Honeywell

Application Manual

SmartVFD HVAC / SmartDrive HVAC

Variable Frequency Drives for Variable Torque Applications

FW0078V013

38-00002-01

INDEX

Document: DPD01378A
Version release date: 9.12.13
Corresponds to application version FW0078V013

1. SAFETY

This manual contains clearly marked cautions and warnings that are intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

Please read the information included in cautions and warnings carefully.

The cautions and warnings are marked as follows:

Table 1. Warning signs

	= **DANGER!** Dangerous voltage
	= **WARNING** or **CAUTION**
	= **Caution!** Hot surface

1.1 Danger

	The components of the power unit are live when the drive is connected to mains potential. Coming into contact with this voltage is extremely dangerous and may cause death or severe injury.
	The motor terminals U, V, W and the brake resistor terminals are live when the AC drive is connected to mains, even if the motor is not running.
	After disconnecting the AC drive from the mains, wait until the indicators on the keypad go out (if no keypad is attached, see the indicators on the cover). Wait 5 more minutes before doing any work on the connections of the drive. Do not open the cover before this time has expired. After expiration of this time, use a measuring equipment to absolutely ensure that no voltage is present. Always ensure absence of voltage before starting any electrical work!
	The control I/O-terminals are isolated from the mains potential. However, the relay outputs and other I/O-terminals may have a dangerous control voltage present even when the AC drive is disconnected from mains.
	Before connecting the AC drive to mains make sure that the front and cable covers of the drive are closed.
	During a ramp stop (see the Application Manual), the motor is still generating voltage to the drive. Therefore, do not touch the components of the AC drive before the motor has completely stopped. Wait until the indicators on the keypad go out (if no keypad is attached, see the indicators on the cover). Wait additional 5 minutes before starting any work on the drive.

1.2 Warnings

	The AC drive is meant for fixed installations only.
	Do not perform any measurements when the AC drive is connected to the mains.
	The earth leakage current of the AC drives exceeds 3.5mA AC. According to standard EN61800-5-1, a reinforced protective ground connection must be ensured. See Chapter 1.3.
	If the AC drive is used as a part of a machine, the machine manufacturer is responsible for providing the machine with a supply disconnecting device (EN 60204-1).
	Only spare parts delivered by Vacon can be used.
	At power-up, power brake or fault reset the motor will start immediately if the start signal is active, unless the pulse control for Start/Stop logic has been selected. Futhermore, the I/O functionalities (including start inputs) may change if parameters, applications or software are changed. Disconnect, therefore, the motor if an unexpected start can cause danger.
	The motor starts automatically after automatic fault reset if the auto restart function is activated. See the Application Manual for more detailed information.
	Prior to measurements on the motor or the motor cable, disconnect the motor cable from the AC drive.
	Do not touch the components on the circuit boards. Static voltage discharge may damage the components.
	Check that the EMC level of the AC drive corresponds to the requirements of your supply network.

1.3 Earthing and earth fault protection

CAUTION!

The AC drive must always be earthed with an earthing conductor connected to the earthing terminal marked with ⏚.

The earth leakage current of the drive exceeds 3.5mA AC. According to EN61800-5-1, one or more of the following conditions for the associated protective circuit must be satisfied:

a) The protective conductor must have a cross-sectional area of at least 10 mm2 Cu or 16 mm2 Al, through its total run.

b) Where the protective conductor has a cross-sectional area of less than 10 mm2 Cu or 16 mm2 Al, a second protective conductor of at least the same cross-sectional area must be provided up to a point where the protective conductor has a cross-sectional area not less than 10 mm2 Cu or 16 mm2 Al.

c) Automatic disconnection of the supply in case of loss of continuity of the protective conductor.

The cross-sectional area of every protective earthing conductor which does not form part of the supply cable or cable enclosure must, in any case, be not less than:

- 2.5mm^2 if mechanical protection is provided or
- 4mm^2 if mechanical protection is not provided.

The earth fault protection inside the AC drive protects only the drive itself against earth faults in the motor or the motor cable. It is not intended for personal safety.

Due to the high capacitive currents present in the AC drive, fault current protective switches may not function properly.

Do not perform any voltage withstand tests on any part of the AC drive. There is a certain procedure according to which the tests must be performed. Ignoring this procedure can cause damage to the product.

NOTE! You can download the English and French product manuals with applicable safety, warning and caution information from **https://customer.honeywell.com/en-US/Pages/default.aspx**.

REMARQUE Vous pouvez télécharger les versions anglaise et française des manuels produit contenant l'ensemble des informations de sécurité, avertissements et mises en garde applicables sur le site **https://customer.honeywell.com/en-US/Pages/default.aspx**.

2. STARTUP WIZARD

2.1 Using the startup wizard

In the *Startup Wizard*, you will be prompted for essential information needed by the drive so that it can start controlling your process. In the Wizard, you will need the following keypad buttons:

Left/Right arrows. Use these to easily move between digits and decimals.

Up/Down arrows. Use these to move between options in menu and to change value.

OK button. Confirm selection with this button.

Back/Reset button. Pressing this button, you can return to the previous question in the Wizard. If pressed at the first question, the Startup Wizard will be cancelled.

Once you have connected power to the drive, follow these instructions to easily set up your drive.

NOTE: You can have your drive equipped with either an advanced commissioning keypad or a text keypad. In the following examples, image of the advanced commissioning keypad is on the left, LCD keypad on the right.

1	Language selection	varies according to the installed language package

2	Daylight saving	Russia US EU OFF
3	Time	hh:mm:ss
4	Day	mm.dd.
5	Year	yyyy

6	Run Startup Wizard?	Yes No

Push the OK button unless you want to set all parameter values manually.

7	Choose your process	Pump Fan

	P3.4.2	P3.4.3	P3.2.4	P3.2.5	P3.4.8	P3.4.10	P3.3.1	P3.1.2.7
Pump	5.0	5.0	1	1	False	60.0	20.0	Untouched
Fan	From table	From table	1	0	True	120.0	20.0	1

Parameters affected:

P3.4.2	Acceleration Time
P3.4.3	Deceleration Time
P3.2.4	Start Function
P3.2.5	Stop Function
P3.4.8	RampTimeOptimizerEnable
P3.4.10	RampTimeOptimizerMaxLimit
P3.3.1	MinFrequency
P3.1.2.7	U/F Ratio

Ramp table for fan setup:

Ramp times	**400 V / 480 V**	**230 V**
20 s	400-1P1 - 400-7P5 / C 0015 – C 0100	230-P55 - 230-4P0 / A 0007 – A 0050
30 s	400-11P - 400-22P / C 0150 – C 0300	230-5P5 - 230-11P / A 0075 – A 0150
45 s	400-30P - 400-55P / C 0400 – C 0750	230-15P - 230-30P / A 0200 – A 0400
60 s	400-75P - 400-90P / C 1000 – C 1250	230-37P - 230-45P / A 0500 – A 0750
90 s	400-110 - 400-160 / C 1500 – C 2500	230-55P / A 1000 – A 1250

8	Set value for *Motor Nominal Speed* (according to nameplate)	*Range:* 24...19,200 rpm
9	Set value for *Motor Nominal Current* (according to nameplate)	*Range:* Varies

Now the Startup Wizard is completed.

The Startup Wizard can be re-initiated by activating the parameter *Restore factory defaults* (par. P6.5.1) in the *Parameter backup* submenu (M6.5).

NOTE: Neigher parameter *Restore factory defaults* (par. P6.5.1) nor the *Startup Wizard* will work if there is an external RUN command on the I/O!

2.2 PID mini-wizard

The PID Mini Wizard can be initiated by choosing Activate for parameter P1.18 in the Quick setup menu. This wizard presupposes that you are going to use the PID controller in the "one feedback / one setpoint" mode. The control place will be I/O A and the default process unit '%'.

The *PID mini wizard* asks for the following values to be set:

1	Process unit selection	(Several selections. See par. P3.13.1.4)

If any other process unit than '%' is selected the following questions appear:

If not the Wizard will directly jump to step 5.

2	Process unit min	
3	Process unit max	
4	Process unit decimals	0...4

5	Feedback 1 source selection	See par. P3.13.2.4.

If one of the analogue input signals is selected the question 6 appears. Otherwise you will be taken to question 7.

6	Analogue input signal range	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA See par. P3.5.2.3.

7	Error inversion	0 = Normal 1 = Inverted
8	Setpoint source selection	See par. P3.13.2.4 for selections.

If one of the analogue input signals is selected the question 9 appears. Otherwise you will be taken to question 11.
If either of the options Keypad Setpoint 1 or 2 is chosen the question 10 will appear.

9	Analogue input signal range	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA See par. P3.5.2.3.
10	Keypad setpoint	

11	Sleep function?	No Yes

If option 'Yes' is selected you will be prompted for three more values:

12	Sleep frequency limit 1 P3.13.2.8 Sleep delay 1 P3.13.2.9 Wake-up level 1	0.00...320.00 Hz

13	Sleep delay 1	0...3000 s
14	Wake-up level 1	Range depends on selected process unit.

2.3 Pump and fan cascade mini-wizard

The PFC mini-wizard asks the most important questions for setting up a PFC system. The PID mini-wizard always precedes the PFC mini-wizard. The keypad will guide you through the questions as in chapter 2.2 then to be followed by the set of questions below:

15	Number of motors	1...5
16	Interlock function	0 = Not used 1 = Enabled
17	Autochange	0 = Disabled 1 = Enabled

If Autochange function is enabled the following three questions will appear. If Autochange will not be used the Wizard jumps directly to question 21.

18	Include FC	0 = Disabled 1 = Enabled
19	Autochange interval	0.0...3000.0 h
20	Autochange: Frequency limit	0.00...50.00 Hz

21	Bandwidth	0...100%
22	Bandwidth delay	0...3600 s

After this, the keypad will show the digital input and relay output configuration recommended by the application (Advanced commissioning keypad only). Write these values down for future reference.

2.4 Fire mode wizard

NOTE! THE WARRANTY IS VOID, IF THE FIRE MODE FUNCTION IS ACTIVATED.

Test Mode can be used to test the Fire Mode function without voiding the warranty.

Fire Mode Wizard is intended for easy commissioning of the Fire Mode function. The Fire Mode Wizard can be initiated by choosing *Activate* for parameter 1.1.2 in the Quick setup menu.

1	Fire Mode frequency source (P3.17.2)	Several selections, see chapter 4.17.

If any other source than '*Fire mode frequency*' is selected the wizard will jump directly to question 3.

2	Fire Mode frequency (P3.17.3)	8.00 Hz...MaxFreqRef (P3.3.1.2)
3	Signal activation?	Should the signal activate on opening or closing contact? 0 = Open contact 1 = Closed contact
4	Fire Mode activation on OPEN (P3.17.4)/ Fire Mode activation on CLOSE (P3.17.5)	Choose the digital input to activate Fire mode. See also chapter 8.13.
5	Fire Mode reverse (P3.17.6)	Choose the digital input to activate the reverse direction in Fire mode. DigIn Slot0.1 = Always direction FORWARD DigIn Slot0.2 = Always direction REVERSE
6	Fire Mode password (P3.17.1)	Choose password to enable the Fire Mode function. 1234 = Enable Test mode 1002 = Enable Fire Mode

2.5 Resonance sweep wizard

Initiating the resonance sweep function

1. Locate parameter P3.7.9 and press OK.
2. Select value 1 'Activate' with the arrow buttons and press OK.
3. With text 'Start sweep' on the display, press the Start button. Sweeping starts.
4. Press the OK button every time the resonance stops in order to tag where the range starts and ends.
5. After successful sweeping you will be prompted to save. If yes, press OK.
6. If the Resonance sweeping function was succesfully completed text 'Successful' appears on the display. Then press OK and the display will return to the parameter P3.7.9 display with value 'Inactive'.

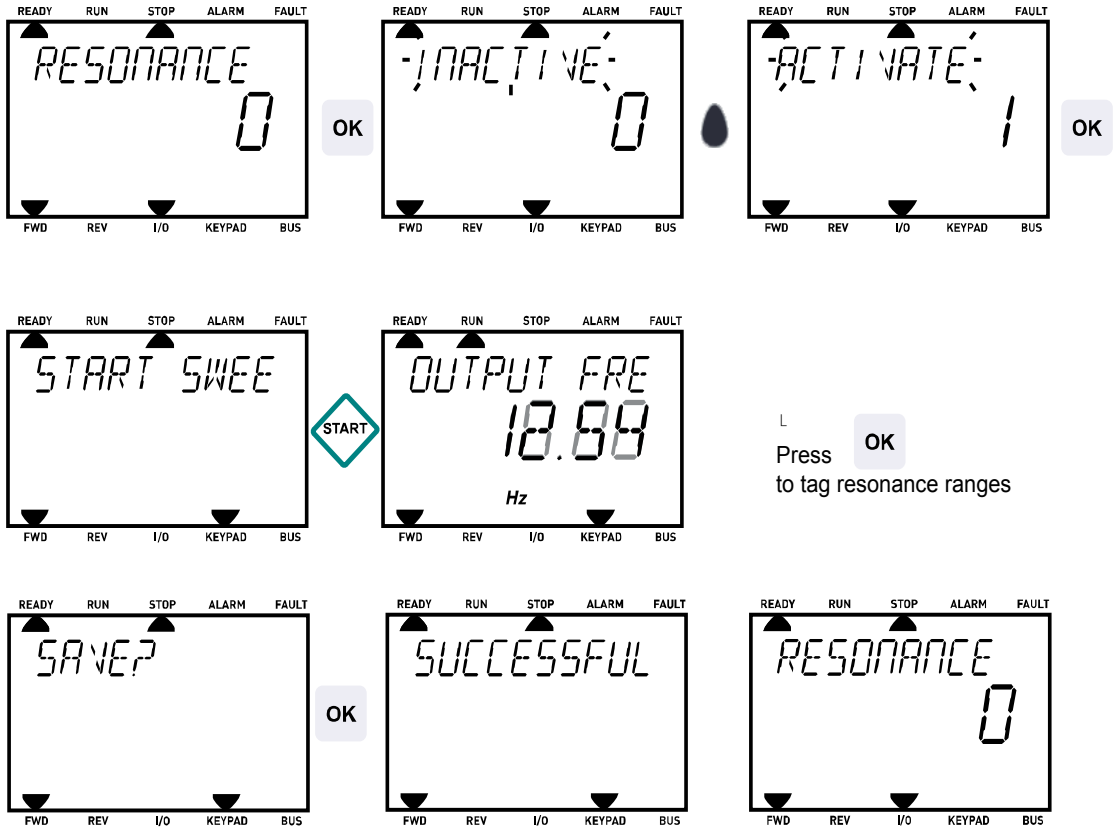


Figure 1. Resonance sweep

3. KEYPAD OF THE DRIVE

The control keypad is the interface between the drive and the user. With the control keypad it is possible to control the speed of a motor, to supervise the state of the equipment and to set the frequency converter's parameters.

There are two keypad types you can choose for your user interface: keypad with an advanced commissioning Human Machine Interface (HMI) and keypad with a Multi-language Human Machine Interface (HMI).

The button section of the keypad is identical for both keypad types.

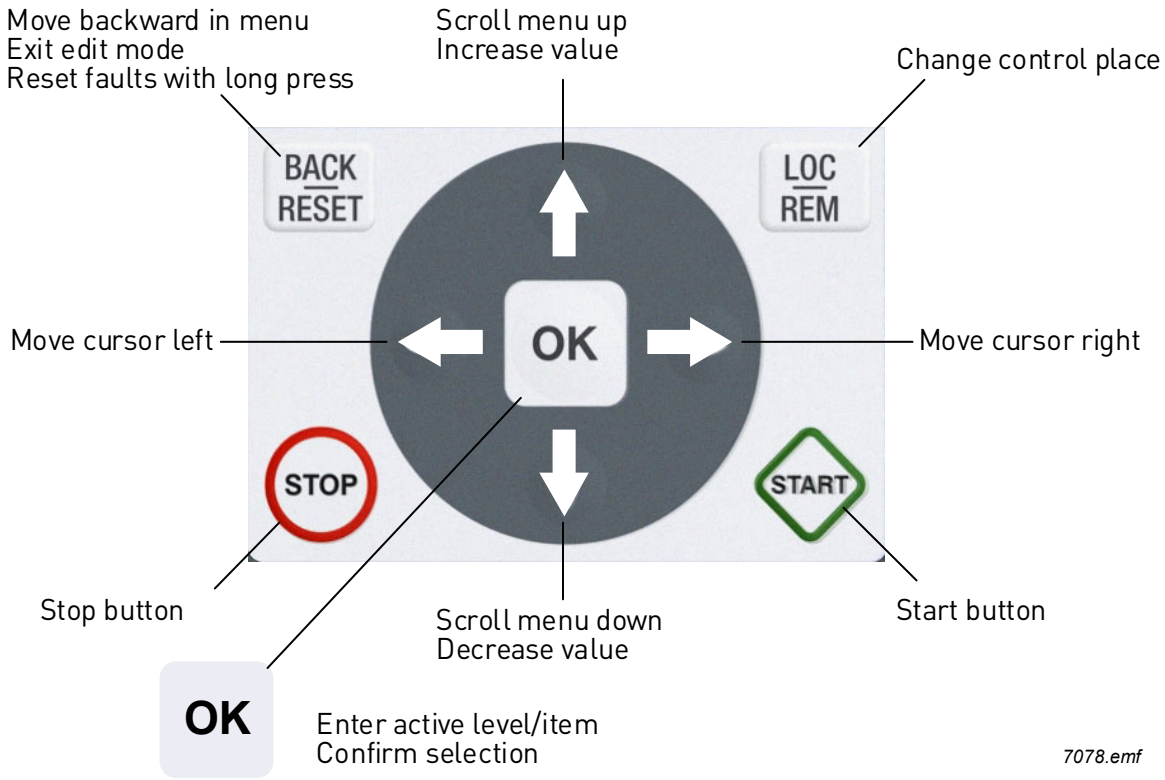


Figure 2. Keypad buttons

3.1 Keypad with Advanced Commissioning Human Machine Interface (HMI)

The advanced commissioning Human Machine Interface (HMI) features a graphical LCD display and 9 buttons with an integrated copy function for parameters.

3.1.1 Display unit

The display unit indicates the status of the motor and the drive and any irregularities in motor or drive functions. On the display, the user sees information about his present location in the menu structure and the item displayed. If the text on the text line is too long to fit in the display, the text will scroll from left to right to reveal the whole text string.

3.1.1.1 Main menu

The data on the control keypad are arranged in menus and submenus. Use the Up and Down arrows to move between the menus. Enter the group/item by pressing the OK button and return to the former level by pressing the Back/Reset button.

The *Location field* indicates your current location. The *Status field* gives information about the present status of the drive. See Figure 3.

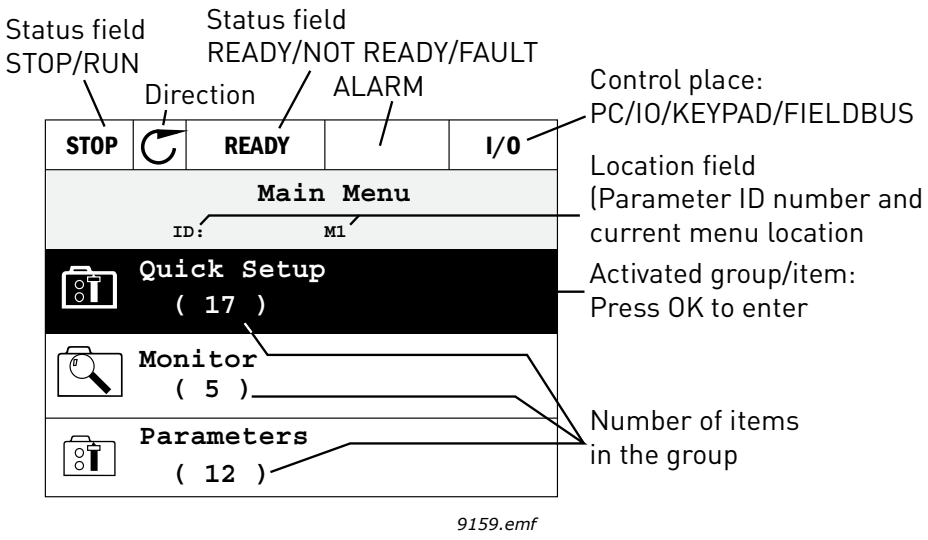


Figure 3. Main menu

3.1.2 Using the advanced commissioning HMI

3.1.2.1 Editing values

Change value of a parameter following the procedure below:

7. Locate the parameter.
8. Press OK to enter the *Edit* mode.
9. Set new value with the arrow buttons up/down. You can also move from digit to digit with the arrow buttons left/right if the value is numerical and change then the value with the arrow buttons up/down.
10. Confirm change with OK button or ignore change by returning to previous level with Back/Reset button.

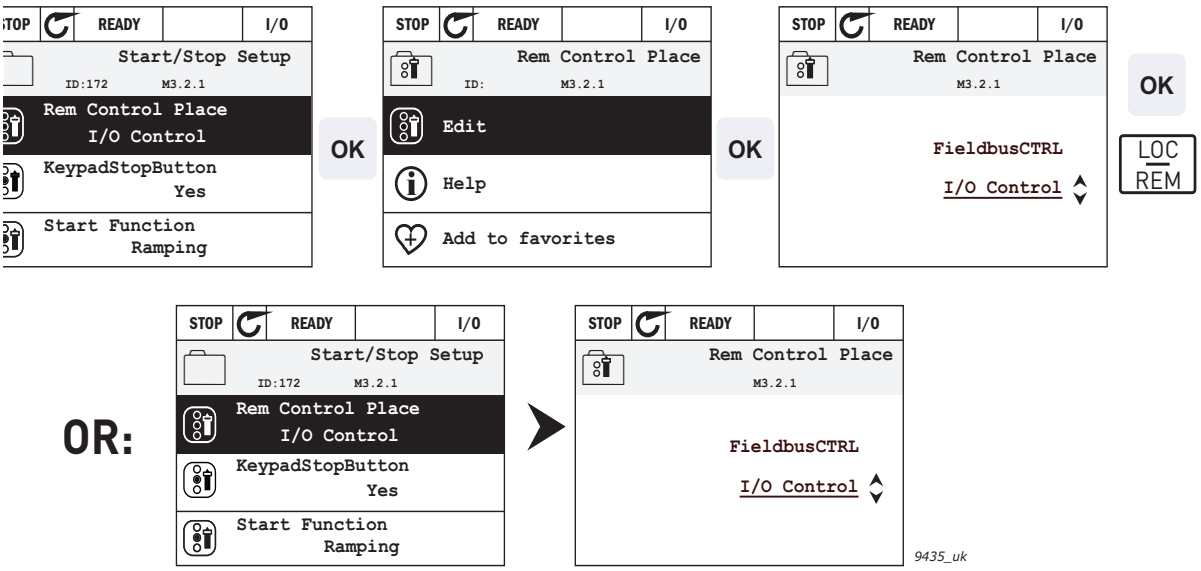


Figure 4. Editing values on advanced commissioning HMI

3.1.2.2 Resetting fault

Instructions for how to reset a fault can be found in chapter 4.7.1 on page 125.

3.1.2.3 Local/remote control button

The LOC/REM button is used for two functions: to quickly access the Control page and to easily change between the Local (Keypad) and Remote control places.

Control places

The control place is the source of control where the drive can be started and stopped. Every control place has its own parameter for selecting the frequency reference source. In the HVAC drive, the *Local control place* is always the keypad.The *Remote control place* is determined by parameter P1.15 (I/O or Fieldbus). The selected control place can be seen on the status bar of the keypad.

Remote control place

I/O A, I/O B and Fieldbus can be used as remote control places. I/O A and Fieldbus have the lowest priority and can be chosen with parameter P3.2.1 *(Rem Control Place)*. I/O B, again, can bypass the remote control place selected with parameter P3.2.1 using a digital input. The digital input is selected with parameter P3.5.1.5 *(I/O B Ctrl Force)*.

Local control

Keypad is always used as control place while in local control. Local control has higher priority than remote control. Therefore, if, for example, bypassed by parameter P3.5.1.5 through digital input while in *Remote*, the control place will still switch to Keypad if *Local* is selected. Switching between Local and Remote Control can be done by pressing the Loc/Rem-button on the keypad or by using the "Local/Remote" (ID211) parameter.

Changing control places

Change of control place from *Remote* to *Local* (keypad).

1. Anywhere in the menu structure, push the *Loc/Rem* button.
2. Push the *Arrow up* or the *Arrow down* button to select *Local/Remote* and confirm with the *OK* button.
3. On the next display, select *Local* or *Remote* and again confirm with the *OK* button.
4. The display will return to the same location as it was when the *Loc/Rem* button was pushed. However, if the Remote control place was changed to Local (Keypad) you will be prompted for keypad reference.

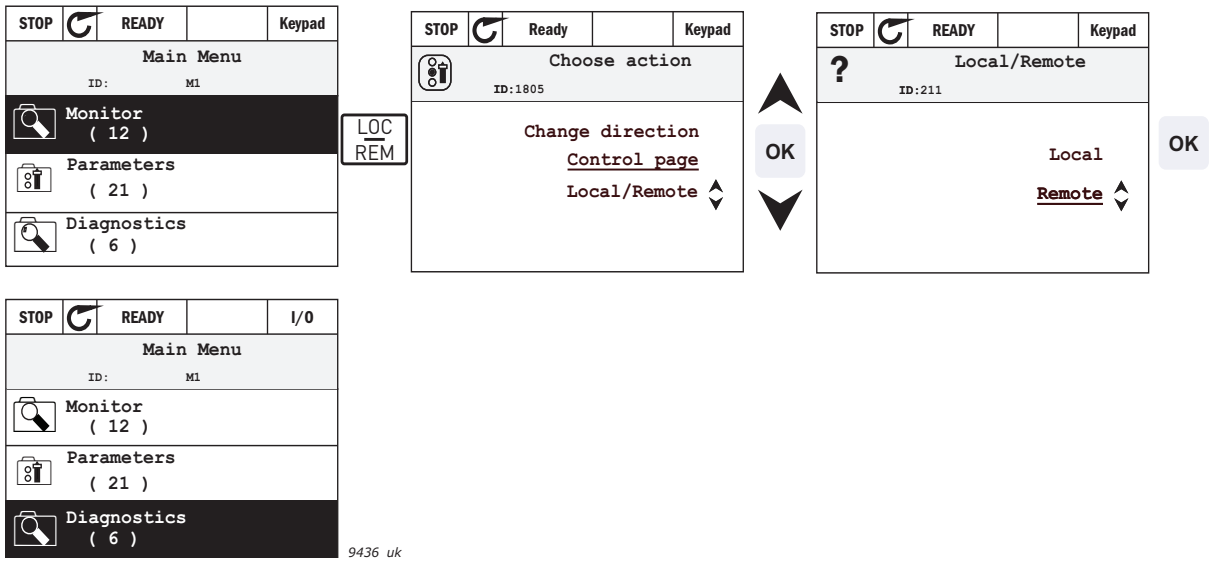


Figure 5. Changing control places

Accessing the control page

The *Control page* is meant for easy operation and monitoring of the most essential values.

1. Anywhere in the menu structure, push the *Loc/Rem* button.
2. Push the *Arrow up* or the *Arrow down* button to select *Control page* and confirm with the *OK* button.
3. If keypad control place and keypad reference are selected to be used you can set the Keypad reference after having pressed the OK button. If other control places or reference values are used the display will show Frequency reference which is not editable. The other values on the page are Multi-monitoring values. You can choose which values appear here for monitoring (for this procedure, see page 22).

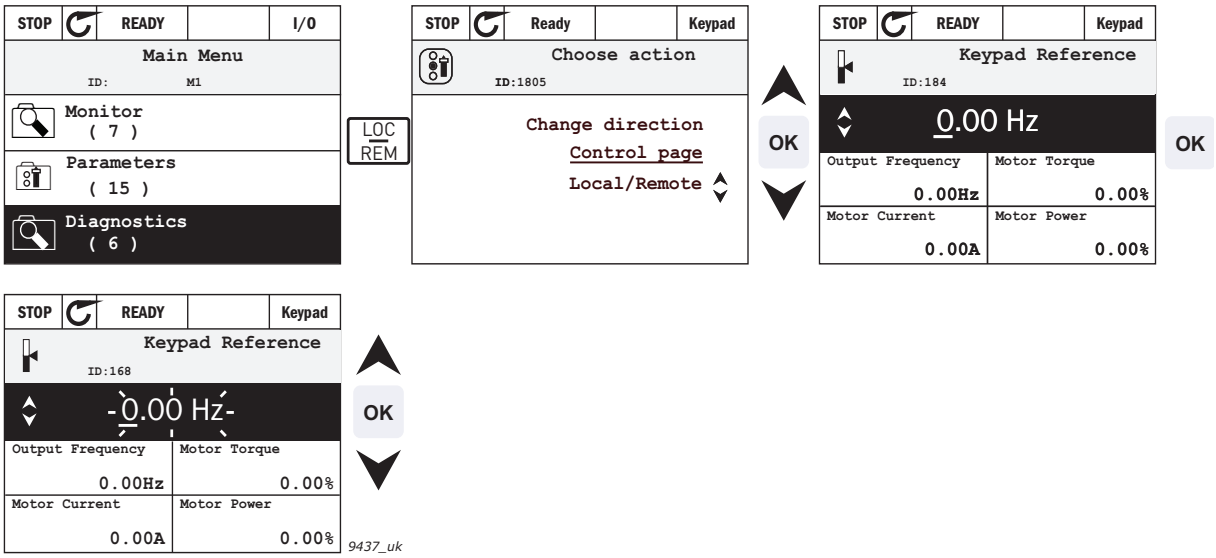


Figure 6. Accessing Control page

3.1.2.4 Help texts

The advanced commissioning HMI features instant help and information displays for various items. All parameters offer an instant help display. Select Help and press the OK button.

Text information is also available for faults, alarms and the startup wizard.

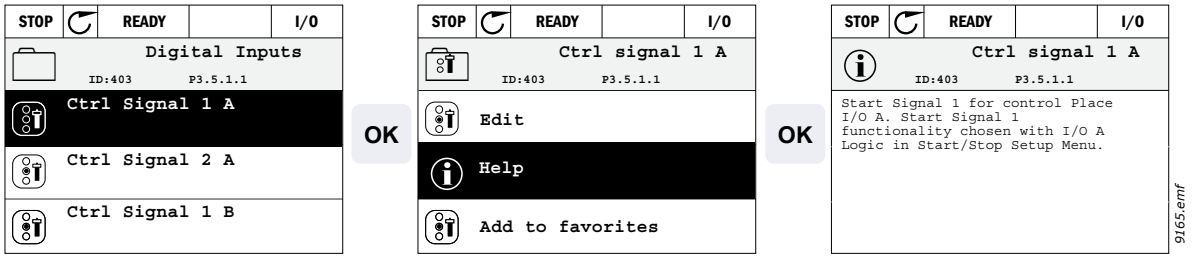


Figure 7. Help text example

3.1.2.5 Adding item to favourites

You might need to refer to certain parameter values or other items often. Instead of locating them one by one in the menu structure, you may want to add them to a folder called *Favourites* where they can easily be reached.

To remove an item from the Favourites, see chapter 3.3.7.

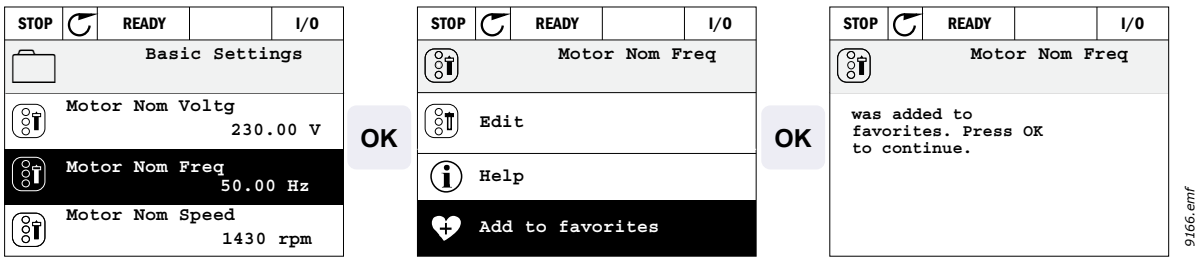


Figure 8. Adding item to Favourites

3.1.2.6 Copying parameters

NOTE: This feature is available in Advanced commissioning HMI only.

The parameter copy function can be used to copy parameters from one drive to another.

The parameters are first saved to the keypad, then the keypad is detached and connected to another drive. Finally the parameters are downloaded to the new drive restoring them from the keypad.
Before any parameters can successfully be copied from one drive to another the drive has to be stopped when the parameters are downloaded.
First go into *User settings* menu and locate the *Parameter backup* submenu. In the *Parameter backup* submenu, there are three possible functions to be selected: *Restore factory defaults* will re-establish the parameter settings originally made at the factory.
By selecting *Save to keypad* you can copy all parameters to the keypad. *Restore from keypad* will copy all parameters from keypad to a drive.

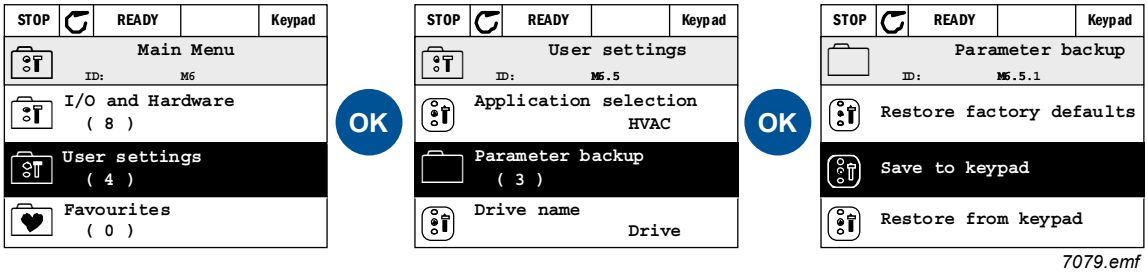


Figure 9. Copying parameters

NOTE: If the keypad is changed between drives of different sizes, the copied values of these parameters will not be used:

Motor nominal current (P3.1.1.4)
Motor nominal voltage (P3.1.1.1)
Motor nominal speed (P3.1.1.3)
Motor nominal power (P3.1.1.6)
Motor nominal frequency (P3.1.1.2)
Motor cos phii (P3.1.1.5)
Switching frequency (P3.1.2.1)
Motor current limit (P3.1.1.7)
Stall current limit (P3.9.12)
Stall time limit (P3.9.13)
Stall frequency (P3.9.14)
Maximum frequency (P3.3.2)

3.1.2.7 Multi-monitor

NOTE: This feature is available in Advanced commissioning HMI only.

On the multi-monitor page, you can collect nine values that you wish to monitor.

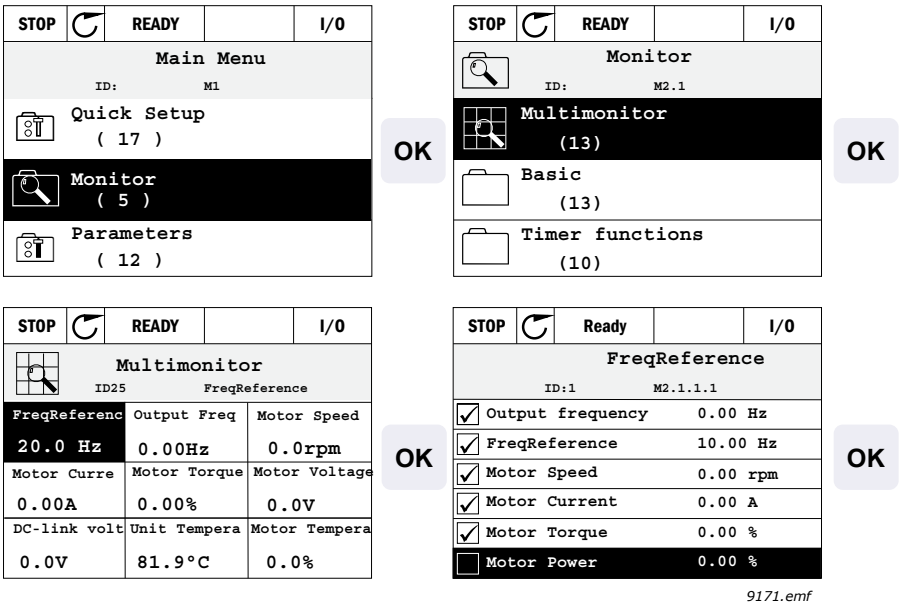


Figure 10. Multi-monitoring page

Change the monitored value by activating the value cell (with arrow buttons left/right) and clicking OK. Then choose a new item on the Monitoring values list and click OK again.

3.2 Keypad with Multi-language Human Machine Interface (HMI)

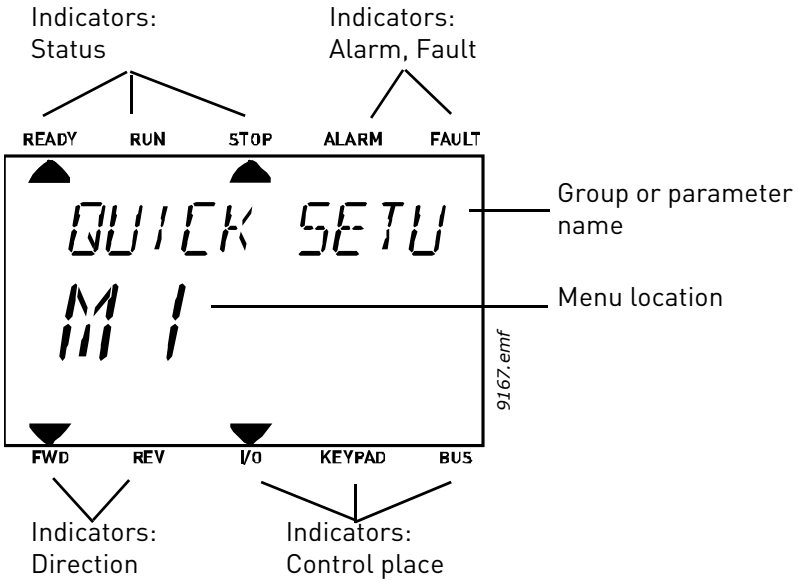
You can also choose a Keypad with Multi-language Human Machine Interface (HMI) for your user interface. It has mainly the same functionalities as the keypad with advanced commissioning HMI although some of these are somewhat limited.

3.2.1 Display unit

The display unit indicates the status of the motor and the drive and any irregularities in motor or drive functions. On the display, the user sees information about his present location in the menu structure and the item displayed. If the text on the text line is too long to fit in the display, the text will scroll from left to right to reveal the whole text string.

3.2.1.1 Main menu

The data on the control keypad are arranged in menus and submenus. Use the Up and Down arrows to move between the menus. Enter the group/item by pressing the OK button and return to the former level by pressing the Back/Reset button.



3.2.2 Using the Multi-language Human Machine Interface

3.2.2.1 Editing values

Change value of a parameter following the procedure below:

1. Locate the parameter.
2. Enter the Edit mode by pressing OK.
3. Set new value with the arrow buttons up/down. You can also move from digit to digit with the arrow buttons left/right if the value is numerical and change then the value with the arrow buttons up/down.
4. Confirm change with OK button or ignore change by returning to previous level with Back/ Reset button.

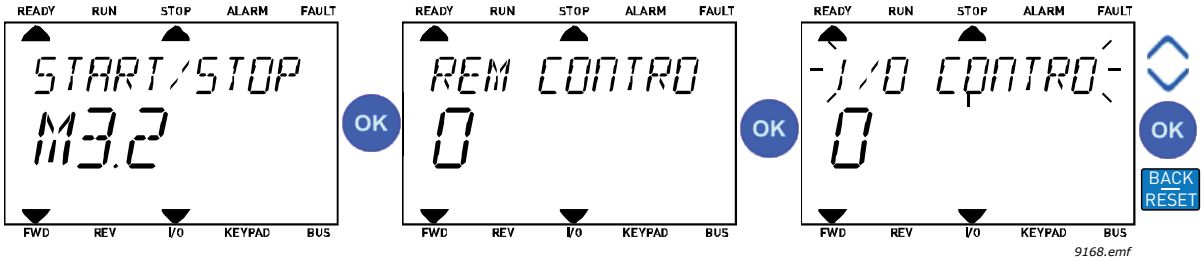


Figure 11. Editing values

3.2.2.2 Resetting fault

Instructions for how to reset a fault can be found in chapter 4.7.1 on page 125.

3.2.2.3 Local/remote control button

The LOC/REM button is used for two functions: to quickly access the Control page and to easily change between the Local (Keypad) and Remote control places.

Control places

The control place is the source of control where the drive can be started and stopped. Every control place has its own parameter for selecting the frequency reference source. In the HVAC drive, the *Local control place* is always the keypad.The *Remote control place* is determined by parameter P1.15 (I/O or Fieldbus). The selected control place can be seen on the status bar of the keypad.

Remote control place

I/O A, I/O B and Fieldbus can be used as remote control places. I/O A and Fieldbus have the lowest priority and can be chosen with parameter P3.2.1 *(Rem Control Place)*. I/O B, again, can bypass the remote control place selected with parameter P3.2.1 using a digital input. The digital input is selected with parameter P3.5.1.5 *(I/O B Ctrl Force)*.

Local control

Keypad is always used as control place while in local control. Local control has higher priority than remote control. Therefore, if, for example, bypassed by parameter P3.5.1.5 through digital input while in *Remote*, the control place will still switch to Keypad if *Local* is selected. Switching between Local and Remote Control can be done by pressing the Loc/Rem-button on the keypad or by using the "Local/Remote" (ID211) parameter.

Changing control places

Change of control place from *Remote* to *Local* (keypad).

1. Anywhere in the menu structure, push the Loc/Rem button.
2. Using the arrow buttons, select Local/Remote and confirm with the OK button.
3. On the next display, select Local or Remote and again confirm with the OK button.
4. The display will return to the same location as it was when the *Loc/Rem* button was pushed. However, if the Remote control place was changed to Local (Keypad) you will be prompted for keypad reference.

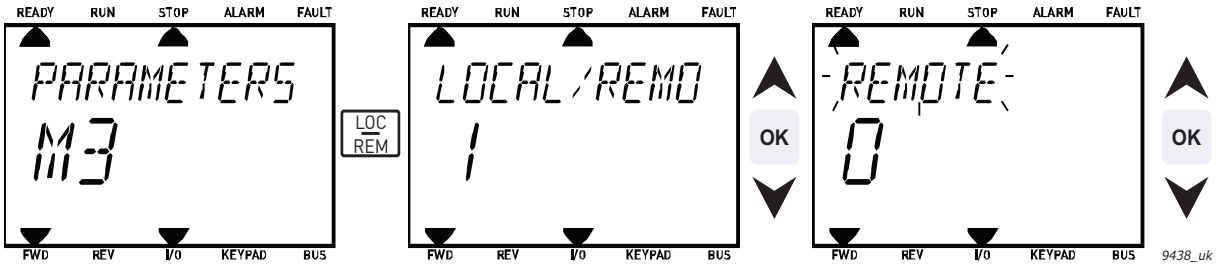


Figure 12. Changing control places

Accessing the control page

The *Control page* is meant for easy operation and monitoring of the most essential values.

1. Anywhere in the menu structure, push the *Loc/Rem* button.
2. Push the *Arrow up* or the *Arrow down* button to select *Control page* and confirm with the *OK* button.
3. The control page appears
   If keypad control place and keypad reference are selected to be used you can set the *Keypad reference* after having pressed the *OK* button. If other control places or reference values are used the display will show Frequency reference which is not editable.

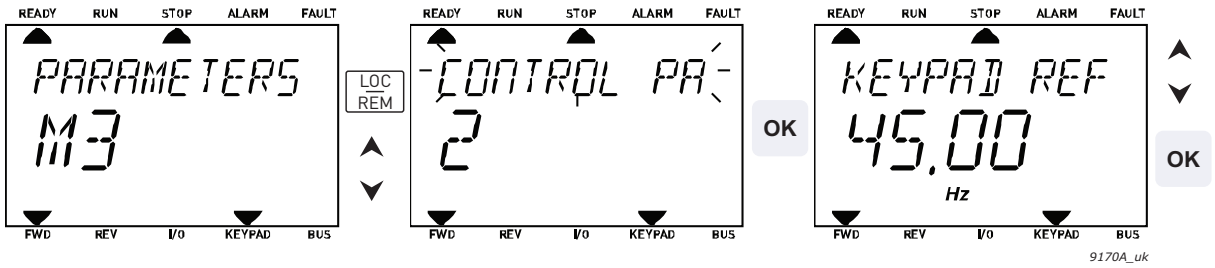


Figure 13. Accessing Control page

3.3 Menu structure

The basic menu structure is depicted in Figure 14. The menu structure is referenced by its index. The HMI contains the same indices as the PC tool. The indices contain a letter indicating the type of information. Those vary slightly between HMI and PC-tool:

- Px.x.x: Parameter
- Vx.x.x: Monitored value (only in HMI)
- Mx.x.x: Monitored value (only in PC-tool)
- Mx.x: Menu with several values/parameters below (only in HMI)

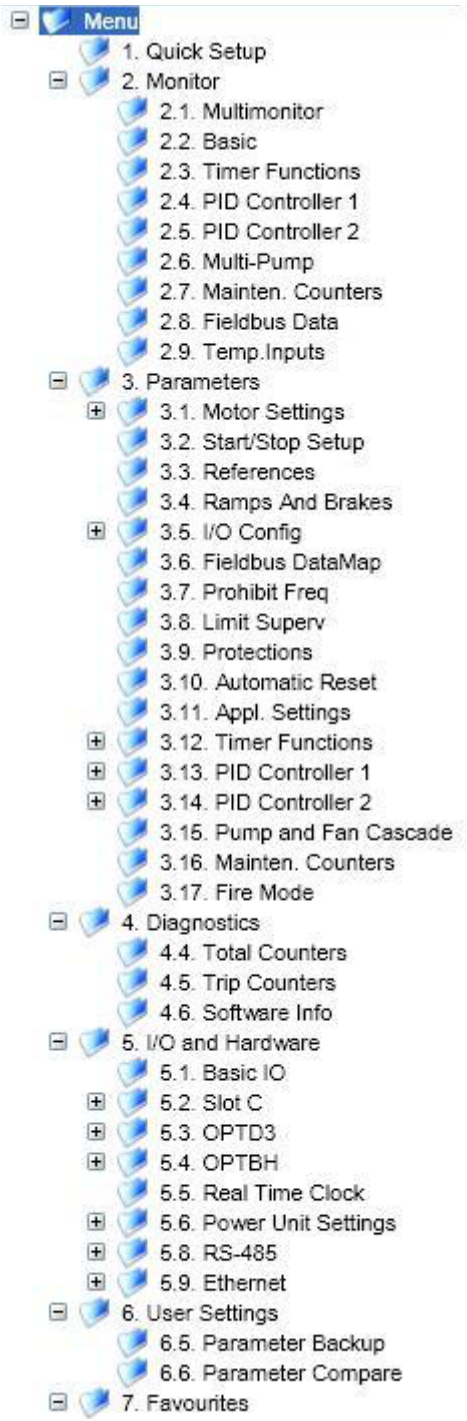


Figure 14.Basic menu structure as shown in pc-tool

3.3.1 Quick setup

The Quick Setup Menu includes the minimum set of most commonly used parameters during installation and commissioning. More detailed information on the parameters of this group you will find in chapter 4.3.

3.3.2 Monitor

Multi-monitor

NOTE: This menu is not available in Multi-language HMI.

On the multi-monitor page, you can collect nine values that you wish to monitor. See chapter 4.4

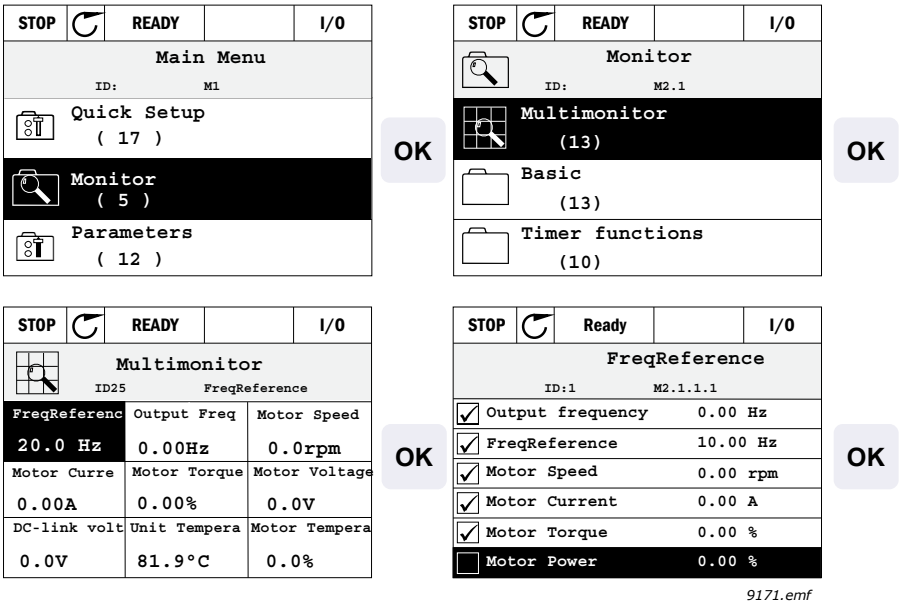


Figure 15. Multi-monitoring page

Change the monitored value by activating the value cell (with arrow buttons left/right) and clicking OK. Then choose a new item on the Monitoring values list and click OK again.

Basic

The basic monitoring values are the actual values of selected parameters and signals as well as statuses and measurements.

Timer functions

Monitoring of timer functions and the Real Time Clock. See chapter 4.4.3.

PID Controller 1

Monitoring of PID controller values. See chapters 4.4.4 and 4.4.5.

PID Controller 2

Monitoring of PID controller values. See chapters 4.4.4 and 4.4.5.

Multi-pump

Monitoring of values related to the use of several drives. See chapter 4.4.6.

Fieldbus data

Fieldbus data shown as monitor values for debugging purposes at e.g. fieldbus commissioning. See chapter 4.4.8.

3.3.3 Parameters

Through this submenu, you can reach the application parameter groups and parameters. More information on parameters in chapter 4.

3.3.4 Diagnostics

Under this menu, you can find *Active faults*, *Reset faults*, *Fault history*, *Counters* and *Software info.*

3.3.4.1 Active faults

Menu	Function	Note
Active faults	When a fault/faults appear(s), the display with the name of the fault starts to blink. Press OK to return to the Diagnostics menu. The *Active faults* submenu shows the number of faults. Select the fault and push OK to see the fault-time data.	The fault remains active until it is cleared with the Reset button (push for 2 s) or with a reset signal from the I/O terminal or fieldbus or by choosing *Reset faults* (see below). The memory of active faults can store the maximum of 10 faults in the order of appearance.

3.3.4.2 Reset faults

Menu	Function	Note
Reset faults	In this menu you can reset faults. For closer instructions, see chapter 4.7.1.	⚠ CAUTION! Remove external Control signal before resetting the fault to prevent unintentional restart of the drive.

3.3.4.3 Fault history

Menu	Function	Note
Fault history	40 latest faults are stored in the Fault history.	Entering the Fault history and clicking OK on the selected fault shows the fault time data (details).

3.3.4.4 Total counters*

Index	Parameter	Min	Max	Unit	Default	ID	Description
V4.4.1	Energy counter			Varies		2291	Amount of energy taken from supply network. No reset. NOTE FOR MULTI-LANGUAGE HMI: The highest energy unit shown on the standard keypad is *MW*. Should the counted energy exceed 999.9 MW, no unit is shown on the keypad.
V4.4.3	Operating time (advanced commissioning HMI)			a d hh:min		2298	Control unit operating time.
V4.4.4	Operating time (multi-language HMI)			a			Control unit operating time in total years.

V4.4.5	Operating time (multi-language HMI)			d			Control unit operating time in total days.
V4.4.6	Operating time (multi-language HMI)			hh:min:ss			Control unit operating time in hours, minutes and seconds.
V4.4.7	Run time (advanced commissioning HMI)			a d hh:min		2293	Motor running time.
V4.4.8	Run time (multi-language HMI)			a			Motor running time in total years.
V4.4.9	Run time (multi-language HMI)			d			Motor running time in total days.
V4.4.10	Run time (multi-language HMI)			hh:min:ss			Motor running time in hours, minutes and seconds
V4.4.11	Power on time (advanced commissioning HMI)			a d hh:min		2294	Amount of time the power unit has been powered so far. No reset.
V4.4.12	Power on time (multi-language HMI)			a			Power on time in total years.
V4.4.13	Power on time (multi-language HMI)			d			Power on time in total days.
V4.4.14	Power on time (multi-language HMI)			hh:min:ss			Power on time in hours, minutes and seconds.
V4.4.15	Start command counter					2295	The number of times the power unit has been started.

Table 2. Diagnostics menu, Total counters parameters

*These parameters are not resettable.

3.3.4.5 Trip counters

Index	Parameter	Min	Max	Unit	Default	ID	Description
P4.5.1	Energy trip counter			Varies		2296	Resettable energy counter. NOTE FOR MULTI-LANGUAGE HMI: The highest energy unit shown on the standard keypad is *MW*. Should the counted energy exceed 999.9 MW, no unit is shown on the keypad. To reset the counter: Multi-language HMI: Apply a long (4 s) push on the OK button. Advanced commissioning HMI: Push OK once. *Reset counter* page will appear. Push OK once again.
P4.5.3	Operating time (advanced commissioning HMI)			a d hh:min		2299	Resettable. See P4.5.1.
P4.5.4	Operating time (multi-language HMI)			a			Operating time in total years.

P4.5.5	Operating time (multi-language HMI)			d			Operating time in total days.
P4.5.6	Operating time (multi-language HMI)			hh:min:ss			Operating time in hours, minutes and seconds.

Table 3. Diagnostics menu, Trip counters parameters

3.3.4.6 Software info

Index	Parameter	Min	Max	Unit	Default	ID	Description
V4.6.1	Software package (advanced commissioning HMI)					2524	Code for software identification.
V4.6.2	Software package ID (multi-language HMI)						
V4.6.3	Software package version (multi-language HMI)						
V4.6.4	System load	0	100	%		2300	Load on control unit CPU.
V4.6.5	Application name (advanced commissioning HMI)					2525	Name of application.
V4.6.6	Application ID					837	Application code.
V4.6.7	Application version					838	

Table 4. Diagnostics menu, Software info parameters

3.3.5 I/O and hardware

Various options-related settings are located in this menu.

3.3.5.1 Basic I/O

Monitor here the statuses of inputs and outputs.

Index	Parameter	Min	Max	Unit	Default	ID	Description
M5.1.1	Digital input 1	0	1			2502	Status of digital input signal
M5.1.2	Digital input 2	0	1			2503	Status of digital input signal
M5.1.3	Digital input 3	0	1			2504	Status of digital input signal
M5.1.4	Digital input 4	0	1			2505	Status of digital input signal
M5.1.5	Digital input 5	0	1			2506	Status of digital input signal
M5.1.6	Digital input 6	0	1			2507	Status of digital input signal
M5.1.7	Analog input 1 mode	1	3			2508	Shows the selected (with jumper) mode for Analogue input signal 1 = 0...20mA 3 = 0...10V
M5.1.8	Analog input 1	0	100	%		2509	Status of analog input signal
M5.1.9	Analog input 2 mode	1	3			2510	Shows the selected (with jumper) mode for Analogue input signal 1 = 0...20mA 3 = 0...10V
M5.1.10	Analog input 2	0	100	%		2511	Status of analog input signal
M5.1.11	Analog output 1 mode	1	3			2512	Shows the selected (with jumper) mode for Analogue output signal 1 = 0...20mA 3 = 0...10V
M5.1.12	Analog output 1	0	100	%		2513	Status of analog output signal
M5.1.13	Relay output 1	0	1				Status of digital output signal
M5.1.14	Relay output 2	0	1				Status of digital output signal
M5.1.15	Relay output 3	0	1				Status of digital output signal
M5.1.16	Thermistor input	0	1				Status of thermistor input. See P3.9.21.

Table 5. I/O and Hardware menu, Basic I/O parameters

3.3.5.2 Option board slots

The parameters of this group depend on the option board installed. If no option board is placed in slots D or E, no parameters are visible. See chapter 4.5.2 for the location of the slots.

Menu	Function	Note
Slot D	Settings	Option board related settings.
	Monitoring	Monitor option board-related info.
Slot E	Settings	Option board related settings.
	Monitoring	Monitor option board-related info.

3.3.5.3 Real time clock

Index	Parameter	Min	Max	Unit	Default	ID	Description
V5.5.1	Battery state	1	3		2	2205	Status of battery. 1 = Not installed 2 = Installed 3 = Change battery
P5.5.2	Time			hh:mm:ss		2201	Current time of day
P5.5.3	Date			dd.mm.		2202	Current date
P5.5.4	Year			yyyy		2203	Current year
P5.5.5	Daylight saving	1	4		1	2204	Daylight saving rule 1 = Off 2 = EU 3 = US 4 = Russia

Table 6. I/O and Hardware menu, Real time clock parameters

3.3.5.4 Power unit settings, fan control

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.6.1.1	Fan control mode	Always on	Opti-mised		Always on	2377	Fan control mode
M5.6.1.5	Fan lifetime			h	0	849	Fan lifetime
P5.6.1.6	Fan lifetime alarm limit	0	200,000	h	50 000	824	Fan lifetime alarm limit
P5.6.1.7	Fan lifetime reset				0	823	Fan lifetime reset

Table 7. Power unit settings, Fan control

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.6.2.1	Brake chopper mode	Dis-abled	Enabled		Disabled	2526	Brake chopper mode

Table 8. Power unit settings, brake chopper

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.6.4.1	Sine filter	Dis-abled	Enabled		Disabled	2527	Sine filter

Table 9. Power unit settings, sine filter

3.3.5.5 Keypad

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.7.1	Timeout time	0	60	min	0	804	Time after which the display returns to page defined with parameter P5.7.2. 0 = Not used
P5.7.2	Default page	0	4		0	2318	0 = None 1 = Enter menu index 2 = Main menu 3 = Control page 4 = Multimonitor
P5.7.3	Menu index	0	255			2499	Set menu index for desired page and activate with parameter P5.7.2 = 1.
P5.7.4	Contrast (advanced commissioning HMI only)	30	70	%	50	830	Set contrast of the display (30...70%).
P5.7.5	Backlight time	0	60	min	5	818	Set the time until the back-light of the display turns off (0...60 min). If set to 0 s, backlight is always on.

Table 10. I/O and Hardware menu, Keypad parameters

3.3.5.6 Fieldbus

Parameters related to different fieldbus boards can also be found in the *I/O and Hardware* menu. These parameters are explained in more detail in the respective fieldbus manual.

Submenu level 1	Submenu level 2	Submenu level 3	Submenu level 4
RS-485	Common settings	Protocol	Modbus/RTU N2 BACnet MS/TP
	Modbus/RTU	Parameters	Slave address
			Baud rate
			Parity type
			Stop bits
			Communication timeout
			Operate mode
		Monitoring	Fieldbus protocol status
			Communication status
			Illegal functions
			Illegal data addresses
			Illegal data values
			Slave device busy
			Memory parity error
			Slave device failure
			Last fault response
			Control word
			Status word
	N2	Parameters	Device address
			Communication timeout
		Monitoring	Fieldbus protocol status
			Communication status
			Invalid data
			Invalid commands
			Command not accepted
			Control word
			Status word

RS-485	BACnet MS/TP	Parameters	Baud rate
			Autobauding
			MAC address
			Instance number
			Communication timeout
		Monitoring	Fieldbus protocol status
			Communication status
			Actual instance number
			Fault code
			Control word
			Status word
Ethernet	Common settings	IP address mode	
		Fixed IP	IP address
			Subnet mask
			Default gateway
		IP address	
		Subnet mask	
		Default gateway	
	Modbus/TCP	Common settings	Connection limit
			Slave address
			Communication timeout
		Monitoring*	Fieldbus protocol status
			Communication status
			Illegal functions
			Illegal data addresses
			Illegal data values
			Slave device busy
			Memory parity error
			Slave device failure
			Last fault response
			Control word
			Status word
	BACnet/IP	Settings	Instance number
			Communication timeout
			Protocol in use
			BBMD IP
			BBMD Port
			Time to live
		Monitoring	Fieldbus protocol status
			Communication status
			Actual instance number
			Control word
			Status word

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.8.1.1	Protocol	0	9		0	2208	0 = No protocol 4 = Modbus RTU 5 = N2 9 = BACNet MSTP

Table 11. Common settings, protocol

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.8.3.1.1	Slave address	1	247		1	2320	Slave address
P5.8.3.1.2	Baud rate	300	230 400	bps	9600	2378	Baud rate
P5.8.3.1.3	Parity type	Even	None		None	2379	Parity type
P5.8.3.1.4	Stop bits	1	2		2	2380	Stop bits
P5.8.3.1.5	Communication timeout	0	65 535	s	10	2321	Comm. timeout
P5.8.3.1.6	Operate mode	Slave	Master		Slave	2374	Operate mode

Table 12. Modbus RTU parameters (This table is only visible when P5.8.1.1 Protocol = 4/Modbus RTU.)

Index	Parameter	Min	Max	Unit	Default	ID	Description
M5.8.3.2.1	Fieldbus protocol status				0	2381	Fieldbus protocol status
P5.8.3.2.2	Communication status	0	0		0	2382	Communication status
M5.8.3.2.3	Illegal functions				0	2383	Illegal functions
M5.8.3.2.4	Illegal data addresses				0	2384	Illegal data addresses
M5.8.3.2.5	Illegal data values				0	2385	Illegal data values
M5.8.3.2.6	Slave device busy				0	2386	Slave device busy
M5.8.3.2.7	Memory parity error				0	2387	Memory parity error
M5.8.3.2.8	Slave device failure				0	2388	Slave device failure
M5.8.3.2.9	Last fault response				0	2389	Last fault response
M5.8.3.2.10	Control word				16#0	2390	Control word
M5.8.3.2.11	Status word				16#0	2391	Status word

Table 13. Modbus RTU monitoring (This table is only visible when P5.8.1.1 Protocol = 4/Modbus RTU)

Index	Parameter	Min	Max	Unit	Default	ID	Description
P 5.8.3.1.1	Device address	1	255		1	2350	Device address
P 5.8.3.1.2	Communication timeout	0	255		10	2351	Communication timeout

Table 14. N2 parameters (This table is only visible when P5.8.1.1 Protocol = 5/N2)

Index	Parameter	Min	Max	Unit	Default	ID	Description
M5.8.3.2.1	Fieldbus protocol status				0	2399	Fieldbus protocol status
M5.8.3.2.2	Communication status				0	2400	Communication status

M5.8.3.2.3	Invalid data				0	2401	Invalid data
M5.8.3.2.4	Invalid commands				0	2402	Invalid commands
M5.8.3.2.5	Command NACK				0	2403	Command NACK
M5.8.3.2.6	Control word				16#0	2404	Control word
M5.8.3.2.7	Status word				16#0	2405	Status word

Table 15. N2 monitoring (This table is only visible when P5.8.1.1 Protocol = 5/N2)

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.8.3.1.1	Baud rate	9600	76 800	bps	9600	2392	Baud rate
P5.8.3.1.2	Autobauding	0	1		0	2330	Autobauding
P5.8.3.1.3	MAC address	1	127		1	2331	MAC address
P5.8.3.1.4	Instance number	0	4 194 303		0	2332	Instance number
P5.8.3.1.5	Communication timeout	0	65 535		10	2333	Communication timeout

Table 16. BACnet MSTP parameters (This table is only visible when P5.8.1.1 Protocol = 9/ BACNetMSTP)

Index	Parameter	Min	Max	Unit	Default	ID	Description
M5.8.3.2.1	Fieldbus protocol status				0	2393	Fieldbus protocol status
M5.8.3.2.2	Communication status				0	2394	Communication status
M5.8.3.2.3	Actual instance				0	2395	Actual instance
M5.8.3.2.4	Fault code				0	2396	Fault code
M5.8.3.2.5	Control word				16#0	2397	Control word
M5.8.3.2.6	Status word				16#0	2398	Status word

Table 17. BACnet MSTP monitoring (This table is only visible when P5.8.1.1 Protocol = 9/ BACNetMSTP)

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.9.1.1	IP address mode	0	1		1	2482	0 = Fixed IP 1 = DHCP with AutoIP

Table 18. Ethernet common settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.9.1.2.1	IP address				192.168.0.10	2529	This parameter is in use if P5.9.1.1 = 0/Fixed IP
P5.9.1.2.2	Subnet mask				255.255.0.0	2530	This parameter is in use if P5.9.1.1 = 0/Fixed IP
P5.9.1.2.3	Default gateway				192.168.0.1	2531	This parameter is in use if P5.9.1.1 = 0/Fixed IP
M5.9.1.3	IP address				0	2483	IP address
M5.9.1.4	Subnet mask				0	2484	Subnet mask
M5.9.1.5	Default gateway				0	2485	Default gateway
M5.9.1.6	MAC address					2486	MAC address

Table 19. Fixed IP

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.9.2.1.1	Connection limit	0	3		3	2446	Connection limit
P5.9.2.1.2	Slave address	0	255		255	2447	Slave address
P5.9.2.1.3	Communication timeout	0	65 535	s	10	2448	Communication timeout

Table 20. Modbus TCP common settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P5.9.3.1.1	Instance number	0	4 194 303		0	2406	Instance number
P5.9.3.1.2	Communication timeout	0	65 535		0	2407	Communication timeout
P5.9.3.1.3	Protocol in use	0	1		0	2408	Protocol in use
P5.9.3.1.4	BBMD IP				192.168.0.1	2409	BBMD IP
P5.9.3.1.5	BBMD Port	1	65 535		47 808	2410	BBMD Port
P5.9.3.1.6	Time to live	0	255		0	2411	Time to live

Table 21. BACnet IP settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
M5.9.3.2.1	Fieldbus protocol status				0	2412	Fieldbus protocol status
P5.9.3.2.2	Communication status	0	0		0	2413	Communication status
M5.9.3.2.3	Actual instance				0	2414	Actual instance
M5.9.3.2.4	Control word				16#0	2415	Control word
M5.9.3.2.5	Status word				16#0	2416	Status word

Table 22. BACnet IP monitoring

3.3.6 User settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P6.1	Language selections	Varies	Varies		Varies	802	Depends on language package.
M6.5	Parameter backup	See Table 24 below.					
M6.6	Parameter compare	See Table 25 below.					
P6.7	Drive name						Give name of drive if needed.

Table 23. User settings menu, General settings

3.3.6.1 Parameter backup

Index	Parameter	Min	Max	Unit	Default	ID	Description
P6.5.1	Restore factory defaults					831	Restores factory default settings. NOTE: Restarts the drive if motor is not running.
P6.5.2	Save to keypad *					2487	Save parameter values to keypad to e.g. copy them to another drive.
P6.5.3	Restore from keypad *					2488	Load parameter values from keypad to the drive.
P6.5.4	Save to Set 1					2489	Save parameter values to parameter set 1.
P6.5.5	Restore from Set 1					2490	Load parameter values from parameter set 1.
P6.5.6	Save to Set 2					2491	Save parameter values to parameter set 2.
P6.5.7	Restore from Set 2					2492	Load parameter values from parameter set 2.

* = Only available with Advanced Commissioning HMI

Table 24. User settings menu, Parameter backup

Index	Parameter	Min	Max	Unit	Default	ID	Description
P6.6.1	Active set - Set 1				0	2493	Starts comparing parameters to the selected set
P6.6.2	Active set - Set 2				0	2494	Starts comparing parameters to the selected set
P6.6.3	Active set - Defaults				0	2495	Starts comparing parameters to the selected set
P6.6.4	Active set - Keypad set				0	2496	Starts comparing parameters to the selected set
P6.7	Drive name				Drive	2528	The name of the drive

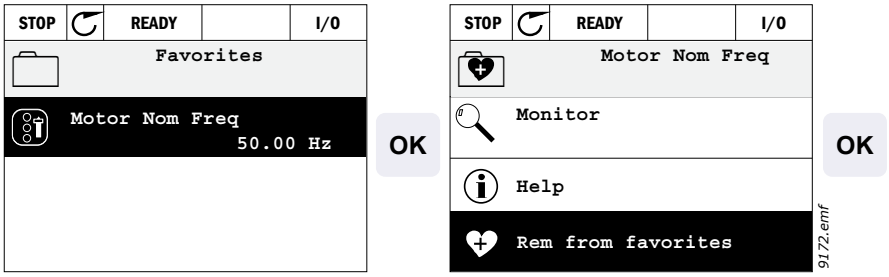
Table 25. User settings menu, Parameter compare

3.3.7 Favourites

NOTE: This menu is available in Advanced Commissioning HMI only.

Favourites are typically used to collect a set of parameters or monitoring signals from any of the keypad menus. You can add items or parameters to the Favourites folder, see chapter

To remove an item or a parameter from the Favourites folder, do the following:



4. COMMISSIONING

The parameters of this application are listed in chapter 4.5 of this manual and explained in more detail in chapter 4.6.

4.1 Specific functions of SmartVFD HVAC/SmartDrive HVAC

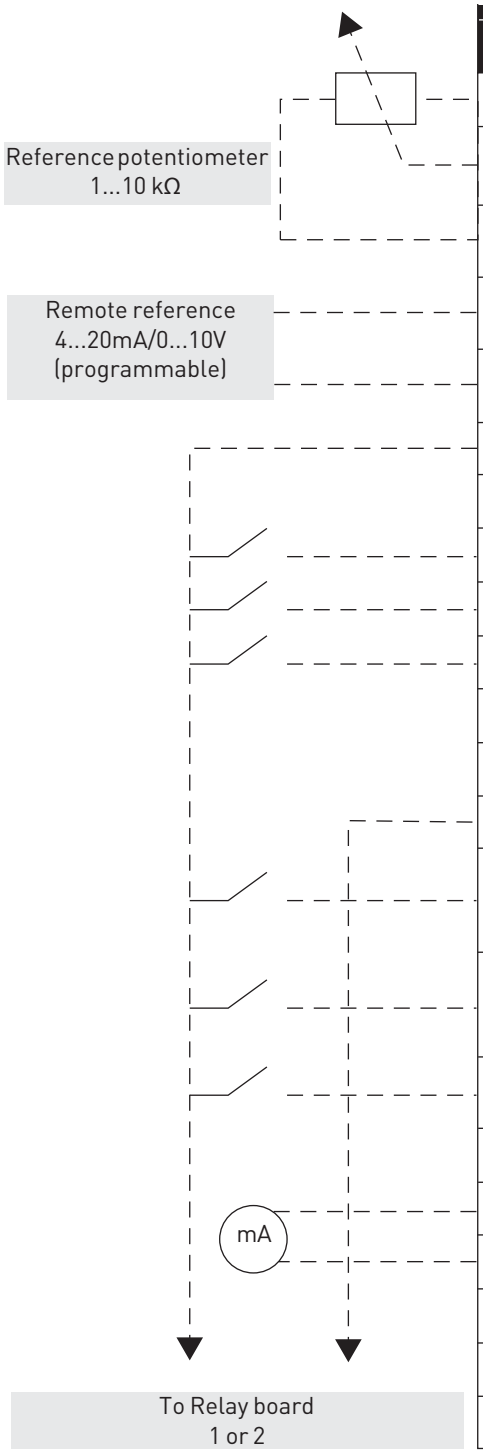
The SmartVFD HVAC/SmartDrive HVAC is an easy-to-use application for basic Pump and Fan applications where only one motor and one drive is needed and also offers extensive possibilities for PID control.

Features

- **Startup Wizard** for extremely fast setup for basic pump or fan applications
- **Mini-Wizards** to ease the setup of standalone PID, Cascade and Fire Mode control applications
- **Loc/Rem-button** for easy change between Local (keypad) and Remote control place. The remote control place is selectable by parameter (I/O or Fieldbus)
- **Control page** for easy operation and monitoring of the most essential values.
- **Run interlock** input (Damper interlock). Drive will not start before this input is activated.
- Different **pre-heat modes** used to avoid condensation problems
- **Real-time clock and timer functions** available (optional battery required). Possible to program 3 time channels to achieve different functions on the drive (e.g. Start/Stop and Preset frequencies)
- **External PID-controller** available. Can be used to control e.g. a valve using the drive's I/O
- **Sleep mode function** which automatically enables and disables drive running with user defined levels to save energy.
- **2-zone PID-controller** (2 different feedback signals; minimum and maximum control)
- **Two setpoint sources** for the PID-control. Selectable with digital input
- **PID setpoint boost function**
- **Feedforward function** to improve the response to the process changes
- **Process value supervision**
- **Pump and Fan Cascade control** for controlling a system with multiple pumps or fans
- **Power ride-through** for automatically adapting the operation to avoid faults in e.g.short-time voltage loss
- **Overtemperature ride-through** for automatically adapting the operation to avoid faults in abnormal ambient temperatures
- **Pressure loss compensation** for compensating pressure losses in the pipework e.g. when sensor is incorrectly placed near the pump or fan
- **Single input control** where the analogue signal (0-10V or 4-20mA) can also be used to start and stop the motor without additional inputs
- **Resonance sweep wizard** to very easily set up skip frequency areas to avoid resonances in the system
- **RTO - Ramp Time Optimizer** to automatically adapt to the system to avoid fast accelerations and decelerations which might harm the water pipes or air ducts
- **Pump soft fill** function to prevent overpressures when filling the pipework with liquid
- **Sine filter** feature is available

4.2 Example of control connections

Table 26. Connection example, standard I/O board



Terminal		Signal	Default
1	+10 Vref	Reference output	
2	AI1+	Analogue input, voltage or current*	Voltage
3	AI1-	Analogue input common (current)	
4	AI2+	Analogue input, voltage or current	Current
5	AI2-	Analogue input common (current)	
6	24Vout	24V aux. voltage	
7	GND	I/O ground	
8	DI1	Digital input 1	Start FWD
9	DI2	Digital input 2	Start REV
10	DI3	Digital input 3	Fault
11	CM	Common A for DIN1-DIN6**	I/O ground
12	24Vout	24V aux. voltage	
13	GND	I/O ground	
14	DI4	Digital input 4	Preset freq select 1
15	DI5	Digital input 5	Preset freq select 2
16	DI6	Digital input 6	Fault reset
17	CM	Common A for DIN1-DIN6**	I/O ground
18	AO1+	Analogue signal (+output)	Output frequency
19	AO-/GND	Analogue output common	
30	+24 Vin	24V auxiliary input voltage	
A	RS485	Serial bus, negative	
B	RS485	Serial bus, positive	

*Selectable with DIP switches, see Installation Manual
**Digital inputs can be isolated from ground. See Installation Manual.

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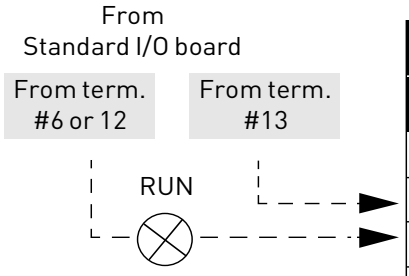
Table 27. Connection example, Relay board



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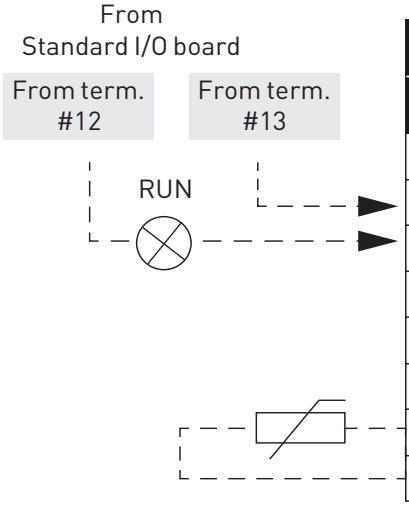
Relay board 1			Default
Terminal		Signal	
21	RO1/1 NC	Relay output 1	RUN
22	RO1/2 CM		
23	RO1/3 NO		
24	RO2/1 NC	Relay output 2	FAULT
25	RO2/2 CM		
26	RO2/3 NO		
32	RO3/1 CM	Relay output 3	READY
33	RO3/2 NO		

Table 28. Connection example, Relay board 2



Relay board 2			Default
Terminal		Signal	
21	RO1/1 NC	Relay output 1	RUN
22	RO1/2 CM		
23	RO1/3 NO		
24	RO2/1 NC	Relay output 2	FAULT
25	RO2/2 CM		
26	RO2/3 NO		
28	TI1+	Thermistor input	NO ACTION
29	TI1-		

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4.3 Quick setup parameters

The Quick Setup parameter group is a collection of parameters that are most commonly used during installation and commissioning. They are collected in the first parameter group so that they can be found fast and easily. They can, however, be also reached and edited in their actual parameter groups. Changing a parameter value in the Quick setup group also changes the value of this parameter in its actual group.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P1.1	Motor nominal voltage	Varies	Varies	V	Varies	110	Find this value U_n on the rating plate of the motor.
P1.2	Motor nominal frequency	8.00	320.00	Hz	60.00	111	Find this value f_n on the rating plate of the motor.
P1.3	Motor nominal speed	24	19200	rpm	1720	112	Find this value n_n on the rating plate of the motor.
P1.4	Motor nominal current	Varies	Varies	A	Varies	113	Find this value I_n on the rating plate of the motor.
P1.5	Motor Cos Phi	0.30	1.00		0.80	120	Find this value on the rating plate of the motor
P1.6	Motor nominal power	0.00	Varies	kW	Varies	116	Find this value I_n on the rating plate of the motor.
P1.7	Motor current limit	Varies	Varies	A	Varies	107	Maximum motor current from AC drive
P1.8	Minimum frequency	0.00	P1.9	Hz	Varies	101	Minimum allowed frequency reference
P1.9	Maximum frequency	P1.8	320.00	Hz	60.00	102	Maximum allowed frequency reference
P1.10	I/O control reference A selection	1	8		7	117	Selection of ref source when control place is I/O A (P3.3.3).
P1.11	Preset frequency 1	M3.3.1	300.00	Hz	10.00	105	Select with digital input: Preset frequency selection 0 (P3.5.1.16) (Default = Digital Input 4)
P1.12	Preset frequency 2	M3.3.1	300.00	Hz	15.00	106	Select with digital input: Preset frequency selection 1 (P3.5.1.17) (Default = Digital Input 5)
P1.13	Acceleration time 1	0.1	3000.0	s	20.0	103	Time to accelerate from zero to maximum speed
P1.14	Deceleration time 1	0.1	3000.0	s	20.0	104	Time to decelerate from minimum to zero speed
P1.15	Remote control place	1	2		1	172	Selection of remote control place (start/stop) 1 = I/O 2 = Fieldbus
P1.16	Automatic reset	0	1		0	731	0 = Disabled 1 = Enabled
P1.17	Motor switch	0	1		0	653	0 = Disabled 1 = Enabled
P1.18	PID Mini-Wizard	0	1		0	1803	0 = Inactive 1 = Activate See chapter 2.2.

P1.19	PFC Wizard *	0	1		0		0 = Inactive 1 = Activate See chapter 2.3.
P1.20	Firemode Wizard	0	1		0		0 = Inactive 1 = Active

Table 29. Quick setup parameter group

4.4 Monitor group

The drive provides you with a possibility to monitor the actual values of parameters and signals as well as statuses and measurements. Some of the values to be monitored are customizable.

4.4.1 Multimonitor view with advanced commissioning HMI

On the multi-monitor page, you can collect nine values that you wish to monitor. See page 22 for more information.

4.4.2 Basic

See Table 30 in which the basic monitoring values are presented.

NOTE!

Only Basic I/O board statuses are available in the Monitor menu. Statuses for all I/O board signals can be found as raw data in the I/O and Hardware system menu.

Check expander I/O board statuses when required in the I/O and Hardware system menu.

Index	Monitoring value	Unit	ID	Description
V2.2.1	Output frequency	Hz	1	Output frequency to motor
V2.2.2	Frequency reference	Hz	25	Frequency reference to motor control
V2.2.3	Motor speed	rpm	2	Motor speed in rpm
V2.2.4	Motor current	A	3	
V2.2.5	Motor torque	%	4	Calculated shaft torque
V2.2.7	Motor shaft power	%	5	Total power consumption of AC drive
V2.2.8	Motor shaft power	kW/hp	73	
V2.2.9	Motor voltage	V	6	
V2.2.10	DC link voltage	V	7	
V2.2.11	Unit temperature	°C/°F	8	Heatsink temperature
V2.2.12	Motor temperature	%	9	Calculated motor temperature
V2.2.13	Analog input 1	%	59	Signal in percent of used range
V2.2.14	Analog input 2	%	60	Signal in percent of used range
V2.2.15	Analog output 1	%	81	Signal in percent of used range
V2.2.16	Motor preheat		1228	0 = OFF 1 = Heating (feeding DC-current)
V2.2.17	Drive Status Word		43	Bit coded status of drive B1=Ready B2=Run B3=Fault B6=RunEnable B7=AlarmActive B10=DC Current in stop B11=DC Brake Active B12=RunRequest B13=MotorRegulatorActive
V2.2.18	Last active fault		37	The fault code of latest activated fault that has not been reset.

Index	Monitoring value	Unit	ID	Description
V2.2.19	Fire mode status		1597	0=Disabled 1=Enabled 2=Activated (Enabled + DI open) 3=Test mode
V2.2.20	Appl.StatusWord1		89	B0 = Interlock 1 B1 = Interlock 2 B5 = I/O A Control Act. B6 = I/O B Control Act. B7 = Fieldbus Control Act. B8 = Local Control Act. B9 = PC Control Act. B10 = Preset Frequencies Act. B12 = FireMode Act. B13 = PreHeat Act.
V2.2.21	Appl.StatusWord2		90	B0 = Acc/Dec Prohibited B1 = Motor Switch Act.

Table 30. Monitoring menu items

4.4.3 Timer functions monitoring

Here you can monitor values of timer functions and the Real Time Clock.

Index	Monitoring value	Unit	ID	Description
V2.3.1	TC 1, TC 2, TC 3		1441	Possible to monitor the statuses of the three Time Channels (TC)
V2.3.2	Interval 1		1442	Status of timer interval
V2.3.3	Interval 2		1443	Status of timer interval
V2.3.4	Interval 3		1444	Status of timer interval
V2.3.5	Interval 4		1445	Status of timer interval
V2.3.6	Interval 5		1446	Status of timer interval
V2.3.7	Timer 1	s	1447	Remaining time on timer if active
V2.3.8	Timer 2	s	1448	Remaining time on timer if active
V2.3.9	Timer 3	s	1449	Remaining time on timer if active
V2.3.10	Real time clock		1450	

Table 31. Monitoring of timer functions

4.4.4 PID1 controller monitoring

Index	Monitoring value	Unit	ID	Description
V2.4.1	PID1 setpoint	Varies	20	Process units selected with parameter
V2.4.2	PID1 feedback	Varies	21	Process units selected with parameter
V2.4.3	PID1 error value	Varies	22	Process units selected with parameter
V2.4.4	PID1 output	%	23	Output to motor control or external control (AO)
V2.4.5	PID1 status		24	0=Stopped 1=Running 3=Sleep mode 4=In dead band (see page 78)

Table 32. PID1-controller value monitoring

4.4.5 PID2 controller monitoring

Index	Monitoring value	Unit	ID	Description
V2.5.1	PID2 setpoint	Varies	83	Process units selected with parameter
V2.5.2	PID2 feedback	Varies	84	Process units selected with parameter
V2.5.3	PID2 error value	Varies	85	Process units selected with parameter
V2.5.4	PID2 output	%	86	Output to external control (AO)
V2.5.5	PID2 status		87	0=Stopped 1=Running 2=In dead band (see page 78)

Table 33. PID2-controller value monitoring

4.4.6 Multi-pump

Index	Monitoring value	Unit	ID	Description
V2.6.1	Motors running		30	The number of motors running when PFC function is used.
V2.6.2	Autochange		1114	Informs the user if autochange is requested.

Table 34. Pump and fan cascade monitoring

4.4.7 Maintenance timers

Index	Monitoring value	Unit	ID	Description
V2.7.1	Counter 1	h/revs	1101	Status of counter (Revs*1000 or hours)
V2.7.2	Counter 2	h/revs	1102	Status of counter (Revs*1000 or hours)
V2.7.3	Counter 3	h/revs	1103	Status of counter (Revs*1000 or hours)

Table 35. Maintenance timers monitoring

4.4.8 Fieldbus data monitoring

Index	Monitoring value	Unit	ID	Description
V2.8.1	FB Control Word		874	Fieldbus control word used by application in bypass mode/format. Depending on the fieldbus type or profile the data can be modified before sent to application.
V2.8.2	FB speed reference		875	Speed reference scaled between minimum and maximum frequency at the moment it was received by the application. Minimum and maximum frequencies can changed after the reference was received without affecting the reference.
V2.8.3	FB data in 1		876	Raw value of process data in 32-bit signed format
V2.8.4	FB data in 2		877	Raw value of process data in 32-bit signed format
V2.8.5	FB data in 3		878	Raw value of process data in 32-bit signed format
V2.8.6	FB data in 4		879	Raw value of process data in 32-bit signed format
V2.8.7	FB data in 5		880	Raw value of process data in 32-bit signed format
V2.8.8	FB data in 6		881	Raw value of process data in 32-bit signed format
V2.8.9	FB data in 7		882	Raw value of process data in 32-bit signed format
V2.8.10	FB data in 8		883	Raw value of process data in 32-bit signed format
V2.8.11	FB Status Word		864	Fieldbus status word sent by application in bypass mode/format. Depending on the FB type or profile the data can be modified before sent to the FB.
V2.8.12	FB speed actual		865	Actual speed in %. 0 and 100% correspond to minimum and maximum frequencies respectively. This is continuously updated depending on the momentary min and max frequencies and the output frequency.
V2.8.13	FB data out 1		866	Raw value of process data in 32-bit signed format
V2.8.14	FB data out 2		867	Raw value of process data in 32-bit signed format
V2.8.15	FB data out 3		868	Raw value of process data in 32-bit signed format
V2.8.16	FB data out 4		869	Raw value of process data in 32-bit signed format

Index	Monitoring value	Unit	ID	Description
V2.8.17	FB data out 5		870	Raw value of process data in 32-bit signed format
V2.8.18	FB data out 6		871	Raw value of process data in 32-bit signed format
V2.8.19	FB data out 7		872	Raw value of process data in 32-bit signed format
V2.8.20	FB data out 8		873	Raw value of process data in 32-bit signed format

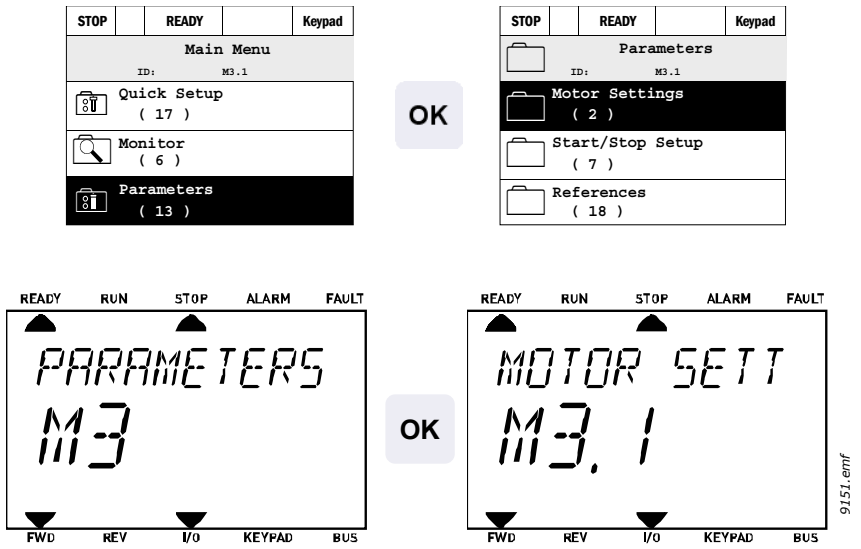
Table 36. Fieldbus data monitoring

4.4.9 Temperature inputs

Index	Monitoring value	Min	Max	Unit	ID	Description
V2.9.1	Temperature Input 1	-50.00	200.00	°C/°F	50	Measured value of Temperature Input 1. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected, the maximum value is shown because measured resistance is endless.
V2.9.2	Temperature Input 2	-50.00	200.00	°C/°F	51	Measured value of Temperature Input 2. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected, the maximum value is shown because measured resistance is endless.
V2.9.3	Temperature Input 3	-50.00	200.00	°C/°F	52	Measured value of Temperature Input 3. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected, the maximum value is shown because measured resistance is endless.

4.5 Application parameters

Find the parameter menu and the parameter groups as guided below.



The HVAC Application embodies the following parameter groups:

Menu and Parameter group	Description
Group 3.1: Motor settings	Basic and advanced motor settings
Group 3.2: Start/Stop setup	Start and stop functions
Group 3.3: Control reference settings	Frequency reference setup
Group 3.4: Ramp & Brakes Setup	Acceleration/Deceleration setup
Group 3.5: I/O Configuration	I/O programming
Group 3.6: Fieldbus Data Mapping	Process data in/out mapping
Group 3.7: Prohibit Frequencies	Prohibit frequencies programming
Group 3.8: Limit supervisions	Programmable limit controllers
Group 3.9: Protections	Protections configuration
Group 3.10: Automatic reset	Auto reset after fault configuration
Group 3.11: Application Settings	Motor power and temperature units configuration
Group 3.12: Timer functions	Configuration of 3 timers based on Real Time Clock.
Group 3.13: PID-controller 1	Parameters for PID Controller 1. Motor control or external usage.
Group 3.14: PID-controller 2	Parameters for PID Controller 2. External usage.
Group 3.15: Pump and Fan Cascade	Parameters for Pump and Fan Cascade.
Group 3.16: Maintenance counters	Parameters for Maintenance counters.
Group 3.17: Fire mode	Parameters for Fire Mode.

Table 37. Parameter groups

4.5.1 Column explanations

Index	=	Location indication on the keypad; Shows the operator the parameter number.
Parameter	=	Name of parameter
Min	=	Minimum value of parameter
Max	=	Maximum value of parameter
Unit	=	Unit of parameter value; Given if available
Default	=	Value preset by factory
ID	=	ID number of the parameter
Description	=	Short description of parameter values or its function
	=	More detailed information on this parameter is available in chapter 4.6. HVAC Application; In the digital document a click on the parameter name leads you sometimes to the detailed description

4.5.2 Parameter programming

The programming of digital inputs is very flexible. There are no digital terminals assigned only for certain function. You can choose the terminal of your choice for the certain function, in other words, functions appear as parameters which the operator defines a certain input for. For a list of functions for the digital inputs, see Table 44 on page 61.

Also *Time Channels* can be assigned to digital inputs. See more information on page 76.

The selectable values of the programmable parameters are of type

DigIN SlotA.1 (advanced commissioning HMI) or

dI A.1 (multi-language HMI)

in which

'DigIN / dI' stand for digital input.
'Slot_' refers to the board;
A and **B** are basic boards, **D** and **E** are option boards (see Figure 16). See chapter 4.5.2.3. The number after the board letter refers to the respective terminal on the selected board. Hence, **SlotA.1** means terminal DIN1 on the basic board in board slot A. The parameter (signal) is **not** connected to any terminal, i.e. it is not used, if, instead of a letter, the final number is preceded by a **'0'** (for example **DigIN Slot0.1 / dI 0.1**).

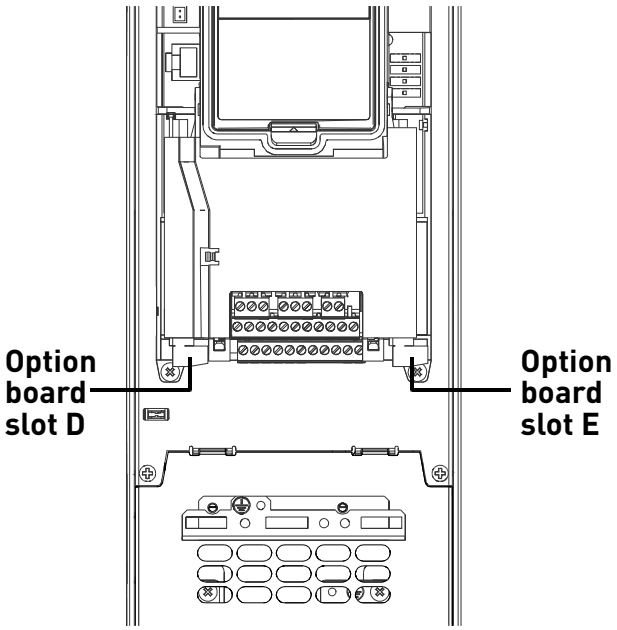


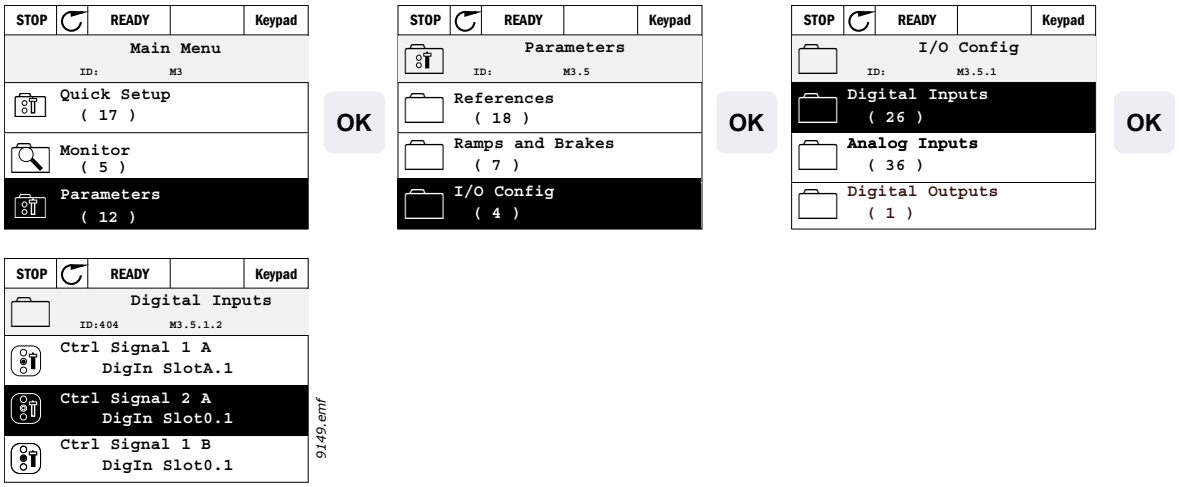
Figure 16. Option board slots

EXAMPLE:

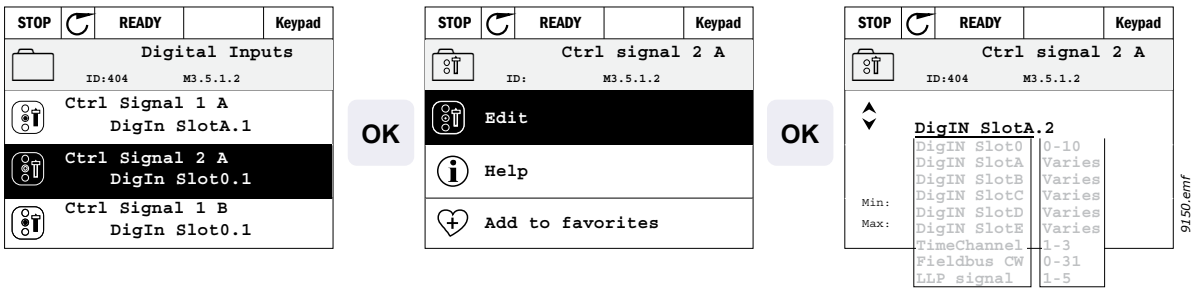
You want to connect the *Control signal 2 A* (parameter P3.5.1.2) to digital input DI2 on Basic I/O board.

4.5.2.1 Example programming with advanced commissioning HMI

1	Locate the parameter *Control signal 2 A* (P3.5.1.2) on the keypad.



2	Enter the *Edit* mode.



3	**Change the value:** The editable part of the value (DigIN Slot0) is underlined and blinking. Change the slot to DigIN SlotA (or assign the signal to Time Channel) with the arrow keys up and down. Make the terminal value (.1) editable by pressing the right key once and change the value to '2' with arrow keys up and down. Accept the change with OK button or return to previous menu level with BACK/ RESET button.

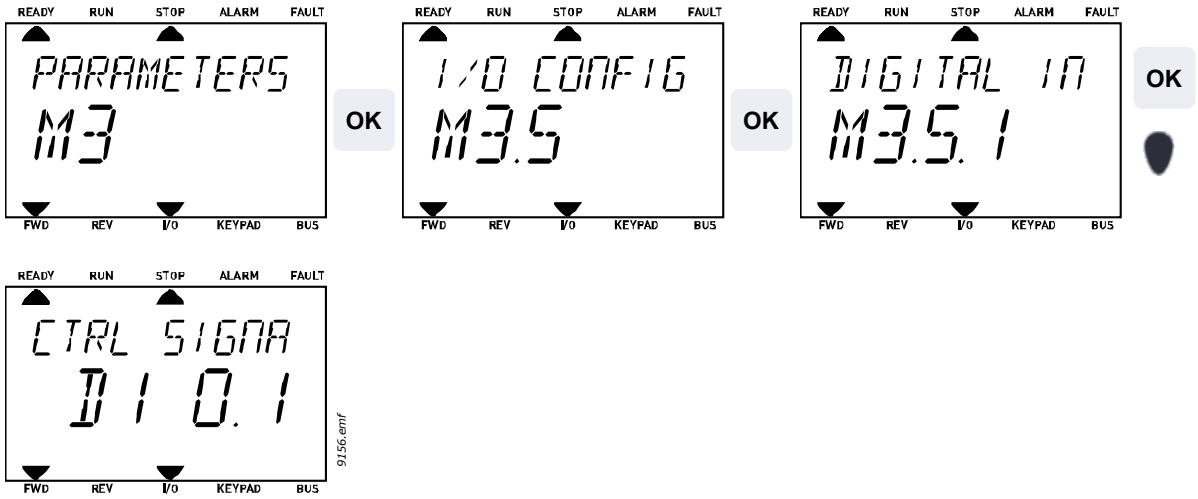
Note: For slot 0.x, the function of the value of x is:

1 = always false

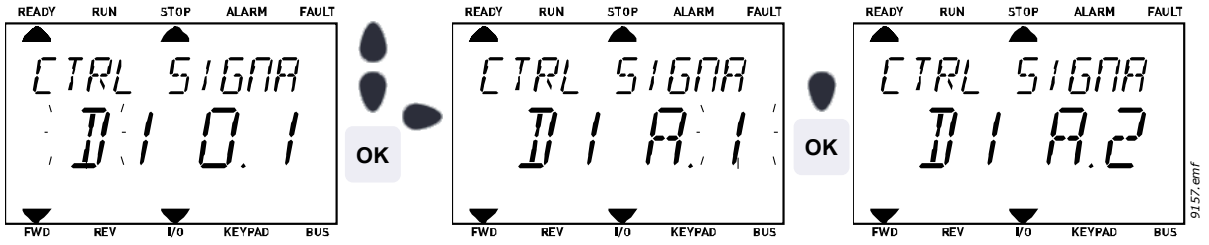
2-9=always true

4.5.2.2 Example programming with multi-language HMI

1	Locate the parameter *Control signal 2 A* (P3.5.1.2) on the keypad Parameters > I/O Config > Digital Inputs.



2	Enter the *Edit* mode by pressing OK. The initial character starts to blink. Change the value of signal source to 'A' with the arrow buttons. Then press the arrow button right. Now the terminal number blinks. Connect the parameter *Control signal 2 A* (P3.5.1.2) to terminal DI2 by setting the terminal number to '2'.



4.5.2.3 Descriptions of signal sources:

Source	Function
Slot0	0= Always FALSE, 1-9 = Always TRUE
SlotA	Number corresponds to digital input in the slot.
SlotB	Number corresponds to digital input in the slot.
SlotC	Number corresponds to digital input in the slot.
SlotD	Number corresponds to digital input in the slot.
SlotE	Number corresponds to digital input in the slot.
TimeChannel (tCh)	1=Time Channel1, 2=Time Channel2, 3=Time Channel3

Table 38. Descriptions of signal sources

4.5.3 Group 3.1: Motor settings

4.5.3.1 Basic Settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.1.1.1	Motor nominal voltage	Varies	Varies	V	Varies	110	Find this value U_n on the rating plate of the motor. This parameter sets the voltage at the field weakening point to 100% * U_{nMotor}. Note also used connection (Delta/Star).
P3.1.1.2	Motor nominal frequency	8.00	320.00	Hz	60.00	111	Find this value f_n on the rating plate of the motor.
P3.1.1.3	Motor nominal speed	24	19200	rpm	1720	112	Find this value n_n on the rating plate of the motor.
P3.1.1.4	Motor nominal current	Varies	Varies	A	Varies	113	Find this value I_n on the rating plate of the motor.
P3.1.1.5	Motor Cos Phi	0.30	1.00		0.80	120	Find this value on the rating plate of the motor
P3.1.1.6	Motor nominal power	Varies	Varies	kW	Varies	116	Find this value In on the rating plate of the motor.
P3.1.1.7	Motor current limit	Varies	Varies	A	Varies	107	Maximum motor current from drive
P3.1.1.8	Motor type	0	1		0	650	0=IM 1=PMM

Table 39. Basic motor settings

4.5.3.2 Motor Control Settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.1.2.1	Switching frequency	1.5	Varies	kHz	Varies	601	Motor noise can be minimised using a high switching frequency. Increasing the switching frequency reduces the capacity of the drive. It is recommended to use a lower frequency when the motor cable is long in order to minimize capacitive currents in the cable.
P3.1.2.2	Motor switch	0	1		0	653	Enabling this function prevents the drive from tripping when the motor switch is closed and opened e.g. using flying start. 0 = Disabled 1 = Enabled
P3.1.2.3	Zero frequency voltage	0.00	40.00	%	Varies	606	This parameter defines the zero frequency voltage of the U/f curve. The default value varies according to unit size.
P3.1.2.4	Motor preheat function	0	3		0	1225	0 = Not used 1 = Always in stop state 2 = Controlled by DI 3 = Temperature limit (heatsink) **NOTE:** Virtual digital input can be activated by Real Time Clock
P3.1.2.5	Motor preheat temperature limit	-20	80	°C/°F	0	1226	Motor preheat is switched on when the heatsink temperature goes below this level (if par. P3.1.2.4 is set to *Temperature limit*. If limit is e.g. 10°C feeding current starts at 10 °C and stops at 11°C (1-degree hysteresis).
P3.1.2.6	Motor preheat current	0	$0.5*I_L$	A	Varies	1227	DC current for pre-heating of motor and drive in stop state. Activated by digital input or by temperature limit.
P3.1.2.7	U/F ratio selection	0	1		0	108	Type of U/f curve between zero frequency and the field weakening point. 0 = Linear 1 = Squared
P3.1.2.8	Overvoltage controller	0	1		1	607	0 = Disabled 1 = Enabled
P3.1.2.9	Undervoltage controller	0	1		1	608	0 = Disabled 1 = Enabled
P3.1.2.10	Energy optimization	0	1		0	666	0 = Disabled 1 = Enabled

P3.1.2.11	Flying start options	0	1		0	1590	0 = Both directions 1 = FreqRef direction

Table 40. Advanced motor settings

4.5.4 Group 3.2: Start/Stop setup

Start/Stop commands are given differently depending on the control place.

Remote control place (I/O A): Start, stop and reverse commands are controlled by 2 digital inputs chosen with parameters P3.5.1.1 and P3.5.1.2. The functionality/logic for these inputs is then selected with parameter P3.2.6 (in this group).

Remote control place (I/O B): Start, stop and reverse commands are controlled by 2 digital inputs chosen with parameters P3.5.1.3 and P3.5.1.4. The functionality/logic for these inputs is then selected with parameter P3.2.7 (in this group).
Local control place (Keypad): Start and stop commands come from the keypad buttons, while the direction of rotation is selected by the parameter P3.3.7.
Remote control place (Fieldbus): Start, stop and reverse commands come from fieldbus.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.2.1	Remote control place	0	1		0	172	Selection of remote control place (start/stop). Can be used to change back to remote control from PC e.g. in case of a broken panel. 0=I/O control 1=Fieldbus control
P3.2.2	Local/Remote	0	1		0	211	Switch between local and remote control places 0=Remote 1=Local
P3.2.3	Keypad Master Stop	0	1		1	1806	0=Disable 1=Enable
P3.2.4	Start function	0	1		0	505	0=Ramping 1=Flying start
P3.2.5	Stop function	0	1		0	506	0=Coasting 1=Ramping
P3.2.6	I/O A start/stop logic	0	3		0	300	**Logic = 0** Ctrl sign 1 = Start fwd Ctrl sign 2 = Start bwd **Logic = 1** Ctrl sign 1 = Start fwd pulse (3-wire) Ctrl sign 2 = Stop pulse (3-wire) **Logic = 2** Ctrl sign 1 = Start fwd pulse Ctrl sign 2 = Start bwd pulse **Logic = 3** Ctrl sign 1 = Start Ctrl sign 2 = Reverse **Logic = 4** Ctrl sign 1 = Start pulse Ctrl sign 2 = Reverse pulse **Logic = 5** Ctrl sign 1 = AI1 threshold Ctrl sign 2 = AI1 threshold
P3.2.7	I/O B start/stop logic	0	3		0	363	See above.

P3.2.8	AI1 start threshold	3.00	100.00	%	20.00	185	If P3.2.6 (I/O Start/Stop Logic) is set to value 3 (AI1 threshold) the motor will start at the level set with parameter this parameter and stop at the same -2% AI1 can also be used as frequency reference at the same time.
P3.2.9	Fieldbus start logic	0	1		1	889	0=Rising edge required 1=State

Table 41. Start/Stop Setup menu

4.5.5 Group 3.3: Control reference settings

The requency reference source is programmable for all control places except *PC*, which always takes the reference from the PC tool.
Remote control place (I/O A): The source of frequency reference can be selected with parameter P3.3.3.
Remote control place (I/O B): The source of frequency reference can be selected with parameter P3.3.4.
Local control place (Keypad): If the default selection for parameter P3.3.5 is used the reference set with parameter P3.3.6 applies.
Remote control place (Fieldbus): The frequency reference comes from fieldbus if the default value for parameter P3.3.9 is kept.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.3.1	Minimum frequency	0.00	P3.3.2	Hz	20.00	101	Minimum allowed frequency reference
P3.3.2	Maximum frequency	P3.3.1	320.00	Hz	50 / 60	102	Maximum allowed frequency reference
P3.3.3	I/O control reference A selection	1	8		6	117	Selection of ref source when control place is I/O A 1 = Preset Frequency 0 2 = Keypad reference 3 = Fieldbus 4 = AI1 5 = AI2 6 = AI1+AI2 7 = PID 1 reference 8 = Motor potentiometer
P3.3.4	I/O control reference B selection	1	8		4	131	Selection of ref source when control place is I/O B. See above. **NOTE**: I/O B control place can only be forced active with digital input (P3.5.1.5).
P3.3.5	Keypad Ctrl Reference selection	1	8		2	121	Selection of ref source when control place is keypad: 1 = Preset Frequency 0 2 = Keypad 3 = Fieldbus 4 = AI1 5 = AI2 6 = AI1+AI2 7 = PID 1 reference 8 = Motor potentiometer
P3.3.6	Keypad reference	0.00	P3.3.2	Hz	0.00	184	The frequency reference can be adjusted on the keypad with this parameter.
P3.3.7	Keypad direction	0	1		0	123	0 = Forward 1 = Reverse
P3.3.8	Keypad reference copy	0	2		1	181	Selects function for Run state & Reference copy when changing to Keypad control: 0 = Copy reference 1 = Copy ref & Run State 2 = No copying

P3.3.9	Fieldbus control reference selection	1	8		3	122	Selection of ref source when control place is Fieldbus: 1 = Preset frequency 0 2 = Keypad 3 = Fieldbus 4 = AI1 5 = AI2 6 = AI1+AI2 7 = PID 1 reference 8 = Motor potentiometer
P3.3.10	Preset frequency mode	0	1		0	182	0 = Binary coded 1 = Number of inputs. Preset frequency is selected according to how many of preset speed digital inputs are active
P3.3.11	Preset frequency 0	P3.3.1	P3.3.2	Hz	5.00	180	Basic preset frequency 0 when selected by Control reference parameter (P3.3.3).
P3.3.12	Preset frequency 1	P3.3.1	P3.3.2	Hz	10.00	105	Select with digital input: Preset frequency selection 0 (P3.5.1.16)
P3.3.13	Preset frequency 2	P3.3.1	P3.3.2	Hz	15.00	106	Select with digital input: Preset frequency selection 1 (P3.5.1.17)
P3.3.14	Preset frequency 3	P3.3.1	P3.3.2	Hz	20.00	126	Select with digital inputs: Preset frequency selection 0 & 1
P3.3.15	Preset frequency 4	P3.3.1	P3.3.2	Hz	25.00	127	Select with digital input: Preset frequency selection 2 (P3.5.1.18)
P3.3.16	Preset frequency 5	P3.3.1	P3.3.2	Hz	30.00	128	Select with digital inputs: Preset frequency selection 0 & 2
P3.3.17	Preset frequency 6	P3.3.1	P3.3.2	Hz	40.00	129	Select with digital inputs: Preset frequency selection 1 & 2
P3.3.18	Preset frequency 7	P3.3.1	P3.3.2	Hz	50.00	130	Select with digital inputs: Preset frequency selection 0 & 1 & 2
P3.3.19	Preset alarm frequency	P3.3.1	P3.3.2	Hz	25.00	183	This frequency used when fault response (in Group 3.9: Protections) is Alarm+preset frequency
P3.3.20	Motor potentiometer ramp time	0.1	500.0	Hz/s	10.0	331	Rate of change in the motor potentiometer reference when increased or decreased.
P3.3.21	Motor potentiometer reset	0	2		1	367	Motor potentiometer frequency reference reset logic. 0 = No reset 1 = Reset if stopped 2 = Reset if powered down

Table 42. Control reference settings

4.5.6 Group 3.4: Ramp & Brakes Setup

Two ramps are available (two sets of acceleration time, deceleration time and ramp shape). The second ramp can be activated by a frequency threshold or a digital input. **NOTE:** Ramp 2 always has higher priority and is used if a digital input for ramp selection is activated or Ramp 2 threshold is smaller than RampFreqOut.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.4.1	Ramp 1 shape	0.0	10.0	s	1.0	500	S-curve time ramp 1
P3.4.2	Acceleration time 1	0.1	3000.0	s	5.0	103	Defines the time required for the output frequency to increase from zero frequency to maximum frequency
P3.4.3	Deceleration time 1	0.1	3000.0	s	5.0	104	Defines the time required for the output frequency to decrease from maximum frequency to zero frequency
P3.4.4	Ramp 2 threshold	0.00	P3.3.2	Hz	0.00	526	Ramp 2 is activated when output frequency exceeds this limit (compared to frequency output from ramp generator). 0=Not in use. Ramp 2 can also be forced with a digital input.
P3.4.5	Ramp 2 shape	0.0	10.0	s	0.0	501	See P3.4.1.
P3.4.6	Acceleration time 2	0.1	3000.0	s	5.0	502	Second ramp which can be activated with a digital input or frequency threshold. See P3.4.2.
P3.4.7	Deceleration time 2	0.1	3000.0	s	5.0	503	Second ramp which can be activated with a digital input or frequency threshold. See P3.4.3.
P3.4.8	Ramp time optimizer	0	1		Varies	1808	0=Disable 1=Enable
P3.4.9	Ramp optimizing percentage	0.0	50.0	%	10.0	1809	Defines how big step changes in acceleration and deceleration times are allowed. 10.0% means that when running against the overvoltage controller at ramp down, the deceleration time is increased with 10.0% of the momentary value.
P3.4.10	Ramp optimizing max time	0.0	3000.0	s	Varies	1810	Ramp time optimizer does not increase the ramp over this limit.
P3.4.11	Start magnetizing time	0,00	600,00	s	0,00	516	This parameter defines the time for how long DC current is fed to motor before acceleration starts.
P3.4.12	Start magnetizing current	Varies	Varies	A	Varies	517	

P3.4.13	DC braking time at stop	0,00	600,00	s	0,00	508	Determines if braking is ON or OFF and the braking time of the DC-brake when the motor is stopping.
P3.4.14	DC brake current	Varies	Varies	A	Varies	507	Defines the current injected into the motor during DC-braking. 0 = Disabled
P3.4.15	Frequency to start DC braking at ramp stop	0,10	10,00	Hz	1,50	515	The output frequency at which the DC-braking is applied.
P3.4.16	Flux braking	0	1		0	520	0=Disabled 1=Enabled
P3.4.17	Flux braking current	0	Varies	A	Varies	519	Defines the current level for flux braking.

Table 43. Ramp and brakes setup

4.5.7 Group 3.5: I/O Configuration

4.5.7.1 Digital inputs

Digital inputs are very flexible to use. Parameters are functions that are connected to the required digital input terminal. The digital inputs are represented as, for example, *DigIN Slot A.2,* meaning the second input on slot A.

It is also possible to connect the digital inputs to time channels which are also represented as terminals.

Unless otherwise mentioned, all parameter functions are ON when the input is active (TRUE).

NOTE! The statuses of digital inputs and the digital output can be monitored in the Multimonitoring view, see chapter 4.4.1.
Default Settings can be made by using DigIIN Slot0.
Slot0.1= FALSE (=0V), Slot0.2 .... Slot0.9 = TRUE (=24VDC)

Index	Parameter	Default	ID	Description
P3.5.1.1	Control signal 1 A	DigIN SlotA.1	403	Start signal 1 when control place is I/O 1 (FWD)
P3.5.1.2	Control signal 2 A	DigIn SlotA.2	404	Start signal 2 when control place is I/O 1 (REV)
P3.5.1.3	Control signal 1 B	DigIN Slot0.1	423	Start signal 1 when control place is I/O B
P3.5.1.4	Control signal 2 B	DigIN Slot0.1	424	Start signal 2 when control place is I/O B
P3.5.1.5	I/O B control force	DigIN Slot0.1	425	TRUE = Force the control place to I/O B
P3.5.1.6	I/O B reference force	DigIN Slot0.1	343	TRUE = Used frequency reference is specified by I/O reference B parameter (P3.3.4).
P3.5.1.7	External fault close	DigIN SlotA.3	405	FALSE = OK TRUE = External fault
P3.5.1.8	External fault open	DigIN Slot0.2	406	FALSE = External fault TRUE = OK
P3.5.1.9	Fault reset	DigIN SlotA.6	414	Resets all active faults
P3.5.1.10	Run enable	DigIN Slot0.2	407	Must be on to set drive in Ready state
P3.5.1.11	Run interlock 1	DigIN Slot0.2	1041	Drive may be ready but start is blocked as long as interlock contact is not TRUE.
P3.5.1.12	Run interlock 2	DigIn Slot0.2	1042	As above.
P3.5.1.13	Acceleration/Deceleration	DigIN Slot0.1	408	Used for switching between ramps 1 and 2. FALSE=Ramp 1 shape, Acceleration time 1 and Deceleration time 1. TRUE=Ramp 2 shape, Acceleration time 2 and Deceleration time 2.
P3.5.1.14	Motor preheat ON	DigIN Slot0.1	1044	FALSE = No action TRUE = Uses the motor preheat DC-Current in Stop state Used when parameter P3.1.2.4 is set to 2.
P3.5.1.16	Preset Speed B0	DigIN SlotA.4	419	Binary selector for Preset frequencies (0-7). See page 58.
P3.5.1.17	Preset Speed B1	DigIN SlotA.5	420	Binary selector for Preset frequencies (0-7). See page 58.
P3.5.1.18	Preset Speed B2	DigIN Slot0.1	421	Binary selector for Preset frequencies (0-7). See page 58.
P3.5.1.19	Timer 1	DigIN Slot0.1	447	Rising edge starts Timer 1 programmed in Group 3.12: Timer functions parameter group
P3.5.1.20	Timer 2	DigIN Slot0.1	448	See above

P3.5.1.21	Timer 3	DigIN Slot0.1	449	See above
P3.5.1.22	PID1 setpoint boost	DigIN Slot0.1	1047	FALSE = No boost TRUE = Boost
P3.5.1.23	PID1 select setpoint	DigIN Slot0.1	1046	FALSE = Setpoint 1 TRUE = Setpoint 2
P3.5.1.24	PID2 start signal	DigIN Slot0.2	1049	FALSE = PID2 in stop mode TRUE = PID2 regulating This parameter will have no effect if PID2 controller is not enabled in the Basic menu for PID2
P3.5.1.25	PID2 select setpoint	DigIN Slot0.1	1048	FALSE = Setpoint 1 TRUE = Setpoint 2
P3.5.1.26	Motor 1 interlock	DigIn Slot0.2	426	FALSE = Not active TRUE = Active
P3.5.1.27	Motor 2 interlock	DigIN Slot0.1	427	FALSE = Not active TRUE = Active
P3.5.1.28	Motor 3 interlock	DigIN Slot0.1	428	FALSE = Not active TRUE = Active
P3.5.1.29	Motor 4 interlock	DigIN Slot0.1	429	FALSE = Not active TRUE = Active
P3.5.1.30	Interlock 5	DigIN Slot0.1	430	FALSE = Not active TRUE = Active
P3.5.1.31	Reset Maintenance counter 1	DigIN Slot0.1	490	TRUE = Reset
P3.5.1.32	Reset Maintenance counter 2	DigIN Slot0.1	491	TRUE = Reset
P3.5.1.33	Reset Maintenance counter 3	DigIN Slot0.1	492	TRUE = Reset
P3.5.1.36	Motor potentiometer UP	DigIN Slot0.1	418	FALSE = Not active TRUE = Active (Motor potentiometer reference INCREASES until the contact is opened)
P3.5.1.37	Motor potentiometer DOWN	DigIN Slot0.1	417	FALSE = Not active TRUE = Active (Motor potentiometer reference DECREASES until the contact is opened)
P3.5.1.38	FireMode PresetFreqSel0	DigIn Slot0.1	15531	Fire Mode prset frequency selection.
P3.5.1.39	FireMode PresetFreqSel1	DigIn Slot0.1	15532	Fire Mode preset frequency selection.

Table 44. Digital input settings

4.5.7.2 Analog inputs

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.5.2.1	AI1 signal selection				AnIN SlotA.1	377	Connect the AI1 signal to the analog input of your choice with this parameter. Programmable.
P3.5.2.2	AI1 signal filter time	0.00	300.00	s	0.1	378	Filter time for analog input
P3.5.2.3	AI1 signal range	0	1		0	379	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.4	AI1 custom. min	-160.00	160.00	%	0.00	380	Custom range min setting 20% = 4-20 mA/2-10 V
P3.5.2.5	AI1 custom. max	-160.00	160.00	%	100.00	381	Custom range max setting
P3.5.2.6	AI1 signal inversion	0	1		0	387	0 = Normal 1 = Signal inverted
P3.5.2.7	AI2 signal selection				AnIN SlotA.2	388	See P3.5.2.1.
P3.5.2.8	AI2 signal filter time	0.00	300.00	s	0.1	389	See P3.5.2.2.
P3.5.2.9	AI2 signal range	0	1		1	390	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.10	AI2 custom. min	-160.00	160.00	%	0.00	391	See P3.5.2.4.
P3.5.2.11	AI2 custom. max	-160.00	160.00	%	100.00	392	See P3.5.2.5.
P3.5.2.12	AI2 signal inversion	0	1		0	398	See P3.5.2.6.
P3.5.2.13	AI3 signal selection				AnIN Slot0.1	141	Connect the AI3 signal to the analog input of your choice with this parameter. Programmable.
P3.5.2.14	AI3 signal filter time	0.00	300.00	s	0.1	142	Filter time for analog input
P3.5.2.15	AI3 signal range	0	1		0	143	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.16	AI3 custom. min	-160.00	160.00	%	0.00	144	20% = 4-20 mA/2-10 V
P3.5.2.17	AI3 custom. max	-160.00	160.00	%	100.00	145	Custom range max setting
P3.5.2.18	AI3 signal inversion	0	1		0	151	0 = Normal 1 = Signal inverted
P3.5.2.19	AI4 signal selection				AnIN Slot0.1	152	See P3.5.2.13. Programmable.
P3.5.2.20	AI4 signal filter time	0.00	300.00	s	0.1	153	See P3.5.2.14.
P3.5.2.21	AI4 signal range	0	1		0	154	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.22	AI4 custom. min	-160.00	160.00	%	0.00	155	See P3.5.2.16.
P3.5.2.23	AI4 custom. max	-160.00	160.00	%	100.00	156	See P3.5.2.17.
P3.5.2.24	AI4 signal inversion	0	1		0	162	See P3.5.2.18.
P3.5.2.25	AI5 signal selection				AnIN Slot0.1	188	Connect the AI5 signal to the analog input of your choice with this parameter. Programmable.
P3.5.2.26	AI5 signal filter time	0.00	300.00	s	0.1	189	Filter time for analog input
P3.5.2.27	AI5 signal range	0	1		0	190	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.28	AI5 custom. min	-160.00	160.00	%	0.00	191	20% = 4-20 mA/2-10 V
P3.5.2.29	AI5 custom. max	-160.00	160.00	%	100.00	192	Custom range max setting

P3.5.2.30	AI5 signal inversion	0	1		0	198	0 = Normal 1 = Signal inverted
P3.5.2.31	AI6 signal selection				AnIN Slot0.1	199	See P3.5.2.13. Programmable.
P3.5.2.32	AI6 signal filter time	0.00	300.00	s	0.1	200	See P3.5.2.14.
P3.5.2.33	AI6 signal range	0	1		0	201	0 = 0…10V / 0…20mA 1 = 2…10V / 4…20mA
P3.5.2.34	AI6 custom. min	-160.00	160.00	%	0.00	202	See P3.5.2.16.
P3.5.2.35	AI6 custom. max	-160.00	160.00	%	100.00	203	See P3.5.2.17.
P3.5.2.36	AI6 signal inversion	0	1		0	209	See P3.5.2.18.

Table 45. Analog input settings

4.5.7.3 Digital outputs, slot B (Basic)

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.5.3.2.1	Basic RO1 function	0	36		2	11001	Function selection for Basic R01: 0 = None 1 = Ready 2 = Run 3 = General fault 4 = General fault inverted 5 = General alarm 6 = Reversed 7 = At speed 8 = Motor regulator active 9 = Preset speed active 10 = Keypad control active 11 = I/O B control activated 12 = Limit supervision 1 13 = Limit supervision 2 14 = Start signal active 15 = Reserved 16 = Fire Mode activation 17 = RTC time chnl 1 control 18 = RTC time chnl 2 control 19 = RTC time chnl 3 control 20 = FB ControlWord B13 21 = FB ControlWord B14 22 = FB ControlWord B15 23 = PID1 in Sleep mode 24 = Reserved 25 = PID1 supervision limits 26 = PID2 supervision limits 27 = Motor 1 control 28 = Motor 2 control 29 = Motor 3 control 30 = Motor 4 control 31 = Motor 5 control 32 = Reserved (Always open) 33 = Reserved (Always open) 34 = Maintenance alarm 35 = Maintenance fault 36 = Thermistor fault 37 = Motor Switch
P3.5.3.2.2	Basic R01 ON delay	0.00	320.00	s	0.00	11002	ON delay for relay
P3.5.3.2.3	Basic R01 OFF delay	0.00	320.00	s	0.00	11003	OFF delay for relay
P3.5.3.2.4	Basic R02 function	0	39		3	11004	See P3.5.3.2.1
P3.5.3.2.5	Basic R02 ON delay	0.00	320.00	s	0.00	11005	See P3.5.3.2.2.
P3.5.3.2.6	Basic R02 OFF delay	0.00	320.00	s	0.00	11006	See P3.5.3.2.3.
P3.5.3.2.7	Basic R03 function	0	39		1	11007	See P3.5.3.2.1. Not visible if only 2 output relays are installed

Table 46. Digital output settings on basic I/O board

4.5.7.4 Expander slots D and E digital outputs

Index	Parameter	Min	Max	Unit	Default	ID	Description
	Application dynamic output list						Shows only parameters for existing outputs in slot D/E. Selections as in Basic R01 Not visible if no digital output exists in slot D/E.

Table 47. Slot D/E digital outputs

4.5.7.5 Analog outputs, Slot A (Basic)

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.5.4.1.1	AO1 function	0	19		2	10050	0=TEST 0% (Not used) 1=TEST 100% 2=Output freq (0 -fmax) 3=Freq reference (0-fmax) 4=Motor speed (0 - Motor nominal speed) 5=Output current (0-I_{nMotor}) 6=Motor torque (0-T_{nMotor}) 7=Motor power (0-P_{nMotor}) 8=Motor voltage (0-U_{nMotor}) 9=DC link voltage (0-1000V) 10=PID1 output (0-100%) 11=PID2 output (0-100%) 12=ProcessDataIn1 13=ProcessDataIn2 14=ProcessDataIn3 15=ProcessDataIn4 16=ProcessDataIn5 17=ProcessDataIn6 18=ProcessDataIn7 19=ProcessDataIn8 **NOTE:** For ProcessDataIn, e.g. value 5000 = 50.00%
P3.5.4.1.2	AO1 filter time	0.00	300.00	s	1.00	10051	Filtering time of analog output signal. See P3.5.2.2 0 = No filtering
P3.5.4.1.3	AO1 minimum	0	1		0	10052	0 = 0 mA / 0V 1 = 4 mA / 2V Note the difference in analog output scaling in parameter P3.5.4.1.4.
P3.5.4.1.4	AO1 minimum scale	Varies	Varies	Varies	0.0	10053	Min scale in process unit (depends on selection of AO1 function)
P3.5.4.1.5	AO1 maximum scale	Varies	Varies	Varies	0.0	10054	Max scale in process unit (depends on selection of AO1 function)

Table 48. Basic I/O board analog output settings

4.5.7.6 Expander slots D to E analog outputs

Index	Parameter	Min	Max	Unit	Default	ID	Description
	Application dynamic output list						Shows only parameters for existing outputs in slot D/E. Selections as in Basic AO1 Not visible if no analog output exists in slot D/E.

Table 49. Slot D/E analog outputs

4.5.8 Group 3.6: Fieldbus Data Mapping

The fieldbus data mapping is used in some communication protocols. Please read the fieldbus manuals for more details.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.6.1	Fieldbus data out 1 selection	0	35000		1	852	Data sent to fieldbus can be chosen with parameter and monitor value ID numbers. The data is scaled to unsigned 16-bit format according to the format on keypad. E.g. 25.5 on keypad equals 255.
P3.6.2	Fieldbus data out 2 selection	0	35000		2	853	Select Process Data Out with parameter ID
P3.6.3	Fieldbus data out 3 selection	0	35000		3	854	Select Process Data Out with parameter ID
P3.6.4	Fieldbus data out 4 selection	0	35000		4	855	Select Process Data Out with parameter ID
P3.6.5	Fieldbus data out 5 selection	0	35000		5	856	Select Process Data Out with parameter ID
P3.6.6	Fieldbus data out 6 selection	0	35000		6	857	Select Process Data Out with parameter ID
P3.6.7	Fieldbus data out 7 selection	0	35000		7	858	Select Process Data Out with parameter ID
P3.6.8	Fieldbus data out 8 selection	0	35000		37	859	Select Process Data Out with parameter ID

Table 50. Fieldbus data mapping

Fieldbus process data out

Values to monitor through fieldbus are:

Data	Value	Scale
Process Data Out 1	Output frequency	0.01 Hz
Process Data Out 2	Motor speed	1 rpm
Process Data Out 3	Motor current	0.1 A
Process Data Out 4	Motor torque	0.1 %
Process Data Out 5	Motor power	0.1 %
Process Data Out 6	Motor voltage	0.1 V
Process Data Out 7	DC-link voltage	1 V
Process Data Out 8	Last active fault code	

Table 51. Fieldbus Process Data Out

4.5.9 Group 3.7: Prohibit Frequencies

In some systems it may be necessary to avoid certain frequencies due to mechanical resonance problems. By setting up prohibit frequencies it is possible to skip these ranges.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.7.1	Prohibit frequency range 1 low limit	-1	320	Hz	0	509	0 = Not used
P3.7.2	Prohibit frequency range 1 high limit	0	320	Hz	0	510	0 = Not used
P3.7.3	Prohibit frequency range 2 low limit	0	320	Hz	0	511	0 = Not used
P3.7.4	Prohibit frequency range 2 high limit	0	320	Hz	0	512	0 = Not used
P3.7.5	Prohibit frequency range 3 low limit	0	320	Hz	0	513	0 = Not used
P3.7.6	Prohibit frequency range 3 high limit	0	320	Hz	0	514	0 = Not used
P3.7.7	Ramp time factor	0.1	10	Times	1	518	Multiplier of the currently selected ramp time between prohibit frequency limits.
P3.7.8	Resonance sweep ramp	0.1	3000	s	60	1812	How fast the resonance sweep should sweep through the frequency range.
P3.7.9	Resonance sweep	0	1		0	1811	0 = Inactive 1 = Activate

Table 52. Prohibit frequencies

4.5.10 Group 3.8: Limit supervisions

The limit supervision can be used to activate the relay outputs (P3.5.3.2.ff). The relays are linked with the setting "12 LimSuperv1" and with the setting "13 LimSuperv2".

Choose here:

1. One or two (P3.8.1/P3.8.5) signal values for supervision.
2. Whether the low or high limits are supervised (P3.8.2/P3.8.6)
3. The actual limit values (P3.8.3/P3.8.7).
4. The hystereses for the set limit values (P3.8.4/P3.8.8).

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.8.1	Supervision #1 item selection	0	7		0	1431	0 = Output frequency 1 = Frequency reference 2 = Motor current 3 = Motor torque 4 = Motor power 5 = DC-link voltage 6 = Analog input 1 7 = Analog input 2
P3.8.2	Supervision #1 mode	0	2		0	1432	0 = Not used 1 = Low limit supervision (output active over limit) 2 = High limit supervision (output active under limit)
P3.8.3	Supervision #1 limit	-200.000	200.000	Varies	25.00	1433	Supervision limit for selected item. Unit appears automatically.
P3.8.4	Supervision #1 limit hysteresis	-200.000	200.000	Varies	5.00	1434	Supervision limit hysteresis for selected item. Unit is set automatically.
P3.8.5	Supervision #2 item selection	0	7		1	1435	See P3.8.1
P3.8.6	Supervision #2 mode	0	2		0	1436	See P3.8.2
P3.8.7	Supervision #2 limit	-200.000	200.000	Varies	40.00	1437	See P3.8.3
P3.8.8	Supervision #2 limit hysteresis	-200.000	200.000	Varies	5.00	1438	See P3.8.4

Table 53. Limits supervision settings

4.5.11 Group 3.9: Protections

Parameters of motor thermal protection (P3.9.6 to P3.9.10)

The motor thermal protection is to protect the motor from overheating. The drive is capable of supplying higher than nominal current to the motor. If the load requires this high current there is a risk that the motor will be thermally overloaded. This is the case especially at low frequencies. At low frequencies the cooling effect of the motor is reduced as well as its capacity. If the motor is equipped with an external fan the load reduction at low speeds is small.

The motor thermal protection is based on a calculated model and it uses the output current of the drive to determine the load on the motor.

The motor thermal protection can be adjusted with parameters. The thermal current I_T specifies the load current above which the motor is overloaded. This current limit is a function of the output frequency.

The thermal stage of the motor can be monitored on the control keypad display. See chapter 4.4.

	If you use long motor cables (max. 100m / 328 ft) together with small drives (≤1.5 kW / 2.0 HP) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.
	The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill. If the control board is powered off, the model is initialised based on the value which had been calculated before the power off (memory functionality).

Parameters of Stall protection (P3.9.11 to P3.9.14)

The motor stall protection protects the motor from short time overload situations such as one caused by a stalled shaft. The reaction time of the stall protection can be set shorter than that of motor thermal protection. The stall state is defined with two parameters, P3.9.12 (*Stall current*) and P3.9.14 (*Stall frequency limit*). If the current is higher than the set limit and the output frequency is lower than the set limit the stall state is true. There is actually no real indication of the shaft rotation. Stall protection is a type of overcurrent protection.

	If you use long motor cables (max. 100m / 328 ft) together with small drives (≤1.5 kW / 2.0 HP) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Con-sider this when setting up the motor thermal protection functions.

Parameters of Underload protection (P3.9.15 to P3.9.18)

The purpose of the motor underload protection is to ensure that there is load on the motor when the drive is running. If the motor loses its load there might be a problem in the process, e.g. a broken belt or a dry pump.

Motor underload protection can be adjusted by setting the underload curve with parameters P3.9.16 (*Underload protection: Field weakening area load*) and P3.9.17 (*Underload protection: Zero frequency load*), see below. The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5Hz (the underload time counter is stopped).

The torque values for setting the underload curve are set in percentage which refers to the nominal torque of the motor. The motor's name plate data, parameter motor nominal current and the drive's nominal current I_H are used to find the scaling ratio for the internal torque value. If other than nominal motor is used with the drive, the accuracy of the torque calculation decreases.

If you use long motor cables (max. 100m / 328 ft) together with small drives (≤1.5 kW / 2.0 HP) the motor current measured by the drive can be much higher than the actual motor current due to capacitive currents in the motor cable. Consider this when setting up the motor thermal protection functions.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.9.1	AI low fault	0	5		0	700	0=No action 1=Alarm 2=Alarm, preset freq 3=Alarm, previous freq 4=Fault 5=Fault, coast
P3.9.2	Response to external fault	0	3		2	701	0 = No action 1 = Alarm 2 = Fault (Stop according to stop mode) 3 = Fault (Stop by coasting)
P3.9.3	Response to Input phase fault	0	1		0	730	Select the supply phase configuration. The input phase supervision ensures that the input phases of the frequency converter have an approximately equal current. 0 = 3 Phase support 1 = 1 Phase support
P3.9.4	Undervoltage fault	0	1		0	727	0 = Fault stored in history 1 = Fault not stored in history
P3.9.5	Response to output phase fault	0	3		2	702	See P3.9.2
P3.9.6	Motor thermal protection	0	3		2	704	See P3.9.2
P3.9.7	Motor ambient temperature factor	-20.0	100.0	°C	40.0	705	Ambient temperature in °C
P3.9.8	Motor thermal zero speed cooling	5.0	150.0	%	Varies	706	Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling.
P3.9.9	Motor thermal time constant	1	200	min	Varies	707	The time constant is the time within which the calculated thermal stage has reached 63% of its final value.
P3.9.10	Motor thermal loadibility factor	0	150	%	100	708	
P3.9.11	Motor stall fault	0	3		0	709	See P3.9.2
P3.9.12	Stall current	0.00	$2*I_H$	A	I_H	710	For a stall stage to occur, the current must have exceeded this limit.

P3.9.13	Stall time limit	1.00	120.00	s	15.00	711	This is the maximum time allowed for a stall stage.
P3.9.14	Stall frequency limit	1.00	P3.3.2	Hz	25.00	712	For a stall state to occur, the output frequency must have remained below this limit for a certain time.
P3.9.15	Underload fault (broken belt/dry pump)	0	3		0	713	See P3.9.2
P3.9.16	Underload protection: Field weakening area load	10.0	150.0	%	50.0	714	This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point.
P3.9.17	Underload protection: Zero frequency load	5.0	150.0	%	10.0	715	This parameter gives value for the minimum torque allowed with zero frequency. If you change the value of parameter P3.1.1.4 this parameter is automatically restored to the default value.
P3.9.18	Underload protection: Time limit	2.00	600.00	s	20.00	716	This is the maximum time allowed for an underload state to exist.
P3.9.19	Response to Fieldbus communication fault	0	4		3	733	See P3.9.1
P3.9.20	Slot communication fault	0	3		2	734	See P3.9.2
P3.9.21	Thermistor fault	0	3		0	732	See P3.9.2
P3.9.22	Soft fill timeout	0	3		2	748	See P3.9.2
P3.9.23	Response to PID1 supervision fault	0	3		2	749	See P3.9.2
P3.9.24	Response to PID2 supervision fault	0	3		2	757	See P3.9.2
P3.9.25	Temperature fault signal	0	6			739	0 = Not Used 1 = TempInput 1 2 = TempInput 2 3 = TempInput 3 4 = TempInput 1-2 5 = TempInput 2-3 6 = TempInput 1-3
P3.9.26	TempAlarm Limit	-30.0	200.0	°C/°F		741	Temperature for triggering an alarm.
P3.9.27	TempFault Limit	-30.0	200.0	°C/°F		742	Temperature for triggering a fault.
P3.9.28	Temperature fault response	0	200.03			740	0 = No action 1 = Alarm 2 = Fault 3 = Fault, coast

Table 54. Protections settings

4.5.12 Group 3.10: Automatic reset

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.10.1	Automatic reset	0	1		0	731	0 = Disabled 1 = Enabled
P3.10.2	Restart function	0	1		1	719	The start mode for Automatic reset is selected with this parameter: 0 = Flying start 1 = According to par. P3.2.4
P3.10.3	Wait time	0,10	10000,0	s	0,50	717	Wait time before the first reset is executed.
P3.10.4	Automatic reset: Trial time	0,00	10000,0	s	60,00	718	When the trial time has elapsed, and the fault is still active, the drive will trip to fault.
P3.10.5	Number of trials	1	10		4	759	NOTE: Total number of trials (irrespective of fault type)
P3.10.6	Autoreset: Undervoltage	0	1		1	720	Autoreset permitted? 0 = No 1 = Yes
P3.10.7	Autoreset: Overvoltage	0	1		1	721	Autoreset permitted? 0 = No 1 = Yes
P3.10.8	Autoreset: Overcurrent	0	1		1	722	Autoreset permitted? 0 = No 1 = Yes
P3.10.9	Autoreset: AI low	0	1		1	723	Autoreset permitted? 0 = No 1 = Yes
P3.10.10	Autoreset: Unit over-temperature	0	1		1	724	Autoreset permitted? 0 = No 1 = Yes
P3.10.11	Autoreset: Motor over-temperature	0	1		1	725	Autoreset permitted? 0 = No 1 = Yes
P3.10.12	Autoreset: External fault	0	1		0	726	Autoreset permitted? 0 = No 1 = Yes
P3.10.13	Autoreset: Underload fault	0	1		0	738	Autoreset permitted? 0 = No 1 = Yes

Table 55. Autoreset settings

4.5.13 Group 3.11: Application Settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
M3.11.1	C°/F° selection	0	1		0	1197	0 = C° 1 = F°
M3.11.2	kW/HP selection	0	1		0	1198	0 = kW 1 = HP

Table 56. Application settings

4.5.14 Group 3.12: Timer functions

The functions of this parameter group can be made the fullest advantage of if the Real Time . Clock settings have been properly made in Parameters P5.5.ff.

You can program up to five incidents to take place between set points of time (*Intervals*) and additionally three timer-based functions to last for a set period of time.

Intervals and Timers are assigned to the three available *Time Channels* .

Example of programming: You want to apply *Preset frequency 1* **(M3.3.11, set to use with parameter M3.5.1.15,** *Preset frequency selection 0***) Mondays, from 08:00 until 16:00 hrs .**

1. Set the parameters for *Interval 1* **(3.12.1):**
M3.12.1.3: *From day*: '**1**' (=Monday)
M3.12.1.1: *ON time*: '**0800**'

M3.12.1.2: *OFF time*: '**1600**'
M3.12.1.4: *To day*: '**1**' (=Monday)

M3.12.1.5: *Assign to channel*: '**1**' (= Time Channel 1)

2. Then assign the selected Time channel to a digital input using the programming method described in chapter 4.5.2.
Go to menu *Parameters* (M3), further down to menu *I/O config* (M3.5) and *Digital inputs* (M3.5.1). Locate the parameter *Preset frequency selection 0* (M3.5.1.15). Change the value of this parameter to *TimeChannel.1*.

Now the function *Preset frequency selection 0* is activated at 08:00 on Monday and deactivated at 16:00 the same day.

The status of the Intervals and Time channels can be monitored in Menu M2.3.

Index	Parameter	Min	Max	Unit	Default	ID	Description
3.12.1 INTERVAL 1							
P3.12.1.1	ON time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1464	ON time
P3.12.1.2	OFF time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1465	OFF time
P3.12.1.3	From day	0	6		0	1466	ON day of week 0=Sunday 1=Monday 2=Tuesday 3=Wednesday 4=Thursday 5=Friday 6=Saturday
P3.12.1.4	To day	0	6		0	1467	See above
P3.12.1.5	Assign to channel	0	3		0	1468	Select affected time channel (1-3) 0=Not used 1=Time channel 1 2=Time channel 2 3=Time channel 3
3.12.2 INTERVAL 2							
P3.12.2.1	ON time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1469	See Interval 1
P3.12.2.2	OFF time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1470	See Interval 1
P3.12.2.3	From day	0	6		0	1471	See Interval 1

P3.12.2.4	To day	0	6		0	1472	See Interval 1
P3.12.2.5	Assign to channel	0	3		0	1473	See Interval 1
3.12.3 INTERVAL 3							
P3.12.3.1	ON time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1474	See Interval 1
P3.12.3.2	OFF time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1475	See Interval 1
P3.12.3.3	From day	0	6		0	1476	See Interval 1
P3.12.3.4	To day	0	6		0	1477	See Interval 1
P3.12.3.5	Assign to channel	0	3		0	1478	See Interval 1
3.12.4 INTERVAL 4							
P3.12.4.1	ON time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1479	See Interval 1
P3.12.4.2	OFF time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1480	See Interval 1
P3.12.4.3	From day	0	6		0	1481	See Interval 1
P3.12.4.4	To day	0	6		0	1482	See Interval 1
P3.12.4.5	Assign to channel	0	3		0	1483	See Interval 1
3.12.5 INTERVAL 5							
P3.12.5.1	ON time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1484	See Interval 1
P3.12.5.2	OFF time	00:00:00	23:59:59	hh:mm:ss	00:00:00	1485	See Interval 1
P3.12.5.3	From day	0	6		0	1486	See Interval 1
P3.12.5.4	To day	0	6		0	1487	See Interval 1
P3.12.5.5	Assign to channel	0	3		0	1488	See Interval 1
3.12.6 TIMER 1							
P3.12.6.1	Duration	0	72000	s	0	1489	The time the timer will run when activated. (Activated by DI)
P3.12.6.2	Assign to channel	0	3		0	1490	Select affected time channel (1-3) 0=Not used 1=Time channel 1 2=Time channel 2 3=Time channel 3
3.12.7 TIMER 2							
P3.12.7.1	Duration	0	72000	s	0	1491	See Timer 1
P3.12.7.2	Assign to channel	0	3		0	1492	See Timer 1
3.12.8 TIMER 3							
P3.12.8.1	Duration	0	72000	s	0	1493	See Timer 1
P3.12.8.2	Assign to channel	0	3		0	1494	See Timer 1

Table 57. Timer functions

4.5.15 Group 3.13: PID-controller 1

4.5.15.1 Basic settings

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.1.1	PID gain	0.00	1000.00	%	100.00	118	If the value of the parameter is set to 100% a change of 10% in the error value causes the controller output to change by 10%.
P3.13.1.2	PID integration time	0.00	600.00	s	1.00	119	If this parameter is set to 1,00 second a change of 10% in the error value causes the controller output to change by 10.00%/s.
P3.13.1.3	PID derivation time	0.00	100.00	s	0.00	132	If this parameter is set to 1,00 second a change of 10% in the error value during 1.00 s causes the controller output to change by 10.00%.
P3.13.1.4	Process unit selection	1	38		1	1036	Select unit for actual value.
P3.13.1.5	Process unit min	Varies	Varies	Varies	0	1033	
P3.13.1.6	Process unit max	Varies	Varies	Varies	100	1034	
P3.13.1.7	Process unit decimals	0	4		2	1035	Number of decimals for process unit value
P3.13.1.8	Error inversion	0	1		0	340	0 = Normal (Feedback < Setpoint -> Increase PID output) 1 = Inverted (Feedback < Setpoint -> Decrease PID output)
P3.13.1.9	Dead band hysteresis	Varies	Varies	Varies	0	1056	Dead band area around the setpoint in process units.The PID output is locked if the feedback stays within the deadband area for a predefined time.
P3.13.1.10	Dead band delay	0.00	320.00	s	0.00	1057	If the feedback stays within the dead band area for a predefined time, the output is locked.

Table 58.

4.5.15.2 Setpoints

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.2.1	Keypad setpoint 1	Varies	Varies	Varies	0	167	
P3.13.2.2	Keypad setpoint 2	Varies	Varies	Varies	0	168	
P3.13.2.3	Setpoint ramp time	0.00	300.0	s	0.00	1068	Defines the rising and falling ramp times for setpoint changes. (Time to change from minimum to maximum)
P3.13.2.4	Setpoint source 1 selection	0	16		1	332	0 = Not used 1 = Keypad setpoint 1 2 = Keypad setpoint 2 3 = AI1 4 = AI2 5 = AI3 6 = AI4 7 = AI5 8 = AI6 9 = ProcessDataIn1 10 = ProcessDataIn2 11 = ProcessDataIn3 12 = ProcessDataIn4 13 = ProcessDataIn5 14 = ProcessDataIn6 15 = ProcessDataIn7 16 = ProcessDataIn8 17 = Temp.Input 1 18 = Temp.Input 2 19 = Temp.Input 3 AI's, ProcessDataIn and Temp.input are handled as percent (0.00-100.00%) and scaled according to Setpoint minimum and maximum. **NOTE:** ProcessDataIn use two decimals.
P3.13.2.5	Setpoint 1 minimum	-200.00	200.00	%	0.00	1069	Minimum value at analog signal minimum.
P3.13.2.6	Setpoint 1 maximum	-200.00	200.00	%	100.00	1070	Maximum value at analog signal maximum.
P3.13.2.7	Sleep frequency limit 1	0.00	320.00	Hz	0.00	1016	Drive goes to sleep mode when the output frequency stays below this limit for a time greater than that defined by parameter *Sleep delay*.
P3.13.2.8	Sleep delay 1	0	3000	s	0	1017	The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped.
P3.13.2.9	Wake-up level 1			Varies	0.0000	1018	Defines the level for the PID feedback value wake-up supervision. Uses selected process units.
P3.13.2.10	Setpoint 1 boost	-2.0	2.0	x	1.0	1071	The setpoint can be boosted with a digital input.
P3.13.2.11	Setpoint source 2 selection	0	16		2	431	See par. P3.13.2.4

P3.13.2.12	Setpoint 2 minimum	-200.00	200.00	%	0.00	1073	Minimum value at analog signal minimum.
P3.13.2.13	Setpoint 2 maximum	-200.00	200.00	%	100.00	1074	Maximum value at analog signal maximum.
P3.13.2.14	Sleep frequency limit 2	0.00	320.00	Hz	0.00	1075	See P3.13.2.7.
P3.13.2.15	Sleep delay 2	0	3000	s	0	1076	See P3.13.2.8.
P3.13.2.16	Wake-up level 2			Varies	0.0000	1077	See P3.13.2.9.
P3.13.2.17	Setpoint 2 boost	-2.0	2.0	x	1.0	1078	See P3.13.2.10.

Table 59.

4.5.15.3 Feedbacks

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.3.1	Feedback function	1	9		1	333	1=Only Source1 in use 2=SQRT(Source1);(Flow=Constant x SQRT(Pressure)) 3=SQRT(Source1- Source 2) 4=SQRT(Source 1) + SQRT (Source 2) 5=Source 1 + Source 2 6=Source 1 - Source 2 7=MIN (Source 1, Source 2) 8=MAX (Source 1, Source 2) 9=MEAN (Source1, Source2)
P3.13.3.2	Feedback function gain	-1000.0	1000.0	%	100.0	1058	Used e.g. with selection 2 in *Feedback function*
P3.13.3.3	Feedback 1 source selection	0	14		2	334	0 = Not used 1 = AI1 2 = AI2 3 = AI3 4 = AI4 5 = AI5 6 = AI6 7 = ProcessDataIn1 8 = ProcessDataIn2 9 = ProcessDataIn3 10 = ProcessDataIn4 11 = ProcessDataIn5 12 = ProcessDataIn6 13 = ProcessDataIn7 14 = ProcessDataIn8 15 = Temp.Input 1 16 = Temp.Input 2 17 = Temp.Input 3 AI's, ProcessDataIn and Temp.input are handled as % (0.00-100.00%) and scaled according to Feedback min and max. **NOTE:** ProcessDataIn use two decimals.
P3.13.3.4	Feedback 1 minimum	-200.00	200.00	%	0.00	336	Minimum value at analog signal minimum.
P3.13.3.5	Feedback 1 maximum	-200.00	200.00	%	100.00	337	Maximum value at analog signal maximum.
P3.13.3.6	Feedback 2 source selection	0	14		0	335	See P3.13.3.3
P3.13.3.7	Feedback 2 minimum	-200.00	200.00	%	0.00	338	Minimum value at analog signal minimum.
P3.13.3.8	Feedback 2 maximum	-200.00	200.00	%	100.00	339	Maximum value at analog signal maximum.

Table 60.

4.5.15.4 Feedforward

Feedforward usually needs accurate process models, but in some simple cases a gain + offset type of feedforward is enough. The feedforward part does not use any feedback measurements of the actual controlled process value (water level in the example on page 113). Feedforward control uses other measurements which are indirectly affecting the controlled process value.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.4.1	Feedforward function	1	9		1	1059	See P3.13.3.1.
P3.13.4.2	Feedforward function gain	-1000	1000	%	100.0	1060	See P3.13.3.2
P3.13.4.3	Feedforward 1 source selection	0	14		0	1061	See P3.13.3.3
P3.13.4.4	Feedforward 1 minimum	-200.00	200.00	%	0.00	1062	See P3.13.3.4
P3.13.4.5	Feedforward 1 maximum	-200.00	200.00	%	100.00	1063	See P3.13.3.5
P3.13.4.6	Feedforward 2 source selection	0	14		0	1064	See P3.13.3.6
P3.13.4.7	Feedforward 2 min	-200.00	200.00	%	0.00	1065	See P3.13.3.7
P3.13.4.8	Feedforward 2 max	-200.00	200.00	%	100.00	1066	See P3.13.3.8

Table 61.

4.5.15.5 Process supervision

Process supervision is used to control that the actual value stays within predefined limits. With this function you can e.g. detect a major pipe burst and stop unnecessary flooding. See more on page 114.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.5.1	Enable process supervision	0	1		0	735	0 = Disabled 1 = Enabled
P3.13.5.2	Upper limit	Varies	Varies	Varies	Varies	736	Upper actual/process value supervision
P3.13.5.3	Lower limit	Varies	Varies	Varies	Varies	758	Lower actual/process value supervision
P3.13.5.4	Delay	0	30000	s	0	737	If the desired value is not reached within this time a fault or alarm is created.

Table 62.

4.5.15.6 Pressure loss compensation

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.6.1	Enable setpoint 1	0	1		0	1189	Enables pressure loss compensation for setpoint 1. 0 = Disabled 1 = Enabled
P3.13.6.2	Setpoint 1 max compensation	Varies	Varies	Varies	Varies	1190	Value added proportionally to the frequency. Setpoint compensation = Max compensation * (FreqOut-MinFreq)/(MaxFreq-MinFreq)
P3.13.6.3	Enable setpoint 2	0	1		0	1191	See P3.13.6.1.
P3.13.6.4	Setpoint 2 max compensation	Varies	Varies	Varies	Varies	1192	See P3.13.6.2.

Table 63.

4.5.15.7 PID1 Soft Fill

The Soft Fill function is used, for example, to avoid pressure pikes, the so-called "water hammers" in pipes when the drive starts to regulate. If not controlled, these spikes might lead to damaged pipes. See more information on page 117.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.13.7.1	Enable soft fill	0	1		0	1094	0=Disable 1=Enable
P3.13.7.2	Soft fill frequency	P3.3.1	P3.3.2	Hz	0.00	1055	The drive accelerates to this frequency before starting to control.
P3.13.7.3	Soft fill level	0	Varies	Varies	0.0000	1095	The drive runs at the Soft Fill frequency until the feedback reaches this value. When reached, the controller starts to regulate.
P3.13.7.4	Soft fill timeout	0	30000	s	0	1096	If the desired value is not reached within this time, fault or alarm is triggered (leaking pipe alarm). 0=No timeout used

Table 64. PID1 Soft fill parameters

4.5.16 Group 3.14: PID-controller 2

4.5.16.1 Basic settings

For more detailed information, see chapter 4.5.15.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.14.1.1	Enable PID	0	1		0	1630	0 = Disabled 1 = Enabled
P3.14.1.2	Output in Stop	0.0	100.0	%	0.0	1100	The output value of the PID controller in % of its maximum output value while it is stopped from digital input
P3.14.1.3	PID gain	0.00	1000.00	%	100.00	1631	
P3.14.1.4	PID integration time	0.00	600.00	s	1.00	1632	
P3.14.1.5	PID derivation time	0.00	100.00	s	0.00	1633	
P3.14.1.6	Process unit selection	0	40		1	1635	
P3.14.1.7	Process unit min	Varies	Varies	Varies	0	1664	
P3.14.1.8	Process unit max	Varies	Varies	Varies	100	1665	
P3.14.1.9	Process unit decimals	0	4		2	1666	
P3.14.1.10	Error inversion	0	1		0	1636	
P3.14.1.11	Dead band hysteresis	Varies	Varies	Varies	0.0	1637	
P3.14.1.12	Dead band delay	0.00	320.00	s	0.00	1638	

Table 65.

4.5.16.2 Setpoints

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.14.2.1	Keypad setpoint 1	0.00	100.00	Varies	0.00	1640	
P3.14.2.2	Keypad setpoint 2	0.00	100.00	Varies	0.00	1641	
P3.14.2.3	Setpoint ramp time	0.00	300.00	s	0.00	1642	
P3.14.2.4	Setpoint source 1 selection	0	16		1	1643	See P3.14.2.4
P3.14.2.5	Setpoint 1 minimum	-200.00	200.00	%	0.00	1644	Minimum value at analog signal minimum.
P3.14.2.6	Setpoint 1 maximum	-200.00	200.00	%	100.00	1645	Maximum value at analog signal maximum.
P3.14.2.7	Setpoint source 2 selection	0	16		0	1646	See P3.14.2.4.
P3.14.2.8	Setpoint 2 minimum	-200.00	200.00	%	0.00	1647	Minimum value at analog signal minimum.
P3.14.2.9	Setpoint 2 maximum	-200.00	200.00	%	100.00	1648	Maximum value at analog signal maximum.

Table 66.

4.5.16.3 Feedback

For more detailed information, see chapter 4.5.15.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.14.3.1	Feedback function	1	9		1	1650	
P3.14.3.2	Feedback function gain	-1000.0	1000.0	%	100.0	1651	
P3.14.3.3	Feedback 1 source selection	0	14		1	1652	See P3.14.3.3
P3.14.3.4	Feedback 1 minimum	-200.00	200.00	%	0.00	1653	Minimum value at analog signal minimum.
P3.14.3.5	Feedback 1 maximum	-200.00	200.00	%	100.00	1654	Maximum value at analog signal maximum.
P3.14.3.6	Feedback 2 source selection	0	14		2	1655	See 3.14.3.3
P3.14.3.7	Feedback 2 minimum	-200.00	200.00	%	0.00	1656	Minimum value at analog signal minimum.
P3.14.3.8	Feedback 2 maximum	-200.00	200.00	%	100.00	1657	Maximum value at analog signal maximum.

Table 67.

4.5.16.4 Process supervision

For more detailed information, see chapter 4.5.15.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.14.4.1	Enable supervision	0	1		0	1659	0 = Disabled 1 = Enabled
P3.14.4.2	Upper limit	Varies	Varies	Varies	Varies	1660	
P3.14.4.3	Lower limit	Varies	Varies	Varies	Varies	1661	
P3.14.4.4	Delay	0	30000	s	0	1662	If the desired value is not reached within this time a fault or alarm is activated.

Table 68.

4.5.17 Group 3.15: Pump and Fan Cascade

The *PFC* functionality allows you to control **up to 5 motors** (pumps, fans) with PID controller 1. The drive is connected to one motor which is the "regulating" motor connecting and disconnecting the other motors to/from the mains, by means of contactors controlled with relays when needed in order to maintain the right setpoint. The *Autochange* function controls the order/priority in which the motors are started in order to guarantee their equal wear. The controlling motor **can be excluded** from the autochange by setting P3.15.4 = 0. Motors can be taken out of use momentarily, e.g. for service, using the motor *Interlock function*. See page 118. **Note:** To use this function additional option boards should be installed depending on how many motors you want to cascade as you need more relays.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.15.1	Number of motors	1	5		1	1001	Total number of motors (pumps/fans) used in PFC system
P3.15.2	Interlock function	0	1		1	1032	Enable/Disable use of interlocks. Interlocks are used to tell the system if a motor is connected or not. 0 = Disabled 1 = Enabled
P3.15.3	Include FC	0	1		1	1028	Include the drive in the autochange and interlocking system. 0 = Disabled 1 = Enabled
P3.15.4	Autochange	0	1		0	1027	Disable/enable rotation of starting order and priority of motors. 0 = Disabled 1 = Enabled
P3.15.5	Autochange interval	0.0	3000.0	h	48.0	1029	After the expiry of the time defined with this parameter, the autochange function takes place if the capacity used lies below the level defined with parameters P3.15.6 and P3.15.7.
P3.15.6	Autochange: Frequency limit	0.00	50.00	Hz	25.00	1031	These parameters define the level below which the capacity used must remain so that the autochange can take place.
P3.15.7	Autochange: Motor limit	0	4		1	1030	
P3.15.8	Bandwidth	0	100	%	10	1097	Percentage of the setpoint. E.g.: Setpoint = 5 bar, Bandwidth = 10%: As long as the feedback value stays within 4.5...5.5 bar motor disconnection or removal will not take place.
P3.15.9	Bandwidth delay	0	3600	s	10	1098	With feedback outside the bandwidth, this time must pass before pumps are added or removed.

Table 69. PFC parameters

4.5.18 Group 3.16: Maintenance counters

Three maintenance counters can be programmed and given alarm and fault levels independently. The alarm or fault level, or both, can be used.

There are two modes (hours or revolutions). Revolutions are estimated by integrating the Motor Speed every second and shown in 1000 revolutions on the keypad.

When one of the limits is reached a warning or a fault is triggered and shown on the panel. It is also possible to send information to a relay that a warning or fault limit has been reached. Timers are also independently resettable with the reset parameter or a digital input.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.16.1	Counter 1 mode	0	2		0	1104	0 = Not used 1 = Hours 2 = Revs*1000
P3.16.2	Counter 1 alarm limit	0	80000	h/revs	0	1105	Defines when to trig a maintenance alarm for Counter 1. 0 = Not used
P3.16.3	Counter 1 fault limit	0	80000	h/revs	0	1106	Defines when to trig a maintenance fault for Counter 1. 0 = Not used
P3.16.4	Counter 1 reset	0	1		0	1107	Changing parameter value from 0 to 1 resets counter.
P3.16.5	Counter 2 mode	0	2		0	1108	0 = Not used 1 = Hours 2 = Revs*1000
P3.16.6	Counter 2 alarm limit	0	80000	h/revs	0	1109	Defines when to trig a maintenance alarm for Counter 2. 0 = Not used
P3.16.7	Counter 2 fault limit	0	80000	h/revs	0	1110	Defines when to trig a maintenance fault for Counter 2. 0 = Not used
P3.16.8	Counter 2 reset	0	1		0	1111	Changing parameter value from 0 to 1 resets counter.
P3.16.9	Counter 3 mode	0	2		0	1163	0 = Not used 1 = Hours 2 = Revs*1000
P3.16.10	Counter 3 alarm limit	0	80000	h/revs	0	1164	Defines when to trig a maintenance alarm for Counter 3. 0 = Not used
P3.16.11	Counter 3 fault limit	0	80000	h/revs	0	1165	Defines when to trig a maintenance fault for Counter 3. 0 = Not used
P3.16.12	Counter 3 reset	0	1		0	1166	Changing parameter value from 0 to 1 resets counter.

Table 70. Maintenance counter parameters

4.5.19 Group 3.17: Fire mode

Drive ignores all commands from keypad, fieldbuses and PC tool and runs at preset frequency when activated. If activated, alarm sign is shown on the keypad and **warranty is void**. In order to enable the function, you need to set a password in the description field for parameter *Fire mode password*.

NOTE! THE WARRANTY IS VOID IF THIS FUNCTION IS ACTIVATED! There is also a different password for test mode to be used for testing the Fire Mode without the warranty becoming void.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P3.17.1	Fire mode password	0	9999		0	1599	1001 = Enabled 1234 = Test mode
P3.17.2	Fire mode activation on DI open				DigIN Slot0.2	1596	Activates fire mode, if fire mode is enabled by correct password. OPEN = Active CLOSED = Inactive
P3.17.3	Fire mode activation on DI close				DigIN Slot0.1	1619	Activates fire mode, if fire mode is enabled by correct password. OPEN = Inactive CLOSED = Active
P3.17.4	FireMode Freq	Min freq	Max freq		0.00	1598	Frequency used when Fire Mode is activated.
P3.17.5	Fire mode freq source	0	8		0	1617	0=FireMode Freq 1=PresetFreq 2=Keypad Ref 3=Fieldbus 4=AI1 5=AI2 6=AI1 + AI2 7=PID1 Ref 8=MotorPot Ref
P3.17.6	Fire mode freq reverse				DigIn Slot0.1	1618	Reverse command of rotation direction while running in Fire Mode. This DI has no effect in normal operation.
P3.17.7	Fire mode preset freq 1	Min freq	Max freq	Hz	10.00	15535	Preset frequency for Fire Mode.
P3.17.8	Fire mode preset freq 2	Min freq	Max freq	Hz	20.00	15536	Preset frequency for Fire Mode.
P3.17.9	Fire mode preset freq 3	Min freq	Max freq	Hz	30.00	15537	Preset frequency for Fire Mode.
V3.17.10	FireMode status	0	3		0	1597	0=Disabled 1=Enabled 2=Activated 3=Test Mode
V3.17.11	FireMode Counter					1679	The counter tells how many times Fire Mode has been activated. The counter cannot be reset.

Table 71. Fire mode parameters

4.5.20 User levels

User level parameters are intended to restrict the visibility of parameters and to prevent unauthorize and inadvertent parametrisation on the keypad.

Index	Parameter	Min	Max	Unit	Default	ID	Description
P8.1	User levels	1	3			1194	1 = Normal 2 = Monitoring 3 = Favourites
P8.2	Access code	0	99999		0	2362	The user can define his own access code for each user level by entering the access code to this parameter when the desired user level has been selected. The access code is asked when the user level is changed.

4.6 HVAC Application - Additional parameter information

Due to its user-friendliness and simplicity of use, the most parameters of the HVAC Application only require a basic description which is given in the parameter tables in chapter 4.5.

In this chapter, you will find additional information on certain most advanced parameters of the HVAC Application. Should you not find the information you need contact your distributor.

V2.2.20 APPLICATION STATUS WORD 1

Application status word 1 tells about different functionalities of the drive if they are activated or not. Notice that these are bit coded and different bits tells about different functionalities.

B0 = Interlock 1

B1 = Interlock 2

B5 = I/O A Control Act.

B6 = I/O B Control Act.

B7 = Fieldbus Control Act.

B8 = Local Control Act.

B9 = PC Control Act.

B10 = Preset Frequencies Act.

B12 = FireMode Act.

B13 = PreHeat Act.

V2.2.21 APPLICATION STATUS WORD 2

Application status word 2 tells about different functionalities of the drive if they are activated or not. Notice that these are bit coded and different bits tells about different functionalities.

B0 = Acc/Dec Prohibited

B1 = Motor Switch Act.

V2.9.1 TEMPERATURE INPUT 1

Measured value of Temperature Input 1. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected the maximum value is shown because measured resistance is endless.

V2.9.2 TEMPERATURE INPUT 2

Measured value of Temperature Input 2. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected the maximum value is shown because measured resistance is endless.

V2.9.3 TEMPERATURE INPUT 3

Measured value of Temperature Input 3. The list of temperature inputs are filled by taking the 3 first available temperature inputs starting from slot D and going to slot E. If input is available but no sensor is connected the maximum value is shown because measured resistance is endless.

P3.1.1.7 MOTOR CURRENT LIMIT

This parameter (*Motor current limit*) determines the maximum motor current from the drive. The parameter value range differs from size to size.

When the current limit is active the drive output frequency is decreased.

NOTE: This is not an overcurrent trip limit.

P3.1.1.8 MOTOR TYPE

This parameter defines the used motor type.

Selection number	Selection name	Description
0	Induction motor (IM)	Select if an induction motor is used.
1	Permanent Magnet Motor (PM)	Select if a permanent magnet motor is used.

P3.1.2.7 U/F RATIO SELECTION

Selection number	Selection name	Description
0	Linear	The voltage of the motor changes linearly as a function of output frequency from zero frequency voltage (P3.1.2.3) to the field weakening point (FWP) voltage at FWP frequency. This default setting should be used if there is no special need for another setting.
1	Squared	The voltage of the motor changes from zero point voltage (P3.1.2.3) following a squared curve form from zero to the field weakening point. The motor runs undermagnetised below the field weakening point and produces less torque. Squared U/f ratio can be used in applications where torque demand is proportional to the square of the speed, e.g. in centrifugal fans and pumps.

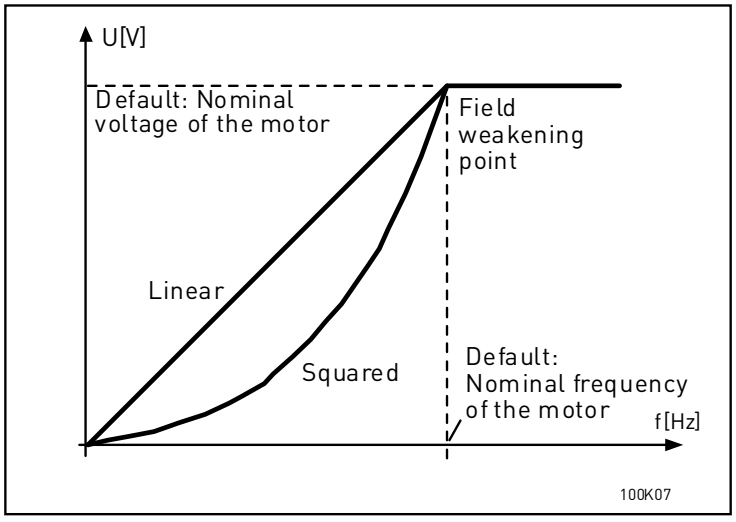
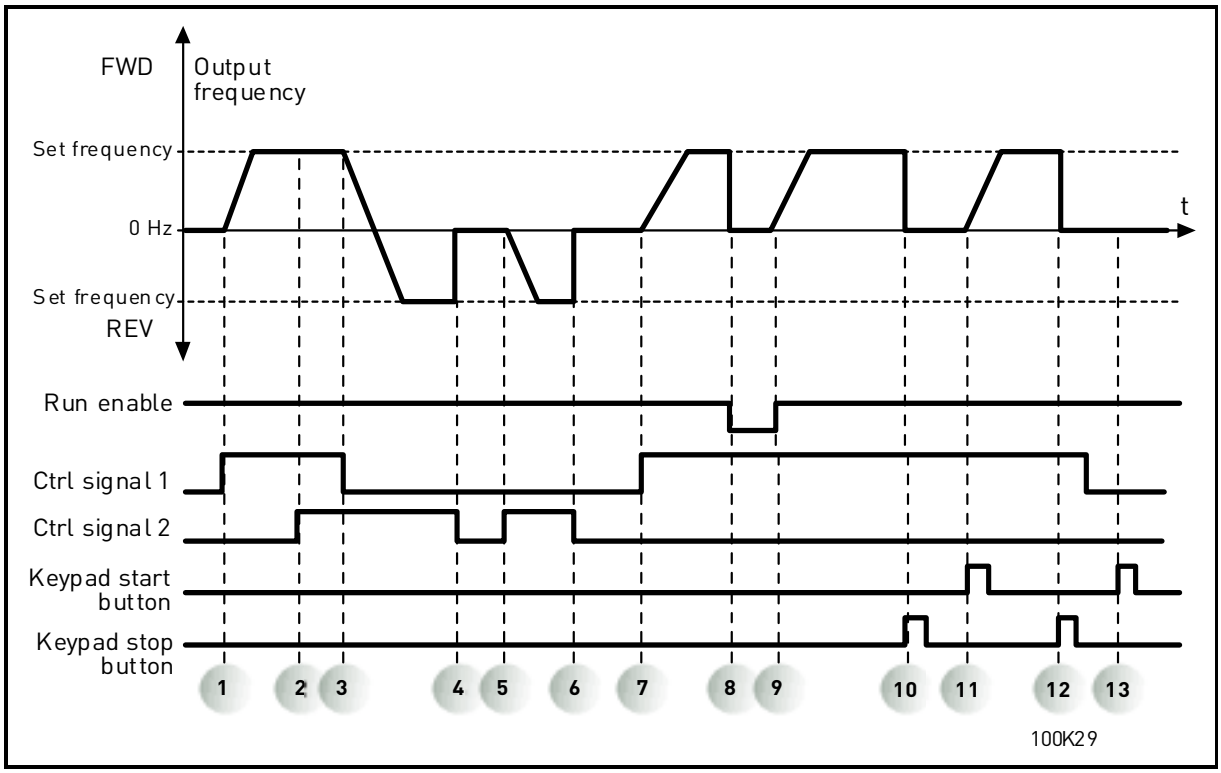


Figure 17.Linear and squared change of motor voltage

P3.1.2.8 OVERVOLTAGE CONTROLLER

P3.1.2.9 UNDERVOLTAGE CONTROLLER

These parameters allow the under-/overvoltage controllers to be switched out of operation. This may be useful, for example, if the mains supply voltage varies more than -15% to +10% and the application will not tolerate this over-/undervoltage.



P3.1.2.10 ENERGY OPTIMIZATION

The drive searches for the minimum motor current in order to save energy and to lower the motor noise. This function can be used e.g. in fan and pump applications.

0 = Disabled

1 = Enabled

P3.1.2.11 FLYING START OPTIONS

When the selection Both directions is chosen, the shaft frequency is searched from both the positive and negative directions. By selection FreqRef direction, the search is limited to the frequency reference direction only to avoid any shaft movement for the other direction.

0 = Both directions

1 = FreqRef direction

P3.2.5 Stop function

Selection number	Selection name	Description
0	Coasting	The motor is allowed to stop on its own inertia. The control by the drive is discontinued and the drive current drops to zero as soon as the stop command is given.
1	Ramp	After the Stop command, the speed of the motor is decelerated according to the set deceleration parameters to zero speed.

P3.2.6 I/O A start/stop logic

Values 0...4 offer possibilities to control the starting and stopping of the drive with digital signal connected to digital inputs. CS = Control signal.

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

The used stop mode is *Coasting* in all examples.

Selection number	Selection name	Description
0	CS1: Forward CS2: Backward	The functions take place when the contacts are closed.

Figure 18. I/O A Start/Stop logic = 0

Explanations:

1	Control signal (CS) 1 activates causing the output frequency to rise. The motor runs forward.	**8**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P3.5.1.10.
2	CS2 activates which, however, has no effect on the output frequency because the first selected direction has the highest priority.	**9**	Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because CS1 is still active.
3	CS1 is inactivated which causes the direction to start changing (FWD to REV) because CS2 is still active.	**10**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P3.2.3 Keypad Master Stop = Yes)
4	CS2 inactivates and the frequency fed to the motor drops to 0.	**11**	The drive starts through pushing the Start button on the keypad.
5	CS2 activates again causing the motor to accelerate (REV) towards the set frequency.	**12**	The keypad stop button is pushed again to stop the drive.
6	CS2 inactivates and the frequency fed to the motor drops to 0.	**13**	The attempt to start the drive through pushing the Start button is not successful because CS1is inactive.
7	CS1 activates and the motor accelerates (FWD) towards the set frequency		

Selection number	Selection name	Description
1	CS1: Forward (edge) CS2: Inverted stop	

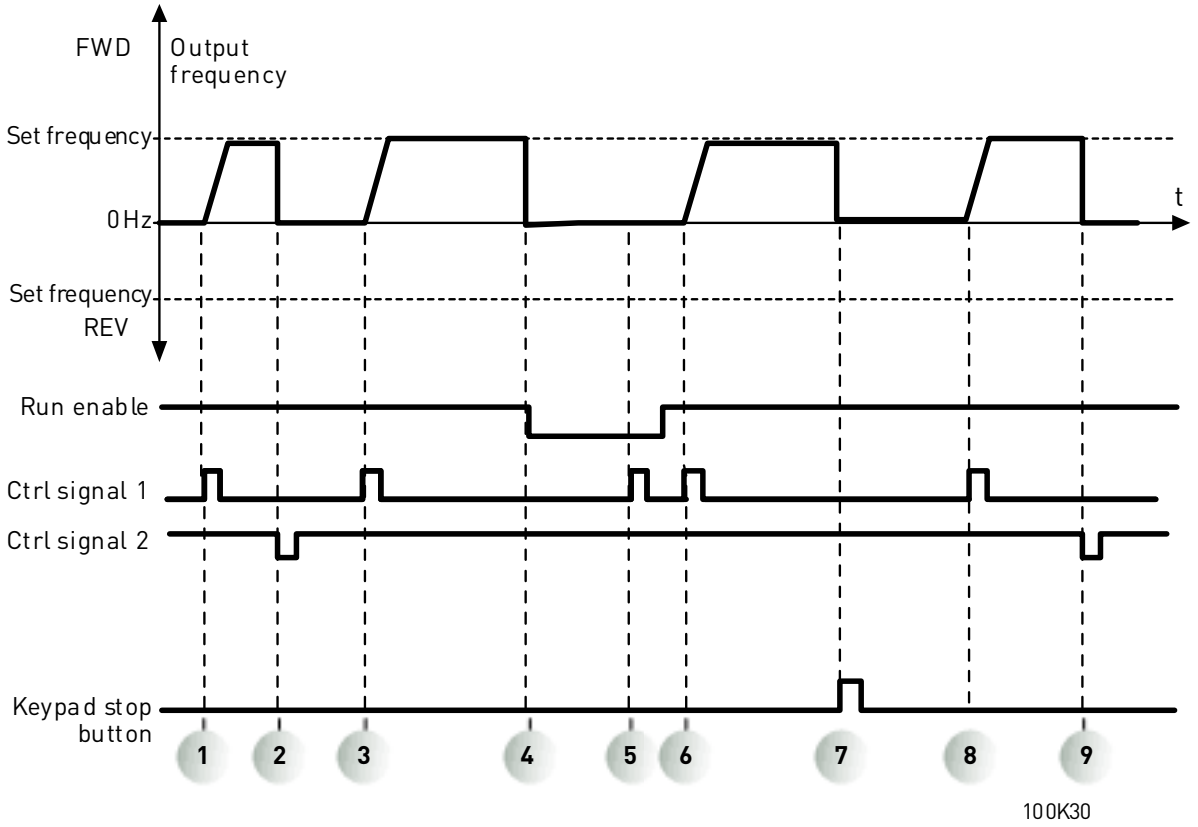


Figure 19. I/O A Start/Stop logic = 1

Explanations:

1	Control signal (CS) 1 activates causing the output frequency to rise. The motor runs forward.	**6**	CS1 activates and the motor accelerates (FWD) towards the set frequency because the Run enable signal has been set to TRUE.
2	CS2 inactivates causing the frequency to drop to 0.	**7**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P3.2.3 Keypad Master Stop = Yes)
3	CS1 activates causing the output frequency to rise again. The motor runs forward.	**8**	CS1 activates causing the output frequency to rise again. The motor runs forward.
4	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P3.5.1.10.	**9**	CS2 inactivates causing the frequency to drop to 0.
5	Start attempt with CS1 is not successful because Run enable signal is still FALSE.		

Selection number	Selection name	Description
2	CS1: Forward (edge) CS2: Backward (edge)	Shall be used to exclude the possibility of an unintentional start. The Start/Stop contact must be opened before the motor can be restarted.

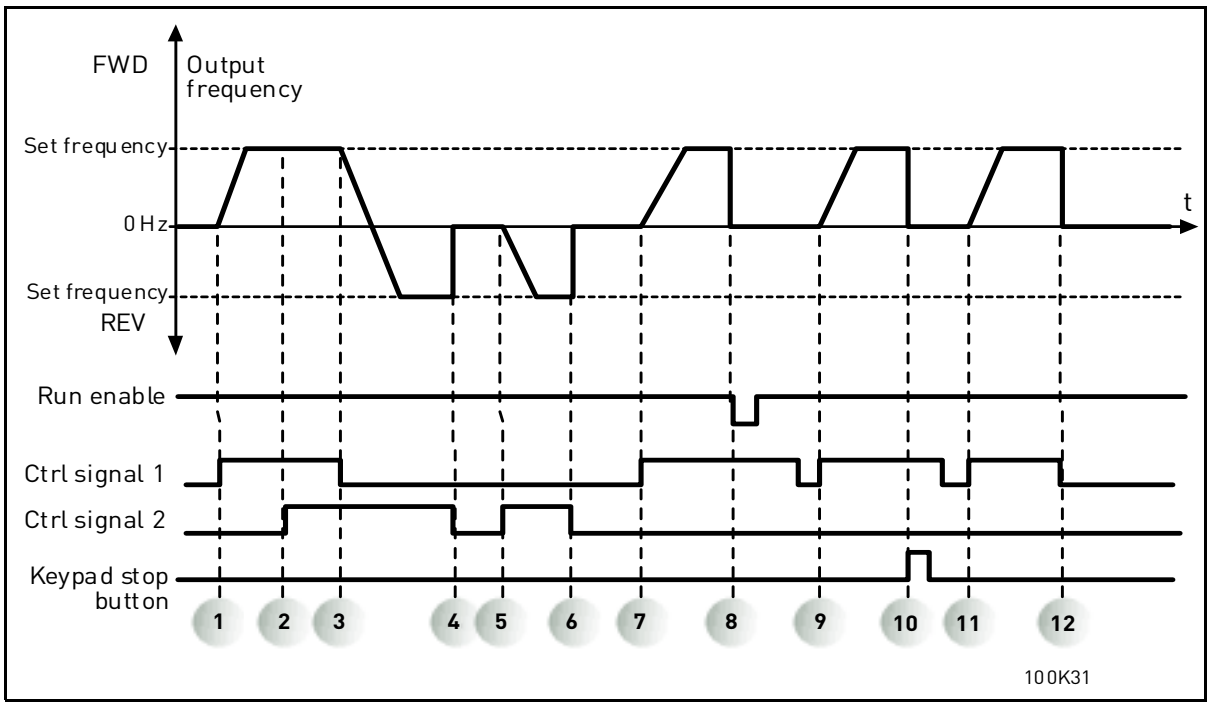


Figure 20. I/O A Start/Stop logic = 2

Explanations:

1	Control signal (CS) 1 activates causing the output frequency to rise. The motor runs forward.	**7**	CS1 activates and the motor accelerates (FWD) towards the set frequency
2	CS2 activates which, however, has no effect on the output frequency because the first selected direction has the highest priority.	**8**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P3.5.1.10.
3	CS1 is inactivated which causes the direction to start changing (FWD to REV) because CS2 is still active.	**9**	Run enable signal is set to TRUE, which, unlike if value 0 is selected for this parameter, has no effect because rising edge is required to start even if CS1 is active.
4	CS2 inactivates and the frequency fed to the motor drops to 0.	**10**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P3.2.3 Keypad Master Stop = Yes).
5	CS2 activates again causing the motor to accelerate (REV) towards the set frequency	**11**	CS1 is opened and closed again which causes the motor to start.
6	CS2 inactivates and the frequency fed to the motor drops to 0.	**12**	CS1 inactivates and the frequency fed to the motor drops to 0.

Selection number	Selection name	Description
3	CS1: Start CS2: Reverse	

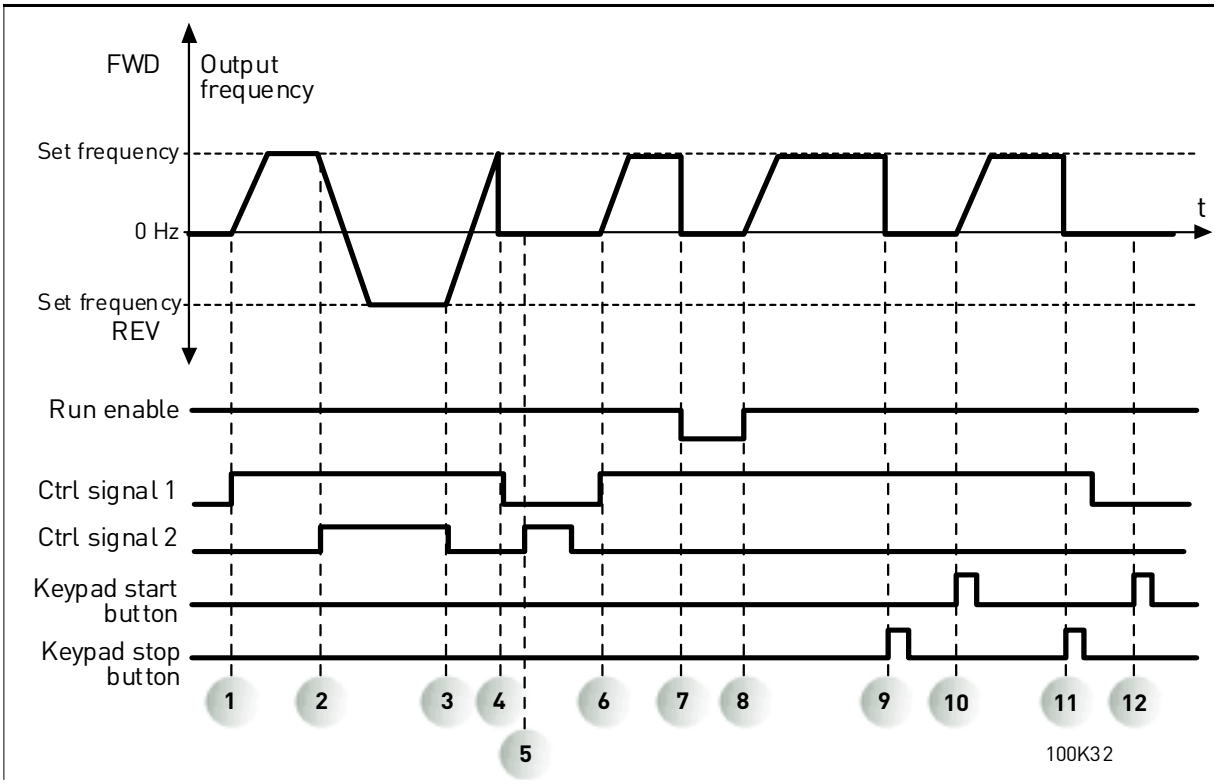


Figure 21.I/O A Start/Stop logic = 3

Explanations:

1	Control signal (CS) 1 activates causing the output frequency to rise. The motor runs forward.	**7**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P3.5.1.10.
2	CS2 activates which causes the direction to start changing (FWD to REV).	**8**	Run enable signal is set to TRUE, which causes the frequency to rise towards the set frequency because CS1 is still active.
3	CS2 is inactivated which causes the direction to start changing (REV to FWD) because CS1 is still active.	**9**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P3.2.3 Keypad Master Stop = Yes)
4	Also CS1 inactivates and the frequency drops to 0.	**10**	The drive starts through pushing the Start button on the keypad.
5	Despite the activation of CS2, the motor does not start because CS1 is inactive.	**11**	The drive is stopped again with the stop button on the keypad.
6	CS1 activates causing the output frequency to rise again. The motor runs forward because CS2 is inactive.	**12**	The attempt to start the drive through pushing the Start button is not successful because CS1 is inactive.

Selection number	Selection name	Description
4	CS1: Start (edge) CS2: Reverse	Shall be used to exclude the possibility of an unintentional start. The Start/Stop contact must be opened before the motor can be restarted.

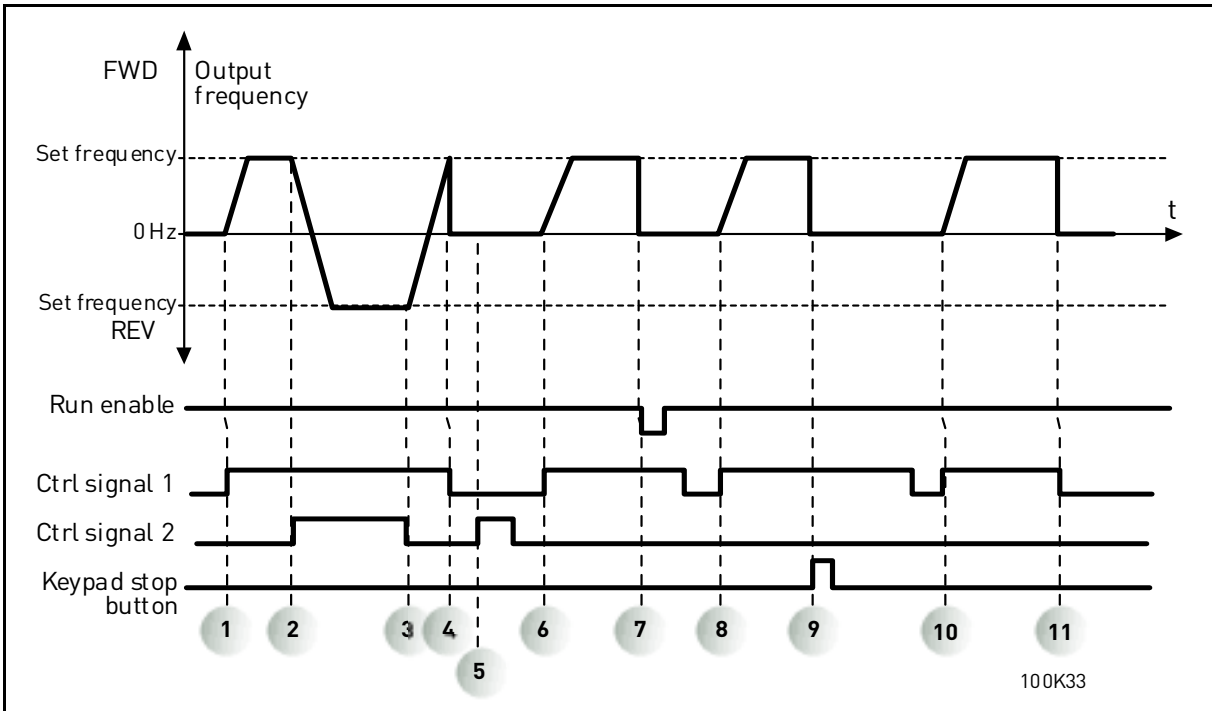


Figure 22. I/O A Start/Stop logic = 4

Explanations:

1	Control signal (CS) 1 activates causing the output frequency to rise. The motor runs forward because CS2 is inactive.	**7**	Run enable signal is set to FALSE, which drops the frequency to 0. The run enable signal is configured with parameter P3.5.1.10.
2	CS2 activates which causes the direction to start changing (FWD to REV).	**8**	Before a successful start can take place, CS1 must be opened and closed again.
3	CS2 is inactivated which causes the direction to start changing (REV to FWD) because CS1 is still active.	**9**	Keypad stop button is pressed and the frequency fed to the motor drops to 0. (This signal only works if P3.2.3 Keypad Master Stop = Yes)
4	Also CS1 inactivates and the frequency drops to 0.	**10**	Before a successful start can take place, CS1 must be opened and closed again.
5	Despite the activation of CS2, the motor does not start because CS1 is inactive.	**11**	CS1 inactivates and the frequency drops to 0.
6	CS1 activates causing the output frequency to rise again. The motor runs forward because CS2 is inactive.		

Selection number	Selection name	Description
5	CS1: Not needed (AI1 level will start the device) CS2: Reverse	Special start mode where no separate start signal is needed. Increasing the value of AI1 will act as a start command. AI1 threshold (P3.2.8) described in Figure 24 will create a safety margin to prevent unintentional starts. So the drive will start after the value of AI1 exceeds the threshold. Control signal 2 can be used for changing the rotation direction.

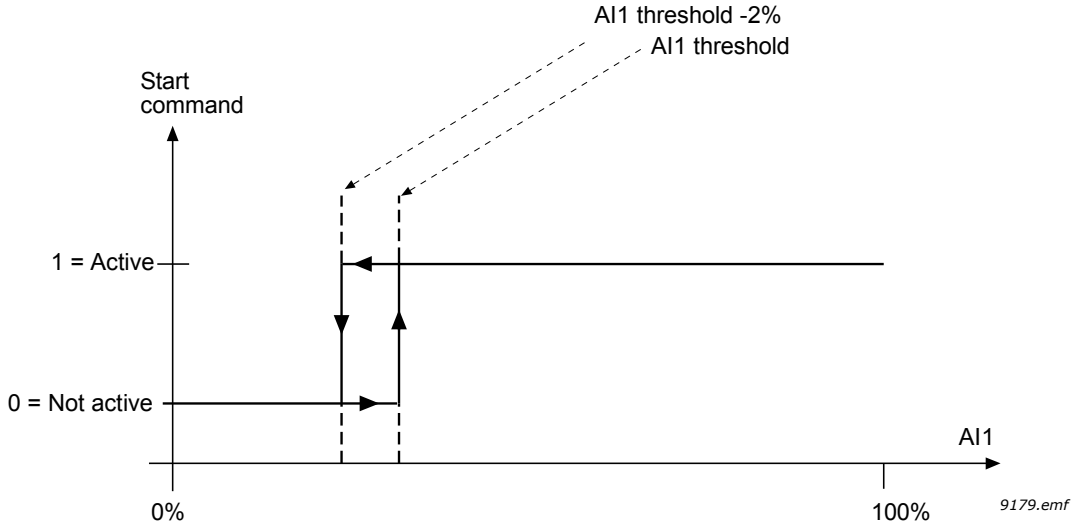


Figure 23. AI1 threshold

P3.2.3 KEYPAD MASTER STOP

The drive can be forced to stop state from keypad stop button even if it is controlled from another control place (*Remote*). If this measure is taken, the drive goes to the alarm state and cannot be restarted from the remote control place before the start button has been pressed (while in *Remote*).

You can still momentarily switch to *Local* and start there but when going back to *Remote* a start button press is needed. This also applies after a power-down as the state of this function is retained in memory.

The function can be enabled or disabled with this parameter.

P3.3.10 PRESET FREQUENCY MODE

You can use the preset frequency parameters to define certain frequency references in advance. These references are then applied by activating/inactivating digital inputs connected to parameters P3.5.1.16, P3.5.1.17 and P3.5.1.18 ((*Preset frequency selection 0, Preset frequency selection 1* and *Preset frequency selection 2*). Two different logics can be selected:

Selection number	Selection name	Note
0	Binary coded	Combine activated inputs according to Table 72 to choose the Preset frequency needed.
1	Number (of inputs used)	According to how many of the inputs assigned for *Preset frequency selections* are active you can apply the *Preset frequencies* 1 to 3.

P3.3.11 TO P3.3.18 PRESET FREQUENCIES 1 TO 7

The values of the preset frequencies are automatically limited between the minimum and maximum frequencies (P3.3.1 and P3.3.2). See table below.

Required action			Activated frequency
Choose value 1 for parameter P3.3.3			Preset frequency 0
B2	B1	B0	Preset frequency 1
B2	B1	B0	Preset frequency 2
B2	B1	B0	Preset frequency 3
B2	B1	B0	Preset frequency 4
B2	B1	B0	Preset frequency 5
B2	B1	B0	Preset frequency 6
B2	B1	B0	Preset frequency 7

Table 72. Selection of preset frequencies (B0 = Preset frequency selection 0, B1 = Preset frequency selection 1, B2 = Preset frequency selection 2); ■ = input activated

EXAMPLE

If you want to activate *Preset frequency 3*, inputs *B0* and *B1* must be activated. *B0* and *B1* are by default set to DigIN SlotA.4 and DigIN SlotA.5 respectively. They can be changed by changing the parameters *Preset Freq Sel0* (P3.5.1.16) and *Preset Freq Sel1* (P3.5.1.17) under Parameters > I/O Config > Digital inputs. By default, *Preset frequency 3* is set to 20.00Hz. You can set it to a different value by changing the parameter *Preset Freq 3* (P3.3.14) under Parameters > References.

P3.4.1 RAMP 1 SHAPE

The start and end of acceleration and deceleration ramps can be smoothed with this parameter. Setting value 0 gives a linear ramp shape which causes acceleration and deceleration to act immediately to the changes in the reference signal.

Setting value 0.1…10 seconds for this parameter produces an S-shaped acceleration/deceleration. The acceleration time is determined with parameters P3.4.2 and P3.4.3. See Figure 24.

These parameters are used to reduce mechanical erosion and current spikes when the reference is changed.

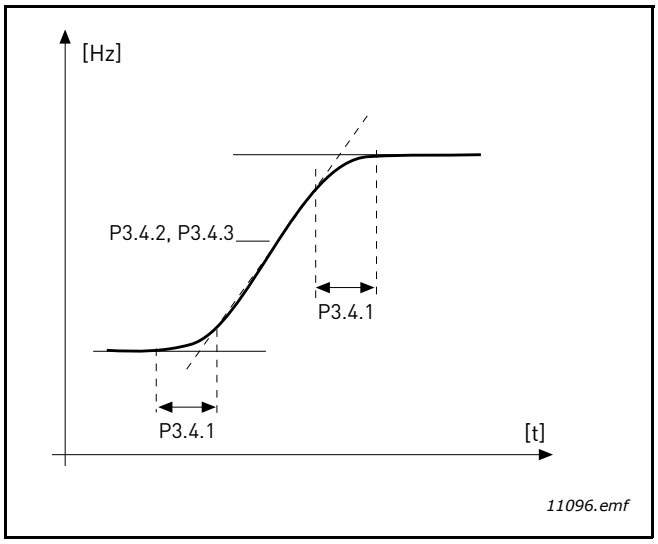


Figure 24. Acceleration/Deceleration (S-shaped)

P3.4.2 ACCELERATION TIME 1

Acceleration Time 1 defines the time it takes for the output frequency to accelerate from zero to Maximum Frequency.

P3.4.3 DECELERATION TIME 1

Deceleration Time 1 defines the time it takes for the output frequency to decelerate from Maximum Frequency to zero.

P3.4.6 ACCELERATION TIME 2

Second ramp which can be activated with a digital input or frequency threshold. Functionality same as Accel Time 1.

P3.4.7 DECELERATION TIME 2

Second ramp which can be activated with a digital input or frequency threshold. Functionality same as Decel Time 1.

P3.4.8 RAMP TIME OPTIMIZER

If the ramp time optimizer is enabled the deceleration time will be increased by the percentage defined in parameter P3.4.9 *Ramp optimizing percentage* every time we hit the overvoltage controller during deceleration, or acceleration time when hitting the current limit during acceleration. There is also a parameter for setting a max limit for the ramp (P3.4.10). The ramp optimizer will not stretch the ramps above this limit.

NOTE: The ramp time optimizer only affects the settings of Ramp 1. Ramp 2 will not be modified.

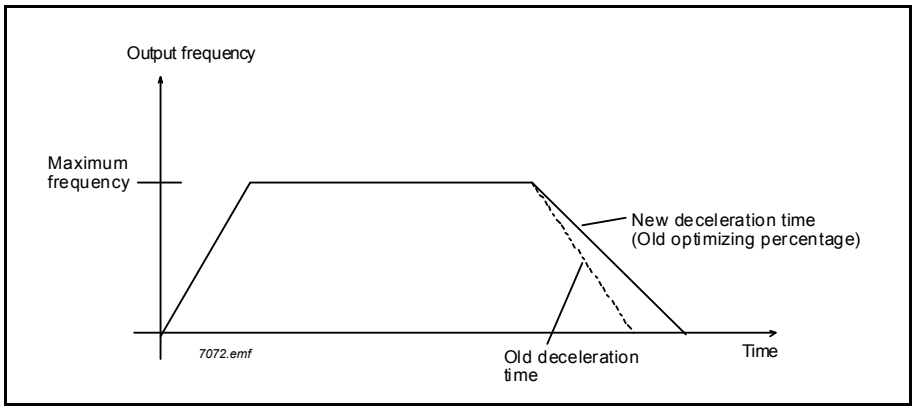


Figure 25.

P3.4.16 FLUX BRAKING

Instead of DC braking, flux braking is a useful way to raise the braking capacity in cases where additional brake resistors are not needed.

When braking is needed, the frequency is reduced and the flux in the motor is increased, which in turn increases the motor's capability to brake. Unlike DC braking, the motor speed remains controlled during braking.

The flux braking can be set ON or OFF.

NOTE: Flux braking converts the energy into heat at the motor, and should be used intermittently to avoid motor damage.

P3.5.1.10 RUN ENABLE

Contact open: Start of motor **disabled**
Contact closed: Start of motor **enabled**

The drive is stopped according to the selected function at P3.2.5. The follower drive will always coast to stop.

P3.5.1.11 RUN INTERLOCK 1
P3.5.1.12 RUN INTERLOCK 2

The drive cannot be started if any of the interlocks are open.

The function could be used for a damper interlock, preventing the drive to start with damper closed.

P3.5.1.16 PRESET SPEED B0
P3.5.1.17 PRESET SPEED B1
P3.5.1.18 PRESET SPEED B2

Connect a digital input to these functions with the programming method presented in chapter 4.5.2) to be able to apply Preset frequencies 1 to 7 (see Table 72 and pages 58, 61 and 99).

P3.5.1.30 INTERLOCK 5

Digital input signal used for motor/pump interlock with Multi-Pump system if Interlocks are enabled in the Multi-Pump menu. If enabled, a closed input tells the system that the motor/pump is available.

P3.5.1.38 FIRE MODE PRESET FREQ SEL 0
P3.5.1.39 FIRE MODE PRESET FREQ SEL 1

Activation for Fire Mode preset frequencies. These two parameters are connected to P3.17.7, P3.17.8 and P3.17.9. By closing and opening contacts different preset frequencies can be used.

Fire Mode preset sel 0	Fire Mode preset sel 1	Preset frequency in use
Open contact	Open contact	None
Closed contact	Open contact	Preset frequency 1
Open contact	Closed contact	Preset frequency 2
Closed contact	Closed contact	Preset frequency 3

P3.5.2.2 AI1 SIGNAL FILTER TIME

When this parameter is given a value greater than 0 the function that filters out disturbances from the incoming analog signal is activated.

NOTE: Long filtering time makes the regulation response slower!

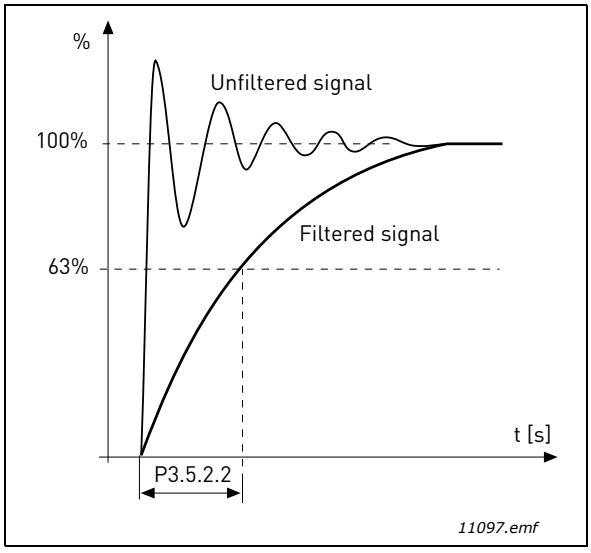


Figure 26. AI1 signal filtering

M3.5.3.2.1 BASIC RO1 FUNCTION

Selection	Selection name	Description
0	None	Output not used
1	Ready	The AC drive is ready to operate
2	Run	The AC drive operates (motor is running)
3	Fault	A fault trip has occurred
4	Fault invert	A fault trip has **not** occurred
5	Alarm	An alarm has been initiated
6	Reverse	The reverse command has been given
7	At speed	The output frequency has reached the set reference
8	MotorRegAct	One of the limit regulators (e.g. current limit, torque limit) is activated
9	Preset Speed	The preset frequency has been selected with digital input
10	Keypad CTRL	Keypad control selected (active control place is keypad)
11	I/O B CTRL	I/O control place B selected (active control place is I/O B)
12	LimSuperv1	Activates if the signal value falls below or exceeds the set supervision limit (P3.8.3 or P3.8.7) depending on the selected function.
13	LimSuperv2	
14	Start Signal	Drive start command is active.
15	Reserved	
16	Fire Mode Activation	FireMode function is active
17	RTC T1 CTRL	Status of Time channel 1
18	RTC T2 CTRL	Status of Time channel 2
19	RTC T3 CTRL	Status of Time channel 3
20	Fieldbus CW.B13	Digital (relay) output control from Fieldbus control word bit 13.
21	Fieldbus CW.B14	Digital (relay) output control from Fieldbus control word bit 14.
22	Fieldbus CW.B15	Digital (relay) output control from Fieldbus control word bit 15.
23	PID1 Sleep	PID-controller is in Sleep mode.
24	Reserved	-
25	PID1 Supervision	PID-controller value is beyond the supervision limits.
26	PID2 Supervision	PID-controller value is beyond the supervision limits.
27	Motor 1 Control	Contactor control for *Multi-pump* function
28	Motor 2 Control	Contactor control for *Multi-pump* function
29	Motor 3 Control	Contactor control for *Multi-pump* function
30	Motor 4 Control	Contactor control for *Multi-pump* function
31	Motor 5 Control	Contactor control for *Multi-pump* function
32	Reserved	-
33	Reserved	-
34	MaintenAlarm	Maintenance counter has reached the alarm limit
35	MaintenFault	Maintenance counter has reached the fault limit

Selection	Selection name	Description
36	Thermistor Fault	A thermistor fault has occurred.
37	Motor Switch	Open motor switch has been detected.

Table 73. Output signals via RO1

P3.7.9 RESONANCE SWEEP

The anti-resonance function slowly sweeps through frequencies from MinFreq to MaxFreq and back to MinFreq with the ramp times set with this parameter. During this sweep, the user should press the OK-button every time passing a resonance range in order to tag where the range starts and ends.

If everything is fine the Prohibit frequency range parameters (in Prohibited Frequencies menu) are provided with right information. If there is a different amount of tags during ramp-up compared to ramp-down nothing will be done but an info message is shown. The same will happen if the bands are not reasonable.

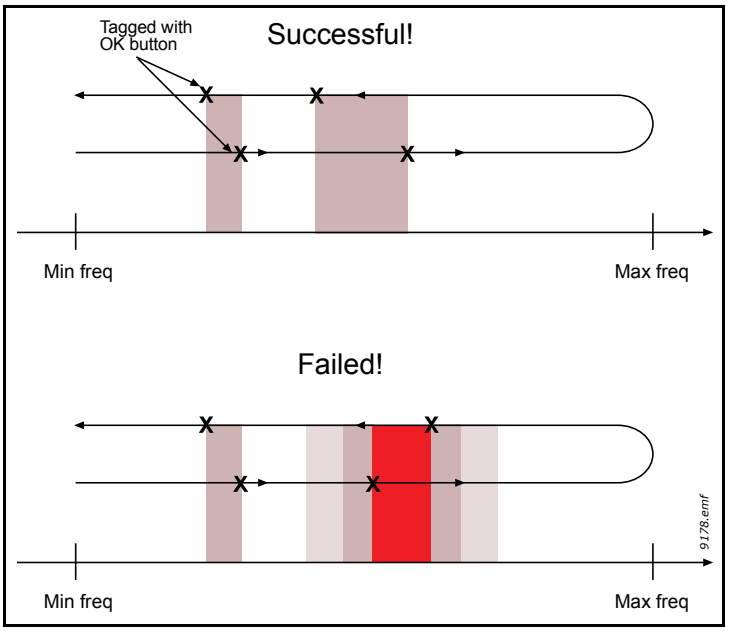


Figure 27.

P3.9.1 AI LOW FAULT

This parameter defines the response for F50 - AI Low Fault (Fault ID: 1050).

Selection number	Selection name	Description
0	No action	No action
1	Alarm	Trigs Alarm
2	Alarm, preset freq	Uses preset frequencies as frequency reference
3	Alarm, previous freq	The last valid frequency is kept as frequency reference
4	Fault	Stop according to Stop mode P3.2.5
5	Fault, coast	Stop by coasting

NOTE: AI Low Fault response 3 (Alarm + Previous Freq) can be used only if analog input 1 or analog input 2 is used as frequency reference.

M3.9.2 RESPONSE TO EXTERNAL FAULT

An alarm message or a fault action and message is generated by an external fault external fault signal in one of the programmable digital inputs (DI3 by default) using parameters P3.5.1.7 and P3.5.1.8. The information can also be programmed into any of the relay outputs.

P3.9.8 MOTOR THERMAL ZERO SPEED COOLING

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling.

The default value is set assuming that there is no external fan cooling the motor. If an external fan is used this parameter can be set to 90% (or even higher).

If you change the parameter P3.1.1.4 *(Motor nominal current)*, this parameter is automatically restored to the default value.

Setting this parameter does not affect the maximum output current of the drive which is determined by parameter P3.1.1.7 alone.

The corner frequency for the thermal protection is 70% of the motor nominal frequency (P3.1.1.2).

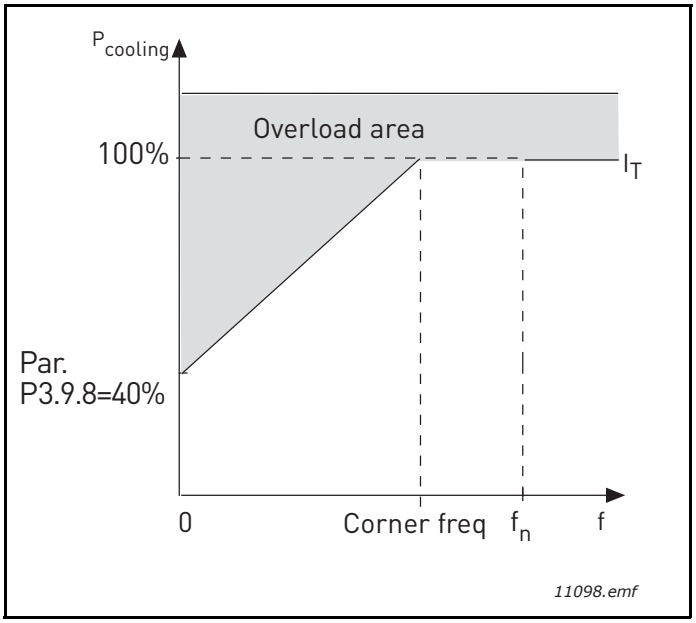


Figure 28. Motor thermal current I_T curve

P3.9.9 MOTOR THERMAL TIME CONSTANT

This is the thermal time constant of the motor. The bigger the motor, the bigger the time constant. The time constant is the time within which the calculated thermal stage has reached 63% of its final value.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers. The default value of the parameter varies from size to size.

If the motor's t6-time (t6 is the time in seconds the motor can safely operate at six times the rated current) is known (given by the motor manufacturer) the time constant parameter can be set basing on it. As a rule of thumb, the motor thermal time constant in minutes equals to 2*t6. If the drive is in stop stage the time constant is internally increased to three times the set pa-

rameter value. The cooling in stop stage is based on convection and the time constant is increased. See Figure 29.

P3.9.10 MOTOR THERMAL LOADIBILITY FACTOR

Setting value to 130% means that the nominal temperature will be reached with 130% of motor nominal current.

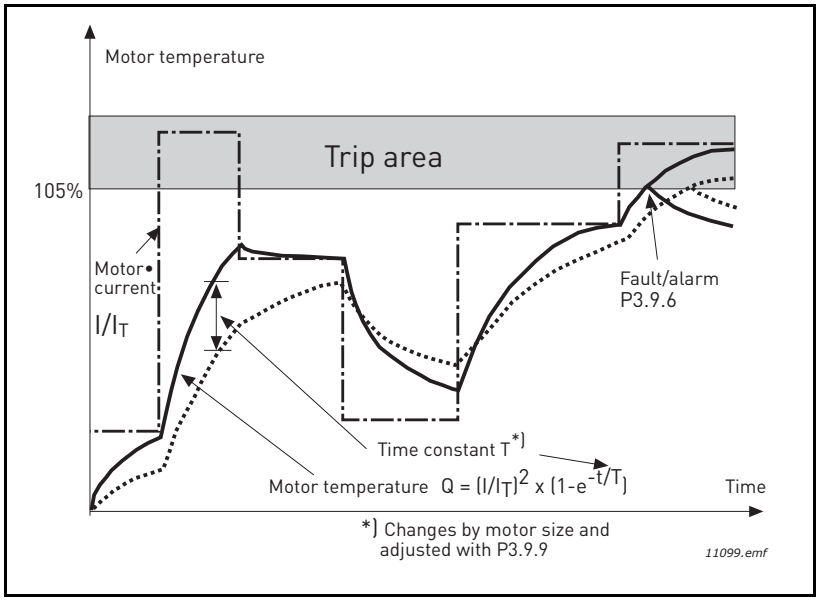


Figure 29. Motor temperature calculation

P3.9.12 STALL CURRENT

The current can be set to 0.0…2*IL. For a stall stage to occur, the current must have exceeded this limit. See Figure 31. If parameter P3.1.1.7 *Motor current limit* is changed, this parameter is automatically calculated to 90% of the current limit. See Group 3.9: Protections.

NOTE! In order to guarantee desired operation, this limit must be set below the current limit.

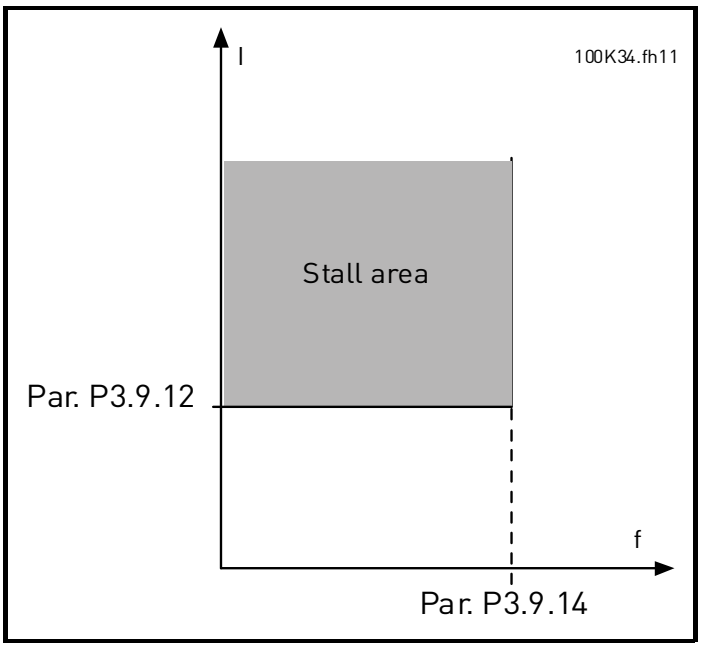


Figure 30.Stall characteristics settings

P3.9.13 STALL TIME LIMIT

This time can be set between 1.0 and 120.0s.

This is the maximum time allowed for a stall stage. The stall time is counted by an internal up/ down counter.

If the stall time counter value goes above this limit the protection will cause a trip (see P3.9.11). See Group 3.9: Protections.

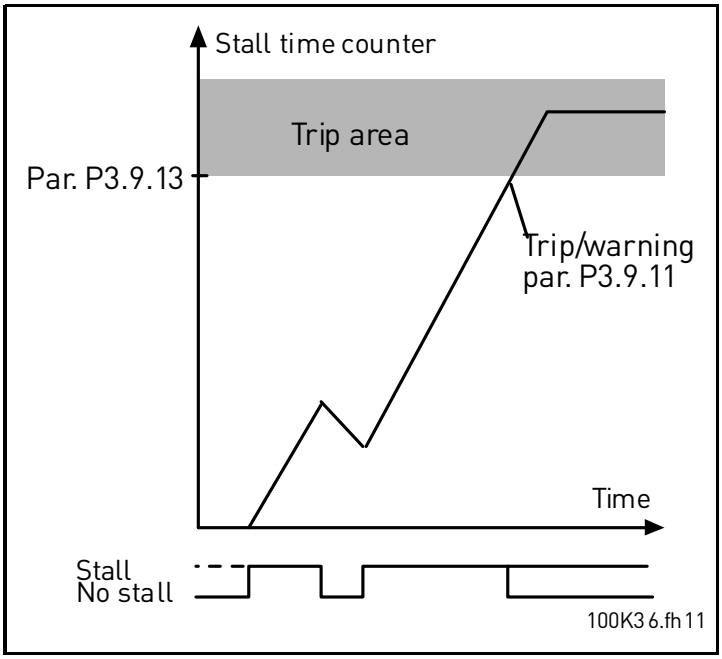


Figure 31.Stall time count

P3.9.16 UNDERLOAD PROTECTION: FIELD WEAKENING AREA LOAD

The torque limit can be set between 10.0-150.0 % x T_{nMotor}..

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See Figure 31.

If you change parameter P3.1.1.4 (*Motor nominal current*) this parameter is automatically restored to the default value. See Group 3.9: Protections.

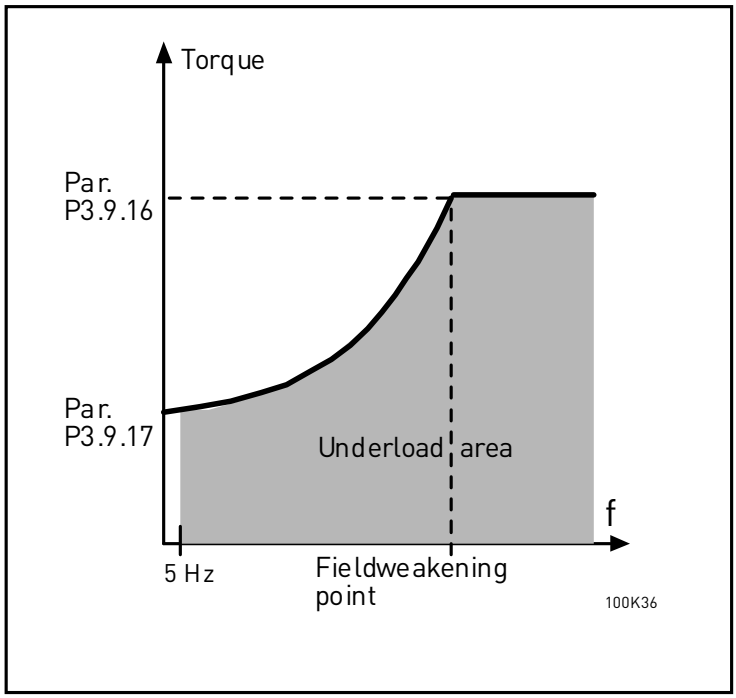


Figure 32. Setting of minimum load

P3.9.18 UNDERLOAD PROTECTION: TIME LIMIT

This time can be set between 2.0 and 600.0 s.

This is the maximum time allowed for an underload state to exist. An internal up/down counter counts the accumulated underload time. If the underload counter value goes above this limit the protection will cause a trip according to parameter P3.9.15). If the drive is stopped the underload counter is reset to zero. See Figure 32 and Group 3.9: Protections.

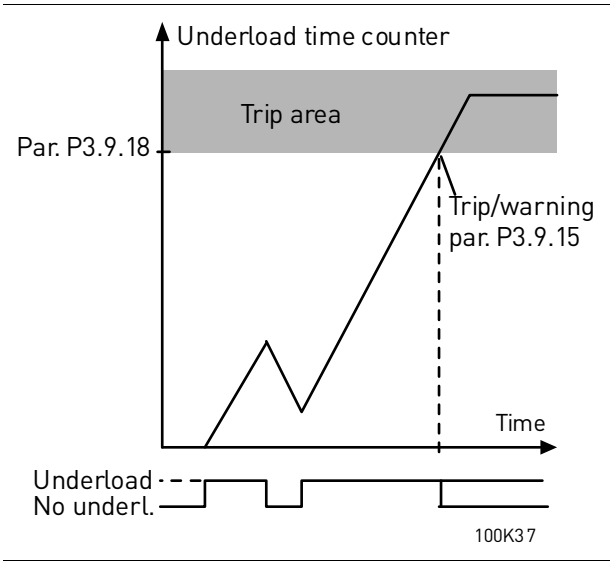


Figure 33. Underload time counter function

P3.9.25 TEMPERATURE FAULT SIGNAL

This parameter allows you to select the temperature inputs to be used for temperature fault.

0 = Not Used

1 = TempInput 1

2 = TempInput 2

3 = TempInput 3

4 = TempInput 1-2

5 = TempInput 2-3

6 = TempInput 1-3

P3.9.26 TEMPERATURE ALARM LIMIT

Temperature for trigging an alarm.

P3.9.27 TEMPERATURE FAULT LIMIT

Temperature for trigging a fault.

P3.9.28 TEMPERATURE FAULT RESPONSE

Determines the response if limit of P3.9.26 or P3.9.27 is reached.

0 = No action

1 = Alarm

2 = Fault

3 = Fault, coast

M3.10.1 AUTOMATIC RESET

Activate the *Automatic reset* after fault with this parameter.

NOTE: Automatic reset is allowed for certain faults only. By giving the parameters P3.10.6 to P3.10.13 the value **0** or **1** you can either allow or deny the automatic reset after the respective faults.

P3.10.3 WAIT TIME
P3.10.4 AUTOMATIC RESET: TRIAL TIME
P3.10.5 NUMBER OF TRIALS

The Automatic reset function keeps resetting the faults appearing during the time set with this parameter. If the number of faults during the trial time exceed the value of parameter P3.10.5 a permanent fault is generated. Otherwise the fault is cleared after the trial time has elapsed and the next fault start the trial time count again.

Parameter P3.10.5 determines the maximum number of automatic fault reset attempts during the trial time set by this parameter. The time count starts from the first autoreset. The maximum number is independent of the fault type.

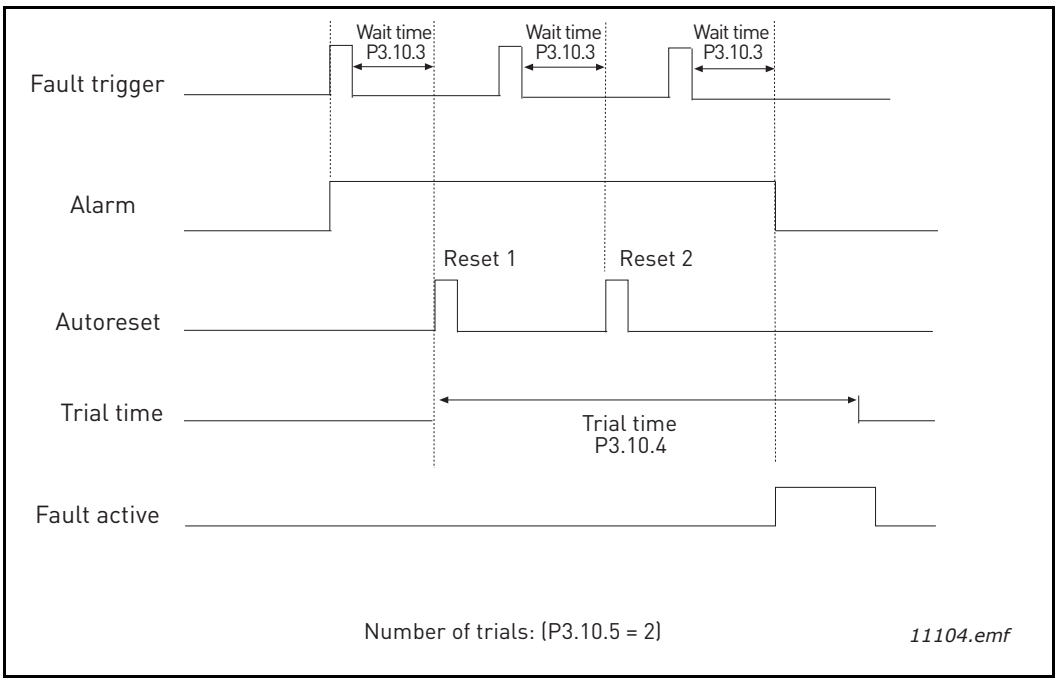


Figure 34. Automatic reset function

P3.13.1.4 PROCESS UNIT SELECTION

P3.14.1.6 PROCESS UNIT SELECTION

	Process Units
%	°C
1/min	GPM
rpm	gal/s
ppm	gal/min
pps	gal/h
l/s	lb/s
l/min	lb/min
l/h	lb/h
kg/s	CFM
kg/min	ft3/s
kg/h	ft3/min
m3/s	ft3/h
m3/min	ft/s
m3/h	in wg
m/s	ft wg
mbar	PSI
bar	lb/in2
Pa	hp
kPa	F
mVS	

Table 74. Process units

P3.13.1.9 DEAD BAND HYSTERESIS
P3.13.1.10 DEAD BAND DELAY

The PID controller output is locked if the actual value stays within the deadband area around the reference for a predefined time. This function will prevent unnecessary movement and wear on actuators, e.g. valves.

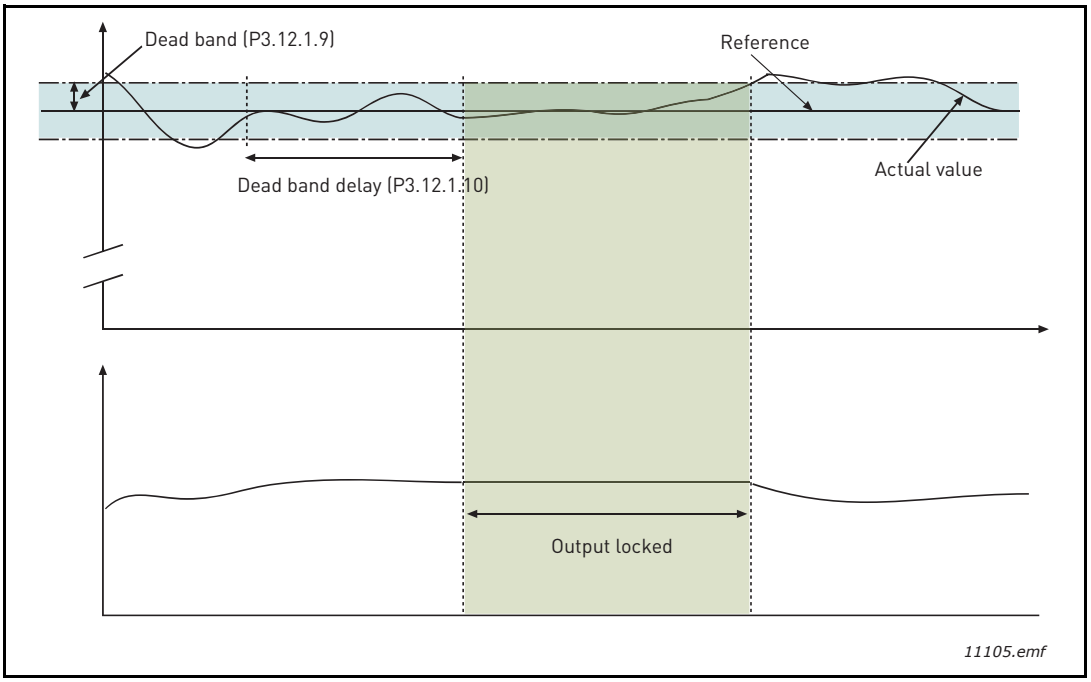


Figure 35. Dead band

P3.13.2.7 SLEEP FREQUENCY LIMIT 1
P3.13.2.8 SLEEP DELAY 1
P3.13.2.9 WAKE-UP LEVEL 1

This function will put the drive into sleep mode if the frequency stays below the sleep limit for a longer time than that set with the Sleep Delay (P3.13.2.8). This means that the start command remains on, but the run request is turned off. When the actual value goes below, or above, the wake-up level depending on the set acting mode the drive will activate the run request again if the start command is still on.

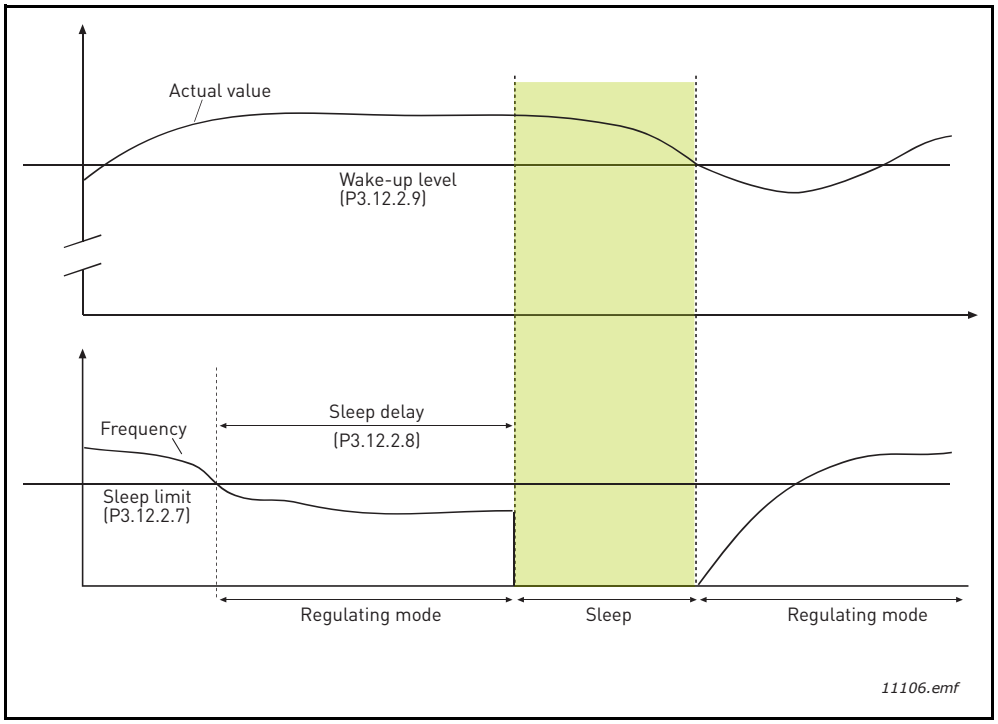


Figure 36. Sleep limit, Sleep delay, Wake-up level

P3.13.4.1 FEEDFORWARD FUNCTION

Feedforward usually needs accurate process models, but in some simple cases a gain + offset type of feedforward is enough. The feedforward part does not use any feedback measurements of the actual controlled process value (water level in the example on page 114). The feedforward control uses other measurements which are indirectly affecting the controlled process value.

Example 1:

Controlling the water level of a tank by means of flow control. The desired water level has been defined as a setpoint and the actual level as feedback. The control signal acts on the incoming flow.

The outflow could be thought of as a disturbance that can be measured. Based on the measurements of the disturbance, we can try to compensate for this disturbance by simple feedforward control (gain and offset) which is added to the PID output.

This way the controller would react much faster to changes in the outflow than if you just had measured the level.

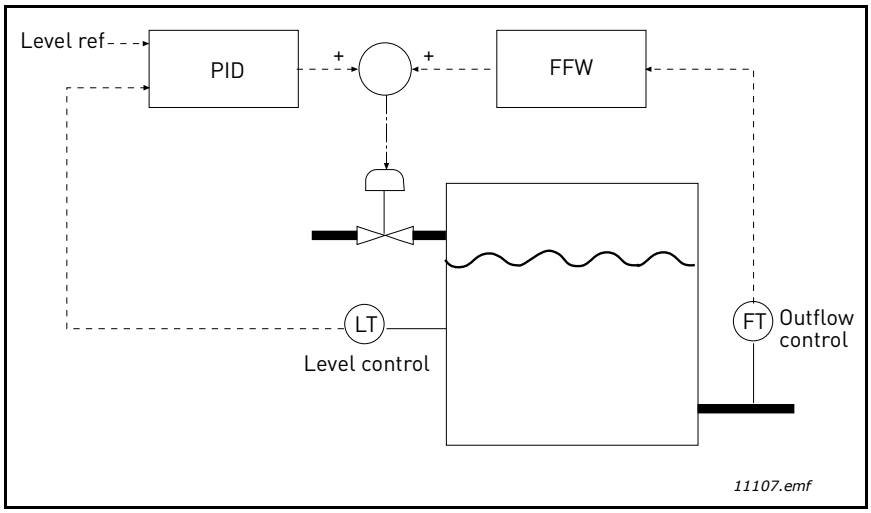


Figure 37. Feedforward control

M3.13.5.1 ENABLE PROCESS SUPERVISION

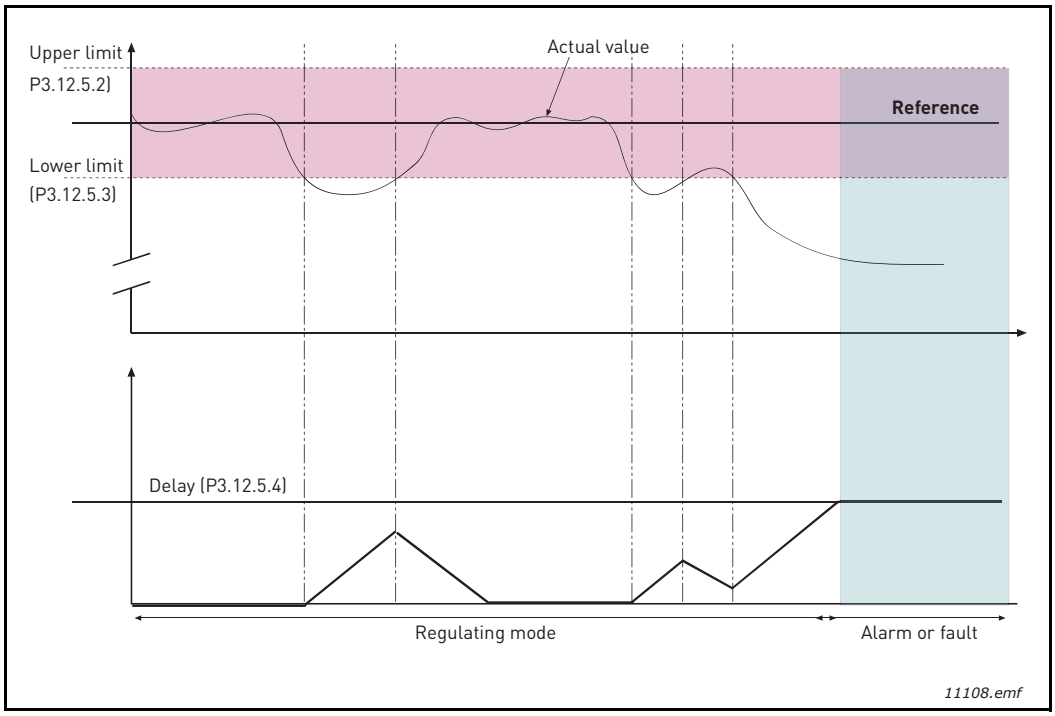


Figure 38. Process supervision

Upper and lower limits around the reference are set. When the actual value goes above or below these a counter starts counting up towards the Delay (P3.13.5.4). When the actual value is within the allowed area the same counter counts down instead. Whenever the counter is higher than the Delay an alarm or fault (depending on the selected response) is generated.

PRESSURE LOSS COMPENSATION

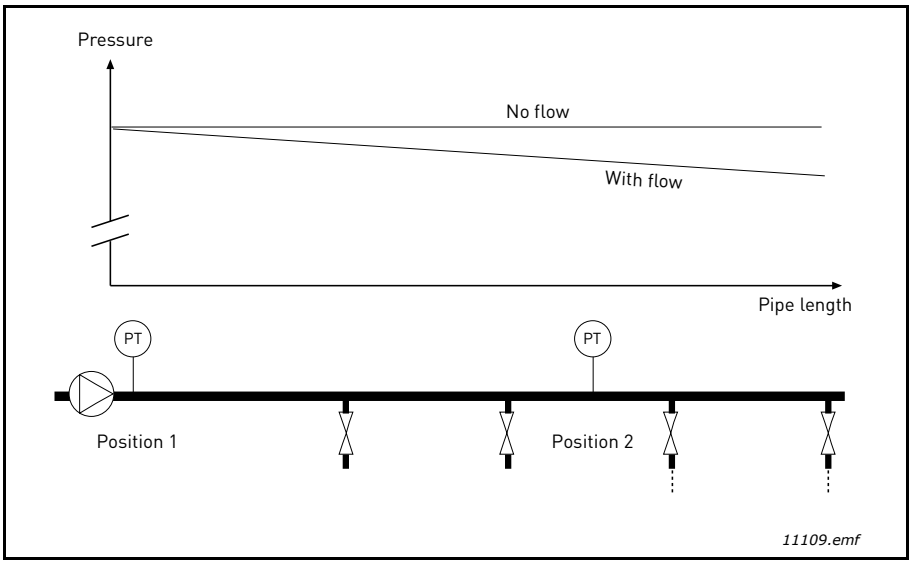


Figure 39. Position of pressure sensor

If pressurizing a long pipe with many outlets, the best place for the sensor would probably be halfway down the pipe (Position 2). However, sensors might, for example, be placed directly after the pump. This will give the right pressure directly after the pump, but farther down in the pipe the pressure will drop depending on the flow.

P3.13.6.1 ENABLE SETPOINT 1
P3.13.6.2 SETPOINT 1 MAX COMPENSATION

The sensor is placed in Position 1. The pressure in the pipe will remain constant when we have no flow. However, with flow, the pressure will drop farther down in the pipe. This can be compensated by raising the setpoint as the flow increases. In this case, the flow is estimated by the output frequency and the setpoint is linearly increased with the flow as in the figure below.

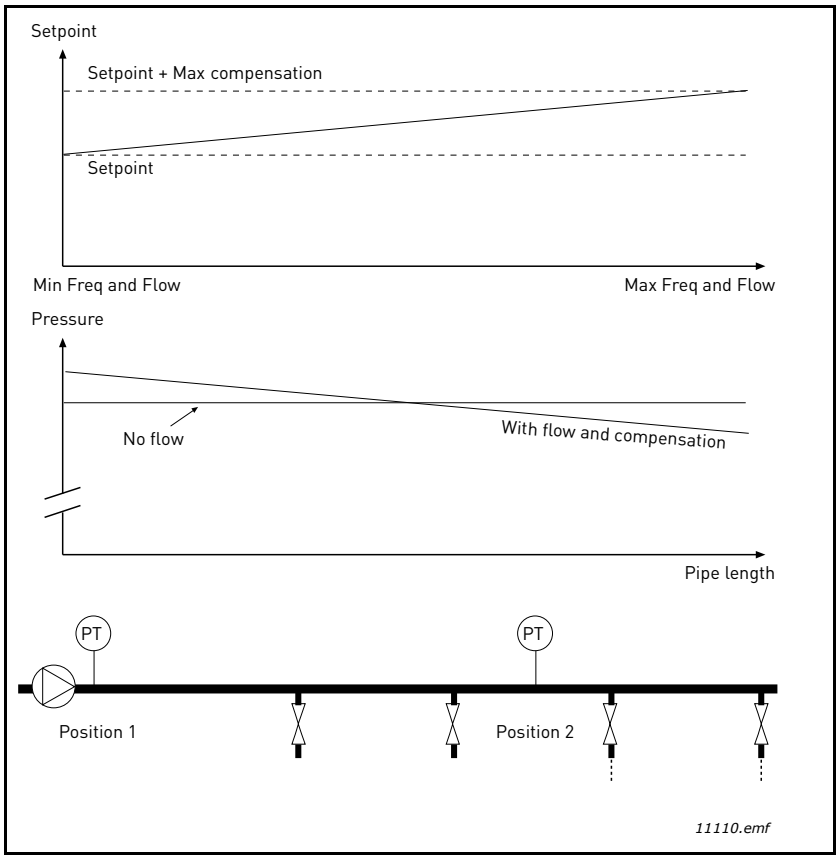


Figure 40. Enable setpoint 1 for pressure loss compensation

PUMP SOFT FILL FUNCTION

The Soft Fill function is used, for example, to avoid pressure pikes, the so-called "water hammers" in pipes when the drive starts to regulate. If not controlled, these spikes might lead to damaged pipes.

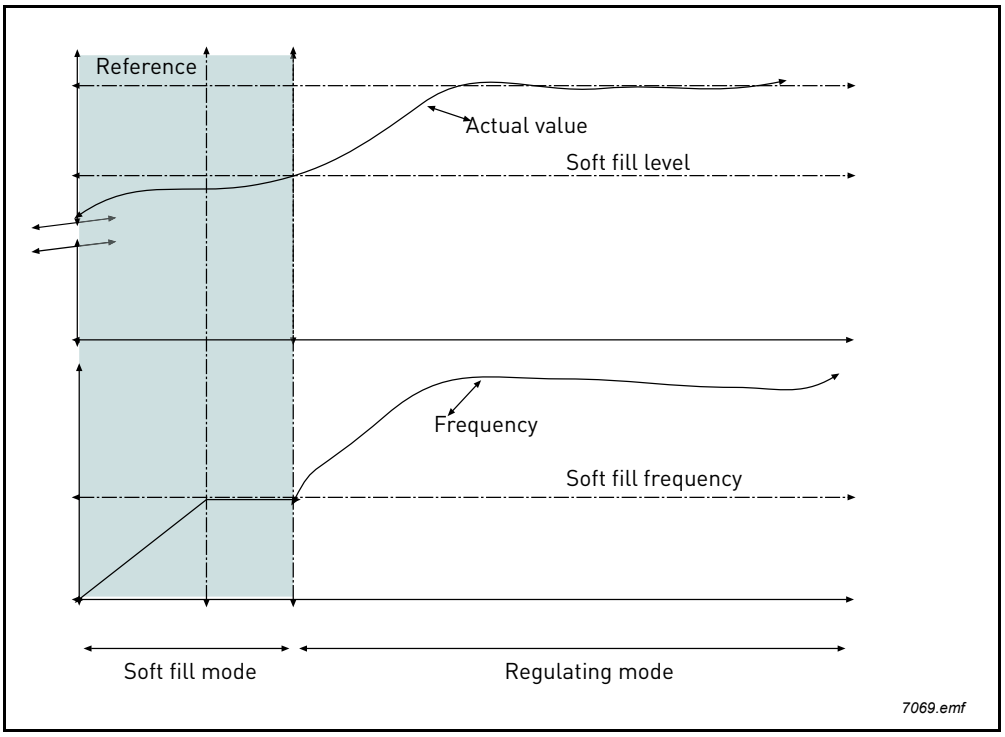


Figure 41.

The drive runs at the *Soft fill frequency* (P3.13.7.2) until the actual value reaches the *Soft fill level* (P3.13.7.3). After this the drive starts to regulate. If the *Soft fill level* isn't reached within the *Soft fill timeout* (P3.13.7.4) an alarm or fault is triggered according to the *Soft fill supervision* response (P3.9.22).

NOTE: The Soft fill function is disabled if parameter P3.13.1.8 *Error inversion* is set to *Inverted*.

Use of Pump and Fan Cascade

A motor/motors are connected/disconnected if the PID controller is not able to keep the process value or feedback within the defined bandwith around the setpoint.

Criteria for connecting/adding motors (also see Figure 42):

- Feedback value outside the bandwidth area.
- Regulating motor running at a “close-to-max” frequency (-2Hz)
- Conditions above are fulfilled for a time longer than the bandwidth delay
- There are more motors available

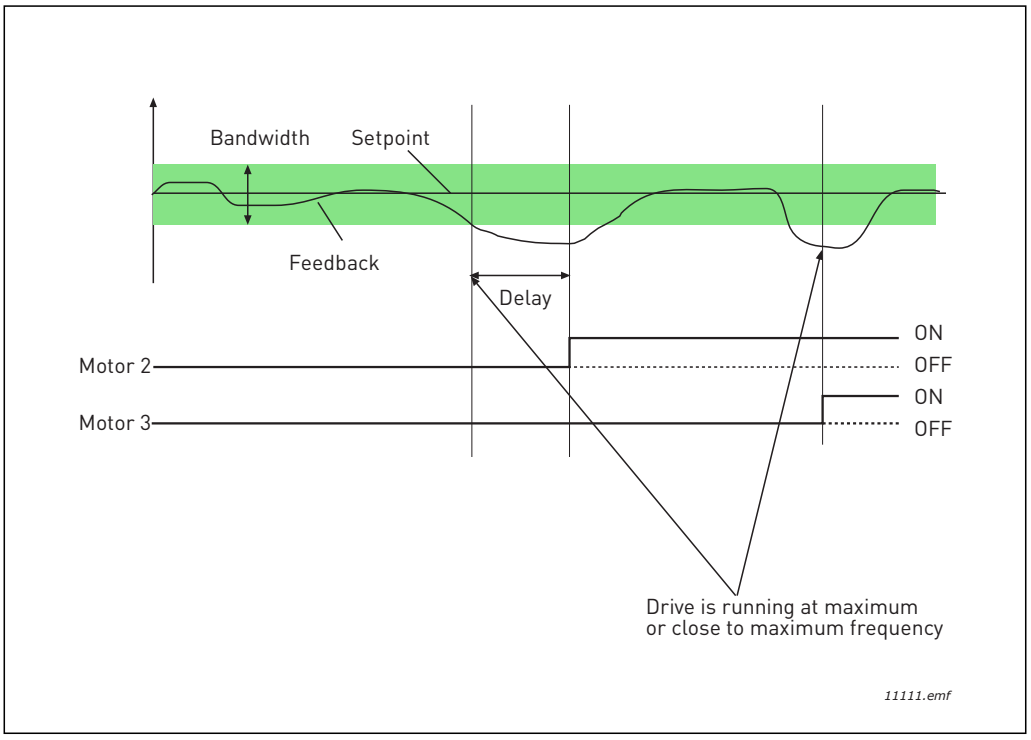


Figure 42.

Criteria for disconnecting/removing motors:

- Feedback value outside bandwidth area.
- Regulating motor running at a “close-to-min” frequency (+2 Hz)
- Conditions above are fulfilled for a time longer than the bandwidth delay
- There are more motors running than the regulating one.

P3.15.2 INTERLOCK FUNCTION

Interlocks can be used to tell the Multi Pump system that a motor is not available e.g. because of the motor is removed from the system for maintenance or bypassed for manual control.

Enable this function to use the interlocks. Choose the needed status for each motor by digital inputs (parameters P3.5.1.26 to P3.5.1.29). If the input is closed (TRUE) the motor is available for the Multi Pump system, otherwise it will not be connected by the Multi Pump logic.

EXAMPLE OF THE INTERLOCK LOGIC:

If the motor starting order is

1->2->3->4->5

Now, the interlock of motor **3** is removed, i.e. the value of parameter P3.5.1.27 is set to FALSE, the order changes to:

1->2->4->5.

If motor **3** is taken into use again (changing the value of parameter P3.5.1.27 to TRUE) the system runs on without stopping and motor **3** is placed last in the sequence:

1->2->4->5->3

As soon as the system is stopped or goes to sleep mode for the next time, the sequence is updated to its original order.

1->2->3->4->5

P3.15.3 INCLUDE FC

Selection	Selection name	Description
0	Disabled	Motor 1 (motor connected to drive) is always frequency controlled and not affected by interlocks.
1	Enabled	All motors can be controlled and are affected by interlocks.

WIRING

There are two different ways to make the connections depending on whether selection **0** or **1** is set as parameter value.

Selection 0, Disabled:

The drive or the regulating motor is not included in the autochange or interlocks logic. The drive is directly connected to motor 1 as in Figure 43 below. The other motors are auxiliary ones connected to the mains by contactors and controlled by relays in the drive.

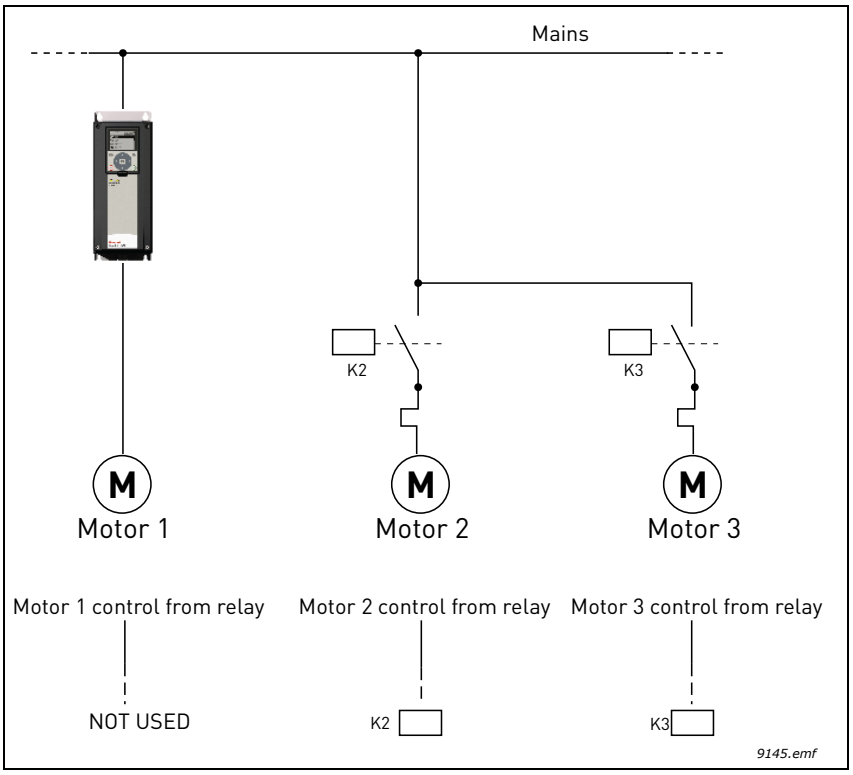


Figure 43.

Selection 1, Enabled:

If the regulating motor needs to be included in the autochange or interlock logic make the connection according to Figure 44 below.

Every motor is controlled with one relay but the contactor logic takes care that the first connected motor is always connected to the drive and next to the mains.

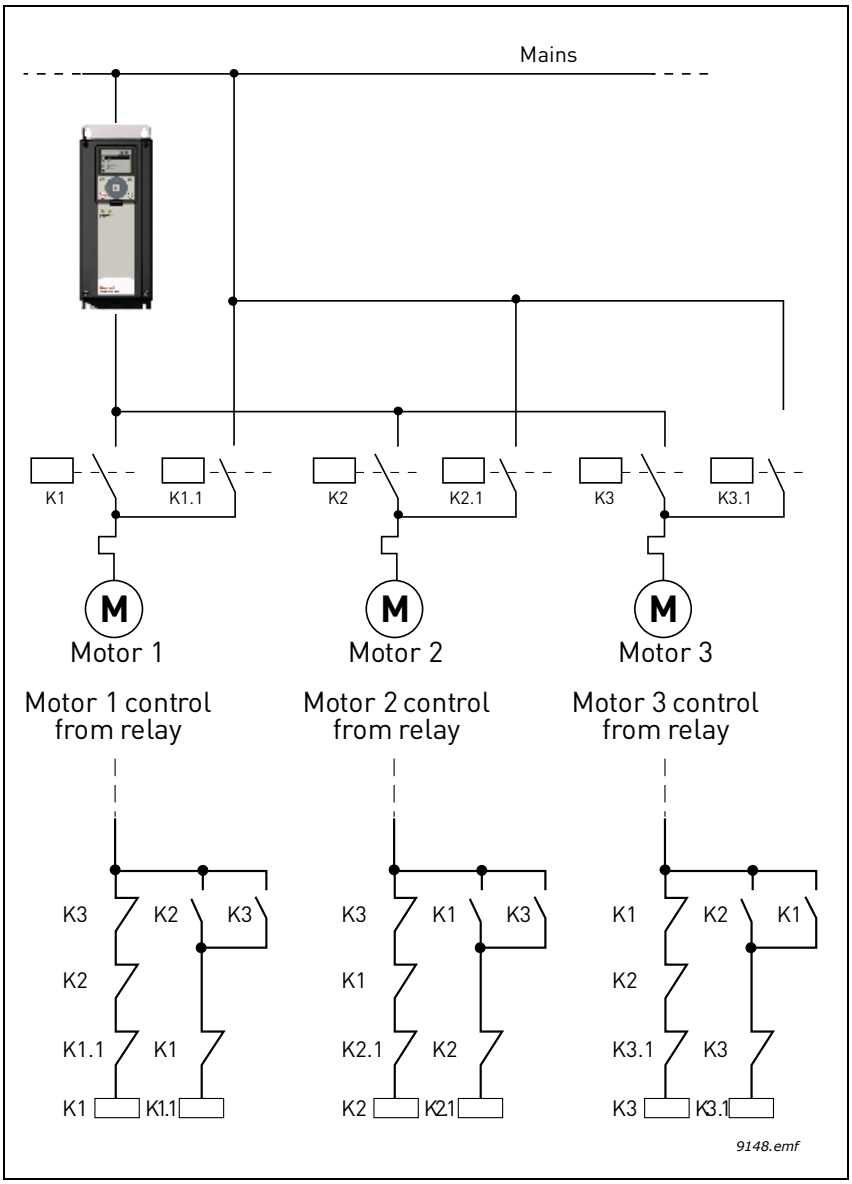

Mains
K1
K1.1
K2
K2.1
K3
K3.1
M
Motor 1
M
Motor 2
M
Motor 3
Motor 1 control from relay
Motor 2 control from relay
Motor 3 control from relay
K3
K2
K3
K2
K1.1
K1
K1
K1.1
K3
K1
K3
K1
K2.1
K2
K2
K2.1
K1
K2
K1
K2
K3.1
K3
K3
K3.1
9148.emf

Figure 44.

P3.15.4 AUTOCHANGE

Selection	Selection name	Description
0	Disabled	The priority/starting order of the motors is always 1-2-3-4-5 in normal operation. It might have changed during run if interlocks have been removed and added again, but the priority/order is always restored after a stop.
1	Enabled	The priority is changed at certain intervals to get an equal wear on all motors. The intervals of the auto-change can be changed (P3.15.5). You can also set a limit of how many motors are allowed to run (P3.15.7) as well as for the maximum frequency of the regulating drive when the autochange is done (P3.15.6). If the autochange interval P3.15.5) has expired, but the frequency and motor limits are not fulfilled, the autochange will be postponed until all conditions are met (this is to avoid e.g. sudden pressure drops because of the system performing an autochange when there is a high capacity demand at a pump station.

EXAMPLE:

In the autochange sequence after the autochange has taken place, the motor with the highest priority is placed last and the others are moved up by one place:

Starting order/priority of motors: **1->2->3->4->5**

--> *Autochange* -->

Starting order/priority of motors: **2->3->4->5->1**

--> *Autochange* -->

Starting order/priority of motors: **3->4->5->1->2**

P3.17.1 FIRE MODE PASSWORD

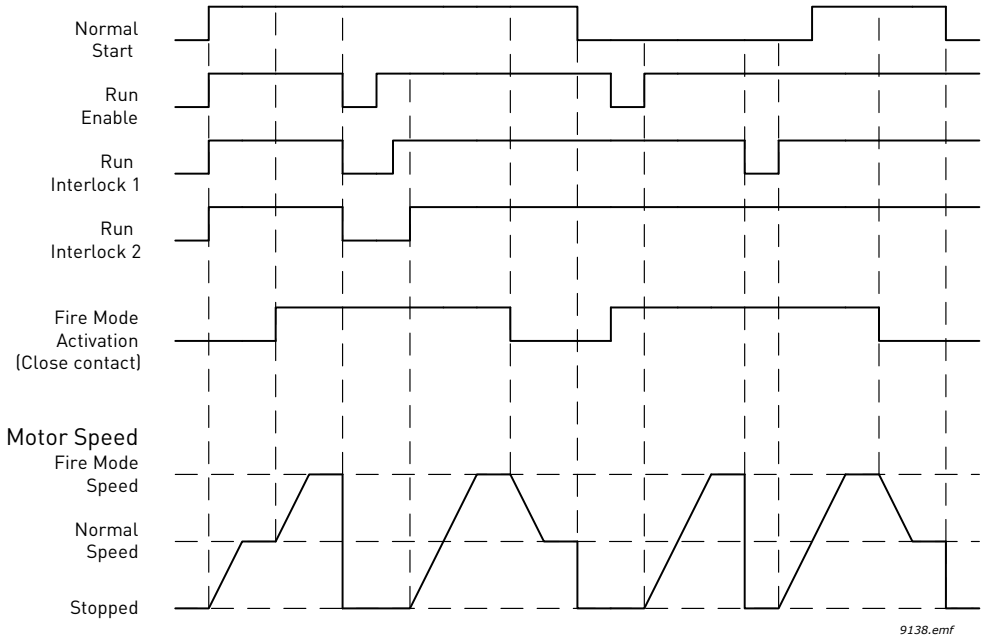
Selection	Selection name	Description
1001	Enabled mode	The drive resets all upcoming faults and continues running at the given speed as long as it is possible. **NOTE:** All Fire mode parameters are locked if this password has been given. To enable changing the Fire mode parameterization, first change the parameter value to zero.
1234	Test mode	If a fault occurs, the upcoming errors are not reset automatically and the drive stops.

P3.17.2 FIRE MODE ACTIVATION ON DI OPEN

If activated, the alarm sign is shown on the keypad and warranty is void. In order to enable the function, you need to set a password in the description field for the parameter Fire Mode password. Note the NC (normally closed) type of this input. It is possible to test the Fire mode with-

out voiding the warranty by using the password that allows the Fire mode to run in test state. In the test state, if an fault occurs, the upcoming errors are not automatically reset and the drive stops.

NOTE: All Fire mode parameters will be locked if Fire mode is enabled and the correct password is given to the Fire mode Password parameter. To change the Fire mode parameterization, change the Fire Mode Password parameter to zero first.



P3.17.3 FIRE MODE ACTIVATION ON DI CLOSE

See above.

P3.17.4 FIRE MODE FREQ

This parameter defines the constant frequency reference that is used when the Fire mode has been activated and the Fire mode frequency has been selected to the frequency reference source in parameter P3.17.5.

See parameter P3.17.6 to select or change the motor rotation direction when the Fire mode function is active.

P3.17.5 FIRE MODE FREQ SOURCE

This parameter defines the frequency source for Fire Mode when Fire mode is enabled.

Selections:
0 = Fire Mode Freq
1 = Preset Freqs
2 = Keypad Ref
3 = Fieldbus
4 = AI1
5 = AI2
6 = AI1 + AI2
7 = PID1 Ref

8 = Motor Pot Ref

P3.17.6 FIRE MODE FREQ REVERSE

This parameter defines the digital input signal to select the motor rotation direction with activated Fire Mode function. It has no effect in normal operation.

If the motor is required to run always FORWARD or always REVERSE in Fire Mode, select:

DigIn Slot0.1 = always FORWARD

DigIn Slot0.2 = always REVERSE

P3.17.7 FIRE MODE PRESET FREQ 1
P3.17.8 FIRE MODE PRESET FREQ 2
P3.17.9 FIRE MODE PRESET FREQ 3

Preset frequency for Fire Mode. When P3.5.1.37 or P3.5.1.38 are in use, these preset frequencies are used along with Fire Mode.

V3.17.10 FIRE MODE STATUS

This monitor value shows the status for Fire Mode.

0 = Disabled

1 = Enabled

2 = Activated

3 = Test Mode

V3.17.11 FIRE MODE COUNTER

Fire Mode counter shows how many times the Fire Mode has been activated. The counter cannot be reset. If the monitor value is other than zero, the warranty of the drive has become void.

P8.1 USER LEVELS

User levels can be used to hide certain folders. P8.2 can be set to prevent user level changes with password.

Selection number	Selection name	Description
1	Normal	All folders visible
2	Monitoring	Quick setup, parameters and favourites are hidden
3	Favourites	Quick setup, parameters and monitor are hidden

P8.2 ACCESS CODE

The user can define his own access code for each user level by entering the access code to this parameter when the desired user level has been selected. The access code will be asked when the user level will be changed.

4.7 Fault tracing

When an unusual operating condition is detected by the drive control diagnostics, the drive initiates a notification visible, for example, on the keypad. The keypad will show the code, the name and a short description of the fault or alarm.

The notifications vary in consequence and required action. *Faults* make the drive stop and require reset of the drive. *Alarms* inform of unusual operating conditions but the drive will continue running. *Infos* may require resetting but do not affect the functioning of the drive.

For some faults you can program different responses in the application. See parameter group Protections.

The fault can be reset with the *Reset button* on the control keypad or via the I/O terminal. The faults are stored in the Fault history menu which can be browsed. The different fault codes you will find in the table below.

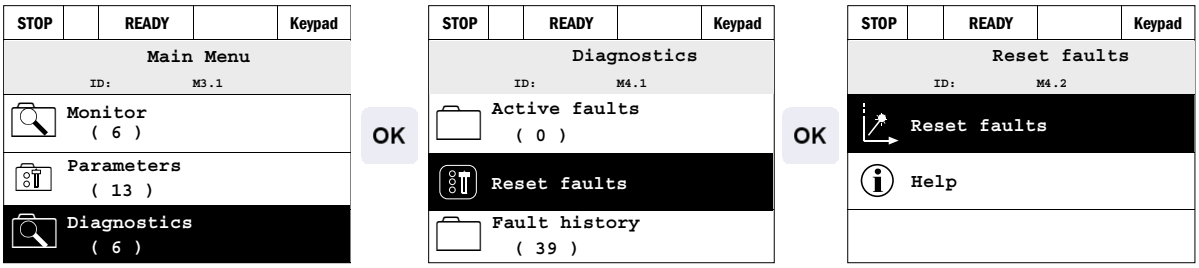
NOTE: When contacting technical support because of a fault condition, always write down all texts and codes on the keypad display.

4.7.1 Fault appears

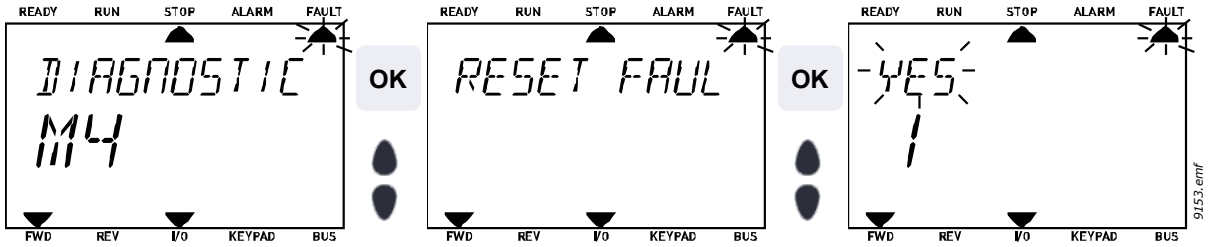
When a fault appears and the drive stops examine the cause of fault, perform the actions advised here and reset the fault as instructed below.

1. With a long (1 s) press on the *Reset* button on the keypad or
2. By entering the *Diagnostics* Menu (M4), entering *Reset faults* (M4.2) and selecting *Reset faults* parameter.
3. For Advanced commissioning HMI only: By selecting value Yes for the parameter and clicking OK.

NOTE: For the Keypad with advanced commissioning Human Machine Interface (HMI) features a graphical LCD display.



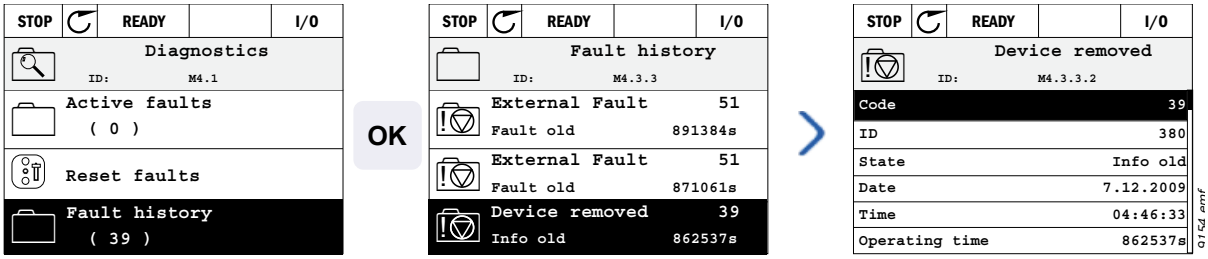
NOTE: For the Keypad with Multi-language Human Machine Interface (HMI).



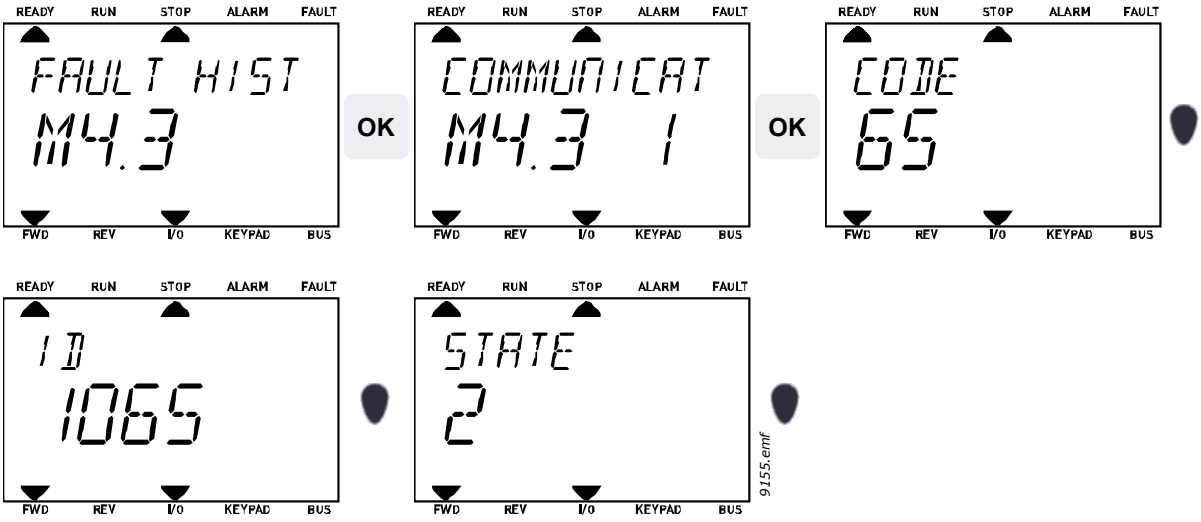
4.7.2 Fault history

In menu M4.3 Fault history you find the maximum number of 40 occurred faults. On each fault in the memory you will also find additional information, see below.

NOTE: For the Keypad with advanced commissioning Human Machine Interface (HMI) features a graphical LCD display.



NOTE: For the Keypad with Multi-language Human Machine Interface (HMI).



4.7.3 Fault codes

Fault code	ID	Fault name	Possible cause	Remedy
1	1	Overcurrent (hardware fault)	Drive has detected too high a current (>4*I_H) in the motor cable: • sudden heavy load increase • short circuit in motor cables • unsuitable motor	Check loading. Check motor. Check cables. Make identification run.
	2	Overcurrent (software fault)		
2	10	Overvoltage (hardware fault)	The DC-link voltage has exceeded the limits defined. • too short a deceleration time • high overvoltage spikes in supply	Make deceleration time longer. Use brake chopper or brake resistor (available as options) Activate overvoltage controller. Check input voltage.
	11	Overvoltage (software fault)		
3	20	Earth fault (hardware fault)	Current measurement has detected that the sum of motor phase current is not zero. • insulation failure in cables or motor	Check motor cables and motor.
	21	Earth fault (software fault)		
5	40	Charging switch	The charging switch is open, when the START command has been given. • faulty operation • component failure	Reset the fault and restart. Should the fault re-occur, contact the technical support.
7	60	Saturation	Various causes: • defective component • brake resistor short-circuit or overload	Cannot be reset from keypad. Switch off power. DO NOT RE-CONNECT POWER! Contact factory. If this fault appears simultaneously with Fault 1, check motor cables and motor

Fault code	ID	Fault name	Possible cause	Remedy
8	600	System fault	Communication between control board and power unit has failed	Reset the fault and restart. Should the fault re-occur, contact the technical support.
	601		Communication between control board and power unit has interference but is still working (ALARM)	
	602		Watchdog has reset the CPU	
	603		Voltage of auxiliary power in power unit is too low	
	604		Phase fault: Voltage of an output phase does not follow the reference	
	605		CPLD has faulted but there is no detailed information about the fault	
	606		Control and power unit software are incompatible	Update software. Should the fault re-occur, contact the distributor near to you.
	607		Software version cannot be read. There is no software in power unit.	Update power unit software. Should the fault re-occur, contact the distributor near to you.
	608		CPU overload. Some part of the software (for example application) has caused an overload situation. The source of fault has been suspended	Reset the fault and restart. Should the fault re-occur, contact the distributor near to you.
	609		Memory access has failed. For example, retain variables could not be restored.	
	610		Necessary device properties cannot be read.	
	647		Software error	Update software. Should the fault re-occur, contact the distributor near to you.
	648		Invalid function block used in application. System software and application are not compatible.	
	649		Resource overload. Error when loading parameter initial values. Error when restoring parameters. Error when saving parameters.	
9	80	Undervoltage (fault)	DC-link voltage is under the voltage limits defined. • most probable cause: too low a supply voltage • AC drive internal fault • defect input fuse • external charge switch not closed	In case of temporary supply voltage break reset the fault and restart the drive. Check the supply voltage. If it is adequate, an internal failure has occurred. Contact the technical support.
	81	Undervoltage (alarm)		
10	91	Input phase	Input line phase is missing.	Check supply voltage, fuses and cable.
11	100	Output phase supervision	Current measurement has detected that there is no current in one motor phase.	Check motor cable and motor.

Fault code	ID	Fault name	Possible cause	Remedy
12	110	Brake chopper supervision (hardware fault)	• no brake resistor installed • brake resistor is broken • brake chopper failure	Check brake resistor and cabling. If the these are ok, the chopper is faulty. Contact the technical support.
	111	Brake chopper saturation alarm		
13	120	Drive undertemperature (fault)	Too low temperature measured in power unit's heatsink or board. Heatsink temperature is under -10°C.	
	121	Drive undertemperature (alarm)		
14	130	Drive overtemperature (fault, heatsink)	Too high temperature measured in power unit's heatsink or board. Heatsink temperature is over 100°C.	Check the correct amount and flow of cooling air. Check the heatsink for dust. Check the ambient temperature. Make sure that the switching frequency is not too high in relation to ambient temperature and motor load.
	131	Drive overtemperature (alarm, heatsink)		
	132	Drive overtemperature (fault, board)		
	133	Drive overtemperature (alarm, board)		
15	140	Motor stalled	Motor stall protection has tripped.	Check motor and load.
16	150	Motor overtemperature	Motor overheating has been detected by drive motor temperature model. Motor is overloaded.	Decrease motor load. If no motor overload exists, check the temperature model parameters.
17	160	Motor underload (broken belt/dry pump)	Motor underload protection has tripped.	FAN: Check that the belt is not broken. PUMP: Check that the pump is not dry.
41	400	IGBT temperature	IGBT temperature (unit temperature + I_2T) is too high.	Check loading. Check motor size. Make identification run.
51	1051	External fault	Digital input	
52	1052 1352	Keypad communication fault	The connection between the control keypad and drive is broken	Check keypad connection and possible keypad cable
53	1053	Fieldbus communication fault	The data connection between the fieldbus master and fieldbus board is broken	Check installation and fieldbus master.
54	1354 1454 1654 1754	Slot A fault Slot B fault Slot D fault Slot E fault	Defective option board or slot	Check board and slot

Fault code	ID	Fault name	Possible cause	Remedy
65	**1065**	PC communication fault	The data connection between the PC and drive is broken	
66	**1066**	Thermistor fault	The thermistor input has detected an increase of motor temperature	Check motor cooling and load. Check thermistor connection (If thermistor input is not in use it has to be short circuited)
68	**1301**	Maintenance counter 1 alarm	Maintenance counter has reached the alarm limit.	Carry out the needed maintenance and reset counter.
	1302	Maintenance counter 1 fault	Maintenance counter has reached the fault limit.	
	1303	Maintenance counter 2 alarm	Maintenance counter has reached the alarm limit.	
	1304	Maintenance counter 2 fault	Maintenance counter has reached the fault limit.	
	1305	Maintenance counter 3 alarm	Maintenance counter has reached the alarm limit.	
	1306	Maintenance counter 3 fault	Maintenance counter has reached the fault limit.	
69	**1310**	Fieldbus mapping error	Non-existing ID number is used for mapping values to Fieldbus Process Data Out.	Check parameters in Fieldbus Data Mapping menu (chapter 4.5.8).
	1311		Not possible to convert one or more values for Fieldbus Process Data Out.	The value being mapped may be of undefined type. Check parameters in Fieldbus Data-Mapping menu (chapter 4.5.8).
	1312		Overflow when mapping and converting values for Fieldbus Process Data Out (16-bit).	
101	**1101**	Process supervision fault (PID1)	PID controller: Feedback value outside of supervision limits (and the delay if set).	
105	**1105**	Process supervision fault (PID2)	PID controller: Feedback value outside of supervision limits (and the delay if set).	

Table 75. Fault codes and descriptions

DPD01378A

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Honeywell Intemational Inc.
1985 Douglas Drive North
Golden Valley, MN 55422
customer.honeywell.com

Honeywell Limited-Honeywell Limitée
35 Dynamic Drive
Toronto, Ontario M1V 4Z9

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EN2B-0370GE51 R0114

January 2014

Honeywell