Emotron VFX/FDU 2.0
AFE - Active Front End Option

Instruction manual

English

2015-01-15

emotron

DEDICATED DRIVE

A CG Product

Emotron VFX/FDU 2.0
AFE - Active Front End Option

Instruction manual - English

Valid from sofware version 4.33-097-05

Document number: 01-5386-01
Edition:r1
Date of release: 15-01-2015

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 motor

If work must be carried out on a connected 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 the standard IEC61800-5-1 the protective earth connection must be assured by one of following conditions:

1. **Use a protective conductor with a cable cross-section of at least 10 mm^2 for copper (Cu) or 16 mm^2 for aluminium (Al).**
2. **Use an additional PE wire, with the same cable cross-section as the used original PE and mains supply wiring.**

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

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 cosφ

Remove all capacitors from the motor and the motor outputs.

Precautions during Autoreset

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 or motor inverter-AC drive. When opening theequipment for installing and/or commissioning activities wait at least 5 minutes. In case of malfunction a qualified technician should check the DC-link or wait for one hour before dismantling the AFR or AC drive for repair.

Contents

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

Motors

The active front end and motor inverter are 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” is used to indicate the complete active front end as a single unit.

Check that the software version number on the first page of this manual matches the software version in the active front end. See chapter chapter 9.8 page 46 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.

```
AFR46-175-54 C E A S – A – N N N N A N –
Position number:
 1    2    3    4  5 6  7  8  9 10 11 12 13 14 15 16
```

Fig. 1 Type code number

Position	Configuration	
1	AFR type	AFR
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	54=IP54
5	Control panel	–=Blank panel C=Standard panel
6	EMC option	E=Standard EMC (Category C3) F=Extended EMC (Category C2) I=IT-Net
7	Power option	A=Active front end
8	Stand-by power supply option	–=No SBS S=SBS included
9	Not used	-
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	
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

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

By using the optional "Extended EMC" filter the VSI fulfils requirements according to category C2,

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 standard AFR or VSI, 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

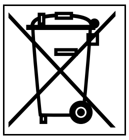
Market	Standard	Description
European	EMC Directive	2004/108/EC
	Low Voltage Directive	2006/95/EC
	WEEE Directive	2002/96/EC
All	EN 60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements.
	EN(IEC)61800-3:2004	Adjustable speed electrical power drive systems Part 3: EMC requirements and specific test methods. EMC Directive: Declaration of Conformity and CE marking
	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.

1.5 Dismantling and scrapping

The enclosures of the drives are made from recyclable material as aluminium, 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
AFE	Active front end
AFR	Regenerative active front end
DFE	Diode front end
VFXR	Regenerative VFX drive
FDUL	Low harmonic FDU drive
AC drive	Frequency converter
VSI	Voltage source inverter (motor inverter)
LCL-filter	Induction - Capacitance - Induction filter
THD	Total harmonic distortion
CP	Control panel, the programming and presentation unit on the AC drive
EInt	Communication format
UInt	Communication format (Unsigned integer)
Int	Communication format (Integer)
Long	Communication format (4 byte integer)
	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	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 AFR is a regenerative active front end (AFE) unit designed to be used together with Emotron motor inverters (VSIs), i.e. VFX or FDU, to comprise a complete VSI. The Emotron AFR consists of an active rectifier module and a LCL-filter. The main objective of the Emotron AFR is to rectify the supply AC voltage into DC voltage to be fed to or regenerated from the VSIs. This is achieved with 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%.

CAUTION!
Always consult CG Drives & Automation before connecting an AFR 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 Fig. 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%.

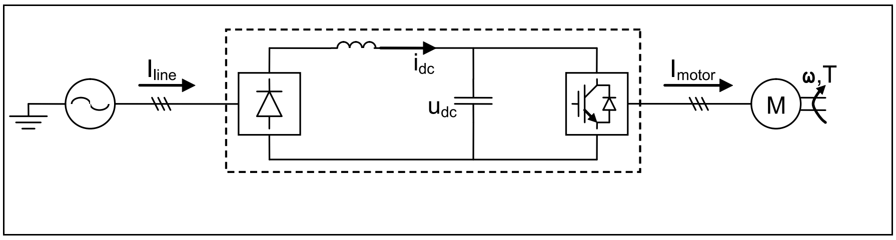


Fig. 2 Standard AC drive.

2.1.2 AC drive with AFR (as this delivery)

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

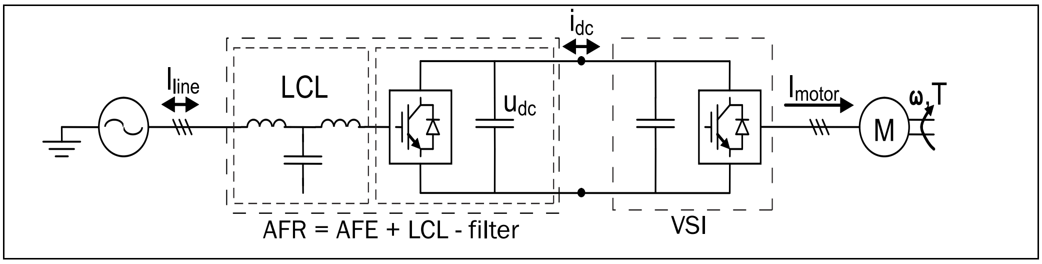


Fig. 3 VSI with AFR.

The AFR 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 (Udc). Other features are the possibility for reactive power compensation and boosted DC-link voltage.

2.2 Emotron AFR cabinet concept

2.2.1 Single drive applications

The Emotron regenerative AC drive, i.e. VFXR, is comprised by an AFR unit, i.e. AFE and filters, and a VSI, i.e. Emotron VFX or FDU. The concept is designed as a cabinet solution, see Fig. 4 ,

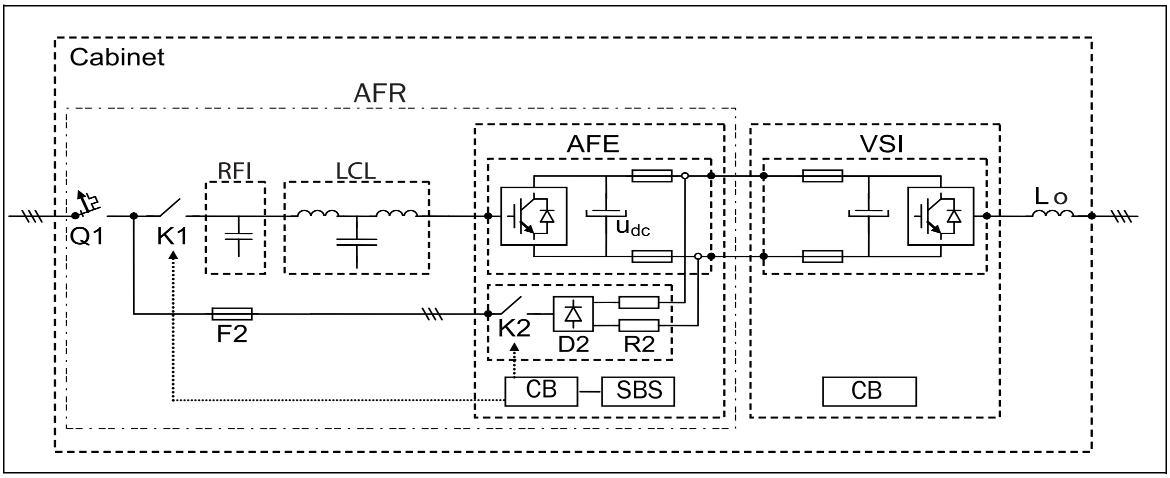


Fig. 4 Single drive in cabinet

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 and integrated pre-charge circuit (K2,D2,R2)
- AFR - 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.

2.2.2 Common DC-bus applications

For common DC-bus applications, the cabinet will contain only the AFR part of Fig. 4, i.e. all except the VSI & Lo.

2.3 Emotron AFR features

2.3.1 Power-up and DC-link charging

Power up and charge control of the Emotron AFR 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.

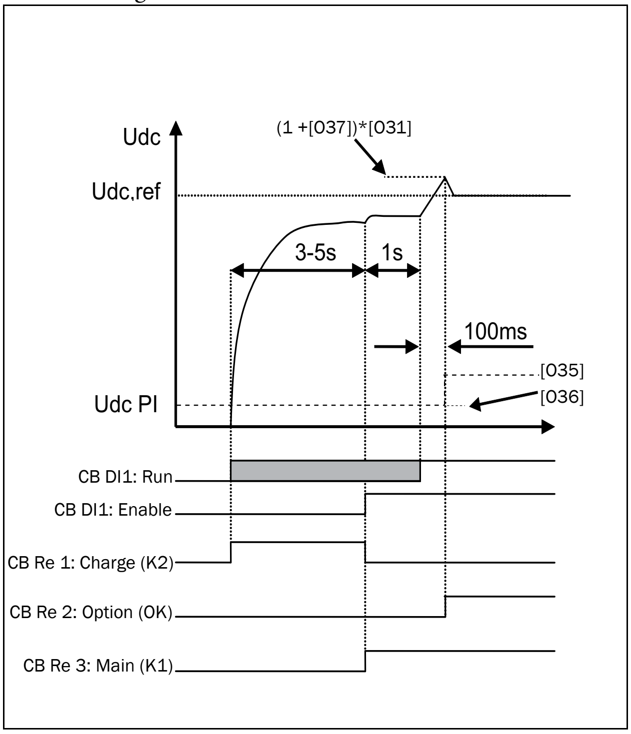


Fig. 5 DC-link voltage (U_{dc}) charge control.

Optional signal Running OK, i.e. U_{dc} under control, is signaled via default CB Relay2 selection 'Option' and is preferably used to enable the VSIs in order to interlock the AFR and VSIs. Typical time delay is <100ms after acknowledged run command.
If Auto ID mode[O16] is used an additional delay of 1s is inserted before Run command is acknowledged.

Table 4 I/O connection for AFR charge operation

AFR 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 only if K1 OK. Preferably used also for "Emergency Stop"input.

2.3.2 Automatic power supply parameter detection

The AFR 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 9.9 page 47 for detailed information about AFR parameters.

2.3.3 Power supply synchronisation

The AFR 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 9.9 page 47 for detailed information about AFR 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 [O17].

2.3.4 Start command

The AFR can be started from digital I/O, control panel (CP) or via serial communication options. Typically the AFR 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 when needed, i.e. when the VSI has a run command. Fig. 16, page 21

2.3.5 Start on regeneration demand

The AFR 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 modulation is deactivated and the free wheeling diodes operates as a DFE and in regenerating operation the AFR is activated and regenerates the energy back to the supply.

Regeneration start/stop operation

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

NOTE:
Requires supply voltage measurement.

2.3.6 Low voltage override

If running with voltage measurement board, AFE 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 (FDUL/VFXR) can continue its operation smoothly on returning of the supply.

NOTE: During the momentary dip, AFE 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 side. Contact your local supplier for assistance.

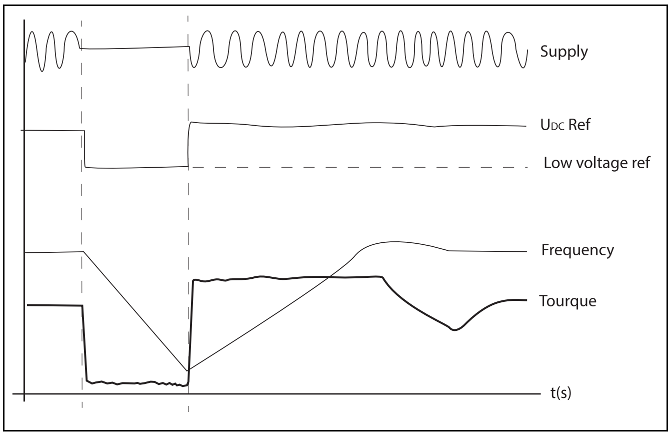


Fig. 6 Low voltage override

2.3.7 PWM modulation

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

2.3.8 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. 7

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.

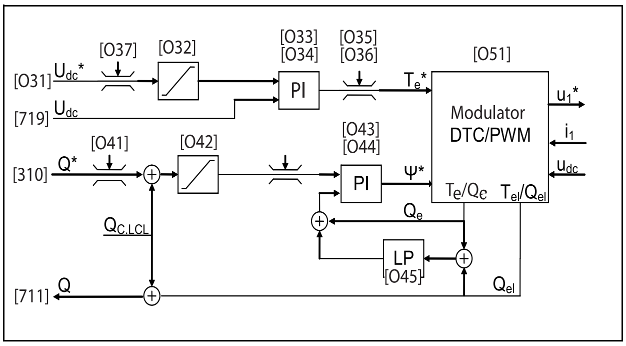


Fig. 7 U_{dc} and Q controllers.

PI - PI regulator

LP - Low pass filter

Te - Active power

Qe - Reactive power

*) Reference

2.3.9 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, i.e. over capacity not used for active power control. The reactive power control is utilised via the Q controller [O40], see Fig. 7.

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

2.3.10 Frequency (f) control

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

2.3.11 Energy actual value signals

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

2.3.12 Power factor calculations

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

$$Powerfactor = \frac{S}{\sqrt{P^2 + Q^2}}$$

S =Apparent Power

P = Active Power

Q = Reactive Power

2.3.13 Fault signals

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

- Supply error - Synchronization failure due to supply error problems
- Phase error - Synchronization failure due to frequency or phase sequence problems
- Sync error - Synchronization failure due to overcurrent
- AutoID error - Failure during Auto Identification Run, i.e. supply not correctly identified.
- Sensor error - Failure in supply voltage measurement option
- Frequency error - Supply frequency out of range
- Voltage error - Supply voltage out of range

2.3.14 Supply voltage measurement option

Supply voltage measurement can add the following improved functions

- AFR as Regenerative unit, i.e. DFE mode used in motor operation and AFR active in generator operation.
- Faster power supply synchronization.
- Improved starting characteristics at start-up.
- Improved performance/detection if VSI already loaded while syncing.

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.

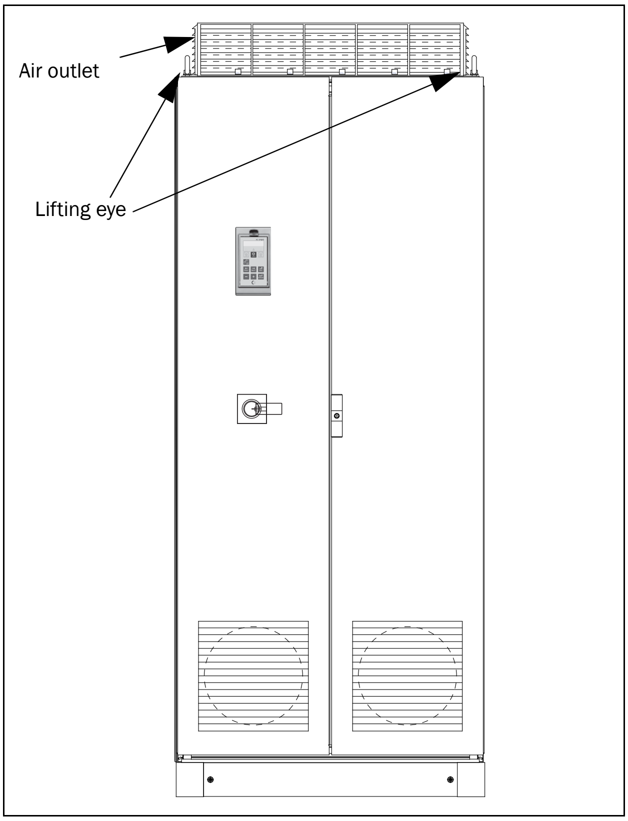


Fig. 8 Use the lifting eyes.

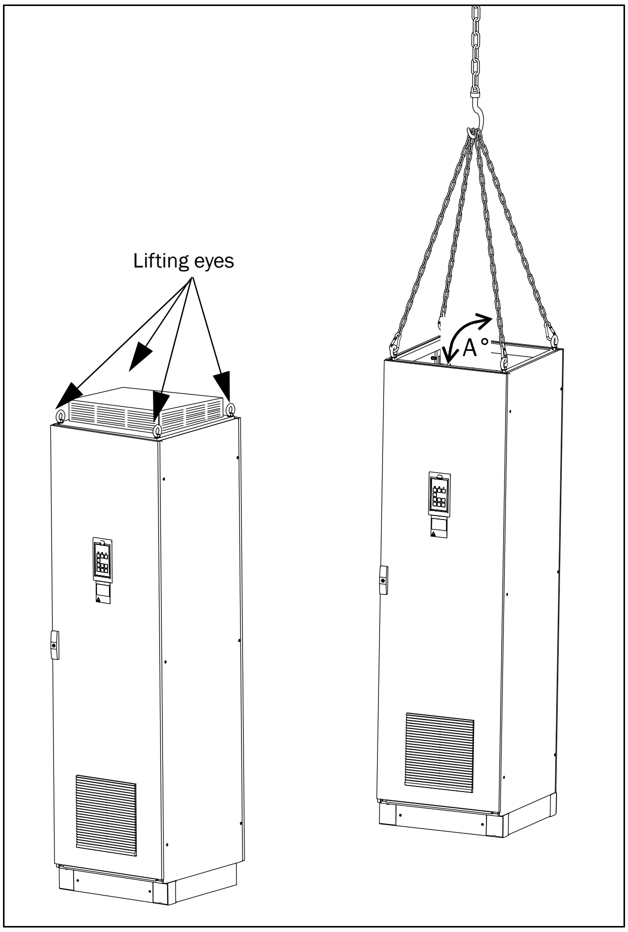


Fig. 9 Remove the roof unit and use the lifting eyes to lift single unit 600mm and 900mm.

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 600N

Regarding lifting instructions for other cabinet sizes, please contact CG Drives & Automation.

3.1.1 Cooling

Fig. 10 below shows the minimum free space required above the AFR and/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.

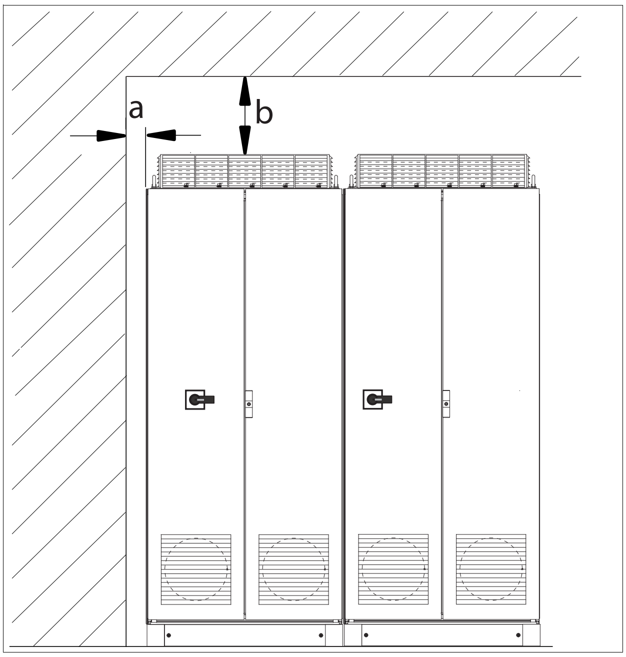


Fig. 10 Required free space around cabinet

Position	Free space
a	65 mm
b	200 mm

NOTE:
When a cabinet is placed between two walls, a minimum distance at each side of 200 mm must be maintained.

3.2 Cabinet mounting

3.2.1 Cooling

If the AFR 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 12.1 page 59.

Table 5 Flow rates cooling fans

Frame	AFR Model	Flow rate [m³/hour]
E46	175	510
F46	250	800
F69	175	
G46	375	1020
H46	500	1600
H69	355	
I46	750	2400
I69	525	
J46	1K0	3200
J69	700	
K46	1K5	4800
K69	1K05	

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

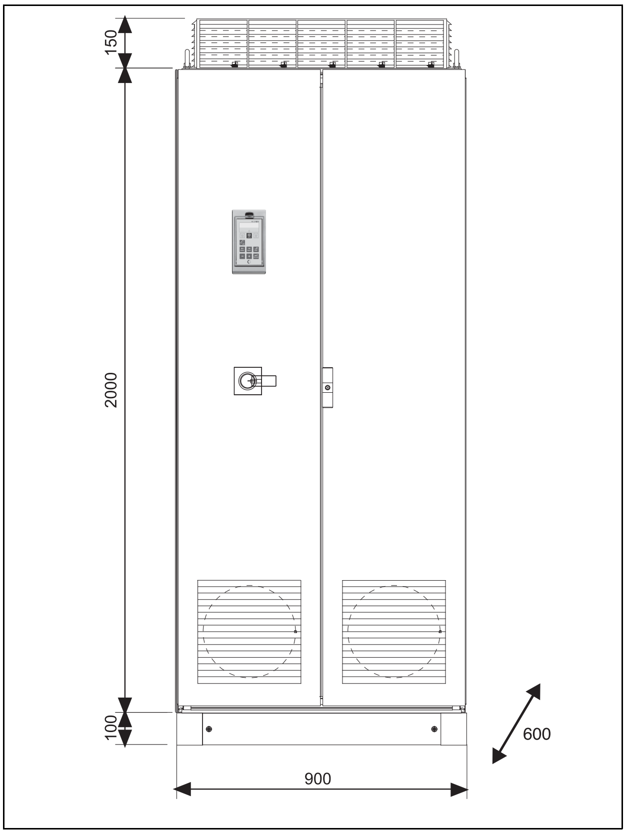


Fig. 11 VFXR/FDUL46: Model 175 to 250

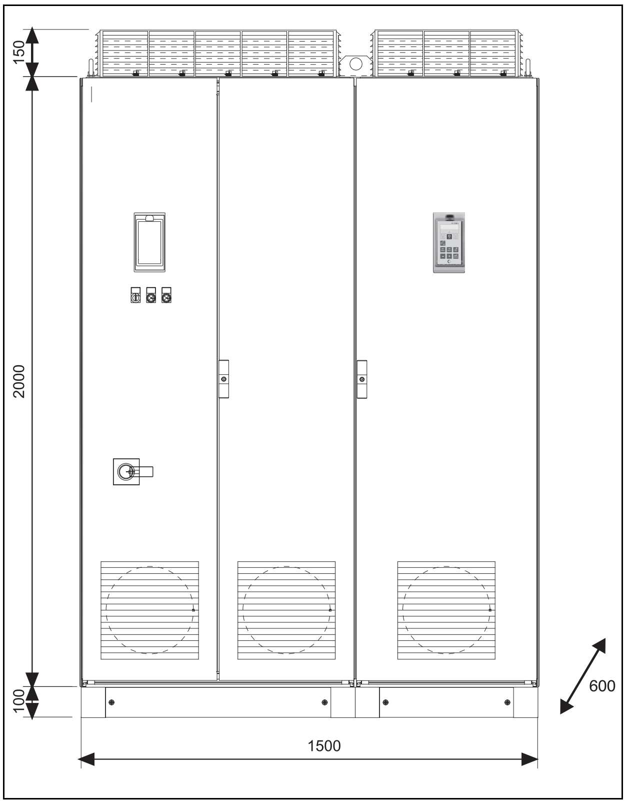


Fig. 12 VFXR/FDUL46: Model 375 to 500

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.

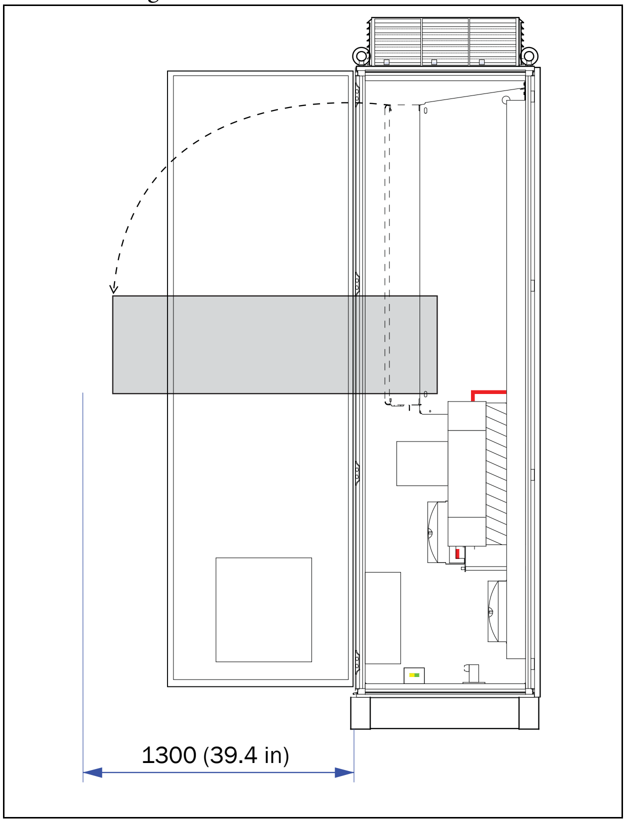


Fig. 13 Recommended free space in front of the cabinet .

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 and VSI is installed.

CAUTION!
Always consult CG Drives & Automation before connecting an AFR 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 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 and AC drive is temporarily stored before being connected, please check the technical data for environmental conditions. If the AFR 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 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

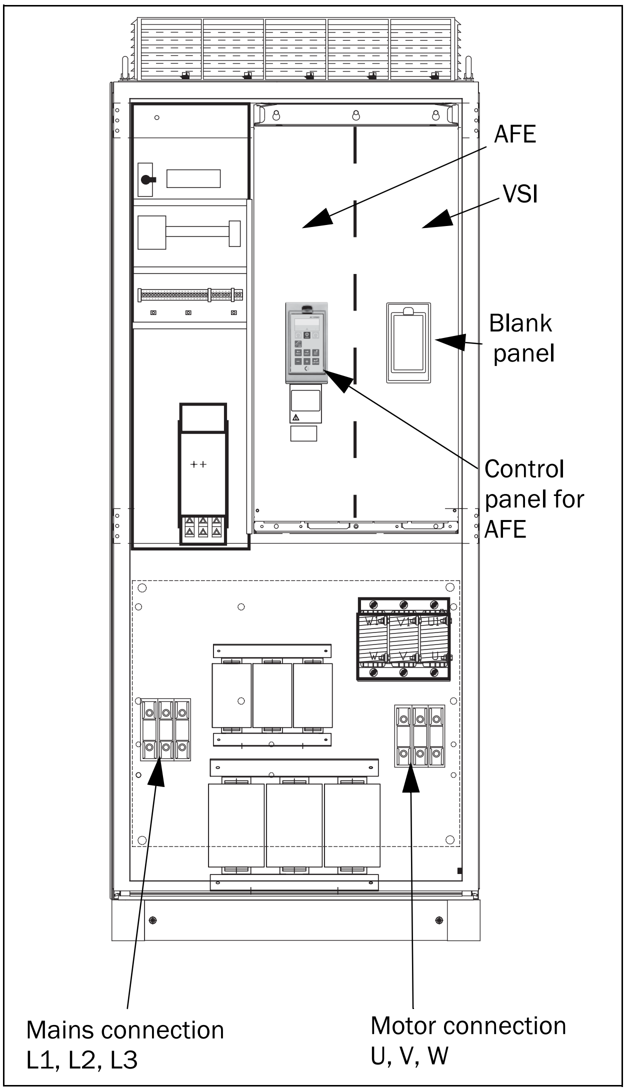


Fig. 14 Connecting motor and mains cables for VFXR/FDUL46 - 109 to 250

Table 6 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)

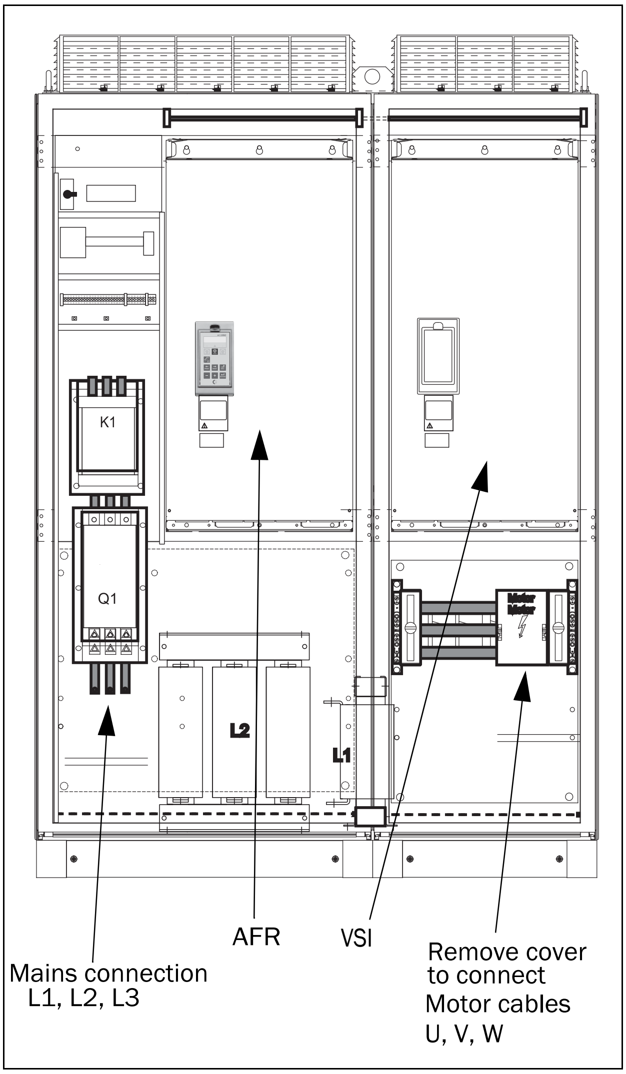


Fig. 15 Connecting motor and mains cables for VFXR/FDUL46 - 375 to 500

4.2.2 Common DC-bus

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

4.3 Cable specifications

Table 7 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.

5. Control Connections for Emotron VFXR and FDUL

Fig. 16 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.

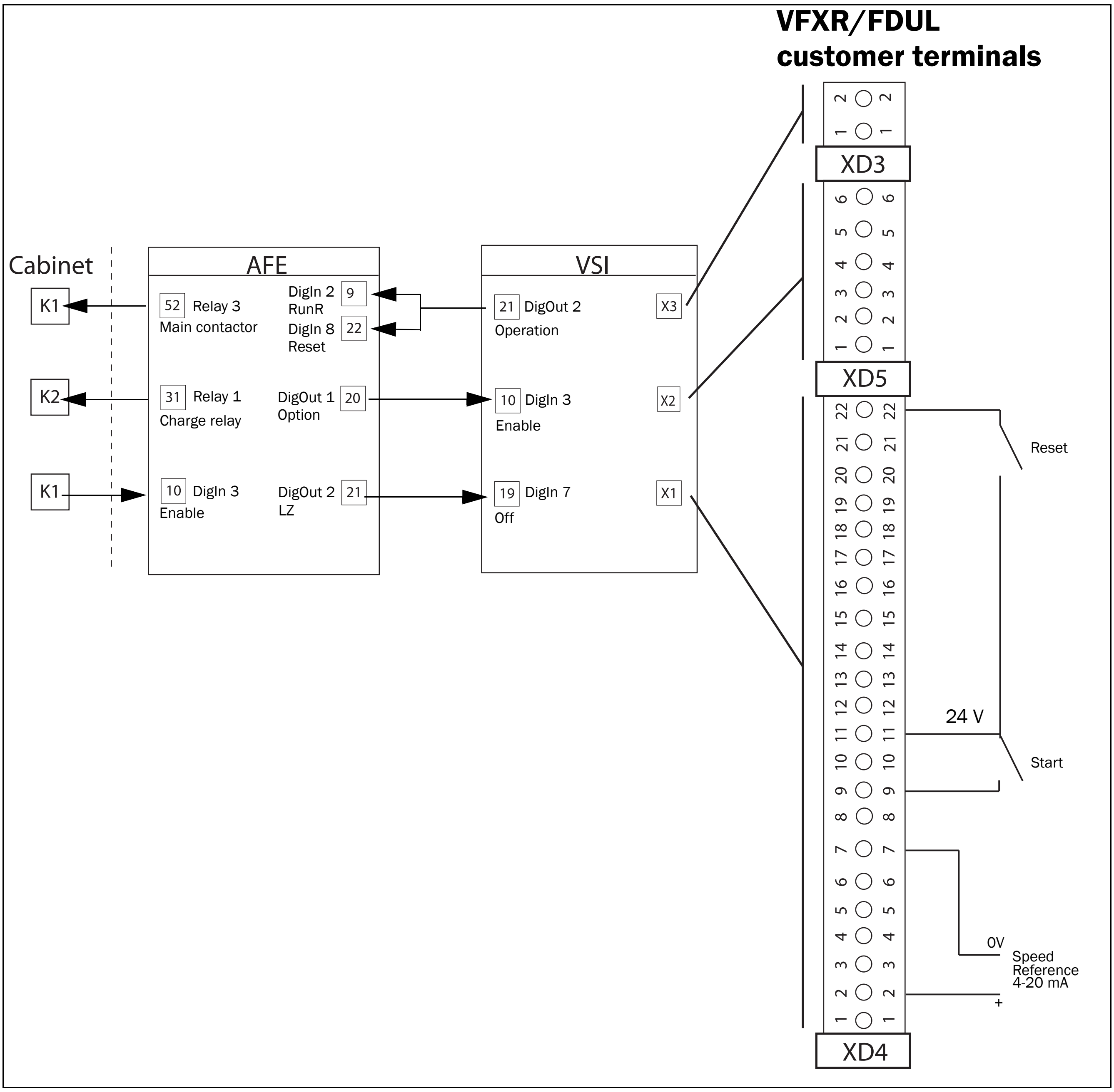


Fig. 16 Recommended control signals

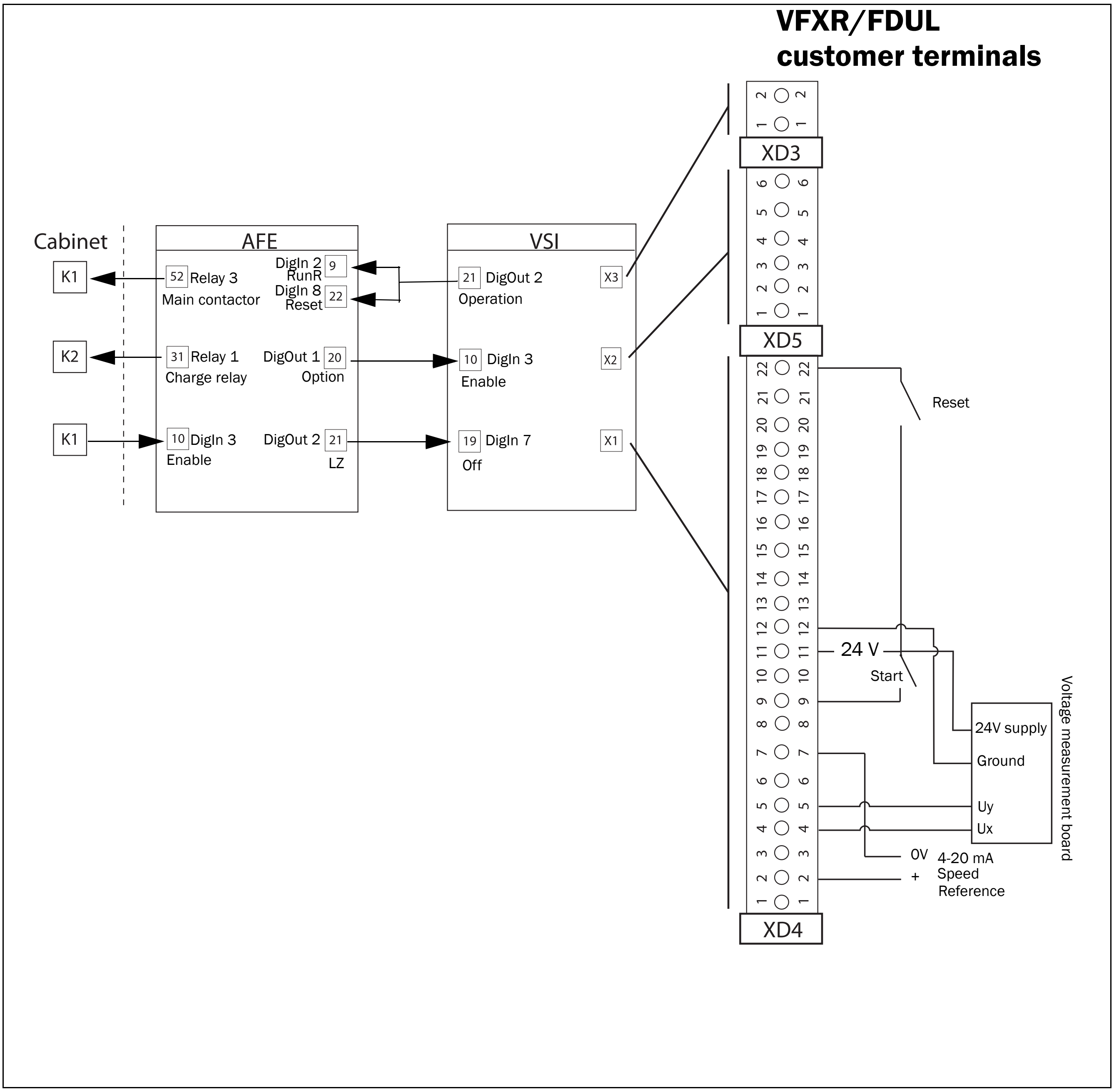


Fig. 17 Alternative wiring scheme with voltage measurement board.

5.1 Terminal connections for AFR

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 9. page 39. For signal specifications refer to chapter 12. page 59.

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

NOTE:
The maximum total combined current for outputs 11, 20 and 21 is 100mA.

Table 8 Control signals for AFR

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	Option (Active when AFR is running)
21	DigOut 2	LZ (Trip pulse of 1s)
Analogue inputs		
2	AnIn 1	Process Ref
3	AnIn 2	Off
4	AnIn 3	Dedicated for supply voltage measurement option.
5	AnIn 4	Dedicated for supply voltage measurement option.
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 output Option (Active when the AFR is running).
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.

5.2 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 9.
The switches on the Control board are accessible after opening the door and removing the PPU cover plate.

Table 9 Switch settings

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

NOTE:
Scaling and offset of AnIn1 - AnIn4 can be configured using the software. See menus [512], [515], [518] and [51B] in instruction manual for Emotron VFX /FDU 2.0.

NOTE:
the 2 analogue outputs AnOut 1 and AnOut 2 can be configured using the software. See in instruction manual for Emotron VFX /FDU 2.0.

NOTE:
Switches for AnIn3 and 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.

5.3 Connecting the Control Signals

5.3.1 Cables

The standard control signal connections are suitable for stranded flexible wire up to 1.5 mm^2 and for solid wire up to 2.5 mm^2.

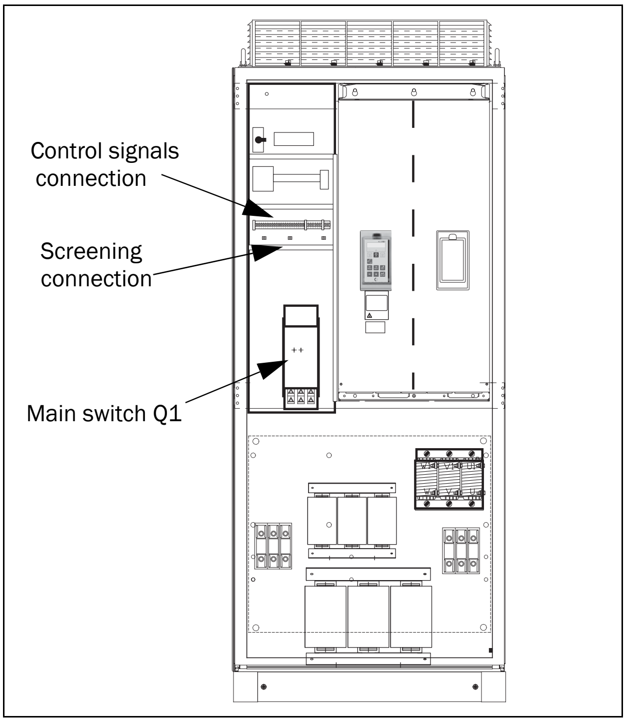


Fig. 18 Connecting the control signals VFXR/FDUL46 -109 to 250.

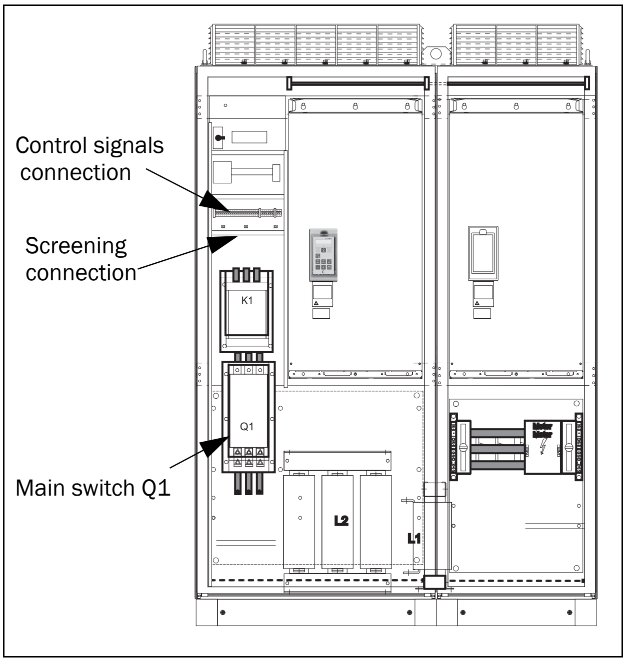


Fig. 19 Connecting control signal VFXR/FDUL46-375 to 500.

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.

5.3.2 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	Rigid cable: 0.14-2.5 mm^2 Flexible cable: 0.14-1.5 mm^2 Cable with ferrule: 0.25-1.5 mm^2	0.5 Nm	Screened
Digital			Screened
Data			Screened
Relay			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.

5.3.3 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. 20.

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.

5.3.4 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 5.3.2 the best results are obtained if the screening is connected to both ends. See Fig. 20.

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

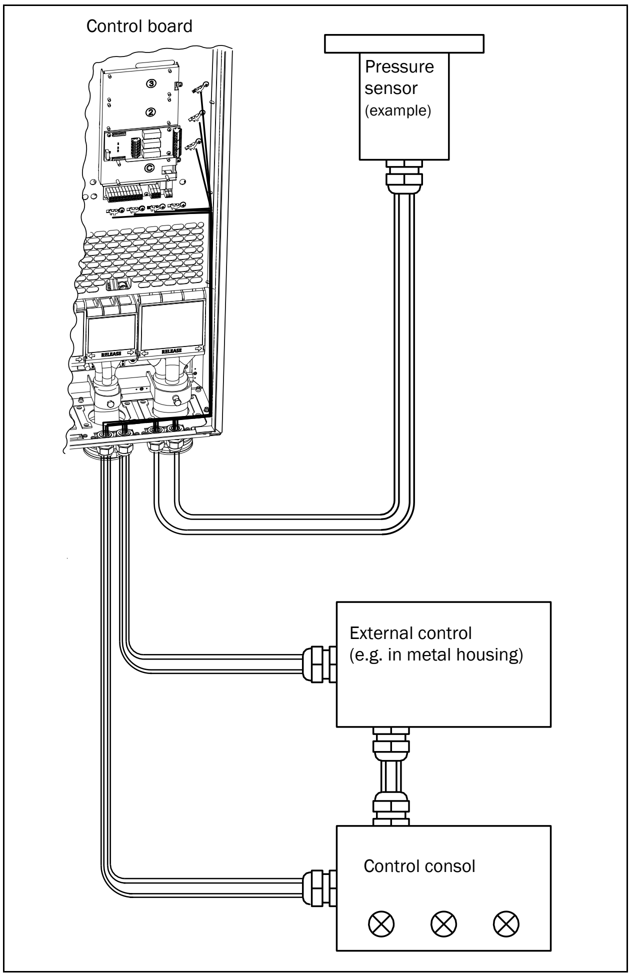


Fig. 20 Electro Magnetic (EM) screening of control signal cables.

5.3.5 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 kΩ). It is therefore strongly advised to use current control signals if the cables are longer than a few metres.

5.3.6 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°.

5.4 Connecting options

See instruction manual for Emotron VFX 2.0 for how to connect option cards.

6. Getting Started

This chapter is a step by step guide that will show you the quickest way to get the motor shaft turning. We will show you setup with remote control.

We assume that the AFR and VSI is mounted in a cabinet as in the chapter 3. page 15.

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, 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 and VSI load current.
Connect mains cables and motor cables according to chapter 4.2 page 19.

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 8. page 33

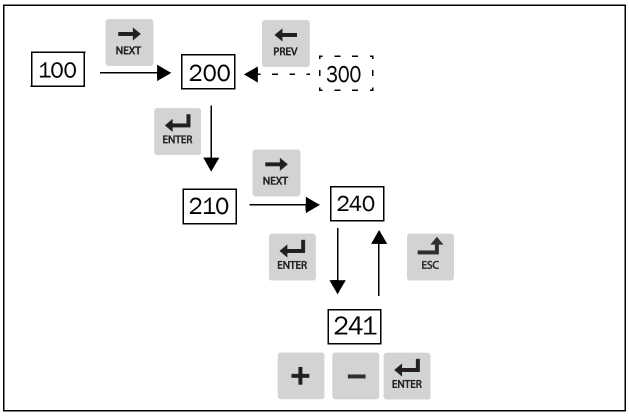


Fig. 21 Example of menu navigation when entering motor voltage

ENTER	step to lower menu level or confirm changed setting
ESC	step to higher menu level or ignore changed setting
NEXT	step to next menu on the same level
PREV	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 is controlled from the VSI.

In order to perform the setup examples, you will use the control panels for the AFR (inside cabinet) and VSI (cabinet door), see Fig. 24, page 33. For further information about the control panel (CP) and menu structure, see chapter 8. page 33.

6.3.1 Set up AFR

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 VFXR/FDUL door. Check wiring according to Fig. 16, page 21.

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 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. If voltage measurement board is connected Set "[O17] Volt sensor" to On.
4. Perform a supply ID-run [O15]
   a) [Set [O15] Supply ID run to On, confirm with ENTER
   b) Give start command
   c) The AFE will now measure and setup supply parameters
   * [O11] Supply volatge
   * [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.
5. 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 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 by pressing Stop/Reset.
6. Setup AFR 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 default parameter setup according to Table 10 below.

Table 10   Default parameter setup for AFR

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	Option	
[542] DigOut 2	LZ	
[523] DigIn 3	Enable	Cabinet hardware control/feedback
[551] Relay 1	Charge K2	
[552] Relay 2	Option	
[553] Relay 3	Main K1	
[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	

7. Now the AFR is set to be controlled from the VSI
8. Close the AFR 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 φ) [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 via I/O, see Table 11.
   a) Set digital output 2 [542] to "Operation". Gives start command to AFR from VSI.
   b) Set digital input 3 [523] to "Enable". Feedback to VSI that AFR is running.
   c) Adapt AFR trip pulse polarity for VSI Extern Trip polarity
   * Set digital input 7 [527] to "Off". Feedback to VSI that AFE is tripped (pulse if 1s).
   * Set digital comparator 1 [6151] to "DigIn7".
   * Set virtual I/O 1 Source [562] to "!D1".
   * Set virtual I/O 1 Destination [561] to "Ext Trip".
   see Table 11.

Table 11   Default parameter setup for VSI (VFX/FDU 2.0)

Parameter	Setup	Comment
[523] DigIn 3	Enable	Feedback AFE running
[542] DigOut 2	Operation	Command AFE run
[527] DigIn 7	Off	Feedback AFE trip via Ext Trip
[561] VIO 1 Dest	External trip	
[562] VIO 1 Source	!D1	
[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. 22.
   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.

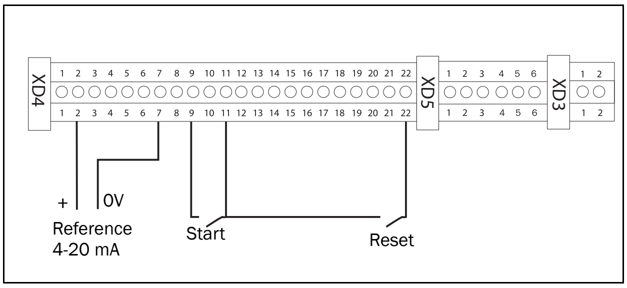


Fig. 22 Wiring

6. Close the door and switch on the power supply. Once the mains is switched on, the internal fans of the AFR 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, VSI and motor are running the main connections are OK.

7. EMC and Machine Directive

7.1 EMC standards

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

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

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.

7.2 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.

8. Operation via the Control Panel

This chapter describes how to use the control panel. If nothing else is mentioned, this information is valid for both AFR and VSI.

8.1 Control panels

There are two control panels, one main panel in the Cabinet door controlling the complete Emotron VFXR/FDUL and one internal AFR panel designated for service engineers.

8.1.1 Main control panel for Emotron VFXR/FDUL

The Emotron VFXR/FDUL is equipped with one main control panel on the cabinet door see Fig. 23. When we further in this chapter describe how to use the control panel this is the one we are referring to.

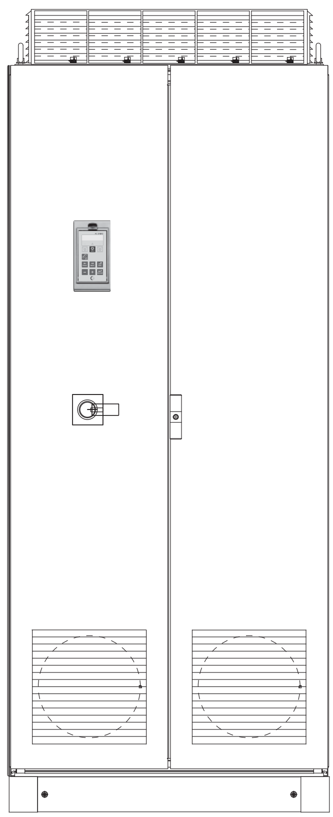


Fig. 23 VXFR with control panel in front door.

8.1.2 Control panel for AFR

Inside the cabinet door you will find a second control panel for the AFR unit, see Fig. 24. 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.

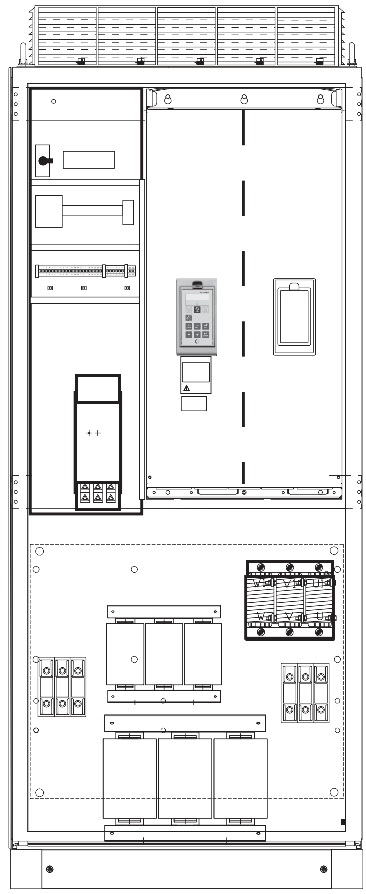


Fig. 24 Open the cabinet door to expose the AFR control panel.

8.2 General

The control panel in the front door displays the status of the Emotron VXFR 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.

8.3 The control panel

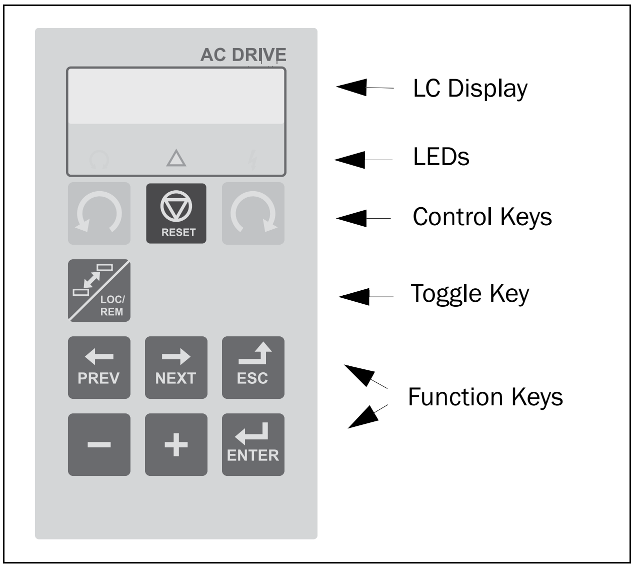


Fig. 25 Control panel

8.3.1 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:

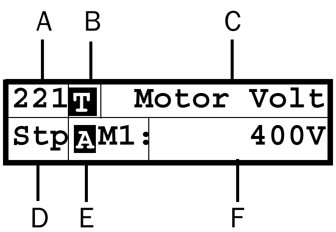


Fig. 26 The display

Area A: Shows the actual menu number (3 or 4 digits).

Area B Shows if the menu is in the toggle loop or the VSI is set for Local operation.

Area C: Shows the heading of the active menu.

Area D: Shows the status of the VSI (3 digits).
The following status indications are possible:

Acc : Acceleration
Dec : Deceleration
I^{2}t : Active I^{2}t protection
Run : Motor runs
Trp : Tripped
Stp : Motor is stopped
VL : Operating at Voltage limit
SL : Operating at Speed limit
CL : Operating at Current limit
TL : Operating at Torque limit
OT : Operating at Temperature Limit
LV : Operating at Low Voltage
Sby : Operating from Standby power supply
SST : Operating Safe Stop, is flashing when activated
LCL : Operating with low cooling liquid level

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 8.3.2 page 34

```
300 Process Appl
Stp A
```

Fig. 27 Example 1st level menu

```
220 Motor Data
Stp A
```

Fig. 28 Example 2nd level menu

```
221 Motor Volt
Stp A M1:    400V
```

Fig. 29 Example 3d level menu

```
4161 Max Alarm
Stp A        0.1s
```

Fig. 30 Example 4th level menu

8.3.2 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.

8.3.3 LED indicators

The symbols on the control panel have the following functions:

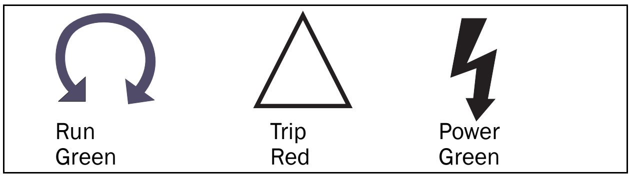


Fig. 31 LED indications

Table 12 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/VSI stopped

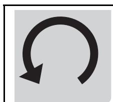
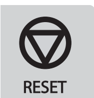
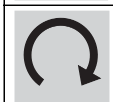
NOTE: If the control panel is built in, the back light of the display has the same function as the Power LED in Table 12 (Blank panel LEDs).

8.3.4 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].

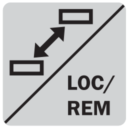
If the Enable function is programmed on one of the digital inputs, this input must be active to allow Run/Stop commands from the control panel.

Table 13 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).

8.3.5 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 8.6, page 38.

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. 32 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.

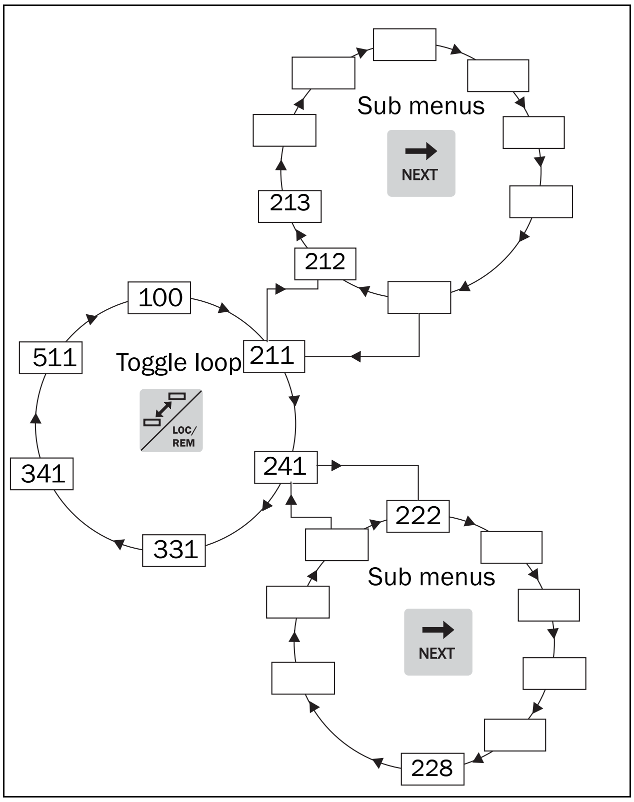


Fig. 32 Default toggle loop

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] according to the selection in Keyboard Reference menu [369].

Remote mode

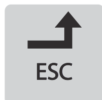
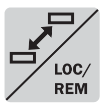
When the VSI is switched to REMOTE operation, the VSI will be controlled according to selected control methods in the menu's Reference Control [214], Run/Stop Control [215] and Reset Control [216]. The actual operation status of the VSI will reflect the status and settings of the programmed control selections, e.g. Start/Stop status and settings of the programmed control selections, acceleration or deceleration speed according to the selected reference value in the menu Acceleration Time [331] / Deceleration Time [332].

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].

8.3.6 Function keys

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

Table 14 Function keys

	ENTER key:	- step to a lower menu level - confirm a changed setting
	ESCAPE key:	- step to a higher menu level - ignore a changed setting, without confirming
	PREVIOUS key:	- step to a previous menu within the same level - go to more significant digit in edit mode
	NEXT key:	- step to a next menu within the same level - go to less significant digit in edit mode
	- key:	- decrease a value - change a selection
	+ key:	- increase a value - change a selection
	TOGGLE and LOC/REM key:	- Toggle between menus in the toggle loop - Switching between local and remote control - Change the sign of a value

8.4 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 (Set/View Reference Value [310]), or it can have 17 selectable menus (menu Speeds [340]).

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

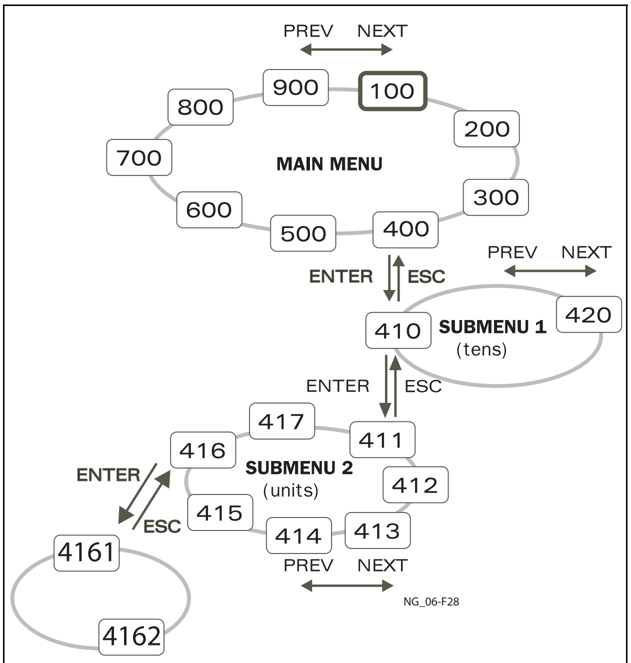


Fig. 33 Menu structure (general principle)

8.4.1 The main menu for AFR

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

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

000 AFR Option

Main setup for AFR dedicated features

8.5 Programming during operation

Most of the parameters can be changed during operation without stopping the AFR 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 is stopped, the message "Stop First" is displayed.

8.6 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.

```
331     Acc Time
StpA█      2.00s
```

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, i.e. from 2 s to 400 s.

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 4 will blink.

```
331     Acc Time
StpA       4.00s
```

Flashing

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

8.7 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.

8.8 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.

100 0rpm / StpA 0.0A	Menu 100 appears after power-up.
NEXT	Press Next for menu [200].
200 MAIN SETUP / StpA	
ENTER	Press Enter for menu [210].
210 Operation / StpA	
ENTER	Press Enter for menu [211].
211 Language / StpA	
+	
211 Language / StpA█Nederlands (Flashing)	Keep + key pressed until desired language has been reached.
ENTER	
211 Language / StpA Nederlands	Save the selected language by pressing Enter.

Fig. 34 Programming example

9. Functional Description for AFR unit

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

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

NOTE:
For communication information refer to the Instruction manuals for Emotron VFX/FDU 2.0

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

Resolution of settings

The resolution for all range settings described in this chapter is 3 significant digits. Table 15 shows the resolutions for 3 significant digits.

Table 15

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

9.1 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 A    0%     0 W
```

Menu [100], Preferred View displays the settings made in menu [110], 1st line, and [120], 2nd line. See Fig. 35.

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

Fig. 35 Display functions

9.1.1 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
Heatsink Tmp	10	Heatsink temperature
AFR Status	12	AFR status
Run Time	13	Run Time
Energy	14	Energy
Mains Time	15	Mains time

9.1.2 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

9.2 Main Setup [200]

The Main Setup menu contains the most important settings to get the AFR 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. This menu will instantaneously be adapted to build in options and show the required settings.

9.2.1 Operation [210]

Selections concerning the control signals and serial communication are described in this submenu 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.

		211 Language Stp A English
Default:		English
English	0	English selected
Svenska	1	Swedish selected
Nederlands	2	Dutch selected
Deutsch	3	German selected
Français	4	French selected
Español	5	Spanish selected
Русский	6	Russian selected
Italiano	7	Italian selected
Česky	8	Czech selected
Turkish	9	Turkish selected

Reference control [214]

To control the reactive power of the AFE needs a reference signal. This reference signal can be controlled by a remote source from the installation, the keyboard of the AFR, or by serial or fieldbus communication. Select the required reference control 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.

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.

Reset Control [216]

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

		216 Reset Ctrl Stp A Keyboard
Default:		Keyboard
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).

Local/Remote key function [217]

Please refer to the instruction manual for Emotron VFX/ FDU 2.0 for further information.

Lock Code [218]

Please refer to the instruction manual for Emotron VFX/ FDU 2.0 for further information.

Remote signal Level/Edge [21A]

Please refer to the instruction manual for Emotron VFX/ FDU 2.0 for further information.

9.2.2 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 with function [721] FI 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 [923], 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.

9.2.3 Trip Autoreset/Trip Conditions [250]

Please refer to the instruction manual for Emotron VFX/ FDU 2.0 for further information.

9.2.4 Serial Communication [260]

Please refer to the instruction manual for Emotron VFX/ FDU 2.0 for further information.

9.3 Process and Application Parameters [300]

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

9.3.1 Set/View Reference Value [310]

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

NOTE:
Positive value - Capacitive or leading.
Negative value - 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..

```
310 Set/View ref
Stp            0%
```

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, see chapter "Reference signal" in instruction manual for Emotron VFX /FDU 2.0.

NOTE:
To get any value in menu [310], Qmax should be other than 0.

9.4 I/Os and Virtual Connections [500]

For settings of the standard inputs and outputs of the AFE refer to the Instruction manual for Emotron VFX/FDU 2.0.

NOTE:
Relay 1 is dedicated to Charge relay K2.
Relay 3 is dedicated for main Contactor K1.

NOTE:
Default values can differ in comparison to standard manual.

NOTE:
If Voltage measurement board is used, AnIn 3 and 4 are fixed to voltage measurement.

9.5 Logical Functions and Timers [600]

For programming of Comparators, Logic Functions and Timers se Instruction manual for Emotron VFX/FDU 2.0.

NOTE:
Default values can differ in comparison to standard manual.

9.6 View Operation/Status [700]

Menu with parameters for viewing all actual operational data, such as speed, torque, power, etc.

9.6.1 Operation [710]

Process Value (Reactive power) [711]

The process value is a display function which can be programmed according to several quantities and units related to the reference value in % of nominal power.

NOTE:
Positive value - Capacitive or leading.
Negative value - Inductive or lagging.

	711 Process Val Stp 0%
Unit	%
Resolution	1%

Torque [713]

Displays the virtual torque in % of nominal power and in W.

NOTE:
Positive value - Generating.
Negative value - Motoring.

	713 Torque Stp 0% 0W
Unit:	W
Resolution:	1 W

Reactive power [714]

Displays the actual reactive power.

NOTE:
Positive value - Capacitive or leading.
Negative value - Inductive or lagging.

	714 ReactPower Stp W
Unit:	W
Resolution:	1W

Electrical Power [715]

Displays the actual electrical output power.

NOTE:
Positive value - Generating.
Negative value - Motoring.

	715 El Power Stp kW
Unit:	kW
Resolution:	1 W

Current [716]

Displays the actual output current.

	716 Current Stp A
Unit:	A
Resolution:	0.1 A

Output Voltage [717]

Displays the actual output voltage, i.e. AFR terminal voltage.

	717 Output Volt 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

Heatsink Temperature [71A]

Displays the actual heatsink temperature.

	71A Heatsink Tmp Stp °C
Unit:	°C
Resolution:	0.1°C

9.6.2 Status [720]

For viewing the overall status of the AFR refer to the instruction manual for Emotron VFX/FDU 2.0.

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	Not used

Communication information

Modbus Instance no/DeviceNet no:	31016
Profibus slot/index	121/160
EtherCAT index (hex)	23f8
Profinet IO index	1016
Fieldbus format	UInt
Modbus format	UInt

9.6.3 Stored values [730]

For viewing the stored values of the AFR refer to the instruction manual for Emotron VFX/FDU 2.0.

9.7 View Trip Log [800]

Main menu with parameters for viewing all the logged trip data. In total the AFR 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.

9.7.1 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      h:mm:ss
```

Unit:	h: m (hours: minutes)
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.

Trip message [811]-[81N]

The information from the status menus are copied to the trip message log when a trip occurs.

Trip menu	Copied from	Description
811	711	Process Value
813	713	Torque
814	714	Reactive Power
815	715	Electrical Power
816	716	Current
817	717	Output voltage
818	718	Frequency
819	719	DC Link voltage
81A	71A	Heatsink Temperature
81C	721	VSI 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	Process reference

Example:

Fig. 36 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. 36 Trip 3

9.7.2 Trip Messages [820] - [890]

Same information as for menu [810].

9.7.3 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.

9.8 System Data [900]

Main menu for viewing all the AFR system data.

9.8.1 AFR Data [920]

AFR Type [921]

Shows the AFR type according to the type number.

The options are indicated on the type plate of the AFR.

```
921        AFR2.0
Stp    AFR46-175
```

Fig. 37 Example of type

Examples:

AFR46-175 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.

Fig. 38 gives an example of the version number.

```
922 Software
Stp   V4.30-97.03
```

Fig. 38 Example of software version

Table 16 Information for Modbus and Profibus number, software version

Bit	Description
7–0	minor
13–8	major
15–14	release 00: V, release version 01: P, pre-release version 10: β, Beta version 11: α, Alpha version

Table 17 Information for Modbus and Profibus number, option version

Bit	Description
7–0	minor
15–8	major

V 4.30 = Version of the Software

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.

9.9 AFR Option [000]

Main menu for AFR dedicated settings.

9.9.1 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.

	011 Supply Volts Stp 400 V
Default:	400 V
Range:	380 - 460 V

Supply Frequency [012]

Nominal supply frequency.
This parameter is important for smooth start-up.
During operation, AFE controller automatically monitors the grid frequency.

	012 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.

	013 Supply Curr Stp AFR. Inom
Default:	AFR. Inom
Range:	0 - AFR. Inom

Supply Sequence [014]

Nominal phase sequence of supply. Supply ID run [015]

		014 Supply Seq Stp Pos
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.

		015 Supply IDrun Stp Off
Default:		Off
Off	0	
On	1	Activate the supply ID-run

Supply Auto [016]

Automatic activation of supply parameter identification after every power-up.

		016 Supply Auto Stp Off
Default:		Off
Off	0	
On	1	Activate automatic ID-run

Volt sensor [017]

Supply voltage sensor option.

		017 Volt sensor Stp Off
Default:		Off
Off	0	
On	1	Activate supply voltage measurement.

NOTE:
Requires supply voltage measurement hardware option.

9.9.2 Charge/Start parameters [020]

Main menu for charge control and start/stop parameters.

Charge control [021]

DC-link Charge relay control function.

		021 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.

NOTE:
Normally open (NO) alternatives requires 24 V Standby supply option.

Start Mode [022]

Start/Stop mode. If set to "Regen" AFR starts on regenerative demand.

		022 Run/Stp Mode Stp Standard
Default:		Standard
Standard	0	AFR active via Run command
Regen	1	AFR 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 in motoring mode.

	023 Reg Stp Mode Stp 1s
Default:	1s
Range	0.0 - 10.0s

NOTE:
Regeneration mode requires supply voltage measurment.

Auto restart[024]

This menu will only be shown if "Volt sensor [017]"iis set to "On".

This parameter allows AFR to withstand momentary dips in the main supply..

		024 Auto restart Stp Off
Default:		Off
Off	0	
On	1	Activates automatic restart

NOTE:
This menu will only appear if menu [017] is set to On.

9.9.3 Udc controller oparameters [030]

Main menu for DC-link voltage (Udc) parameters.

Udc reference [031]

DC-link voltage reference value..

	031 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.

	032 Udc ramp Stp 1s
Default:	1s
Range	0.0 - 10.0s

Udc PI Gain controller [033]

Proportional gain of Udc PI controller..

	033 Udc PI Gain Stp 5.0
Default:	5.0
Range	0.0 - 10.0

Udc PI Time controller [O34]

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 [O35]

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 [O36]

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[O37]

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 [O37 Udc margin], i.e.

$$\sqrt{3} \times Uac \times (1 + [O37])$$

where Uac is actual supply voltage.

9.9.4 Reactive power (Q) controller parameters [O40]

Q Max limit [O41]

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 [O42]

Q ramp time, defined as time from 0->100%.

	O42 Q ramp Stp 1s
Default:	1s
Range	0.0 - 10.0s

Q PI Gain [O43]

Q PI controller P gain.

	O43 Q PI Gain Stp 0.10
Default:	0.10
Range	0.00 - 1.00

Q PI Time [O44]

Q PI controller I time.

	O44 Q PI Time Stp 0.1s
Default:	0.1s
Range	0.0 - 10.0s

Q Filter time [O45]

Q filter time in dynamic/static feedback loop.

	O45 Q Filter Stp 1s
Default:	1s
Range	0.0 - 10.0s

9.9.5 Frequency controller parameters [050]

Frequency type [051]

Use frequency observer to handle variations in supply frequency.

		051 Freq Type Stp Observer
Default:		Observer
Observer	0	Use observer
Fixed	1	Use fixed frequency

9.9.6 View energy status [080]

Energy from Supply [081]

Energy from Supply (Total = Motoring - Generating).

	081 Energy Suppl Stp 1Wh
Unit:	Wh
Resolution:	1Wh

Energy to Motor [082]

Energy delivered to Motor (Motoring mode).

	082 Energy Motor Stp 1Wh
Unit:	Wh
Resolution:	1Wh

Energy to Supply [083]

Energy delivered to Supply (Generating mode).

	083 Energy Gen Stp 1Wh
Unit:	Wh
Resolution:	1Wh

Reset energy [084]

Clear all energy Wh counters [O81] - [O83]

		084 Reset Energy Stp No
Default:		No
No	0	
Yes	1	Clear Wh counters.

9.9.7 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 %

Power factor [095]

Internal power factor reference (Cos_φ), actual value.

	095 Cos_φ Stp 0.012
Range:	-1 to 1
Resolution:	0.001

10. Troubleshooting, Diagnoses and Maintenance

10.1 Trips, warnings and limits

In order to protect the AFR 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/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/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/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 18 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
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		
Phase error	On		
Sync error	On		
AutoID error	On		
Sensor error	On		
Freq Error	On		
Volt Error			

* Refer to Table 19 regarding which Desat or Power Fault is triggered.

NOTE: For VSI refer to the Instruction manual for Emotron FDU/VFX.

10.2 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 active front end and variable speed drive are mostly just a small part of a complete VSI 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/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 7. page 31.

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 or VSI or any part of the system (motor cable housing, conduits, electrical panels, cabinets, etc.) to inspect or take measure-ments as suggested in this instruction manual, it is absolutely necessary to read and follow the safety instructions in the manual.

10.2.1 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.

10.2.2 Opening the variable speed drive

WARNING!
Always switch the mains voltage off if it is necessary to open the AFR 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 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 or VSI.

10.2.3 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 and VSI. Wait at least 5 minutes before continuing.

10.2.4 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. 39 Autoreset trip

Fig. 39 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 19 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) O(ver) volt M(ains) cut	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.
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 mains supply voltage is within the limits of the VSI. - Try to use other mains supply lines if dip is caused by other machinery
Desat Desat U+ * Desat U- * Desat V+ * Desat V- * Desat W+ * Desat W- * Desat BCC *	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 cabinett and cable connections
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 mains supply voltage is within the limits of the VSI. - Try to use other mains supply lines if dip is caused by other machinery.

Table 19 Trip condition, their possible causes and remedial action

Trip condition	Possible Cause	Remedy
Power Fault	One of the PF(Power Fault) trips below has occured, 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.
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 syncronisation current pulse detected	- 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)
Phase Error	Failed to verify setup phase sequence during synchronisation	
Sync Error	Overcurrent during synchronisation to supply	- Check mains supply voltage - Check LCL-filter and cables - Check Circuit breaker and main contactor - Check supply parameters [O11]-[O14]
AutoID Error	Failure during ID run -Supply could not be identified	
Sensor Error *	Error in voltage measurement	- Check mains supply voltage - Check wiring of voltage sensor
Freq. Error	Supply frequency out of range	- Check mains supply voltage and frequency - Check LCL-filter and cables - Check Circuit breaker and main contactor - Check supply parameters [O11] - [O14]
Volt Error	Supply voltage out of range	

* = 2...6 Module number if parallel power units (size 300–1500 A)

NOTE:
For VSI refer to the Instruction manual for Emotron FDU/ VFX.

10.3 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.

11. Options

11.1 Voltage measurement board

Part number	Description
01-5178-00	Voltage measurement board.
01-5178-50	Voltage measurement board 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 also allows the active frontend 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.

11.2 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.

11.3 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.

12. Technical Data

12.1 Electrical and mechanical specifications related to model

12.1.1 Emotron VFXR/FDUL

Table 20 VFXR/FDUL typical motor power at mains voltage 400 V (refer also to the instruction manual for Emotron VFX/FDU)

VFXR/FDUL Model	Max output current Imax [A]*	Normal duty 120%, 1 min every 10 min		Heavy duty 150%, 1 min every 10 min		Frame	Dimensions Height=2,250 mm Depth=600 mm Width [mm]	Weight [kg]	AFR model
		Rated current Inom [A]	Power @400 V [kW]	Rated current Inom [A]	Power @400 V [kW]				
46-109	131	109	55	87	45	E46+E=G	800	380	AFR46-175
46-146	175	146	75	117	55	E46+E=G	800	400	AFR46-175
46-175	210	175	90	140	75	E46+E=G	900	480	AFR46-175
46-210	252	210	110	168	90	F46+F=H	900	500	AFR46-250
46-250	300	250	132	200	110	F46+F=H	900	500	AFR46-250
46-300	360	300	160	240	132	F46+H=I	1,300	700	AFR46-250
46-375	450	375	200	300	160	G46 +G	1,500	750	AFR46-375
46-430	516	430	220	344	200	G46+H	1,500	830	AFR46-375
46-500	600	500	250	400	220	H46+H	1,500	880	AFR46-500
46-600	720	600	315	480	250	H46+I	1,900	1,040	AFR46-500
46-650	780	650	355	520	315	I46+I	2,200	1,210	AFR46-750
46-750	900	750	400	600	355	I46+I	2,200	1,210	AFR46-750
46-860	1,032	860	450	688	400	I46+J	2,500	1,370	AFR46-750
46-1K0	1,200	1,000	560	800	450	J46+J	3,000	1,600	AFR46-1K0
46-1K2	1,440	1,200	630	960	500	J46+KA	3,300	1,700	AFR46-1K0
46-1K5	1,800	1,500	800	1,200	630	K46+K	4,500	2,250	AFR46-1K5
46-1K75	2,100	1,750	900	1,400	800	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 21 VFXR/FDUL typical motor power at mains voltage 690 V

VFXR/ FDUL Model	Max output current Imax [A]*	Normal duty 120%, 1 min every 10 min		Heavy duty 150%, 1 min every 10 min		Frame	Dimensions Height=2250 mm Depth=600 mm Width [mm]	Weight [kg]	AFR model
		Rated current Inom [A]	Power @690 V [kW]	Rated current Inom [A]	Power @690 V [kW]				
69-109	131	109	110	87	90	F69+F69=H69	800	410	AFR69-175
69-146	175	146	132	117	110	F69+F69=H69	800	430	AFR69-175
69-185	222	185	160	148	132	F69+F69=H69	900	540	AFR69-175
69-250	300	250	250	200	200	H69+H69	1,800	870	AFR69-350
69-300	360	300	315	240	250	H69+H69	1,800	870	AFR69-350
69-375	450	375	355	300	315	H69+H69	1,800	910	AFR69-350
69-430	516	430	450	344	355	I69+I69	2,800	1,350	AFR69-525
69-560	672	560	560	448	450	I69+I69	2,800	1,390	AFR69-525
69-749	900	750	710	600	600	J69+J69	On request		AFR69-700
69-995	1,200	1,000	1,000	800	800	K69+KA69	On request		AFR69-1K05
69-1K12	1,344	1,120	1,100	896	900	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.

12.1.2 Emotron AFR

Table 22 AFR46 Typical output DC power at mains voltage 400 V

Model	Max input current Imax [A]*	Normal duty 120%, 1 min every 10 min		Frame	Dimensions Height=2250mm Depth=600mm Width [mm]	Weight [kg]
		Rated input current Inom [A]	Output DC power @400 V AC [kW]			
AFR46-175	210	175	115	E46	600	290
AFR46-250	300	250	165	F46	800	400
AFR46-375	450	375	250	G46	1,000	560
AFR46-500	600	500	330	H46	1,200	660
AFR46-750	900	750	500	I46	1,500	830
AFR46-1K0	1,200	1,000	660	J46	1,800	1,100
AFR46-1K5	1,800	1,500	1,000	K46	2,700	1,600

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 23 AFR69 typical output DC power at mains voltage 690 V

Model	Max input current Imax [A]*	Normal duty 120%, 1 min every 10 min		Frame	Dimensions Height=2250mm Depth=600mm Width [mm]	Weight [kg]
		Rated input current Inom [A]	Output DC power @690 V AC [kW]			
AFR69-175	210	175	200	F69	800	320
AFR69-350	420	350	400	H69	1,200	590
AFR69-525	630	525	600	I69	1,700	860
AFR69-700	840	700	800	J69	On request	
AFR69-1K05	1,260	1,050	1,200	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.

12.2 General electrical specifications

Table 24 General electrical specifications

General	
Mains voltage: VFXR46/FDUL46/AFR46 VFXR69/FDUL69/AFR69/ Mains frequency: Input total power factor: Output voltage VFXR/FDUL46 and VFXR/FDUL69 Output voltage AFR46/AFR69	380 - 460 V +10%/-15% 480 - 690 V +10%/-15% 48 to 52Hz and 58 to 62Hz 1.0 (0 - 1.2) * Mains supply voltage (V AC) (1.0 - 1.2) * $\sqrt{2}$ * Mains supply voltage (V DC)
Switching frequency: VFXR/FDUL46 and VFXR/FDUL69 AFR46/AFR69	3 kHz (adjustable 1.5 - 6 kHz, FDUL only) 3 kHz
Efficiency at nominal load VFXR/FDUL46 and VFXR/FDUL69 AFR46/AFR69	97% 98%
Harmonics to supply, THDI	< 5 %
Control signal inputs: Analogue (differential)	
Analogue Voltage/current: Max. input voltage: Input impedance: Resolution: Hardware accuracy: Non-linearity	0-±10 V/0-20 mA via switch +30 V/30 mA 20 kΩ (voltage) 250 Ω (current) 11 bits + sign 1% type + 1½ LSB fsd 1½ LSB
Digital:	
Input voltage: Max. input voltage: Input impedance: Signal delay:	High: >9 V DC, Low: <4 V DC +30 V DC <3.3 V_{DC}: 4.7 kΩ ≥3.3 V_{DC}: 3.6 kΩ ≤8 ms
Control signal outputs Analogue	
Output voltage/current: Max. output voltage: Short-circuit current (∞): Output impedance: Resolution: Maximum load impedance for current Hardware accuracy: Offset: Non-linearity:	0-10 V/0-20 mA via software setting +15 V @5 mA cont. +15 mA (voltage), +140 mA (current) 10 Ω (voltage) 10 bit 500 Ω 1.9% type fsd (voltage), 2.4% type fsd (current) 3 LSB 2 LSB
Digital	
Output voltage: Shortcircuit current(∞):	High: >20 V DC @50 mA, >23 V DC open Low: <1 V DC @50 mA 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)

12.3 Operation at higher temperatures

All Emotron AFE units are made for operation at maximum of 40 °C ambient temperature. However it is possible to use the AFE units at higher temperatures with some loss in performance, using derating.
Derating, - 2,5% per degree Celsius is possible. Maximum is +5 °C (45 °C).

12.4 Environmental conditions

Table 25 Operation

Parameter	Normal operation
Nominal ambient temperature	0°C–40°C See Chapter 12.3, for different conditions
Atmospheric pressure	86–106 kPa
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 600068-2-6, Sinusodial vibrations: 10<f<57 Hz, 0.075 mm 57<f<150 Hz, 1g
Altitude	0–1,000 m, 460 V AFE units, with derating 1%/100m of rated current up to 4,000 m. Coated boards recommended > 2,000m 690 V AFE units, with derating 1%/100m of rated current up to 2,000 m.

Table 26 Storage

Parameter	Storage condition
Temperature	-20 to +60 °C
Atmospheric pressure	86–106 kPa
Relative humidity according to IEC 60721-3-1	Class 1K4, max. 95% and non condensing and no formation of ice.

12.5 Control signals

Table 27

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	Off	0 -10 V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
4	AnIn3	Dedicated for supply voltage measurement option	0 -10 V DC or 0/4–20 mA bipolar: -10 - +10 V DC or -20 - +20 mA	analogue input
5	AnIn4	Dedicated for supply voltage measurement option	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	Option (Active when AFR is running)	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 N/C is opened when the relay is active (valid for all relays) N/O is closed when the relay is active (valid for all relays)	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 Option (active when the AFR is running)	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			

13. Menu List

In the download area on our website, www.cgglobal.com or www.emotron.com, you find a communication information list and a list for noting parameter set information.

				DEFAULT	CUSTOM
100	Preferred View				
	110	1st Line		Current	
	120	2nd Line		Torque	
200	Main Setup				
	210	Operation			
		211	Language	English	
		214	Ref Control	Keyboard	
		215	Run/Stp Ctrl	Keyboard	
		216	Reset Ctrl	Keyboard	
		217	Local/Rem		
		2171	LocRefCtrl	Standard	
		2172	LocRunCtrl	Standard	
		218	Lock Code?	0	
		21A	Level / Edge	Level	
		21B	Supply Volts	Not defined	
	240	Set Handling			
		241	Select Set	A	
		243	Default>Set	A	
300	Process				
	310	Set/View ref		0%	
500	I/Os				
	510	An Inputs			
		511	AnIn1 Fc	Process Ref	
		512	AnIn1 Setup	User Bipol V	
		513	AnIn1 Advn		
		514	AnIn2 Fc	Off	
		515	AnIn2 Setup	0 - 10 V	
		516	AnIn2 Advan		
		517	AnIn3 Fc	Off	
		518	AnIn3 Setup	User Bipol V	
		519	AnIn3 Advan		
		51A	AnIn4 Fc	Off	
		51B	AnIn4 Setup	User Bipol V	
		51C	AnIn4 Advan		
	520	Dig Inputs			
		521	DigIn 1	RunL	
		522	DigIn 2	RunR	
		523	DigIn 3	Enable	
		524	DigIn 4	Off	
		525	DigIn 5	Off	
		526	DigIn 6	Off	
		527	DigIn 7	Off	
		528	DigIn 8	Reset	
	530	An Outputs			
		531	AnOut1 Fc	Current	
		532	AnOut1 Setup	4-20mA	
		533	AnOut1 Adv		
		534	AnOut2 FC	Torque	
		535	AnOut2 Setup	4-20mA	
		536	AnOut2 Advan		
	540	Dig Outputs			
		541	DigOut 1	Option	
		542	DigOut 2	LZ	
	550	Relays			
		551	Relay 1	Charge K2	
		552	Relay 2	Option	
		553	Relay 3	Main K1	
		55D	Relay Adv		
		55D1	Relay 1 Mode	N.O	
		55D2	Relay 2 Mode	N.O	
		55D3	Relay 3 Mode	N.O	
	560	Virtual I/Os			
		561	VIO 1 Dest	Off	
		562	VIO 1 Source	Off	
		563	VIO 2 Dest	Off	
		564	VIO 2 Source	Off	
		565	VIO 3 Dest	Off	
		566	VIO 3 Source	Off	
		567	VIO 4 Dest	Off	
		568	VIO 4 Source	Off	
		569	VIO 5 Dest	Off	
		56A	VIO 5 Source	Off	
		56B	VIO 6 Dest	Run R	
		56C	VIO 6 Source	DigIn 1	
		56D	VIO 7 Dest	Run L	
		56E	VIO 7 Source	DigIn 2	
		56F	VIO 8 Dest	Off	
		56G	VIO 8 Source	Operation	
600	Logical&Timers				
	610	Comparators			
		611	CA1 Setup		
		6111	CA1 Value	Current	
		6112	CA1 Level HI	30	
		6113	CA1 Level LO	20	
		6114	CA1 Type	Hysteresis	
		6115	CA1 Bipolar	Unipolar	
		612	CA2 Setup		
		6121	CA2 Value	Torque	
		6122	CA2 Level HI	20	
		6123	CA2 Level LO	10	
		6124	CA2 Type	Hysteresis	
		6125	CA2 Bipolar	Unipolar	
		613	CA3 Setup		
		6131	CA3 Value	Process Val	
		6132	CA3 Level HI	300	
		6133	CA3 Level LO	200	
		6134	CA3 Type	Hysteresis	
		6135	CA3 Bipolar	Unipolar	

				DEFAULT	CUSTOM
		614	CA4 Setup		
		6141	CA4 Value	Process Err	
		6142	CA4 Level HI	100	
		6143	CA4 Level LO	- 100	
		6144	CA4 Type	Window	
		6145	CA4 Bipolar	Bipolar	
		615	CD Setup		
		6151	CD1	Trip	
		6152	CD2	T2Q	
		6153	CD3	Trip	
		6154	CD4	Ready	
	620	Logic Y			
		621	Y Comp 1	CA1	
		622	Y Operator 1	&	
		623	Y Comp 2	!A2	
		624	Y Operator 2	&	
		625	Y Comp 3	CD1	
	630	Logic Z			
		631	Z Comp 1	CD1	
		632	Z Operator 1	&	
		633	Z Comp2	!D2	
		634	Z Operator 2	.	
		635	Z Comp 3	CD1	
	640	Timer1			
		641	Timer1 Trig	Off	
		642	Timer1 Mode	Off	
		643	Timer1 Delay	0:00:00	
		644	Timer 1 T1	0:00:00	
		645	Timer1 T2	0:00:00	
		649	Timer1 Value	0:00:00	
	650	Timer2			
		651	Timer2 Trig	Trip	
		652	Timer2 Mode	Delay	
		653	Timer2 Delay	0:00:01	
		654	Timer2 T1	0:00:01	
		655	Timer2 T2	0:00:00	
		659	Tmer2 Value	0:00:00	
700	Oper/Status				
	710	Operation			
		711	Process Val		
		713	Torque		
		714	React Power		
		715	El Power		
		716	Current		
		717	Output volt		
		718	Frequency		
		719	DC Voltage		
		71A	Heatsink Tmp		
	720	Status			
		721	VSD Status		
		722	Warning		
		723	DigIn Status		
		724	DigOut Status		
		725	AnIn 1 - 2		

				DEFAULT	CUSTOM
		726	AnIn 3 - 4		
		727	AnOut 1 - 2		
	730	Stored Val			
		731	Run Time	00:00:00	
		7311	Reset RunTm	No	
		732	Mains Time	00:00:00	
		733	Energy	...kWh	
		7331	Rst Energy	No	
800	View TripLog				
	810	Trip Message (811 - 81o)			
		811	Process Val		
		813	Torque		
		814	Shaft Power		
		815	El Power		
		816	Current		
		817	Output volt		
		818	Frequency		
		819	DC Voltage		
		81A	Heatsink Tmp		
		81B	VSD Status		
		81C	FI Status		
		81D	DigIn status		
		81E	DigOut status		
		81F	AnIn 1 - 2		
		81G	AnIn 3 - 4		
		81H	AnOut 1 - 2		
		81L	Run Time	00:00:00	
		81M	Mains Time	00:00:00	
		81N	Energy	...kWh	
		81o	Set/View ref		
	820	Trip Message (821 - 82o)			
	830	Trip Message (831 - 83o)			
	840	Trip Message (841 - 84o)			
	850	Trip Message (851 - 85o)			
	860	Trip Message (861 - 86o)			
	870	Trip Message (871 - 87o)			
	880	Trip Message (881 - 88o)			
	890	Trip Message (891 - 89o)			
	8A0	Reset Trip l		No	
900	System Data				
	920	AFR Data			
		921	AFR 2.0		
		922	Software		
		9221	Build Info		
		923	Unit name	0	
O00	AFR Option				
	O10	Supply			
		O11	Supply Volts	AFR. Unom	
		O12	Supply Freq	50Hz	
		O13	Supply Curr	AFR. Inom	
		O14	Supply Seq	Pos	
		O15	Supply ID run	Off	
		O16	Supply Auto	Off	
		O17	Volt sensor	Off	

			DEFAULT	CUSTOM
020	Start/Stop			
	021	Charge ctrl	Supply-NC	
	022	Run/Stop Mode	Standard	
	023	Reg Stp Time	1s	
	024	Auto restart	Off	
030	Udc control			
	031	Udc ref	1.05*Upeak	
	032	Udc ramp	1s	
	033	Udc PI Gain	5	
	034	Udc PI Time	0.2s	
	035	Udc PI max	200%	
	036	Udc PI Charg	20%	
	037	Udc margin	5%	
040	Q control			
	041	Q max	0%	
	042	Q ramp	1s	
	043	Q PI Gain	0.1	
	044	Q PI Time	0.1s	
	045	Q Filter	1s	
050	Frequency control			
	051	Frequency mode	Observer	
080	View energy			
	081	Energy suppl	...kWh	
	082	Energy Motor	...kWh	
	083	Energy Gen	...kWh	
	084	Reset energy	No	
090	View control			
	091	Udc Ref / Val	105% / 100%	
	092	T Ref / Val	20% / 0%	
	093	Q Ref / Val	-5% / 0%	
	094	Psi Ref / Val	100% / 100%	
	095	Cos_φ	0.99	

13.1 Communication information list

For communication information regarding menu numbers not included in the list below, please refer to the Emotron FDU or Emotron VFX instruction manual.

AFE Option Parameters		Modbus instance / DeviceNet number	Profibus slot / index	EtherCAT index (HEX)	Fieldbus format	Modbus format
700	View Operation/Status					
710	Operation					
711	Process value	31001	121/145	23e9	Long, 1 = 0.001	EInt
713	Torque	31003 Nm, 31004 %	121/147,121/148	23eb, 23ec	Long, 1 = 0.1 Nm Long, 1 = 1%	EInt
714	Reactive power	31005	121/149	23ed	Long, 1 = 1W	EInt
715	Electrical Power	31006	121/150	23ee	Long, 1=1W	EInt
716	Current	31007	121/151	23ef	Long, 1=0.1A	EInt
717	Output voltage	31008	121/152	23f0	Long, 1=0.1 V	EInt
718	Frequency	31009	121/153	23f1	Long, 1= 0.1 Hz	EInt
719	DC-link Voltage	31010	121/154	23f2	Long, 1=0.1 V	EInt
71A	Heat Sink Temperature	31011	121/155	23f3	Long, 1 = 0.1 C	EInt
O00	AFE option					
O10	Supply					
O11	Supply Volts	48001	188/60		Long, 1=1V	EInt
O12	Supply Freq	48002	188/61		Long, 1=1Hz	EInt
O13	Supply Curr	48003	188/62		Long, 1=0.1A	EInt
O14	Supply Seq	48004	188/63		UInt, 1=1	UInt
O15	Supply Idrun	48005	188/64		UInt, 1=1	UInt
O16	Supply Auto	48006	188/65		UInt, 1=1	UInt
O17	Volt Sensor	48007	188/66		UInt, 1=1	UInt
O20	Start/Stop					
O21	Charge Ctrl	48011	188/70		UInt, 1=1	UInt
O22	Run/Stp Mode	48012	188/71		UInt, 1=1	UInt
O23	Reg Stp Time	48013	188/72		Long, 1=0.01s	EInt
O24	Auto restart	48014	188/73		UInt, 1=1	UInt
O30	Udc Control					
O31	Udc ref	48021	188/80		Long, 1=0.1V	EInt
O32	Udc ramp	48022	188/81		Long, 1=0.01s	EInt
O33	Udc PI Gain	48023	188/82		Long, 1=0.1	EInt
O34	Udc PI Time	48024	188/83		Long, 1=0.01s	EInt
O35	Udc PI Max	48025	188/84		Long, 1=1%	EInt
O36	Udc PI Charg	48026	188/85		Long, 1=1%	EInt
O37	Udc Margin	48027	188/86		Long, 1=0.1%	EInt
O40	Q Control					
O41	Q max	48031	188/90		Long, 1=1%	EInt
O42	Q ramp	48032	188/91		Long, 1=0.01s	EInt
O43	Q PI Gain	48033	188/92		Long, 1=0.01	EInt
O44	Q PI Time	48034	188/93		Long, 1=0.01s	EInt
O45	Q Filter	48035	188/94		Long, 1=0.01s	EInt

AFE Option Parameters		Modbus instance / DeviceNet number	Profibus slot / index	EtherCAT index (HEX)	Fieldbus format	Modbus format
O50	Freq Control					
O51	Freq Type	48041	188/100		UInt, 1=1	UInt
O80	View Energy					
O81	Energy Suppl	31034	121/178		Long, 1=1Wh	EInt
O82	Energy Motor	48071	188/130		Long, 1=1Wh	EInt
O83	Energy Gen	48075	188/134		Long, 1=1Wh	EInt
O84	Reset Energy	48079	188/138			
O90	View Control					
O91	UdcRef Val	48081	188/140		Long, 1=0.1	EInt
O92	T Ref Val	48083	188/142		Long, 1=0.1	EInt
O93	Q Ref Val	48085	188/144		Long, 1=0.1	EInt
O94	PsiRef Val	48087	188/146		Long, 1=0.1	EInt
O95	Cos_phi	48089	188/148		Long, 1=0.001	EInt

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

Instruction manual: 01-5386-01r1
2015-01-15