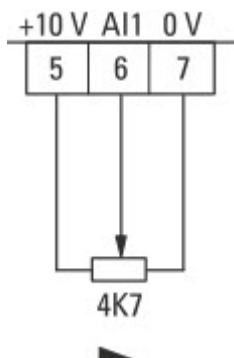


PowerXL™

DC1...E1 Variable Frequency Drives Set Point Setting



Level 2	<ul style="list-style-type: none"> 1 – Fundamental – No previous experience necessary 2 – Basic – Basic knowledge recommended 3 – Advanced – Reasonable knowledge required 4 – Expert – Good experience recommended
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Danger! - Dangerous electrical voltage!

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Cover or enclose any adjacent live components.
- Follow the engineering instructions (AWA/IL) for the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE, PES) must be connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes. Unlatching of the emergency-stop devices must not cause a restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been properly installed and with the housing closed.
- Wherever faults may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, mechanical interlocks etc.).
- Frequency inverters may have hot surfaces during and immediately after operation.
- Removal of the required covers, improper installation or incorrect operation of motor or frequency inverter may destroy the device and may lead to serious injury or damage.
- The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live frequency inverters.
- The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to cable cross sections, fuses, PE).
- Transport, installation, commissioning and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations).
- Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the frequency inverters using the operating software are permitted.
- All covers and doors must be kept closed during operation.
- To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the frequency inverter (increased motor speed or sudden standstill of motor). These measures include:
 - Other independent devices for monitoring safety related variables (speed, travel, end positions etc.).
 - Electrical or non-electrical system-wide measures (electrical or mechanical interlocks).
 - Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs.

Disclaimer

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1 General

Variable frequency drives of the series **PowerXL™ DC1...E1** are used for the speed control of asynchronous motors. The speed set point can be provided in different ways:

- via an analog signal at the control terminals
- as a fixed frequency value, which is selected by a digital command
- as a digital reference, which is adjusted via keypad or control terminals
- via a connected fieldbus.

These possibilities are the same for all DC1...E1 power ratings.

This Application Note describes:

- the different ways of set point setting
- the handling of the references

Set point setting via fieldbus is not handled inside this Application Note.

Further information:

AP040057EN I/O Configuration describes:

- the existing input and output terminals
- the possibility to extend the number of I/Os
- the technical data
- the assignment of functions to terminals

AP040054EN Starting, Stopping and Operation describes:

- the different possibilities at starting and stopping
- the respective control commands
- the setting of the relevant parameters
- the behavior in case of a fault

Some required parameters are inside Level 2 of the menu. This level has to be activated by prompting the "Password Level2" (P-37) into P-14 (Password). Password Level2 is "101" by default.

1.1 Settings in Hz or rpm

Parameter P-10 „Motor Nom Speed“ determines, if the setting is done in Hz or rpm:

P-10 = 0: Setting / display of the output frequency in Hz

P-10 > 0: all speed related parameters (P-01, P-02, P-20 ... P-23, P-26, P-27, P-29) are set and displayed in rpm.

PNU	Parameter	Name	Range	Default
217.0	P-10	Motor Nom Speed	0 / 200 ... 30000 rpm	0 rpm

1.2 Upper and lower speed limit

The speed range of the connected motor is determined by the parameters “f-min” (P-02) and “f-max” (P-01). The reference is linear between these two values.

Please note, that the value of P-01 cannot be exceeded, even when multiple references are added up. The value of P-02 cannot be undercut. This is true for both senses of rotation.

$$\text{Frequency respectively speed} = P-02 + (\text{set point}_{\text{actual}} / \text{set point}_{\text{max}}) \cdot (P-01 - P-02)$$

Example 1:

P-10 = 0 (setting / display in Hz)

P-01 = 50 Hz

P-02 = 0.0 Hz

Set point via analog input: 0 ... 10 V

Set point actually set: 5 V

$$\text{Frequency} = 0 \text{ Hz} + (5 \text{ V} / 10 \text{ V}) \cdot (50 \text{ Hz} - 0 \text{ Hz}) = 0 \text{ Hz} + 0.5 \cdot 50 \text{ Hz} = 25 \text{ Hz}$$

Example 2:

P-10 = 1470 rpm (setting / display in rpm)

P-01 = 1470 rpm

P-02 = 300 rpm

Set point via analog input: 0 ... 10 V

Set point actually set: 5 V

$$\text{Speed} = 300 \text{ rpm} + (5 \text{ V} / 10 \text{ V}) \cdot (1470 \text{ rpm} - 300 \text{ rpm}) = 300 \text{ rpm} + 0.5 \cdot 1170 \text{ rpm} = 885 \text{ rpm}$$

PNU	Parameter	Name	Range	Default
20.1	P-01	f-max	P-02 ... 5 · P-09 (500 Hz max)	50.0 Hz
20.0	P-02	f-min	0.0 Hz ... P-01	0.0 Hz

Note:

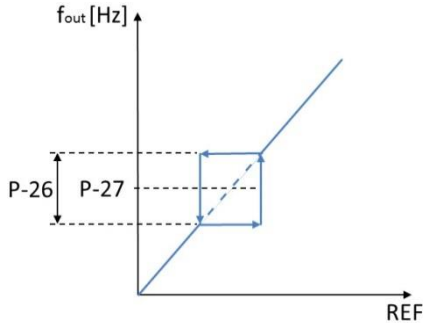
- With values of P-10 > 0 the setting is done in rpm instead of Hz.
- The value, which can be set with P-01 „f-max“, is limited to five times „Motor Nom Frequency“ (P-09) with a maximum of 500 Hz.
- In case the set point value is provided with an analog signal -10 ... + 10 V, „f-min“ (P-02) must be set to zero.
- When the value of P-09 „Motor Nom Frequency“ is changed, P-01 is set to the value of P-09.

1.3 Behavior during change over between reference sources

During a change over between two reference sources, e.g. from an analog signal to a fixed frequency, the new reference is approached with the actual ramp. The ramp times are determined by “t-acc” (P-03) for acceleration and “t-dec” (P-04) for deceleration.

1.4 Skip frequencies to avoid resonances

In some applications an operation of the motor in a certain frequency band leads to mechanical resonances, which can end up in a destruction of machine parts. The devices of the series **PowerXL™ DC1...E1** have the possibility to skip this frequency band for steady operation to avoid this effect.



Fading out frequencies is possible with all kind of reference signals, not depending on where they come from, e.g. analog input, fixed frequency, output of a PI controller, digital reference ... , whatever is selected.

The band width is determined by P-26 “f-SkipBand1”, while the center point is defined by P-27 “f-Skip1”. The diagram on the left hand side shows the behavior. Setting P-26 to zero, deactivates the function.

REF = Reference

Example:

A motor runs up to 50 Hz. In the range between 15 Hz and 25 Hz mechanical resonances can occur. Therefore the motor may not run inside this range steadily.

Band width: $P-26 = 25 \text{ Hz} - 15 \text{ Hz} = 10 \text{ Hz}$

Center point: $P-27 = \frac{15 \text{ Hz} + 25 \text{ Hz}}{2} = 20 \text{ Hz}$

How it works:

The reference is below the disabled range. → Drive runs with the set frequency. → Increase of reference into the disabled range → Motor accelerates and remains at the lower limit (in this example: 15 Hz). → Increase of reference above the disabled range → Motor accelerates with the ramp, set with P-03 “t-acc” to the new speed. → Motor operates above the disabled range according to the reference. → Reduction of reference into the disabled area → Motor decelerates and remains at the upper limit (in this example: 25 Hz). → Reduction of reference below the disabled area → Motor decelerates with the ramp, set with P-04 “t-dec” to the new speed.

PNU	Parameter	Name	Range	Default
22.0	P-26	f-SkipBand1	0...P-01	0 Hz ¹⁾
21.0	P-27	f-Skip1	0...P-01	0Hz ¹⁾

¹⁾ The default setting of P-10 “Motor Nom Speed” = 0. In this case the values for P-26 and P-27 are given in Hz. When P-10 is different from „0“, P-26 and P-27 have to be set in min⁻¹.

2 Analog reference

Variable frequency drives of the series DC1...E1 have two analog inputs:

- Analog input AI1 terminal 6
- Analog input AI2 terminal 4

The configuration of the inputs and outputs is described inside the Application Note „I/O Configuration“ (AP040035EN). Beside the setting of the signal format (voltage or current), offset and a scaling factor can be used to adopt the speed to the input signal.

2.1 Selecting the sense of rotation

The analog value at the respective terminal determines the amount of speed.

The control commands FWD and REV select clockwise or counter clockwise sense of rotation. If a change of sense is required, the actual command (e.g. FWD) has to be removed first, before applying the other one (e.g. REV). Applying FWD and REV simultaneously leads to a Quick Stop with the ramp set with “t-QuickDec” P-24.

When using a reference signal of -10 V ... + 10 V (- 10- 10) the sense of rotation is determined by the polarity of the signal.

2.2 Format of the analog value

The speed reference signal can be a voltage signal as well as a current one. It is invertible and thus the maximum speed can be selected with the minimum analog signal level and vice versa.

Format	counter clockwise rotation		clockwise rotation	
	f-min	f-max	f-min	f-max
0 ... 10 V (U 0-10)	0 V + REV	10 V + REV	0 V + FWD	10 V + FWD
-10 V ... + 10 V (- 10- 10)*	0 V	+10 V + REV -10 V + FWD	0 V	+10 V + FWD -10 V + REV
0 ... 20 mA (A 0-20)	0 mA + REV	20 mA + REV	0 mA + FWD	20 mA + FWD
4 ... 20 mA (E 4-20)	4 mA + REV	20 mA + REV	4 mA + FWD	20 mA + FWD
4 ... 20 mA (r 4-20)	4 mA + REV	20 mA + REV	4 mA + FWD	20 mA + FWD
20 ... 4 mA (E 20-4)	20 mA + REV	4 mA + REV	20 mA + FWD	4 mA + FWD
20 ... 4 mA (r 20-4)	20 mA + REV	4 mA + REV	20 mA + FWD	4 mA + FWD
10 ... 0 V (U 10-0)	10 V + REV	0 V + REV	10 V + FWD	0 V + FWD

*When selecting -10 V ... +10 V, the minimum frequency (P-02) must be set to zero!

Note: In case a terminal configuration without the commands FWD and REV is selected with P-15, the sense of rotation is set with the commands START and DIR.

- Clockwise rotation → START
- Counter clockwise rotation → START + DIR

3 Fixed frequencies

Fixed frequencies are references, which are set once, e.g. during commissioning and which can be selected by a digital command when required. The devices of the series DC1...E1 have up to 4 fixed frequencies f-Fix1 ... f-Fix4, which can be selected independently.

3.1 Setting the frequency value

The setting of the fixed frequencies is done with P-20 up to P-23. Each value can be between zero and the maximum frequency „f-max“ (P-01). It has to be noted, that the minimum frequency “f-min” (P-02) will not be undercut, even when the fixed frequency is set to a lower value than P-02.

Example:

P-02 (f-min) = 10 Hz

P-20 (f-Fix1) = 5 Hz

When f-Fix1 is selected, the drive runs with 10 Hz!

PNU	Parameter	Name	Range	Default
5.1	P-20	f-Fix1	0 ... f-max (P-01)	15.0 Hz
5.2	P-21	f-Fix2	0 ... f-max (P-01)	0 Hz
5.3	P-22	f-Fix3	0 ... f-max (P-01)	0 Hz
5.4	P-23	f-Fix4	0 ... f-max (P-01)	0 Hz

NOTE: A change of P-09 “Motor Nom Frequency” sets the values of P-20 ... P-23 to the default ones.

3.2 Selecting the sense of rotation

When using a fixed frequency the sense of rotation is determined by the commands FWD (clockwise) and REV (counter clockwise) respectively DIR. A negative sign leads to an inversion.

Required sense of rotation	Commands for selection	Polarity of the fixed frequency
Clockwise rotation	FWD resp. START	+
Counter clockwise rotation	FWD resp. START	-
Clockwise rotation	REV resp. START + DIR	+
Counter clockwise rotation	REV resp. START + DIR	-

3.3 Selecting the fixed frequency

The fixed frequencies can be activated via commands at the control terminals or via a field bus. The selection is binary coded → for 4 fixed frequencies 2 Bits (B0 ... B1) are required. The predefined terminal configurations selected with P-15 enable access to the fixed frequencies.

3.3.1 Selection with predefined terminal configurations (P-15)

P-12 = 0: Terminal mode				
P-15	DI1 (Terminal 2)	DI2 (Terminal 3)	DI3/AI2 (Terminal 4)	DI4/AI1 (Terminal 6)
0	START	DIR	Select AI1 REF / f-Fix1	AI1 REF
1	FWD	Select AI1 REF / f-Fix	Select f-Fix Bit0	AI1 REF
2	FWD	Select f-Fix Bit0	Select f-Fix Bit1	Select f-Fix / f-max
3	FWD	Select AI1 REF / f-Fix1	EXTFLT	AI1 REF
4	FWD	Select AI1 REF / AI2 REF	AI2 REF	AI1 REF
5	FWD	REV	Select AI1 REF / f-Fix1	AI1 REF
6	START	DIR	EXTFLT	AI1 REF
7	FWD	REV	EXTFLT	AI1 REF
8	START	DIR	Select f-Fix Bit0	Select f-Fix Bit1
9	FWD	REV	Select f-Fix Bit0	Select f-Fix Bit1
10	Pulse FWD (NO)	Pulse STOP (NC)	Select AI1 REF / f-Fix1	AI1 REF
11	Pulse FWD (NO)	Pulse STOP (NC)	Pulse REV (NO)	AI1 REF
12	FWD	Select t-dec / t-QuickDec	Select AI1 REF / f-Fix1	AI1 REF
13	FWD	Select f-Fix Bit0	EXTFLT	Select f-Fix Bit1
14	Pulse FWD (NO)	Pulse STOP (NC)	Pulse REV (NO)	Select DIG REF / f-Fix1
15	FWD	Select f-Fix4 / AI1 REF	Select Fire Mode / Normal OP	AI1 REF
16	START	Select f-Fix4 / f-Fix2	Select Fire Mode / Normal OP	DIR
17	FWD	Select f-Fix Bit0	Select Fire Mode / Normal OP	Select f-Fix Bit1

Inside the Application Note „I/O Configuration“ (AP040035EN) the configuration of the control terminals is described. The following commands are important for the selection of fixed frequencies:

Abbreviation	Function															
Select AI1 REF / f-Fix	Selection between the analog speed reference at analog input AI1 (terminal 6) and a fixed frequency. The fixed frequency itself is selected with the commands “Select f-Fix Bit0 ... 1”. Low = analog reference, High = Fixed frequency															
Select AI1 REF / f-Fix1	Selection between the analog speed reference at analog input AI1 (terminal 6) and the fixed frequency 1 (f-Fix1), set with P-20. Low = analog reference, High = f-Fix1.															
Select BUS REF / f-Fix	Selection between references. Low = reference from a field bus, High = Fixed frequency. The fixed frequency itself is selected with the commands “Select f-Fix Bit0 ... 1”.															
Select BUS REF / f-Fix1	Selection between references. Low = reference from a fieldbus, High = f-Fix1, set with P-20.															
Select DIG REF / f-Fix	Selection between a digital reference, set with a keypad or via the commands UP and DOWN and a fixed frequency. The fixed frequency itself is selected with the commands “Select f-Fix Bit0 ... 1”. Low = digital reference, High = fixed frequency															
Select DIG REF / f-Fix1	Selection between a digital reference, set with a keypad or via the commands UP and DOWN and f-Fix1, set with P-20 Low = digital reference, High = f-Fix1															
Select f-Fix Bit 0 Select f-Fix Bit 1	Selection of the fixed frequency with digital commands. The fixed frequencies f-Fix1 ... f-Fix4 are defined with P-20 ... P-23. <table border="1"> <thead> <tr> <th></th> <th>Bit 1</th> <th>Bit 0</th> </tr> </thead> <tbody> <tr> <td>f-Fix1 (P-20)</td> <td>Low</td> <td>Low</td> </tr> <tr> <td>f-Fix2 (P-21)</td> <td>Low</td> <td>High</td> </tr> <tr> <td>f-Fix3 (P-22)</td> <td>High</td> <td>Low</td> </tr> <tr> <td>f-Fix4 (P-23)</td> <td>High</td> <td>High</td> </tr> </tbody> </table>		Bit 1	Bit 0	f-Fix1 (P-20)	Low	Low	f-Fix2 (P-21)	Low	High	f-Fix3 (P-22)	High	Low	f-Fix4 (P-23)	High	High
	Bit 1	Bit 0														
f-Fix1 (P-20)	Low	Low														
f-Fix2 (P-21)	Low	High														
f-Fix3 (P-22)	High	Low														
f-Fix4 (P-23)	High	High														

Abbreviation	Function
Select f-fix / f-max	Selection between a fixed frequency and the maximum speed, set with P-01. The fixed frequency itself is selected with the commands "Select f-Fix Bit0 ... 1". Low = Fixed frequency, High = maximum speed.
Select f-fix4 / AI1REF	Selection between fixed frequency f-Fix4, set with P-23 and the analog reference at terminal 6 Low = f-Fix4, High = analog reference
Select f-fix4 / f-Fix2	Selection between the fixed frequencies f-Fix4 (P-23) and f-Fix2 (P-21) Low = f-Fix4, High = f-Fix2
Select PID REF / f-Fix	Selection between references. Low = reference from the output of the PI controller, High = Fixed frequency. The fixed frequency itself is selected with the commands "Select f-Fix Bit0 ... 1".
Select PID REF / f-Fix1	Selection between references. Low = reference from the output of the PI controller, High = f-Fix1, set with P-20

3.3.2 Use of fixed frequencies in device functions

In certain situations, fixed frequencies are selected by a device function. Please take care, that there is no collision because of user specific settings.

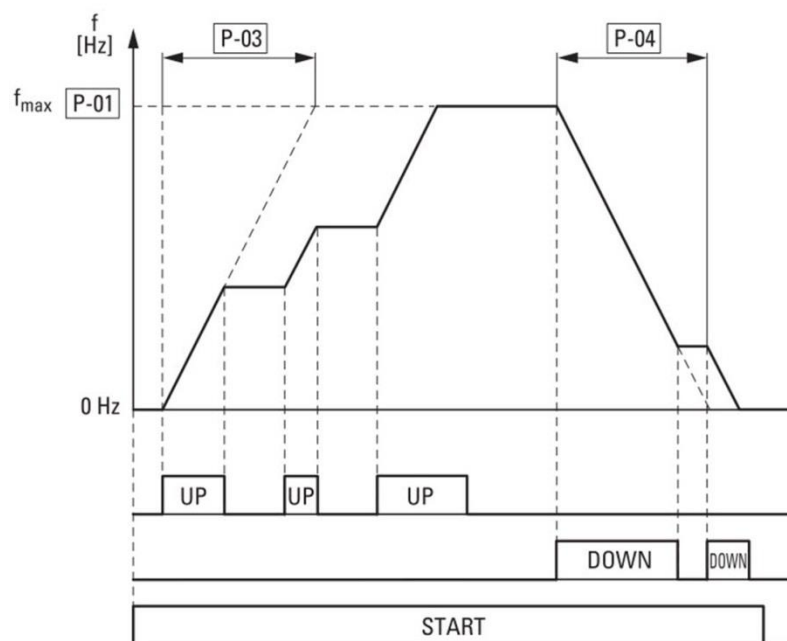
Fixed frequency	Function
f-Fix1	When P-16 = 4 or 6 and/or P-47 = 3 or 5 (analog inputs with a signal 4 ... 20 mA) the drive ramps to f-Fix1, in case of wire break in the reference circuit.

4 Digital reference

The speed reference of the variable frequency drives DC1...E1 can also be given via digital commands. The command UP (faster) increases the content of the reference counter, while DOWN (slower) reduces it. The use of a digital reference has the advantage, that the reference can be set from different locations by paralleling push buttons, which is required in cases of large machines.

The setting occurs between the minimum speed / frequency (f-min, P-02) and the maximum frequency / speed (f-max, P-01) with the actual ramp. The setting can be done with the keypad as well as via terminals.

Example:



- When an enabled drive gets the “UP” command, the motor accelerates according to the actual ramp according to “t-acc” (P-03)
- When the „UP“ command is removed, the speed remains constant. Applying “UP” again leads to a further acceleration. The maximum frequency / speed is defined with “f-max” (P-01).
- Consequently, applying „DOWN“ leads to a speed reduction.
- When starting, the drive ramps to the speed determined by P-31 without an “UP” command.

4.1 Configuration

4.1.1 Terminals / Keypad

The possibility, where to modify the digital reference, is determined by P-12:

UP / DOWN via keypad and possibly via terminals in case P-15 = 0 / 2 / 3 / 4. No reversing by using the keypad possible.	P-12 = 1
UP / DOWN via keypad and possibly via terminals in case P-15 = 0 / 2 / 3 / 4. Reversing by using the keypad is possible.	P-12 = 2

With all other settings of P-12 operation with a digital reference is not possible.

P-12 = 1 or 2: digital reference				
P-15	DI1 (Terminal 2)	DI2 (Terminal 3)	DI3/AI2 (Terminal 4)	DI4/AI1 (Terminal 6)
0	START	UP	DOWN	DIR
1	not allowed			
2	FWD	UP	DOWN	Select DIG REF / f-Fix1
3	FWD	UP	EXTFLT	DOWN
4	START	UP	Select DIG REF / AI1 REF	AI1 REF
5	not allowed			
6	START	DIR	EXTFLT	Select DIG REF / f-Fix1
7	FWD	REV	EXTFLT	Select DIG REF / f-Fix1
8	not allowed			
9	not allowed			
10	not allowed			
11	not allowed			
12	not allowed			
13	FWD	no function	EXTFLT	no function
14	not allowed			
15	FWD	Select f-Fix / DIG REF	Select Fire Mode / Normal OP	Select f-Fix4 / f-Fix2
16	FWD	Select f-Fix4 / DIG REF	Select Fire Mode / Normal OP	DIR
17	FWD	Select DIG REF / f-Fix4	Select Fire Mode / Normal OP	DIR

4.1.2 Reference at start and at changeover between speed sources

When starting a drive with a digital reference and when changing over from another speed source, e.g. a fixed frequency, to a digital reference the reference value to be ramped to is determined by the setting of P-31 "Digital Reference Reset Mode":

- P-31 = 0 or 2
 - Minimum speed
 - Example 1: Behavior at start
 - Drive runs with digital reference → switch OFF → restart → drive ramps to the minimum speed, set with P-02 „f-min“.
 - Example 2: Behavior at changeover between speed sources
 - Drive runs with digital reference → Changeover to another speed source by applying a signal to the terminal → drive ramps to the speed required by the other speed source → Select "Digital reference" by removing the signal from the terminal → drive ramps to the minimum speed, set with P-02 „f-min“. The speed can now be changed with the keys on the keypad or with the signals UP and DOWN at the control terminals.
- P-31 = 1 or 3
 - Start with the latest speed before switching OFF or changing over to another speed source, set with the keypad or with the commands UP and DOWN at the terminals. This also applies to cases where another speed source was active at the time of switching OFF, but which is not selected at restart.

- Example 1: The digital reference was set with the keypad to 1000 rpm. The speed source was changed from “Digital reference” to „Fixed Frequency 1” by means of a command at the control terminals. The drive is switched OFF when “Fixed Frequency1” is active.
 - Select „Digital reference“ at the terminals → drive ramps to the 1000 rpm set with the keypad
 - „Fixed Frequency 1“ was selected at the terminal when restarting → Drive ramps to Fixed Frequency 1
 - Changeover to “Digital reference” with the signal at the terminals → drive ramps to 1000 rpm
- Example 2: Switching OFF when the drive runs with another speed source than the digital reference
 - Selection of the other speed source is still active at restart → drive ramps to the speed of the other speed source.
 - Selection of the other speed source is not active at restart → drive ramps to the latest digital reference.
- P-31 = 4 or 6
 - Start with the speed before switching OFF / changing over. This setting is mostly used in cases where a changeover between speed sources, e.g. between a digital reference and a fixed frequency, is required.
 - Example 1: Changeover between a digital reference and another speed source
 - Drive runs with digital reference → Changeover → drive ramps to the speed of the other speed source → back to digital reference → drive runs with the speed of the previous speed source, which was selected before changing over. The speed can now be changed with the keys on the keypad or with the signals UP and DOWN at the control terminals. ATTENTION: In case a fixed frequency is used as speed source, it may have no negative sign!
 - Example 2: Switching OFF when a digital reference is active and restart
 - Drive ramps to the minimum speed, set with P-02 „f-min“.
 - Example 3: Switching OFF when another speed source is active
 - Selection of another speed source is still active at restart: drive ramps to the speed provided by the other speed source
 - Selection of another speed source not active at restart: Drive ramps to the minimum speed, set with P-02 „f-min“.
- P-31 = 5 or 7
 - Fixed Frequency 4 (P-23)
 - Note: At start the sense of rotation is ALWAYS determined by the commands at the terminals. A possible negative sign of the fixed frequency value is not taken into account!

P-31 „Digital Reference Reset Mode“ also determines, how the drive can be started when P-12 = 1 or 2:

- P-31 = 0 / 1 / 4 / 5
 - Starting of the drive by pushing the green START button on the keypad.
 - To start, an additional signal at the terminals is necessary (START / FWD / REV)
- P-31 = 2 / 3 / 6 / 7
 - The start of the drive is carried out via the terminals (see also 4.1.1). A start with the button on the keypad is not possible.
 - Note: With P-12 = 2 it is still possible to reverse the drive by pushing the green button on the keypad.

PNU	Parameter	Name	Range	Default
620.3	P-31	Digital Reference Reset Mode	0 / 1 / 4 / 5: START via keypad 0: Minimum speed (P-02) 1: Previous speed from Keypad / terminals (UP/DOWN) 4: Running speed before switching OFF / changing over 5: f-Fix4 (P-23) 2 / 3 / 6 / 7: START via terminals 2: Minimum speed (P-02) 3: Previous speed from Keypad / terminals (UP/DOWN) 6: Running speed before switching OFF / changing over 7: f-Fix4 (P-23)	1

4.2 Operation

4.2.1 Starting / Stopping

Drives, which operate with a digital reference, can be started via terminals as well as via keypad. The possibilities depend on the setting of parameter P-31 "Digital Reference Reset Mode".

P-31 = 0 / 1 / 4 / 5:

A signal at the terminals as well as the START command from the keypad is necessary. The signal at the terminal must be present before the button on the keypad is pushed.

P-31 = 2 / 3 / 6 / 7:

Start with a signal at the terminals. START and STOP button on the keypad are disabled. In this case the keypad cannot be used to start and stop the drive, but with P-12 = 2 the green button can still be used to reverse it (see 4.1.2).

4.2.2 Increase / reduce speed

When using a digital reference the speed is changed via the commands UP and DOWN. For the duration of the commands the speed is increased respectively reduced. The commands are given via the keypad or via terminals.

The behavior of the drive is depending on keypad or terminal adjustment. While a command via terminals modifies the speed with the actual ramp directly, an adjustment with the keypad has a slope and works more smoothly. This results in a delay of about 1.5 s for every actuation.

With the setting of P-12 = 1 or 2 a speed adjustment via keypad is always possible, an adjustment via terminals only with the settings P-12 = 1 or 2 AND P-15 = 0 / 2 / 3 / 4.

Note:

- Simultaneous use of UP and DOWN via keypad reduces the speed.
- When applying UP and DOWN simultaneously to the terminals, the command which was applied first gets priority.
- A speed adjustment via keypad is also possible in cases where starting and stopping via keypad is disabled.

4.2.3 Change sense of rotation

The sense of rotation at start with a digital reference is basically determined by the terminal commands. With P12 = 2 one has the possibility to reverse the motor by pressing the green Start button on the keypad. Behavior at start: see column "Sense of rotation at START" in the table below.

P-12	P-31	P-15	Sense of rotation via terminal	Sense of rotation via keypad	Sense of rotation at START
P-12 = 1	P-31 = 0 ... 7	P-15 = 2 / 3 / 4 / 13 / 15	NO	NO	No change of sense of rotation possible
		P-15 = 0 / 6 / 16 / 17	YES (DIR)		Sense of rotation as selected via terminals
	P-31 = 2 / 3 / 6 / 7	P-15 = 7	YES (FWD / REV)		
P-12 = 2	P-31 = 0 ... 7	P-15 = 2 / 3 / 4 / 13 / 15	NO	YES (INV)	Sense of rotation as selected via terminals, taking into account a possible inversion at the time of stopping the drive (Start button on the keypad).
		P-15 = 0 / 6 / 16 / 17	YES (DIR)		
	P-31 = 2 / 3 / 6 / 7	P-15 = 7	YES (FWD / REV)		

Note:

- P-15 = 7
 - Applying the FWD and REV commands simultaneously leads to a Quickstop with the ramp set with P-24 „t-QuickDec“.
 - In applications with reversion, the Stop Mode should be set in a way, that the ramp is active (P1-5 = 0 or 2). If this is not the case a changeover between the commands FWD and REV is detected as stop command and the drive behaves according the setting with P-05. After this, it restarts into the opposite direction. If, application dependent, P-05 is set to "coast to stop" (setting 1), spin start has to be enabled with P-33 = 1.
- P-12 = 2
 - A possible inversion with the Start button on the keypad is stored at stop. The drive restarts with the same sense of rotation he had before stopping. Please note, that in this case the sense of rotation at restart cannot be clearly defined by the terminal commands.