Synchronizing / Bypass option

for Emotron VFX2.0, FDU2.0 AC drives

Emotron FDUL/VFXR/AFR low harmonic/regenerative drives

Instruction manual

English

e m o t r o n

DEsICATED DRIVE

A **CG** Product

Emotron Sync/Bypass option

for Emotron VFX2.0, FDU2.0 AC drives
valid from software version 4.32-011-01
Emotron FDUL/VFXR/AFR low harmonic/regenerative drives
valid from software version 4.33-097-05

Instruction manual – English

Safety

Instruction manual

Read this instruction manual first!

This option is a supplementary part of the
Emotron VFX/FDU AC drives and
Emotron FDUL/VFXR/AFR low harmonic/regenerative drives
hereinafter in this manual referred to as the "main product" and the user must
be acquainted with the original instruction manual of the main product. All
safety instructions, warnings, etc. as mentioned in this instruction manual must
be known to the user.

Safety instructions

Read the safety instructions in the instruction manual for the main product.

Installation

Installation, commissioning, dismounting, making measurements, etc. on the
main product may only be carried out by personnel who are technically quali-
fied for the task. Installation must also be carried out in accordance with the
local standards. Ensure that all necessary safety measures are taken.

WARNING!
Take all necessary safety precautions during installation and
commissioning to prevent personal injuries, e.g. by an
uncontrolled load.

Opening the main product

WARNING!
Always switch off the mains supply before opening the main
product.
For AC drives, wait at least 7 minutes to allow the buffer
capacitors to discharge.

Always take adequate precautions before opening the main product, even
though the connections for the control signals and jumpers are isolated from the
mains voltage.

Contents

1. Introduction

The Sync/Bypass option is used with the main product to monitor/measure the grid voltage. The output is in cartesian rectangular components, which can be used internally by the drive to compute grid voltage, frequency and supply phase sequence.

Emotron VFX2.0 and FDU2.0

can use this option for synchronizing the inverter output to the actual grid voltage and frequency.

This is a kind of option that can be useful when the same drive is used for ramping up the several motors. For example ramping up the pumps to the grid speed.

NOTE: The Sync/Bypass option has to be ordered together with the Emotron VFX/FDU AC drive, as it needs special AC drive control board together with special software.

Emotron FDUL/VFXR/AFR

can use this option along with the low harmonic/regenerative drive i.e. Emotron FDUL/VFXR/AFR.

It serves as a grid monitor and supply the required information for synchronizing the drive unit to the grid. Using this option Emotron VFXR/FDUL can be started even if the VSI is already loaded. Also this option is required if user want LVO feature in Emotron VFXR/FDUL/AFR.

NOTE: This instruction manual is valid for both Emotron FDU/VFX AC drives and Emotron FDUL/VFXR/AFR harmonic/regenerative drives. Common information is written once for both. Instructions that differ are written separately for each product.

1.1 Description

This instruction manual describes the installation and use of the Sync/Bypass option.

Delivery and unpacking

Check the delivery. The shipment should contain:

• Sync/Bypass unit

• Cable clamp for connection of control cable shield.

• This manual

Check for visible signs of damage. Do not install if damage is found. If damage is found or something is missing from the package, please contact your supplier.

2.   Installation

This chapter describes how to mount the option.

The option kit includes

•   Sync/Bypass unit

•   Cable clamp for connection of control cable shield.

•   This instruction manual

Fig. 1   Sync option unit and clamp for shield connection.

Make sure that the AC drive has been switched off for at least seven minutes to ensure that the capacitor bank is discharged before continuing with installation! Also make sure that no external equipment connected to the drive's interface is powered on.

•   Mount the Sync/Bypass option on a DIN-rail close to the main product.

Shielding

Connect the shield of control cable to the earthing clamp in the main product close to the control board.
Connect the other side of the shield with the clamp (included in delivery) close to the option unit, see Fig. 2.
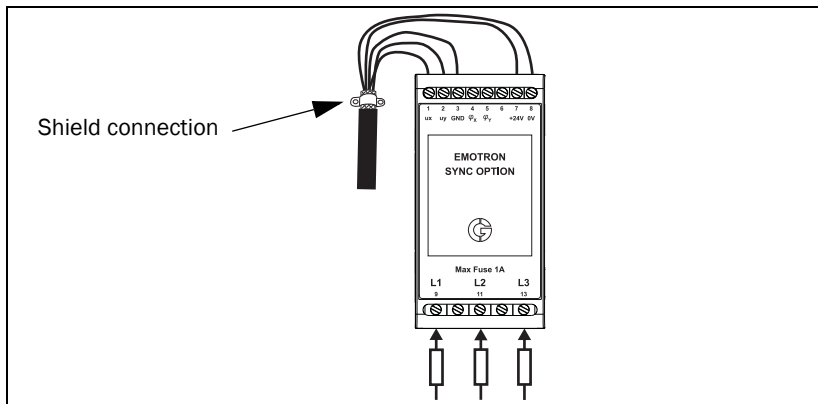

Fig. 2   Shield connection close to he option unit.

3. Connections

This chapter describes how to connect the Sync/Bypass option.

3.1 Connecting the Sync/Bypass option

Connection to Emotron VFX and FDU AC drives

The total system (according to Fig. 3) consists of:

- Emotron VFX/FDU with special software (4.3X - 011 - 0X) and modified Control board.

- Sync/Bypass option board.

- Standard output choke (not included in delivery)

- Bypass switch (not included in delivery)

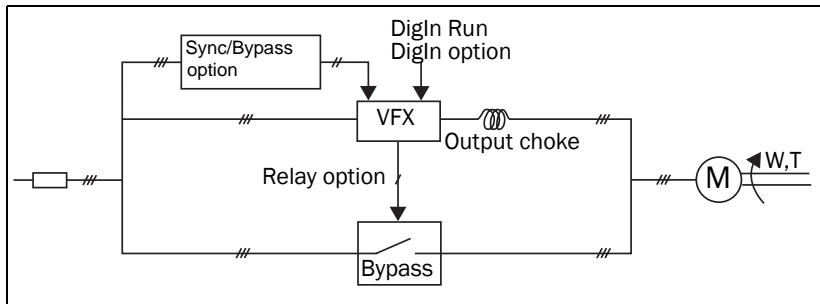Wiring for Sync option is shown in Fig. 6, page 10

Fig. 3   Emotron FDU and VFX with Sync/Bypass option.

Connection to Emotron VFXR/FDUL/AFE/AFR

The total system (according to Fig. 4)consists of:

- Emotron VFXR/FDUL/AFE/AFR with software 4.33-097-05 or later

- Sync/Bypass option serving as Supply voltage measurement unit
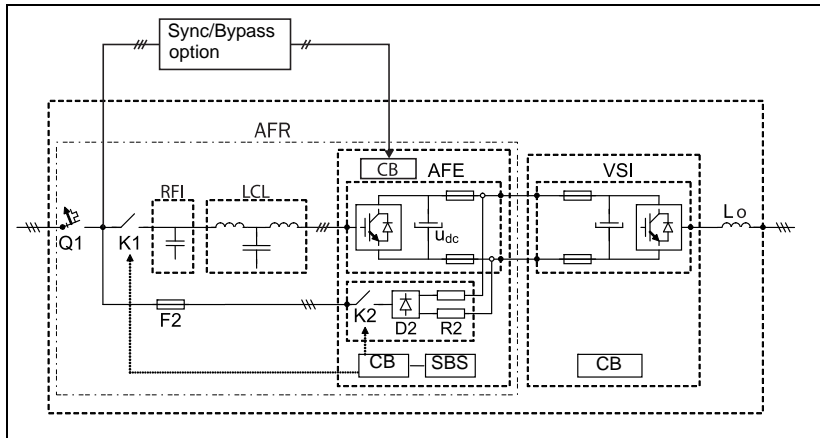
Wiring for Sync option is shown in Fig. 6, page 10

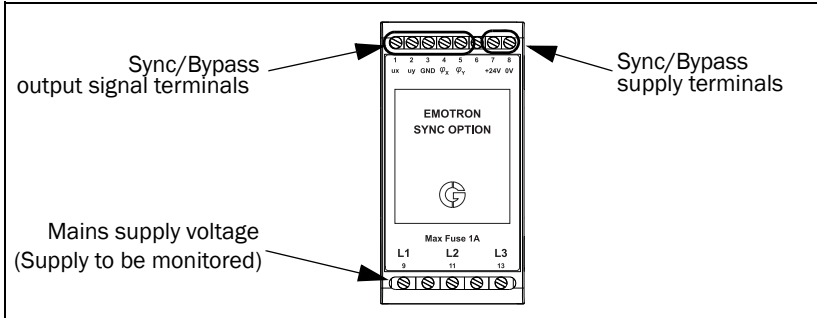*Fig. 4   Emotron FDUL/VFXR/AFR drive system with Sync/Bypass option.*

3.2 Terminals

Fig. 5   Sync/Bypass option terminals.

Table 1   List of terminals and connections.

| Terminal	Name	Function	Cable dimension
Terminals 1 - 8 for connections to 24 VDC, ground and measured analogue signals			
1	ux	Connect to AnIn3	0.5 mm^2 Use screened cables
2	uy	Connect to AnIn4	
3	GND	Connect to Ground	
4	φ_x	Not used	
5	φ_y	Not used	
6		Not used	
7	+24 V	Connect to 24 V_{DC} supply	
8	0 V	Connect to Ground	
Terminals 9, 11 and 13 connect mains supply to be monitored			
9	L1	Three phase supply, 380 - 690 V, 50 - 60 Hz Install fuses of Max 1 A.	1 mm^2
11	L2		
13	L3		

3.3   Connections and wiring
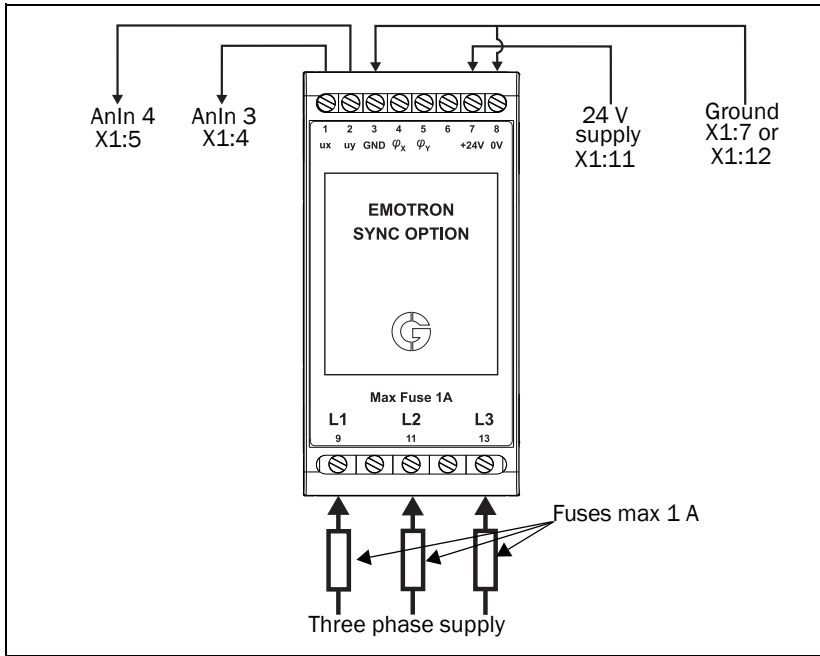
Fig. 6   Sync/Bypass option board connection and wiring.

3.3.1 Sync/Bypass input supply voltage

The Sync/Bypass option requires +24 V_{DC} supply for its normal operation. Sync/Bypass option uses operational amplifiers for measuring the voltage, therefore it is important to have +24 V_{DC} supply input, otherwise the Sync/Bypass option can lead up to a wrong measurement.

Table 2   Input supply terminals

Connection terminal		Description
Sync/bypass option terminals	**Control board terminals**	
7: +24 V	X1:11	+24 VDC supply. Control board of the main product can be used to supply +24 VDC to the Sync/Bypass option from X1:11 on the control board. For detailed information consult the instruction manual of the main product.
3:GND or 8:0 V	X1:7 or X1:12	It is important for Sync/Bypass option to have proper reference signal. It can be obtained from Control board of the main product, terminals X1:7 or X1:12.

Input measuring signals

The voltage to be measured must be connected to L1, L2, L3 terminals. Sync/Bypass option measures three phase input supply up to 690V.

It is important to connect the three phases on the Sync/Bypass option in the same sequence as on the drive unit.

3.3.2 Outputs

Sync bypass option measures supply voltage and give two analogue outputs as a measurement i.e Ux and Uy.

Drive controller uses Ux and Uy for computing the grid supply voltage amplitude, frequency and phase sequence.

Output terminals

Table 3   Output terminals

Connection terminal		Description
Ux	1	Ux must be connected to analogue input 3 on the Control board
Uy	2	Uy must be connected to analogue input 4 on the Control board

4. Configuration

This chapter describes how to set parameters on main product (VFX/FDU/FDUL/VFXR/AFR)and how to use the Sync/Bypass option.

4.1 Menus and switches required to be set in Main product

Menus/switches described in this section are same in both VFX/FDU and VFXR/FDUL/AFR. These menus/switches needs to be set during commissioning of the product..

Table 4   Required setting with Sync/Bypass option.

Menu		Default	Required Setting
518	AnIn 3 setup	4 - 20 mA	User Bipolar V
51B	AnIn 4 setup	4 - 20 mA	User Bipolar V

NOTE: To be able to use AnIn3 and AnIn4 for voltage measurement, Set the Switches S3 and S4 to U (Volt) position for AnIn 3 and AnIn 4.

Table 5   Switch settings for S3 and S4

Input	Signal type	Switch
AnIn3	Voltage	S3
AnIn3	Current (default)	S3
AnIn4	Voltage	S4
AnIn4	Current (default)	S4

4.2 Emotron VFX/FDU 2.0 AC drives

Following option menus/parameters are available for user settings when using Sync/Bypass option with Emotron FDU/VFX AC drives.

These menu parameters are not valid for Emotron AFR/FDUL/AFR.

Table 6   Menus for Sync/Bypass option in Emotron VFX/FDU 2.0 AC drives

Menu		Default value	Range/ Setting	Description	Modbus number
000	Sync option				
010	Sync pars				
011	Sync Enable	Off	Off External Internal	Off - Syncing disabled Ext - Syncing from outside Int - Syncing controller by Control board	48001
012	Sync Time	1 s	0 - 32 s	Maximum time for bypass switch detection, i.e. parallel operation **Note: Should be setup to maximum closing time of bypass switch.**	48002
013	Sync _Curr %	50 %	0 - 200 %	Bypass switch detection level based on margin on actual motor current. Detection to a fast current increase compared to mean measured current level in % above the mean value.	48003
014	Sync Curr A	Inv Imax	0 - 3000 A	Bypass switch detection level based om motor current. **Note: Should be set higher than maximum motor current and should not be more than inverters maximum current.**	48004

Table 6   Menus for Sync/Bypass option in Emotron VFX/FDU 2.0 AC drives

Menu		Default value	Range/ Setting	Description	Modbus number
O15	Sync _Volt %	20 %	0 - 200 %	Bypass switch detection level based on actual DC-link voltage. Detection to a fast DC-link change compared to mean measured DC-link voltage level in % above the mean value.	48005
O16	Sync Volt V	Inv Umax	0 - 3000 V	Bypass switch detection level based on actual DC-link voltage. **Note: Should not be more than inverter maximum voltage.**	48006
O20	Sync Status			Tells the state of the inverter.	
O21	Status	0000		Syncing process, status register: - - - X = State - - x - = Syncing flag - x - - = Bypass detect flag See further in Table 7 below.	48011

Explanation of menu O21 status:

Table 7   Menu O21 status explanation

State "- - - X"	Syncing flag "- - X -"	Bypass detect flag "- X - -":
0=Stopped 1=Normal Run 2=Syncing 3=Bypassing 4=Bypassed	1 = Syncing active, trying to sync to supply frequency 3 = Frequency synced, trying to sync to supply amplitude 7 = Frequency and amplitude synced, trying to sync to supply angle F = Synced	1 = Timeout (depends on setting in [O12]) 2 = Sync on current 4 = Sync on voltage 8 = Error

Added selections in standard menus

Table 8   Added selections in standard menus.

Menu		Selection	Comment
52#	Digin #	... 32: Option ...	Synchronization command
56#	VIO # Dest		
54#	Dig Out #	... 90: Option ...	Bypass switch command
55#	Relay #		
56#	VIO # Source		

4.3   Emotron VFXR/FDUL/AFR drives

Following option menu/parameter is available for user settings when using Sync/Bypass option with Emotron VFXR/FDUL/AFR drives.

Table 9   Parameter valid for Emotron VFXR/FDUL/AFR drives.

Menu		Default value	Setting	Description
517	AnIn3 Fc	OFF	U_x	Measures x component of voltage
51A	AnIn4 Fc	OFF	U_y	Measures y component of voltage
O17	Volt sensor	OFF	ON	Activate supply voltage measurement

Note: selection U_x and U_y only appear if [O17] is set to "ON".

5. Functional description

5.1 Using Sync/Bypass option with Emotron VFX/FDU 2.0 AC drives

Normal running

The AC drive is running normally with reference value from i.e. setup source.

Syncing

AC drive synchronize to supply in three steps:

1. Ramp drive speed/frequency to supply speed/frequency.
2. Synchronizing drive speed/frequency and amplitude to supply frequency and amplitude.
3. Synchronizing drive phase angle to supply phase angle.

Bypassing

The AC drive tries to detect actual closing of the Bypass switch. After detection the bypass state is entered.

The detection of closed bypass switch is triggered either from:

1. Time-out according to set time in menu [O12].
2. Current peak detected according to menus [O13] and [O14].
3. DC voltage increase, detected according to menus [O15] and [O16].

Status menu [O21] shows the current state of sync/bypass option software i.e. OPT11. It also shows on which condition the bypass switch has been operated.

NOTE: If menu "Sync time [O12]" = 0 s, the AC drive will be stopped when bypass switch is commanded.

NOTE: If menu "Sync time [O12]" = 32 s, time-out is disabled, i.e. AC drive runs until current or DC Voltage detection. This is useful during commissioning to verify actual phase sequence if bypass switch operation is prohibited.

Fig. 7 below explains how the current peak detection level is generated from menus [O13] and [O14] depending on the actual motor current.
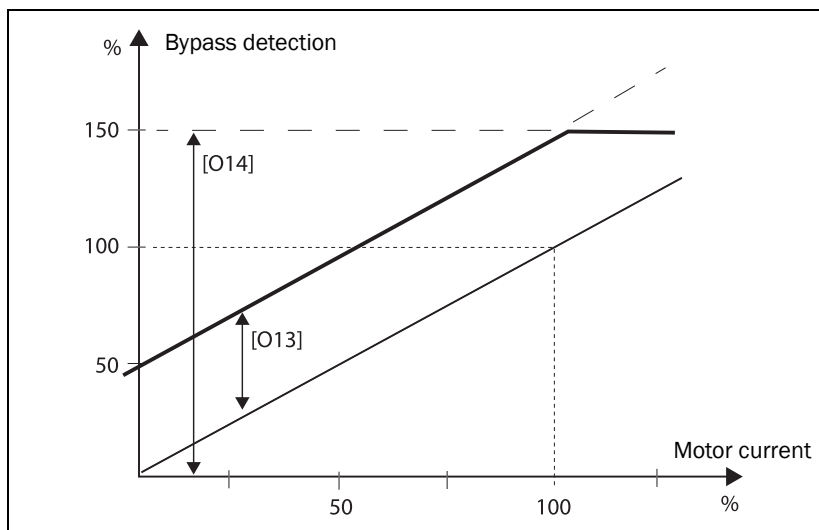

Fig. 7   Detection of bypass current as function of actual motor current.

NOTE: that the digital output function "Option" is in high state. This output should be used to activate the bypass switch.
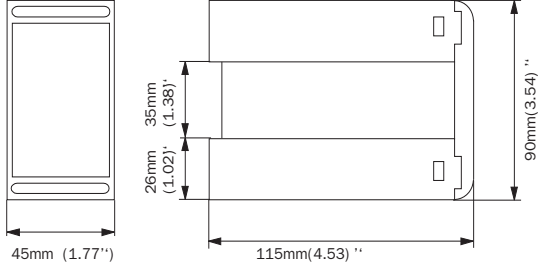

Bypassed

The AC drive operation is blocked or not active.

NOTE: that if the AC drives run command is removed, the inverter will turn to Stopped state and thereby the digital output function "Option" will turn low. If this is the case, external hold circuits for the bypass switch will be needed.

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6. Specifications

Table 10   Technical specifications.

Dimensions (WxHxD)	45x90x115 mm (1.77" x 3.54" x 4.53")
Mounting	35 mm DIN rail 46277
Weight	0.12 kg (4.2 oz)
Mains voltage	3 x 380-690 V_{AC} Max Ripple (notch): 3% of mains voltage. Max mains supply distortion: 2% to 3%. **Note: Supply distortion means the deviation of mains voltage, frequency from RMS/average value.** Max dU/dt: 350 V/ms
Mains Frequency	45 to 65 Hz
Mains current (RMS)	20 mA (RMS) at 400V 30 mA (RMS) at 690 V
Input DC voltage	24 V_{DC} $\pm$ 10 %
Input DC-current	50 mA
Output supply Ux and Uy (RMS)	2.286 at 400 V 3.94 at 690 V
Output current	< 1 mA
Terminal wire size	Terminal 9, 11, 13; Main supply wire - 1 mm^2 Terminal 1 - 8; Control signal wire - 0.5 mm^2
Main supply Fuse	Install max 1 A fuses on Main supply.
Operating temperature	-20 to +50°C
Protection class	IP20

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