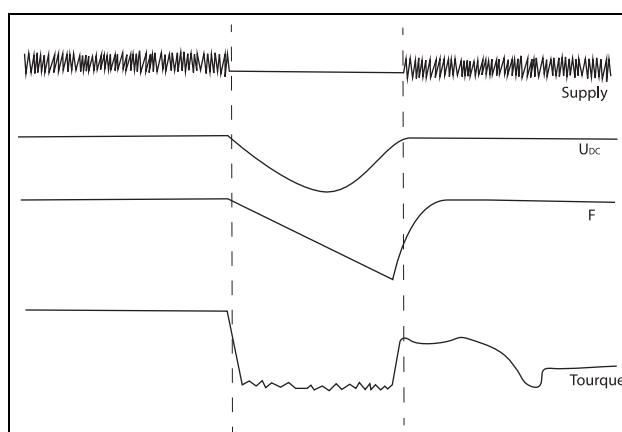


Fig. 29 Under voltage override

NOTE: AFG/FDUG/VFXG offer more advance features of fault ride though based on grid code requirements. For more details read section 7.17.

7.8 PWM modulation

The AFR/AFG uses carrier wave based PWM modulation for controlling the IGBTs.

7.9 Active power (Energy) control

The energy control is utilized by the DC-link voltage controller [O30] which balances the active power flow from supply to load, see Fig. 30

It is possible to set/change

- U_{DC} reference value - limited by the requirement of operation, i.e. voltage amplitude control.
- U_{DC} ramp time
- U_{DC} margin value
- U_{DC} controller parameters.

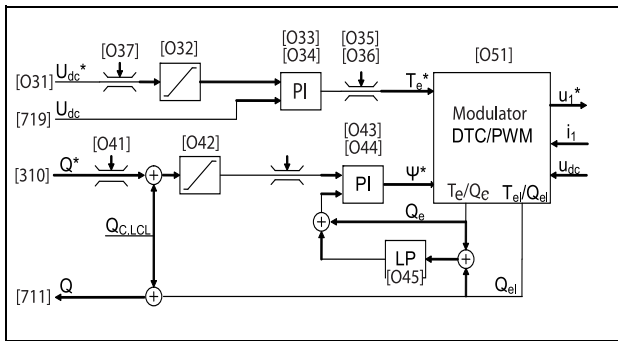


Fig. 30 U_{dc} and Q controllers in AFR.

PI - PI regulator

LP - Low pass filter

T_e - Active power

Q_e - Reactive power

*) Reference

7.10 Limit the regeneration capability of AFR/AFG

It is possible to limit the amount of energy fed back to the grid while braking. This feature can be utilized in cases where grid (or generator) can not handle all braking energy. Part of braking energy is fed to the grid and remaining part of energy needs to be burnt across the braking resistor.

NOTE: Brake IGBT and resistor are required in this case. For proper selection of brake resistor please see in chapter "Brake chopper" on page 155.

NOTE: Contact local supplier if assistance is required.

7.11 Reactive power (Q or cos ϕ) control (normally not used)

The reactive power (Q or cos ϕ) control can be used for reactive power compensation of other loads, i.e. motors. The amount of reactive power compensation possible is dependent on the unused capacity of the AFR/AFG, i.e. over capacity not used for active power control. The reactive power control is utilised via the Q controller [O40], see Fig. 30.

It is possible to set/change

- Q reference value via standard reference source (Remote, CP or COM)
- Q max limit
- Q ramp time
- Q controller parameters

7.12 Frequency (f) control

The AFR/AFG handles frequency variations via the supply frequency observer [O50].

7.13 Energy actual value signals

The AFR/AFG provides separate signals for: consumed, generated and total energy in group [O80] of the AFR/AFG.

7.14 Power factor calculations

The AFR/AFG- unit also presents the power factor at the connection terminals of the unit.

$$\cos \phi = \frac{Q}{|Q|} \frac{|P|}{\sqrt{P^2 + Q^2}}$$

P = Active Power

Q = Reactive Power

+ve value of Cos ϕ indicated the over excited state of operation whereas -ve value indicate the under-excited state of operation of AFR/AFG.

7.15 Fault signals

The AFR/AFG provides separate fault signals for specific AFR/AFG related trips:

- Supply error - Synchronization failure due to supply error problems.
- Sup Chk Err - Synchronization failure due to frequency or phase sequence mismatch.
- Sync error - Synchronization failure due to overcurrent.
- AutoID error - Failure during Auto Identification Run, i.e. supply not correctly identified.
- Sup F Err - Failure due to too much variation in supply frequency.
- Sup U Err - Failure due to too much variation in supply voltage.
- GCP xxx - Fault signal indicating that grid code related protection is activated/triggered.
- URVT - Under voltage ride through error. Grid voltage went outside the permitted voltage-time zone of Fig. 44
- OVRT - Over-voltage ride through error. Grid voltage went outside the permitted voltage-time zone of Fig. 44.
- Passive AID - Island detection error based on passive method.
- Active AID - Island detection error based on active method.
- Resistor Err - Brake resistor over load protection error.
- Open CB - Open circuit breaker detected on the supply side.
- PLL Not lock - AFR/AFG waiting for the PLL to be locked. (PLL not ready yet).

7.16 Supply voltage measurement board (SVMB) (synchronizing/bypass option)

Supply voltage measurement board (SVMB) is mandatory for AFG/FDUG/VFXG operation whereas it is optional for AFR/FDUL/VFXR operation. In case of AFR/FDUL/VFXR, as mentioned in section 7.7 voltage measurement is required for under voltage ride through function. Adding voltage measurement board offers following additional features

- AFR/FDUL/VFXR as regenerative unit i.e. DFE mode used in motor operation and AFR active in generator operation.
- Faster supply ID-Run and supply synchronization.
- Improved performance/synchronization if VSI (DC-link) is already loaded before synchronization.
- In case of AFG/FDUG/VFXG, SVMB ver.2 adds grid code functionality.

SVMB exists in two different variants i.e. ver.1 and ver.2. SVMB ver.2 is developed for AFG/FDUG/VFXG applications but can be used with AFR/FDUL/VFXR.

7.16.1 Supply voltage measurement board (hardware) - ver.1

For AFR/FDUL/VFXR applications, the grid voltage can be measured using ver.1 of SVMB. Figure x shows how to connect SVMB ver.1. Grid phase voltages should be connected on high voltage side L1, L2 and L3. X and y component of grid voltage generated from SVMB ver.1 should be connected to analogue inputs on the AFE control board as shown in figure x. SVMB ver.1 takes +24V supply from the AFE control board as shown in figure x. It should be noted that the SVMB ver.1 draws 50 mA (out of 100 mA) from the AFE control board.

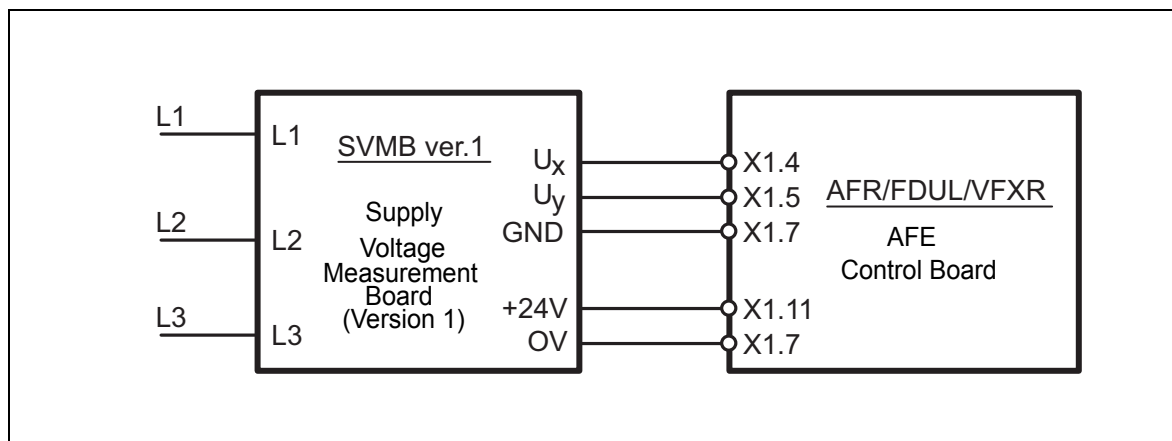


Fig. 31 Grid measurement circuit by means of SVMB ver.1

7.16.2 Supply voltage measurement board (hardware) - ver.2

The grid voltage is measured by means of the AFE option "Supply Voltage Measurement Board version 2" (SVMB ver.2). The SVMB ver.2 is a mandatory AFE option requirement in order to fulfill the basic grid codes, i.e. grid voltage and frequency protection functions. The SVMB ver.2 should be connected to the grid phase voltages on the high voltage (HV) side and provides for galvanically isolated conversion to the low-voltage (LV) side which should in turn be connected to (and fed from) the user I/O on the AFE control board (CB), see Fig. 32.

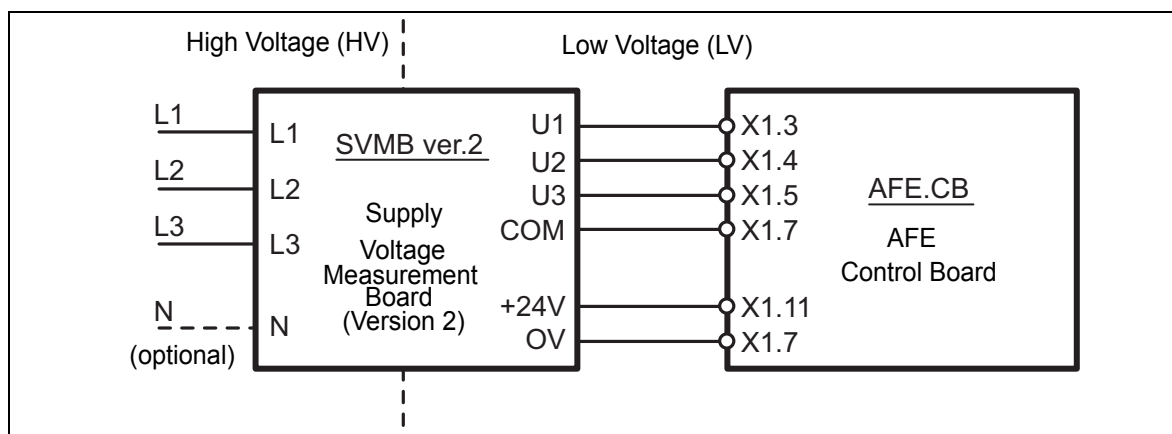


Fig. 32 Grid measurement circuit by means of SVMB ver.2 for AFE

It should be noted that the connection of the grid neutral to the N-input is optional BUT required if true phase-to-neutral voltages are to be monitored.

7.17 Grid code functionality

AFG offers grid code functionality for generation applications where AFG is connected to the utility grid. It includes:

- Grid monitoring or Protective functions (voltage and frequency protections)
- Reactive power support.
- Grid fault ride through and Anti-Islanding

7.17.1 Grid monitoring or protective functions

Grid voltage and frequency monitoring and protective functions are standard requirements for fulfilling the basic grid codes for distributed renewable generation systems (DRGS) connected to either the low-voltage (200-690 V) or medium voltage networks (1-25 kV), i.e. IEEE 1547, IEC 50438/50549, BDEW etc. This section gives a detailed description of the monitoring and protective functions with respect to voltage and frequency implemented in the CG/Emotron Active Front-End (AFE) intended for renewable energy sources (RES). The protective function features are implemented in AFE SW option version 97.09 and later, and requires the SVMB version 2, see section 7.16 for grid voltage measurement.

7.17.1.1 Grid voltage and frequency protection

The grid voltage and frequency protective functions operate on the extracted information of the phase voltages (or line-line voltages) and the frequency from the SVMB, see the block-diagram of the grid protection functionality in Fig. 33.

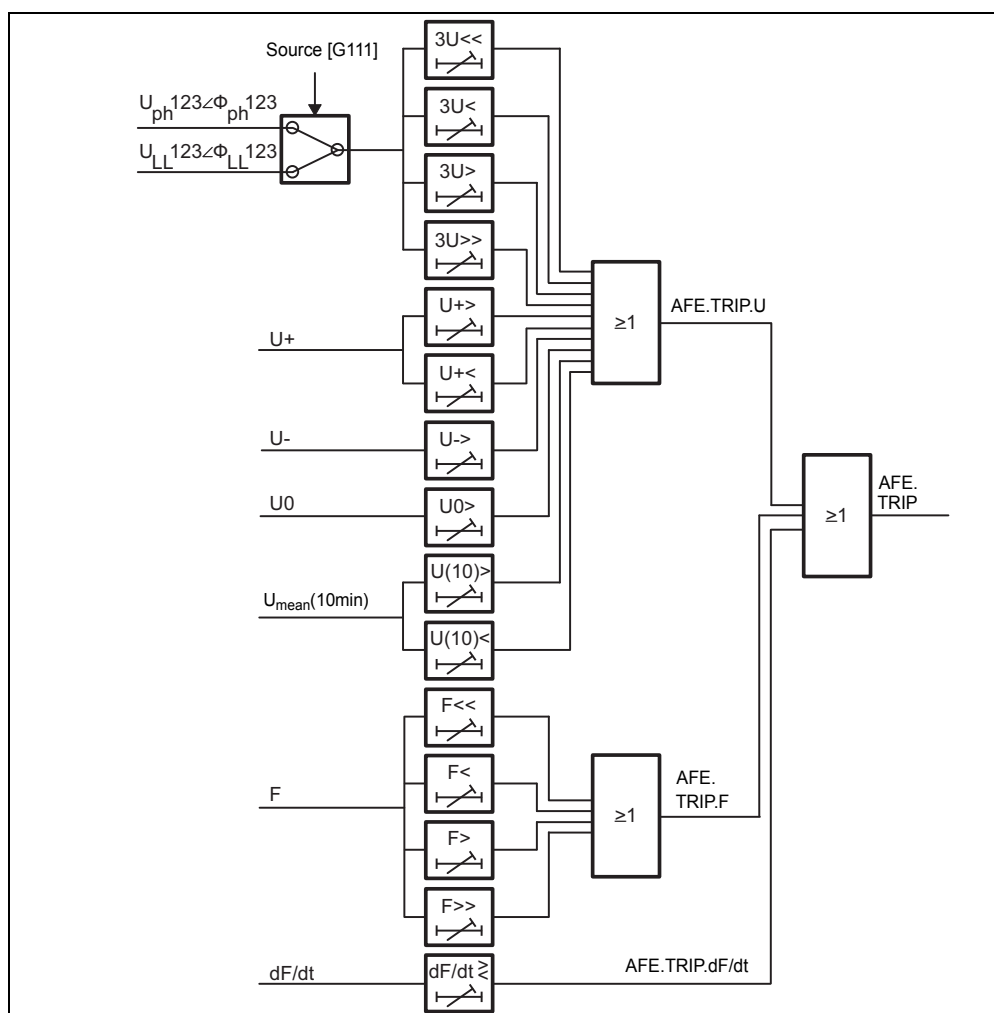


Fig. 33 Block diagram of voltage and frequency protection functionality in the AFE.

The over- and under-voltage protection contains two stages (3U>, 3U>> and 3U<, 3U<<), each with independently settable trip levels and trip times, see Fig. 34. The voltage protections are all of three phase type and contain one common hysteresis limit and reset timer. The source for voltage protection can be the phase voltages or line to line voltages.

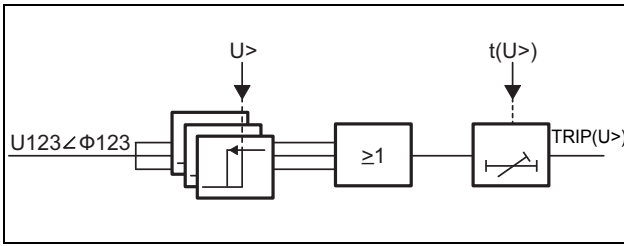


Fig. 34 Detailed block diagram of the three phase over-/under-voltage protection (First over-voltage stage $[3U >]$ is shown).

The additional over- and under-voltage protection based on the symmetrical voltages (U_+ , U_- or U_0) or the 10 minute mean value ($U_{mean(10min)}$) contains one stage with independently settable trip levels and trip times. The additional voltage protections are all of single type and uses the same common hysteresis limit and reset timer as the three phase voltage protection.

The over- and under-frequency protection contains two stages ($F >$, $F >>$ and $F <$, $F <<$), each with independently settable trip levels and trip times, see Fig. 35. The frequency protection contains one common hysteresis limit and reset timer.

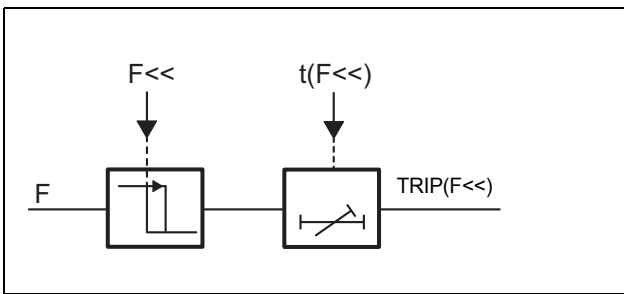


Fig. 35 Detailed block diagram of the over-/under-frequency protection (Second under-frequency stage $[F <<]$ is shown).

The rate of change of frequency (ROCOF) protection contains one stage ($dF/dt >$), within settable trip level and trip time, see Fig. 36. The ROCOF protection contains hysteresis limit and reset timer.

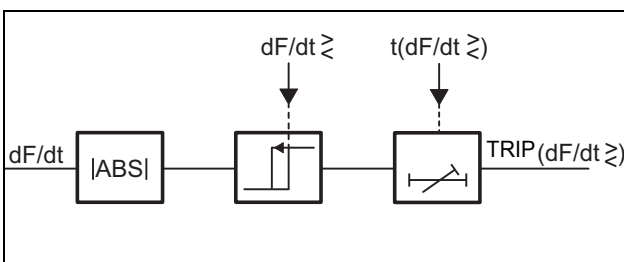


Fig. 36 Detailed block diagram of ROCOF protection functionality.

Voltage protection and frequency protection can be configured in menus $[G11]$ and $[G12]$ respectively. Details of these menus can be found in section 11.

7.17.2 Reactive power (Q) support

Often it is desired by the network operator that generating plants connected to network operators network must be able to provide voltage or reactive power support. For that, generating plants should have the possibility of supplying or consuming reactive power to/from the network. To fulfill the reactive power support requirements, Emotron AFR/AFG offers number of different operating modes i.e.

- Q fix
- $\cos\theta$ fix
- Q (U)
- $\cos\theta(U)$
- Q (P)
- $\cos\theta(P)$

Q fix

AFR/AFG controls reactive power output according to the set point.

$\cos\theta$ fix

AFR/AFG controls $\cos\theta$ at the supply terminals of AFR/AFG according to the set point.

Q (U)

AFR/AFG controls reactive power output as a function of measured supply voltage. For voltage related control mode, a characteristic (Q-U) curve can be configured using 4 configurable points (user parameters) which defines the reactive power behavior as a function of voltage. Response of Q(U) control matches the dynamics of first order filter.

$\cos\theta(U)$

AFR/AFG controls $\cos\theta$ of the output as a function of measured supply voltage. For voltage related control mode, a characteristic ($\cos\theta$ -U) curve can be configured using 4 configurable points (user parameters) which defines the $\cos\theta$ behavior as a function of voltage. Response of $\cos\theta(U)$ control matches the dynamics of first order filter.

Q (P)

AFR/AFG controls reactive power output as a function of supplied active power. For power related control mode, a characteristic (Q-P) curve can be configured using 4 configurable points (user parameters) which defines the reactive power behavior as a function of active power. Response of Q(P) control matches the dynamics of first order filter.

$\cos\theta(P)$

AFR/AFG controls $\cos\theta$ of the output as a function of supplied active power. For power related control mode, a characteristic ($\cos\theta$ -P) curve can be configured using 4 configurable points (user parameters) which defines the $\cos\theta$ behaviour of the output as a function of active power. Response of $\cos\theta(P)$ control matches the dynamics of first order filter.

Fig. 37 shows the derivation of reactive power reference $[310]$ in different operating modes. Only one mode can be active at a time. Fig. 38 shows the typical Q - U or $\cos\theta$ - U characteristics curve. Characteristics curve can be configured by defining 4-points in Q-U ($\cos\theta$ -U) reference frame.

NOTE:

Q_{ref} [310] derived from reactive power (Q) support functions ([G22] ... [G27]) is further limited by maximum reactive power limit (Q limit) defined in menu [041].

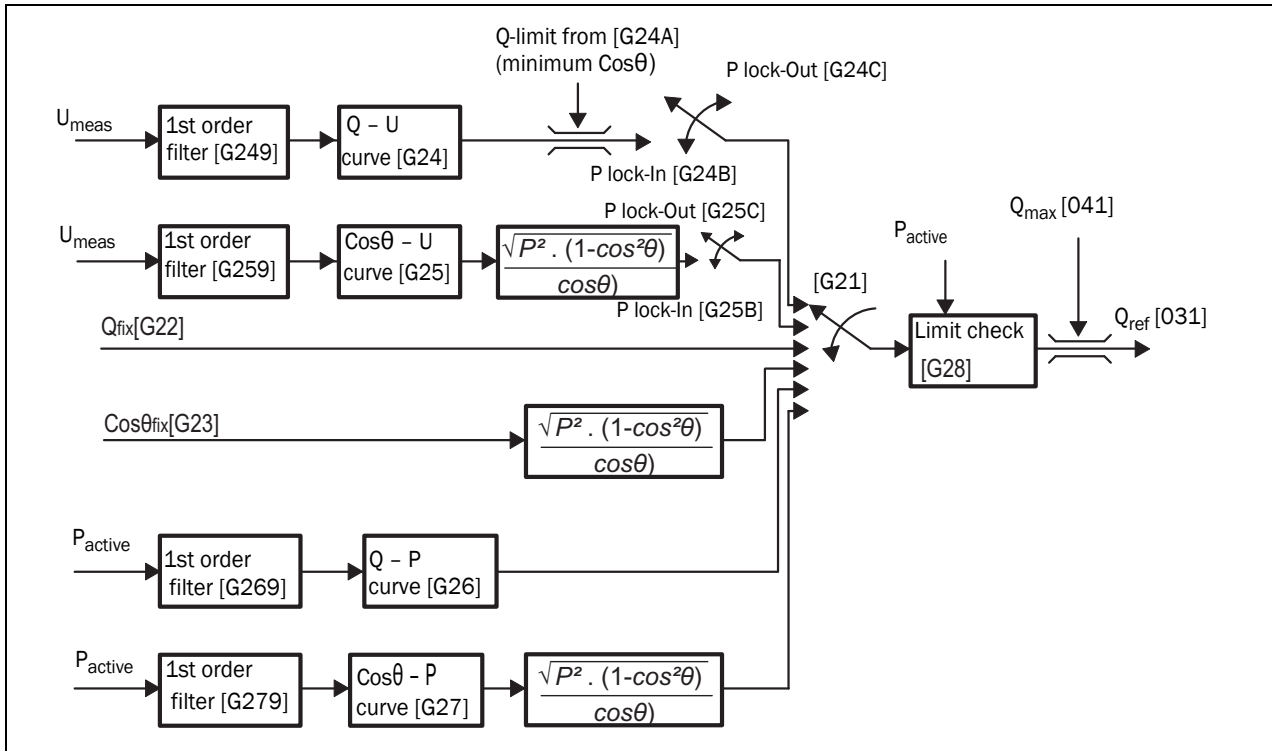


Fig. 37 Derivation of reactive power reference

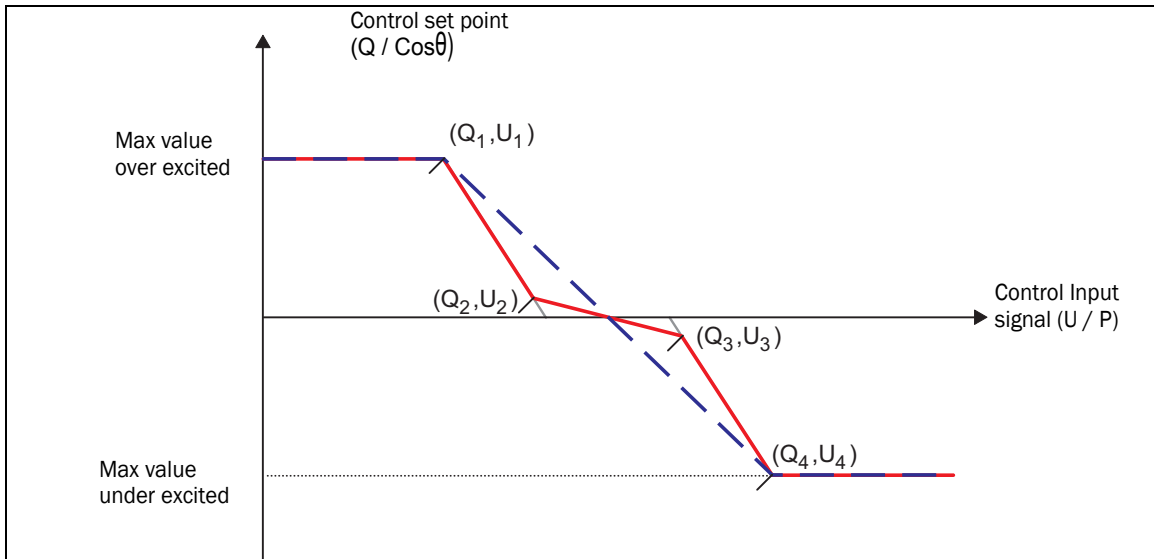


Fig. 38 Typical Q-U and $\cos\theta$ -U characteristics curve

NOTE:

Actual reactive power capability of AFR/AFG is limited by the ratings of the inverter. Therefore, the AFR/AFG must be rated properly in order to have enough reactive power available to fulfill the requirements laid by the grid codes or grid operator.

Active/reactive power priority

AFR/AFG can be configured to prioritize the active or reactive power for the case when kVA (or current) limit is reached for AFR/AFG unit. Prioritizing active power (P) means that reactive power (Q) will be limited to the AFR/AFG current capacity available after producing/consuming the active power. Similarly prioritizing reactive power (Q) means that active power (P) will be limited to the AFR/AFG current capacity available after producing/consuming the reactive power. P/Q priority can be configured in menu [G283]. By default, AFR/AFG prioritize the active power over reactive power.

Lock-In and Lock-Out active power levels

Lock-In and Lock-Out active power levels can be configured for Q(U) and $\cos\theta$ (U) modes.

Lock-In active power level

Q(U) and $\cos\theta$ (U) modes are turned on when the actual (filtered) active power level is higher than the set value of lock-in active power [G24B] or [G25B] respectively.

Lock-Out active power level

Q(U) and $\cos\theta$ (U) modes are turned off when the actual (filtered) active power level is lower than the set value of lock-out active power [G24C] or [G25C] respectively.

Fig. 39 shows a typical example of lock-in and lock-out values for Q(U) mode.

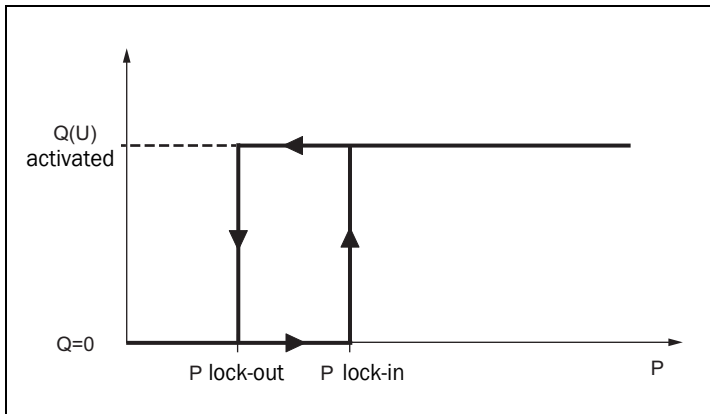


Fig. 39 Example of lock-in and lock-out values for Q(U) mode.
(Source IEC 50549-2)

NOTE:

Hysteresis between lock-in and lock-out is available only if lock-in is higher than the lock-out value. In that cases, the difference between lock-in and lock-out acts as a hysteresis.

7.17.3 Grid fault ride through and Anti Islanding

Grid voltage and frequency disturbance handling such as grid fault ride-through (FRT) and anti-islanding detection (AID) are standard requirements for fulfilling the grid codes for distributed renewable generation systems (DRGS) connected to either the low-voltage (200-690 V) or medium voltage networks (1-25 kV), i.e. IEEE 1547, IEC 50438/50549, BDEW etc. This section gives a detailed description of the FRT and AID functionality implemented in the

CG/Emotron Active Front-End for Generation (AFG) intended for renewable energy sources (RES). The FRT and AID features are implemented in AFE software (SW) option version 97.10 and later, and requires the SVMB version 2, see section for grid voltage measurement.

The AFG continuous and transient operation capabilities are listed in Table 12 and should be considered as the absolute maximum operation capability.

Table 12

Electrical Quantity	Continuous operating range	Comment
Voltage (U)	85 - 110% of U_N	340 - 440 V @ $U_N = 400$ V
Current (I)	0 - 110% of I_N	
Active power (P)	0 - 100% of S_N (limited by I_N)	100% @ $\cos\Phi = 1.0$ 90% @ $\cos\Phi = \pm 0.9$
Reactive power (Q)	$\pm 100\%$ of S_N (limited by I_N) $Q > 0\%$ (over-excited) $Q < 0\%$ (under-excited)	$\pm 100\%$ @ $P = 0\%$ $\pm 48\%$ @ $P = 90\%$ ($\cos\Phi = \pm 0.9$) $\pm 0\%$ @ $P = 100\%$ ($\cos\Phi = 1.0$)
Power factor ($\cos\Phi$)	$\pm 0.01 - \pm 1.0$ $\cos\Phi > 0$ (over-excited) $\cos\Phi < 0$ (under-excited)	
Frequency (F)	85 - 115% of F_N (absolute maximum)	42.5 - 57.5 Hz @ $F_N = 50$ Hz 51 - 69 Hz @ $F_N = 60$ Hz
	92 - 108% of F_N (normal maximum)	46 - 54 Hz @ $F_N = 50$ Hz 55 - 65 Hz @ $F_N = 60$ Hz
Rate-of-change-of-frequency (dF/dt)	$\pm 5\%/s$	± 2.5 Hz/s @ $F_N = 50$ Hz ± 3.0 Hz/s @ $F_N = 60$ Hz
	$\pm 5\%$ step	± 2.5 Hz step @ $F_N = 50$ Hz ± 3.0 Hz step @ $F_N = 60$ Hz

7.17.3.1 Grid fault ride through (FRT)

This section specifies the transient operation capability of the AFG during FRT, i.e. during grid disturbances. The absolute FRT capability of AFG is developed in order to include as many grid codes as feasible but priority has been given to fulfill the requirements for Europe (EN 50549-1 and EN 50549-2) and US (UL 1741- Supplement SA).

Grid fault ride through (FRT) capability of AFG includes following main functions.

- Over voltage ride through (OVRT)
- Under voltage ride through (UVRT)
- Over frequency ride through (OFRT)
- Under frequency ride through (UFRT)

For grid fault ride through (FRT) (both voltage and frequency) the AFG can (by own control means) handle grid disturbances that limits the actual AC output generated power by dissipating the possible excessive energy (feed into the AFG) into a brake resistor via the integrated brake chopper IGBT.

7.17.3.1.1 Over voltage ride through (OVRT)

The AFG OVRT capability is shown in Fig. 40. The capability applies to all kind of over voltages, i.e. 1-, 2- and 3-phase over voltages.

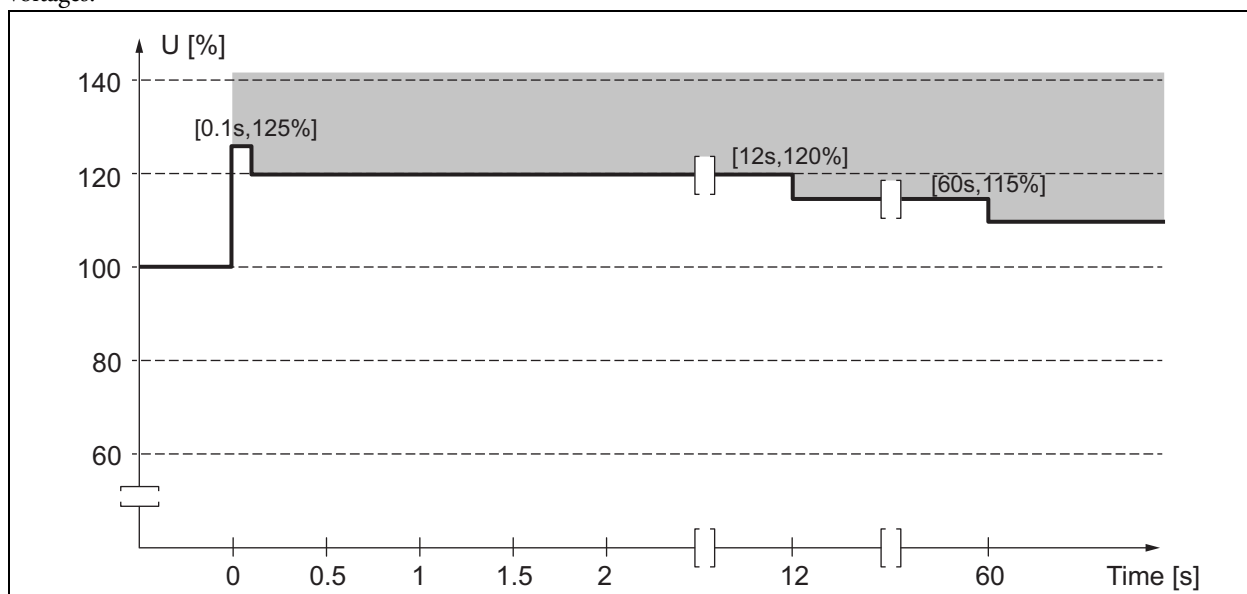


Fig. 40 OVRT capability

NOTE:

The upper voltage capability depends on ratio between the AFG voltage rating and the nominal grid voltage. For case with nominal grid voltage 400V, the OVRT capability with type AFG46 up to 125 % is possible but for case with nominal grid voltage of 440V, the OVRT capability with type AFG46 is only possible up to 120 %.

7.17.3.1.2 Under voltage ride through (UVRT)

The AFG UVRT capability is shown in Fig. 41. The capability applies to all kind of faults causing under voltages, i.e. 1-, 2- and 3-phase faults with/without simultaneous ground fault.

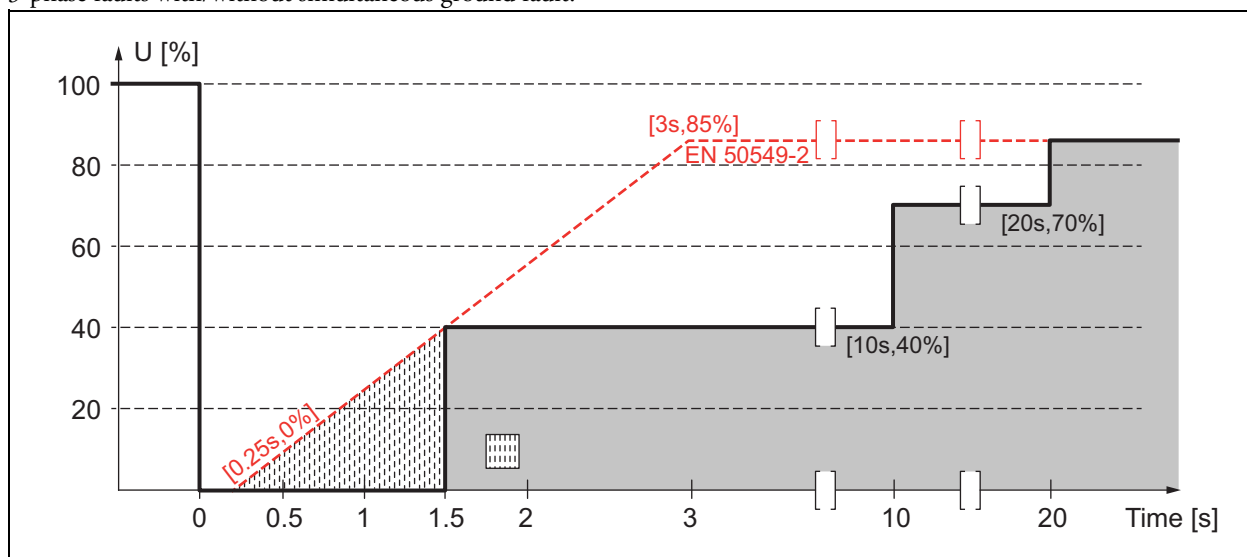


Fig. 41 UVRT capability

NOTE:

The FRT mode I(zero) is required for UVRT with long duration in combination with a remaining grid voltage <40 %.

7.17.3.1.3 Dynamic voltage support during UVRT and OVRT

The AFG grid voltage FRT detection is always performed based on the measured/estimated positive sequence (U+) and the negative sequence (U-) voltage components. Additionally, FRT detection is also performed on the individual line-line or phase-neutral voltages.

The AFG behavior during UVRT and OVRT are defined by the setup FRT mode via parameters [G325] for UVRT and [G327] for OVRT. The supported FRT modes are:

- I(cont) Continued operation mode where the pre-fault P and Q control is maintained to the extent possible.
- I(Q) Additional dynamic reactive current injection of both positive (I+) and negative (I-) sequence components according to EN 50549-2 (2019, section 4.7.4.2.1) with Q priority, i.e. the active current is limited in favor for reactive current if the AFG current limit is reached.
- I(P) Additional dynamic reactive current injection of both positive (I+) and negative (I-) sequence components according to EN 50549-2 (2019, section 4.7.4.2.1) with P priority, i.e. the reactive current is limited if the AFG current limit is reached.

I(zer) Zero current mode where the output current is immediately reduced below 10% of the rated AFG current as long as the grid voltage is outside the static voltage range. Note, that this mode corresponds to the operation state "momentary cessation" as defined in UL 1741 (Supplement SA) or alternatively to an active "gate blocking" operation state.

In order to avoid activation of the dynamic voltage support for small voltage variations, a configurable voltage insensitivity range (dead-band) can be defined via parameter [G323].

Additionally, configurable voltage thresholds for automatic activation of the zero current mode I(zer) for both OVRT and UVRT can be defined respectively in parameters [G326] and [G328].

The active and reactive current limits during voltage fault ride through (UVRT and OVRT) are individual and defined via parameters [G321] and [G322], respectively. For stable fault recovery, an additional active current limitation based on the actual grid voltage during the fault is needed as shown in Fig. 42. For a remaining grid voltage below 40% the active current limit is linearly reduced to 0 and instead shifted to a reactive current demand given in below equation up to the reactive current limit.

$$I_{Qref} = \sqrt{I_{PMAX}^2 - I_{Pref}^2}$$

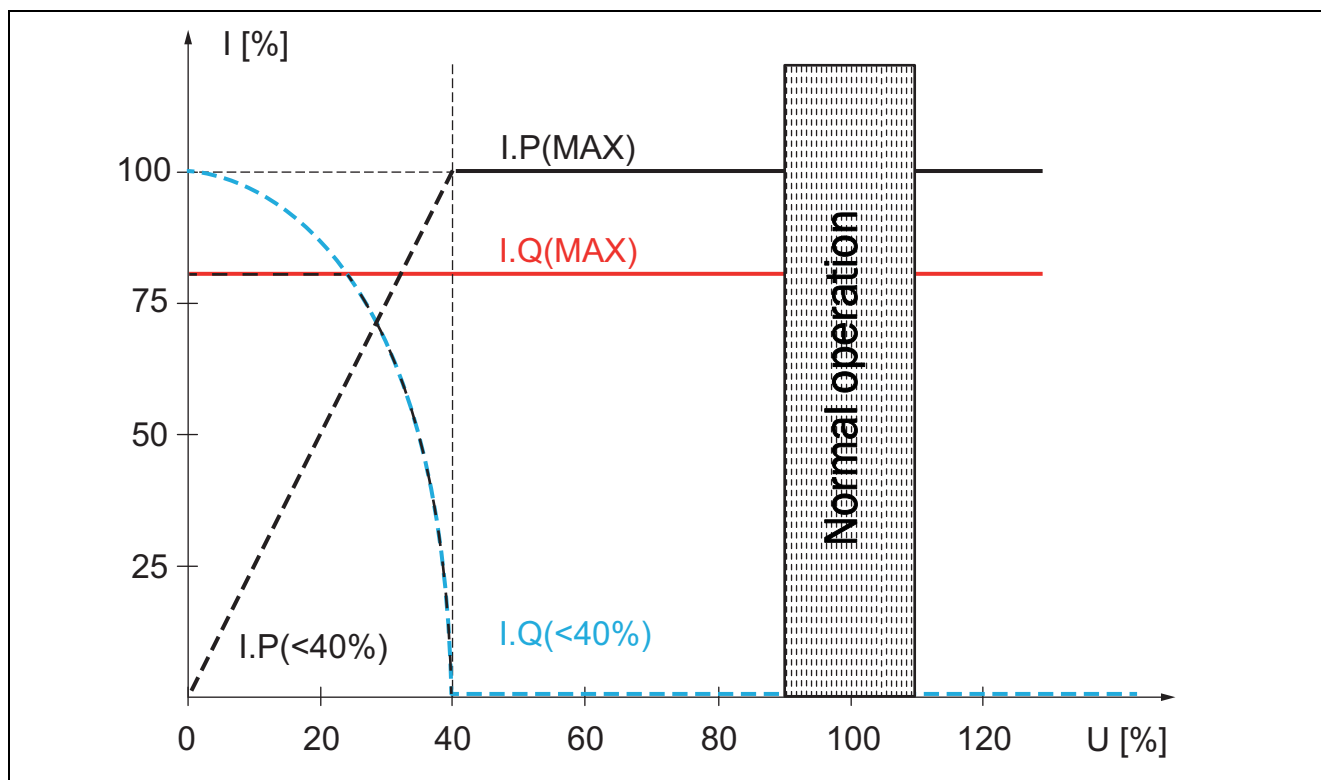


Fig. 42 Active (I_P) and reactive (I_Q) current limiting during UVRT/OVRT

The maximum time for dynamic grid support is defined in parameter [G324]. If the maximum time expires then the AFG unit resumes operation according to the FRT mode I(cont), i.e. continued operation mode.

The additional reactive current injection for modes I_(Q) and I_(P) can be configured via individual gain parameters [G329] and [G32A] for the positive- and negative sequence reactive current support as shown in Fig. 43.

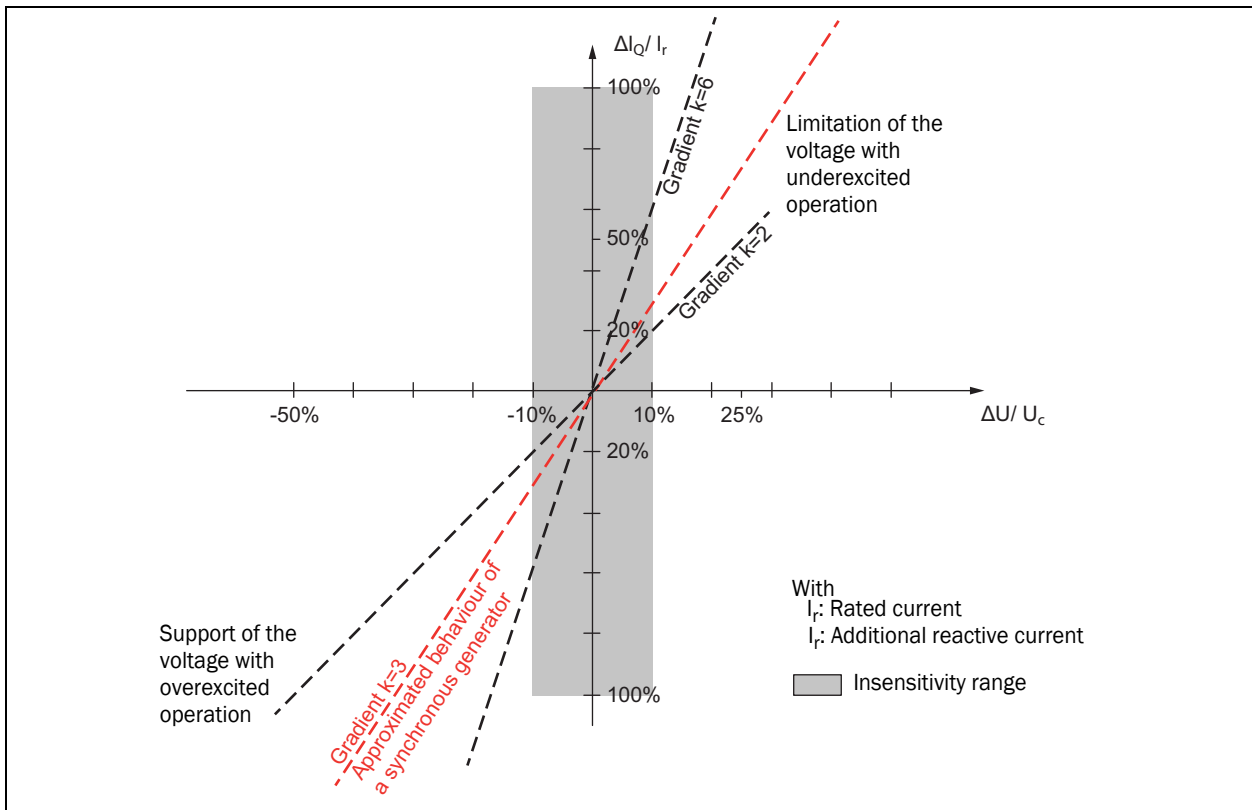


Fig. 43 FRT modes I(Q) and I(P) dynamic reactive current support for positive- and negative sequence according to EN 50549-2. Dedicated trip areas in the time-domain for both UVRT and OVRT are configurable via parameters [G32D]-[G32G] for UVRT and [G32H]-[G32K] for OVRT as shown in Fig. 44 (Source IEC 50549-2).

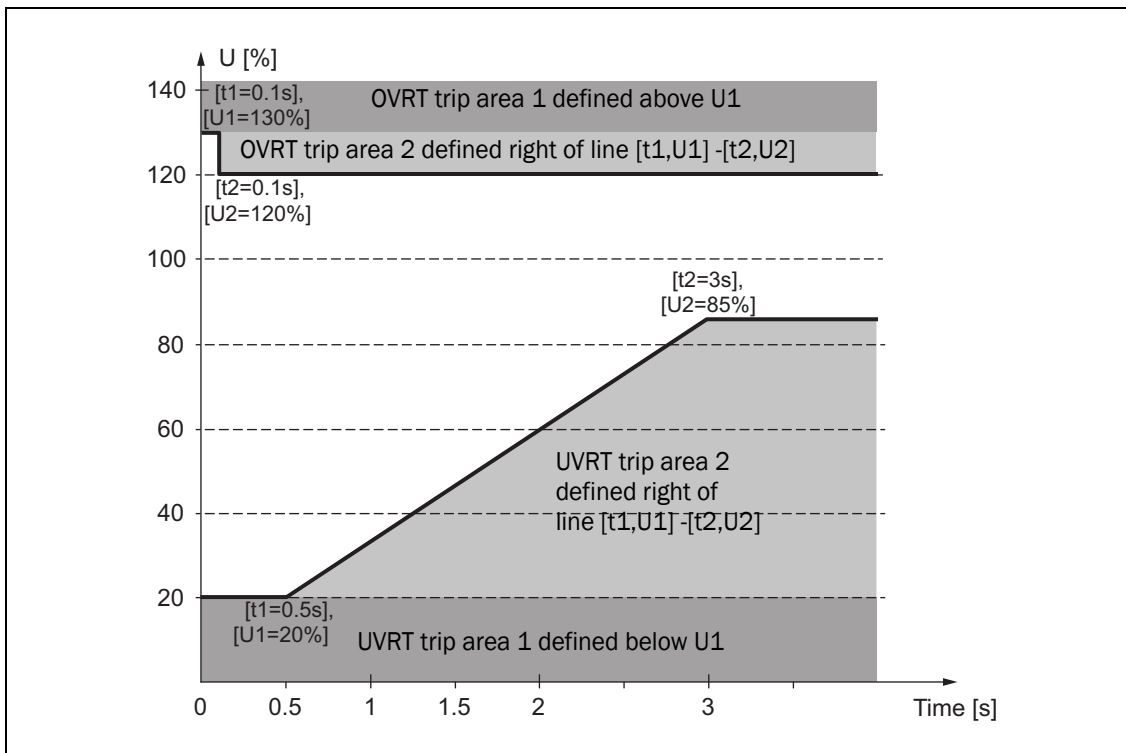


Fig. 44 UVRT and OVRT trip area description

7.17.3.1.4 Over frequency ride through (OFRT)

The AFG dynamic frequency support for OFRT is implemented according to the specifications for LFSM-O (Limited Frequency Sensitivity Mode - Overfrequency) in EN 50549-2 (2019, section 4.6.1), as shown in Fig. 45. The active power response is activated (if enabled via [G341]) when the grid frequency is greater than the defined start frequency (F_{start}) [G342] for the intentional start delay time (t_{start}) [G343]. The amount of active power reduction is calculated based on the droop (D) [G344] and the pre-disturbance active power (P_{ref}) according to below given equation.

$$\Delta P = \frac{1}{D[344]} \cdot \frac{F_{start}[342] - F}{F_{nom}[O12]} \cdot P_{ref}$$

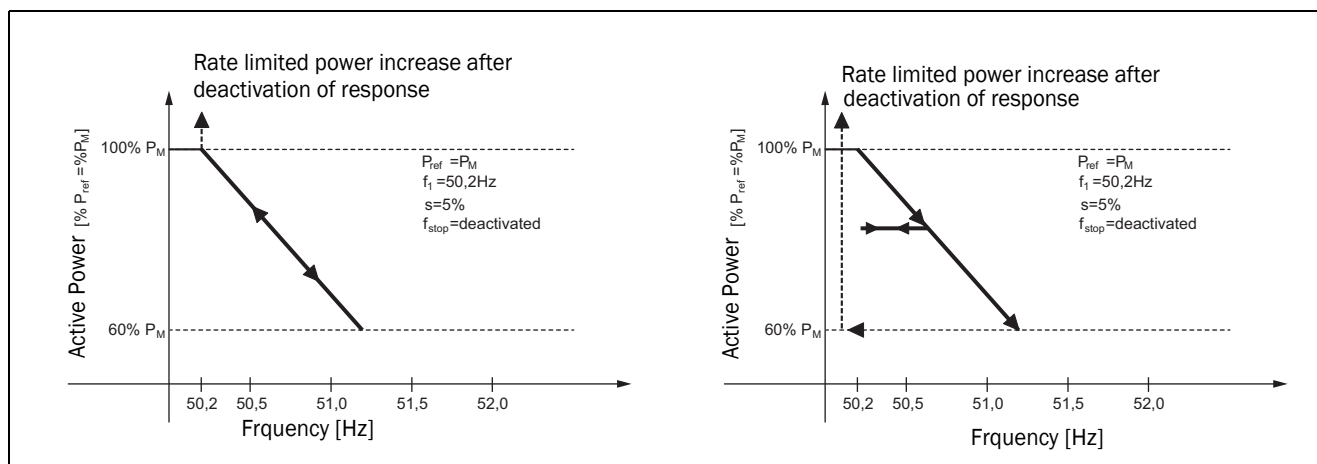


Fig. 45 Active power response during OFRT (source IEC 50549-2).

Left: Fig. 45 - Example of Active power frequency response to over frequency.

Right: Fig. 45 - Example of active power frequency response to over frequency with configured deactivation threshold.

If the deactivation threshold feature is enabled, then there should be no response according to the droop for decreasing frequency. Instead, the active power should remain constant until the frequency falls below the deactivation threshold (F_{stop}) [G345] including an additional deactivation delay time (t_{stop}) [G346].

7.17.3.1.5 Under frequency ride through (UFRT)

Active response to frequency deviations typically sets requirement for increasing the AC output power during low frequency conditions. Therefore, active response during UFRT needs to be handled by the plant energy management control system.

7.17.3.2 Anti - Islanding detection (AID)

Two different methods for detecting the anti-islanding are implemented in AFG. These are:

- Passive anti-islanding detection (AID) method
- Active anti-islanding detection (AID) method

7.17.3.2.1 Passive AID method

This method detects islanding based on sudden voltage phase jumps or frequency jumps. Passive AID can be turned on or off in menu [G331].

7.17.3.2.2 Active AID method

This method detects islanding based on active injection of detection signals. Active AID can be turned on or off in menu [G332].

NOTE: Contact local supplier or authorized Emotron service personal if further assistance is required with AID detection.

7.18 Brake resistor overload protection

The brake resistor overload protection is simply a short-term (surge) on-time filter which sums the on-time of the short active pulses and trips the AFG when the time value exceeds the maximum short-term surge load, i.e. time duration [G35] $t(Rb)_{max}$, of the brake resistor. The filter is decremented with a time-constant corresponding to 5 minutes to avoid filling up the filter in case of consecutive disturbances with sufficient time duration between the disturbances.

7.19 Detection of open circuit

A detection feature for an open circuit condition, i.e. an open main circuit breaker, possibly triggered by relay protection on the primary side (medium voltage side) of the plant transformer is available. The open circuit detection is triggered in case large deviations between the internal current reference and the actual output current is detected. Open circuit is detected if the actual output current is below the current threshold [G361] while the internal current reference is above the threshold [G361] multiplied by two. An open circuit trip is generated after the open circuit trip time [G362] has elapsed.

7.20 Remote control functions

Operation of the Run/Stop/Enable/Reset functions

As default, all the run/stop/reset related commands are programmed for remote operation via the inputs on the terminal strip (terminals 1-22) on the control board. With the function “Run/Stp Ctrl” [215] and “Reset Control” [216], this can be selected for keyboard or serial communication control.

NOTE: The examples in this paragraph do not cover all possibilities. Only the most relevant combinations are given. The starting point is always the default setting (factory) of the AC drive.

7.20.1 Default settings of the Run/Stop/Enable/Reset functions

The default settings are shown in Fig. 46. In this example the AFR/AFG drive is started and stopped with DigIn 2 and a reset after trip can be given with DigIn 8.

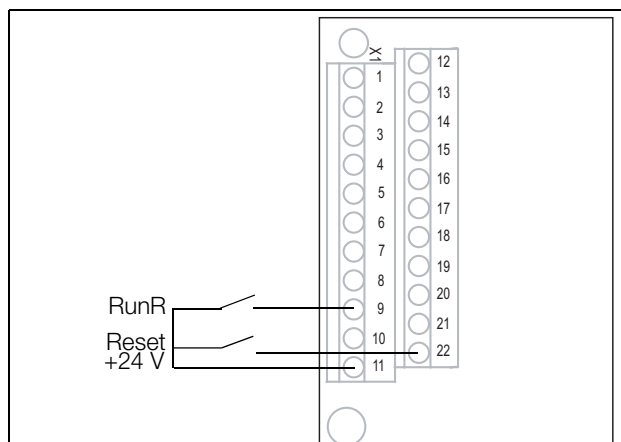


Fig. 46 Default setting Run/Reset commands

The inputs are default set for level-control. The rotation is determined by the setting of the digital inputs.

7.20.1.1 Enable and Stop functions

Both functions can be used separately or simultaneously. The choice of which function is to be used depends on the application and the control mode of the inputs (Level/Edge [21A]).

NOTE: In Edge mode, at least one digital input must be programmed to “stop”, because the Run commands are only able to start the AC drive.

7.20.1.1.1 Enable

Input must be active (HI) to allow any Run signal. If the input is made LOW, the output of the AC drive is immediately disabled and the AFR/AFG will stop immediately.



CAUTION!
If the Enable function is not programmed to a digital input, it is considered to be active internally.

7.20.1.1.2 Stop

If the input is low then the AFR/AFG drive will stop immediately. To run the AFR/AFG, input must be high.

7.20.1.2 Reset and Autoreset operation

If the AFR/AFG drive is in Stop Mode due to a trip condition, the AFR/AFG drive can be remotely reset by a pulse (“low” to “high” transition) on the Reset input, default on DigIn 8.

Depending on the selected control method, a restart takes place as follows:

7.20.1.2.1 Level-control

If the Run inputs remain in their position the AFR/AFG drive will start immediately after the Reset command is given.

7.20.1.2.2 Edge-control

After the Reset command is given a new Run command must be applied to start the AFR/AFG drive again.

Autoreset is enabled if the Reset input is continuously active. The Autoreset functions are programmed in menu “Autoreset [250]”.

NOTE: If the control commands are programmed for Keyboard control or Com, Autoreset is not possible.

7.20.1.3 Run Inputs Level-controlled

The inputs are set as default for level-control. This means that an input is activated by making the input continuously “High”. This method is commonly used if, for example, PLCs are used to operate the AFR/AFG drive.



CAUTION! Level-controlled inputs DO NOT comply with the Machine Directive, if the inputs are directly used to start and stop the machine.

The examples given in this and the following paragraphs follow the input selection shown in Fig. 47.

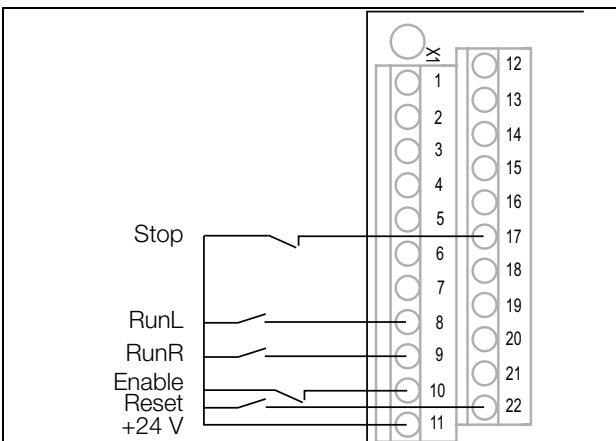


Fig. 47 Example of wiring for Run/Stop/Enable/Reset inputs

The Enable input must be continuously active in order to accept any run-right or run-left command. If both RunR and RunL inputs are active, then the AFR/AFG drive stops. Fig. 48 gives an example of a possible sequence.

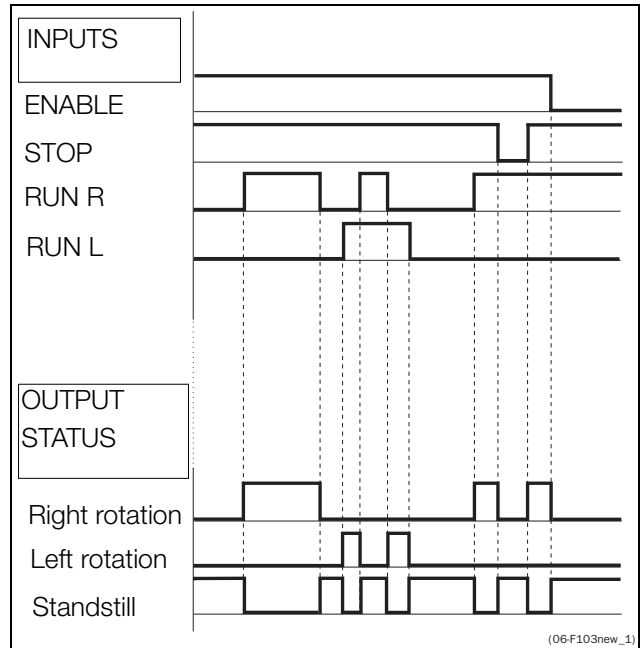


Fig. 48 Input and output status for level-control

7.20.1.4 Run Inputs Edge-controlled

Menu “[21A] Level/Edge” must be set to Edge to activate edge control. This means that an input is activated by a “low” to “high” transition or vice versa.

NOTE: Edge-controlled inputs comply with the Machine Directive (see Chapter 8. page 51), if the inputs are directly used for starting and stopping the machine.

See Fig. 47. The Enable and Stop input must be active continuously in order to accept any run-right or run-left command. The last edge (RunR or RunL) is valid. Fig. 49 gives an example of a possible sequence.

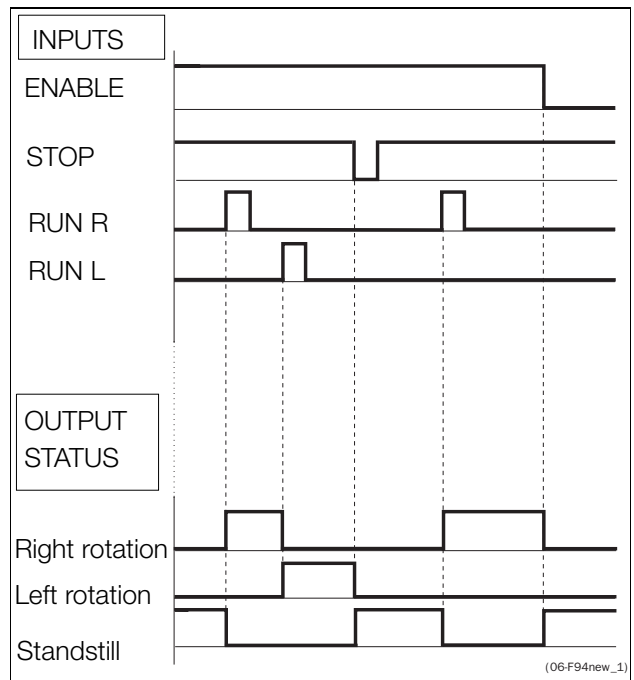


Fig. 49 Input and output status for edge-control

8. EMC and Machine Directive

8.1 EMC standards

The active front end and variable speed drive complies with the following EMC standards:

Generic EMC standards i.e. EN(IEC) 61000-6-2 and 61000-6-4

EN(IEC)61800-3:2004 Adjustable speed electronic power drive systems, part 3, EMC product standards:

In addition to that, AFG complies with low frequency electromagnetic immunity and emission requirements for dispersed generation systems in LV network i.e. IEC/TR 61000-3-15.

Standard: Category C3, for systems of rated supply voltage < 1000 VAC, intended for use in the second environment.

Optional: Category C2, for systems of rated supply voltage < 1.000 V, which is neither a plug in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by experienced person with the necessary skills in installing and/or commissioning variable speed drives including their EMC aspects.

8.2 Stop categories and emergency stop

The following information is important if emergency stop circuits are used or needed in the installation where a variable speed drive is used. EN 60204-1 defines 3 stop categories:

Category 0: Uncontrolled STOP:

Stopping by switching off the supply voltage. A mechanical stop must be activated. This STOP may not be implemented with the help of a variable speed drive or its input/output signals.

Category 1: Controlled STOP:

Stopping until the motor has come to rest, after which the mains supply is switched off. This STOP may not be implemented with the help of a variable speed drive or its input/output signals.

Category 2: Controlled STOP:

Stopping while the supply voltage is still present. This STOP can be implemented with each of the variable speed drives STOP command.



WARNING!

EN 60204-1 specifies that every machine must be provided with a category 0 stop. If the application prevents this from being

implemented, this must be explicitly stated.

Furthermore, every machine must be provided with an Emergency Stop function. This emergency stop must ensure that the voltage at the machine contacts, which could be dangerous, is removed as quickly as possible, without resulting in any other danger. In such an Emergency Stop situation, a category 0 or 1 stop may be used. The choice will be decided on the basis of the possible risks to the machine.

NOTE:

With option Safe Stop, a stop according EN-IEC 62061:2005 SIL 2 & EN-ISO 13849-1:2006, can be achieved. See Instruction manual for Emotron VFX/FDU2.0.

9. Operation via the Control Panel

This chapter describes how to use the control panel.

9.1 Control panels

In case of FDUL/VFXR/FDUG/VFXG deliveries, there are two control panels, one main panel in the Cabinet door controlling the complete Emotron FDUL/VFXR/FDUG/VFXG and one internal AFR/AFG panel designated for service engineers.

In case of AFR/AFG deliveries, there is only one panel that controls the AFR/AFG.

There are two different types of control panels. One with 4-line LCD display and one with a 2-line LCD display. In chapter 9.5 page 62 and chapter 9.4 page 58 are the panels described.

9.1.1 Main control panel for Emotron FDUL/VFXR/FDUG/VFXG

The Emotron FDUL/VFXR/FDUG/VFXG is equipped with one main control panel on the cabinet door see Fig. 50. When we further in this chapter describe how to use the control panel this is the one we are referring to.

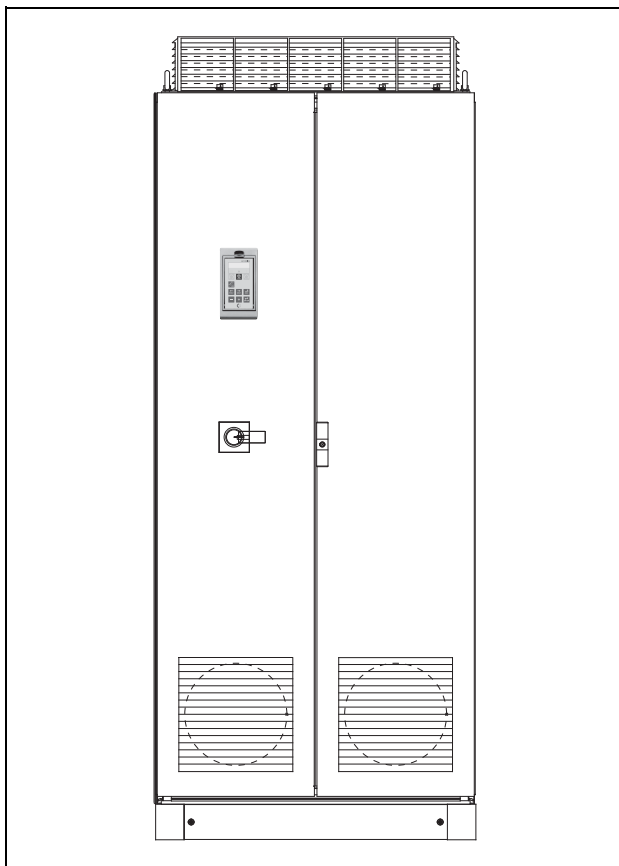


Fig. 50 VFXR with control panel in front door.

9.1.2 Control panel for AFR/AFG

Inside the cabinet door you will find a second control panel for the AFR/AFG unit, see Fig. 51. In this display you can observe status, trips and set parameters. Normally you do not need to do any changes in this panel. This panel is designated for use by service engineers.

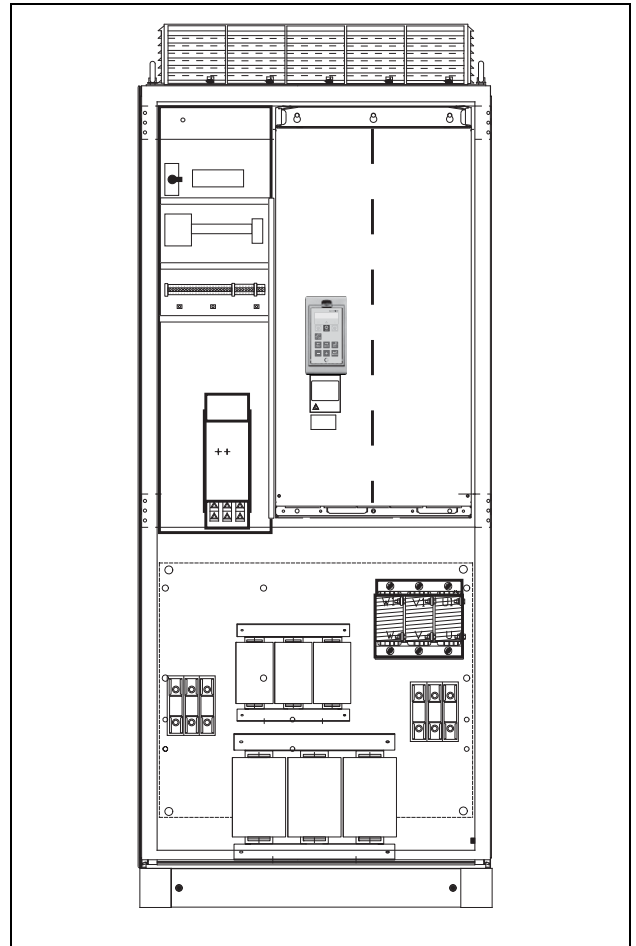


Fig. 51 Open the cabinet door to expose the AFR/AFG control panel.

9.2 General

The control panel in the front door displays the status of the Emotron FDUL/VFXR/FDUG/VFXG and is used to set all the user parameters. It is also possible to control the motor directly from the control panel. The control panel can be built-in or located externally via serial communication.

NOTE:

The VSI can run without the control panel being connected. However the settings must be such that all control signals are set for external use.

9.3 Control panel with 2-line display

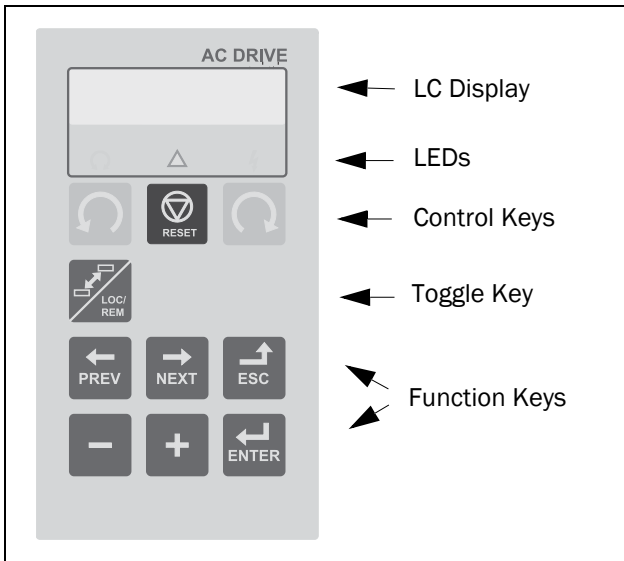


Fig. 52 Control panel

9.3.1 The display

The display is back lit and consists of 2 rows, each with space for 16 characters. The display is divided into six areas.

The different areas in the display are described below:

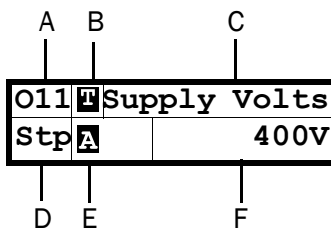


Fig. 53 The display

- Area A: Shows the actual menu number (3 or 4 digits).
- Area B: Shows if the menu is in the toggle loop or the driveunit is set for Local operation.
- Area C: Shows the heading of the active menu.
- Area D: Shows the status of the driveunit (3 digits). The following status indications are possible:

Digits	Description	Shown in		Bit*
		AFE	VSI	
Stp	AFE/VSI is stopped	X	X	0
Run	AFE/VSI runs	X	X	1
Acc	Acceleration		X	2
Dec	Deceleration		X	3
Trp	Tripped	X	X	4
SST	Operating Safe Stop, is flashing when activated		X	5
VL	Operating at voltage limit	X	X	6
SL	Operating at speed limit		X	7
CL	Operating at current limit	X	X	8
TL	Operating at torque limit	X	X	9
OT	Operating at temperature limit	X	X	10
I ² t	Active I ² t protection	X	X	11
LV	Operating at low voltage	X	X	12
Sby	Operating from Standby power supply	X	X	13
LCL	Operating with low cooling liquid level	X	X	14
Slp	Sleep mode	X	X	15
SPS	Spin start active		X	16

*) For a VSI the status shown in Area D on the control panel can be read via a fieldbus or serial communication, e.g. using Modbus address No. 30053.

It is also possible to read all status indications, not just the highest prioritized one, via a fieldbus or serial communication, e.g. using Modbus address No. 30180 and 30182. This information is also shown in EmoSoftCom PC-tool (optional) see menu "Area D status [72B]" of VSI instruction.

- Area E: Shows active parameter set and if it is a motor parameter.
- Area F: Shows the setting or selection in the active menu. This area is empty at the 1st level and 2nd level menu. This area also shows warnings and alarm messages. In some situations this area could indicate +++ or - - - please see further information in chapter 9.3.2 page 55.

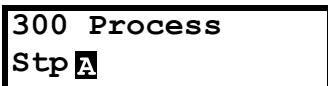


Fig. 54 Example 1st level menu

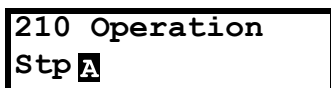


Fig. 55 Example 2nd level menu

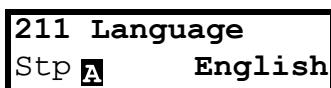


Fig. 56 Example 3d level menu

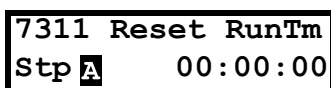


Fig. 57 Example 4th level menu

9.3.2 Indications on the display

The display can indicate +++ or --- if a parameter is out of range. In the VSI there are parameters which are dependent on other parameters. For example, if the speed reference is 500 and the maximum speed value is set to a value below 500, this will be indicated with +++ on the display. If the minimum speed value is set over 500, --- is displayed.

9.3.3 LED indicators

The symbols on the control panel have the following functions:

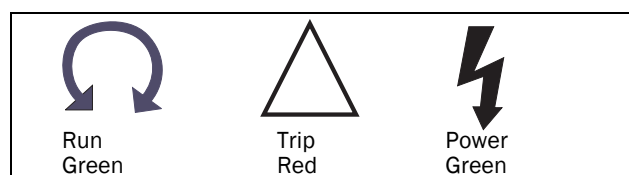


Fig. 58 LED indications

Table 13 LED indication

Symbol	Function		
	ON	FLASHING	OFF
POWER (green)	Power on	-----	Power off
TRIP (red)	Tripped	Warning/Limit	No trip
RUN (green)	Running	AC drive speed increase/decrease (VSI only)	AFR/AFG/VSI stopped

NOTE: If the control panel is built in, the back light of the display has the same function as the Power LED in Table 13 (Blank panel LEDs).

9.3.4 Control keys

The control keys are used to give the Run, Stop or Reset commands directly. As default these keys are disabled, set for remote control. Activate the control keys by selecting Keyboard in the menus Ref Control [214] and Reset Ctrl [216].

If the Enable function is programmed on one of the digital inputs, this input must be active to allow Run/Stop commands from the control panel.

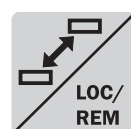
Table 14 Control keys

	RUN L:	gives a start with left rotation
	STOP/RESET:	stops or resets
	RUN R:	gives a start with right rotation

NOTE:

It is not possible to simultaneously activate the Run/Stop commands from the keyboard and remotely from the terminal strip (terminals 1-22).

9.3.5 The Toggle and Loc/Rem Key



This key has two functions: Toggle and switching between Loc/Rem function.

Press one second to use the toggle function

Press and hold the toggle key for more than five seconds to switch between Local and Remote function, depending on the settings in [2171] and [2172].

When editing values, the toggle key can be used to change the sign of the value, see section 9.7, page 63.

Toggle function

Using the toggle function makes it possible to easily step through selected menus in a loop. The toggle loop can contain a maximum of ten menus. As default the toggle loop contains the menus needed for Quick Setup. You can use the toggle loop to create a quick-menu for the parameters that are most importance to your specific application.

NOTE:

Do not keep the Toggle key pressed for more than five seconds without pressing either the +, - or Esc key, as this may activate the Loc/Rem function of this key instead. See menu [217].

Add a menu to the toggle loop

1. Go to the menu you want to add to the loop.
2. Press the Toggle key and keep it pressed while pressing the + key.

Delete a menu from the toggle loop

1. Go to the menu you want to delete using the toggle key.
2. Press the Toggle key and keep it pressed while pressing the - key.

Delete all menus from the toggle loop

1. Press the Toggle key and keep it pressed while pressing the Esc key.
2. Confirm with Enter. The menu Preferred view [100] is displayed.

Default toggle loop

Fig. 59 shows the default toggle loop. This loop contains the necessary menus that need to be set before starting. Press Toggle to enter menu [211] then use the Next key to enter the sub menus [212] to [21A] and enter the parameters. When you press the Toggle key again, menu [221] is displayed.

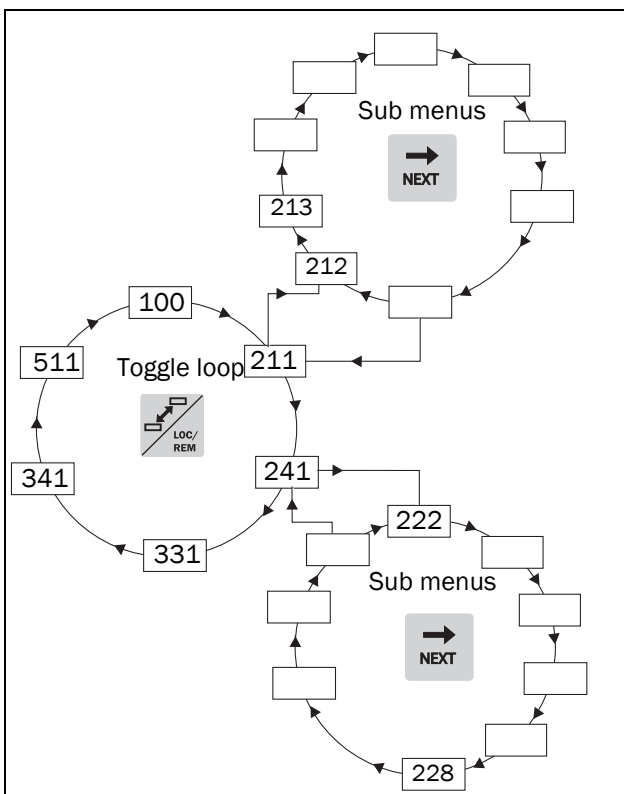


Fig. 59 Default toggle loop.

Indication of menus in toggle loop

Menus included in the toggle loop are indicated with a **T** in area B in the display.

Loc/Rem function

The Loc/Rem function of this key is disabled as default.
Enable the function in menu [2171] and/or [2172].

With the function Loc/Rem you can change between local and remote control of the VSI from the control panel. The function Loc/Rem can also be changed via the DigIn, see menu Digital inputs [520]

Change control mode

1. Press the Loc/Rem key for five seconds, until Local? or Remote? is displayed.
2. Confirm with Enter.
3. Cancel with Esc.

Local mode

Local mode is used for temporary operation. When switched to LOCAL operation, the VSI is controlled via the defined Local operation mode, i.e. [2171] and [2172]. The actual status of the VSI will not change, e.g. Run/Stop conditions and the actual speed will remain exactly the same. When the VSI is set to Local operation, the display will show **L** in area B in the display.

The VSI will be started and stopped using the keys on the control panel. The reference signal can be controlled using the + and - keys on the keyboard, when in the menu [310].

Remote mode








When the VSI is switched to REMOTE operation, the VSI will be controlled according to selected control methods in the menu's Reference Control [214], Run/Stop Control [215] and Reset Control [216]. The actual operation status of the VSI will reflect the status and settings of the programmed control selections, e.g. Start/Stop status and settings of the programmed control selections.

To monitor the actual Local or Remote status of the VSI control, a “Loc/Rem” function is available on the Digital Outputs or Relays. When the VSI is set to Local, the signal on the DigOut or Relay will be active high, in Remote the signal will be inactive low. See menu Digital Outputs [540] and Relays [550].

9.3.6 Function keys

The function keys operate the menus and are also used for programming and read-outs of all the menu settings.

Table 15 Function keys

	ENTER key:	<ul style="list-style-type: none"> - step to a lower menu level - confirm a changed setting
	ESCAPE key:	<ul style="list-style-type: none"> - step to a higher menu level - ignore a changed setting, without confirming
	PREVIOUS key:	<ul style="list-style-type: none"> - step to a previous menu within the same level - go to more significant digit in edit mode
	NEXT key:	<ul style="list-style-type: none"> - step to a next menu within the same level - go to less significant digit in edit mode
	- key:	<ul style="list-style-type: none"> - decrease a value - change a selection
	+ key:	<ul style="list-style-type: none"> - increase a value - change a selection
	TOGGLE and LOC/REM key:	<ul style="list-style-type: none"> - Toggle between menus in the toggle loop - Switching between local and remote control - Change the sign of a value

9.4 Control panel with 4-line display

This control panel with 4-line display is equipped with real time clock function. This means that actual date and time will be shown at e.g. a trip condition.

There is also an optional Control panel with Bluetooth communication available. See chapter 13.6 Control panel on page 156 for more information.

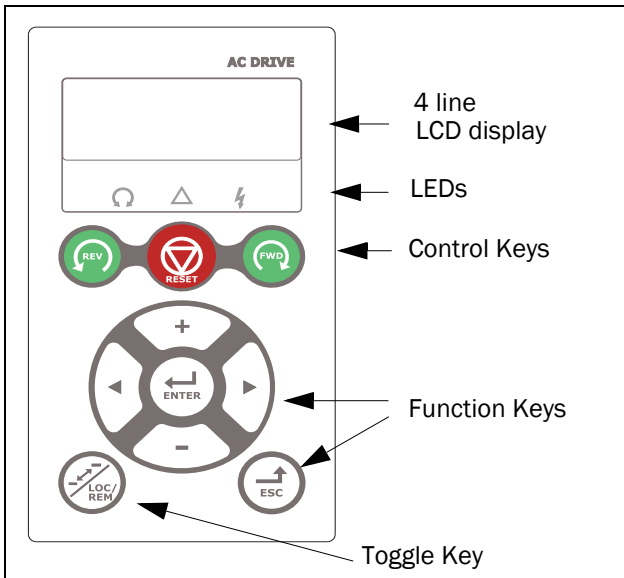


Fig. 60 Control panel with 4-line display, LEDs and Keys.

9.4.1 The display

The display is back lit and consists of 4 rows, each with space for 20 characters. The display is divided into following areas. The different areas in the display are described below:

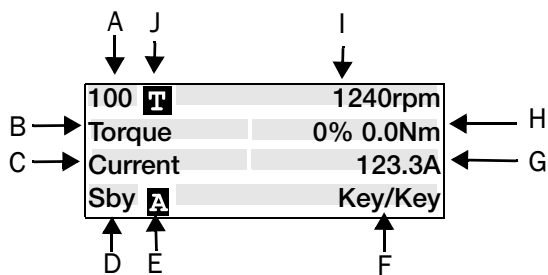


Fig. 61 The display.

- Area A: Shows the actual menu number (3 or 4 digits).
- Area B: Menu name or heading (Except in menus 100+ mode), 8 characters field.
- Area C: Edit Cursor if editing or heading in menu [100], 8 characters field.
- Area D*: Shows the status of the AC drive (3 digits). The following status indications are possible:

Digits	Description	Bit*
Stp	AFE/VSI is stopped	0
Run	AFE/VSI runs	1
Acc	Acceleration	2
Dec	Deceleration	3
Trp	Tripped	4
SST	Operating Safe Stop, is flashing when activated	5
VL	Operating at voltage limit	6
SL	Operating at speed limit	7
CL	Operating at current limit	8
TL	Operating at torque limit	9
OT	Operating at temperature limit	10
I ² t	Active I ² t protection	11
LV	Operating at low voltage	12
Sby	Operating from Standby power supply	13
LCL	Operating with low cooling liquid level	14
Slp	Sleep mode	15
SPS	Spin start active	16

*) The status shown in Area D on the control panel can be read via a fieldbus or serial communication, e.g. using Modbus address No. 30053.

It is also possible to read all status indications, not just the highest prioritized one, via a fieldbus or serial communication, e.g. using Modbus address No. 30180 and 30182. This information is also shown in EmoSoftCom PC-tool (optional), see menu "Area D status [72B]" of VSI instruction.

- Area E: Shows active parameter set: **A**, **B**, **C**, or **D** [241].
- Area F: Active control source.
- Area G: Parameter value, shows the setting or selection in the active menu, 12 characters field.
This area is empty at the 1st level and 2nd level menu. This area also shows warnings and alarm messages. In some situations this area could indicate "+++" or "---" see further information in the Instruction manual.
- Area H: Signal values shown in menu [100], 12 characters field.
- Area I: Preferred read-out value (chosen in menu [110])
- Area J: Shows if the menu is in the toggle loop and/or the AC drive is set for Local operation.
T = in Toggle loop
L T = in Local operation and Toggle loop
L = Local operation

NOTE:

In area B and area C only 8 characters are available, this means that some texts will be shortened.


Menu [100] Preferred view

This menu is displayed at every power-up. During operation, the menu [100] will automatically be displayed when the keyboard is not operated for 5 minutes.

Menu “[100] Preferred View” displays the settings made in menu “[110], 1st line”, “[120], 2nd line” and “[130], 3rd line”.

100 T	1240rpm	← First line - set in Menu [110].
Torque	0% 0.0Nm	← Second line - set in Menu [120]
Current	123.3A	← Third line - set in Menu [130]
Sby A	Key/Key	

Extended signal monitoring

If you hold the  key when in menu [100] following window will appear, as long as the key is pressed.

Here First, Second and Third line are shown as selected in menu [100].

Then additional information will be displayed, selected in the menus [140], [150] and [160] according to below.

100 T	0rpm	← First line - set in Menu [110].
3.9V	0.0A	← Second line - set in Menu [120].
0.0°C	0.0Hz	← Third line - set in Menu [130].
Sby A	A /Rem/Rem/--	← Fourth line - set in Menu [140]
		← Fifth line - set in Menu[150].
		← Sixth line - set in Menu[160]



Use menu “[170] View mode” to select active type of menu [100] presentation, select if “Normal 100” or “Always 100+” Extended signal monitoring” shall be shown at power-up. A third choice is menu “Normal100wo” = menu [100] without explaining text at second and third line.

9.4.2 Editing mode

All other menus (read and read/write menus) are used in following way.



221 T	1240rpm	← Shows Menu number to the left and to the right signal selected in menu [110].
Motor Volts		← Shows menu name to the left
M1	380V	← Shows menu value to the right and if it is a Motor parameter active Motor set (M1 in this case) is displayed to the left.
Run A	Key/Key	← Shows Drive status/Parameter set and Control source as in menu [100]

During editing, preferred view will not be displayed and the cursor will appear blinking to the left. See also below.

211 T		← Preferred view is not shown during editing.
Language		
	English	←  = blinking during editing
Run A	Loc/Loc	

9.4.3 Fault logger

As real-time clock is available, line 2 will show trip/warning message and line three will show date and time when the trip condition occurred.

810 	1240rpm
Ext trip	
2017-01-25	12:34.40
Run 	Rem/Rem

9.4.4 Real Time clock

In this 4 line Control panel (PPU) there is a built in Real time clock. This means that actual date and time will be shown at e.g. a trip condition. There is a built-in capacitor to be able to keep the clock running if the power disappear.

In case of loss of power, the backup time for the Real time clock function is at least 60 days.

Actual date and time will be set from factory. Date and time is shown and can be set in following menus.

Clock [930]


This menu group displays actual time and date, read only.

Time and date are factory set to CET (Central European mean time). Adjust if required in following sub-menus.

930 	1240rpm
Clock	
2017-01-23	12:34.40
Run 	Key/Key

Time [931]

Actual time, displayed as hh:mm:ss. Adjustable setting.

931 	1240rpm
Time	
	12:34.40
Run 	Key/Key

Unit	hh:mm:ss (hours: minutes: seconds)
------	------------------------------------

Date [932]



Actual date, displayed as YYYY-MM-DD. Adjustable setting.

932 	1240rpm
Date	
	2017-01-23
Run 	Key/Key

Unit:	YYYY-MM-DD (year-month-day)
-------	-----------------------------

Weekday [933]

Display of actual weekday, read only.

933 	1240rpm
Weekday	
	Monday
Run 	Key/Key

9.4.5 LED indicators

The symbols on the control panel have the following functions:

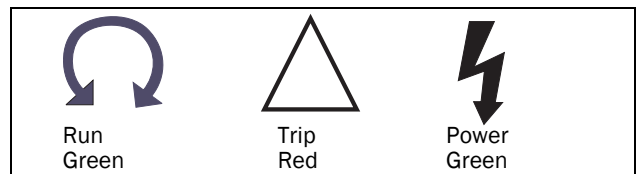


Fig. 62 LED indications

Table 16 LED indication

Symbol	Function		
	ON	FLASHING	OFF
POWER (green)	Power on	-----	Power off
TRIP (red)	Tripped	Warning/Limit	No trip
RUN (green)	Running	AC drive speed increase/decrease (VSI only)	AFR/AFG/VSI stopped




NOTE: If the control panel is built in, the back light of the display has the same function as the Power LED in Table 16 (Blank panel LEDs).

9.4.6 Control keys

The control keys are used to give the Run, Stop or Reset commands directly. As default these keys are disabled, set for remote control. Activate the control keys by selecting Keyboard in the menus Ref Control [214] and Reset Ctrl [216].

If the Enable function is programmed on one of the digital inputs, this input must be active to allow Run/Stop commands from the control panel.

Table 17 Control keys

	RUN L:	gives a start with left rotation
	STOP/RESET:	stops or resets
	RUN R:	gives a start with right rotation

NOTE:

It is not possible to simultaneously activate the Run/ Stop commands from the keyboard and remotely from the terminal strip (terminals 1-22).

9.4.7 The Toggle and Loc/Rem Key



This key has two functions: Toggle and switching between Loc/Rem function.

Press one second to use the toggle function

Press and hold the toggle key for more than five seconds to switch between Local and Remote function, depending on the settings in [2171] and [2172].

When editing values, the toggle key can be used to change the sign of the value, see section 9.7, page 63.

Toggle function

Using the toggle function makes it possible to easily step through selected menus in a loop. The toggle loop can contain a maximum of ten menus. As default the toggle loop contains the menus needed for Quick Setup. You can use the toggle loop to create a quick-menu for the parameters that are most importance to your specific application.

NOTE:

Do not keep the Toggle key pressed for more than five seconds without pressing either the +, - or Esc key, as this may activate the Loc/Rem function of this key instead. See menu [217].

Add a menu to the toggle loop

1. Go to the menu you want to add to the loop.
2. Press the Toggle key and keep it pressed while pressing the + key.

Delete a menu from the toggle loop

1. Go to the menu you want to delete using the toggle key.
2. Press the Toggle key and keep it pressed while pressing the - key.

Delete all menus from the toggle loop

1. Press the Toggle key and keep it pressed while pressing the Esc key.
2. Confirm with Enter. The menu Preferred view [100] is displayed.

Default toggle loop

Fig. 63 shows the default toggle loop. This loop contains the necessary menus that need to be set before starting. Press Toggle to enter menu [211] then use the Next key to enter the sub menus [212] to [21A] and enter the parameters. When you press the Toggle key again, menu [221] is displayed.

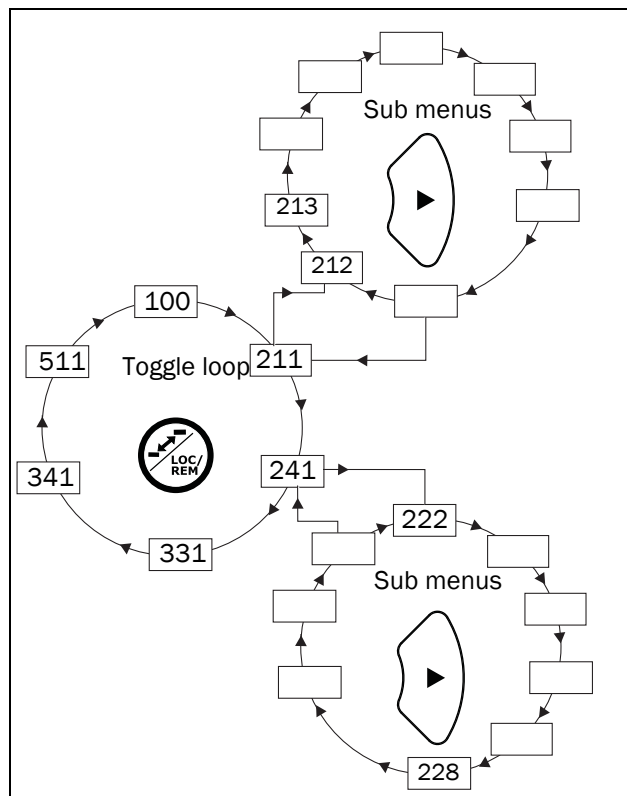


Fig. 63 Toggle loop example.

Indication of menus in toggle loop

Menus included in the toggle loop are indicated with a **T** in area B in the display.

Loc/Rem function

The Loc/Rem function of this key is disabled as default. Enable the function in menu [2171] and/or [2172].

With the function Loc/Rem you can change between local and remote control of the VSI from the control panel. The function Loc/Rem can also be changed via the DigIn, see menu Digital inputs [520]

Change control mode

1. Press the Loc/Rem key for five seconds, until Local? or Remote? is displayed.
2. Confirm with Enter.
3. Cancel with Esc.

Local mode

Local mode is used for temporary operation. When switched to LOCAL operation, the VSI is controlled via the defined Local operation mode, i.e. [2171] and [2172]. The actual status of the VSI will not change, e.g. Run/Stop conditions and the actual speed will remain exactly the same. When the VSI is set to Local operation, the display will show **T** in area B in the display.

The VSI will be started and stopped using the keys on the control panel. The reference signal can be controlled using the + and - keys on the keyboard, when in the menu [310].

Remote mode

When the VSI is switched to REMOTE operation, the VSI will be controlled according to selected control methods in the menu's Reference Control [214], Run/Stop Control [215] and Reset Control [216]. The actual operation status of the VSI will reflect the status and settings of the programmed control selections, e.g. Start/Stop status and settings of the programmed control selections.

To monitor the actual Local or Remote status of the VSI control, a "Loc/Rem" function is available on the Digital Outputs or Relays. When the VSI is set to Local, the signal on the DigOut or Relay will be active high, in Remote the signal will be inactive low. See menu Digital Outputs [540] and Relays [550].

9.4.8 Function keys

The function keys operate the menus and are also used for programming and read-outs of all the menu settings.

Table 18 Function keys

	ENTER key:	<ul style="list-style-type: none"> - step to a lower menu level - confirm a changed setting
	ESCAPE key:	<ul style="list-style-type: none"> - step to a higher menu level - ignore a changed setting, without confirming
	PREVIOUS key:	<ul style="list-style-type: none"> - step to a previous menu within the same level - go to more significant digit in edit mode
	NEXT key:	<ul style="list-style-type: none"> - step to a next menu within the same level - go to less significant digit in edit mode
	- key:	<ul style="list-style-type: none"> - decrease a value - change a selection
	+ key:	<ul style="list-style-type: none"> - increase a value - change a selection
	TOGGLE and LOC/REM key:	<ul style="list-style-type: none"> - Toggle between menus in the toggle loop - Switching between local and remote control - Change the sign of a value

9.5 The menu structure

The menu structure consists of 4 levels:

Main Menu 1st level	The first character in the menu number.
2nd level	The second character in the menu number.
3rd level	The third character in the menu number.
4th level	The fourth character in the menu number.

This structure is consequently independent of the number of menus per level.

For instance, a menu can have one selectable menu ([O51] Freq Type, or it can have 7 selectable menus ([O30] Udc Control).

NOTE:

If there are more than 10 menus within one level, the numbering continues in alphabetic order.

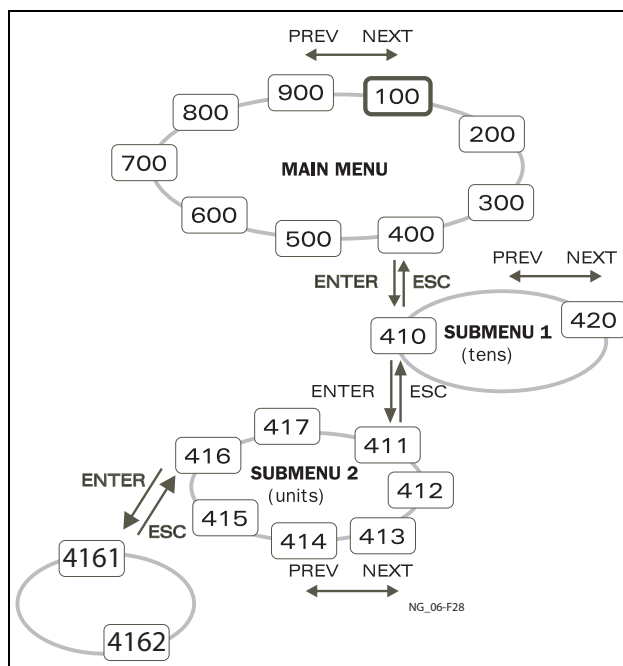


Fig. 64 Menu structure (general principle)

9.5.1 The main menu for AFR/AFG

This section gives you a short description of the functions in the Main menu for AFR/AFG.

For Emotron VFX and FDU refer to the standard instruction manual.

100 Preferred View

Displayed at power-up. It displays the actual process value as default. Programmable for many other read-outs.

200 Main Setup

Main settings to get the AFR/AFG operable. The supply data settings are the most important. Also option utility and settings.

300 Process and Application Parameters

Settings more relevant to the application such as Reactive power, Reference etc.

500 Inputs/Outputs and Virtual Connections

All settings for inputs and outputs are entered here.

600 Logical Functions and Timers

All settings for conditional signal are entered here.

700 View Operation and Status

Viewing all the operational data like frequency, load, power, current, etc.

800 View Trip Log

Viewing the last 10 trips in the trip memory.

900 Service Information and AFR/AFG Data

Electronic type label for viewing the software version and AFR/AFG type.

000 AFE Option

Main setup for AFR/AFG dedicated features.

G00 Grid Code parameters

All settings for grid code requirements are entered here.

9.6 Programming during operation

Most of the parameters can be changed during operation without stopping the AFR/AFG or VSI. Parameters that can not be changed are marked with a lock symbol in the display.

NOTE:

If you try to change a function during operation that only can be changed when the AFR/AFG is stopped, the message "Stop First" is displayed.

9.7 Editing values in a menu

Most values in the second row in a menu can be changed in two different ways. Enumerated values like the baud rate can only be changed with alternative 1.

2621	Baudrate
Stp	38400

Alternative 1

When you press the + or - keys to change a value, the cursor is flashing to the left in the display and the value is increased or decreased when you press the appropriate key. If you keep the + or - keys pressed, the value will increase or decrease continuously. When you keep the key pressed the change speed will increase. The Toggle key is used to change the sign of the entered value. The sign of the value will also change when zero is passed. Press Enter to confirm the value.

011	Supply Volts
Stp	A 400 V

▲ Flashing

Alternative 2

Press the + or - key to enter edit mode. Then press the Prev or Next key to move the cursor to the right most position of the value that should be changed. The cursor will make the selected character blink. Move the cursor using the Prev or Next keys. When you press the + or - keys, the character at the cursor position will increase or decrease. This alternative is suitable when you want to make large changes.

To change the sign of the value, press the toggle key. This makes it possible to enter negative values.

Example: When you press Next the "400" will blink.

011	Supply Volts
Stp	A 400 V

Flashing ▲

Press Enter to save the setting and Esc to leave the edit mode.

9.8 Copy current parameter to all sets

When a parameter is displayed, press the Enter key for 5 seconds. Now the text To all sets? is displayed. Press Enter to copy the setting for current parameter to all sets.

9.9 Programming example

This example shows how to program a change of Language from English (default) to Nederlands.

The flashing cursor indicates that a change has taken place but is not saved yet. If at this moment, the power fails, the change will not be saved.

Use the ESC, Prev, Next or the Toggle keys to proceed and to go to other menus.

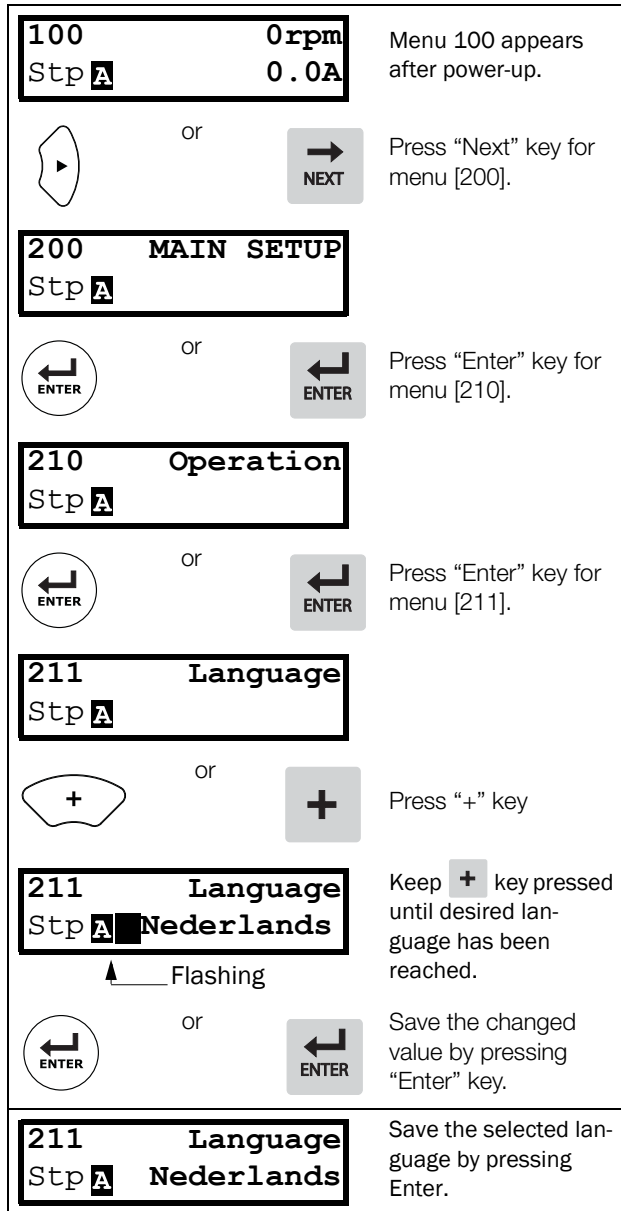


Fig. 65 Programming example

10. Serial communication

The AC drive provides possibility for different types of serial communication.

- Modbus RTU via RS232/485
- Fieldbuses as Profibus DP and DeviceNet
- Industrial Ethernet as Modbus/TCP, Profinet IO, EtherCAT and EtherNet/IP

10.1 Modbus RTU

Use the isolated RS232/485 option board for serial communication. This port is galvanically isolated. The protocol used for data exchange is based on the Modbus RTU protocol, originally developed by Modicon. The physical connection is RS232/485. The AC drive acts as a slave with selectable address in a master-slave configuration. The communication is half-duplex. It has a standard non return zero (NRZ) format.

The baud rate is adjustable between 2400 to 38400.

The character frame format (always 11 bits) has:

- one start bit
- eight data bits
- two stop bits
- no parity

The AC drive has also an asynchronous serial communication interface behind the control panel. Please note that this port is not galvanically isolated.

It is possible to temporarily connect a personal computer with for example the software EmoSoftCom (programming and monitoring software) to the RS232 connector on the control panel. This can be useful when copying parameters between AC drives etc. For permanent connection of a personal computer you have to use one of the communication option boards.

NOTE: This RS232 port is not isolated.



WARNING!

Correct and safe use of a RS232 connection depends on the ground pins of both ports being the same potential.

Problems can occur when connecting two ports of e.g. machinery and computers where both ground pins are not the same potential. This may cause hazardous ground loops that can destroy the RS232 ports.

The RS232 connection behind the control panel is not galvanically isolated.

The RS232/485 option board from CG Drives & Automation is galvanically isolated.

Note that the control panel RS232 connection can safely be used in combination with commercial available isolated USB to RS232 converters.

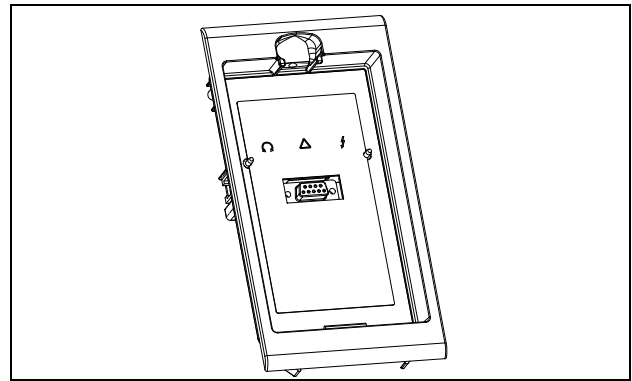


Fig. 66 RS232 connector behind the control panel

10.2 Start and stop commands

Set start and stop commands via serial communication.

Modbus/DeviceNet Instance number	Function
42901	Reset
42902	Run, active together with either RunR or RunL to perform start.
42903	RunR
42904	RunL

Note! Bipolar reference mode is activated if both RunR and RunL is active.

10.3 Reference signal

When menu “Reference Control [214]” is set to “Com” the following parameter data should be used:

Default	0
Range	-16384 to 16384
Corresponding to	-100% to 100% ref

Communication information

Modbus /DeviceNet Instance number	42905
Profibus slot /Index	168/64
EtherCAT index (hex)	4b59
Profinet IO index	19289
Fieldbus format	Int
Modbus format	Int

10.4 Description of the EInt formats

Eint is only used with Modbus-RTU and Modbus-TCP protocols.

A parameter with Eint format can be represented in two different formats (F). Either as a 15 bit unsigned integer format (F= 0) or a Emotron floating point format (F=1). The most significant bit (B15) indicates the format used. See detailed description below.

All parameters written to a register may be rounded to the number of significant digits used in the internal system.

The matrix below describes the contents of the 16-bit word for the two different EInt formats:

B15	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0
F=1	e3	e2	e1	e0	m10	m9	m8	m7	m6	m5	m4	m3	m2	m1	m0
F=0	B14	B13	B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1	B0

If the format bit (B15) is 0, then all bits may be treated as a standard unsigned integer (UInt)

If the format bit is 1, then is the number interpreted as this:

Value = $M \cdot 10^E$, where M=m10..m0 represents a two- complement signed mantissa and E= e3..e0 represents a two- complement signed exponent.

NOTE: Parameters with EInt format may return values both as 15 bit unsigned int (F=0) or in Emotron floating point (F=1).

Example, resolution

If you write the value 1004 to a register and this register has 3 significant digits, it will be stored as 1000.

In the Emotron floating point format (F=1), one 16-bit word is used to represent large (or very small numbers) with 3 significant digits.

If data is read or written as a fixed point (i.e. no decimals) number between 0-32767, the 15 bit Unsigned integer format (F=0) may be used.

Detailed description of Emotron floating point format

e3-e0 4-bit signed exponent. Gives a value range:
 -8..+7 (binary 1000 .. 0111)
 m10-m0 11-bit signed mantissa.Gives a value range:
 -1024..+1023 (binary 10000000000..01111111111)

A signed number should be represented as a two complement binary number, like below:

Value Binary

```
-8 1000
-7 1001
..
-2 1110
-1 1111
0 0000
1 0001
2 0010
..
6 0110
7 0111
```

The value represented by the Emotron floating point format is $m \cdot 10^e$.

To convert a value from the Emotron floating point format to a floating point value, use the formula above.

To convert a floating point value to the Emotron floating point format, see the C-code example below.

Example, floating point format

The number 1.23 would be represented by this in Emotron floating point format,

```
F  EEEE  MMMMMMMMMMMM
1 1110 00001111011
F=1 -> floating point format used
E=-2
M=123
```

The value is then $123 \times 10^{-2} = 1.23$

Example 15bit unsigned int format

The value 72.0 can be represented as the fixed point number 72. It is within the range 0-32767, which means that the 15-bit fixed point format may be used.

The value will then be represented as:

```
B15 B14 B13 B12 B11 B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 B0
0   0   0   0   0   0   0   0   0   1   0   0   1   0   0   0
```

Where bit 15 indicates that we are using the fixed point format (F=0).

Programming example:

```
typedef struct
{
    int m:11; // mantissa, -1024..1023
    int e: 4; // exponent -8..7
    unsigned int f: 1; // format, 1->special emoint format
}    eint16;
//-----
unsigned short int float_to_eint16(float value)
{
    eint16 etmp;
    int dec=0;

    while (floor(value) != value && dec<16)
    {
        dec++; value*=10;
    }
    if (value>=0 && value<=32767 && dec==0)
        *(short int *)&etmp=(short int)value;
    else if (value>=-1000 && value<0 && dec==0)
    {
        etmp.e=0;
        etmp.f=1;
        etmp.m=(short int)value;
    }
    else
    {
        etmp.m=0;
        etmp.f=1;
        etmp.e=-dec;
        if (value>=0)
            etmp.m=1; // Set sign
        else
            etmp.m=-1; // Set sign
        value=fabs(value);
        while (value>1000)
        {
            etmp.e++; // increase exponent
            value=value/10;
        }
        value+=0.5; // round
        etmp.m=etmp.m*value; // make signed
    }
    return (*(unsigned short int *)&etmp);
}
//-----
float eint16_to_float(unsigned short int value)
{
    float f;
    eint16 evalue;

    evalue=*(eint16 *)&value;
    if (evalue.f)
    {
        if (evalue.e>=0)
            f=(int)evalue.m*pow10(evalue.e);
        else
            f=(int)evalue.m/pow10(abs(evalue.e));
    }
    else
        f=value;

    return f;
}
//-----
```


11. Functional description

This chapter describes the menus and parameters in the AFR/AFG software. You will find a short description of each function and information about default values, ranges, etc.

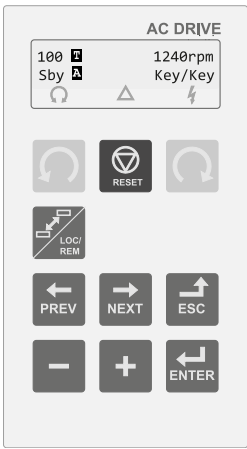
Regarding the functional description for FDUL/VFXR/FDUG/VFXG refer to the instruction manual for Emotron VFX/FDU 2.0, chapter “Functional description”.

NOTE:
Functions marked with the sign  cannot be changed during Run Mode.

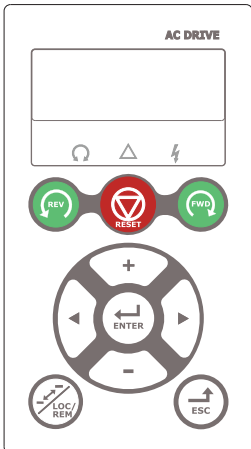
Description of table layout.

Menu no. Menu name		
Status Selected value		
Default:		
Selection or range	Integer value of selection	Description

There are two models of Control panels available with different LCD displays and layout.



2-line display



4-line display


11.1 2-line LCD display

See chapter “The menu structure” on page 62 for detailed information.

100 	3.20kW
Sby 	Key/Key

Preferred View [100]

This menu is displayed at every power-up. During operation, the menu [100] will automatically be displayed when the keyboard is not operated for 5 minutes. The automatic return function will be switched off when the Toggle and Stop key is pressed simultaneously. As default it displays the actual current and torque.

100	0.0A
Stp 	0 W

Menu [100], Preferred View displays the settings made in menu [110], 1st line, and [120], 2nd line. See Fig. 67.


100	(1st Line)
Stp 	(2nd Line)

Fig. 67 Display functions

11.2 4-line LCD display



See chapter “Control panel with 4-line display” on page 58 for detailed information.

100 	0.0A
Torque	0% 0W
Frequency	50.0Hz
Sby 	Key/Key


Menu [100] Preferred View

This menu is displayed at every power-up. During operation, the menu [100] will automatically be displayed when the keyboard is not operated for 5 minutes.

Menu “[100] Preferred View” displays the settings made in menu “[110], 1st line”, “[120], 2nd line” and “[130], 3rd line”.




100 	0.0A	← First line - set in Menu[110].
Torque	0% 0W	← Second line - set in Menu[120]
Frequency	50.0Hz	← Third line - set in Menu[130]
Sby 	Key/Key	

Extended signal monitoring

If you hold the  key when in menu [100] following window will appear, as long as the key is pressed.

Here First, Second and Third line are shown as selected in menu [100].

Then additional information will be displayed, selected in the menus [140], [150] and [160] according to below.

100 	0W	← First line - set in Menu[110].
3.9V	0.0A	← Second line - set in Menu[120].
0.0°C	0.0Hz	← Third line - set in Menu[130].
Sby 	 /Rem/Rem/--	← Fourth line - set in Menu[140]
		← Fifth line - set in Menu[150].
		← Sixth line - set in Menu[160]

Use menu “[170] View mode” to select active type of menu [100] presentation, select if “Normal 100” or “Always 100+” Extended signal monitoring” shall be shown at power-up. A third choice is menu “Normal 100wo” = menu [100] without explaining text at second and third line.

11.3 Menus

11.3.1 Resolution of settings

The resolution for all range settings described in this chapter is 3 significant digits. Table 19 shows the resolutions for 3 significant digits.

Table 19

3 Digit	Resolution
0.01-9.99	0.01
10.0-99.9	0.1
100-999	1
1000-9990	10
10000-99900	100

11.3.2 1st Line [110]

Sets the content of the upper row in the menu [100] Preferred View.

110 1st Line Stp A Current		
Default:		Current
Dependent on menu		
Process Val	0	Process value (Q)
Torque	2	Torque
Process Ref	3	Process reference
React Power	4	Reactive power
El Power	5	Electrical power
Current	6	Current
Output volt	7	Output voltage
Frequency	8	Frequency
DC Voltage	9	DC voltage
IGBT Temp	10	IGBT temperature
AFR/AFG Status	12	AFR/AFG status
Run Time	13	Run Time
Energy	14	Energy
Mains Time	15	Mains time

11.3.3 2nd Line [120]

Sets the content of the lower row in the menu [100] Preferred View. Same selection as in menu [110].

120 2nd Line Stp A Torque	
Default:	Torque

NOTE: Following menus [130] to [170] are only valid for the control panel with 4-line display.

11.3.4 3rd Line [130]

Sets the content of the third line in the menu "[100] Preferred View". Same selection as in menu [110].

130 3rd Line Stp A Frequency	
Default:	Frequency

11.3.5 4th Line [140]

Sets the content of the fourth line in the menu "[100] Preferred View". Same selection as in menu [110].

140 4th Line Stp A AFR/AFG Status	
Default:	AFR/AFG Status

11.3.6 5th Line [150]

Sets the content of the fifth line in the menu "[100] Preferred View". Same selection as in menu [110].

150 5th Line Stp A DC Voltage	
Default:	DC Voltage

11.3.7 6th Line [160]

Sets the content of the sixth line in the menu "[100] Preferred View". Same selection as in menu [110].

160 6th Line Stp A IGBT Temp	
Default:	IGBT Temp

11.3.8 View mode [170]

Select how menu [100] shall be displayed.

170 View mode Stp A Normal 100		
Default:		Normal 100
Normal 100	0	Preferred view as set in menu 110, 120, 130
Always 100+	1	Extended signal monitoring as set in menus 110 - 160
Normal 100wo	2	As Normal 100 without text at second and third lines.

11.4 Main Setup [200]

The Main Setup menu contains the most important settings to get the AFR/AFG operational and set up for the application. It includes different sub menus concerning the control of the unit, protection, utilities and automatic resetting of faults and serial communication. This menu will instantaneously be adapted to build in options and show the required settings.

11.4.1 Operation [210]

Selections concerning the control signals and serial communication are described in this sub menu and is used to set the AFE up for the application.

Language [211]

Select the language used on the Display. Once the language is set, this selection will not be affected by the Load Default command [243].

211 Language Stp A English		
Default:		English
English	0	English selected
Svenska	1	Swedish selected
Nederlands	2	Dutch selected
Deutsch	3	German selected
Русский	6	Russian selected

Reference control [214]

To control the reactive power of the AFR/AFG needs a reference signal. This reference signal can be controlled by a remote source from the installation, the keyboard of the AFR/AFG, or by serial or fieldbus communication. Select the required reference control source for the application in this menu.

214 Ref Control Stp A Keyboard		
Default:		Keyboard
Remote	0	The reference signal comes from the analogue inputs of the terminal strip (terminals 1-22).
Keyboard	1	Reference is set with the + and - keys on the Control Panel. Can only be done in menu Set/View reference [310].
Com	2	The reference is set via the serial communication (RS 485, Fieldbus.) See Fieldbus or RS232/485 option manual for details.
Option	3	The command comes from an option. Only available if the option can control the reference value.

NOTE:

If the reference is switched from Remote to Keyboard, the last remote reference value will be the default value for the control panel.

Run/Stop Control [215]

This function is used to select the source for run and stop commands.

215 Run/Stp Ctrl Stp A Keyboard		
Default:	Keyboard	
Remote	0	The start/stop signal comes from the digital inputs of the terminal strip (terminals 1-22).
Keyboard	1	Start and stop is set on the Control Panel.
Com	2	The start/stop is set via the serial communication (RS 485, Fieldbus.) See Fieldbus or RS232/485 option manual for details.
Option	3	The start/stop is set via option.

Reset Control [216]

When the AFR/AFG is stopped due to a failure, a reset command is required to make it possible to restart the AFR/AFG. Use this function to select the source of the reset signal.

216 Reset Ctrl Stp A Remote+Keyb		
Default:	Remote+Keyb	
Remote	0	The command comes from the inputs of the terminal strip (terminals 1-22).
Keyboard	1	The command comes from the command keys of the Control Panel.
Com	2	The command comes from the serial communication (RS 485, Fieldbus).
Remote + Keyb	3	The command comes from the inputs of the terminal strip (terminals 1-22) or the keyboard.
Com + Keyb	4	The command comes from the serial communication (RS485, Fieldbus) or the keyboard.
Rem+Keyb +Com	5	The command comes from the inputs of the terminal strip (terminals 1-22), the keyboard or the serial communication (RS485, Fieldbus).
Option	6	The command comes from an option. Only available if the option can control the reset command.

Local/Remote key function [217]

The Toggle key on the keyboard, see section 9.3.5, page 55, has two functions and is activated in this menu. As default the key is just set to operate as a Toggle key that moves you easily through the menus in the toggle loop. The second function of the key allows you to easily swap between Local and normal operation (set up via [214] and [215]) of the AFR/AFG drive. Local mode can also be activated via a digital input. If both [2171] and [2172] is set to Standard, the function is disabled.

2171 LocRefCtrl Stp A Standard		
Default:	Standard	
Standard	0	Local reference control set via [214]
Remote	1	Local reference control via remote
Keyboard	2	Local reference control via keyboard
Com	3	Local reference control via communication

2172 LocRunCtrl Stp A Standard		
Default:	Standard	
Standard	0	Local Run/Stop control set via [215]
Remote	1	Local Run/Stop control via remote
Keyboard	2	Local Run/Stop control via keyboard
Com	3	Local Run/Stop control via communication

Lock Code? [218]

To prevent the keyboard being used or to change the setup of the AFR/AFG drive and/or process control, the keyboard can be locked with a password. This menu, "Lock Code [218]", is used to lock and unlock the keyboard. Enter the password "291" to lock/unlock the keyboard operation. If the keyboard is not locked (default) the selection "Lock Code?" will appear. If the keyboard is already locked, the selection "Unlock Code?" will appear.

When the keyboard is locked, parameters can be viewed but not changed. The reference value can be changed and the AC drive can be started, stopped and reversed if these functions are set to be controlled from the keyboard.

218 Lock Code? Stp A 0		
Default:	0	
Range:	0-9999	

Remote signal Level/Edge [21A]

In this menu you select the way to control the inputs for RunR, RunL and Reset that are operated via the digital inputs on the terminal strip. The inputs are default set for level-control, and will be active as long as the input is made and kept high. When edge-control is selected, the input will be activated by the low to high transition of the input. See section 7.18 for more information.

21A Level/Edge Stp A Level		
Default:	Level	
Level	0	The inputs are activated or deactivated by a continuous high or low signal. Is commonly used if, for example, a PLC is used to operate the AFR/AFG drive.
Edge	1	The inputs are activated by a transition; for Run and Reset from "low" to "high" and for Stop from "high" to "low".



CAUTION!

Level controlled inputs **DO NOT** comply with the Machine Directive if the inputs are directly used to start and stop the machine.

NOTE:

Edge controlled inputs can comply with the Machine Directive (see the section 8.) if the inputs are directly used to start and stop the machine.

Mains supply voltage [21B]



WARNING!

This menu must be set according to the AC drive product label and the supply voltage used. Wrong setting might damage the AC drive or brake resistor.

In this menu the nominal mains supply voltage connected to the AC drive can be selected. The setting will be valid for all parameter sets. The default setting, Not defined, is never selectable and is only visible until a new value is selected.

This menu specifies the AC supply voltage. The corresponding DC voltage is 1.34 times higher.

Once the supply voltage is set, this selection will not be affected by the Load Default command [243].

Brake chopper activation level is adjusted using the setting of [21B].

NOTE:

The setting is affected by the "Load from CP" command [245] and if loading parameter file via EmoSoftCom.

21B Supply Volts Stp A Not defined

Default:	Not defined	
Not Defined	0	Inverter default value used. Only valid if this parameter is never set.
220-240 VAC	1	Only valid for AFR/AFG46
380-415 VAC	3	Only valid for AFR/AFG46/69
440-480 VAC	4	Only valid for AFR/AFG46/69
500-525 VAC	5	Only valid for AFR/AFG69
550-600 VAC	6	Only valid for AFR/AFG69
660-690 VAC	7	Only valid for AFR/AFG69

11.4.2 Parameter Set Handling [240]

Select Set [241]

Here you select the parameter set.

Note. The active front end unit only supports one parameter set.

241 Select Set Stp A A		
Default:		A
Selection:		A
A	0	Fixed selection to parameter set A

The active set can be viewed in menu [721] AFR/AFG status.

Load Default Values Into Set [243]

With this function the factory setting can be selected for the parameter set. When loading the default settings, all changes made in the software are set to factory settings.

243 Default>Set Stp A A		
Default:		A
A	0	Only the selected parameter set will revert to its default settings.
Factory	5	All settings, except [211], [261] and [Unit name], will revert to the default settings.

NOTE:


Trip log hour counter and other VIEW ONLY menus are not regarded as settings and will be unaffected.

NOTE:

If "Factory" is selected, the message "Sure?" is displayed. Press the + key to display "Yes" and then Enter to confirm.

Copy All Settings to Control Panel [244]

All the settings can be copied into the control panel. Start commands will be ignored during copying.


244 Copy to CP Stp A No Copy		
		
Default:		No Copy
No Copy	0	Nothing will be copied
Copy	1	Copy all settings

NOTE: The actual value of menu [310] will not be copied into control panel memory set.

Load Settings from Control Panel [245]

This function can load all parameters from the control panel to the AC drive. Parameter sets from the source AC drive are copied to all parameter sets in the target AC drive, only set A to set A for AFR/AFG.

Start commands will be ignored during loading.

245 Load from CP Stp A No Copy		
		
Default:		No Copy
No Copy	0	Nothing will be loaded.
A	1	Data from parameter set A is loaded.

NOTE:

[244] and [245] applies only on parameter set A menus ranging from [100] to [900].

[244] and [245] does not act on AFE Option parameters [000] and grid code parameters [G00].

11.4.3 Trip Autoreset/Trip Conditions [250]

The benefit of this feature is that occasional trips that do not affect the process will be automatically reset. Only when the failure keeps on coming back, recurring at defined times and therefore cannot be solved by the AFR/AFG drive, will the unit give an alarm to inform the operator that attention is required.

Also see section 12.2, page 148.

Autoreset example:

In an application it is known that the main supply voltage sometimes disappears for a very short time, a so-called “dip”. That will cause the AC drive to trip an “Undervoltage alarm”. Using the Autoreset function, this trip will be acknowledged automatically.

- Enable the Autoreset function by making the reset input continuously high.
- Activate the Autoreset function in the menu [251], Number of trips.
- Select in menu [259] Undervoltage the trip conditions that shall be allowed to be automatically reset by the Autoreset function, after the set delay time has expired.

Number of Trips [251]

Any number set above 0 activates the Autoreset. This means that after a trip, the AFR/AFG drive will restart automatically according to the number of attempts selected. No restart attempts will take place unless all conditions are normal.

If the Autoreset counter (not visible) contains more trips than the selected number of attempts, the Autoreset cycle will be interrupted. No Autoreset will then take place.

If there are no trips for more than 10 minutes, the Autoreset counter decreases by one.

If the maximum number of trips has been reached, the trip message hour counter is marked with an “A”. A normal reset is then required.

Example:

- Number of allowed autoreset attempts [251]= 5.
- Within 10 minutes 6 trips occur.
- At the 6th trip there is no autoreset, because the autoreset counter is set to allow only 5 attempts to autoreset a trip.
- To reset the autoreset counter, give a new reset command (from one of the sources for reset control selected in menu [216]).
- The autoreset counter is now zeroed.

<div>251 No of Trips</div> <div>Stp A 0</div>		
Default:	0 (no Autoreset)	
Range:	0–10 attempts	

NOTE:

An auto reset is delayed by the remaining ramp time.

Over temperature [252]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

<div>252 Overtemp</div> <div>Stp A Off</div>		
Default:	Off	
Off	0	Off
1–3600	1–3600	1–3600 s

NOTE: An auto reset is delayed by the remaining ramp time.

Over volt D [253]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

<div>253 Overvolt D</div> <div>Stp A Off</div>		
Default:	Off	
Off	0	Off
1–3600	1–3600	1–3600 s

NOTE:

An auto reset is delayed by the remaining ramp time.

Over volt G [254]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

254 Overvolt G Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Over volt [255]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

255 Over volt Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Power Fault [258]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

258 Power Fault Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Undervoltage [259]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

259 Undervoltage Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

PT100 [25C]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

25C PT100 Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

PTC [25E]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

25E PTC Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

External Trip [25G]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

25G Ext Trip Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Communication Error [25I]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

25I Com Error Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Over current F [250]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

250 Over curr F Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Over Speed [25Q]

Delay time starts counting when the fault is gone. When the time delay has elapsed, the alarm will be reset if the function is active.

25Q Over speed Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

External Motor Temperature [25R]

Delay time starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

25R Ext Mot Temp Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

Liquid cooling low level [25T]

Delay time starts counting when the fault disappears. When the time delay has elapsed, the alarm will be reset if the function is active.

25T LC Level Stp A Off		
Default:	Off	
Off	0	Off
1-3600	1-3600	1-3600 s

11.4.4 Serial Communication [260]

This function is to define the communication parameters for serial communication. There are two types of options available for serial communication, RS232/485 (Modbus/RTU) and fieldbus modules (CANopen, Profibus, DeviceNet, Modbus/TCP, Profinet IO, EtherCAT and EtherNet/IP).

For more information see section 10. and respective option manual.

Comm Type [261]

Select RS232/485 [262] or Fieldbus [263].

261 Com Type Stp A RS232/485		
Default:	RS232/485	
RS232/485	0	RS232/485 selected
Fieldbus	1	Fieldbus selected (CANopen, Profibus, DeviceNet, Modbus/TCP, Profinet IO, EtherCAT or EtherNet/IP)

NOTE: Toggling the setting in this menu will perform a soft reset (re-boot) of the Fieldbus module.

RS232/485 [262]

Press Enter to set up the parameters for RS232/485 (Modbus/RTU) communication.

262 RS232/485 Stp A		
--------------------------------------	--	--

Baud rate [2621]

Set the baud rate for the communication.

NOTE:

This baud rate is only used for the isolated RS232/485 option.

2621 Baudrate Stp A 9600		
Default:	9600	
2400	0	Selected baud rate
4800	1	
9600	2	
19200	3	
38400	4	

Address [2622]

Enter the unit address for the AC drive.

NOTE:

This address is only used for the isolated RS232/485 option.

2622 Address Stp A 1	
Default:	1
Selection:	1–247

Fieldbus [263]

Press Enter to set up the parameters for fieldbus communication.

263 Fieldbus Stp A

Address [2631]

Enter/view the unit/node address of the AC drive. Read & write access for CANopen, Profibus, DeviceNet. Read - only for EtherCAT.

2631 Address Stp A 62	
Default:	62
Range:	CANopen 1-127, Profibus 0–126, DeviceNet 0–63
Node address valid for CANopen (RW), Profibus(RW), DeviceNet (RW) and EtherCAT (RO).	

Process Data Mode [2632]

Enter the mode of process data (cyclic data). For further information, see the Fieldbus option manual.

NOTE:

For CANopen module this menu is forced to “8”.

2632 PrData Mode Stp A Basic	
Default:	Basic
None	0 Control/status information is not used.
Basic	4 4 byte process data control/status information is used.
Extended	8 4 byte process data (same as Basic setting) + additional proprietary protocol for advanced users is used.

Read/Write [2633]

Select read/write to control the inverter over a fieldbus network. For further information, see the Fieldbus option manual.

2633 Read/Write Stp A RW	
Default:	RW
RW	0
Read	1
Valid for process data. Select R (read only) for logging process without writing process data. Select RW in normal cases to control inverter.	

Additional Process Values [2634]

Define the number of additional process values sent in cyclic messages.

NOTE:

For CANopen module this menu is forced to “Basic”.

2634 AddPrValues Stp A 0	
Default:	0
Range:	0-8

CANBaudrate [2635]

Set the baud rate for CANopen fieldbus.

NOTE: Used for CANopen module only.

2635 CANBaudrate Stp A 8	
Default:	8
0	10 kbps
1	20 kbps
2	50 kbps
3	Reserve
4	100 kbps
5	125 kbps
6	250 kbps
7	500 kbps
8	1 Mbps
9	Auto *

* Under normal traffic conditions, i.e. with cyclic bus traffic above 2 Hz, the baud rate should be detected within 5 seconds.

NOTE:

The automatic baud rate detection will NOT work if there is no traffic on the network.

Communication Fault [264]

Main menu for communication fault/warning settings. For further details please see the Fieldbus option manual.

Communication Fault Mode [2641]

Selects action if a communication fault is detected.

2641 ComFt Mode Stp A Off		
Default:	Off	
Off	0	No communication supervision.
Trip	1	RS232/485 selected: The AC drive will trip if there is no communication for time set in parameter [2642]. Fieldbus selected: The AC drive will trip if: 1. The internal communication between the control board and fieldbus option is lost for time set in parameter [2642]. 2. If a serious network error has occurred.
Warning	2	RS232/485 selected: The AC drive will give a warning if there is no communication for time set in parameter [2642]. Fieldbus selected: The AC drive will give a warning if: 1. The internal communication between the control board and fieldbus option is lost for time set in parameter [2642]. 2. If a serious network error has occurred.

NOTE:

Menu [214] and/or [215] must be set to COM to activate the communication fault function.

Communication Fault Time [2642]

Defines the delay time for the trip/warning.

2642 ComFt Time Stp A 0.5 s	
Default:	0.5 s
Range:	0.1-15 s

Ethernet [265]

Settings for Ethernet module (Modbus/TCP, Profinet IO). For further information, see the Fieldbus option manual.

NOTE:

The Ethernet module must be re-booted to activate the below settings. For example by toggling parameter [261]. Non-initialized settings indicated by flashing display text.

IP Address [2651]

2651 IP Address 0. 0. 0. 0	
Default:	0.0.0.0

MAC Address [2652]

2652 MAC Address Stp A 000000000000	
Default:	An unique number for the Ethernet module.

Subnet Mask [2653]

2653 Subnet Mask 0. 0. 0. 0	
Default:	0.0.0.0

Gateway [2654]

2654 Gateway 0. 0. 0. 0	
Default:	0.0.0.0

DHCP [2655]

2655 DHCP Stp A Off	
Default:	Off
Selection:	On/Off

Fieldbus Signals [266]

Defines mapping for additional process values. For further information, see the Fieldbus option manual.

FB Signal 1 - 16 [2661] - [266G]

Used to create a block of parameters which are read/written via communication. 1 to 8 read + 1 to 8 write parameters possible.

<div>2661 FB Signal 1 Stp A 0</div>	
Default:	0
Range:	0-65535

FB Status [269]

Sub menus showing status of fieldbus parameters. Please see the Fieldbus manual for detailed information.

<div>269 FB Status Stp A</div>	
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11.5 Process and Application Parameters [300]

These parameters are mainly adjusted to obtain optimum process or front end performance.

11.5.1 Reactive power Reference Value [310]

Set/view reference value for reactive power in % of AFR/ AFR unit nominal power.

NOTE:

Positive value - Over excited (Capacitive or leading).

Negative value - Under excited (Inductive or lagging).

View reference value

As default the menu [310] is in view operation. The value of the active reference signal is displayed.

Set reference value

If the function Reference Control [214] is set to: Ref Control = Keyboard, the reference value can be set in menu Set/View Reference [310] as a normal parameter or as a motor potentiometer with the + and - keys on the control panel.

<div>310 Q_ref Stp 0%</div>	
Default:	0%
Range	0 to +/- Qmax [041]

NOTE:

Write access to this parameter is only allowed when menu "Ref Control [214] is set to Keyboard. When Reference control is used, source "COM" is used, see section 11.4.4.

NOTE:

To get any value in menu [310], Q max in menu [041] should be other than 0.

11.5.2 Preset References [360]

Motor Potentiometer [361]

Sets the properties of the motor potentiometer function. See the parameter “DigIn1 [521]” for the selection of the motor potentiometer function.

<div> <div>361 Motor Pot</div> <div>Stp A Volatile</div> </div>		
Default:	Non Volatile	
Volatile	0	After a stop, trip or power down, the AC drive will start always from zero speed (or minimum speed, if selected).
Non volatile	1	Non Volatile. After a stop, trip or power down of the AC drive, the reference value at the moment of the stop will be memorized. After a new start command the output speed will resume to this saved value.

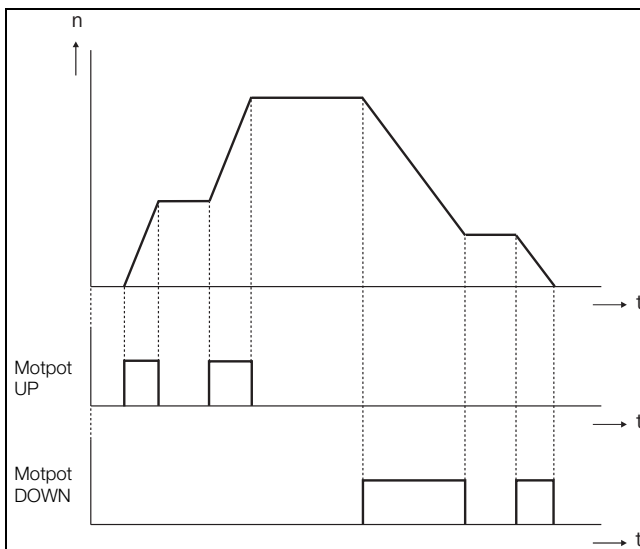


Fig. 68 MotPot function

Preset Ref 1 [362] to Preset Ref 7 [368]

Preset reference have priority over the analogue inputs. Preset references are activated by the digital inputs. The digital inputs must be set to the function Pres. Ref 1, Pres. Ref 2 or Pres. Ref 4.

Depending on the number of digital inputs used, up to 7 preset references can be activated per parameter set. Using all the parameter sets, up to 28 preset references are possible.

<div> <div>362 Preset Ref 1</div> <div>Stp 0%</div> </div>	
Default:	0%
Dependent on:	Max value depends on [O41]. Unit depends on mode selected in [G21]. Unit is % for Q-references and no unit for power factor references.

The same settings are valid for the menus [363] to [368].

The selection of the presets is as in Table 20.

Table 20

Preset Ctrl3	Preset Ctrl2	Preset Ctrl1	Output Speed
0	0	0	Analogue reference
0	0	1 ¹⁾	Preset Ref 1
0	1 ¹⁾	0	Preset Ref 2
0	1	1	Preset Ref 3
1 ¹⁾	0	0	Preset Ref 4
1	0	1	Preset Ref 5
1	1	0	Preset Ref 6
1	1	1	Preset Ref 7

¹⁾= selected if only one preset reference is active

1 = active input

0 = non active input

NOTE: If only Preset Ctrl3 is active, then the Preset Ref 4 can be selected. If Presets Ctrl2 and 3 are active, then the Preset Ref 2, 4 and 6 can be selected.

Keyboard reference mode [369]

This parameter sets how the reference value [310] is edited.

<div>369 Key Ref Mode</div> <div>Stp MotPot</div>		
Default:	MotPot	
Normal	0	The reference value is edited as a normal parameter (the new reference value is activated when Enter is pressed after the value has been changed).
MotPot	1	The reference value is edited using the motor potentiometer function (the new reference value is activated directly when the key + or - is pressed).
MotPot+	2	This selection makes it possible to update the reference in "[310]" directly from the [100]-menu. Pressing +/- in the [100]-menu changes the menu to [310] and there you can continue to press +/- to update the reference. When no key has been pressed for a second the menu returns to [100] automatically.

11.6 I/Os and Virtual Connections [500]

Main menu with all the settings of the standard inputs and outputs of the AFR/AFG drive.

11.6.1 Analogue Inputs [510]

Submenu with all settings for the analogue inputs.

NOTE:

Analogue inputs [51x] can be used for voltage measurement using voltage measurement board (sync/bypass) option.

AnIn1 Function [511]

Sets the function for Analogue input 1. Scale and range are defined by AnIn1 Advanced settings [513].

<div>511 AnIn1 Fc</div> <div>Stp A Process Ref</div>		
Default:	Process Ref	
Off	0	Input is not active
Max Torque	2	The input acts as an upper torque limit.
Process Val	3	The input value equals the actual process value (feedback) and is compared to the reference signal (set point) by the PID controller, or can be used to display and view the actual process value.
Process Ref	4	Reference value is set for control in process units, see Process Source [321] and Process Unit [322].
Ux	7	x-axis (cartesian coordinate) supply voltage measurement output signal from supply voltage measurement board (SVMB) to control board analogue input.
Uy	8	y-axis (cartesian coordinate) supply voltage measurement output signal from supply voltage measurement board (SVMB) to control board analogue input.
U(L1)	9	Supply phase L1 voltage measurement output signal from supply voltage measurement board (SVMB) to control board analogue input.
U(L2)	10	Supply phase L2 voltage measurement output signal from supply voltage measurement board (SVMB) to control board analogue input.
U(L3)	11	Supply phase L3 voltage measurement output signal from supply voltage measurement board (SVMB) to control board analogue input.

NOTE: When AnInX Func=Off, the connected signal will still be available for Comparators [610].

Adding analogue inputs

If more than one analogue input is set to the same function, the values of the inputs can be added together. In the following examples we assume that Process Source [321] is set to Speed.

Example 1: Add signals with different weight (fine tuning).

Signal on AnIn1 = 10 mA

Signal on AnIn2 = 5 mA

[511] AnIn1 Function = Process Ref.

[512] AnIn1 Setup = 4-20 mA

[5134] AnIn1 Function Min = Min (0 rpm)

[5136] AnIn1 Function Max = Max (1500 rpm)

[5138] AnIn1 Operation = Add+

[514] AnIn2 Function = Process Ref.

[515] AnIn2 Setup = 4-20 mA

[5164] AnIn2 Function Min = Min (0 rpm)

[5166] AnIn2 Function Max = User defined

[5167] AnIn2 Value Max = 300 rpm

[5168] AnIn2 Operation = Add+

Calculation:

$AnIn1 = (10-4) / (20-4) \times (1500-0) + 0 = 562.5 \text{ rpm}$

$AnIn2 = (5-4) / (20-4) \times (300-0) + 0 = 18.75 \text{ rpm}$

The actual process reference will be:

$+562.5 + 18.75 = 581 \text{ rpm}$

Analogue Input Selection via Digital Inputs:

When two different external Reference signals are used, e.g. 4-20mA signal from control centre and a 0-10 V locally mounted potentiometer, it is possible to switch between these two different analogue input signals via a Digital Input set to "AnIn Select".

AnIn1 is 4-20 mA

AnIn2 is 0-10 V

DigIn3 is controlling the AnIn selection; HIGH is 4-20 mA, LOW is 0-10 V

"[511] AnIn1 Fc" = Process Ref;
set AnIn1 as reference signal input

"[512] AnIn1 Setup" = 4-20mA;
set AnIn1 for a current reference signal

"[513A] AnIn1 Enabl" = DigIn;
set AnIn1 to be active when DigIn3 is HIGH

"[514] AnIn2 Fc" = Process Ref;
set AnIn2 as reference signal input

"[515] AnIn2 Setup" = 0-10V;
set AnIn2 for a voltage reference signal

"[516A] AnIn2 Enabl" = !DigIn;
set AnIn2 to be active when DigIn3 is LOW

"[523] DigIn3=AnIn";
set DigIn3 as input for selection of AI reference

Subtracting analogue inputs

Example 2: Subtract two signals

Signal on AnIn1 = 8 V

Signal on AnIn2 = 4 V

[511] AnIn1 Function = Process Ref.

[512] AnIn1 Setup = 0-10 V

[5134] AnIn1 Function Min = Min (0 rpm)

[5136] AnIn1 Function Max = Max (1500 rpm)

[5138] AnIn1 Operation = Add+

[514] AnIn2 Function = Process Ref.

[515] AnIn2 Setup = 0-10 V

[5164] AnIn2 Function Min = Min (0 rpm)

[5166] AnIn2 Function Max = Max (1500 rpm)

[5168] AnIn2 Operation = Sub-

Calculation:

$AnIn1 = (8-0) / (10-0) \times (1500-0) + 0 = 1200 \text{ rpm}$

$AnIn2 = (4-0) / (10-0) \times (1500-0) + 0 = 600 \text{ rpm}$

The actual process reference will be:

$+1200 - 600 = 600 \text{ rpm}$

AnIn1 Setup [512]

The analogue input setup is used to configure the analogue input in accordance with the signal used that will be connected to the analogue input. With this selection the input can be determined as current (4-20 mA) or voltage (0-10 V) controlled input. Other selections are available for using a threshold (live zero), a bipolar input function, or a user defined input range. With a bipolar input reference signal, it is possible to control the motor in two directions. See Fig. 69.

NOTE:

The selection of voltage or current input is done with S1. When the switch is in voltage mode only the voltage menu items are selectable. With the switch in current mode only the current menu items are selectable.

512 AnIn1 Setup		
Stp A User Bipol V		
Default:		User Bipol V
Dependent on		Setting of switch S1
4-20mA	0	The current input has a fixed threshold (Live Zero) of 4 mA and controls the full range for the input signal. See Fig. 81.
0-20mA	1	Normal full current scale configuration of the input that controls the full range for the input signal. See Fig. 80.
User mA	2	The scale of the current controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.
User Bipol mA	3	Sets the input for a bipolar current input, where the scale controls the range for the input signal. Scale can be defined in advanced menu AnIn Bipol.

0–10V	4	Normal full voltage scale configuration of the input that controls the full range for the input signal. See Fig. 80.
2–10V	5	The voltage input has a fixed threshold (Live Zero) of 2 V and controls the full range for the input signal. See Fig. 81.
User V	6	The scale of the voltage controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.
User Bipol V	7	Sets the input for a bipolar voltage input, where the scale controls the range for the input signal. Scale can be defined in advanced menu AnIn Bipol.

NOTE:

Always check the needed set up when the setting of S1 is changed; selection will not adapt automatically.

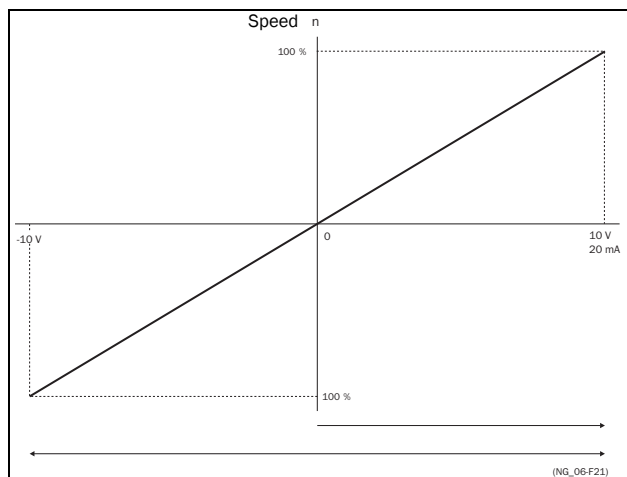


Fig. 69

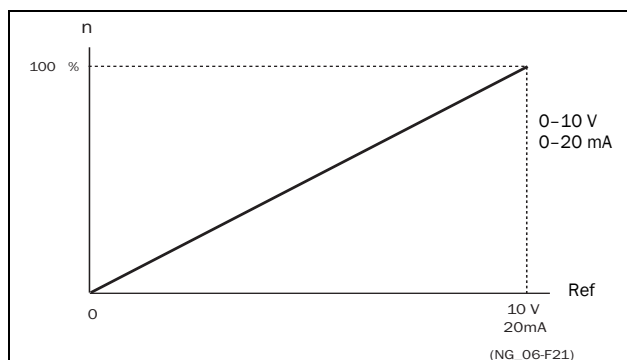


Fig. 70 Normal full-scale configuration

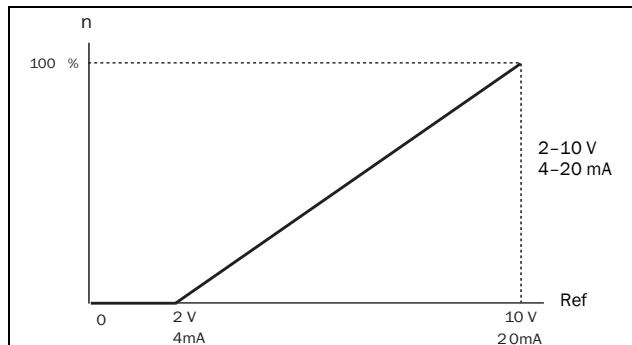


Fig. 71 2–10 V/4–20 mA (Live Zero)

AnIn1 Advanced [513]

NOTE:

The different menus will automatically be set to either “mA” or “V”, based on the selection in AnIn 1 Setup [512].

513 AnIn1 Advan Stp A
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AnIn1 Min [5131]

Parameter to set the minimum value of the external reference signal. Only visible if [512] = User mA/V.

5131 AnIn1 Min Stp A	4mA
Default:	4 mA
Range:	0.00–20.00 mA 0–10.00 V

AnIn1 Max [5132]

Parameter to set the maximum value of the external reference signal. Only visible if [512] = User mA/V.

5132 AnIn1 Max Stp	20mA
Default:	20 mA
Range:	0.00–20.00 mA 0–10.00 V

Special function: Inverted reference signal

If the AnIn minimum value is higher than the AnIn maximum value, the input will act as an inverted reference input, see Fig. 72.

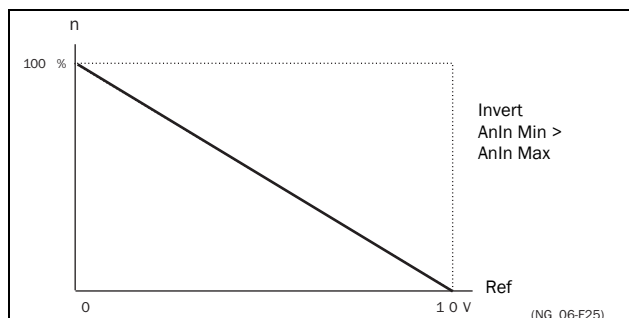


Fig. 72 Inverted reference

AnIn1 Bipol [5133]

This menu is automatically displayed if AnIn1 Setup is set to User Bipol mA or User Bipol V. The window will automatically show mA or V range according to selected function. The range is set by changing the positive maximum value; the negative value is automatically adapted accordingly. Only visible if [512] = User Bipol mA/V. The inputs RunR and RunL input need to be active, and “Rotation [219]”, must be set to “R+L”, to operate the bipolar function on the analogue input.

<div>5133 AnIn1 Bipol</div> <div>Stp A 20mA</div>	
Default:	20 mA
Range:	0.0–20.0 mA, 0.00–10.00 V

AnIn1 Function Min [5134]

With AnIn1 Function Min the physical minimum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn1 [511].

<div>5134 AnIn1 FcMin</div> <div>Stp A Min</div>	
Default:	Min
Min	0 Min value
Max	1 Max value
User-defined	2 Define user value in menu [5135]

Table 21 shows corresponding values for the min and max selections depending on the function of the analogue input [511].

Table 21

AnIn Function	Min	Max
Speed	Min Speed [341]	Max Speed [343]
Torque	0%	Max Torque [351]
Process Ref	Process Min [324]	Process Max [325]
Process Value	Process Min [324]	Process Max [325]

AnIn1 Function Value Min [5135]

With AnIn1 Function ValMin you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5134].

<div>5135 AnIn1 VaMin</div> <div>Stp A 0.000</div>	
Default:	0.000
Range:	-10000.000 – 10000.000

AnIn1 Function Max [5136]

With AnIn1 Function Max the physical maximum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn1 [511]. See Table 21.

<div>5136 AnIn1 FcMax</div> <div>Stp A Max</div>	
Default:	Max
Min	0 Min value
Max	1 Max value
User-defined	2 Define user value in menu [5137]

AnIn1 Function Value Max [5137]

With AnIn1 Function VaMax you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5136].

<div>5137 AnIn1 VaMax</div> <div>Stp A 0.000</div>	
Default:	0.000
Range:	-10000.000 – 10000.000

NOTE:

With AnIn Min, AnIn Max, AnIn Function Min and AnIn Function Max settings, loss of feedback signals (e.g. voltage drop due to long sensor wiring) can be compensated to ensure an accurate process control.

Example:

Process sensor is a sensor with the following specification:

Range: 0–3 bar

Output: 2–10 mA

Analogue input should be set up according to:

[512] AnIn1 Setup = User mA

[5131] AnIn1 Min = 2 mA

[5132] AnIn1 Max = 10 mA

[5134] AnIn1 Function Min = User-defined

[5135] AnIn1 VaMin = 0.000 bar

[5136] AnIn1 Function Max = User-defined

[5137] AnIn1 VaMax = 3.000 bar

AnIn1 Operation [5138]

<div>5138 AnIn1 Oper</div> <div>Stp A Add+</div>		
Default:	Add+	
Add+	0	Analogue signal is added to selected function in menu [511].
Sub-	1	Analogue signal is subtracted from selected function in menu [511].

AnIn1 Filter [5139]

If the input signal is unstable (e.g. fluctuation reference value), the filter can be used to stabilize the signal. A change of the input signal will reach 63% on AnIn1 within the set AnIn1 Filter time. After 5 times the set time, AnIn1 will have reached 100% of the input change. See Fig. 73.

<div>5139 AnIn1 Filt</div> <div>Stp A 0.1 s</div>		
Default:	0.1 s	
Range:	0.001 – 10.0 s	

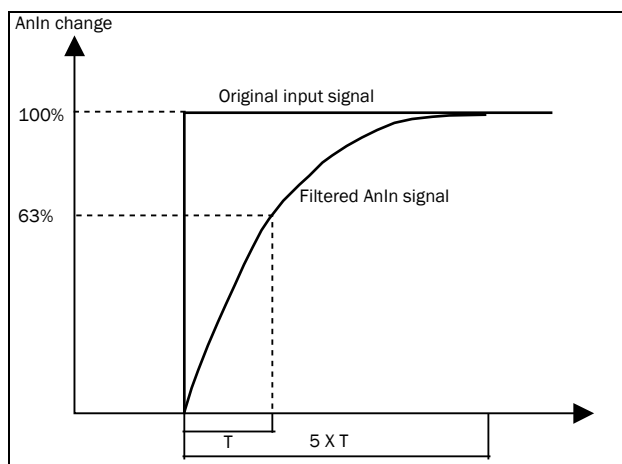


Fig. 73

AnIn1 Enable [513A]

Parameter for enable/disable analogue input selection via digital inputs (DigIn set to function AnIn Select).

<div>513A AnIn1 Enabl</div> <div>Stp A On</div>		
Default:	On	
On	0	AnIn1 is always active
!DigIn	1	AnIn1 is only active if the digital input is low.
DigIn	2	AnIn1 is only active if the digital input is high.

AnIn2 Function [514]

Parameter for setting the function of Analogue Input 2. Same function as “AnIn1 Fc [511]”.

<div>514 AnIn2 Fc</div> <div>Stp A Off/U(L1)</div>		
Default:	AFR: Off AFG: U(L1)	
Selection:	Same as in menu [511]	

AnIn2 Setup [515]

Parameter for setting the function of Analogue Input 2.

Same functions as “AnIn1 Setup [512]”.

<div>515 AnIn2 Setup</div> <div>Stp A 4–20mA</div>		
Default:	4 – 20 mA	
Dependent on	Setting of switch S2	
Selection:	Same as in menu [512].	

AnIn2 Advanced [516]

Same functions and submenus as under “AnIn1 Advan [513]”.

<div>516 AnIn2 Advan</div> <div>Stp A</div>		
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AnIn3 Function [517]

Parameter for setting the function of Analogue Input 3.

Same function as “AnIn1 Fc [511]”.

<div>517 AnIn3 Fc Stp A Off/U(L2)</div>	
Default:	AFR: Off AFG: U(L2)
Selection:	Same as in menu [511]

AnIn3 Setup [518]

Same functions as “AnIn1 Setup [512]”.

<div>518 AnIn3 Setup Stp A 4-20mA</div>	
Default:	User V
Dependent on	Setting of switch S3
Selection:	Same as in menu [512].

AnIn3 Advanced [519]

Same functions and submenus as under “AnIn1 Advan [513]”.

<div>519 AnIn3 Advan Stp A</div>	
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AnIn4 Function [51A]

Parameter for setting the function of Analogue Input 4.

Same function as “AnIn1 Fc [511].”

<div>51A AnIn4 Fc Stp A Off/U(L3)</div>	
Default:	AFR: Off AFG: U(L3)
Selection:	Same as in menu [511]

AnIn4 Set-up [51B]

Same functions as “AnIn1 Setup [512]”.

<div>51B AnIn4 Setup Stp AUser Bipol V</div>	
Default:	User Bipol V
Dependent on	Setting of switch S4
Selection:	Same as in menu [512].

AnIn4 Advanced [51C]

Same functions and submenus as under “AnIn1 Advan [513]”.

<div>51C AnIn4 Advan Stp A</div>	
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11.6.2 Digital Inputs [520]

Submenu with all the settings for the digital inputs.


NOTE: Additional inputs will become available when the I/O option boards are connected.

Digital Input 1 [521]

To select the function of the digital input.

On the standard control board there are eight digital inputs.

If the same function is programmed for more than one input that function will be activated according to “OR” logic if nothing else is stated.

<div> <div>521</div> <div>DigIn 1</div> <div>Stp </div> <div>RunL</div> </div>		
Default:		RunL
Off	0	The input is not active.
Ext. Trip	3	Be aware that if there is nothing connected to the input, the AC drive will trip at “External trip” immediately. NOTE: The External Trip is active low. NOTE: Activated according to “AND” logic.
Stop	4	Stop command according to the selected Stop mode in menu [33B]. NOTE: The Stop command is active low. NOTE: Activated according to “AND” logic.
Enable	5	Enable command. General start condition to run the AC drive. If made low during running the output of the AC drive is cut off immediately, causing the motor to coast to zero speed. NOTE: If none of the digital inputs are programmed to “Enable”, the internal enable signal is active. NOTE: Activated according to “AND” logic.
RunR	6	Run Right command (positive speed). The output of the AC drive will be a clockwise rotary field.
RunL	7	Run Left command (negative speed). The output of the AC drive will be a counter-clockwise rotary field.
Reset	9	Reset command. To reset a Trip condition and to enable the Autoreset function.
MotPot Up	13	Increases the internal reference value according to the set AccMotPot time [333]. Has the same function as a “real” motor potentiometer, see Table 122.
MotPot Down	14	Decreases the internal reference value according to the set DecMotPot time [334]. See MotPot Up.

Timer 1	21	Timer 1 Delay [643] will be activated on the rising edge of this signal.
Timer 2	22	Timer 2 Delay [653] will be activated on the rising edge of this signal.
Ext Mot Temp	27	Be aware that if there is nothing connected to the input, the AC drive will trip at “External Motor Temp” immediately. NOTE: The External Motor Temp is active low.
Loc/Rem	28	Activate local mode defined in [2171] and [2172].
LC Level	30	Liquid cooling low level signal. NOTE: The Liquid Cooling Level is active low.
Sleep	32	Possible to enter sleep mode through DigIn

NOTE:
DigIn1 [521] and DigIn2 [522] are read only menus.


Table 22

Parameter Set	Set Ctrl 1	Set Ctrl 2
A	0	0
B	1	0
C	0	1
D	1	1

NOTE:
To activate the parameter set selection, menu [241] must be set to DigIn.

Digital Input 2 [522] to Digital Input 8 [528]

Same function as “DigIn 1 [521]”. Default function for DigIn 3 is Enable and for DigIn 8 is Reset. For DigIn 4 to 7 the default function is Off.

<div> <div>522</div> <div>DigIn 2</div> <div>Stp </div> <div>RunR</div> </div>		
Default:		RunR
Selection:		Same as in menu [521]

Additional digital inputs [529] to [52H]

Additional digital inputs with I/O option board installed, “B1 DigIn 1 [529]” - “B3 DigIn 3 [52H]”. B stands for board and 1 to 3 is the number of the board which is related to the position of the I/O option board on the option mounting plate. The functions and selections are the same as “DigIn 1 [521]”. The default function is Off.

11.6.3 Analogue Outputs [530]

Submenu with all settings for the analogue outputs. Selections can be made from application and AC drive values, in order to visualize actual status. Analogue outputs can also be used as a mirror of the analogue input. Such a signal can be used as:

- a reference signal for the next AC drive in a Master/Slave configuration (see Fig. 74).
- a feedback acknowledgement of the received analogue reference value.

AnOut1 Function [531]

Sets the function for the Analogue Output 1. Scale and range are defined by AnOut1 Advanced settings [533].

<div> <div>531</div> <div>AnOut1 Fc</div> <div>Stp A</div> <div>Current</div> </div>		
Default:		Current
Process Val	0	Actual process value according to Process feedback signal.
Torque	2	Actual torque.
Process Ref	3	Actual process reference value.
React Power	4	Actual reactive power.
Frequency	5	Actual frequency.
Current	6	Actual current.
El power	7	Actual electrical power.
Output volt	8	Actual output voltage.
DC voltage	9	Actual DC link voltage.
AnIn1	10	Mirror of received signal value on AnIn1.
AnIn2	11	Mirror of received signal value on AnIn2.
AnIn3	12	Mirror of received signal value on AnIn3.
AnIn4	13	Mirror of received signal value on AnIn4.
Torque Ref	15	Actual torque reference value (=0 in V/Hz mode)

NOTE:

When selections AnIn1, AnIn2 AnIn4 is selected, the setup of the AnOut (menu [532] or [535]) has to be set to 0-10V or 0-20mA. When the AnOut Setup is set to e.g. 4-20mA, the mirroring is not working correct.

NOTE:

Output volt and DC voltage are presented as a percentage of 1000 V (when selected on AnOut function).

AnOut 1 Setup [532]

Preset scaling and offset of the output configuration.

532 AnOut1 Setup Stp A 4-20mA		
Default:		4-20mA
4-20mA	0	The current output has a fixed threshold (Live Zero) of 4 mA and controls the full range for the output signal. See Fig. 71.
0-20mA	1	Normal full current scale configuration of the output that controls the full range for the output signal. See Fig. 70.
User mA	2	The scale of the current controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.
User Bipol mA	3	Sets the output for a bipolar current output, where the scale controls the range for the output signal. Scale can be defined in advanced menu AnOut Bipol.
0-10V	4	Normal full voltage scale configuration of the output that controls the full range for the output signal. See Fig. 70.
2-10V	5	The voltage output has a fixed threshold (Live Zero) of 2 V and controls the full range for the output signal. See Fig. 71.
User V	6	The scale of the voltage controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.
User Bipol V	7	Sets the output for a bipolar voltage output, where the scale controls the range for the output signal. Scale can be defined in advanced menu AnOut Bipol.

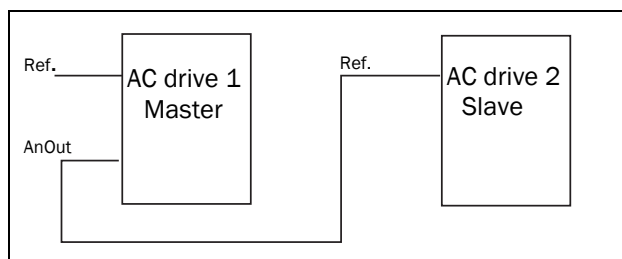


Fig. 74

AnOut1 Advanced [533]

With the functions in the AnOut1 Advanced menu, the output can be completely defined according to the application needs. The menus will automatically be adapted to “mA” or “V”, according to the selection in “AnOut1 Setup [532]”.

533 AnOut 1 Advan Stp A

AnOut1 Min [5331]

This parameter is automatically displayed if User mA or User V is selected in menu “AnOut 1 Setup [532]”. The menu will automatically adapt to current or voltage setting according to the selected setup. Only visible if [532] = User mA/V.

5331 AnOut 1 Min Stp A 4mA	
Default:	4 mA
Range:	0.00 – 20.00 mA, 0 – 10.00 V

AnOut1 Max [5332]

This parameter is automatically displayed if User mA or User V is selected in menu “AnOut1 Setup [532]”. The menu will automatically adapt to current or voltage setting according to the selected setup. Only visible if [532] = User mA/V.

5332 AnOut 1 Max Stp A 20.00mA	
Default:	20.00 mA
Range:	0.00-20.00 mA, 0-10.00 V

AnOut1 Bipol [5333]

Automatically displayed if User Bipol mA or User Bipol V is selected in menu AnOut1 Setup. The menu will automatically show mA or V range according to the selected function. The range is set by changing the positive maximum value; the negative value is automatically adapted accordingly. Only visible if [512] = User Bipol mA/V.

5333 AnOut1Bipol Stp A 20.00 mA	
Default:	20.00 mA
Range:	-10.00-10.00 V, -20.0-20.0 mA

AnOut1 Function Min [5334]

With AnOut1 Function Min the physical minimum value is scaled to selected presentation. The default scaling is dependent of the selected function of “AnOut1 [531]”.

5334 AnOut1FCMin Stp A Min		
Default:		Min
Min	0	Min value
Max	1	Max value
User defined	2	Define user value in menu [5335]

Table 23 shows corresponding values for the min and max selections depending on the function of the analogue output [531].

Table 23

AnOut Function	Min Value	Max Value
Process Value	Process Min [324]	Process Max [325]
Torque	0%	Max Torque [351]
Process Ref	Process Min [324]	Process Max [325]
React Power	0%	Motor Power [223]
Frequency	Fmin *	Motor Frequency [222]
Current	0 A	Motor Current [224]
El Power	0 W	Motor Power [223]
Output Voltage	0 V	Motor Voltage [221]
DC voltage	0 V	1000 V
AnIn1	AnIn1 Function Min	AnIn1 Function Max
AnIn2	AnIn2 Function Min	AnIn2 Function Max
AnIn3	AnIn3 Function Min	AnIn3 Function Max
AnIn4	AnIn4 Function Min	AnIn4 Function Max
Torque Ref	0%	Max Torque [351]

*) Fmin is dependent on the set value in menu “Minimum Speed [341]”.

Example

Set the AnOut function for Motorfrequency to 0Hz, set AnOut functionMin [5334] to “User-defined” and AnOut1 VaMin[5335] = 0.0. This results in an analogue output signal from 0/4 mA to 20mA: 0Hz to Fmot.

This principle is valid for all Min to Max settings.

AnOut1 Function Value Min [5335]

With AnOut1 Function VaMin you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5334].

5335 AnOut1VaMin Stp A 0.000	
Default:	0.000
Range:	-10000.000–10000.000

AnOut1 Function Max [5336]

With AnOut1 Function Min the physical minimum value is scaled to selected presentation. The default scaling is dependent on the selected function of AnOut1 [531]. See Table 23.

5336 AnOut1FCMax Stp A Max		
Default:		Max
Min	0	Min value
Max	1	Max value
User defined	2	Define user value in menu [5337]

NOTE:

It is possible to set AnOut1 up as an inverted output signal by setting AnOut1 Min > AnOut1 Max. See Fig. 72, page 86.

AnOut1 Function Value Max [5337]

With AnOut1 Function VaMax you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5334].

5337 AnOut1VaMax Stp A 0.000	
Default:	0.000
Range:	-10000.000–10000.000

AnOut2 Function [534]

Sets the function for the Analogue Output 2.

534 AnOut2 Fc Stp A Torque	
Default:	Torque
Selection:	Same as in menu [531]

AnOut2 Setup [535]

Preset scaling and offset of the output configuration for analogue output 2.

535 AnOut2 Setup Stp A 4-20mA	
Default:	4-20mA
Selection:	Same as in menu [532]

AnOut2 Advanced [536]

Same functions and submenus as under AnOut1 Advanced [533].

536 AnOut2 Advan Stp A	
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11.6.4 Digital Outputs [540]

Submenu with all the settings for the digital outputs.

Digital Out 1 [541]

Sets the function for the digital output 1.

NOTE: The definitions described here are valid for the active output condition.

541 DigOut 1 Stp A LY		
Default:	LY	
Off	0	Output is not active and constantly low.
On	1	Output is made constantly high, i.e. for checking circuits and trouble shooting.
Run	2	Running. The AC drive output is active = produces current for the motor.
Stop	3	The AC drive output is not active.
At Process	6	The output = Reference.
No Trip	8	No Trip condition active.
Trip	9	A Trip condition is active.
AutoRst Trip	10	Autoreset trip condition active.
Limit	11	A Limit condition is active.
Warning	12	A Warning condition is active.
Ready	13	The AC drive is ready for operation. This means that the AC drive is powered up and healthy.
$T = T_{lim}$	14	The torque is limited by the torque limit function.
$I > I_{nom}$	15	The output current is higher than the motor nominal current [224], reduced according to Motor ventilation [228], see Fig. , page 108.
Sgnl<Offset	17	One of the AnIn input signals is lower than 75% of the threshold level.
GCP Trip	18	Grid Code Protections (GCP) trip condition is active.
GCP Trigg	19	Grid Code Protections (GCP) triggered (condition for tripping met).
GCP Trip>	20	Grid Code Protections (GCP) over-trips condition is active.
GCP Trigg>	21	Grid Code Protections (GCP) over-trips condition triggered (condition for CGP tripping met).
GCP Trip<	22	Grid Code Protections (GCP) under-trips condition is active.

GCP Trigg<	23	Grid Code Protections (GCP) undertrips condition triggered (condition for GCP tripping met).
LY	24	Logic output Y.
!LY	25	Logic output Y inverted.
LZ	26	Logic output Z.
!LZ	27	Logic output Z inverted.
CA 1	28	Analogue comparator 1 output.
!A1	29	Analogue comp 1 inverted output.
CA 2	30	Analogue comparator 2 output.
!A2	31	Analogue comp 2 inverted output.
CD 1	32	Digital comparator 1 output.
!D1	33	Digital comp 1 inverted output.
CD2	34	Digital comparator 2 output.
!D2	35	Digital comp 2 inverted output.
Operation	36	Run command is active or AC drive running. The signal can be used to control the mains contactor if the AC drive is equipped with Standby supply option.
T1Q	37	Timer1 output
!T1Q	38	Timer1 inverted output
T2Q	39	Timer2 output
!T2Q	40	Timer2 inverted output
Loc/Rem	57	Local/Rem mode indication Local = 1, Remote = 0
Standby	58	Standby supply option is active
PTC Trip	59	Trip when function is active
PT100 Trip	60	Trip when function is active
Overvolt	61	Overvoltage due to high main voltage
Overvolt G	62	Overvoltage due to generation mode
Overvolt D	63	Overvoltage due to deceleration
I ² t	66	I ² t limit protection active
V-Limit	67	Overvoltage limit function active
C-Limit	68	Overcurrent limit function active
Overtemp	69	Over temperature warning
Low voltage	70	Low voltage warning
DigIn 1	71	Digital input 1
DigIn 2	72	Digital input 2
DigIn 3	73	Digital input 3
DigIn 4	74	Digital input 4
DigIn 5	75	Digital input 5
DigIn 6	76	Digital input 6
DigIn 7	77	Digital input 7
DigIn 8	78	Digital input 8

ManRst Trip	79	Active trip that needs to be manually reset
Com Error	80	Serial communication lost
External Fan	81	The AC drive requires external cooling. Internal fans are active.
LC Pump	82	Activate liquid cooling pump
LC HE Fan	83	Activate liquid cooling heat exchanger fan
LC Level	84	Liquid cooling low level signal active
Com Active	87	Fieldbus communication active.
Option	90	Failure occurred in built-in option board.
CA3	91	Analogue comparator 3 output
!A3	92	Analogue comparator 3 inverted output
CA4	93	Analogue comparator 4 output
!A4	94	Analogue comparator 4 inverted output
CD3	95	Digital comparator 3 output
!D3	96	Digital comparator 3 inverted output
CD4	97	Digital comparator 4 output
!D4	98	Digital comparator 4 inverted output
C1Q	99	Counter 1 output
!C1Q	100	Counter 1 inverted output
C2Q	101	Counter 2 output
!C2Q	102	Counter 2 Inverted output
CLK1	106	Clock 1 output signal (CLK1) is activated.
!CLK1	107	Clock 1 output signal (CLK1) is not activated.
CLK2	108	Clock 2 output signal (CLK2) is activated.
!CLK2	109	Clock 2 output signal (CLK2) is not activated.
Charge Relay	110	Signal / Digital output for controlling charge contactor.
Main Relay	111	Signal/ Digital output for controlling mains contactor.
Udc OK	112	AFR/AFG is up and running.

Digital Out 2 [542]

NOTE:

The definitions described here are valid for the active output condition.

Sets the function for the digital output 2.

<div>542 DigOut2</div> <div>Stp A LZ</div>	
Default:	LZ
Selection:	Same as in menu [541]

11.6.5 Relays [550]

NOTE:

Relay 1 is dedicated to Charge relay K2.
Relay 3 is dedicated for main Contactor K1.

Submenu with all the settings for the relay outputs. The relay mode selection makes it possible to establish a “fail safe” relay operation by using the normal closed contact to function as the normal open contact.

NOTE:

Additional relays will become available when I/O option boards are connected. Maximum 3 boards with 3 relays each.

Relay 1 [551]

Sets the function for the relay output 1. Same function as digital output 1 [541] can be selected.

<div>551 Relay 1</div> <div>Stp A Charge relay</div>	
Default:	Charge relay

NOTE: Relay1 [551] is read only menu.

Relay 2 [552]

NOTE:

The definitions described here are valid for the active output condition.

Sets the function for the relay output 2.

<div>552 Relay 2</div> <div>Stp A LY</div>	
Default:	LY
Selection:	Same as in menu [541]

Relay 3 [553]

Sets the function for the relay output 3.

<div>553 Relay 3</div> <div>Stp A Main Relay</div>	
Default:	Main relay

NOTE: Relay 3 [553] is read only menu.

Board Relay [554] to [55C]

These additional relays are only visible if an I/O option board is fitted in slot 1, 2, or 3. The outputs are named B1 Relay 1–3, B2 Relay 1–3 and B3 Relay 1–3. B stands for board and 1–3 is the number of the board which is related to the position of the I/O option board on the option mounting plate. Default is Off.

NOTE:

Visible only if optional board is detected or if any input/output is activated.

Relay Advanced [55D]

This function makes it possible to ensure that the relay will also be closed when the AC drive is malfunctioning or powered down.

Example

A process always requires a certain minimum flow. To control the required number of pumps by the relay mode NC, the e.g. the pumps can be controlled normally by the pump control, but are also activated when the AC drive is tripped or powered down.

55D Relay Adv
Stp A

Relay 1 Mode [55D1]

55D1 Relay1 Mode		
Stp A N.O		
Default:	N.O	
N.O	0	The normal open contact of the relay will be activated when the function is active.
N.C	1	The normally closed contact of the relay will act as a normal open contact. The contact will be opened when function is not active and closed when function is active.

Relay Modes [55D2] to [55DC]

Same function as for “Relay 1 Mode [55D1]”.

11.6.6 Virtual Connections [560]

Functions to enable eight internal connections of comparator, timer and digital signals, without occupying physical digital in/outputs. Virtual connections are used to wireless connection of a digital output function to a digital input function. Available signals and control functions can be used to create your own specific functions.

Example of start delay

The motor will start in RunR 10 seconds after DigIn1 gets high. DigIn1 has a time delay of 10 s.

Menu	Parameter	Setting
[521]	DigIn1	Timer 1
[561]	VIO 1 Dest	RunR
[562]	VIO 1 Source	T1Q
[641]	Timer1 Trig	DigIn 1
[642]	Timer1 Mode	Delay
[643]	Timer1 Delay	0:00:10

NOTE:

When a digital input and a virtual destination are set to the same function, this function will act as an OR logic function.

Virtual Connection 1 Destination [561]

With this function the destination of the virtual connection is established. When a function can be controlled by several sources, e.g. VC destination or Digital Input, the function will be controlled in conformity with “OR logic”. See DigIn for descriptions of the different selections.

561 VIO 1 Dest	
Stp A Off	
Default:	Off
Selection:	Same selections as for Digital Input 1, menu [521].

Virtual Connection 1 Source [562]

With this function the source of the virtual connection is defined. See DigOut 1 for description of the different selections.

562 VIO 1 Source	
Stp A Off	
Default:	Off
Selection:	Same as for menu [541].

Virtual Connections 2-8 [563] to [56G]

Same function as virtual connection 1 [561] and [562].

11.7 Logical Functions and Timers [600]

With the Comparators, Logic Functions and Timers, conditional signals can be programmed for control or signalling features. This gives you the ability to compare different signals and values in order to generate monitoring/controlling features.

11.7.1 Comparators [610]

The comparators available make it possible to monitor different internal signals and values, and visualize via digital relay outputs, when a specific value or status is reached or established.

Analogue comparators [611] - [614]

There are 4 analogue comparators that compare any available analogue value (including the analogue reference inputs) with two adjustable levels. The two levels available are Level HI and Level LO. There are two analogue comparator types selectable, an analogue comparator with hysteresis and an analogue window comparator.

The analogue hysteresis type comparator uses the two available levels to create a hysteresis for the comparator between setting and resetting the output. This function gives a clear difference in switching levels, which lets the process adapt until a certain action is started. With such a hysteresis, even an unstable analogue signal can be monitored without getting a nervous comparator output signal. Another feature is the possibility to get a fixed indication that a certain level has been passed. The comparator can latch by setting Level LO to a higher value than Level HI.

The analogue window comparator uses the two available levels to define the window in which the analogue value should be within for setting the comparator output. The input analogue value of the comparator can also be selected as bipolar, i.e. treated as signed value or unipolar, i.e. treated as absolute value.

Refer to Fig. 79, page 101 where these functions are illustrated.

Digital comparators [615]

There are 4 digital comparators that compare any available digital signal.

The output signals of these comparators can be logically tied together to yield a logical output signal.

All the output signals can be programmed to the digital or relay outputs or used as a source for the virtual connections [560].

CA1 Setup [611]

Analogue comparator 1, parameter group.

Analogue Comparator 1, Value [6111]

Selection of the analogue value for Analogue Comparator 1 (CA1).

Analogue comparator 1 compares the selectable analogue value in menu [6111] with the constant Level HI in menu [6112] and constant Level LO in menu [6113]. If Bipolar type[6115] input signal is selected then the comparison is made with sign otherwise if unipolar selected then comparison is made with absolute values.

For Hysteresis comparator type [6114], when the value exceeds the upper limit level high, the output signal CA1 is set high and !A1 low, see Fig. 75. When the value decreases below the lower limit, the output signal CA1 is set low and !A1 high.

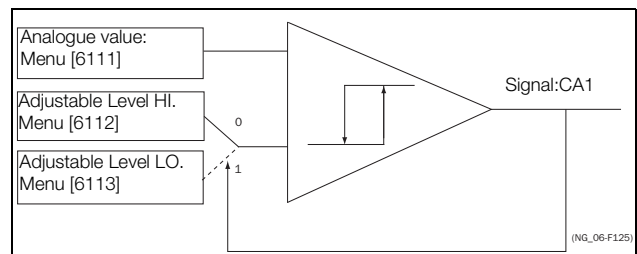


Fig. 75 Analogue comparator type Hysteresis

For Window comparator type [6114], when the value is between the lower and upper levels, the output signal value CA1 is set high and !A1 low, see Fig. 78, page 99. When the value is outside the band of lower and upper levels, the output CA1 is set low and !A1 high.

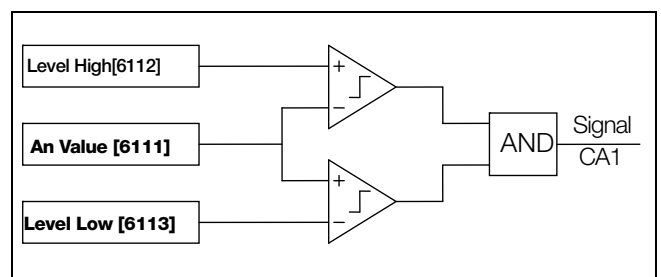


Fig. 76 Analogue comparator type "Window"

The output signal can be programmed as a virtual connection source and to the digital or relay outputs.

6111 CA1 Value Stp A Current		
Default:		Current
Process Val	0	Set by Process settings [321] and [322]
Torque	2	%
React power	3	kVA
EI Power	4	kW
Current	5	A
Output Volt	6	V
Frequency	7	Hz
DC Voltage	8	V
IGBT Temp	9	°C
PT100_1	10	°C
PT100_2	11	°C
PT100_3	12	°C
Energy	13	kWh
Run Time	14	h
Mains Time	15	h
AnIn1	16	%
AnIn2	17	%
AnIn3	18	%
AnIn4	19	%
Process Ref	20	Set by Process settings [321] and [322]
Process Err	21	

Example

Create automatic RUN/STOP signal via the analogue reference signal. Analogue current reference signal, 4-20 mA, is connected to Analogue Input 1. "AnIn1 Setup", menu [512] = 4-20 mA and the threshold is 4 mA. Full scale (100%) input signal on "AnIn 1" = 20 mA. When the reference signal on "AnIn1" increases 80% of the threshold (4 mA x 0.8 = 3.2 mA), the AC drive will be set in RUN mode. When the signal on "AnIn1" goes below 60% of the threshold (4 mA x 0.6 = 2.4 mA) the AC drive is set to STOP mode. The output of CA1 is used as a virtual connection source that controls the virtual connection destination RUN.

Menu	Function	Setting
511	AnIn1 Function	Process reference
512	AnIn1 Set-up	4-20 mA, threshold is 4 mA
6111	CA1 Value	AnIn1
6112	CA1 Level HI	16% (3.2mA/20mA x 100%)
6113	CA1 Level LO	12% (2.4mA/20mA x 100%)
6114	CA1 Type	Hysteresis
561	VIO 1 Dest	RunR
562	VIO 1 Source	CA1
215	Run/Stp Ctrl	Remote

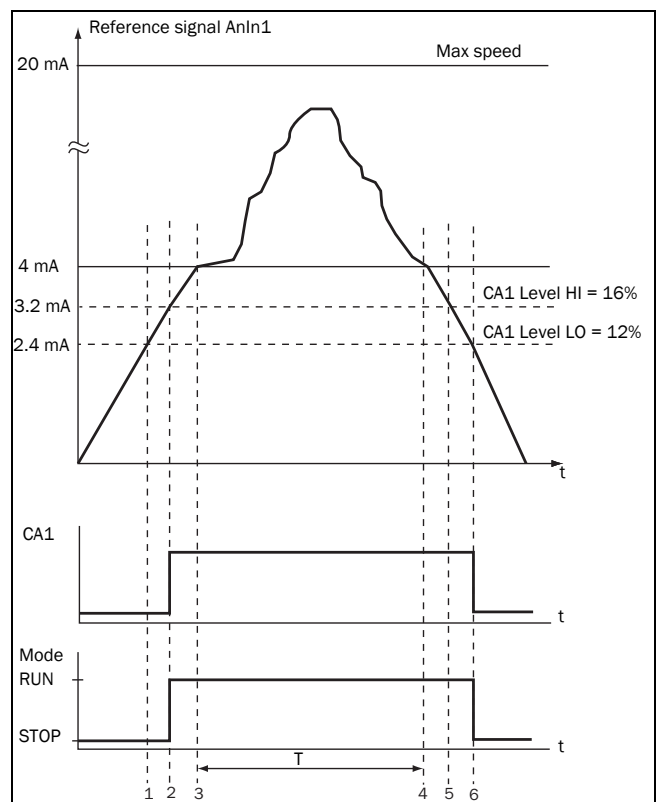


Fig. 77

No.	Description
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 output stays low, mode=RUN.
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high, mode=RUN.
3	The reference signal passes the threshold level of 4 mA, the motor speed will now follow the reference signal.
T	During this period the motor speed will follow the reference signal.

No.	Description
4	The reference signal reaches the threshold level, motor speed is 0 rpm, mode = RUN.
5	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 output stays high, mode =RUN.
6	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 output=STOP.

Analogue Comparator 1, Level High [6112]

Sets the analogue comparator high level, with range according to the selected value in menu [6111].

<div>6112 CA1 Level HI</div> <div>Stp A 30.0 A</div>	
Default:	30.0 A
Range:	See min/max in table below.

Min/Max setting range for menu [6112]

Mode	Min	Max	Decimals
Process Val	Set by Process settings [321] and [322]		3
Speed, rpm	0	Max speed	0
Torque, %	0	Max torque	0
Reactive Power, kW	0	Motor $P_n \times 4$	0
EI Power, kW	0	Motor $P_n \times 4$	0
Current, A	0	Motor $I_n \times 4$	1
Output volt, V	0	1000	1
Frequency, Hz	0	400	1
DC voltage, V	0	1250	1
Heatsink temp, °C	0	100	1
PT 100_1_2_3, °C	-100	300	1
Energy, kWh	0	1000000	0
Run time, h	0	65535	0
Mains time, h	0	65535	0
AnIn 1-4%	0	100	0
Process Ref	Set by Process settings [321] and [322]		3
Process Err	Set by Process settings [321] and [322]		3

NOTE: If Bipolar selected [6115] then Min value is equal to -Max in the table.

Example

This example describes, both for hysteresis and window type comparator, the normal use of the constant level high and low.

Menu	Function	Setting
6111	CA1 Value	Current
6112	CA1 Level HI	30 A
6113	CA1 Level LO	20 A
6114	CA1 Type	Hysteresis
561	VC1 Dest	Timer 1
562	VC1 Source	CA1

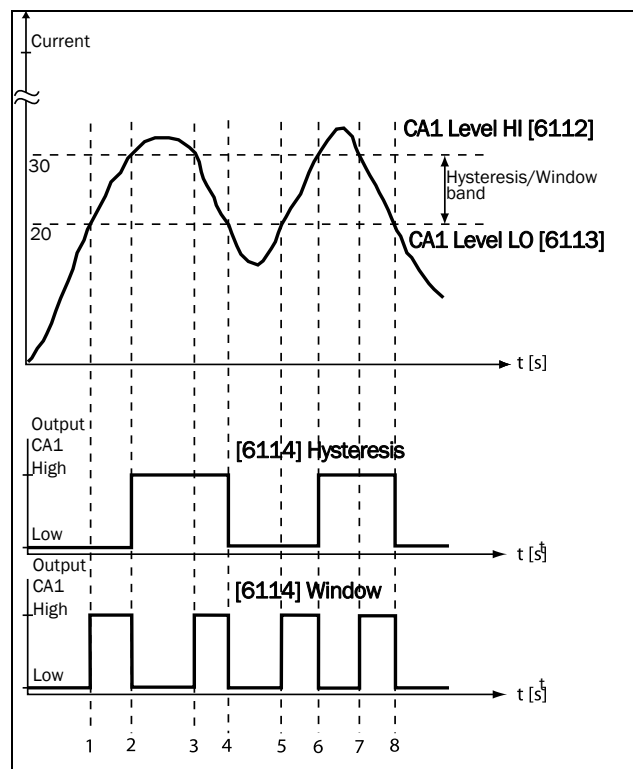


Fig. 78

Table 24 Comments to Fig. 78 regarding Hysteresis selection.

No.	Description	Hysteresis
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
3	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
4	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓
5	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
6	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
7	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
8	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓

Table 25 Comments to Fig. 78 regarding Window selection.

No.	Description	Window
1	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	↑
2	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓
3	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	↑
4	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓
5	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	↑
6	The reference signal passes the Level HI value from below (signal outside Window band), the comparator CA1 is reset, output is set low.	↓
7	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	↑
8	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓

Analogue Comparator 1, Level Low [6113]

Sets the analogue comparator low level, with unit and range according to the selected value in menu [6111].

<div> <div>6113 CA1 Level LO</div> <div>Stp A 20.0A</div> </div>	
Default:	20.0 A
Range:	Range as [6112].

Analogue Comparator 1, Type [6114]

Selects the analogue comparator type, i.e. Hysteresis or Window type. See Fig. 79 and Fig. 80.

<div> <div>6114 CA1 Type</div> <div>Stp A Hysteresis</div> </div>	
Default:	Hysteresis
Hysteresis	0 Hysteresis type comparator
Window	1 Window type comparator

Analogue Comparator 1, Polarity [6115]

Selects how the selected value in [6111] should be handled prior to the analogue comparator, i.e. as absolute value or handled with sign. See Fig. 79

<div> <div>6115 CA1 Polar</div> <div>Stp A Unipolar</div> </div>	
Default:	Unipolar
Unipolar	0 Absolute value of [6111] used
Bipolar	1 Signed value of [6111] used

Example

See Fig. 79 and Fig. 80 for different principle functionality of comparator features 6114 and 6115.

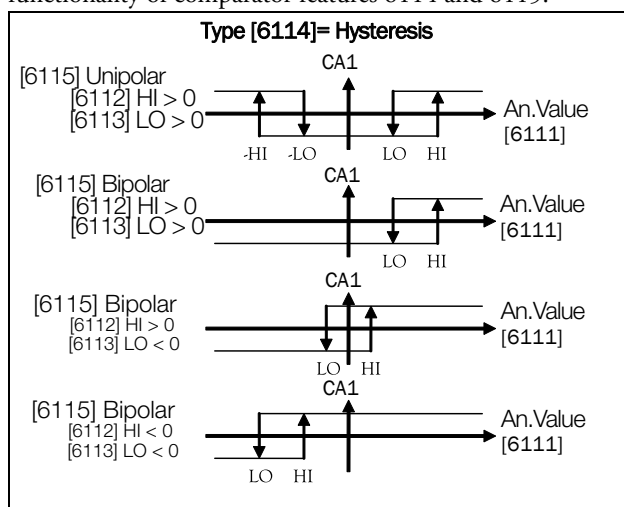


Fig. 79 Principle functionality of comparator features for “Type [6114] = Hysteresis ” and “Polar [6115]”.

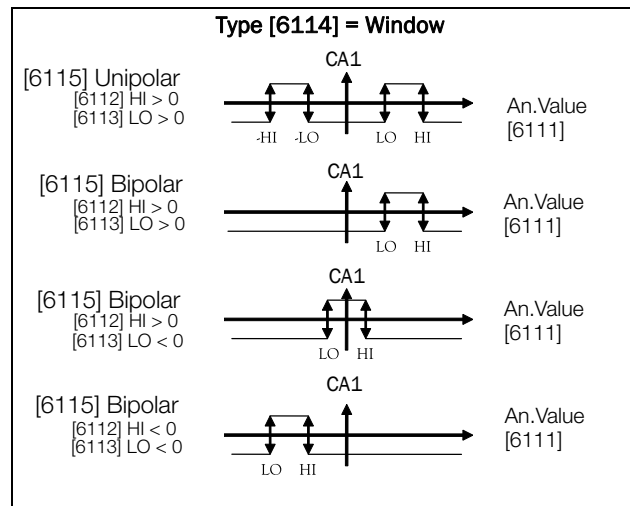


Fig. 80 Principle functionality of comparator features for “Type [6114] = Window” and “Polar [6115]”.

NOTE:

When “Unipolar “ is selected, absolute value of signal is used.

NOTE:

When “Bipolar” is selected in [6115] then:

1. Functionality is not symmetrical .
2. Ranges for high/low are bipolar

CA2 Setup [612]

Analogue comparator 2, parameter group.

Analogue Comparator 2, Value [6121]

Function is identical to analogue comparator 1, value [6111].

<div> <div>6121 CA2 Value</div> <div>Stp A Torque</div> </div>	
Default:	Torque
Selections:	Same as in menu [6111]

Analogue Comparator 2, Level High [6122]

Function is identical to analogue comparator 1, level high [6112].

<div> <div>6122 CA2 Level HI</div> <div>Stp A 20%</div> </div>	
Default:	20%
Range:	Enter a value for the high level.

Analogue Comparator 2, Level Low [6123]

Function is identical to analogue comparator 1, level low [6113].

6123 CA2 Level LO Stp A 10%	
Default:	10%
Range:	Enter a value for the low level.

Analogue Comparator 2, Type [6124]

Function is identical to analogue comparator 1, Type [6114].

6124 CA2 Type Stp A Hysteresis	
Default:	Hysteresis
Hysteresis	0 Hysteresis type comparator
Window	1 Window type comparator

Analogue Comparator 2, Polar [6125]

Function is identical to analogue comparator 1, Polar [6115].

6125 CA2 Polar Stp A Unipolar	
Default:	Unipolar
Unipolar	0 Absolute value of [6111] used
Bipolar	1 Signed value of [6111] used

CA3 Setup [613]

Analogue comparators 3, parameter group.

Analogue Comparator 3, Value [6131]

Function is identical to analogue comparator 1, value [6111].

6131 CA3 Value Stp A Process Val	
Default:	Process Val
Selections:	Same as in menu [6111]

Analogue Comparator 3, Level High [6132]

Function is identical to analogue comparator 1, level high [6112].

6132 CA3 Level HI Stp A 300rpm	
Default:	300rpm
Range:	Enter a value for the high level.

Analogue Comparator 3, Level Low [6133]

Function is identical to analogue comparator 1, level low [6113].

6133 CA3 Level LO Stp A 200rpm	
Default:	200 rpm
Range:	Enter a value for the low level.

Analogue Comparator, 3 Type [6134]

Function is identical to analogue comparator 1, level Type [6114].

6134 CA3 Type Stp A Hysteresis	
Default:	Hysteresis
Hysteresis	0 Hysteresis type comparator
Window	1 Window type comparator

Analogue Comparator 3, Polar [6135]

Function is identical to analogue comparator 1, Polar [6115].

6135 CA3 Polar Stp A Unipolar	
Default:	Unipolar
Unipolar	0 Absolute value of [6111] used
Bipolar	1 Signed value of [6111] used

CA4 Setup [614]

Analogue comparators 4, parameter group.

Analogue Comparator 4, Value [6141]

Function is identical to analogue comparator 1, value [6111].

6141 CA4 Value Stp A Process Err	
Default:	Process Err
Selections:	Same as in menu [6111]

Analogue Comparator 4, Level High [6142]

Function is identical to analogue comparator 1 level high [6112].

6142 CA4 Level HI Stp A 100rpm	
Default:	100rpm
Range:	Enter a value for the high level.

Analogue Comparator 4, Level Low [6143]

Function is identical to analogue comparator 1, level low [6113].

6143 CA4 Level LO Stp A -100rpm	
Default:	-100 rpm
Range:	Enter a value for the low level.

Analogue Comparator 4, Type [6144]

Function is identical to analogue comparator 1, level Type [6114]

6144 CA4 Type Stp A Window	
Default:	Window
Hysteresis	0 Hysteresis type comparator
Window	1 Window type comparator

Analogue Comparator 4, Polar [6145]

Function is identical to analogue comparator 1, Polar [6115]

6145 CA4 Polar Stp A Bipolar	
Default:	Bipolar
Unipolar	0 Absolute value of [6111] used
Bipolar	1 Signed value of [6111] used

Digital comparator Setup [615]

Digital comparators, parameter group.

Digital Comparator 1 [6151]

Selection of the input signal for digital comparator 1 (CD1).

The output signal CD1 is set high if the selected input signal is active. See Fig. 81.

The output signal can be programmed to the digital or relay outputs or used as a source for the virtual connections [560].

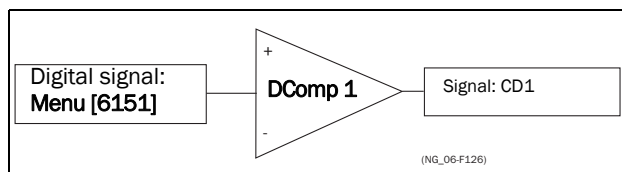


Fig. 81 Digital comparator

6151 CD1 Stp A Trip	
Default:	Trip
Selection:	Same selections as for "DigOut 1 [541]".

Digital Comparator 2 [6152]

Function is identical to digital comparator 1 [6151].

6152 CD 2 Stp A T2Q	
Default:	T2Q
Selection:	Same selections as for "DigOut 1 [541]".

Digital Comparator 3 [6153]

Function is identical to digital comparator 1 [6151].

6153 CD 3 Stp A Udc OK	
Default:	Udc OK
Selection:	Same selections as for "DigOut 1 [541]".

Digital Comparator 4 [6154]

Function is identical to digital comparator 1 [6151].

<div><div>6154</div><div>CD 4</div><div>Stp A Ready</div></div>	
Default:	Ready
Selection:	Same selections as for "DigOut 1 [541]".

11.7.2 Logic Output Y [620]

By means of an expression editor, the comparator signals can be logically combined into the Logic Y function.

The expression editor has the following features:

- The following signals can be used:
CA1, CA2, CD1, CD2 or LZ (or LY)
- The following signals can be inverted:
!A1, !A2, !D1, !D2, or !LZ (or !LY)
- The following logical operators are available:
" + " : OR operator
" & " : AND operator
" ^ " : EXOR operator

Expressions according to the following truth table can be made:

Input		Result		
A	B	& (AND)	+ (OR)	^(EXOR)
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

The output signal can be programmed to the digital or relay outputs or used as a Virtual Connection Source [560].

620 LOGIC Y

Stp CA1 & !A2 & CD1

The expression must be programmed by means of the menus [621] to [625].

Example:

Broken belt detection for Logic Y

This example describes the programming for a so-called "broken belt detection" for fan applications.

The comparator CA1 is set for frequency > 10Hz.

The comparator !A2 is set for load < 20%.

The comparator CD1 is set for Run.

The 3 comparators are all AND-ed, given the "broken belt detection".

In menus [621]-[625] expression entered for Logic Y is visible.

Set menu [621] to CA1

Set menu [622] to &

Set menu [623] to !A2

Set menu [624] to &

Set menu [625] to CD1

Menu [620] now holds the expression for Logic Y:

CA1 & !A2 & CD1

which is to be read as:

(CA1 & !A2) & CD1

NOTE: Set menu [624] to "." to finish the expression when only two comparators are required for Logic Y.

Y Comp 1 [621]

Selects the first comparator for the logic Y function.

621 Y Comp 1 Stp A !D3		
Default:	!D3	
CA1	0	
IA1	1	
CA2	2	
IA2	3	
CD1	4	
!D1	5	
CD2	6	
!D2	7	
LZ/LY	8	
!LZ/!LY	9	
T1	10	
!T1	11	
T2	12	
!T2	13	
CA3	14	
IA3	15	
CA4	16	
IA4	17	
CD3	18	
!D3	19	
CD4	20	
!D4	21	
C1	22	
!C1	23	
C2	24	
!C2	25	
CK1	26	
!K1	27	
CK2	28	
!K2	29	

Y Operator 1 [622]

Selects the first operator for the logic Y function.

622 Y Operator 1 Stp A &		
Default:	&	
.	0	When · (dot) is selected, the Logic Y expression is finished (when only two expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Y Comp 2 [623]

Selects the second comparator for the logic Y function.

623 Y Comp 2 Stp A !D3	
Default:	!D3
Selection:	Same as menu [621]

Y Operator 2 [624]

Selects the second operator for the logic Y function.

624 Y Operator 2 Stp A .		
Default:	.	
.	0	When · (dot) is selected, the Logic Y expression is finished (when only two expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Y Comp 3 [625]

Selects the third comparator for the logic Y function.

625 Y Comp 3 Stp A CD1	
Default:	CD1
Selection:	Same as menu [621]

11.7.3 Logic Output Z [630]

630 LOGIC Z Stp A CA1&!A2&CD1
--

The expression must be programmed by means of the menus [631] to [635].

Z Comp 1 [631]

Selects the first comparator for the logic Z function.

<div><div>631</div><div>Z Comp 1</div><div>Stp A</div><div>CD1</div></div>	
Default:	CD1
Selection:	Same as menu [621]

Z Operator 1 [632]

Selects the first operator for the logic Z function.

<table><tr><td>632 Z Operator 1 Stp A &</td></tr></table>		632 Z Operator 1 Stp A &
632 Z Operator 1 Stp A &		
Default:	&	
Selection:	Same as menu [622]	

Z Comp 2 [633]

Selects the second comparator for the logic Z function.

<table><tr><td>633</td><td>Z Comp 2</td></tr><tr><td>Stp A</td><td>!D2</td></tr></table>		633	Z Comp 2	Stp A	!D2
633	Z Comp 2				
Stp A	!D2				
Default:	!D2				
Selection:	Same as menu [621]				

Z Operator 2 [634]

Selects the second operator for the logic Z function.

<div>634 Z Operator 2 Stp A .</div>	
Default:	.
Selection:	Same as menu [624]

Z Comp 3 [635]

Selects the third comparator for the logic Z function.

<div><div>635 Z Comp 3</div><div>Stp A CD1</div></div>	
Default:	CD1
Selection:	Same as menu [621]

11.7.4 Timer1 [640]

The Timer functions can be used as a delay timer or as an interval with separate On and Off times (alternate mode). In delay mode, the output signal T1Q becomes high if the set delay time is expired. See Fig. 82.

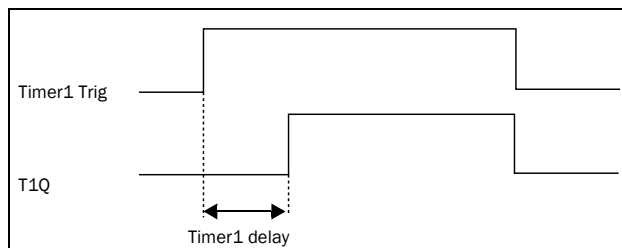


Fig. 82

In alternate mode, the output signal T1Q will switch automatically from high to low etc. according to the set interval times “Timer1 T1” and “Timer 1 T2”. See Fig. 83.

The output signal can be programmed to the digital or relay outputs used in logic functions [620] and [630], or as a virtual connection source [560].

NOTE:

The actual timers are common for all parameter sets. If the actual set is changed, the timer functionality [641] to [645] will change according set settings but the timer value will stay unchanged. So initialization of the timer might differ for a set change compared to normal triggering of a timer.

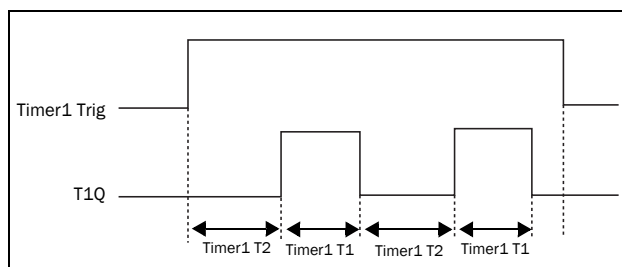


Fig. 83

Timer 1 Trig [641]

Selection of the Timer input trigger signal.

<div>641 Timer1 Trig</div> <div>Stp A Off</div>	
Default:	Off
Selection:	Same selections as Digital Output 1 menu [541].

Timer 1 Mode [642]

Selection of mode of operation for Timer.

<div>642 Timer1 Mode</div> <div>Stp A Off</div>		
Default:	Off	
Off	0	
Delay	1	
Alternate	2	

Timer 1 Delay [643]

This menu is only visible when timer mode is set to delay.

This menu can only be edited as in alternative 2, see section 9.7.

Timer 1 delay sets the time that will be used by the first timer after it is activated. Timer 1 can be activated by a high signal on a DigIn that is set to Timer 1 or via a virtual destination [560].

<div>643 Timer1Delay</div> <div>Stp A 00:00:00</div>	
Default:	00:00:00 (hr:min:sec)
Range:	00:00:00–9:59:59

Timer 1 T1 [644]

When timer mode is set to Alternate and Timer 1 is enabled, this timer will automatically keep on switching according to the independently programmable on and off times. The Timer 1 in Alternate mode can be enabled by a digital input or via a virtual connection. See Fig. 83. Timer 1 T1 sets the on time in the alternate mode.

<div>644 Timer 1 T1</div> <div>Stp A 00:00:00</div>	
Default:	00:00:00 (hr:min:sec)
Range:	00:00:00–9:59:59

Timer 1 T2 [645]

Timer 1 T2 sets the off time in the alternate mode.

<div>645 Timer1 T2</div> <div>Stp A 00:00:00</div>	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

NOTE:

“Timer 1 T1 [644]” and “Timer 1 T2 [645]” are only visible when Timer Mode is set to Alternate.

Timer 1 Value [649]

Timer 1 Value shows actual value of the timer.

649 Timer1 Value Stp A 00:00:00	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

11.7.5 Timer2 [650]

Refer to the descriptions for Timer1.

Timer 2 Trig [651]

651 Timer2 Trig Stp A Trip	
Default:	Trip
Selection:	Same selections as Digital Output 1 menu [541].

Timer 2 Mode [652]

652 Timer2 Mode Stp A Delay	
Default:	Delay
Selection:	Same as in menu [642]

Timer 2 Delay [653]

653 Timer2Delay Stp A 00:00:01	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

Timer 2 T1 [654]

654 Timer 2 T1 Stp A 00:00:00	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

Timer 2 T2 [655]

655 Timer 2 T2 Stp A 00:00:00	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

Timer 2 Value [659]

Timer 2 Value shows actual value of the timer.

<div> <div>659 Timer2 Value</div> <div>Stp A 00:00:00</div> </div>	
Default:	00:00:00, hr:min:sec
Range:	00:00:00–9:59:59

11.7.6 Counters [660]

Counter functions for counting pulses and signalling on digital output when counter reaches specified high and low limit levels.

The counter is counting up on positive flanks on the triggered signal, the counter is cleared as long as the Reset signal is active.

The counter can be automatically decremented with specified decrement time, if no new trigger signal has occurred within the decrement time.

The counter value is clamped to the high limit value and the digital output function (C1Q or C2Q) is active when counter value equals high limit value.

See Fig. 84 for more information of the counters.

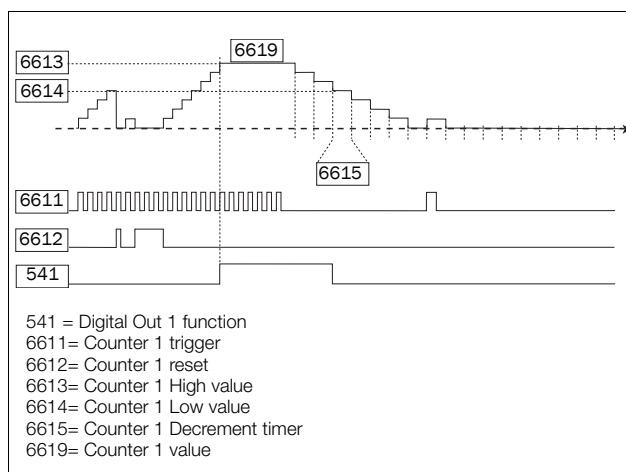


Fig. 84 Counters, operating principle.

Counter 1 [661]

Counter 1 parameter group.

Counter 1 Trigger [6611]

Selection of the digital output signal used as trigger signal for counter 1. Counter 1 is incremented by 1 on every positive flank on the trigger signal.

NOTE: Maximum counting frequency is 8 Hz.

<div> <div>6611 C1 Trig</div> <div>Stp A Off</div> </div>	
Default:	Off
Selection:	Same selections as "Digital Out 1 [541]".

Counter 1 Reset [6612]

Selection of the digital signal used as reset signal for counter 1. Counter 1 is cleared to 0 and held to 0 as long as reset input is active (high).

NOTE: Reset input has top priority.

6612 C1 Reset Stp A Off	
Default:	Off
Selection:	Same selections as "Digital Out 1 [541]".

Counter 1 High value [6613]

Sets counter 1 high limit value. Counter 1 value is clamped to selected high limit value and the counter 1 output (C1Q) is active (high) when the counter value equals the high value.

NOTE:
Value 0 means that counter output is always true (high).

6613 C1 High Val Stp A 0	
Default:	0
Range:	0 - 10000

Counter 1 Low value [6614]

Sets counter 1 low limit value. Counter 1 output (C1Q) is de-activated (low) when the counter value is equal or smaller than the low value.

NOTE:
Counter high value has priority so if high and low values are equal then the counter output is de-activated when the value is smaller than the low value.

6614 C1 Low Val Stp A 0	
Default:	0
Range:	0 - 10000

Counter 1 Decrement timer [6615]

Sets counter 1 automatic decrement timer value. The counter 1 is decremented by 1 after elapsed decrement time and if no new trigger has happened within the decrement time. The decrement timer is reset to 0 at every counter 1 trig pulse.

6615 C1 DecTimer Stp A Off		
Default:		Off
Off	0	Off
1 - 3600	1 - 3600	1 - 3600 s

Counter 1 Value [6619]

Parameter shows the actual value of counter 1.

NOTE:
Counter 1 value is common for all parameter sets.

NOTE: The value is volatile and lost at power down.

6619 C1 Value Stp A 0	
Default:	0
Range:	0 - 10000

Counter 2 [662]

Refer to description for Counter 1 [661].

Counter 2 Trigger [6621]

Function is identical to Counter 1 Trigger [6611].

6621 C2 Trig Stp A Off	
Default:	Off
Selection:	Same selections as Digital Out 1 [541].

Counter 2 Reset [6622]

Function is identical to Counter 1 Reset [6612].

6622 C2 Reset Stp A Off	
Default:	Off
Selection:	Same selections as Digital Out 1 [541].

Counter 2 High value [6623]

Function is identical to Counter 1 High value [6613].

6623 C2 High Val Stp A 0	
Default:	0
Range:	0 - 10000

Counter 2 Low value [6624]

Function is identical to Counter 1 Low value [6614].

6624 C2 Low Val Stp A 0	
Default:	0
Range:	0 - 10000

Counter 2 Decrement timer [6625]

Function is identical to Counter 1 Decrement timer [6615].

6625 C2 DecTimer Stp A Off		
Default:		Off
Off	0	Off
1 - 3600	1 - 3600	1 - 3600 s

Counter 2 Value [6629]

Parameter shows the actual value of counter 2.

NOTE: Counter 2 value is common for all parameter sets.		
NOTE: The value is volatile and lost at power down.		

6629 C2 Value Stp A 0	
Default:	0
Range:	0 - 10000

11.7.7 Clock Logic [670]

Group 670 if only available if the drive is equipped with a 4-line type Control panel (incl. RTC).

There are two Clock functions, Clock 1 and Clock 2. Each clock with separate settings for Time on, Time Off, Date on, Date Off and Weekday. These clocks can be used for activating/deactivating desired functions via Relay, digital output or Virtual I/O (For example creating start and stop commands).

Clock 1 [671]

The time, date and weekday for clock 1 are set in these submenus.

671 Clock 1 Stp A

Clock 1 Time On [6711]

Time when the clock 1 output signal (CLK1) is activated.

6711 Clk1TimeOn Stp A 00:00:00	
Default:	00:00:00 (hours:minutes:seconds)
Range:	00:00:00-23:59:59

Clock 1 Time Off [6712]

Time when the clock 1 output signal (CLK1) is deactivated.

6712 Clk1TimeOff Stp A 00:00:00	
Default:	00:00:00 (hours:minutes:seconds)
Range:	00:00:00-23:59:59

Clock 1 Date On [6713]

Date when the clock 1 output signal (CLK1) is activated.

6713 Clk1DateOn Stp A 2017-01-01	
Default:	2017-01-01
Range:	YYYY-MM-DD (year-month-day)

Clock 1 Date Off [6714]

Date when the clock output signal (CLK1) is deactivated. Note that if "Clk1DateOff" is set to an earlier date than "Clk1DateOn", the result will be that the clock is not deactivated at the set date.

6714 Clk1DateOff Stp A 2017-01-01	
Default:	2017-01-01
Range:	YYYY-MM-DD (year-month-day)

Clock 1 Weekday [6715]

Weekdays when the clock function is active. Having entered the editing mode, select or unselect the desired weekdays with the cursor using the PREV and NEXT keys on the control panel. Confirm by pressing ENTER. Exit the editing mode and the activated weekdays will be viewed in the menu display. The deactivated weekdays are replaced by a dash mark "-" (e.g. "MTWTF - -").

6715 Clk1Weekday	
6715 Clk1Weekday Stp A MTWTFSS	
Default:	MTWTFSS (all activated)
Range:	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.

NOTE: Please make sure that the correct time and date settings are done for the real time clock, menu group [930] "Clock".

Example 1:

The output CLK1 shall be active Mondays to Fridays on working hours, e.g. 08:00-17:00. This signal is used to start e.g. a fan with virtual I/O.

Menu	Text	Setting
6711	Clk1TimeOn	08:00
6712	Clk1TimeOff	17:00
6713	Clk1DateOn	2017-02-01 (date in the past)
6714	Clk1DateOff	2099-12-31 (Date in the future)
6715	Clk1Weekday	MTWTF- -
561	VIO 1 Dest	Run FWD
562	VIO 1 Source	Clk1

Example 2:

The output CLK1 shall be active on weekends, all day.

Menu	Text	Setting
6711	Clk1TimeOn	0:00:00
6712	Clk1TimeOff	23:59:59
6713	Clk1DateOn	2017-02-01 (date in the past)
6714	Clk1DateOff	2099-12-31 (Date in the future)
6715	Clk1Weekday	- - - - - SS
561	VIO 1 Dest	Run FWD
562	VIO 1 Source	Clk1

Clock 2 [672]

Refer to the description for Clock 1 [671].

11.8 View Operation/Status [700]

Menu with parameters for viewing all actual operational data, such as frequency, torque, power, etc.

11.8.1 Operation [710]

Reactive power value [711]

Displays the actual controlled reactive power value in % of nominal power.

NOTE:

Positive value - Capacitive or leading.

Negative value - Inductive or lagging.

<div>711 Q Value</div> <div>Stp 0%</div>	
Unit:	%
Resolution:	1%

Displacement power factor [712]

Displays the calculated displacement power factor at AFR/AFG terminals. Power factor calculation is given in section 7.14.

NOTE:

Positive value - Over excited power factor.

Negative value - Under excited power factor.

NOTE:

Sign in displacement power factor is just to differentiate between excited and under excited power factor.

<div>712 Cosφ</div> <div>Stp 0.012</div>	
Range:	-1 to 1
Resolution:	0.001

Torque [713]

Displays the virtual torque in % of nominal power and in W.

NOTE:

Positive value - Generating.

Negative value - Motoring.

<div>713 Torque</div> <div>Stp 0% 0W</div>	
Unit:	W
Resolution:	1 W

Reactive power [714]

Displays the actual reactive power.

NOTE:

Positive value - Over excited or capacitive.

Negative value - Under excited or Inductive.

<div>714 React Power</div> <div>Stp VA</div>	
Unit:	VA
Resolution:	1VA

Electrical Power [715]

Displays the actual electrical output power.

NOTE:

Positive value - Generating.

Negative value - Motoring.

<div>715 El Power</div> <div>Stp W</div>	
Unit:	W
Resolution:	1 W

Current [716]

Displays the actual output current.

<div>716 Current</div> <div>Stp A</div>	
Unit:	A
Resolution:	0.1 A

Supply Voltage [717]

Displays the calculated supply voltage at point of AFE connection.

717 Supply Voltage Stp V	
Unit:	V
Resolution:	1 V

Frequency [718]

Displays the actual output frequency.

NOTE:

Positive value = Positive phase sequence, i.e. L1 - L2 - L3.

Negative value = Negative phase sequence, i.e. L3 - L2 - L1.

718 Frequency Stp Hz	
Unit:	Hz
Resolution:	0.1 Hz

DC Link Voltage [719]

Displays the actual DC link voltage.

719 DC Voltage Stp V	
Unit:	V
Resolution:	1 V

IGBT Temperature [71A]

Displays the actual IGBT temperature.

71A IGBT Temp Stp °C	
Unit:	°C
Resolution:	0.1 °C

PT100_1_2_3 Temp [71B]

Displays the actual PT100 temperature, for PT100 board 1.

71B PT100 1,2,3	
Unit:	°C
Resolution:	1 °C

PT100_4_5_6 Temp [71C]

Displays the actual PT100 temperature, for PT100 board 2.

71C PT100 4,5,6	
Unit:	°C
Resolution:	1 °C

11.8.2 Status [720]

AFR/AFG Status [721]

Indicates the overall status of the AC drive.

721 AFR/AFG Status
Stp 1/222/333/44

Fig. 85 AC drive status

Display position	Function	Status value
1	Parameter Set	A,B,C,D
222	Source of reference value	-Rem (remote) -Key (keyboard) -Com (Serial comm.) -Opt (option)
333	Source of Run/ Stop command	-Rem (remote) -Key (keyboard) -Com (Serial comm.) -Opt (option)
44	Limit functions	- - - -No limit active -VL (Voltage Limit) -SL (Speed Limit) -CL (Current Limit) -TL (Torque Limit)

Example: “A/Key/Rem/TL”

This means:

A: Parameter Set A is active.

Key: Reference value comes from the keyboard (CP).

Rem: Run/Stop commands come from terminals 1-22.

TL: Torque Limit active.

Description of communication format

Integer values and bits used

Bit	Integer representation
1 - 0	Active Parameter set, where 0=A, 1=B, 2=C, 3=D
4 - 2	Source of Reference control value, where 0=Rem, 1=Key, 2=Com, 3=Option
7 - 5	Source of Run/Stop/Reset command, where 0=Rem, 1=Key, 2=Com, 3=Option
13 - 8	Active limit functions, where 0=No limit, 1=VL, 2=SL, 3=CL, 4=TL
14	Inverter is in warning (A warning condition is active)
15	Inverter is tripped (A Trip condition is active)

Example:

Previous example “A/Key/Rem/TL”

is interpreted “0/1/0/4”

In bit format this is presented as

Bit	Interpretation	Integer representation	
0 LSB	0	A(0)	Parameter set
1	0		
2	1	Key (1)	Source of control
3	0		
4	0		
5	0	Rem (0)	Source of command
6	0		
7	0		
8	0	TL (4)	Limit functions
9	0		
10	1		
11	0		
12	0		
13	0		
14	0		Warning condition
15 MSB	0		Trip condition

In the example above it is assumed that we have no trip or warning condition (the alarm LED on the control panel is off).

Warning [722]

Display the actual or last warning condition. A warning occurs if the AC drive is close to a trip condition but still in operation. During a warning condition the red trip LED will start to blink as long as the warning is active.

722	Warnings
Stp	warn.msg

The active warning message is displayed in menu [722]. If no warning is active the message "No Error" is displayed.

The following warnings are possible:

Communi- cation integer value	Warning message
0	No Error
2	PTC
5	Ext trip
6	Mon MaxAlarm
7	Mon MinAlarm
8	Comm error
9	PT100
12	Ext Mot Temp
13	LC Level
15	Option
16	Over temp
17	Over curr F
18	Over volt D
19	Over volt G
20	Over volt M
21	Over speed
22	Under voltage
23	Power fault
24	Desat
25	DCLink error
26	Int error
27	Ovolt m cut
28	Over voltage
29	Start denied
30	Not used

Digital Input Status [723]

Indicates the status of the digital inputs. See Fig. 86.

- 1 DigIn 1
- 2 DigIn 2
- 3 DigIn 3
- 4 DigIn 4
- 5 DigIn 5
- 6 DigIn 6
- 7 DigIn 7
- 8 DigIn 8

The positions one to eight (read from left to right) indicate the status of the associated input:

- 1 High
- 0 Low

The example in Fig. 86 indicates that DigIn 1, DigIn 3 and DigIn 6 are active at this moment.

723 DigIn Status
Stp 1010 0100

Fig. 86 Digital input status example

Digital Output Status [724]

Indicates the status of the digital outputs and relays. See Fig. 87.

RE indicate the status of the relays on position:

- 1 Relay1
- 2 Relay2
- 3 Relay3

DO indicate the status of the digital outputs on position:

- 1 DigOut1
- 2 DigOut2

The status of the associated output is shown.

- 1 High
- 0 Low

The example in Fig. 87 indicates that DigOut1 is active and Digital Out 2 is not active. Relay 1 is active, relay 2 and 3 are not active.

724 DigOutStatus
Stp RE 100 DO 10

Fig. 87 Digital output status example

Analogue Input Status [725]

Indicates the status of the analogue inputs 1 and 2.

725 AnIn 1	2
Stp -100%	65%

Fig. 88 Analogue input status

The first row indicates the analogue inputs.

- 1 AnIn 1
- 2 AnIn 2

Reading downwards from the first row to the second row the status of the belonging input is shown in %:

-100% AnIn1 has a negative 100% input value
65% AnIn2 has a 65% input value

So the example in Fig. 88 indicates that both the Analogue inputs are active.

NOTE:

The shown percentages are absolute values based on the full range/scale of the in- or output; so related to either 0–10 V or 0–20 mA.

Analogue Input Status [726]

Indicates the status of the analogue inputs 3 and 4.

726 AnIn 3	4
Stp -100%	65%

Fig. 89 Analogue input status

Analogue Output Status [727]

Indicates the status of the analogue outputs. Fig. 90. E.g. if 4-20 mA output is used, the value 20% equals to 4 mA.

727 AnOut 1	2
Stp -100%	65%

Fig. 90 Analogue output status

The first row indicates the Analogue outputs.

- 1 AnOut 1
- 2 AnOut 2

Reading downwards from the first row to the second row the status of the belonging output is shown in %:

-100%AnOut1 has a negative 100% output value
65%AnOut2 has a 65% output value

The example in Fig. 90 indicates that both the Analogue outputs are active.

NOTE:

The shown percentages are absolute values based on the full range/scale of the in- or output; so related to either 0–10 V or 0–20 mA.

I/O board Status [728] - [72A]

Indicates the status for the additional I/O on option boards 1 (B1), 2 (B2) and 3 (B3).

728 IO B1
Stp RE 000 DI100

VIO Status [72C]

Shows the values of the 8 Virtual IO's in menu [560]

72C VIO Status
Stp 00000000

11.8.3 Stored values [730]

The shown values are the actual values built up over time. Values are stored at power down and updated again at power up.

Run Time [731]

Displays the total time that the AC drive has been in the Run Mode.

<div>731 Run Time Stp hh:mm:ss</div>	
Unit:	00:00:00 (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Reset Run Time [7311]

Reset the run time counter. The stored information will be erased and a new registration period will start.

<div>7311 Reset RunTm Stp A No</div>	
Default:	No
No	0
Yes	1

NOTE:

After reset the setting automatically reverts to “No”.

Mains time [732]

Displays the total time that the AC drive has been connected to the mains supply. This timer cannot be reset.

<div>732 Mains Time Stp hh:mm:ss<</div>	
Unit:	00:00:00 (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Energy [733]

Displays the total energy consumption since the last energy reset [7331] took place.

<div>733 Energy Stp kWh</div>	
Unit:	Wh (shows Wh, kWh, MWh or GWh)
Range:	0.0–1GWh, Counter will restart at 0 after 1GWh

Reset Energy [7331]

Resets the energy counter. The stored information will be erased and a new registration period will start.

<div>7331 Rst Energy Stp A No</div>	
Default:	No
Selection:	No, Yes

NOTE:

After reset the setting automatically goes back to “No”.

11.9 View Trip Log [800]

Main menu with parameters for viewing all the logged trip data. In total the AFR/AFG saves the last 9 trips in the trip memory. The trip memory refreshes on the FIFO principle (First In, First Out). Every trip in the memory is logged on the time of the Run Time [731] counter. At every trip, the actual values of several parameter are stored and available for troubleshooting.

11.9.1 Trip Message log [810]

Display the cause of the trip and what time that it occurred. When a trip occurs the status menus are copied to the trip message log. There are nine trip message logs [810]–[890]. When the tenth trip occurs the oldest trip will disappear.

8x0 Trip message Stp hh:mm:ss	
Unit:	hh:mm:ss (hours: minutes: seconds)
Range:	0h: 0m–65355h: 59m

810	Ext Trip
Stp	132:12:14

For fieldbus integer value of trip message, see message table for warnings, [722].

NOTE:

Bits 0–5 used for trip message value. Bits 6–15 for internal use.

With four line PPU and real time clock

Every trip in the memory is logged on actual time and date. At every trip, the actual values of several parameter are stored and available for troubleshooting.

8x0 Trip message	
Unit:	h: m (hours: minutes)
Range:	0h: 0m–65355h: 59m

810	Ext Trip
------------	-----------------

For fieldbus integer value of trip message, see message table for warnings, [722].

Trip message [811] to [81P]

The information from the status menus are copied to the trip message log when a trip occurs.

Trip menu	Copied from	Description
811	711	Q value
812	712	Cos φ
813	713	Torque
814	714	Reactive power
815	715	Electrical power
816	716	Current
817	717	Supply voltage
818	718	Frequency
819	719	DC Link voltage
81A	71A	IGBT temperature
81C	721	AFR/AFG status
81D	723	Digital input status
81E	724	Digital output status
81F	725	Analogue input status 1-2
81G	726	Analogue input status 3-4
81H	727	Analogue output status 1-2
81L	731	Run Time
81M	732	Mains Time
81N	733	Energy
81O	310	Q reference
81P	72C	VIO status

Example:

Fig. 91 shows the third trip memory menu [830]: Over temperature trip occurred after 1396 hours and 13 minutes in Run time.

830 Over temp
Stp 1396h:13m

Fig. 91 Trip 3

11.9.2 Trip Messages [820] - [890]

Same information as for menu [810].

11.9.3 Reset Trip Log [8A0]

Resets the content of the 10 trip memories.

8A0 Reset Trip Stp No		
Default:	No	
No	0	
Yes	1	

NOTE: After the reset the setting goes automatically back to "NO". The message "OK" is displayed for 2 sec.

11.10 System Data [900]

Main menu for viewing all the AFR/AFG system data.

11.10.1 AFR/AFG Data [920]

AFR/AFG Type [921]

Shows the AFR/AFG type according to the type number.

The options are indicated on the type plate of the AFR/AFG.

921	AFR/AFG2.0
Stp	AFR/AFG46-175

Fig. 92 Example of type

Examples:

AFR/AFG46-175 suited for 380-460 V mains supply and a rated input current of 175 A.

Software [922]

Shows the software version number of the AFR/AFG.

Fig. 93 gives an example of the version number.

922 Software
Stp v4.45-97.10

Fig. 93 Example of software version

V 4.45 = Software version

- 97.10 = option version, is only visible and valid for special software, type OEM adapted software.

97 = (major) special software variant number

10 = (minor) revision of this special software

Table 26 Information for Modbus and Profibus number, software version

Bit	Description
7-0	minor version
13-8	major version
15-14	release type 00: V, release version 01: P, pre-release version 10: β, Beta version 11: α, Alpha version

Table 27 Information for Modbus and Profibus number, option version

Bit	Description
7-0	minor option version
15-8	major option version

NOTE:

It is important that the software version displayed in menu [920] is the same software version number as the software version number written on the title page of this instruction manual. If not, the functionality as described in this manual may differ from the functionality of the AFR/AFG.

Build Info [921]

Software version created, Date and time.

<div>9221 Build Info Stp</div>	
Default:	YY:MM:DD:HH:MM:SS

Build ID [922]

Software identification code.

<div>9222 Build ID Stp 0E1B7F9E</div>	
Example:	0E1B7F9E

Unit name [923]

Option to enter a name of the unit for service use or customer identity. The function enables the user to define a name with max 12 characters. Use the Prev and Next key to move the cursor to the required position. Then use the + and - keys to scroll in the character list. Confirm the character by moving the cursor to the next position by pressing the Next key.

Example

Create user name USER 15.

1. When in the menu [923] press Next to move the cursor to the right most position.
2. Press the + key until the character U is displayed.
3. Press Next.
4. Then press the + key until S is displayed and confirm with Next.
5. Repeat until you have entered USER15.

923 USER 15	
Default:	No characters shown

When sending a unit name you send one character at a time starting at the right most position.

Bluetooth ID [924]

Unique ID number for connecting to “EmoPPU” app.

924 Bluetooth ID	
Default:	NA

11.10.2 Clock [930]

This menu group displays actual time and date, read only.

Time and date are factory set to CET (Central European mean time). Adjust if required in following sub-menus.

Time [931]

Actual time, displayed as HH:MM:SS. Adjustable setting.

931 Time	
Default:	00:00:00

Date [932]

Actual date, displayed as YYYY-MM-DD. Adjustable setting.

932 Date	
Default:	2017-01-01

Weekday [933]

Display of actual weekday, read only.

933 Weekday		
Default:		Monday
Monday	0	
Tuesday	1	
Wednesday	2	
Thursday	3	
Friday	4	
Saturday	5	
Sunday	6	
MTWTFSS	7	

11.11 AFE Option [000]

Main menu for AFE dedicated settings.


11.11.1 Supply parameters [010]

Main menu for power supply parameters.

Supply Volts [011]

Nominal supply voltage.


This parameter is important for smooth start-up. During operation, AFE controller automatically monitors the grid voltage.

	O11 Supply Volts Stp 400/690 V
Default:	400 V
Range:	380 - 460 V 480 - 690 V

Supply Frequency [012]

Nominal supply frequency.

This parameter is important for smooth start-up. During operation, AFE controller automatically monitors the grid frequency.

	O12 Supply Freq Stp 50 Hz
Default:	50Hz
Range:	50 - 60Hz


Supply Current [013]

Nominal supply current. Only used for mains supply synchronisation and overcurrent protection.

	O13 Supply Curr Stp AFR/AFG. Inom
Default:	175A
Range:	0 - AFR/AFG. Inom


Supply Sequence [014]

Nominal phase sequence of supply. Supply ID run [015]

		<div>O14 Supply Seq StpPos</div>
Default:		Pos
Pos	0	Positive phase sequence, i.e. L1-L2-L3
Neg	1	Negative phase sequence, i.e. L3-L2-L1


Supply IDrun [015]

Identification run to measure and set up supply parameters.

<div></div> <div>O15 Supply IDrun StpOff</div>		
Default:		Off
Off	0	
On	1	Activate the supply ID-run

Supply Auto [016]

Automatic activation of supply parameter identification after every power-up.

<div><div></div><div>O16 Supply Auto Stp Off</div></div>	
Default: Off	
Off	0
On	1
Activate automatic ID-run	

NOTE:

Select ID-Run method in [025].

11.11.2 Charge/Start parameters [020]

Main menu for charge control and start/stop parameters.

Charge control [021]

DC-link Charge relay control function.

O21 Charge Ctrl Stp Supply-NC		
Default:	Supply - NC	
Supply - NC	0	Charge at power supply via NC terminal on Relay 1.
Supply - NO	1	Charge at power supply via NO terminal on Relay 1.
Run - NO	2	Charge at run command via NO terminal on Relay 1.
Enable - NO	3	Charge at Enable command via NO terminal on Relay 1.
No Trip - NO	4	Charge at power supply via NO terminal on R1 provided that AFR/AFG is not tripped.
Run!Trp - NO	5	Charge at run command via NO terminal on R1 provided that AFR/AFG is not tripped.
Enb!Trp - NO	6	Charge at Enable command via NO terminal on R1 provided that AFR/AFG is not tripped.

NOTE:

Normally open (NO) alternatives requires 24 V Standby supply option.

Start Mode [022]

Start/Stop mode. If set to "Regen" AFR/AFG starts on regenerative demand.

O22 Run/Stp Mode Stp Standard		
Default:	Standard	
Standard	0	AFR/AFG active via Run command
Regen	1	AFR/AFG active only if regeneration required and valid run command.

NOTE:

Regeneration mode requires supply voltage measurement hardware option.

Regeneration stop delay time [023]

Regeneration stop delay time after AFR/AFG in motoring mode.

O23 Reg Stp Time Stp 1s		
Default:	1s	
Range	0.00 - 10.0s	

NOTE:

Regeneration mode requires supply voltage measurement.

Auto restart [024]

This parameter allows AFR to withstand momentary dips in the main supply. For details see section 7.7

O24 Auto restart Stp Off		
Default:	Off	
Off	0	
On	1	Activates automatic restart

Start type [025]

This parameter selects the method to be used during synchronization (start) of AFR/AFG and ID-Run. Selecting Pulses method uses pulses for synchronization and ID-Run whereas selecting sensor uses information from supply voltage measurement board for synchronization and ID-Run.

O25 Start Type Stp Pulses		
Default:	Pulses	
Pulses	0	Use pulses for sync and ID-Run
Sensor	1	Use SVMB for sync and ID-Run

NOTE:

Start type with sensor requires SVMB to be connected and setup correctly.

11.11.3 Udc controller parameters [030]

Main menu for DC-link voltage (Udc) parameters.

Udc reference [031]

DC-link voltage reference value.

	O31 Udc ref Stp 1.05*Upeak
Default:	1.05*Upeak
Range	Upeak to Umax

NOTE:

Actual DC - link voltage reference value is limited via actual supply voltage and [037 Udc margin].

Udc ramp time [032]

Udc ramp time, defined as time from 0 -> 1000V.

	O32 Udc ramp Stp 1s
Default:	1s
Range	0.0 - 10.0s

Udc PI Gain controller [033]

Proportional gain of Udc PI controller.

	O33 Udc PI Gain Stp 5.0
Default:	5.0
Range	0.0 - 10.0

Udc PI Time controller [034]

Integral time constant of Udc PI controller.

	O34 Udc PI Time Stp 0.2s
Default:	0.2s
Range	0.0 - 10.0s

Udc PI Max limit [035]

Udc PI controller max limit, i.e. active power limit.

	O35 Udc PI Max Stp 200%
Default:	200%
Range	0 - 400%

Udc PI Charge limit [036]

Udc PI controller max charge limit during synchronization, i.e. during Udc charging.

	O36 Udc PI Charg Stp 20%
Default:	20%
Range	0 - 100%

Udc margin [037]

Udc reference control margin from actual output voltage.

	O37 Udc margin Stp 5%
Default:	5%
Range	0.0 - 20.0%

NOTE:

Actual internal DC - link voltage reference value is limited via actual supply voltage and [037 Udc margin], i.e.

$$\sqrt{2} \times U_{ac} \times (1 + [037])$$

where U_{ac} is the phase to phase RMS voltage.

11.11.4 Reactive power (Q) controller parameters [040]

Q Max limit [041]

Reactive power max. limit value, i.e. amount of unused capacity that is allowed for Q - compensation.

	O41 Q Max Stp 0%
Default:	0%
Range	0 to 100%

NOTE:

Reactive power limited internally by the amount of actual active power.

Q ramp time [041]

Q ramp time, defined as time from 0->100%.

	O42 Q ramp Stp 1s
Default:	1s
Range	0.0 - 10.0s

Q PI Gain [043]

Q PI controller P gain.

	O43 Q PI Gain Stp 0.10
Default:	0.10
Range	0.00 - 1.00

Q PI Time [044]

Q PI controller I time.

	O44 Q PI Time Stp 0.1s
Default:	0.1s
Range	0.0 - 10.0s

Q Filter time [045]

Q filter time in dynamic/static feedback loop.

	O45 Q Filter Stp 1s
Default:	1s
Range	0.0 - 10.0s

11.11.5 Frequency controller parameters [050]

Frequency type [051]

Selects frequency observer type to handle variations in supply frequency.

O51 Freq Type Stp Observer/Sensor		
Default:	AFR: Observer AFG: Sensor	
Observer	0	Use internal frequency observer (without sensor).
Fixed	1	Use fixed frequency
Sensor	2	Use grid frequency information from supply voltage measurement board

NOTE:
Frequency type with sensor requires SVMB to be connected and setup correctly.

11.11.6 View energy status [080]

Energy from Supply [081]

Energy from Supply (Total = Motoring - Generating).

O81 Energy Suppl Stp 1Wh	
Unit:	Wh
Resolution:	1Wh

Energy to Motor [082]

Energy delivered to Motor (Motoring mode).

O82 Energy Motor Stp 1Wh	
Unit:	Wh
Resolution:	1Wh

Energy to Supply [083]

Energy delivered to Supply (Generating mode).

O83 Energy Gen Stp 1Wh	
Unit:	Wh
Resolution:	1Wh

Reset energy [084]

Clear all energy Wh counters [081] - [083].

O84 Reset Energy Stp No		
Default:	No	
No	0	
Yes	1	Clear Wh counters.

11.11.7 View control status [090]

Udc Reference and actual value [091]

Internal Udc reference (after ramp) and actual value.

091 Udc Ref Val Stp 110%/100%	
Unit:	%
Resolution:	1%

T Reference and actual value [092]

Internal T reference (Udc PI output) and actual value.

092 T Ref Val Stp 20%/0%	
Unit:	%
Resolution:	1%

Q Reference and actual value [093]

Internal Q reference (after ramp) and actual value..

093 Q Ref Val Stp -5%/0%	
Unit:	%
Resolution:	1%

Psi Reference and actual value [094]

Internal Psi reference (Q PI output) and actual value.

094 Psi Ref Val Stp 100%/100%	
Unit:	%
Resolution:	1%

11.12 Grid Code Functions [G00]

This menu contains settings related to grid monitoring, grid code voltage and frequency protection functions, grid code reactive power control modes and grid code dynamic support i.e. UVRT, OVRT, OFRT, anti-islanding and open circuit detection.

11.12.1 Grid Code Protection Functions [G10]

Settings related to grid code voltage and frequency protection functions.

Grid Code Voltage Protection [G11]

This sub menu provides settings related to voltage source, voltage trip levels, trip time, hysteresis, reset time etc.

Voltage Source for Grid Code Voltage Protections [G111]

Voltage source for all grid code voltage protections i.e. protection based on phase voltages or on line-line voltages. Selection Off here disable all grid code voltage protections.

G111 Source 3U Stp Off		
Default:	Off	
Off	0	Grid code voltage protections are disabled.
3U (phase)	1	Phase voltages
3U (LL)	2	Line-Line voltages

1st Stage Grid Code Over Voltage Protection level [G112]

Trip level for first stage grid code over voltage protection.

G112 3U> Level Stp 115.0%	
Default:	115.0%
Range:	100.0% - 200.0%

1st Stage Grid Code Over Voltage Protection Trip Time [G113]

Trip time for first stage grid code over voltage protection.

G113 3U> Time Stp 1.50s	
Default:	1.50 s
Range:	0 = Off 0.01 s - 60.00 s

2nd Stage Grid Code Over Voltage Protection level [G114]

Trip level for second stage grid code over voltage protection.

	G114 3U>> Level Stp 120.0%
Default:	120.0%
Range:	100.0% - 200.0%

2nd Stage Grid Code Over Voltage Protection Trip Time [G115]

Trip time for second stage grid code over voltage protection.

	G115 3U>> Time Stp 0.20s
Default:	0.20 s
Range:	0=Off 0.01 s - 60.00 s

1st Stage Grid Code Under Voltage Protection level [G116]

Trip level for first stage grid code under voltage protection.

	G116 3U< Level Stp 85.0%
Default:	85.0%
Range:	0.0% - 100.0%

1st Stage Grid Code Under Voltage Protection Trip Time [G117]

Trip time for first stage grid code under voltage protection.

	G117 3U< Time Stp 1.50s
Default:	1.50s
Range:	0 = Off 0.01s - 60.00s

2nd Stage Grid Code Under Voltage Protection level [G118]

Trip level for second stage grid code under voltage protection.

	G118 3U<< Level Stp 80.0%
Default:	80.0%
Range:	0.0% - 100.0%

2nd Stage Grid Code Under Voltage Protection Trip Time [G119]

Trip time for second stage grid code under voltage protection.

	G119 3U<< Time Stp 0.20s
Default:	0.20s
Range:	0=Off 0.01s - 60.00s

Grid Code Voltage Protection Voltage Hysteresis [G11A]

This voltage hysteresis setting is common (applicable) to all grid code voltage protections.

	G11A U Hysteres Stp 2.0%
Default:	2.0%
Range:	0.0% - 100.0%

Grid Code Voltage Protection Reset Time [G11B]

This reset time setting is common (applicable) to all grid code voltage protections.

	G11B U Rst Time Stp 1.00s
Default:	1.00s
Range:	0=Off 0.00s - 60.00s

Grid Code Positive Sequence Over Voltage Protection level [G11C]

Trip level for grid code +ve sequence over voltage protection.

	G11C U+> Level Stp 110.0%
Default:	110.0%
Range:	100.0% - 200.0%

Grid Code Positive Sequence Over Voltage Protection Trip Time [G11D]

Trip time for grid code +ve sequence over voltage protection.

	G11D U+> Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code Positive Sequence Under Voltage Protection level [G11E]

Trip level for grid code +ve sequence under voltage protection.

	G11E U+< Level Stp 85.0%
Default:	85.0%
Range:	0.0% - 100.0%

Grid Code Positive Sequence Under Voltage Protection Trip Time [G11F]

Trip time for grid code +ve sequence under voltage protection.

	G11F U+< Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code Negative Sequence Over Voltage Protection level [G11G]

Trip level for grid code -ve sequence over voltage protection.

	G11G U-> Level Stp 5.0%
Default:	5.0%
Range:	0.0% - 100.0%

Grid Code Negative Sequence Over Voltage Protection Trip Time [G11H]

Trip time for grid code -ve sequence over voltage protection.

	G11H U-> Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code Zero Sequence Over Voltage Protection level [G11I]

Trip level for grid code zero sequence over voltage protection.

	G11I U0> Level Stp 10.0%
Default:	10.0%
Range:	0.0% - 100.0%

Grid Code Zero Sequence Over Voltage Protection Trip Time [G11J]

Trip time for grid code zero sequence over voltage protection.

	G11J U0> Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code 10-Minute Mean Over Voltage Protection level [G11K]

Trip level for grid code 10-minute mean over voltage protection.

	G11K Umean> Lvl Stp 110.0%
Default:	110.0%
Range:	100.0% - 200.0%

Grid Code 10-Minute Mean Over Voltage Protection Trip Time [G11L]

Trip time for grid code 10-minute mean over voltage protection.

	G11L Umean> Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code 10-Minute Mean Under Voltage Protection level [G11M]

Trip level for grid code 10-minute mean under voltage protection.

	G11M Umean< Lvl Stp 90.0%
Default:	90.0%
Range:	0.0% - 100.0%

Grid Code 10-Minute Mean Under Voltage Protection Trip Time [G11N]

Trip time for grid code 10-minute mean under voltage protection.

	G11N Umean< Time Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code Reactive Power Under Voltage Protection level [G110]

Trip level for grid code reactive power under voltage protection.

Using this protection, the generating plant (AFE/AFG) is disconnected from the network after trip time [G11P] elapse, if the measured network voltage is below trip level [G110] and if the generating plant (AFE) simultaneously extracts inductive reactive power from the network.

	G110 U(Q<0)< Lvl Stp 85.0%
Default:	85.0%
Range:	0.0% - 100.0%

Grid Code Reactive Power Under Voltage Protection Trip Time [G11P]

Trip time for grid code reactive power under voltage protection.

	G11P U(Q<0)< Tim Stp Off
Default:	Off
Range:	0=Off 0.01s - 60.00s

Grid Code Frequency Protection [G12]

This sub menu provide settings related to frequency trip levels, trip time, hysteresis and reset time etc.

Frequency Source For Grid Code Frequency Protections [G121]

Common frequency source for all grid code frequency protections. Selecting mean uses the mean of all phase frequencies. Selection Off disables all grid code frequency protections.

<div><div>G121</div><div>Source F</div><div>Stp</div><div>Off</div></div>		
Default:		Off
Off	0	Grid code frequency protections are disabled.
Mean	1	Mean of all phase frequencies.

1st Stage Grid Code Over Frequency Protection level [G122]

Trip level for first stage grid code over frequency protection.

	G122 F> Level Stp 102.0%
Default:	102.0%
Range:	100.0% - 200.0%

1st Stage Grid Code Over Frequency Protection Trip Time [G123]

Trip time for first stage grid code over frequency protection.

	G123 F> Time Stp 1.50s
Default:	1.50 s
Range:	0 = Off 0.01s - 60.00s

2nd Stage Grid Code Over Frequency Protection level [G124]

Trip level for second stage grid code over frequency protection.

	G124 F>> Level Stp 105.0%
Default:	105.0%
Range:	100.0% - 200.0%

2nd Stage Grid Code Over Frequency Protection Trip Time [G125]

Trip time for second stage grid code over frequency protection.

	G125 F>> Time Stp 0.20s
Default:	0.20s
Range:	0 = Off 0.01s - 60.00s

1st Stage Grid Code Under Frequency Protection level [G126]

Trip level for first stage grid code under frequency protection.

	G126 F< Level Stp 98.0%
Default:	98.0%
Range:	0.0% - 100.0%

1st Stage Grid Code Under Frequency Protection Trip Time [G127]

Trip time for first stage grid code under frequency protection.

	G127 F< Time Stp 1.50s
Default:	1.50s
Range:	0 = Off 0.01s - 60.00s

2nd Stage Grid Code Under Frequency Protection level [G128]

Trip level for second stage grid code under frequency protection.

	G128 F<< Level Stp 95.0%
Default:	95.0%
Range:	0.0% - 100.0 %

2nd Stage Grid Code Under Frequency Protection Trip Time [G129]

Trip time for second stage grid code under frequency protection.

	G129 F<< Time Stp 0.20s
Default:	0.20s
Range:	0 = Off 0.01s - 60.00s

Grid Code Frequency Protection Frequency Hysteresis [G12A]

This frequency hysteresis setting is common (applicable) to all grid code frequency protections.

	G12A F Hysteres Stp 0.2%
Default:	0.2%
Range:	0.0% - 100.0%

Grid Code Frequency Protection Reset Time [G12B]

This reset time setting is common (applicable) to all grid code frequency protections.

	G12B F Rst Time Stp 1.00s
Default:	1.00s
Range:	0=Off 0.00s - 60.00s

Grid Code ROCOF Protection [G13]

This sub menu provides settings related to Rate Of Change Of Frequency (ROCOF) protection. Trip level, trip time, hysteresis and reset time can be configured here.

Grid Code ROCOF Protection level [G131]

Trip level for rate of change of frequency (ROCOF) protection.

G131 ROCOF Level Stp 2.00%/s	
Default:	2.00%/s
Range:	0.0%/s - 100.0%/s

Grid Code ROCOF Protection Trip Time [G132]

Trip time for rate of change of frequency (ROCOF) protection.

G132 ROCOF Time Stp 2.00s	
Default:	2.00s
Range:	0 = Off 0.01s - 60.00s

Grid Code ROCOF Protection ROCOF Hysteresis [G133]

ROCOF hysteresis for grid code ROCOF protection.

G133 ROCOF Hyst Stp 0.02%/s	
Default:	0.02%/s
Range:	0.0%/s - 100.0%/s

Grid Code ROCOF Protection Reset Time [G134]

Reset time settings for ROCOF protection.


G134 ROCOF Rst T Stp 1.00s	
Default:	1.00s
Range:	0.00s - 60.00s

11.12.2 Grid Code Reactive Power (Q) Functions [G20]

Settings related to different grid code reactive power (Q) support modes.

Grid Code Reactive Power (Q) support mode [G21]

Select the required grid code reactive power (Q) support mode here.

		<div><div>G21</div><div>Q mode</div><div>Stp</div><div>Off</div></div>
Default:		Off
Off	0	Disables grid code reactive power support.
Q fix	1	Reactive power support via the set point (from Keyb, remote or comm).
CosΦ fix	2	Reactive power support via the set point (from Keyb, remote or comm).
Q(U)	3	Reactive power support as a function of grid/network voltage.
CosΦ(U)	4	Reactive power support as a function of grid/network voltage.
Q (P)	5	Reactive power support as a function of feed in power.
CosΦ(P)	6	Reactive power support as a function of feed in power.

Q control via the set point (Q fix) [G22]

This sub-menu provides the additional settings (over excited and under excited Q limits) when the reactive power (Q) reference is controlled via the set point i.e. Q reference is provided by the set point. Set point can be configured locally through keyboard [310], from remote (analogue input) or through serial communication. For details read section 7.17.2, page 41.

Maximum Reactive Power (Q) in Over Excitation [G221]

Sets the maximum limit of reactive power (Q) in over-excited mode.

G221 Q max oe Stp 50%	
Default:	50%
Range:	0% - 100%

NOTE:

-ve sign in [G221] indicates the under excited mode and +ve sign indicates the over-excited mode.

NOTE:

Q_{ref} [310] is additionally also limited by Q_{max} [041] as shown in Fig. 37.

Maximum Reactive Power (Q) in Under Excitation [G222]

Sets the maximum limit of reactive power (Q) in under-excited mode.

	G222 Q max ue Stp -50%
Default:	-50%
Range:	-100% - 0%

NOTE:

-ve Q value in [G222] indicates the under excited mode and +ve sign indicates the over-excited mode.

NOTE:

Q_{ref} [310] is additionally also limited by Q_{max} [041] as shown in Fig. 37.

CosΦ control via the set point (CosΦ fix) [G23]

This sub-menu provides the additional settings (over excited and under excited CosΦ limits) when the displacement power factor (CosΦ) reference is controlled via the set point i.e. CosΦ reference is provided by the set point. Set point can be configured locally through keyboard [310], from remote (analogue input) or through serial communication. Internally reactive power (Q) reference is calculated from the set displacement power factor (CosΦ). For details read section Reactive power (Q) support, section 7.17.2, page 41.

Minimum Displacement Power Factor (CosΦ) In Over Excitation [G231]

Sets the minimum limit of displacement power factor (CosΦ) in over-excited mode.

	G231 CosΦ min oe Stp 0.90
Default:	0.90
Range:	0.00 - 1.00

NOTE:

-ve Q sign in [G231] indicates the under excited mode and +ve sign indicates the over-excited mode.

NOTE:

Calculated Q_{ref} [310] is additionally also limited by Q_{max} [041] as shown in Fig. 37.

Minimum Displacement Power Factor (CosΦ) In Under Excitation [G232]

Sets the minimum limit of displacement power factor (CosΦ) in under-excited mode.

	G232 CosΦ min ue Stp -0.90
Default:	-0.90
Range:	-1.00 - 0

NOTE:

-ve Q value in [G232] indicates the under excited mode and +ve sign indicates the over-excited mode.

NOTE:

Calculated Q_{ref} [310] is additionally also limited by Q_{max} [041] as shown in Fig. 37.

Q control as a function of grid voltage Q(U) [G24]

AFR/AFG can support grid/network voltage in the event of grid/network voltage variations by providing or consuming the reactive power. For that, reactive power (Q) support can be configured as a function of grid/network measured voltage. Characteristics of reactive power (Q) support as a function of measured grid/network voltage can be configured using four configurable points. For details read section Reactive power (Q) support, section 7.17.2. In this menu, settings related Q-U characteristic curve can be configured.

Reactive Power (Q1) At Voltage Level (U1) [G241]

Desired reactive power support (Q1) at measured grid/network voltage (U1) level.

	G241 Q1 Stp 50%
Default:	50%
Range:	-100% - 100%

NOTE:

-ve Q1 value in [G241] indicates the under excited mode and +ve sign indicates the over-excited mode.

Grid/Network Voltage (U1) level [G242]

Grid/Network voltage (U1) level at which specified Q1 is supplied.

	G242 Stp	U1 85%
Default:	85%	
Range:	0% - 120%	

Reactive Power (Q2) Voltage level (U2) [G243]

Desired reactive power support (Q2) at measured grid/network voltage (U2) level.

	G243 Stp	Q2 10%
Default:	10%	
Range:	-100% - 100%	

NOTE:

-ve Q2 value in [G243] indicates the under excited mode and +ve sign indicates the over-excited mode.

Grid/Network Voltage (U2) level [G244]

Grid/Network voltage (U2) level at which specified Q2 is supplied.

	G244 Stp	U2 95%
Default:	95%	
Range:	0% - 120%	

Reactive Power (Q3) At Voltage level (U3) [G245]

Desired reactive power support (Q3) at measured grid/network voltage (U3) level.

	G245 Stp	Q3 -10%
Default:	-10%	
Range:	-100% - 100%	

NOTE:

-ve Q3 value in [G245] indicates the under excited mode and +ve sign indicates the over-excited mode.

Grid/Network Voltage (U3) level [G246]

Grid/Network voltage (U3) level at which specified Q3 is supplied.

	G246 Stp	U3 105%
Default:	105%	
Range:	0% - 120%	

Reactive Power (Q4) At Voltage level (U4) [G247]

Desired reactive power support (Q4) at measured grid/network voltage (U4) level.

	G247 Stp	Q4 -50%
Default:	-50%	
Range:	-100% - 100%	

NOTE:

-ve Q4 value in [G247] indicates the under excited mode and +ve sign indicates the over-excited mode.

Grid/Network Voltage (U4) level [G248]

Grid/Network voltage (U4) level at which specified Q4 is supplied.

	G248 Stp	U4 110%
Default:	110%	
Range:	0% - 120%	

Filter Time Constant On Grid/Network Voltage Measurement [G249]

Grid/Network voltage measurement used for Q(U) support has a first order filter. Time constant for that first order filter can be configured here. This is common time constant for all the voltage levels i.e. U1, U2, U3 and U4.

	G249 Stp	Filt time 3.0s
Default:	3.0s	
Range:	0.0s - 60.0s	

Minimum Allowed Displacement Power Factor in Q(U) mode [G24A]

Minimum allowed displacement power factor in Q(U) mode at AFR/AFG connection terminals. It limits the Q-reference in order to not allow the displacement power factor to go below the value specified in this menu.

G24A CosΦ min Stp 0.01	
Default:	0.01
Range:	0.01s - 1.00s

Lock-In Active Power Level [G24B]

Q(U) mode is turned on if the actual active power of AFR/AFG is higher than the value set in this menu.

G24B P lock In Stp 10%	
Default:	10%
Range:	0 = Off 1% - 100%

Lock-Out Active Power Level [G24C]

Q(U) mode is turned off if the actual active power of AFR/AFG is lower than the value set in this menu.

G24C P lock Out Stp 0%	
Default:	0%
Range:	0% - 100%

NOTE:

Setting 0 (off) in [G24B] turns off the lock-in and lock out function for Q (U).

NOTE:

Hysteresis between lock-in and lock-out is available only if lock-in is higher than the lock-out value. In that cases, the difference between lock-in and lock-out acts as a hysteresis.

CosΦ control as a function of grid voltage CosΦ(U) [G25]

AFR/AFG can support grid/network voltage in the event of grid/network voltage variations by providing or consuming the reactive power. For that, displacement power factor (CosΦ) at the terminals of AFR/AFG can be configured as a function of grid/network measured voltage. Characteristics of displacement power factor (CosΦ) as a function of measured grid/network voltage can be configured using four configurable points. For details read section Reactive power (Q) support, section 7.17.2, page 41. In this menu, settings related CosΦ -U characteristic curve can be configured.

Displacement power factor (CosΦ1) At Voltage level (U1) [G251]

Desired displacement power factor (CosΦ1) at measured grid/network voltage (U1) level.

G251 CosΦ1 Stp 0.90	
Default:	0.90
Range:	-1.00 - 1.00

NOTE:

-ve CosΦ1 value in [G251] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Grid/Network Voltage (U1) level [G252]

Grid/Network voltage (U1) level at which specified CosΦ1 is maintained.

G252 U1 Stp 85%	
Default:	85%
Range:	0%- 120%

Displacement power factor (CosΦ2) At Voltage level (U2) [G253]

Desired displacement power factor (CosΦ2) at measured grid/network voltage (U2) level.

G253 CosΦ2 Stp 0.95	
Default:	0.95
Range:	-1.00 - 1.00

NOTE:

-ve CosΦ2 value in [G253] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Grid/Network Voltage (U2) level [G254]

Grid/Network voltage (U2) level at which specified $\cos\Phi_2$ is maintained.

	G254 U2 Stp 95%
Default:	95%
Range:	0%- 120%

Displacement power factor ($\cos\Phi_3$) At Voltage level (U3) [G255]

Desired displacement power factor ($\cos\Phi_3$) at measured grid/network voltage (U3) level.

	G255 CosΦ_3 Stp -0.95
Default:	-0.95
Range:	-1.00 - 1.00

NOTE:

-ve $\cos\Phi_3$ value in [G255] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Grid/Network Voltage (U3) level [G256]

Grid/Network voltage (U3) level at which specified $\cos\Phi_3$ is maintained.

	G256 U3 Stp 105%
Default:	105%
Range:	0%- 120%

Displacement power factor ($\cos\Phi_4$) At Voltage level (U4) [G257]

Desired displacement power factor ($\cos\Phi_4$) at measured grid/network voltage (U4) level.

	G257 CosΦ_4 Stp -0.90
Default:	-0.90
Range:	-1.00 - 1.00

NOTE:

-ve $\cos\Phi_4$ value in [G257] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Grid/Network Voltage (U4) level [G258]

Grid/Network voltage (U4) level at which specified $\cos\Phi_4$ is maintained.

	G258 U4 Stp 110%
Default:	110%
Range:	0%- 120%

Filter Time Constant On Grid/Network Voltage Measurement [G259]

Grid/Network voltage measurement used for $\cos\Phi$ (U) support has a first order filter. Time constant for that first order filter can be configured here. This is common time constant for all the voltage levels i.e. U1, U2, U3 and U4.

	G259 Filt time Stp 3.0sec
Default:	3.0s
Range:	0.0s - 60.0s

Lock-In Active Power Level [G25B]

$\cos\Phi$ (U) mode is turned on if the actual active power of AFR/AFG is higher than the value set in this menu.

	G25B P lock IN Stp 10%
Default:	10%
Range:	0 = Off 1% - 100%

Lock-Out Active Power Level [G25C]

$\cos\Phi$ (U) mode is turned off if the actual active power of AFR/AFG is lower than the value set in this menu.

	G25C P lock Out Stp 0%
Default:	0%
Range:	0% - 100%

NOTE:

Setting 0 (off) in [G25B] turns off the lock-in and lock out function for $\cos\Phi$ (U).

NOTE:

Hysteresis between lock-in and lock-out is available only if lock-in is higher than the lock-out value. In that cases, the difference between lock-in and lock-out acts as a hysteresis.

Q control as a function of feed in active power Q(P) [G26]

AFR/AFG reactive power support can also be configured as a function of feed in active power. Characteristics of the reactive power (Q) support as a function of feed in active power can be configured using four configurable points. For details read section Reactive power (Q) support, section 7.17.2, page 41. In this menu, settings related Q-P characteristic curve can be configured.

Reactive Power (Q1) At Active Power Level (P1) [G261]

Desired reactive power support (Q1) at calculated feed in active power (P1) level.

	G261	Q1
	Stp	10%
Default:	10%	
Range:	-100% - 100%	

NOTE:

-ve Q1 value in [G261] indicates the under excited mode and +ve sign indicates the over-excited mode.

Feed In Active Power level (P1) [G262]

Feed in active power (P1) level at which specified Q1 is supplied.

	G262	P1
	Stp	25%
Default:	25%	
Range:	0% - 100%	

Reactive Power (Q2) At Active Power Level (P2) [G263]

Desired reactive power support (Q2) at calculated feed in active power (P2) level.

	G263	Q2
	Stp	50%
Default:	50%	
Range:	-100% - 100%	

NOTE:

-ve Q2 value in [G263] indicates the under excited mode and +ve sign indicates the over-excited mode.

Feed In Active Power Level (P2) [G264]

Feed in active power (P2) level at which specified Q2 is supplied.

	G264	P2
	Stp	50%
Default:	50%	
Range:	0% - 100%	

Reactive Power (Q3) At Active Power Level (P3) [G265]

Desired reactive power support (Q3) at calculated feed in active power (P3) level.

	G265	Q3
	Stp	40%
Default:	40%	
Range:	-100% - 100%	

NOTE:

-ve Q3 value in [G265] indicates the under excited mode and +ve sign indicates the over-excited mode.

Feed In Active Power Level (P3) [G266]

Feed in active power (P3) level at which specified Q3 is supplied.

	G266	P3
	Stp	75%
Default:	75%	
Range:	0% - 100%	

Reactive Power (Q4) At Active Power Level (P4) [G267]

Desired reactive power support (Q4) at calculated feed in active power (P4) level.

	G267	Q4
	Stp	0%
Default:	0%	
Range:	-100% - 100%	

NOTE:

-ve Q4 value in [G267] indicates the under excited mode and +ve sign indicates the over-excited mode.

Feed In Active Power level (P4) [G268]

Feed in active power (P4) level at which specified Q4 is supplied.

	G268 P4 Stp 100%
Default:	100%
Range:	0% - 100%

Filter Time Constant On Active Power Calculations [G269]

Calculated feed in active power (P) used for Q(P) support has a first order filter. Time constant for that first order filter can be configured here. This is common time constant for all the active power levels i.e. P1, P2, P3 and P4.

	G269 Filt time Stp 3.0s
Default:	3.0s
Range:	0.0s - 60.0s

CosΦ control as a function of feed in active power CosΦ (P) [G27]

Displacement power factor (CosΦ) at the terminals of AFE/ AFG can also be configured as a function of feed in active power. Characteristics of displacement power factor (CosΦ) as a function of feed in active power can be configured using four configurable points. For details read section Reactive power (Q) support, section 7.17.2. In this menu, settings related to CosΦ -P characteristic curve can be configured.

Displacement power factor (CosΦ1) At Active Power Level (P1) [G271]

Desired displacement power factor (CosΦ1) at calculated feed in active power (P1) level.

	G271 CosΦ1 Stp 0.90
Default:	0.90
Range:	-1.00 - 1.00

NOTE:

-ve CosΦ1 value in [G271] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Feed In Active Power level (P1) [G272]

Feed in active power (P1) level at which specified CosΦ1 is maintained.

	G272 P1 Stp 25%
Default:	25%
Range:	0% - 100%

Displacement power factor (CosΦ2) At Active Power Level (P2) [G273]

Desired displacement power factor (CosΦ2) at calculated feed in active power (P2) level.

	G273 CosΦ2 Stp 0.70
Default:	0.70
Range:	-1.00 - 1.00

NOTE:

-ve CosΦ2 value in [G273] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Feed In Active Power level (P2) [G274]

Feed in active power (P2) level at which specified CosΦ2 is maintained.

	G274 P2 Stp 50%
Default:	50%
Range:	0% - 100%

Displacement power factor (CosΦ3) At Active Power Level (P3) [G275]

Desired displacement power factor (CosΦ3) at calculated feed in active power (P3) level.

	G275 CosΦ3 Stp 0.88
Default:	0.88
Range:	-1.00 - 1.00

NOTE:

-ve CosΦ3 value in [G275] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Feed In Active Power level (P3) [G276]

Feed in active power (P3) level at which specified CosΦ3 is maintained.

	G276	P3
	Stp	75%
Default:	75%	
Range:	0% - 100%	

Displacement power factor (CosΦ4) At Active Power level (P4) [G277]

Desired displacement power factor (CosΦ4) at calculated feed in active power (P4) level.

	G277	CosΦ4
	Stp	1.00
Default:	1.00	
Range:	-1.00 - 1.00	

NOTE:

-ve CosΦ4 value in [G277] indicates the under excited (Q-absorbed) mode and +ve sign indicates the over-excited (Q-delivered) mode.

Feed In Active Power level (P4) [G278]

Feed in active power (P4) level at which specified CosΦ4 is maintained.

	G278	P4
	Stp	100%
Default:	100%	
Range:	0% - 100%	

Filter Time Constant On Active Power Calculations [G279]

Calculated feed in active power (P) used for CosΦ(P) support has a first order filter. Time constant for that first order filter can be configured here. This is common time constant for all the active power levels i.e. P1, P2, P3 and P4.

	G279	Filt time
	Stp	3.0s
Default:	3.0s	
Range:	0.0s - 60.0s	

Limiting Reactive Power (Q) [G28]

Settings related to active power threshold level, reactive power limit when active power is below threshold level and priority between active and reactive power are given in this sub-menu.

Active Power (P) Threshold Level [G281]

This is the active power threshold level below which reactive power (Q) is limited according to the limit set in [G282].

	G281	P threshold
	Stp	0%
Default:	0%	
Range:	0%: Functionality is OFF 1% - 100%	

Reactive Power (Q) Limit Below Active Power (P) Threshold level [G282]

Reactive power limit when the active power is below the threshold level [G281] can be configured here.

	G282	Q limit
	Stp	10%
Default:	10%	
Range:	0% - 100%	

Active (P) or Reactive (Q) Power Priority (P/Q) [G283]

AFR/AFG can be configured to prioritize active or reactive power depending upon the requirement. The priority setting defines the AFR/AFG behavior when kVA (or current) limit is reached. When AFR/AFG is configured with active power priority and the kVA (or current) limit is reached, reactive power is reduced to maintain the active power production. Similarly, when AFR/AFG is configured with reactive power priority and the kVA (or current) limit is reached, active power is reduced to maintain the reactive power production.

	G283	Prio P/Q
	Stp	P
Default:	P	
P	0	Active power is prioritized.
Q	1	Reactive power is prioritized.

11.12.3 GC Disturbance [G30]

This menu contains settings related to GC-FRT functions which include UVRT, OVRT, UFRT, OFRT, AID. It also provides settings related to open circuit detection and brake resistor over-load protection. Other than that, normal operation range for AFR/AFG can also be defined in this menu.

GC NormRange [G31]

Operating range (for supply voltage and frequency) for normal continuous operation of AFR/AFG unit can be configured in this menu.

Umin [G311]

Menu for defining the minimum supply voltage required for continuous normal operation of AFR/AFG.

	G311 Stp	Umin 85.0%
Default:	85.0%	
Range:	0.0% - 100.0%	

Umax [G312]

Menu for defining the maximum allowed supply voltage for continuous normal operation of AFR/AFG.

	G312 Stp	Umax 110.0%
Default:	110.0%	
Range:	100.0% - 140.0%	

Fmin [G313]

Menu for defining the minimum supply frequency required for continuous normal operation of AFR/AFG.

	G313 Stp	Fmin 92.0%
Default:	92.0%	
Range:	85.0% - 100.0%	

Fmax [G314]

Menu for defining the maximum allowed supply frequency for continuous normal operation of AFR/AFG.

	G314 Stp	Fmax 108.0%
Default:	108.0%	
Range:	100.0% - 115.0%	

Umaxmax [G315]

Absolute maximum voltage that can be injected/supplied by the AFR/AFG.

	G315 Stp	Umaxmax 125.0%
Default:	125.0%	
Range:	100.0% - 140.0%	

GC dU(FRT) [G32]

This menu contains parameters related to dynamic voltage support during UVRT and OVRT.

NOTE:

BCC and brake resistor is required for UVRT and OVRT functionality if the energy source cannot be controlled.

dU I_{max}(P) [G321]

Maximum active current during FRT. Normalized to AFR/AFG nominal currents.

	G321 Stp	dU I_{max}(P) 100%
Default:	100%	
Range:	0% - 120%	

dU I_{max}(Q) [G322]

Maximum reactive current during FRT. Normalized to AFR/AFG nominal currents.

	G322 Stp	dU I_{max}(Q) 100.0%
Default:	100%	
Range:	0% - 120%	

dU U_{band} [G323]

Voltage insensitivity dead-band.

Voltage steps within the insensitivity dead-band do not activate dynamic voltage support.

	G323 Stp	dU U_{band} 10.0%
Default:	10.0%	
Range:	0.0% - 20.0%	

dU Timemax [G324]

Maximum duration of dynamic voltage support. After this time expires, AFR/AFG then continues the operation corresponding to dynamic support mode I(cont).

G324 dU Timemax Stp Off	
Default:	Off
Range:	0.01s - 300.00s

dU Mode UV [G325]

Dynamic voltage support mode during UVRT.

G325 dU Mode UV Stp I (cont)		
Default:	I(cont)	
I(cont)	0	Continued operation with pre-fault P, Q (to the extent possible).
I(Q)	1	Additional reactive current support with reactive power/current priority.
I(P)	2	Additional reactive current support with active power/current priority.
I(zero)	3	Zero current for momentary cessation.

dU Zero UV [G326]

Voltage threshold level below which zero current UVRT mode is activated (forced) irrespective of mode set in [G325]. Voltage threshold level is normalized to nominal grid voltage.

G326 dU Zero UV Stp 15%	
Default:	15 %
Range:	0% - 100%

dU Mode OV [G327]

Dynamic support mode during OVRT.

G327 dU Mode OV Stp I (cont)		
I(cont)	0	Continued operation with pre-fault P, Q (to the extent possible).
I(Q)	1	Additional reactive current support with reactive power/current priority.
I(P)	2	Additional reactive current support with active power/current priority.
I(zero)	3	Zero current for momentary cessation.

dU Zero OV [G328]

Voltage threshold level above which zero current OVRT mode is activated (forced) irrespective of mode set in [G325]. Voltage threshold level is normalized to nominal grid voltage.

G328 dU Zero OV Stp 120%	
Default:	120%
Range:	100% - 140%

dU K1 [G329]

Gain (K1) for positive sequence reactive current support during voltage disturbance according to EN 50549-2.

G329 dU K1 Stp 2.00	
Default:	2.00
Range:	0.00 - 6.00

dU K2 [G32A]

Gain (K2) for negative sequence reactive current support during voltage disturbance according to EN 50549-2.

G32A dU K2 Stp 0.00	
Default:	0.00
Range:	0.00 - 6.00

Trip UV t1 [G32D]

UVRT trip-curve [1] time.
Selection t1=Off means that UVRT trip area [1] in Fig. 44 is inactivated.

G32D Trip UV t1 Stp 0.25s	
Default:	0.25s
Range:	0.01s - 60.00s

Trip UV U1 [G32E]

UVRT trip-curve [1] voltage. In Fig. 44 UVRT trip area [1] is defined as the area below the horizontal line from [t(fault),U1] to [t1,U1].

G32E Trip UV U1 Stp 0%	
Default:	0%
Range:	0% - 100%

Trip UV t2 [G32F]

UVRT trip-curve [2] time.

In Fig. 44, t2 = Off means that UVRT trip area [2] is inactivated.

G32F Trip UV t2 Stp 3.00s	
Default:	3.00s
Range:	0.01s - 60.00s

Trip UV U2 [G32G]

UVRT trip-curve [2] voltage.

In Fig. 44, UVRT trip area [2] is defined as the area to the right of the linear line from [t1,U1] to [t2,U2] (and if selection t1=Off then area on the right of line from [t2,0] to [t2,U2]).

G32G Trip UV U2 Stp 85%	
Default:	85%
Range:	0% - 100%

Trip OV t1 [G32H]

OVRT trip-curve [1] time.

Selection t1=Off means that OVRT trip area [1] in Fig. 44 is inactivated.

G32H Trip OV t1 Stp 0.10s	
Default:	0.10s
Range:	0.01s - 60.00s

Trip OV U1 [G32I]

OVRT trip-curve [1] voltage.

In Fig. 44, OVRT trip area [1] is defined as the area above the horizontal line from [t(fault),U1] to [t1,U1].

G32I Trip OV U1 Stp 130%	
Default:	130%
Range:	100% - 140%

Trip OV t2 [G32J]

OVRT trip-curve [2] time.

In Fig. 44, t2 = Off means that OVRT trip area [2] is inactivated.

G32J Trip OV t2 Stp 0.10s	
Default:	0.10s
Range:	0.01s - 60.00s

Trip OV U2 [G32K]

OVRT trip-curve [2] voltage.

In Fig. 44, OVRT trip area [2] is defined as the area to the right of the linear line from [t1,U1] to [t2,U2] (and if selection t1=Off then area on the right of line from [t2,140%] to [t2,U2]).

G32K Trip OV U2 Stp 120%	
Default:	120%
Range:	100% - 140%

GC AID [G33]

This menu contain parameters related to anti-islanding detection (AID) settings.

Passive AID [G331]

Enable/disable the passive AID method.

G331 Passive AID Stp Off		
Default:	Off	
Off	0	Disable
On	1	Enable

Active AID [G332]

Enable/disable the active AID method.

G332 Active AID Stp Off		
Default:	Off	
Off	0	Disable
On	1	Enable

NOTE:

Contact local supplier or authorized Emotron service personal if further assistance is required with AID detection.

GC dF(FRT) [G34]

This menu specifies the dynamic frequency support parameters during under frequency rider through (UFRT) and over frequency ride through (OFRT).

Active response to grid frequency reduction typically sets requirement for increasing the AC output power. Therefore, active response during UFRT needs to be handled by the plant energy management control system and not implemented in AFG.

NOTE:

BCC and brake resistor is required for OFRT functionality if the energy source cannot be controlled.

dOF Mode [G341]

Enable/disable the OFRT function according to LFSM-O (limited frequency sensitivity mode - over-frequency).

G341 dOF Mode		
Stp		
Off		
Default:	Off	
Off	0	Disable
On	1	Enable

dOF Fstart [G342]

Frequency at which OFRT function should activate (start) according to LFSM-O.
Normalized to nominal grid frequency.

G342 dOF Fstart		
Stp		
100.4%		
Default:	100.4%	
Range:	100.0% - 110.0%	

dOF tstart [G343]

Delay time before activation (start) of OFRT function according to LFSM-O.

G343 dOF tstart		
Stp		
0.0s		
Default:	0.0s	
Range:	0.0s - 10.0s	

dOF Droop [G344]

Droop (D) for LFSM-O (OFRT) function where $\Delta P = (1/D[G344]) * (F_{start}[G342] - F) / F_{nom}[O12] * P(dOF)$ where P(dOF) corresponds to the actual AC output power at the instant when F reaches Fstart[G342].

G344 dOF Droop		
Stp		
5.0%		
Default:	5.0%	
Range:	2.0% - 12.0%	

dOF Fstop [G345]

Deactivation threshold frequency for LFSM-O (OFRT) function.

NOTE:

The deactivation threshold frequency is disabled if $F_{stop}[G345] \geq F_{start}[G342]$.

G345 dOF Fstop		
Stp		
110.0%		
Default:	110.0%	
Range:	100.0% - 110.0%	

dOF tstop [G346]

Deactivation delay time (if enabled) for LFSM-O (OFRT) function. Off means that the deactivation threshold is disabled.

G346 dOF tstop		
Stp		
Off		
Default:	Off	
Range:	0=Off 0.1s - 600.0s	

t (Rbrake) max [G35]

This menu specifies the thermal limitation of the brake resistor. It specifies the maximum short-term surge duration for the brake resistor.

Off means that the resistor protection is disabled.

An AFG trip is triggered when the resistor on-timer reaches t(Rb)max.

The resistor timer is decremented with a time constant of 5 minutes.

G35 t (Rbrake) max		
Stp		
Off		
Default:	Off	
Range:	0=Off 0.1 - 60.0s	

GC Open CB [G36]

This menu specifies the open-circuit detection parameters.

Open I< [G361]

Current detection level for open circuit.

	G361 Open I< Stp 20.0%
Default:	20.0%
Range:	0.0% - 100.0%

Open Ttrip [G362]

Open circuit detection trip time.

	G362 Open Ttrip Stp 0.02s
Default:	0.02s
Range:	0=Off 0.01s - 0.10s

11.12.4 Grid Monitor [G90]

These menus give the state of grid by presenting measured grid voltages, grid frequency etc. These menus are only read-out menus for reflecting the grid status. On power-up, if PLL's could not lock then the values in these menus start blinking in order to indicate the non-locked PLL's.

Phase Voltages [G91]

Amplitude of phase voltages i.e. U1, U2 and U3.

	G91 U1 U2 U3 Stp 230 230 230V
Unit:	V
Resolution:	1V

Line Voltages [G92]

Amplitude of line voltages i.e. U12, U23 and U31.

	G92 U12 U23 U31 Stp 400 400 400V
Unit:	V
Resolution:	1V

Symmetrical Voltages [G93]

Amplitude of symmetrical voltages i.e. U+, U- and U0.

	G93 U+ U- U0 Stp 230 0 0V
Unit:	V
Resolution:	1V

Grid Frequency [G94]

	G94 F Stp 50.00Hz
Unit:	Hz
Resolution:	0.01Hz

Rate Of Change Of Frequency [G95]

Shows the rate of change of grid frequency.

	G95 dF/dt Stp 0.00Hz/s
Unit:	Hz/s
Resolution:	0.01 Hz/s

Mean Value Of Grid Voltage [G96]

Shows the 10-minute mean value of the grid voltage.

	G96 U(10min) Stp 400.0V
Unit:	V
Resolution:	0.1V

PLL status [G9A]

Shows the status of phase locked loops.

	G9A PLL Status Stp 0011
Resolution:	16-bit Hex-number
Bit wise description:	Internal status bits of the grid monitoring PLLs Bit 0 (LSB): PLL Locked status (1->locked) Bit 1: Reserved for future use. Bit 2: Reserved for future use. Bit 3: Reserved for future use. Bit 5-4: Phase sequence status (1->Pos, 2->Neg) Bit 7-6: Reserved for future use Bit 15-8: Used for FRT status (see FRT spec) *Bit 9-8: UVRT status (1->active, 2-> recovery) *Bit 11-10: OVRT status (1->active, 2-> recovery) *Bit 13-12: AAID status (1->active) *Bit 14: Open-circuit status (1->active) *Bit 15: OFRT status (1->active)

12. Troubleshooting, Diagnoses and Maintenance

12.1 Trips, warnings and limits

In order to protect the AFR/AFG or VSI the principal operating variables are continuously monitored by the system. If one of these variables exceeds the safety limit an error/warning message is displayed. In order to avoid any possibly dangerous situations, the inverter sets itself into a stop Mode called Trip and the cause of the trip is shown in the display.

“Trip”

- The AFR/AFG/VSI stops immediately.
- The Trip relay or output is active (if selected).
- The Trip LED is on.
- The accompanying trip message is displayed.
- The “TRP” status indication is displayed (area D of the display).

Apart from the TRIP indicators there are two more indicators to show that the inverter is in an “abnormal” situation.

“Warning”

- The AFR/AFG/VSI is close to a trip limit.
- The Warning relay or output is active (if selected).
- The Trip LED is flashing.
- The accompanying warning message is displayed in window [722] Warning.
- One of the warning indications is displayed (area F of the display).

“Limits”

- The AFR/AFG/VSI is limiting torque and/or frequency to avoid a trip.
- The Limit relay or output is active (if selected).
- The Trip LED is flashing.
- One of the Limit status indications is displayed (area D of the display).

Table 28 List of trips and warnings

Trip/Warning messages	Selections	Trip (Normal/Soft)	Warning indicators (Area D)
Ext trip	Via DigIn	Normal/Soft	
Comm error	Trip/Off/Warn	Normal/Soft	
Over temp	On	Normal	OT
Over curr F	On	Normal	
Over volt G	On	Normal	
Over volt	On	Normal	
Under voltage	On	Normal	LV

Table 28 List of trips and warnings

LC Level	Trip/Off/Warn Via DigIn	Normal/Soft	LCL
Desat ### *	On	Normal	
DClink error	On	Normal	
Power Fault	On	Normal	
PF ##### *	On	Normal	
Ovolt m cut	On	Normal	
Supply error	On	Normal	
Sup Chk Err	On	Normal	
Sync error	On	Normal	
AutoID error	On	Normal	
Sup F Err	On	Normal	
Sup U Err	On	Normal	
Sensor Err	On	Normal	
GCP 3U>	On/Off	Normal	
GCP 3U>>	On/Off	Normal	
GCP 3U<	On/Off	Normal	
GCP 3U<<	On/Off	Normal	
CGP U+>	On/Off	Normal	
CGP U+<	On/Off	Normal	
CGP U->	On/Off	Normal	
CGP U0>	On/Off	Normal	
CGP Umean>	On/Off	Normal	
CGP Umean<	On/Off	Normal	
GCP U(Q<0)<	On/Off	Normal	
GCP F>	On/Off	Normal	
GCP F>>	On/Off	Normal	
GCP F<	On/Off	Normal	
GCP F<<	On/Off	Normal	
GCP ROCOF	On/Off	Normal	
UVRT	On/Off	Normal	
OVRT	On/Off	Normal	
Passive AID	On/Off	Normal	
Active AID	On/Off	Normal	
Resistor Err	On/Off	Normal	
Open CB	On/Off	Normal	
Rect I Error	Off/Warn		
PLL Not Lock	Off/Warn		

* Refer to Table 29 regarding which Desat or Power Fault is triggered.

NOTE: For VSI refer to the instruction manual for Emotron FDU/VFX.

12.2 Trip conditions, causes and remedial action

The table later on in this section must be seen as a basic aid to find the cause of a system failure and to how to solve any problems that arise. An AC drive is mostly just a small part of a complete AC drive system. Sometimes it is difficult to determine the cause of the failure, although the motor inverter gives a certain trip message it is not always easy to find the right cause of the failure. Good knowledge of the complete drive system is therefore necessary. Contact your supplier if you have any questions.

The AFR/AFG/VSI is designed in such a way that it tries to avoid trips by limiting torque, overvolt etc.

Failures occurring during commissioning or shortly after commissioning are most likely to be caused by incorrect settings or even bad connections.

Failures or problems occurring after a reasonable period of failure-free operation can be caused by changes in the system or in its environment (e.g. wear).

Failures that occur regularly for no obvious reasons are generally caused by Electro-Magnetic Interference. Be sure that the installation fulfils the demands for installation stipulated in the EMC directives. See chapter 8. page 51.

Sometimes the so-called "Trial and error" method is a quicker way to determine the cause of the failure. This can be done at any level, from changing settings and functions to disconnecting single control cables or replacing entire drives.

The Trip Log can be useful for determining whether certain trips occur at certain moments. The Trip Log also records the time of the trip in relation to the run time counter.



WARNING!

If it is necessary to open the AFR/AFG or VSI or any part of the system (motor cable housing, conduits, electrical panels, cabinets, etc.) to inspect or take measurements as suggested in this instruction manual, it is absolutely necessary to read and follow the safety instructions in the manual.

12.2.1 Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc., of or at the motor inverter may only be carried out by personnel technically qualified for the task.

12.2.2 Opening the FDUL/VFXR/ FDUG/VFXG



WARNING!

Always switch the mains voltage off if it is necessary to open the AFR/AFG or VSI and wait at least 7 minutes to allow the capacitors to discharge.



WARNING!

In case of malfunctioning always check the DC-link voltage, or wait one hour after the mains voltage has been switched off, before dismantling the AFR/AFG or VSI for repair.

The connections for the control signals and the switches are isolated from the mains voltage. Always take adequate precautions before opening the AFR/AFG or VSI.

12.2.3 Precautions to take with a connected motor

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always first be disconnected from the AFR/AFG and VSI. Wait at least 5 minutes before continuing.

12.2.4 Autoreset Trip

If the maximum number of Trips during Autoreset has been reached, the trip message hour counter is marked with an "A".

830	OVERVOLT	G
Trp	A	345:45:12

Fig. 94 Autoreset trip

Fig. 94 shows the 3rd trip memory menu [830]: Overvoltage G trip after the maximum Autoreset attempts took place after 345 hours, 45 minutes and 12 seconds of run time.

Table 29 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy
Ext trip	External input (DigIn 1-8) active: - active low function on the input.	- Check the equipment that initiates the external input - Check the programming of the digital inputs DigIn 1-8
Comm error	Error on serial communication (option)	- Check cables and connection of the serial communication. - Check all settings with regard to the serial communication - Restart the equipment including the VSI
Over temp	Heatsink temperature too high: - Too high ambient temperature of the VSI - Insufficient cooling - Too high current - Blocked or stuffed fans	- Check the cooling of the VSI cabinet. - Check the functionality of the built-in fans. The fans must switch on automatically if the heatsink temperature gets too high. At power up the fans are briefly switched on. - Check VSI and motor rating - Clean fans
Over curr F	Current exceeds the peak VSI current: - Too high load - Excessive load change - Soft short-circuit between phases or phase to earth - Poor or loose cable connections	- Check the main supply voltage. - Check on bad line cable connections - Check on bad earth cable connection - Check on water or moisture in the motor housing and cable connections.
Over volt G(enerator)	Too high DC Link voltage	- Check the main supply voltage - Try to take away the interference cause or use other main supply lines.
Over volt (Mains)	Too high DC Link voltage, due to too high mains voltage	- Check the main supply voltage - Try to take away the interference cause or use other main supply lines.
O(ver) volt M(ains) cut		
Under voltage	Too low DC Link voltage: - Too low or no supply voltage - Mains voltage dip due to starting other major power consuming machines on the same line.	- Make sure all three phases are properly connected and that the terminal screws are tightened. - Check that the DC supply voltage is within the limits of the VSI. - Try to use other mains supply lines if dip is caused by other machinery
Desat	Failure in output stage, desaturation of IGBTs	- Check on bad line cable connections - Check on bad earth cable connections - Check on water and moisture in the cabinet and cable connections
Desat U+ *		
Desat U- *		
Desat V+ *		
Desat V- *		
Desat W+ *		
Desat W- *		
Desat BCC *		
DC link error	DC link voltage ripple exceeds maximum level	- Make sure all three phases are properly connected and that the terminal screws are tightened. - Check that the DC supply voltage is within the limits of the VSI. - Try to use other mains supply lines if dip is caused by other machinery.
Power Fault	One of the PF(Power Fault) trips below has occurred, but could not be determined.	- Check the PF errors and try to determine the cause. The trip history can be helpful.
PF Fan Err *	Error in fan module	- Check for clogged air inlet filters in panel door and blocking material in fan module.
PF Curr Err	Error in current balancing: - between different modules. - between two phases within one module.	- Check LCL - filter - Check fuses and line connections
PF Overvolt *	Error in DC - link	- Check LCL - filter. - Check fuses and line connections.

Table 29 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy
PF Comm Err *	Internal communication error	Contact service
PF Int Temp *	Internal temperature too high	Check internal fans
PF Temp Err *	Malfunction in temperature sensor	Contact service
Supply error	No synchronisation current pulse detected	<ul style="list-style-type: none"> - Check mains supply voltage - Check LCL-filter and cables - Check Circuit breaker and main contactor
Sup Chk Err	Actual supply frequency or phase sequence does not correspond to the settings in respective menus [012] and [014].	<ul style="list-style-type: none"> - Check mains supply voltage - Check LCL-filter and cables - Check Circuit breaker and main contactor - Check wiring of the voltage sensor (if "Sync option" is used) - Re-do supply ID-Run.
Sync Error	Overcurrent during synchronisation to supply	<ul style="list-style-type: none"> - Check mains supply voltage - Check LCL-filter and cables - Check Circuit breaker and main contactor - Check supply parameters [011]-[014] - Check if DC-link is not already loaded (check if any load drawing current from DC-link).
AutoID Error	Failure during ID run -Supply could not be identified	<ul style="list-style-type: none"> - Check corresponding Digital Input signal is high if enable signal is set in DigIn setting menu [520].
Sup U Err	Too much deviation in supply voltage.	<ul style="list-style-type: none"> - Check mains supply voltage - Check wiring of synchronization option board (voltage measurement board) if used. - Check if supply/grid voltage fluctuating too much.
Sup F Err	Too much deviation in supply voltage.	<ul style="list-style-type: none"> - Check mains supply voltage - Check wiring of synchronization option board (voltage measurement board) if used. - Check if supply/grid voltage fluctuating too much.
Sensor Err	Supply voltage measurement board is not configured/connected properly.	<ul style="list-style-type: none"> - Check and verify all the required settings for supply voltage measurement board. - Check the wiring connections required for supply voltage measurement board.
GCP 3U>	Monitored grid voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP 3U>>	Monitored grid voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP 3U<	Monitored grid voltage is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP 3U<<	Monitored grid voltage is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.

Table 29 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy
GCP U+>	Monitored positive sequence grid voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP U+<	Monitored positive sequence grid voltage is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP U->	Monitored negative sequence grid voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP U0>	Monitored zero sequence grid voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP Umean>	Monitored 10-minute mean voltage is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP Umean<	Monitored 10-minute mean voltage is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP U(Q<0)<	Monitored grid voltage is lower than the corresponding trip level setting plus the AFR/AFG consuming reactive power from the grid/network at the same time.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP F>	Monitored grid frequency is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP F>>	Monitored grid frequency is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP F<	Monitored grid frequency is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.

Table 29 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy
GCP F<<	Monitored grid frequency is lower than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
GCP ROCOF	Monitored rate of change of grid frequency is higher than the corresponding trip level setting.	<ul style="list-style-type: none"> - Check if the trip level settings are realistic. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid. - Check if supply/grid is stable
UVRT	UVRT trip, i.e. trip area (1 or 2) has been reached.	<ul style="list-style-type: none"> - Check the mains grid supply is within the acceptable operation range of AFR/AFG. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
OVRT	OVRT trip, i.e. trip area (1 or 2) has been reached.	<ul style="list-style-type: none"> - Check the mains grid supply is within the acceptable operation range of AFR/AFG. - Check the mains supply wiring. - Check the connection wiring of supply voltage measurement board. - Check the drive nominal settings are according to the connected supply/grid.
Passive AID	AID trip from passive detection.	<ul style="list-style-type: none"> - Check the mains cable connection of AFR/AFG to grid is proper. - Check the mains grid supply is within the acceptable operation range of AFR/AFG.
Active AID	AID trip from active detection.	<ul style="list-style-type: none"> - Check the mains cable connection of AFR/AFG to grid is proper. - Check the mains grid supply is within the acceptable operation range of AFR/AFG.
Resistor Err	Brake resistor protection trip.	<ul style="list-style-type: none"> - Contact authorized service team.
Open CB	Open circuit detected	<ul style="list-style-type: none"> - An open main circuit breaker, possibly triggered by relay protection on the primary side (medium voltage side) of the plant transformer. Check if the main circuit breaker is opened.
Rect I Error	AFR/AFG cannot be started as the DC-link is already loaded. This protection is active when supply voltage measurement board is not used.	<ul style="list-style-type: none"> - Check if there is a load connected to the DC-link of AFR/AFG.
PLL Not Lock	AFR/AFG is waiting for the PLL to be locked (PLL not ready yet).	<ul style="list-style-type: none"> - Check setup (AnIn settings) for SVMB is correct. - Check supply (power) wires are connected properly to SVMB. - Check the supply sequence to AFR/AFG and to SVMB is same. - Wait for the PLL to be locked.

* = 2...6 Module number if parallel power units (size 300–1500 A)

NOTE:

For VSI refer to the Instruction manual for Emotron FDU/VFX.

12.3 Maintenance

The AC drive is designed to require minimum of servicing and maintenance. There are however some things which must be checked regularly in order to optimise product life time.

- Keep the AC drive unit clean and cooling efficient (clean air inlets, heatsink profile, parts, components, etc)
- There is an internal fan that should be inspected and cleaned from dust if necessary.
- If AC drives are built into cabinets, also check and clean the dust filters of the cabinets regularly.
- Check external wiring, connections and control signals.
- Check tightening of all terminal screws regularly, especially important are power and motor cable connections

Preventive maintenance can optimise the product life time and secure trouble free operation without interruptions.

For more information on maintenance, please contact your CG Drives & Automation service partner.

Precautions to take with a connected motor

NOTE:

Refer to motor manufacturers instruction manual for motor maintenance requirements.

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always first be disconnected from the drive unit.

If your drive is connected to a PMSM (Permanent magnet motor) it is most important that you also disconnect the motor before performing any maintenance on the drive unit.

**WARNING!**

Do not work on a drive when a rotating PMSM- permanent magnet motor is connected to it.

A rotating PMSM motor energizes the drive including its power terminals.

13. Options

13.1 Supply voltage measurement board (SVMB)

Part number	Description
01-5178-00	Supply voltage measurement board ver.1
01-5178-50	Supply voltage measurement board ver.1 with coated board.
01-6681-00	Supply voltage measurement board ver.2
01-6681-50	Supply voltage measurement board ver.2 with coated board.

The Voltage measurement board monitors the grid voltage and provides useful information to the frontend. This option can improve the starting of the active frontend and allows the AFR/VFXR/FDUL to withstand the momentary dips in the supply voltage. The voltage measurement board can also be useful for synchronizing the AFE to the grid during the case when VSI is loaded. Without this board there can be problems in synchronizing to the grid if VSI is heavily loaded.

SVMB ver.2 is mandatory for AFG (grid code) functionality.

13.2 Liquid cooling

AC drive modules in frame sizes E - O and F69 - T69 are available in a liquid cooled version. These units are designed for connection to a liquid cooling system, normally a heat exchanger of liquid-liquid or liquid-air type. Heat exchanger is not part of the liquid cooling option.

Drive units with parallel power modules (frame size G - T69) are delivered with a dividing unit for connection of the cooling liquid. The drive units are equipped with rubber hoses with leak-proof quick couplings.

The Liquid cooling option is described in a separate manual.

13.3 I/O Board

Part number	Description
01-3876-01	I/O option board 2.0

Each I/O option board 2.0 provides three extra relay outputs and three extra isolated digital inputs (24V). The I/O Board works in combination with the Pump/Fan Control, but can also be used as a separate option. Maximum 3 I/O boards possible. This option is described in a separate manual.

13.4 Brake chopper

It is required to use brake resistor with AFR/AFG if AFR/AFG will be used for a limited regeneration. In this case part of the energy goes back to the grid and remaining part of the energy burns across the brake resistor. The brake resistor must be mounted outside the drive. The choice of the resistor depends on the application switch-on duration and duty-cycle. This option can not be after mounted..



WARNING!

The table gives the minimum values of the brake resistors. Do not use resistors lower than this value. The AC drive can trip or even be damaged due to high braking currents.

The following formula can be used to define the power of the connected brake resistor:

$$P_{\text{resistor}} = \frac{(\text{Brake level } V_{\text{DC}})^2}{R_{\text{min}}} \times \text{ED}$$

Where:

P_{resistor} required power of brake resistor

Brake level V_{DC} is the DC brake voltage level (see Table 30)

R_{min} minimum allowable brake resistor (see Table 31 and Table 32)

ED effective braking period. Defined as:

$$\text{ED} = \frac{t_{\text{br}}}{120 [\text{s}]}$$

t_{br} Active braking time at nominal braking power during a 2 minute operation cycle.

Maximum value of ED = 1, meaning continuous braking.

Table 30

Supply voltage (V_{AC}) (set in menu [21B])	Brake level (V_{DC})
220-240	380
380-415	660
440-480	780
500-525	860
550-600	1000
660-690	1150

NOTE: This instruction manual provides help only if brake resistor is to be mounted on AFR/AFG unit. Please consult standard FDU/VFX instruction manual if brake resistor is to be connected on VSI side of FDUL/VFXR/FDUG/VFXG.

Table 31 Brake resistor AFR/AFG46 V types

Type	Rmin [ohm] if supply 380–415 V _{AC}	Rmin [ohm] if supply 440–480 V _{AC}
-175	3.8	4.4
-250	2.7	3.1
-375	2 x 3.8	2 x 4.4
-500	2 x 2.7	2 x 3.1
-750	3 x 2.7	3 x 3.1
-1K0	4 x 2.7	4 x 3.1
-1K5	6 x 2.7	6 x 3.1

Table 32 Brake resistor AFR/AFG69 V types

Type	Rmin [ohm] if supply 500–525 V _{AC}	Rmin [ohm] if supply 550–600 V _{AC}	Rmin [ohm] if supply 660–690 V _{AC}
-175	4.9	5.7	6.5
-350	2 x 4.9	2 x 5.7	2 x 6.5
-525	3 x 4.9	3 x 5.7	3 x 6.5
-700	4 x 4.9	4 x 5.7	4 x 6.5
-1K05	6 x 4.9	6 x 5.7	6 x 6.5

NOTE: Although the AC drive will detect a failure in the brake electronics, the use of resistors with a thermal overload which will cut off the power at overload is strongly recommended.

The brake chopper option is built-in by the manufacturer and must be specified when the AC drive is ordered.

13.5 EmoSoftCom

EmoSoftCom is an optional software that runs on a personal computer. It can also be used to load parameter settings from the AC drive to the PC for backup and printing. Recording can be made in oscilloscope mode. Please contact CG Drives & Automation sales for further information.

13.6 Control panel

Control panel with a 4-line display.

Part number		Description
IP54	IP20/21	
01-6520-00	01-6521-00	4-line PPU (standard)
01-6520-10	01-6521-10	4-line PPU with Bluetooth (optional)

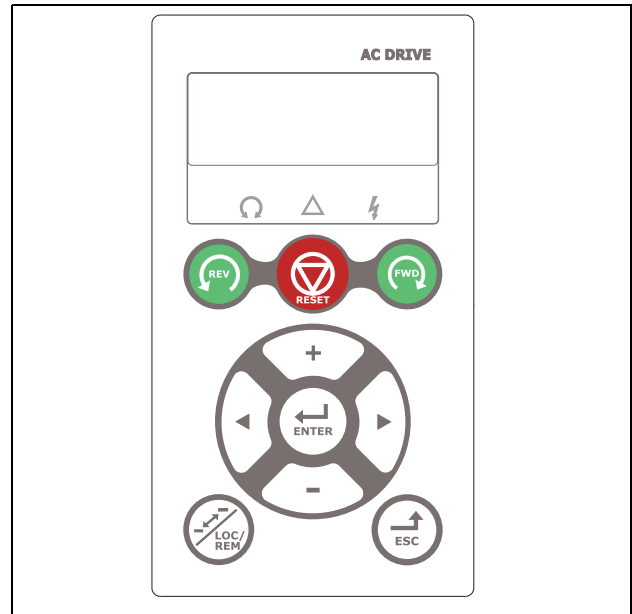


Fig. 95 Control panel with 4-line display.

The display is back lit and consists of 4 rows, each with space for 20 characters. The Control panel is equipped with real time clock function. This means that actual date and time will be shown at e.g. a trip condition. There is also an optional Control panel with Bluetooth communication available for connection with cellphone or tablet.

13.7 External control panel kits (4-line)

13.7.1 Control panel kit, including blank panel

Part number	Description
01-6878-40	Control panel kit (size B)
01-6879-40	Control panel kit (size C)
01-6880-40	Control panel kit (size D and up)



Fig. 96 Control panel kit, including blank panel.

External control panel IP54 suitable for mounting on a cabinet door. This option is to be used in combination with an AC drive module ordered with a built-in control panel.

13.7.2 Control panel kit, including control panel

Part number	Description
01-6878-00	Standard PPU (size B)
01-6878-10	PPU with Bluetooth (size B)
01-6879-00	Standard PPU (size C)
01-6879-10	PPU with Bluetooth (size C)
01-6880-00	Standard PPU (size D and up)
01-6880-10	PPU with Bluetooth (size D and up)



Fig. 97 Control panel kit, including control panel.

External control panel IP54 suitable for mounting on a panel door. This option is to be used in combination with an AC drive module ordered with a blank control panel.

13.8 External control panel options (2-line)

Part number	Description
01-3957-00	Panel kit complete including 2-line panel (2-line PPU)
01-3957-01	Panel kit complete including blank panel

Mounting cassette, blank panel and straight RS232-cable are available as options for the control panel. These options may be useful, for example for mounting a control panel in a cabinet door.

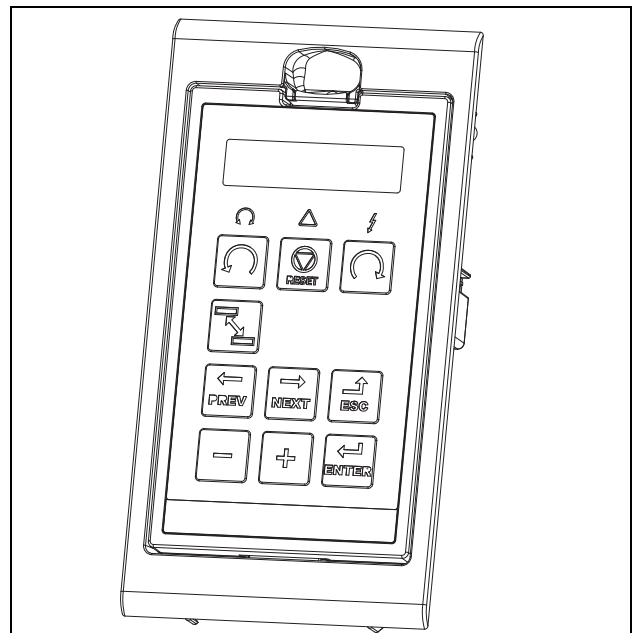


Fig. 98 Control panel in mounting cassette

13.9 Standby supply board option

Part number	Description
01-3954-00	Standby power supply kit for after mounting. Not for frame sizes D & D2

The standby supply board option provides the possibility of keeping the communication system up and running without having the 3-phase mains connected. One advantage is that the system can be set up without mains power. The option will also give backup for communication failure if main power is lost.

The standby supply board option is supplied with external $\pm 10\%$ 24 V_{DC} protected by a 2 A slow acting fuse, from a double isolated transformer. The terminals X1:1, X1:2 (on size E to F) are voltage polarity independent.

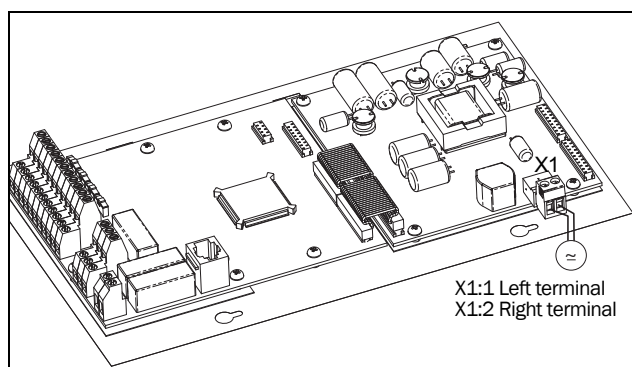


Fig. 99 Connection of standby supply option on frame sizes E, E2, F and F2.

X1 terminal	Name	Function	Specification
1	Ext. supply 1	External, AC drive main power independent, supply voltage for control and communication circuits	24 V _{DC} or V _{AC} $\pm 10\%$ Double isolated
2	Ext. supply 2		

14. Technical Data

14.1 Electrical and mechanical specifications related to model

14.1.1 Emotron VFXR/FDUL

Table 33 VFXR/FDUL typical motor power at mains voltage 400 V and 460 V (refer also to the instruction manual for Emotron VFXF/DFU)

VFXR/FDUL Model	Max output current I _{max} [A]*	Normal duty 120%, 1 min every 10 min			Heavy duty 150%, 1 min every 10 min			Frame	Dimensions Height=2,250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)	Weight kg (lbs)	AFR model
		Rated current I _{nom} [A]	Power @400 V [kW]	Power @460 V [HP]	Rated current I _{nom} [A]	Power @400 V [kW]	Power @460 V [HP]				
46-109	131	109	55	75	87	45	60	E46+E=G	800 (31.5)	380 (836)	AFR46-175
46-146	175	146	75	100	117	55	75	E46+E=G	800 (31.5)	400 (880)	AFR46-175
46-175	210	175	90	125	140	75	100	E46+E=G	900 (35.4)	480 (1056)	AFR46-175
46-210	252	210	110	150	168	90	125	F46+F=H	900 (35.4)	500 (1100)	AFR46-250
46-250	300	250	132	200	200	110	150	F46+F=H	900 (35.4)	500 (1100)	AFR46-250
46-300	360	300	160	250	240	132	200	F46+H=I	1300 (51.2)	700 (1540)	AFR46-250
46-375	450	375	200	300	300	160	250	G46 +G	1500 (59.1)	750 (1650)	AFR46-375
46-430	516	430	220	350	344	200	250	G46+H	1500 (59.1)	830 (1826)	AFR46-375
46-500	600	500	250	400	400	220	350	H46+H	1500 (59.1)	880 (1936)	AFR46-500
46-600	720	600	315	500	480	250	400	H46+I	1900 (74.8)	1040 (2288)	AFR46-500
46-650	780	650	355	550	520	315	400	I46+I	2200 (86.6)	1210 (2662)	AFR46-750
46-750	900	750	400	600	600	355	500	I46+I	2200 (86.6)	1210 (2662)	AFR46-750
46-860	1032	860	450	700	688	400	550	I46+J	2500 (98.4)	1370 (3014)	AFR46-750
46-1K0	1200	1000	560	800	800	450	650	J46+J	3000 (118.1)	1600 (3527)	AFR46-1K0
46-1K2	1440	1200	630	900	960	500	750	J46+KA	3300 (129.9)	1700 (3748)	AFR46-1K0
46-1K5	1800	1500	800	1250	1200	630	1000	K46+K	4500 (177.2)	2250 (4960)	AFR46-1K5
46-1K75	2100	1750	900	1500	1400	800	1200	K46+L	On request		AFR46-1K5

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

Table 34 VFXR/FDUL typical motor power at mains voltage 575 V and 690 V

VFXR/ FDUL Model	Max output current I _{max} [A]*	Normal duty 120%, 1 min every 10 min			Heavy duty 150%, 1 min every 10 min			Frame	Dimensions Height=2,250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)	Weight kg (lbs)	AFR model
		Rated current I _{nom} [A]	Power @690 V [kW]	Power @575 V [HP]	Rated current I _{nom} [A]	Power @690 V [kW]	Power @575 V [HP]				
69-109	131	109	110	100	87	90	75	F69+F69=H69	800 (31.5)	410 (902)	AFR69-175
69-146	175	146	132	125	117	110	100	F69+F69=H69	800 (31.5)	430 (946)	AFR69-175
69-185	222	185	160	150	148	132	125	F69+F69=H69	900 (35.4)	540 (1188)	AFR69-175
69-250	300	250	250	250	200	200	200	H69+H69	1,800 (70.9)	870 (1914)	AFR69-350
69-300	360	300	315	300	240	250	250	H69+H69	1,800 (70.9)	870 (1914)	AFR69-350
69-375	450	375	355	350	300	315	300	H69+H69	1,800 (70.9)	910 (2002)	AFR69-350
69-430	516	430	450	400	344	355	350	I69+I69	2,800 (110.2)	1350 (2970)	AFR69-525
69-560	672	560	560	600	448	450	400	I69+I69	2,800 (110.2)	1390 (3058)	AFR69-525
69-749	900	750	710	750	600	600	600	J69+J69	On request		AFR69-700
69-995	1200	1000	1000	1000	800	800	850	K69+KA69	On request		AFR69-1K05
69-1K12	1344	1120	1100	1200	896	900	950	K69+K69	On request		AFR69-1K05

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

14.1.2 Emotron VFXG/FDUG

Contact Emotron sales for further information.

14.1.3 Emotron AFR

Table 35 AFR46 Typical output DC power at mains voltage 400 V and 460V.

Model	Max input current I _{max} [A]*	Normal duty 120%, 1 min every 10 min			Frame	Dimensions Height=2,250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)	Weight kg (lbs)
		Rated input current I _{nom} [A]	Output DC power @400 V AC [kW]	Output DC power @460 V AC [HP]			
AFR46-175	210	175	115	177	E46	600 (23.6)	290 (638)
AFR46-250	300	250	165	254	F46	800 (31.5)	400 (880)
AFR46-375	450	375	250	385	G46	1000 (39.4)	560 (1232)
AFR46-500	600	500	330	508	H46	1200 (47.2)	660 (1452)
AFR46-750	900	750	500	770	I46	1500 (59.1)	830 (1826)
AFR46-1K0	1200	1000	660	1017	J46	1800 (70.9)	1100 (2425)
AFR46-1K5	1800	1500	1000	1541	K46	2700 (106.3)	1600 (3527)

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

Table 36 AFR69 typical output DC power at mains voltage 575 V and 690 V.

Model	Max input current I _{max} [A]*	Normal duty 120%, 1 min every 10 min			Frame	Dimensions Height=2,250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)	Weight kg (lbs)
		Rated input current I _{nom} [A]	Output DC power @690 V AC [kW]	Output DC power @575 V AC [HP]			
AFR69-175	210	175	200	223	F69	800 (31.5)	320 (704)
AFR69-350	420	350	400	446	H69	1,200 (47.2)	590 (1298)
AFR69-525	630	525	600	670	I69	1,700 (66.9)	860 (1892)
AFR69-700	840	700	800	893	J69	On request	
AFR69-1K05	1260	1050	1200	1340	K69	On request	

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

14.1.4 Emotron AFG

Table 37 AFG46 Typical output DC power at mains voltage 400V.

Model	Max input current I _{max} [A]* @400 V AC	Normal duty 120%, 1 min every 10 min		Frame (IP20 stacked)	Dimensions Height=2.250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)
		Rated input current I _{nom} [A] @400 V AC	Output power @400 V AC @ 0.9 DPF [kW]**		
AFG46-109	131	109	68	E (single)	600 (23.6)
AFG46-175	210	175	110	E (single)	600 (23.6)
AFG46-250	300	250	156	F (single)	600 (23.6)
AFG46-350	420	350	220	G	800 (31.5)
AFG46-500	600	500	312	H	1000 (39.4)
AFG46-750	900	750	468	I	1200 (47.2)
AFG46-1K0	1200	1000	624	J	1800 (70.9)
AFG46-1K5	1800	1500	936	K	2400 (94.5)

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

**) Power given is at 0.9 displacement power factor. At unity power displacement factor, higher output power can be achieved accordingly.

**) For 460V AC supply, same output power available with reduced current capability.

Table 38 AFG69 Typical output power at mains voltage 690 V.

Model	Max input current I _{max} [A]* @690 V AC	Normal duty 120%, 1 min every 10 min		Frame (IP20 stacked)	Dimensions Height=2,250 mm (88.6 in) Depth=600 mm (23.6 in) Width mm (inches)
		Rated input current I _{nom} [A] @690 V AC	Output power @690 V AC [kW] **		
AFG69-146	175	146	156	F69 (single)	600 (23.6)
AFG69-292	350	292	312	H69	1000 (39.4)
AFG69-438	525	438	468	I69	1200 (47.2)
AFG69-584	700	584	624	J69	1800 (70.9)
AFG69-876	1050	876	936	K69	2400 (94.5)

Assembled in IP54 cabinet including main switch + main contactor or motorized circuit breaker.

*) Available for a limited time and as long as drive temperature permits.

**) Power given is at 0.9 displacement power factor. At unity power displacement factor, higher output power can be achieved accordingly.

14.2 General electrical specifications

Table 39 General electrical specifications

General	
Mains voltage:	VFXR46/FDUL46/VFXG46/FDUG46/AFR46/AFG46 VFXR69/FDUL69/VFXG69/FDUG69/AFR69/AFG69
Mains frequency:	380 - 460 V +10%/-15% 480 - 690 V +10%/-15%
Input total power factor:	48 to 52Hz and 58 to 62Hz
Output voltage	1.0 (0 - 1.2) * Mains supply voltage (V AC)
Output voltage	(1.0 - 1.2) * $\sqrt{2}$ * Mains supply voltage (V DC)
Switching frequency:	VFXR/FDUL46, VFXG/FDUG46 and VFXR/FDUL69, VFXG/FDUG69 AFR46/AFR69 AFG46/AFG69
Efficiency at nominal load	3 kHz (adjustable 1.5 - 6 kHz, FDUL only) 3 kHz 3150 *Main frequency/50
Harmonics to supply, THDI	97% 98% < 5%
Control signal inputs: Analogue (differential)	
Analogue Voltage/current:	0-±10 V/0-20 mA via switch
Max. input voltage:	+30 V/30 mA
Input impedance:	20 k Ω (voltage) 250 Ω (current)
Resolution:	11 bits + sign
Hardware accuracy:	1% type + 1½ LSB fsd
Non-linearity	1½ LSB
Digital:	
Input voltage:	High: >9 V DC, Low: <4 V DC
Max. input voltage:	+30 V DC
Input impedance:	<3.3 V _{DC} : 4.7 k Ω ≥3.3 V _{DC} : 3.6 k Ω
Signal delay:	≤8 ms
Control signal outputs Analogue	
Output voltage/current:	0-10 V/0-20 mA via software setting
Max. output voltage:	+15 V @5 mA cont.
Short-circuit current (∞):	+15 mA (voltage), +140 mA (current)
Output impedance:	10 Ω (voltage)
Resolution:	10 bit
Maximum load impedance for current	500 Ω
Hardware accuracy:	1.9% type fsd (voltage), 2.4% type fsd (current)
Offset:	3 LSB
Non-linearity:	2 LSB
Digital	
Output voltage:	High: >20 V DC @50 mA, >23 V DC open Low: <1 V DC @50 mA
Shortcircuit current(∞):	100 mA max (together with +24 V DC)
Relays	
Contacts	0.1 - 2 A/U _{max} 250 VAC or 42 V _{DC}
References	
+10 V DC -10 V DC +24 V DC	+10 V DC @10 mA Short-circuit current +30 mA max -10 V DC @10 mA +24 V DC Short-circuit current +100 mA max (together with Digital Outputs)

14.3 Operation at higher temperatures

All Emotron AFE units are made for operation at maximum of 40 °C (104 °F) ambient temperature. However it is possible to use the AFE units at higher temperatures with some loss in performance, using derating.

Derating of output current with - 2,5% per degree Celsius to max +5 °C or -1,39% per degree Fahrenheit to max 9 °F.

Max temp = 45 °C (113 °F).

14.4 Environmental conditions

Table 40 Operation

Parameter	Normal operation
Nominal ambient temperature	0°C–40 °C (32 °F - 104 °F) See Chapter 14.3, for different conditions
Atmospheric pressure	86–106 kPa (12.5 - 15.4 PSI)
Relative humidity, non-condensing	0–90%
Contamination, according to IEC 60721-3-3	No electrically conductive dust allowed. Cooling air must be clean and free from corrosive materials. Chemical gases, class 3C2 (Coated boards 3C3). Solid particles, class 3S2.
Vibrations	According to IEC 60068-2-6, Sinusoidal vibrations: 10<f<57 Hz, 0.075 mm (0.00295 ft) 57<f<150 Hz, 1g (0.035 oz)
Altitude	0–1,000 m (0 - 3280 ft) 460 V AFE units, with derating 1%/100 m (328 ft) of rated current up to 4,000 m (13123 ft). 690 V AFE units, with derating 1%/100 m (328 ft) of rated current up to 2,000 m (6562 ft). Coated boards required for 2000 - 4000 m (6562 - 23123 ft)

Table 41 Storage

Parameter	Storage condition
Temperature	-20 to +60 °C (-4 to +140 °F)
Atmospheric pressure	86–106 kPa (12.5 - 15.4 PSI)
Relative humidity according to IEC 60721-3-1	Class 1K4, max. 95% and non condensing and no formation of ice.

14.5 Control signals

Table 42

Terminal X1	Name:	Function (Default):	Signal:	Type:
1	+10 V	+10 VDC Supply voltage	+10 V DC, max 10 mA	output
2	AnIn1	Process reference	0 -10 V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
3	AnIn2	AFR: Off AFG: U(L1)	0 -10 V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
4	AnIn3	AFR: Off AFG: U(L2)	0 -10 V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
5	AnIn4	AFR: Off AFG: U(L3)	0 -10V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
6	-10 V	-10VDC Supply voltage	-10 V DC, max 10 mA	output
7	Common	Signal ground	0V	output
8	DigIn 1	RunL (Fixed)	0-8/24 V DC	digital input
9	DigIn 2	RunR (Fixed)	0-8/24 V DC	digital input
10	DigIn 3	Enable	0-8/24 V DC	digital input
11	+24 V	+24VDC Supply voltage	+24 V DC, 100 mA	output
12	Common	Signal ground	0 V	output
13	AnOut 1		0 ±10 V DC or 0/4– +20 mA	analogue output
14	AnOut 2	0 to max torque	0 ±10 V DC or 0/4– +20 mA	analogue output
15	Common	Signal ground	0 V	output
16	DigIn 4	Off	0-8/24 V DC	digital input
17	DigIn 5	Off	0-8/24 V DC	digital input
18	DigIn 6	Off	0-8/24 V DC	digital input
19	DigIn 7	Off	0-8/24 V DC	digital input
20	DigOut 1	LY, Active when AFE is not running or Dc-link voltage has not reached reference value.	24 V _{DC} , 100 mA	digital output
21	DigOut 2	LZ (trip pulse of 1s)	24 V _{DC} , 100 mA	digital output
22	DigIn 8	RESET	0-8/24 VDC	digital input
Terminal X2				
31	N/C 1	Relay 1 output Dedicated for Charge Relay contactor K2.	potential free change over 0.1 – 2 A/U _{max} 250 V AC or 42 V DC	relay output
32	COM 1			
33	N/O 1			
41	N/C 2	Relay 2 Output LY, Active when AFE is not running or Dc-link voltage has not reached reference value.	potential free change over 0.1 – 2 A/U _{max} 250 V AC or 42 V DC	relay output
42	COM 2			
43	N/O 2			
Terminal X3				
51	COM 3	Relay 3 Output, Dedicated for Main Contactor K1	potential free change over 0.1 – 2 A/U _{max} 250 V AC or 42 V DC	relay output
52	N/O 3			

15. Menu List and communication information

This is a list of the menu parameters and their factory settings, along with communication settings for the most important bus formats. Complete lists with communication data and parameter set information could be downloaded from www.cgglobal.com or www.emotron.com.

Menu Parameters	Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
100	Preferred View							69	
110	1st Line	Current	43001	168/160	4BB9	19385	UInt	71	
120	2nd Line	Torque	43002	168/161	4BBA	19386	UInt	71	
130	3rd Line	Frequency	43003	168/162	4BBB	19387	UInt	71	
140	4th Line	AFR Status	43004	168/163	4BBC	19388	UInt	71	
150	5th Line	DC Voltage	43005	168/164	4BBD	19389	UInt	71	
160	6th Line	IGBT Temp	43006	168/165	4BBE	19390	UInt	71	
170	View mode	Normal 100	43007	168/166	4BBF	19391	UInt	72	
200	Main Setup							72	
210	Operation							72	
211	Language	English	43011	168/170	4BC3	19395	UInt	72	
214	Ref Control	Keyboard	43014	168/173	4BC6	19398	UInt	72	
215	Run/Stp Ctrl	Keyboard	43015	168/174	4BC7	19399	UInt	73	
216	Reset Ctrl	Remote+Keyb	43016	168/175	4BC8	19400	UInt	73	
217	Local/Rem							73	
2171	LocRefCtrl	Standard	43009	168/168	4BC1	19393	UInt	73	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
2172	LocRunCtrl	Standard	43010	168/169	4BC2	19394	UInt	UInt	73	
218	Lock Code?	0	43018	168/177	4BCA	19402	UInt, 1=1	UInt	73	
21A	Level/Edge	Level	43020	168/179	4BCC	19404	UInt	UInt	74	
21B	Supply Volts	Not defined	43381	170/30	4D35	19765	UInt	UInt	74	
240	Set Handling								75	
241	Select Set	A	43022	168/181	4BCE	19406	UInt	UInt	75	
243	Default>Set	A	43023	168/182	4BCF	19407	UInt	UInt	75	
244	Copy to CP	No Copy	43024	168/183	4BD0	19408	UInt	UInt	75	
245	Load from CP	No Copy	43025	168/184	4BD1	19409	UInt	UInt	75	
250	Autoreset								76	
251	No of Trips	0	43071	168/230	4BFF	19455	UInt, 1=1	UInt	76	
252	Overtemp	Off	43072	168/231	4C00	19456	Long, 1=1s	Elnt	76	
253	Overvolt D	Off	43075	168/234	4C03	19459	Long, 1=1s	Elnt	76	
254	Over volt G	Off	43076	168/235	4C04	19460	Long, 1=1s	Elnt	77	
255	Over volt	Off	43077	168/236	4C05	19461	Long, 1=1s	Elnt	77	
258	Power Fault	Off	43087	168/246	4C0F	19471	Long, 1=1s	Elnt	77	
259	Undervoltage	Off	43088	168/247	4C10	19472	Long, 1=1s	Elnt	77	
25C	PT100	Off	43078	168/237	4C06	19462	Long, 1=1s	Elnt	77	
25E	PTC	Off	43084	168/243	4C0C	19468	Long, 1=1s	Elnt	77	
25G	Ext Trip	Off	43080	168/239	4C08	19464	Long, 1=1s	Elnt	77	
25I	Com Error	Off	43089	168/248	4C11	19473	Long, 1=1s	Elnt	77	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
250	Over curr F	Off	43082	168/241	4C0A	19466	Long, 1=1s	Elnt	78	
25Q	Over speed	Off	43096	169/0	4C18	19480	Long, 1=1s	Elnt	78	
25R	Ext Mot Temp	Off	43097	169/1	4C19	19481	Long, 1=1s	Elnt	78	
25T	LC Level	Off	43099	169/3	4C1B	19483	Long, 1=1s	Elnt	78	
260	Serial Com								78	
261	Com Type	RS232/485	43031	168/190	4BD7	19415	UInt	UInt	78	
262	RS232/485								78	
2621	Baudrate	9600	43032	168/191	4BD8	19416	UInt	UInt	78	
2622	Address	1	43033	168/192	4BD9	19417	UInt, 1=1	UInt	79	
263	Fieldbus								79	
2631	Address	62	43034	168/193	4BDA	19418	UInt, 1=1	UInt	79	
2632	PrData Mode	Basic	43035	168/194	4BDB	19419	UInt	UInt	79	
2633	Read/Write	RW	43036	168/195	4BDC	19420	UInt	UInt	79	
2634	AddPrValues	0	43039	168/198	4BDF	19423	UInt, 1=1	UInt	79	
2635	CANBaudrate	8	43030	168/189	4BD6	19414	UInt, 1=1	UInt	79	
264	Com Fault								80	
2641	ComFlt Mode	Off	43037	168/196	4BDD	19421	UInt	UInt	80	
2642	ComFlt Time	0.5 s	43038	168/197	4BDE	19422	Long, 1=0.1s	Elnt	80	
265	Ethernet								80	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
2651	IP Address	0.0.0.0	42701	167/115	4A8D	19085	UInt, 1=1	UInt	80	
			42702	167/116	4A8E	19086	UInt, 1=1	UInt		
			42703	167/117	4A8F	19087	UInt, 1=1	UInt		
			42704	167/118	4A90	19088	UInt, 1=1	UInt		
2652	MAC Address	000000000000	42705	167/119	4A91	19089	UInt, 1=1	UInt	80	
			42706	167/120	4A92	19090	UInt, 1=1	UInt		
			42707	167/121	4A93	19091	UInt, 1=1	UInt		
			42708	167/122	4A94	19092	UInt, 1=1	UInt		
			42709	167/123	4A95	19093	UInt, 1=1	UInt		
			42710	167/124	4A96	19094	UInt, 1=1	UInt		
2653	Subnet Mask	0.0.0.0	42711	167/125	4A97	19095	UInt, 1=1	UInt	80	
			42712	167/126	4A98	19096	UInt, 1=1	UInt		
			42713	167/127	4A99	19097	UInt, 1=1	UInt		
			42714	167/128	4A9A	19098	UInt, 1=1	UInt		
2654	Gateway	0.0.0.0	42715	167/129	4A9B	19099	UInt, 1=1	UInt	80	
			42716	167/130	4A9C	19100	UInt, 1=1	UInt		
			42717	167/131	4A9D	19101	UInt, 1=1	UInt		
			42718	167/132	4A9E	19102	UInt, 1=1	UInt		
2655	DHCP	Off	42719	167/133	4A9F	19103	UInt	UInt	80	
266	FB Signal								81	
2661	FB Signal 1	0	42801	167/215	4AF1	19185	UInt, 1=1	UInt	81	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
2662	FB Signal 2	0	42802	167/216	4AF2	19186	UInt, 1=1	UInt	81	
2663	FB Signal 3	0	42803	167/217	4AF3	19187	UInt, 1=1	UInt	81	
2664	FB Signal 4	0	42804	167/218	4AF4	19188	UInt, 1=1	UInt	81	
2665	FB Signal 5	0	42805	167/219	4AF5	19189	UInt, 1=1	UInt	81	
2666	FB Signal 6	0	42806	167/220	4AF6	19190	UInt, 1=1	UInt	81	
2667	FB Signal 7	0	42807	167/221	4AF7	19191	UInt, 1=1	UInt	81	
2668	FB Signal 8	0	42808	167/222	4AF8	19192	UInt, 1=1	UInt	81	
2669	FB Signal 9	0	42809	167/223	4AF9	19193	UInt, 1=1	UInt	81	
266A	FB Signal10	0	42810	167/224	4AFA	19194	UInt, 1=1	UInt	81	
266B	FB Signal11	0	42811	167/225	4AFB	19195	UInt, 1=1	UInt	81	
266C	FB Signal12	0	42812	167/226	4AFC	19196	UInt, 1=1	UInt	81	
266D	FB Signal13	0	42813	167/227	4AFD	19197	UInt, 1=1	UInt	81	
266E	FB Signal14	0	42814	167/228	4AFE	19198	UInt, 1=1	UInt	81	
266F	FB Signal15	0	42815	167/229	4AFF	19199	UInt, 1=1	UInt	81	
266G	FB Signal16	0	42816	167/230	4B00	19200	UInt, 1=1	UInt	81	
269	FB Status								81	
300	Process								81	
310	Q Ref	0%	42991	168/150	4BAF	19375	Long, 1=1 or 1=0.001	EInt	81	
360	Preset Ref								82	
361	Motor Pot	Non Volatile	43131	169/35	4c3b	199515	UInt	UInt	82	
362	Preset Ref 1	0%	43132	169/36	4c3c	199516	Long, 1=1 or 0.01	EInt	82	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
363	Preset Ref 2	0%	43133	169/37	4c3d	199517	Long, 1=1 or 0.01	Elnt	82	
364	Preset Ref 3	0%	43134	169/38	4c3e	199518	Long, 1=1 or 0.01	Elnt	82	
365	Preset Ref 4	0%	43135	169/39	4c3f	199519	Long, 1=1 or 0.01	Elnt	82	
366	Preset Ref 5	0%	43136	169/40	4c40	199520	Long, 1=1 or 0.01	Elnt	82	
367	Preset Ref 6	0%	43137	169/41	4c41	199521	Long, 1=1 or 0.01	Elnt	82	
368	Preset Ref 7	0%	43138	169/42	4c42	199522	Long, 1=1 or 0.01	Elnt	82	
369	Key Ref Mode		43139	169/43	4c43	199523	UInt	UInt	83	
500	I/Os								83	
510	An Inputs								83	
511	AnIn1 Fc	Process Ref	43201	169/105	4C81	19585	UInt	UInt	83	
512	AnIn1 Setup	UserBipol V	43202	169/106	4C82	19586	UInt	UInt	84	
513	AnIn1 Advan								85	
5131	AnIn1 Min	4mA	43203	169/107	4C83	19587	Long, 1=0.01	Elnt	85	
5132	AnIn1 Max	20mA	43204	169/108	4C84	19588	Long, 1=0.01	Elnt	85	
5133	AnIn1 Bipol	20mA	43205	169/109	4C85	19589	Long, 1=0.01	Elnt	86	
5134	AnIn1 FcMin	Min	43206	169/110	4C86	19590	UInt	UInt	86	
5135	AnIn1 VaMin	0.000	43541	170/190	4DD5	19925	Long, 1=1 or 1=0.001	Elnt	86	
5136	AnIn1 FcMax	Max	43207	169/111	4C87	19591	UInt	UInt	86	
5137	AnIn1 VaMax	0	43551	170/200	4DDF	19935	Long, 1=0.001	Elnt	86	
5138	AnIn1 Oper	Add +	43208	169/112	4C88	19592	UInt	UInt	87	
5139	AnIn1 Filt	0.1s	43209	169/113	4C89	19593	Long, 1=0.001s	Elnt	87	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
513A	AnIn1 Enabl	On	43210	169/114	4C8A	19594	UInt	UInt	87	
514	AnIn2 Fc	Off	43211	169/115	4C8B	19595	UInt	UInt	87	
515	AnIn2 Setup	4-20 mA	43212	169/116	4C8C	19596	UInt	UInt	87	
516	AnIn2 Advan								87	
5161	AnIn2 Min	4mA	43213	169/117	4C8D	19597	Long, 1=0.01	Elnt	87	
5162	AnIn2 Max	20mA	43214	169/118	4C8E	19598	Long, 1=0.01	Elnt	87	
5163	AnIn2 Bipol	20mA	43215	169/119	4C8F	19599	Long, 1=0.01	Elnt	87	
5164	AnIn2 FcMin	Min	43216	169/120	4C90	19600	UInt	UInt	87	
5165	AnIn2 VaMin	0	43542	170/191	4DD6	19926	Long, 1=0.001	Elnt	87	
5166	AnIn2 FcMax	Max	43217	169/121	4C91	19601	UInt	UInt	87	
5167	AnIn2 VaMax	0	43552	170/201	4DE0	19936	Long, 1=0.001	Elnt	87	
5168	AnIn2 Oper	Add +	43218	169/122	4C92	19602	UInt	UInt	87	
5169	AnIn2 Filt	0.1s	43219	169/123	4C93	19603	Long, 1=0.001s	Elnt	87	
516A	AnIn2 Enabl	On	43220	169/124	4C94	19604	UInt	UInt	87	
517	AnIn3 Fc	Off	43221	169/125	4C95	19605	UInt	UInt	88	
518	AnIn3 Setup	User V	43222	169/126	4C96	19606	UInt	UInt	88	
519	AnIn3 Advan								88	
5191	AnIn3 Min	4mA	43223	169/127	4C97	19607	Long, 1=0.01	Elnt	88	
5192	AnIn3 Max	20mA	43224	169/128	4C98	19608	Long, 1=0.01	Elnt	88	
5193	AnIn3 Bipol	20mA	43225	169/129	4C99	19609	Long, 1=0.01	Elnt	88	
5194	AnIn3 FcMin	Min	43226	169/130	4C9A	19610	UInt	UInt	88	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
5195	AnIn3 VaMin	0	43543	170/192	4DD7	19927	Long, 1=0.001	EInt	88	
5196	AnIn3 FcMax	Max	43227	169/131	4C9B	19611	UInt	UInt	88	
5197	AnIn3 VaMax	0	43553	170/202	4DE1	19937	Long, 1=0.001	EInt	88	
5198	AnIn3 Oper	Add +	43228	169/132	4C9C	19612	UInt	UInt	88	
5199	AnIn3 Filt	0.1s	43229	169/133	4C9D	19613	Long, 1=0.001s	EInt	88	
519A	AnIn3 Enabl	On	43230	169/134	4C9E	19614	UInt	UInt	88	
51A	AnIn4 Fc	Off	43231	169/135	4C9F	19615	UInt	UInt	88	
51B	AnIn4 Setup	User Bipol V	43232	169/136	4CA0	19616	UInt	UInt	88	
51C	AnIn4 Advan	4mA							88	
51C1	AnIn4 Min	4mA	43233	169/137	4CA1	19617	Long, 1=0.01	EInt	88	
51C2	AnIn4 Max	20mA	43234	169/138	4CA2	19618	Long, 1=0.01	EInt	88	
51C3	AnIn4 Bipol	20mA	43235	169/139	4CA3	19619	Long, 1=0.01	EInt	88	
51C4	AnIn4 FcMin	Min	43236	169/140	4CA4	19620	UInt	UInt	88	
51C5	AnIn4 VaMin	0	43544	170/193	4DD8	19928	Long, 1=0.001	EInt	88	
51C6	AnIn4 FcMax	Max	43237	169/141	4CA5	19621	UInt	UInt	88	
51C7	AnIn4 VaMax	0	43554	170/203	4DE2	19938	Long, 1=0.001	EInt	88	
51C8	AnIn4 Oper	Add +	43238	169/142	4CA6	19622	UInt	UInt	88	
51C9	AnIn4 Filt	0.1s	43239	169/143	4CA7	19623	Long, 1=0.001s	EInt	88	
51CA	AnIn4 Enabl	On	43240	169/144	4CA8	19624	UInt	UInt	88	
520	Dig Inputs								89	
521	DigIn 1	RunL	43241	169/145	4CA9	19625	UInt	UInt	89	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
522	DigIn 2	RunR	43242	169/146	4CAA	19626	UInt	UInt	89	
523	DigIn 3	Enable	43243	169/147	4CAB	19627	UInt	UInt	89	
524	DigIn 4	Off	43244	169/148	4CAC	19628	UInt	UInt	89	
525	DigIn 5	Off	43245	169/149	4CAD	19629	UInt	UInt	89	
526	DigIn 6	Off	43246	169/150	4CAE	19630	UInt	UInt	89	
527	DigIn 7	Off	43247	169/151	4CAF	19631	UInt	UInt	89	
528	DigIn 8	Reset	43248	169/152	4CB0	19632	UInt	UInt	89	
529	B1 DigIn 1	Off	43501	170/150	4DAD	19885	UInt	UInt	89	
52A	B1 DigIn 2	Off	43502	170/151	4DAE	19886	UInt	UInt	90	
52B	B1 DigIn 3	Off	43503	170/152	4DAF	19887	UInt	UInt	90	
52C	B2 DigIn 1	Off	43504	170/153	4DB0	19888	UInt	UInt	90	
52D	B2 DigIn 2	Off	43505	170/154	4DB1	19889	UInt	UInt	90	
52E	B2 DigIn 3	Off	43506	170/155	4DB2	19890	UInt	UInt	90	
52F	B3 DigIn 1	Off	43507	170/156	4DB3	19891	UInt	UInt	90	
52G	B3 DigIn 2	Off	43508	170/157	4DB4	19892	UInt	UInt	90	
52H	B3 DigIn 3	Off	43509	170/158	4DB5	19893	UInt	UInt	90	
530	An Outputs								90	
531	AnOut1 Fc	Current	43251	169/155	4CB3	19635	UInt	UInt	90	
532	AnOut1 Setup	4-20mA	43252	169/156	4CB4	19636	UInt	UInt	91	
533	AnOut1 Advan								91	
5331	AnOut1 Min	4mA	43253	169/157	4CB5	19637	Long, 1=0.01	Elnt	91	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
5332	AnOut1 Max	20.00mA	43254	169/158	4CB6	19638	Long, 1=0.01	Elnt	91	
5333	AnOut1Bipol	20.00mA	43255	169/159	4CB7	19639	Long, 1=0.01	Elnt	91	
5334	AnOut1FcMin	Min	43256	169/160	4CB8	19640	UInt	UInt	92	
5335	AnOut1VaMin	0.000	43545	170/194	4DD9	19929	Long, 1=1 or 1=0.001	Elnt	92	
5336	AnOut1FcMax	Max	43257	169/161	4CB9	19641	UInt	UInt	92	
5337	AnOut1VaMax	0.000	43555	170/204	4DE3	19939	Long, 1=1 or 1=0.001	Elnt	92	
534	AnOut2 Fc	Torque	43261	169/165	4CBD	19645	UInt	UInt	92	
535	AnOut2 Setup	4-20mA	43262	169/166	4CBE	19646	UInt	UInt	93	
536	AnOut2 Advan								93	
5361	AnOut2 Min	4mA	43263	169/167	4CBF	19647	Long, 1=0.01	Elnt	93	
5362	AnOut2 Max	20mA	43264	169/168	4CC0	19648	Long, 1=0.01	Elnt	93	
5363	AnOut2Bipol	20mA	43265	169/169	4CC1	19649	Long, 1=0.01	Elnt	93	
5364	AnOut2FcMin	Min	43266	169/170	4CC2	19650	UInt	UInt	93	
5365	AnOut2VaMin	0	43546	170/195	4DDA	19930	Long, 1=1 or 1=0.001	Elnt	93	
5366	AnOut2FcMax	Max	43267	169/171	4CC3	19651	UInt	UInt	93	
5367	AnOut2VaMax	0	43556	170/205	4DE4	19940	Long, 1=1 or 1=0.001	Elnt	93	
540	Dig Outputs								93	
541	DigOut 1	LY	43271	169/175	4CC7	19655	UInt	UInt	93	
542	DigOut 2	LZ	43272	169/176	4CC8	19656	UInt	UInt	95	
550	Relays								95	
551	Relay 1	Charge relay	43273	169/177	4CC9	19657	UInt	UInt	95	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
552	Relay 2	LY	43274	169/178	4CCA	19658	UInt	UInt	95	
553	Relay 3	Main Relay	43275	169/179	4CCB	19659	UInt	UInt	95	
554	B1 Relay 1	Off	43511	170/160	4DB7	19895	UInt	UInt	96	
555	B1 Relay 2	Off	43512	170/161	4DB8	19896	UInt	UInt	96	
556	B1 Relay 3	Off	43513	170/162	4DB9	19897	UInt	UInt	96	
557	B2 Relay 1	Off	43514	170/163	4DBA	19898	UInt	UInt	96	
558	B2 Relay 2	Off	43515	170/164	4DBB	19899	UInt	UInt	96	
559	B2 Relay 3	Off	43516	170/165	4DBC	19900	UInt	UInt	96	
55A	B3 Relay 1	Off	43517	170/166	4DBD	19901	UInt	UInt	96	
55B	B3 Relay 2	Off	43518	170/167	4DBE	19902	UInt	UInt	96	
55C	B3 Relay 3	Off	43519	170/168	4DBF	19903	UInt	UInt	96	
55D	Relay Advan								96	
55D1	Relay1 Mode	N.O	43276	169/180	4CCC	19660	UInt	UInt	96	
55D2	Relay2 Mode	N.O	43277	169/181	4CCD	19661	UInt	UInt	96	
55D3	Relay3 Mode	N.O	43278	169/182	4CCE	19662	UInt	UInt	96	
55D4	B1R1 Mode	N.O	43521	170/170	4DC1	19905	UInt	UInt	96	
55D5	B1R2 Mode	N.O	43522	170/171	4DC2	19906	UInt	UInt	96	
55D6	B1R3 Mode	N.O	43523	170/172	4DC3	19907	UInt	UInt	96	
55D7	B2R1 Mode	N.O	43524	170/173	4DC4	19908	UInt	UInt	96	
55D8	B2R2 Mode	N.O	43525	170/174	4DC5	19909	UInt	UInt	96	
55D9	B2R3 Mode	N.O	43526	170/175	4DC6	19910	UInt	UInt	96	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
55DA	B3R1 Mode	N.O	43527	170/176	4DC7	19911	UInt	UInt	96	
55DB	B3R2 Mode	N.O	43528	170/177	4DC8	19912	UInt	UInt	96	
55DC	B3R3 Mode	N.O	43529	170/178	4DC9	19913	UInt	UInt	96	
560	Virtual I/Os								96	
561	VIO 1 Dest	Off	43281	169/185	4CD1	19665	UInt	UInt	96	
562	VIO 1 Source	Off	43282	169/186	4CD2	19666	UInt	UInt	96	
563	VIO 2 Dest	Off	43283	169/187	4CD3	19667	UInt	UInt	96	
564	VIO 2 Source	Off	43284	169/188	4CD4	19668	UInt	UInt	96	
565	VIO 3 Dest	Off	43285	169/189	4CD5	19669	UInt	UInt	96	
566	VIO 3 Source	Off	43286	169/190	4CD6	19670	UInt	UInt	96	
567	VIO 4 Dest	Off	43287	169/191	4CD7	19671	UInt	UInt	96	
568	VIO 4 Source	Off	43288	169/192	4CD8	19672	UInt	UInt	96	
569	VIO 5 Dest	Off	43289	169/193	4CD9	19673	UInt	UInt	96	
56A	VIO 5 Source	Off	43290	169/194	4CDA	19674	UInt	UInt	96	
56B	VIO 6 Dest	Run R	43291	169/195	4CDB	19675	UInt	UInt	96	
56C	VIO 6 Source	DigIn 1	43292	169/196	4CDC	19676	UInt	UInt	96	
56D	VIO 7 Dest	Run L	43293	169/197	4CDD	19677	UInt	UInt	96	
56E	VIO 7 Source	DigIn 2	43294	169/198	4CDE	19678	UInt	UInt	96	
56F	VIO 8 Dest	Off	43295	169/199	4CDF	19679	UInt	UInt	96	
56G	VIO 8 Source	Operation	43296	169/200	4CE0	19680	UInt	UInt	96	
600	Logic&Timers								97	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
610	Comparators								97	
611	CA1 Setup								97	
6111	CA1 Value	Current	43401	170/50	4D49	19785	UInt	UInt	97	
6112	CA1 LevelHI	30.0A	43402	170/51	4D4A	19786	Long, 1=1 or 1=0.001	Elnt	99	
6113	CA1 LevelLO	20.0A	43403	170/52	4D4B	19787	Long, 1=1 or 1=0.001	Elnt	101	
6114	CA1 Type	Hysteresis	43481	170/130	4D99	19865	UInt	UInt	101	
6115	CA1 Polar	Unipolar	43486	170/135	4D9E	19870	UInt	UInt	101	
612	CA2 Setup								101	
6121	CA2 Value	Torque	43404	170/53	4D4C	19788	UInt	UInt	101	
6122	CA2 LevelHI	20%	43405	170/54	4D4D	19789	Long, 1=1 or 1=0.001	Elnt	101	
6123	CA2 LevelLO	10%	43406	170/55	4D4E	19790	Long, 1=1 or 1=0.001	Elnt	102	
6124	CA2 Type	Hysteresis	43482	170/131	4D9A	19866	UInt	UInt	102	
6125	CA2 Polar	Unipolar	43487	170/136	4D9F	19871	UInt	UInt	102	
613	CA3 Setup								102	
6131	CA3 Value	Process Val	43471	170/120	4D8F	19855	UInt	UInt	102	
6132	CA3 LevelHI	300rpm	43472	170/121	4D90	19856	Long, 1=1 or 1=0.001	Elnt	102	
6133	CA3 LevelLO	200rpm	43473	170/122	4D91	19857	Long, 1=1 or 1=0.001	Elnt	102	
6134	CA3 Type	Hysteresis	43483	170/132	4D9B	19867	UInt	UInt	102	
6135	CA3 Polar	Unipolar	43488	170/137	4DA0	19872	UInt	UInt	102	
614	CA4 Setup								103	
6141	CA4 Value	Process Err	43474	170/123	4D92	19858	UInt	UInt	103	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
6142	CA4 LevelHI	100 rpm	43475	170/124	4D93	19859	Long, 1=1 or 1=0.001	EInt	103	
6143	CA4 LevelLO	- 100 rpm	43476	170/125	4D94	19860	Long, 1=1 or 1=0.001	EInt	103	
6144	CA4 Type	Window	43484	170/133	4D9C	19868	UInt	UInt	103	
6145	CA4 Polar	Bipolar	43489	170/138	4DA1	19873	UInt	UInt	103	
615	CD Setup								103	
6151	CD1	Trip	43407	170/56	4D4F	19791	UInt	UInt	103	
6152	CD2	T2Q	43408	170/57	4D50	19792	UInt	UInt	103	
6153	CD3	Udc OK	43477	170/126	4D95	19861	UInt	UInt	103	
6154	CD4	Ready	43478	170/127	4D96	19862	UInt	UInt	104	
620	Logic Y								104	
621	Y Comp 1	!D3	43411	170/60	4D53	19795	UInt	UInt	105	
622	Y Operator 1	&	43412	170/61	4D54	19796	UInt	UInt	105	
623	Y Comp 2	!D3	43413	170/62	4D55	19797	UInt	UInt	105	
624	Y Operator 2	.	43414	170/63	4D56	19798	UInt	UInt	105	
625	Y Comp 3	CD1	43415	170/64	4D57	19799	UInt	UInt	105	
630	Logic Z								106	
631	Z Comp 1	CD1	43421	170/70	4D5D	19805	UInt	UInt	106	
632	Z Operator 1	&	43422	170/71	4D5E	19806	UInt	UInt	106	
633	Z Comp 2	!D2	43423	170/72	4D5F	19807	UInt	UInt	106	
634	Z Operator 2	.	43424	170/73	4D60	19808	UInt	UInt	106	
635	Z Comp 3	CD1	43425	170/74	4D61	19809	UInt	UInt	106	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
640	Timer1								107	
641	Timer1 Trig	Off	43431	170/80	4D67	19815	UInt	UInt	107	
642	Timer1 Mode	Off	43432	170/81	4D68	19816	UInt	UInt	107	
643	Timer1 Delay	00:00:00	43433	170/82	4D69	19817	UInt, 1=1h	UInt	107	
			43434	170/83	4D6A	19818	UInt, 1=1m	UInt		
			43435	170/84	4D6B	19819	UInt, 1=1s	UInt		
644	Timer1 T1	00:00:00	43436	170/85	4D6C	19820	UInt, 1=1h	UInt	107	
			43437	170/86	4D6D	19821	UInt, 1=1m	UInt		
			43438	170/87	4D6E	19822	UInt, 1=1s	UInt		
645	Timer1 T2	00:00:00	43439	170/88	4D6F	19823	UInt, 1=1h	UInt	107	
			43440	170/89	4D70	19824	UInt, 1=1m	UInt		
			43441	170/90	4D71	19825	UInt, 1=1s	UInt		
649	Timer1 Value	00:00:00	42921	168/80	4B69	19305	UInt, 1=1h	UInt	108	
			42922	168/81	4B6A	19306	UInt, 1=1m	UInt		
			42923	168/82	4B6B	19307	UInt, 1=1s	UInt		
650	Timer2								108	
651	Timer2 Trig	Trip	43451	170/100	4D7B	19835	UInt	UInt	108	
652	Timer2 Mode	Delay	43452	170/101	4D7C	19836	UInt	UInt	108	
653	Timer2 Delay	00:00:00	43453	170/102	4D7D	19837	UInt, 1=1h	UInt	108	
			43454	170/103	4D7E	19838	UInt, 1=1m	UInt		
			43455	170/104	4D7F	19839	UInt, 1=1s	UInt		

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
654	Timer2 T1	00:00:00	43456	170/105	4D80	19840	UInt, 1=1h	UInt	108	
			43457	170/106	4D81	19841	UInt, 1=1m	UInt		
			43458	170/107	4D82	19842	UInt, 1=1s	UInt		
655	Timer2 T2	00:00:00	43459	170/108	4D83	19843	UInt, 1=1h	UInt	108	
			43460	170/109	4D84	19844	UInt, 1=1m	UInt		
			43461	170/110	4D85	19845	UInt, 1=1s	UInt		
659	Timer2 Value	00:00:00	42924	168/83	4B6C	19308	UInt, 1=1h	UInt	109	
			42925	168/84	4B6D	19309	UInt, 1=1m	UInt		
			42926	168/85	4B6E	19310	UInt, 1=1s	UInt		
660	Counters								109	
661	Counter1								109	
6611	C1 Trig	Off	43571	170/220	4DF3	19955	UInt	UInt	109	
6612	C1 Reset	Off	43572	170/221	4DF4	19956	UInt	UInt	110	
6613	C1 High Val	0	43573	170/222	4DF5	19957	Long, 1=1	Elnt	110	
6614	C1 Low Val	0	43574	170/223	4DF6	19958	Long, 1=1	Elnt	110	
6615	C1 DecTimer	Off	43575	170/224	4DF7	19959	Long, 1=1s	Elnt	110	
6619	C1 Value	0	42927	168/86	4B6F	19311	UInt, 1=1	UInt	110	
662	Counter2								110	
6621	C2 Trig	Off	43581	170/230	4DFD	19965	UInt	UInt	110	
6622	C2 Reset	Off	43582	170/231	4DFE	19966	UInt	UInt	110	
6623	C2 High Val	0	43583	170/232	4DFF	19967	Long, 1=1	Elnt	111	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
6624	C2 Low Val	0	43584	170/233	4E00	19968	Long, 1=1	Elnt	111	
6625	C2 DecTimer	Off	43585	170/234	4E01	19969	Long, 1=1s	Elnt	111	
6629	C2 Value	0	42928	168/87	4B70	19312	UInt, 1=1	UInt	111	
670	Clock logic								111	
671	Clock 1								111	
6711	Clk1TimeON	00:00:00	43600	170/249	4E10	19984	Long, 1=1h	Elnt	111	
			43601	170/250	4E11	19985	Long, 1=1m	Elnt		
			43602	170/251	4E12	19986	Long, 1=1s	Elnt		
6712	Clk1TimeOff	00:00:00	43603	170/252	4E13	19987	Long, 1=1h	Elnt	111	
			43604	170/253	4E14	19988	Long, 1=1m	Elnt		
			43605	170/254	4E15	19989	Long, 1=1s	Elnt		
6713	Clk1DateOn	2017-01-01	43606	171/0	4E16	19990	Long, 1=1y	Elnt	111	
			43607	171/1	4E17	19991	Long, 1=1m	Elnt		
			43608	171/2	4E18	19992	Long, 1=1d	Elnt		
6714	Clk1DateOff	2017-01-01	43609	171/3	4E19	19993	Long, 1=1y	Elnt	112	
			43610	171/4	4E1A	19994	Long, 1=1m	Elnt		
			43611	171/5	4E1B	19995	Long, 1=1d	Elnt		
6715	Clk1Weekday	MTWTFSS	43612	171/6	4E1C	19996	UInt, 1=1	UInt	112	
672	Clock 2								112	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
6721	Clk2TimeON	00:00:00	43615	171/9	4E1F	19999	Long, 1=1h	EInt	112	
			43616	171/10	4E20	20000	Long, 1=1m	EInt		
			43617	171/11	4E21	20001	Long, 1=1s	EInt		
6722	Clk2TimeOff	00:00:00	43618	171/12	4E22	20002	Long, 1=1h	EInt	112	
			43619	171/13	4E23	20003	Long, 1=1m	EInt		
			43620	171/14	4E24	20004	Long, 1=1s	EInt		
6723	Clk2DateOn	2017-01-01	43621	171/15	4E25	20005	Long, 1=1y	EInt	112	
			43622	171/16	4E26	20006	Long, 1=1m	EInt		
			43623	171/17	4E27	20007	Long, 1=1d	EInt		
6724	Clk2DateOff	2017-01-01	43624	171/18	4E28	20008	Long, 1=1y	EInt	112	
			43625	171/19	4E29	20009	Long, 1=1m	EInt		
			43626	171/20	4E2A	20010	Long, 1=1d	EInt		
6725	Clk2Weekday	MTWTFSS	43627	171/21	4E2B	20011	UInt, 1=1	UInt	112	
700	Oper/Status								113	
710	Operation								113	
711	Q Value		31001	121/145	23E9	1001	Long, 1=1%	EInt	113	
712	Cos ϕ		31002	121/146	23EA	1002	Int, 1=0.001	Int	113	
713	Torque		31003	121/147	23EB	1003	Long, 1=0.1W	EInt	113	
			31004	121/148	23EC	1004	Long, 1=1%	EInt		
714	React Power		31005	121/149	23ED	1005	Long, 1=1VA	EInt	113	
715	EI Power		31006	121/150	23EE	1006	Long, 1=1W	EInt	113	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
716	Current		31007	121/151	23EF	1007	Long, 1=0.1A	Elnt	113	
717	Supply volt		31008	121/152	23F0	1008	Long, 1=0.1V	Elnt	114	
718	Frequency		31009	121/153	23F1	1009	Long, 1=0.1Hz	Elnt	113	
719	DC Voltage		31010	121/154	23F2	1010	Long, 1=0.1V	Elnt	114	
71A	IGBT Temp		31011	121/155	23F3	1011	Long, 1=0.1 °C	Elnt	114	
71B	PT100 1,2,3		31012	121/156	23F4	1012	Long, 1=1 °C	Elnt	114	
			31013	121/157	23F5	1013	Long, 1=1 °C	Elnt		
			31014	121/158	23F6	1014	Long, 1=1 °C	Elnt		
71C	PT100 4,5,6		31097	121/241	2449	1097	Long, 1=1 °C	Elnt	114	
			31098	121/242	244A	1098	Long, 1=1 °C	Elnt		
			31099	121/243	244B	1099	Long, 1=1 °C	Elnt		
720	Status								115	
721	AFR Status		31015	121/159	23F7	1015	UInt	UInt	115	
722	Warning		31016	121/160	23F8	1016	UInt	UInt	116	
723	DigIn Status		31017	121/161	23F9	1017	UInt, 1=1	UInt	116	
724	DigOutStatus		31018	121/162	23FA	1018	UInt, 1=1 bit 0=DigOut1, bit 1=DigOut2 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3	UInt	116	
725	AnIn 1 2		31019	121/163	23FB	1019	Long, 1=1%	Elnt	117	
			31020	121/164	23FC	1020	Long, 1=1%	Elnt		

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
726	AnIn 3 4		31021	121/165	23FD	1021	Long, 1=1%	EInt	117	
			31022	121/166	23FE	1022	Long, 1=1%	EInt		
727	AnOut1 2		31023	121/167	23FF	1023	Long, 1=1%	EInt	117	
			31024	121/168	2400	1024	Long, 1=1%	EInt		
728	IO B1		31025	121/169	2401	1025	UInt, 1=1 bit 0=DigIn1 bit 1=DigIn2 bit 2=DigIn3 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3	UInt	117	
729	IO B2		31026	121/170	2402	1026	UInt, 1=1 bit 0=DigIn1 bit 1=DigIn2 bit 2=DigIn3 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3	UInt	117	
72A	IO B3		31027	121/171	2403	1027	UInt, 1=1 bit 0=DigIn1 bit 1=DigIn2 bit 2=DigIn3 bit 8=Relay1 bit 9=Relay2 bit 10=Relay3	UInt	117	
72C	VIO Status		30181	118/90	20B5	181	UInt	UInt	117	
730	Stored Val								118	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
731	Run Time	00:00:00	31028	121/172	2404	1028	Long, 1=1h	Elnt	118	
			31029	121/173	2405	1029	Long, 1=1m	Elnt		
			31030	121/174	2406	1030	Long, 1=1s	Elnt		
7311	Reset RunTm	No	7	0/6	2007	7	UInt	UInt	118	
732	Mains Time	00:00:00	31031	121/175	2407	1031	Long, 1=1h	Elnt	118	
			31032	121/176	2408	1032	Long, 1=1m	Elnt		
			31033	121/177	2409	1033	Long, 1=1s	Elnt		
733	Energy	...Wh	31034	121/178	240A	1034	Long, 1=1Wh	Elnt	118	
7331	Rst Energy	No	6	0/5	2006	6	UInt	UInt	118	
800	View TripLog								119	
810	Trip Message (Log 1)		31101	121/245	244D	1101	UInt, 1=1	UInt	119	
811	Q Value		31102	121/246	244E	1102	Long, 1=0.001%	Elnt	119	
812	Cos ϕ		31103	121/247	244F	1103	Int, 1=1	Int	119	
813	Torque		31104	121/248	2450	1104	Long, 1=0.1W	Elnt	119	
			31105	121/249	2451	1105	Long, 1=1%	Elnt		
814	React Power		31106	121/250	2452	1106	Long, 1=1VA	Elnt	119	
815	El Power		31107	121/251	2453	1107	Long, 1=1W	Elnt	119	
816	Current		31108	121/252	2454	1108	Long, 1=0.1A	Elnt	119	
817	Supply volt		31109	121/253	2455	1109	Long, 1=0.1V	Elnt	119	
818	Frequency		31110	121/254	2456	1110	Long, 1=0.1Hz	Elnt	119	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
819	DC Voltage		31111	122/0	2457	1111	Long, 1=0.1V	Elnt	119	
81A	IGBT Temp		31112	122/1	2458	1112	Long, 1=0.1 °C	Elnt	119	
81C	AFR Status		31116	122/5	245C	1116	UInt	UInt	119	
81D	DigIn Status		31117	122/6	245D	1117	UInt, 1=1	UInt	119	
81E	DigOutStatus		31118	122/7	245E	1118	UInt, 1=1	UInt	119	
81F	AnIn 1 2		31119	122/8	245F	1119	Long, 1=1%	Elnt	119	
			31120	122/9	2460	1120	Long, 1=1%	Elnt		
81G	AnIn 3 4		31121	122/10	2461	1121	Long, 1=1%	Elnt	119	
			31122	122/11	2462	1122	Long, 1=1%	Elnt		
81H	AnOut 1 2		31123	122/12	2463	1123	Long, 1=1%	Elnt	119	
			31124	122/13	2464	1124	Long, 1=1%	Elnt		
81L	Run Time		31128	122/17	2468	1128	Long, 1=1h	Elnt	119	
			31129	122/18	2469	1129	Long, 1=1m	Elnt		
			31130	122/19	246A	1130	Long, 1=1s	Elnt	119	
81M	Mains Time		31131	122/20	246B	1131	Long, 1=1h	Elnt		
			31132	122/21	246C	1132	Long, 1=1m	Elnt	119	
			31133	122/22	246D	1133	Long, 1=1s	Elnt		
81N	Energy		31134	122/23	246E	1134	Long, 1=1Wh	Elnt	119	
81O	Q Ref		31135	122/24	246F	1135	Long, 1=0.001%	Elnt	119	
81P	VIO Status		31136	122/25	2470	1136	UInt, 1=1	UInt	119	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
820	Trip Message (Log 2)		31151 to 31189	122/40 to 122/78	247F to 24A5	1151 to 1189			119	
830	Trip Message (Log 3)		31201 to 31239	122/90 to 122/128	24B1 to 24D7	1201 to 1239			119	
840	Trip Message (Log 4)		31251 to 31289	122/140 to 122/178	24E3 to 2509	1251 to 1289			119	
850	Trip Message (Log 5)		31301 to 31339	122/190 to 122/228	2515 to 253B	1301 to 1339			119	
860	Trip Message (Log 6)		31351 to 31389	122/240 to 123/23	2547 to 256D	1351 to 1389			119	
870	Trip Message (Log 7)		31401 to 31439	123/35 to 123/73	2579 to 259F	1401 to 1439			119	
880	Trip Message (Log 8)		31451 to 31489	123/85 to 123/123	25AB to 25D1	1451 to 1489			119	
890	Trip Message (Log 9)		31501 to 31539	123/135 to 123/173	25DD to 2603	1501 to 1539			119	
8A0	Reset Trip L	No	8	0/7	2008	8	UInt	UInt	120	
900	System Data								120	
920	AFR Data								120	
921	AFR Type		31037	121/181	240D	1037	UInt, 1=1	UInt	120	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
922	Software		31038	121/182	240E	1038	UInt	UInt	120	
			31039	121/183	240F	1039	UInt	UInt		
9221	Build Info		31040	121/184	2410	1040	UInt	UInt	121	
			31041	121/185	2411	1041	UInt	UInt		
			31042	121/186	2412	1042	UInt	UInt		
			31043	121/187	2413	1043	UInt	UInt		
			31044	121/188	2414	1044	UInt	UInt		
			31045	121/189	2415	1045	UInt	UInt		
9222	Build ID	0E1B7F9E							121	
923	Unit Name	0	42301	165/225	48FD	18685	UInt	UInt	121	
			42302	165/226	48FE	18686	UInt	UInt		
			42303	165/227	48FF	18687	UInt	UInt		
			42304	165/228	4900	18688	UInt	UInt		
			42305	165/229	4901	18689	UInt	UInt		
			42306	165/230	4902	18690	UInt	UInt		
			42307	165/231	4903	18691	UInt	UInt		
			42308	165/232	4904	18692	UInt	UInt		
			42309	165/233	4905	18693	UInt	UInt		
			42310	165/234	4906	18694	UInt	UInt		
			42311	165/235	4907	18695	UInt	UInt		
			42312	165/236	4908	18696	UInt	UInt		

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
924	Bluetooth ID		42620	167/34	4A3C	19004	UInt, 1=1	UInt	121	
930	Clock								121	
931	Time	00:00:00	42601	167/15	4A29	18985	Long, 1=1h	EInt	121	
			42602	167/16	4A2A	18986	Long, 1=1m	EInt		
			42603	167/17	4A2B	18987	Long, 1=1s	EInt		
932	Date	2017-01-01	42604	167/18	4A2C	18988	Long, 1=1y	EInt	121	
			42605	167/19	4A2D	18989	Long, 1=1m	EInt		
			42606	167/20	4A2E	18990	Long, 1=1d	EInt		
933	Weekday	Monday	42607	167/21	4A2F	18991	Long	EInt	121	
000	AFE option								122	
010	Supply								122	
011	Supply Volts	400V	48001	188/60			Long, 1=1	EInt	122	
012	Supply Freq	50Hz	48002	188/61			Long, 1=1	EInt	122	
013	Supply Curr	175A	48003	188/62			Long, 1=0.1	EInt	122	
014	Supply Seq	Pos	48004	188/63			UInt, 1=1	UInt	122	
015	Supply Idrun	Off	48005	188/64			UInt, 1=1	UInt	122	
016	Supply Auto	Off	48006	188/65			UInt, 1=1	UInt	122	
020	Start/Stop								123	
021	Charge Ctrl	Supply-NC	48011	188/70			UInt, 1=1	UInt	123	
022	Run/Stp Mode	Standard	48012	188/71			UInt, 1=1	UInt	123	
023	Reg Stp Time	1s	48013	188/72			Long, 1=0.01	EInt	123	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
024	Auto Restart	Off	48014	188/73			UInt, 1=1	UInt	123	
025	Start Type	Pulses	48015	188/74			UInt, 1=1	UInt	123	
030	Udc Control								123	
031	Udc ref	1.05*Upeak	48021	188/80			Long, 1=0.1	Elnt	124	
032	Udc ramp	1s	48022	188/81			Long, 1=0.01	Elnt	124	
033	Udc PI Gain	5.0	48023	188/82			Long, 1=0.1	Elnt	124	
034	Udc PI Time	0.2s	48024	188/83			Long, 1=0.01	Elnt	124	
035	Udc PI Max	200%	48025	188/84			Long, 1=1	Elnt	124	
036	Udc PI Chrg	20%	48026	188/85			Long, 1=1	Elnt	124	
037	Udc Margin	5%	48027	188/86			Long, 1=0.1	Elnt	124	
040	Q Control								125	
041	Q max	0%	48031	188/90			Long, 1=1	Elnt	125	
043	Q PI Gain	0.10	48033	188/92			Long, 1=0.01	Elnt	125	
044	Q PI Time	0.1s	48034	188/93			Long, 1=0.01	Elnt	125	
045	Q Filter	1s	48035	188/94			Long, 1=0.01	Elnt	125	
050	Freq Control								126	
051	Freq Type	Observer	48041	188/100			UInt, 1=1	UInt	126	
080	View Energy								126	
081	Energy Suppl		31034	121/178			Long, 1=1Wh	Elnt	126	
082	Energy Motor		48071	188/130			Long, 1=1Wh	Elnt	126	
083	Energy Gen		48075	188/134			Long, 1=1Wh	Elnt	126	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
084	Reset Energy	No	48079	188/138			UInt, 1=1	UInt	126	
090	View Control								127	
091	UdcRef Val		48081	188/140			Long, 1=0.1	Elnt	127	
092	T Ref Val		48083	188/142			Long, 1=0.1	Elnt	127	
093	Q Ref Val		48085	188/144			Long, 1=0.1	Elnt	127	
094	PsiRef Val		48087	188/146			Long, 1=0.1	Elnt	127	
G00	Grid Code								127	
G10	GC Protect								127	
G11	GCP Voltage								127	
G111	Source 3U	Off	48201	189/5			UInt, 1=1	UInt	127	
G112	3U> Level	115.0%	48202	189/6			UInt, 1=0.1%	UInt	127	
G113	3U> Time	1.50s	48203	189/7			UInt, 1=0.01s	UInt	127	
G114	3U>> Level	120.0%	48204	189/8			UInt, 1=0.1%	UInt	128	
G115	3U>> Time	0.20s	48205	189/9			UInt, 1=0.01s	UInt	128	
G116	3U< Level	85.0%	48206	189/10			UInt, 1=0.1%	UInt	128	
G117	3U< Time	1.50s	48207	189/11			UInt, 1=0.01s	UInt	128	
G118	3U<< Level	80.0%	48208	189/12			UInt, 1=0.1%	UInt	128	
G119	3U<< Time	0.20s	48209	189/13			UInt, 1=0.01s	UInt	128	
G11A	U Hysteres	2.0%	48210	189/14			UInt, 1=0.1%	UInt	128	
G11B	U Rst Time	1.00s	48211	189/15			UInt, 1=0.01s	UInt	128	
G11C	U+> Level	110.0%	48212	189/16			UInt, 1=0.1%	UInt	128	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G11D	U+> Time	Off	48213	189/17			UInt, 1=0.01s	UInt	129	
G11E	U+< Level	85.0%	48214	189/18			UInt, 1=0.1%	UInt	129	
G11F	U+< Time	Off	48215	189/19			UInt, 1=0.01s	UInt	129	
G11G	U-> Level	5.0%	48216	189/20			UInt, 1=0.1%	UInt	129	
G11H	U-> Time	Off	48217	189/21			UInt, 1=0.01s	UInt	129	
G11I	U0> Level	10.0%	48218	189/22			UInt, 1=0.1%	UInt	129	
G11J	U0> Time	Off	48219	189/23			UInt, 1=0.01s	UInt	129	
G11K	Umean> Lvl	110.0%	48220	189/24			UInt, 1=0.1%	UInt	129	
G11L	Umean> Time	Off	48221	189/25			UInt, 1=0.01s	UInt	130	
G11M	Umean< Lvl	90.0%	48222	189/26			UInt, 1=0.1%	UInt	130	
G11N	Umean< Time	Off	48223	189/27			UInt, 1=0.01s	UInt	130	
G11O	U(Q<0)< Lvl	85.0%	48224	189/28			UInt, 1=0.1%	UInt	130	
G11P	U(Q<0)< Tim	Off	48225	189/29			UInt, 1=0.01s	UInt	130	
G12	GCP Freq								130	
G121	Source F	Off	48230	189/34			UInt, 1=1	UInt	130	
G122	F> Level	102.0%	48231	189/35			UInt, 1=0.1%	UInt	130	
G123	F> Time	1.50s	48232	189/36			UInt, 1=0.01s	UInt	130	
G124	F>> Level	105.0%	48233	189/37			UInt, 1=0.1%	UInt	131	
G125	F>> Time	0.20s	48234	189/38			UInt, 1=0.01s	UInt	131	
G126	F< Level	98.0%	48235	189/39			UInt, 1=0.1%	UInt	131	
G127	F< Time	1.50s	48236	189/40			UInt, 1=0.01s	UInt	131	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G128	F<< Level	95.0%	48237	189/41			UInt, 1=0.1%	UInt	131	
G129	F<< Time	0.20s	48238	189/42			UInt, 1=0.01s	UInt	131	
G12A	F Hysteres	0.2%	48239	189/43			UInt, 1=0.1%	UInt	131	
G12B	F Rst Time	1.00s	48240	189/44			UInt, 1=0.01s	UInt	131	
G13	GCP ROCOF								132	
G131	ROCOF Level	2.00%/s	48245	189/49			UInt, 1=0.01%/s	UInt	132	
G132	ROCOF Time	2.00s	48246	189/50			UInt, 1=0.01s	UInt	132	
G133	ROCOF Hyst	0.02%/s	48247	189/51			UInt, 1=0.01%/s	UInt	132	
G134	ROCOF Rst T	1.00s	48248	189/52			UInt, 1=0.01s	UInt	132	
G20	GC Q ctrl								132	
G21	Q mode	Off	48251	189/55			UInt, 1=1	UInt	132	
G22	Q fix								132	
G221	Q max oe	50%	48255	189/59			Int, 1=1%	Int	132	
G222	Q max ue	-50%	48256	189/60			Int, 1=1%	Int	133	
G23	CosΦ fix								133	
G231	CosΦ min oe	0.90	48258	189/62			Int, 1=0.01	Int	133	
G232	CosΦ min ue	-0.90	48259	189/63			Int, 1=0.01	Int	133	
G24	Q(U)								133	
G241	Q1	50%	48261	189/65			Int, 1=1%	Int	133	
G242	U1	85%	48265	189/69			UInt, 1=1%	UInt	134	
G243	Q2	10%	48262	189/66			Int, 1=1%	Int	134	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G244	U2	95%	48266	189/70			UInt, 1=1%	UInt	134	
G245	Q3	-10%	48263	189/67			Int, 1=1%	Int	134	
G246	U3	105%	48267	189/71			UInt, 1=1%	UInt	134	
G247	Q4	-50%	48264	189/68			Int, 1=1%	Int	134	
G248	U4	110%	48268	189/72			UInt, 1=1%	UInt	134	
G249	Filt time	3.0s	48269	189/73			UInt, 1=0.1s	UInt	134	
G24A	Cosφ min	0.01	48270	189/74			Int, 1=0.01	Int	135	
G24B	P lock In	10%	48301	189/105			UInt, 1=1%	UInt	135	
G24C	P lock out	0%	48302	189/106			UInt, 1=1%	UInt	135	
G25	CosΦ(U)								135	
G251	CosΦ1	0.9	48271	189/75			Int, 1=0.01	Int	135	
G252	U1	85%	48275	189/79			UInt, 1=1%	UInt	135	
G253	CosΦ2	0.95	48272	189/76			Int, 1=0.01	Int	135	
G254	U2	95%	48276	189/80			UInt, 1=1%	UInt	136	
G255	CosΦ3	-0.95	48273	189/77			Int, 1=0.01	Int	136	
G256	U3	105%	48277	189/81			UInt, 1=1%	UInt	136	
G257	CosΦ4	-0.90	48274	189/78			Int, 1=0.01	Int	136	
G258	U4	110%	48278	189/82			UInt, 1=1%	UInt	136	
G259	Filt time	3.0s	48279	189/83			UInt, 1=0.1s	UInt	136	
G25B	P lock In	10%	48306	189/110			UInt, 1=1%	UInt	136	
G25C	P lock out	0%	48307	189/111			UInt, 1=1%	UInt	136	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G26	Q(P)								137	
G261	Q1	10%	48281	189/85			Int, 1=1%	Int	137	
G262	P1	25%	48285	189/89			UInt, 1=1%	UInt	137	
G263	Q2	50%	48282	189/86			Int, 1=1%	Int	137	
G264	P2	50%	48286	189/90			UInt, 1=1%	UInt	137	
G265	Q3	40%	48283	189/87			Int, 1=1%	Int	137	
G266	P3	75%	48287	189/91			UInt, 1=1%	UInt	137	
G267	Q4	0%	48284	189/88			Int, 1=1%	Int	137	
G268	P4	100%	48288	189/92			UInt, 1=1%	UInt	138	
G269	Filt time	3.0s	48289	189/93			UInt, 1=0.1s	UInt	138	
G27	CosΦ(P)								138	
G271	CosΦ1	0.90	48291	189/95			Int, 1=0.01	Int	138	
G272	P1	25%	48295	189/99			UInt, 1=1%	UInt	138	
G273	CosΦ2	0.70	48292	189/96			Int, 1=0.01	Int	138	
G274	P2	50%	48296	189/100			UInt, 1=1%	UInt	138	
G275	CosΦ3	0.88	48293	189/97			Int, 1=0.01	Int	138	
G276	P3	75%	48297	189/101			UInt, 1=1%	UInt	139	
G277	CosΦ4	1.0	48294	189/98			Int, 1=0.01	Int	139	
G278	P4	100%	48298	189/102			UInt, 1=1%	UInt	139	
G279	Filt time	3.0s	48299	189/103			UInt, 1=0.1s	UInt	139	
G28	Limits								139	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G281	P threshold	0%	48252	189/56			UInt, 1=1%	UInt	139	
G282	Q limit	10%	48253	189/57			UInt, 1=1%	UInt	139	
G283	Prio P/Q	P	48254	189/58			UInt, 1=1	UInt	139	
G30	GC Distrbnce								140	
G31	GC NormRange								140	
G311	Umin	85.0%	48321	189/125			UInt, 1=0.1%	UInt	140	
G312	Umax	110.0%	48322	189/126			UInt, 1=0.1%	UInt	140	
G313	Fmin	92.0%	48323	189/127			UInt, 1=0.1%	UInt	140	
G314	Fmax	108.0%	48324	189/128			UInt, 1=0.1%	UInt	140	
G315	Umaxmax	125.0%	48325	189/129			UInt, 1=0.1%	UInt	140	
G32	GC dU(FRT)								140	
G321	dU lmax(P)	100%	48331	189/135			UInt, 1=1%	UInt	140	
G322	dU lmax(Q)	100%	48332	189/136			UInt, 1=1%	UInt	140	
G323	dU Uband	10.0%	48333	189/137			UInt, 1=0.1%	UInt	140	
G324	dU Timemax	Off	48334	189/138			UInt, 1=0.01s	UInt	141	
G325	dU Mode UV	I(cont)	48335	189/139			UInt, 1=1	UInt	141	
G326	dU Zero UV	15%	48336	189/140			UInt, 1=1%	UInt	141	
G327	dU Mode OV	I(cont)	48337	189/141			UInt, 1=1	UInt	141	
G328	dU Zero OV	120%	48338	189/142			UInt, 1=1%	UInt	141	
G329	dU k1	2.00	48339	189/143			UInt, 1=0.01	UInt	141	
G32A	dU k2	0.00	48340	189/144			UInt, 1=0.01	UInt	141	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G32D	Trip UV t1	0.25s	48343	189/147			UInt, 1=0.01s	UInt	141	
G32E	Trip UV U1	0%	48344	189/148			UInt, 1=1%	UInt	141	
G32F	Trip UV t2	3.00s	48345	189/149			UInt, 1=0.01s	UInt	142	
G32G	Trip UV U2	85%	48346	189/150			UInt, 1=1%	UInt	142	
G32H	Trip OV t1	0.10s	48347	189/151			UInt, 1=0.01s	UInt	142	
G32I	Trip OV U1	130%	48348	189/152			UInt, 1=1%	UInt	142	
G32J	Trip OV t2	0.10s	48349	189/153			UInt, 1=0.01s	UInt	142	
G32K	Trip OV U2	120%	48350	189/154			UInt, 1=1%	UInt	142	
G33	GC AID								142	
G331	Passive AID	Off	48351	189/155			UInt, 1=1	UInt	142	
G332	Active AID	Off	48352	189/156			UInt, 1=1	UInt	142	
G34	GC dF(FRT)								143	
G341	dOF Mode	Off	48361	189/165			UInt, 1=1	UInt	143	
G342	dOF Fstart	100.4%	48362	189/166			UInt, 1=0.1%	UInt	143	
G343	dOF tstart	0.0s	48363	189/167			UInt, 1=0.1s	UInt	143	
G344	dOF Droop	5.0%	48364	189/168			UInt, 1=0.1%	UInt	143	
G345	dOF Fstop	110.0%	48365	189/169			UInt, 1=0.1%	UInt	143	
G346	dOF tstop	Off	48366	189/170			UInt, 1=0.1s	UInt	143	
G35	t(Rbrake)max	Off	48370	189/174			UInt, 1=0.1s	UInt	143	
G36	GC Open CB								144	
G361	Open I<	20.0%	48368	189/172			UInt, 1=0.1%	UInt	144	

Menu Parameters		Default settings	Modbus Instance/ DeviceNet No.	Profibus slot/ index	EtherCAT Index (HEX)	Profinet index	Fieldbus format	Modbus format	Page	Remarks
G362	Open Ttrip	0.02s	48369	189/173			UInt, 1=0.01s	UInt	144	
G90	Grid Monitor								144	
G91	U1		48401	189/205			UInt, 1=1	UInt	144	
	U2		48402	189/206			UInt, 1=1	UInt		
	U3		48403	189/207			UInt, 1=1	UInt		
G92	U12		48404	189/208			UInt, 1=1	UInt	144	
	U23		48405	189/209			UInt, 1=1	UInt		
	U31		48406	189/210			UInt, 1=1	UInt		
G93	U+		48407	189/211			UInt, 1=1	UInt	144	
	U-		48408	189/212			UInt, 1=1	UInt		
	U0		48409	189/213			UInt, 1=1	UInt		
G94	F		48410	189/214			Int, 1=0.01Hz	Int	144	
G95	dF/dt		48411	189/215			Int, 1=0.01Hz/s	Int	145	
G96	U(10min)		48412	189/216			UInt, 1=0.1V	UInt	145	
G9A	PLL Status		48420	189/224					145	

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CG Drives & Automation Sweden AB
Mörsaregatan 12
Box 222 25
SE-250 24 Helsingborg
Sweden
T +46 42 16 99 00
F +46 42 16 99 49
www.emotron.com/www.cgglobal.com

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