

**VACON<sup>®</sup> 100 INDUSTRIAL**  
**VACON<sup>®</sup> 100 X**  
**AC DRIVES**

**SOLAR PUMP**  
**APPLICATION GUIDE**



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# 1. PREFACE

The VACON® AC drive contains a preloaded VACON® 100 Solar Pump application for instant use.

## 1.1 SPECIFIC FUNCTIONS OF VACON® SOLAR PUMP APPLICATION

The VACON® 100 Solar Pump application allows flexible use of VACON® 100 frequency converters. This dedicated application software was developed to drive a solar pump with an optimized MPPT (Maximum Power Point Tracking) for VACON® 100 supplied by solar panels.

The MPPT is based on 4 parallel algorithms:

- Feed-Forward Controller (to follow the radiation variations)
- Correction Controller (to compensate the temperature variations)
- Oscillation Damping Regulator (to prevent the panel entering in the “current source” branch of the characteristic)
- Local Maxima logic (to prevent the regulator from being trapped in a local maximum lower than absolute maximum)

### Features

- The MPP Tracker controls DC voltage reference in order to find the maximum power.
- **Extensive wizards** for start-up, PID-control used to facilitate commissioning
- **‘Funct’ button** for easy change between Local (keypad) and Remote control place. The remote control place is selectable by parameter (I/O or Fieldbus)
- **8 preset frequencies**
- **Motor potentiometer** functions
- 2 programmable **ramp times**, 2 **supervisions** and 3 ranges of **prohibited frequencies**
- **Control page** for easy operation and monitoring of the most essential values.
- **Fieldbus** data mapping
- **Automatic reset**
- Different **pre-heat modes** used to avoid condensation problems
- **Maximum output frequency 320 Hz**
- **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 AC drive 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**
- **Maintenance** counter
- **Underload protection** can be managed by measuring Motor torque (standard sensorless mode) or by measuring the water flow with a flow meter sensor. This sensor can be an analogue signal or a digital input. With this sensor it is possible to measure the water flow [litres/min] and the total volume of the water flow [m<sup>3</sup>].
- **Sleep mode** can be enabled or disabled with a parameter.
- Digital inputs can be used to **measure water levels** (minimum and maximum).

## 1.2 VERSION HISTORY

This guide is regularly reviewed and updated. All suggestions for improvement are welcome.

The original language of this guide is English.

*Table 1. Version history*

| Edition   | Remarks  |
|-----------|--|
| DPD01602D | Added lifting instructions to Chapter 3.3.<br>Updated DC fuse selection information in Chapter 3.4.<br>Updated Photovoltaic system dimensioning information in Chapter 3.7.<br>Added power ratings to Chapter 3.8.<br>Added over voltage category information to Chapter 3.10.4.<br>Updated DC power connection information in Chapter 3.12. |

## 2. SAFETY

This manual contains clearly marked warning information which is intended for your personal safety and to avoid any unintentional damage to the product or connected appliances.

**Before installing, commissioning or using the frequency converter, please read the warning information contained in the corresponding operating guide/installation manual.**

**Please read the following additional safety instructions carefully.**

**Only Danfoss authorized, trained and qualified personnel are allowed to install, operate and maintain the drive.**

### 2.1 DANGER

These warnings are intended to personnel responsible for grounding the frequency converter.



Ignoring the following instructions can be **extremely dangerous and may cause death or severe injury.**



Ground the frequency converter to ensure personnel **safety and to reduce electromagnetic interference.**



**After disconnecting** the AC drive from the mains or from the DC input supply, **wait** until the indicators on the keypad go out (if no keypad is attached, see the indicators on the cover). Wait an additional 60 seconds before starting any work on the connections of the drive. After expiration of this time, use measuring equipment to absolutely ensure that no voltage is present. **Always ensure absence of voltage before starting any electrical work!**

### 2.2 WARNINGS



The **touch current** of the drive exceeds 3.5 mA AC. According to standard EN61800-5-1, **a reinforced protective ground connection** must be ensured. See the Installation Manual/Operating Guide of your product for further information.



**Never work on the photovoltaic generator** or frequency converter and its input/output cables when the frequency converter is connected to the mains or to the photovoltaic generator.



**Before performing any measurement on the frequency converter**, disconnect or isolate the mains supply voltage or the DC input supply.



**Do not touch the components on the frequency converter** or on the string box cabinet that have high DC voltage.



The photovoltaic generator **cells exposed to light supply DC voltage** even at low light intensity.





### 3. INSTALLATION


The installation instructions in this chapter are intended only for VACON® 100 X (MM4-MM6) and VACON® 100 INDUSTRIAL (MR5-MR12) drives with additional solar pump application. See the corresponding operating guide/installation manual for more installation instructions.

**NOTE!** The Solar pump application is active only with a plus code: +A1181. The drive can be ordered from factory using this plus code or it can be activated afterwards by license key.


#### 3.1 DANGER

|   |  |
|---|--|
|  | <b>The terminals are live</b> when the drive is connected to a photovoltaic system. <b>Photovoltaic cells generate DC voltage even at low intensity of sunlight.</b> |
|  | <b>Wait 60 seconds</b> until the drive is discharged, <b>before switching between AC and DC supply</b> (photovoltaic system) and vice versa.                         |

#### 3.2 WARNING

|  |   |
|--|---|
|  | Do not remove the EMC screws in the solar pump application. IT (impedance-grounded) AC supply network is not allowed in the solar pump application. |
|--|---|

#### 3.3 LIFTING THE AC DRIVE

|   |   |
|---|---|
|  | <b>LIFTING HEAVY LOAD</b><br>Not following the safe lifting instructions can result in death or serious injury. <ul style="list-style-type: none"> <li>• Do not walk under suspended loads.</li> <li>• Use lifting devices that are appropriate for the weight of the unit.</li> <li>• Use the recommended lifting method.</li> </ul> |
|---|---|

The AC drive is delivered horizontally in a cardboard box or on a wooden pallet. Open the package only when you install the drive. Do not keep the drive in storage in the vertical position.

##### 3.3.1 WEIGHT OF THE AC DRIVE

The weights of AC drives of different enclosure sizes are different. It can be necessary for you to use a lifting device to move the drive from its package. See the weights of the different enclosure sizes in below table.

Table 2. Weights of VACON® 100 X drives (MM4-MM6)

| Enclosure size | Weight |      |
|----------------|--------|------|
|                | [kg]   | [lb] |
| MM4            | 8.8    | 19.4 |
| MM5            | 14.9   | 32.8 |
| MM6            | 31.5   | 69.4 |

Table 3. Weights of VACON® 100 Wall-mounted Drives (MR4-MR9)

| Enclosure size | Weight |       |
|----------------|--------|-------|
|                | [kg]   | [lb]  |
| MR4            | 6.0    | 13.2  |
| MR5            | 10.0   | 20.0  |
| MR6            | 20.0   | 44.1  |
| MR7            | 37.5   | 82.7  |
| MR8            | 66.0   | 145.5 |
| MR9            | 119.5  | 263.5 |

Table 4. Weights of VACON® 100 IP00 Drive Modules (MR8-MR12)

| Enclosure size or item   | Weight |      |
|--|--------|------|
|  | [kg]   | [lb] |
| MR8 IP00 drive module  | 50     | 110  |
| MR9 IP00 drive module  | 107    | 214  |
| MR10 IP00 drive module   | 221    | 487  |
| MR10 IP00 drive module and the options module with the brake chopper   | 252    | 556  |
| MR10 IP00 drive module and the options module with the brake chopper and the common-mode filter                    | 258    | 569  |
| MR10 IP00 drive module and the options module with the brake chopper, the common-mode filter, and the dU/dt filter | 289    | 637  |
| MR10 IP00 drive module and the options module with AC fuses and fuse switch (+CIFD)                                | 332    | 732  |
| MR11 IP00 drive module   | 214    | 472  |
| MR12 IP00 drive module   | 442    | 974  |
| MR12 IP00 drive module and the options module with the brake chopper   | 504    | 1111 |
| MR12 IP00 drive module and the options module with the brake chopper and the common-mode filter                    | 516    | 1138 |
| MR12 IP00 drive module and the options module with the brake chopper, the common-mode filter, and the dU/dt filter | 578    | 1274 |
| MR12 IP00 drive module and the options module with AC fuses and fuse switch (+CIFD)                                | 570    | 1257 |

### 3.3.2 LIFTING ENCLOSURE SIZES MM4-MM6 AND MR4-MR9

|          |   |
|----------|---|
| <b>1</b> | Remove the drive from the cardboard box or the pallet where it was bolted to. |
| <b>2</b> | Use a lifting device that is sufficiently strong for the weight of the drive. |
| <b>3</b> | Put the lifting hooks symmetrically in a minimum of 2 holes.                  |
| <b>4</b> | The maximum lifting angle is 45°.   |

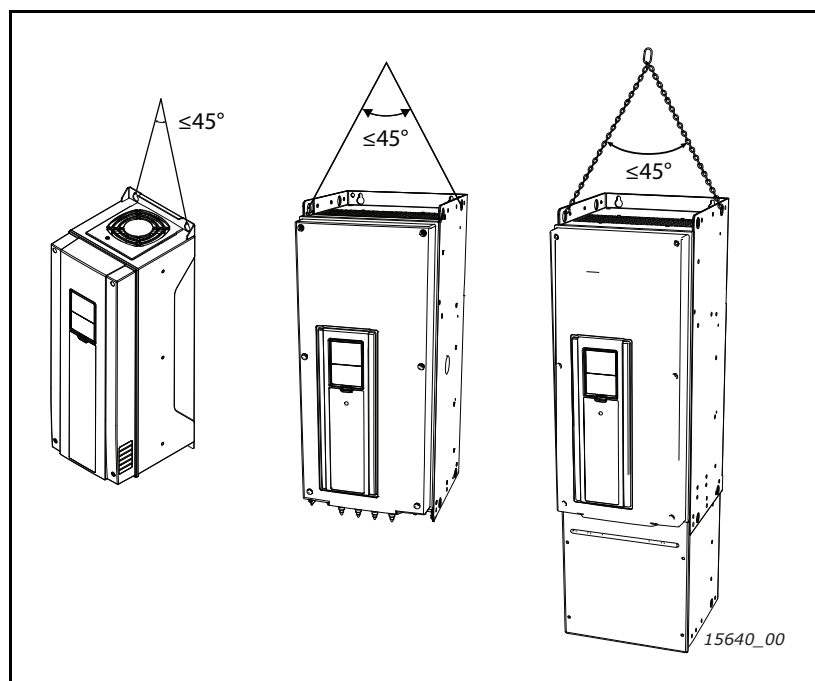


Figure 1. Lifting enclosure sizes MM4-MM6 and MR4-MR9

### 3.3.3 LIFTING VACON® 100 IP00 DRIVE MODULES MR10/MR12 WITHOUT OPTIONS

|          |   |
|----------|---|
| <b>1</b> | Remove the drive from the package.  |
| <b>2</b> | Make sure that the support (A in Figure 2) is attached to the bottom of the drive. It gives the terminals protection when you lift the drive or put it vertically on the floor. |
| <b>3</b> | Use a lifting device that is sufficiently strong for the weight of the drive.   |
| <b>4</b> | Put the lifting hooks in the holes on the top of the cabinet. The maximum lifting angle is 60°.   |
| <b>5</b> | After the lifting, you can remove the support if necessary. You can also use it as a fixing bracket.  |

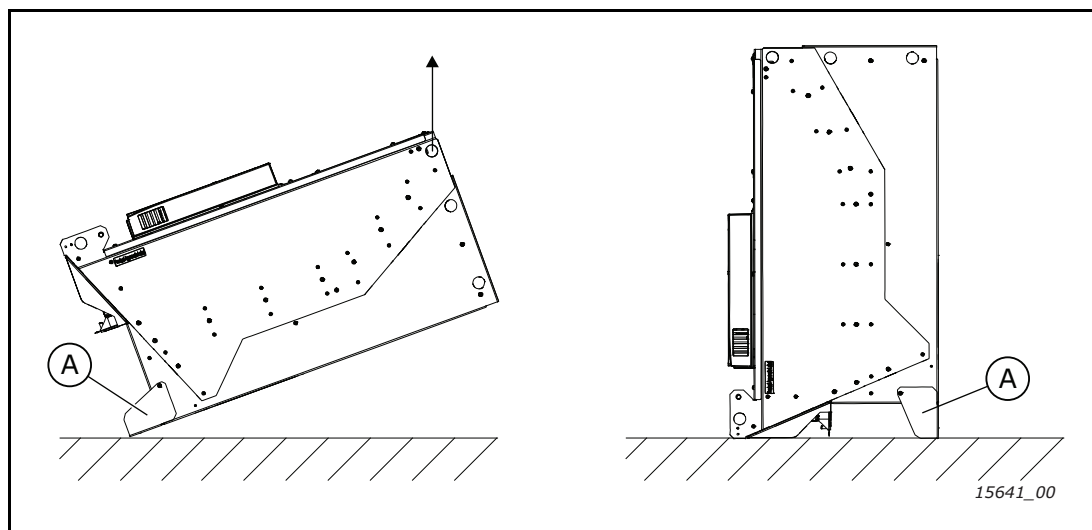


Figure 2. Lifting VACON® 100 IP00 Drive Modules MR10/MR12 without options

### 3.3.4 LIFTING VACON® 100 IP00 DRIVE MODULES MR10/MR12 WITH AN OPTIONS MODULE

|          |   |
|----------|---|
| <b>1</b> | Remove the drive from the package.  |
| <b>2</b> | Use a lifting device that is sufficiently strong for the weight of the drive.                   |
| <b>3</b> | Put the lifting hooks in the holes on the top of the cabinet. The maximum lifting angle is 60°. |
| <b>4</b> | Lift the drive into a vertical position.  |

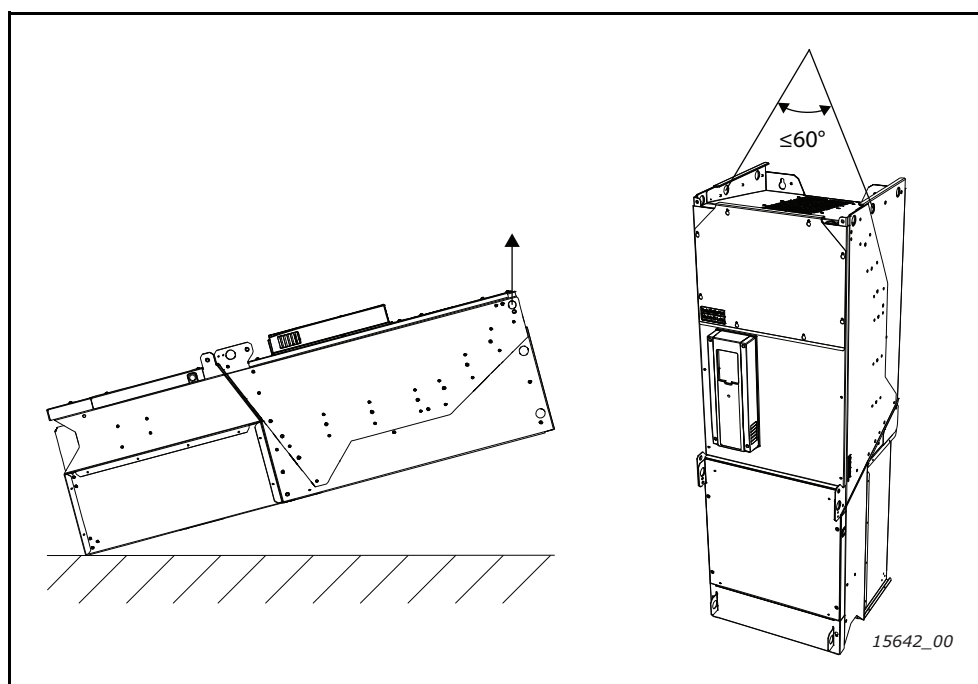


Figure 3. Lifting VACON® 100 IP00 Drive Modules MR10/MR12 with options module

### 3.4 DC FUSE SELECTION

The fuses on the DC-Input of the inverter must have the following characteristics:

*Table 5. Fuse characteristics*

| Fuse type  | Min. Voltage rating |
|------------|---------------------|
| DC current | 1000 V              |

It is recommended to use gPV fuses, which are developed for solar application, in order to protect cables and panels against reverse over current, when multiple strings are connected in parallel. See chapter 3.5. for recommended gPV fuse manufacturer.

The photovoltaic fuses have to meet the IEC 60269-6 or the UL 2579 standard.

The maximum  $I_{SC}$  PV and inverter back-feed current depend on the used DC fuses. Make sure that the breaking capacity of the fuses is sufficient for the final application. Also, local regulations must be taken into account.

See the tables below for recommended fuse sizes:

*Table 6. Recommended fuse sizes, Mains voltage 3AC 208-240 V, 50/60 Hz, up to 400 V in V DC*

| Enclosure size | AC drive type | Rated continuous current [A] | IEC60269-6 Fuse size [A] | UL-2579 Fuse size [A] | Total number of fuses |
|----------------|---------------|------------------------------|--------------------------|-----------------------|-----------------------|
| MM4            | 0007          | 6.6                          | 12                       | 12                    | 2                     |
|                | 0008          | 8.0                          | 15                       | 15                    | 2                     |
|                | 0011          | 11.0                         | 20                       | 20                    | 2                     |
|                | 0012          | 12.5                         | 20                       | 25                    | 2                     |
| MM5            | 0018          | 18.0                         | 30                       | 40                    | 2                     |
|                | 0024          | 24.0                         | 40                       | 50                    | 2                     |
|                | 0031          | 31.0                         | 50                       | 63                    | 2                     |
| MM6            | 0048          | 48.0                         | 80                       | 100                   | 2                     |
|                | 0062          | 62.0                         | 100                      | 125                   | 2                     |
| MR5            | 0018          | 18.0                         | 30                       | 40                    | 2                     |
|                | 0024          | 24.0                         | 40                       | 50                    | 2                     |
|                | 0031          | 31.0                         | 50                       | 63                    | 2                     |
| MR6            | 0048          | 48.0                         | 80                       | 100                   | 2                     |
|                | 0062          | 62.0                         | 100                      | 125                   | 2                     |
| MR7            | 0075          | 75.0                         | 125                      | 160                   | 2                     |
|                | 0088          | 88.0                         | 160                      | 200                   | 2                     |
|                | 0105          | 105.0                        | 200                      | 200                   | 2                     |
| MR8            | 0140          | 140.0                        | 250                      | 315                   | 2                     |
|                | 0170          | 170.0                        | 315                      | 400                   | 2                     |
|                | 0205          | 205.0                        | 400                      | 400                   | 2                     |
| MR9A           | 0261          | 261.0                        | 500                      | 500                   | 2                     |
|                | 0310          | 310.0                        | 600                      | 630                   | 2                     |

Table 7. Recommended fuse sizes, Mains voltage 3AC 380-480/500 V, 50/60 Hz, up to 800 V in V DC

| Enclosure size | AC drive type | Rated continuous current [A] | IEC60269-6 Fuse size [A] | UL-2579 Fuse size [A] | Total number of fuses |
|----------------|---------------|------------------------------|--------------------------|-----------------------|-----------------------|
| MM4            | 0003          | 3.4                          | 6                        | 6                     | 2                     |
|                | 0004          | 4.8                          | 8                        | 8                     | 2                     |
|                | 0005          | 5.6                          | 10                       | 10                    | 2                     |
|                | 0008          | 8.0                          | 12                       | 15                    | 2                     |
|                | 0009          | 9.6                          | 15                       | 16                    | 2                     |
|                | 0012          | 12.0                         | 20                       | 20                    | 2                     |
| MM5            | 0016          | 16.0                         | 25                       | 30                    | 2                     |
|                | 0023          | 23.0                         | 40                       | 40                    | 2                     |
|                | 0031          | 31.0                         | 50                       | 63                    | 2                     |
| MM6            | 0038          | 38.0                         | 63                       | 63                    | 2                     |
|                | 0046          | 46.0                         | 80                       | 80                    | 2                     |
|                | 0061          | 61.0                         | 100                      | 100                   | 2                     |
|                | 0072          | 72.0                         | 125                      | 125                   | 2                     |
| MR5            | 0016          | 16.0                         | 30                       | 30                    | 2                     |
|                | 0023          | 23.0                         | 40                       | 50                    | 2                     |
|                | 0031          | 31.0                         | 50                       | 63                    | 2                     |
| MR6            | 0038          | 38.0                         | 63                       | 80                    | 2                     |
|                | 0046          | 46.0                         | 80                       | 100                   | 2                     |
|                | 0061          | 61.0                         | 100                      | 125                   | 2                     |
| MR7            | 0072          | 72.0                         | 125                      | 150                   | 2                     |
|                | 0087          | 87.0                         | 160                      | 200                   | 2                     |
|                | 0105          | 105.0                        | 200                      | 200                   | 2                     |
| MR8            | 0140          | 140.0                        | 250                      | 315                   | 2                     |
|                | 0170          | 170.0                        | 315                      | 400                   | 2                     |
|                | 0205          | 205.0                        | 400                      | 400                   | 2                     |
| MR9A           | 0261          | 261.0                        | 500                      | 500                   | 2                     |
|                | 0310          | 310.0                        | 600                      | 630                   | 2                     |
| MR9B           | 0386          | 385.0                        | 2 x 350                  | 2 x 400               | 4                     |
| MR10           | 0385          | 385.0                        | 2 x 350                  | 2 x 400               | 4                     |
|                | 0460          | 460.0                        | 2 x 500                  | 2 x 500               | 4                     |
|                | 0520          | 520.0                        | 2 x 500                  | 2 x 500               | 4                     |
|                | 0590          | 590.0                        | 2 x 600                  | 2 x 600               | 4                     |
| MR11           | 0651          | 650.0                        | 4 x 350                  | 4 x 400               | 8                     |
|                | 0731          | 730.0                        | 4 x 400                  | 4 x 400               | 8                     |

Table 7. Recommended fuse sizes, Mains voltage 3AC 380-480/500 V, 50/60 Hz, up to 800 V in V DC

| Enclosure size | AC drive type | Rated continuous current [A] | IEC60269-6 Fuse size [A] | UL-2579 Fuse size [A] | Total number of fuses |
|----------------|---------------|------------------------------|--------------------------|-----------------------|-----------------------|
| MR12           | 0650          | 650.0                        | 4 x 350                  | 4 x 400               | 8                     |
|                | 0730          | 730.0                        | 4 x 400                  | 4 x 400               | 8                     |
|                | 0820          | 820.0                        | 4 x 400                  | 4 x 500               | 8                     |
|                | 0920          | 920.0                        | 4 x 500                  | 4 x 500               | 8                     |
|                | 1040          | 1040.0                       | 4 x 600                  | 4 x 600               | 8                     |
|                | 1180          | 1180.0                       | 4 x 600                  | 4 x 630               | 8                     |

### 3.5 MANUFACTURERS OF gPV FUSES

Recommended manufacturers of gPV type fuses:

- Littelfuse
- Siba
- Bussmann
- Mersen
- ETI
- DF Electric

### 3.6 PARALLEL DIODE SELECTION

When VACON® 100 X (MM4-MM6) or VACON® 100 INDUSTRIAL (MR5-MR12) is used in the Solar Pump application, a diode must be connected between DC+ and DC- to protect the inverter against reverse voltage. See tables below for diode specification.

Table 8. Diode specification, Mains voltage 3AC 208-240 V, 50/60 Hz, up to 400 V in V DC

| AC drive       |               | Diode specifications |                         |                        |
|----------------|---------------|----------------------|-------------------------|------------------------|
| Enclosure size | AC drive type | min. IFav [A]        | Min. Voltage rating [V] | Max. Vf [V] @ IFav [A] |
| MM4            | 0007          | 15                   | 1200                    | 1.5                    |
|                | 0008          | 18                   |                         |                        |
|                | 0011          | 25                   |                         |                        |
|                | 0012          | 28                   |                         |                        |
| MM5            | 0018          | 40                   |                         |                        |
|                | 0024          | 54                   |                         |                        |
|                | 0031          | 70                   |                         |                        |
| MM6            | 0048          | 110                  |                         |                        |
|                | 0062          | 140                  |                         |                        |
| MR5            | 0018          | 50                   | 1200                    | 1.5                    |
|                | 0024          | 63                   |                         |                        |
|                | 0031          | 80                   |                         |                        |
| MR6            | 0048          | 125                  |                         |                        |
|                | 0062          | 160                  |                         |                        |
| MR7            | 0075          | 200                  |                         |                        |
|                | 0088          | 250                  |                         |                        |
|                | 0105          | 250                  |                         |                        |
| MR8            | 0140          | 400                  |                         |                        |
|                | 0170          | 500                  |                         |                        |
|                | 0205          | 500                  |                         |                        |
| MR9A           | 0261          | 625                  |                         |                        |
|                | 0310          | 800                  |                         |                        |



Table 9. Diode specification, Mains voltage 3AC 380-480/500 V, 50/60 Hz, up to 800 V in V DC

| AC drive       |               | Diode specifications |                         |                        |
|----------------|---------------|----------------------|-------------------------|------------------------|
| Enclosure size | AC drive type | min. IFav [A]        | Min. Voltage rating [V] | Max. Vf [V] @ IFav [A] |
| MM4            | 0003          | 8                    | 1200                    | 1.5                    |
|                | 0004          | 12                   |                         |                        |
|                | 0005          | 12                   |                         |                        |
|                | 0008          | 18                   |                         |                        |
|                | 0009          | 22                   |                         |                        |
|                | 0012          | 28                   |                         |                        |
| MM5            | 0016          | 36                   |                         |                        |
|                | 0023          | 50                   |                         |                        |
|                | 0031          | 70                   |                         |                        |
| MM6            | 0038          | 85                   |                         |                        |
|                | 0046          | 100                  |                         |                        |
|                | 0061          | 140                  |                         |                        |
|                | 0072          | 160                  |                         |                        |
| MR5            | 0016          | 40                   | 1200                    | 1.5                    |
|                | 0023          | 63                   |                         |                        |
|                | 0031          | 80                   |                         |                        |
| MR6            | 0038          | 100                  |                         |                        |
|                | 0046          | 125                  |                         |                        |
|                | 0061          | 160                  |                         |                        |
| MR7            | 0072          | 200                  |                         |                        |
|                | 0087          | 250                  |                         |                        |
|                | 0105          | 250                  |                         |                        |
| MR8            | 0140          | 400                  |                         |                        |
|                | 0170          | 500                  |                         |                        |
|                | 0205          | 500                  |                         |                        |
| MR9A           | 0261          | 625                  |                         |                        |
|                | 0310          | 800                  |                         |                        |
| MR9B           | 0386          | 1000                 |                         |                        |
| MR10           | 0385          | 1000                 |                         |                        |
|                | 0460          | 1250                 |                         |                        |
|                | 0520          | 1250                 |                         |                        |
|                | 0590          | 1500                 |                         |                        |
| MR11           | 0651          | 2 x 1000             |                         |                        |
|                | 0731          | 2 x 1000             |                         |                        |

Table 9. Diode specification, Mains voltage 3AC 380-480/500 V, 50/60 Hz, up to 800 V in V DC

| AC drive       |               | Diode specifications |                         |                        |
|----------------|---------------|----------------------|-------------------------|------------------------|
| Enclosure size | AC drive type | min. IFav [A]        | Min. Voltage rating [V] | Max. Vf [V] @ IFav [A] |
| MR12           | 0650          | 2 x 1000             | 1200                    | 1.5                    |
|                | 0730          | 2 x 1000             |                         |                        |
|                | 0820          | 2 x 1250             |                         |                        |
|                | 0920          | 2 x 1250             |                         |                        |
|                | 1040          | 2 x 1500             |                         |                        |
|                | 1180          | 2 x 1575             |                         |                        |

### 3.7 PHOTOVOLTAIC SYSTEM DIMENSIONING

The photovoltaic system has to be dimensioned in order to not exceed the values specified in the tables below. The VACON® 100 X enclosure sizes are MM4-MM6, and VACON® 100 INDUSTRIAL enclosure sizes are MR5-MR12.

Non-isolated inverters must be used with PV modules that have an IEC 61730 Class A rating.

Table 10. AC drive (208...240 V 3AC 50/60 Hz, up to 400 V DC) DC-link input ratings

| Enclosure size | AC drive type | DC supply [V DC]                        | Max. Recommended PV Array Power [kW] | V <sub>max</sub> PVa (absolute maximum) [V DC] | PV input operating voltage range [V DC] | Maximum operating PV input current [A DC] |
|----------------|---------------|---|--------------------------------------|--|---|---|
| MM4            | 0006          | 234-400<br>No tolerance permissible, 0% | 2.2                                  | 400  | 234-400                                 | 7.0                                       |
|                | 0008          |   | 3.0                                  | 400  | 234-400                                 | 9.0                                       |
|                | 0011          |   | 4.4                                  | 400  | 234-400                                 | 12.0                                      |
|                | 0012          |   | 6.0                                  | 400  | 234-400                                 | 14.0                                      |
| MM5            | 0018          |   | 8.0                                  | 400  | 234-400                                 | 20.0                                      |
|                | 0024          |   | 11.0                                 | 400  | 234-400                                 | 27.0                                      |
|                | 0031          |   | 15.0                                 | 400  | 234-400                                 | 35.0                                      |
| MM6            | 0048          |   | 22.0                                 | 400  | 234-400                                 | 54.0                                      |
|                | 0062          |   | 30.0                                 | 400  | 234-400                                 | 69.0                                      |
| MR5            | 0018          | 234-400<br>No tolerance permissible, 0% | 8.0                                  | 400  | 234-400                                 | 20.0                                      |
|                | 0024          |   | 11.0                                 | 400  | 234-400                                 | 27.0                                      |
|                | 0031          |   | 15.0                                 | 400  | 234-400                                 | 35.0                                      |
| MR6            | 0048          |   | 22.0                                 | 400  | 234-400                                 | 54.0                                      |
|                | 0062          |   | 30.0                                 | 400  | 234-400                                 | 71.0                                      |
| MR7            | 0075          |   | 37.0                                 | 400  | 234-400                                 | 85.0                                      |
|                | 0088          |   | 44.0                                 | 400  | 234-400                                 | 101.0                                     |
|                | 0105          |   | 60.0                                 | 400  | 234-400                                 | 121.0                                     |
| MR8            | 0140          |   | 74.0                                 | 400  | 234-400                                 | 161.0                                     |
|                | 0170          |   | 90.0                                 | 400  | 234-400                                 | 198.0                                     |
|                | 0205          |   | 110.0                                | 400  | 234-400                                 | 239.0                                     |
| MR9A           | 0261          |   | 150.0                                | 400  | 234-400                                 | 304.0                                     |
|                | 0310          |   | 180.0                                | 400  | 234-400                                 | 361.0                                     |

Table 11. AC drive (380...480/500 V 3AC 50/60Hz, up to 800 V DC) DC-link input ratings

| Enclosure size | AC drive type | DC supply [V DC]                             | Max. Recommended PV Array Power [kW] | V <sub>max</sub> PVa (absolute maximum) [V DC] | PV input operating voltage range [V DC] | Maximum operating PV input current [A DC] |
|----------------|---------------|--|--------------------------------------|--|---|---|
| MM4            | 0003          | 300/436*-800<br>No tolerance permissible, 0% | 2.2                                  | 800  | 300/436*-800                            | 4.0                                       |
|                | 0004          |  | 3.0                                  | 800  | 300/436*-800                            | 5.0                                       |
|                | 0005          |  | 4.4                                  | 800  | 300/436*-800                            | 6.0                                       |
|                | 0008          |  | 6.0                                  | 800  | 300/436*-800                            | 9.0                                       |
|                | 0009          |  | 8.0                                  | 800  | 300/436*-800                            | 11.0                                      |
|                | 0012          |  | 11.0                                 | 800  | 300/436*-800                            | 13.0                                      |
| MM5            | 0016          |  | 15.0                                 | 800  | 300/436*-800                            | 18.0                                      |
|                | 0023          |  | 22.0                                 | 800  | 300/436*-800                            | 26.0                                      |
|                | 0031          |  | 30.0                                 | 800  | 300/436*-800                            | 34.0                                      |
| MM6            | 0038          |  | 37.0                                 | 800  | 300/436*-800                            | 42.0                                      |
|                | 0046          |  | 44.0                                 | 800  | 300/436*-800                            | 51.0                                      |
|                | 0061          |  | 60.0                                 | 800  | 300/436*-800                            | 68.0                                      |
|                | 0072          |  | 74.0                                 | 800  | 300/436*-800                            | 80.0                                      |

Table 11. AC drive (380...480/500 V 3AC 50/60Hz, up to 800 V DC) DC-link input ratings

| Enclosure size | AC drive type | DC supply [V DC]                        | Max. Recommended PV Array Power [kW] | V <sub>max</sub> PVa (absolute maximum) [V DC] | PV input operating voltage range [V DC] | Maximum operating PV input current [A DC] |
|----------------|---------------|---|--------------------------------------|--|---|---|
| MR5            | 0016          | 436-800<br>No tolerance permissible, 0% | 15.0                                 | 800  | 436-800                                 | 18.0                                      |
|                | 0023          |   | 22.0                                 | 800  | 436-800                                 | 26.0                                      |
|                | 0031          |   | 30.0                                 | 800  | 436-800                                 | 35.0                                      |
| MR6            | 0038          |   | 37.0                                 | 800  | 436-800                                 | 43.0                                      |
|                | 0046          |   | 44.0                                 | 800  | 436-800                                 | 52.0                                      |
|                | 0061          |   | 60.0                                 | 800  | 436-800                                 | 69.0                                      |
| MR7            | 0072          |   | 74.0                                 | 800  | 436-800                                 | 82.0                                      |
|                | 0087          |   | 90.0                                 | 800  | 436-800                                 | 100.0                                     |
|                | 0105          |   | 110.0                                | 800  | 436-800                                 | 121.0                                     |
| MR8            | 0140          |   | 150.0                                | 800  | 436-800                                 | 161.0                                     |
|                | 0170          |   | 180.0                                | 800  | 436-800                                 | 198.0                                     |
|                | 0205          |   | 220.0                                | 800  | 436-800                                 | 239.0                                     |
| MR9A           | 0261          |   | 264.0                                | 800  | 436-800                                 | 304.0                                     |
|                | 0310          |   | 320.0                                | 800  | 436-800                                 | 361.0                                     |
| MR9B           | 0386          |   | 400.0                                | 800  | 436-800                                 | 454.0                                     |
| MR10           | 0460          |   | 500.0                                | 800  | 436-800                                 | 542.0                                     |
|                | 0520          |   | 500.0                                | 800  | 436-800                                 | 613.0                                     |
|                | 0590          |   | 630.0                                | 800  | 436-800                                 | 695.0                                     |
| MR11           | 0651          |   | 710.0                                | 800  | 436-800                                 | 766.0                                     |
|                | 0731          |   | 800.0                                | 800  | 436-800                                 | 860.0                                     |
| MR12           | 0820          |   | 900.0                                | 800  | 436-800                                 | 966.0                                     |
|                | 0920          |   | 1000.0                               | 800  | 436-800                                 | 1084.0                                    |
|                | 1040          |   | 1120.0                               | 800  | 436-800                                 | 1225.0                                    |
|                | 1180          |   | 1260.0                               | 800  | 436-800                                 | 1390.0                                    |

\* The minimum value is 300 V when the application version is AMIT1181\_V205 and the drive is manufactured after June 2019.

### 3.8 POWER RATINGS

Table 12. AC drive (208...240 V 3AC 50/60 Hz, up to 400 V DC) output ratings

| Enclosure size | AC drive type | Voltage (nominal or range) [V AC] | Current (maximum continuous) [A AC] | Current (inrush) [A AC] (2 s) | Frequency (nominal or range) [Hz] | Power (maximum continuous) [W] (230 V) | Power factor range | Max. output fault current [A AC] | Max. output over current protection [A AC] |
|----------------|---------------|-----------------------------------|-------------------------------------|-------------------------------|-----------------------------------|--|--------------------|----------------------------------|--|
| MM4            | 0006          | 0-240                             | 6.6                                 | 13.2                          | 0-320                             | 1100                                   | 0.3-1              | 19.9                             | 19.9                                       |
|                | 0008          | 0-240                             | 8.0                                 | 16.0                          | 0-320                             | 1500                                   | 0.3-1              | 26.3                             | 26.3                                       |
|                | 0011          | 0-240                             | 11.0                                | 22.0                          | 0-320                             | 2200                                   | 0.3-1              | 33.1                             | 33.1                                       |
|                | 0012          | 0-240                             | 12.5                                | 25.0                          | 0-320                             | 3000                                   | 0.3-1              | 39.8                             | 39.8                                       |
| MM5            | 0018          | 0-240                             | 18.0                                | 36.0                          | 0-320                             | 4000                                   | 0.3-1              | 72.3                             | 72.3                                       |
|                | 0024          | 0-240                             | 24.2                                | 48.4                          | 0-320                             | 5500                                   | 0.3-1              | 72.3                             | 72.3                                       |
|                | 0031          | 0-240                             | 31.0                                | 62.0                          | 0-320                             | 7500                                   | 0.3-1              | 91.1                             | 91.1                                       |
| MM6            | 0048          | 0-240                             | 48.0                                | 96.0                          | 0-320                             | 11000                                  | 0.3-1              | 154.3                            | 154.3                                      |
|                | 0062          | 0-240                             | 62.0                                | 124.0                         | 0-320                             | 15000                                  | 0.3-1              | 185.7                            | 185.7                                      |
| MR5            | 0018          | 0-240                             | 18.0                                | 25.0                          | 0-320                             | 4000                                   | 0.3-1              | 50.0                             | 50.0                                       |
|                | 0024          | 0-240                             | 24.0                                | 36.0                          | 0-320                             | 5500                                   | 0.3-1              | 72.0                             | 72.0                                       |
|                | 0031          | 0-240                             | 31.0                                | 46.0                          | 0-320                             | 7500                                   | 0.3-1              | 100.0                            | 100.0                                      |
| MR6            | 0048          | 0-240                             | 48.0                                | 62.0                          | 0-320                             | 11000                                  | 0.3-1              | 124.0                            | 124.0                                      |
|                | 0062          | 0-240                             | 62.0                                | 96.0                          | 0-320                             | 15000                                  | 0.3-1              | 192.0                            | 192.0                                      |
| MR7            | 0075          | 0-240                             | 75.0                                | 124.0                         | 0-320                             | 18500                                  | 0.3-1              | 248.0                            | 248.0                                      |
|                | 0088          | 0-240                             | 88.0                                | 150.0                         | 0-320                             | 22000                                  | 0.3-1              | 300.0                            | 300.0                                      |
|                | 0105          | 0-240                             | 105.0                               | 176.0                         | 0-320                             | 30000                                  | 0.3-1              | 352.0                            | 352.0                                      |
| MR8            | 0140          | 0-240                             | 140.0                               | 210.0                         | 0-320                             | 37000                                  | 0.3-1              | 456.0                            | 456.0                                      |
|                | 0170          | 0-240                             | 170.0                               | 280.0                         | 0-320                             | 45000                                  | 0.3-1              | 560.0                            | 560.0                                      |
|                | 0205          | 0-240                             | 205.0                               | 340.0                         | 0-320                             | 55000                                  | 0.3-1              | 680.0                            | 680.0                                      |
| MR9A           | 0261          | 0-240                             | 261.0                               | 410.0                         | 0-320                             | 75000                                  | 0.3-1              | 844.0                            | 844.0                                      |
|                | 0310          | 0-240                             | 310.0                               | 502.0                         | 0-320                             | 90000                                  | 0.3-1              | 1004.0                           | 1004.0                                     |

Table 13. AC drive (380...480/500 V 3AC 50/60 Hz, up to 800 V in VDC) output ratings

| Enclosure size | AC drive type | Voltage (nominal or range) [V AC] | Current (maximum continuous) [A AC] | Current (inrush) [A AC] (2 s) | Frequency (nominal or range) [Hz] | Power (maximum continuous) [W] (400 V) | Power factor range | Max. output fault current [A AC] | Max. output over current protection [A AC] |
|----------------|---------------|-----------------------------------|-------------------------------------|-------------------------------|-----------------------------------|--|--------------------|----------------------------------|--|
| MM4            | 0003          | 0-500                             | 3.4                                 | 6.8                           | 0-320                             | 1100                                   | 0.3-1              | 13.1                             | 13.1                                       |
|                | 0004          | 0-500                             | 4.8                                 | 9.6                           | 0-320                             | 1500                                   | 0.3-1              | 16.6                             | 16.6                                       |
|                | 0005          | 0-500                             | 5.6                                 | 11.2                          | 0-320                             | 2200                                   | 0.3-1              | 19.9                             | 19.9                                       |
|                | 0008          | 0-500                             | 8.0                                 | 16.0                          | 0-320                             | 3000                                   | 0.3-1              | 26.3                             | 26.3                                       |
|                | 0009          | 0-500                             | 9.6                                 | 19.2                          | 0-320                             | 4000                                   | 0.3-1              | 33.1                             | 33.1                                       |
|                | 0012          | 0-500                             | 12.0                                | 24.0                          | 0-320                             | 5500                                   | 0.3-1              | 39.8                             | 39.8                                       |
| MM5            | 0016          | 0-500                             | 16.0                                | 32.0                          | 0-320                             | 7500                                   | 0.3-1              | 51.0                             | 51.0                                       |
|                | 0023          | 0-500                             | 23.0                                | 46.0                          | 0-320                             | 11000                                  | 0.3-1              | 72.3                             | 72.3                                       |
|                | 0031          | 0-500                             | 31.0                                | 62.0                          | 0-320                             | 15000                                  | 0.3-1              | 91.1                             | 91.1                                       |
| MM6            | 0038          | 0-500                             | 38.0                                | 76.0                          | 0-320                             | 18500                                  | 0.3-1              | 122.5                            | 122.5                                      |
|                | 0046          | 0-500                             | 46.0                                | 92.0                          | 0-320                             | 22000                                  | 0.3-1              | 154.3                            | 154.3                                      |
|                | 0061          | 0-500                             | 61.0                                | 122.0                         | 0-320                             | 30000                                  | 0.3-1              | 185.7                            | 185.7                                      |
|                | 0072          | 0-500                             | 72.0                                | 108.0                         | 0-320                             | 37000                                  | 0.3-1              | 185.7                            | 185.7                                      |
| MR5            | 0016          | 0-500                             | 16.0                                | 24.0                          | 0-320                             | 7500                                   | 0.3-1              | 48.0                             | 48.0                                       |
|                | 0023          | 0-500                             | 23.0                                | 32.0                          | 0-320                             | 11000                                  | 0.3-1              | 64.0                             | 64.0                                       |
|                | 0031          | 0-500                             | 31.0                                | 46.0                          | 0-320                             | 15000                                  | 0.3-1              | 92.0                             | 92.0                                       |
| MR6            | 0038          | 0-500                             | 38.0                                | 62.0                          | 0-320                             | 18500                                  | 0.3-1              | 124.0                            | 124.0                                      |
|                | 0046          | 0-500                             | 46.0                                | 76.0                          | 0-320                             | 22000                                  | 0.3-1              | 152.0                            | 152.0                                      |
|                | 0061          | 0-500                             | 61.0                                | 92.0                          | 0-320                             | 30000                                  | 0.3-1              | 184.0                            | 184.0                                      |
| MR7            | 0072          | 0-500                             | 72.0                                | 122.0                         | 0-320                             | 37000                                  | 0.3-1              | 244.0                            | 244.0                                      |
|                | 0087          | 0-500                             | 87.0                                | 144.0                         | 0-320                             | 45000                                  | 0.3-1              | 288.0                            | 288.0                                      |
|                | 0105          | 0-500                             | 105.0                               | 174.0                         | 0-320                             | 55000                                  | 0.3-1              | 348.0                            | 348.0                                      |
| MR8            | 0140          | 0-500                             | 140.0                               | 210.0                         | 0-320                             | 75000                                  | 0.3-1              | 420.0                            | 420.0                                      |
|                | 0170          | 0-500                             | 170.0                               | 280.0                         | 0-320                             | 90000                                  | 0.3-1              | 560.0                            | 560.0                                      |
|                | 0205          | 0-500                             | 205.0                               | 340.0                         | 0-320                             | 110000                                 | 0.3-1              | 680.0                            | 680.0                                      |
| MR9A           | 0261          | 0-500                             | 261.0                               | 410.0                         | 0-320                             | 132000                                 | 0.3-1              | 820.0                            | 820.0                                      |
|                | 0310          | 0-500                             | 310.0                               | 502.0                         | 0-320                             | 160000                                 | 0.3-1              | 1004.0                           | 1004.0                                     |
| MR9B           | 0386          | 0-500                             | 385.0                               | 620.0                         | 0-320                             | 200000                                 | 0.3-1              | 1240.0                           | 1240.0                                     |
| MR10           | 0460          | 0-500                             | 460.0                               | 770.0                         | 0-320                             | 250000                                 | 0.3-1              | 1540.0                           | 1540.0                                     |
|                | 0520          | 0-500                             | 520.0                               | 920.0                         | 0-320                             | 250000                                 | 0.3-1              | 1840.0                           | 1840.0                                     |
|                | 0590          | 0-500                             | 590.0                               | 1040.0                        | 0-320                             | 315000                                 | 0.3-1              | 2080.0                           | 2080.0                                     |
| MR11           | 0651          | 0-500                             | 650.0                               | 1180.0                        | 0-320                             | 355000                                 | 0.3-1              | 2360.0                           | 2360.0                                     |
|                | 0731          | 0-500                             | 730.0                               | 1300.0                        | 0-320                             | 400000                                 | 0.3-1              | 2600.0                           | 2600.0                                     |
| MR12           | 0820          | 0-500                             | 820.0                               | 1460.0                        | 0-320                             | 450000                                 | 0.3-1              | 2920.0                           | 2920.0                                     |
|                | 0920          | 0-500                             | 920.0                               | 1640.0                        | 0-320                             | 500000                                 | 0.3-1              | 3280.0                           | 3280.0                                     |
|                | 1040          | 0-500                             | 1040.0                              | 1840.0                        | 0-320                             | 560000                                 | 0.3-1              | 3680.0                           | 3680.0                                     |
|                | 1180          | 0-500                             | 1180.0                              | 1840.0                        | 0-320                             | 630000                                 | 0.3-1              | 3680.0                           | 3680.0                                     |

### 3.9 GROUNDING

#### 3.9.1 POLE GROUNDING

It is prohibited to connect any pole, DC+ or DC-, of the photovoltaic system directly to PE.

#### 3.9.2 DRIVE GROUNDING

All non-current-carrying metal parts (module frames, enclosures) and also the midpoint of the current carrying conductors of the photovoltaic system must be connected to the PE of the drive.

### 3.10 AC GRID CONNECTION

#### 3.10.1 MORE THAN ONE SOURCE OF SUPPLY

It is not recommended to supply the drive simultaneously from the photovoltaic cell and from grid.

#### 3.10.2 TOGGLE BETWEEN AC AND DC

If both the DC input and the AC input are used (for example, when the energy from the photovoltaic system is not sufficient), it is not allowed to switch directly between AC and DC supply. When switching from one supply to the other, it is mandatory to wait until the drive is discharged.

The minimum AC-DC switchover delay is 30 s for VACON® 100 X MM4-MM6 and VACON® 100 MR5-MR6.

The minimum AC-DC switchover delay is 60 s for VACON® 100 MR7-MR12.



**DANGER!** To completely isolate the equipment, use a two-pole disconnect switch for the photovoltaic input (suitable for DC) and for the grid input (AC switch). Only one of these switches is allowed to be on at a time. The delay time must be respected when changing from one switch to the other. Failure to follow these instructions can lead to death or serious injury.



**DANGER!** If it is necessary to connect the drive simultaneously on AC and DC supply, note that if the AC supply is lost, the drive must be separated from the AC supply grid. Failure to follow these instructions can lead to death or serious injury.

#### 3.10.3 DUAL SUPPLY FUNCTIONALITY

Sometimes a back up from the AC mains is needed in case the power from the photovoltaic supply is not enough, for example, during night time and cloudy weather. The connection can be created in several different ways. In this chapter, three alternative solutions are described.

Common safety related topic in every solution is to make sure that in case of possible malfunction of drive there is no DC voltage connected into AC side. DC voltage from photovoltaic system can make AC supply side parts energized having dangerous voltage, in case AC power is down. DC voltage can go very far distance wise into AC side, as far as galvanically possible. This can be very dangerous especially during AC grid service. System must have a way to prevent this happening.

##### 3.10.3.1 Changeover switch

Using a manually operated changeover switch is the most recommended way to make the switchover between AC and DC supply. In this case, a digital input can be programmed to select normal reference when using AC supply or MPPT when using DC supply. The changeover switch must have a potential free auxiliary contact. See parameter P3.5.1.53 Mains Supply On. In case of a failure, the changeover switch also prevents the DC voltage from going into the AC side.

##### 3.10.3.2 AC and DC connected simultaneously without control

In this case, there is no possibility to have any control if AC or DC supply is used for energy source. Supply always comes automatically from the source where the voltage is higher. Therefore, photo-



voltaic dimensioning is very critical. In addition to that, a blocking diode on the DC side is needed to protect solar panels in case their voltage is low. On the AC side, function of the blocking diode is made by drive rectifier diodes. However, in case of malfunction of rectifier diodes also electromechanics separation is needed in case AC supply goes down. It is mandatory to separate the drive from AC supply in case of power down. There are different methods to make the separation. See one example in chapter 3.8.3.3.

### 3.10.3.3 Automatic Dual supply control

This functionality can be used by activating the drive relay output to control additional contactor on the AC supply side. See the related programming in chapter 7.2.23.3. The functionality can have three different operation modes:

0 - Always active (supply from AC and DC used together)

Works in the same way as described in chapter 3.8.3.2, but AC supply is only used when the drive is at Run state.

1 - Closed loop Irradiation

Controls the AC supply contactor based on irradiation measurement on analog input.

2 - Closed loop Sensorless

Controls the AC supply contactor based on periodic PV capacity checks.

In this case, the AC contactor can also be used to separate the drive from mains automatically when the AC supply goes down. For this, it is mandatory to have a separate control relay on the AC side to detect supply voltage. This relay can be used to force contactor to switch off. The contactor auxiliary contact should be connected into the drive digital input configured in P3.5.1.60, to tell contactor status.

### **3.10.4 OVERVOLTAGE CATEGORY**

The overvoltage category of the AC drive is Category III.

### **3.11 EXTERNAL +24 V SUPPLY**

Using external supply can be used to keep control energized when mains power is down. System software version FW0072V030 or newer should be used.

### 3.12 DC POWER CONNECTION

The external DC switch must comply with Australian regulations, particularly with AS 60947.3:2018.

#### 3.12.1 VACON® 100 X DRIVES

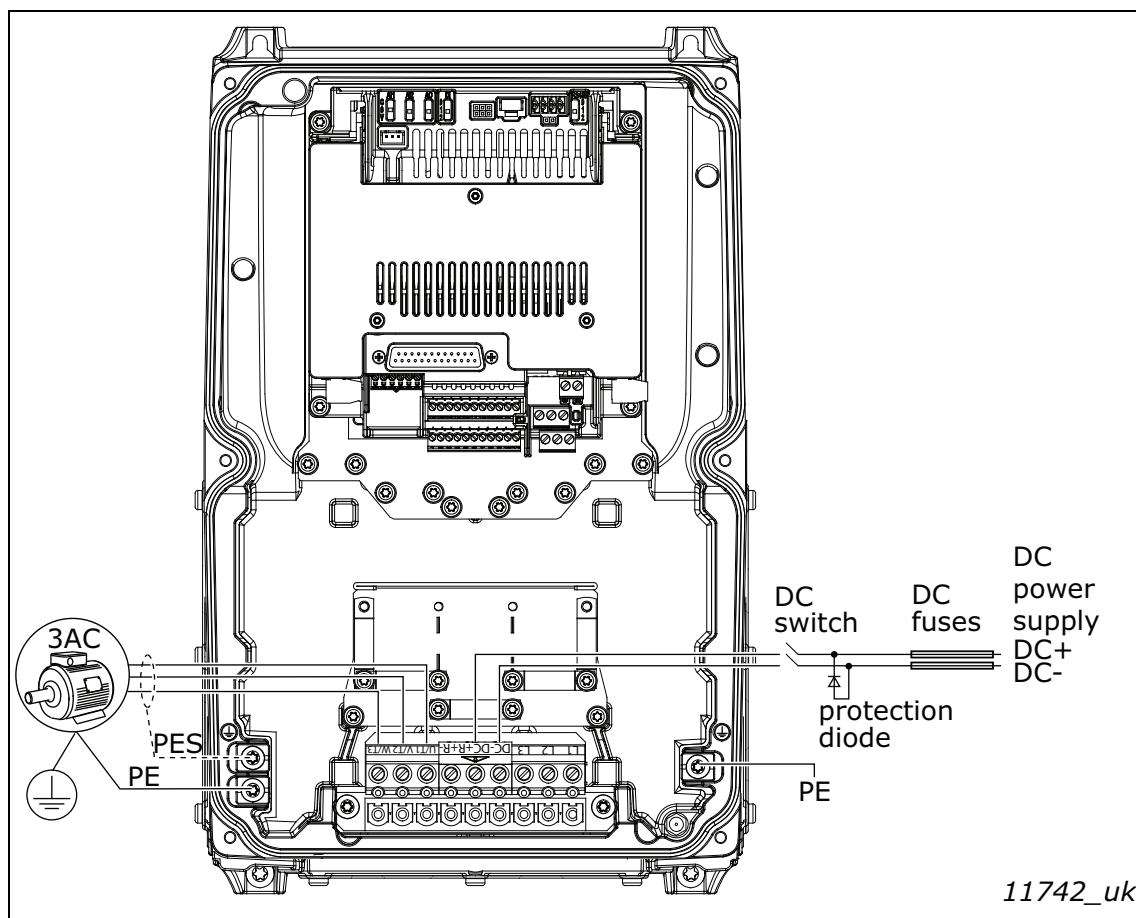


Figure 4. Example of the power connections: MM4/MM5

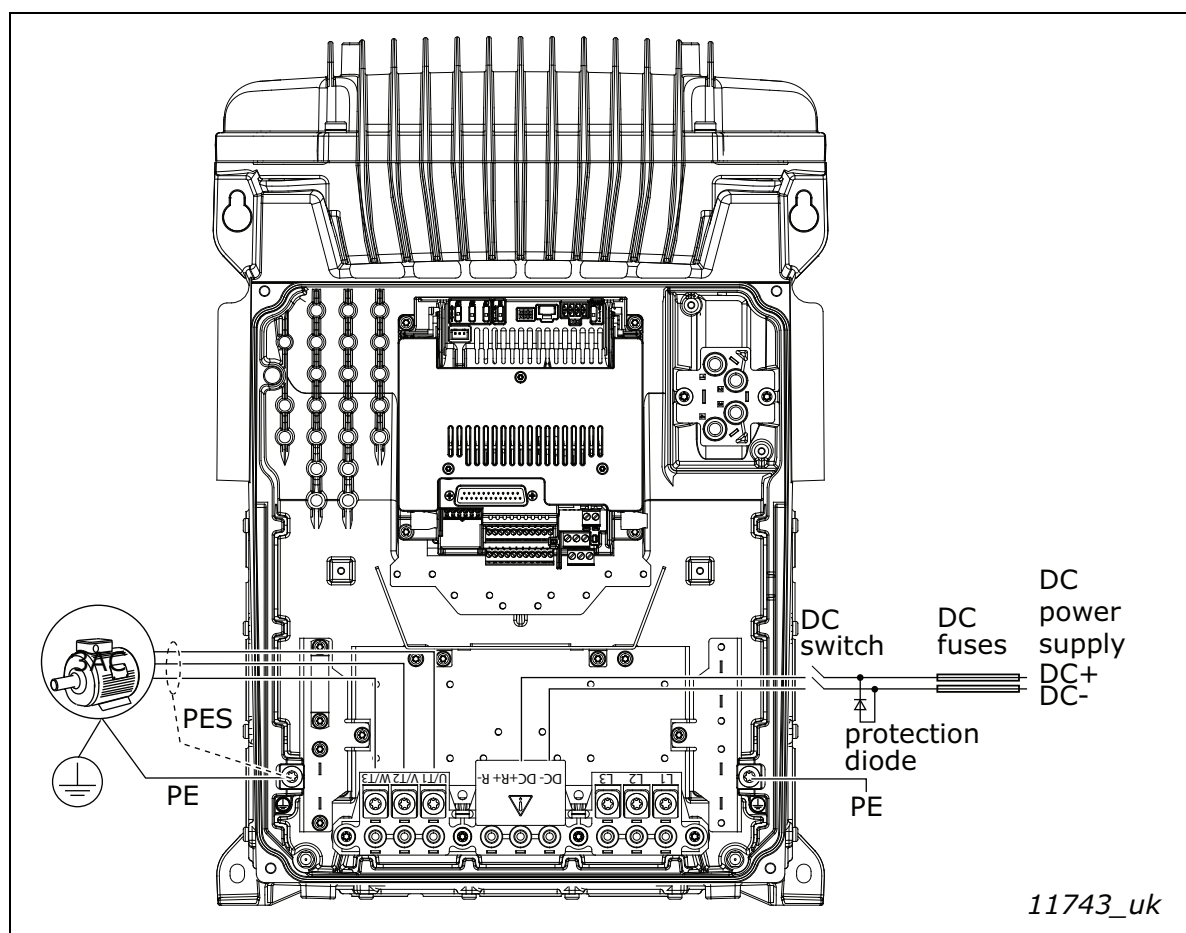


Figure 5. Example of the power connections: MM6

### 3.12.2 VACON® 100 INDUSTRIAL DRIVES

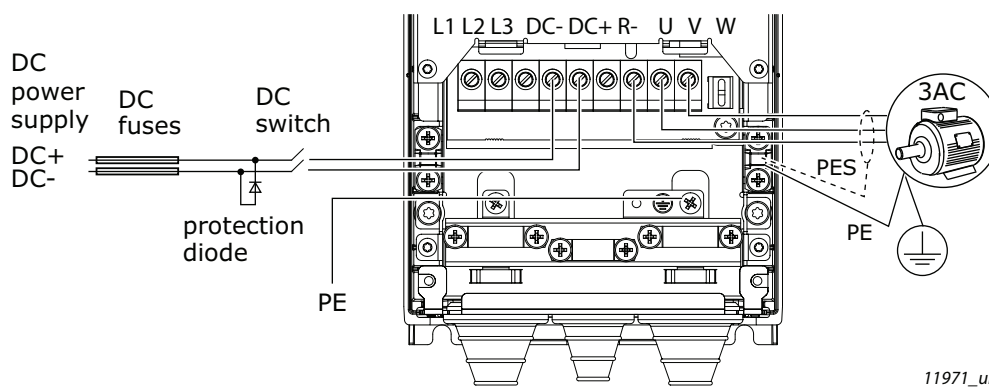


Figure 6. Example of the power connections: MR5-MR7

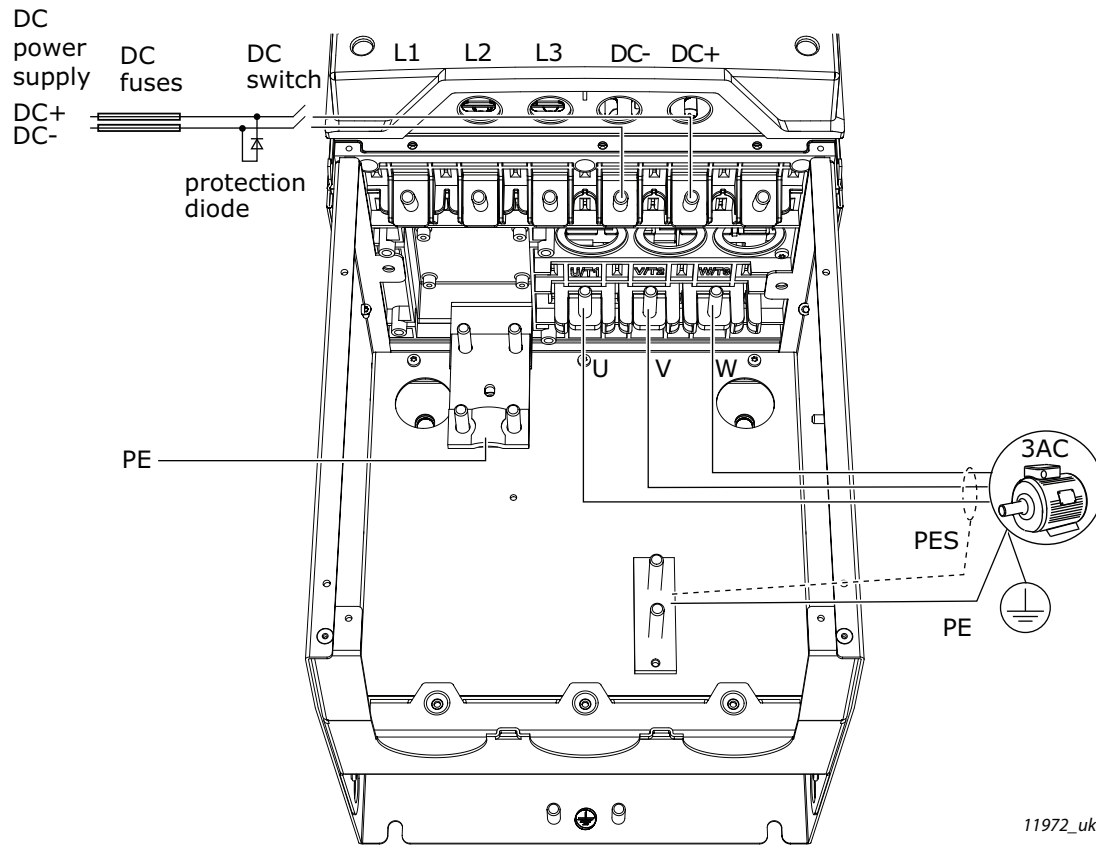


Figure 7. Example of the power connections: MR8

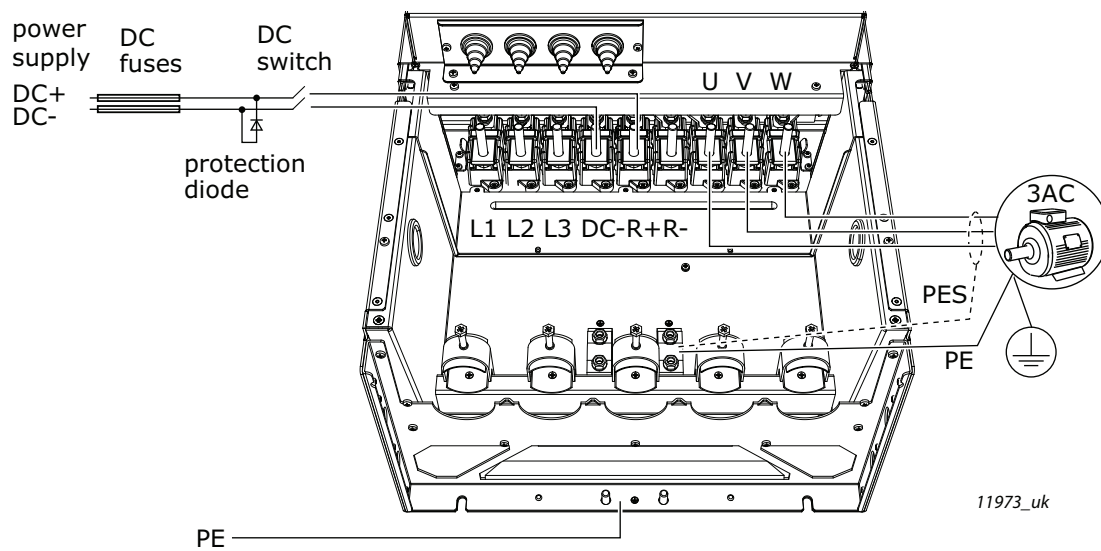


Figure 8. Example of the power connections: MR9

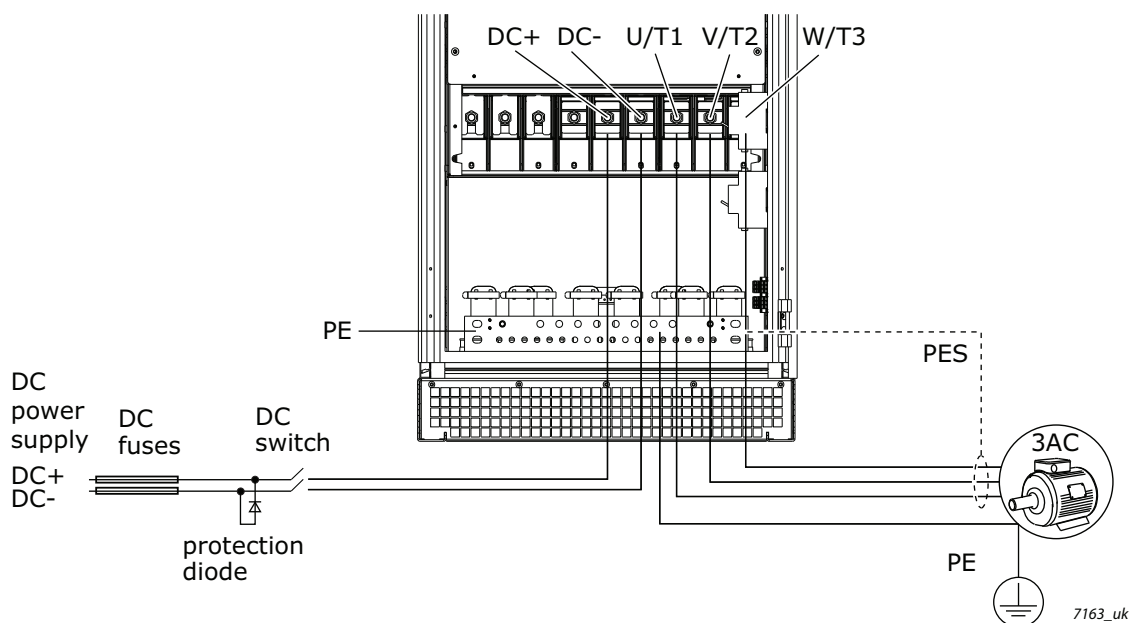


Figure 9. Example of the power connections: MR10 without extension box

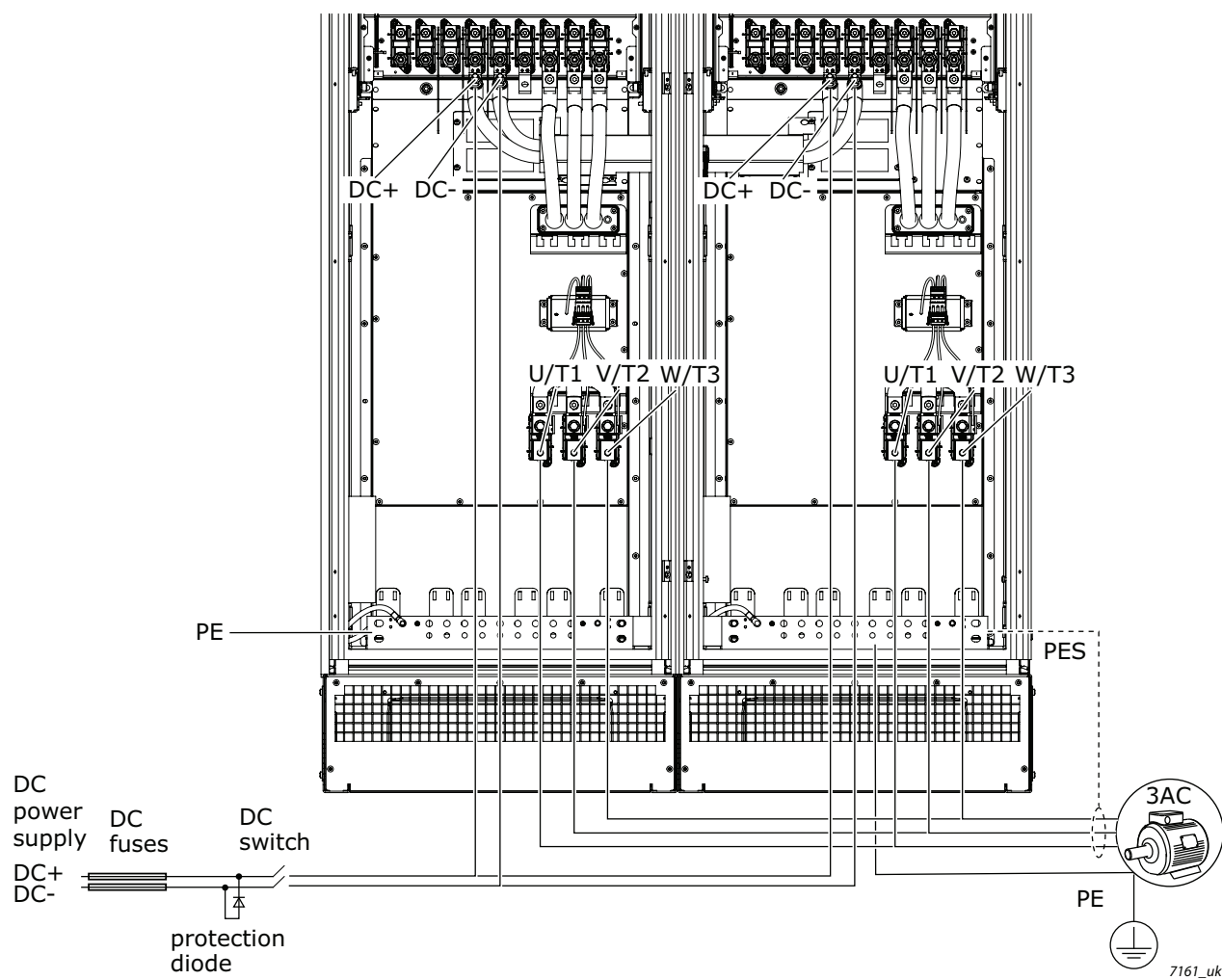


Figure 10. Example of the power connections: MR11 without extension box

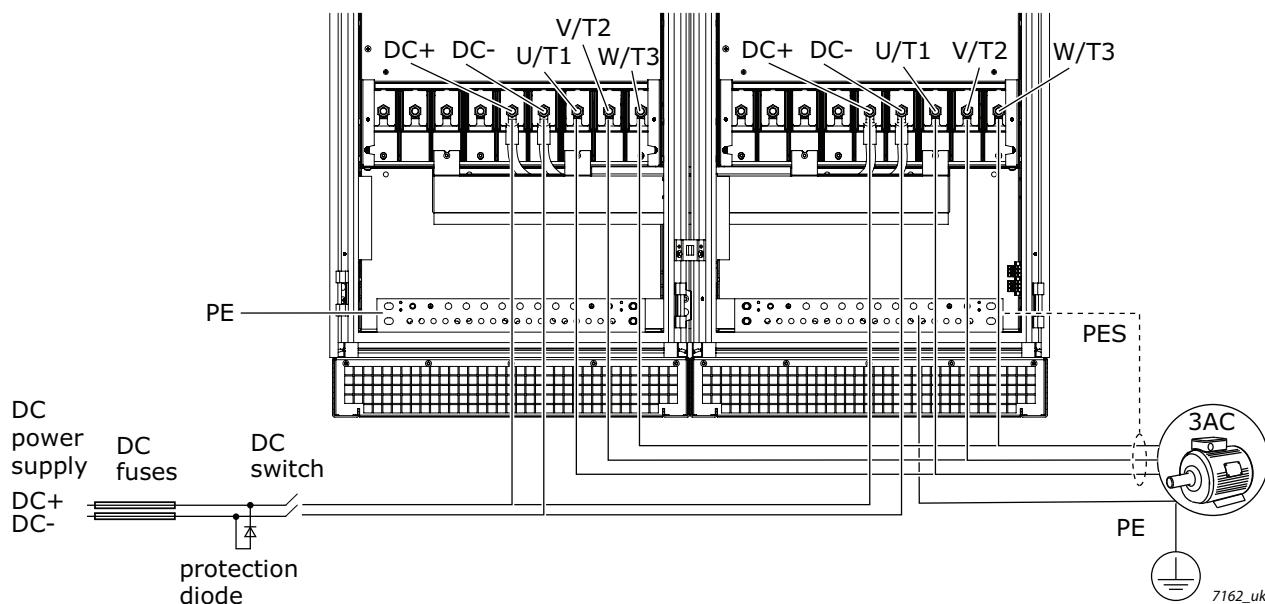


Figure 11. Example of the power connections: MR12 without extension box

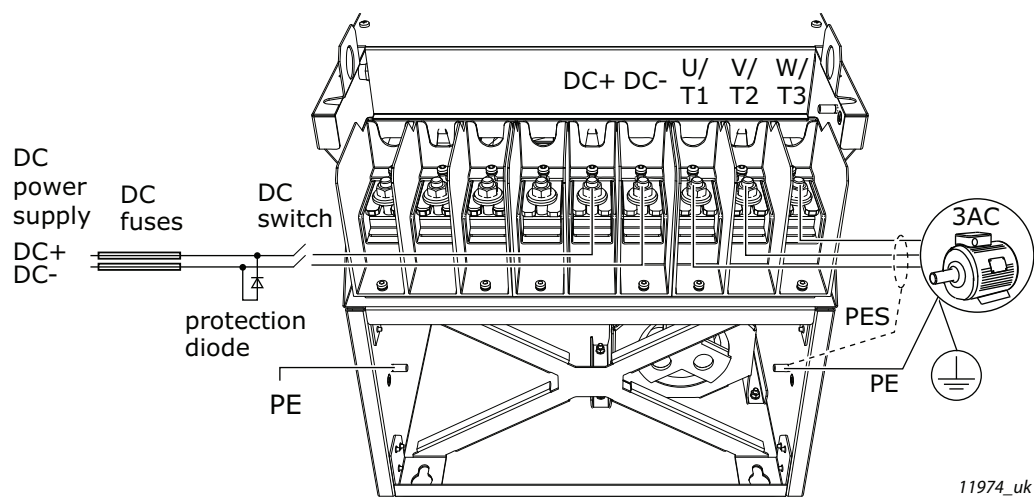


Figure 12. Example of the power connections: MR10 and MR12 with extension box

## 4. STARTUP

### 4.1 FIRST STARTUP

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 canceled.

Once you have connected power to your VACON® 100 X AC drive, follow these instructions to easily set up your drive.

**NOTE:** You can have your AC drive equipped with a keypad with either a graphical or a text keypad.

|          |                           |                             |
|----------|---------------------------|-----------------------------|
| <b>1</b> | Language selection (P6.1) | Depends on language package |
|----------|---------------------------|-----------------------------|

|          |                           |                           |
|----------|---------------------------|---------------------------|
| <b>2</b> | Daylight saving* (P5.5.5) | Russia<br>US<br>EU<br>OFF |
| <b>3</b> | Time* (P5.5.2)            | hh:mm:ss                  |
| <b>4</b> | Year* (P5.5.4)            | yyyy                      |
| <b>5</b> | Date* (P5.5.3)            | dd.mm.                    |

\* These questions appear if battery is installed

|          |                     |           |
|----------|---------------------|-----------|
| <b>6</b> | Run Startup Wizard? | Yes<br>No |
|----------|---------------------|-----------|

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

|           |   |   |
|-----------|---|---|
| <b>7</b>  | Make a selection of an application<br>(P1.2 Application, ID212)               | Standard<br>Local/Remote<br>Multi-step speed<br>PID control<br>Multi-purpose<br>Motor potentiometer |
| <b>8</b>  | Set a value for P3.1.2.2 Motor Type<br>(so that it agrees with the nameplate) | PM motor<br>Induction motor   |
| <b>9</b>  | Set value for <i>P3.1.1.1 Motor Nom Voltg</i><br>(according to nameplate)     | <i>Range: Varies</i>  |
| <b>10</b> | Set value for <i>P3.1.1.2 Motor Nom Freq</i><br>(according to nameplate)      | 8.00...320.00 Hz  |
| <b>11</b> | Set value for <i>P3.1.1.3 Motor Nom Speed</i><br>(according to nameplate)     | <i>Range: 24...19.200 rpm</i>   |
| <b>12</b> | Set value for <i>P3.1.1.4 Motor Nom Currnt</i><br>(according to nameplate)    | <i>Range: Varies</i>  |
| <b>13</b> | Set value for <i>P3.1.1.5 Motor Cos Phi</i><br>(according to nameplate)       | <i>Range: 0.30...1.00</i>   |
| <b>14</b> | Set value for <i>P3.3.1.1 Minimum frequency reference</i>                     | <i>Range: 0.00...50.00 Hz</i>   |
| <b>15</b> | Set value for <i>P3.3.1.2 MaxFreqReference</i>                                | <i>Range: 0.00...320.00 Hz</i>  |
| <b>16</b> | Set value for <i>P3.4.1.2 Accel Time 1</i>                                    | <i>Range: 0.1...300.0 s</i>   |
| <b>17</b> | Set value for <i>P3.4.1.3 Decel Time 1</i>                                    | <i>Range: 0.1...300.0 s</i>   |

If you set Motor Type to Induction Motor, you see the next question. If your selection is PM Motor, the value of parameter P3.1.1.5 Motor Cos Phi is set to 1.00 and the wizard goes directly to question 18.

|           |  |                                |
|-----------|--|--------------------------------|
| <b>18</b> | Set value for <i>P3.3.1.1 MinFreqReference</i> | <i>Range: 0.00...50.00 Hz</i>  |
| <b>19</b> | Set value for <i>P3.3.1.2 MaxFreqReference</i> | <i>Range: 0.00...320.00 Hz</i> |
| <b>20</b> | Set value for <i>P3.4.1.2 Accel Time 1</i>     | <i>Range: 0.1...300.0 s</i>    |
| <b>21</b> | Set value for <i>P3.4.1.3 Decel Time 1</i>     | <i>Range: 0.1...300.0 s</i>    |



|           |                             |     |
|-----------|-----------------------------|-----|
| <b>22</b> | Run the Application wizard? | Yes |
|           |                             | No  |

To continue to the application wizard, set the selection to Yes and push the OK button.

After these selections, the Start-up wizard is completed. To start the Start-up wizard again, you have 2 alternatives. Go to the parameter P6.5.1 Restore Factory Defaults or to the parameter B1.1.2 Start-up Wizard. Then set the value to Activate.

## 4.2 DESCRIPTION OF THE APPLICATIONS

Use the parameter P1.2 (Application) to make a selection of an application for the drive. Immediately when the parameter P1.2 changes, a group of parameters get their preset values.

### 4.2.1 M1 QUICK SETUP PARAMETER GROUP

In the Quick Setup parameter group you will find the different wizards of the VACON® 100 X Solar Pump Application. The wizards help you to quickly set up your drive for use prompting you for a number of essential data.

Table 14. Quick setup parameter group

| Code  | Parameter        | Min    | Max    | Unit | Default | ID   | Description   |
|-------|------------------|--------|--------|------|---------|------|---|
| B1.1  | Startup wizard   | 0      | 1      |      | 0       | 1170 | 0 = Do not activate<br>1 = Activate<br>Choosing <b>Activate</b> initiates the Startup Wizard (see chapter 4.1).             |
| P1.2  | Application      | 0      | 5      |      | 0       | 212  | 0 = Standard<br>1 = Local/Remote<br>2 = Multi-Step Speed<br>3 = PID Control<br>4 = Multi-Purpose<br>5 = Motor Potentiometer |
| P1.3  | MinFreqReference | 0.00   | P1.4   | Hz   | 0.00    | 101  | Minimum allowed frequency reference   |
| P1.4  | MaxFreqReference | P1.3   | 320.00 | Hz   | 50.00   | 102  | Maximum allowed frequency reference   |
| P1.5  | Accel Time 1     | 0.1    | 300.0  | s    | 5.0     | 103  | Defines the time required for the output frequency to increase from zero frequency to maximum frequency                     |
| P1.6  | Decel Time 1     | 0.1    | 300.0  | s    | 5.0     | 104  | Defines the time required for the output frequency to decrease from maximum frequency to zero frequency                     |
| P1.7  | Current limit    | Varies | Varies | A    | Varies  | 107  | Maximum motor current from AC drive   |
| P1.8  | Motor type       | 0      | 1      |      | 0       | 650  | 0 = Induction motor<br>1 = PM motor   |
| P1.9  | Motor Nom Voltg  | Varies | Varies | V    | Varies  | 110  | Find this value $U_n$ on the rating plate of the motor. Note also used connection (Delta/Star).                             |
| P1.10 | Motor Nom Freq   | 8.00   | 320.00 | Hz   | Varies  | 111  | Find this value $f_n$ on the rating plate of the motor.   |
| P1.11 | Motor Nom Speed  | 24     | 19200  | rpm  | Varies  | 112  | Find this value $n_n$ on the rating plate of the motor.   |
| P1.12 | Motor Nom Currnt | Varies | Varies | A    | Varies  | 113  | Find this value $I_n$ on the rating plate of the motor.   |
| P1.13 | Motor Cos Phi    | 0.30   | 1.00   |      | 0.74    | 120  | Find this value on the rating plate of the motor  |

Table 14. Quick setup parameter group

|       |                     |   |   |  |   |     |   |
|-------|---------------------|---|---|--|---|-----|---|
| P1.14 | Energy optimization | 0 | 1 |  | 0 | 666 | 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<br>0 = Disabled<br>1 = Enabled   |
| P1.15 | Identification      | 0 | 1 |  | 0 | 631 | The identification run calculates or measures the motor parameters that are necessary for a good control of the motor and speed.<br>0 = No action<br>1 = At standstill<br>2 = With rotation<br>Before you do the identification run, you must set the motor nameplate parameters. |
| P1.16 | Start function      | 0 | 1 |  | 0 | 505 | 0=Ramping<br>1=Flying start   |
| P1.17 | Stop function       | 0 | 1 |  | 0 | 506 | 0=Coasting<br>1=Ramping   |
| P1.18 | Automatic reset     | 0 | 1 |  | 0 | 731 | 0 = Disabled<br>1 = Enabled   |
| P1.19 | External fault      | 0 | 3 |  | 2 | 701 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)   |
| P1.20 | AI Low Fault        | 0 | 5 |  | 0 | 700 | Response when an analogue signal in use goes below 50% of the minimum signal range. 0 = No action<br>1 = Alarm<br>2 = Alarm, Preset Freq<br>3 = Alarm, Previous Freq<br>4 = Fault (Stop according to stop mode)<br>5 = Fault (Stop by coasting)                                   |
| P1.21 | Rem.Ctrl. Place     | 0 | 1 |  | 0 | 172 | Selection of remote control place (start/stop). Can be used to change back to remote control from VACON® Live e.g. in case of a broken panel.<br>0=I/O control<br>1=Fieldbus control  |
| P1.22 | I/O A Ref sel       | 1 | 9 |  | 5 | 117 | Selection of ref source when control place is I/O A<br>1 = Preset Frequency 0<br>2 = Keypad reference<br>3 = Fieldbus<br>4 = AI1<br>5 = AI2<br>6 = AI1+AI2<br>7 = PID reference<br>8 = Motor potentiometer<br>9 = Max Power   |

*Table 14. Quick setup parameter group*

|       |                  |   |   |  |   |     |  |
|-------|------------------|---|---|--|---|-----|--|
| P1.23 | Keypad Ref sel   | 1 | 9 |  | 2 | 121 | Selection of ref source when control place is keypad:<br>See P1.22   |
| P1.24 | Fieldbus Ref sel | 1 | 9 |  | 3 | 122 | Selection of ref source when control place is Fieldbus:<br>See P1.22 |
| P1.25 | AI1 signal range | 0 | 1 |  | 0 | 379 | 0 = 0...10 V / 0...20 mA<br>1 = 2...10 V / 4...20 mA                 |
| P1.26 | AI2 signal range | 0 | 1 |  | 1 | 390 | 0 = 0...10 V / 0...20 mA<br>1 = 2...10 V / 4...20 mA                 |

Table 14. Quick setup parameter group

|       |                    |   |    |  |   |       |   |
|-------|--------------------|---|----|--|---|-------|---|
| P1.27 | R01 function       | 0 | 60 |  | 2 | 11001 | Function selection for Basic R01:<br>0 = None<br>1 = Ready<br>2 = Run<br>3 = General fault<br>4 = General fault inverted<br>5 = General alarm<br>6 = Reversed<br>7 = At speed<br>8 = Thermistor fault<br>9 = Motor regulator active<br>10 = Start signal active<br>11 = Keypad control active<br>12 = I/O B control activated<br>13 = Limit supervision 1<br>14 = Limit supervision 2<br>15 = SinglePowerOn<br>16 = No function<br>17 = Preset speed active<br>18 = No function<br>19 = PID in Sleep mode<br>20 = PID soft fill active<br>21 = PID supervision limits<br>22 = Ext. PID superv. limits<br>23 = Input press. alarm/fault<br>24 = Frost prot. alarm/fault<br>25 - 30 = No function<br>31 = RTC time chnl 1 control<br>32 = RTC time chnl 2 control<br>33 = RTC time chnl 3 control<br>34 = FB ControlWord B13<br>35 = FB ControlWord B14<br>36 = FB ControlWord B15<br>37 = FB ProcessData1.B0<br>38 = FB ProcessData1.B1<br>39 = FB ProcessData1.B2<br>40 = Maintenance alarm<br>41 = Maintenance fault<br>42 = No function<br>43 = No function<br>44 = Block Out.1<br>45 = Block Out.2<br>46 = Block Out.3<br>47 = Block Out.4<br>48 = Block Out.5<br>49 = Block Out.6<br>50 = Block Out.7<br>51 = Block Out.8<br>52 = Block Out.9<br>53 = Block Out.10<br>54 = No function<br>55 = No function<br>56 = Auto-cleaning active<br>57 = Motor Switch Open<br>58 = TEST (Always Closed)<br>59 = No function<br>60 = DualSupply AC switch |
| P1.28 | Basic R02 function | 0 | 46 |  | 3 | 11004 | See P1.27   |

Table 14. Quick setup parameter group

|       |              |   |    |  |   |       |   |
|-------|--------------|---|----|--|---|-------|---|
| P1.30 | AO1 function | 0 | 19 |  | 2 | 10050 | 0=TEST 0% (Not used)<br>1=TEST 100%<br>2=Output freq (0 -fmax)<br>3=Freq reference (0-fmax)<br>4=Motor speed (0 - Motor nominal speed)<br>5=Output current (0-I <sub>nMotor</sub> )<br>6=Motor torque (0-T <sub>nMotor</sub> )<br>7=Motor power (0-P <sub>nMotor</sub> )<br>8=Motor voltage (0-U <sub>nMotor</sub> )<br>9=DC link voltage (0-1000 V)<br>10=PID1 output (0-100%)<br>11=Ext.PID output (0-100%)<br>12=ProcessDataIn1 (0-100%)<br>13=ProcessDataIn2 (0-100%)<br>14=ProcessDataIn3 (0-100%)<br>15=ProcessDataIn4 (0-100%)<br>16=ProcessDataIn5 (0-100%)<br>17=ProcessDataIn6 (0-100%)<br>18=ProcessDataIn7 (0-100%)<br>19=ProcessDataIn8 (0-100%) |
|-------|--------------|---|----|--|---|-------|---|

#### 4.2.2 STANDARD APPLICATION

You can use the Standard application in speed-controlled processes where no special functions are necessary, for example pumps, fans, or conveyors.

It is possible to control the drive from the keypad, Fieldbus or I/O terminal.

When you control the drive with the I/O terminal, the frequency reference signal is connected to AI1 (0...10 V) or AI2 (4...20 mA). The connection depends the type of the signal. There are also 3 preset frequency references available. You can activate the preset frequency references with DI4 and DI5. The start/stop signals of the drive are connected to DI1 (start forward) and DI2 (start reverse).

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

##### 4.2.2.1 M1.31 Standard

*Table 15. Standard start-up wizard menu*

| Code    | Parameter     | Min  | Max  | Unit | Default | ID  | Description  |
|---------|---------------|------|------|------|---------|-----|--|
| P1.31.1 | Preset Freq 1 | P1.3 | P1.4 | Hz   | 10.0    | 105 | Make the selection of a preset frequency with the digital input DI4.         |
| P1.31.2 | Preset Freq 2 | P1.3 | P1.4 | Hz   | 15.0    | 106 | Make the selection of a preset frequency with the digital input DI5.         |
| P1.31.3 | Preset Freq 3 | P1.3 | P1.4 | Hz   | 20.0    | 126 | Make the selection of a preset frequency with the digital input DI4 and DI5. |

### 4.2.3 LOCAL/REMOTE APPLICATION

Use the Local/Remote application when, for example, it is necessary to switch between 2 different control places.

To change between the Local and the Remote control place, use DI6. When Remote control is active, you can give the start/stop commands from Fieldbus or from I/O terminal (DI1 and DI2). When Local control is active, you can give the start/stop commands from the keypad, Fieldbus or I/O terminal (DI4 and DI5).

For each control place, you can make a selection of the frequency reference from the keypad, Fieldbus or I/O terminal (AI1 or AI2).

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

#### 4.2.3.1 M1.33 Local/Remote

Table 16. Local/Remote start-up wizard menu

| Code    | Parameter           | Min | Max | Unit | Default       | ID  | Description  |
|---------|---------------------|-----|-----|------|---------------|-----|--|
| P1.32.1 | I/O B Ref sel       | 1   | 9   |      | 9             | 131 | Selection of ref source when control place is I/O B. See above.<br><b>NOTE:</b> I/O B control place can only be forced active with digital input (P3.5.1.7). |
| P1.32.2 | I/O B Ctrl force    |     |     |      | DigIN SlotA.6 | 343 | TRUE = Used frequency reference is specified by I/O reference B parameter (P3.3.1.6).  |
| P1.32.3 | I/O B Ref force     |     |     |      | DigIN SlotA.6 | 411 | Force control to fieldbus  |
| P1.32.4 | Ctrl signal 1 B     |     |     |      | DigIN SlotA.4 | 423 | Start signal 1 when control place is I/O B   |
| P1.32.5 | Ctrl signal 2 B     |     |     |      | DigIN SlotA.5 | 424 | Start signal 2 when control place is I/O B   |
| P1.32.6 | Keypad Ctrl force   |     |     |      | DigIN Slot0.1 | 410 | Force control to keypad  |
| P1.32.7 | Fieldbus Ctrl force |     |     |      | DigIN Slot0.1 | 411 | Force control to fieldbus  |
| P1.32.8 | Ext fault close     |     |     |      | DigIN SlotA.3 | 405 | FALSE = OK<br>TRUE = External fault  |
| P1.32.9 | Ext fault open      |     |     |      | DigIN Slot0.2 | 406 | FALSE = External fault<br>TRUE = OK  |



#### 4.2.4 MULTI-STEP APPLICATION

You can use the Multi-step speed application with processes where more than 1 fixed frequency reference is necessary (for example test benches).

It is possible to use 1 + 7 frequency references: 1 basic reference (AI1 or AI2) and 7 preset references.

Make a selection of the preset frequency references with digital signals DI4, DI5 and DI6. If none of these inputs are active, the frequency reference is removed from the analogue input (AI1 or AI2). Give the start/stop commands from the I/O terminal (DI1 and DI2).

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

##### 4.2.4.1 M1.33 Multi-step speed

Table 17. Multi-step speed start-up wizard menu

| Code     | Parameter       | Min  | Max  | Unit | Default       | ID  | Description  |
|----------|-----------------|------|------|------|---------------|-----|--|
| P1.33.1  | Preset Freq 1   | P1.3 | P1.4 | Hz   | 10.0          | 105 |  |
| P1.33.2  | Preset Freq 2   | P1.3 | P1.4 | Hz   | 15.0          | 106 |  |
| P1.33.3  | Preset Freq 3   | P1.3 | P1.4 | Hz   | 20.0          | 126 |  |
| P1.33.4  | Preset Freq 4   | P1.3 | P1.4 | Hz   | 25.0          | 127 |  |
| P1.33.5  | Preset Freq 5   | P1.3 | P1.4 | Hz   | 30.0          | 128 |  |
| P1.33.6  | Preset Freq 6   | P1.3 | P1.4 | Hz   | 40.0          | 129 |  |
| P1.33.7  | Preset Freq 7   | P1.3 | P1.4 | Hz   | 50.0          | 130 |  |
| P1.33.8  | PresetFreqMode  | 0    | 1    |      | 0             | 182 | 0 = Binary coded<br>1 = Number of inputs. Preset frequency is selected according to how many of preset speed digital inputs are active |
| P1.33.9  | Ext fault close |      |      |      | DigIN SlotA.3 | 405 | FALSE = OK<br>TRUE = External fault  |
| P1.33.10 | Ext fault open  |      |      |      | DigIN Slot0.2 | 406 | FALSE = External fault<br>TRUE = OK  |

#### 4.2.5 PID CONTROL APPLICATION

You can use the PID control application with processes where you control the process variable (for example pressure) through control of the speed of the motor.

In this application, the internal PID controller of the drive is configured for 1 setpoint and 1 feedback signal.

It is possible to use 2 control places. Make the selection of the control place A or B with DI6. When control place A is active, the start/stop commands are given by DI1, and the PID controller gives the frequency reference. When control place B is active, start/stop commands are given by DI4, and AI1 gives the frequency reference.

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

##### 4.2.5.1 M1.34 PID Control

Table 18. PID Control start-up wizard menu

| Code    | Parameter        | Min  | Max     | Unit | Default | ID  | Description  |
|---------|------------------|------|---------|------|---------|-----|--|
| P1.34.1 | 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%.       |
| P1.34.2 | Integration Time | 0.00 | 600.00  | s    | 1.00    | 119 | If this parameter is set to 1,00s a change of 10% in the error value causes the controller output to change by 10.00%/s.             |
| P1.34.3 | Derivation Time  | 0.00 | 100.00  | s    | 0.00    | 132 | If this parameter is set to 1,00s a change of 10% in the error value during 1.00 s causes the controller output to change by 10.00%. |

Table 18. PID Control start-up wizard menu

|         |             |        |        |        |   |     |  |
|---------|-------------|--------|--------|--------|---|-----|--|
| P1.34.4 | FB 1 Source | 0      | 20     |        | 2 | 334 | 0 = Not used<br>1 = AI1<br>2 = AI2<br>3 = AI3<br>4 = AI4<br>5 = AI5<br>6 = AI6<br>7 = ProcessDataIn1<br>8 = ProcessDataIn2<br>9 = ProcessDataIn3<br>10 = ProcessDataIn4<br>11 = ProcessDataIn5<br>12 = ProcessDataIn6<br>13 = ProcessDataIn7<br>14 = ProcessDataIn8<br>15 = Temperature input 1<br>16 = Temperature input 2<br>17 = Temperature input 3<br>18 = Temperature input 4<br>19 = Temperature input 5<br>20 = Temperature input 6<br>AI's and ProcessDataIn are handled as % (0.00-100.00%) and scaled according to Feedback min and max.<br><b>NOTE:</b> ProcessDataIn use two decimals.  |
| P1.34.5 | SP 1 Source | 0      | 22     |        | 1 | 332 | 0 = Not used<br>1 = Keypad setpoint 1<br>2 = Keypad setpoint 2<br>3 = AI1<br>4 = AI2<br>5 = AI3<br>6 = AI4<br>7 = AI5<br>8 = AI6<br>9 = ProcessDataIn1<br>10 = ProcessDataIn2<br>11 = ProcessDataIn3<br>12 = ProcessDataIn4<br>13 = ProcessDataIn5<br>14 = ProcessDataIn6<br>15 = ProcessDataIn7<br>16 = ProcessDataIn8<br>17 = Temperature input 1<br>18 = Temperature input 2<br>19 = Temperature input 3<br>20 = Temperature input 4<br>21 = Temperature input 5<br>22 = Temperature input 6<br>AI's and ProcessDataIn are handled as percent (0.00-100.00%) and scaled according to Setpoint minimum and maximum. <b>NOTE:</b> ProcessDataIn signals use 2 decimals. |
| P1.34.6 | Keypad SP 1 | Varies | Varies | Varies | 0 | 167 |  |

Table 18. PID Control start-up wizard menu

|          |                  |      |        |        |      |      |  |
|----------|------------------|------|--------|--------|------|------|--|
| P1.34.7  | SP 1 Sleep Freq  | 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 <i>Sleep delay</i> . |
| P1.34.8  | SP 1 Sleep Delay | 0    | 3000   | s      | 0    | 1017 | The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped.  |
| P1.34.9  | SP 1 WakeUpLevel |      |        | Varies | 0.00 | 1018 | Defines the level for the PID feedback value wake-up supervision. Uses selected process units.   |
| P1.34.10 | Preset Freq 1    | P1.3 | P1.4   | Hz     | 10.0 | 105  | Preset Frequency 1   |

#### 4.2.6 MULTI-PURPOSE APPLICATION

You can use the Multi-purpose application for different processes (for example conveyors) where a wide range of motor control functions is necessary.

It is possible to control the drive from the keypad, Fieldbus or I/O terminal. When you use I/O terminal control, the start/stop commands are given through DI1 and DI2, and the frequency reference from AI1 or AI2.

There are 2 acceleration/deceleration ramps available. The selection between Ramp1 and Ramp2 is made by DI6.

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

##### 4.2.6.1 M1.35 Multi-purpose

Table 19. Multi-purpose start-up wizard menu

| Code     | Parameter               | Min   | Max      | Unit | Default | ID  | Description   |
|----------|-------------------------|-------|----------|------|---------|-----|---|
| P1.35.1  | Control mode            | 0     | 1        |      | 0       | 600 | 0 = U/f Freq ctrl open loop<br>1 = Speed control open loop  |
| P1.35.2  | Auto TorqueBoost        | 0     | 1        |      | 0       | 109 | Automatic torque boost can be used in application where starting torque due to starting friction is high.<br>0= Disabled<br>1= Enabled      |
| P1.35.3  | Start Acceleration Time | 0.1   | 3000.0   | s    | 2.0     | 502 | Start Acceleration Time   |
| P1.35.5  | Preset Freq 1           | P1.3  | P1.4     | Hz   | 10.0    | 105 | Preset Frequency 1  |
| P1.35.6  | U/f ratio               | 0     | 2        |      | 0       | 108 | Type of U/f curve between zero frequency and the field weakening point.<br>0=Linear<br>1=Squared<br>2=Programmable                          |
| P1.35.7  | Field WeakngPnt         | 8.00  | P3.3.1.2 | Hz   | Varies  | 602 | The field weakening point is the output frequency at which the output voltage reaches the field weakening point voltage                     |
| P1.35.8  | Voltage at FWP          | 10.00 | 200.00   | %    | 100.00  | 603 | Voltage at field weakening point in % of motor nominal voltage  |
| P1.35.9  | U/f Mid Freq            | 0.00  | P3.1.4.2 | Hz   | Varies  | 604 | Provided that the programmable U/f curve has been selected (par. P3.1.4.1), this parameter defines the middle point frequency of the curve. |
| P1.35.10 | U/f Mid Voltg           | 0.0   | 100.0    | %    | 100.0   | 605 | Provided that the programmable U/f curve has been selected (par. P3.1.4.1), this parameter defines the middle point voltage of the curve.   |

Table 19. Multi-purpose start-up wizard menu

|          |                    |        |        |    |        |      |   |
|----------|--------------------|--------|--------|----|--------|------|---|
| P1.35.11 | Zero Freq Voltg    | 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.  |
| P1.35.12 | StartMagnCurrent   | 0.00   | Varies | A  | Varies | 517  | Defines the DC current fed into motor at start. Disabled if set to 0.   |
| P1.35.13 | StartMagnTime      | 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.   |
| P1.35.14 | DC Brake Current   | Varies | Varies | A  | Varies | 507  | Defines the current injected into the motor during DC-braking.<br>0 = Disabled  |
| P1.35.15 | DC BrakeTime       | 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.   |
| P1.35.16 | DC Start Freq      | 0,10   | 10,00  | Hz | 1,50   | 515  | The output frequency at which the DC-braking is applied.  |
| P1.35.17 | Load drooping      | 0.00   | 50.00  | %  | 0.00   | 620  | The drooping function enables speed drop as a function of load. Drooping will be defined in percent of nominal speed at nominal load.   |
| P1.35.18 | Load drooping time | 0.00   | 2.00   | s  | 0.00   | 656  | Load drooping is used in order to achieve a dynamic speed drooping because of changing load. This parameter defines the time during which the speed is restored to the level it was before the load increase. |
| P1.35.19 | Load drooping mode | 0      | 1      |    | 0      | 1534 | 0 = Normal; Load drooping factor is constant through the whole frequency range<br>1 = Linear removal; Load drooping is removed linearly from nominal frequency to zero frequency                              |

#### 4.2.7 MOTOR POTENTIOMETER APPLICATION

Use the Motor potentiometer application for the processes where the frequency reference of the motor is controlled (that is, increased and decreased) through digital inputs.

In this application, the I/O terminal is set to the default control place. the start/stop commands are given with DI1 and DI2. The frequency reference of the motor is increased with DI5 and decreased with DI6.

It is possible to configure all the drive outputs freely in all the applications. There are 1 analogue output (Output Frequency) and 3 relay outputs (Run, Fault, Ready) available on the basic I/O board.

##### 4.2.7.1 M1.36 Motor Potentiometer

*Table 20. Motor Potentiometer start-up wizard menu*

| Code    | Parameter        | Min  | Max   | Unit | Default | ID  | Description   |
|---------|------------------|------|-------|------|---------|-----|---|
| P1.36.1 | MotPot ramp time | 0.1  | 500.0 | Hz/s | 10.0    | 331 | Rate of change in the motor potentiometer reference when increased or decreased with parameters P3.3.4.1 or P3.3.4.2.     |
| P1.36.2 | MotPot Reset     | 0    | 2     |      | 1       | 367 | Motor potentiometer frequency reference reset logic.<br>0 = No reset<br>1 = Reset if stopped<br>2 = Reset if powered down |
| P1.36.3 | Preset Freq 1    | P1.3 | P1.4  | Hz   | 20.0    | 105 | Make the selection of a preset frequency with the digital input DI4 and DI5.  |

## 5. USER INTERFACES

### 5.1 KEYPAD OF THE DRIVE

The control keypad is the interface between the VACON® 100 AC 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 AC drive's parameters.

There are two keypad types you can choose for your user interface: *Keypad with graphical display* and *Text keypad*.

#### 5.1.1 BUTTONS

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

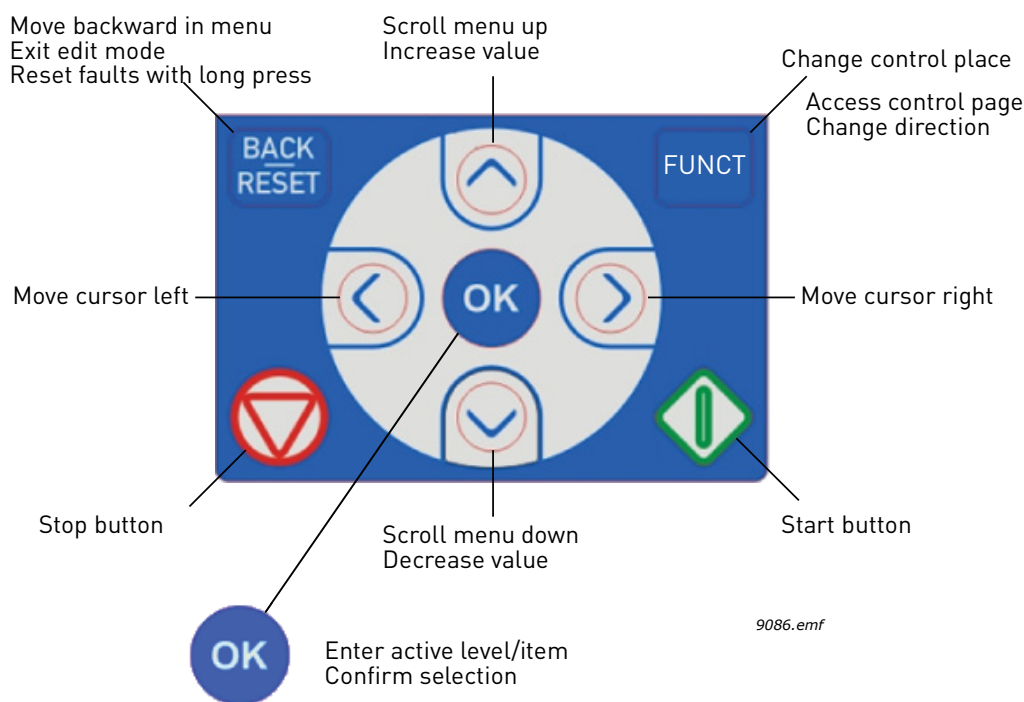


Figure 13. Keypad buttons

#### 5.1.2 DISPLAY

The keypad display 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 the drive and his present location in the menu structure and the item displayed.

#### 5.1.3 NAVIGATION ON KEYPAD

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 13.



### 5.1.4 GRAPHICAL KEYPAD

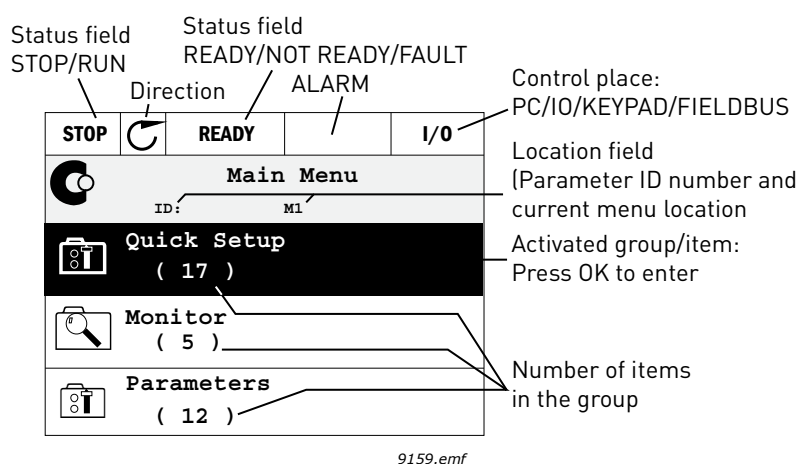


Figure 14. Main menu

#### 5.1.4.1 Using the graphical keypad

##### Editing values

The selectable values can be accessed and edited in two different ways on the graphical keypad.

##### Parameters with one valid value

Typically, one parameter is set one value. The value is selected either from a list of values (see example below) or the parameter is given a numerical value from a defined range (e.g. 0.00...50.00 Hz).

Change value of a parameter following the procedure below:

1. Locate the parameter.
2. Enter the *Edit* mode.
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 then change 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.

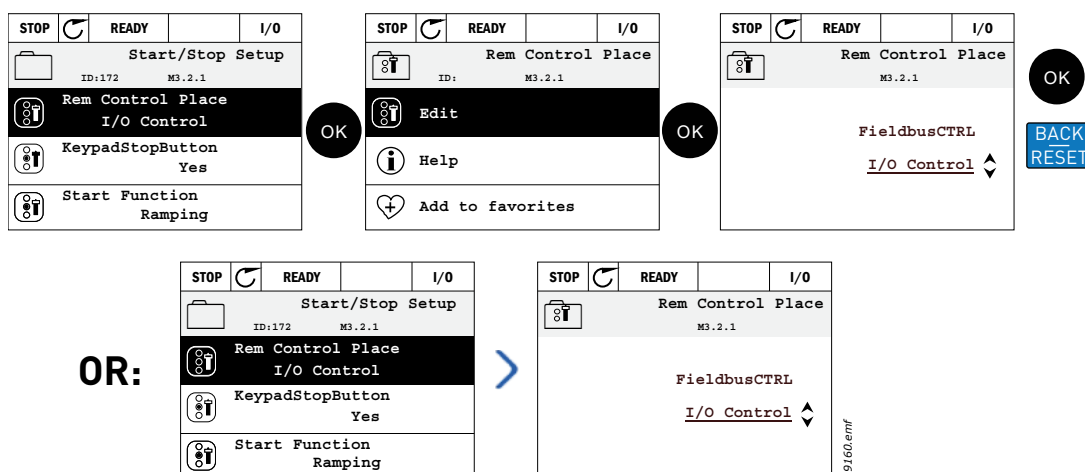


Figure 15. Typical editing of values on graphical keypad (text value)

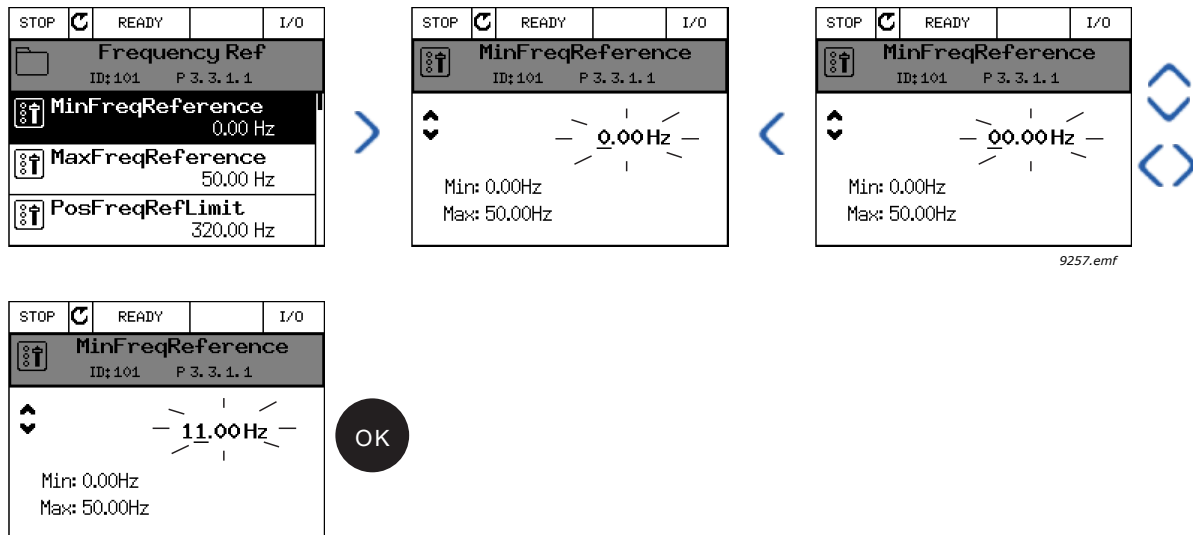


Figure 16. Typical editing of values on graphical keypad (numerical value)

### Parameters with checkbox selection

Some parameters allow selecting several values. Make a check box selection at each value you wish to activate as instructed below.

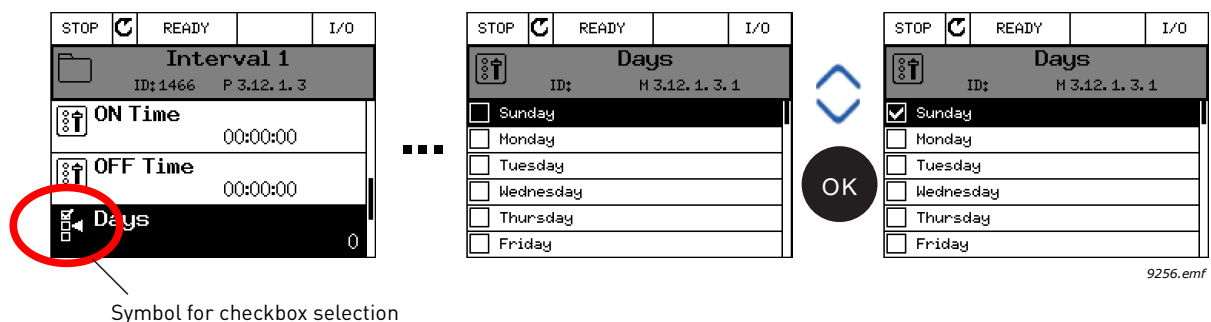


Figure 17. Applying the checkbox value selection on graphical keypad

### Resetting fault

Instructions for how to reset a fault can be found in chapter 8 .

### Function button

The FUNCT button is used for four functions:

1. to quickly access the Control page,
2. to easily change between the Local (Keypad) and Remote control places,
3. to change the rotation direction and
4. to quickly edit a parameter value.

### 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. The *Local control place* is always the keypad. The *Remote control place* is determined by parameter P3.2.1 (I/O or Field-bus). 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 P3.5.1.7 (*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 P3.5.1.7 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 FUNCT-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 *FUNCT* 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 *FUNCT* button was pushed. However, if the Remote control place was changed to Local (Keypad) you will be prompted for keypad reference.

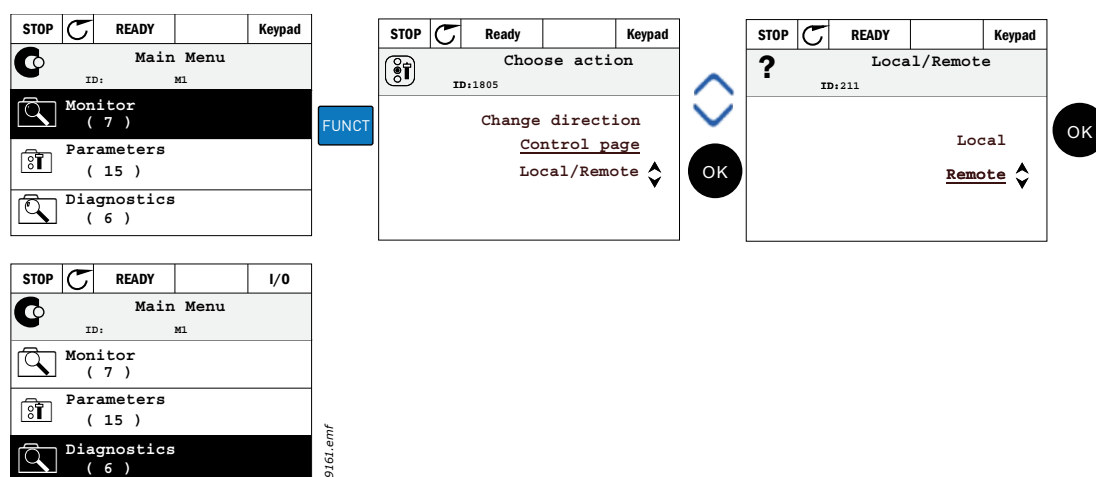


Figure 18. Changing control places

## 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 *FUNCT* 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. The other values on the page are Multimonitoring values. You can choose which values appear here for monitoring (for this procedure, see page 61).

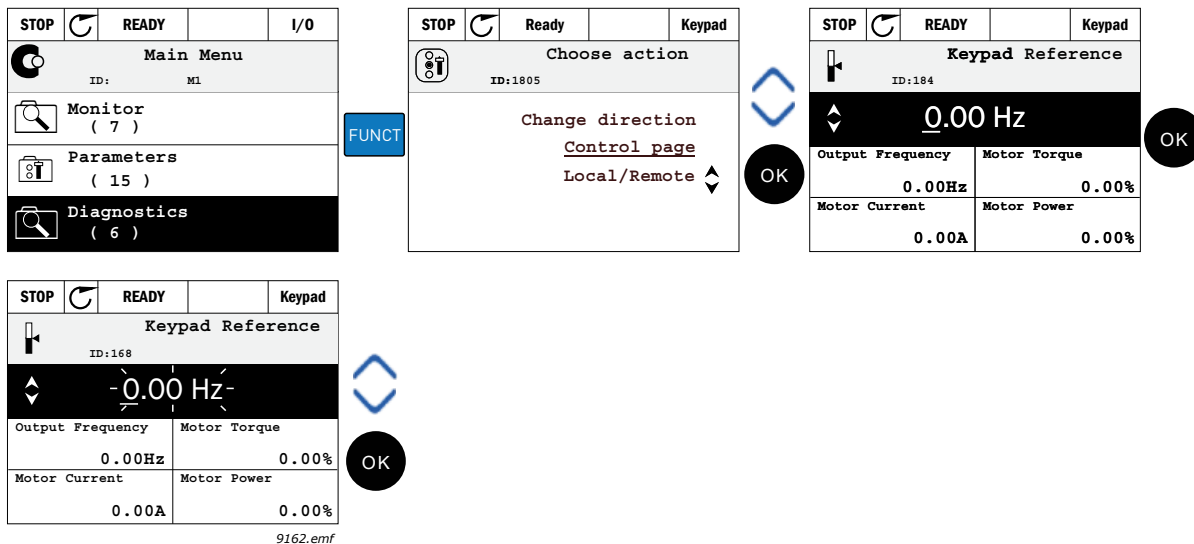
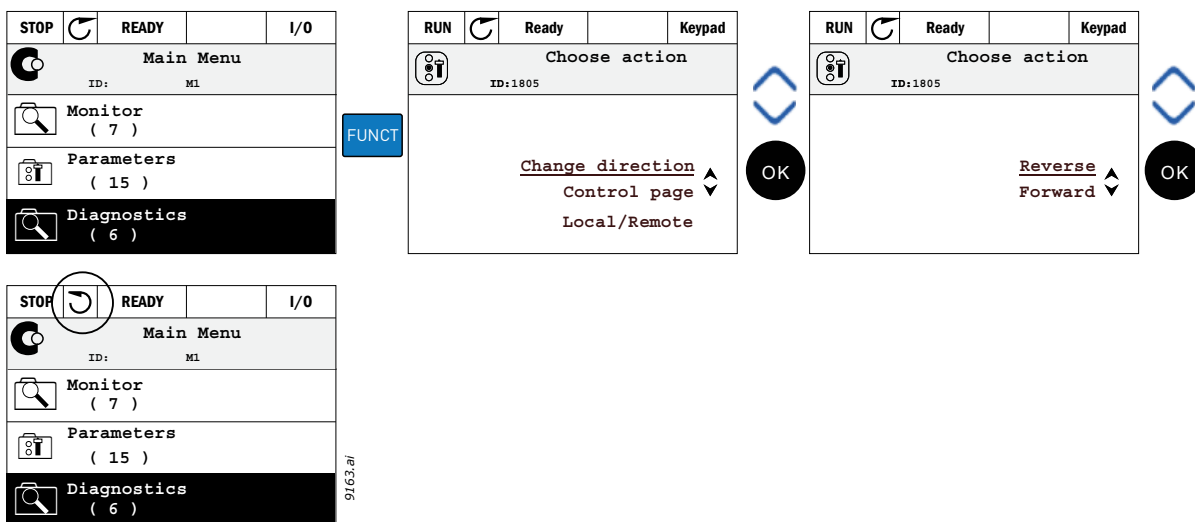


Figure 19. Accessing Control page

## Changing direction

Rotation direction of the motor can quickly be changed by applying the FUNCT button. **NOTE!** *Changing direction* command is not visible in the menu unless the selected control place is *Local*.

1. Anywhere in the menu structure, push the Funct button.
2. Push the Arrow up or the Arrow down button to select Change direction and confirm with the OK button.
3. Then choose the direction you wish to run the motor to. The actual rotation direction is blinking. Confirm with the OK button.
4. The rotation direction changes immediately and the arrow indication in the status field changes.



## Quick edit

Through the *Quick edit* functionality you can quickly access the desired parameter by entering the parameter's ID number.

1. Anywhere in the menu structure, push the FUNCT button.
2. Push the Arrow up or the Arrow down buttons to select Quick Edit and confirm with the OK button.

- Then enter the ID number of parameter or monitoring value you wish to access. Press OK button to confirm.
- Requested Parameter/Monitoring value appears on the display (in editing/monitoring mode.)

### Copying parameters

**NOTE:** This feature is available in graphical keypad 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 the keypad to the drive, the drive **has to be stopped** before the parameters are uploaded.

- 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.

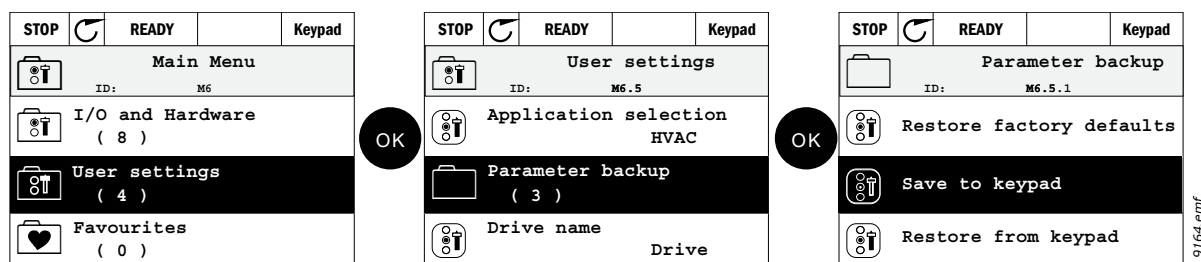


Figure 20. Parameter copy

**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 phi (P3.1.1.5)
- Switching frequency (P3.1.2.3)
- Motor current limit (P3.1.3.1)
- Stall current limit (P3.9.3.2)
- Stall time limit (P3.9.3.3)
- Stall frequency (P3.9.3.4)
- Maximum frequency (P3.3.1.2)

### Help texts

The graphical keypad 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.

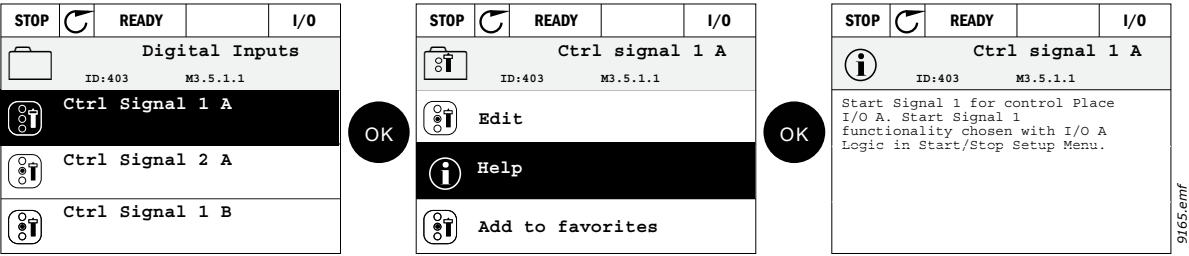


Figure 21. Help text example

Adding item to favorites

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 *Favorites* where they can easily be reached.

To remove an item from the Favorites, see chapter 5.3.7.

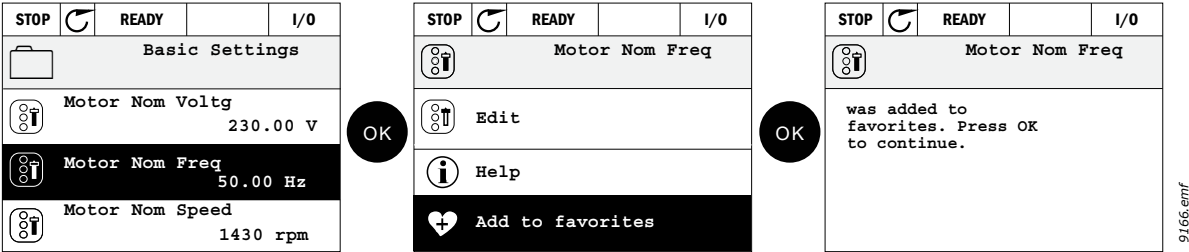


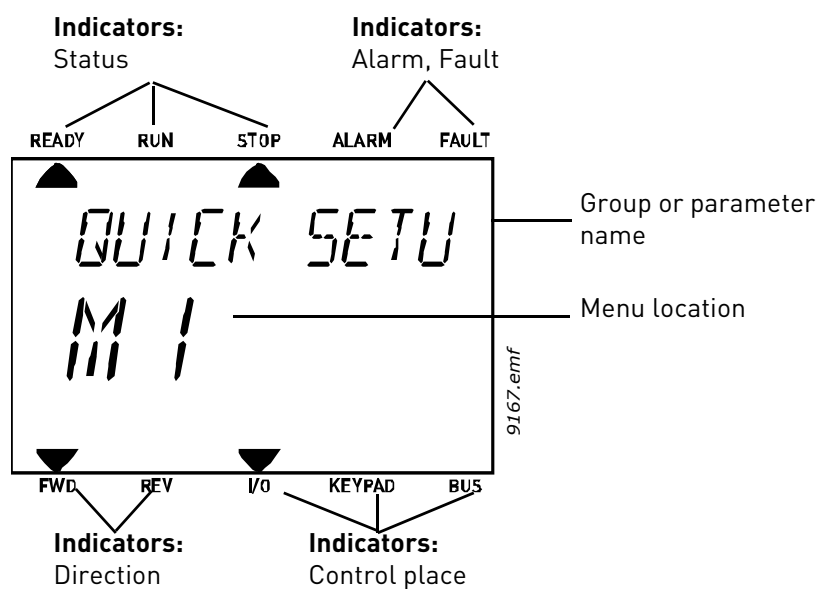
Figure 22. Adding item to Favorites

### 5.1.5 TEXT KEYPAD

You can also choose a so-called *Text keypad* for your user interface. It has mainly the same functionalities as the graphical keypad although some of these are somewhat limited.

#### 5.1.5.1 Keypad display

The keypad display 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 the drive and 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.



#### 5.1.5.2 Using the text keypad

##### 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.

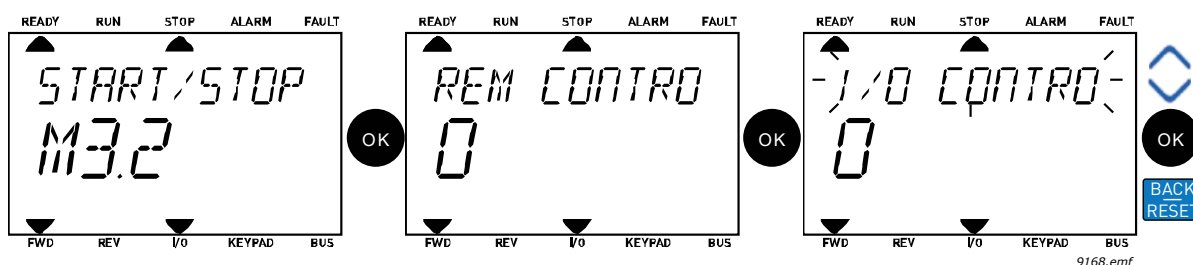


Figure 23. Editing values

## Resetting fault

Instructions for how to reset a fault can be found in chapter 8 on page 184.

## Function button

The FUNCT button is used for four functions:

### 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. The *Local control place* is always the keypad. The *Remote control place* is determined by parameter P3.2.1 (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 P3.5.1.7 (*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 P3.5.1.7 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 FUNCT-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 *FUNCT* 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 *FUNCT* button was pushed. However, if the Remote control place was changed to Local (Keypad) you will be prompted for keypad reference.



Figure 24. 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 *FUNCT* 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.

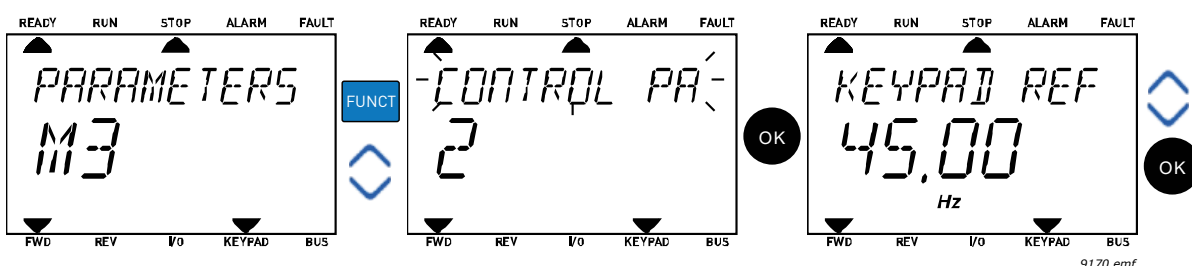


Figure 25. Accessing Control page

## Changing direction

Rotation direction of the motor can quickly be changed by applying the *FUNCT* button. **NOTE!** *Changing direction* command is not visible in the menu unless the selected control place is *Local*.

1. Anywhere in the menu structure, push the *Funct* button.
2. Push the *Arrow up* or the *Arrow down* button to select *Change direction* and confirm with the *OK* button.
3. Then choose the direction you wish to run the motor to. The actual rotation direction is blinking. Confirm with the *OK* button.
4. The rotation direction changes immediately and the arrow indication in the status field changes.

### Quick edit

Through the *Quick edit* functionality you can quickly access the desired parameter by entering the parameter's ID number.

1. Anywhere in the menu structure, push the FUNCT button.
2. Push the Arrow up or the Arrow down buttons to select Quick Edit and confirm with the OK button.
3. Then enter the ID number of parameter or monitoring value you wish to access. Press OK button to confirm.
4. Requested Parameter/Monitoring value appears on the display (in editing/monitoring mode.)

## 5.2 VACON® LIVE

VACON® Live is a PC tool for commissioning and maintenance of the VACON® 10, VACON® 20, and VACON® 100 AC drives). You can download VACON® Live from [www.danfoss.com](http://www.danfoss.com).

The VACON® Live PC tool includes these functions.

- Parametrization, monitoring, drive info, data logger, etc.
- The software download tool VACON® Loader
- RS-422 and Ethernet support
- Windows XP, Vista 7 and 8 support
- 17 languages: English, German, Spanish, Finnish, French, Italian, Russian, Swedish, Chinese, Czech, Danish, Dutch, Polish, Portuguese, Romanian, Slovak and Turkish You can make the connection between the AC drive and the PC tool with the black USB/RS-422 cable from VACON or the VACON® 100 Ethernet cable. The RS-422 drivers are installed automatically during the installation of VACON® Live. After you installed the cable, VACON® Live finds the connected drive automatically.

See more on how to use VACON® Live in the help menu of the program.

### 5.3 MENU STRUCTURE

Click on and select the item you wish to receive more information about (electronic manual).

Table 21. Keypad menus

|                         |                       |
|-------------------------|-----------------------|
| <b>Quick setup</b>      | See chapter 4.        |
| <b>Monitor</b>          | Multi-monitor*        |
|                         | Trend curve*          |
|                         | Basic                 |
|                         | I/O                   |
|                         | Extras/Advanced       |
|                         | Timer functions       |
|                         | PID Controller        |
|                         | ExtPID controller     |
|                         | Mainten. counters     |
|                         | Fieldbus data         |
|                         | Solar                 |
| <b>Parameters</b>       | See chapter 7.        |
| <b>Diagnostics</b>      | Active faults         |
|                         | Reset faults          |
|                         | Fault history         |
|                         | Total counters        |
|                         | Trip counters         |
|                         | Software info         |
| <b>I/O and hardware</b> | Basic I/O             |
|                         | Slot D                |
|                         | Slot E                |
|                         | Real time clock       |
|                         | Power unit settings   |
|                         | Keypad                |
|                         | RS-485                |
|                         | Ethernet              |
| <b>User settings</b>    | Language selections   |
|                         | Application selection |
|                         | Parameter backup*     |
|                         | Drive name            |
| <b>Favorites*</b>       | See chapter .         |
| <b>User levels</b>      | See chapter 5.3.8.    |

\*. Not available in text keypad

### 5.3.1 QUICK SETUP

In the Quick Setup parameter group you will find the different wizards of the VACON® 100 X Solar Pump Application. More detailed information on the parameters of this group you will find in chapter 4.

### 5.3.2 MONITOR

#### Multi-monitor

**NOTE:** This menu is not available in text keypad.

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

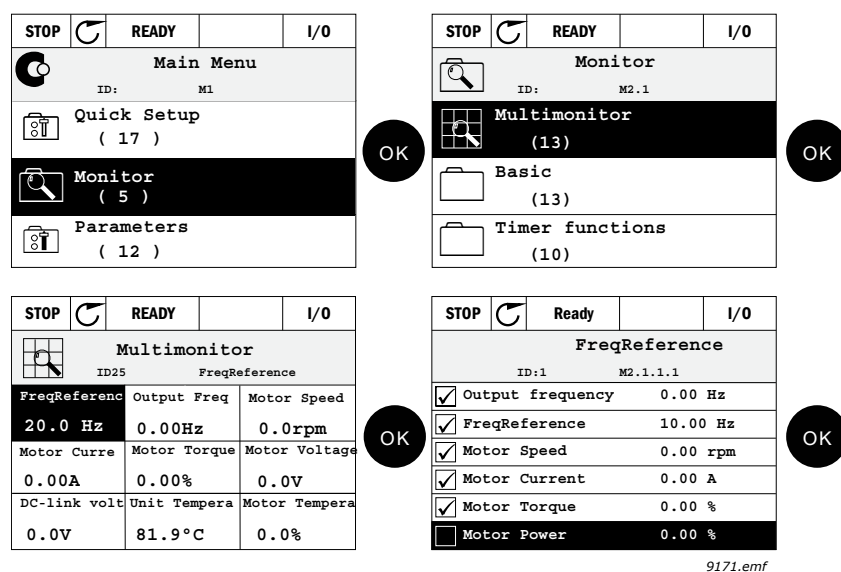


Figure 26. Multi-monitoring page

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. More detailed information on the monitor items can be found in chapter 6.

#### Trend curve

The *Trend Curve* feature is a graphical presentation of two monitor values at a time.

#### Basic

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

#### I/O

Statuses and levels of various input and output signal values can be monitored here.

#### Extras/Advanced

Monitoring of different advanced values, e.g. fieldbus values.

#### Timer functions

Monitoring of timer functions and the Real Time Clock.

#### PID Controller

Monitoring of PID controller values.

**External PID Controller**

Monitoring of external PID controller values.

**Maintenance counters**

Monitoring of values related to Maintenance counters.

**Fieldbus data**

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

**Solar**

Monitoring of values related to Solar specific application.

### 5.3.3 PARAMETERS

Through this submenu, you can reach the application parameter groups and parameters. More information on parameters in chapter 7.

### 5.3.4 DIAGNOSTICS

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

#### 5.3.4.1 *Active faults*

Table 22.

| Menu                 | Function   | Note  |
|----------------------|--|---|
| <b>Active faults</b> | 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 <i>Active faults</i> 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 <i>Reset faults</i> (see below). The memory of active faults can store the maximum of 10 faults in the order of appearance. |

#### 5.3.4.2 *Reset faults*

Table 23.

| Menu                | Function   | Note   |
|---------------------|--|--|
| <b>Reset faults</b> | In this menu you can reset faults. For closer instructions, see chapter 8. | <b>CAUTION!</b> Remove external Control signal before resetting the fault to prevent unintentional restart of the drive. |

#### 5.3.4.3 *Fault history*

Table 24.

| Menu                 | Function  | Note  |
|----------------------|---|---|
| <b>Fault history</b> | 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). |

#### 5.3.4.4 *Total counters*

Table 25. Diagnostics menu, Total counters parameters

| Code   | Parameter                         | Min | Max | Unit       | Default | ID   | Description  |
|--------|-----------------------------------|-----|-----|------------|---------|------|--|
| V4.4.1 | Energy counter                    |     |     | Varies     |         | 2291 | Amount of energy taken from supply network. No reset.<br><b>NOTE FOR TEXT KEYPAD:</b> The highest energy unit shown on the standard keypad is <i>MW</i> . Should the counted energy exceed 999.9 MW, no unit is shown on the keypad. |
| V4.4.3 | Operating time (graphical keypad) |     |     | a d hh:min |         | 2298 | Control unit operating time  |

Table 25. Diagnostics menu, Total counters parameters

|         |                                     |  |  |            |  |      |  |
|---------|-------------------------------------|--|--|------------|--|------|--|
| V4.4.4  | Operating time<br>(text keypad)     |  |  | a          |  |      | Control unit operating time in total years                       |
| V4.4.5  | Operating time<br>(text keypad)     |  |  | d          |  |      | Control unit operating time in total days                        |
| V4.4.6  | Operating time<br>(text keypad)     |  |  | hh:min:ss  |  |      | Control unit operating time in hours, minutes and seconds        |
| V4.4.7  | Run time<br>(graphical keypad)      |  |  | a d hh:min |  | 2293 | Motor running time   |
| V4.4.8  | Run time<br>(text keypad)           |  |  | a          |  |      | Motor running time in total years                                |
| V4.4.9  | Run time<br>(text keypad)           |  |  | d          |  |      | Motor running time in total days                                 |
| V4.4.10 | Run time<br>(text keypad)           |  |  | hh:min:ss  |  |      | Motor running time in hours, minutes and seconds                 |
| V4.4.11 | Power on time<br>(graphical keypad) |  |  | a d hh:min |  | 2294 | Amount of time the power unit has been powered so far. No reset. |
| V4.4.12 | Power on time<br>(text keypad)      |  |  | a          |  |      | Power on time in total years                                     |
| V4.4.13 | Power on time<br>(text keypad)      |  |  | d          |  |      | Power on time in total days                                      |
| V4.4.14 | Power on time<br>(text keypad)      |  |  | 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.             |

### 5.3.4.5 Trip counters

Table 26. Diagnostics menu, Trip counters parameters

| Code   | Parameter                            | Min | Max | Unit       | Default | ID   | Description  |
|--------|--------------------------------------|-----|-----|------------|---------|------|--|
| P4.5.1 | Energy trip counter                  |     |     | Varies     |         | 2296 | Resettable energy counter.<br><b>NOTE:</b> The highest energy unit shown on the standard keypad is <i>MW</i> . Should the counted energy exceed 999.9 MW, no unit is shown on the keypad.<br><b>To reset the counter:</b><br><u>Standard text keypad:</u><br>Apply a long (4 s) push on the OK button.<br><u>Graphical keypad:</u><br>Push OK once. <i>Reset counter</i> page will appear. Push OK once again. |
| P4.5.3 | Operating time<br>(graphical keypad) |     |     | a d hh:min |         | 2299 | Resettable. See P4.5.1.  |
| P4.5.4 | Operating time<br>(text keypad)      |     |     | a          |         |      | Operating time in total years  |
| P4.5.5 | Operating time<br>(text keypad)      |     |     | d          |         |      | Operating time in total days   |
| P4.5.6 | Operating time<br>(text keypad)      |     |     | hh:min:ss  |         |      | Operating time in hours, minutes and seconds   |



### 5.3.4.6 *Software info*

Table 27. Diagnostics menu, Software info parameters

| Code   | Parameter                              | Min | Max | Unit | Default | ID   | Description                      |
|--------|--|-----|-----|------|---------|------|----------------------------------|
| V4.6.1 | Software package (graphical keypad)    |     |     |      |         |      | Code for software identification |
| V4.6.2 | Software package ID (text keypad)      |     |     |      |         |      |                                  |
| V4.6.3 | Software package version (text keypad) |     |     |      |         |      |                                  |
| V4.6.4 | System load                            | 0   | 100 | %    |         | 2300 | Load on control unit CPU.        |
| V4.6.5 | Application name (graphical keypad)    |     |     |      |         |      | Name of application.             |
| V4.6.6 | Application ID                         |     |     |      |         |      | Application code.                |
| V4.6.7 | Application version                    |     |     |      |         |      |                                  |

### 5.3.5 I/O AND HARDWARE

Various options-related settings are located in this menu. Note that the values in this menu are raw values i.e. not scaled by the application.

#### 5.3.5.1 *Basic I/O*

Monitor here the statuses of inputs and outputs.

*Table 28. I/O and Hardware menu, Basic I/O parameters*

| Code    | Parameter              | Min | Max | Unit | Default | ID | Description   |
|---------|------------------------|-----|-----|------|---------|----|---|
| V5.1.1  | Digital input 1        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.2  | Digital input 2        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.3  | Digital input 3        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.4  | Digital input 4        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.5  | Digital input 5        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.6  | Digital input 6        | 0   | 1   |      | 0       |    | Status of digital input signal  |
| V5.1.7  | Analogue input 1 mode  | 1   | 3   |      | 3       |    | Shows the selected (with jumper) mode for Analogue input signal<br>1 = 0...20 mA<br>3 = 0...10 V  |
| V5.1.8  | Analogue input 1       | 0   | 100 | %    | 0.00    |    | Status of analogue input signal   |
| V5.1.9  | Analogue input 2 mode  | 1   | 3   |      | 3       |    | Shows the selected (with jumper) mode for Analogue input signal<br>1 = 0...20 mA<br>3 = 0...10 V  |
| V5.1.10 | Analogue input 2       | 0   | 100 | %    | 0.00    |    | Status of analogue input signal   |
| V5.1.11 | Analogue output 1 mode | 1   | 3   |      | 1       |    | Shows the selected (with jumper) mode for Analogue output signal<br>1 = 0...20 mA<br>3 = 0...10 V |
| V5.1.12 | Analogue output 1      | 0   | 100 | %    | 0.00    |    | Status of analogue output signal  |
| V5.1.13 | Relay output 1         | 0   | 1   |      | 0       |    | Status of relay output signal   |
| V5.1.14 | Relay output 2         | 0   | 1   |      | 0       |    | Status of relay output signal   |
| V5.1.15 | Relay output 3         | 0   | 1   |      | 0       |    | Status of relay output signal   |

### 5.3.5.2 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.

As an option board is removed, info text 39 *Device removed* will appear on the display.

Table 29. Option board-related parameters

| 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. |

### 5.3.5.3 Programming of digital and analogue inputs

The programming of inputs in the VACON® 100 X Solar Pump Application is very flexible. The available inputs on the standard and optional I/O can be used for various functions according to the operator's choice.

The available I/O can be expanded with optional boards to be inserted in board slots D and E. More information about the installation of optional boards you will find in the VACON® 100 X Installation manual.

### 5.3.5.4 Digital inputs

The applicable functions for digital inputs are arranged as parameters in parameter group M3.5.1. The value given to the parameter is a reference to the digital input you choose to use for the function. The list of functions that you can assign to the available digital inputs is presented on Digital Inputs group.

#### Example

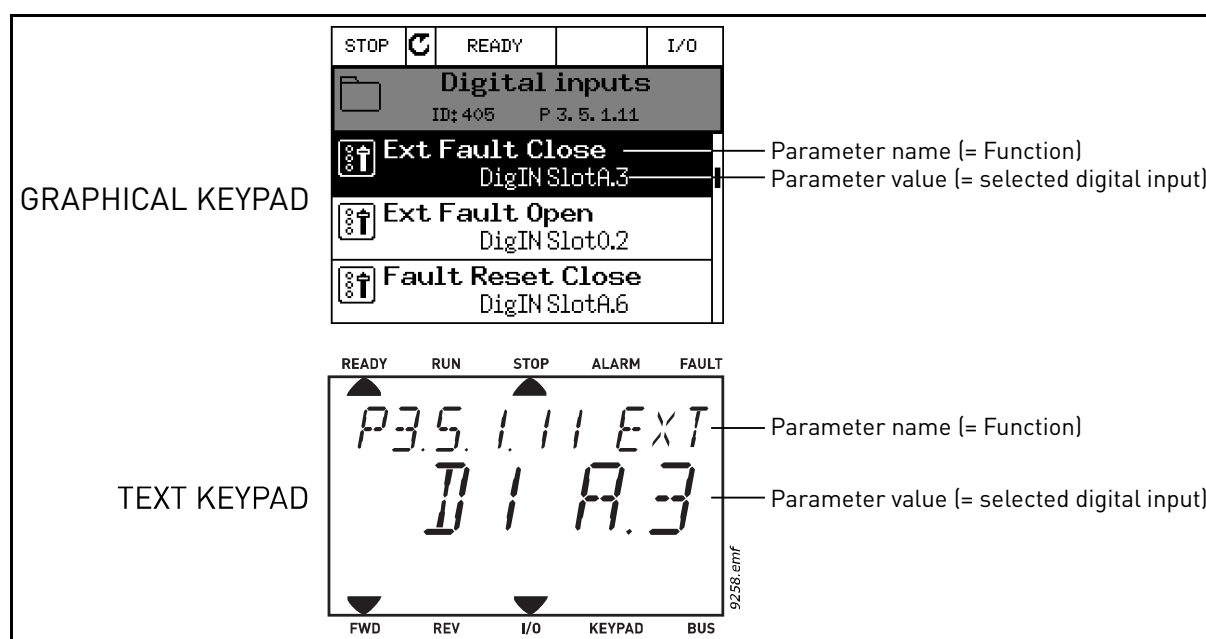


Figure 27.

Given the standard I/O board compilation on the VACON® 100 AC drive, there are 6 digital inputs available (Slot A terminals 8, 9, 10, 14, 15 and 16). In the programming view, these inputs are referred to as follows:

Table 30.

| Input type<br>(Graphical keypad) | Input type<br>(Text keypad) | Slot | Input # | Explanation   |
|----------------------------------|-----------------------------|------|---------|---|
| DigIN                            | dI                          | A.   | 1       | Digital input #1 (terminal 8) on board in Slot A (standard I/O board).  |
| DigIN                            | dI                          | A.   | 2       | Digital input #2 (terminal 9) on board in Slot A (standard I/O board).  |
| DigIN                            | dI                          | A.   | 3       | Digital input #3 (terminal 10) on board in Slot A (standard I/O board). |
| DigIN                            | dI                          | A.   | 4       | Digital input #4 (terminal 14) on board in Slot A (standard I/O board). |
| DigIN                            | dI                          | A.   | 5       | Digital input #5 (terminal 15) on board in Slot A (standard I/O board). |
| DigIN                            | dI                          | A.   | 6       | Digital input #6 (terminal 16) on board in Slot A (standard I/O board). |

In the example Figure 27, the function *External fault close* located in menu M3.5.1 as parameter P3.5.1.11, is by default given the value *DigIN SlotA.3* (graphical keypad) or *dI A.3* (text keypad). This means that the function *External fault close* is now controlled with a digital signal to digital input DI3 (terminal 10).

This is what is shown in the parameter list.

| Code      | Parameter            | Default       | ID  | Description                         |
|-----------|----------------------|---------------|-----|-------------------------------------|
| P3.5.1.11 | External fault close | DigIN SlotA.3 | 405 | FALSE = OK<br>TRUE = External fault |

Assume you need to change the selected input. Instead of DI3 you wish to use DI6 (terminal 16) on the standard I/O. Do as instructed here:

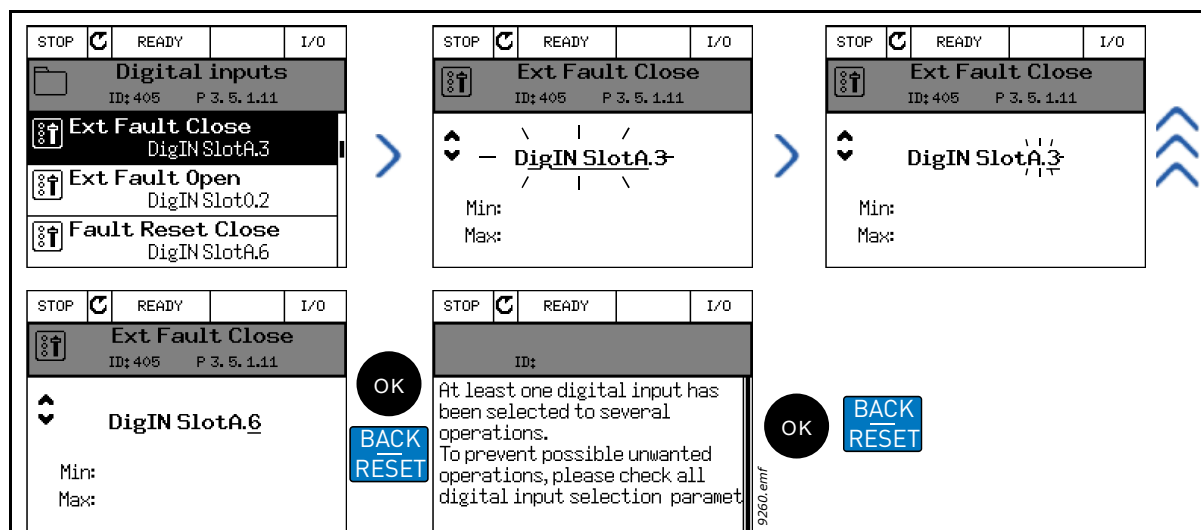


Figure 28. Programming digital inputs with graphical keypad

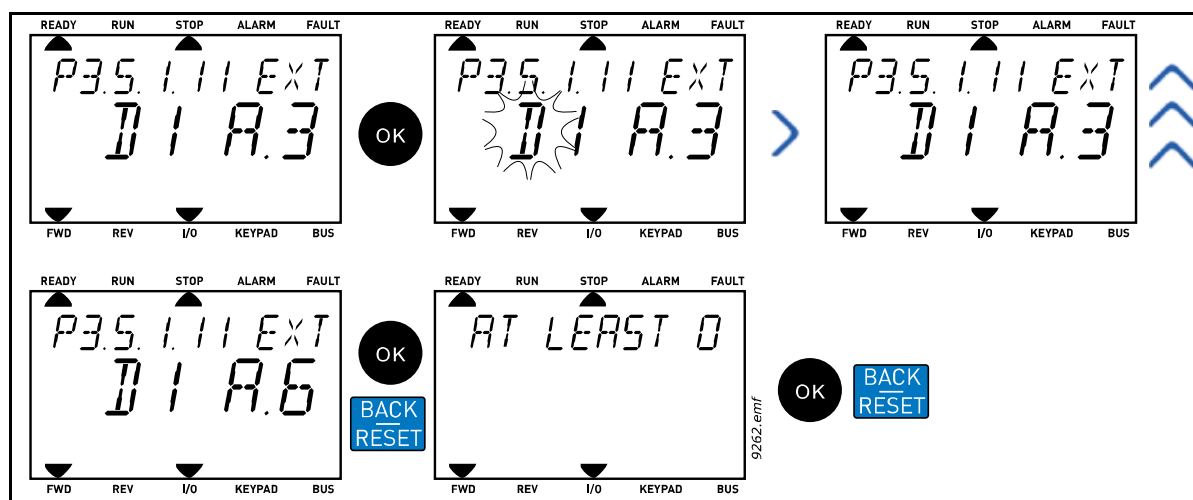


Figure 29. Programming digital inputs with text keypad

Table 31. Programming digital inputs

| PROGRAMMING INSTRUCTIONS   |  |
|--|--|
| Graphical keypad   | Text keypad  |
| 1. Select the parameter and push the <i>Arrow right</i> button.  | 1. Select the parameter and push the <i>OK</i> button.   |
| 2. You are now in the <i>Edit</i> mode as the slot value <i>DigIN SlotA.</i> is blinking and underlined. (Should you have more digital inputs available in your I/O, for example, through inserted option boards in slots <b>D</b> or <b>E</b> , they can also be selected here.). | 2. You are now in the <i>Edit</i> mode as the letter <i>d</i> is blinking. (Should you have more digital inputs available in your I/O, for example, through inserted option boards in slots <b>D</b> or <b>E</b> , they can also be selected here.). |
| 3. Push the <i>Arrow right</i> button again to activate the terminal value 3.  | 3. Push the <i>Arrow right</i> button to activate the terminal value 3. The letter <i>d</i> stops blinking.  |
| 4. Push the <i>Arrow up</i> button three times to change the terminal value to 6. Confirm with <i>OK</i> button.   | 4. Push the <i>Arrow up</i> button three times to change the terminal value to 6. Confirm with <i>OK</i> button.   |
| 5. <b>NOTE!</b> If the digital input DI6 was already used for some other function a message is displayed. You might then want to change either of these selections.  | 5. <b>NOTE!</b> If the digital input DI6 was already used for some other function a message will scroll through the display. You might then want to change either of these selections.   |

Now, the function *External fault close* is controlled with a digital signal to digital input DI6 (terminal 16).

|              |   |
|--------------|---|
| <b>NOTE!</b> | The function is not assigned to any terminal, or, the the input is set to be always FALSE, if its value is <i>DigIN Slot0.1</i> (graphical keypad) or <i>dI 0.1</i> (text keypad). This is the default value of the majority of parameters in group M3.5.1. |
|              | On the other hand, some inputs have been by default set to be always TRUE. Their value shows <i>DigIN Slot0.2</i> (graphical keypad) or <i>dI 0.2</i> (text keypad).  |
| <b>NOTE!</b> | Also <i>Time Channels</i> can be assigned to digital inputs. See more information on page 119.  |

### 5.3.5.5 Analogue inputs

The target input for the analogue frequency reference signal can also be chosen from the available analogue inputs.

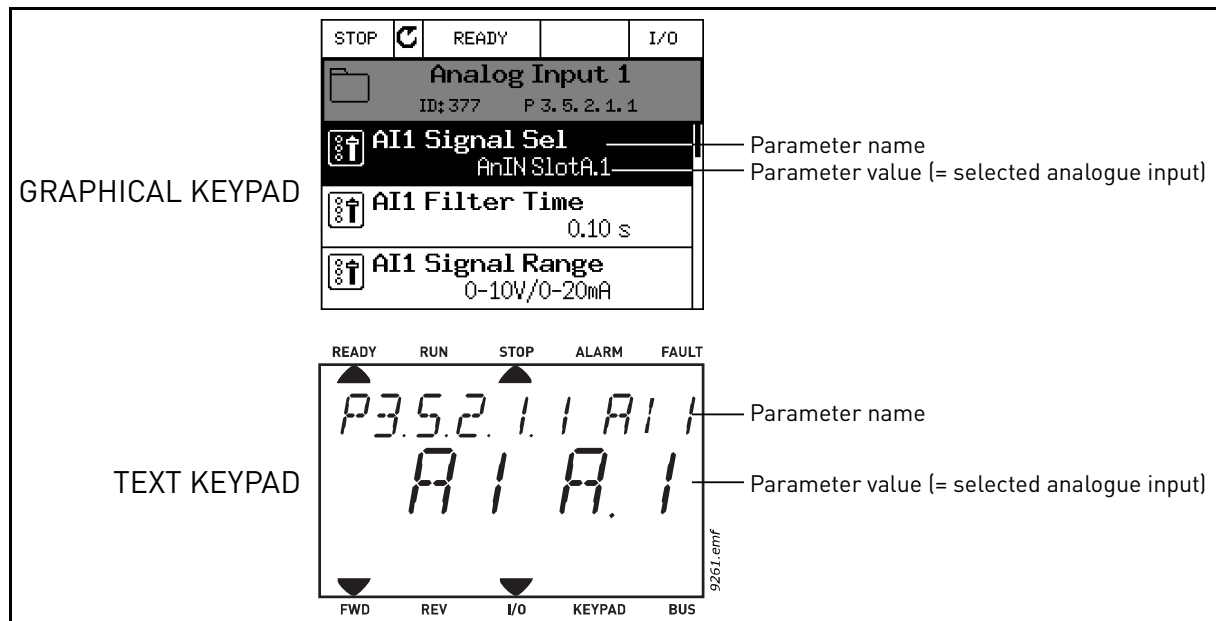


Figure 30.

Given the standard I/O terminals on the VACON® 100 X AC drive, there are 2 analogue inputs available. In the programming view, these inputs are referred to as follows:

Table 32. Programming analogue inputs

| Input type<br>(Graphical keypad) | Input type<br>(Text keypad) | Slot | Input # | Explanation  |
|----------------------------------|-----------------------------|------|---------|--|
| AnIN                             | AI                          | A.   | 1       | Analogue input #1 (terminals 2/3) on board in Slot A (standard I/O terminals). |
| AnIN                             | AI                          | A.   | 2       | Analogue input #2 (terminals 4/5) on board in Slot A (standard I/O terminals). |

In the example Figure 30, the parameter *AI1 signal selection* located in menu M3.5.2.1 with parameter code P3.5.2.1.1, is by default given the value *AnIN SlotA.1* (graphical keypad) or *AI A.1* (text keypad). This means that the target input for the analogue frequency reference signal AI1 is now the analogue input in terminals 2/3. Whether the signal is voltage or current, must be determined with the *dip switches*. See the Installation manual for more information.

This is what is shown in the parameter list on page 104:

| Code       | Parameter            | Min | Max | Unit | Default      | ID  | Description  |
|------------|----------------------|-----|-----|------|--------------|-----|--|
| P3.5.2.1.1 | AI1 signal selection |     |     |      | AnIN SlotA.1 | 377 | Connect the AI1 signal to the analogue input of your choice with this parameter. Programmable. See page 104. |

Assume you need to change the selected input. Instead of AI1 you wish to use the analogue input on your option board in slot D. Do as instructed here:

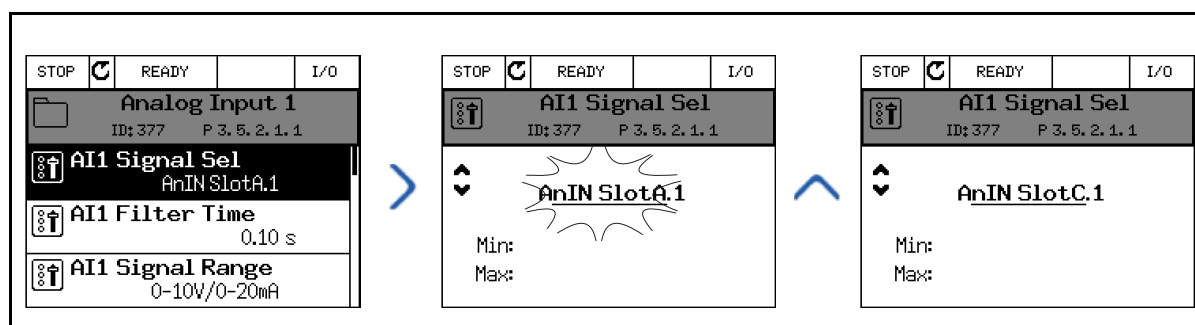


Figure 31. Programming analogue inputs with graphical keypad

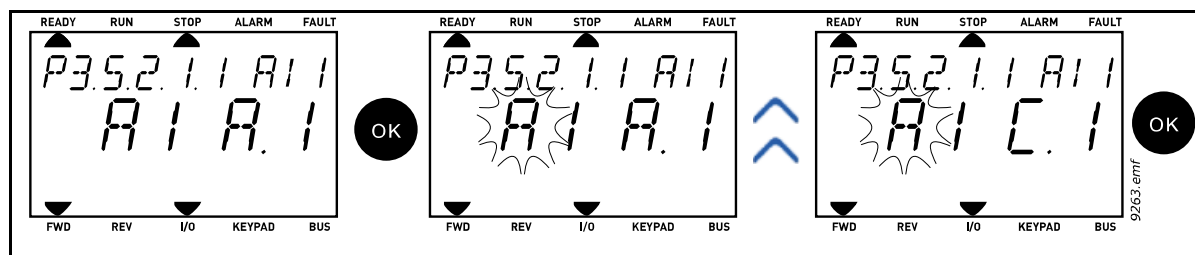


Figure 32. Programming analogue inputs with text keypad

| PROGRAMMING INSTRUCTIONS  |  |
|---|--|
| Graphical keypad  | Text keypad  |
| 1. Select the parameter and push the <i>Arrow right</i> button.   | 1. Select the parameter and push the <i>OK</i> button.   |
| 2. You are now in the <i>Edit</i> mode as the slot value <i>AnIN SlotA.</i> is blinking and underlined.               | 2. You are now in the <i>Edit</i> mode as the letter <i>A</i> is blinking.                                   |
| 3. Push the <i>Arrow up</i> button once to change the slot value to <i>AnIN SlotC.</i> Confirm with <i>OK</i> button. | 3. Push the <i>Arrow up</i> button once to change the slot value to <i>C.</i> Confirm with <i>OK</i> button. |

### 5.3.5.6 Descriptions of signal sources

Table 33. Descriptions of signal sources

| Source        | Function   |
|---------------|--|
| Slot0.#       | <b>Digital inputs:</b><br>A digital signal can be forced to a constant FALSE or TRUE state using this functionality. For example, some signals have been set to be always in TRUE state by manufacturer, e.g parameter P3.5.1.15 (Run enable). Unless changed, Run enable signal is always on.<br># = 1: Always FALSE<br># = 2-10: Always TRUE<br><b>Analogue inputs</b> (used for testing purposes):<br># = 1: Analogue input = 0% signal strength<br># = 2: Analogue input = 20% signal strength<br># = 3: Analogue input = 30% signal strength<br>etc.<br># = 10: Analogue input = 100% signal strength |
| SlotA.#       | Number (#) corresponds to digital input in slot A(Standard terminals).   |
| SlotD.#       | Number (#) corresponds to digital input in slot D.   |
| SlotE.#       | Number (#) corresponds to digital input in slot E.   |
| TimeChannel.# | Number (#) corresponds to: 1=Time Channel1, 2=Time Channel2, 3=Time Channel3   |
| Fieldbus CW.# | Number (#) refers to Control Word bit number.  |
| FieldbusPD.#  | Number (#) refers to Process Data 1 bit number.  |

### 5.3.5.7 Default assignments of digital and analogue inputs in VACON® 100 application

Digital and analogue inputs are assigned certain functions by the factory. In this application, the default assignments are:

Table 34. Default assignments of inputs

| Input | Terminal(s) | Reference | Assigned function    | Parameter code |
|-------|-------------|-----------|----------------------|----------------|
| DI1   | 8           | A.1       | Control signal 1 A   | P3.5.1.1       |
| DI2   | 9           | A.2       | Control signal 2 A   | P3.5.1.2       |
| DI3   | 10          | A.3       | External fault close | P3.5.1.11      |
| DI4   | 14          | A.4       | Preset Freq Sel0     | P3.5.1.21      |
| DI5   | 15          | A.5       | Preset Freq Sel1     | P3.5.1.22      |
| DI6   | 16          | A.6       | External fault close | P3.5.1.13      |
| AI1   | 2/3         | A.1       | AI1 signal selection | P3.5.2.1.1     |
| AI2   | 4/5         | A.2       | AI2 signal selection | P3.5.2.2.1     |



5.3.5.8 Real time clock*Table 35. I/O and Hardware menu, Real time clock parameters*

| Code   | Parameter       | Min | Max | Unit     | Default | ID   | Description  |
|--------|-----------------|-----|-----|----------|---------|------|--|
| V5.5.1 | Battery state   | 1   | 3   |          | 2       | 2205 | Status of battery.<br>1 = Not installed<br>2 = Installed<br>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<br>1 = Off<br>2 = EU; Starts on last Sunday in March, ends last Sunday in October<br>3 = US; Start on 2nd Sunday in March, ends on 1st Sunday in November<br>4 = Russia (permanent) |

5.3.5.9 Power unit settings**Fan control**

The fan operates in speed-controlled mode. The speed is controlled according to the drive's internal logic that receives data from temperature measurements.

*Table 36. Power unit settings, Fan control*

| Code     | Parameter | Min | Max | Unit | Default | ID  | Description   |
|----------|-----------|-----|-----|------|---------|-----|---|
| V5.6.1.3 | Fan stop  | 0   | 1   |      | 1       | 826 | If enabled, the fan will stop in 5 minutes when the drive is in Ready state.<br>0 = Disabled<br>1 = Enabled |

**Brake chopper***Table 37. Power unit settings, Brake chopper*

| Code     | Parameter          | Min | Max | Unit | Default | ID | Description  |
|----------|--------------------|-----|-----|------|---------|----|--|
| V5.6.2.1 | Brake chopper mode | 0   | 3   |      | 0       |    | 0 = Disabled<br>1 = Enabled (Run)<br>2 = Enabled (Run & Stop)<br>3 = Enabled (Run, no testing) |

**Sine filter***Table 38. Power unit settings, Sine filter*

| Code     | Parameter   | Min | Max | Unit | Default | ID | Description                 |
|----------|-------------|-----|-----|------|---------|----|-----------------------------|
| V5.6.4.1 | Sine filter | 0   | 1   |      | 0       |    | 0 = Disabled<br>1 = Enabled |

5.3.5.10 Keypad*Table 39. I/O and Hardware menu, Keypad parameters*

| Code   | Parameter      | Min | Max | Unit | Default | ID | Description  |
|--------|----------------|-----|-----|------|---------|----|--|
| P5.7.1 | Timeout time   | 0   | 60  | min  | 0       |    | Time after which the display returns to page defined with parameter P5.7.2.<br>0 = Not used  |
| P5.7.2 | Default page   | 0   | 4   |      | 0       |    | The page the keypad shows when the drive is powered on or when the time defined with P5.7.1 has expired. If the value is set to 0 the page last visited is shown.<br>0 = None<br>1 = Enter menu index<br>2 = Main menu<br>3 = Control page<br>4 = Multimonitor |
| P5.7.3 | Menu index     |     |     |      |         |    | Set menu index for desired page and activate with parameter P5.7.2 = 1.  |
| P5.7.4 | Contrast*      | 30  | 70  | %    | 50      |    | Set contrast of the display (30...70%).  |
| P5.7.5 | Backlight time | 0   | 60  | min  | 5       |    | Set the time until the back light of the display turns off (0...60 min). If set to 0 s, back light is always on.   |

\*. Only available with graphical keypad

5.3.5.11    *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.

*Table 40.*

| Submenu level 1 | Submenu level 2 | Submenu level 3 | Submenu level 4       |
|-----------------|-----------------|-----------------|-----------------------|
| <b>RS-485</b>   | Common settings | Protocol        | NA                    |
| <b>Ethernet</b> | Common settings | IP address mode | NA                    |
|                 |                 | IP address      | NA                    |
|                 |                 | Subnet mask     | NA                    |
|                 |                 | Default gateway | NA                    |
|                 |                 | MAC address     | NA                    |
|                 | Modbus/TCP      | Common settings | Connection limit      |
|                 |                 |                 | Slave address         |
|                 |                 |                 | Communication timeout |
|                 | BacNet IP       | Settings        | Instance number       |
|                 |                 |                 | Communication timeout |
|                 |                 |                 | Protocol in use       |
|                 |                 |                 | BBMD IP               |
|                 |                 |                 | BBMD port             |
|                 |                 |                 | Time to live          |
|                 |                 | Monitoring      | FB protocol status    |
|                 |                 |                 | Communication status  |
|                 |                 |                 | Actual instance       |
|                 |                 |                 | Control Word          |
|                 |                 |                 | Status Word           |

### 5.3.6 USER SETTINGS

*Table 41. User settings menu, General settings*

| Code | Parameter             | Min                        | Max    | Unit | Default | ID  | Description                   |
|------|-----------------------|----------------------------|--------|------|---------|-----|-------------------------------|
| P6.1 | Language selections   | Varies                     | Varies |      | Varies  | 802 | Depends on language package.  |
| P6.2 | Application selection |                            |        |      |         | 801 |                               |
| M6.5 | Parameter backup      | See chapter 5.3.6.1 below. |        |      |         |     |                               |
| P6.7 | Drive name            |                            |        |      |         |     | Give name of drive if needed. |

#### 5.3.6.1 Parameter backup

*Table 42. User settings menu, Parameter backup parameters*

| Code   | Parameter                | Min | Max | Unit | Default | ID  | Description  |
|--------|--------------------------|-----|-----|------|---------|-----|--|
| P6.5.1 | Restore factory defaults |     |     |      |         | 831 | Restores default parameter values and initiates the Startup Wizard when activated        |
| P6.5.2 | Save to keypad*          | 0   | 1   |      | 0       |     | Save parameter values to keypad to e.g. copy them to another drive.<br>0 = No<br>1 = Yes |
| P6.5.3 | Restore from keypad*     |     |     |      |         |     | Load parameter values from keypad to the drive.  |
| B6.5.4 | Save to Set 1            |     |     |      |         |     | Store a customized parameter set (all parameters included in the application)            |
| B6.5.5 | Restore from Set 1       |     |     |      |         |     | Load the customized parameter set to the drive.  |
| B6.5.6 | Save to Set 2            |     |     |      |         |     | Store another customized parameter set (all parameters included in the application)      |
| B6.5.7 | Restore from Set 2       |     |     |      |         |     | Load the customized parameter set 2 to the drive.  |

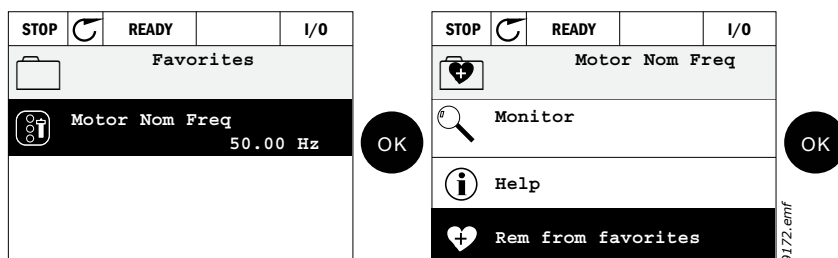
\*. Only available with graphical keypad

### 5.3.7 FAVORITES

**NOTE:** This menu is not available in text keypad.

Favorites 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 Favorites folder, see chapter .

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

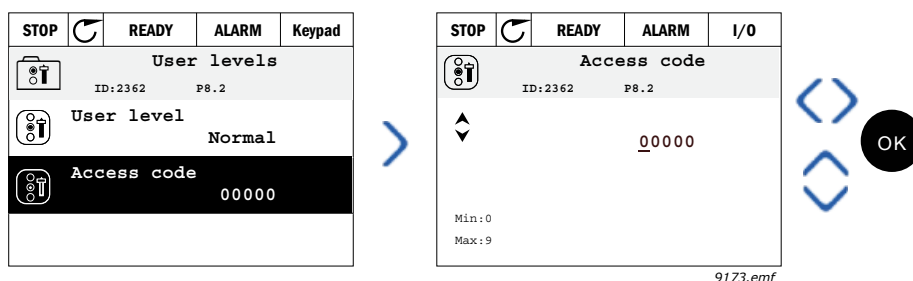


### 5.3.8 USER LEVELS

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

Table 43. User level parameters

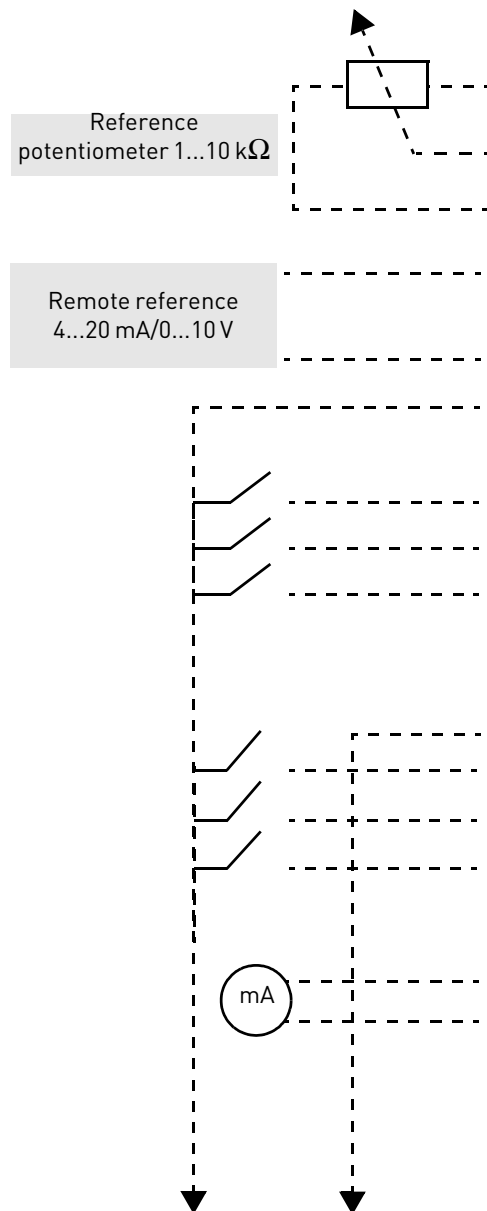
| Code | Parameter   | Min | Max   | Unit | Default | ID   | Description   |
|------|-------------|-----|-------|------|---------|------|---|
| P8.1 | User level  | 1   | 3     |      | 1       | 1194 | 1 = Normal; All menus visible in the Main menu<br>2 = Monitoring; Only Monitor, Favorites and User Levels menus are visible in the main menu<br>3 = Favorites; Only Favorites and User Levels menus are visible in the Main menu                                    |
| P8.2 | Access code | 0   | 99999 |      | 0       | 2362 | If set to other value than 0 before switching to monitoring when e.g. user level <i>Normal</i> is active, the access code will be asked when trying to switch back to <i>Normal</i> . Can therefore be used to prevent unauthorized parameterization on the keypad. |



## 5.4 EXAMPLE OF CONTROL CONNECTIONS

The terminals of the *Standard I/Os* and the *Relays* are described below. The terminals shown on shadowed background are assigned for signals with optional functions selectable with DIP switches. See more information in VACON® 100 X Installation Manual.

Table 44. Control I/O terminal signals and connection example.

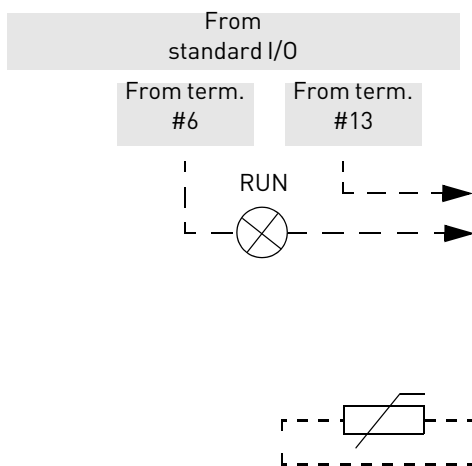




| Standard I/O |          |                                     |
|--------------|----------|-------------------------------------|
| Terminal     |          | Signal                              |
| 1            | +10 Vref | Reference output                    |
| 2            | AI1+     | Analogue input, voltage or current  |
| 3            | AI1-     | Analogue input common               |
| 4            | AI2+     | Analogue input, voltage or current  |
| 5            | AI2-     | Analogue input common               |
| 6            | 24 Vout  | 24 V aux. voltage                   |
| 7            | GND      | I/O ground                          |
| 8            | DI1      | Digital input 1                     |
| 9            | DI2      | Digital input 2                     |
| 10           | DI3      | Digital input 3                     |
| 11           | CM       | Common for DI1-DI6*                 |
| 12           | 24 Vout  | 24 V aux. voltage                   |
| 13           | GND      | I/O ground                          |
| 14           | DI4      | Digital input 4                     |
| 15           | DI5      | Digital input 5                     |
| 16           | DI6      | Digital input 6                     |
| 17           | CM       | Common for DI1-DI6*                 |
| 18           | AO1+     | Analogue output, voltage or current |
| 19           | AO-/GND  | Analogue output common              |
| 30           | +24 Vin  | 24 V auxiliary input voltage        |
| A            | RS485    | Serial bus, negative                |
| B            | RS485    | Serial bus, positive                |

\*. Can be isolated from ground, see VACON® 100 X Installation Manual.

### 5.4.1 RELAY AND THERMISTOR INPUT TERMINALS

Table 45. I/O terminal signals for relay and thermistor terminals and connection example.



| Relays and thermistor |       |  |
|-----------------------|-------|--|
| Terminal              |       | Signal   |
| 21                    | R01/1 |  Relay output 1 |
| 22                    | R01/2 |  |
| 23                    | R01/3 |  |
| 24                    | R02/1 |  Relay output 2 |
| 25                    | R02/2 |  |
| 26                    | R02/3 |  |
| 28                    | TI1+  | Thermistor input   |
| 29                    | TI1-  |  |

### 5.4.2 SAFE TORQUE OFF (STO) TERMINALS

For more information on the functionalities of the Safe Torque Off (STO), see VACON® 100 X Installation Manual.

Table 46. I/O terminal signals for the STO functions.

| Safe Torque Off terminals |  |
|---------------------------|--|
| Terminal                  | Signal   |
| S1                        | Isolated digital input 1 (inter-changeable polarity);<br>+24 V $\pm$ 20%, 10...15 mA |
| G1                        |  |
| S2                        | Isolated digital input 2 (inter-changeable polarity);<br>+24 V $\pm$ 20%, 10...15 mA |
| G2                        |  |
| F+                        | Isolated feedback (CAUTION! Polarity to be respected);<br>+24 V $\pm$ 20%            |
| F-                        | Isolated feedback (CAUTION! Polarity to be respected);<br>GND                        |

## 6. MONITORING MENU

### 6.1 MONITOR GROUP

VACON® 100 X AC 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.

#### 6.1.1 MULTIMONITOR

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

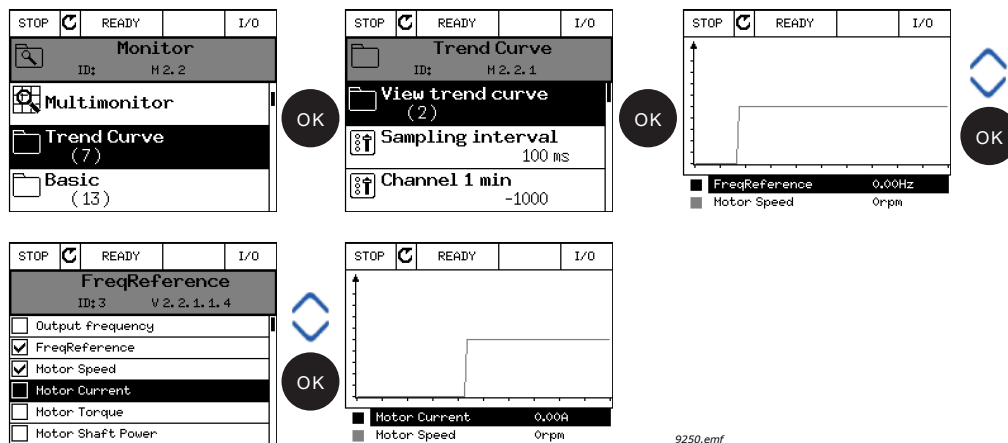
#### 6.1.2 TREND CURVE

The *Trend Curve* feature is a graphical presentation of two monitor values at a time.

Selecting values to monitor starts logging the values. In the Trend curve submenu, you can view the trend curve, make the signal selections, give the minimum and maximum settings, Sampling interval and choose whether to use Autoscaling or not.

Change values to monitor following the procedure below:

1. Locate the *Trend curve* menu in the *Monitor* menu and press OK.
2. Further enter the menu *View trend curve* by pressing OK again.
3. The current selections to monitor are *FreqReference* and *Motor speed* visible at the bottom of the display.
4. Only two values can be monitored as trend curves simultaneously. Select the one of the current values you wish to change with the arrow buttons and press OK.
5. Browse the list of given monitoring values with the arrow buttons, select the one you wish and press OK.
6. The trend curve of the changed value can be seen on the display.



The *Trend Curve* feature also allows you to halt the progression of the curve and read the exact individual values.

1. In Trend curve view, select the display with the arrow button up (the frame of the display turns bold) and press OK at the desired point of the progressing curve. A vertical hairline appears on the display.
2. The display freezes and the values at the bottom of the display correspond to the location of the hairline.
3. Use the arrow buttons left and right to move the hairline to see the exact values of some other location.



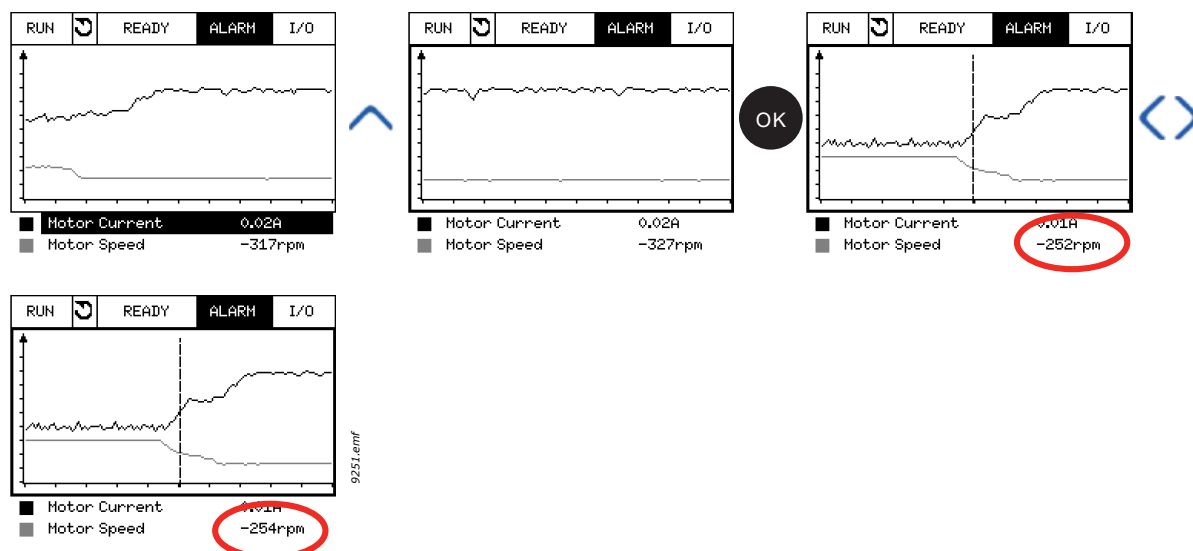


Table 47. Trend curve parameters

| Code   | Parameter         | Min     | Max    | Unit | Default | ID   | Description  |
|--------|-------------------|---------|--------|------|---------|------|--|
| M2.2.1 | View Trend curve  |         |        |      |         |      | Enter this menu to select and monitor values for viewing in curve form.                                    |
| P2.2.2 | Sampling interval | 100     | 432000 | ms   | 100     | 2368 | Set here the sampling interval.  |
| P2.2.3 | Channel 1 min     | -214748 | 1000   |      | -1000   | 2369 | Used by default for scaling. Adjustments might be necessary.   |
| P2.2.4 | Channel 1 max     | -1000   | 214748 |      | 1000    | 2370 | Used by default for scaling. Adjustments might be necessary.   |
| P2.2.5 | Channel 2 min     | -214748 | 1000   |      | -1000   | 2371 | Used by default for scaling. Adjustments might be necessary.   |
| P2.2.6 | Channel 2 max     | -1000   | 214748 |      | 1000    | 2372 | Used by default for scaling. Adjustments might be necessary.   |
| P2.2.7 | Autoscale         | 0       | 1      |      | 0       | 2373 | The selected signal is automatically scaled between min and max values if this parameter is given value 1. |

### 6.1.3 BASIC

See Table 48 in which the basic monitoring values are presented.

#### NOTE!

Only standard 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.

*Table 48. Basic monitoring menu items*

| Code    | Monitoring value  | Unit  | Scale  | ID   | Description  |
|---------|-------------------|-------|--------|------|--|
| V2.3.1  | Output frequency  | Hz    | 0.01   | 1    | Output frequency to motor  |
| V2.3.2  | FreqReference     | Hz    | 0.01   | 25   | Frequency reference to motor control   |
| V2.3.3  | Motor speed       | rpm   | 1      | 2    | Motor actual speed in rpm  |
| V2.3.4  | Motor current     | A     | Varies | 3    |  |
| V2.3.5  | Motor torque      | %     | 0.1    | 4    | Calculated shaft torque  |
| V2.3.7  | Motor shaft power | %     | 0.1    | 5    | Calculated motor shaft power in %  |
| V2.3.8  | Motor shaft power | kW/hp | Varies | 73   | Calculated motor shaft power in kW or hp. Units depends on the unit selection parameter. |
| V2.3.9  | Motor voltage     | V     | 0.1    | 6    | Output voltage to motor  |
| V2.3.10 | DC link voltage   | V     | 1      | 7    | Measured voltage in the drive's DC-link  |
| V2.3.11 | Unit temperature  | °C    | 0.1    | 8    | Heat sink temperature in °C or °F  |
| V2.3.12 | Motor temperature | %     | 0.1    | 9    | Calculated motor temperature in percent of nominal working temperature.                  |
| V2.3.13 | Motor Preheat     |       | 1      | 1228 | Status of Motor preheat function.<br>0 = OFF<br>1 = Heating (feeding DC-current)         |

## 6.1.4 I/O

Table 49. I/O signal monitoring

| Code    | Monitoring value   | Unit | Scale | ID | Description  |
|---------|--------------------|------|-------|----|--|
| V2.4.1  | Slot A DIN 1, 2, 3 |      | 1     | 15 | Shows the status of digital inputs 1-3 in slot A (standard I/O)      |
| V2.4.2  | Slot A DIN 4, 5, 6 |      | 1     | 16 | Shows the status of digital inputs 4-6 in slot A (standard I/O)      |
| V2.4.3  | Slot B R0 1, 2, 3  |      | 1     | 17 | Shows the status of relay inputs 1-3 in slot B                       |
| V2.4.4  | Analogue input 1   | %    | 0.01  | 59 | Input signal in percent of used range. Slot A.1 as default.          |
| V2.4.5  | Analogue input 2   | %    | 0.01  | 60 | Input signal in percent of used range. Slot A.2 as default.          |
| V2.4.6  | Analogue input 3   | %    | 0.01  | 61 | Input signal in percent of used range. Slot D.1 as default.          |
| V2.4.7  | Analogue input 4   | %    | 0.01  | 62 | Input signal in percent of used range. Slot D.2 as default.          |
| V2.4.8  | Analogue input 5   | %    | 0.01  | 75 | Input signal in percent of used range. Slot E.1 as default.          |
| V2.4.9  | Analogue input 6   | %    | 0.01  | 76 | Input signal in percent of used range. Slot E.2 as default.          |
| V2.4.10 | Slot A AO1         | %    | 0.01  | 81 | Analog output signal in percent of used range. Slot A (standard I/O) |

## 6.1.5 EXTRAS &amp; ADVANCED

Table 50. Advanced values monitoring

| Code   | Monitoring value | Unit | Scale | ID | Description  |
|--------|------------------|------|-------|----|--|
| V2.6.1 | DriveStatusWord  |      | 1     | 43 | Bit coded word<br>B1=Ready<br>B2=Run<br>B3=Fault<br>B6=RunEnable<br>B7=AlarmActive<br>B10=DC Current in stop<br>B11=DC Brake Active<br>B12=RunRequest<br>B13=MotorRegulatorActive  |
| V2.6.2 | Ready status     |      | 1     | 78 | Bit coded information about ready criteria. Useful for debugging when the drive is not in ready status.<br>Values are visible as checkboxes on graphical keypad. If checked ( <input checked="" type="checkbox"/> ) , the value is active.<br>B0: RunEnable high<br>B1: No fault active<br>B2: Charge switch closed<br>B3: DC voltage within limits<br>B4: Power manager initialized<br>B5: Power unit is not blocking start<br>B6: System software is not blocking start  |
| V2.6.3 | Appl.StatusWord1 |      | 1     | 89 | Bit coded statuses of application.<br>Values are visible as checkboxes on graphical keypad. If checked ( <input checked="" type="checkbox"/> ) , the value is active.<br>B0=Interlock 1<br>B1=Interlock 2<br>B2=Reserved<br>B3=Ramp 2 active<br>B4=Mechanical brake control<br>B5=I/O A control active<br>B6=I/O B control active<br>B7=Fieldbus Control Active<br>B8=Local control active<br>B9=PC control active<br>B10=Preset frequencies active<br>B11=Inching active<br>B12=Fire Mode active<br>B13=Motor Preheat active<br>B14=Forced stop active<br>B15=Drive stopped from keypad |
| V2.6.4 | Appl.StatusWord2 |      | 1     | 90 | Bit coded status of application.<br>Values are visible as checkboxes on graphical keypad. If checked ( <input checked="" type="checkbox"/> ) , the value is active.<br>B0=Acc/Dec prohibited<br>B1=Motor switch open<br>B5=Jockey pump active<br>B6=Priming pump active<br>B7=Input pressure supervision (Alarm/Fault)<br>B8=Frost protection (Alarm/Fault)<br>B9=Autocleaning active  |
| V2.6.5 | DIN StatusWord1  |      | 1     | 56 | 16-bit word where each bit represents the status of one digital input. 6 digital inputs from every slot are read. Word 1 starts from input 1 in slot A (bit0) and goes all the way to input 4 in slot C (bit15).   |

Table 50. Advanced values monitoring

| Code    | Monitoring value    | Unit | Scale | ID   | Description   |
|---------|---------------------|------|-------|------|---|
| V2.6.6  | DIN StatusWord2     |      | 1     | 57   | 16-bit word where each bit represents the status of one digital input. 6 digital inputs from every slot are read. Word 1 starts from input 5 in slot C (bit0) and goes all the way to input 6 in slot E (bit13).  |
| V2.6.7  | MotCurrent1 deci.   |      | 0.1   | 45   | Motor current monitor value with fixed number of decimals and less filtering. Can be used e.g. for fieldbus purposes to always get the right value regardless of frame size, or for monitoring when less filtering time is needed for the motor current.                          |
| V2.6.8  | FreqRef Source      |      | 1     | 1495 | Shows the momentary frequency reference source.<br>0=PC<br>1=Preset Freqs<br>2=Keypad Reference<br>3=Fieldbus<br>4=AI1<br>5=AI2<br>6=AI1+AI2<br>7=PID Controller<br>8=Motor Potentiom.<br>9=Joystick<br>10=Inching<br>100=Not defined<br>101=Alarm,PresetFreq<br>102=Autocleaning |
| V2.6.9  | LastActiveFaultCode |      | 1     | 37   | The fault code of latest activated fault that has not been reset.   |
| V2.6.10 | LastActiveFault ID  |      | 1     | 95   | The fault ID of latest activated fault that has not been reset.   |
| V2.6.11 | LastActiveAlarmCode |      | 1     | 74   | The alarm code of latest activated alarm that has not been reset.   |
| V2.6.12 | LastActiveAlarm ID  |      | 1     | 94   | The alarm ID of latest activated alarm that has not been reset.   |
| V2.6.13 | MotorRegulat.Status |      | 1     | 77   | Motor limit controller status. Checked = limit controller is active, Unchecked = limit controller is not active   |

### 6.1.6 TIMER FUNCTIONS

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

*Table 51. Monitoring of timer functions*

| Code    | Monitoring value | Unit | Scale | ID   | Description  |
|---------|------------------|------|-------|------|--|
| V2.7.1  | TC 1, TC 2, TC 3 |      | 1     | 1441 | Possible to monitor the statuses of the three Time Channels (TC) |
| V2.7.2  | Interval 1       |      | 1     | 1442 | Status of timer interval   |
| V2.7.3  | Interval 2       |      | 1     | 1443 | Status of timer interval   |
| V2.7.4  | Interval 3       |      | 1     | 1444 | Status of timer interval   |
| V2.7.5  | Interval 4       |      | 1     | 1445 | Status of timer interval   |
| V2.7.6  | Interval 5       |      | 1     | 1446 | Status of timer interval   |
| V2.7.7  | Timer 1          | s    | 1     | 1447 | Remaining time on timer if active                                |
| V2.7.8  | Timer 2          | s    | 1     | 1448 | Remaining time on timer if active                                |
| V2.7.9  | Timer 3          | s    | 1     | 1449 | Remaining time on timer if active                                |
| V2.7.10 | Real time clock  |      |       | 1450 | hh:mm:ss   |

### 6.1.7 PID CONTROLLER

*Table 52. PID Controller value monitoring*

| Code   | Monitoring value | Unit   | Scale                  | ID | Description  |
|--------|------------------|--------|------------------------|----|--|
| V2.8.1 | PID setpoint     | Varies | According to P3.13.1.7 | 20 | PID controller setpoint value in process units. Process unit is selected with a parameter.                                   |
| V2.8.2 | PID feedback     | Varies | According to P3.13.1.7 | 21 | PID controller feedback value in process units. Process unit is selected with a parameter.                                   |
| V2.8.3 | PID error        | Varies | According to P3.13.1.7 | 22 | PID controller error value. Deviation of feedback from setpoint in process units. Process unit is selected with a parameter. |
| V2.8.4 | PID output       | %      | 0.01                   | 23 | PID output in percent (0...100%). This value can be fed e.g. to Motor Control (Frequency reference) or Analogue output       |
| V2.8.5 | PID status       |        | 1                      | 24 | 0=Stopped<br>1=Running<br>3=Sleep mode<br>4=In dead band   |

### 6.1.8 EXT PID CONTROLLER

Table 53. External PID Controller value monitoring

| Code   | Monitoring value | Unit   | Scale                   | ID | Description   |
|--------|------------------|--------|-------------------------|----|---|
| V2.9.1 | ExtPID setpoint  | Varies | According to P3.14.1.10 | 83 | External PID controller setpoint value in process units. Process unit is selected with a parameter.                                   |
| V2.9.2 | ExtPID feedback  | Varies | According to P3.14.1.10 | 84 | External PID controller feedback value in process units. Process unit is selected with a parameter.                                   |
| V2.9.3 | ExtPID error     | Varies | According to P3.14.1.10 | 85 | External PID controller Error value. Deviation of feedback from setpoint in process units. Process unit is selected with a parameter. |
| V2.9.4 | ExtPID output    | %      | 0.01                    | 86 | External PID controller output in percent (0..100%). This value can be fed e.g. to Analogue output.                                   |
| V2.9.5 | ExtPID status    |        | 1                       | 87 | 0=Stopped<br>1=Running<br>4=In dead band  |

### 6.1.9 MAINTEN. COUNTERS

Table 54. Maintenance counter monitoring

| Code    | Monitoring value | Unit    | Scale  | ID   | Description   |
|---------|------------------|---------|--------|------|---|
| V2.11.1 | MaintenCounter 1 | h/ kRev | Varies | 1101 | Status of maintenance counter in revolutions multiplied by 1000, or hours.<br>For configuration and activation of this counter, see chapter Group 3.16: Maintenance counters. |

### 6.1.10 FIELD BUS DATA

Table 55. Fieldbus data monitoring

| Code     | Monitoring value   | Unit | Scale  | ID  | Description   |
|----------|--------------------|------|--------|-----|---|
| V2.12.1  | FB Control Word    |      | 1      | 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.   |
| V2.12.2  | FB Speed Reference |      | Varies | 875 | Speed reference scaled between minimum and maximum frequency at the moment it was received by the application. Minimum and maximum frequencies can be changed after the reference was received without affecting the reference. |
| V2.12.3  | FB data in 1       |      | 1      | 876 | Raw value of process data in 32-bit signed format   |
| V2.12.4  | FB data in 2       |      | 1      | 877 | Raw value of process data in 32-bit signed format   |
| V2.12.5  | FB data in 3       |      | 1      | 878 | Raw value of process data in 32-bit signed format   |
| V2.12.6  | FB data in 4       |      | 1      | 879 | Raw value of process data in 32-bit signed format   |
| V2.12.7  | FB data in 5       |      | 1      | 880 | Raw value of process data in 32-bit signed format   |
| V2.12.8  | FB data in 6       |      | 1      | 881 | Raw value of process data in 32-bit signed format   |
| V2.12.9  | FB data in 7       |      | 1      | 882 | Raw value of process data in 32-bit signed format   |
| V2.12.10 | FB data in 8       |      | 1      | 883 | Raw value of process data in 32-bit signed format   |

Table 55. Fieldbus data monitoring

| Code     | Monitoring value | Unit | Scale | ID  | Description   |
|----------|------------------|------|-------|-----|---|
| V2.12.11 | FB Status Word   |      | 1     | 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.   |
| V2.12.12 | FB Speed Actual  |      | 0.01  | 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. |
| V2.12.13 | FB data out 1    |      | 1     | 866 | Raw value of process data in 32-bit signed format   |
| V2.12.14 | FB data out 2    |      | 1     | 867 | Raw value of process data in 32-bit signed format   |
| V2.12.15 | FB data out 3    |      | 1     | 868 | Raw value of process data in 32-bit signed format   |
| V2.12.16 | FB data out 4    |      | 1     | 869 | Raw value of process data in 32-bit signed format   |
| V2.12.17 | FB data out 5    |      | 1     | 870 | Raw value of process data in 32-bit signed format   |
| V2.12.18 | FB data out 6    |      | 1     | 871 | Raw value of process data in 32-bit signed format   |
| V2.12.19 | FB data out 7    |      | 1     | 872 | Raw value of process data in 32-bit signed format   |
| V2.12.20 | FB data out 8    |      | 1     | 873 | Raw value of process data in 32-bit signed format   |

#### 6.1.1.1 SOLAR

Table 56. Solar monitoring items

| Code    | Monitoring value     | Unit             | Scale | ID   | Description  |
|---------|----------------------|------------------|-------|------|--|
| V2.15.1 | Vmp ref              | V                |       | 1914 | DC voltage reference for MPP regulation                        |
| V2.15.2 | Vmp ref correct      | V                |       | 1942 | Present correction on DC voltage reference (P&O + oscillation) |
| V2.15.3 | Motor power          | kW               |       | 1938 | Motor shaft power  |
| V2.15.4 | Energy counter       | MWh              |       | 1937 | Counter of energy taken by the supply                          |
| B2.15.5 | Energy counter reset |                  |       | 1932 | To reset V2.15.4   |
| V2.15.6 | Irradiation measure  | W/m <sup>2</sup> |       | 1982 | Measurement from irradiation signal.                           |



## 6.1.12 FLOW

Table 57. Flow monitoring items

| Code    | Monitoring value      | Unit                             | Scale | ID   | Description   |
|---------|-----------------------|----------------------------------|-------|------|---|
| V2.16.1 | Actual flow           | l/min                            |       | 1956 | Actual flow: it is measured by transducer define with P3.23.1 |
| V2.16.2 | Volume counter 1*     | m <sup>3</sup>                   |       | 1955 | Cumulative water volume counter.                              |
| V2.16.3 | Volume counter 2*     | 10 <sup>4</sup> x m <sup>3</sup> |       | 1962 | Cumulative water volume counter.                              |
| B2.16.4 | Volume counters reset |                                  |       | 1961 | To reset V2.16.2 and V2.16.3                                  |

**NOTE!**

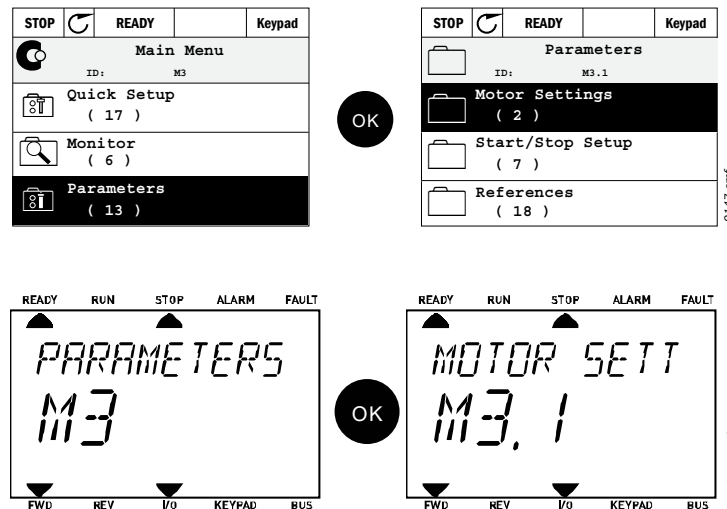
\* The total volume of water in [m<sup>3</sup>] is given by: V2.16.2 + (V2.16.3 x 10000).

## 7. PARAMETERS

The VACON® AC drive contains a preloaded VACON® 100 X Solar Pump application for instant use. The parameters of this application are listed in this chapter.

### 7.1 APPLICATION PARAMETER LISTS

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




The VACON® 100 X Solar Pump Application embodies the following parameter groups:

Table 58. 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: References         | Parameters for setting references and preset speeds. |
| Group 3.4: Ramps And Brakes   | Acceleration/Deceleration setup                      |
| Group 3.5: I/O Config         | I/O programming                                      |
| Group 3.6: Fieldbus DataMap   | Process data in/out mapping                          |
| Group 3.7: Prohibit Freq      | Prohibit frequencies programming                     |
| Group 3.8: Supervisions       | Programmable limit controllers                       |
| Group 3.9: Protections        | Protections configuration                            |
| Group 3.10: Automatic reset   | Auto reset after fault configuration                 |
| Group 3.11: Appl. Settings    | Application settings                                 |
| Group 3.12: Timer functions   | Configuration of 3 timers based on Real Time Clock.  |
| Group 3.13: PID Controller    | Parameters for PID Controller 1.                     |
| Group 3.14: ExtPID Controller | Parameters for external PID Controller.              |
| Group 3.16: Mainten. Counters | Parameters related to Maintenance counters.          |
| Group 3.21: Pump Control      | Pump function parameters                             |
| Group 3.22: Solar             | Solar specific function parameters                   |
| Group 3.23: Flow meter        | Flow meter parameters                                |

**7.1.1 COLUMN EXPLANATIONS**

- Code = 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 information on this parameter available; Click the parameter name

**7.1.2 GROUP 3.1: MOTOR SETTINGS**7.1.2.1 Group 3.1.1: Motor nameplate*Table 59. Motor nameplate parameters*

| Code     | Parameter        | Min    | Max    | Unit | Default | ID  | Description   |
|----------|------------------|--------|--------|------|---------|-----|---|
| P3.1.1.1 | Motor Nom Voltg  | Varies | Varies | V    | Varies  | 110 | Find this value $U_n$ on the rating plate of the motor. Note also used connection (Delta/Star). |
| P3.1.1.2 | Motor Nom Freq   | 8.00   | 320.00 | Hz   | Varies  | 111 | Find this value $f_n$ on the rating plate of the motor.   |
| P3.1.1.3 | Motor Nom Speed  | 24     | 19200  | rpm  | Varies  | 112 | Find this value $n_n$ on the rating plate of the motor.   |
| P3.1.1.4 | Motor Nom Currnt | 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   |      | 0.74    | 120 | Find this value on the rating plate of the motor  |
| P3.1.1.6 | Motor Nom Power  | Varies | Varies | kW   | Varies  | 116 | Find this value $P_n$ on the rating plate of the motor.   |

7.1.2.2 Group 3.1.2: Motor Control*Table 60. Motor control*

| Code     | Parameter      | Min | Max    | Unit | Default | ID  | Description   |
|----------|----------------|-----|--------|------|---------|-----|---|
| P3.1.2.1 | Control mode   | 0   | 1      |      | 0       | 600 | 0 = U/f Freq ctrl open loop<br>1 = Speed control open loop  |
| P3.1.2.2 | Motor type     | 0   | 1      |      | 0       | 650 | 0 = Induction motor<br>1 = PM motor   |
| P3.1.2.3 | Switching Freq | 1.5 | Varies | kHz  | Varies  | 601 | Increasing the switching frequency reduces the capacity of the AC drive. It is recommended to use a lower frequency when the motor cable is long in order to minimize capacitive currents in the cable. Motor noise can also be minimised using a high switching frequency. |

Table 60. Motor control

| Code      | Parameter           | Min  | Max   | Unit | Default | ID   | Description  |
|-----------|---------------------|------|-------|------|---------|------|--|
| P3.1.2.4  | Identification      | 0    | 1     |      | 0       | 631  | The automatic motor identification calculates or measures the motor parameters that are needed for optimum motor and speed control.<br>0 = No action<br>1 = At standstill  |
| P3.1.2.5  | Magnetizing current | 0.0  | 2*IH  | A    | 0.0     | 612  | Motor magnetizing current (no-load current). The values of the U/f parameters are identified by the magnetizing current if given before the identification run. If this value is set to zero, magnetizing current will be internally calculated. |
| P3.1.2.6  | 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.<br>0 = Disabled<br>1 = Enabled   |
| P3.1.2.7  | Load drooping       | 0.00 | 50.00 | %    | 0.00    | 620  | The drooping function enables speed drop as a function of load. Drooping will be defined in percent of nominal speed at nominal load.  |
| P3.1.2.8  | Load drooping time  | 0.00 | 2.00  | s    | 0.00    | 656  | Load drooping is used in order to achieve a dynamic speed drooping because of changing load. This parameter defines the time during which the speed is restored to the level it was before the load increase.                                    |
| P3.1.2.9  | Load drooping mode  | 0    | 1     |      | 0       | 1534 | 0 = Normal; Load drooping factor is constant through the whole frequency range<br>1 = Linear removal; Load drooping is removed linearly from nominal frequency to zero frequency   |
| P3.1.2.11 | Under Volt. Control | 0    | 1     |      | 1       | 608  | 0 = Disabled<br>1 = Enabled  |
| P3.1.2.12 | Energy optimization | 0    | 1     |      | 0       | 666  | 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<br>0 = Disabled<br>1 = Enabled  |
| P3.1.2.13 | StatorVoltAdjust    | 50.0 | 150.0 | %    | 100.0   | 659  | Parameter for adjusting the stator voltage in permanent magnet motors.   |
| P3.1.2.14 | Overmodulation      | 0    | 1     |      | 1       |      | Maximizes drive output voltage, but increases motor current harmonics.<br>0 = Disabled<br>1 = Enabled  |

### 7.1.2.3 Group 3.1.3: Limits

Table 61. Motor limit settings

| Code     | Parameter        | Min    | Max    | Unit | Default | ID   | Description                          |
|----------|------------------|--------|--------|------|---------|------|--------------------------------------|
| P3.1.3.1 | Current limit    | Varies | Varies | A    | Varies  | 107  | Maximum motor current from AC drive  |
| P3.1.3.2 | MotorTorqueLimit | 0.0    | 300.0  | %    | 300.0   | 1287 | Maximum motoring side torque limit   |
| P3.1.3.3 | GenerTorqueLimit | 0.0    | 300.0  | %    | 300.0   | 1288 | Maximum generating side torque limit |
| P3.1.3.4 | MotorPowerLimit  | 0.0    | 300.0  | %    | 300.0   | 1290 | Maximum motoring side power limit    |
| P3.1.3.5 | GenerPowerLimit  | 0.0    | 300.0  | %    | 300.0   | 1289 | Maximum generating side power limit  |

### 7.1.2.4 Group 3.1.4: Open loop

Table 62. Open loop settings

| Code     | Parameter            | Min   | Max      | Unit | Default | ID   | Description   |
|----------|----------------------|-------|----------|------|---------|------|---|
| P3.1.4.1 | U/f ratio            | 0     | 2        |      | 0       | 108  | Type of U/f curve between zero frequency and the field weakening point.<br>0=Linear<br>1=Squared<br>2=Programmable  |
| P3.1.4.2 | Field WeakngPnt      | 8.00  | P3.3.1.2 | Hz   | Varies  | 602  | The field weakening point is the output frequency at which the output voltage reaches the field weakening point voltage   |
| P3.1.4.3 | Voltage at FWP       | 10.00 | 200.00   | %    | 100.00  | 603  | Voltage at field weakening point in % of motor nominal voltage  |
| P3.1.4.4 | U/f Mid Freq         | 0.00  | P3.1.4.2 | Hz   | Varies  | 604  | Provided that the programmable U/f curve has been selected (par. P3.1.4.1), this parameter defines the middle point frequency of the curve.   |
| P3.1.4.5 | U/f Mid Voltg        | 0.0   | 100.0    | %    | 100.0   | 605  | Provided that the programmable U/f curve has been selected (par. P3.1.4.1), this parameter defines the middle point voltage of the curve.   |
| P3.1.4.6 | Zero Freq Voltg      | 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.  |
| P3.1.4.7 | Flying Start Options | 0     | 1        |      | 0       | 1590 | Check box selection:<br>B0 = Search shaft frequency from same direction as frequency reference.<br>B1 = Disable AC scanning<br>B4 = Use frequency reference for initial guess<br>B5 = Disable DC pulses |

Table 62. Open loop settings

| Code      | Parameter                   | Min | Max   | Unit | Default | ID   | Description  |
|-----------|-----------------------------|-----|-------|------|---------|------|--|
| P3.1.4.8  | FlyStartScanCurrent         | 0.0 | 100.0 | %    | 45.0    | 1610 | Defined in percentage of motor nominal current.  |
| P3.1.4.9  | Auto TorqueBoost            | 0   | 1     |      | 0       | 109  | Automatic torque boost can be used in application where starting torque due to starting friction is high.<br>0= Disabled<br>1= Enabled |
| P3.1.4.10 | Torque boost motor gain     | 0.0 | 100.0 | %    | 100.0   | 667  | Scaling factor for motoring side IR-compensation when torque boost is used.  |
| P3.1.4.11 | Torque boost generator gain | 0.0 | 100.0 | %    | 0.0     | 665  | Scaling factor for generating side IR-compensation when torque boost is used.  |

### 7.1.2.5 Group 3.1.4.12: I/f start

The *I/f Start* function is typically used with permanent magnet synchronous motors (PMSM) to start the motor with constant current control. This is useful with high power motors in which the resistance is low and the tuning of the U/f curve difficult.

The *I/f Start* function can be used with induction motors (IM), too, e.g. if the tuning of the U/f curve is difficult at low frequencies.

Applying the I/f Start function may also prove useful in providing sufficient torque for the motor at startup.

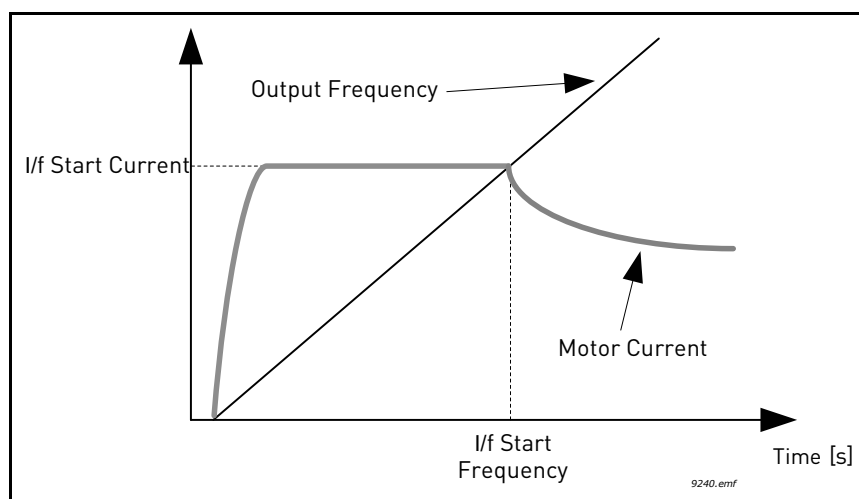


Figure 33. I/f start

Table 63. I/f start parameters

| Code        | Parameter           | Min | Max      | Unit | Default | ID  | Description   |
|-------------|---------------------|-----|----------|------|---------|-----|---|
| P3.1.4.12.1 | I/f start           | 0   | 1        |      | 0       | 534 | 0 = Disabled<br>1 = Enabled   |
| P3.1.4.12.2 | I/f start frequency | 0.0 | P3.1.1.2 | %    | 15.0    | 535 | Output frequency limit below which the defined I/f start current is fed to motor. |
| P3.1.4.12.3 | I/f start current   | 0.0 | 100.0    | %    | 80.0    | 536 | The current fed to the motor when the I/f start function is activated.            |

### 7.1.2.6 Group 3.1.4.13: Stabilizers

| Code        | Parameter          | Min    | Max    | Unit | Default | ID   | Description  |
|-------------|--------------------|--------|--------|------|---------|------|--|
| P3.1.4.13.1 | TorqStabGain       | 0.0    | 500.0  | %    | 50.0    | 1412 | Gain of the torque stabilizer in open loop motor control operation.                          |
| P3.1.4.13.2 | TorqStabGainFWP    | 0.0    | 500.0  | %    | 50.0    | 1414 | Gain of the torque stabilizer at field weakening point in open loop motor control operation. |
| P3.1.4.13.3 | TorqStabDampTC     | 0.0005 | 1.0000 | s    | 0.0050  | 1413 | Damping time of torque stabilizer  |
| P3.1.4.13.4 | TorqStabDampTC PMM | 0.0005 | 1.0000 | s    | 0.0500  | 1735 | Damping time constant of torque stabilizer for PM-motor.                                     |

### 7.1.3 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 P3.5.1.4 and P3.5.1.5. 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 P3.3.1.9.

**Remote control place (Fieldbus):** Start, stop and reverse commands come from fieldbus.

Table 64. Start/Stop Setup menu

| Code   | Parameter          | Min | Max | Unit | Default | ID  | Description  |
|--------|--------------------|-----|-----|------|---------|-----|--|
| P3.2.1 | Rem.Ctrl. Place    | 0   | 1   |      | 0       | 172 | Selection of remote control place (start/stop). Can be used to change back to remote control from VACON® Live e.g. in case of a broken panel.<br>0=I/O control<br>1=Fieldbus control   |
| P3.2.2 | Local/Remote       | 0   | 1   |      | 0       | 211 | Switch between local and remote control places<br>0=Remote<br>1=Local  |
| P3.2.3 | Keypad stop button | 0   | 1   |      | 0       | 114 | 0=Stop button always enabled (Yes)<br>1=Limited function of Stop button (No)   |
| P3.2.4 | Start function     | 0   | 1   |      | 0       | 505 | 0=Ramping<br>1=Flying start  |
| P3.2.5 | Stop function      | 0   | 2   |      | 0       | 506 | 0: coasting<br>1: ramp to min frequency<br>2: ramp to zero frequency   |
| P3.2.6 | I/O A logic        | 0   | 4   |      | 1       | 300 | <b>Logic = 0:</b><br>Start sign 1 = Start Forward<br>Start sign 2 = Start Backward<br><b>Logic = 1:</b><br>Start sign 1 = Start<br>Start sign 2 = Reverse<br><b>Logic = 2:</b><br>Double Start<br><b>Logic = 3:</b><br>Start sign 1 + Analogue sign<br><b>Logic = 4:</b><br>Solar only |
| P3.2.7 | I/O B logic        | 0   | 4   |      | 1       | 363 | See above.   |
| P3.2.8 | FB Start logic     | 0   | 1   |      | 0       | 889 | 0=Rising edge required<br>1=State  |



Table 64. Start/Stop Setup menu

| Code    | Parameter             | Min  | Max    | Unit | Default | ID   | Description   |
|---------|-----------------------|------|--------|------|---------|------|---|
| P3.2.10 | Rem to Loc Funct      | 0    | 2      |      | 2       | 181  | Choose whether to copy the Run state and Reference when changing from Remote to Local (keypad) control:<br>0 = Keep Run<br>1 = Keep Run & Reference<br>2 = Stop |
| P3.2.11 | Start Analogue Signal | 0    | 1      |      | 0       | 1810 | 0= AI1<br>1= AI2  |
| P3.2.12 | Start Analogue Level  | 0.00 | 100.00 | %    | 10.00   | 1857 | Start is set below this level (unscaled signal). Start-stop logic is reversed if > P3.2.13  |
| P3.2.13 | Stop Analogue Level   | 0.00 | 100.00 | %    | 80.00   | 1856 | Start is set above this level (unscaled signal). Start-stop logic is reversed if < P3.2.12  |

### 7.1.4 GROUP 3.3: REFERENCES

#### 7.1.4.1 Frequency reference

The frequency 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 P3.3.1.5.

**Remote control place (I/O B):** The source of frequency reference can be selected with parameter P3.3.1.6.

**Local control place (Keypad):** If the default selection for parameter P3.3.1.7 is used the reference set with parameter P3.3.1.8 applies.

**Remote control place (Fieldbus):** The frequency reference comes from fieldbus if the default value for parameter P3.3.1.11 is kept.

Table 65. Frequency reference parameters

| Code     | Parameter        | Min      | Max      | Unit | Default | ID   | Description   |
|----------|------------------|----------|----------|------|---------|------|---|
| P3.3.1.1 | MinFreqReference | 0.00     | P3.3.1.2 | Hz   | 0.00    | 101  | Minimum allowed frequency reference   |
| P3.3.1.2 | MaxFreqReference | P3.3.1.1 | 320.00   | Hz   | 50.00   | 102  | Maximum allowed frequency reference   |
| P3.3.1.3 | PosFreqRefLimit  | -320.0   | 320.0    | Hz   | 320.00  | 1285 | Final frequency reference limit for positive direction.   |
| P3.3.1.4 | NegFreqRefLimit  | -320.0   | 320.0    | Hz   | -320.00 | 1286 | Final frequency reference limit for negative direction.<br><b>NOTE:</b> This parameter can be used e.g. to prevent motor from running in reverse direction.   |
| P3.3.1.5 | I/O A Ref sel    | 1        | 9        |      | 5       | 117  | Selection of ref source when control place is I/O A<br>1 = Preset Frequency 0<br>2 = Keypad reference<br>3 = Fieldbus<br>4 = AI1<br>5 = AI2<br>6 = AI1+AI2<br>7 = PID reference<br>8 = Motor potentiometer<br>9 = Max Power   |
| P3.3.1.6 | I/O B Ref sel    | 1        | 9        |      | 9       | 131  | Selection of ref source when control place is I/O B. See above.<br><b>NOTE:</b> I/O B control place can only be forced active with digital input (P3.5.1.7).  |
| P3.3.1.7 | Keypad Ref Sel   | 1        | 9        |      | 2       | 121  | Selection of ref source when control place is keypad:<br>1 = Preset Frequency 0<br>2 = Keypad reference<br>3 = Fieldbus<br>4 = AI1<br>5 = AI2<br>6 = AI1+AI2<br>7 = PID reference<br>8 = Motor potentiometer<br>9 = Max Power |

Table 65. Frequency reference parameters

| Code      | Parameter         | Min  | Max      | Unit | Default | ID   | Description   |
|-----------|-------------------|------|----------|------|---------|------|---|
| P3.3.1.8  | Keypad Reference  | 0.00 | P3.3.1.2 | Hz   | 0.00    | 184  | The frequency reference can be adjusted on the keypad with this parameter.  |
| P3.3.1.9  | Keypad Direction  | 0    | 1        |      | 0       | 123  | Motor rotation when control place is keypad<br>0 = Forward<br>1 = Reverse   |
| P3.3.1.10 | Fieldbus Ref Sel  | 1    | 9        |      | 3       | 122  | Selection of ref source when control place is Fieldbus:<br>1 = Preset Frequency 0<br>2 = Keypad reference<br>3 = Fieldbus<br>4 = AI1<br>5 = AI2<br>6 = AI1+AI2<br>7 = PID reference<br>8 = Motor potentiometer<br>9 = Max Power   |
| P3.3.1.11 | Adapt To AC Volt. | No   | Yes      |      | No      | 1931 | Parameter enables the possible limitation on maximum output frequency when connected to AC mains (digital input from P3.5.1.53 is active), in case the available voltage is not sufficient to reach the motor nominal U/f ratio (from P3.1.1.1 and P3.1.1.2).<br>The function can be useful if the motor has been chosen depending on high DC voltage from solar modules, but this voltage is not reachable with AC supply. |

#### 7.1.4.2 Group 3.3.3: Preset Freqs

Table 66. Preset frequencies parameters

| Code     | Parameter      | Min      | Max      | Unit | Default | ID  | Description  |
|----------|----------------|----------|----------|------|---------|-----|--|
| P3.3.3.1 | PresetFreqMode | 0        | 1        |      | 0       | 182 | 0 = Binary coded<br>1 = Number of inputs. Preset frequency is selected according to how many of preset speed digital inputs are active |
| P3.3.3.2 | Preset Freq 0  | P3.3.1.1 | P3.3.1.2 | Hz   | 5.00    | 180 | Basic preset frequency 0 when selected by Control reference parameter (P3.3.1.5).  |
| P3.3.3.3 | Preset Freq 1  | P3.3.1.1 | P3.3.1.2 | Hz   | 10.00   | 105 | Select with digital input:<br>Preset frequency selection 0 (P3.3.3.10)   |
| P3.3.3.4 | Preset Freq 2  | P3.3.1.1 | P3.3.1.2 | Hz   | 15.00   | 106 | Select with digital input:<br>Preset frequency selection 1 (P3.3.3.11)   |
| P3.3.3.5 | Preset Freq 3  | P3.3.1.1 | P3.3.1.2 | Hz   | 20.00   | 126 | Select with digital inputs: Preset frequency selection 0 & 1   |
| P3.3.3.6 | Preset Freq 4  | P3.3.1.1 | P3.3.1.2 | Hz   | 25.00   | 127 | Select with digital input:<br>Preset frequency selection 2 (P3.3.3.12)   |

Table 66. Preset frequencies parameters

| Code      | Parameter        | Min      | Max      | Unit | Default       | ID  | Description   |
|-----------|------------------|----------|----------|------|---------------|-----|---|
| P3.3.3.7  | Preset Freq 5    | P3.3.1.1 | P3.3.1.2 | Hz   | 30.00         | 128 | Select with digital inputs: Preset frequency selection 0 & 2                  |
| P3.3.3.8  | Preset Freq 6    | P3.3.1.1 | P3.3.1.2 | Hz   | 40.00         | 129 | Select with digital inputs: Preset frequency selection 1 & 2                  |
| P3.3.3.9  | Preset Freq 7    | P3.3.1.1 | P3.3.1.2 | Hz   | 50.00         | 130 | Select with digital inputs: Preset frequency selection 0 & 1 & 2              |
| P3.3.3.10 | Preset Freq Sel0 |          |          |      | DigIN SlotA.4 | 419 | Binary selector for Preset speeds (0-7). See parameters P3.3.3.2 to P3.3.3.9. |
| P3.3.3.11 | Preset Freq Sel1 |          |          |      | DigIN SlotA.5 | 420 | Binary selector for Preset speeds (0-7). See parameters P3.3.3.2 to P3.3.3.9. |
| P3.3.3.12 | Preset Freq Sel2 |          |          |      | DigIN Slot0.1 | 421 | Binary selector for Preset speeds (0-7). See parameters P3.3.3.2 to P3.3.3.9. |

#### 7.1.4.3 Group 3.3.4: Motor Potentiometer

With a motor potentiometer function, the user can increase and decrease the output frequency. By connecting a digital input to parameter P3.3.4.1 (*MotPot UP*) and having the digital input signal active, the output frequency will rise as long as the signal is active. The parameter P3.3.4.2 (*MotPot DOWN*) works vice versa, decreasing the output frequency.

The rate how the output frequency either rises or falls when Motor Potentiometer Up or Down is activated is determined by the *Motor potentiometer ramp time* (P3.3.4.3)

The Motor potentiometer reset parameter (P3.3.4.4) is used to choose whether to reset (set to Min-Freq) the Motor Potentiometer frequency reference when stopped or when powered down.

Motor potentiometer frequency reference is available in all control places in menu Group 3.3: References. The motor potentiometer reference can be changed only when the drive is in run state.

Table 67. Motor potentiometer parameters

| Code     | Parameter        | Min | Max   | Unit | Default       | ID  | Description   |
|----------|------------------|-----|-------|------|---------------|-----|---|
| P3.3.4.1 | MotPot UP        |     |       |      | DigIN Slot0.1 | 418 | FALSE = Not active<br>TRUE = Active (Motor potentiometer reference INCREASES until the contact is opened)                 |
| P3.3.4.2 | MotPot DOWN      |     |       |      | DigIN Slot0.1 | 417 | FALSE = Not active<br>TRUE = Active (Motor potentiometer reference DECREASES until the contact is opened)                 |
| P3.3.4.3 | MotPot Ramp Time | 0.1 | 500.0 | Hz/s | 10.0          | 331 | Rate of change in the motor potentiometer reference when increased or decreased with parameters P3.3.4.1 or P3.3.4.2.     |
| P3.3.4.4 | MotPot Reset     | 0   | 2     |      | 1             | 367 | Motor potentiometer frequency reference reset logic.<br>0 = No reset<br>1 = Reset if stopped<br>2 = Reset if powered down |

**7.1.5 GROUP 3.4: RAMPS AND BRAKES**7.1.5.1 Group 3.4.1: Ramp 1*Table 68. Ramp 1 setup*

| Code     | Parameter               | Min | Max    | Unit | Default | ID  | Description   |
|----------|-------------------------|-----|--------|------|---------|-----|---|
| P3.4.1.2 | Accel 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 |
| P3.4.1.3 | Decel 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 |
| P3.4.1.4 | Start Acceleration Time | 0.1 | 3000.0 | s    | 2.0     | 502 | Time from 0 to min frequency  |

7.1.5.2 Group 3.4.3: Start Magnetizat*Table 69. Start magnetization parameters*

| Code     | Parameter        | Min  | Max    | Unit | Default | ID  | Description   |
|----------|------------------|------|--------|------|---------|-----|---|
| P3.4.3.1 | StartMagnCurrent | 0.00 | Varies | A    | Varies  | 517 | Defines the DC current fed into motor at start. Disabled if set to 0.                               |
| P3.4.3.2 | StartMagnTime    | 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. |

7.1.5.3 Group 3.4.3: DC brake*Table 70. DC-brake parameters*

| Code     | Parameter        | Min    | Max    | Unit | Default | ID  | Description   |
|----------|------------------|--------|--------|------|---------|-----|---|
| P3.4.4.1 | DC Brake Current | Varies | Varies | A    | Varies  | 507 | Defines the current injected into the motor during DC-braking. 0 = Disabled                         |
| P3.4.4.2 | DC BrakeTime     | 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. |
| P3.4.4.3 | DC Start Freq    | 0,10   | 10,00  | Hz   | 1,50    | 515 | The output frequency at which the DC-braking is applied.  |

7.1.5.4 Group 3.4.5: Flux Braking*Table 71. Flux braking parameters*

| Code     | Parameter       | Min | Max    | Unit | Default | ID  | Description                                 |
|----------|-----------------|-----|--------|------|---------|-----|---|
| P3.4.5.1 | Flux Braking    | 0   | 1      |      | 0       | 520 | 0=Disabled<br>1=Enabled                     |
| P3.4.5.2 | Braking Current | 0   | Varies | A    | Varies  | 519 | Defines the current level for flux braking. |

### 7.1.6 GROUP 3.5: I/O CONFIG

#### 7.1.6.1 *Default assignments of programmable inputs*

Table 72 below presents the default assignments of programmable digital and analogue inputs in VACON® 100 X Solar Pump application.

*Table 72. Default assignments of inputs*

| Input | Terminal(s) | Reference | Assigned function            | Parameter code |
|-------|-------------|-----------|------------------------------|----------------|
| D11   | 8           | A.1       | Ctrl signal 1 A              | P3.5.1.1       |
| D12   | 9           | A.2       | Ctrl signal 2 A              | P3.5.1.2       |
| D13   | 10          | A.3       | External fault close         | P3.5.1.11      |
| D14   | 14          | A.4       | Preset frequency selection 0 | P3.5.1.21      |
| D15   | 15          | A.5       | Preset frequency selection 1 | P3.5.1.22      |
| D16   | 16          | A.6       | External fault close         | P3.5.1.13      |
| A11   | 2/3         | A.1       | A11 signal selection         | P3.5.2.1.1     |
| A12   | 4/5         | A.2       | A12 signal selection         | P3.5.2.2.1     |

#### 7.1.6.2 *Group 3.5.1: Digital inputs*

Digital inputs are very flexible to use. Parameters are functions that are connected to the required digital input terminal (see chapter 5). 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.

**NOTE!** The statuses of digital inputs and the digital output can be monitored in the Multimonitoring view.

*Table 73. Digital input settings*

| Code      | Parameter           | Default       | ID  | Description   |
|-----------|---------------------|---------------|-----|---|
| P3.5.1.1  | Ctrl signal 1 A     | DigIN SlotA.1 | 403 | Ctrl signal 1 when control place is I/O A (FWD)                                       |
| P3.5.1.2  | Ctrl signal 2 A     | DigIN SlotA.2 | 404 | Ctrl signal 2 when control place is I/O A (REV)                                       |
| P3.5.1.4  | Ctrl signal 1 B     | DigIN Slot0.1 | 423 | Start signal 1 when control place is I/O B  |
| P3.5.1.5  | Ctrl signal 2 B     | DigIN Slot0.1 | 424 | Start signal 2 when control place is I/O B  |
| P3.5.1.7  | I/O B Ctrl Force    | DigIN Slot0.1 | 425 | TRUE = Force the control place to I/O B   |
| P3.5.1.8  | I/O B Ref Force     | DigIN Slot0.1 | 343 | TRUE = Used frequency reference is specified by I/O reference B parameter (P3.3.1.6). |
| P3.5.1.9  | Fieldbus Ctrl Force | DigIN Slot0.1 | 411 | Force control to fieldbus   |
| P3.5.1.10 | Keypad Ctrl Force   | DigIN Slot0.1 | 410 | Force control to keypad   |
| P3.5.1.11 | Ext Fault Close     | DigIN SlotA.3 | 405 | FALSE = OK<br>TRUE = External fault   |
| P3.5.1.12 | Ext Fault Open      | DigIN Slot0.2 | 406 | FALSE = External fault<br>TRUE = OK   |
| P3.5.1.13 | Fault Reset Close   | DigIN SlotA.6 | 414 | Resets all active faults when TRUE  |
| P3.5.1.14 | Fault Reset Open    | DigIN Slot0.1 | 213 | Resets all active faults when FALSE   |
| P3.5.1.15 | Run Enable          | DigIN Slot0.2 | 407 | Must be on to set drive in Ready state  |



Table 73. Digital input settings

| Code      | Parameter             | Default       | ID        | Description   |
|-----------|-----------------------|---------------|-----------|---|
| P3.5.1.16 | Run Interlock 1       | DigIN Slot0.2 | 1041      | Drive may be ready but start is blocked as long as interlock is on (Damper interlock).  |
| P3.5.1.17 | Run Interlock 2       | DigIN Slot0.2 | 1042      | As above.   |
| P3.5.1.21 | Preset Freq Sel0      | DigIN SlotA.4 | 419       | Binary selector for Preset speeds (0-7). See page 99.   |
| P3.5.1.22 | Preset Freq Sel1      | DigIN SlotA.5 | 420       | Binary selector for Preset speeds (0-7). See page 99.   |
| P3.5.1.23 | Preset Freq Sel2      | DigIN Slot0.1 | 421       | Binary selector for Preset speeds (0-7). See page 99.   |
| P3.5.1.24 | MotPot UP             | DigIN Slot0.1 | 418       | FALSE = Not active<br>TRUE = Active (Motor potentiometer reference INCREASES until the contact is opened)   |
| P3.5.1.25 | MotPot DOWN           | DigIN Slot0.1 | 417       | FALSE = Not active<br>TRUE = Active (Motor potentiometer reference DECREASES until the contact is opened)   |
| P3.5.1.27 | Timer 1               | DigIN Slot0.1 | 447       | Rising edge starts Timer 1 programmed in Group 3.12: Timer functions parameter group  |
| P3.5.1.28 | Timer 2               | DigIN Slot0.1 | 448       | See above   |
| P3.5.1.29 | Timer 3               | DigIN Slot0.1 | 449       | See above   |
| P3.5.1.30 | PID SP Boost          | DigIN Slot0.1 | 1046      | FALSE = No boost<br>TRUE = Boost  |
| P3.5.1.31 | PID SP Selection      | DigIN Slot0.1 | 1047      | FALSE = Setpoint 1<br>TRUE = Setpoint 2   |
| P3.5.1.32 | ExtPID StartSignal    | DigIN Slot0.2 | 1049      | FALSE = PID2 in stop mode<br>TRUE = PID2 regulating<br>This parameter will have no effect if the external PID-controller is not enabled in Group 3.14: ExtPID Controller.                                 |
| P3.5.1.33 | ExtPID SP Select      | DigIN Slot0.1 | 1048      | FALSE = Setpoint 1<br>TRUE = Setpoint 2   |
| P3.5.1.40 | MainCounter1Reset     | DigIN Slot0.1 | 490       | Reset the counter from digital input.<br>TRUE = Reset   |
| P3.5.1.48 | AutoClean Activ.      | DigIN Slot0.1 | 1715      | Start the Auto-cleaning sequence.<br>The sequence will be aborted if activation signal is removed before the sequence has been completed.<br><b>NOTE!</b> The drive will start if the input is activated! |
| P3.5.1.49 | Param. Set 1/2 Sel.   | DigIN Slot0.1 | 496       | Parameter set 1/2 selection.<br>Open= Parameter Set 1<br>Closed= Parameter Set 2  |
| P3.5.1.50 | User Defined Fault 1  | DigIN Slot0.1 | 1552<br>3 | Digital input selection for activating User Defined Fault (1 or 2).<br>Open= No operation<br>Closed= Fault Activated  |
| P3.5.1.51 | User Defined Fault 2  | DigIN Slot0.1 | 1552<br>4 | Digital input selection for activating User Defined Fault (1 or 2).<br>Open= No operation<br>Closed= Fault Activated  |
| P3.5.1.52 | Energy Counter reset  | DigIN Slot0.1 | 1933      | Energy Counter reset  |
| P3.5.1.53 | Mains supply on       | DigIN Slot0.1 | 1934      | Mains supply on   |
| P3.5.1.54 | Flowmeter pulse       | DigIN Slot0.1 | 1953      | Digital input for pulse flow meter (P3.23.1 = 1)  |
| P3.5.1.55 | Volume counters reset | DigIN Slot0.1 | 1957      | Digital input for Volume counters reset   |
| P3.5.1.56 | Minimum water level   | DigIN Slot0.2 | 1963      | Digital input for minimum water level in the well   |

Table 73. Digital input settings

| Code      | Parameter             | Default               | ID   | Description  |
|-----------|-----------------------|-----------------------|------|--|
| P3.5.1.57 | Minimum level logic   | Level ok = input high | 1965 | Selections for minimum water level logic:<br>0 = water level is ok when digital input for Minimum water level is high<br>1 = water level is ok when digital input for Minimum water level is low<br>The drive trips with F63 (Low water level) when water level is not OK. The fault is reset with autoreset logic of Under load (see P3.10.5 - 8) when level is restored.<br>Min level signal/fault refers to level in a well from which water is taken.            |
| P3.5.1.58 | Maximum water level   | DigIN Slot0.2         | 1966 | Digital input for maximum water level in the well  |
| P3.5.1.59 | Maximum level logic   | Level ok = input high | 1967 | Selections for maximum water level logic:<br>0 = water level is ok when digital input for Maximum water level is high<br>1 = water level is ok when digital input for Maximum water level is low<br>The drive trips with F64 (Max water level) when water level is not ok. The fault is reset with autoreset logic of Underload (see P3.10.5 - 8) when level is restored.<br>Max level signal/fault refers to level in a possible tank where pumped water is stored. |
| P3.5.1.60 | Dual Supply Enable    | DigIN Slot0.2         | 1991 | Digital input high enables relay for the AC switch connection and Dual supply mode logics.   |
| P3.5.1.61 | DualS M2Check Disable | DigIN Slot0.1         | 1989 | Digital input high disables the periodic Mode 2 DC voltage check, when Dual supply Mode 2 sensorless is active.  |

### 7.1.6.3 Group 3.5.2: Analog inputs

**NOTE!** The number of usable analogue inputs depends on your (option) board setup. The standard I/O board embodies 2 analogue inputs.

#### Group 3.5.2.1: Analog Input 1

Table 74. Analogue input 1 settings

| Code       | Parameter              | Min     | Max    | Unit | Default      | ID  | Description   |
|------------|------------------------|---------|--------|------|--------------|-----|---|
| P3.5.2.1.1 | AI1 signal selection   |         |        |      | AnIN SlotA.1 | 377 | Connect the AI1 signal to the analogue input of your choice with this parameter. Programmable. See page 91. |
| P3.5.2.1.2 | AI1 signal filter time | 0.00    | 300.00 | s    | 0.1          | 378 | Filter time for analogue input.   |
| P3.5.2.1.3 | AI1 signal range       | 0       | 1      |      | 0            | 379 | 0 = 0...10 V / 0...20 mA<br>1 = 2...10 V / 4...20 mA  |
| P3.5.2.1.4 | AI1 custom. min        | -160.00 | 160.00 | %    | 0.00         | 380 | Custom range min setting<br>20% = 4-20 mA/2-10 V  |
| P3.5.2.1.5 | AI1 custom. max        | -160.00 | 160.00 | %    | 100.00       | 381 | Custom range max setting  |
| P3.5.2.1.6 | AI1 signal inversion   | 0       | 1      |      | 0            | 387 | 0 = Normal<br>1 = Signal inverted   |

#### Group 3.5.2.2: Analog Input 2

Table 75. Analogue input 2 settings

| Code       | Parameter            | Min | Max | Unit | Default      | ID  | Description     |
|------------|----------------------|-----|-----|------|--------------|-----|-----------------|
| P3.5.2.2.1 | AI2 signal selection |     |     |      | AnIN SlotA.2 | 388 | See P3.5.2.1.1. |



Table 75. Analogue input 2 settings

|            |                        |         |        |   |        |     |                 |
|------------|------------------------|---------|--------|---|--------|-----|-----------------|
| P3.5.2.2.2 | AI2 signal filter time | 0.00    | 300.00 | s | 0.1    | 389 | See P3.5.2.1.2. |
| P3.5.2.2.3 | AI2 signal range       | 0       | 1      |   | 1      | 390 | See P3.5.2.1.3  |
| P3.5.2.2.4 | AI2 custom. min        | -160.00 | 160.00 | % | 0.00   | 391 | See P3.5.2.1.4. |
| P3.5.2.2.5 | AI2 custom. max        | -160.00 | 160.00 | % | 100.00 | 392 | See P3.5.2.1.5. |
| P3.5.2.2.6 | AI2 signal inversion   | 0       | 1      |   | 0      | 398 | See P3.5.2.1.6. |

**Group 3.5.2.3: Analog Input 3**

Table 76. Analogue input 3 settings

| Code       | Parameter              | Min     | Max    | Unit | Default      | ID  | Description     |
|------------|------------------------|---------|--------|------|--------------|-----|-----------------|
| P3.5.2.3.1 | AI3 signal selection   |         |        |      | AnIN SlotD.1 | 141 | See P3.5.2.1.1. |
| P3.5.2.3.2 | AI3 signal filter time | 0.00    | 300.00 | s    | 0.1          | 142 | See P3.5.2.1.2. |
| P3.5.2.3.3 | AI3 signal range       | 0       | 1      |      | 0            | 143 | See P3.5.2.1.3  |
| P3.5.2.3.4 | AI3 custom. min        | -160.00 | 160.00 | %    | 0.00         | 144 | See P3.5.2.1.4. |
| P3.5.2.3.5 | AI3 custom. max        | -160.00 | 160.00 | %    | 100.00       | 145 | See P3.5.2.1.5. |
| P3.5.2.3.6 | AI3 signal inversion   | 0       | 1      |      | 0            | 151 | See P3.5.2.1.6. |

**Group 3.5.2.4: Analog Input 4**

Table 77. Analogue input 4 settings

| Code       | Parameter              | Min     | Max    | Unit | Default      | ID  | Description     |
|------------|------------------------|---------|--------|------|--------------|-----|-----------------|
| P3.5.2.4.1 | AI4 signal selection   |         |        |      | AnIN SlotD.2 | 152 | See P3.5.2.1.1. |
| P3.5.2.4.2 | AI4 signal filter time | 0.00    | 300.00 | s    | 0.1          | 153 | See P3.5.2.1.2. |
| P3.5.2.4.3 | AI4 signal range       | 0       | 1      |      | 0            | 154 | See P3.5.2.1.3  |
| P3.5.2.4.4 | AI4 custom. min        | -160.00 | 160.00 | %    | 0.00         | 155 | See P3.5.2.1.4. |
| P3.5.2.4.5 | AI4 custom. max        | -160.00 | 160.00 | %    | 100.00       | 156 | See P3.5.2.1.5. |
| P3.5.2.4.6 | AI4 signal inversion   | 0       | 1      |      | 0            | 162 | See P3.5.2.1.6. |

**Group 3.5.2.5: Analog Input 5**

Table 78. Analogue input 5 settings

| Code       | Parameter              | Min     | Max    | Unit | Default      | ID  | Description     |
|------------|------------------------|---------|--------|------|--------------|-----|-----------------|
| P3.5.2.5.1 | AI5 signal selection   |         |        |      | AnIN SlotE.1 | 188 | See P3.5.2.1.1. |
| P3.5.2.5.2 | AI5 signal filter time | 0.00    | 300.00 | s    | 0.1          | 189 | See P3.5.2.1.2. |
| P3.5.2.5.3 | AI5 signal range       | 0       | 1      |      | 0            | 190 | See P3.5.2.1.3  |
| P3.5.2.5.4 | AI5 custom. min        | -160.00 | 160.00 | %    | 0.00         | 191 | See P3.5.2.1.4. |
| P3.5.2.5.5 | AI5 custom. max        | -160.00 | 160.00 | %    | 100.00       | 192 | See P3.5.2.1.5. |
| P3.5.2.5.6 | AI5 signal inversion   | 0       | 1      |      | 0            | 198 | See P3.5.2.1.6. |

**Group 3.5.2.6: Analog Input 6***Table 79. Analogue input 6 settings*

| Code       | Parameter              | Min     | Max    | Unit | Default         | ID  | Description     |
|------------|------------------------|---------|--------|------|-----------------|-----|-----------------|
| P3.5.2.6.1 | AI6 signal selection   |         |        |      | AnIN<br>SlotE.2 | 199 | See P3.5.2.1.1. |
| P3.5.2.6.2 | AI6 signal filter time | 0.00    | 300.00 | s    | 0.1             | 200 | See P3.5.2.1.2. |
| P3.5.2.6.3 | AI6 signal range       | 0       | 1      |      | 0               | 201 | See P3.5.2.1.3  |
| P3.5.2.6.4 | AI6 custom. min        | -160.00 | 160.00 | %    | 0.00            | 202 | See P3.5.2.1.4. |
| P3.5.2.6.5 | AI6 custom. max        | -160.00 | 160.00 | %    | 100.00          | 203 | See P3.5.2.1.5. |
| P3.5.2.6.6 | AI6 signal inversion   | 0       | 1      |      | 0               | 209 | See P3.5.2.1.6. |

### 7.1.6.4 Group 3.5.3: Digital outputs

#### Group 3.5.3.2: Slot B Basic

Table 80. Digital output settings on standard I/O board

| Code       | Parameter           | Min  | Max    | Unit | Default | ID    | Description  |
|------------|---------------------|------|--------|------|---------|-------|--|
| P3.5.3.2.1 | R01 function        | 0    | 60     |      | 2       | 11001 | Function selection for Basic R01:<br>0 = None<br>1 = Ready<br>2 = Run<br>3 = General fault<br>4 = General fault inverted<br>5 = General alarm<br>6 = Reversed<br>7 = At speed<br>8 = Thermistor fault<br>9 = Motor regulator active<br>10 = Start signal active<br>11 = Keypad control active<br>12 = I/O B control activated<br>13 = Limit supervision 1<br>14 = Limit supervision 2<br>15 = SinglePowerOn<br>16 = No function<br>17 = Preset speed active<br>18 = No function<br>19 = PID in Sleep mode<br>20 = PID soft fill active<br>21 = PID supervision limits<br>22 = Ext. PID superv. limits<br>23 = Input press. alarm/fault<br>24 = Frost prot. alarm/fault<br>25 - 30 = No function<br>31 = RTC time chnl 1 control<br>32 = RTC time chnl 2 control<br>33 = RTC time chnl 3 control<br>34 = FB ControlWord B13<br>35 = FB ControlWord B14<br>36 = FB ControlWord B15<br>37 = FB ProcessData1.B0<br>38 = FB ProcessData1.B1<br>39 = FB ProcessData1.B2<br>40 = Maintenance alarm<br>41 = Maintenance fault<br>42 = No function<br>43 = No function<br>54 -55 = No function<br>56 = Auto-cleaning active<br>57 = Motor Switch Open<br>58 = TEST (Always Closed)<br>59 = No function<br>60 = DualSupply AC switch |
| M3.5.3.2.2 | Basic R01 ON delay  | 0.00 | 320.00 | s    | 0.00    | 11002 | ON delay for relay   |
| M3.5.3.2.3 | Basic R01 OFF delay | 0.00 | 320.00 | s    | 0.00    | 11003 | OFF delay for relay  |
| M3.5.3.2.4 | Basic R02 function  | 0    | 59     |      | 3       | 11004 | See P3.5.3.2.1   |
| M3.5.3.2.5 | Basic R02 ON delay  | 0.00 | 320.00 | s    | 0.00    | 11005 | See M3.5.3.2.2.  |
| M3.5.3.2.6 | Basic R02 OFF delay | 0.00 | 320.00 | s    | 0.00    | 11006 | See M3.5.3.2.3.  |

### 7.1.6.5 Expander slots D and E digital outputs

Shows only parameters for existing outputs on option boards placed in slots D and E. Selections as in Standard R01 (P3.5.3.2.1).

This group or these parameters are not visible if no digital outputs exist in slots D or E.

### 7.1.6.6 Group 3.5.4: Analogue outputs

#### Group 3.5.4.1: Slot A Basic

Table 81. Standard I/O board analogue output settings

| Code       | Parameter         | Min    | Max    | Unit   | Default | ID    | Description   |
|------------|-------------------|--------|--------|--------|---------|-------|---|
| P3.5.4.1.1 | A01 function      | 0      | 19     |        | 2       | 10050 | 0=TEST 0% (Not used)<br>1=TEST 100%<br>2=Output freq (0 -fmax)<br>3=Freq reference (0-fmax)<br>4=Motor speed (0 - Motor nominal speed)<br>5=Output current (0-I <sub>nMotor</sub> )<br>6=Motor torque (0-T <sub>nMotor</sub> )<br>7=Motor power (0-P <sub>nMotor</sub> )<br>8=Motor voltage (0-U <sub>nMotor</sub> )<br>9=DC link voltage (0-1000 V)<br>10=PID1 output (0-100%)<br>11=Ext.PID output (0-100%)<br>12=ProcessDataIn1 (0-100%)<br>13=ProcessDataIn2 (0-100%)<br>14=ProcessDataIn3 (0-100%)<br>15=ProcessDataIn4 (0-100%)<br>16=ProcessDataIn5 (0-100%)<br>17=ProcessDataIn6 (0-100%)<br>18=ProcessDataIn7 (0-100%)<br>19=ProcessDataIn8 (0-100%) |
| P3.5.4.1.2 | A01 filter time   | 0.0    | 300.0  | s      | 1.0     | 10051 | Filtering time of analogue output signal. See P3.5.2.1.2<br>0 = No filtering  |
| P3.5.4.1.3 | A01 minimum       | 0      | 1      |        | 0       | 10052 | 0 = 0 mA / 0 V<br>1 = 4 mA / 2 V<br>Signal type (current/voltage) selected with dip switches.<br>Note the difference in analogue output scaling in parameter P3.5.4.1.4. See also parameter P3.5.2.1.3.   |
| P3.5.4.1.4 | A01 minimum scale | Varies | Varies | Varies | 0.0     | 10053 | Min scale in process unit (depends on selection of A01 function).   |
| P3.5.4.1.5 | A01 maximum scale | Varies | Varies | Varies | 0.0     | 10054 | Max scale in process unit (depends on selection of A01 function)  |

### 7.1.6.7 Expander slots D to E analogue outputs

Shows only parameters for existing outputs on option boards placed in slots D and E. Selections as in Standard A01 (P3.5.4.1.1).

This group or these parameters are not visible if no digital outputs exist in slots D or E.

## 7.1.7 GROUP 3.6: FIELDBUS DATAMAP

Table 82. Fieldbus data mapping

| Code   | Parameter        | Min | Max   | Unit | Default | ID  | Description  |
|--------|------------------|-----|-------|------|---------|-----|--|
| P3.6.1 | FB DataOut 1 Sel | 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 | FB DataOut 2 Sel | 0   | 35000 |      | 2       | 853 | Select Process Data Out with parameter ID  |
| P3.6.3 | FB DataOut 3 Sel | 0   | 35000 |      | 3       | 854 | Select Process Data Out with parameter ID  |
| P3.6.4 | FB DataOut 4 Sel | 0   | 35000 |      | 4       | 855 | Select Process Data Out with parameter ID  |
| P3.6.5 | FB DataOut 5 Sel | 0   | 35000 |      | 5       | 856 | Select Process Data Out with parameter ID  |
| P3.6.6 | FB DataOut 6 Sel | 0   | 35000 |      | 6       | 857 | Select Process Data Out with parameter ID  |
| P3.6.7 | FB DataOut 7 Sel | 0   | 35000 |      | 7       | 858 | Select Process Data Out with parameter ID  |
| P3.6.8 | FB DataOut 8 Sel | 0   | 35000 |      | 37      | 859 | Select Process Data Out with parameter ID  |

## Fieldbus process data out

Default values for Process Data Out to monitor through fieldbus are listed in Table 83.

Table 83. Fieldbus Process Data Out

| 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 | 1       |

**Example:** Value '2500' for *Output Frequency* corresponds to '25.00 Hz' (scaling value is 0.01).

All monitoring values listed in chapter 6 are given the scaling value.

**7.1.8 GROUP 3.7: PROHIBIT FREQ**

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. When the (input) frequency reference is increased, the internal frequency reference is kept at the low limit until the (input) reference is above the high limit.

*Table 84. Prohibit frequencies*

| Code   | Parameter        | Min   | Max    | Unit  | Default | ID  | Description   |
|--------|------------------|-------|--------|-------|---------|-----|---|
| P3.7.1 | Range 1 Low Lim  | -1,00 | 320,00 | Hz    | 0,00    | 509 | 0 = Not used  |
| P3.7.2 | Range 1 High Lim | 0,00  | 320,00 | Hz    | 0,00    | 510 | 0 = Not used  |
| P3.7.3 | Range 2 Low Lim  | 0,00  | 320,00 | Hz    | 0,00    | 511 | 0 = Not used  |
| P3.7.4 | Range 2 High Lim | 0,00  | 320,00 | Hz    | 0,00    | 512 | 0 = Not used  |
| P3.7.5 | Range 3 Low Lim  | 0,00  | 320,00 | Hz    | 0,00    | 513 | 0 = Not used  |
| P3.7.6 | Range 3 High Lim | 0,00  | 320,00 | Hz    | 0,00    | 514 | 0 = Not used  |
| P3.7.7 | Ramp TimeFactor  | 0,1   | 10,0   | Times | 1,0     | 518 | Multiplier of the currently selected ramp time between prohibit frequency limits. |

**7.1.9 GROUP 3.8: SUPERVISIONS**

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).

*Table 85. Supervision settings*

| Code   | Parameter     | Min    | Max   | Unit   | Default | ID   | Description  |
|--------|---------------|--------|-------|--------|---------|------|--|
| P3.8.1 | Superv1 Item  | 0      | 11    |        | 0       | 1431 | 0 = Output frequency<br>1 = Frequency reference<br>2 = Motor current<br>3 = Motor torque<br>4 = Motor power<br>5 = DC-link voltage<br>6 = Analogue input 1<br>7 = Analogue input 2<br>8 = Analogue input 3<br>9 = Analogue input 4<br>10 = Analogue input 5<br>11 = Analogue input 6 |
| P3.8.2 | Superv1 Mode  | 0      | 2     |        | 0       | 1432 | 0 = Not used<br>1 = Low limit supervision (output active under limit)<br>2 = High limit supervision (output active over limit)   |
| P3.8.3 | Superv1 Limit | -50.00 | 50.00 | Varies | 25.00   | 1433 | Supervision limit for selected item. Unit appears automatically.   |
| P3.8.4 | Superv1 Hyst  | 0.00   | 50.00 | Varies | 5.00    | 1434 | Supervision limit hysteresis for selected item. Unit is set automatically.   |
| P3.8.5 | Superv2 Item  | 0      | 11    |        | 1       | 1435 | See P3.8.1   |
| P3.8.6 | Superv2 Mode  | 0      | 2     |        | 0       | 1436 | See P3.8.2   |
| P3.8.7 | Superv2 Limit | -50.00 | 50.00 | Varies | 40.00   | 1437 | See P3.8.3   |

Table 85. Supervision settings

|        |                     |      |       |        |      |      |  |
|--------|---------------------|------|-------|--------|------|------|--|
| P3.8.8 | Superv2 Hyst        | 0.00 | 50.00 | Varies | 5.00 | 1438 | See P3.8.4   |
| P3.8.9 | Single PO Threshold | 150  | 500   | V      | 300  | 1968 | Single PO (Power On) Threshold can be used to set level for R01 or R02 to switch off when DC voltage goes below the setting level. The relay function must be programmed as 15/Single Power On.<br>Relay can be used to control to connect additional resistor into DC supply. Resistor will eliminate power on/off cycle when supply voltage drops into drive shut down level. Resistor size can be selected approximately equal to drive standby losses. |

### 7.1.10 GROUP 3.9: PROTECTIONS

#### 7.1.10.1 Group 3.9.1: General

Table 86. General protections settings

| Code      | Parameter          | Min      | Max      | Unit | Default | ID  | Description  |
|-----------|--------------------|----------|----------|------|---------|-----|--|
| P3.9.1.2  | External fault     | 0        | 3        |      | 2       | 701 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)                          |
| P3.9.1.3  | InputPhase Fault   | 0        | 1        |      | 1       | 730 | 0= 3 Phases support<br>1= 1 Phase support  |
| P3.9.1.4  | Undervoltage Flt   | 0        | 1        |      | 0       | 727 | 0 = Fault stored in history<br>1 = Fault not stored in history   |
| P3.9.1.5  | OutputPhase Flt    | 0        | 3        |      | 2       | 702 | See P3.9.1.2   |
| P3.9.1.6  | FieldbusComm Flt   | 0        | 4        |      | 3       | 733 | 0 = No action<br>1 = Alarm<br>2 = Alarm, PresetFreq<br>3 = Fault (Stop according to stop mode)<br>4 = Fault (Stop by coasting) |
| P3.9.1.7  | SlotComm Flt       | 0        | 3        |      | 2       | 734 | See P3.9.1.2   |
| P3.9.1.8  | Thermistor Fault   | 0        | 3        |      | 0       | 732 | See P3.9.1.2   |
| P3.9.1.9  | PID SoftFill Fault | 0        | 3        |      | 2       | 748 | See P3.9.1.2   |
| P3.9.1.10 | PID Supervision    | 0        | 3        |      | 2       | 749 | See P3.9.1.2   |
| P3.9.1.11 | ExtPID Supervision | 0        | 3        |      | 2       | 757 | See P3.9.1.2   |
| P3.9.1.13 | PresetAlarmFreq    | P3.3.1.1 | P3.3.1.2 | Hz   | 25.00   | 183 | This frequency used when fault response (in Group 3.9: Protections) is Alarm+preset frequency                                  |
| P3.9.1.14 | STO Fault          | 0        | 3        |      | 3       | 775 | Defines drive operation when STO function has been activated (eg. Emergency stop button has been pressed).                     |

### 7.1.10.2 Group 3.9.2: Motor Therm Prot

The motor thermal protection is to protect the motor from overheating. The AC 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 IT 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 7.1.



|   |  |
|---|--|
|  | <b>NOTE!</b> If you use long motor cables (max. 100 m) together with small drives ( $\leq 1.5$ kW) 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. |
|  | <b>CAUTION!</b> The calculated model does not protect the motor if the airflow to the motor is reduced by blocked air intake grill. The model starts from zero if the control board is powered off.  |

Table 87. Motor thermal protection settings

| Code     | Parameter        | Min   | Max   | Unit | Default | ID  | Description   |
|----------|------------------|-------|-------|------|---------|-----|---|
| P3.9.2.1 | Motor Therm Prot | 0     | 3     |      | 2       | 704 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)<br>If available, use the motor thermistor to protect the motor. Choose then value 0 for this parameter. |
| P3.9.2.2 | MotAmbient Temp  | -20.0 | 100.0 | °C   | 40.0    | 705 | Ambient temperature in °C   |
| P3.9.2.3 | ZeroSpeedCooling | 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.   |
| P3.9.2.4 | ThermTimeConst   | 1     | 200   | min  | Varies  | 707 | The time constant is the time within which the calculated thermal stage has reached 63% of its final value.   |
| P3.9.2.5 | MotThermLoadbil  | 10    | 150   | %    | 100     | 708 | Motor thermal Loadability states how much the motor can be thermally loaded. E.g. 90% means that the motor temperature will settle around 100% when continuously running at 90% of nominal load.              |



Table 87. Motor thermal protection settings

|          |                      |     |       |   |      |     |   |
|----------|----------------------|-----|-------|---|------|-----|---|
| P3.9.2.6 | MotTempInitialMode   | 0   | 3     |   | 2    | 777 | The estimated temperature rise is added to a motor ambient temperature set by the parameter P3.9.2.2 MotAmbientTemp.<br>0 = Disabled<br>2 = Last value<br>3 = Real time clock |
| P3.9.2.7 | MotTempInitialAdjust | 0.0 | 100.0 | % | 33.0 | 778 | Motor thermal memory adjust [%].<br>Depending on the parameter P3.9.2.6 MotTempInitialMode, this parameter is used as a constant or scaling coefficient.                      |

### 7.1.10.3 Group 3.9.3: Motor Stall

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, P3.9.3.2 (*Stall Current*) and P3.9.3.4 (*Stall Freq. 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.



**NOTE!** If you use long motor cables (max. 100 m) together with small drives ( $\leq 1.5$  kW) 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 stall protection functions.

Table 88. Motor stall protection settings

| Code     | Parameter         | Min  | Max      | Unit | Default | ID  | Description  |
|----------|-------------------|------|----------|------|---------|-----|--|
| P3.9.3.1 | MotorStall Flt    | 0    | 3        |      | 0       | 709 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)    |
| P3.9.3.2 | Stall Current     | 0.00 | 5.2      | A    | 3.7     | 710 | For a stall stage to occur, the current must have exceeded this limit.                                   |
| P3.9.3.3 | Stall Time Limit  | 1.00 | 120.00   | s    | 15.00   | 711 | This is the maximum time allowed for a stall stage.  |
| P3.9.3.4 | Stall Freq. Limit | 1.00 | P3.3.1.2 | Hz   | 25.00   | 712 | For a stall state to occur, the output frequency must have remained below this limit for a certain time. |

### 7.1.10.4 Group 3.9.4: Motor Underload

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 P3.9.4.2 (*Underload protection: Field weakening area load*) and P3.9.4.3 (*Zero frequency load*).

The underload curve is a squared curve set between the zero frequency and the field weakening point. The protection is not active below 5 Hz (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<sub>H</sub> 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.



**NOTE!** If you use long motor cables (max. 100 m) together with small drives ( $\leq 1.5$  kW) 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 underload protection functions.

Table 89. Motor underload protection settings

| Code     | Parameter           | Min          | Max        | Unit  | Default      | ID   | Description   |
|----------|---------------------|--------------|------------|-------|--------------|------|---|
| P3.9.4.1 | Underload Flt       | 0            | 3          |       | 0            | 713  | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)<br>See P3.9.4.5 for the underload mode. When P3.9.4.5 = 0, Underload is determined by P3.9.4.2 - P3.9.4.4. When P3.9.4.5 = 1, the fault is related to P3.9.4.6. |
| P3.9.4.2 | Fieldweak. 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.   |
| P3.9.4.3 | Zero Freq. Load     | 5.0          | 150.0      | %     | 10.0         | 715  | This parameter gives value for the minimum torque allowed with zero frequency.<br>If you change the value of parameter P3.1.1.4 this parameter is automatically restored to the default value.  |
| P3.9.4.4 | Time Limit          | 2.00         | 600.00     | s     | 20.00        | 716  | This is the maximum time allowed for an underload state to exist.   |
| P3.9.4.5 | UnderloadDetectMode | Motor Torque | Flow Meter |       | Motor Torque | 1950 | 0 = Motor Torque<br>1 = Flowmeter (transducer defined by P3.23.1)   |
| P3.9.4.6 | Minimum Flow        | 1            | 214748     | l/min | 300          | 1951 | Value to determine underload fault if P3.9.4.5 is 1   |

7.1.10.5 Group 3.9.6: Temperature input fault 1

**NOTE!** This parameter group is visible only with an option board for temperature measurement (OPT-BH) installed.

Table 90. Temperature input fault 1 settings

| Code     | Parameter              | Min   | Max   | Unit | Default | ID  | Description  |
|----------|------------------------|-------|-------|------|---------|-----|--|
| P3.9.6.1 | Temperature signal 1   | 0     | 63    |      | 0       | 739 | Selection of signals to use for alarm and fault triggering. B0 = Temperature Signal 1<br>B1 = Temperature Signal 2<br>B2 = Temperature Signal 3<br>B3 = Temperature Signal 4<br>B4 = Temperature Signal 5<br>B5 = Temperature Signal 6<br>Max value is taken of the chosen signals and used for alarm/fault triggering.<br><b>NOTE!</b> Only 6 first temperature inputs are supported (counting boards from slot A to slot E). |
| P3.9.6.2 | Alarm limit 1          | -30.0 | 200.0 | °C   | 120.0   | 741 | Temperature limit for triggering alarm. <b>NOTE!</b> Only inputs chosen with parameter P3.9.6.1 are compared.  |
| P3.9.6.3 | Fault limit 1          | -30.0 | 200.0 | °C   | 120.0   | 742 | Temperature limit for triggering alarm. <b>NOTE!</b> Only inputs chosen with parameter P3.9.6.1 are compared.  |
| P3.9.6.4 | Fault limit response 1 | 0     | 3     |      | 2       | 740 | 0 = No response<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)  |

7.1.10.6 Group 3.9.6: Temperature input fault 2

**NOTE!** This parameter group is visible only with an option board for temperature measurement (OPT-BH) installed.

Table 91. Temperature input fault 2 settings

| Code     | Parameter              | Min   | Max   | Unit | Default | ID  | Description  |
|----------|------------------------|-------|-------|------|---------|-----|--|
| P3.9.6.5 | Temperature signal 2   | 0     | 63    |      | 0       | 763 | Selection of signals to use for alarm and fault triggering. B0 = Temperature Signal 1<br>B1 = Temperature Signal 2<br>B2 = Temperature Signal 3<br>B3 = Temperature Signal 4<br>B4 = Temperature Signal 5<br>B5 = Temperature Signal 6<br>Max value is taken of the chosen signals and used for alarm/fault triggering.<br><b>NOTE!</b> Only 6 first temperature inputs are supported (counting boards from slot A to slot E). |
| P3.9.6.6 | Alarm limit 2          | -30.0 | 200.0 | °C   | 120.0   | 764 | Temperature limit for triggering alarm. <b>NOTE!</b> Only inputs chosen with parameter P3.9.6.5 are compared.  |
| P3.9.6.7 | Fault limit 2          | -30.0 | 200.0 | °C   | 120.0   | 765 | Temperature limit for triggering alarm. <b>NOTE!</b> Only inputs chosen with parameter P3.9.6.5 are compared.  |
| P3.9.6.8 | Fault limit response 2 | 0     | 3     |      | 2       | 766 | 0 = No response<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)  |

7.1.10.7    Group 3.9.8: AI Low Protection*Table 92. AI Low Protection settings*

| Code     | Parameter         | Min | Max | Unit | Default | ID  | Description   |
|----------|-------------------|-----|-----|------|---------|-----|---|
| P3.9.8.1 | AI Low Protection | 0   | 2   |      | 2       | 767 | This parameter defines if the AI Low protection is enabled or disabled.<br>0 = Disabled<br>1 = Enabled in Run State<br>2 = Enabled in Run&Stop States   |
| P3.9.8.2 | AI Low Fault      | 0   | 5   |      | 0       | 700 | Response when an analogue signal in use goes below 50% of the minimum signal range. 0 = No action<br>1 = Alarm<br>2 = Alarm, Preset Freq<br>3 = Alarm, Previous Freq<br>4 = Fault (Stop according to stop mode)<br>5 = Fault (Stop by coasting) |

7.1.10.8    Group 3.9.9: User Defined Fault 1*Table 93. User Defined Fault 1 settings*

| Code     | Parameter             | Min | Max | Unit | Default       | ID        | Description   |
|----------|-----------------------|-----|-----|------|---------------|-----------|---|
| P3.9.9.1 | User Defined Fault 1  |     |     |      | DigIN Slot0.1 | 1552<br>3 | Digital input selection for activating User Defined Fault (1 or 2)                                    |
| P3.9.9.2 | UserDef. Fault1 Resp. | 0   | 3   |      | 3             | 1552<br>5 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting) |

7.1.10.9    Group 3.9.10: User Defined Fault 2*Table 94. User Defined Fault 2 settings*

| Code      | Parameter             | Min | Max | Unit | Default       | ID        | Description   |
|-----------|-----------------------|-----|-----|------|---------------|-----------|---|
| P3.9.10.1 | User Defined Fault 2  |     |     |      | DigIN Slot0.1 | 1552<br>4 | Digital input selection for activating User Defined Fault (1 or 2)                                    |
| P3.9.10.2 | UserDef. Fault2 Resp. | 0   | 3   |      | 3             | 1552<br>6 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting) |

## 7.1.11 GROUP 3.10: AUTOMATIC RESET

Table 95. Autoreset settings

| Code    | Parameter                         | Min  | Max    | Unit | Default | ID   | Description  |
|---------|-----------------------------------|------|--------|------|---------|------|--|
| P3.10.1 | Automatic reset                   | 0    | 1      |      | 0       | 731  | 0 = Disabled<br>1 = Enabled  |
| P3.10.2 | Wait time                         | 0.10 | 10.0   | m    | 1.0     | 717  | Wait time before the first reset is executed.  |
| P3.10.3 | Automatic reset tries             | 1    | 10     |      | 5       | 759  | NOTE: Total number of trials (irrespective of fault type)  |
| P3.10.4 | Restart Function                  | 0    | 1      |      | 1       | 719  | We can choose what kind of start function we want to use when doing an autoreset of the drive.<br>0 = Flying start<br>1 = Start Function |
| P3.10.5 | Underload reset Time <sub>1</sub> | 0.1  | 1200.0 | m    | 2.0     | 1927 |  |
| P3.10.6 | Underload reset Time <sub>2</sub> | 0.1  | 1200.0 | m    | 30.0    | 1928 |  |
| P3.10.7 | Underload reset Time <sub>3</sub> | 0.1  | 1200.0 | m    | 300.0   | 1929 |  |
| P3.10.8 | Underload Tries T1,T2             | 1    | 10     |      | 2       | 1930 |  |

## 7.1.12 GROUP 3.11: APPL. SETTINGS

Table 96. Application Settings

| Code    | Parameter          | Min | Max  | Unit | Default | ID   | Description  |
|---------|--------------------|-----|------|------|---------|------|--|
| P3.11.1 | Parameter Password | 0   | 9999 |      | 0       | 1806 |  |
| P3.11.2 | C/F selection      | 0   | 1    |      | 0       | 1197 | 0 = Celsius<br>1 = Fahrenheit  |
| P3.11.3 | kW/hp selection    | 0   | 1    |      | 0       | 1198 | 0 = kW<br>1 = hp   |
| P3.11.4 | Multimonitor View  | 0   | 2    |      | 1       | 1196 | Division of keypad display into sections in Multimonitor view.<br>0 = 2x2 sections<br>1 = 3x2 sections<br>2 = 3x3 sections |
| P3.11.5 | FuncButtonConfig   | 0   | 15   |      | 15      | 1195 | With this parameter it's possible to configure what alternatives are visible when pressing the function button.            |

### 7.1.13 GROUP 3.12: TIMER FUNCTIONS

The time functions (Time Channels) in the VACON® 100 X give you the possibility to program functions to be controlled by the internal RTC (Real Time Clock). Practically every function that can be controlled by a digital input can also be controlled by a Time Channel. Instead of having an external PLC controlling a digital input you can program the "closed" and "opened" intervals of the input internally.

**NOTE!** The functions of this parameter group can be made the fullest advantage of only if the battery (option) has been installed and the Real Time Clock settings have been properly made during the Startup Wizard (see page 31 and page 32). **It is not recommended** to use these functions without battery backup because the time and date settings of the drive will be reset at every power down if no battery for the RTC is installed.

#### Time channels

The on/off logic for the *Time channels* is configured by assigning *Intervals* or/and *Timers* to them. One *Time channel* can be controlled by many *Intervals* or *Timers* by assigning as many of these as needed to the *Time channel*.

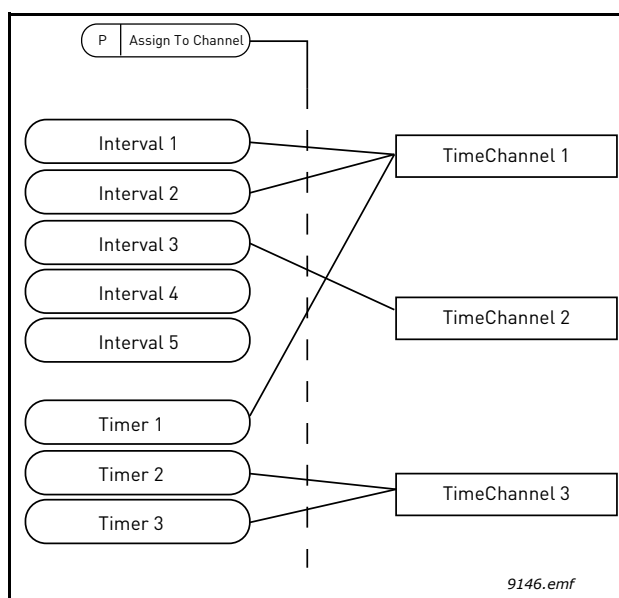


Figure 34. The intervals and timers can be assigned to time channels in a flexible way. Every interval and timer has its own parameter for assigning to a time channel.

#### Intervals

Every interval is given an "ON Time" and "OFF Time" with parameters. This is the daily time that the interval will be active during the days set with "From Day" and "To Day" parameters. E.g. the parameter setting below means that the interval is active from 7 am to 9 am every weekday (Monday to Friday). The Time Channel to which this Interval is assigned will be seen as a closed "virtual digital input" during that period.

**ON Time:** 07:00:00

**OFF Time:** 09:00:00

**From Day:** Monday

**To Day:** Friday

## Timers

Timers can be used to set a Time Channel active during a certain time by a command from a digital input (or a Time Channel).

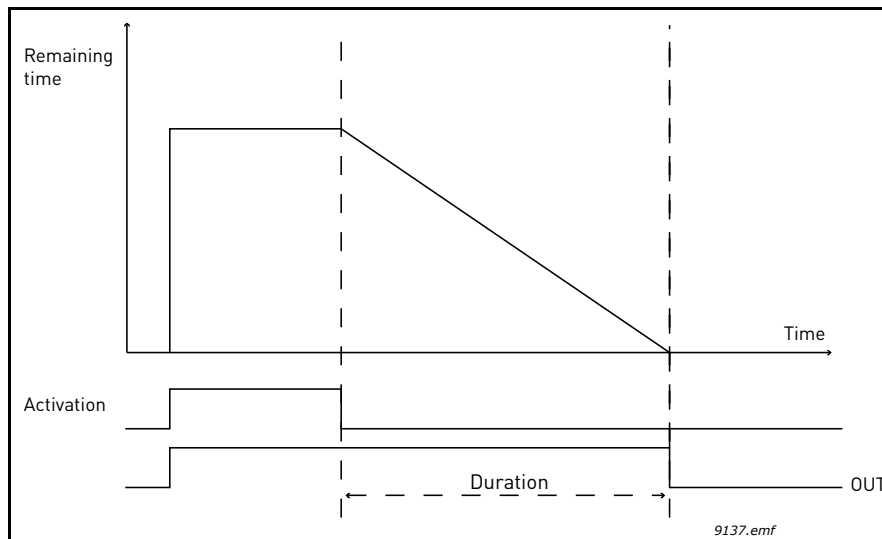


Figure 35. Activation signal comes from a digital input or "a virtual digital input" such as a Time channel. The Timer counts down from falling edge.

The below parameters will set the Timer active when Digital Input 1 on Slot A is closed and keep it active for 30s after it is opened.

**Duration:** 30s

**Timer:** DigIn SlotA.1

**Tip:** A duration of 0 seconds can be used for simply overriding a Time channel activated from a digital input without any off delay after the falling edge.

## EXAMPLE

### Problem:

We have an AC drive for air conditioning in a warehouse. It needs to run between 7am - 5pm on weekdays and 9am - 1pm on weekends. Additionally, we need to be able to manually force the drive to run outside working hours if there are people in the building and to leave it running for 30 min afterwards.

### Solution:

We need to set up two intervals, one for weekdays and one for weekends. A Timer is also needed for activation outside the office hours. An example of configuration below.

#### Interval 1:

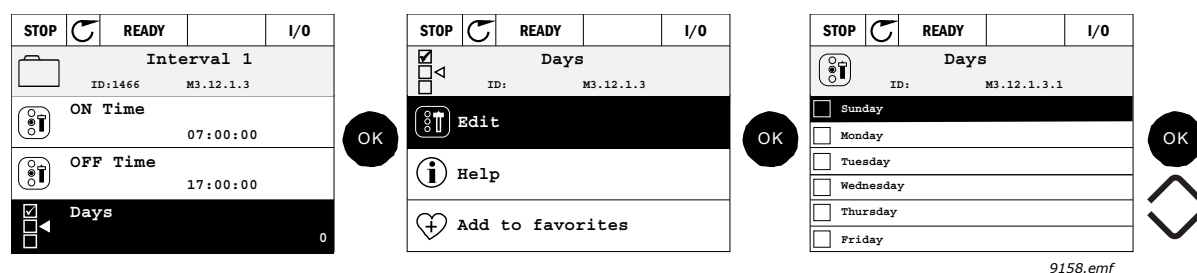
P3.12.1.1: ON Time: **07:00:00**

P3.12.1.2: OFF Time: **17:00:00**

P3.12.1.3: Days: **Monday, Tuesday, Wednesday, Thursday, Friday**

P3.12.1.4: Assign to channel: **Time channel 1**





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## Interval 2:

P3.12.2.1: *ON Time*: **09:00:00**

P3.12.2.2: *OFF Time*: **13:00:00**

P3.12.2.3: *Days*: **Saturday, Sunday**

P3.12.2.4: *AssignToChannel*: **Time channel 1**

## Timer 1

The manual bypassing can be handled by a digital input 1 on slot A (by a different switch or connection to lighting).

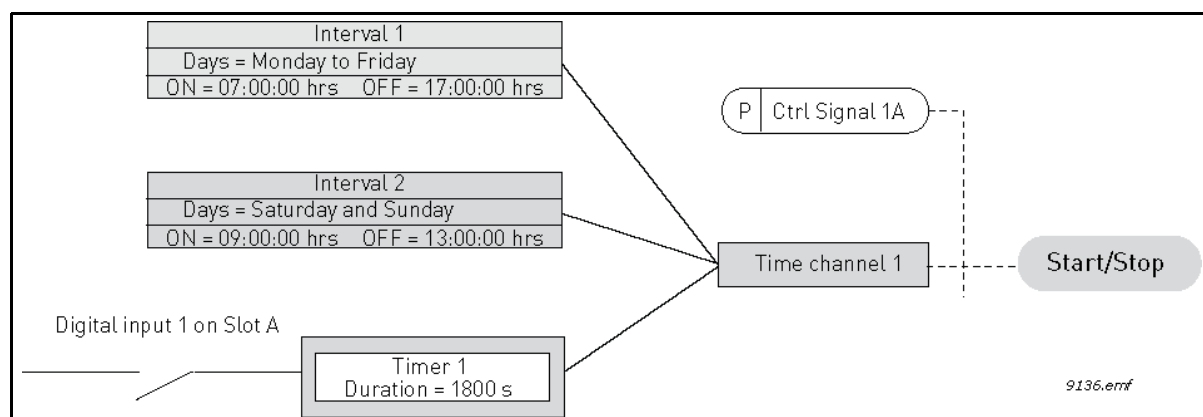
P3.12.6.1: *Duration*: **1800s** (30 min)

P3.12.6.3: *Assign to channel*: **Time channel 1**

P3.12.6.2: *Timer 1: DigIn SlotA.1* (Parameter located in digital inputs menu.)

Finally select the Channel 1 for the I/O Run command.

P3.5.1.1: *Control signal 1 A*: **Time Channel 1**



9136.emf

Figure 36. Final configuration where Time channel 1 is used as control signal for start command instead of a digital input.

7.1.13.1 Group 3.12.1: Interval 1*Table 97. Timer functions, Interval 1*

| Code      | Parameter         | Min      | Max      | Unit     | Default  | ID   | Description   |
|-----------|-------------------|----------|----------|----------|----------|------|---|
| 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 | Days              |          |          |          |          | 1466 | Days of week when active.<br>Checkbox selection:<br>B0 = Sunday<br>B1 = Monday<br>B2 = Tuesday<br>B3 = Wednesday<br>B4 = Thursday<br>B5 = Friday<br>B6 = Saturday |
| P3.12.1.4 | Assign to channel |          |          |          |          | 1468 | Select affected time channel (1-3)<br>0=Not used<br>1=Time channel 1<br>2=Time channel 2<br>3=Time channel 3  |

7.1.13.2 Group 3.12.2: Interval 2*Table 98. Timer functions, Interval 2*

| Code      | Parameter         | Min      | Max      | Unit     | Default  | ID   | Description    |
|-----------|-------------------|----------|----------|----------|----------|------|----------------|
| 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 | Days              |          |          |          |          | 1471 | See Interval 1 |
| P3.12.2.4 | Assign to channel |          |          |          |          | 1473 | See Interval 1 |

7.1.13.3 Group 3.12.3: Interval 3*Table 99. Timer functions, Interval 3*

| Code      | Parameter         | Min      | Max      | Unit     | Default  | ID   | Description    |
|-----------|-------------------|----------|----------|----------|----------|------|----------------|
| 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 | Days              |          |          |          |          | 1476 | See Interval 1 |
| P3.12.3.4 | Assign to channel |          |          |          |          | 1478 | See Interval 1 |

7.1.13.4 Group 3.12.4: Interval 4*Table 100. Timer functions, Interval 4*

| Code      | Parameter         | Min      | Max      | Unit     | Default  | ID   | Description    |
|-----------|-------------------|----------|----------|----------|----------|------|----------------|
| 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 | Days              |          |          |          |          | 1481 | See Interval 1 |
| P3.12.4.4 | Assign to channel |          |          |          |          | 1483 | See Interval 1 |

7.1.13.5 Group 3.12.5: Interval 5*Table 101. Timer functions, Interval 5*

| Code      | Parameter         | Min      | Max      | Unit     | Default  | ID   | Description    |
|-----------|-------------------|----------|----------|----------|----------|------|----------------|
| 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 | Days              |          |          |          |          | 1486 | See Interval 1 |
| P3.12.5.4 | Assign to channel |          |          |          |          | 1488 | See Interval 1 |

7.1.13.6 Group 3.12.6: Timer 1*Table 102. Timer functions, Timer 1*

| Code      | Parameter         | Min | Max   | Unit | Default          | ID   | Description   |
|-----------|-------------------|-----|-------|------|------------------|------|---|
| 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 | Timer 1           |     |       |      | DigINSlot<br>0.1 | 447  | Rising edge starts Timer 1 programmed in Group 3.12: Timer functions parameter group.   |
| P3.12.6.3 | Assign to channel |     |       |      |                  | 1490 | Select affected time channel (1-3)<br>Check box selection:<br>B0 = Time channel 1<br>B1 = Time channel 2<br>B2 = Time channel 3 |

7.1.13.7 Group 3.12.7: Timer 2*Table 103. Timer functions, Timer 2*

| Code      | Parameter         | Min | Max   | Unit | Default          | ID   | Description |
|-----------|-------------------|-----|-------|------|------------------|------|-------------|
| P3.12.7.1 | Duration          | 0   | 72000 | s    | 0                | 1491 | See Timer 1 |
| P3.12.7.2 | Timer 2           |     |       |      | DigINSlot<br>0.1 | 448  | See Timer 1 |
| P3.12.7.3 | Assign to channel |     |       |      |                  | 1492 | See Timer 1 |

7.1.13.8 Group 3.12.8: Timer 3*Table 104. Timer functions, Timer 3*

| Code      | Parameter         | Min | Max   | Unit | Default          | ID   | Description |
|-----------|-------------------|-----|-------|------|------------------|------|-------------|
| P3.12.8.1 | Duration          | 0   | 72000 | s    | 0                | 1493 | See Timer 1 |
| P3.12.8.2 | Timer 3           |     |       |      | DigINSlot<br>0.1 | 448  | See Timer 1 |
| P3.12.8.3 | Assign to channel |     |       |      |                  | 1494 | See Timer 1 |

**7.1.14 GROUP 3.13: PID CONTROLLER**7.1.14.1 Group 3.13.1: Basic Settings*Table 105. PID controller 1 basic settings*

| Code       | Parameter        | Min    | Max     | Unit   | Default | ID   | Description  |
|------------|------------------|--------|---------|--------|---------|------|--|
| P3.13.1.1  | 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  | Integration Time | 0.00   | 600.00  | s      | 1.00    | 119  | If this parameter is set to 1,00s a change of 10% in the error value causes the controller output to change by 10.00%/s.   |
| P3.13.1.3  | Derivation Time  | 0.00   | 100.00  | s      | 0.00    | 132  | If this parameter is set to 1,00s 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  | ProcessUnitSel.  | 1      | 38      |        | 1       | 1036 | Select unit for actual value.  |
| P3.13.1.5  | ProcessUnitMin   | Varies | Varies  | Varies | 0       | 1033 | Value in Process units at 0% feedback or setpoint.<br>This scaling is done for monitoring purpose only. The PID controller still uses the percentage internally for feedbacks and setpoints. |
| P3.13.1.6  | ProcessUnitMax   | Varies | Varies  | Varies | 100     | 1034 | See above.   |
| P3.13.1.7  | ProcessUnitDeci  | 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)<br>1 = Inverted (Feedback < Setpoint -> Decrease PID output)   |
| P3.13.1.9  | Dead Band        | 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.   |

7.1.14.2 *Group 3.13.2: Setpoints*

Table 106. Setpoints settings

| Code       | Parameter          | Min     | Max    | Unit   | Default       | ID   | Description  |
|------------|--------------------|---------|--------|--------|---------------|------|--|
| P3.13.2.1  | Keypad SP 1        | Varies  | Varies | Varies | 0             | 167  |  |
| P3.13.2.2  | Keypad SP 2        | Varies  | Varies | Varies | 0             | 168  |  |
| P3.13.2.3  | 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  | SP Boost Activat.  | Varies  | Varies |        | DigIN Slot0.1 | 1046 | FALSE = No boost<br>TRUE = Boost   |
| P3.13.2.5  | Setpoint Selection | Varies  | Varies |        | DigIN Slot0.1 | 1047 | FALSE = Setpoint 1<br>TRUE = Setpoint 2  |
| P3.13.2.6  | SP 1 Source        | 0       | 22     |        | 1             | 332  | 0 = Not used<br>1 = Keypad setpoint 1<br>2 = Keypad setpoint 2<br>3 = AI1<br>4 = AI2<br>5 = AI3<br>6 = AI4<br>7 = AI5<br>8 = AI6<br>9 = ProcessDataIn1<br>10 = ProcessDataIn2<br>11 = ProcessDataIn3<br>12 = ProcessDataIn4<br>13 = ProcessDataIn5<br>14 = ProcessDataIn6<br>15 = ProcessDataIn7<br>16 = ProcessDataIn8<br>17 = Temperature input 1<br>18 = Temperature input 2<br>19 = Temperature input 3<br>20 = Temperature input 4<br>21 = Temperature input 5<br>22 = Temperature input 6<br>AI's and ProcessDataIn are handled as percent (0.00-100.00%) and scaled according to Setpoint minimum and maximum. <b>NOTE:</b> ProcessDataIn signals use 2 decimals. |
| P3.13.2.5  | SP 1 Minimum       | -200.00 | 200.00 | %      | 0.00          | 1069 | Minimum value at analogue signal minimum.  |
| P3.13.2.6  | SP 1 Maximum       | -200.00 | 200.00 | %      | 100.00        | 1070 | Maximum value at analogue signal maximum.  |
| P3.13.2.10 | SP 1 Boost         | -2.0    | 2.0    | x      | 1.0           | 1071 | The setpoint can be boosted with a digital input.  |
| P3.13.2.11 | SP 2 Source        | 0       | 22     |        | 2             | 431  | See par. P3.13.2.6   |
| P3.13.2.12 | SP 2 Minimum       | -200.00 | 200.00 | %      | 0.00          | 1073 | Minimum value at analogue signal minimum.  |
| P3.13.2.13 | SP 2 Maximum       | -200.00 | 200.00 | %      | 100.00        | 1074 | Maximum value at analogue signal maximum.  |
| P3.13.2.17 | SP 2 Boost         | -2.0    | 2.0    | x      | 1.0           | 1078 | See P3.13.2.10.  |

7.1.14.3 *Group 3.13.3: Feedbacks*

Table 107. Feedback settings

| Code      | Parameter    | Min     | Max    | Unit | Default | ID   | Description   |
|-----------|--------------|---------|--------|------|---------|------|---|
| P3.13.3.1 | Function     | 1       | 9      |      | 1       | 333  | 1=Only Source1 in use<br>2=SQRT(Source1);(Flow=Constant x SQRT(Pressure))<br>3= SQRT(Source1- Source 2)<br>4= SQRT(Source 1) + SQRT (Source 2)<br>5= Source 1 + Source 2<br>6= Source 1 - Source 2<br>7=MIN (Source 1, Source 2)<br>8=MAX (Source 1, Source 2)<br>9=MEAN (Source 1, Source 2)   |
| P3.13.3.2 | Gain         | -1000.0 | 1000.0 | %    | 100.0   | 1058 | Used e.g. with selection 2 in <i>Feedback function</i>  |
| P3.13.3.3 | FB 1 Source  | 0       | 20     |      | 2       | 334  | 0 = Not used<br>1 = AI1<br>2 = AI2<br>3 = AI3<br>4 = AI4<br>5 = AI5<br>6 = AI6<br>7 = ProcessDataIn1<br>8 = ProcessDataIn2<br>9 = ProcessDataIn3<br>10 = ProcessDataIn4<br>11 = ProcessDataIn5<br>12 = ProcessDataIn6<br>13 = ProcessDataIn7<br>14 = ProcessDataIn8<br>15 = Temperature input 1<br>16 = Temperature input 2<br>17 = Temperature input 3<br>18 = Temperature input 4<br>19 = Temperature input 5<br>20 = Temperature input 6<br>AI's and ProcessDataIn are handled as % (0.00-100.00%) and scaled according to Feedback min and max.<br><b>NOTE:</b> ProcessDataIn use two decimals. |
| P3.13.3.4 | FB 1 Minimum | -200.00 | 200.00 | %    | 0.00    | 336  | Minimum value at analogue signal minimum.   |
| P3.13.3.5 | FB 1 Maximum | -200.00 | 200.00 | %    | 100.00  | 337  | Maximum value at analogue signal maximum.   |
| P3.13.3.6 | FB 2 Source  | 0       | 20     |      | 0       | 335  | See P3.13.3.3   |
| P3.13.3.7 | FB 2 Minimum | -200.00 | 200.00 | %    | 0.00    | 338  | Minimum value at analogue signal minimum.   |
| P3.13.3.8 | FB 2 Maximum | -200.00 | 200.00 | %    | 100.00  | 339  | Maximum value at analogue signal maximum.   |

7.1.14.4 Group 3.13.4: 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 170). VACON® feedforward control uses other measurements which are indirectly affecting the controlled process value.

*Table 108. Feedforward settings*

| Code      | Parameter    | Min     | Max    | Unit | Default | ID   | Description    |
|-----------|--------------|---------|--------|------|---------|------|----------------|
| P3.13.4.1 | Function     | 1       | 9      |      | 1       | 1059 | See P3.13.3.1. |
| P3.13.4.2 | Gain         | -1000   | 1000   | %    | 100.0   | 1060 | See P3.13.3.2  |
| P3.13.4.3 | FF 1 Source  | 0       | 25     |      | 0       | 1061 | See P3.13.3.3  |
| P3.13.4.4 | FF 1 Minimum | -200.00 | 200.00 | %    | 0.00    | 1062 | See P3.13.3.4  |
| P3.13.4.5 | FF 1 Maximum | -200.00 | 200.00 | %    | 100.00  | 1063 | See P3.13.3.5  |
| P3.13.4.6 | FF 2 Source  | 0       | 25     |      | 0       | 1064 | See P3.13.3.6  |
| P3.13.4.7 | FF 2 Minimum | -200.00 | 200.00 | %    | 0.00    | 1065 | See P3.13.3.7  |
| P3.13.4.8 | FF 2 Maximum | -200.00 | 200.00 | %    | 100.00  | 1066 | See P3.13.3.8  |

7.1.14.5 Group 3.13.5: Sleep Function

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.

*Table 109. Sleep function settings*

| Code      | Parameter        | Min  | Max    | Unit   | Default | ID   | Description  |
|-----------|------------------|------|--------|--------|---------|------|--|
| P3.13.5.1 | SP 1 Sleep Freq  | 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 <i>Sleep delay</i> .         |
| P3.13.5.2 | SP 1 Sleep Delay | 0    | 3000   | s      | 0       | 1017 | The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped.  |
| P3.13.5.3 | SP 1 WakeUpLevel |      |        | Varies | 0.00    | 1018 | Defines the level for the PID feedback value wake-up supervision. Uses selected process units.   |
| P3.13.5.4 | SP 1 WakeUpMode  | 0    | 1      |        | 0       | 1019 | Select if wake up level should work as an absolute level or as an offset below the actual setpoint value.<br>0 = Absolute Level<br>1 = Relative Setpoint |
| P3.13.5.5 | SP 2 Sleep Freq  | 0.00 | 320.00 | Hz     | 0.00    | 1075 | Drive goes to sleep mode when the output frequency stays below this limit for a time greater than that defined by parameter <i>Sleep delay</i> .         |
| P3.13.5.6 | SP 2 Sleep Delay | 0    | 3000   | s      | 0       | 1076 | The minimum amount of time the frequency has to remain below the Sleep level before the drive is stopped.  |

Table 109. Sleep function settings

|           |                  |   |   |        |      |      |  |
|-----------|------------------|---|---|--------|------|------|--|
| P3.13.5.7 | SP 2 WakeUpLevel |   |   | Varies | 0.00 | 1077 | Defines the level for the PID feedback value wake-up supervision. Uses selected process units.   |
| P3.13.5.8 | SP 2 WakeUpMode  | 0 | 1 |        | 0    | 1020 | Select if wake up level should work as an absolute level or as an offset below the actual setpoint value.<br>0 = Absolute Level<br>1 = Relative Setpoint |

7.1.14.6 Group 3.13.6: Feedback Superv.

Process supervision is used to control that the *PID Feedback value* (process 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 172.

Table 110. Process supervision parameters

| Code      | Parameter         | Min    | Max    | Unit   | Default | ID  | Description   |
|-----------|-------------------|--------|--------|--------|---------|-----|---|
| P3.13.6.1 | Enable Superv     | 0      | 1      |        | 0       | 735 | 0 = Disabled<br>1 = Enabled   |
| P3.13.6.2 | Upper limit       | Varies | Varies | Varies | Varies  | 736 | Upper actual/process value supervision  |
| P3.13.6.3 | Lower limit       | Varies | Varies | Varies | Varies  | 758 | Lower actual/process value supervision  |
| P3.13.6.4 | Delay             | 0      | 30000  | s      | 0       | 737 | If the desired value is not reached within this time a fault or alarm is created.                     |
| P3.13.6.5 | Supervision Fault | 0      | 3      |        | 2       | 749 | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting) |

7.1.14.7 Group 3.13.7: Press.Loss.Comp.

Table 111. Pressure loss compensation parameters

| Code      | Parameter      | Min    | Max    | Unit   | Default | ID   | Description  |
|-----------|----------------|--------|--------|--------|---------|------|--|
| P3.13.7.1 | Enable SP 1    | 0      | 1      |        | 0       | 1189 | Enables pressure loss compensation for setpoint 1.<br>0 = Disabled<br>1 = Enabled  |
| P3.13.7.2 | SP 1 Max Comp. | Varies | Varies | Varies | Varies  | 1190 | Value added proportionally to the frequency.<br>Setpoint compensation = Max compensation * (FreqOut-MinFreq)/(MaxFreq-MinFreq) |
| P3.13.7.3 | Enable SP 2    | 0      | 1      |        | 0       | 1191 | See P3.13.7.1.   |
| P3.13.7.4 | SP 2 Max Comp. | Varies | Varies | Varies | Varies  | 1192 | See P3.13.7.2.   |



### 7.1.14.8 Group 3.13.8: Soft Fill

The process is brought to a certain level (P3.13.8.3) at slow frequency (P3.13.8.2) before the PID controller starts to control. In addition, you can also set a timeout for the soft fill function. If the set level is not reached within the timeout a fault is triggered. This function can be used e.g. to fill the empty pipe line slowly in order to avoid "water hammers" that could otherwise break the pipes.

It is recommended to use the Soft Fill function always when using the Multi Pump functionality.

Table 112. Soft fill settings

| Code      | Parameter        | Min    | Max    | Unit   | Default | ID   | Description  |
|-----------|------------------|--------|--------|--------|---------|------|--|
| P3.13.8.1 | Enable           | 0      | 1      |        | 0       | 1094 | 0 = Disabled<br>1 = Enabled  |
| P3.13.8.2 | SoftFill Freq    | 0.00   | 50.00  | Hz     | 20.00   | 1055 | The drive accelerates to this frequency before starting to control.  |
| P3.13.8.3 | SoftFill Level   | Varies | Varies | Varies | 0.0000  | 1095 | The drive runs at the PID start frequency until the feedback reaches this value. At this point the controller starts to regulate (depending on acting mode). |
| P3.13.8.4 | Timeout Time     | 0      | 30000  | s      | 0       | 1096 | If the desired value is not reached within this time a fault or alarm is created.<br>0 = No timeout ( <b>NOTE!</b> No fault triggered if value '0' is set)   |
| P3.13.8.5 | Timeout Response | 0      | 3      |        | 2       | 738  | 0 = No action<br>1 = Alarm<br>2 = Fault (Stop according to stop mode)<br>3 = Fault (Stop by coasting)  |

### 7.1.14.9 Group 3.13.9: Input Press.Superv.

The *Input pressure supervision* function is used to supervise that there is enough water in the inlet of the pump, to prevent the pump from sucking air or causing suction cavitation. This function requires a pressure sensor to be installed on the pump inlet, see Figure 37.

If the pump inlet pressure falls below the defined alarm limit, an alarm will be triggered and the pump output pressure reduced by decreasing the PID controller setpoint value. If the inlet pressure still keeps falling below the fault limit, the pump is stopped and a fault will be triggered.

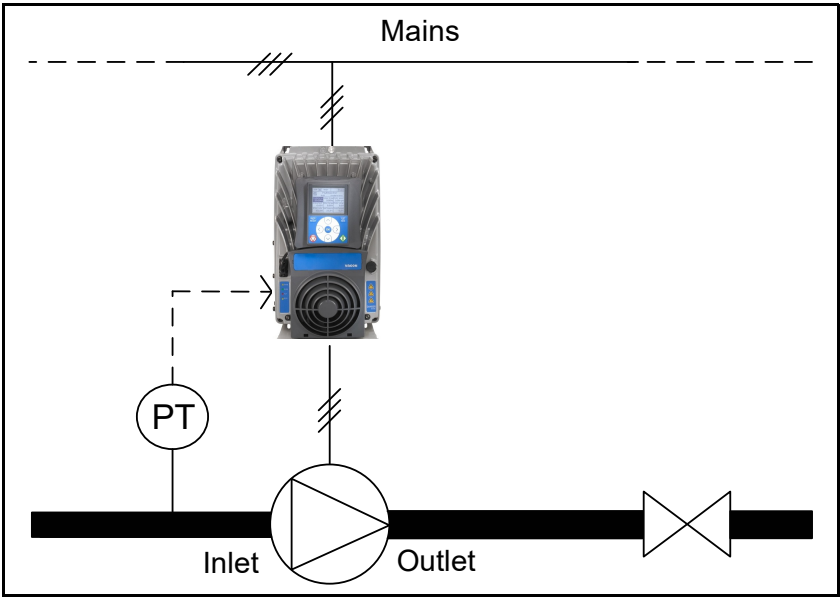


Figure 37. Location of pressure sensor

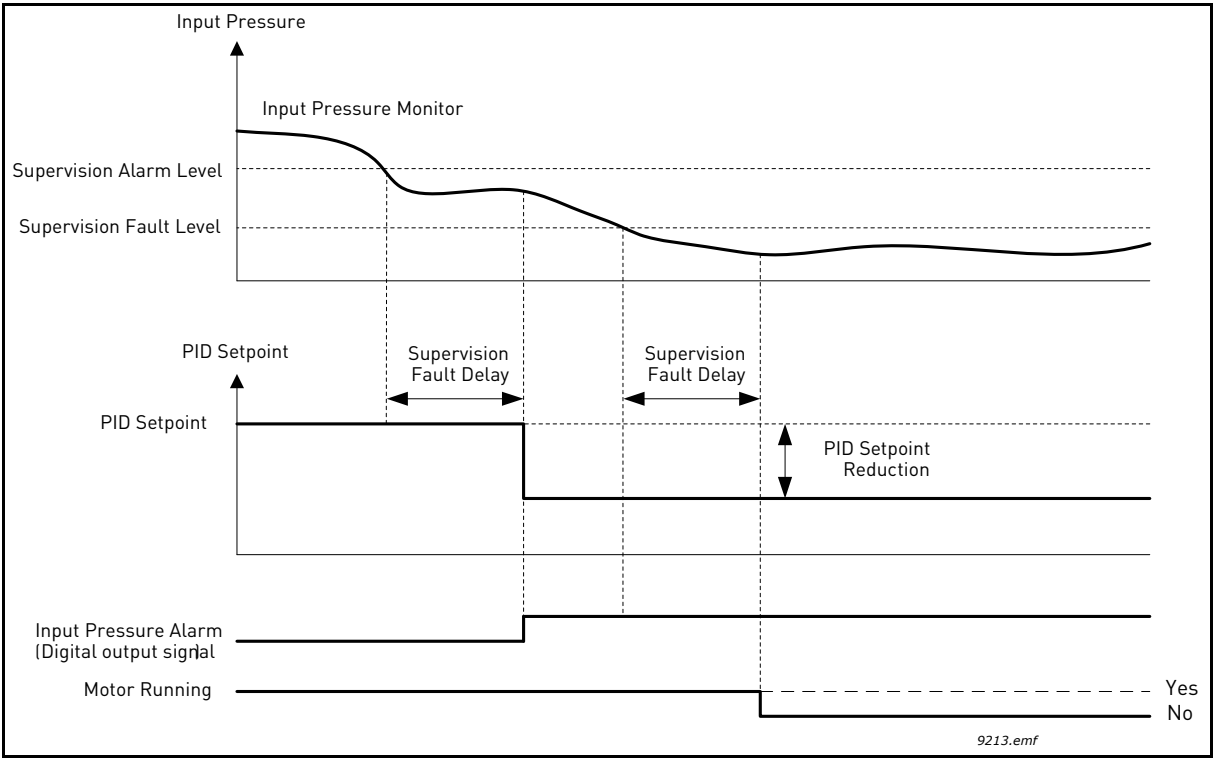


Figure 38. Input pressure supervision

Table 113. Input pressure supervision parameters

| Code      | Parameter      | Min | Max | Unit | Default | ID   | Description  |
|-----------|----------------|-----|-----|------|---------|------|--|
| P3.13.9.1 | Superv. Enable | 0   | 1   |      | 0       | 1685 | 0 = Disabled<br>1 = Enabled<br>Enables the Input Pressure Supervision. |

Table 113. Input pressure supervision parameters

| Code       | Parameter            | Min    | Max    | Unit   | Default | ID   | Description  |
|------------|----------------------|--------|--------|--------|---------|------|--|
| P3.13.9.2  | Superv. Signal       | 0      | 13     | Hz     | 0       | 1686 | The source of input pressure measurement signal:<br>0=Analogue input 1<br>1=Analogue input 2<br>2=Analogue input 3<br>3=Analogue input 4<br>4=Analogue input 5<br>5=Analogue input 6<br>6=ProcessDataIn1 (0-100%)<br>7=ProcessDataIn2 (0-100%)<br>8=ProcessDataIn3 (0-100%)<br>9=ProcessDataIn4 (0-100%)<br>10=ProcessDataIn5 (0-100%)<br>11=ProcessDataIn6 (0-100%)<br>12=ProcessDataIn7 (0-100%)<br>13=ProcessDataIn8 (0-100%) |
| P3.13.9.3  | Superv. Unit Sel.    | 0      | 8      | Varies | 2       | 1687 | Select unit for supervision. The supervision signal (P3.13.9.2) can be scaled to process units on the panel.   |
| P3.13.9.4  | Superv. Unit Decimal | 0      | 4      |        | 2       | 1688 | Choose how many decimals to show.  |
| P3.13.9.5  | Superv. Unit Min     | Varies | Varies | Varies | Varies  | 1689 | Unit min and max parameters are the signal values corresponding to e.g. 4mA and 20 mA respectively (scaled linearly between these).  |
| P3.13.9.6  | Superv. Unit Max     | Varies | Varies | Varies | Varies  | 1690 |  |
| P3.13.9.7  | Superv. Alarm Level  | Varies | Varies | Varies | Varies  | 1691 | Alarm (Fault ID 1363) will be launched if supervision signal stays below the alarm level longer than the time defined by parameter P3.13.9.9.  |
| P3.13.9.8  | Superv. Fault Level  | Varies | Varies | Varies | Varies  | 1692 | Fault (Fault ID 1409) will be launched if supervision signal stays below the fault level longer than the time defined by parameter P3.13.9.9.  |
| P3.13.9.9  | Superv. Fault Delay  | 0.00   | 60.00  | s      | 5.00    | 1693 | Delay time to launch the <b>Input pressure supervision alarm</b> or <b>fault</b> if the supervision signal stays below the alarm/fault level longer than defined by this parameter.  |
| P3.13.9.10 | PID setpoint Reduct. | 0.0    | 100.0  | %      | 10.0    | 1694 | Defines the rate of the PID controller setpoint reduction when the Input pressure supervision alarm is active.   |
| V3.13.9.11 | InputPress. Monitor  | Varies | Varies | Varies | Varies  | 1695 | Monitoring value for selected Input pressure supervision signal.<br>Scaling value according to P3.13.9.4.  |

Table 114. Sleep - no demand detected

| Code       | Parameter                        | Min  | Max        | Unit      | Default | ID   | Description       |
|------------|----------------------------------|------|------------|-----------|---------|------|-------------------|
| P3.13.10.1 | Sleep No Demand Detection Enable | 0    | 1          |           | 0       | 1649 | 0 = No<br>1 = Yes |
| P3.13.10.2 | SNDD Error Hysteresis            | 0    | 99999.9    | P3.13.1.4 | 0.5     | 1658 |                   |
| P3.13.10.3 | SNDD Frequency Hysteresis        | 0.00 | P3.3.1.2   | Hz        | 3.00    | 1663 |                   |
| P3.13.10.4 | SNDD Supervision Time            | 0    | 600        | s         | 120     | 1668 |                   |
| P3.13.10.5 | SNDD Actual Add                  | 0.00 | P3.13.10.2 | P3.13.1.4 | 0.5     | 1669 |                   |

### 7.1.15 GROUP 3.14: EXTPID CONTROLLER

#### 7.1.15.1 Group 3.14.1: Basic settings

For more detailed information, see chapter 7.1.14.

Table 115. Basic settings for external PID-controller

| Code       | Parameter        | Min    | Max     | Unit   | Default       | ID   | Description  |
|------------|------------------|--------|---------|--------|---------------|------|--|
| P3.14.1.1  | Enable ExtPID    | 0      | 1       |        | 0             | 1630 | 0 = Disabled<br>1 = Enabled  |
| P3.14.1.2  | Start signal     |        |         |        | DigIN Slot0.2 | 1049 | FALSE = PID2 in stop mode<br>TRUE = PID2 regulating<br>This parameter will have no effect if PID2 controller is not enabled in the Basic menu for PID2 |
| P3.14.1.3  | 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   |
| P3.14.1.4  | Gain             | 0.00   | 1000.00 | %      | 100.00        | 1631 |  |
| P3.14.1.5  | Integration Time | 0.00   | 600.00  | s      | 1.00          | 1632 |  |
| P3.14.1.6  | Derivation Time  | 0.00   | 100.00  | s      | 0.00          | 1633 |  |
| P3.14.1.7  | ProcessUnitSel.  | 0      | 37      |        | 0             | 1635 |  |
| P3.14.1.8  | ProcessUnitMin   | Varies | Varies  | Varies | 0             | 1664 |  |
| P3.14.1.9  | ProcessUnitMax   | Varies | Varies  | Varies | 100           | 1665 |  |
| P3.14.1.10 | ProcessUnitDeci  | 0      | 4       |        | 2             | 1666 |  |
| P3.14.1.11 | Error inversion  | 0      | 1       |        | 0             | 1636 |  |
| P3.14.1.12 | Dead Band        | Varies | Varies  | Varies | 0.0           | 1637 |  |
| P3.14.1.13 | Dead Band Delay  | 0.00   | 320.00  | s      | 0.00          | 1638 |  |

### 7.1.15.2 Group 3.14.2: Setpoints

Table 116. External PID-controller, setpoints

| Code       | Parameter          | Min     | Max    | Unit   | Default       | ID   | Description   |
|------------|--------------------|---------|--------|--------|---------------|------|---|
| P3.14.2.1  | Keypad SP 1        | 0.00    | 100.00 | Varies | 0.00          | 1640 |   |
| P3.14.2.2  | Keypad SP 2        | 0.00    | 100.00 | Varies | 0.00          | 1641 |   |
| P3.14.2.3  | Ramp Time          | 0.00    | 300.00 | s      | 0.00          | 1642 |   |
| P3.14.2.4  | Setpoint Selection | Varies  | Varies |        | DigIN Slot0.1 | 1048 | FALSE = Setpoint 1<br>TRUE = Setpoint 2   |
| P3.14.2.5  | SP 1 Source        | 0       | 22     |        | 1             | 1643 | 0 = Not Used<br>1 = Keypad Setpoint 1<br>2 = Keypad Setpoint 2<br>3 = AI1<br>4 = AI2<br>5 = AI3<br>6 = AI4<br>7 = AI5<br>8 = AI6<br>9 = ProcessDataIn1<br>10 = ProcessDataIn2<br>11 = ProcessDataIn3<br>12 = ProcessDataIn4<br>13 = ProcessDataIn5<br>14 = ProcessDataIn6<br>15 = ProcessDataIn7<br>16 = ProcessDataIn8<br>17 = Temperature Input 1<br>18 = Temperature Input 2<br>19 = Temperature Input 3<br>20 = Temperature Input 4<br>21 = Temperature Input 5<br>22 = Temperature Input 6<br>AI's and ProcessDataIn are handled as percent (0.00-100.00%) and scaled according to Setpoint minimum and maximum.<br><b>NOTE:</b> ProcessDataIn signals use 2 decimals. |
| P3.14.2.6  | SP 1 Minimum       | -200.00 | 200.00 | %      | 0.00          | 1644 | Minimum value at analogue signal minimum.   |
| P3.14.2.7  | SP 1 Maximum       | -200.00 | 200.00 | %      | 100.00        | 1645 | Maximum value at analogue signal maximum.   |
| P3.14.2.8  | SP 2 Source        | 0       | 22     |        | 0             | 1646 | See P3.14.2.5.  |
| P3.14.2.9  | SP 2 Minimum       | -200.00 | 200.00 | %      | 0.00          | 1647 | Minimum value at analogue signal minimum.   |
| P3.14.2.10 | SP 2 Maximum       | -200.00 | 200.00 | %      | 100.00        | 1648 | Maximum value at analogue signal maximum.   |

7.1.15.3 Group 3.14.3: Feedbacks

For more detailed information, see chapter 7.1.14.

*Table 117. External PID-controller, feedbacks*

| Code      | Parameter    | Min     | Max    | Unit | Default | ID   | Description                               |
|-----------|--------------|---------|--------|------|---------|------|---|
| P3.14.3.1 | Function     | 1       | 9      |      | 1       | 1650 |   |
| P3.14.3.2 | Gain         | -1000.0 | 1000.0 | %    | 100.0   | 1651 |   |
| P3.14.3.3 | FB 1 Source  | 0       | 25     |      | 1       | 1652 | See P3.13.3.3.                            |
| P3.14.3.4 | FB 1 Minimum | -200.00 | 200.00 | %    | 0.00    | 1653 | Minimum value at analogue signal minimum. |
| P3.14.3.5 | FB 1 Maximum | -200.00 | 200.00 | %    | 100.00  | 1654 | Maximum value at analogue signal maximum. |
| P3.14.3.6 | FB 2 Source  | 0       | 25     |      | 2       | 1655 | See P3.13.3.6.                            |
| P3.14.3.7 | FB 2 Minimum | -200.00 | 200.00 | %    | 0.00    | 1656 | Minimum value at analogue signal minimum. |
| P3.14.3.8 | FB 2 Maximum | -200.00 | 200.00 | %    | 100.00  | 1657 | Maximum value at analogue signal maximum. |

7.1.15.4 Group 3.14.4: Feedback Superv.

For more detailed information, see chapter 7.1.14.

*Table 118. External PID-controller, process supervision*

| Code      | Parameter         | Min    | Max    | Unit   | Default | ID   | Description   |
|-----------|-------------------|--------|--------|--------|---------|------|---|
| P3.14.4.1 | Enable Superv     | 0      | 1      |        | 0       | 1659 | 0 = Disabled<br>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. |
| P3.14.4.5 | Supervision Fault | 0      | 3      |        | 2       | 757  | See P3.9.1.2  |

**7.1.16 GROUP 3.16: MAINTEN. COUNTERS**

The maintenance counter is a way of indicating the operator that maintenance needs to be carried out. For example, a belt needs to be replaced or oil in a gearbox should be changed.

There are two different modes for the maintenance counters, hours or revolutions\*1000. The counters are only incremented during Run mode in either case. **NOTE:** Revolutions are based on motor speed which is only an estimate (integration every second).

When the counter exceeds the limit an alarm or fault will be triggered respectively. Individual maintenance alarm and fault signals can be connected to a digital/relay output.

When maintenance has been carried out the counter can be reset through either a digital input or a parameter B3.16.4.

*Table 119. Maintenance counter parameters*

| Code    | Parameter             | Min            | Max    | Unit   | Default | ID   | Description   |
|---------|-----------------------|----------------|--------|--------|---------|------|---|
| P3.16.1 | Counter 1 mode        | 0              | 2      |        | 0       | 1104 | 0 = Not used<br>1 = Hours<br>2 = Revolutions*1000               |
| P3.16.2 | Counter 1 alarm limit | 214748<br>3647 | 80000  | h/kRev | 0       | 1105 | When to trig a maintenance alarm for counter 1.<br>0 = Not used |
| P3.16.3 | Counter 1 fault limit | 214748<br>3647 | 80000  | h/kRev | 0       | 1106 | When to trig a maintenance fault for counter 1.<br>0 = Not used |
| B3.16.4 | Counter 1 reset       | 0              | 1      |        | 0       | 1107 | Activate to reset counter 1.                                    |
| P3.16.5 | Counter 1 DI reset    | Varies         | Varies |        | 0       | 490  | TRUE = Reset  |

**7.1.17 GROUP 3.21: PUMP CONTROL**7.1.17.1 Group 3.21.1: Auto-Cleaning

The Auto-cleaning function is used to remove any dirt or other material that may have attached to the pump impeller. Auto-cleaning is used e.g. in wastewater systems to keep up the performance of the pump. Auto Cleaning function can also be used to clear the blocked pipe or valve.

*Table 120. Auto-cleaning parameters*

| Code      | Parameter           | Min  | Max    | Unit | Default          | ID   | Description   |
|-----------|---------------------|------|--------|------|------------------|------|---|
| P3.21.1.1 | Clean Function      | 0    | 1      |      | 0                | 1714 | 0=Disabled<br>1=Enabled   |
| P3.21.1.2 | Clean Activation    |      |        |      | DigIN<br>Slot0.1 | 1715 | Digital input signal used to start the Auto Cleaning sequence. Auto-cleaning sequence will be aborted if activation signal is removed before the sequence has been completed.<br><b>NOTE:</b> The drive will start if the input is activated! |
| P3.21.1.3 | Clean Cycles        | 1    | 100    |      | 5                | 1716 | Number of forward/reverse cleaning cycles.  |
| P3.21.1.4 | Clean Forward Freq. | 0.00 | 50.00  | Hz   | 45.00            | 1717 | Forward direction frequency in Auto-cleaning cycle.   |
| P3.21.1.5 | Clean Forward Time  | 0.00 | 320.00 | s    | 2.00             | 1718 | Running time for forward direction frequency in Auto-cleaning cycle.  |
| P3.21.1.6 | Clean Reverse Freq. | 0.00 | 50.00  | Hz   | 45.00            | 1719 | Reverse direction frequency in Auto-cleaning cycle.   |
| P3.21.1.7 | Clean Reverse Time  | 0.00 | 320.00 | s    | 0.00             | 1720 | Running time for reverse direction frequency in Autocleaning cycle  |
| P3.21.1.8 | Clean Accel Time    | 0.1  | 300.0  | s    | 0.1              | 1721 | Motor acceleration time when Auto-cleaning is active  |
| P3.21.1.9 | Clean Decel Time    | 0.1  | 300.0  | s    | 0.1              | 1722 | Motor deceleration time when Auto-cleaning is active  |



**7.1.18 GROUP 3.22: SOLAR**7.1.18.1 Group 3.22.1: Start Settings*Table 121. Start Settings parameters*

| Code      | Parameter                 | Min             | Max      | Unit | Default   | ID   | Description  |
|-----------|---------------------------|-----------------|----------|------|-----------|------|--|
| P3.22.1.1 | Start DC Voltage          | P3.22.2.16+ 5 V | 1100     | V    | Varies    | 1916 | DV voltage threshold level to activate Run enable.                   |
| P3.22.1.2 | Short restart delay       | 0.1             | 5.0      | m    | 1.0       | 1917 | Delay time to restart  |
| P3.22.1.3 | Short restart delay tries | 1               | 10       |      | 5         | 1918 | Number of restart tries  |
| P3.22.1.4 | Long restart delay        | 6.0             | 30.0     | m    | 10.0      | 1919 | Long delay time to restart   |
| P3.22.1.5 | Sleep in solar mode       | Dis-abled       | Enable d |      | Dis-abled | 1964 | 0 = Sleep disabled<br>1 = Sleep according to P3.13.5.1 and P3.13.5.2 |

**NOTE!**

Sleep in solar mode can be managed according to P3.13.5.1 and P3.13.5.2

When P3.22.1.5 = 1, the drive will stop if the output frequency is below the value in P3.13.5.1, for the time in P3.13.5.2. It will restart as after a stop due to low power.

Sleep function allows to program a minimum frequency P3.3.1.1 that is below the efficient range of the pump. MPPT can reach this low value, leading to a minimum output power and avoiding to stop the drive in case of temporary reduced irradiation. If the condition persists, sleep logic will then stop the drive.

7.1.18.2 Group 3.22.2: MPPT*Table 122. MPPT parameters*

| Code       | Parameter               | Min              | Max    | Unit | Default | ID   | Description   |
|------------|-------------------------|------------------|--------|------|---------|------|---|
| P3.22.2.1  | Vmp at 100% power       | P3.22.2.16 + 5 V | 1100   | V    | Varies  | 1920 |   |
| P3.22.2.2  | Vmp at 10% power        | P3.22.2.16 + 5 V | 1100   | V    | Varies  | 1921 |   |
| P3.22.2.3  | Panel/Motor power ratio | 50.00            | 100.00 | %    | 100.00  | 1922 |   |
| P3.22.2.4  | P gain                  | 0.000            | 1.000  |      | 0.050   | 1923 | Gain for internal PI regulator. The internal frequency reference keeps the panels working on MPP. |
| P3.22.2.5  | I gain                  | 0.000            | 1.000  |      | 0.050   | 1924 | Integration time.   |
| P3.22.2.6  | Acceleration time       | 0.1              | 60.0   | s    | 1.0     | 1925 | Time from minimum to maximum frequency  |
| P3.22.2.7  | Deceleration time       | 0.1              | 60.0   | s    | 1.0     | 1926 | Time from maximum to minimum frequency  |
| P3.22.2.8  | P&O update time         | 2                | 6      | s    | 3       | 1939 |   |
| P3.22.2.9  | P&O voltage step        | 3                | 10     | V    | 5       | 1940 |   |
| P3.22.2.10 | P&O power variation     | 0.2              | 5.0    | %    | 1.0     | 1941 |   |
| P3.22.2.11 | P&O local max volt step | 20               | 60     | V    | 30      | 1945 |   |

Table 122. MPPT parameters

|            |                     |         |        |    |        |      |  |
|------------|---------------------|---------|--------|----|--------|------|--|
| P3.22.2.12 | P&O local max time  | 1       | 60     | m  | 10     | 1946 |  |
| P3.22.2.13 | P&O local max freq  | 0.00    | 20.00  | Hz | 10.00  | 1947 |  |
| P3.22.2.14 | Damping sensitivity | 5       | 50     | V  | 10     | 1943 | Amplitude of oscillation to be recognized  |
| P3.22.2.15 | Damping time        | 3       | 10     | s  | 4      | 1944 | Time for the oscillations on DC voltage  |
| P3.22.2.16 | Minimum DC voltage  | Varies* | Varies | V  | Varies | 1995 | If the DC-link voltage goes below this threshold, the under-voltage regulator will quickly decrease the output frequency. In case it results lower than the programmed minimum reference, the drive stops with warning 60. The value depends on the voltage range. |

\* Min value is 300 V is valid for VACON® 100 X 380-500 V AC when the application version is AMIT1181\_V205 and the drive is manufactured after June 2019. For older VACON® 100 X 380-500 V AC and VACON® 100 380-500 V AC minimum value is 400 V.

### 7.1.19 GROUP 3.23: FLOW METER

Table 123. Flow meter parameters

| Code    | Parameter               | Min      | Max    | Unit    | Default  | ID   | Description   |
|---------|-------------------------|----------|--------|---------|----------|------|---|
| P3.23.1 | Flow meter signal       | Not used | AI4    |         | Not used | 1958 | 0: Not used<br>1: Digital pulse<br>2: AI1<br>3: AI2<br>4: AI3<br>5: AI4   |
| P3.23.2 | Flow at max anlg signal | 0        | 200000 | l/min   | 1000     | 1960 | Considered when flow meter signal is from analogue signal (AI1 - AI4). It is the flow level at maximum analogue signal. |
| P3.23.3 | Pulse output volume     | 1        | 10000  | l/pulse | 100      | 1954 | Considered when flow meter signal is from Digital pulse. It is the total volume of water for each pulse.                |

## 7.1.20 GROUP 3.24: DUAL SUPPLY

Table 124. Common settings

| Code      | Parameter            | Min | Max  | Unit | Default | ID   | Description  |
|-----------|----------------------|-----|------|------|---------|------|--|
| P3.24.1.1 | AC Voltage           | 210 | 700  | V    | 0       | 1974 | Nominal voltage of AC grid.  |
| V3.24.1.2 | Nominal DC Voltage   | 0   | 1200 | V    | 0       | 1990 | Monitor of calculated value of nominal DC voltage, when supply is from AC grid.        |
| P3.24.1.3 | Dual Supply Mode     | 0   | 2    |      | 0       | 1971 | 0 = Always active<br>1 = Closed loop Irradiation<br>2 = Closed loop Sensorless         |
| P3.24.1.4 | DC Offset for AC Off | 1   | 100  | V    | 30      | 1977 | Offset added to M3.24.1.1, as DC voltage threshold above which AC can be switched Off. |
| P3.24.1.5 | AC Off at Stop Delay | 1   | 3600 | s    | 60      | 1973 | Delay to switch AC Off at stop, if it happened with AC On condition.                   |

Table 125. Mode 0 parameters

| Code      | Parameter       | Min    | Max      | Unit | Default | ID   | Description |
|-----------|-----------------|--------|----------|------|---------|------|-------------|
| P3.24.2.1 | AC On Condition | At Run | At Start |      | At Run  | 1972 |             |

Table 126. Mode 1 Irradiation parameters

| Code      | Parameter             | Min   | Max   | Unit             | Default | ID   | Description   |
|-----------|-----------------------|-------|-------|------------------|---------|------|---|
| P3.24.3.1 | Irradiation Signal    | AI1   | AI2   |                  | AI1     | 1980 | Selection between AI1 and AI2.  |
| P3.24.3.2 | Max Irradiation       | 100   | 5000  | W/m <sup>2</sup> | 1500    | 1981 | Value of irradiation at maximum signal.   |
| P3.24.3.3 | AC On Irradiation     | 0     | 1500  | W/m <sup>2</sup> | 200     | 1984 | Threshold for irradiation, below which AC relay is switched On.                             |
| P3.24.3.4 | AC Off Irrad. Offset  | 10    | 1500  | W/m <sup>2</sup> | 200     | 1985 | Value added to P3.24.3.3 to determine the threshold for switching AC Off.                   |
| P3.24.3.5 | Irrad. Stabiliz. Time | 1     | 120   | s                | 20      | 1986 | Irradiation has to stay below/above thresholds for this time, to activate switching On/Off. |
| P3.24.3.6 | Identification        | No    | Yes   |                  | No      | 1987 |   |
| P3.24.3.7 | Identif. Frequency    | 20,00 | 50,00 | Hz               | 30,00   | 1988 |   |

Table 127. Mode 2 Sensorless parameters

| Code      | Parameter                  | Min   | Max   | Unit | Default | ID   | Description   |
|-----------|----------------------------|-------|-------|------|---------|------|---|
| P3.24.4.1 | AC On Frequency            | 20,00 | 50,00 | Hz   | 25,00   | 1975 | AC relay is switched On if motor frequency stays below threshold, for delay time.   |
| P3.24.4.2 | AC On Delay                | 1     | 180   | s    | 30      | 1976 | AC relay is switched On if motor frequency stays below threshold, for delay time.   |
| P3.24.4.3 | DC Check Reference         | 20,00 | 50,00 | Hz   | 30,00   | 1978 | Frequency reference at which DC voltage is checked, for possible switching Off.   |
| P3.24.4.4 | DC Check Period            | 1     | 180   | min  | 20      | 1979 | Time for periodic DC voltage check, at reduced frequency.   |
| P3.24.4.5 | DC Check Stabiliz.<br>Time | 1     | 30    | s    | 5       | 1983 | DC voltage must stay above the threshold for this time (both at maximum and reduced speed), to activate AC switching Off. |

## 7.2 ADDITIONAL PARAMETER INFORMATION

Due to its user-friendliness and simplicity of use, the most parameters of the VACON® 100 X Solar Pump Application only require a basic description which is given in the parameter tables in chapter 7.1.

In this chapter, you will find additional information on certain most advanced parameters of the VACON® 100 X Solar Pump Application. Should you not find the information you need contact your distributor.

### 7.2.1 MOTOR CONTROL

#### P3.1.1.2 MOTOR NOM FREQ

**NOTE!** When this parameter is changed, parameters P3.1.4.2 and P3.1.4.3 will be automatically initialized depending on the selected motor type. See Table 130.

#### P3.1.2.1 CONTROL MODE

Table 128.

| Selection number | Selection name            | Description   |
|------------------|---------------------------|---|
| 0                | U/f control (open loop)   | Drive frequency reference is set to output frequency without slip compensation. Motor actual speed is finally defined by motor load.          |
| 1                | Speed control (open loop) | Drive frequency reference is set to motor speed reference. The motor speed is remains the same regardless of motor load. Slip is compensated. |

#### P3.1.2.2 MOTOR TYPE

This parameter defines the used motor type.

Table 129.

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

When this parameter is changed, parameters P3.1.4.2 and P3.1.4.3 will be automatically initialized according to the selected motor type.

See Table 130 for the initialization values:

Table 130.

| Parameter                     | Induction Motor (IM)    | Permanent Magnet Synchronous Motor (PMSM) |
|-------------------------------|-------------------------|---|
| P3.1.4.2<br>(Field WeakngPnt) | Motor nominal frequency | Internally calculated                     |
| P3.1.4.3<br>(Voltage at FWP)  | 100,0%                  | Internally calculated                     |

### P3.1.2.4 IDENTIFICATION

The automatic motor identification calculates or measures the motor parameters that are needed for optimum motor and speed control.

Identification Run is a part of tuning the motor and the drive specific parameters. It is a tool for commissioning and service of the drive with the aim to find as good parameter values as possible for most drives.

Table 131.

| Selection number | Selection name                     | Description   |
|------------------|------------------------------------|---|
| 0                | No action                          | No identification requested.  |
| 1                | Identification at standstill       | The drive is run without speed to identify the motor parameters. The motor is supplied with current and voltage but with zero frequency. U/f ratio is identified.   |
| 2                | Identification with motor rotating | The drive is run with speed to identify the motor parameters. U/f ratio and magnetization current are identified.<br><b>NOTE:</b> This identification run must be performed with no load on the motor shaft for accurate results. |

The automatic identification is activated by setting this parameter to desired value and giving a start command in the requested direction. The start command to the drive has to be given within 20 s. If no start command is given within this time the identification run is cancelled, the parameter will be reset to its default setting and an *Identification* alarm will be launched.

The identification run can be stopped at any time with normal stop command and the parameter is reset to its default setting. An *Identification* alarm will be launched if the identification run has failed.

**NOTE:** New start command (Rising edge) is required to start the drive after identification.

### P3.1.2.6 MOTOR SWITCH

This function is typically used if there is a switch between the drive and the motor. Such switches are often found in residential and industrial applications to make sure that an electrical circuit can be completely de-energized from the motor for service or maintenance.

When this parameter is enabled and the motor switch is opened to disconnect the running motor, the drive detects the loss of motor without tripping. It is not necessary to make any changes in the run command or the reference signal to the drive from the process control station. When the motor is re-connected after completed maintenance by closing the switch, the drive detects the motor connection and runs the motor to the reference speed as per the process commands.

If the motor is rotating when re-connected, the drive detects the speed of the running motor through its *Flying start* feature and then controls it to desired speed as per the process commands.

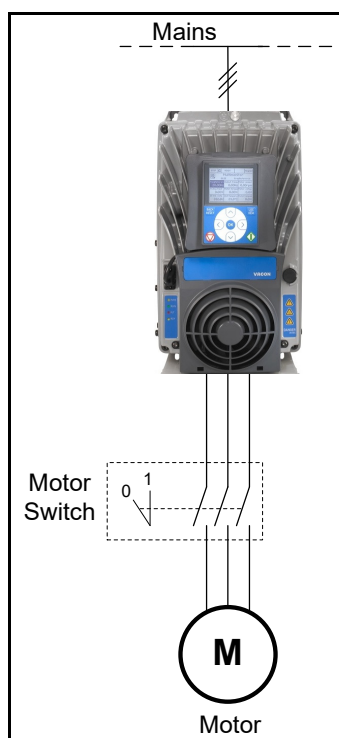


Figure 39. Motor switch

### P3.1.2.7 LOAD DROOPING

The drooping function enables speed drop as a function of load. This parameter sets that amount corresponding to the nominal torque of the motor.

This function is used e.g. when balanced load is needed for mechanically connected motors or dynamic speed drooping is needed because of changing load.

E.g. if load drooping is set to 10% for a motor with a nominal frequency of 50 Hz and the motor is loaded with nominal load (100% of torque) the output frequency is allowed to decrease 5 Hz from the frequency reference.

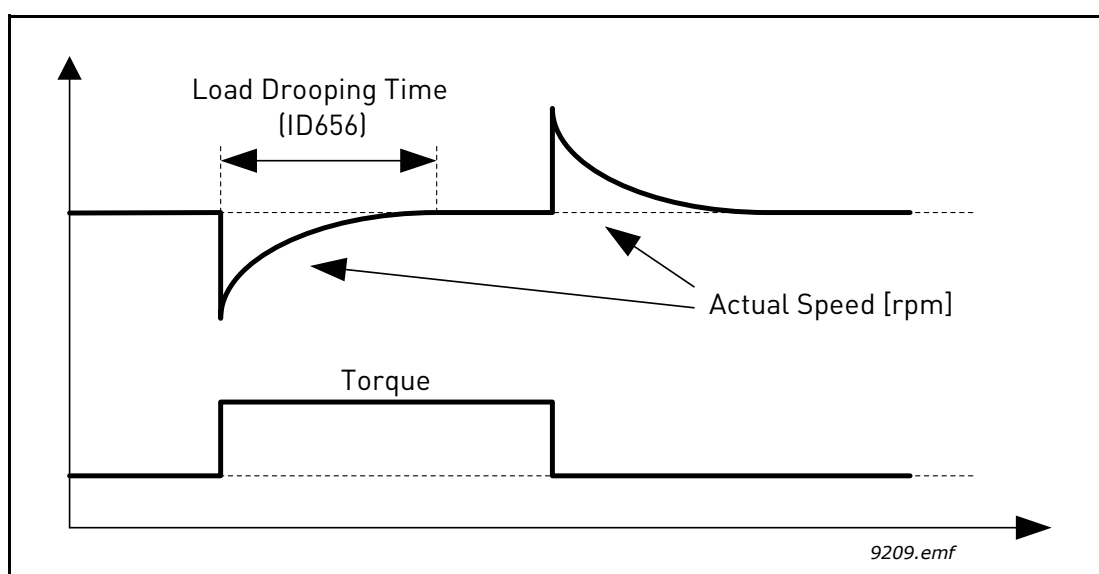


Figure 40. Load drooping

### P3.1.2.11 UNDER VOLT. CONTROL

This parameter allow the under voltage controller to be switched out of operation. This may be useful, for example, if the mains supply voltage varies more than -15% and the application will not tolerate this under voltage. In this case, the regulator controls the output frequency taking the supply fluctuations into account.

### P3.1.2.13 STATORVOLTADJUST

**NOTE!** This parameter will be automatically set during the identification run. It is recommended to make the identification run, if possible. See parameter P3.1.2.4.

*Stator voltage adjust* parameter is used only when *Permanent magnet synchronous motor (PMS motor)* has been selected for parameter P3.1.2.2. This parameter has no affect if *Induction motor* has been selected. With an induction motor in use, the value has been internally forced to 100% and it cannot be changed.

When the value of parameter P3.1.2.2 (Motor type) parameter is changed to *PMS Motor*, the parameters P3.1.4.2 (Field WeakngPnt) and P3.1.4.3 (Voltage at FWP) will be automatically extended up to the limits of the drive's full output voltage, retaining the defined U/f-ratio. This internal extension is done to avoid running the PMS motor in the field weakening area because the PMS motor nominal voltage is typically much lower than the full output voltage capability of the drive.

PMS motor nominal voltage typically represents the motor's back-EMF voltage at nominal frequency, but depending on the motor manufacturer, it may represent e.g. the stator voltage at nominal load.

This parameter gives an easy way to adjust the drive's U/f curve near to the motor's back-EMF curve without needing to change several U/f curve parameters. The *StatorVoltAdjust* parameter defines the drive's output voltage in percent of the motor's nominal voltage at the motor's nominal frequency.

The U/f curve of the drive is typically tuned slightly above the back-EMF curve of the motor. The motor current increases the more the drive's U/f-curve differs from the motor's back-EMF -curve.

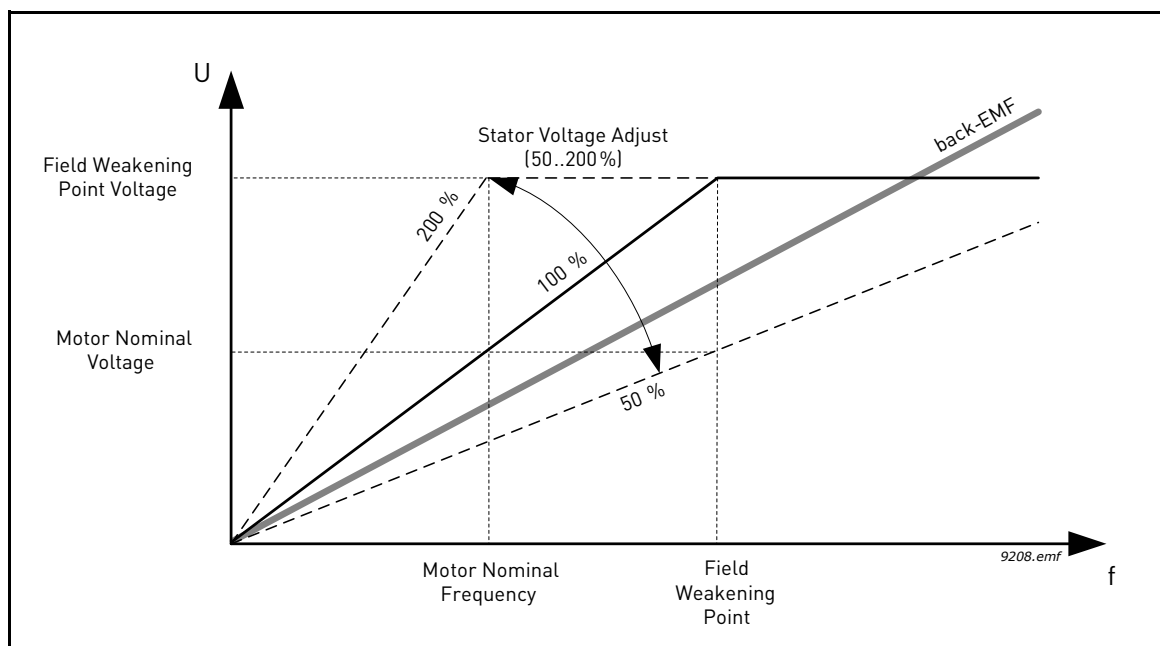


Figure 41. Principle of Stator voltage adjustment



**P3.1.3.1 CURRENT LIMIT**

This parameter determines the maximum motor current from the AC 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.

**7.2.2 OPEN LOOP****P3.1.4.1 U/F RATIO**

Table 132.

| Selection number | Selection name | Description  |
|------------------|----------------|--|
| 0                | Linear         | The voltage of the motor changes linearly as a function of output frequency from zero frequency voltage (P3.1.4.6) to the field weakening point (FWP) voltage (P3.1.4.3) at FWP frequency (P3.1.4.2) 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 (P3.1.4.6) following a squared curve form from zero to the field weakening point (P3.1.4.2) The motor runs under magnetized 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. |
| 2                | Programmable   | The U/f curve can be programmed with three different points (see Figure 43): Zero frequency voltage (P1), Midpoint voltage/frequency (P2) and Field weakening point (P3). Programmable U/f curve can be used if more torque is needed at low frequencies. The optimal settings can automatically be achieved with Motor identification run (P3.1.2.4).   |

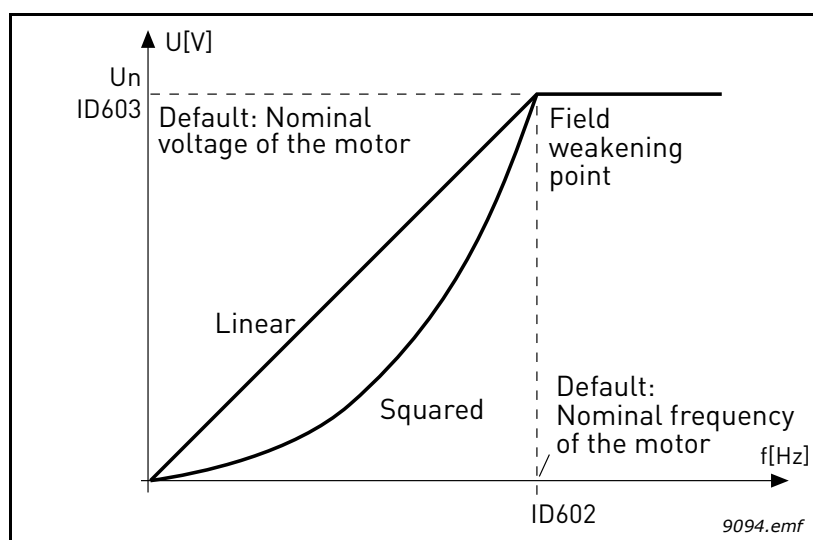


Figure 42. Linear and squared change of motor voltage

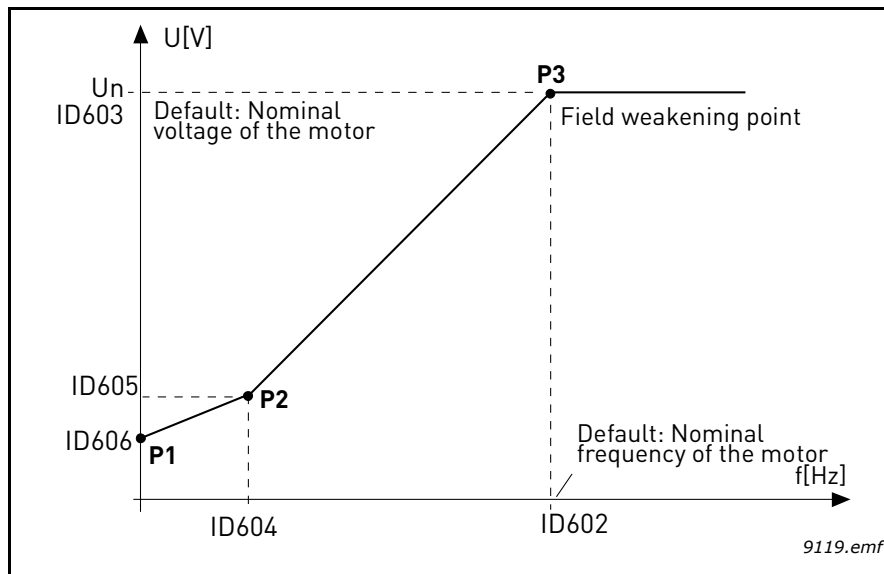


Figure 43. Programmable U/f curve

|              |  |
|--------------|--|
| <b>NOTE!</b> | This parameter is forced to value '1' <i>Linear</i> when parameter <i>Motor type</i> is set to value '1' <i>Permanent Magnet Synchronous Motor (PMSM)</i> .  |
| <b>NOTE!</b> | When this parameter is changed, parameters P3.1.4.2, P3.1.4.3, P3.1.4.4, P3.1.4.5 and P3.1.4.6 will be automatically set to their default values if parameter P3.1.2.2 is set to '0' <i>Induction Motor (IM)</i> . |

### P3.1.4.3 VOLTAGE AT FWP

Above the frequency at the field weakening point, the output voltage remains at the set maximum value. Below the frequency at the field weakening point, the output voltage depends on the setting of the U/f curve parameters. See parameters P3.1.4.1, P3.1.4.4 and P3.1.4.5.

When the parameters P3.1.1.1 and P3.1.1.2 (*Motor Nom Voltg* and *Motor Nom Freq*) are set, the parameters P3.1.4.2 and P3.1.4.3 are automatically given the corresponding values. If you need different values for the field weakening point and the maximum output voltage, change these parameters **after** setting the parameters P3.1.1.1 and P3.1.1.2.

If the programmed maximum frequency is higher than motor nominal frequency, field weakening point is automatically set at maximum frequency and fwp voltage is set proportionally higher than 100%.

This could allow to exploit the higher voltage possibly coming from the panels.

In this situation the current limit has to be set properly, to prevent a motor overload.

If the drive is fed from mains, maximum output frequency will be limited by actual DC voltage, according to nominal U/f ratio.

#### P3.1.4.12.1 I/F START

If the function is activated, the drive is set to current control mode and a constant current defined by P3.1.4.11.3 is fed to the motor until the drive output frequency exceeds the level defined with P3.1.4.11.2. When the output frequency has increased above I/f Start Frequency level, drive operation mode is changed smoothly back to normal U/f –control mode.

**P3.1.4.12.2 I/F START FREQ**

I/f start function is used when the drive's output frequency is below this frequency limit. When the output frequency exceeds this limit, the drive operation mode is changed back to normal U/f control mode.

**P3.1.4.12.3 I/F START CURRENT**

This parameter defines the current to be fed to the motor when the I/f start function is activated.

**7.2.3 START/STOP SETUP****P3.2.5 STOP FUNCTION**

Table 133.

| 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 to min frequency  | After the Stop command, the speed of the motor is decelerated to minimum frequency according to the set deceleration parameters.                                    |
| 2                | Ramp to zero frequency | After the Stop command, the speed of the motor is decelerated to zero frequency according to the set deceleration parameters.                                       |

**P3.2.6 I/O A START LOGIC**

Values 0...4 offer possibilities to control the starting and stopping of the AC 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.

Table 134. I/O A Start Logic selections

| Selection number | Selection name                              | Note   |
|------------------|---|--|
| 0                | CS 1: Start Forward<br>CS 2: Start Backward | The function takes place when the contacts are closed. |
| 1                | CS 1: Start Forward<br>CS 2: Reverse        | The function takes place when the contacts are closed. |

Table 134. I/O A Start Logic selections

| Selection number | Selection name          | Note  |
|------------------|-------------------------|---|
| 2                | Double Start            | Run command is set when both Start 1 and Start 2 signals are high. It is reset when both the start signals are low.<br>This can be used for a simple tank level control with hysteresis: if the tank has to be filled, two NC contact sensors will be placed at minimum and maximum levels. The drive will start below the minimum and stop above the maximum.<br>If the tank has to be emptied, two NO contact sensors have to be used. The drive will start above the maximum and stop below the minimum. |
| 3                | Start sign 1 + Analogue | Run command is set when Start 1 signal is high and a selectable analogue input is below (or above) a programmable threshold.<br>This can be used for a tank level control, where the analogue measurement is used for both starting the pump and controlling the speed.   |
| 4                | Solar only              | Run command is always active. Actual running condition is determined by DC voltage level available from the solar array.  |

Table 135.

| Selection number | Selection name                | Note   |
|------------------|-------------------------------|--|
| 0                | CS1: Forward<br>CS2: Backward | The functions take place when the contacts are closed. |

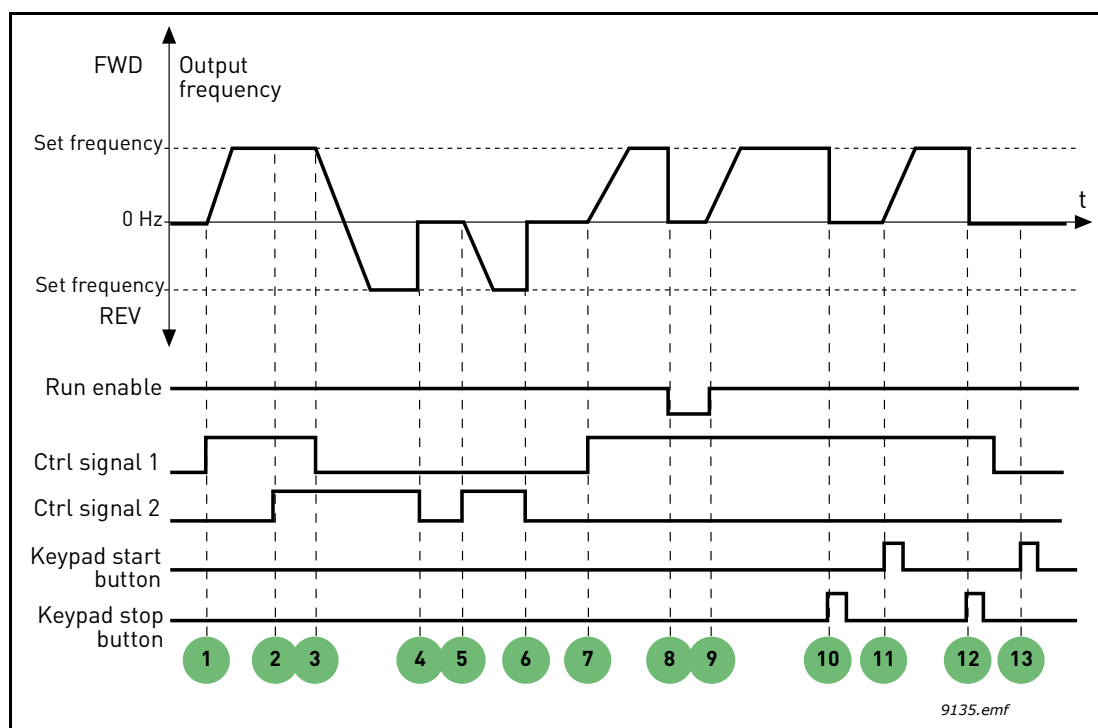


Figure 44. I/O A Start logic = 0

**Explanations:**

Table 136.

|   |  |    |  |
|---|--|----|--|
| 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 P3.5.1.15.         |
| 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 stop button = 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 CS1 is inactive.                               |
| 7 | CS1 activates and the motor accelerates (FWD) towards the set frequency  |    |  |

Table 137.

| Selection number | Selection name             | Note   |
|------------------|----------------------------|--|
| 1                | CS1: Start<br>CS2: Reverse | The function takes place when the contacts are closed. |

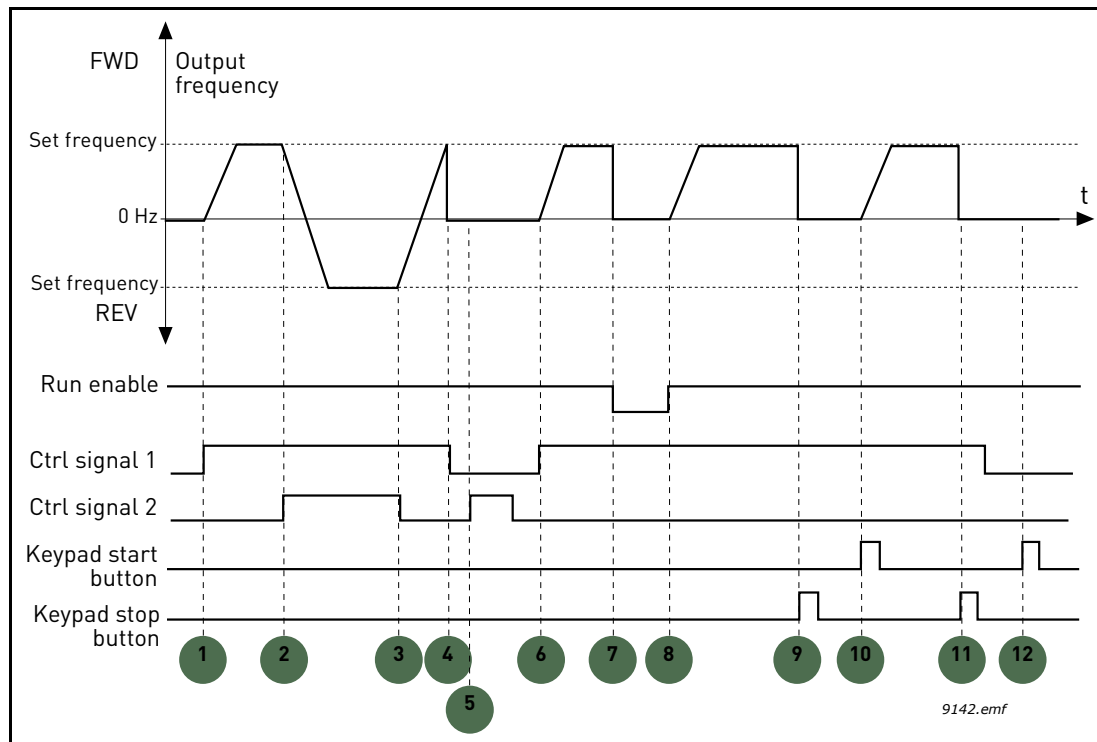


Figure 45. I/O A Start logic = 1

Table 138.

|   |   |    |  |
|---|---|----|--|
| 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 P3.5.1.15.         |
| 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 stop button = 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.                               |

#### 7.2.4 REFERENCES

##### P3.3.1.1 MINFREQREFERENCE

Minimum frequency reference.

**NOTE:** When drive is fed by solar power, if available power is not sufficient to maintain dc voltage above the minimum and frequency above the minimum, the drive will be stopped.

**NOTE:** if motor current limit is reached, actual output frequency might be lower than this parameter. If this is not acceptable, stall protection should be activated.

**P3.3.1.2 MAXFREQREFERENCE**

Maximum frequency reference.

**7.2.5 PRESET FREQS****P3.3.3.1 PRESETFREQMODE**

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 P3.3.3.10, P3.3.3.11 and P3.3.3.12 (*Preset Freq Sel0*, *Preset Freq Sel1* and *Preset Freq Sel2*). Two different logics can be selected:

Table 139.

| Selection number | Selection name          | Note   |
|------------------|-------------------------|--|
| 0                | Binary coded            | Combine activated inputs according to Table 141 to choose the Preset frequency needed.   |
| 1                | Number (of inputs used) | According to how many of the inputs assigned for <i>Preset frequency selections</i> are active you can apply the <i>Preset frequencies</i> 1 to 3. |

**P3.3.3.2 TO P3.3.3.9 PRESET FREQ 0 TO 7**

Value '0' selected for parameter P3.3.3.1:

Preset frequency 0 can be chosen as reference by selecting value 1 for parameter P3.3.1.5.

Other preset frequencies 1 to 7 are selected as reference by dedicating digital inputs for parameters P3.3.3.10, P3.3.3.11 and/or P3.3.3.12. Combinations of active digital inputs determine the used preset frequency according to Table 141 below.

The values of the preset frequencies are automatically limited between the minimum and maximum frequencies (P3.3.1.1 and P3.3.1.2). See table below.





*Preset Freq 0:*

Table 140.

| Required action                       | Activated frequency |
|---------------------------------------|---------------------|
| Choose value 1 for parameter P3.3.1.5 | Preset Freq 0       |

*Preset frequencies 1 to 7:*





Table 141. Selection of preset frequencies;  = input activated

| Activate digital input for parameter |   |   | Activated frequency |
|--------------------------------------|---|---|---------------------|
| P3.3.3.12                            | P3.3.3.11   | P3.3.3.10   | Preset Freq 1       |
| P3.3.3.12                            |  | P3.3.3.10   | Preset Freq 2       |
| P3.3.3.12                            | P3.3.3.11   |  | Preset Freq 3       |
| P3.3.3.12                            | P3.3.3.11   | P3.3.3.10   | Preset Freq 4       |
| P3.3.3.12                            |  | P3.3.3.10   | Preset Freq 5       |
| P3.3.3.12                            | P3.3.3.11   |  | Preset Freq 6       |
| P3.3.3.12                            | P3.3.3.11   | P3.3.3.10   | Preset Freq 7       |

**Value '1' selected for parameter P3.3.3.1:**

According to how many of the inputs assigned for Preset frequency selections are active, you can apply the Preset frequencies 1 to 3.

Table 142. Selection of preset frequencies;  = input activated

| Activated input |   |   | Activated frequency |
|-----------------|---|---|---------------------|
| P3.3.3.12       | P3.3.3.11   | P3.3.3.10   | Preset Freq 1       |
| P3.3.3.12       |  | P3.3.3.10   | Preset Freq 1       |
| P3.3.3.12       | P3.3.3.11   |  | Preset Freq 1       |
| P3.3.3.12       | P3.3.3.11   | P3.3.3.10   | Preset Freq 2       |
| P3.3.3.12       |  | P3.3.3.10   | Preset Freq 2       |
| P3.3.3.12       | P3.3.3.11   |  | Preset Freq 2       |
| P3.3.3.12       | P3.3.3.11   | P3.3.3.10   | Preset Freq 3       |

**P3.3.3.10**    **PRESET FREQ SEL0**

**P3.3.3.11**    **PRESET FREQ SEL1**

**P3.3.3.12**    **PRESET FREQ SEL2**

Connect a digital input to these functions (see chapter 7.1.2) to be able to apply Preset frequencies 1 to 7 (see Table 141 and pages 99, 103 and 151).



### 7.2.6 MOTOR POTENTIOM.

#### P3.3.4.1 **MotPot UP**

#### P3.3.4.2 **MotPot DOWN**

With a motor potentiometer, the user can increase and decrease the output frequency. By connecting a digital input to parameter P3.3.4.1 (*MotPot UP*) and having the digital input signal active, the output frequency will rise as long as the signal is active. The parameter P3.3.4.2 (*MotPot DOWN*) works vice versa, decreasing the output frequency.

The rate how the output frequency either rises or falls when Motor Potentiometer Up or Down is activated is determined by the *Motor potentiometer ramp time* (P3.3.4.3) and the Ramp acceleration/deceleration times (P3.4.1.2/P3.4.1.3).

The Motor potentiometer reset parameter (P3.3.4.4) will set the frequency reference to zero if activated.

#### P3.3.4.4 **MotPot RESET**

Defines the logic for resetting the motor potentiometer frequency reference.

| Selection number | Selection name | Note   |
|------------------|----------------|--|
| 0                | No reset       | The previous motor potentiometer frequency reference is kept past the stop state and stored to memory in case of power down. |
| 1                | Stop state     | Motor potentiometer frequency reference is set to zero when the drive is in stop state or the drive is powered down.         |
| 2                | Powered down   | Motor potentiometer frequency reference is set to zero only in a power down situation.                                       |

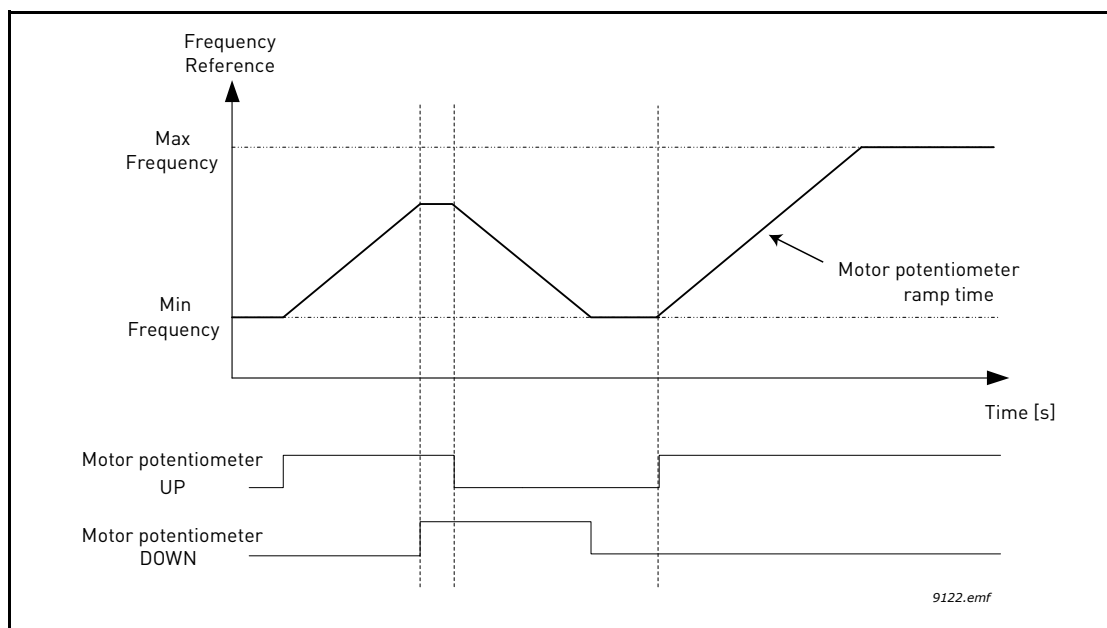


Figure 46. Motor potentiometer parameters

## 7.2.7 RAMPS AND BRAKES

### **P3.4.1.2 ACCEL TIME 1**

Ramp time, referred to variation from zero frequency to max frequency.

A specific acceleration time from zero to minimum frequency is available (P2.9).

Normal acceleration time (P1.3) is active only in case power is from mains supply.

### **P3.4.1.3 DECEL TIME 1**

Ramp time, referred to variation from max frequency to zero.

Normal deceleration time (P3.4.1.3) is active in mains supply and in case the external frequency reference is lowered below the reference of maximum power. It is also active when start command falls and ramping stop is programmed (stop mode is anyway by coasting, when the output frequency is below minimum).

Specific acceleration and deceleration time are used during power regulation. They are available as parameters in MPPT group, but it is suggested not to change them, unless needed because of stability issues.

### **P3.4.1.4 START ACCELERATION TIME**

A specific acceleration time from zero to minimum frequency is available (P3.4.1.4). Normal acceleration time (P3.4.1.3) is active only in case power is from mains supply. Normal deceleration time (P3.4.1.4) is active in mains supply and in case the external frequency reference is lowered below the reference of maximum power. It is also active when start command falls and ramping stop is programmed (stop mode is anyway by coasting, when the output frequency is below minimum).

Specific acceleration and deceleration time are used when power is from solar panels. They are available as parameters in MPPT group, but it is suggested not to change them, unless needed because of stability issues.

## 7.2.8 FLUX BRAKING

### **P3.4.5.1 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.

## 7.2.9 DIGITAL INPUTS

### **P3.5.1.15 RUN ENABLE**

Contact open: Start of motor **disabled**

Contact closed: Start of motor **enabled**

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

### **P3.5.1.16 RUN INTERLOCK 1**

### **P3.5.1.17 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.

### **P3.5.1.52 ENERGY COUNTER RESET**

This parameter enables reset of Energy counter.

### **P3.5.1.53 MAINS SUPPLY ON**

In case the drive is fed by mains supply, the controller knows this situation through a specific digital input.

The functions related to DC voltage (start enable, MPPT) are disabled in this condition.

## 7.2.10 ANALOG INPUTS

### P3.5.2.1.2 AI1 FILTER TIME

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

**NOTE: Long filtering time makes the regulation response slower!**

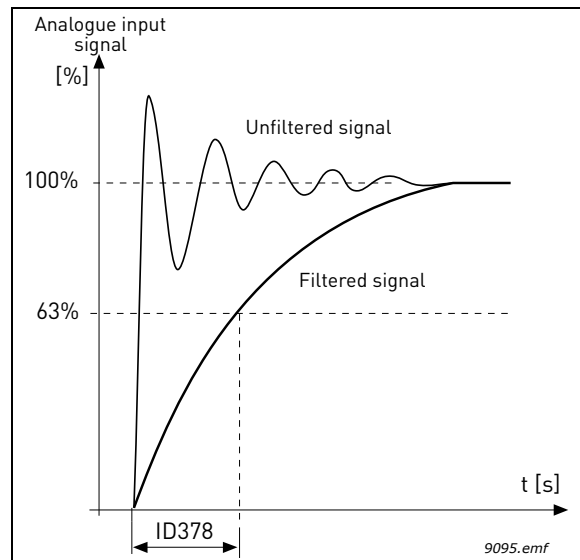


Figure 47. AI1 signal filtering

### P3.5.2.1.3 AI1 SIGNAL RANGE

The signal range for the analogue signal can be selected as:

Type of the analogue input signal (current or voltage) is selected by the dip switches on the control board (see Installation manual).

In the following examples, the analogue input signal is used as a frequency reference. The figures show how the scaling of the analogue input signal is changed depending on the setting of this parameter.

| Selection number | Selection name     | Description  |
|------------------|--------------------|--|
| 0                | 0...10 V/0...20 mA | Analogue input signal range 0...10 V or 0...20 mA (depending on dip switch settings on the control board). Input signal used 0...100%. |

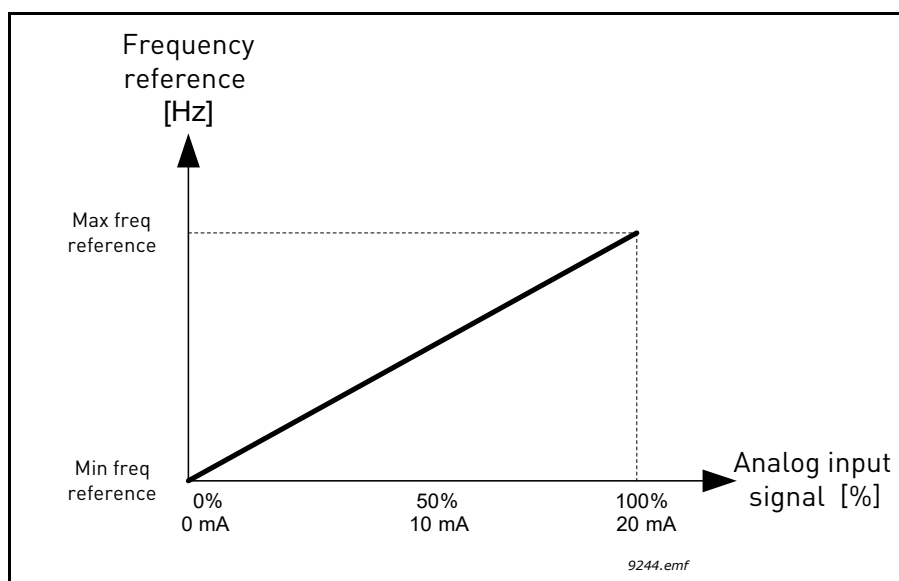


Figure 48. Analogue input signal range, selection '0'

| Selection number | Selection name     | Description   |
|------------------|--------------------|---|
| 1                | 2...10 V/4...20 mA | Analogue input signal range 2...10 V or 4...20 mA (depending on dip switch settings on the control board). Input signal used 20...100%. |

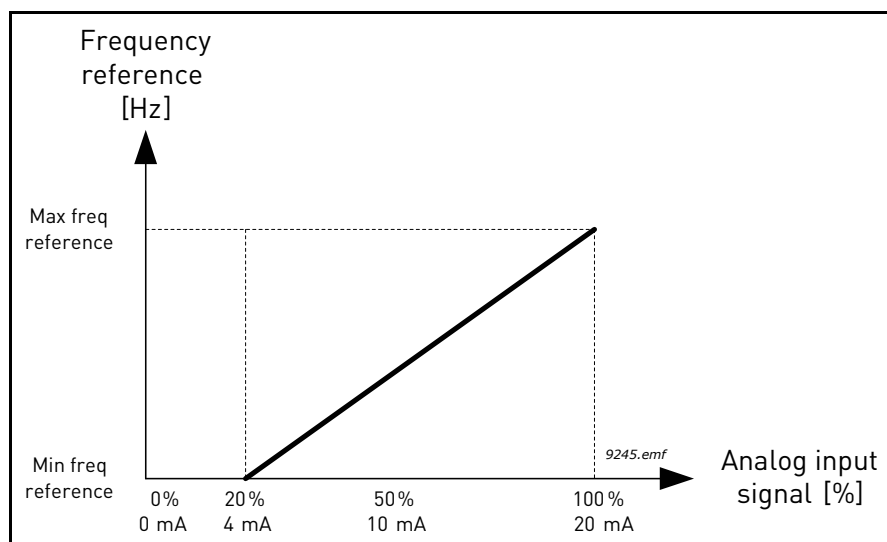


Figure 49. Analogue input signal range, selection '1'

#### **P3.5.2.1.4 AI1 CUSTOM MIN**

#### **P3.5.2.1.5 AI1 CUSTOM MAX**

These parameters allow you to freely adjust the analogue input signal range between -160...160%.

**Example:** If the analogue input signal is used as frequency reference and these parameters are set to 40...80%, the frequency reference is changed between the *Minimum frequency reference* and the *MaxFreqReference* when the analogue input signal is changed between 8...16 mA.

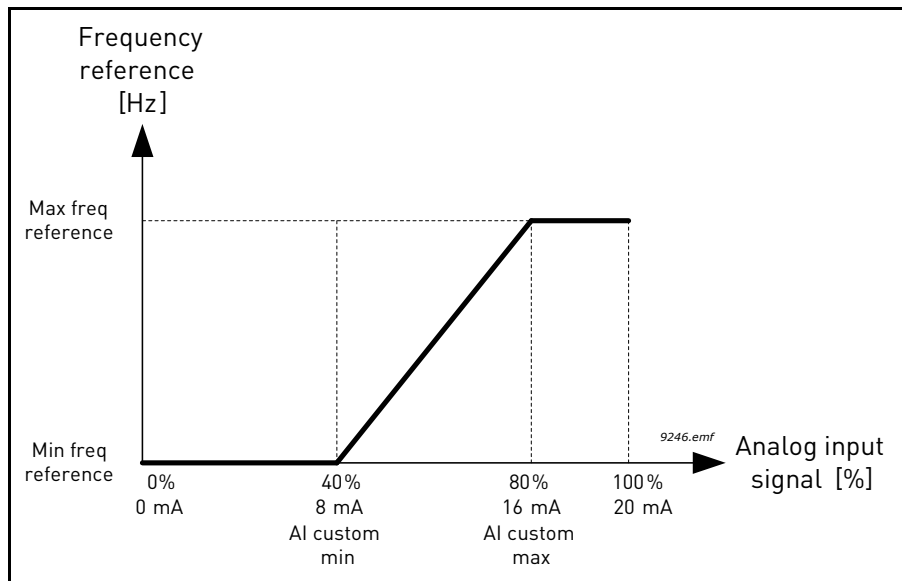


Figure 50. AI signal custom min/max

### P3.5.2.1.6 AI1 SIGNAL INV

Invert the analogue signal with this parameter.

In the following examples, the analogue input signal is used as frequency reference. The figures show how the scaling of the analogue input signal is changed depending on the setting of this parameter.

| Selection number | Selection name | Description  |
|------------------|----------------|--|
| 0                | Normal         | No inversion. The analogue input signal value 0% corresponds to the <i>Minimum frequency reference</i> and the analogue input signal value 100% to the MaxFreqReference. |

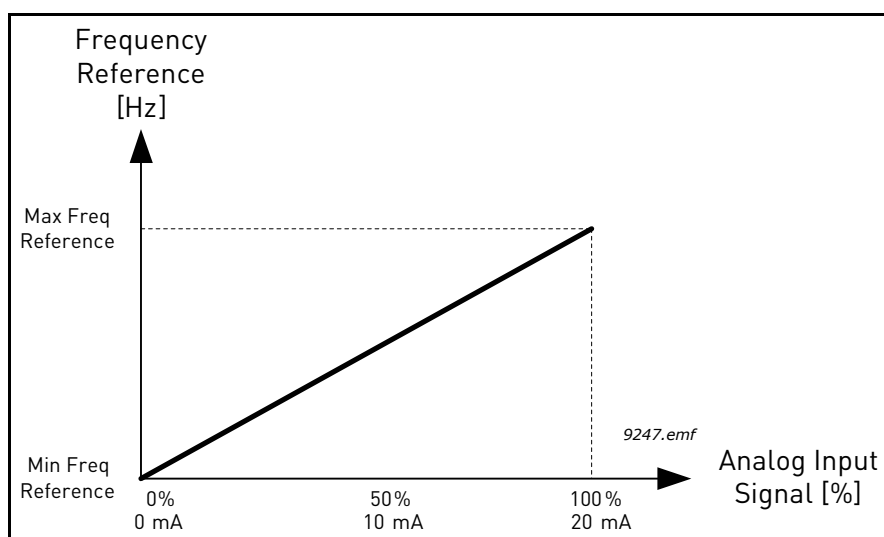


Figure 51. AI signal inversion, selection '0'

| Selection number | Selection name | Description  |
|------------------|----------------|--|
| 1                | Inverted       | Signal inverted. The analogue input signal value 0% corresponds to the MaxFreqReference and the analogue input signal value 100% to the <i>Minimum frequency reference</i> . |

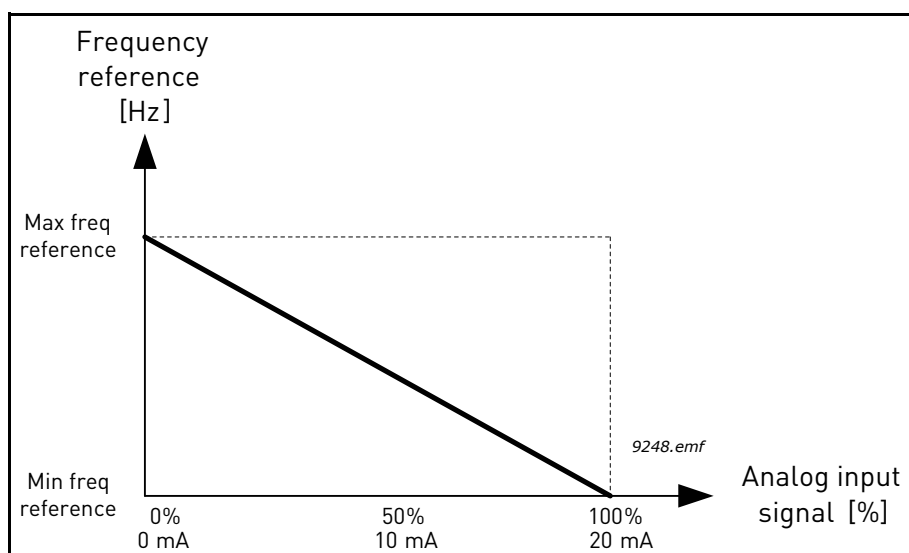


Figure 52. AI signal inversion, selection '1'

#### 7.2.11 DIGITAL OUTPUTS

##### P3.5.3.2.1 RO1 FUNCTION

Table 143. Output signals via RO1

| 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         | General fault           | A fault trip has occurred   |
| 4         | General fault inverted  | A fault trip has <b>not</b> occurred  |
| 5         | General alarm           | An alarm has been initiated   |
| 6         | Reversed                | The reverse command has been given  |
| 7         | At speed                | The output frequency has reached the set frequency reference  |
| 8         | Thermistor fault        | A thermistor fault has occurred.  |
| 9         | Motor regulator active  | One of the limit regulators (e.g. current limit, torque limit) is activated   |
| 10        | Start signal active     | Drive start command is active.  |
| 11        | Keypad control active   | Keypad control selected (active control place is keypad).   |
| 12        | I/O B control activated | I/O control place B selected (active control place is I/O B)  |
| 13        | Limit supervision 1     | 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. |
| 14        | Limit supervision 2     |   |

Table 143. Output signals via R01

| Selection | Selection name             | Description   |
|-----------|----------------------------|---|
| 15        | SinglePowerOn              | Single PO (Power On) Threshold can be used to set level for R01 or R02 to switch off when DC voltage goes below the setting level. The relay function must be programmed as 15/Single Power On. Relay can be used to control to connect additional resistor into DC supply. Resistor will eliminate power on/off cycle when supply voltage drops into drive shut down level. Resistor size can be selected approximately equal to drive standby losses. |
| 16        | No function                |   |
| 17        | Preset speed active        | The preset frequency has been selected with digital input signals.  |
| 18        | No function                |   |
| 19        | PID in Sleep mode          | PID-controller is in Sleep mode.  |
| 20        | PID Soft Fill active       | PID-controller Soft Fill function is activated.   |
| 21        | PID supervision limits     | PID-controller feedback value is beyond the supervision limits.   |
| 22        | Ext PID supervision limits | External PID-controller feedback value is beyond the supervision limits.  |
| 23        | Input press. alarm/fault   | The input pressure signal value of the pump has fallen below the value defined.   |
| 24        | Frost prot. alarm/fault    |   |
| 25        | No function                |   |
| 26        | No function                |   |
| 27        | No function                |   |
| 28        | No function                |   |
| 29        | No function                |   |
| 30        | No function                |   |
| 31        | RTC time chnl 1 control    | Status of Time channel 1  |
| 32        | RTC time chnl 2 control    | Status of Time channel 2  |
| 33        | RTC time chnl 3 control    | Status of Time channel 3  |
| 34        | FB ControlWord B13         | Digital (relay) output control from Fieldbus control word bit 13.   |
| 35        | FB ControlWord B14         | Digital (relay) output control from Fieldbus control word bit 14.   |
| 36        | FB ControlWord B15         | Digital (relay) output control from Fieldbus control word bit 15.   |
| 37        | FB ProcessData1.B0         | Digital (relay) output control from Fieldbus Process Data In1, bit 0.   |
| 38        | FB ProcessData1.B1         | Digital (relay) output control from Fieldbus Process Data In1, bit 1.   |
| 39        | FB ProcessData1.B2         | Digital (relay) output control from Fieldbus Process Data In1, bit 2.   |
| 40        | Maintenance alarm          | Maintenance counter has reached the alarm limit defined with parameter.   |
| 41        | Maintenance Fault          | Maintenance counter has reached the alarm limit defined with parameter.   |
| 42        | No function                |   |
| 43        | No function                |   |
| 54        | No function                |   |
| 55        | No function                |   |
| 56        | Auto-cleaning active       | Pump auto-cleaning function is activated.   |
| 57        | Motor Switch Open          |   |



Table 143. Output signals via R01

| Selection | Selection name       | Description |
|-----------|----------------------|-------------|
| 58        | TEST (Always Closed) |             |
| 59        | No function          |             |
| 60        | DualSupply AC switch |             |

### 7.2.12 ANALOG OUTPUTS

#### P3.5.4.1.1 AO1 FUNCTION

This parameter defines the content of the analogue output signal 1. The scaling of the analogue output signal depends on the selected signal. See Table 144.

Table 144. AO1 signal scaling

| Selection | Selection name             | Description  |
|-----------|----------------------------|--|
| 0         | Test 0% (Not used)         | Analogue output is forced either to 0% or 20% depending on parameter P3.5.4.1.3. |
| 1         | TEST 100%                  | Analogue output is forced to 100% signal (10 V / 20 mA).                         |
| 2         | Output frequency           | Actual output frequency from zero to MaxFreqReference.                           |
| 3         | Frequency reference        | Actual frequency reference from zero to MaxFreqReference.                        |
| 4         | Motor speed                | Actual motor speed from zero to Motor Nom Speed.                                 |
| 5         | Output current             | Drive output current from zero to Motor Nom Currnt.                              |
| 6         | Motor torque               | Actual motor torque from zero to motor nominal torque (100%).                    |
| 7         | Motor power                | Actual motor power from zero to Motor Nom Power (100%).                          |
| 8         | Motor voltage              | Actual motor voltage from zero to Motor Nom Voltg.                               |
| 9         | DC-link voltage            | Actual DC-link voltage 0...1000 V.   |
| 10        | PID output                 | PID controller output (0...100%).  |
| 11        | ExtPID output              | External PID controller output (0...100%).                                       |
| 12        | Fieldbus Process Data In 1 | Fieldbus Process Data In 1 from 0...10000 (corresponding 0...100.00%).           |
| 13        | Fieldbus Process Data In 2 | Fieldbus Process Data In 2 from 0...10000 (corresponding 0...100.00%).           |
| 14        | Fieldbus Process Data In 3 | Fieldbus Process Data In 3 from 0...10000 (corresponding 0...100.00%).           |
| 15        | Fieldbus Process Data In 4 | Fieldbus Process Data In 4 from 0...10000 (corresponding 0...100.00%).           |
| 16        | Fieldbus Process Data In 5 | Fieldbus Process Data In 5 from 0...10000 (corresponding 0...100.00%).           |
| 17        | Fieldbus Process Data In 6 | Fieldbus Process Data In 6 from 0...10000 (corresponding 0...100.00%).           |
| 18        | Fieldbus Process Data In 7 | Fieldbus Process Data In 7 from 0...10000 (corresponding 0...100.00%).           |
| 19        | Fieldbus Process Data In 8 | Fieldbus Process Data In 8 from 0...10000 (corresponding 0...100.00%).           |

**P3.5.4.1.4 AO1 MINSCALE****P3.5.4.1.5 AO1 MAXSCALE**

These parameters can be used to freely adjust the analogue output signal scaling. The scale is defined in process units and it depends on the selection of parameter P3.5.4.1.1.

**Example:** The drive's output frequency is selected for the content of the analogue output signal and parameters P3.5.4.1.4 and P3.5.4.1.5 are set to 10...40 Hz.

When the drive's output frequency changes between 10 and 40 Hz the analogue output signal changes between 0...20 mA.

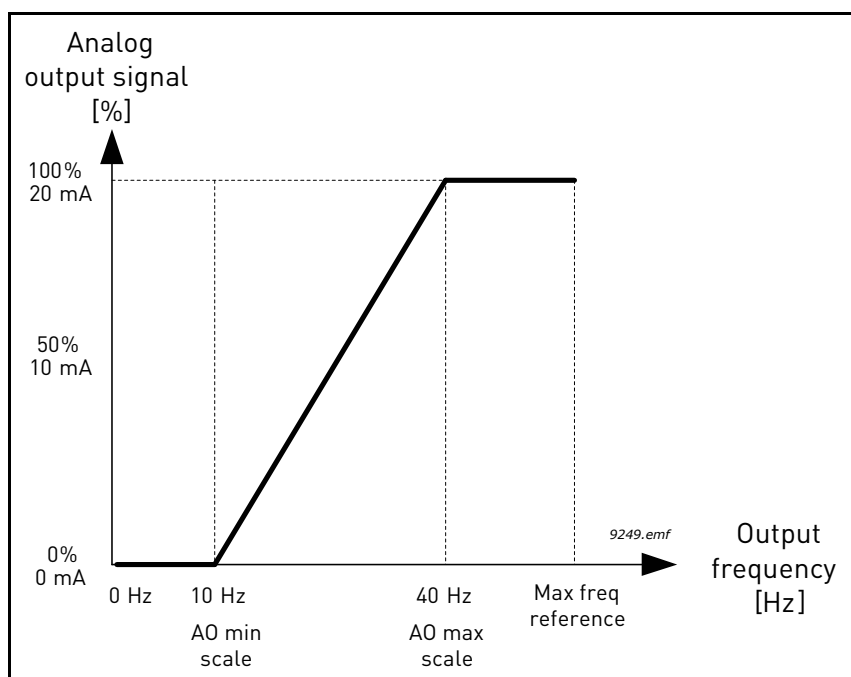


Figure 53. AO1 signal scaling

## 7.2.13 PROHIBIT FREQ

|               |                         |
|---------------|-------------------------|
| <b>P3.7.1</b> | <b>RANGE 1 LOW LIM</b>  |
| <b>P3.7.2</b> | <b>RANGE 1 HIGH LIM</b> |
| <b>P3.7.3</b> | <b>RANGE 2 LOW LIM</b>  |
| <b>P3.7.4</b> | <b>RANGE 2 HIGH LIM</b> |
| <b>P3.7.5</b> | <b>RANGE 3 LOW LIM</b>  |
| <b>P3.7.6</b> | <b>RANGE 3 HIGH LIM</b> |

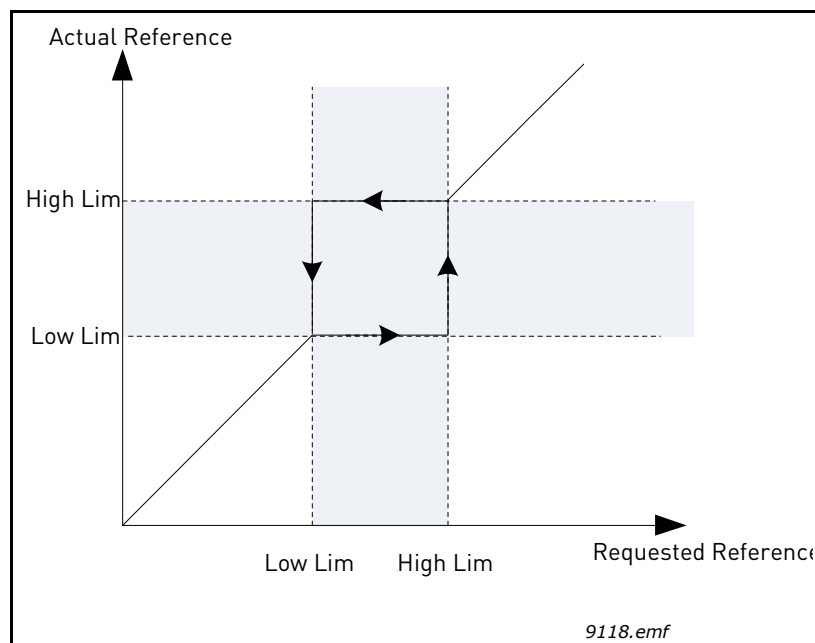


Figure 54. Prohibited frequencies

**P3.7.7** **RAMP TIME FACTOR**

The *Ramp time factor* defines the acceleration/deceleration time when the output frequency is in a prohibited frequency range. The *Ramp time factor* is multiplied with the value of parameters P3.4.1.2/P3.4.1.3 (*Ramp acceleration/deceleration time*). For example the value 0.1 makes the acceleration/deceleration time ten times shorter.

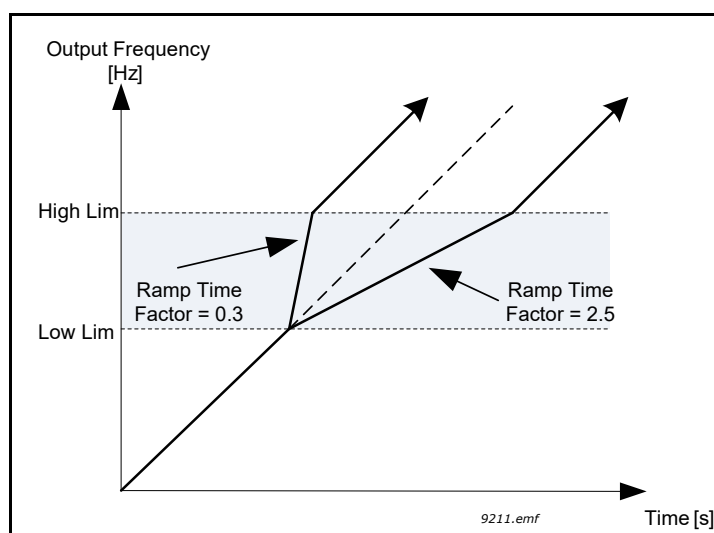


Figure 55. Ramp time factor

## 7.2.14 PROTECTIONS

### P3.9.1.2 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 P3.5.1.11 and P3.5.1.12. The information can also be programmed into any of the relay outputs.

### P3.9.2.3 ZEROSPEEDCOOLING

Defines the cooling factor at zero speed in relation to the point where the motor is running at nominal speed without external cooling. See Figure 56.

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 Nom Currnt*), 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 P3.1.3.1 alone.

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

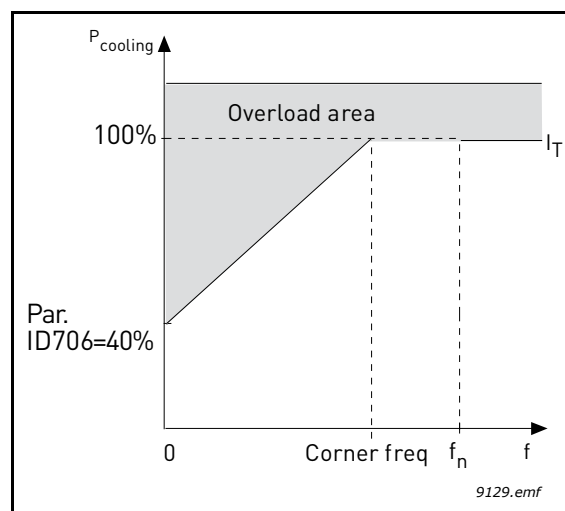


Figure 56. Motor thermal current  $I_T$  curve

### P3.9.2.4 THERMALTIMECONST

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  $t_6$ -time ( $t_6$  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  $2 \cdot t_6$ . If the drive is in stop stage the time constant is internally increased to three times the set parameter value. The cooling in stop stage is based on convection and the time constant is increased. See Figure 58.

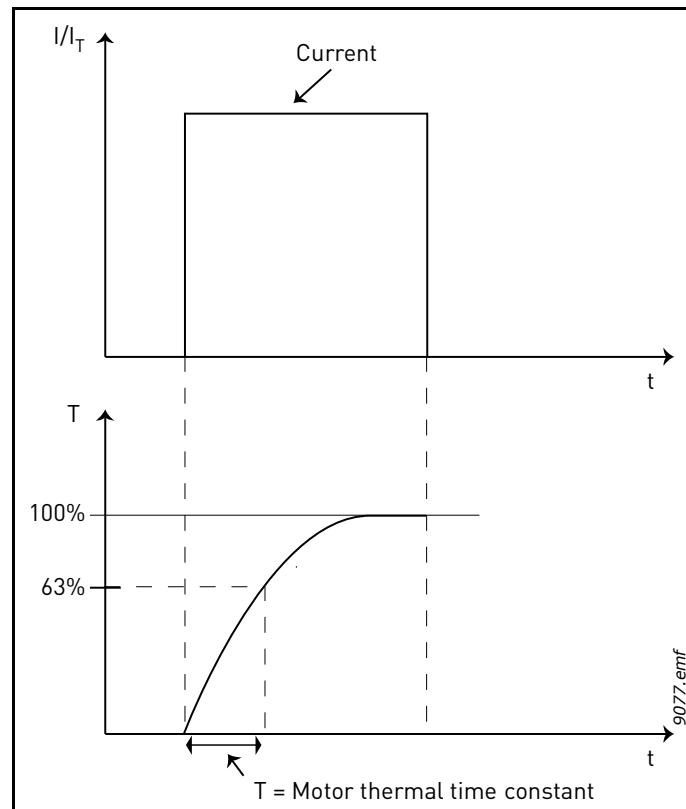


Figure 57. Motor thermal time constant

### P3.9.2.5 MOTHERMLOADBIL

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

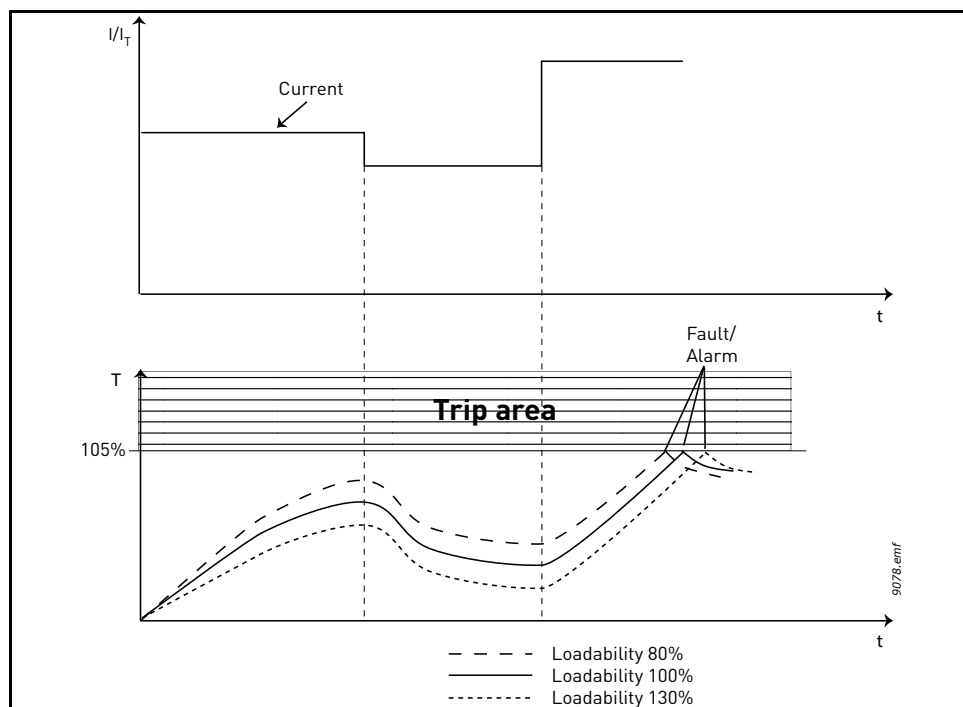


Figure 58. Motor temperature calculation

**P3.9.2.6 MOTTEMPINITIALMODE**

Table 145.

| Selection | Description  |
|-----------|--|
| 0         | Disabled, The estimated motor temperature rise is set to zero.   |
| 1         | Constant, Sets the motor temperature rise estimate to a value which equals the parameter P3.9.2.7 MotTemplnitialAdjust value.  |
| 2         | Last value, Sets the motor temperature rise estimate to a last saved motor temperature rise estimate multiplied with the parameter P3.9.2.7 MotTemplnitialAdjust value.  |
| 3         | Real time clock, Similar to the last value mode, but the last saved motor temperature rise estimate is affected by real time and the parameter P3.9.2.4 ThermTimeConst. This mode requires that a battery is connected to the real time clock. |

**P3.9.3.2 STALL CURRENT**

The current can be set to  $0.0...2 \cdot I_L$ . For a stall stage to occur, the current must have exceeded this limit. See Figure 59. If parameter P3.1.3.1 *Current Limit* is changed, this parameter is automatically calculated to 90% of the current limit.

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

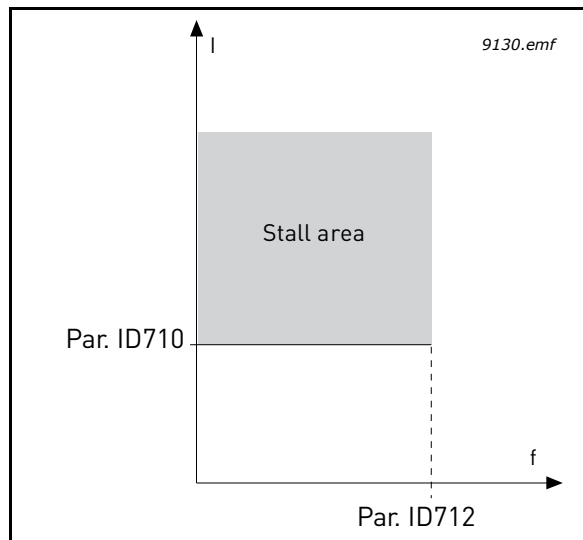


Figure 59. Stall characteristics settings

**P3.9.3.3 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 P3.9.3.1).

**P3.9.4.2 FIELDWEAK. LOAD**

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

This parameter gives the value for the minimum torque allowed when the output frequency is above the field weakening point. See Figure 60.

If you change parameter P3.1.1.4 (*Motor Nom Currnt*) this parameter is automatically restored to the default value.

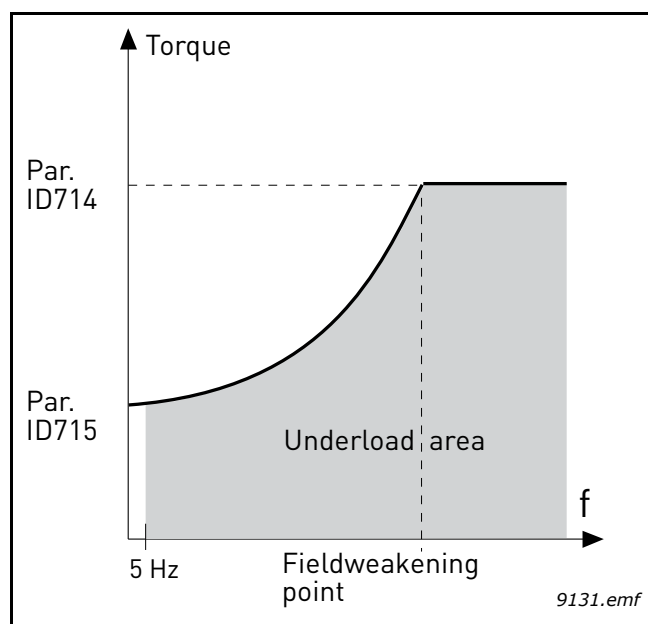


Figure 60. Setting of minimum load

#### P3.9.4.4 TIME LIMIT

This time can be set between 2.0 and 600.0 s.

This is the maximum time allowed for an under load state to exist. An internal up/down counter counts the accumulated under load time. If the under load counter value goes above this limit the protection will cause a trip according to parameter P3.9.4.1). If the drive is stopped the under load counter is reset to zero. See Figure 61.

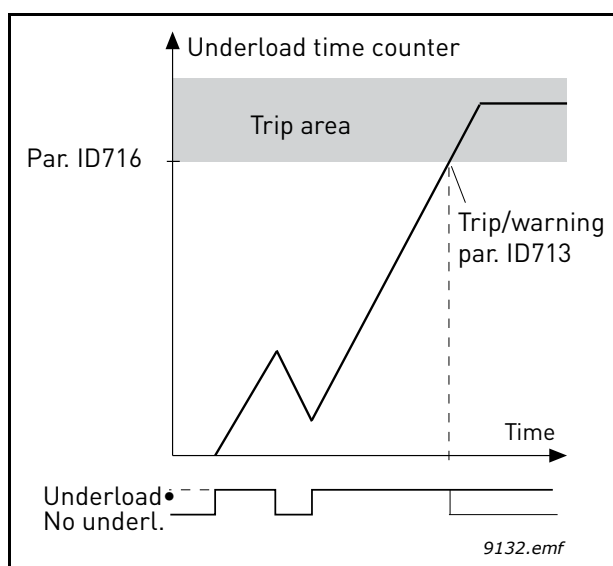


Figure 61. Under load time counter function

### 7.2.15 AUTOMATIC RESET

#### **P3.10.1 AUTOMATIC FAULT RESET**

0: Disabled

1: Enabled

The automatic reset function deletes fault state when the fault cause has been eliminated and the wait time P10.2 has elapsed. Parameter P10.4 determines the maximum number of automatic resets that can be effected during the trial time set by parameter P10.3. The time count starts from the first automatic reset. If the number of faults detected during the trial time exceeds the values of trials, the fault status becomes permanent and a reset command is needed.

#### **P3.10.2 WAIT TIME**

Time after which the converter attempts to restart the motor automatically after the fault has been cleared.

#### **P3.10.3 AUTOMATIC RESET TRIES**

Trials attempted during one hour.

#### **P3.10.4 RESTART FUNCTION**

We can chose what kind of start function we want to use when doing an autoreset of the drive. If run command is kept active during the autoreset sequence.

0= Flying Start

1= Start Function (according to P3.2.4)

#### **P3.10.5 TO**

#### **P3.10.7 UNDERLOAD RESET TIME 1-3**

Under voltage fault is reset without limitations, also when P10.1 is not active. The drive will restart according the delay times defined by the parameters P14.1.1 to P14.1.4.

Under load (dry run) fault is reset when P3.10.1 is active, without limitations in number, but according to a specific time schedule.

At first fault, autoreset is done after time 1 (P3.10.5). If under load fault happens again, after the number of tries defined in P3.10.8, delay becomes time 2 (P3.10.6).

Similarly, delay will change to time 3 (P3.10.7) if further tries are unsuccessful.

Five minutes of correct working will reset the tries counter.

#### **Any other fault:**

Generic autoreset is enabled by P3.10.1. Faults will be reset after the wait time (P3.10.2), unless the number of faults in a hour overcomes the threshold in P3.10.3. Any fault event, apart under voltage and under load, causes counter increasing.

**Note:** fault led (red) blinks during the autoreset wait time.

#### **P3.10.8 UNDERLOAD TRIES T1, T2**

Trials attempted during Underload Reset time 1 and Underload Reset time 2.



## 7.2.16 FEEDBACKS

**P3.13.1.9 DEAD BAND****P3.13.1.10 DEAD BAND DELAY**

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

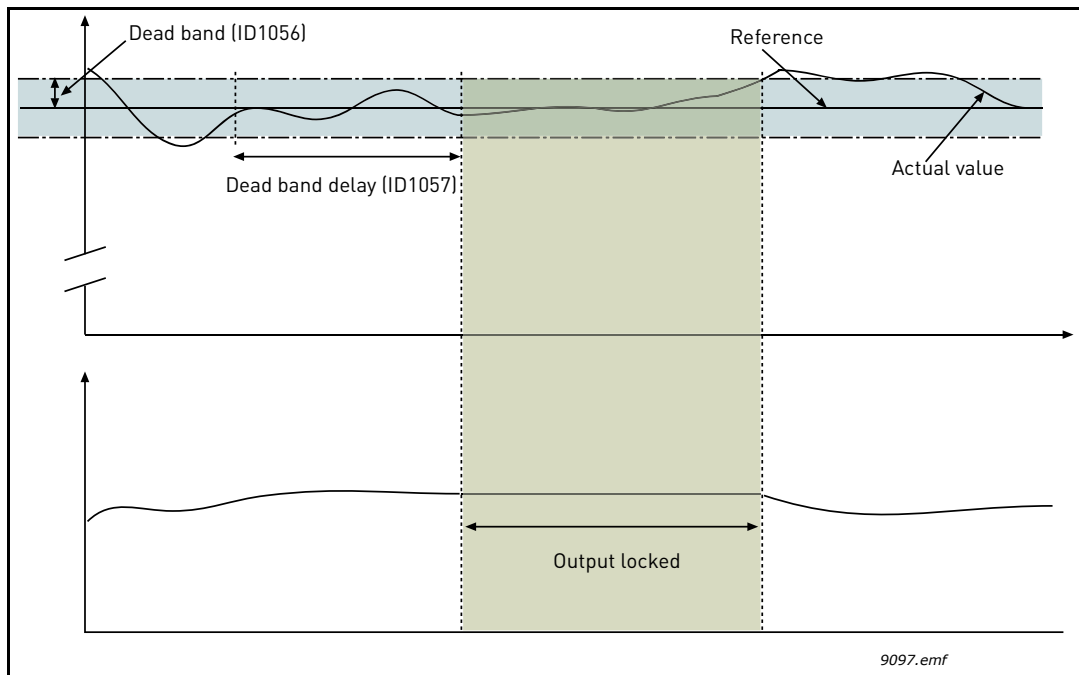


Figure 62. Dead band

### 7.2.17 FEEDFORWARD

#### 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 170). VACON® 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.

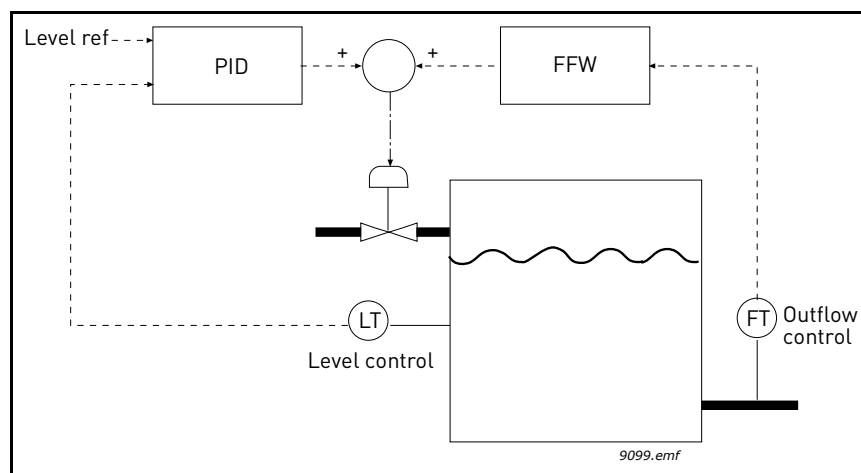


Figure 63. Feedforward control

## 7.2.18 SLEEP FUNCTION

**P3.13.5.1 SLEEP FREQUENCY LIMIT 1****P3.13.5.2 SP 1 SLEEP DELAY****P3.13.5.3 SP 1 WAKEUPLEVEL**

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 (P3.13.5.2). 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.

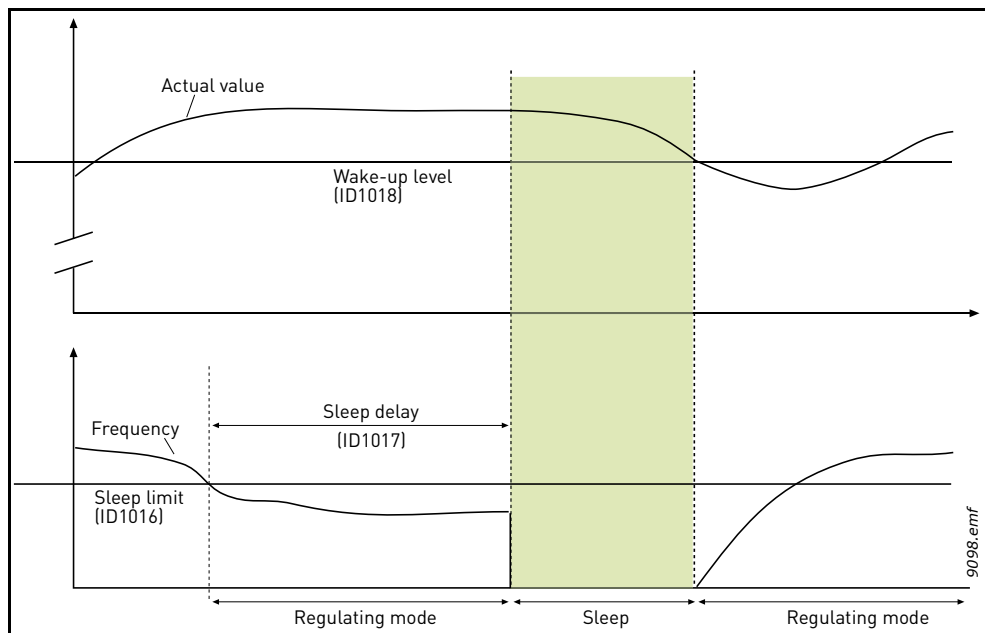


Figure 64. Sleep limit, Sleep delay, Wake-up level

## 7.2.19 FEEDBACK SUPERV.

**P3.13.6.1 ENABLE SUPERV**

These parameters define the range within which the PID Feedback signal value is supposed to stay in a normal situation. If the PID Feedback signal goes above or below the defined supervision range for longer time than what is defined as the *Delay*, a PID Supervision fault (F101) will be triggered.

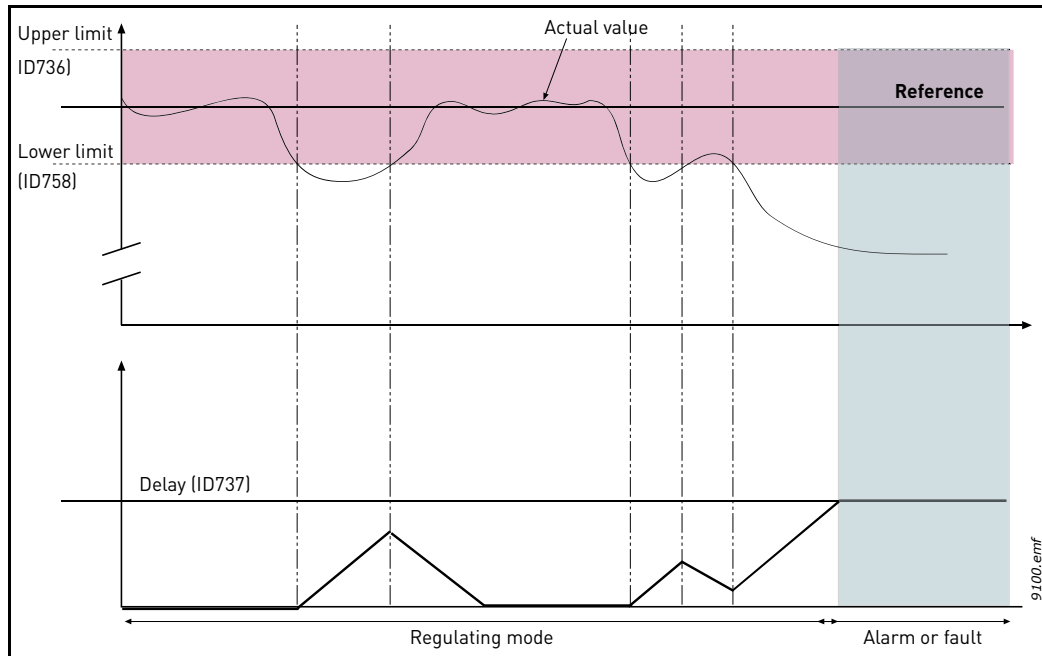


Figure 65. Process supervision

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 (P3.13.6.4). 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 with parameter P3.13.6.5) is generated.

## 7.2.20 PRESS.LOSS.COMP

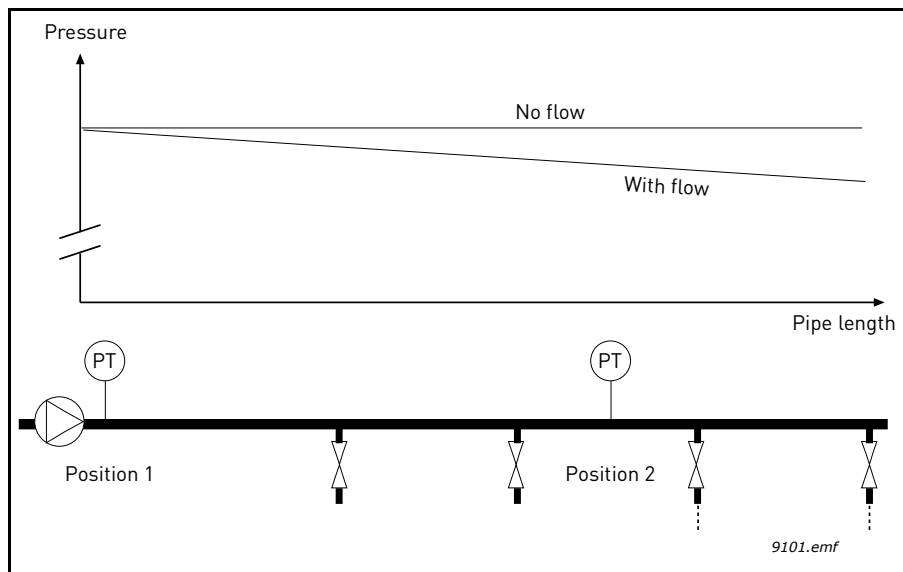


Figure 66. Position of pressure sensor

If pressurizing a long pipe with many outlets, the best place for the sensor would probably be half-way 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.

**P3.13.7.1 ENABLE SP 1****P3.13.7.2 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.

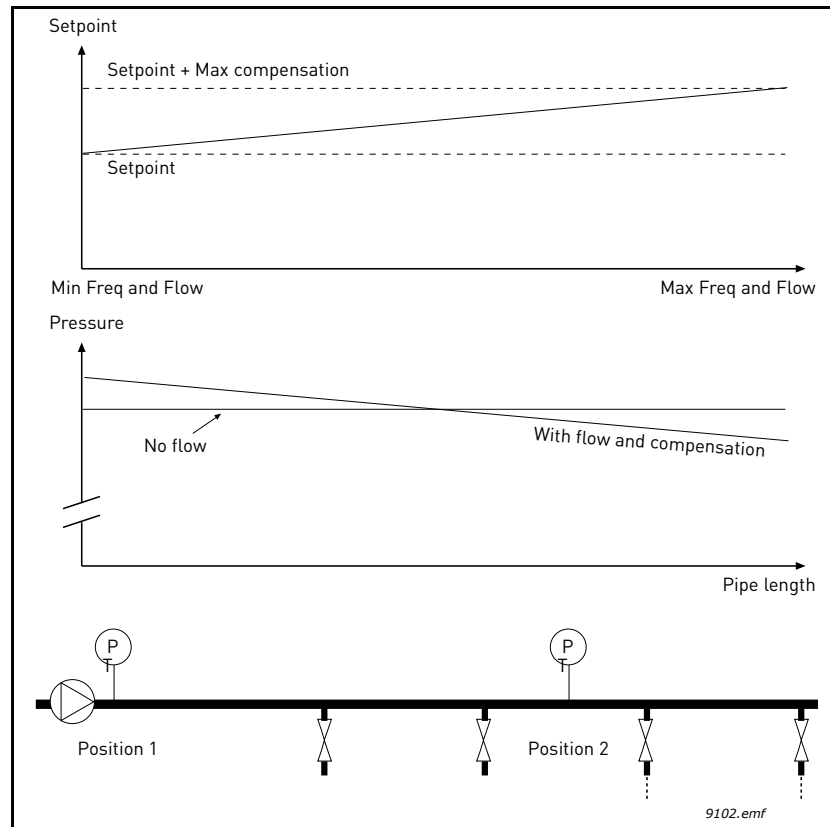


Figure 67. Enable setpoint 1 for pressure loss compensation

## 7.2.21 SOFT FILL

**P3.13.8.1** *ENABLE***P3.13.8.2** *SOFTFILL FREQ***P3.13.8.3** *SOFTFILL LEVEL***P3.13.8.4** *TIMEOUT TIME*

The drive runs at the soft fill frequency (par. P3.13.8.2) until the feedback value reaches the soft fill level set parameter P3.13.8.3. After this the drive starts to regulate, bump less, from the soft fill frequency. If the soft fill level is not reached within the timeout (P3.13.8.4) an alarm or fault is triggered (according to the set Soft Fill timeout response (P3.9.1.9)).

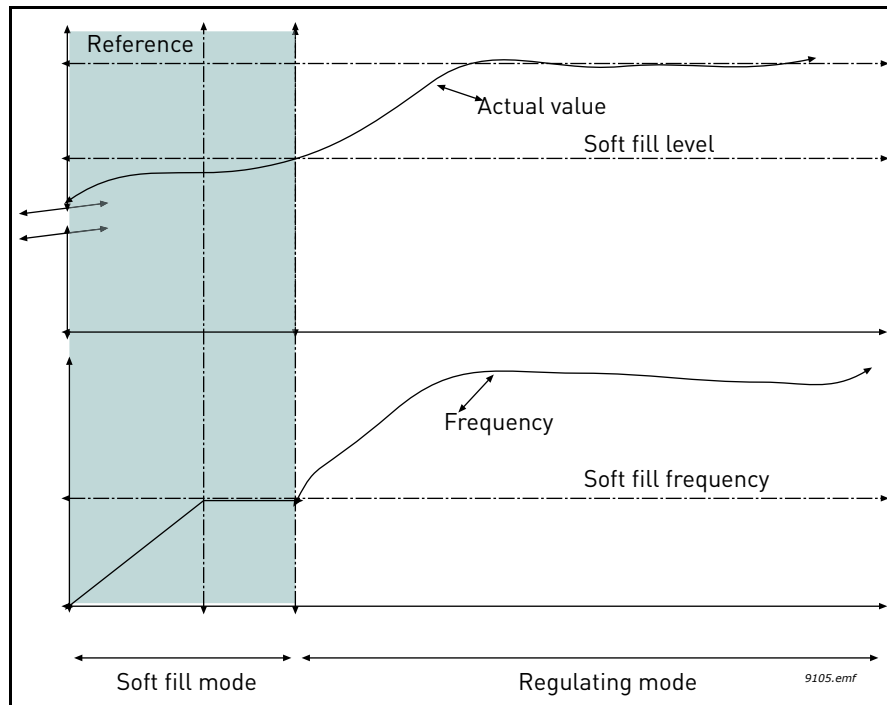


Figure 68. Soft fill function

## 7.2.22 AUTO-CLEANING

### P3.21.1.1 CLEANING FUNCTION

If Auto-cleaning function is enabled by parameter P3.21.1.1 the Auto-cleaning sequence will start by activating the digital input signal selected by parameter P3.21.1.2.

### P3.21.1.2 CLEANING ACTIVATION

See above.

### P3.21.1.3 CLEANING CYCLES

The Forward/reverse cycle will be repeated for the amount of times defined by this parameter.

### P3.21.1.4 CLEAN FORWARD FREQ.

Auto-cleaning function is based on rapidly accelerating and decelerating the pump. The user can define a forward/reverse cycle by setting parameters P3.21.1.4, P3.21.1.5, P3.21.1.6 and P3.21.1.7.

### P3.21.1.5 CLEAN FORWARD TIME

See parameter P3.21.1.4 Clean Forward Freq. above.

### P3.21.1.6 CLEAN REVERSE FREQ.

See parameter P3.21.1.4 Clean Forward Freq. above.

### P3.21.1.7 CLEAN REVERSE TIME

See parameter P3.21.1.4 Clean Forward Freq. above.

### P3.21.1.8 CLEANING ACCELERATION TIME

The user can also define separated acceleration and deceleration ramps for the Auto-cleaning function with parameters P3.21.1.8 and P3.21.1.9.

### P3.21.1.9 CLEANING DECELERATION TIME

See parameter P3.21.1.8 Cleaning acceleration time above.

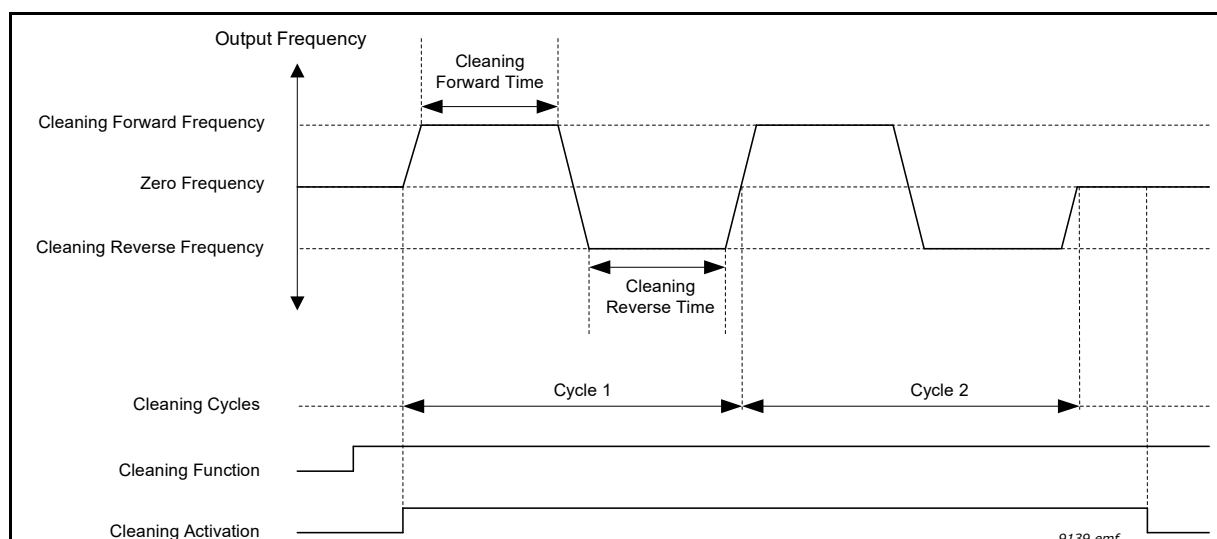


Figure 69. Auto-cleaning functionality



**7.2.23 SOLAR**7.2.23.1 Start Settings**P3.22.1.1 START DC VOLTAGE**

Start enable from solar condition needs that the DC voltage is above the threshold in P3.22.1.1 (at least for 5s).

**P3.22.1.2 SHORT RESTART DELAY**

The drive starts and tries to reach minimum frequency. If this doesn't happen within a defined time, the drive will stop and retry only after the short delay time P3.22.1.2 has elapsed.

**P3.22.1.3 SHORT RESTART DELAY TRIES****P3.22.1.4 LONG RESTART DELAY**

After a certain number of failed attempts (P3.22.1.3), the time between start attempts will change to long delay time P3.22.1.4.

If the drive can run continuously for the same long delay time, next start attempts will begin with short delay again. The same sequence is applied in case a running drive stops because of a temporary decrease in solar power.

**Note!** If the drive is supplied by mains, the drive is always enabled to start from external command.

7.2.23.2 MPPT

Generally, the MPP voltage of a panel is higher when the available power is high (good irradiation, low temperature).

The output power to the motor is considered an indicator of the panel state: if the drive can progressively increase motor speed and get a good amount of power, it means that the panel has basically "high" MPP voltage.

The DC voltage reference for the regulator is automatically changed by the MPP Tracker.

It results from four parallel algorithms:

- Feed-forward controller
- Correction controller
- Oscillation damping regulator
- Local Maxima logic

### MPPT feed-forward parameters

MPP feed-forward controller continuously changes the reference from  $V_{mp@10\%}$  to  $V_{mp@100\%}$ , according to actual motor power. The main purpose of this term is to follow variation of irradiation.

#### **P3.22.2.1 VMP AT 100% POWER**

#### **P3.22.2.2 VMP AT 10% POWER**

The  $V_{mp}$  parameters should be obtained from panel characteristics, considering standard temperature and irradiation at 10% and 100% level.

If the second value is not known, subtract 50-60 V from the first value as a rough estimation.

The accuracy of these values is not really critical, because the correction logic can easily compensate error of some tens of volts. It is better to set values possibly higher than the real ones, and let the correction decrease the voltage reference, to get maximum power.

#### **P3.22.2.3 PANEL/MOTOR RATIO**

In case the solar panels have less maximum power than the motor, a value lower than 100% should be set in P3.22.2.3.

### MPPT regulator

The drive tries to get the maximum power from solar panels by keeping the DC voltage at the optimum point (Max Power Point).

There is a PI regulator that changes the internal frequency reference, so that the power sent to the motor keeps the panels working on MPP.

The voltage reference can be monitored (V2.3.1) and compared to actual DC voltage (V2.3.10), to check the effect of gain tuning.

Continuous, low amplitude and high frequency oscillations mean gains too high.

Ramp times are meant to smooth the output frequency, but without introducing significant delay in response.

#### **P3.22.2.4 P GAIN**

Proportional gain [Hz/V]. If set to 1.000, a variation of 1 V on DC bus voltage causes a variation of 1 Hz on frequency reference

#### **P3.22.2.5 I GAIN**

Integral gain [Hz/Vxs]. If set to 1.000, a variation of 1 V on DC bus voltage causes a variation of 1 Hz per second on frequency reference.

#### **P3.22.2.6 ACCELERATION TIME**

Time from minimum to maximum frequency. Used only when solar power is active.

#### **P3.22.2.7 DECELERATION TIME**

Time from maximum to minimum frequency. Used only when solar power is active.

### MPPT correction parameters

This algorithm changes the DC voltage reference, to compensate temperature variations (usually slow) and to correct the error in feed-forward curve.

Correction can be up to +/- 150 V.

The correction term is determined by "perturb-and-observe" logic (P&O).

#### **P3.22.2.8 P&O UPDATE TIME**

#### **P3.22.2.9 P&O VOLTAGE STEP**

DC voltage reference is periodically (at intervals defined by P3.22.2.8) increased or decreased by a small value (P3.22.2.9). If the variation brings a higher motor power, next variation will follow the same direction, otherwise it will be reversed.

A short perturb period (P3.22.2.8) makes the regulation faster, assuming that the PI gains are not too low (power variation has to complete within the period).

The correction term can be monitored (V2.2), to help the tuning of reference feed-forward. When the panels temperature is close to standard, 25 °C, the correction term should result small (+/- 20 to 30 V).

The correction decreases towards negative maximum as temperature increases.

The correction term increases towards positive maximum in case of low temperature.

If something different is observed, feed-forward values should be improved.

#### **P3.22.2.10 P&O POWER VARIATION**

P3.22.2.10 determines the variation in motor power, above which iteration of voltage reference change continues in the same direction.

Small value leads to a regulation very close to the maximum of the panel curve, with possible instability. Higher values lead to a more stable point, but with lower efficiency.

### P&O in local max points

A panel with partial irradiation, or somehow defective, could cause a discontinuity on the power/voltage curve of the array. In this situation the basic P&O logic (perturb and observe) could lead to a local maximum point, that is not corresponding to maximum available power.

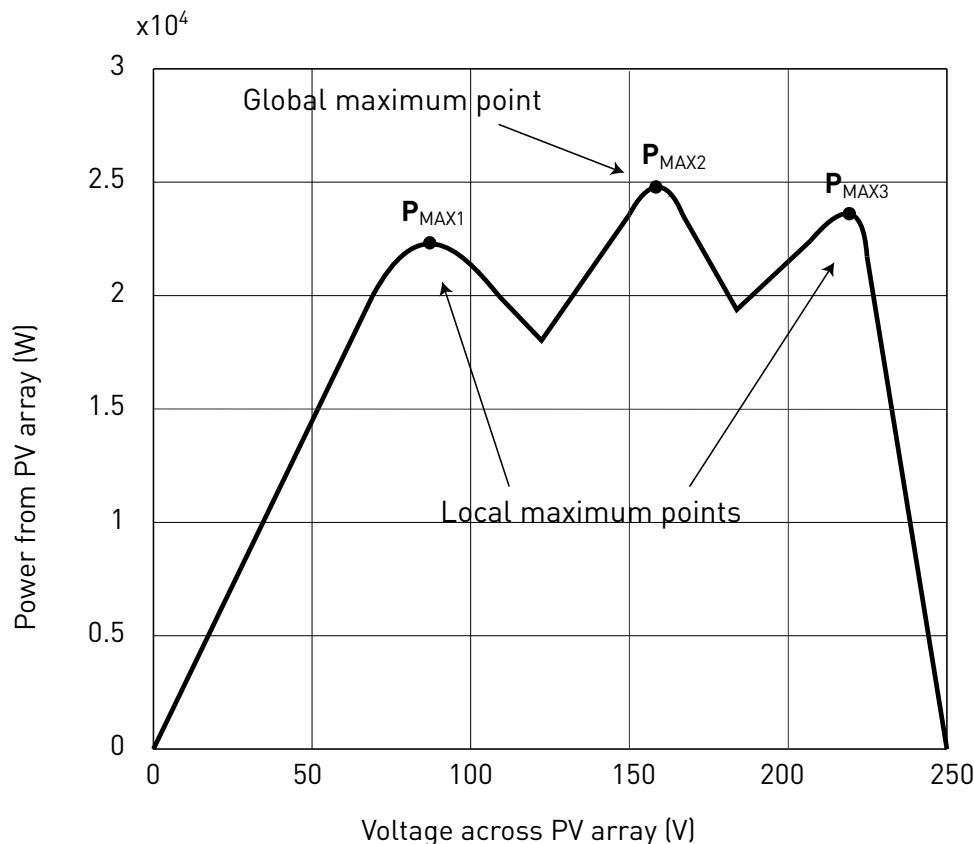


Figure 70.

#### P3.22.2.11 P&O LOCAL MAX VOLT STEP

To bypass discontinuity on power/voltage curve of array, after having reached a stable point, the P&O takes a bigger downward step (P3.22.2.11) in voltage. This step allows to overcome the local maximum and continue to search for the actual MPP.

If the point is the real MPP, the lower voltage reference will cause a drop in DC voltage and some oscillations, that are recognized and automatically damped by increasing the DC voltage reference.

The function can be disabled by programming P3.22.2.11= 0 V.

#### P3.22.2.12 P&O LOCAL MAX TIME

Further attempts to reach a higher MPP after an unsuccessful attempt will follow only after the programmable masking time (P3.22.2.12).

#### P3.22.2.13 P&O LOCAL MAX FREQ

The downward step is done only when output frequency is above minimum frequency + P3.22.2.13.

### MPPT Oscillation Damping

If the power regulation enters the “current source” branch of the panel current/voltage characteristic, the typical result is a oscillation in DC voltage and output frequency. The damping logic rec-

ognizes oscillation in DC voltage and quickly increases the voltage reference correction term. This brings the panels back in "voltage source" branch.

#### **P3.22.2.14 DAMPING SENSITIVITY**

P3.22.2.14 parameter determines the amplitude of oscillation, to be recognized.

If the value is too low, normal variation in voltage level could be considered oscillation, and the DC voltage reference incorrectly increased.

#### **P3.22.2.15 DAMPING TIME**

Oscillation is recognized when the logic sees three maximum and minimum point during the time defined by P3.22.2.15.

If the time is too short, the logic could fail with slow oscillations.

If the time is too long, spaced and unrelated min and max points could be confused with an oscillation.

#### **P3.22.2.16 MINIMUM DC VOLTAGE**

The value depends on the voltage range.

*Table 146.*

| Voltage range | Value                             | Default |
|---------------|-----------------------------------|---------|
| 230 VAC       | 230–300 V                         | 230 V   |
| 400/500 VAC   | 300 (new xml)/410 (old xml)–600 V | 410 V   |
| 525/690 VAC   | 530–800 V                         | 530 V   |

The value (+ 5 V) is also used as the minimum limit for the DC voltage related parameters P3.22.1.1, P3.22.2.1, P3.22.2.2.

### **7.2.24 DUAL SUPPLY PARAMETERS**

#### **Common settings**

##### **P3.24.1.1 AC VOLTAGE**

Nominal voltage of AC grid.

##### **V3.24.1.2 NOMINAL DC VOLTAGE**

Monitor of calculated value of nominal DC voltage, when supply is from AC grid.

##### **P3.24.1.3 DUAL SUPPLY MODE**

0 - Always active

1 - Closed loop Irradiation

2 - Closed loop Sensorless

##### **P3.24.1.4 DC OFFSET FOR AC OFF**

Offset added to M3.24.1.1, as DC voltage threshold above which AC can be switched Off. If DC value is above threshold, it means that the PV modules can sustain the full power, in present motor working condition.

### **P3.24.1.5 AC OFF AT STOP DELAY**

Delay to switch AC Off at stop, if it happened with AC On condition.

#### **Mode 0 Always active**

In mode 0, relay for AC supply is always On when pump is running. There are two possible conditions, to switch the relay On.

### **P3.24.2.1 AC ON CONDITION**

At Run: as AC switch relay is Off at power-on, the drive must start from PV modules supply, after that the relay is immediately switched On. AC grid backup will avoid further stops, in case of low power from modules.

At Start: external Start signal is sufficient condition to switch the relay On and connect to AC grid. This can happen also if the drive is powered up with only backup 24V on control board.

#### **Mode 1 Irradiation**

In mode 1, relay for AC supply is managed accordingly to measurement of irradiation from analogue signal.

There is an absolute minimum threshold for switching On, and an offset added to this as threshold to switch Off.

AC relay is switched On also in case of Low Power alarm at start or Undervoltage fault.

With AC connected, MPPT will reach the maximum motor speed. Power is shared between AC grid and PV modules, according to their actual capacity.

In this condition, DC voltage stays naturally close to rectified AC voltage (V3.24.1.1).

DC voltage will increase in case the modules can sustain the needed full power.

When switching Off condition is reached (high irradiation), motor speed is decreased until DC voltage increases above (V3.24.1.1 + P3.24.1.4). That is the working point aligned with present power available from PV module. Relay is switched Off afterwards.

It is possible to activate Identification of minimum irradiation threshold. It means that the value of parameter is internally adjusted, so that the AC switching On condition always happens when the motor is close to a programmable speed. This compensates the changeable ratio between irradiation and power, that is function of temperature.

### **P3.24.3.1 IRRADIATION SIGNAL**

Selection between AI1 and AI2.

### **P3.24.3.2 MAX IRRADIATION**

Value of irradiation at maximum signal.

### **P3.24.3.3 AC ON IRRADIATION**

Threshold for irradiation, below which AC relay is switched On.

### **P3.24.3.4 AC OFF IRRADIATION OFFSET**

Value added to P3.24.3.3 to determine the threshold for switching AC Off.

### **P3.24.3.5 IRRADIATION STABILIZATION TIME**

Irradiation has to stay below/above thresholds for this time, to activate switching On/Off.

### **P3.24.3.6 IDENTIFICATION**

#### **P3.24.3.7 IDENTIFICATION FREQUENCY**

When active, identification adjust the value of P3.24.3.3, to align the conditions of low irradiation and desired minimum power from the PV modules (defined as minimum frequency, set in P3.24.3.7).

If irradiation goes below P3.24.3.3, but present motor frequency is higher than P3.24.3.7, than the value in P3.24.3.3 is reduced. This will avoid switching to AC, when the power from PV modules is still enough.

On the other hand, if irradiation is still higher than P3.24.3.3, but MPPT regulation decreases the frequency below P3.24.3.7, present irradiation value is used to update P3.24.3.3. This will activate the AC switching On.

### **Mode 2 Sensorless**

In mode 2, relay for AC supply is activated when the pump is running below a certain speed.

AC relay is switched On also in case of Low Power alarm at start or Under voltage fault. And in case DC voltage was already below the threshold ( $M3.24.1.1 + P3.24.1.4$ ) when external Start command is given.

With AC connected, MPPT will reach the maximum motor speed. Power is shared between AC grid and PV modules, according to their actual capacity.

In this condition, DC voltage stays naturally close to rectified AC voltage ( $V3.24.1.1$ ).

DC voltage will increase in case the modules can sustain the needed full power.

If the threshold ( $V3.24.1.1 + P3.24.1.4$ ) is reached, AC is switched Off.

Besides this, when AC switch is On, the drive periodically decreases the motor speed to a programmable level, to check if PV modules can sustain at least that reduced power. If DC voltage has increased above the threshold, AC is switched Off. Otherwise MPPT will go back to max speed. This DC voltage check can be disabled by digital input (RTC channel possibility).

#### **P3.24.4.1 AC ON FREQUENCY**

AC relay is switched On if motor frequency stays below threshold, for delay time.

#### **P3.24.4.2 AC ON DELAY**

AC relay is switched On if motor frequency stays below threshold, for delay time.

#### **P3.24.4.3 DC CHECK REFERENCE**

Frequency reference at which DC voltage is checked, for possible switching Off. Higher values mean to use PV modules alone only if they have a good power availability.

#### **P3.24.4.4 DC CHECK PERIOD**

Time for periodic DC voltage check, at reduced frequency. It can be disabled by means of digital input set in P3.5.1.60. This can be connected to RTC channels, for time of the day related actions.

#### **P3.24.4.5 DC CHECK STABILIZATION TIME**

DC voltage must stay above the threshold for this time (both at maximum and reduced speed), to activate AC switching Off.

## 8. FAULTS

### 8.1 FAULT TRACING

When an unusual operating condition is detected by the AC 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. *Info* 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 distributor or factory because of a fault condition, always write down all texts and codes on the keypad display.

### 8.2 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 keypad with LCD display only:** By selecting value Yes for the parameter and clicking OK.

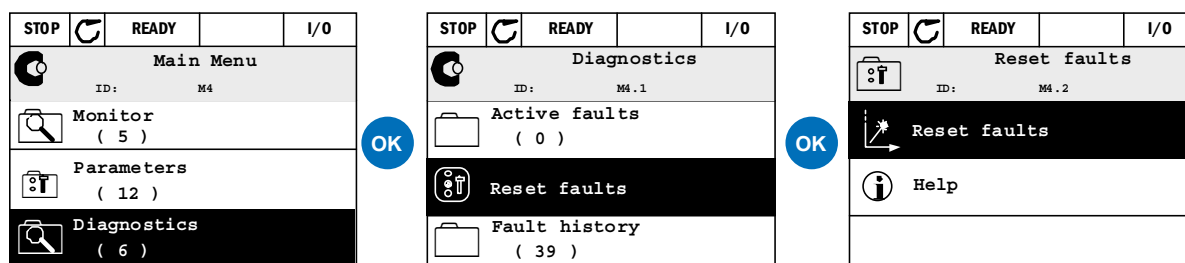


Figure 71. Diagnostic menu with graphical keypad.

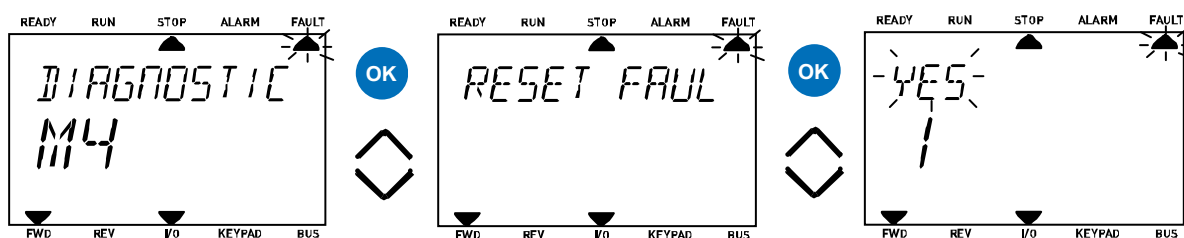


Figure 72. Diagnostic menu with text keypad.



### 8.3 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.

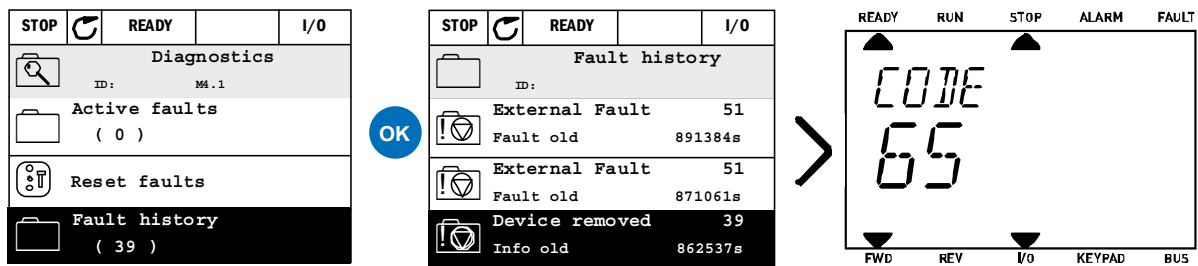


Figure 73. Fault history menu with graphical keypad.

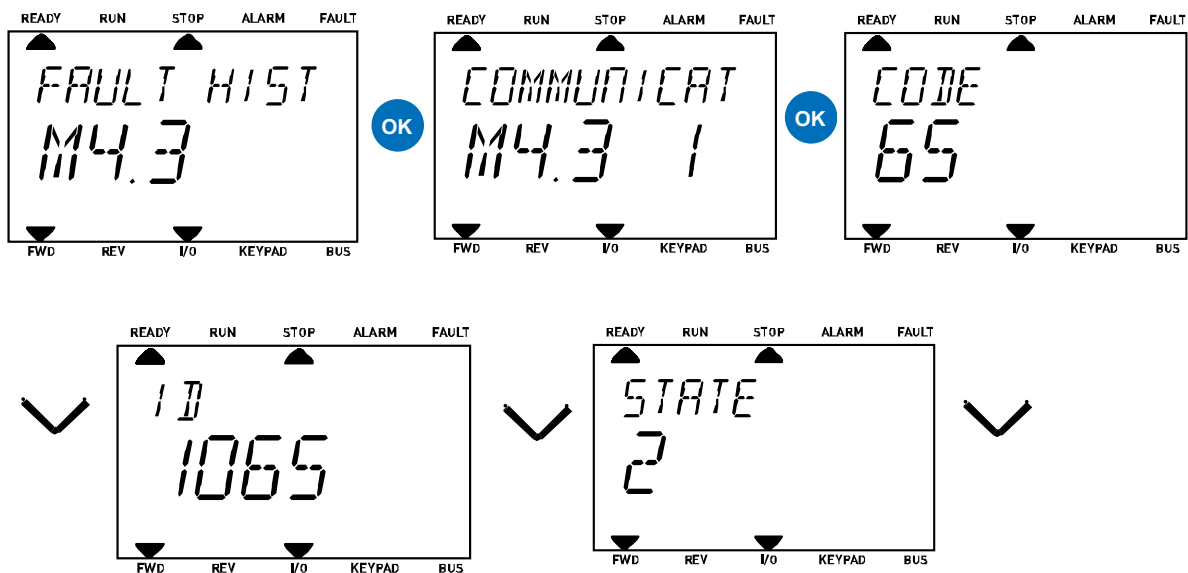


Figure 74. Fault history menu with text keypad.

## 8.4 FAULT CODES

Table 147. Fault codes and descriptions

| Fault code | Fault ID | Fault name                   | Possible cause   | Remedy  |
|------------|----------|------------------------------|--|---|
| 1          | 1        | Overcurrent (hardware fault) | AC drive has detected too high a current ( $>4 \cdot I_M$ ) in the motor cable: <ul style="list-style-type: none"> <li>sudden heavy load increase</li> <li>short circuit in motor cables</li> <li>unsuitable motor</li> </ul>                            | Check loading.<br>Check motor.<br>Check cables and connections.<br>Make identification run.<br>Check ramp times.  |
|            | 2        | Overcurrent (software fault) |  |   |
| 2          | 10       | Overvoltage (hardware fault) | The DC-link voltage has exceeded the limits defined. <ul style="list-style-type: none"> <li>too short a deceleration time</li> <li>brake chopper is disabled</li> <li>high overvoltage spikes in supply</li> <li>Start/Stop sequence too fast</li> </ul> | Make deceleration time longer.<br>Use brake chopper or brake resistor (available as options).<br>Activate overvoltage controller.<br>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. <ul style="list-style-type: none"> <li>insulation failure in cables or motor</li> </ul>  | 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. <ul style="list-style-type: none"> <li>faulty operation</li> <li>component failure</li> </ul>  | Reset the fault and restart.<br>Should the fault re-occur, contact the distributor near to you.   |
| 7          | 60       | Saturation                   | Various causes: <ul style="list-style-type: none"> <li>defective component</li> <li>brake resistor short-circuit or overload</li> </ul>  | Cannot be reset from keypad.<br>Switch off power.<br><b>DO NOT RE-CONNECT POWER!</b><br>Contact factory.<br>If this fault appears simultaneously with F1, check motor cables and motor. |

Table 147. Fault codes and descriptions

| Fault code | Fault ID | Fault name           | Possible cause   | Remedy   |
|------------|----------|----------------------|--|--|
| 8          | 600      | System fault         | Communication between control board and power unit has failed.   | Reset the fault and restart.<br>Should the fault re-occur, contact the distributor near to you.  |
|            | 601      |                      | Communication between control board and power unit has interference, but it is still working.  |  |
|            | 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.<br>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.  |  |
|            | 614      |                      | Configuration error.   |  |
|            | 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.<br>Error when loading parameter initial values.<br>Error when restoring parameters.<br>Error when saving parameters.  |  |
| 9          | 80       | Undervoltage (fault) | DC-link voltage is under the voltage limits defined.   | In case of temporary supply voltage break reset the fault and restart the AC drive. Check the supply voltage. If it is adequate, an internal failure has occurred.<br>Contact the distributor near to you. |
|            | 81       | Undervoltage (alarm) | <ul style="list-style-type: none"> <li>most probable cause: too low a supply voltage</li> <li>AC drive internal fault</li> <li>defect input fuse</li> <li>external charge switch not closed</li> </ul> <b>NOTE!</b> This fault is activated only if the drive is in Run state. |  |
| 10         | 91       | Input phase          | Input line phase is missing.   | Check supply voltage, fuses and cable.   |

Table 147. Fault codes and descriptions

| Fault code | Fault ID | Fault name                                  | Possible cause  | Remedy   |
|------------|----------|---|---|--|
| 11         | 100      | Output phase supervision                    | Current measurement has detected that there is no current in one motor phase.   | Check motor cable and motor.   |
| 12         | 110      | Brake chopper supervision (hardware fault)  | No brake resistor installed.<br>Brake resistor is broken.<br>Brake chopper failure.   | Check brake resistor and cabling.<br>If these are ok, the chopper is faulty. Contact the distributor near to you.  |
|            | 111      | Brake chopper saturation alarm              |   |  |
| 13         | 120      | AC drive under-temperature (fault)          | Too low temperature measured in power unit's heatsink or board. Heat-sink temperature is under -10 °C.  | Check the ambient temperature  |
| 14         | 130      | AC drive over-temperature (fault, heatsink) | Too high temperature measured in power unit's heatsink or board. Heat-sink temperature is over 100 °C.  | Check the correct amount and flow of cooling air.<br>Check the heatsink for dust.<br>Check the ambient temperature.<br>Make sure that the switching frequency is not too high in relation to ambient temperature and motor load. |
|            | 131      | AC drive over-temperature (alarm, heatsink) |   |  |
|            | 132      | AC drive over-temperature (fault, board)    |   |  |
|            | 133      | AC drive over-temperature (alarm, board)    |   |  |
| 15         | 140      | Motor stalled                               | Motor is stalled.   | Check motor and load.  |
| 16         | 150      | Motor overtemperature                       | Motor is overloaded.  | Decrease motor load.<br>If no motor overload exists, check the temperature model parameters.   |
| 17         | 160      | Motor underload                             | Motor is underloaded.   | Check load.  |
| 19         | 180      | Power overload (short-time supervision)     | Drive power is too high.  | Decrease load.   |
|            | 181      | Power overload (long-time supervision)      |   |  |
| 25         | 240      | Motor control fault                         | Start angle identification has failed.  | Reset the fault and restart.<br>Should the fault re-occur, contact the distributor near to you.  |
|            | 241      |   | Generic motor control fault.  |  |
| 26         | 250      | Start-up prevented                          | Start-up of the drive has been prevented. Run request is ON when a new software (firmware or application), parameter setting or any other file, which has affects the operation of the drive, has been loaded to drive. | Reset the fault and stop the AC drive.<br>Load the software and start the AC drive.  |
| 30         | 530      | STO fault                                   | Emergency stop button has been connected or some other STO operation has been activated.  | When the STO function is activated, the drive is in safe state.  |
| 32         | 312      | Fan cooling                                 | Fan life time is up.  | Change fan and reset fan life time counter.  |

Table 147. Fault codes and descriptions

| Fault code | Fault ID     | Fault name                      | Possible cause   | Remedy  |
|------------|--------------|---------------------------------|--|---|
| 33         | 320          | Fire mode enabled               | Fire mode of the drive is enabled. The drive's protections are not in use.   | Check the parameter settings  |
| 37         | 360          | Device changed (same type)      | Option board changed for one previously inserted in the same slot. The board's parameter settings are saved.   | Device is ready for use. Old parameter settings will be used.   |
| 38         | 370          | Device changed (same type)      | Option board added. The option board was previously inserted in the same slot. The board's parameter settings are saved.   | Device is ready for use. Old parameter settings will be used.   |
| 39         | 380          | Device removed                  | Option board removed from slot.  | Device no longer available.   |
| 40         | 390          | Device unknown                  | Unknown device connected (power unit/option board)   | Device no longer available.   |
| 41         | 400          | IGBT temperature                | IGBT temperature (unit temperature + I <sub>2</sub> T) is too high.  | Check loading.<br>Check motor size.<br>Make identification run.   |
| 44         | 430          | Device changed (different type) | Option board changed or Power unit changed. No parameter settings are saved.   | Set the option board parameters again if option board was changed. Set converter parameters again if power unit was changed.  |
| 45         | 440          | Device changed (different type) | Option board added. The option board was not previously present in the same slot. No parameter settings are saved.   | Set the option board parameters again.  |
| 46         | 662          | Real Time Clock                 | RTC battery voltage level is low and the battery should be changed.  | Replace the battery.  |
| 47         | 663          | Software updated                | Software of the drive has been updated (either the whole software package or application).   | No actions needed.  |
| 50         | 1050         | AI low fault                    | At least one of the available analogue input signals has gone below 50% of the defined minimum signal range. Control cable is broken or loose. Signal source has failed. | Change the failed parts.<br>Check the analog input circuit.<br>Check that parameter <i>A11 signal range</i> is set correctly. |
| 51         | 1051         | External Fault                  | Fault activated by digital input.  | Check the digital input or the device connected to it.<br>Check the parameter settings.                                       |
| 52         | 1052<br>1352 | Keypad communication fault      | The connection between the control keypad and frequency converter 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         | 1654         | Slot D fault                    | Defective option board or slot   | Check board and slot.   |
|            | 1754         | Slot E fault                    |  |   |

Table 147. Fault codes and descriptions

| Fault code | Fault ID | Fault name                  | Possible cause   | Remedy  |
|------------|----------|-----------------------------|--|---|
| 57         | 1057     | Identification              | Identification run has failed.   | Check that motor is connected to the drive.<br>Ensure that there is no load on the motor shaft.<br>Ensure that the start command will not be removed before completion of identification run. |
| 58         | 1058     | Mechanical brake            | Actual status of mechanical brake remains different from the control signal for longer than what is defined.   | Check the status and connections of the mechanical brake.   |
| 60         | 1060     | Low DC Power                | The drive has stopped due to insufficient power from solar panels. The drive cannot start because DC voltage is below the threshold level of P14.1.1 or P3.22.1.6. | Check voltage settings and make sure that acceleration or deceleration ramps are not too slow.  |
| 61         | 1061     | Restart Delay               | The drive will start after the programmed delay.   |   |
| 63         | 1063     | Low water level             | The minimum water level is not ok.   | Check settings and water level status.  |
| 64         | 1064     | Max water level             | The maximum water level is not ok.   | Check settings and water level status.  |
| 65         | 1065     | PC communication fault      | The data connection between the PC and frequency converter is broken   |   |
| 66         | 1066     | Thermistor fault            | The thermistor input has detected an increase of motor temperature   | Check motor cooling and load.<br>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 2 alarm | Maintenance counter has reached the alarm limit.   | Carry out the needed maintenance and reset counter.   |
|            | 1303     | Maintenance counter 3 alarm | Maintenance counter has reached the alarm limit.   | Carry out the needed maintenance and reset counter.   |
|            | 1304     | Maintenance counter 4 alarm | Maintenance counter has reached the alarm limit.   | Carry out the needed maintenance and reset counter.   |
| 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.   |
|            | 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.  |
|            | 1312     |                             | Overflow when mapping and converting values for Fieldbus Process Data Out (16-bit).  |   |
| 71         | 1071     | Unsupported                 | The drive is not VACON® 100 X.   |   |
|            | 1171     | Unsupported                 | The drive has not solar property.  |   |

Table 147. Fault codes and descriptions

| Fault code | Fault ID | Fault name                       | Possible cause   | Remedy  |
|------------|----------|----------------------------------|--|---|
| 76         | 1076     | Start prevented                  | Start command is active and was blocked in order to prevent unintentional rotation of the motor during the first power-up. | Reset drive to restore the normal operation. The need of restart depends on the parameter settings.   |
| 77         | 1077     | >5 connections                   | Maximum number of 5 simultaneous active fieldbus or PC tool connections supported by the application exceeded.             | Remove excessive active connections.  |
| 100        | 1100     | Soft fill time-out               | The Soft fill function in the PID controller has timed out. The wanted process value was not achieved within time.         | Reason might be a pipe burst.   |
| 101        | 1101     | Process supervision fault (PID1) | PID controller: Feedback value outside of supervision limits (and the delay if set).                                       | Check settings.   |
| 105        | 1105     | Process supervision fault (PID2) | PID controller: Feedback value outside of supervision limits (and the delay if set).                                       | Check settings.   |
| 109        | 1109     | Input pressure supervision       | Input pressure supervision signal has gone below the alarm limit.  | Check the process.<br>Check the parameters<br>Check the input pressure sensor and connections.  |
|            | 1409     |                                  | Input pressure supervision signal has gone below the fault limit.  |   |
| 111        | 1315     | Temperature fault 1              | At least one of the selected temperature input signals has reached the alarm limit.  | Find the cause of temperature raise.<br>Check the temperature sensor and connections.<br>Check that the temperature input is hardwired if no sensor is connected.<br>See option board manual for further information. |
|            | 1316     |                                  | At least one of the selected temperature input signals has reached the fault limit.  |   |
| 112        | 1317     | Temperature fault 2              | At least one of the selected temperature input signals has reached the fault limit.  |   |
|            | 1318     |                                  | At least one of the selected temperature input signals has reached the fault limit.  |   |
| 117        | 1600     | Pump Underload                   | Motor underload caused by dry pump.  | Check pump operation.   |

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