

Valid for all FDU inverters with  
Software V3.xx or higher



## **PUMP CONTROL OPTION** **for FDU frequency inverter**

### **INSTRUCTION MANUAL**

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# SAFETY INSTRUCTIONS

## Notes, cautions, warnings and danger signs

The following indications have the meanings given and are printed in bold typeface:

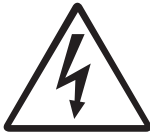
**NOTE! Additional information as an aid to avoid problems**

**CAUTION!**



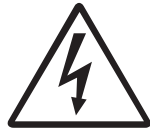
**Failure to follow these instructions can result in malfunction or damage to the frequency inverter.**

**WARNING!**



**Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the frequency inverter.**

**DANGER!**



**The life of the user is in danger.**

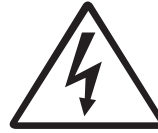
## Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc. of or on the frequency inverter may only be carried out by personnel who are technically qualified for the task.

## Installation

Installation must be made by authorised personnel only and according to the local standards. Ensure that all necessary safety measures are taken.

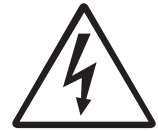
**DANGER!**



**Take all necessary safety precautions during installation and commissioning to prevent personal injuries.**

## Opening the frequency inverter

**DANGER!**



**Always switch off the mains supply before opening the inverter and wait at least 5 minutes to allow the buffer capacitors to discharge.**

## Instruction manual

Read this and the FDU instruction manual before continuing!

The I/O Board option instruction manual is fully integrated in this instruction manual. This manual is primarily focusing on pump control, however, it should be noted that the I/O Board also can be used as a general extended I/O, see § 4.3 and § 4.4.

## Users

This instruction manual is intended for:

- Installation engineers
- Designers
- Maintenance engineers
- Service engineers
- Operators
- Programmers

## Software version

Always check that the software version number on the title page of this instruction manual is the same as used in the FDU frequency inverter. See also § 1.3, page 7.

## Safety instructions

Read the safety instructions in the FDU manual!

Always take adequate precautions before opening the frequency inverter, although the connections for the control signals and jumpers are isolated from the mains voltage.

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# 1. GENERAL INFORMATION

## 1.1 Introduction

The PUMP CONTROL option is standard available in the FDU frequency inverter from software version 3.xx and up. Maximum 3 pumps can be controlled with the standard FDU Frequency inverter.

If the I/O Board option is installed a maximum of 7 pumps can be controlled. Also the I/O Board option gives more sophisticated pump control functions. The I/O Board can also be used as a general extended I/O, see § 4.3 and § 4.4. After installation of the I/O Board, the software automatically detect the presence of the option and subsequently the related windows and menus will become active in the SETUP MENU of the inverter.

The PUMP CONTROL function is used to control a number of drives (pumps, fans, etc.) (max 6 additional drives with the I/O Board connected) of which one is always driven by the FDU. Other names for these kind of controllers are 'Cascade controller' or 'Hydrophore controller'.

Depending on the flow, pressure or temperature, additional pumps can be activated via the appropriate signals by the output relays of the FDU and/or the I/O Board. The system is developed in a way that one FDU will be the master of the system

All additional pumps can be activated via an inverter, soft starter, Y/Δ or D.O.L. switched..

Pumps in parallel will operate as a flow controller, See Fig. 1.

Pumps in series will operate as a pressure control see Fig. 2. The basic control principle is shown in Fig. 3.

**NOTE! Read this instruction manual carefully before commencing installation, connecting or working with the frequency inverter with PUMP CONTROL option.**

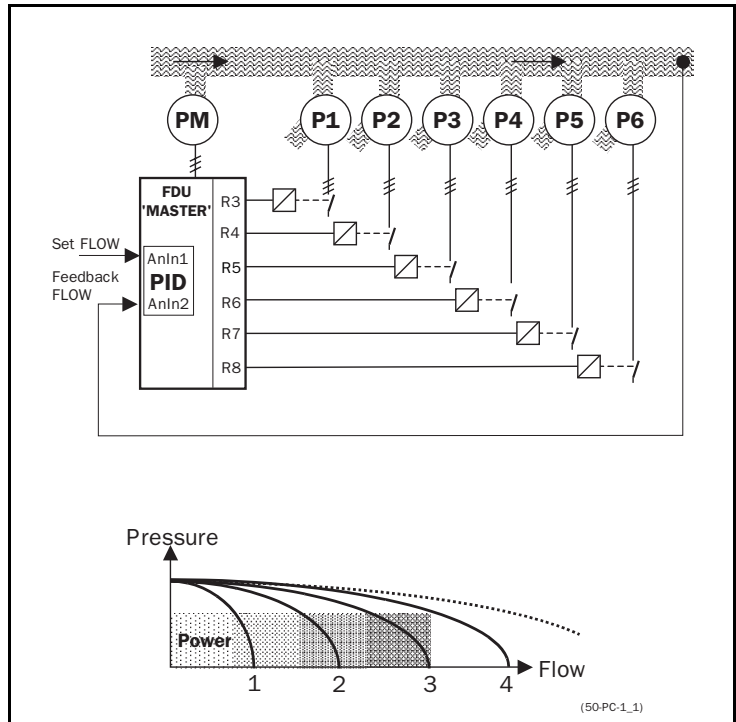


Fig. 1 Flow control with PUMP CONTROL option.

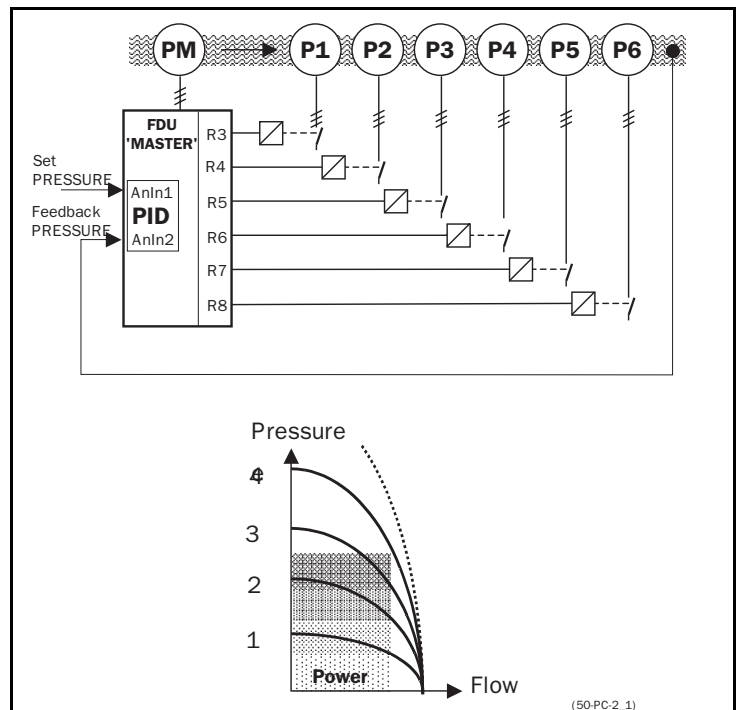


Fig. 2 Pressure control with PUMP CONTROL option.

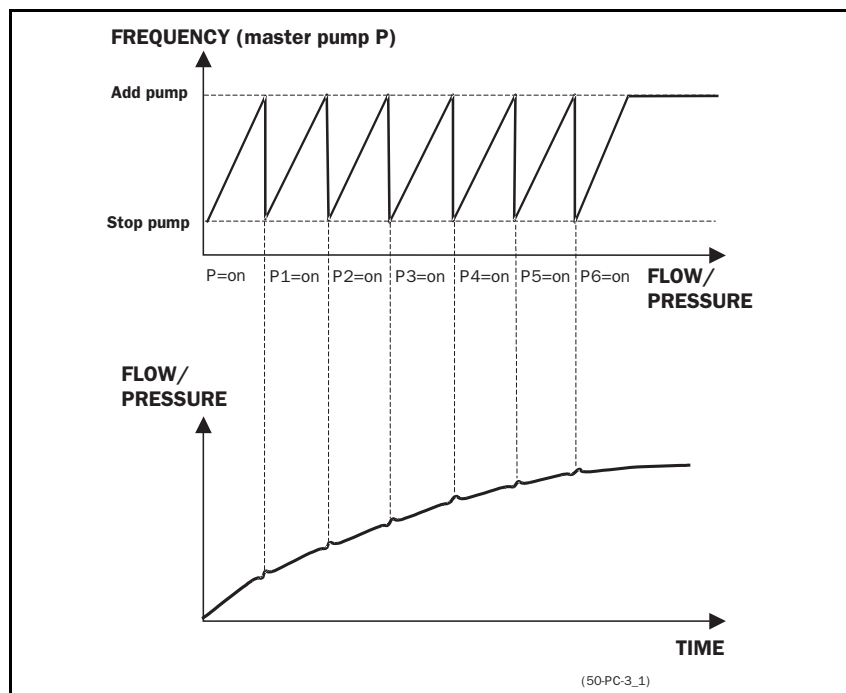


Fig. 3 Basic Control principle.

## 1.2 Description

This instruction manual describes the installation and use of the option PUMP CONTROL which is integrated in all types of FDU frequency inverters with software version 3.xx or higher. The manual of the I/O Board option is fully integrated in this instruction manual.

## 1.3 Software and Hardware compatibility

The in § 1.2 mentioned frequency inverters must be fitted with software version 3.xx or higher. The PUMP CONTROL functions is not available in lower software versions. The I/O Board option will not function together with lower software versions.

The FDU frequency inverters with software 3.xx or higher are always equipped with the so-called 'second generation' control board. The 'first generation' control boards are not designed to be connected with the I/O Board option. The 'first generation' control boards cannot be upgraded with software version 3.xx or higher.

See § 5.10 VIEW SYSTEM DATA in the FDU instruction manual how to check the software version of the frequency inverter.

## 1.4 Safety

Because this option is a supplementary part of the frequency inverter, the user must be acquainted with the instruction manual of the FDU frequency inverter. All safety instructions, warnings etc. as mentioned in these instruction manuals are to be known to the user.

**NOTE! If in doubt contact your supplier before installing or commissioning the product.**

## 2. MAIN FEATURES

This chapter gives an overview and short description of the features of the PUMP CONTROL option. Further, a reference to the related windows and to the instruction manual is given.

- FDU frequency Inverter version R3.

**NOTE! All examples in this instruction manual assume that the I/O Board is installed.**

### 2.1 Fixed MASTER

This is the default setting of the PUMP CONTROL. The FDU controls the Master pump which is always running. The relay outputs start and stop the other pumps P1 to P6, depending on flow/pressure. In this configuration maximum 7 pumps can be controlled. To equalize the life time of the additional pumps it is possible to select the pumps depending on the run time history of each pump.

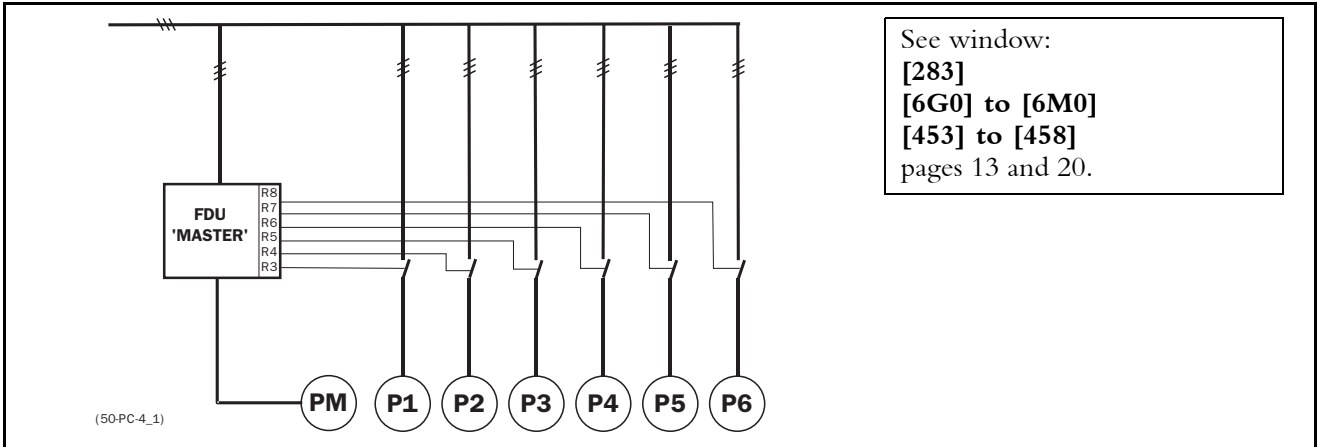


Fig. 4 Fixed MASTER control

**NOTE! The pumps MAY have different powers, however the MASTER pump MUST always be the largest.**

### 2.2 Alternating MASTER

With this function the Master pump is not fixed to the FDU all the time. After the inverter is powered up the Master pump is selected with RELAY 9 depending on the so-called "Change Condition". At Power up RELAY 9 'selects' a pump with help of a special circuit, which prevents dual powering at the same pump. Chapter 3. page 11 gives detailed wiring diagram with 3 pumps. The purpose of this function is that all pumps are equally used, so the lifetime of all pumps, including the Master pump, will be equalized. Maximum 6 pumps can be controlled with this function.

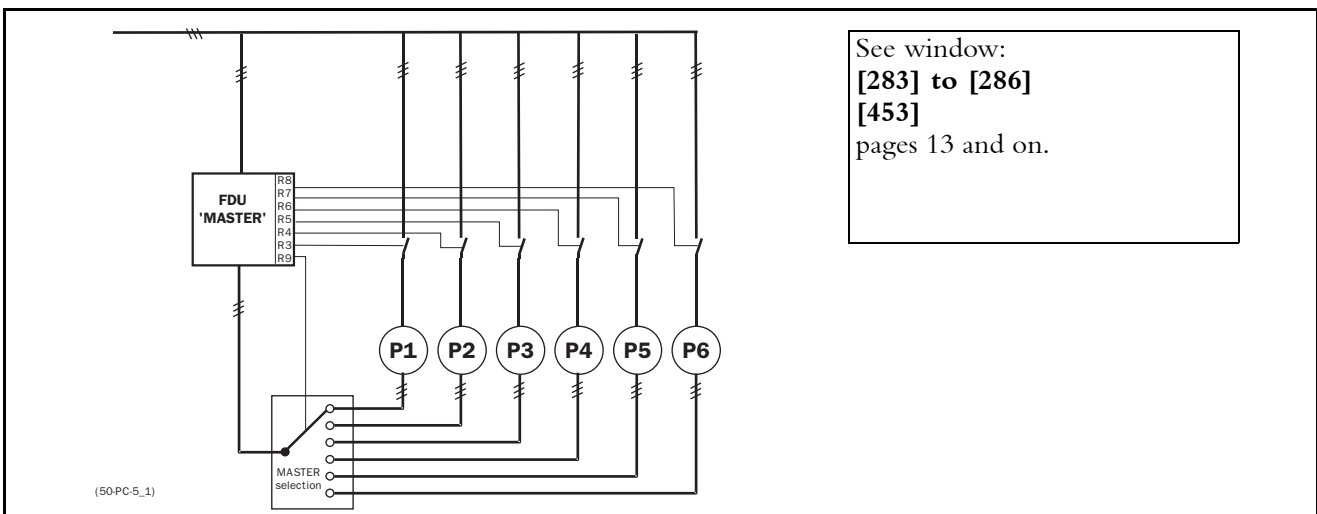


Fig. 5 Alternating MASTER Control.

**NOTE! The pumps MUST have all the same power.**

### 2.3 Feedback 'Status' input

In this example the additional pumps are controlled by an other kind of drive (e.g. soft starter, frequency inverter, etc.). The digital inputs on the I/O Board can be programmed as a "Error" input for each pump. If a drive fails the digital input will monitor this and the PUMP CONTROL option will not use that particular drive anymore and automatically switch to another drive. This means that the control continues without using this (faulty) drive. This function can also be used to stop manually a particular pump for maintenance purpose, without shutting down the whole pump system. Off course the maximum flow/pressure is then limited to the maximum pump power of the remaining pumps.

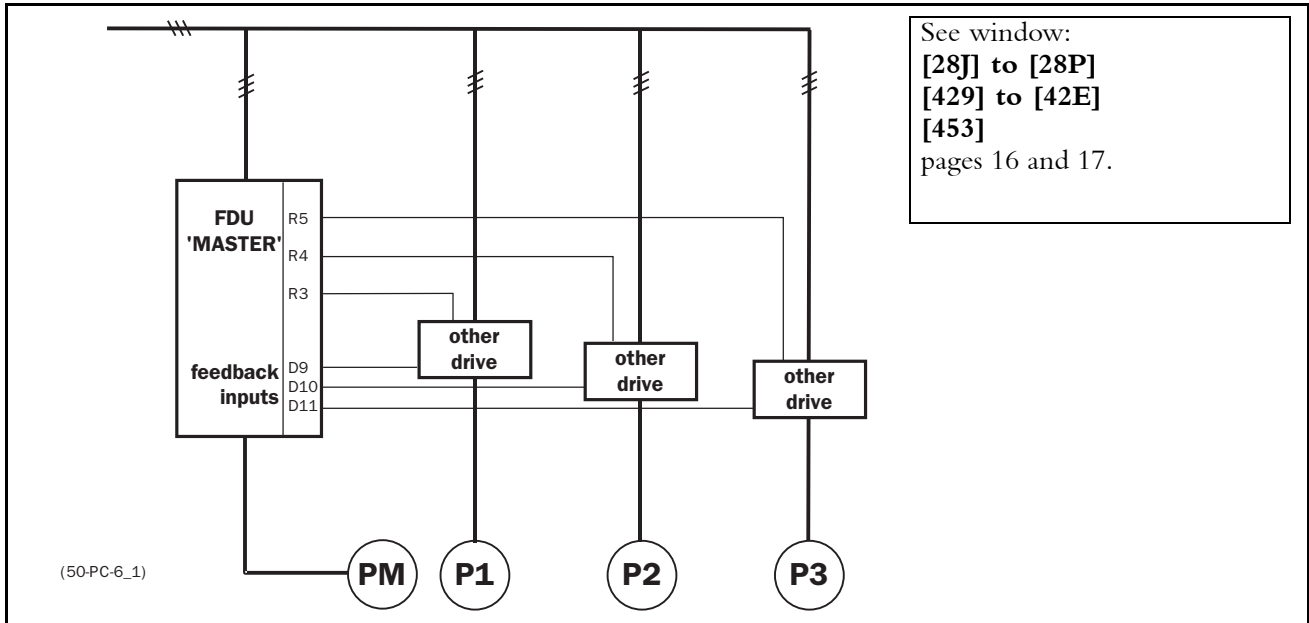


Fig. 6 Feedback "Status" input.

### 2.4 Fail safe operation

Some pump systems must always have a minimum flow or pressure level, even if the frequency inverter is tripped or damaged. So at least 1 or 2 (or maybe all) additional pumps must keep running after the inverter is powered down or tripped. This kind of "safe" pump operation can be obtained by using the NC contacts of the pump control relays. This can be programmed for each individual additional pump. In this example pumps P5 and P6 will run at max power if the inverter fails or is powered down.

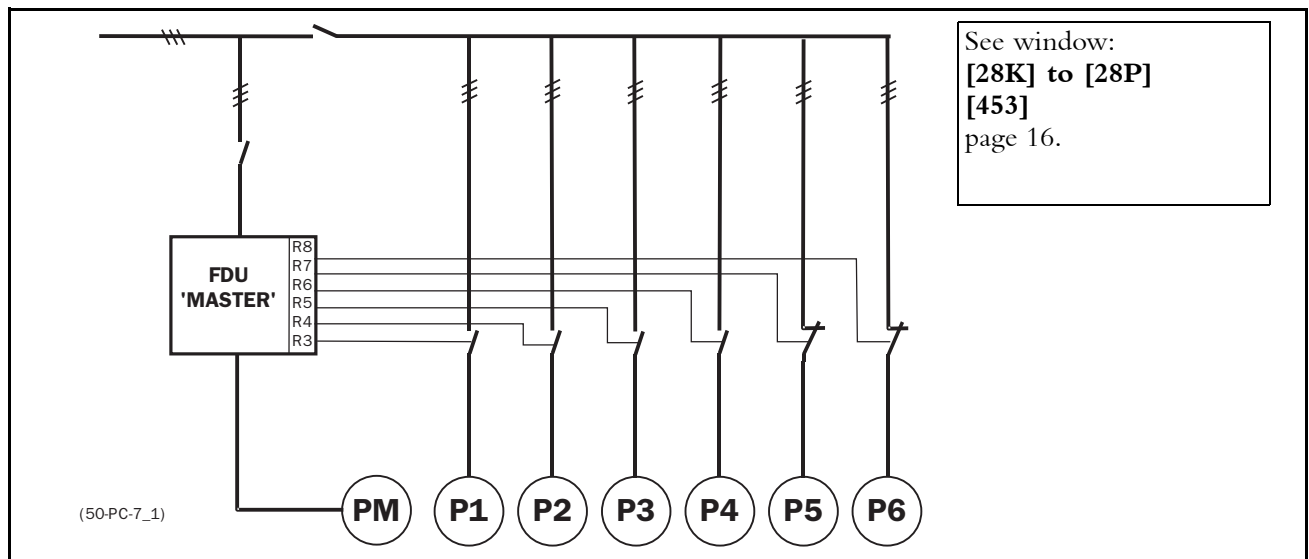


Fig. 7 Example "Fail safe" operation.



## 2.5 PID control

When the PUMP CONTROL option is activated automatically the PID controller is switched on. The analog inputs AnIn 1 and AnIn 2 function as PID set value and feedback value inputs. Most pump control system will work with a feedback value. However the PID controller can still be switched off if a different kind of control is needed.

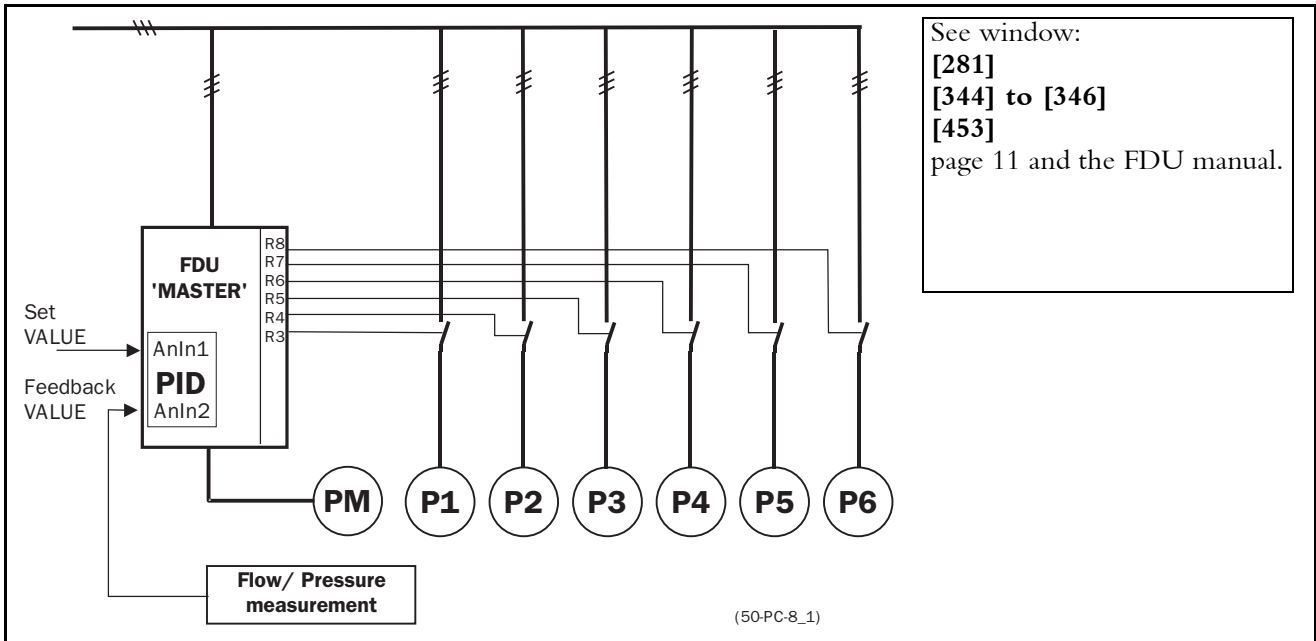


Fig. 8 PID control

## 2.6 Standby mode

If the Feedback Value (flow or pressure) is higher than the Set Value for a longer period of time it is possible to force the system temporarily in the Standby mode. In the Standby mode the output frequency of the Master drive will go 0Hz. If the Feedback value exceeds or falls below a certain value again, the system automatically starts up again.

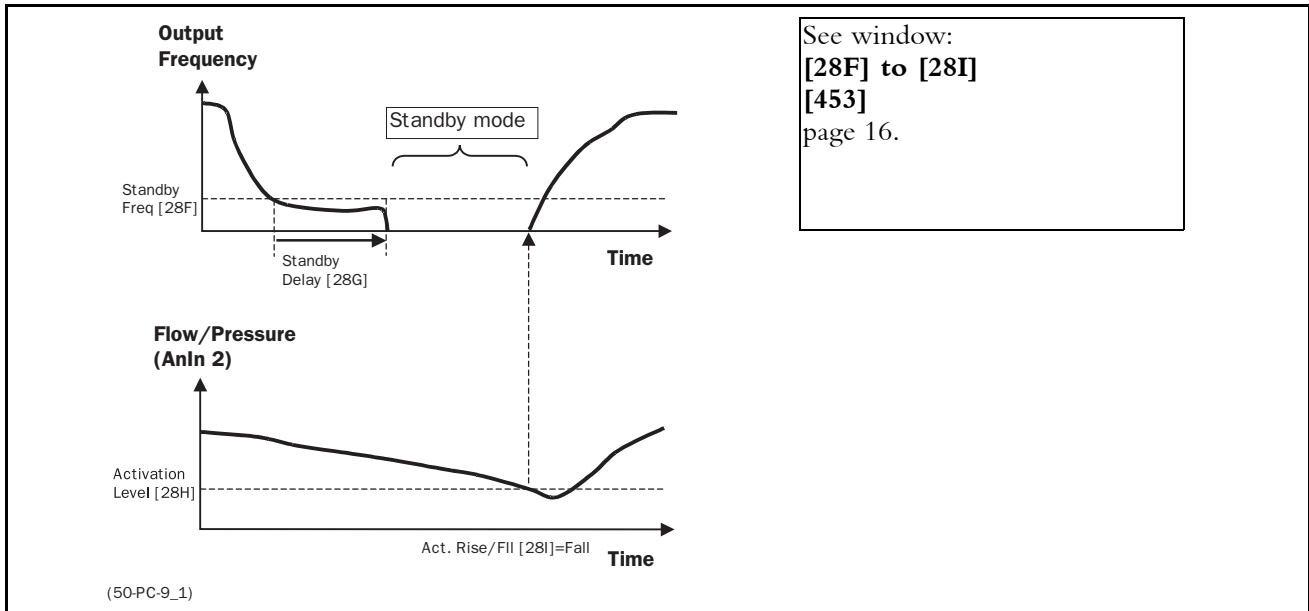


Fig. 9 Standby mode

### 3. WIRING ALTERNATING MASTER

Fig. 10 and Fig. 11 show how the MASTER SELECTOR (RELAY 9) is to be used. At power up K4 will come in first. Then one of the pumps controls will be chosen as MASTER pump (K1, K2 or K3), depending on the Change Condition [284], see page 13. The Master Pump contactor overtakes itself and K4 drops. Further the Master and Additional contactors are interlocking each other to prevent dual powering of the pump and damaging the inverter. (K11/K12, K13/K14, K15/K16).



**CAUTION!** The wiring for the Alternating Master control needs special attention and should be wired exactly as described here, to avoid destructive short circuiting at the output of the inverter.

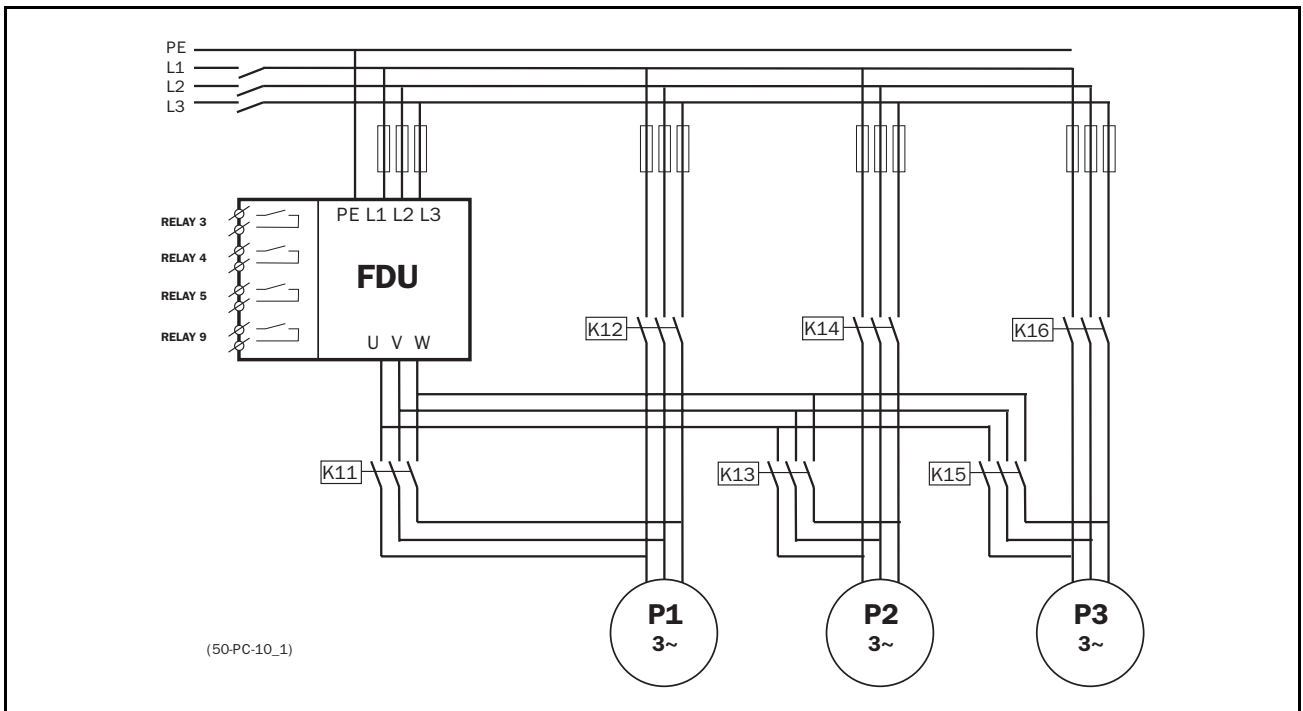


Fig. 10 Power connections for Alternating MASTER circuit with 3 pumps.

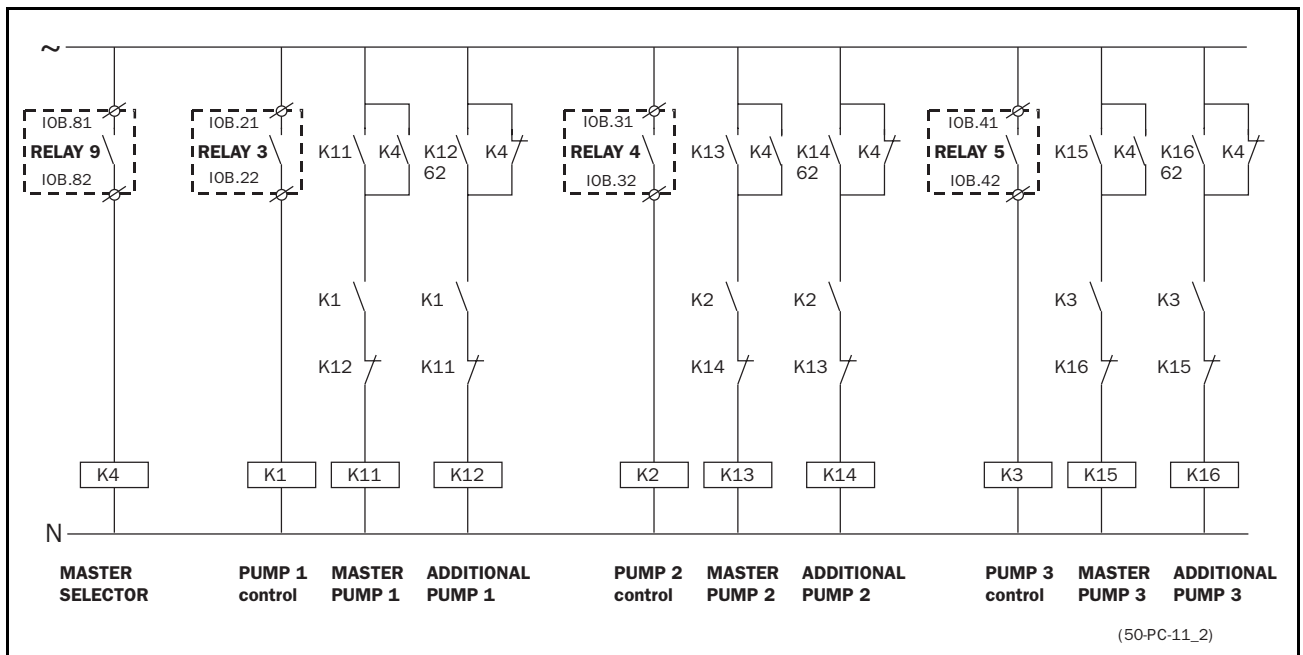


Fig. 11 Control connections for Alternating MASTER circuit with 3 pumps.

## 4. FUNCTIONS

In the FDU a number of new windows appear in the menu when the I/O Board is connected and automatically detected at power up.

### 4.1 Macro Pump/Fan [271]

The Macro function is extended with the Macro PUMP/FAN. Applying this macro will set the most important Pump control functions according to the table below:

Table 1 Macro Pump/Fan

Window	Selection/Range
212 Ref Control	Remote
213 Run/Stop Control	Remote
214 Rotation	R
281 Pump control	On
343 PID Control	On (for all four parameter sets)
411 AnIn 1 Function	Frequency If the window 343 is On, "PID Control" is displayed
412 AnIn 1 Setup	0-10V/0-20mA
416 AnIn 2 Setup	0-10V/0-20mA
429 DigIn 9	Drive 1 Feedb
42A DigIn 10	Drive 2 Feedb
42B DigIn 11	Drive 3 Feedb
42C DigIn 12	Drive 4 Feedb
42D DigIn 13	Drive 5 Feedb
42E DigIn 14	Drive 6 Feedb
453 Relay 3	Drive 1
453 Relay 4	Drive 2
453 Relay 5	Drive 3
453 Relay 6	Drive 4
453 Relay 7	Drive 5
453 Relay 8	Drive 6

See the FDU instruction manual for more information about using the Macro function.

### 4.2 Pump/Fan Control [280]

The Pump/fan Control functions are in menu [280]. The option can also be used for fans.

#### 4.2.1 Control [281]

This will switch on the pump control and opens and sets all relevant functions and windows for the PUMP CONTROL.

**NOTE! If the I/O Board is not used, not all PUMP CONTROL parameters appear. See Chapter 9. page 29.**

281 Pump/Fan Ctl	
Stp	Off
Default:	Off
Selection:	On, Off
<b>Off</b>	Pump Control is switched off.
<b>On</b>	Pump Control is on: - Pump Control parameters [282] to [28P] appear and are activated according to default settings. - DigIn 9 [429] to DigIn 14 [42E] are added in the menu structure. - Relay 3 [435] to Relay 8 [458] are added in the menu structure. - View functions [6G0] to [6M0] are added in the menu structure. - PID control [343] is set to 'On'. - Rotation [214] is set to 'R'.

#### 4.2.2 Number of drives [282]

Sets the total number of drives which are used, including the Master drive. The setting here depends on the parameter Select Drive [283]. After the number of drives is chosen it is important to set the relays for the pump control. If the digital inputs are used for status feedback also these must be set for the pump control.

282 No of Drives	
Stp	2
Default:	2
Selection:	2, 3, 4, 5, 6, 7
<b>2-3</b>	Number of drives if I/O Board is not used. Digital inputs Status Feedback is not possible. - RELAY 1 and 2 are to be set to Drive 1 and Drive 2.
<b>2-6</b>	Number of drives if 'Alternating MASTER' is used, see Select Drive [283] and page 13. (I/O Board is used) - RELAY 3 to RELAY 8 are to be set to Drive 1 and Drive 6. See § 4.4 page 19. - If digital inputs are used: DigIn 9 to DigIn 14 are to be set to Drive 1 feedback to Drive 6 feedback. See § 4.3 page 18.
<b>2-7</b>	Number of drives if 'Fixed MASTER' is used, see Select Drive [283] page 13. (I/O Board is used) - RELAY 3 to RELAY 8 are to be set to Drive 1 and Drive 6. See § 4.4 page 19. - If digital inputs are used: DigIn 9 to DigIn 14 are to be set to Drive 1 feedback to Drive 6 feedback. See § 4.3 page 18.

### 4.2.3 Select Drive [283]

Sets the main operation of the pump system. 'Sequence' and 'Runtime' are Fixed MASTER operation. 'All' means Alternating MASTER operation. See also chapter 2 MAIN FEATURES, page 8.

<b>283 Select Drive Stp                      Sequence</b>	
Default:	Sequence
Selection:	Sequence, Run Time, All
<b>Sequence</b>	Fixed MASTER operation: - The additional drives will be selected in sequence, i.e. first Drive 1 then Drive 2 etc. - Maximum 7 drives can be used
<b>Run Time</b>	Fixed MASTER operation: - The additional drives will be selected depending on the Run Time. So the drive with the lowest Run Time will be selected first. The Run Time is monitored in windows [6G0] to [6L0] in sequence. For each drive the Run Time can be reset. - When drives are stopped, the drive with the longest Run Time will be stopped first. - Maximum 7 drives can be used.
<b>All</b>	Alternating MASTER operation: - At power up of the inverter one drive is selected as the Master drive. The selecting criteria depends on the Change Condition [284]. The drive will be selected depending on the Run Time. So the drive with the lowest Run Time will be selected first. The Run Time is monitored in windows [6G0] to [6L0] in sequence. For each drive the Run Time can be reset. - Maximum 6 drives can be used. - See chapter 2 and 3, page 8 and page 11 for more detailed information.

**NOTE! This window will NOT appear if less than 3 drives are selected.**

### 4.2.4 Change Condition [284]

This determines the criteria of Changing the Master. This window only appears if the Alternating MASTER operation is selected. The elapsed Run Time of each drive is monitored. See § 4.5 page 20. The elapsed Run Time always determines which drive will be the 'new' Master drive.

This function is only active and visible if:

- Select Drive [283]=All

<b>284 Change Cond Stp                      Both</b>	
Default:	Both
Selection:	Stop, Timer, Both
<b>Stop</b>	The Run Time of the Master drive determines when a master drive has to be changed. The change will only take place after a: - Power Up - Stop - Standby condition - Trip condition.
<b>Timer</b>	The Master drive will be changed if the timer setting in Change Timer [285] has elapsed. The change will take place immediately. So during operation the additional pumps will be stopped temporarily, the 'new' Master will be selected according to the Run Time and the additional pumps will be started again. It is possible to leave 2 pumps running during the change operation. This can be set with Drives on Change [286], see § 4.2.5 page 13.
<b>Both</b>	The Master drive will be changed if the timer setting in Change Timer [285] has elapsed. The 'new' Master will be selected according to the elapsed Run Time. The change will only take place after a: - Power Up - Stop - Standby condition - Trip condition

**NOTE! If the Status feedback inputs (DigIn 9 to DigIn 14) are used the Master drive will be changed immediately if the feedback generates an 'Error'.**

### 4.2.5 Change Timer [285]

When the time set here is elapsed, the Master drive will be changed. This function is only active and visible if:

- Select Drive [283]=All

- Change Cond [284]= Timer/ Both

<b>285 Change Timer Stp                      1h</b>	
Default:	50
Range:	1-3000h

#### 4.2.6 Drives on Change [286]

If a Master drive is changed according to the Timer function (Change Condition=Timer/Both [284]), it is possible to leave additional pumps running during the change operation. With this function the change operation will be as smooth as possible. The maximum number to be programmed in this window depends on the number of additional drives.

**Example:**

If the number of drives is set to 6 the maximum value will be 4.

This function is only active and visible if:

- Select Drive [283]=All

<b>286 Drives on Ch</b>	
Stp	0
Default:	0
Range:	0-(the number of drives - 2)

#### 4.2.7 Upper Band [287]

If the output frequency of the master drive comes into the Upper Band an additional drive will be added after a delay time. This delay time is set in Start Delay [289]. See § 4.2.9 page 14.

<b>287 Upper Band</b>	
Stp	10%
Default:	10%
Range:	0-100% of total $F_{MIN}$ to $F_{MAX}$

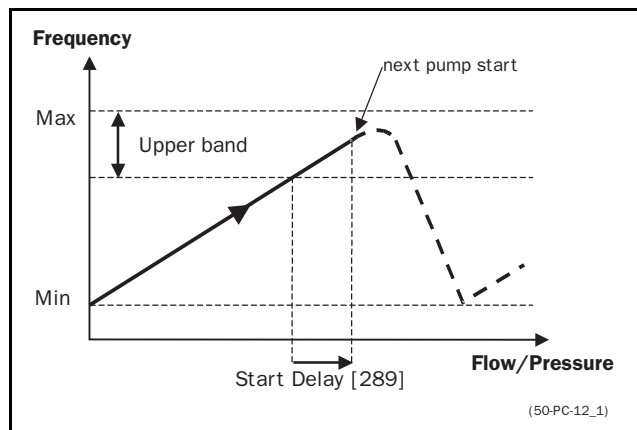


Fig. 12 Upper Band

#### 4.2.8 Lower Band [288]

If the output frequency of the master drive comes into the Lower Band an additional drive will be stopped after a delay time. This delay time is set in Stop Delay [28A]. See § 4.2.10 page 14.

<b>288 Lower Band</b>	
Stp	10%
Default:	10%
Range:	0-100% of total $F_{MIN}$ to $F_{MAX}$

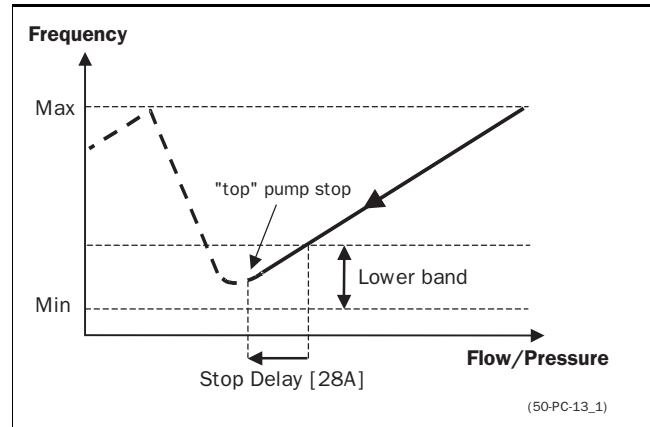


Fig. 13 Lower Band

#### 4.2.9 Start Delay [289]

This delay time must be elapsed before the next pump is started. A delay time prevents nervous switching of pumps. See Fig. 12.

<b>289 Start Delay</b>	
Stp	0s
Default:	0s
Range:	0-999s

#### 4.2.10 Stop Delay [28A]

This delay time must be elapsed before the 'top' pump is stopped. A delay time prevents nervous switching of pumps. See Fig. 13.

<b>28A Stop Delay</b>	
Stp	0s
Default:	0s
Range:	0-999s

#### 4.2.11 Upper Band Limit [28B]

If the output frequency of the inverter reaches the Upper Band Limit, the next pump is started immediately without delay. If a start delay is used this delay will be ignored.

<b>28B Upp Band Lim</b>	
Stp                      0%	
Default:	0%
Range:	0 - Upper Band level. 0% (=F <sub>MAX</sub> ) means that the Limit function is switched off.

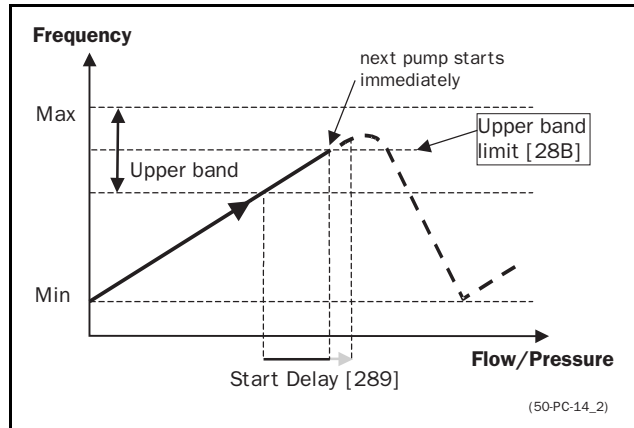


Fig. 14 Upper Band Limit

#### 4.2.12 Lower Band Limit [28C]

If the output frequency of the inverter reaches the Lower Band Limit, the 'top' pump is stopped immediately without delay. If a stop delay is used this delay will be ignored.

<b>28C Low Band Lim</b>	
Stp                      0%	
Default:	0%
Range:	0 - Lower Band level. 0% (=F <sub>MIN</sub> ) means that the Limit function is switched off.

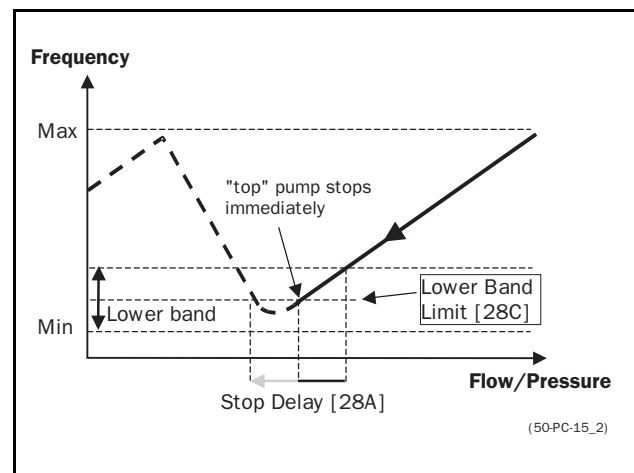


Fig. 15 Lower Band Limit

#### 4.2.13 Settle Time [28D]

The Settle Time allows the pump which just has been switched on to settle before the pump control continues. If a additional pump is started D.O.L. (Direct On Line) or Y/ Δ , the flow or pressure can still fluctuate due to the 'rough' start/stop method. This could cause unnecessary starting and stopping of additional pumps.

##### During the Settle time:

- PID controller is off.
- the output frequency is kept at a fixed level after adding a pump.

<b>28D Settle Time</b>	
Stp                      0s	
Default:	0s
Range:	0-999s

#### 4.2.14 Transition Frequency [28E]

The transition frequency is used to minimize a flow/pressure overshoot when switching over to another pump. The setting depends on the dynamics of both master drive and the additional. drives.

##### In general:

- If a next pump has 'slow' start/stop dynamics, then a higher transition frequency should be used.
- If a next pump has 'fast' start/stop dynamics, then a lower transition frequency should be used.

<b>28E Trans Freq</b>	
Stp                      60%	
Default:	60%
Range:	0-120% of the actual frequency. The limits are between F <sub>MIN</sub> and F <sub>MAX</sub>

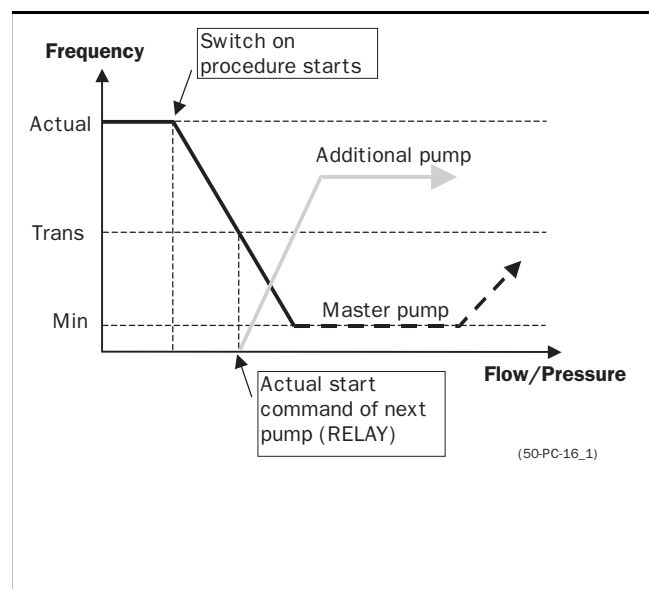


Fig. 16 Transition frequency

The transition frequency can best be set by trial and error.

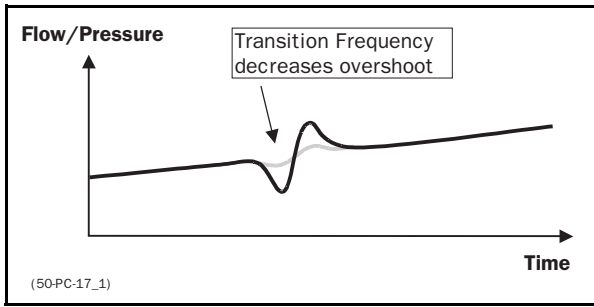


Fig. 17 Effect of transition frequency

#### 4.2.15 Standby Frequency [28F]

Some systems will maintain flow or pressure even if the pumps are stopped. In that case the master will enter "Standby Mode" and stop the additional pumps temporary until the flow/pressure falls below a certain level, after which the system starts up automatically again.

To activate the "Standby Mode", the following parameters must be set.:

**- Standby Frequency [28F]**

This sets the frequency level of the inverter below which the "Standby Mode" will be activated.

**- Standby Delay [28G]**

During this delay the frequency must be below the Standby Frequency level before the Standby Mode is activated.

**- Activation Level [28H]**

If the feedback input (flow/pressure) comes below this level the "Standby Mode" is abandoned.

**- Activation Rise/Fall [28I]**

Feedback signal must be higher (Rise) or lower (Fall) than the activation level, to abandon the "Standby Mode".

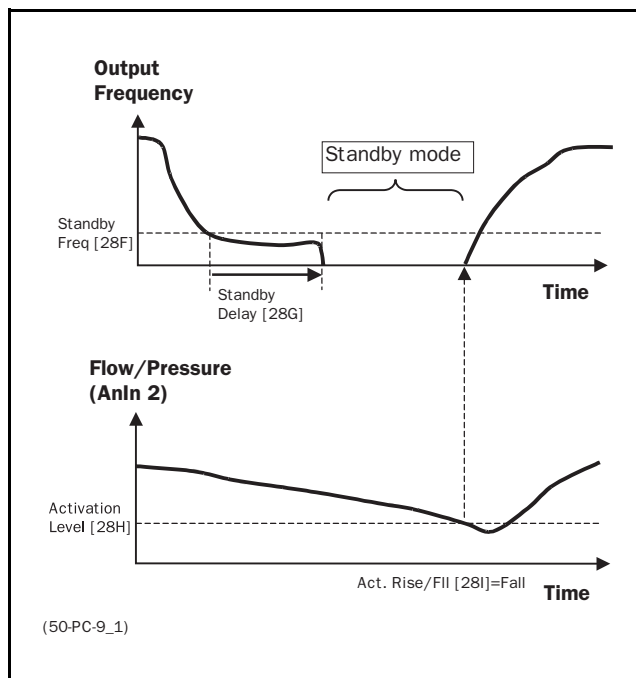


Fig. 18 Standby Mode.

<b>28F Standby Freq</b>	
Stp                      0.0Hz	
Default:	0Hz
Range:	F <sub>MIN</sub> - (F <sub>MAX</sub> -1Hz) 0Hz means that the "Standby Mode" is switched off.

#### 4.2.16 Standby Delay [28G]

See § 4.2.15 page 16. The Standby Delay is the time that the frequency must be below the Standby Frequency level, before the system enters the "Standby Mode".

<b>28G Stdby Delay</b>	
Stp                      0s	
Default:	0s
Range:	0-999s

#### 4.2.17 Activation Level [28H]

See § 4.2.15 page 16. If the Feedback signal on AnIn 2 (flow/pressure) comes below the Activation Level, the system will start up again. The "Standby Mode" is then abandoned.

<b>28H Act. Level</b>	
Stp                      0%	
Default:	0%
Range:	0-100% (AnIn 2 input)

#### 4.2.18 Activation Rise/Fall [28I]

See § 4.2.15 page 16. This function determines whether the feedback signal must be higher or lower than the Activation Level to abandon the "Standby Mode".

<b>28I Act.Rise/Fll</b>	
Stp                      Fall	
Default:	Fall
Selection:	Rise, Fall
<b>Fall</b>	The feedback signal on AnIn 2 must go below the selected Standby Frequency [28F] to activate the system (abandon "Standby Mode"). This must be used if PID Control [343]=Normal. See Instruction manual FDU Frequency inverter.
<b>Rise</b>	The feedback signal on AnIn 2 must go above the selected Standby Frequency [28F] to activate the system (abandon "Standby Mode"). This must be used if PID Control [343]=Invert. See Instruction manual FDU Frequency inverter.

#### 4.2.19 Use inputs [28J]

To activate the Feedback Status function on digital inputs DigIn 9 to DigIn 14. See § 2.3 page 9 for an example of the use of the feedback status inputs. If other kind of drives are used to start or control the additional drives (soft starter, frequency inverter, Y/ Δ), these drives can give a status feedback (e.g. failure on the drive) to the Pump Control. In that case the Pump Control will not select that particular drive. If the Drive is already selected it will be stopped immediately. If all selected Feedback Status inputs are active, then the inverter will trip on EXTERNAL TRIP. This means that no additional drive is available at that moment.

**NOTE! The Digital inputs DigIn 9 to DigIn 14 are only available if the I/O Board is used.**

<b>28J Use inputs</b> Stp                      No	
Default:	No
Selection:	No, Yes
<b>No</b>	The Feedback status function is not used. The digital inputs DigIn 9 to DigIn 14 can be used for other functions. See § 4.3 page 18.
<b>Yes</b>	The Feedback Status function is active. <ul style="list-style-type: none"> <li>- The digital inputs which are used for the pump control must be set to "Drive# Feedb". See § 4.3 page 18.</li> <li>- If an input is made inactive (LOW) then the pump control will not use the accompanying pump, instead it will select an other one.</li> </ul> <p>If that pump is all ready running, it will be stopped immediately and an other pump will be selected . (e.g. "Drive 1 Feedb" corresponds with "Drive 1" on a RELAY output).</p> <p><b>NOTE! If all Feedback Status inputs are active, then the Pump Control can not select an alternative drive. An EXTERNAL TRIP will be generated and the system will be stopped immediately.</b></p>

#### 4.2.20 Output Polarity [28k] to [28P]

Each relay output ("Drive 1" to "Drive 6") can be programmed for N.O. or N.C. operation. The N.C. contact can be used for a 'Fail safe' operation of the Pump control. In that case the relay will be closed at power down or if the inverter is tripped or broken, so the pump keeps on running. This can be important for pump system which needs an absolute minimum flow or pressure even in power down or failure situations. See § 2.4 page 9.

<b>28K Output Pot 1</b> Stp                      Normal	
Default:	Normal
Selection:	Normal, Inverted
<b>Normal</b>	The selected output relay for the pump function "DRIVE 1" will be <u>active</u> if valid. Use the relay N.O. contact to start the pump.
<b>Inverted</b>	The selected output relay for the pump function "DRIVE 1" will be <u>inactive</u> if valid. Use the relay N.C. contact to start the pump.

The same functions are valid for the following windows:

<b>28L Output Pot 2</b> Stp                      Normal	polarity for "RELAY #=Drive 2"
<b>28M Output Pot 3</b> Stp                      Normal	polarity for "RELAY #=Drive 3"
<b>28N Output Pot 4</b> Stp                      Normal	polarity for "RELAY #=Drive 4"
<b>28O Output Pot 5</b> Stp                      Normal	polarity for "RELAY #=Drive 5"
<b>28P Output Pot 6</b> Stp                      Normal	polarity for "RELAY #=Drive 6"



### 4.3 Digital Inputs

6 digital inputs are added with windows [429] to [42E]. All the inputs have the same selection as the original digital inputs DigIn 1 to DigIn 8. See the FDU instruction manual for more detailed information.

	<b>429 DigIn 9</b> Stp <b>Off</b>
Default:	Off
Selection:	Off, Ext trip, Stop, Enable, RunR, RunL, Run, Reset, AnIn select, Pres Ref1, Pres Ref2, Pres Ref4, MotPot Up, MotPot Down, Jog, Drive1 fdb, Drive2 fdb, Drive3 fdb, Drive4 fdb, Drive5 fdb, Drive6 fdb, Mains Off
<b>Off</b>	The input is not active.
<b>Ext. Trip</b>	<b>NOTE! The External Trip is active low. Be aware that if there is nothing connected to the input, the inverter will trip at External trip immediately.</b>
<b>Stop</b>	Stop command according to the selected Stop mode in window [31A]  <b>NOTE! The Stop command is active low.</b>
<b>Enable</b>	Enable command. General start condition to run the inverter. If made low during running the output of the inverter is cut off immediately, causing the motor to coast to zero speed.  <b>NOTE! If none of the DigIns are programmed to Enable, the internal Enable signal is active.</b>
<b>RunR</b>	Run Right command. The output of the inverter will be a clockwise rotary field.
<b>RunL</b>	Run Left command. The output of the inverter will be a counter-clockwise rotary field.
<b>Run</b>	Run command. The direction of the rotary field is determined by the setting of window Rotation [214] and window Direction [324].
<b>Reset</b>	Reset command. To reset a Trip condition and to enable the Autoreset function.
<b>AnIn Select</b>	Selects AnIn2 or 1 if they have the same function. Can be used for local/Remote control. Low: AnIn1 active High: AnIn2 active.
<b>Preset Ref1</b>	To select the Preset Frequency Reference.
<b>Preset Ref2</b>	To select the Preset Frequency Reference.
<b>Preset Ref4</b>	To select the Preset Frequency Reference.

<b>MotPot Up</b>	Increases the internal reference value acc. to the set acceleration time with a min. of 0.5 s. Has the same function as a "real" motor potentiometer.
<b>MotPot Down</b>	Decreases the internal reference value according to the set deceleration time with a minimum of 0.5s.
<b>Jog</b>	To activate the Jog function. Gives a Run command with the set Jog Freq. and Direction.
<b>Drive 1 feedb</b>	Feedback input Drive 1 for Pump control. This selection is only visible if the I/O Board is used.
<b>Drive 2 feedb</b>	Feedback input Drive 2 for Pump control. This selection is only visible if the I/O Board is used.
<b>Drive 3 feedb</b>	Feedback input Drive 3 for Pump control. This selection is only visible if the I/O Board is used.
<b>Drive 4 feedb</b>	Feedback input Drive 4 for Pump control. This selection is only visible if the I/O Board is used.
<b>Drive 5 feedb</b>	Feedback input Drive 5 for Pump control. This selection is only visible if the I/O Board is used.
<b>Drive 6 feedb</b>	Feedback input Drive 6 for Pump control. This selection is only visible if the I/O Board is used.
<b>Mains Off</b>	Active when mains contactor is off.

The same functions are valid for the following windows:

<b>42A DigIn 10</b> Stp <b>Off</b>
---------------------------------------

<b>42B DigIn 11</b> Stp <b>Off</b>
---------------------------------------

<b>42C DigIn 12</b> Stp <b>Off</b>
---------------------------------------

<b>42D DigIn 13</b> Stp <b>Off</b>
---------------------------------------

<b>42E DigIn 14</b> Stp <b>Off</b>
---------------------------------------

## 4.4 Relay Outputs

When the I/O Board is installed, windows [453] to [458] will become active. All the relay outputs have the same selection as the original relay outputs Relay1 and Relay2, as well as the digital outputs DigOut1 and DigOut2. The functions marked with \* are only available for Relay3 to Relay8.

See also the Chapter 7.2 page 25 and the FDU instruction manual for more detailed information.

	<b>453 Relay 3</b> Stp <span style="float: right;"><b>Run</b></span>
Default:	Run
Selection:	Run, Stop, 0Hz, Acc/Dec, At freq, At max freq, No trip, Trip, Autoreset Trip, Limit, Warning, Ready, $T=T_{LIM}$ , $I>I_{NOM}$ , Sgnl<Offset, Alarm, Pre-alarm, Max Alarm, Max Pre-alarm, Min Alarm, Min Pre-alarm, LY, !LY, LZ, !LZ, CA1, !A1, CA2, !A2, CD1, !D1, CD2, !D2, Drive1, Drive2, Drive3, Drive4, Drive5, Drive6, All Drives, Only Master
<b>Run</b>	The inverter output is active.
<b>Stop</b>	The inverter output is not active.
<b>0Hz</b>	The output frequency =0+0.1Hz when in Run condition
<b>Acc/Dec</b>	The speed is increasing or decreasing.
<b>At freq</b>	The Output Freq =Reference Freq.
<b>At max freq</b>	The frequency is limited by the Maximum Frequency.
<b>No trip</b>	No trip condition active.
<b>Trip</b>	A Trip condition is active.
<b>Autoorst Trip</b>	Autoreset trip condition is active
<b>Limit</b>	A Limit condition is active.
<b>Warning</b>	A warning condition is active.
<b>Ready</b>	The inverter is ready for operation. This means that the inverter is powered up and healthy and ready to take a command.
<b><math>T=T_{LIM}</math></b>	The Torque is limited by the Torque Limit function.
<b><math>I&gt;I_{NOM}</math></b>	The output current is higher than the inverter rated current.
<b>Sgnl&lt;Offset</b>	One of the AnIn input signals is lower than 75% of the offset level.
<b>Alarm</b>	Max or Min Alarm level reached.
<b>Pre-alarm</b>	Max or Min Pre-alarm level reached.
<b>Max Alarm</b>	Max Alarm level reached.
<b>Max Pre-alarm</b>	Max Pre-alarm level reached.
<b>Min Alarm</b>	Min Alarm level reached.
<b>Min Pre-Alarm</b>	Min Pre-alarm level reached.

<b>LY</b>	Logic output Y.
<b>!LY</b>	Logic output Y inverted.
<b>LZ</b>	Logic output Z.
<b>!LZ</b>	Logic output Z inverted.
<b>CA1</b>	Analog Comparator output 1.
<b>!A1</b>	Analog Comparator output 1 inverted.
<b>CA2</b>	Analog Comparator output 2.
<b>!A2</b>	Analog Comparator output 2 inverted.
<b>CD1</b>	Digital Comparator output 1.
<b>!D1</b>	Digital Comparator output 1.inverted.
<b>CD2</b>	Digital Comparator output 2.
<b>!D2</b>	Digital Comparator output 2.inverted.
<b>DRIVE 1</b>	Select Drive 1 for pump control.
<b>DRIVE 2</b>	Select Drive 2 for pump control.
<b>DRIVE 3 *</b>	Select Drive 3 for pump control.
<b>DRIVE 4 *</b>	Select Drive 4 for pump control.
<b>DRIVE 5 *</b>	Select Drive 5 for pump control.
<b>DRIVE 6 *</b>	Select Drive 6 for pump control.
<b>All Drives *</b>	All additional drives are on.
<b>Only Master *</b>	Only the master drive is on.

The same functions are valid for the following windows:

<b>454 Relay 4</b> Stp <span style="float: right;"><b>Stop</b></span>
--

<b>455 Relay 5</b> Stp <span style="float: right;"><b>Limit</b></span>
---

<b>456 Relay 6</b> Stp <span style="float: right;"><b>Warning</b></span>
---

<b>457 Relay 7</b> Stp <span style="float: right;"><b>Alarm</b></span>
---

<b>458 Relay 8</b> Stp <span style="float: right;"><b>Pre-Alarm</b></span>
---

## 4.5 Run Time counters [6G0] to [6L0] and reset [6G1] to [6L1]

The additional pumps are individually monitored with regard to the elapsed run time. The Run Time counter is used for the change conditions if pumps are to be added or if the master pump has to be changed. See § 4.2.3 and § 4.2.4 page 13. Each Run time counter can be reset individually.

<b>6G0 Run Time 1</b>	
Stp	h: m
Unit:	h: m (hours: minutes)
Range:	0h:0m - 65535h:59m

<b>6G1 Rst Run Tm 1</b>	
Stp	no
Default :	No
Selection:	No, Yes

The same functions are valid for the following windows:

<b>6H0 Run Time 2</b>	
Stp	h: m

<b>6H1 Rst Run Tm 2</b>	
Stp	no

<b>6I0 Run Time 3</b>	
Stp	h: m

<b>6I1 Rst Run Tm 3</b>	
Stp	no

<b>6J0 Run Time 4</b>	
Stp	h: m

<b>6J1 Rst Run Tm 4</b>	
Stp	no

<b>6K0 Run Time 5</b>	
Stp	h: m

<b>6K1 Rst Run Tm 5</b>	
Stp	no

<b>6L0 Run Time 6</b>	
Stp	h: m

<b>6L1 Rst Run Tm 6</b>	
Stp	no

## 4.6 Additional Pump Status [6M0]

This window displays the actual status of each additional pump used by the pump control option.

<b>6M0 Pump</b>	<b>123456</b>
Stp	*****

The first row shows the total number of pumps dedicated to the pump control. The number correspond with the selected relay output number E.g.: Pump 1 is "DRIVE 1".

The following indicators are possible

"C"	<b>Controlled (Master).</b> The pump is controlled by the frequency inverter. This will only be shown if the function "Alternating MASTER" is used.
"D"	<b>Direct (Slave).</b> The pump is switched on directly by the relay output.
"O"	<b>Off</b> Pump is selected, but switched off.
"E"	<b>Error</b> This will only be shown if digital feedback inputs are used
" "	Not selected (empty flag)

**Example:**

<b>6M0 Pump</b>	<b>123456</b>
Stp	D COOE

This example shows:

- Alternating MASTER function is used with 5 pumps. Pump 6 is not selected.
- Pump 2 is the Master pump controlled by the FDU.
- Pump 1 is switched on.
- Pump 3 & 4 are switched off.
- Pump 5 is out of order due to an error status on the digital feedback input.

## 5. CHECKLIST AND TIPS

<b>1. Main Functions</b>	<p>Start by choosing which of the two main functions to use:</p> <ul style="list-style-type: none"> <li>- <b>"Alternating MASTER" function</b></li> </ul> <p>In this case the "Master" pump can be alternated, however, this function needs a bit more complicated wiring compared to the "Fixed MASTER" function described below. The I/O Board option is necessary.</p> <ul style="list-style-type: none"> <li>- <b>"Fixed MASTER" function:</b></li> </ul> <p>One pump is always the master, only the additional pumps alternate.</p> <p>Notice that there is a big difference in the wiring of the system between these main functions, so it not possible to change between these 2 functions later. For further information see Chapter 2. page 8.</p>
<b>2. Number of pumps/drives</b>	<p>If the system consists of 2 or 3 pumps the I/O Board option is not needed. However the following functions are not possible then:</p> <ul style="list-style-type: none"> <li>- "Alternating MASTER" function</li> <li>- Digital status feedback inputs</li> </ul> <p>With the I/O Board option installed, the maximum number of pumps is:</p> <ul style="list-style-type: none"> <li>- 6 pumps if "Alternating MASTER" function is selected. (see § 2.2 page 8)</li> <li>- 7 pumps if "Fixed MASTER" function is selected. (see § 2.1 page 8)</li> </ul>
<b>3. Pump size</b>	<ul style="list-style-type: none"> <li>- <b>"Alternating MASTER" function:</b></li> </ul> <p>The sizes of the pumps must be equal.</p> <ul style="list-style-type: none"> <li>- <b>"Fixed MASTER" function:</b></li> </ul> <p>The pumps may have different power sizes, however, the master pump (FDU) must always be the largest power.</p>
<b>4. Programming the Digital inputs</b>	<p>The Digital Status feedback inputs are only available if the I/O Board is installed. If the Digital inputs are used (see § 2.3 page 9), the function Use Inputs [28J] must be set to "On". The inputs themselves are not automatically set for the feedback (DigIn #= Drive # feedb). Always check that the inputs are programmed according to the number of pumps used. If the Pump/Fan Macro (window [271]) is used then the Digital Inputs are set automatically for the pump function (see Table 1).</p>
<b>5. Programming the Relay outputs</b>	<p>After the Pump controller is switched on in window [281] the number of relays must be set in window [282] (Number of Drives). The relays themselves are not automatically set for the pump control function. Always check that the relays are programmed according to the number of pumps used. If the Pump/Fan Macro (window [271]) is used, the Relays are set automatically for the pump function (see Table 1).</p>
<b>6. Use the Macro function</b>	<p>If the Macro: Pump/Fan [271] is used, the system is set for a "Fixed MASTER" with 2 pumps. So basically only the correct number of pumps has to be set in window [282] (Number of drives). The relays and digital inputs (if used) are all set to the correct "Drive" number.</p>
<b>7. Equal Pumps</b>	<p>If all pumps are equal in power size it is likely that the Upper band is much smaller than the Lower band, because the maximum pump discharge of the master pump is the same if the pump is connected to the mains (50Hz). This can give a very narrow hysteresis causing an unstable control area in the flow/pressure. By setting the maximum frequency of the inverter just a little above 50Hz it means that the master pump has a slightly bigger pump discharge than the pump on the mains. Of course caution has to be taken to prevent the master pump running at a higher frequency for a longer period of time, to prevent overload of the master pump.</p>
<b>8. Minimum Frequency</b>	<p>With pumps and fans it is normal to use a minimum frequency, because at lower speed the discharge of the pump or fan will be low until 30-50% of the nominal speed (depends on size, power, pump properties etc.). When using a minimum frequency, a much smoother and better control range of the whole system will be obtained.</p>

## 6. FUNCTIONAL EXAMPLES OF START/STOP TRANSITIONS

### 6.1 Starting an additional pump

This figure shows a possible sequence with all levels and functions involved when a additional pump is started by means of the pump control relays. The starting of the 2nd pump is controlled by one of the Relay outputs. The relay in this example starts the pump direct on line. Of course other start/stop equipment like a soft starter could be controlled by the relay output.

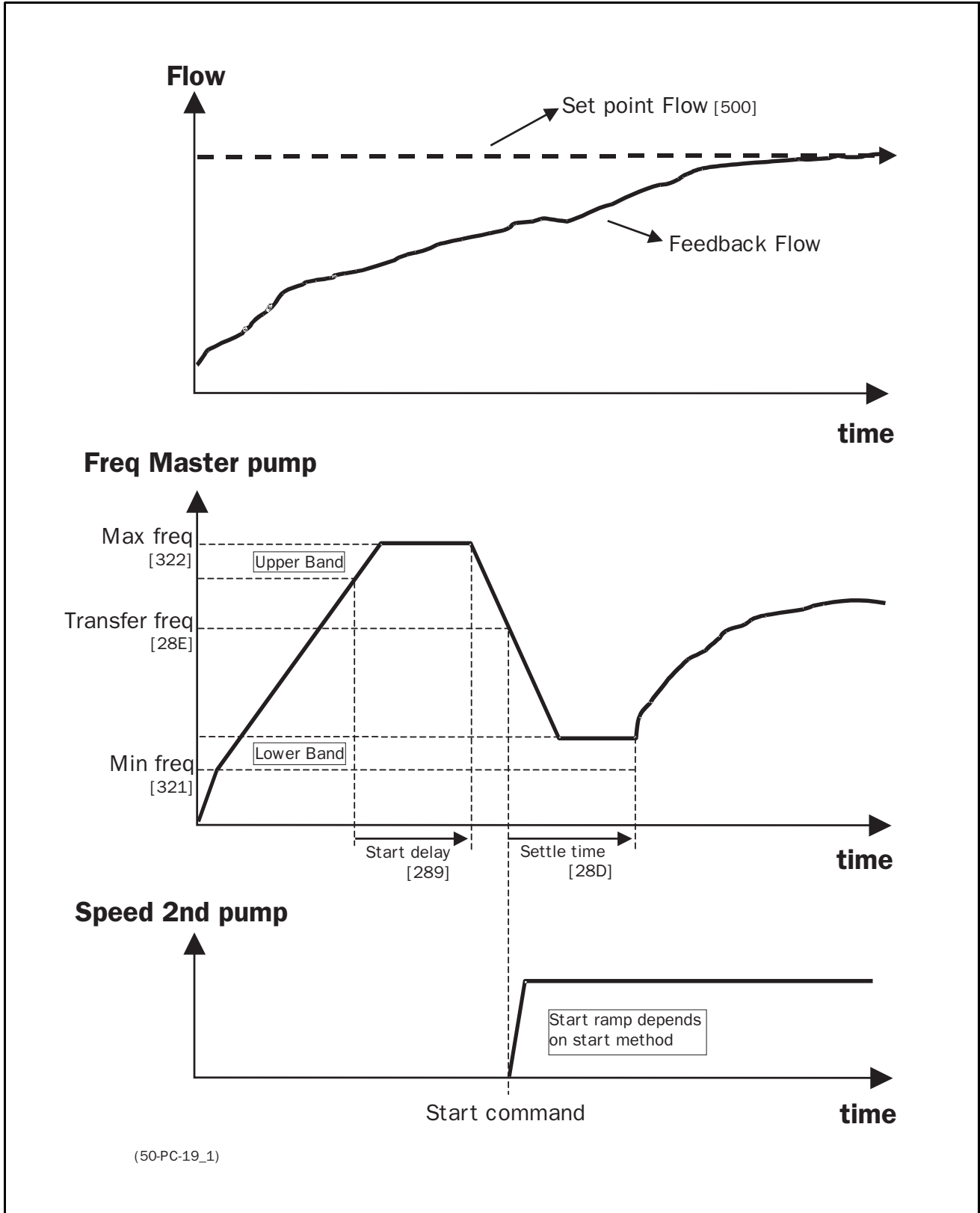


Fig. 19 Time sequence starting an additional pump

## 6.2 Stopping an additional pump

This figure shows a possible sequence with all levels and functions involved when a additional pump is stopped by means of the pump control relays. The stopping of the 2nd pump is controlled by one of the Relay outputs. The relay in this example stops the pump direct on line. Of course other start/stop equipment like a soft starter could be controlled by the relay output.

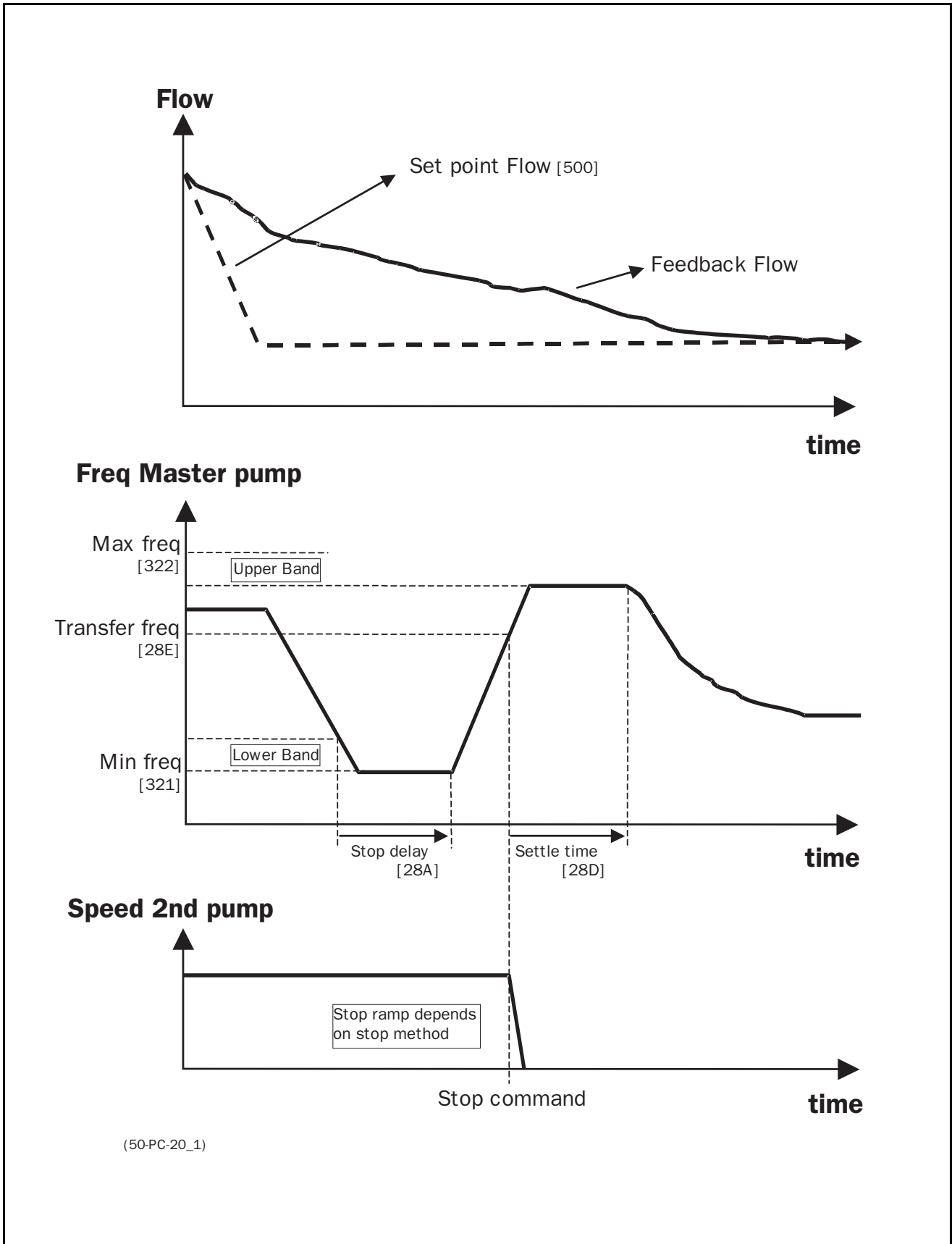


Fig. 20 Time sequence stopping an additional pump

# 7. I/O BOARD CONNECTIONS AND FUNCTIONS

## 7.1 I/O BOARD layout

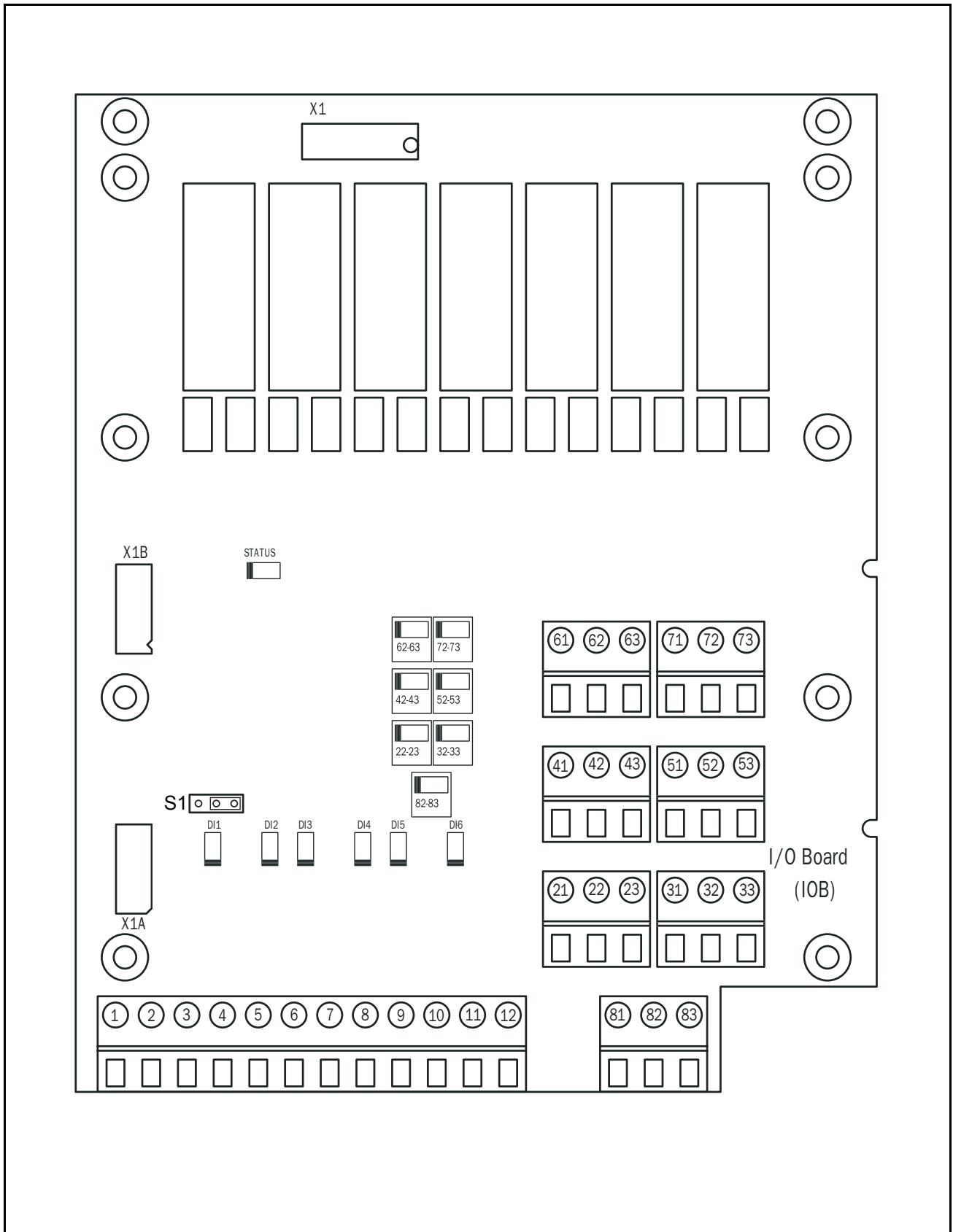


Fig. 21 I/O BOARD layout

## 7.2 User connections

Table 2 User Connections I/O BOARD

IOB	Name:	Function (default):	Signal:	Type:
21	N/C 3	Relay 3 programmable output, default: RUN, active if inverter is running	Potential free change over 2A/250VAC/AC1	Relay output
22	COM 3			
23	N/O 3			
31	N/C 4	Relay 4 programmable output, default: STOP, active if inverter is stopped	Potential free change over 2A/250VAC/AC1	Relay output
32	COM 4			
33	N/O 4			
41	N/C 5	Relay 5 programmable output, default: LIMIT, active if a limit is present	Potential free change over 2A/250VAC/AC1	Relay output
42	COM 5			
43	N/O 5			
51	N/C 6	Relay 6 programmable output, default: WARN- ING, active if a warning is present	Potential free change over 2A/250VAC/AC1	Relay output
52	COM 6			
53	N/O 6			
61	N/C 7	Relay 7 programmable output, default: ALARM, active if a alarm is present	Potential free change over 2A/250VAC/AC1	Relay output
62	COM 7			
63	N/O 7			
71	N/C 8	Relay 8 programmable output, default: PRE- ALARM, active if a pre-alarm is present	Potential free change over 2A/250VAC/AC1	Relay output
72	COM 8			
73	N/O 8			
81	N/C 9	Relay 9 fixed output: MASTER SELECTION, dedi- cated for PUMP CONTROL function	Potential free change over 2A/250VAC/AC1	Relay output
82	COM 9			
83	N/O 9			
1	DigIn 9 +	Digital input 9	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
2	DigIn 9 -	Default: Off		
3	DigIn 10 +	Digital input 10	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
4	DigIn 10 -	Default: Off		
5	DigIn 11 +	Digital input 11	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
6	DigIn 11 -	Default: Off		
7	DigIn 12 +	Digital input 12	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
8	DigIn 12 -	Default: Off		
9	DigIn 13 +	Digital input 13	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
10	DigIn 13 -	Default: Off		
11	DigIn 14 +	Digital input 14	0-24VDC or 0-24VAC, imp. 2.7-3.2kΩ. <b>See CAUTION below table!</b>	Differential digital input
12	DigIn 14 -	Default: Off		



**CAUTION! Galvanic isolation between digital input channels is limited! Maximum allowed voltage difference between digital input channels is: 50VDC or 50VAC.**



### 7.3 LEDs

The LEDs on the I/O Board have the following indication function:

Table 3 LED functions

LED	Indication
STATUS	Blinking slow (1Hz)= OK Blinking fast = Communication error Off = No supply
22-23	Relay 3 active (22 and 23 connected)
32-33	Relay 4 active (32 and 33 connected)
42-43	Relay 5 active (42 and 43 connected)
52-53	Relay 6 active (52 and 53 connected)
62-63	Relay 7 active (62 and 63 connected)
72-73	Relay 8 active (72 and 73 connected)
82-83	Relay 9 active (82 and 83 connected)
DI1	Digital input 1 active
DI2	Digital input 2 active
DI3	Digital input 3 active
DI4	Digital input 4 active
DI5	Digital input 5 active
DI6	Digital input 6 active

### 7.4 Jumper

The jumper S1 is used to select address. The position of the jumper must be according to Fig. 21, otherwise the communication will fail.

### 7.5 Internal connectors

Table 4 Internal connectors

Connector:	Function:
X1	For connection to X5 on the control board via a 10 pin ribbon cable. Used when it is not possible to mount the I/O Board on top of the control board.
X1a	Connects the I/O Board to the X5a connector on the control board. See also chapter 8 page 27
X1b	Connects a 2nd option card with the (lower) I/O Board. See also chapter 8, page 27.

### 7.6 Use of the differential digital inputs

The digital inputs DigIn 9 to DigIn 14 are differential inputs. This means that the common of the signal is not connected with the common of the inverter, nor with the common of any other input or output. The advantage of this is that the input is less sensitive to external interference as only the difference in signal on the two wires is used. Another advantage is that control signals from different PLCs with a different common potential can be connected without any problem. See Fig. 22 for an example with 3 different control sources.



**CAUTION! Galvanic isolation between digital input channels is limited! Maximum allowed voltage difference between digital input channels is: 50VDC or 50VAC.**

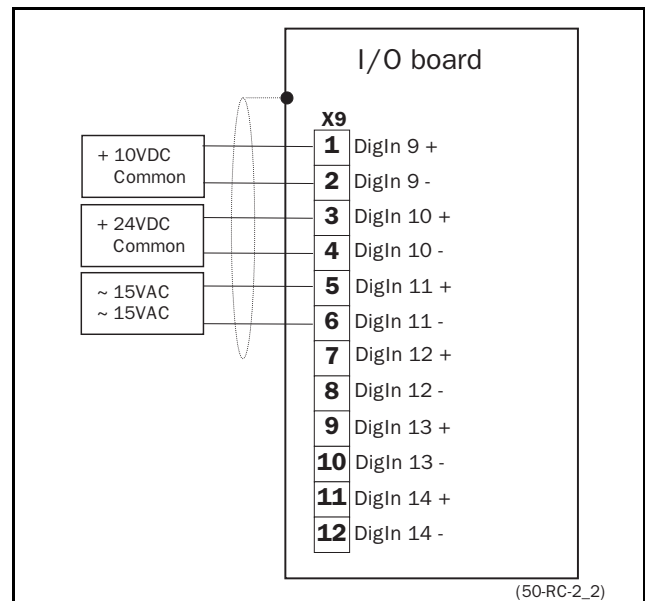


Fig. 22 Example differential inputs

To use the differential input for a non-differential signal it is necessary to connect the negative signal to the common of the inverter. This can be very convenient if the signals are from the same source as the control signals on the FDU frequency inverter itself.

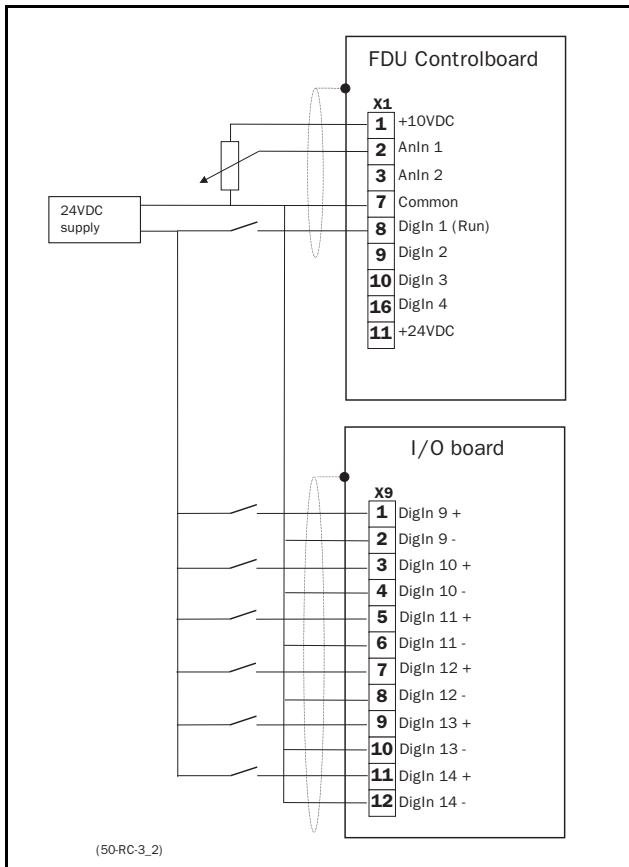


Fig. 23 Example non-differential use of digital inputs

**NOTE! The maximum load off the internal +24VDC supply (FDU control board X1:11) is  $\leq 100\text{mA}$ . Therefore the number of digital inputs (Imp.:  $2.7\text{k}\Omega$ - $3.2\text{k}\Omega$ ) which can be controlled by this source is limited. The use of an external source it to be advised.**

## 8. INSTALLATION

The I/O Board must be mounted according to Fig. 24. **Note! It is important to mount the insulation sheet.**

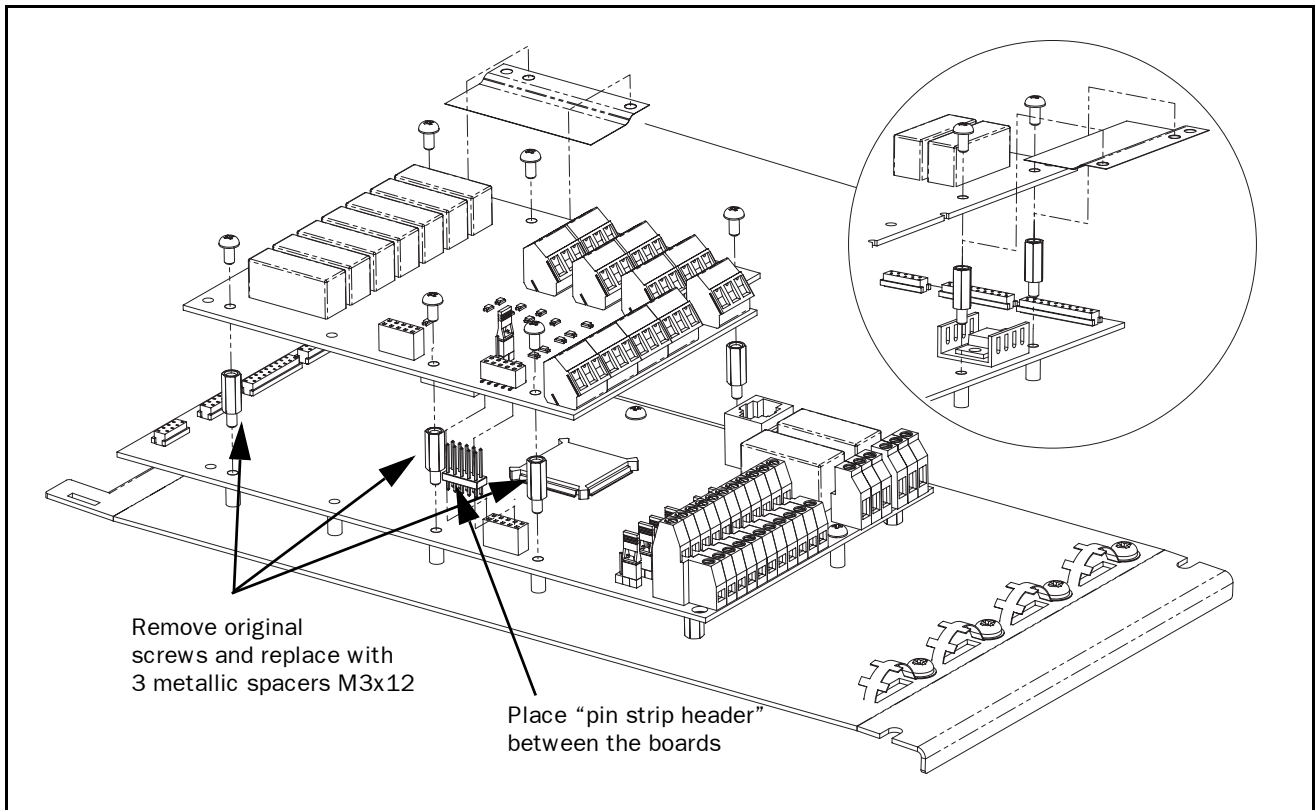


Fig. 24 Installation of the I/O Board

# 9. SETUP MENU LIST PUMP CONTROL FDU Version 3.XX

This is the complete list including all PUMP CONTROL functions.

<b>FDU type</b>	
<b>Serial number</b>	
<b>Software version</b>	

<b>Company</b>	
<b>Date</b>	
<b>Project</b>	

- Functions with \* can be changed during Run.
- Some windows are hidden and will only appear depending on a selected functions. This table shows also the hidden windows.
- All shaded functions appear automatically if the I/O Board is installed.

		Default	Custom
200	MAIN SETUP		
280	Pump/Fan Control		
281	Control	Off	
282	Number of Drives	2	
283	Select Drive	sequence	
284	* Change Condition	Both	
285	* Change Timer	50h	
286	* Drives Change	0	
287	* Upper Band	10%	
288	* Lower Band	10%	
289	* Start Delay	0s	
28A	* Stop Delay	0s	
28B	* Upp Band Lim	10%	
28C	* Low Band Lim	10%	
28D	* Settle Time	0s	
28E	* Trans Freq	60%	
28F	* Standby Freq	0.0Hz	
28G	* Standby Delay	0s	
28H	* Activation level	0%	
28I	* Activation rise/fall	Fall	
28J	Use Inputs	No	
28K	Output pot. 1	Normal	
28L	Output pot. 2	Normal	
28M	Output pot. 3	Normal	
28N	Output pot. 4	Normal	
28O	Output pot. 5	Normal	
28P	Output pot. 6	Normal	

400	I/O		
420	Digital Inputs		
421	DigIn 1	Run	
422	DigIn 2	Off	
423	DigIn 3	Off	
424	DigIn 4	Reset	
425	DigIn 5	Off	
426	DigIn 6	Off	
427	DigIn 7	Off	
428	DigIn 8	Off	
429	DigIn 9	Off	
42A	DigIn 10	Off	
42B	DigIn 11	Off	
42C	DigIn 12	Off	
42D	DigIn 13	Off	
42E	DigIn 14	Off	
450	Relays		
451	* Relay 1 Funct	Trip	
452	* Relay 2 Funct	Ready	
453	* Relay 3 Funct	Run	
454	* Relay 4 Funct	Stop	
455	* Relay 5 Funct	Limit	
456	* Relay 6 Funct	Warning	
457	* Relay 7 Funct	Alarm	
458	* Relay 8 Funct	Pre-Alm	
600	View Operation		
6G0	Run Time 1		
6G1	* Reset RUN Time 1	No	
6H0	Run Time 2		
6H1	* Reset RUN Time 2	No	
6I0	Run Time 3		
6I1	* Reset RUN Time 3	No	
6J0	Run Time 4		
6J1	* Reset RUN Time 4	No	
6K0	Run Time 5		
6K1	* Reset RUN Time 5	No	
6L0	Run Time 6		
6L1	* Reset RUN Time 6	No	
6M0	Additional Pump Status		

# 10. SETUP MENU LIST FDU VERSION 3.XX

This is the complete list including all PUMP CONTROL functions

<b>FDU type</b>	
<b>Serial number</b>	
<b>Software version</b>	

<b>Company</b>	
<b>Date</b>	
<b>Project</b>	

- Functions with \* can be changed during Run.
- Some windows are hidden and will only appear depending on a selected functions. This table shows also the hidden windows.
- All shaded parameters appear automatically if the I/O Board is installed.

		Default	Custom
100	Start-up window		
110	* 1 <sup>st</sup> Line	Speed	
120	* 2 <sup>nd</sup> Line	Torque	
200	Main Setup		
210	Operation		
211	* V/Hz mode	Linear	
212	Ref Control	Remote	
213	Run/Stop Ctrl	Remote	
214	Rotation	R+L	
215	Level/Edge	Level	
216	* IxR Comp	0%	
217	Mains	400V	
220	Motor Data		
221	Motor Power	P <sub>NOM</sub>	
222	Motor Voltage	U <sub>NOM</sub>	
223	Motor Frequency	f <sub>MOT</sub> Hz	
224	Motor Current	I <sub>NOM</sub>	
225	Motor Speed	n <sub>MOT</sub>	
226	Motor Cosphi	(P <sub>NOM</sub> )	
230	Utility		
231	Language	English	
232	* Lock Code?	0	
233	* Copy Set	A>B	
234	* Select Set	A	
235	Load Default	A	
236	* Copy to CP	CP M 1	
237	CP>All Sets	CP M 1	
238	CP>Active Set	CP M 1	
239	CP>Settings	CP M 1	
240	Auto restart		
241	Number of trips	0	
242	Overtemperature	No	
243	Overcurrent	No	
244	Overvoltage D	No	
245	Overvoltage G	No	
246	Overvoltage L	No	
247	Motortemp	No	

248	External trip	No	
249	Motor lost	No	
24A	Alarm	No	
24B	Locked rotor	No	
24C	Power fault	No	
24D	Undervoltage	No	
24E	Comm Error	No	
250	Option: Serial Communication		
251	Baud rate	9600	
252	Address	1	
253	Interrupt	Trip	
260	PTC		
261	* PTC Function	Off	
270	Macros		
271	Select Macro	LocRem ANA	
280	Pump/Fan Control		
281	Control	Off	
282	Number of Drives	2	
283	Select Drive	sequence	
284	* Change Condition	Both	
285	* Change Timer	50h	
286	* Drives Change	0	
287	* Upper Band	10%	
288	* Lower Band	10%	
289	* Start Delay	0s	
28A	* Stop Delay	0s	
28B	* Upp Band Lim	10%	
28C	* Low Band Lim	10%	
28D	* Settle Time	0s	
28E	* Trans Freq	60%	
28F	* Standby Freq	0.0Hz	
28G	* Standby Delay	0s	
28H	* Activation level	0%	
28I	* Activation rise/fall	Fall	
28J	Use Inputs	No	
28K	Output potential 1	Normal	
28L	Output potential 2	Normal	
28M	Output potential 3	Normal	

	28N	Output potential 4	Normal	
	28O	Output potential 5	Normal	
	28P	Output potential 6	Normal	
300	Parameter Sets			
	310	* Run/Stop		
	311	* Acc Time	2s	
	312	* Acc MotPot	16s	
	313	* Acc>Min Freq	2s	
	314	* Acc Ramp	Lin	
	315	* Dec Time	2s	
	316	* Dec MotPot	16s	
	317	* Dec<Min freq	2s	
	318	* Dec Ramp	Lin	
	319	* Start Mode	Normal	
	31A	* Stop Mode	Decel	
	31B	* Spin start	Off	
	320	* Frequencies		
	321	* Min Freq	0Hz	
	322	* Max Freq	$f_{MOT}$ Hz	
	323	* Min Freq Mode	Scale	
	324	* Freq Direction	R+L	
	325	* MotPot function	Non vola	
	326	* Preset Freq 1	10Hz	
	327	* Preset Freq 2	20Hz	
	328	* Preset Freq 3	30Hz	
	329	* Preset Freq 4	35Hz	
	32A	* Preset Freq 5	40Hz	
	32B	* Preset Freq 6	45Hz	
	32C	* Preset Freq 7	50Hz	
	32D	* Skip Frq 1 LO	0Hz	
	32E	* Skip Frq 1 HI	0Hz	
	32F	* Skip Frq 2 LO	0Hz	
	32G	* Skip Frq 2 HI	0Hz	
	32H	* Jog Freq	2Hz	
	330	* Torques		
	331	* Torque Limit	Off	
	332	* Max Torque	120%	
	340	* Controllers		
	341	* Flux Optimise	Off	
	342	* Sound Char	F	
	343	* PID Controller	Off	
	344	* PID P Gain	1.0	
	345	* PID I Time	1.00	
	346	* PID D Time	0.00	
	350	* Limits/Protections		
	351	* Low Volt OR	Off	
	352	* Rotor locked	Off	
	353	* Motor lost	Trip	
	354	* Motor $I^2t$ Type	Trip	
	355	* Motor $I^2t$ I	$I_{NOM}$	
400	I/O			
	410	Analogue Inputs		
	411	AnIn1 Function	Freq	

	412	AnIn1 Set up	0-10V/ 0-20mA	
	413	* AnIn1 Offset	0	
	414	* AnIn1 Gain	1.00	
	415	AnIn2 Function	Off	
	416	AnIn2 Set up	0-10V/ 0-20mA	
	417	* AnIn2 Offset	0	
	418	* AnIn2 Gain	1.00	
	420	Digital Inputs		
	421	DigIn 1	Run	
	422	DigIn 2	Off	
	423	DigIn 3	Off	
	424	DigIn 4	Reset	
	425	DigIn 5	Off	
	426	DigIn 6	Off	
	427	DigIn 7	Off	
	428	DigIn 8	Off	
	429	DigIn 9	Off	
	42A	DigIn 10	Off	
	42B	DigIn 11	Off	
	42C	DigIn 12	Off	
	42D	DigIn 13	Off	
	42E	DigIn 14	Off	
	430	Analogue Outputs		
	431	* AnOut 1 Funct	Speed	
	432	* AnOut 1 Set up	0-10V/ 0-20mA	
	433	* AnOut 1 Offset	0	
	434	* AnOut 1 Gain	1.00	
	435	* AnOut 2 Funct	Torque	
	436	* AnOut 2 Set-up	0-10V/ 0-20mA	
	437	* AnOut 2 Offset	0	
	438	* AnOut 2 Gain	1.00	
	440	Digital Outputs		
	441	* DigOut 1 Funct	Run	
	442	* DigOut 2 Funct	No Trip	
	450	Relays		
	451	* Relay 1 Funct	Trip	
	452	* Relay 2 Funct	Ready	
	453	* Relay 3 Funct	Run	
	454	* Relay 4 Funct	Stop	
	455	* Relay 5 Funct	Limit	
	456	* Relay 6 Funct	Warning	
	457	* Relay 7 Funct	Alarm	
	458	* Relay 8 Funct	Pre-Alm	
500	Set/View reference value			
600	View Operation			
	610	Frequency		
	620	Load		
	630	Electrical power		
	640	Current		
	650	Voltage		
	660	DC-Link Voltage		

670	Heat sink temperature	
680	FI Status	
690	Digital input status	
6A0	Analogue input status	
6B0	Run Time	
	6B1 * Reset RUN Tm	No
6C0	Mains Time	
6D0	Energy	
	6D1 * Reset Energy	No
6E0	Process Speed	
	6E1 * Set Prc Unit	None
	6E2 * Set Prc Scale	1.000
6F0	Warnings	
6G0	Run Time 1	
	6G1 * Reset RUN Time 1	No
6H0	Run Time 2	
	6H1 * Reset RUN Time 2	No
6I0	Run Time 3	
	6I1 * Reset RUN Time 3	No
6J0	Run Time 4	
	6J1 * Reset RUN Time 4	No
6K0	Run Time 5	
	6K1 * Reset RUN Time 5	No
6L0	Run Time 6	
	6L1 * Reset RUN Time 6	No
6M0	Additional Pump Status	
700	View Trip Log	Cause
	710 Trip 1	
	720 Trip 2	
	730 Trip 3	
	740 Trip 4	
	750 Trip 5	
	760 Trip 6	
	770 Trip 7	
	780 Trip 8	
	790 Trip 9	
	7A0 Trip 10	
	7B0 Reset Trip Log	No
800	MONITOR	
	810 Alarm Functions	
	811 * Alarm select	Off
	812 * Ramp enable	Off
	813 * Start delay	2
	814 * Alarm delay	0.1
	815 * Auto Set	No
	816 * Max Alarm	150
	817 * Max Pre-alarm	110
	818 * Min Alarm	0
	819 * Min Pre-alarm	90

820	Comparators	
	821 * CA1 Value	Speed
	821 * CA1 Value	Speed
	822 * CA1 Constant	300rpm
	823 * CA2 Value	Torque
	824 * CA2 Constant	10%
	825 * CD1	Run
	826 * CD2	DigIn1
830	Logic Y	
	831 * Y Comp 1	CA1
	832 * Y Operator 1	&
	833 * Y Comp 2	!A2
	834 * Y Operator 2	&
	835 * Y Comp 3	CD1
840	Logic Z	
	841 * Z Comp 1	CA1
	842 * Z Operator 1	&
	843 * Z Comp 2	!A2
	844 * Z Operator 2	&
	845 * Z Comp 3	CD1
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