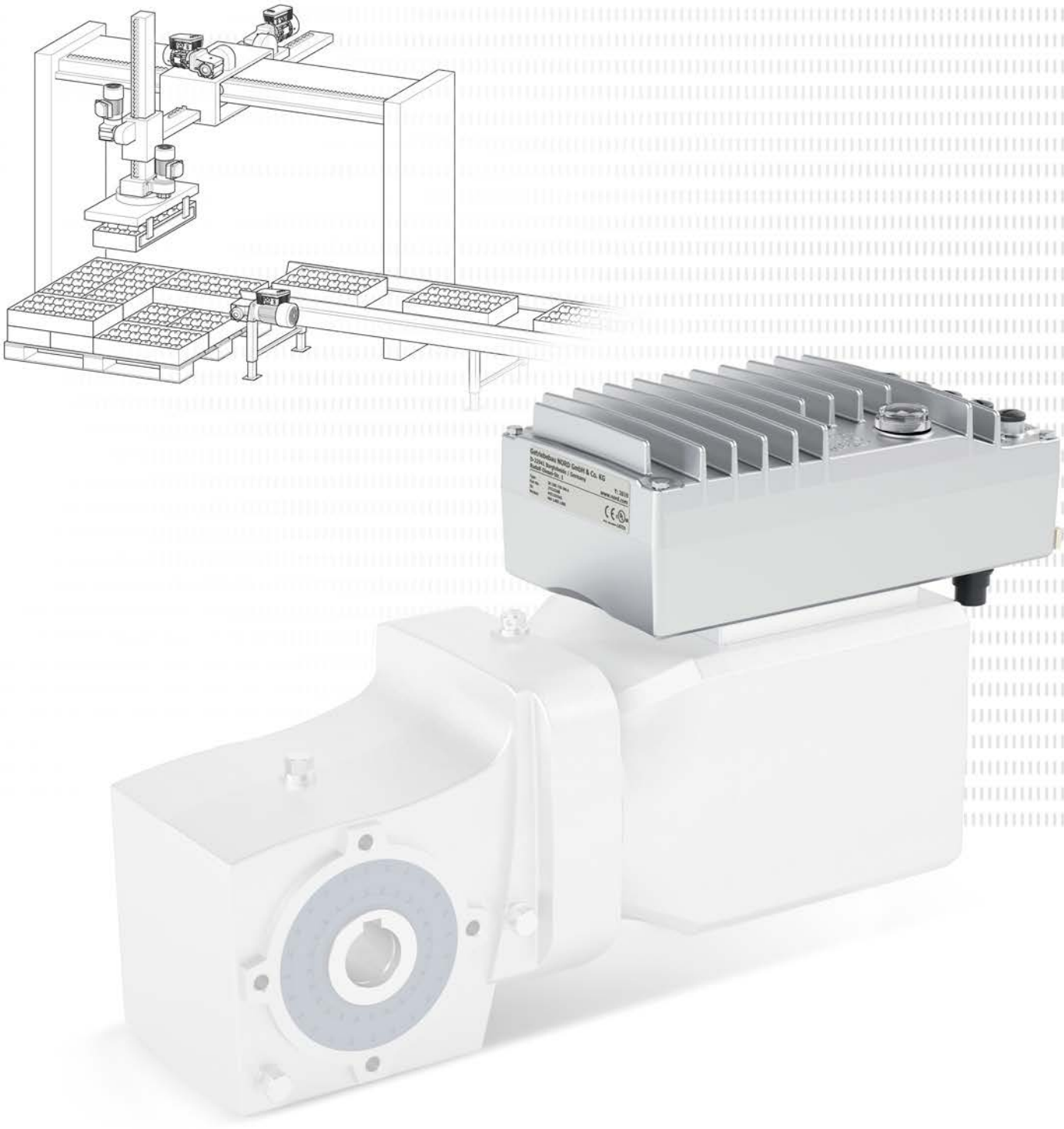

**BU 0810 – en**

# POSICON positioning control

**Supplemental manual for series SK 300P**

NORD DRIVESYSTEMS

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# 1 Introduction

## 1.1 General

### 1.1.1 Documentation

Designation: **BU 0810**

Part number: **6078102**

Series: **POSICON for frequency inverters from the series NORDAC *ON+*** (SK 31xP)

### 1.1.2 Document history

| Edition<br>Order number | Series | Version<br>Software | Remarks |
|---|---|---|---|
| **BU 0810**,<br>April 2021 | SK 3xxP | V 1.1 R1 | First edition |
| **BU 0810**,<br>November 2021 | SK 3xxP | V 1.3 R1 | Revised edition |
| **6078102**/ 4821 | | | |
| **BU 0810**,<br>January 2022 | SK 3xxP | V 1.3 R1 | Revised edition |
| **6078102**/ 0322 | | | |

### 1.1.3 Copyright notice



### 1.1.4 Publisher

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### 1.1.5 About this manual

This manual is intended to assist you in the setup of a positioning application for a frequency inverter manufactured by Getriebebau NORD GmbH & Co. KG (abbreviated as NORD). It is intended for all qualified electricians who plan, install and set up the positioning application (🕮 Section 2.2 "Selection and qualification of personnel"). The information in this manual assumes that the qualified electricians who are entrusted with this work are familiar with using electronic drive technology and in particular with devices manufactured by NORD.

This manual only contains information and descriptions of the POSICON technology function and the relevant additional information for frequency inverters manufactured by Getriebebau NORD GmbH & Co. KG.

## 1.2 Other applicable documents

This document is only valid in combination with the operating instructions for the frequency inverter which is used. Safe commissioning of the drive application depends on the availability of the information contained in this document.. A list of the documents can be found in 🕮 Section 9.2 "Documents and software".

The necessary documents can be found under www.nord.com.

## 1.3 Presentation conventions

### 1.3.1 Warning information

Warning information for the safety of users are marked as follows:

**⚠ DANGER**

This warning information warns of danger to persons that results in severe injuries or death.

**⚠ WARNING**

This warning information warns of danger to persons that could result in severe injuries or death.

**⚠ CAUTION**

This warning information warns of danger to persons that could usually result in moderate injuries.

***NOTICE***

This warning information warns of material damage.

### 1.3.2 Other information

**Information**

This information shows tips and important information.

### 1.3.3 Text markings

The following markings are used to differentiate between various types of information:

#### Text

| Type of information | Example | Marking |
|---|---|---|
| Instructions | 1.<br>2. | Instructions whose sequence must be complied with are numbered sequentially. |
| Bullet points | • | Bullet points are marked with a dot. |
| Parameter | **P162** | Parameters are indicated by a “P” prefix, a three-digit number and bold lettering. |
| Arrays | [-01] | Arrays are indicated by square brackets. |
| Factory settings | { 0.0 } | Factory settings are indicated by curly brackets. |
| Software descriptions | “**Cancel**” | Menus, fields, windows, buttons and tabs are indicated by quotation marks and bold lettering. |

#### Numbers

| Type of information | Example | Marking |
|---|---|---|
| Binary numbers | 100001b | Binary numbers are indicated by the suffix “b” |
| Hexadecimal numbers | 0000h | Hexadecimal numbers are indicated by the suffix “h” |

#### Symbols used

| Type of information | Example | Marking |
|---|---|---|
| Cross-reference | 🕮 Chapter | Internal cross-reference: A mouse click on the text calls up the stated point in the document. |
| | 🕮 Supplementary manual | External cross-reference |
| Hyperlink | http://www.nord.com/ | References to external websites are indicated in blue and underlined. A mouse click calls up the website. |

#### Type designations

| Designation | Description |
|---|---|
| SK 1x0E | Frequency inverter of SK 180E series |
| SK 2xxE | Frequency inverter of SK 200E series |
| SK 2x0E-FDS | Frequency inverter of SK 250E-FDS series |
| SK 3xxP | Frequency inverter of SK 300P series |
| SK 5xxE | Frequency inverter of SK 500E series |
| SK 5xxP | Frequency inverter of SK 500P series |

# 2 Safety

## 2.1 Intended use

The POSICON technology function from Getriebebau NORD GmbH & Co. KG is a software-assisted functional extension for frequency inverters manufactured by NORD. It forms an integral part of the frequency inverter and cannot be used without this. Because of this, all of the specific safety information for the relevant frequency inverter contained in the relevant manual (🕮 Section 9.2 "Documents and software") apply without restriction.

The POSICON technology function is essentially used as a solution for complex drive applications with positioning functions which are implemented using frequency inverters manufactured by NORD.

## 2.2 Selection and qualification of personnel

The POSICON technology function may only be commissioned by qualified electricians. These must have the necessary knowledge of the technology functions and the electronic drive technology and the configuration aids which (e.g. NORD CON software) which are used, as well as the peripherals (including the controller) which are used in association with the drive application.

In addition, the qualified electricians must also be familiar with the installation, commissioning and operation of the sensors and electronic drive technology, as well as all of the accident prevention regulations, guidelines and laws which apply at the place of use.

### 2.2.1 Qualified personnel

Qualified personnel includes persons who due to their specialist training and experience have sufficient knowledge in a specialised area and are familiar with the relevant occupational safety and accident prevention regulations as well as the generally recognised technical rules.

These persons must be authorised to carry out the necessary work by the operator of the system.

### 2.2.2 Qualified electrician

An electrician is a person who, because of their technical training and experience, has sufficient knowledge with regard to

- Switching on, switching off, isolating, earthing and marking power circuits and devices,
- Proper maintenance and use of protective devices in accordance with defined safety standards.
- Emergency treatment of injured persons.

## 2.3 Safety information

Only use the technology function **POSICON positioning control** and the frequency inverter from Getriebebau NORD GmbH & Co. KG for their intended purposes as stated in 🕮 Section 2.2 "Selection and qualification of personnel".

Observe the instructions in this manual in order to ensure the safe use of the technology function.

Only commission the frequency inverter in a technically unmodified form and not without the necessary covers. Take care that all connections and cables are in good condition.

Work on and with the frequency inverter must only be carried out by qualified personnel, 🕮 Section 2.1 "Intended use".

# 3 Electrical Connection

**WARNING**

**Electric shock**

Contact with electrically live components may result in electric shock, possibly with serious or fatal injuries.

- Disconnect the device electrically before starting installation work.
- Only work on devices with switched-off power.

**WARNING**

**Electric shock**

The frequency inverter has a hazardous voltage for up to 5 minutes after it has been switched off

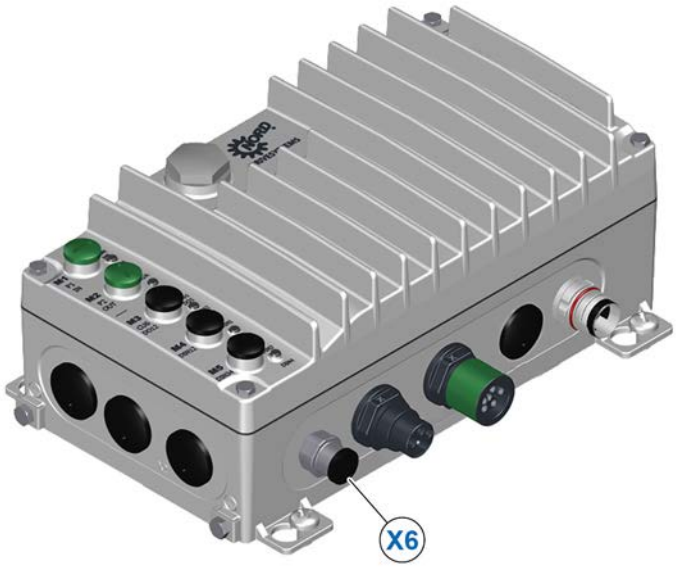
- Only begin work after a waiting time of at least 5 minutes since the mains was switched off (disconnection).

Position control by the frequency inverter can only be used if it receives immediate feedback of the current position of the drive unit.

An encoder is usually used to detect the current position.

## 3.1 Connection to the device

Electrical connection of the position measurement systems is made via plug connections on the device. For motor-mounted devices with integrated universal encoder (option), the connection is already made internally at the factory.




External universal encoders are connected via the optional encoder connection **X6** to the wall-mounted NORDAC *ON+*.

## 3.2 Encoders

**Encoder input**

The incremental encoder connection is an input for a type with two tracks and TTL-compatible signals for EIA RS 422-compliant drivers. The maximum current consumption of the incremental encoder must not exceed 150 mA.

The pulse number per rotation can be between 16 and 8192 increments. This is set with the normal scaling via parameter **P301** "Incremental encoder pulse number" in the "Speed control" menu group. For cable lengths >20 m and motor speeds above 1500 $min^{-1}$, the encoder should not have more than 2048 pulses/revolution.

### Information

**Encoder signal faults**

Wires that are not required (e.g. Track A inverse/ B inverse) must be insulated. Otherwise, if these wires come into contact with each other or the cable shield, short-circuits may occur, which can cause encoder signal problems or destruction of the encoder.

### Information

**Rotation direction**

The counting direction of the incremental encoder must correspond to the direction of rotation of the motor. If the two directions are not identical, the connections of the encoder tracks (Track A and Track B) must be switched. Alternatively, the resolution (pulse number) of the encoder in **P301** can be set with a negative prefix.

Alternatively, the motor phase sequence can be changed via parameter **P583**. In this way the direction of rotation can be changed using the software only.

**Incremental encoder**

Depending on the resolution (pulse number), incremental encoders generate a defined number of pulses for each rotation of the encoder shaft (Track A / Track A inverse). With this, the precise speed of the encoder or motor can be measured by the frequency inverter. By the use of a second track (B / B inverse) shifted by 90° (¼ period), the direction of rotation can also be determined.

The 12 V encoder power supply is made internally by the frequency inverter. An additional external source is not required.

For the NORDAC *ON*+, a HTL encoder may be connected via the M12 socket **M5**. An RS485, SSI/BISS or TTL encoder is optionally integrated for motor-mounted devices. Its internal connection has already been made on delivery.

For wall-mounted devices, the connection of an external RS485, SSI/BISS or TTL encoder is made via the optional encoder connection **X6**. The connection of a HTL encoder is always made via the M12 socket **M5.**

Parameterisation of the corresponding functions is done with the parameters from the "Control parameters" group (P300 et seq.). TTL encoders enable the best performance for control of a drive unit with frequency inverters.

### Information

If the equipment deviates from the standard equipment for the motors (Type 5820.0H40, 10 … 30 V encoder, TTL/RS422 or encoder type 5820.0H30, 10 … 30 V encoder, HTL), please note the accompanying data sheet or consult your supplier.

### RS485 encoder

When using permanently excited synchronous motors, RS485 incremental encoders are optionally installed. The encoder is primarily used for the motor speed control and the commutation position of the synchronous motor. An absolute position is not recorded.

The encoder comprises two components:

- Magnet wheel, which is pressed onto the motor shaft between the A bearing cover and the rotor package with the permanent magnets
- Sensor circuit board**,** which is screwed to the A bearing cover inside the motor and scans and processes the magnetisation patterns of the magnet wheel

Regardless of the actual number of magnetic poles on the magnet wheel, the sensor circuit board enables a freely definable number of (rectangle) output periods by high resolution of the position and subsequent signal synthesis.

Thus, the sensor circuit board's zero pulses output can be positioned electronically so that they are in the position required for commutation of the synchronous motor.

The RS485 encoder supply voltage is 10 … 30 V DC. The power supply is made via the frequency inverter.

### SSI encoders

SSI encoders whose signals are TTL compatible according to EIA RS 422 can be used.

The zero point of the absolute encoder is determined by its position and should therefore be adjusted accordingly on installation.

The cycle frequency is 100 kHz. With this cycle frequency, cable lengths of up to 80 m are possible. The cables must be in the form of twisted pairs and shielded.

The encoder supply voltage is 10 … 30 V DC. An external source or the internal voltage may be used as the voltage source.

### BISS encoder

BISS is a further development of the SSI interface. It also operates with 2 RS485 channels. With BISS encoders, the position is transmitted together with a checksum. This enables increased transmission reliability in comparison with SSI.

BISS encoders are also available with an integrated incremental track.

The encoder supply voltage is 10 … 30 V DC. An external source or the internal voltage may be used as the voltage source.

# 4 Function description

## 4.1 Introduction

The positioning function can be used for positioning and position control tasks. The various methods for setpoint specification and detection of actual values are described below.

Setpoints can be specified as absolute or relative positions. *Absolute position specification* is advisable for applications with fixed positions, for example transfer trolleys, elevators, storage and retrieval devices, etc. *Relative position specification* can be used for all axes which operate step-wise, in particular with endless axes such as turntables and cycled compartmentalised conveyor belts. Setpoint specification is also possible via the bus (e.g. PROFINET). For this, the position can be specified as a value or via a combination of bits as a position number or increment.

Switchover between positioning and speed specification is made by parameter set switching. For this, the position control in parameter **P600** is parameterised to “OFF” in one parameter set and to “≠ OFF” in another parameter set. Switching between parameter sets is possible at any time, even during operation.

## 4.2 Position Detection

### 4.2.1 Position detection with incremental encoders

For an absolute actual position, a reference point is required with the aid of which the zero position of the axis can be determined. Position detection operated independently of the enabling signal of the frequency inverter and parameter **P600** “Position control”. The pulses from the incremental encoder are counted in the frequency inverter and added to the actual position. The frequency inverter detects the actual position for as long as it is supplied with power. Position changes which are made when the frequency inverter is switched off, do not result in a change of the actual position. Therefore, a reference run is usually necessary for each “Power on” of the frequency inverter.

The resolution or pulse number of the incremental encoder is set in parameter **P301** “Encoder resolution”. By setting negative pulse numbers, the direction of rotation according to the installation position of the encoder can be changed. After switching on the frequency inverter power supply, the actual position = 0 (P619 "Incremental mode" without option “…+Save position”) or it has the value which was present on switch-off (P619 "Incremental mode" with option “…+Save position”).

**Information**

**Loss of data due to premature loss of control voltage**

For NORDAC *ON*+, the control unit must be supplied with 24 V control voltage for at least 5 minutes after the last position change. This is the only way to ensure that the data are permanently saved in the FI.

If the frequency inverter is not operated in Servo Mode (**P300** “*Control method*” CFC closed-loop), the encoder can be mounted in a position other than on the motor shaft. In this case the speed ratio between the motor and the incremental encoder must be parameterised.

For this, the number of rotations of the encoder are converted into the number of rotations of the motor with the aid of parameter **P607** “Positive speed ratio” and **P608** “Negative speed ratio”.

$n_M = n_G * Ü_b / U_n$

| | | |
|---|---|---|
| $n_M$: | Number of motor rotations | |
| $n_G$: | Number of encoder rotations | |
| $Ü_b$: | Ratio | (**P607 [-02]**) |
| $U_n$: | Reduction ratio | (**P608 [-02]**) |

**Example**

The encoder is installed on the output side of the gear unit. The gear unit has a speed ratio of **i = 26.3**.

The following values are parameterised: **P607 [-02]** = 263

**P608 [-02]** = 10

**Information**

**Rotation direction**

The direction of rotation of the incremental encoder must correspond to the direction of rotation of the motor. With a positive output frequency (direction of rotation right) the actual position value must increase. If the direction of rotation is not correct, this can be corrected with a negative value in **P607** “Speed ratio”.

With the aid of the value in parameter **P609 [-02]** “Offset position” the zero point can be set to a position other than that which is determined by the reference point. The offset is taken into account after conversion of the number of encoder revolutions to the number of motor revolutions. After a change to the positive or negative speed ratio (**P607 [-02]** and **P608 [-02]** the offset must be input again.

#### 4.2.1.1 Reference run

The reference run is started via one of the digital inputs or one of the Bus IO bits. For this, a digital input (**P420**…) or a Bus IO In bit (**P480**…) must be set to function 22. The direction of the reference point search is specified via the functions “*Enable right/left*” The actual setpoint frequency determines the speed of the reference run. The reference point is also read in via one of the digital inputs or the Bus IO In bits (setting 23).

**Information**

**Use of BUS IO In bits**

Control via Bus IO In bits requires that a bus setpoint (**P546**…) is assigned the function 17.

**Reference runs**

The reference run can be performed by various methods. The type of reference run and be selected in parameter **P623** ((see chapter 6.1.6 "Positioning" on page 46)). Optionally, for the reference run, a frequency can be set via parameters **P624 [-01]** and **P624 [-02]**.

Feedback from the frequency inverter on completion of the reference point run with adoption of the valid reference point can be given via a digital signal. For this, a digital output (**P434**…) or a Bus IO Out bit (**P481**…) must be set to function 20.

**Information**

**Loss of position**

If an incremental encoder is used for position detection, in parameter P619 "Incremental mode" the setting “+ Save position” function 1 or 3) should be used. Otherwise the actual values (position, reference point) are lost when the control voltage is switched off.

The reference point run is aborted by removal of the “Enable” or by “Quick Stop” or “Disable voltage”. No error message is issued.

For referencing with the “*Reference run*” function, the position control, i.e. the present operation mode is interrupted.

#### 4.2.1.2 Reset position

Alternative to a reference run, one of the digital inputs (**P420**…) or one of the Bus IO In Bits (**P480**…) can be set to setting 61 “*Reset position*”. Unlike with function 23 “*Reference run*” the input or the Bus IO In Bit is always effective and sets the actual position to 0 immediately after a signal change from 0 → 1. If an offset has been parameterised in parameter **P609** the axis is moved by this value.

A position reset is performed regardless of the “*Position control*” setting in parameter **P600**. If relative positioning (function 1) is selected in parameter **P610** the setpoint position is simultaneously set to the value 0.

Referencing with function 61 “*Reset position*” can be performed during active position control, i.e. during positioning operation.

**Information**

**Repeat accuracy**

Referencing with the function “*Reset position*” depends on the tolerance of the reference point switch and the speed with which the switch is approached. Therefore, with this type of referencing, the repeat accuracy is somewhat less than with the function “*Reference run*”, however it is sufficient for most applications.

**Information**

**Use of Bus IO In Bits**

Control via Bus IO In Bits requires that a bus setpoint (**P546**…) is assigned with the function 17.

### 4.2.2 Position detection with absolute encoders

The absolute encoder digitally transmits the actual position signals to the frequency inverter. The position is always fully available in the absolute encoder and is correct, even if the axis has been moved while the frequency inverter is switched off. A reference point run is therefore not necessary.

If an absolute encoder is connected, parameter **P604** "*Travel measurement system*" must be parameterised to an absolute function (Setting 3 ... 8).

The encoder resolution is set in the parameter **P605**.

If the absolute encoder is not mounted on the motor shaft, the speed ratio between the motor and the absolute encoder must be parameterised. For this, the number of rotations of the encoder are converted into the number of rotations of the motor with the aid of parameter **P607** "*Positive speed ratio*" and **P608** "*Negative speed ratio*".

$n_M = n_G * Ü_b / U_n$

| | | |
|---|---|---|
| $n_M$: | Number of motor rotations | |
| $n_G$: | Number of encoder rotations | |
| $Ü_b$: | Positive speed ratio | (**P607 from [-04]**) |
| $U_n$: | Negative speed ratio | (**P608 from [-04]**) |

**Example**

The encoder is installed on the output side of the gear unit. The gear unit has a speed ratio of **i = 26.3**.

The following values are parameterised:

**P607 from [-04]** = 263

**P608 from [-04]** = 10

**Information**

**Rotation direction**

The direction of rotation of the incremental encoder must correspond to the direction of rotation of the motor. With a positive output frequency (direction of rotation right) the actual position value must increase. If the direction of rotation is not correct, this can be corrected with a negative value in **P607** "*Speed ratio*".

With the aid of a value which can be parameterised in parameter **P609 from [-04]** "*Offset position*", the zero point can be set to a position other than that which is determined by the reference point. The offset is taken into account after conversion of the number of encoder revolutions to the number of motor revolutions. After a change to the positive or negative speed ratio (**P607 from [-04]** and **P608 from [-04]** the offset must be input again.

**Information**

**Maximum possible position**

The maximum possible position in parameter **P615** "*Maximum position*" results from the resolution of the encoder and the positive or negative speed ratio **P607** and **P608**. However, the maximum value can never exceed +/- 2.000.000 rotations.

#### 4.2.2.1 Additional settings: SSI Absolute encoders

The protocol settings for SSI absolute encoders are made in parameter **P617**.

This defines

- The format in which positions are to be transmitted (Binary / Gray Code),
- Whether a power failure on the encoder is reported to the frequency inverter ("*Power Fail Bit*"),
- Whether the encoder supports the communication variant "*Multiply-Transmit*", in which the position is transmitted a second time in mirrored form in order to improve transmission reliability.

#### 4.2.2.2 Referencing of an absolute encoder

In a similar manner to incremental encoders, via the functions 22 "*Reference run*" (📖 Section 4.2.1.1 "Reference run") and 61 "*Reset position*" (📖 Section 4.2.1.2 "Reset position") absolute encoders can be set to the value "0" or the value set in parameter **P609 [-01]** (universal encoder) "*Offset Position*".

The accuracy for resetting the encoder position depends to a large extent on the actual speed of movement, the bus load and the baud rate, as well as the type of encoder. Therefore the *absolute encoder may only be reset while at a standstill*.

If both incremental encoders and absolute encoders are connected to the frequency inverter, both encoders are reset on execution of the function "*Reference run*" or "*Reset position*"

**Information**

**Restrictions for SSI encoders**

With SSI encoders, the position can only be changed with a position offset **P609 [-01]** . A reset ("*Reset position*" / "*Reference run*") is not possible.

### 4.2.3 Encoder monitoring

With active position control (**P600**, setting ≠ 0) the function of a connected absolute encoder is monitored. A corresponding error message is generated if a fault occurs. The last valid position in the frequency inverter remains visible (**P601**).

Monitoring is disabled if position control is not active (**P600**, setting = 0). No error message is generated in case of an encoder fault. The actual encoder position remains on display in parameter **P601**.

- If an absolute and an incremental encoder are present, the position difference between the two encoders can be monitored with parameter **P631** "*Slip error 2 encoders*". The maximum permissible position deviation between the absolute and the incremental encoder is specified by the value which is set in this parameter. If the permissible deviation is exceeded error message ***E14.6*** is triggered.
- With parameter **P630** "Position slip error" the actual position of the encoder is compared with the change of position which is calculated from the actual speed (estimated position) If the position difference exceeds the value set in **P630**, error message ***E14.5*** is triggered.

  The deviation between real speed (angle of rotation) and calculated angle of rotation depends on how well the drive can follow the setpoint. This varies depending on the power of the drive, duration of proceedings, inertia of the system, ramp gradient of the acceleration and the controller setting.
  On reaching a target position, the estimated position is replaced by the actual position value from the encoder in order to prevent a summation of errors.

- The permissible working range can be specified with parameters **P616** "*Minimum position*" and **P615** "*Maximum position*". If the drive goes outside of the permissible range, error messages ***E14.7*** or ***E14.8*** are triggered.

  Position setpoints which are larger than the values in **P616** or smaller than those in **P615** are automatically limited by the frequency inverter to the values which are set in the two parameters.

Position monitoring is not active if the value 0 or P621, value 1 ore P619 one of the values 2 or 3 are set in the relevant parameters.

### 4.2.4 Linear or optimum path position methods

The encoder which is used for positioning is enabled via parameter **P604** "*Path measurement system*" Allocation of the measuring method for linear or rotary systems ("optimum path measurement") is performed with **P619** or **P621**.

If the "optimum path" measuring method is used, the overrun point must be specified in **P620**.

Parameter **P601** "*Actual position*" should be selected to check the setting and function of the encoder.

**Parameter settings for linear positioning method**

| | Encoder type | Linear |
|---|---|---|
| Incremental encoder | **P604** | **P619** [-01 ] or [-02] |
| Absolute encoder | **P604** | **P621** [-01] |

**Parameter settings for optimum path positioning method**

| | Encoder type | Path optimised | Overflow point |
|---|---|---|---|
| Incremental encoder | **P604** | **P619** [-01 ] or [-02] | **P620** [-01 ] or [-02] |
| Absolute encoder | **P604** | **P619** [-01] | **P620** [-01] |

#### 4.2.4.1 Optimum path positioning

For turntable applications, the individual positions are distributed around the circumference. Use of linear positioning is not advisable for this, as the frequency inverter would not always take the shortest path to the selected position (e.g. start position -0.375, specified position +0.375, see the following illustration “linear path”

In contrast, positioning with path optimisation automatically selects the shortest path and therefore independently decides the direction of rotation of the drive. The drive also runs over the overrun point of the relevant encoder (see the following illustration “Optimum path”). The overrun point corresponds to half of a rotation of the encoder (*Singleturn applications*).

If the number of encoder rotations deviates from the number of rotations of the turntable application (*Multiturn applications*), the overrun point, i.e. the point at which the application (turntable) has rotated one half of a rotation must be determined. This value must be entered in parameter **P620** „*Absolute encoder*“.

**Information**

**Overrun point in P620**

For multiturn applications care must be taken that the overrun point can only be entered with a precision of three decimal places.

Deviations from this result in an additive error after each overrun. In this case it is advisable to reference the encoder after each rotation of the system.

The zero point of a singleturn absolute encoder is determined by its installation and can be varied with parameter **P609 from [-04]** “*Offset position*”. If an incremental encoder is used, either a “Reference run” or a “Reset position” must be performed in order to determine the zero position. The zero position can be varied by an entry in parameter **P609 [-02]** “*Offset position*”.

**Information**

**Multiturn absolute encoders**

A multiturn absolute encoder can also be used as a singleturn absolute encoder. For this, the multiturn resolution (**P605 [-01]**) must be set to “0”.

**Information**

**Incremental encoder**

The incremental encoder must be mounted directly onto the motor. There must be no additional speed ratio between motor and encoder.

### Examples of “singleturn applications”

The overrun point for a singleturn application is calculated according to the following equation:

$\pm n_{max} = 0.5 * Ü_b / U_n$

| | | |
|---|---|---|
| $n_{max}$: | Number of motor revolution = Overflow point | **(P620)** |
| $Ü_b$: | Ratio | (**P607 [-xx]**)[1)] |
| $U_n$: | Reduction ratio | (**P608 [-xx]**)[1)] |

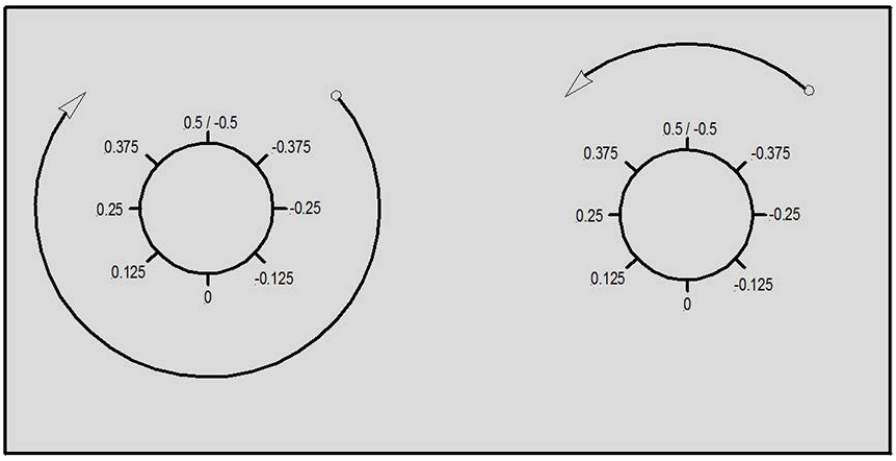
1) Depending on the encoder used for position control, e.g. CANopen encoder: [-xx] = [-01]

### Example 1

The encoder is mounted on the motor shaft (positive and negative speed ratio = “1“).

$\pm n_{max} = 0.5 * 1 / 1 = 0.5$ rotations

| | | | |
|---|---|---|---|
| The following values are parameterised: | **P607 [-01]** | = | 1 |
| | **P608 [-01]** | = | 1 |
| | **P620** | = | 0.5 |




Linear path Optimum path

**Figure 1: Turntable positioning with a singleturn application**

## Information

**Parameterisation P620**

In this case (singleturn application, encoder on the motor shaft) **P620** can remain in the factory setting (setting 0).

### Example of a “multiturn application”

The overrun point for a multiturn application is calculated according to the following equation:

The following example is shown for a positive and negative speed ratio of “1”. The entire movement path is 101 rotations of the encoder. The maximum value for the position or overrun point is calculated as follows:

$\pm n_{max} = 0.5 * U_D * Ü_b / U_n$

| | | |
|---|---|---|
| $n_{max}$: | Number of motor revolution = Overflow point | **(P620)** |
| $Ü_b$: | Ratio | (**P607 [-xx]**)[1)] |
| $U_n$: | Reduction ratio | (**P608 [-xx]**)[1)] |
| $U_D$: | Number of revolutions of the encoder for one revolution of the application | |

[1)] Depending on the encoder used for position control, e.g. CANopen encoder: [-xx] = [-01]

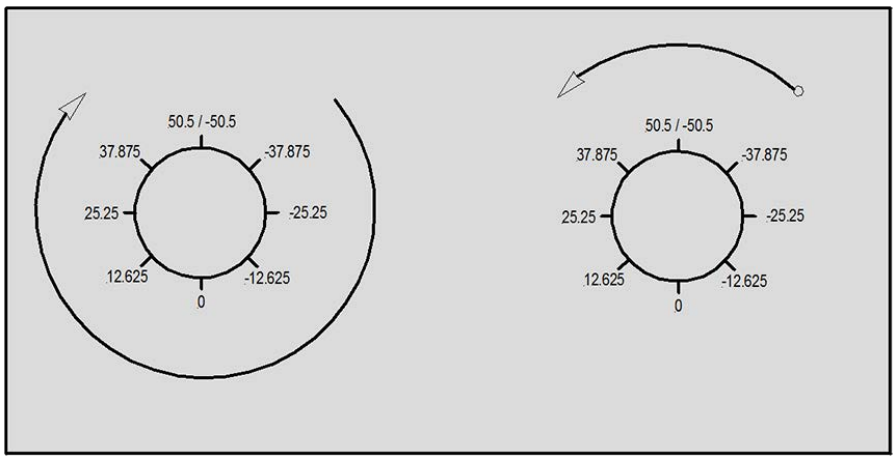
### Example

The encoder, a CANopen encoder, is mounted on the motor shaft (positive and negative speed ratio = “1“). The entire movement path is **101** rotations of the encoder.

$\pm n_{max} = 0.5 * 101 * 1 / 1 = 50.5$ revolutions

The following values are parameterised:

| | | |
|---|---|---|
| **P607 [-01]** | = | 1 |
| **P608 [-01]** | = | 1 |
| **P620** | = | 50.5 |




Linear path Optimum path

**Figure 2: Turntable positioning with a multiturn application**

## 4.3 Setpoint specification

Setpoints can be specified by the following method:

- Digital inputs or Bus IO In bits as absolute position using position array
- Digital inputs or Bus IO In bits as relative position using position increment array
- Bus setpoint

For this, it is irrelevant whether an incremental or an absolute encoder is used for position detection, i.e. detection of the actual position.

### 4.3.1 Absolute setpoint position (Position array) via digital inputs or BUS IO bits

Positioning with absolute setpoint positions is used if certain fixed positions exist to which the drive is to be moved (“Move to position x”). This includes storage and retrieval equipment.

With the function 0 = “Position array” in parameter **P610** “Setpoint mode”, the positions stored in parameter **P613** can be selected via the digital inputs of the frequency inverter or Bus IO In bits..

The position numbers result from the binary value. A position setpoint (**P613**) can be parameterised for each position number. The position setpoint can be entered either via a control panel (ControlBox or ParameterBox) or with a PC by means of the NORDCON parameterisation and diagnostic software. Alternatively, a digital input or BUS IO In bit must be parameterised to function 24 “Teach-in”. Triggering of this digital function results in adoption of the actual position in the arrays of parameter **P613** (🕮 Section 4.4 "Teach-in function for saving positions")

With function 62 “*Sync. Position array*” (**P420** “*Digital inputs*“ or **P480** „*BUS I/O In bits*“) it is possible to pre-select a stored position without moving to the position immediately. The pre-selected position is only adopted as a setpoint and moved to after the input has been set to “1” (🕮 Section 4.3.3.2 "Relative setpoint position (Position increment array) via the field bus").

If the absolute position is specified via Bus IO bits, the position number results from bits 0 ... 5 of the serial interface. For this, one of the bus setpoints (**P546**…, “*Bus setpoint function*“) must be set to 17 “*Bus IO In Bits 0-7*“ and the function assigned to the relevant bits in **P480** “*BusIO In bits function*“.

**Information**

**Setpoint addition**

Position setpoints from different sources are added together. I.e. the frequency inverter adds all individual setpoints which are specified to it to form a resulting setpoint and travels to this destination (e.g. setpoint via digital input + setpoint via bus).

### 4.3.2 Relative setpoint position (Position array) via digital inputs or BUS IO In Bits

Positioning with relative setpoint positions is used if no fixed positions, but rather relative positions exist to which the drive is to be moved (“Move by x increments”). This includes endless axes.

As with fixed positions, the position increments are also defined with parameter **P613**. The number of increments available is restricted to the first 63 entries (**P613 [-01] … [-63]**).

When the signal changes from “0” to “1” the value of the selected element is added to the setpoint position. Positive and negative values are possible, so that return to the starting position is possible. Addition is performed for each positive signal flank, regardless of whether or not the frequency inverter is enabled. A multiple of the parameterised increment can therefore be specified by several consecutive pulses to the assigned input. The pulse width and pulse pause width must be at least 10 ms.

If the relative setpoint position is specified via Bus IO In Bits, the position number results from bits 0 … 5 of the serial interface. For this, one of the bus setpoints (**P546**…, “Bus setpoint function”) must be set to 17 “*Bus IO In Bits 0-7*“. The functions of the relevant bits must be assigned under **P480** “*Funct. BusIO In Bits*“.

### 4.3.3 Bus setpoints

The setpoint can be transferred via various field bus systems. The position can be specified as *Rotations* or *Increments*.

*A motor rotation corresponds to a resolution of 1/1000 rotations or 32768 increments.*

The source of the bus setpoints must be selected via the corresponding field bus in parameter **P510** "*Setpoint source*". The settings for the position setpoints which are to be transmitted via the bus must be set in parameters **P546**… "*Bus setpoint function*".

The High word and the Low word must be used in order to be able to use the entire position range (32 bit position).

**Example**

One motor rotation (see value in **P602**) = 1.000 rev. = Bus setpoint $1000_{dec}$

#### 4.3.3.1 Absolute setpoint position (Position array) via the field bus

If "*Setpoint mode*" function 3 "*Bus*" is parameterised in parameter **P610** the setpoint specification for the absolute position is **only** made via a field bus system. The settings for the field bus system are made in parameter **P509** "*Control word source*". With the "*Bus*" function, the functions of the digital inputs and the Bus IO In bits for position specification from parameter **P613** "Position" / Position array element are not enabled.

#### 4.3.3.2 Relative setpoint position (Position increment array) via the field bus

If "*Setpoint mode*" function 4 "*Bus increment*" is parameterised in parameter **P610** the setpoint specification for the relative position is only made via a field bus system. The settings for the field bus system are made in parameter **P509** "*Control word source*". The setpoint is adopted on a change of flank from "0" to "1" for function 62 "*Sync. position array*" (**P420** or **P480**).

## 4.4 Teach-in function for saving positions

As an alternative to direct input, parameterisation of the absolute setpoint position can also be performed via the function "*Teach-in*".

Two inputs are required for "*Teach-in*" via digital inputs or Bus IO In bits. One input or one of the parameters **P420**… or **480** is parameterised to function 24 "*Teach-in*" and a further input must be parameterised to function 25 "*Quit Teach-in*".

The "*Teach-in*" function is started with a "1" signal to the relevant input and remains active until the signal is withdrawn.

With a change from "0" to "1" of the "*Quit Teach-in*" signal the actual position value is saved as a position setpoint in parameter **P613** "*Position*". The position number or the position array element or position increment array element is specified with function 55 … 60 "*Bit 0 … 5 PosArr / Inc*" of the digital inputs **P420** or Bus IO In bits **P480**.

If no input is accessed (position 0) the position number is generated with an internal counter. The counter is increased with each position adoption.

**Example**

- Start of "*Teach-in*" without position specification:
  Internal counter has the value 1,
- Triggering of "*Quit Teach-in*" function
  - Saving of the actual position in the first storage space (**P613 [-01]**)
  - Increase of the internal counter to 2
- Triggering of "Quit Teach-in" function
  - Saving of the actual position in the first storage space (**P613 [-02]**)
  - Increase of the internal counter to 3

etc.

As soon as a position is addressed via the digital inputs, the counter is set to this position.

As long as "Teach-in" is active, the frequency inverter can be accessed with enable signals and frequency setpoints (as for **P600** "*Position control*" setting "*Off*")

The "Teach-in" function can also be implemented via a serial interface or Bus IO In bits. For this, one of the bus setpoints (**P546**…, "*Bus setpoint function*") must be set to "*Bus IO In bits 0..7*". The functions of the relevant bits must be assigned under **P480** "*Bus IO In bits function*".

## 4.5 Speed ratio of setpoint and actual values

Position values relate to motor rotations. If a different reference is required, with the aid of parameter **P607** [-03] the “Positive speed ratio” and **P608** [-03] the negative speed ratio ratio can be converted to a different unit. No decimal places can be entered in the parameters **P607** “*Positive speed ratio*” and **P608** “*Negative speed ratio*”. To achieve greater accuracy, the two values must both be multiplied by a factor which is as large as possible. The product must not exceed the value 2.000.000 i.e. the factor must not be too large.

**Example**

Lifting equipment

- Unit in [cm]
- Gear unit: i = 26.3
- Drum diameter: d = 50.5 cm
- Factor: 100 (selected)

$$\frac{\text{Reduction ratio (P608)}}{\text{Speed ratio (P607)}} = \frac{\pi \times 50{,}5cm}{26.3} = \frac{158.65 \times 100}{26.3 \times 100} = \frac{15865}{2630} \approx \frac{6cm}{revolution.}$$

The required unit can be selected in parameter **P640** “*Pos. value unit*”. Accordingly, for this example parameter **P640** must be parameterised to function 4 = “*cm*”.

## 4.6 Position control

### 4.6.1 Position control: Positioning variants (P600)

Four different positioning variants are possible.

- Linear ramp with maximum frequency (**P600**, setting 1)

  Acceleration is linear. The speed of constant movement is always according to the maximum frequency which is set in parameter **P105**. The acceleration time **P102** and the deceleration time **P103** relate to the maximum frequency **P105**.
  **Example**

  **P105** = 50 Hz, **P102** = 10 s;
  Ramp time = **P102** = 10 s
  → The drive accelerates from 0 Hz to 50 Hz in 10 s

- Linear ramp with setpoint frequency (**P600**, setting 2)

  Acceleration is linear. The speed for constant movement is specified with the frequency setpoint. This can be changed via the analogue input or a bus setpoint. The acceleration time (**P102**) and the deceleration time (**P103**) relate to the maximum frequency (**P105**).
  **Example**

  **P105** = 50 Hz, **P102** = 10 s, Setpoint 50 % (25 Hz);
  Ramp time = **P102*** 0.5 = 5 s
  → The drive accelerates from 0 Hz to 25 Hz in 5 s

- S-ramp with maximum frequency (**P600**, setting 3)

  The speed of constant movement is always according to the maximum frequency which is set in parameter **P105**, however in positioning mode, the S- ramps are used for the frequency ramps. In contrast to the conventional linear frequency increase or reduction according to the acceleration or deceleration time, acceleration or deceleration is according to “soft”rounding (jerk-free) from a static state. Also, the acceleration or deceleration is gradually reduced when the final speed has been reached. The S-ramp always corresponds to a rounding of 100% and only applies for positioning. The effective *ramp time is doubled* by the use of S-ramps. The acceleration time (**P102**) and the deceleration time (**P103**) relate to the maximum frequency (**P105**).
  **Example**

  **P105** = 50 Hz, **P102** = 10 s;
  Ramp time = **P102** * 2 = 10 s* 2 = 20 s
  → The drive accelerates from 0 Hz to 50 Hz in 20 s

  *The S-ramp function is disabled during reference runs.*

- S-ramp with setpoint frequency (**P600**, setting 4)

  The speed for constant running is specified with the frequency setpoint. However, in positioning mode, the S-ramps are used as the frequency ramps (see previous paragraph).
  The setpoint frequency can be changed via the analogue input or a bus setpoint. The acceleration time (**P102**) and the deceleration time (**P103**) relate to the maximum frequency (**P105**) and are calculated as follows:

  Ramp time = 2 * Acceleration time * √(Setpoint frequency / Maximum frequency)

  **Example**

  **P105** = 50 Hz, **P102** = 10 s, Setpoint 50 % = Setpoint frequency 25 Hz;
  Ramp time = 2 * **P102** * √ (Setpoint frequency/ **P105**) = 2 * 10 s * √ ( 25 Hz / 50 Hz)
  → The drive accelerates from 0 Hz to 25 Hz in 14.1 s

  *The S-ramp function is disabled during reference runs.*

**Information**

**Setpoint frequency or ramp times**

During positioning movement changes to the setpoint frequency or the ramp times have no effect on the acceleration or final speed of the drive. The new valuers are only adopted and included in the calculation for the positioning movement after the target position has been reached.

**Information**

**P106: Ramp smoothing**

Parameter P106 "*Ramp smoothing"* is disabled when position control is active (P600, setting ≠ 0).

**Information**

**Effective ramp time**

The actual or effective ramp time can deviate from the parameterised values if load limits are reached or in case of short movement distances.

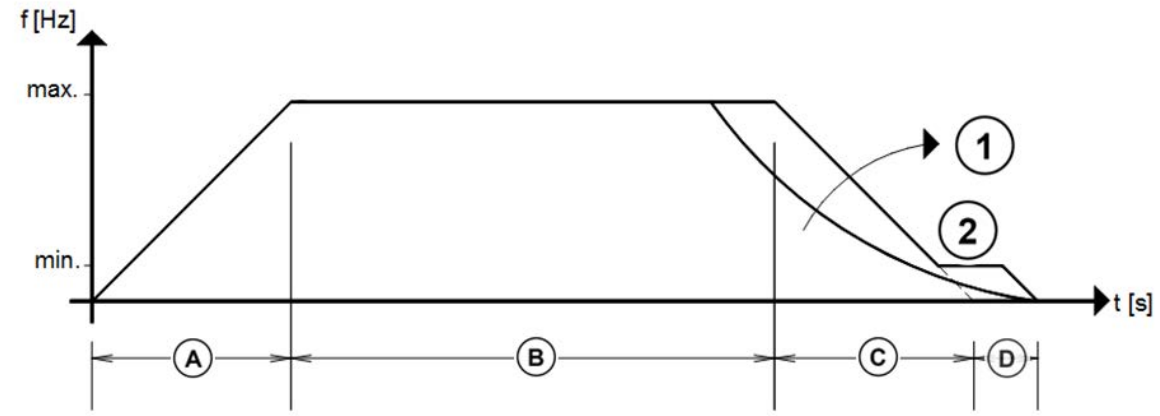
## 4.7 Position control: Function

Position control functions as a P control loop. The setpoint and actual positions are continuously compared with each other. The setpoint frequency is formed by multiplication of this difference with parameter **P611** "*Position controller P.*" The value is then limited to the maximum frequency which is parameterised in parameter **P105**.

A path time is calculated from the deceleration time parameterised in **P103** and the actual speed. Without consideration of the deceleration time by the path calculation, the speed would usually be reduced too late and the specified position overshot. Examples are highly dynamic applications with extremely short acceleration and deceleration times, as well as applications in which only small path increments are specified.

A so-called target window can be specified in parameter **P612** "*Large target window*". Within the target window, the setpoint is limited to the minimum frequency which is set in **P104** and therefore enables a type of slow running. This frequency cannot be less than 2 Hz. The "*Slow running*" function is especially advisable for applications with greatly varying loads or if the drive has to be operated without speed control (**P300** = „VFC open-loop").

Parameter **P612** defines the starting point and therefore the path for the slow movement, which ends at the specified position. This has no effect on the output message "*Position reached*" (e.g. parameter **P434**).




| | |
|---|---|
| A = | Acceleration time |
| B = | Travel with maximum frequency |
| C = | Deceleration time |
| D = | Time determined by the "*Large target window*" (**P612**) |
| 1 = | Position controller P |
| 2 = | Travel with minimum frequency |

**Figure 3: Position control sequence**

## 4.8 Remaining path positioning

Remaining path positioning is position control variant. For this, on a trigger pulse, the drive changes from normal speed control to position control and travels for a defined distance before coming to a standstill.

**Relevant parameters for remaining path positioning**

| Parameters | Value | Meaning |
|---|---|---|
| P420… or P480 | 78 | Remaining path trigger |
| P610 | 10 | Remaining path positioning |
| P613 [-01] | xx | Remaining path if the drive is enabled with "*Enable right*" |
| P613 [-02] | xx | Remaining path if the drive is enabled with "*Enable left*" |

**Sequence for remaining path positioning**

After enabling, the drive unit first moves with the setpoint frequency until there is a positive flank 0 → 1 from the sensor at the input with function "*Trigger remaining path*". The drive then switches to position control and then moves for the distance which has been programmed in parameter **P613** [-01] or [-02]. If a position setpoint is transmitted to the frequency inverter via the bus, this is added to the value in **P613** [-01] or [-02]. If no value is entered in **P613** [-01] or [-02] the bus setpoint represents the relative remaining path.

Once the target position has been reached, the drive remains in this position.

A new pulse at the input with the function "*Trigger remaining path*" triggers the function again. The drive then moves a further remaining path. For this it is irrelevant whether the drive is stationary at its target position or is still moving.

The following options are available to start a new remaining path positioning process (start in setpoint mode):

- Stop the drive (remove enable) and enable the drive again, or
- Trigger digital-In function 62 "*Sync. position array*" (via digital input **P420**…, or BUS IO In bit **P480**)

The status message "*Position reached*" is only displayed after remaining path positioning is complete. During constant movement at the setpoint frequency the status message "*Position reached*" is disabled.

The accuracy of remaining path positioning depends on the jitter of the response time, the speed and the initiator which is used. The jitter of the response time of a digital input is typically 1 … 2 ms. The positioning error therefore corresponds to the distance which is travelled with the present speed during the jitter time.

Remaining path positioning is always performed with a linear ramp. S-ramps which have been set do not have any effect. If a position limit is enabled (**P615** / **P616**), this is taken into account in the constant movement.

## 4.9 Output messages

The frequency inverter provides various status messages for the positioning function. These can be a physical output (e.g. via digital output **P434**…) or alternatively as a Bus IO Out Bit (**P481**). To use the Bus IO Out Bits, one of the bus actual values (**P543**…) must be set to “BusIO Out Bits 0-7“”.

### Information

**Availability of status messages**

The status messages are also available if the position control is not enabled (**P600** = Setting “disabled”).

| Function (Setting) | Description |
|---|---|
| Reference (20) | The message is active if a valid reference point is available.<br>The signal switches off when a reference run is started.<br>The signal state when the power supply is switched on depends on the setting in **P619 "Incremental mode"**. For settings for incremental encoders *with save position* and for absolute encoders the signal state after switch-on is “active (High)”, otherwise “Low”. |
| End position (21) | With this function the frequency inverter signals that the specified position has been reached. The message is active if the deviation between the specified and the actual position is smaller than the value set in parameter **P625** “*Output hysteresis*“ and the actual frequency is lower than the frequency which is parameterised in parameter **P104** “*Minimum frequency*” + 2 Hz. In synchronous mode, the condition is not the frequency which is parameterised in **P104** but rather the setpoint frequency. |
| Position (22) | This message is active if the actual position is greater or equal to parameter **P626** “*Output comparison position*“. The signal switches off again when the actual position is smaller than **P626** minus hysteresis (**P625**). The prefix is taken into account.<br>Output signal 0 → 1 (“high”): $p_{ist} \geq p_{vergl}$<br>Output signal 1 → 0 (“low“): $p_{ist} < p_{vergl} - p_{hyst}$ |
| Comparison position value (23) | This function corresponds to function 22 “*Comparison position*”, with the difference that the actual position is treated as an absolute value (without prefix).<br>Output signal 0 → 1 (“High”): $\lvert p_{ist}\rvert \geq p_{vergl}$<br>Output signal 1 → 0 (“Low”): $\lvert p_{ist}\rvert < \lvert p_{vergl}\rvert - p_{hyst}$ |
| Abs. pos.array (24) | This message is active if a position which is parameterised in parameter **P613** has been reached or overrun. This function is always available regardless of the setting in **P610**. |
| Comparison position reached (25) | This message is active if the amount of the difference between the actual position and the value parameterised in parameter **P626** “*Comparison position output*” is smaller than the value set in parameter **P625** “*Output hysteresis* “<br>Output signal 0 → 1 (“High”): $\lvert p_{vergl.} - p_{ist}\rvert < p_{hyst}$ |
| Comparison position value reached (26) | This message is active if the amount of the difference between the actual position and the value parameterised in parameter **P626** “*Comparison position output*” is smaller than the value set in parameter **P625** “*Output hysteresis* “<br>Output signal 0 → 1 (“High”): $\lvert(\lvert p_{vergl}\rvert - \lvert p_{ist}\rvert)\rvert < p_{hyst}$ |

**Table 1: Digital output messages for positioning function**

# 5 Commissioning

1. Connect encoder
2. Commission the encoder by changing the parameters. For this, make the necessary settings for each axis in the relevant parameter set.

| Step | | Interface / position measurement system (encoder) | | | | | |
|---|---|---|---|---|---|---|---|
| | | Incremental | | Absolute | Universal | | |
| | | HTL | TTL | CANopen | SIN/COS | SSI/ BISS | Endat/ Hiperface |
| 1 | Contact assignment | P420 [-01] … [-06] | P420 [-05] DIN5 TTL Zero track | – | – | | |
| 2 | Selection of the position measurement system | P604 | | | | | |
| 3 | Resolution | P301 [-02] | P301 [-01] | P605 [-01, -02] | P301 [-03] | P605 [-03, -04] | |
| 4 | Position detection Linear / Modulo | P619 [-02] | P619 [-01] | P621 [-01] | P619 [-03] | P621 [-02] | |
| 5 | Additional settings | – | – | P514, P515 [-1] | – | P617, (P622) | – |
| 6 | Speed ratio<br>Speed ratio | P607 [-02] | P607 [-01] | P607 [-04] | P607 [-03] | P607 [-05] | |
| | Speed reduction ratio | P608 [-02] | P608 [-01] | P608 [-04] | P608 [-03] | P608 [-05] | |
| 8 | Check the direction of rotation, resolution and speed ratio | P660 [-02], P583 | P660 [-01], P583 | P660 [-04], P583 | P660 [-03], P583 | P660 [-05], P583 | |
| 8 | Setpoint processing (source and type) | P610 | | | | | |
| 9 | Overflow point (only for modulo) | P620 [-02] | P620 [-01] | P620 [-04] | P620 [-03] | - | - |
| 10 | Reference the encoder | P420 [-XX] = 22, 23, 31, 32, 61; P623 = XX; (P624 [-XX] = XX) | | | | | |
| 11 | Define the offset | P609 [-02] | P609 [-01] | P609 [-04] | P609 [-03] | P609 [-05] | |
| 12 | Define the limits | P612 / P615 / P616 | | | | | |
| 13 | Define the target position | P613 | | | | | |
| 14 | Define the reference point run | P623 / P624 | | | | | |
| 15 | Monitoring etc. | P625, P626, P630 et seq. | | | | | |

# 6 Parameters

The following only lists the specific parameters and display and setting options for the **POSICON** technology function. For a detailed overview of all available parameters, please refer to the frequency inverter manual (BU0800).

## 6.1.1 Explanation of parameter description

| **P000** (parameter number) | **Operating para. disp.** (parameter name) | | **xx** [1] | **S** | **P** |
|---|---|---|---|---|---|
| **Setting range** (or display range) | Representation of typical display format (e.g. (bin = binary) of possible setting range and number of decimal places | **Other applicable parameter(s):** | List of other directly related parameters | | |
| **Arrays** | [-01] | If parameters have a substructure in several arrays, this is shown here. | | | |
| **Factory setting** | { 0 } | Typical default setting of parameters in the as-delivered condition of the FI, or to which it is set after carrying out "Restore factory settings" (see parameter P523). | | | |
| **Scope of application** | List of variants for which this parameter applies. If the parameter is generally valid, i.e. for the entire model series, this line is omitted. | | | | |
| **Description** | Description, function, meaning and similar for this parameter. | | | | |
| **Note** | Additional notes about this parameter | | | | |
| **Setting values** (or display values) | List of possible settings with description of their respective functions | | | | |

1) xx = Other codes

**Information**

Unused lines of information are not listed.

*Notes / Explanations*

| Label | Designation | Meaning |
|---|---|---|
| **S** | Supervisor parameter | The parameter can only be displayed and changed if the relevant supervisor code has been set (see parameter **P003**). |
| **P** | Depending on the parameter set | The parameter provides various setting options which depend on the selected parameter set. |

### 6.1.2 Operating displays

| P001 | Selection of display value | | |
|---|---|---|---|
| **Description** | ControlBox operating display selection | | |
| **Setting values** | **Value** | **Meaning** | |
| | 0 | Actual frequency | Present supplied output frequency |
| | 16 | Position setpoint | Setpoint position |
| | 17 | Actual position | Present actual position (actual position) |
| | 50 | TTL actual position | Actual position from TTL incremental encoder |
| | 51 | CANopen actual position | Actual position from CANopen absolute encoder |
| | 52 | Act. pos. diff. | Actual position difference between setpoint and actual position |
| | 53 | Act. pos. diff. Abs/Inc | Actual position difference between absolute and incremental encoder (see also **P631**) |
| | 54 | Act. pos. diff. Cal./Meas. | Actual position difference between the calculated and measured value of an encoder (see also **P630**) |
| | 55 | Pos. act. Univ. encoder | Actual position from universal encoder |
| | 56 | HTL actual position | Actual position from HTL incremental encoder |
| | 57 | Actual position Sin/Cos | Actual position from Sin/Cos encoder |
| | 58 | Reserved | |

### 6.1.3 Speed control

| P301 | Incremental encoder | | |
|---|---|---|---|
| **Setting range** | 0 … 27 | | |
| **Arrays** | [-01] = Universal | [-02] = HTL | |
| **Factory setting** | { 5 } | { 3 } | |
| **Description** | "*Encoder resolution*". Input of the pulse count per rotation of the connected encoder. If the direction of rotation of the encoder is not the same as the FI, (depending on installation and wiring), this can be taken into account by selecting the corresponding negative pulse numbers. | | |
| **Note** | **P301** is also significant for position control via incremental encoders. If an incremental encoder is used for positioning, **P604 = 1**, setting of the pulse number is made here. | | |
| **Setting values** | **Value** | **Value** | |
| | 0 | 500 pulses | 8 | -500 pulses |
| | 1 | 512 pulses | 9 | -512 pulses |
| | 2 | 1000 pulses | 10 | -1000 pulses |
| | 3 | 1024 pulses | 11 | -1024 pulses |
| | 4 | 2000 pulses | 12 | -2000 pulses |
| | 5 | 2048 pulses | 13 | -2048 pulses |
| | 6 | 4096 pulses | 14 | -4096 pulses |
| | 7 | 5000 pulses | 15 | -5000 pulses |
| | | | 16 | -8192 pulses |
| | 17 | 8192 pulses | | |
| | 18 | 16 pulses | 23 | -16 pulses |
| | 19 | 32 pulses | 24 | -32 pulses |
| | 20 | 64 pulses | 25 | -64 pulses |
| | 21 | 128 pulses | 26 | -128 pulses |
| | 22 | 256 pulses | 27 | -256 pulses |

| P302 | Type Univers. encoder | |
|---|---|---|
| **Setting range** | 0 … 5 | |
| **Factory setting** | { 1 } | |
| **Description** | Via this parameter, the encoder type is selected. | |
| **Note** | | |
| **Setting values** | **Value** | **Value** |
| | 0 UART | |
| | 1 TTL | |
| | 2 BiSS | |
| | 3 SSI | |
| | 4 BiSS inverted | |
| | 5 SSI inverted | |

### 6.1.4 Control terminals

| P420 | Digital inputs | |
|---|---|---|
| **Setting range** | 0 … 84 | |
| **Arrays** | [-01] = Digital input 1 | Digital input 1 (DIN1) integrated into the FI |
| | [-02] = Digital input 2 | Digital input 2 (DIN2) integrated into the FI |
| | [-03] = Digital input 3 | Digital input 3 (DIN3) integrated into the FI |
| | [-04] = Digital input 4 | Digital input 4 (DIN4) integrated into the FI |
| | [-05] = Reserved | |
| | [-06] = Reserved | |
| | [-07] = Reserved | |
| | [-08] = Reserved | |
| **Factory setting** | { 0 } | |
| **Description** | "*Digital input functions*". Up to 4 inputs which can be freely programmed with digital functions are available. | |

**Setting values**

| Value | | Description | Signal |
|---|---|---|---|
| 00 | No function | Input switched off. | --- |
| 01 | Enable right | The FI delivers an output signal with the rotation field “Right” if a positive setpoint is present. 0 → 1 Flank (P428 = 0) | high |
| 02 | Enable left | The FI delivers an output signal with the rotation field “Left” if a positive setpoint is present. 0 → 1 Flank (P428 = 0) | high |
| If the drive is to start up automatically when the mains is switched on (**P428 = 1**), a permanent High level for enabling must be provided (bridge between DIN 1 and the control voltage output). If the functions “Enable right” and “Enable left” are actuated simultaneously, the device is blocked.<br>If the device is in fault status but the cause of the fault no longer exists, the error message is acknowledged with a 1 → 0 flank. | | | |
| 03 | Phase seq. reversal | Causes the rotation field to change direction (combined with Enable right or left). | high |
| 04 | Fixed frequency 1 [1)] | The frequency from P429 is added to the actual setpoint. | high |
| 05 | Fixed frequency 2 [1)] | The frequency from P430 is added to the actual setpoint. | high |
| 06 | Fixed frequency 3 [1)] | The frequency from P431 is added to the actual setpoint. | high |
| 07 | Fixed frequency 4 [1)] | The frequency from P432 is added to the actual setpoint. | high |
| 08 | Param. set switching | First bit of the parameter set switching; selection of the active parameter set 1…4 (P100). | high |
| 09 | Maintain the freq. | During the acceleration or deceleration phase, a Low level will cause the actual output frequency to be “maintained”. A High level allows the ramp to continue. | low |
| 10 | Voltage disable [2)] | The frequency inverter output voltage is switched off; the motor runs down freely. | low |
| 11 | Quick stop [2)] | The FI reduces the frequency according to the quick stop time from P426. | low |
| 12 | Fault acknowledgem. [2)] | Fault acknowledgement with an external signal. If this function is not programmed, a fault can also be acknowledged by a Low enable setting (P506). | 0→1 Flank |
| 13 | PTC resistor input [2)] | Analogue evaluation of signal which is present. Switching threshold approx. 2.5 V, Switch-off delay = 2 sec, warning after 1 sec. | level |
| 14 | Remote control [2),3)] | With bus system control, Low level switches the control to control via control terminals. | high |

| | | | |
|---|---|---|---|
| 15 | Jog frequency [1] | The fixed frequency value can be adjusted using the HIGHER/LOWER and ENTER keys (P113), if control is via the ControlBox or ParameterBox. | high |
| 16 | Motor potentiometer | As in setting 09, however, the frequency is not maintained below the minimum frequency P104 and above the maximum frequency P105. | low |
| 17 | ParaSetSwitching 2 | Second bit of the parameter set switching; selection of the active parameter set 1…4 (P100). | high |
| 18 | Watchdog [2] | Input must see a High flank cyclically (P460), otherwise a shutdown will occur with error E012. Function starts with the 1st High flank. | 0→1 Flank |
| 21 | Fixed frequency 5 [1] | The frequency from P433 is added to the actual setpoint. | high |
| 31 | Inhibit turn right [2] | Blocks the “Enable right/left” via a digital input or bus control. Does not depend on the actual direction of rotation of the motor (e.g. following negated setpoint). | low |
| 32 | Inhibit turn left [2] | | low |
| 47 | Motorpot. Freq. + | In combination with enable R/L the output frequency can be continuously varied. To save a current value in **P113**, both inputs must be at a High voltage for 0.5 s. This value is then used as the next starting value for the same direction of rotation (Enable R/L) otherwise start at $f_{MIN}$. Values from other setpoint sources (e.g. fixed frequencies) are not taken into account. | high |
| 48 | Motorpot. Freq. - | | high |
| 50 | Bit0 fixedfreq.Array | “*Fixed frequency array*”, binary coded digital inputs to generate up to 32 fixed frequencies. **P465 [-01]... [-31]** | high |
| 51 | Bit1 fixedfreq.Array | | high |
| 52 | Bit2 fixedfreq.Array | | high |
| 53 | Bit3 fixedfreq.Array | | high |
| 65 | 3-Wire-Direction (closing switch to reverse direction of rotation) | Alternative to enable R/L (01, 02), in which a permanently applied level is required.<br>Here, only a control pulse is required to trigger the function. Control of the FI can therefore be performed entirely with keys.<br>A pulse on the function "Phase seq. reversal" inverts the present direction of rotation. This function is reset with a "Stop signal" or by activating a key. | 0→1 Flank |
| 66 | Bit 0 Freq-/Ramp.Arr | “*Frequency/ramp array*”, binary coded digital inputs to generate up to 32 fixed frequencies (**P465**). | |
| 67 | Bit 1 Freq-/Ramp.Arr | | |
| 68 | Bit 2 Freq-/Ramp.Arr | | |
| 69 | Bit 3 Freq-/Ramp.Arr | | |
| 71 | Motorpot.F+ and Save | “*Motor potentiometer function frequency +/- with automatic saving*”. With this motor potentiometer function, a setpoint (sum) is set via the digital inputs and is simultaneously saved. With controller enabling R/L, this is then started up in the corresponding enable rotation direction. The frequency is retained on change of direction.<br>Simultaneous activation of the +/- functions causes the frequency setpoint to be set to zero.<br>The frequency setpoint can also be displayed in **P718** and pre-set in the operating status “Ready for switch-on”.<br>A set minimum frequency **P104** is still effective. Other setpoint values, e.g. analogue or fixed frequencies, can be added or subtracted.<br>Adjustment of the frequency setpoint is performed with the ramps from **P102 / 103**. | high |
| 72 | Motorpot.F- and Save | | high |
| 73 [2] | Inhibit right+quick | As for setting 31, but coupled to the "Quick stop²" function | low |
| 74 [2] | Inhibit left + quick | As for setting 32, but coupled to the “Quick stop” function. | low |
| 83 | DO 1 man. set | Via the “BusIO In Bits” function, the digital output can be set directly via the BusIO or via the control word. | |
| 84 | DO 2 man. set | | |

[1] If neither of the digital inputs is programmed for left or right enable, actuation of a fixed frequency or jog frequency enables the frequency inverter. The rotation field direction depends on the sign of the setpoint

[2] Also effective for control via BUS (e.g. Ethernet, USS)

[3] Function cannot be selected via BusIO In Bits

| P434 | Digital out function | | P |
|---|---|---|---|
| **Setting range** | 0 … 53 | | |
| | [-01] = Digital output 1 | Digital output 1 (DO1) integrated into the FI | |
| | [-02] = Digital output 2 | Digital output 2 (DO2) integrated into the FI | |
| **Scope of application** | **[-01] … [-02]** | | |
| **Factory setting** | [-01] = { 0 } [-02] = { 0 } | | |
| **Description** | "*Digital output function*". Up to 2 digital outputs are available which can be freely programmed with digital functions. These can be seen in the following table. | | |

**Setting values**

| Value | | Description | Signal |
|---|---|---|---|
| 00 | No function | Input switched off. | Low |
| 01 | External brake | For control of a mechanical brake on the motor. | High |
| 02 | Inverter is working | Voltage applied to inverter output (U - V - W). | High |
| 03 | Current limit | Based on the nominal motor current setting in P203. This value can be adjusted with scaling P435. | High |
| 04 | Torque current limit | Based on motor data settings in P203 and P206. Signals a corresponding torque load on the motor. This value can be adjusted with scaling P435. | High |
| 05 | Frequency limit | Based on the nominal motor frequency setting in P201. This value can be adjusted by scaling P435. | High |
| 06 | Level with setpoint | Indicates that the FI has completed the frequency increase or decrease. Setpoint frequency = Actual frequency! From a difference of 1 Hz → Setpoint not reached, contact opens. | High |
| 07 | Fault | General fault message, fault is active or not yet acknowledged. Fault: Contact opens, ready for operation: Contact closes. | Low |
| 08 | Warning | General warning. A limit value was reached that could result in a later shutdown of the device. | Low |
| 09 | Overcurrent warning | At least 130 % of the nominal device current was supplied for 30 seconds. | Low |
| 10 | Mot.overtemp.warning | "*Motor overtemperature (Warning)*". The motor temperature is evaluated via the thermistor input or a digital input. → Motor is too hot. The warning is given immediately, overtemperature switch-off after 2 s. | Low |
| 11 | Torque current limit active | "*Torque current limit/Current limit active (Warning)*". The limit value in P112 or P536 has been reached. A negative value in P435 inverts the behaviour. Hysteresis = 10 % | Low |
| 12 | Value of P541 | The output can be set using parameter P541 independently of the actual operating status of the FI. | High |
| 13 | Torq.curr. limit gen | Limit value in P112 was reached in the generator range. Hysteresis = 10 % | High |
| 14 | Effect. power limit | Ratio of the stated mechanical power to the nominal power of the motor. | |
| 15 | Freq+current limit | | |
| 16 | Quick stop active | A quick stop (P427) has been triggered. | High |
| 17 | Quick stop+STO act. | A quick stop (P427) is triggered if STO "*Voltage disable*" or "*Quick stop*" are enabled. | High |
| 18 | Inverter ready | The device is ready for operation. After being enabled it delivers an output signal. | High |
| 19 | Gen. torque limit | As for 13, however a limit value can be set via P435. | High |

| | | | |
|---|---|---|---|
| 20 | Reference | Reference point available / has been saved | [1] |
| 21 | End position | The specified position has been reached | [1] |
| 22 | Position | Position value in **P626** reached | [1] |
| 23 | Abs. pos. | Position value (amount) in **P626** reached (without consideration of prefix) | [1] |
| 24 | Abs. pos.array | A value set in **P613** has been reached or exceeded. | [1] |
| 25 | = Position | Comparison position reached, as for function 22, however with consideration of **P625** | [1] |
| 26 | = Abs. pos. | Comparison position value reached, as for function 23, however with consideration of **P625** | [1] |
| 27 | Flying saw synchron. | The slave drive has completed the starting phase of the “flying saw” function and is now synchronised with the master axis. | |
| 28 | Rotorpos PMSM ok | The PMSM rotor position is known. | High |
| 29 | Motor stopped | Speed less than P505 | High |
| 30 | BusIO In Bit 0 | Control by Bus In Bit 0 (P546 …) | High |
| 31 | BusIO In Bit 1 | Control by Bus In Bit 1 (P546 …) | High |
| 32 | BusIO In Bit 2 | Control by Bus In Bit 2 (P546 …) | High |
| 33 | BusIO In Bit 3 | Control by Bus In Bit 3 (P546 …) | High |
| 34 | BusIO In Bit 4 | Control by Bus In Bit 4 (P546 …) | High |
| 35 | BusIO In Bit 5 | Control by Bus In Bit 5 (P546 …) | High |
| 36 | BusIO In Bit 6 | Control by Bus In Bit 6 (P546 …) | High |
| 37 | BusIO In Bit 7 | Control by Bus In Bit 7 (P546 …) | High |
| 38 | Value Bus setpoint | Value from Bus setpoint (P546 ...) | High |
| 39 | STO inactive | The signal is low if STO or Safe Stop are active. | High |
| 40 | Output via PLC | The output is set by the integrated PLC | High |
| 43 | STO o. OUT2/3 inact. | Neither safe stop, voltage disable nor quick stop are active. | High |
| 50 | State digital – In 1 | A signal is present at digital input 1. | High |
| 51 | State digital – In 2 | A signal is present at digital input 2. | High |
| 52 | State digital – In 3 | A signal is present at digital input 3. | High |
| 53 | State digital – In 4 | A signal is present at digital input 4. | High |

[1] For detailed information about output messages, please refer to 📖 Section 4.9 "Output messages"

| **P480** | **Funct. BusIO In Bits** | | **S** |
|---|---|---|---|
| **Setting range** | 0 … 82 | | |
| **Arrays** | [-01] = BusIO In Bit 0 | In Bit 0 … 3 via bus | |
| | [-02] = BusIO In Bit 1 | | |
| | [-03] = BusIO In Bit 2 | | |
| | [-04] = BusIO In Bit 3 | | |
| | [-05] = BusIO In Bit 4 | In Bit 4 … 7 via bus | |
| | [-06] = BusIO In Bit 5 | | |
| | [-07] = BusIO In Bit 6 | | |
| | [-08] = BusIO In Bit 7 | | |
| | [-09] = Flag 1 | See "Use of markers" at the end of the description of parameter P481 | |
| | [-10] = Flag 2 | | |
| | [-11] = Bit8 bus controlword | Assignment of a function for Bit 8 or 9 of the control word | |
| | [-12] = Bit9 bus controlword | | |
| **Factory setting** | [-01] … [-12] = { 0 } | | |
| **Description** | “*Bus IO In Bits function*”. The BusIO In Bits are perceived as digital inputs P420. They can be set to the same functions.<br>In order to use this function, one of the bus setpoints P546 must be set to "BusIO In Bits 0-7". The required function must then be assigned to the relevant bit. | | |
| **Note** | For the possible functions of the Bus In Bits, please refer to the table of digital input functions. Function 14 "Remote control" is not possible. | | |

| | | | |
|---|---|---|---|
| 0 | Off | Input not used | |
| 22 | Reference point run | Start reference run<br>(📖 Section 4.2.1.1) | High |
| 23 | Reference point | Reference point reached<br>(📖 Section 4.2.1.1) | High |
| 24 | Teach - In | Start Teach – in function<br>(📖 Section 4.4) | High |
| 25 | Quit – Teach – in | Save the actual position<br>(📖 Section 4.4) | Flank<br>0→1 |
| 31 | Inhibit turn right | Blocks the "*Enable right/left*" via a digital input or Bus control. Does not depend on the actual direction of rotation of the motor (e.g. following negated setpoint). | Low |
| 32 | Inhibit turn left | | Low |
| 55 | Bit 0 PosArr / Inc | Bit 0 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 56 | Bit 1 PosArr / Inc | Bit 1 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 57 | Bit 2 PosArr / Inc | Bit 2 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 58 | Bit 3 PosArr / Inc | Bit 3 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 59 | Bit 4 PosArr / Inc | Bit 4 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 60 | Bit 5 PosArr / Inc | Bit 5 Position array / Position increment array<br>(📖 Section 4.3) | High |
| 61 | Reset position | Reset the actual position<br>(📖 Section 4.2.1.2) | Flank<br>0→1 |
| 62 | Sync. position array | Adoption of a preselected position<br>(📖 Section 4.3) | Flank<br>0→1 |
| 63 | Synchronous mode off | With function **P610** = 2 “Synchronous mode” the synchronous mode is interrupted, but the drive remains under position control. With the 0→1 flank the position setpoint (**P602**) of the lead drive is reset. The drive moves back to position “0” or to the position saved in the position offset (**P609**) and remains there. | High |
| | | With function **P610** = 5 “flying saw” the slave moves back to its starting position and remains there until the next “Start flying saw” command. A new start command is only accepted if the slave has reached its starting position. With the 0→1 flank the position setpoint (**P602**) of the lead drive is reset. | Flank<br>0→1 |
| 64 | Start flying saw | Start command for the slave drive to synchronise to the master. | Flank<br>0→1 |
| 77 | Stop Flying Saw | The “flying saw” function is interrupted. | Flank<br>0→1 |
| 78 | Remaining path trigger | With function **P610** = 10 “Remaining path positioning” the drive switches to position control and travels the parameterised “remaining path”.<br>(📖 Section 4.8) | Flank<br>0→1 |

| P481 | Function BusIO Out bits | S | |
|---|---|---|---|
| **Arrays** | [-01] … [-18] | | |
| **Description** | Assignment of functions for Bus IO Out bits. The frequency inverter treats the Bus IO Out bits as digital outputs. | | |
| **Setting values** | **Value** | **Meaning** | |

| | | |
|---|---|---|
| 0 | Off | Output not used |
| 20 | Reference | Reference point available / has been saved |
| 21 | Position reached | The specified position has been reached |
| 22 | Comparison position | Position value in **P626** reached |
| 23 | Comparison position value | Position value (amount) in **P626** reached (without consideration of prefix) |
| 24 | Position array value | A value set in **P613** has been reached or exceeded. |
| 25 | Comparison position reached | Comparison position reached, as for function 22, however with consideration of **P625** |
| 26 | Comparison position value reached | Comparison position value reached, as for function 23, however with consideration of **P625** |
| 27 | Flying saw synchronisation | The slave drive has completed the starting phase of the “flying saw” function and is now synchronised with the master axis. |

Note: For detailed information about output messages, please refer to 📖 Section 4.9 "Output messages"

### 6.1.5 Additional parameters

| P543 | Bus actual value | | | | S | P |
|---|---|---|---|---|---|---|
| **Setting range** | 0 … 57 | | | | | |
| **Arrays** | [-01] = Actual bus value 1 | [-02] = Actual bus value 2 | [-03] = Actual bus value 3 | | | |
| | [-04] = Actual bus value 4 | [-05] = Actual bus value 5 | | | | |
| **Factory setting** | [-01] = { 1 } | [-02] = { 4 } | [-03] = { 9 } | [-04] = { 0 } | [-05] = { 0 } | |
| **Description** | Setting of the return values for bus control. | | | | | |
| **Setting values** | **Value / Meaning** | | | | | |

| | | | |
|---|---|---|---|
| 0 | Off | 14 | Setp. pos.HighWord [1] |
| 1 | Actual frequency | 15 | Cur.pos.Inc.HighWord [1] |
| 2 | Actual speed | 16 | Set.pos.Inc.HighWord [1] |
| 3 | Current | 19 | Freq. Master Value |
| 4 | Torque current | 20 | Set Freq. After Ramp |
| 5 | State digital-IO | 21 | Act. Freq. w/o Slip |
| 6 | Current pos.LowWord [1] | 22 | Speed encoder [1] |
| 7 | Setpoint pos.LowWord [1] | 23 | Act. freq. With slip |
| 8 | Set point frequency | 24 | Lead.act.freq.+slip |
| 9 | Error code | 53 | Actual value 1 PLC |
| 10 | Curr.pos.Inc.LowWord [1] | 54 | Actual value 2 PLC |
| 11 | Setp.pos.Inc.LowWord [1] | 55 | Actual value 3 PLC |
| 12 | BusIO Out Bits 0-7 | 56 | Actual value 4 PLC |
| 13 | Current pos.HighWord [1] | 57 | Actual value 5 PLC |

[1] Only for NORDAC *ON+*

| P546 | Funct. Bus set point | | | S | P |
|---|---|---|---|---|---|
| **Setting range** | 0 … 57 | | | | |
| **Arrays** | [-01] = Bus set point 1 | [-02] = Bus set point 2 | [-03] = Bus set point 3 | | |
| | [-04] = Bus set point 4 | [-05] = Bus set point 5 | | | |
| **Factory setting** | [-01] = { 1 } | All other { 0 } | | | |
| **Description** | Assignment of a function to a bus set point value. | | | | |

**Setting values**

| Value | | |
|---|---|---|
| 0 | Off | The bus setpoint is not used. |
| 17 | BusIO Out Bits 0-7 | BusIO Out Bits 0-7 of the frequency inverter |
| 21 | Set position Low word | Lower 16-bit value of the set position (absolute position) of the frequency inverter |
| 22 | Setpoint pos. High word | Upper 16-bit value of the set position (absolute position) of the frequency inverter |
| 23 | Setpoint pos. Inc.Low word | Lower 16-bit value of the set position (relative position) of the frequency inverter |
| 24 | Setpoint pos. inc. High word | Upper 16-bit value of the set position (relative position) of the frequency inverter |
| 47 | Gear ratio factor | Setting of the speed ratio between the master and the slave |

| P583 | Motor phase sequence | S | P |
|---|---|---|---|
| **Setting range** | 0 ... 2 | | |
| **Factory setting** | { 0 } | | |
| **Description** | The motor phase control sequence (U – V – W) can be changed with this parameter. This enables the direction of rotation of the motor to be changed without changing the motor connections. | | |
| **Note** | If there is a voltage on the output terminals (U – V – W) (e.g. on enabling) the parameter setting or the parameter set may be changed by setting parameter **P583**. Otherwise the frequency inverter switches off with error message **E016.2**. | | |

**Setting values**

| Value | | Meaning |
|---|---|---|
| 0 | Normal | No change |
| 1 | Inverted | *"Invert motor phase sequence"* The direction of rotation of the motor is changed. The counting direction of the encoder for speed detection (if present) remains unchanged. |
| 2 | Inverted by encoder | As for setting {1}, however in addition the counting direction of the encoder is changed. |

### 6.1.6 Positioning

| P600 | Position control | | S | P |
|---|---|---|---|---|
| Setting range | 0 … 4 | | | |
| Factory setting | { 0 } | | | |
| Description | Enabling the position control. | | | |
| Note | Details 🕮 Section 4.6.1 "Position control: Positioning variants (P600)" | | | |
| Setting values | Value | Meaning | | |
| | 0 | Off | Positioning control is disabled | |
| | 1 | Lin. Ramp (max. freq.) | Position control is active with a linear ramp and maximum frequency | |
| | 2 | Lin.ramp(setp.freq.) | Position control is active with a linear ramp and setpoint frequency | |
| | 3 | S-ramp (max. freq.) | Position control is active with an S ramp and maximum frequency | |
| | 4 | S-ramp (set freq.) | Position control is active with an S ramp and setpoint frequency | |

| P601 | Actual position |
|---|---|
| Display range | - 50000,000 … 50000,000 rev. |
| Description | Display of the actual position. |

| P602 | Actual setpoint position |
|---|---|
| Display range | - 50000,000 … 50000,000 rev. |
| Description | Display of the actual setpoint position. |

| P603 | Act. position diff. | S |
|---|---|---|
| Display range | - 50000,000 … 50000,000 rev. | |
| Description | Display of the actual difference between the set position and the actual position. | |

| P604 | Encoder type | | S | P |
|---|---|---|---|---|
| Setting range | 0 … 1 | | | |
| Factory setting | { 0 } | | | |
| Description | Selection of the encoder used to detect the position (actual position). | | | |
| Note | Only one multiturn encoder may be parameterised simultaneously in one of the 4 parameter sets. | | | |
| | **Before activating** an absolute encoder via parameter **P604** it is essential to set the resolution of the absolute encoder in parameter **P605**. Also refer to the information in **P605**. | | | |
| Setting values | Value | Meaning | | |
| | 0 | Universal | Position detection with universal encoder | |
| | 1 | HTL incremental | Position detection with incremental encoder (HTL) | |

| P605 | Abs. Encoder res. | S |
|---|---|---|
| **Setting range** | 0 … 16 Bit | |
| **Arrays** | [-01] = Universal singleturn<br>[-02] = Universal multiturn | |
| **Factory setting** | [-01] = { 12 } | [-02] = { 13 } |
| **Description** | Setting the resolution of the absolute encoder. | |
| **Note** | Before activating the absolute encoder (**P604**) the resolution of the absolute encoder must be correctly set in **P605**. Otherwise, the values entered in parameter **P605** may be transferred to the absolute encoder. | |

**Setting values**

Conversion of encoder resolution (Bit value → decimal value):

| Setting [Bit] | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | … |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Resolution | 1 | 2 | 4 | 8 | 16 | 32 | 64 | 128 | 256 | 512 | 1024 | 2048 | 4096 | … |

Example

– Absolute encoder with 12-bit single-turn resolution:
  **P605** [-01] = 0
  **P605** [-02] = 12

– Absolute encoder with 24-bit resolution, of which 12-bit single-turn resolution:
  **P605** [-01] = 12
  **P605** [-02] = 12

| P607 | Ratio | S |
|---|---|---|
| **Setting range** | - 2 000 000 … 2 000 000 | |
| **Arrays** | [-01] = Universal<br>[-02] = HTL<br>[-03] = Set-/actual value | |
| | [-04] = Synchronism | |
| **Factory setting** | { all 1 } | |
| **Description** | Ratio set-up. (🕮 Section 4.5 "Speed ratio of setpoint and actual values") | |
| **Note** | Also heed parameter **P608**. | |

| P608 | Reduction ratio | S |
|---|---|---|
| **Setting range** | 1 … 2 000 000 | |
| **Arrays** | [-01] = Universal<br>[-02] = HTL<br>[-03] = Set-/actual value<br>[-04] = Synchronism | |
| **Factory setting** | { all 1 } | |
| **Description** | Speed ratio setting, see 4.5 "Speed ratio of setpoint and actual values". | |
| **Note** | If the encoder is not mounted on the motor shaft, the speed ratio (i) between the motor shaft and the drive shaft on which the encoder is mounted must be stated. Only integer values can be entered. Because of the speed ratio must be divided into a positive speed ratio (**P607**) and a negative speed ratio (**P608**).<br>E.g. i = 3.5 = 35 /10 → **P607 = 35**, P608 = 10 | |

| P609 | Offset position | S |
|---|---|---|
| **Setting range** | - 50000.000 … 50000.000 rev. | |
| **Arrays** | [-01] = Universal<br>[-02] = HTL | |
| **Factory setting** | { all 0 } | |
| **Description** | Set-up of an offset for defining an absolute and a relative position setpoint. | |

| P610 | Setpoint Mode | S |
|---|---|---|
| **Setting range** | 0 … 10 | |
| **Factory setting** | { 0 } | |
| **Description** | Specification of setpoint position (type and source) | |
| **Note** | For detailed information see 🕮 Section 4.3 "Setpoint specification", 4.9 "Output messages". | |

**Setting values**

| Value | | Meaning |
|---|---|---|
| 0 | Position Array | Specification of absolute position [1] |
| 1 | Pos. Inc. Array | Specification of relative position [1] |
| 2 | Synchronous operation | Position specification from master drive unit (note **P509**) [2] |
| 3 | Bus | … as for 0, via bus (note **P509**) |
| 4 | Bus Increment | … as for 1, via bus (note **P509**) |
| 5 | Flying saw | … as for 2, however extended with the "Flying Saw" function [2] |
| 6 | Auxiliary setpoint source | … as for 0, within the limits of P615 and P616 via analogue signal (P400 set to "Setpoint position" function) |
| 7 | Relative position increment | … as for 1, in this case the movement increment relates to the current actual position – accordingly, the setpoint position is extended by the required increment relative to the current actual position. |
| 8 | Relative bus increment | … as for 7, via bus (note **P509**) |
| 9 | *Reserved* | |
| 10 | Remaining path position | Position specification for "Residual path positioning" mode (🕮 Section 4.8) |

1) Any setpoint from the bus (note**P509**, **P546**…) is added!

2) Any programmed position increment via the digital inputs or Bus IO Bits is added!

| P611 | Position controller P | S | P |
|---|---|---|---|
| **Setting range** | 0.1 … 100.0 % | | |
| **Factory setting** | { 5 } | | |
| **Description** | Adjustment of the proportional amplification P ( P amplification) of the position control. The rigidity of the axis when at a standstill increases with increasing values of P. | | |
| **Note** | • Values which are too large cause overshooting.<br>• Values which are too low cause imprecise positioning. | | |

| P612 | Target window size | S | P |
|---|---|---|---|
| **Setting range** | 0.0 … 100.0 rev. | | |
| **Factory setting** | { 0 } | | |
| **Description** | Slow running at the end of the positioning process can be achieved through the size of the target window. The target window corresponds to the starting point for slow running. | | |
| **Note** | Within the target window or during slow running the speed is specified by parameter **P104** (minimum frequency) and not by the maximum or setpoint frequency. With **P104 = 0** slow running is carried out with 2 Hz. | | |

| P613 | Position | S | P * |
|---|---|---|---|
| **Setting range** | - 50000,000 … 50000,000 rev. | | |
| **Arrays** | [-01] = Position 1, position array element 1 or position increment array element 1<br>[-02] = Position 2, position array element 2 or position increment array element 2<br>… …<br>[-06] = Position 6, position array element 6 or position increment array element 6<br>[-07] = Position 7, position array element 7<br>… …<br>[-63] = Position 63, position array element 63 | | |
| **Factory setting** | { all 0 } | | |
| **Description** | Setting of various position setpoints which can be selected via digital inputs or a field bus. | | |
| **Note** | • All arrays (position array Element 1 … 63) are available for positioning with absolute setpoint positions) (see **P610**).<br>• The first 6 arrays (position array Element 1 … 6) are available for positioning with relative setpoint positions) (see **P610**). With each change of signal from "0" to "1" at the relevant digital input, the value allocated to the digital input is added to the position setpoint value. This also applies to control via the bus. | | |
| | This parameter *depends on the parameter set*. Therefore *4 times the number* of relative (24) or absolute positions (252) are available. | | |

| P615 | Maximum position | S | P |
|---|---|---|---|
| **Setting range** | - 50000,000 … 50000,000 rev. | | |
| **Factory setting** | { 0 } | | |
| **Description** | Setting of the upper setpoint limit for a permissible positioning range. If the setpoint limit is exceeded error message **E14.7** is activated. | | |
| **Note** | • Rotary axes ("Turntable applications")<br>Parameter **P619**: With the setting **P619 = 2** "*Modulo Pos*" or **P619 = 3** "*Save Modulo Pos*" parameter **P615** has no function. | | |
| | • Positioning with incremental encoder<br>Parameter **P619**: With the setting **P619 = 0** "*Normal*" or **P619 = 1** "*Save position*" the monitoring function is only active for referenced incremental encoders. I.e. referencing of the incremental encoder is necessary every time the frequency encoder is switched on.<br>In contrast, with setting **619 = 1** "*Save position"* the initial referencing on commissioning is sufficient to be able to use the function when the frequency inverter is switched on again.<br>• With the setting **P610 = 6** "*Auxiliary setpoint source*" monitoring is always deactivated. | | |
| **Setting values** | 0 = Monitoring is disabled | | |

| P616 | Minimum position | S | P |
|---|---|---|---|
| **Setting range** | - 50000,000 … 50000,000 rev. | | |
| **Factory setting** | { 0 } | | |
| **Description** | Setting of the lower setpoint limit for a permissible positioning range. If the setpoint limit is undershot error message **E14.8** is activated. | | |
| **Note** | • Rotary axes ("Turntable applications")<br>Parameter **P619**: if one of the functions "*Modulo Pos*" { 2 } or "*Save Modulo Pos*" { 3 } has been set, parameter **P616** has no function. | | |

| | |
|---|---|
| | • Positioning with incremental encoder<br>Parameter **P619**: With the setting **P619 = 0** "*Normal*" or **P619 = 1** "*Save position*" the monitoring function is only active for referenced incremental encoders. I.e. referencing of the incremental encoder is necessary every time the frequency encoder is switched on.<br>In contrast, with setting **619 = 1** "*Save position"* the initial referencing on commissioning is sufficient to be able to use the function when the frequency inverter is switched on again.<br>• With the setting **P610 = 6** "*Auxiliary setpoint source*" monitoring is always deactivated. |
| **Setting values** | 0 = Monitoring is disabled |

| **P617** | **Type SSI encoder** | **S** |
|---|---|---|
| **Setting range** | 000 … 111 (binary) | |
| **Factory setting** | { 000 } | |
| **Description** | Protocol settings for SSI encoder. | |

**Setting values**

| Bit | | Meaning |
|---|---|---|
| 1 | Power Fail Bit | Activate Bit if the transfer protocol contains a Power Fail Bit (PFB). If the PFB changes to the value 1, the error message **E 25.4** is triggered. |
| 2 | Gray=1/Binary=0 | Data format for the position transmission |
| 4 | Multiply-Transmit | Encoder supports the communication variant "*Multiple Transmit*", which serves the increased transmission reliability through the 2-fold transmission of the position data in mirrored form. |
| 8 | + 1 LSB | Insert 1 further Bit to the right of the position |
| 16 | + 2 LSB | Insert 2 further bits to the right of the position |
| 32 | + 4 LSB | Insert 4 further bits to the right of the position |

| **P619** | **Incremental mode** | **S** |
|---|---|---|
| **Setting range** | 0 … 3 | |
| **Arrays** | [-01] = Universal encoder<br>[-02] = HTL encoder | |
| **Factory setting** | { all 0 } | |
| **Description** | Selection of the mode for detection of position (actual position) with an incremental encoder. | |

**Setting values**

| Value | | Meaning |
|---|---|---|
| 0 | Normal | Position detection with the selected incremental encoder |
| 1 | Save position | … as for 0, with saving of the position |
| 2 | Modulo Pos | ... as for 0 with emulation of a singleturn absolute encoder for optimum path positioning |
| 3 | Save Modulo Pos | … as for 2, with saving of the position |

| **P620** | **Absolute encoder** | **S** |
|---|---|---|
| **Setting range** | 0 … 50000,000 rev. | |
| **Arrays** | [-01] = Universal<br>[-02] = HTL encoder | |
| **Factory setting** | { all 0 } | |
| **Description** | *"Absolute encoder range"*, Definition of the overflow point for the rotary axis / turntable positioning function (number of rotations until encoder overflow). | |
| **Note** | Only relevant if **P619** is in setting (2) or (3), or in the case of a CANopen application, if **P621** is in setting (1). | |
| **Setting values** | 0 = A value range of ± 0.5 rev. (0.5 rotations) is assumed. | |

| P622 | Shift SSI Position | S | |
|---|---|---|---|
| Setting range | 0 … 7 | | |
| Factory setting | { 0 } | | |
| Description | With SSI encoders the position is typically transmitted with the first bit. However, there are some SSI encoders where transmission of the position is made with other bits. This parameter defines an offset in order to conceal the surplus bits. | | |

| Setting values | Value | | Meaning |
|---|---|---|---|
| | 0 | | No offset |
| | 1 ... | 7 | Telegram offset of 1 (… 7) Bit |

| P623 | Reference run type | S | P |
|---|---|---|---|
| Setting range | 0 … 34 | | |
| Factory setting | { 15 } | | |
| Description | *"Reference run type"*, selection of a variant for the reference run. | | |

| Setting values | Value | | Meaning |
|---|---|---|---|
| | 0 | No ref. pt. run | No reference run |
| | 1 | DS402 Method 17 | Reference run according to CANopen Drive Profile DS402 "homing method 17 … 30" |
| | 2 | DS402 Method 18 | |
| | … | … | |
| | 14 | DS402 Method 30 | |
| | 15 | NORD Method 1 | Once the reference point has been reached, the drive reverses. When the reference point switch is left (negative flank), this is adopted as the reference point.<br>The reference point is therefore typically in the side of the reference point switch on which the reference point run started.<br>Note: If the reference point switch is passed over (switch too narrow, speed too high), this is also taken as the reference point when leaving the reference point switch (negative flank). The reference point is therefore not on the side of the reference point switch from which the reference point run was started. |
| | 16 | NORD Method 2 | As for 15, however passing over the reference point switch does not result in adoption as the reference point. A negative flank only results in adoption as the reference point after reversal has been completed.<br>The reference point is therefore definitely on the side of the reference point switch from which the reference point run was started. |
| | 17 | NORD Method 3 | If the reference point switch is passed over during the reference point run (positive flank → negative flank) the drive adopts the average value of both positions and sets this as the reference point. The drive reverses and therefore stops at the reference point which has been thus determined. |

| P624 | Reference run frequency | | S | P |
|---|---|---|---|---|
| **Setting range** | 0 … 399.0 Hz | | | |
| **Arrays** | [-01] = Search for switch | The set frequency is used as the specified frequency up to the reference switch (initiator). | | |
| | [-02] = Search for reference point | The set frequency is used as the specified frequency up to the reference point. | | |
| **Factory setting** | { all 0 } | | | |
| **Description** | *"Reference run frequency"*, Specification of the speed for the reference run. | | | |
| **Setting values** | **Value** | **Meaning** | | |
| | 0 | The value from the setpoint source is used | | |
| | 1… 399.0 | Frequency value for the reference run | | |

| P625 | Hysteresis output | S | P |
|---|---|---|---|
| **Setting range** | 0.00...99.99 rev | | |
| **Factory setting** | { 1 } | | |
| **Description** | Difference between switch-on and switch-off point to prevent oscillation of the output signal. | | |
| **Note** | Relevant for POSICON output messages. Parameter **P436** … or **P483** … accordingly have no effect. (🕮 Section 4.9 "Output messages") | | |

| P626 | Comparative position output | S | P |
|---|---|---|---|
| **Setting range** | - 50000.000 … 50000.000 rev. | | |
| **Factory setting** | { 0 } | | |
| **Description** | Comparative position for digital output messages. | | |
| **Note** | Relevant for POSICON output messages. (🕮 Section 4.9 "Output messages") | | |

| P630 | Position slip error | S | P |
|---|---|---|---|
| **Setting range** | 0.00...99.99 rev | | |
| **Factory setting** | { 0 } | | |
| **Description** | Permissible deviation between the estimated and actual position. The error message **E14.5** becomes active if the permissible deviation is exceeded.<br>As soon as a target position is reached, the estimated position is set to the current actual position. | | |
| **Note** | The estimated position is determined from the calculated position, which results on the basis of the actual speed. | | |
| **Setting values** | 0 = Monitoring is disabled | | |

| P633 | Slip error delay | S | P |
|---|---|---|---|
| **Setting range** | 0 ... 99.99 s | | |
| **Factory setting** | { 0 } | | |
| **Description** | "*Slip error delay*", delay of slip error monitoring after enabling. | | |

| P640 | Unit of pos. value | | S |
|---|---|---|---|
| **Setting range** | 0 … 9 | | |
| **Factory setting** | { 0 } | | |
| **Description** | Assignment of a measurement unit for the position values. | | |
| **Note** | For details see 🕮 Section 4.5 "Speed ratio of setpoint and actual values" | | |
| **Setting values** | **Value** | **Meaning** | |
| | 0 | rev | Rotations |
| | 1 | ° | Degrees |
| | 2 | rad | Radians |
| | 3 | mm | Millimetres |
| | 4 | cm | Centimetres |
| | 5 | dm | Decimetres |
| | 6 | m | Metres |
| | 7 | in | Inch |
| | 8 | ft | Feet |
| | 9 | (no unit) | No unit |

| P660 | Position encoder | S |
|---|---|---|
| **Display range** | - 50000.000 … 50000.000 rev. | |
| **Arrays** | [-01] = Universal<br>[-02] = HTL | |
| **Description** | Displays the current position measured by the respective rotary encoder. | |
| **Note** | The function of parameter **P660** is comparable with the function of parameter **P601.** However the actual positions of all connected encoders can be read out from the arrays of parameter **P660**. | |

### 6.1.7 Information

| P700 | Actual operating status | |
|---|---|---|
| **Display range** | 0.0 … 99.9 | |
| **Arrays** | [-01] = Actual error | Indicates the presently active (unacknowledged) fault. |
| | [-02] = Actual warning | Indicates a present warning message. |
| | [-03] = Reason for switch-on inhibit | Indicates the reason for active switch-on inhibit. |
| | [-04] = Extended actual error (DS402) | Displays the present active error according to DS402 terminology. |
| **Description** | Messages (coded) for the actual operating status of the frequency inverter such as faults, warnings or the cause of a switch-on inhibit 7 "Operating status messages". | |
| **Note** | Display of bus-level error messages is in decimal integer format. The displayed value must be divided by 10 in order to correspond with the correct format.<br>Example: Display: 20 → Error number: **2.0** | |
| | The error number range from **50.0** to **99.9** displays messages from any extension modules. The meaning of these numbers is explained in the relevant documentation for the extension module. | |

| P701 | Last fault |
|---|---|
| **Display range** | 0.0 … 999.9 |
| **Arrays** | [-01] … [-10] |
| **Description** | "*Last fault 1 … 10*". This parameter stores the last 10 faults 7 "Operating status messages". |

# 7 Operating status messages

The majority of functions and operating data of the frequency inverter are continuously monitored and simultaneously compared with limit values. If a deviation is detected, the frequency inverter responds with a warning or an error message.

For basic information about this, please refer to the frequency inverter operating instructions.

All faults or reasons which result in a switch-on block of the frequency inverter and which are associated with POSICON functionality are listed below.

## 7.1 Messages

### Warnings

| Coding | | ERROR TEXT | Cause<br>• Remedy |
|---|---|---|---|
| Group | Number | | |
| **E013** | **13.0** | **Encoder error** | No signal from encoder<br>• Check 5 V sensor if present.<br>• Check supply voltage of encoder. |
| | **13.1** | **Speed slip error**<br>"Speed slip error" | The slip speed error limit was reached.<br>• Increase value in P327 |
| | **13.2** | **Disconnect. control** | The slip error monitoring was triggered; the motor could not follow the setpoint.<br>• Check motor data P201-P209! (important for current controllers)<br>• Check motor circuit<br>• Check encoder settings P300 and following<br>• Increase value for torque limit in P112<br>• Increase value for current limit in P536<br>• Check deceleration time P103 and extend if necessary |
| | **13.3** | **"Rotation direction" slip error**<br>"Rotation direction slip error" | • Unexpected direction of rotation of the encoder. |
| | **13.5** | **Fly.saw acceleration**<br>"Flying saw acceleration" | The acceleration value set in P613 [-63] is too low. |
| | **13.6** | **Fly.saw wrong value**<br>“Flying saw value incorrect” | The prefix of the acceleration path (P613 [-63]) does not match the prefix of the master drive. |
| | **13.8** | **Limit switch right** | The right limit switch was reached during the reference run although this is not permitted. |
| | **13.9** | **Limit switch left** | The left limit switch was reached during the reference run although this is not permitted. |
| E014 | **14.2** | **Reference point Error** | The reference point run was cancelled without a reference point being found.<br>• Check the reference point switch and the control unit |

| | | | |
|---|---|---|---|
| | **14.4** | **Absolute encoder error** | Absolute encoder defective or connection faulty (Error message is only possible with positioning enabled)<br>• Check absolute encoder and wiring<br>• Check the parameterisation in the frequency inverter<br>• Five seconds after switching on the frequency inverter there is no contact with the encoder<br>• The encoder does not respond to an SDO command from the frequency inverter<br>• The parameters set in the frequency inverter do not correspond to the possibilities for the encoder (e.g. resolution in parameter P605)<br>• The frequency inverter does not receive a position value over a period of 50ms |
| | **14.5** | **Pos. diff. Speed** | Change of position and speed do not match<br>• Check the position detection and the setting in P630 |
| | **14.6** | **Diff.betw.Abs. & Inc.** | Difference between absolute and incremental encoders<br>• Check the position detection and the setting in P631<br>• Position change for the absolute and incremental encoders do not match<br>• Check the speed ratio or reduction ratio and offset of both encoders in P607 … P609. |
| | **14.7** | **Max. Pos. Exceeded** | Maximum position has been exceeded<br>• Check the specified setpoint and the control setting in P615 |
| | **14.8** | **Min. Pos. Undershot** | Minimum position undershot<br>• Check the setpoint setting in P616 |
| E025 | **25.1** | **Uni. enc. comm.**<br>*“Universal encoder communication”* | Universal encoder interface communication error (CRC checksum error)<br>• Poor cable shielding<br>• Incorrect encoder resolution (BISS, SSI)<br>• SSI does not support Multiply Transmit (**P617**) |
| | **25.2** | **No corresp. uni. enc.**<br>“No corresponding universal encoder” | No connection to the selected universal encoder.<br>• The encoder or data cable are not connected correctly<br>• No power supply to the encoder<br>• Encoder incorrectly set, check **P604** |
| | **25.3** | **Uni. enc. res.**<br>*“Universal encoder resolution”* | The set universal encoder does not match the resolution sent by the encoder.<br>• Check P605. |
| | **25.4** | **Uni. enc. error**<br>*“Universal encoder error”* | The universal encoder reports an internal error to the frequency inverter.<br>• Re-start encoder. |
| E025 | **25.5** | **Uni. encoder parameter** | Two different multiturn encoder types have been parameterised.<br>• Only identical multiturn encoders may be used. Use and parameterisation of two different multiturn encoders (P604 [-04] to [-07]) in the 4 parameter sets results in an error. |

## Information

### Check of signal quality

**P650** [-03] counts the communication errors to the universal encoder since switch-on. A high value may indicate that the encoder cable is poorly shielded.

A communication error does not necessarily result in a fault. An error message is only triggered if several consecutive communications have failed.

**Switch-on block message, “not ready”**

| Control panel display | | Reason | Cause |
|---|---|---|---|
| Group | Details in P700 [-03] | Text | • Remedy |
| I014 | **14.4** | **Absolute encoder error** | Absolute encoder defective or communication interrupted<br>• Check absolute encoder and wiring<br>• Check the parameterisation in the frequency inverter<br>• Five seconds after switching on the frequency inverter there is no contact with the encoder<br>• The encoder does not respond to an SDO command from the frequency inverter<br>• The parameters set in the frequency inverter do not correspond to the possibilities for the encoder (e.g. resolution in parameter P605)<br>• The frequency inverter does not receive a position value over a period of 50ms |

1) Indication of operating mode (message) on the *ParameterBox* or virtual operating unit of the *NORD CON-Software*: **"Not ready"**

## 7.2 FAQ operational problems

Typical operating errors and sources of error in connection with positioning and speed control are listed below. It is recommended that the same sequence as for commissioning is used for troubleshooting. Accordingly, it should first be checked whether the affected axis is running without control. After this, the speed and position controllers should be tested.

### 7.2.1 Operation with speed feedback, without position control

| Symptom | Cause |
|---|---|
| • Motor only rotates slowly<br>• Motor runs unevenly | • Incorrect assignment of the direction of rotation of the motor to the counting direction of the incremental encoder<br>– Change the sign in P301<br>• Incorrect incremental encoder type (no RS422 outputs)<br>• Encoder cable interrupted<br>– Check the voltage difference of track A and B with **P709**<br>• Encoder voltage supply missing<br>• Incorrect pulse number parameterised<br>– Check the resolution in P301<br>• Incorrect motor parameters<br>– Check P200 et seq.<br>• Encoder track missing |
| • With active speed feedback (servo mode enabled) the motor runs correctly, but runs unevenly at low speeds<br>• Overcurrent switch-off at higher speeds | • Incremental encoder incorrectly mounted<br>• Interference in encoder signals |
| • Overcurrent switch-off when braking | • For field weakening operation in servo mode, the torque limit must not exceed 200 % |

### 7.2.2 Operation with active position control

| Symptom | Cause |
|---|---|
| • Target position exceeded | • Position control P amplification considerably too large<br>– Check P611<br>• Speed controller (servo mode) not optimally set<br>– Set I amplification to approx. 3 % / ms,<br>– Set P amplification to approx. 120 % |
| • Drive oscillates at the target position | • Position control P amplification considerably too large<br>– Check P611 |
| • Drive moves in the wrong direction (away from the setpoint position) | • The direction of rotation of the absolute encoder does not match the direction of rotation of the motor<br>– Parameterise a negative value for the speed ratio (**P607**) |
| • Drive unit sags away after enabling is removed (lifting gear) | • Setpoint delay missing (control parameter)<br>• For servo mode = "Off" the control must be locked immediately by the event "End Point Reached" |

### 7.2.3 Position control with incremental encoders

| Symptom | Cause |
|---|---|
| • Position drifts away | • Interference pulse in the encoder cable |
| • No reproducible precision when approaching the position, | • At all speeds<br>– Interference pulse in the encoder cable<br>• Only at high speed (n > 1000 rpm)<br>– Pulse number of the encoder too large in association with the length of the encoder cable → pulse frequency too high<br>– Encoder not mounted correctly / loose |

### 7.2.4 Position control with absolute encoders

| Symptom | Cause |
|---|---|
| • Actual position value always runs to the same value and then no longer changes | • Encoder connection faulty |
| • Position not always found at the same place, axis sometimes jumps backwards and forwards. | • Axis stiff<br>• Axis jams<br>• Encoder not mounted correctly / loose |
| • Position value jumps or does not match the number of revolutions of the encoder | • Encoder defective<br>Check the absolute encoder:<br>– Remove the encoder<br>– Set the speed ration and reduction to "1" (P607, P608)<br>– Manually rotate the encoder shaft. The displayed position must match the number of revolutions of the encoder, otherwise the encoder has a malfunction. |

### 7.2.5 Other encoder errors (universal encoder interface)

| Circumstances | Cause |
|---|---|
| • Hiperface encoder<br>After enabling, the frequency inverter goes into fault state with error E25.0 | • Sin/Cos signals not connected correctly<br>– The voltage signal can be checked with **P651**. |
| • SSI encoders | |
| The position jumps to the value 0 too early. | Multiply Transmit (OFF), PBF (OFF). Coding is binary<br>• The resolution is set too low. |
| The position does not count evenly up or down, but jumps. | Multiply Transmit (OFF), PBF (OFF).<br>• Position coding (Gray, Binary) is set incorrectly.<br>• Resolution is set incorrectly, especially with the coding type Gray. |
| The position jumps with a power of 2. | Multiply Transmit (OFF), PBF (OFF). Coding is binary<br>• The resolution is set too low. |
| Continuously occurring Multiply Transmit error. | • Encoder does not support Multiply Transmit |
| • BISS encoders | |
| Communication error although the encoder has been connected correctly. | • Resolution set incorrectly |
| Communication error after enable. | • Resolution set incorrectly |
| Speed ratio present although none has been set. | • Resolution set incorrectly |
| • The universal encoder reports an internal error or a warning. | • If the encoder reports and internal error, the cause must be determined from the reason which is entered in **P650** [-01], using the documentation from the encoder manufacturer.<br>An internal warning is not critical for positioning and can be obtained from parameter **P650** [-02]<br>• A BISS encoder only signals a **1** as the cause of a warning or error. Such a message means that a warning or error has occurred since the last initialisation. If the message does not disappear, the power supply to the encoder must be disconnected for 1 minute to reset the message.<br>• Frequent errors or warnings after long and error-free operation indicate that the encoder will soon fail! |

# 8 Technical Data

The POSICON function essentially has the following technical data.

| | | |
|---|---|---|
| **Encoder type** | | |
| | Incremental | SK 31xP: HTL, TTL, RS-485 |
| | Absolute | SK 31xP: BISS, SSI |
| **Number of positions** | | |
| | Absolute | 252 |
| | Relative | 24 |
| **Measurement detection resolution** | | 1/1000 position |
| **Functionalities** | | • Absolute positioning<br>• Relative positioning<br>• Residual path positioning<br>• Rotary table positioning / module axes (path optimised)<br>• Reference point run<br>• Reset position<br>• Position synchronisation (Master - Slave)<br>– Flying Saw<br>– Diagonal Saw |
| **Setpoint specification** | | • Digital inputs<br>• Bus IO In Bits<br>• Analogue inputs<br>• Bus setpoints |
| **Status messages** | | • Setpoint / Actual position and position deviations<br>• Operating status<br>– Position reached<br>– Reference point available<br>– … |
| **Types of acceleration** | | • With maximum speed<br>• With fixed or variable speed setpoint<br><br>.... each optionally with "S ramp" (ramp smoothing) |
| **Monitoring** | | • Communication<br>– To encoder<br>– Between Master and Slave<br>• Operating characteristics<br>– Target window / permissible positioning range (min/ max. position)<br>– Slip error<br>~ Calculated value in comparison with the actual encoder value<br>~ Measured value between two encoders |

| | |
|---|---|
| ***Note:*** | Only the encoder for the active parameter set is monitored. |
| **Position detection** | • Sequential position detection for up to 4 axes with different encoders is possible.<br>• With correct parameterisation the position of all connected encoders is detected. Via the integrated PLC of the frequency inverter the positions can be transmitted to a higher level PLC and used for monitoring (e.g. standstill monitoring of inactive drive axes). |

# 9 Appendix

## 9.1 Service and commissioning information

In case of problems, e.g. during commissioning, please contact our service department:

Tel.: +49 4532 289-2125

Our service is available to you at all times (24/7) and can support you the best if you have the following device information and accessories available:

- Type designation,
- Serial number,
- Firmware version.

## 9.2 Documents and software

Documents and software can be downloaded from our website www.nord.com.

**Other applicable documents and further information**

| Documentation | Contents |
|---|---|
| BU 0800 | Manual for frequency inverter NORDAC *ON / ON+* **SK 3xxP** |
| BU 0000 | Manual for use of NORDCON software |
| BU 0040 | Manual for use of NORD ParameterBoxes |

**Software**

| Software | Description |
|---|---|
| NORDCON | Parameterisation and diagnostic software |

## 9.3 Index of keywords

- **Absolute encoder, singleturn** — Encoder that gives a unique, coded information for every measuring step within a revolution. The data information is retained even after a power failure. If disconnected from the mains, the data is further recorded.
- **Absolute encoder, multiturn** — ... such as absolute encoder, singleturn, however, the number of revolutions is also recorded.
- **Resolution (Encoder resolution)** — For singleturn encoders, the resolution indicates the number of measuring steps per revolution. For multiturn encoders, the resolution indicates the number of measuring steps per revolution multiplied with the number of revolutions.
- **Baud rate** — Transfer rate for serial interfaces in bits per second
- **Binary code** — Name for a code that transmits messages via “0“ and “1“ signals.
- **Bit / byte** — A bit (binary-digit) is the smallest information unit in the binary system, a byte has 8 bits.
- **Broadcast** — In a network, all slave participants are addressed simultaneously by the master.
- **Encoder** — Electro- or opto-mechanical device for recording rotary movements. A distinction is made between absolute encoders and incremental encoders.
- **Precision** — Deviation between the actual and the measured position.
- **Total resolution** — See resolution
- **Incremental encoder** — Encoder that gives an electrical impulse (high/low) for every measuring step.
- **Jitter** — Indicates a small precision fluctuation during the act of transfer or the variance of the runtime of data packages.
- **Multiturn encoder** — See “Absolute encoder, multiturn”
- **Reset position** — Function for setting a zero point (or offset) at any point in the resolution range of an encoder, without its mechanical adjustment.
- **Singleturn encoder** — See “Absolute encoder, singleturn”
- **Pulse number** — A number of light/dark segments are applied to an impulse disc made out of glass. These segments are scanned by a light beam in the encoder and determine the possible resolution of an encoder.

## 9.4 Abbreviations

- **Abs.** Absolute
- **AIN** Analogue input
- **AOUT** Analogue output
- **DIN** Digital input
- **DOUT** Digital output
- **FI** Frequency inverter
- **GND** Ground
- **Inc** Incremental
- **IO** IN / OUT (Input / Output)
- **P** Parameter set dependant parameter, i.e. a parameter which can be assigned with different functions of values in each of the 4 parameter sets of the frequency inverter.
- **Pos** Position
- **S** Supervisor parameter, i.e. a parameter which is only visible if the correct Supervisor Code is entered in parameter **P003**.

# Key word index

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