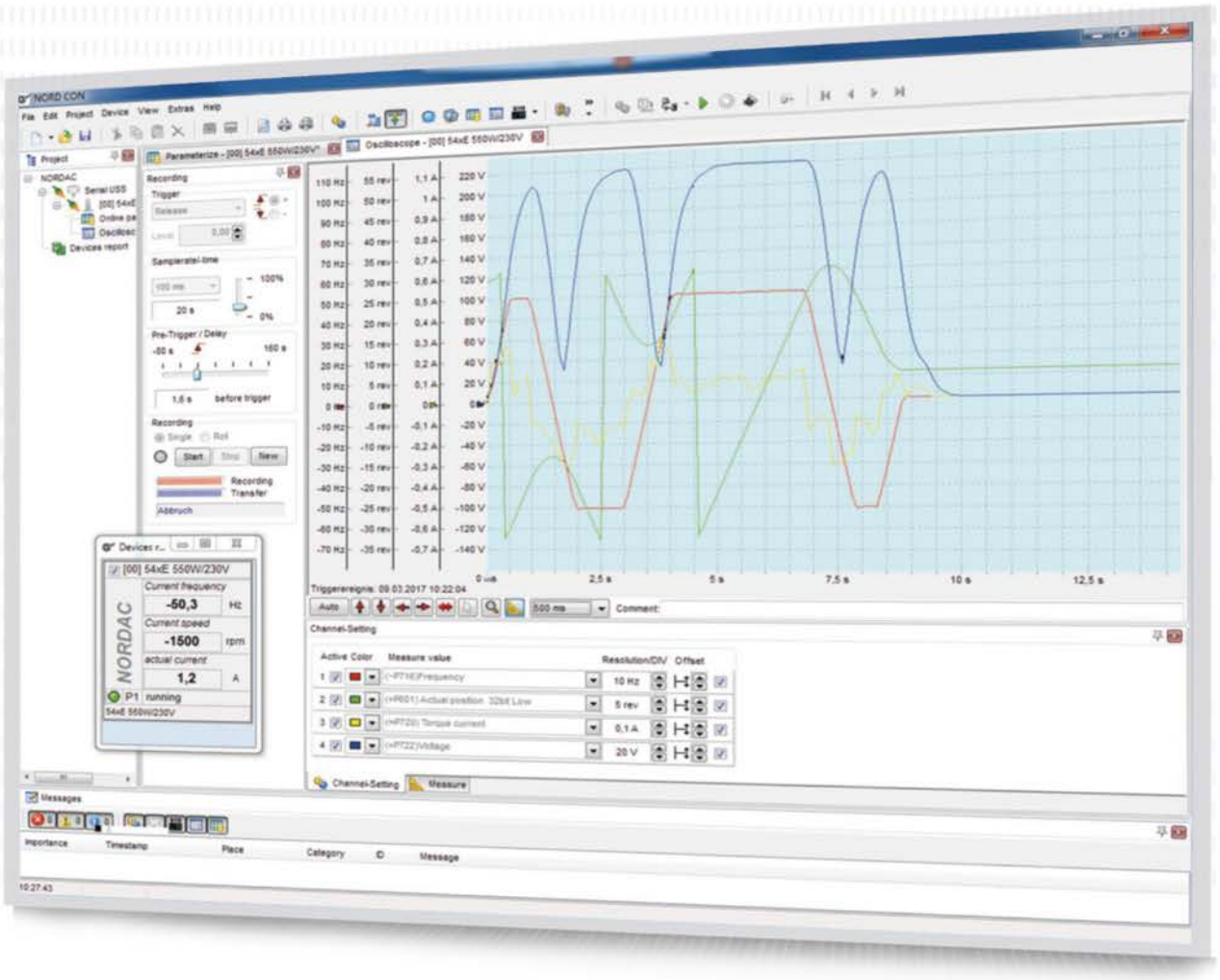

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NORDCON

Manual

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1 Introduction

1.1 About NORDCON

NORDCON is a PC program intended to 4 "Parameterization" and 5.1 "Overview" the inverters and option modules produced by Getriebebau NORD.

With NORDCON, up to 31 frequency inverters can be controlled simultaneously via the integrated RS485 interface. Communication with the frequency inverters is handled by the PC's serial interface.

To enable trial runs or system start-ups, the connected frequency inverters can be controlled via the PC. The program also provides for continuous monitoring of the current status of the frequency inverter while these activities are going on. Complete process sequences can be developed using macros.

With NORDCON, you can perform, document, and save the parameter settings of a frequency inverter which will be read out by the inverter or transmitted to it respectively. Parameter databases can be created or manipulated off-line - i.e. without a frequency inverter being connected.

The program further provides for remote control of the connected frequency inverters. For the frequency inverter to be remote-controlled the operating unit of the type in question is simulated on the PC. This is a convenient way of operating devices which are either difficult to access or haven't got an operating unit themselves.

8 "Macro editor"

6 "Remote control"

1.2 How to use NORDCON

Information — **Serial interface**

For the parameterisation and controlling of the devices with NORDCON, your PC requires a serial interface.

1. Installation

Please start the installation program of NORDCON on the enclosed CD or load the installation program from the Internet (""http://www2.nord.com/cms/de/documentation/software/software-overview.jsp""). Enter all necessary information and install NORDCON into the standard directory.

2. Connect

If the frequency inverter is equipped with an RS232 optional interface, it can be directly connected to the PC with a serial 1-1 cable. In this case, only one frequency inverter can be connected. Each NORD Frequency inverter frequency inverter features an integrated RS485 interface which can be activated via the control terminals. This interface allows for configuration of a master/slave bus system with up to 31 devices max. For NORDCON to be connected to such a bus, an RS232 - RS485 converter will be required.

Information **USS Settings**

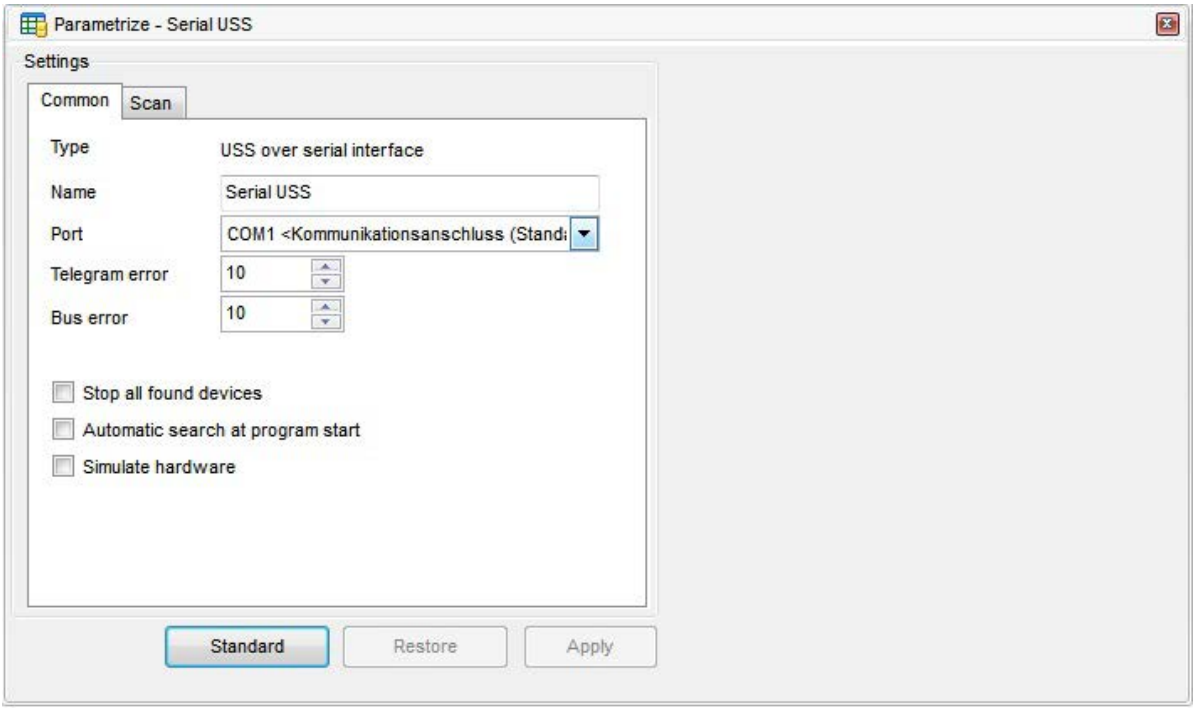
If several devices are operated simultaneously, make absolutely sure that a unique USS address is assigned to each of the devices connected, and that all of them have the same 3.1.2 "Bus scan"setting (see also Operating Instructions of the frequency inverter type involved).

3. Run NORDCON

In order to start NORDCON, you use the shortcut "NORDCON start" or "Start->Program->->Nord->NORDCON 2.8->NORDCON".

4. Setup of the communication module

In order to set the communication parameters, one must select the appropriate module in the project view. Over the menu entry "Device-> Parameterise" the parameter dialogue of the module can be opened. In the edit field "Port" must be inserted the correct COM port number. After that you have to push the button "Apply". Additional settings are not necessary for the first application and the window can be closed.



5. Bus scan

After the start of bus scan, all ready and connected devices are searched for. All found devices are represented in the project tree and in the equipment overview. Subsequently, the first device in the list is marked and the users can use all device-specific functions.

6. Work with the devices

The user can now select the device by clicking the device in the device overview or in the project tree. Functions, like control or parametrises, are available in the popup menu of the project tree, the tool bar or the main menu.

2.4 "View "Project""

2.3 "Toolbars"

5 "Control"

4 "Parameterization"

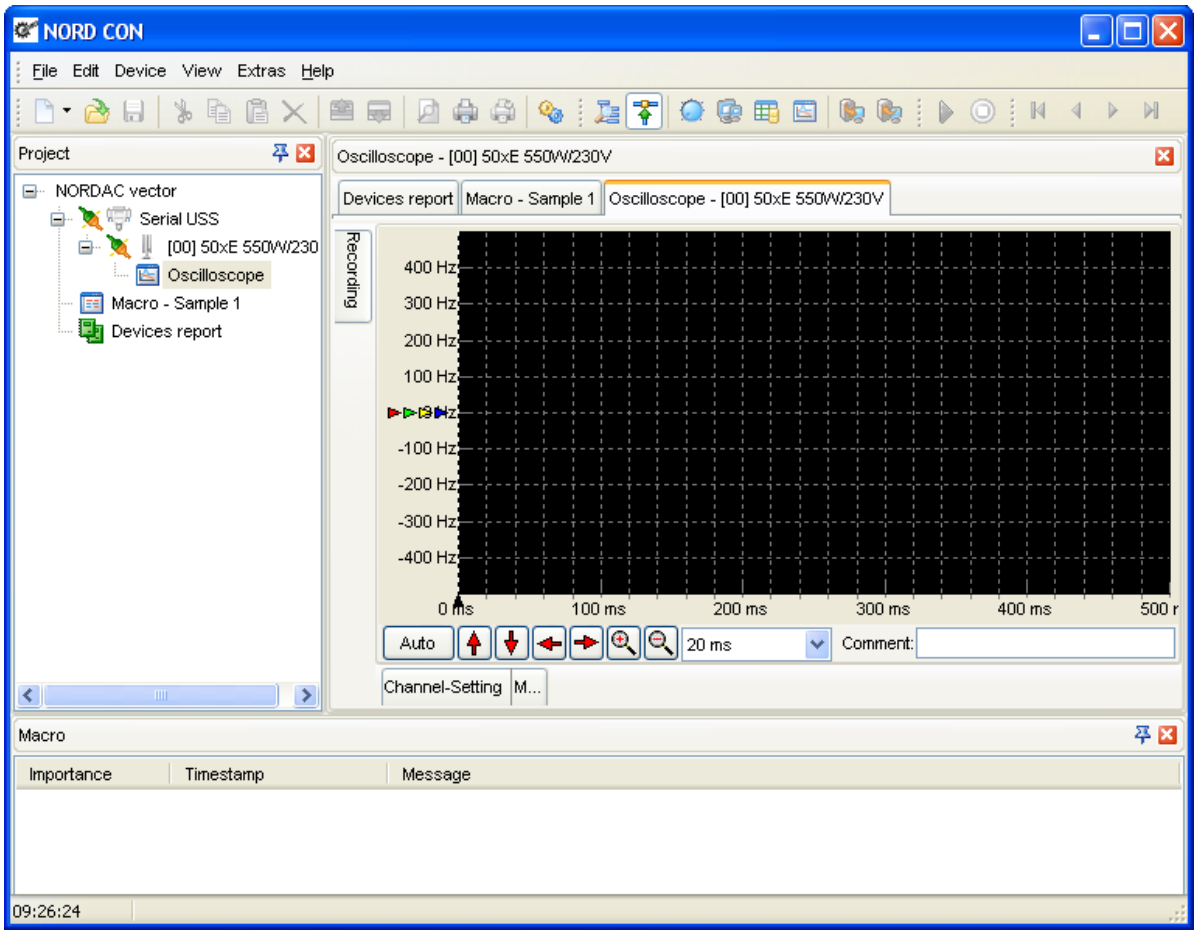
2 Graphic user interface

2.1 Structure of the program interface

The main window consists of main menu, toolbars, work area, and the different views. In the work area the different editor windows like parameter windows or macros are displayed. The windows can be positioned freely or can be docked at the sides of the work area. In order to change the position of a docked window, click on the header bar of the window and keep the mouse button pressed. Subsequently, the new position can be specified with the pointer of mouse. A coloured rectangle shows the current position and dock condition. After releasing the left mouse button, the actual action is implemented. In addition, the user can dock or undock the window by clicking on the header bar. The layout is stored when closing application and resumed with the restart.

The interface is divided into the following areas:

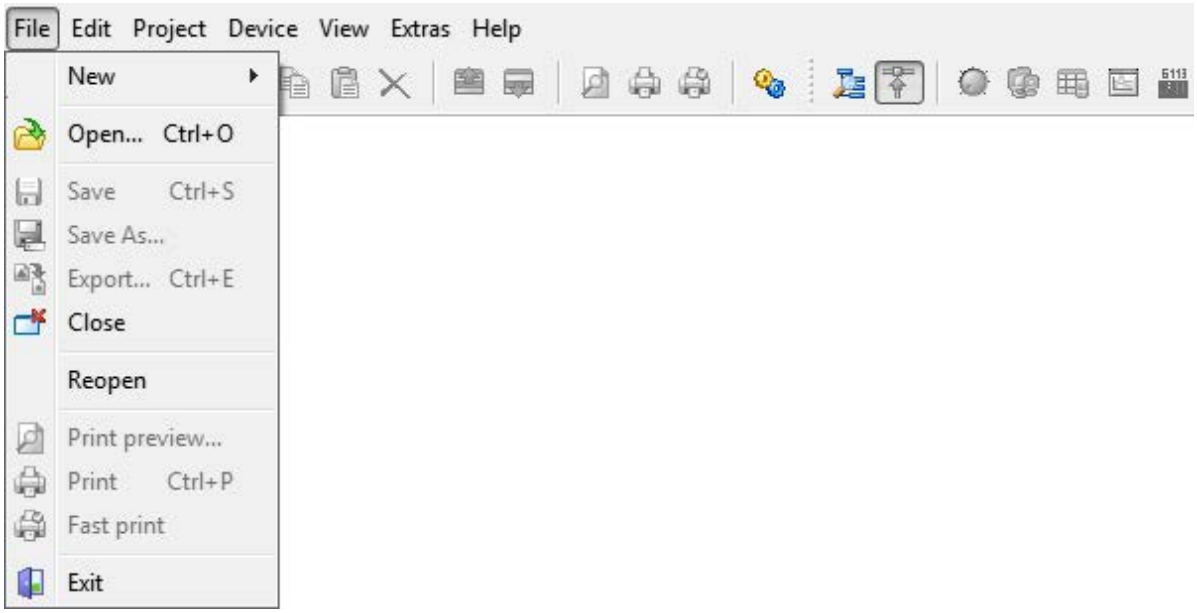
- 2.2 "Main menu"
- 2.3 "Toolbars"
- Working Area
- 2.4 "View "Project""
- 2.5 "View "Messages""
- 2.6 "View "Remote""



2.2 Main menu

The main menu is the central place for all actions of application. All editor windows register their window-specific actions there. The actions are divided in categories.

2.2.1 Category "File"



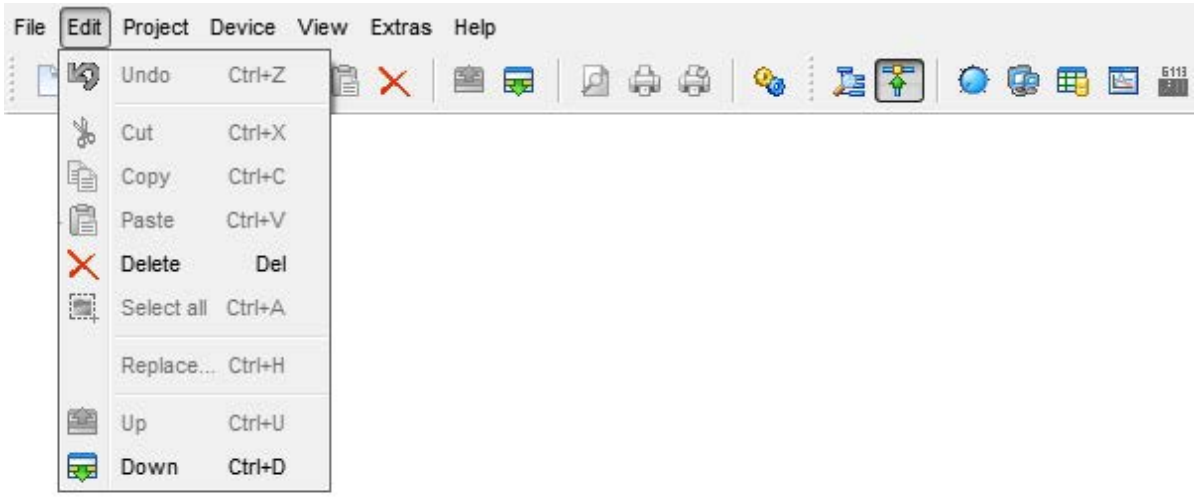
Name of action	Shortcut	Icon	Description
New dataset			The action opens the parameter window for a new device. The user must select the desired device in a previous window.
New macro			The action opens the macro editor with a new document. If the macro window is already opened, the user can store the current document. **Attention**: In the current version, only one macro window can be opened!
PLC program			The action opens the PLC editor with an empty document. If a PLC program is already opened, the user can store the current document.
Open	Ctrl + O		The action opens the file choice dialogue in order to open a stored document. The user selects a document type with the file filter, and selects the file afterwards. The following types are supported: • Parameter files (*.ndbx, *.db (V1.27)) • Scope files (*.scox, *.sco (V1.27)) • Macro files (*.ncmx, *.ncm (V1.27)) • PLC files (*.awlx, *.awl, *.nstx)
Save	Ctrl + S		The action stores the current document. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Save as...			The action stores the current document with a new name. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.

Name of action	Shortcut	Icon	Description
Export	Ctrl + E		The action exports the data active editor windows into a file. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Reopen			The action contains a submenu in which the opened last documents are listed. History is limited to 5. When clicking on one of the files, it is opened again.
Print	Ctrl + P		The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented. This action is deactivated if no editor window is opened or the editor does not support the action.
Print preview...			The action opens a print preview for the active editor. Depending upon editor, the printing preview can be differently developed. This action is deactivated if no editor window is opened or the editor does not support the action.
Exit			The action closes application.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

2.2.2 Category "Edit"



Name of action	Shortcut	Icon	Description
Undo	Ctrl + Z		The action undoes the last action. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Cut	Ctrl + X		The action cuts the selected object and copies it into the clipboard. The action is passed on to the active control member and implemented there. Depending upon the type of editor, different operations can be implemented.
Copy	Ctrl + C		The action copies the selected object into the clipboard. The action is passed on to the active control member and implemented there. Depending upon the type of editor,

Name of action	Shortcut	Icon	Description
			different operations can be implemented.
Paste	Ctrl + V		The action copies the contents of the clipboard to the selected position. The action is passed on to the active control member and implemented there. Depending upon the type of editor, different operations can be implemented. **Note**: The action is deactivated if the current control element does not support this action or the contents of the clipboard cannot be inserted.
Delete	Ctrl + Del		The action deletes the selected object. The action is passed on to the active control and implemented there. Depending upon the type of editor, different operations can be implemented.
Select all	Ctrl + A		The action selects all objects of the active control.
Replace...	Ctrl + H		The action searches for the indicated text and replaces these then by other text. In a dialogue, the appropriate option can be adjusted.
Up	Ctrl + U		The action shifts the selected object one position upward.
Down	Ctrl + D		The action entry shifts the selected object one position downward.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

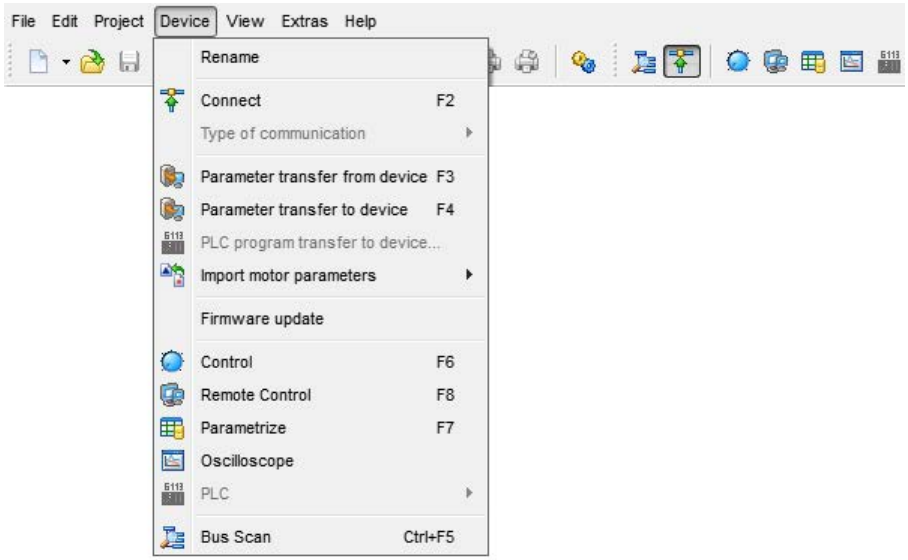
2.2.3 Category "Project"

Name of action	Shortcut	Icon	Description
Send all from file…			The action opens a file and sends the stored parameters to the devices.
Save all to file…			The action reads all parameters of devices and saves it in a file.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

2.2.4 Category "Device"



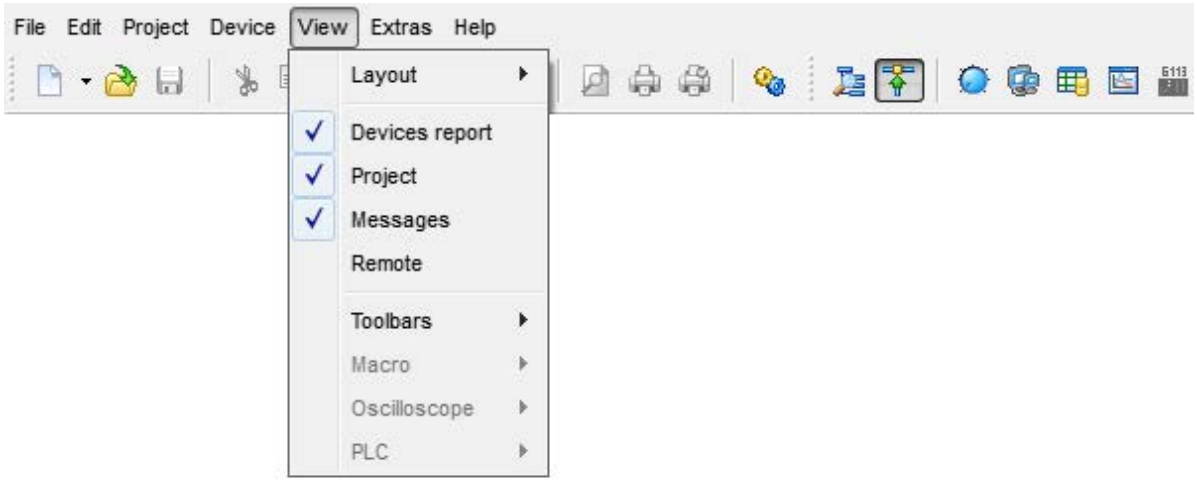
Name of action	Key combination	Picture	Description
Rename			With the aid of this menu item the user can change the name of the highlighted frequency inverter.
Connect	F2		This menu item connects or disconnects the connection to the highlighted frequency inverter.
Communication type/serial USS			This menu item sets the communication module to "serial USS". The device list is deleted if the communication type is changed!
Communication type/Ethernet			This menu item sets the communication module to "Ethernet". The frequency inverter list is deleted if the communication type is changed!
Parameter transfer from device	F3		This menu item starts the upload of parameters from the device to the PC.
Parameter transfer to device	F4		This menu item starts the upload of parameters from the PC to the device.
Transfer PLC program to device			This menu item transfers a saved PLC program to the selected frequency inverter.
Import motor parameters			This function enables motor data to be imported from an external source. If the user has selected a motor parameter file (* csv) in the file selection dialogue, all of the motors which this file contains are listed. Select a data record from the list and confirm with OK. The parameters will then be transferred to the selected frequency inverter. If the parameter window is open, the values in the parameter window are imported and not transferred to the frequency inverter. Transfer of the parameters must be carried out separately.
Update firmware			This menu item starts the firmware upload program.
Control	F6		This menu item opens the "Control" window of the highlighted frequency inverter in the work area. If the window has already been opened, it is brought into the foreground.
Remote control	F8		This menu item opens the "Remote Control" window of

Name of action	Key combination	Picture	Description
			the highlighted in the "View and Control" window. If the window has already been opened, it is brought into the foreground.
Parameter setup	F7		This menu item opens the "Parameters" window of the highlighted frequency inverter in the work area. If the window has already been opened, it is brought into the foreground.
Oscilloscope			This menu item opens the "Oscilloscope" window of the highlighted frequency inverter in the work area. If the window has already been opened, it is brought into the foreground.
PLC			This menu item opens the "PLC" window of the highlighted frequency inverter in the work area. If the window has already been opened, it is brought into the foreground.
Bus scan	Ctrl + F5		This menu item performs a network scan for the selected communication module. **Notice:** During a network scan all inverters are removed from the list of frequency inverters and all device-specific windows are closed.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

2.2.5 Category "View"

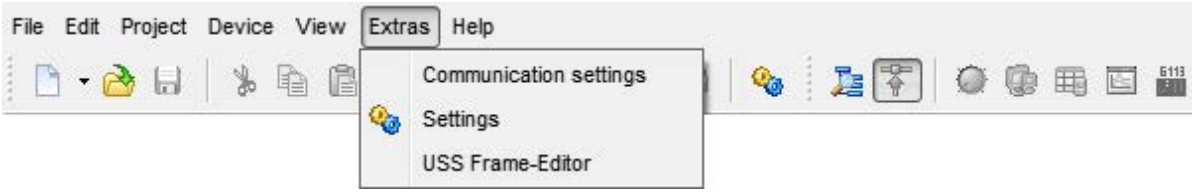


Name of action	Shortcut	Description
Layout -> Standard		The action returns the standard layout for all views. The position of the editor windows is not changed.
Layout -> Standard all windows		The action returns the standard application layout for all windows including the work area.
Device report		The action closes or opens the device report.
2.4 "View "Project""		The action closes or opens the view "Project".
2.5 "View "Messages""		The action closes or opens the view "Messages".
2.6 "View "Remote""		The action closes or opens the view "Remote control".
Toolbar->Standard		The action closes or opens the toolbar "Standard".
Toolbar->Device		The action closes or opens the toolbar "Device".
Toolbar ->Start		The action closes or opens the toolbar "Start".
Macro		The action opens a submenu. In this submenu, all special actions of the macro editor are listed. The state and the execution of the actions managed by the active macro editor. If no window is active, all actions are deactivated.
Oscilloscope		The action opens a submenu. In this submenu, all special actions of the oscilloscope are listed. The state and the execution of the actions managed by the active oscilloscope. If no window is active, all actions are deactivated.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

2.2.6 Category "Extras"



Name of action	Shortcut	Description
Communication settings		The action opens a window to edit the communication settings from the selected communication module.
Settings		The action opens a window to edit the global settings of the program.
USS Frame-Editor		The action opens a the USS frame editor.

2.2.7 Category "Help"

Name of action	Shortcut	Description
Help	F1	The action opens online help and selects the register map "Contents".
Index		The action opens online help and selects the register map "Index".
About NORDCON		The action opens a dialogue with the program information.

2.3 Toolbars

In the toolbars, the most common actions are available for fast access. By clicking the appropriate symbol in the bar with the mouse, the desired action is specified.

2.3.1 Standard

Name of action	Icon	Description
New data set		The action opens the parameter window for a new device. Before the user can open the dialogue, the device must be selected.
New Macro		The action opens the macro editor with an empty document. If a macro is already open, the user can store the current document. Attention: In the current version, only one macro window can be opened!
New PLC program		The action opens the PLC editor with an empty document. If a program is already opened, the user can store the current document.
Open		The action opens the file dialog in order to open a stored document. The user selects a document type with the file filter and select the file afterwards. The following types are supported: • Parameter dataset V1.27 (*.db) • Parameter dataset (*.ndbx) • Scope-File (*.sco) • Scope-File V2.1 (*.scox) • Macro (*.ncmx) • Macro V1.27 (*.ncm) • PLC Program (*.awlx)
Save		The action stores the current document. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.

Name of action	Icon	Description
Cut		The action cuts the selected object and copies it into the clipboard. The action is passed on to the active control element and implemented there. Depending upon the type of editor, different operations can be implemented.
Copy		The action copies the selected object into the clipboard. The action is passed on to the active control element and implemented there. Depending upon the type of editor, different operations can be implemented.
Paste		The action copies contents of the clipboard to the selected position. The action is passed on to the active control member and implemented there. Depending upon the type of editor, different operations can be implemented. **Note**: The action is deactivated if the current control element does not support this action or the contents of the clipboard cannot be inserted.
Delete		The action deletes the selected object. The action is passed on to the active control member and implemented there. Depending upon the type of editor, different operations can be implemented.
Up		The action shifts the selected object a position upward.
Down		The action shifts the selected object a position downward.
Preview		The action opens a print preview for the active editor. Depending upon editor, the printing preview can be differently developed. This action is deactivated if no editor window is opened or the editor does not support the action.
Print		The action prints the content from the active editor. This action is deactivated if no editor window is opened or the editor does not support the action.
Fast print		The action prints the content from the active editor without the print dialog. This action is deactivated if no editor window is opened or the editor does not support the action.
Settings		The action opens a window to edits the global settings of the program.

2.3.2 Device

Name of action	Icon	Description
Bus scan		The action implements a network scan for the selected communication module. **Note**: With a network scan, all devices are removed from the device list and all device-specific windows are closed!
Connect		The action connects or disconnects the connection to the selected device.
Control		The action opens the "Control" window of the selected device in the work area. If the window was already opened, it is brought into the foreground.
Remote		The action opens the "Remote" window of the selected device. If the window was already opened, it is brought into the foreground.

Name of action	Icon	Description
Parameterise		The action opens the "Parameter" window of the selected device in the work area. If the window was already opened, it is brought into the foreground.
Oscilloscope		The action opens the "Oscilloscope" of the selected device in the work area. If the window was already opened, it is brought into the foreground.
PLC		The action opens the PLC editor of the selected device in the work area. If the window was already opened, it is brought into the foreground.
Parameter transfer from device		The action uploads the parameters from the device to the PC.
Parameter transfer to device		The action downloads the parameters from the PC to the device.

2.3.3 Start

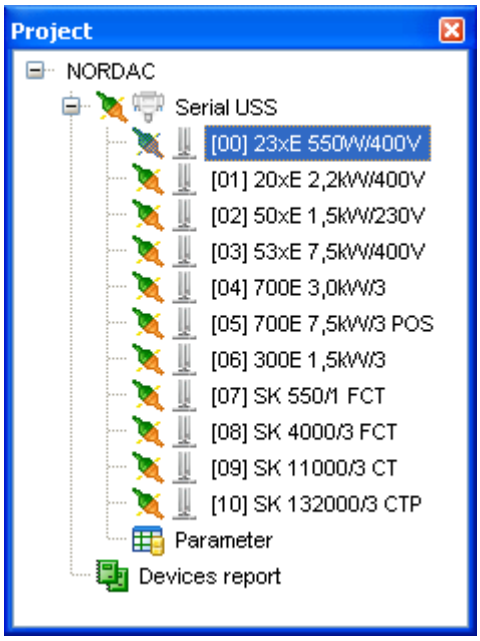
Name of action	Shortcut	Icon	Description
PLC settings			The action opens the settings of the PLC.
Compile	Shift + F7		The action starts the translation of a PLC program.
Programming	Shift F8		The action loads a PLC program to the Device.
Run	F9		The action runs a PLC program or a macro. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Cancel	F11		The action terminates running a PLC program or macro. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Next	F12		The action executes the next instruction. The action is passed on to the active editor window and implemented there. Depending upon the type of editor, different operations can be implemented.
Debug	Shift + F5		The action runs the PLC program with the debug mode.

Information

An action is deactivated if no editor window is opened or if the editor does not support the action.

2.4 View "Project"

In View "Project", all devices of the project are displayed in a tree structure. It can be closed or opened with the main menu option "View->Project ". With the help of the mouse, you can navigate between the individual devices. If the view is selected, you can additionally select a device with the arrow keys "up" and "down". If the pointer of mouse is over a device entry, a reference about the type of device and fieldbus address is indicated. After the selection of a device, the user can execute all actions with the tool bar as well as the popup menu. If an action is shaded grey, the selected devices do not support. The 2.4.1 "Structure of context menu"is opened by clicking the right mouse button in the view.



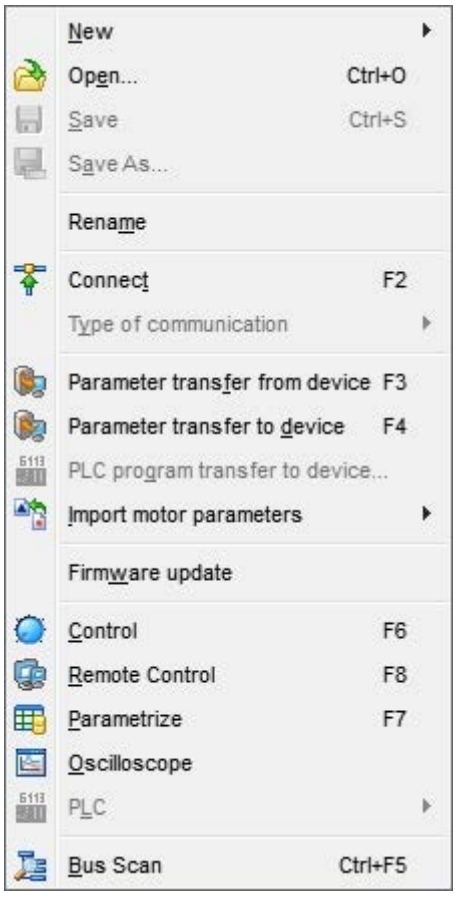
Status of device

 The connection to the device is online

 The connection to the device is offline

2.4.1 Structure of context menu

The display shows the context menu of the project view. The menu always relates to the marked node in the project tree.



Name of action	Key combination	Description
New parameter set		This menu item opens the parameter window for a new device. The user must select the required device in a dialogue beforehand.
New macro		This menu item opens the macro editor with an empty document. If the macro editor was already open, the user is asked to save the current document. **Attention:** Only 1 macro editor can be open in the current version!
New PLC program		This menu item opens the PLC editor with an empty document. If the window was already open, the user is given the opportunity to save the current document.
Open	CTRL + O	This menu item opens the PLC editor with an empty document. If the window was already open, the user is given the opportunity to save the current document.
Save	CTRL + S	This menu item saves the current document. The action is forwarded to the active editor window and carried out there. Depending on the editor type, different operations can be carried out there.
Save as		This menu item saves the current document under a new name. The action is forwarded to the active editor window and carried out there. Depending on the editor type, different operations can be carried out there.
Rename		This action opens an input field for changing the device name.
Connect	F2	This action connects or disconnects the connection to the highlighted device.

Name of action	Key combination	Description
Communication type/serial USS		This menu item sets the communication module to "serial USS". The device list is deleted if the communication type is changed!
Communication type/Ethernet		This menu item sets the communication module to "Ethernet". The device list is deleted if the communication type is changed!
Parameter upload from frequency inverter	F3	This action starts the upload of parameters from the device to the PC.
Parameter download to device	F4	This menu item starts the download of parameters from the PC to the device.
Update firmware		This action starts the program for uploading the firmware.
Control	F6	This action opens the "Control" window of the highlighted device in the work area. If the window has already been opened, it is brought into the foreground.
Remote control	F8	This action opens the "Remote Control" window of the highlighted device in the "View and Control" window. If the window has already been opened, it is brought into the foreground.
Parameter setup	F7	This action opens the "Parameter" window of the highlighted device in the work area. If the window has already been opened, it is brought into the foreground.
Oscilloscope		This action opens the "Oscilloscope" window of the highlighted device in the work area. If the window has already been opened, it is brought into the foreground.
PLC		This action opens the "PLC" window of the highlighted device in the work area. If the window has already been opened, it is brought into the foreground.
Bus scan	CTRL + F5	This action triggers a new bus scan. **Attention:** During a bus scan, all devices are removed from the device list and all device-specific windows are closed!

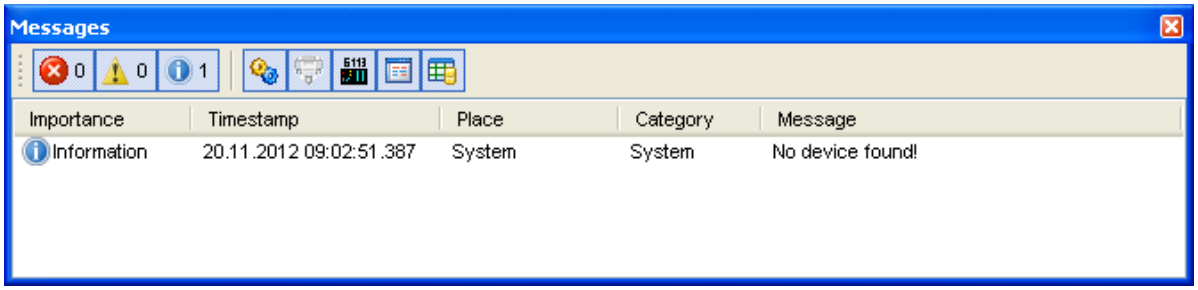
2.5 View "Messages"

The view contains a list of all NORDCON messages. The entries are displayed by default as time ascending. The order can be adjusted by clicking on a column header. Following filters are available for filtering:

Filter	Icon	Description
Error		When this filter is enabled, displays all errors. In addition, it shows the number of errors in the caption of the button.
Warning		When this filter is enabled, all warnings are displayed. The number of warnings is displayed in the caption of the button.
Information		When this filter is enabled, all information will be displayed. The number of information items is displayed in the caption of the button.
System		When this filter is enabled, all messages of the "System" category are displayed.
Communication		When this filter is enabled, all messages of the "Communications" category are displayed.
PLC		When this filter is enabled, all messages of the "PLC" category are displayed.

Macro		When this filter is enabled, displays all messages in the "Macro" category.
Parameter		When this filter is enabled, displays all messages in the "Parameter" category.

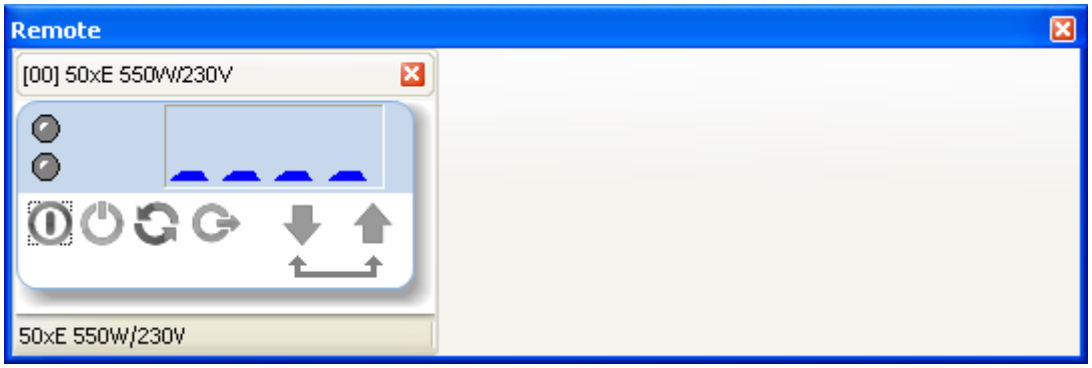
The messages can be saved or deleted via the popup menu (right mouse button). These actions can be carried out via the main menu ("Extras/Messages").



Name of action	Description
Delete	The action deletes the list.
Save	The action stores the entries into a file.

2.6 View "Remote"

The view "remote" contains all windows of the function „2.6 "View "Remote"""". The view opens automatically when opening the first window and closes after closing the latest. The view can be docked or undocked like all views to the work area. If the view was closed by the user, it can be opened by the action "Remote" again. The new windows are always docked to the left side of the last window. With the help of the mouse, it can be undocked or docked again. If the view is displayed for the first time (View->Remote), all remote windows are automatically opened.



Information **Remote**

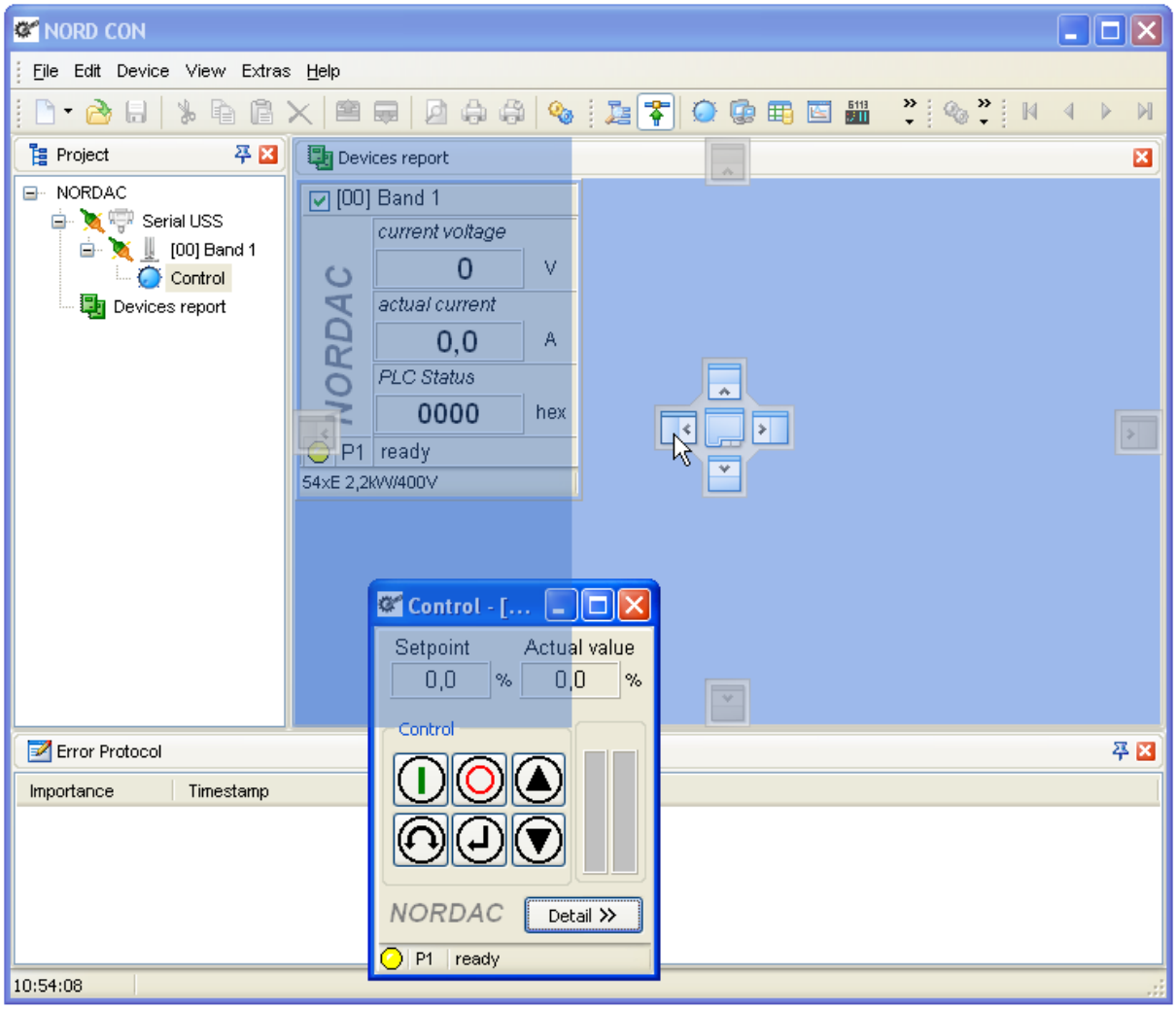
Windows of type "Remote" can be docked only into the view "Remote".

2.7 Docking and Undocking

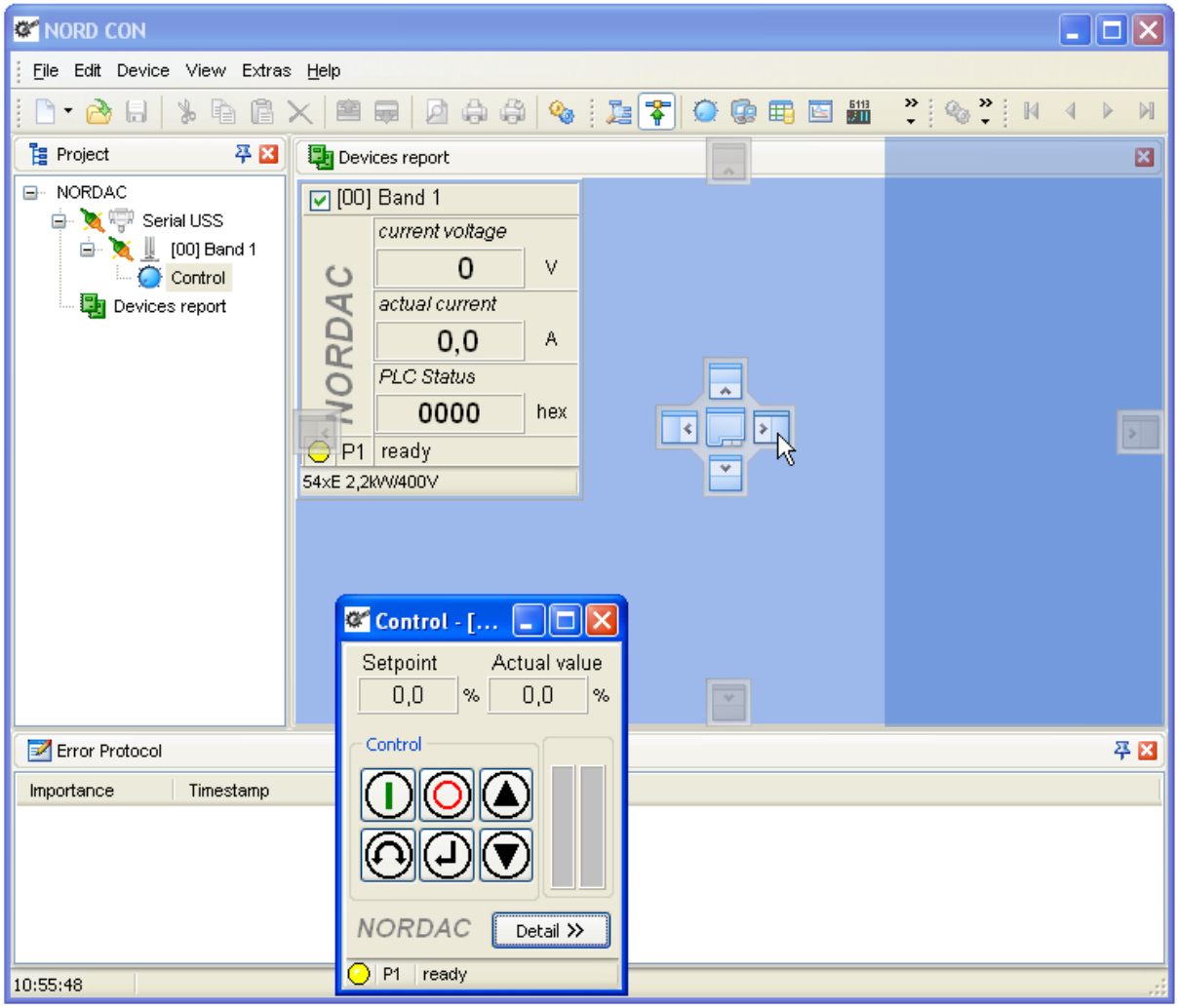
With the new design of NORDCON, the user has the possibility to adapt the layout of the window to their own requirements. In principle, you can undock each view and editor window and position them freely on the screen. For this, the user must press the left mouse button over the title border and move the coloured rectangle to the desired position. After releasing the mouse button, the view or editor windows remains in those positions as independent windows. With the editor windows, there is additionally the possibility - with the popup menu, which opens when clicking with the right mouse button on the title border to undock the windows. The docking functions are similar to the undocking functions. The coloured rectangle indicates in each case the current docking position.

Type of window	Rule
View of main window(e.g. Project, Logs, Remote)	The views of the main window can be docked only to the left, right and/or lower edge of the work area. Within these windows, there are no rules and the user can select the position freely.
Editor window (e.g. Macro editor, Parameter window, Oscilloscope)	The editor windows can only be docked into the work area. The adjustment is fixed however on down and/or above, or as register map.
Views of the Macro editor	The views of the macro editor can be docked only to the macro window. The adjustment here is fixed on left, right or down. Within the views, no rules are defined.
Views of the oscilloscope	The views of the oscilloscope window can be docked only to the oscilloscope window. The adjustment here is fixed on left, right or down. Within the views no rules are defined.
"Remote" windows	"Remote" windows can only be docked to the view "Remote". Here the adjustment is fixed on left.

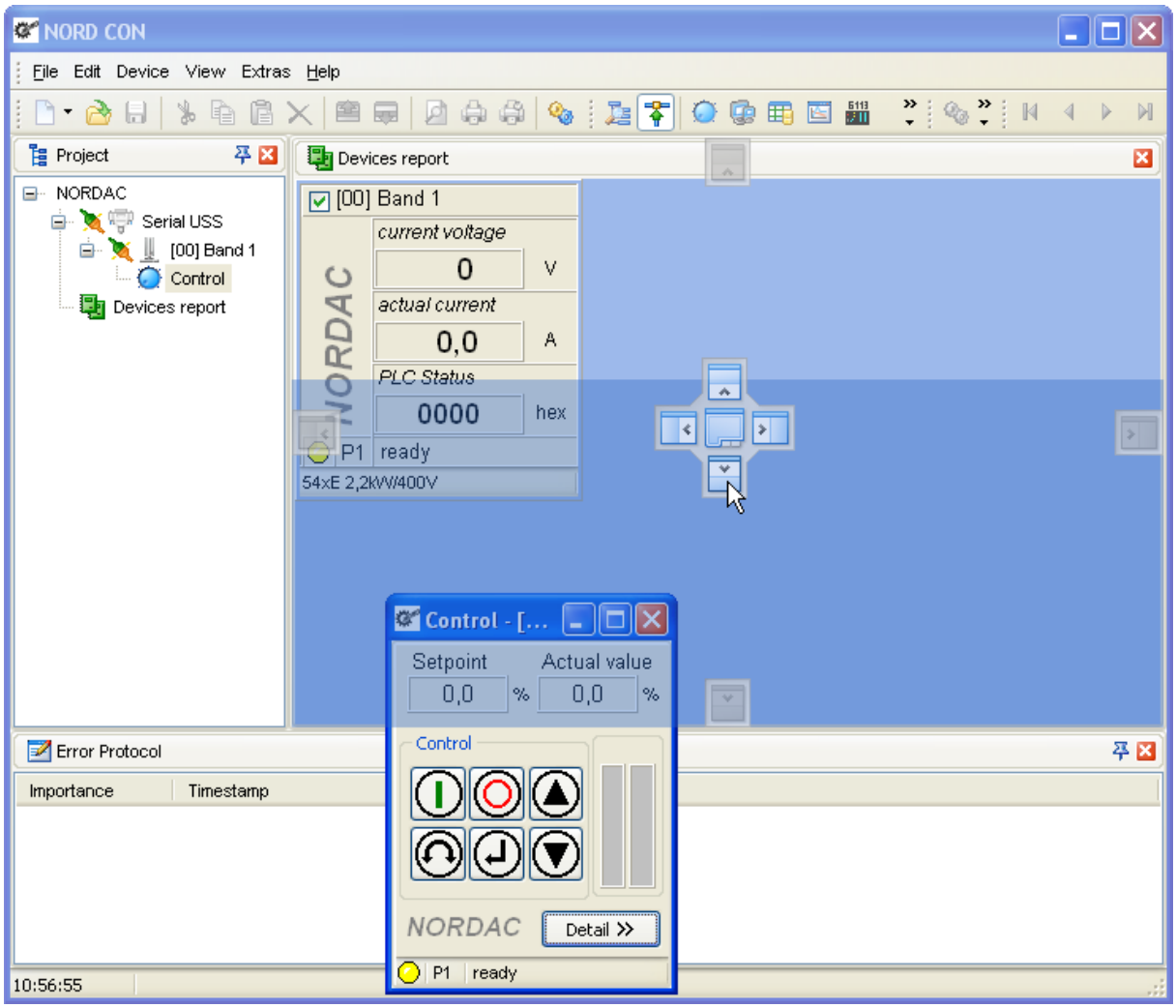
Docking position left



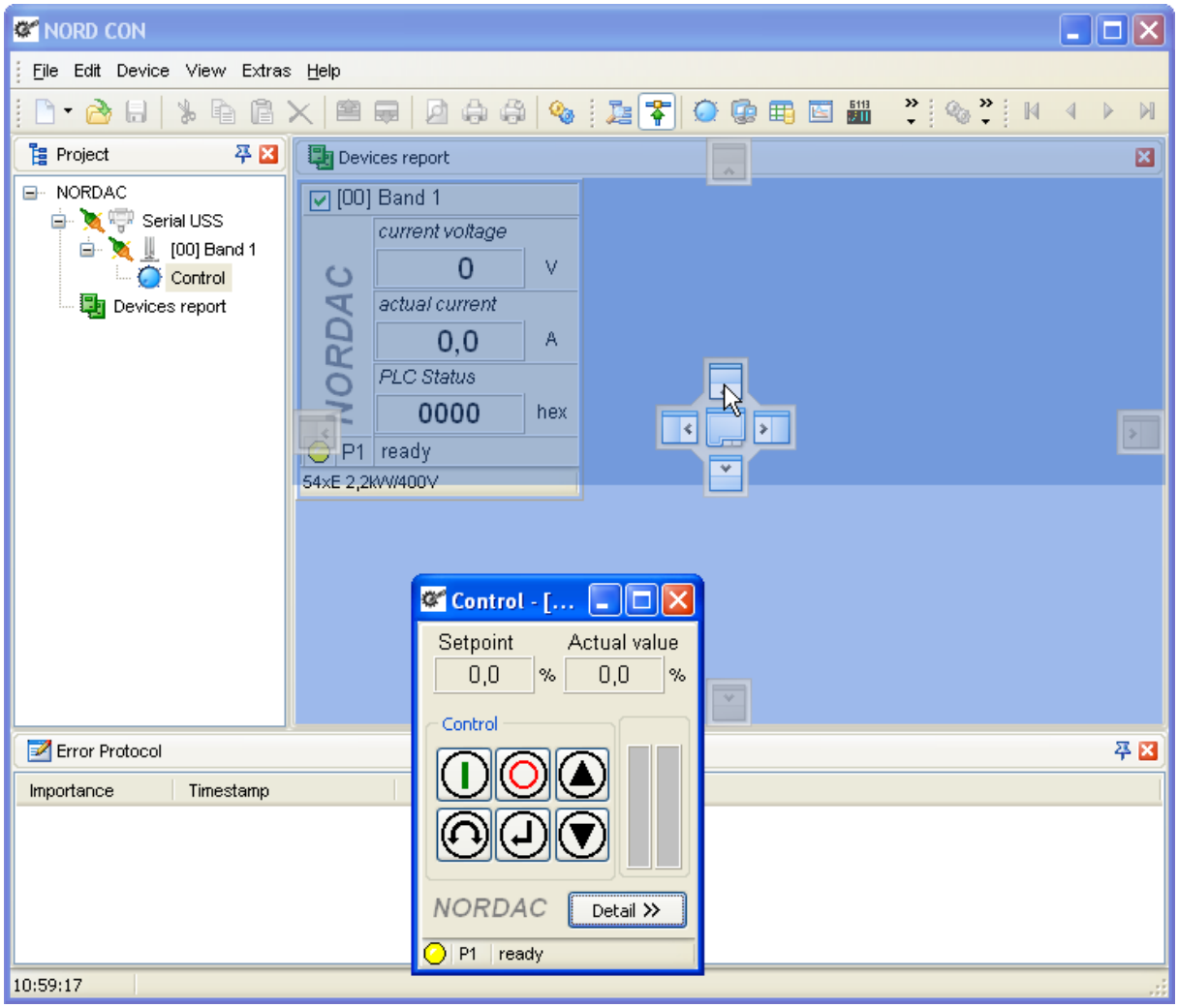
Docking position right



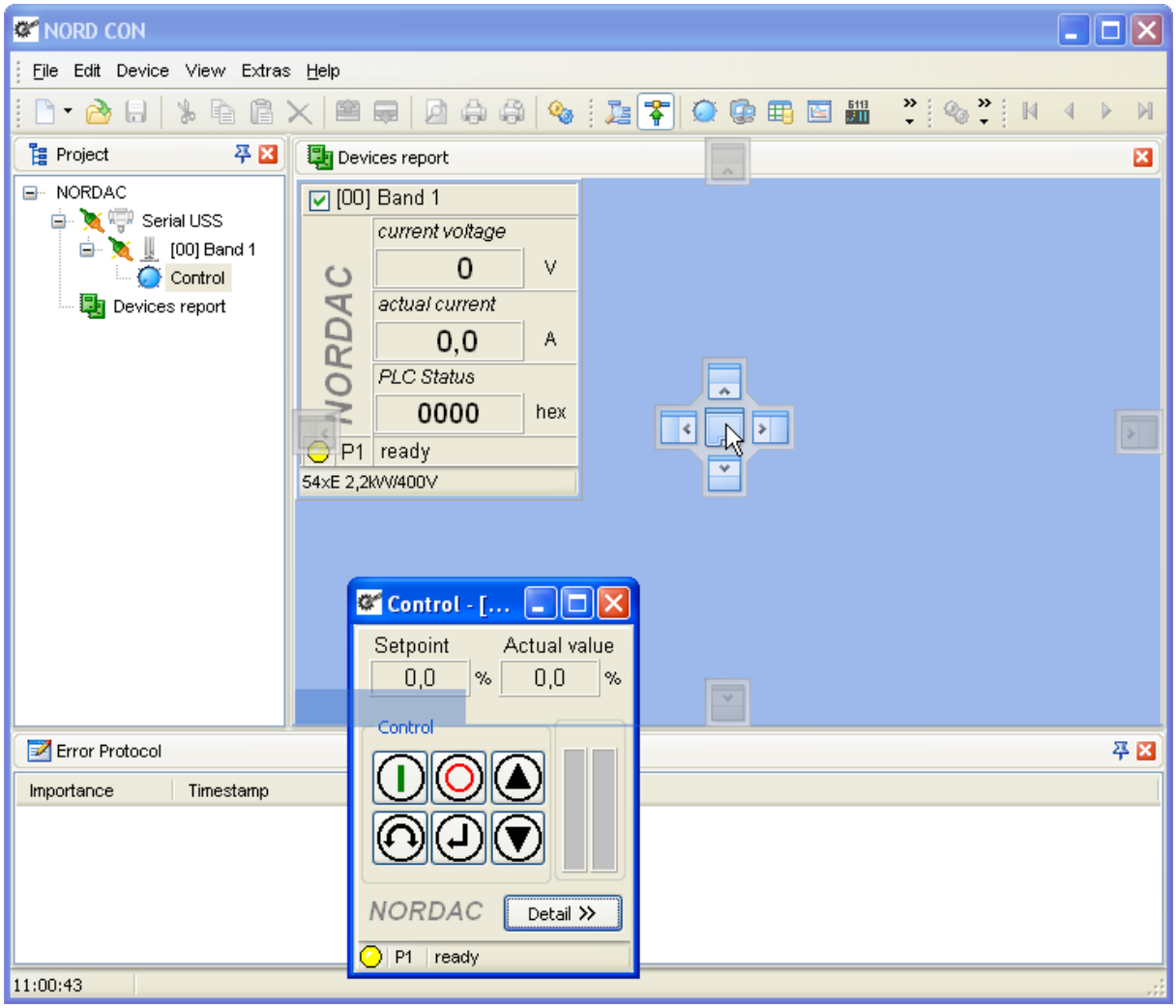
Docking position down



Docking position up



Docking position tab



3 Communication

In order to start a connection to a device, you must insert the appropriate communication module in the project. After the installation, a USS communication module is configured. With the action "Parameterise" the user can modify the parameters of the module.

3.1 USS

3.1.1 General settings

Name

The user can assign a name for the communication module in the input field.

Port

In the selection box, the user specifies the COM port of the PC to which the frequency inverter is connected.

Telegram error

In the input field, the user specifies the number of permissible telegram errors. Telegram errors occur if the content of the telegram is not correct, i.e. if the response does not correspond to the parameter entry. Usually a response is given after 2 telegrams for each order. The number of permissible telegram errors specifies how many attempts are permitted before an error message is displayed.

Bus error

In the input field, the user specifies the number of permissible bus errors. A bus error occurs if the receipt or transmission telegram has an error. The incorrect telegrams are deleted. Here, the permissible number of incorrect telegrams for which an error is generated can be set. The error tolerance should be set to an appropriately higher value for environments in which there is interference.

Stop all detected devices

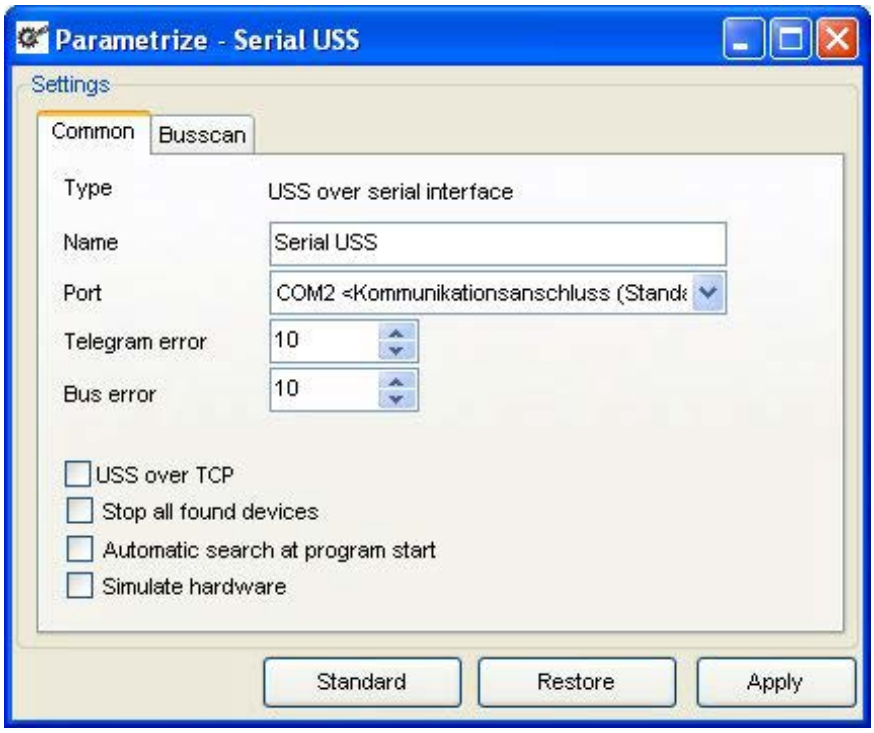
If this option is enabled, after the device search the NORDCON sends a "Disable" command to each of the devices which are detected. The device is stopped if it can be controlled via the bus (P509).

Automatic device search after program start

This option enables or disables the automatic search when the program is started. If this option is enabled, a device search is started automatically when the NORDCON is started.

Simulate hardware

With this option, the user can enable or disable simulation of a connected piece of hardware.



Information **Changes**

All changes only become effective after pressing the "Adopt" button. The currently valid settings can be restored with the "Restore" button.

3.1.2 Bus scan

Baud rate

In the selection box, the user can choose the communication speed of the serial interface. The same value must be chosen on the frequency inverter. When using multiple frequency inverters, the setting must be identical on all connected devices. The baud rates over 115200 Bit/s are user specific baud rates and not supported by all devices.

Information **Connection problems**

Older serial PC interfaces are sometimes not able to justify the accurate user specific baud rate. From this reason no connection can be made to the device.

Bus-Scan with all baud rates

With the action, the user activates or deactivates the bus scan with all baud rates. If the baud rate of the connected device is unknown, the search with all baud rates can find the right one to start communication.

Starting baud rate

In the selection box, the user can define the baud rate for start of the baud rate search.

Starting address

In this field, the USS address can be defined, from where the search run of NORDCON starts to find connected devices. All frequency inverters with lower address cannot be found by NORDCON.

End address

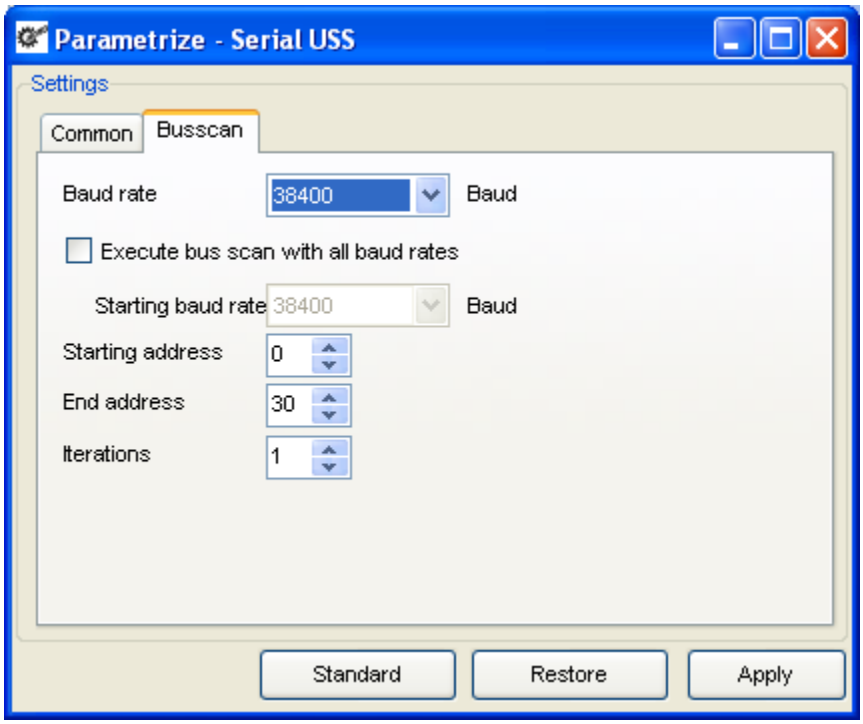
In this field, the user can define the USS address for the ending of the search for connected devices. All inverters with a higher address number cannot be found by NORDCON.

Stop all connected devices

With the action, the user can activate or deactivate the stopping (disable) of connected devices. When this function is active, all enabled devices are stopped if the interface of the device is programmed to "bus".

Automatic device search after start of program

With this action the user can activate or deactivate the automatic device search after the start of the program. When this function is active, NORDCON automatically starts the bus scan after the program is started.

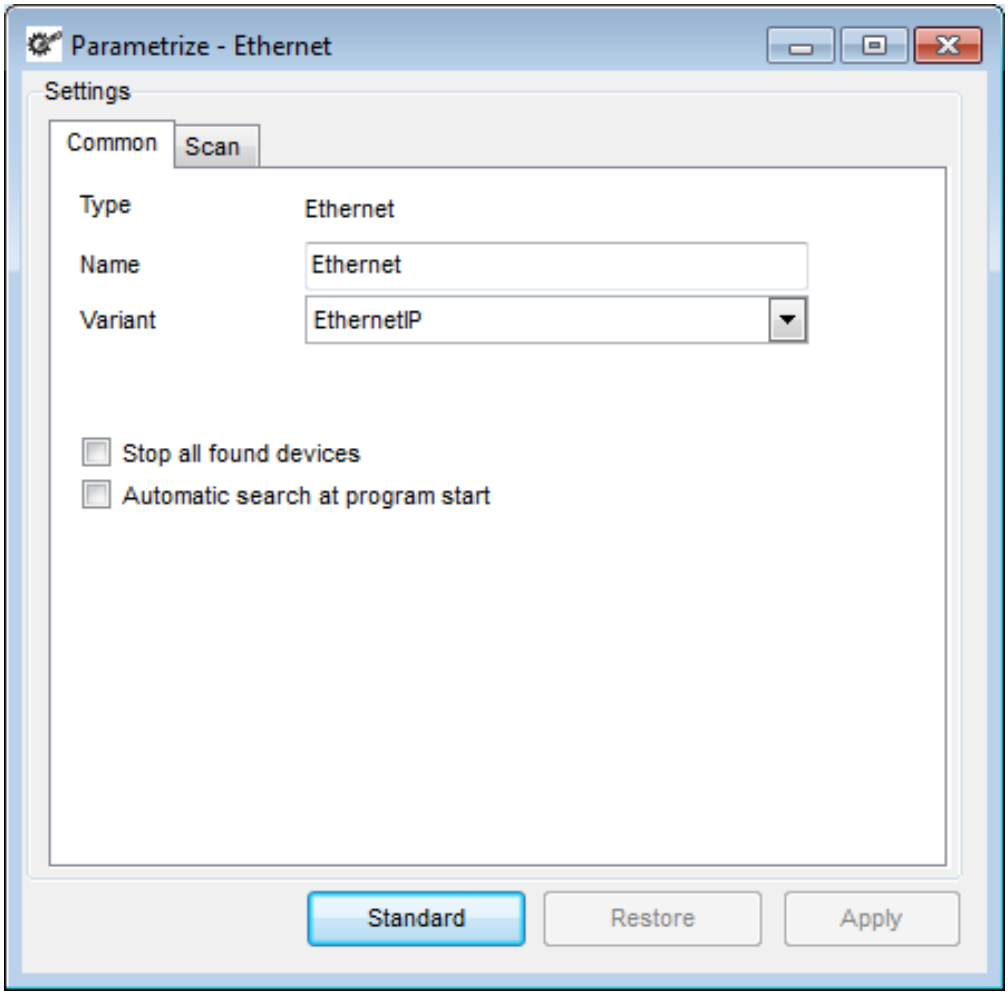


Information **Changes**

All changes only become effective after pressing the "Adopt" button. The currently valid settings can be restored with the "Restore" button.

3.2 Ethernet

3.2.1 General settings



Name

In the edit field, the user can assign a name for the communication module.

Kind

In the combo box the user defines the kind of communication (PROFINET, EtherCAT or EthernetIP).

Stop all found devices

If this option is enabled, each detected device will be sent the "Disable" command after search, provided that the device can be controlled via bus.

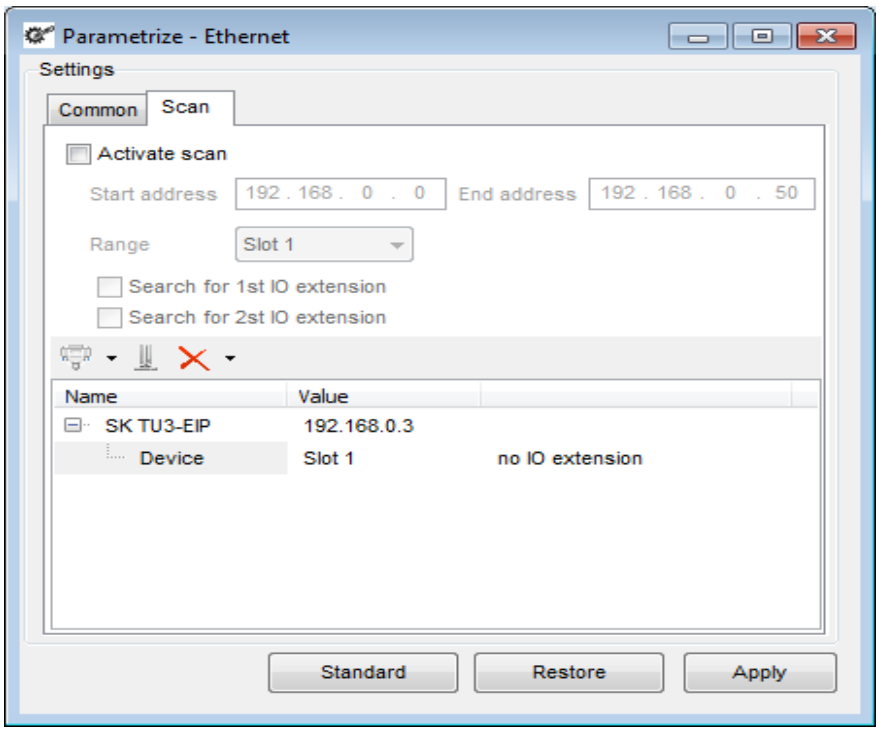
Automatic search at program start

If this option is enabled, the device search is initiated after the program start.

Information **Changes**

All changes only become effective after pressing the "Adopt" button. The currently valid settings can be restored with the "Restore" button.

3.2.2 Bus scan



Activate scan

The option defines whether the device search is enabled. If the search is enabled, all IP addresses from the start address to the end address are searched for devices. If the search is disabled, the following configuration is used in a bus scan.

Start address

In this input field, enter the start address for the device search.

End address

In this input field, enter the end address for the device search.

Add bus module

Use the button to add a new bus module to the device list.

Add device

Use the button to add a new device to the device list.

Delete

Use the button to remove the selected entry in the device list.

Value - Bus module (IP address):

In this column, enter the IP address of the connected bus module.

Value - Device:

In this column, enter the slot of the device (see following table).

Slot 1	Slot 2	Slot 3	Slot 4	Slot 5	Slot 6	Slot 7	Slot 8
System bus address 32 or SK 5xxE via TU3	System bus address 34	System bus address 36	System bus address 38	System bus address 40	System bus address 42	System bus address 44	System bus address 46

Example:

Additional - Device:

In this column, enter the configuration of the IO extensions.

Bus module	Slot 1	Slot 2	Slot 3	Slot 4	Slots 5–8
SK TU3-EIP V1.2 SK TU3-PNT V1.2	SK 5xxE	Not available	Not available	Not available	Not available
SK TU3-PNT V1.4 SK TU3-EIP V1.4	SK 5xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE
SK CU4-EIP V1.2 SK TU4-EIP V1.2 SK CU4-PNT V1.2 SK TU4-PNT V1.2	SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxE SK 2xxE SK 19xE SK 1xxE	Not available
Not available	SK 55xP	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	SK 5xxP SK 5xxE SK 2xxE SK 19xE SK 1xxE	Not available
Not available	SK 3xxP	Not available	Not available	Not available	Not available

Information

Access rights

Please note that you need access rights for parameterisation and control via the bus module. Please check the operating instructions for the bus module used.

Information

Please make sure you enter an address range for the device search that only includes NORD devices. Otherwise, problems may occur during the device search.

Information

Changes

All changes only become effective after pressing the "Adopt" button. The currently valid settings can be restored with the "Restore" button.

4 Parameterization

All parameters of the frequency inverter that can be changed can also be changed by NORDCON. All of the parameters can be stored and retransmitted to the frequency inverter. Parameters which have been read out can be printed out for documentation purposes.

4.1 How to manipulate parameters

The selected parameter is read out and the value transferred to the 'Current Setting' box. Management of the parameters of a frequency inverter is ensured by databases. These databases can be stored, printed out or manipulated again at a later date.

Information **Menu "Parameterise"**

The menu "Parameterise" is indicated only if a parameter window is marked.

NORDCON features two ways of parameter manipulation:

Action	Place	Description
New	File -> New -> Dataset	The current database is re-initialized, in other words the current and the new settings are deleted.
Open	File -> Open	Any database that was saved can be reopened.
Save	File -> Save	The current database is saved with the current name.
Save as...	File -> Save as...	The current database is saved with a new name.
Print preview...	File -> Print preview...	The current parameter settings are printed out.
Read all parameters or Read all	Parameterise -> Read -> All Parameter	All of the parameters of the frequency inverter are read out and entered into the database.
Read actual menu group	Parameterise -> Read -> Actual menu group	The parameters of the selected menu group are read out and entered into the database.
Send new settings	Parameterise -> Send -> new Values	All parameters for which a new value was entered in the 'New settings' box are transmitted to the frequency inverter. A selection is possible as to whether this operation is to be performed on all parameters or only on those belonging to the current menu group.
Send Factory settings	Parameterise -> Send -> Reset values	The settings transmitted will be the default settings of all parameters or of the parameters of the current menu group respectively
Selection Enable	Parameterise -> Selection -> Release	All of the parameters (or those included in the current menu group respectively), are enabled.
Selection Disable	Parameterise -> Selection -> no Release	None of the parameters (or of those belonging to the current menu group), are enabled.
Standard	Button "Standard"	The default value is allocated to the currently selected parameter.

Action	Place	Description
Send	Button "Send"	The value "new setting" of the current parameter is transferred to the inverter
Read	Button "Read"	The selected parameter is read out and the value transferred to the 'Current Setting' box.

With the Auto-read option the selected parameter is read out automatically.

4.2 Selective parameterisation

NORDCON allows for masking some parameters or other, a feature which may facilitate manipulation or serve the purpose of restricting parameter readout or transmission to those which remain unmasked, or in other words have been filtered out.

Information

When a filter has been activated, all operations are executed only on those parameters which are displayed.

Before any parameter can be masked the enable command must be inactivated. This can be done using the checkbox preceding the parameter, or via the 4.1 "How to manipulate parameters" menu.

The Filter box provides for the setting options mentioned below:

- **Selection only** Only the enabled parameters are displayed (i.e. where the check box preceding the parameter was clicked once).

- **No standard** Only the parameters with a value that is different from the standard setting are displayed.

- **Info parameters**
  - **Yes** Information parameters are displayed.
  - **No** Information parameters are not displayed.
- **Only** Information parameters are displayed exclusively.

4.3 Off-line Parameterisation

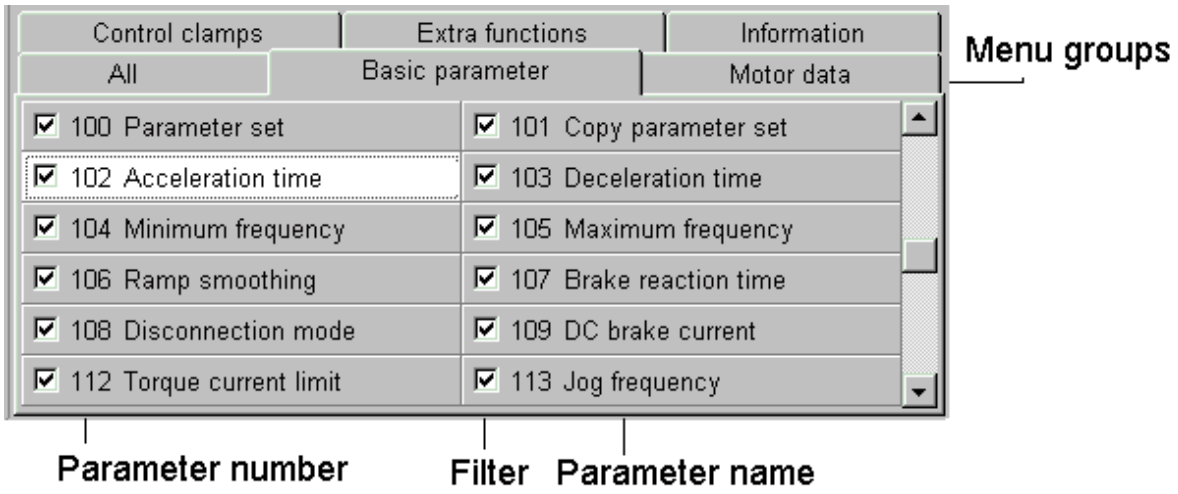
Off-line parameterisation implies that a database is manipulated which is not allocated to any frequency inverter connected.

Off-line parameterisation is started via the database menu in the main window.

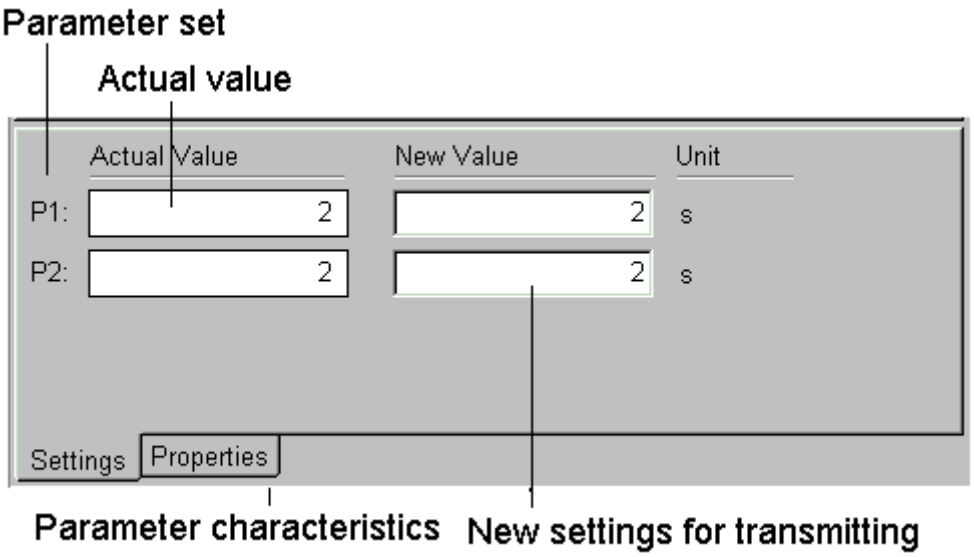
Name	Description
New	A new database can be created. The new database is allocated to a frequency inverter type which is set using a selection box.
Open	Any database that was read into memory can be opened and manipulated.

4.4 Parameter Viewing

Each parameter has a parameter name and a unique parameter number by which it can directly be accessed. The parameters are divided into menu groups.



Each parameter has a parameter value and parameter characteristics:



When a parameter has been selected, values of all parameter sets, if it can be set differently in the sets, are displayed.

4.5 Comparison report

The report shows the differences and similarities between two data records in a window. Basically, only data records in one device family can be compared. The parameters are shown in the form of a list. If two parameters differ, the line is marked with a grey bar. It is also checked whether a value differs from the standard value. If this is the case, the value is displayed in red.

Information **Save dataset**

After the report has been generated, the data record can no longer be saved! For this reason, it is advisable to save the data record beforehand.

Online / Offline comparison

A device with NORDCON must be connected in order to perform the comparison. The parameter window for the device must then be opened, and it is advisable to read out all parameters. The parameter selection can be restricted even further using the filters. A report can then be generated using the “Parameter Setup -> Comparison” menu item. After calling up the function, the user must select a stored data record for the comparison. If the parameters which are read out are going to be used as a back-up, the user must subsequently save the current data record. The report is then generated and displayed.

Information

The configuration of the open parameter set is used as the reference for the parameters and the standard values. If a data record that does not correspond with the configuration of the device is selected, any parameters that are not present are shown empty and marked as different.

Offline / Offline comparison

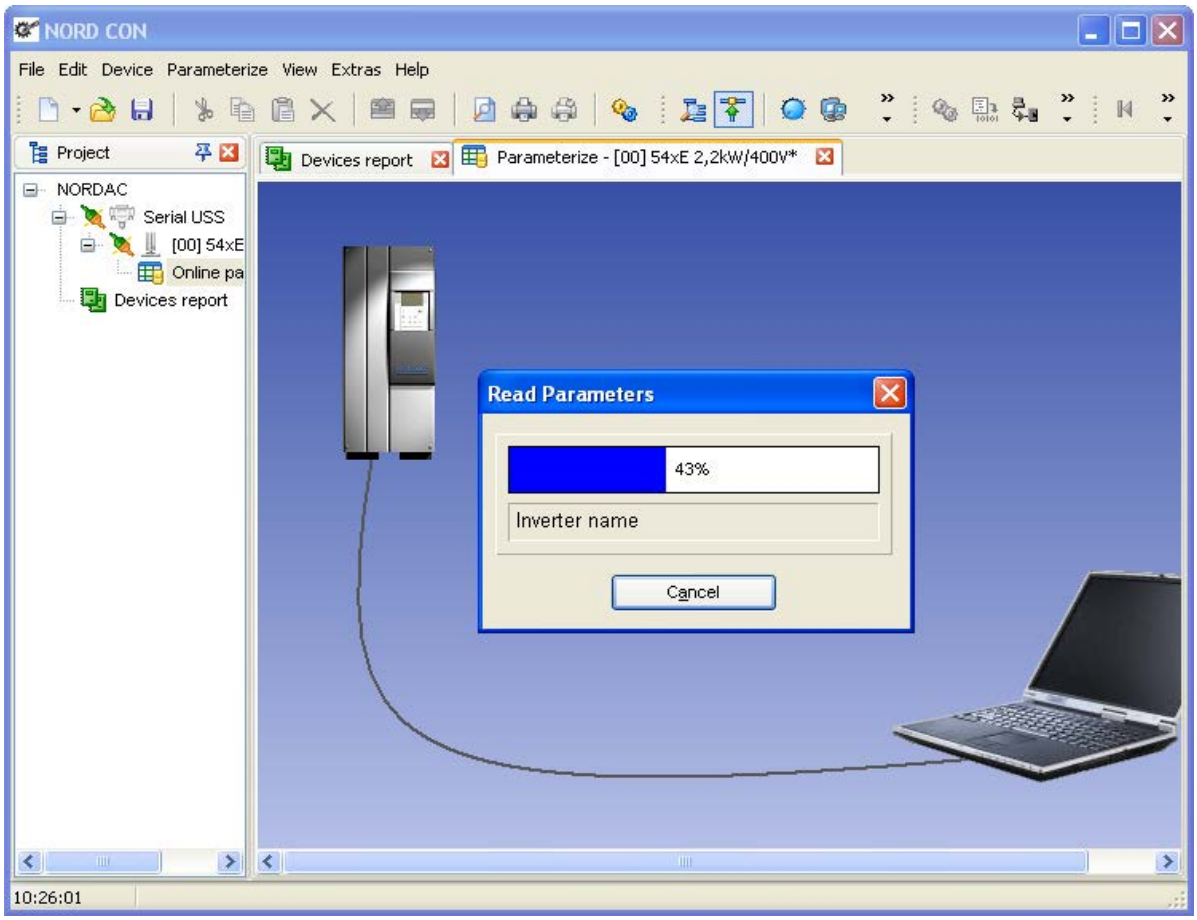
A saved or new data record must be opened in order to perform the comparison. The parameter selection can be restricted even further using the filters. Then a report can be generated using the “Parameter Setup -> Comparison” menu item. After calling up the function, the user must select a stored data record for the comparison. The report is then generated and displayed.

Information

The configuration of the open parameter set is used as the reference for the parameters and the standard values. If a data record that does not correspond with the configuration of the device is selected, any parameters that are not present are shown empty and marked as different.

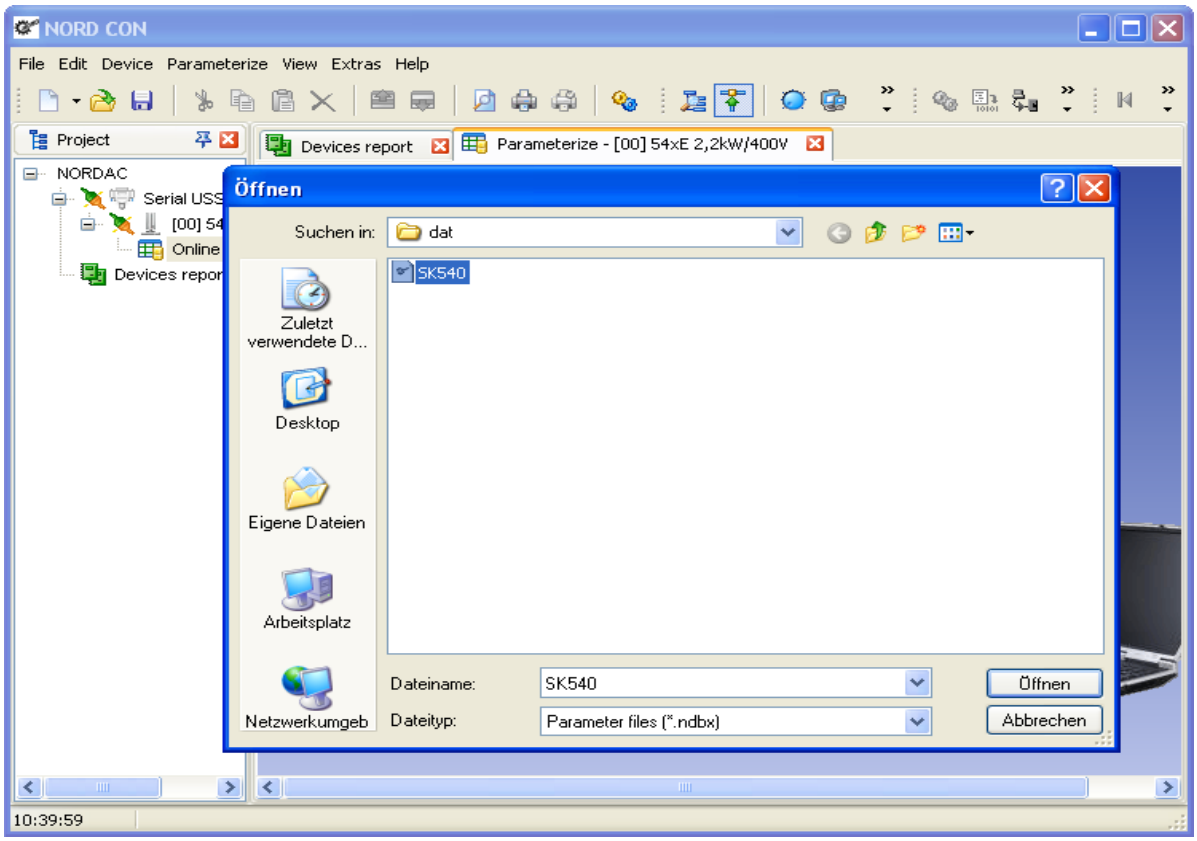
4.6 Parameter upload from device

The “Parameter upload from device” function loads the parameters of a device onto the PC and then saves the values in a parameter file. This action can be called up using the “Device” toolbar or via the “Device/Parameter upload from device” menu item. After executing the function, the following window opens and the upload of the parameters starts automatically. If communication errors occur during the transfer, these are displayed in the message window. At the end of the transfer the user is requested to enter a file name for the file. If the user confirms with “Save”, the parameters are saved.



4.7 Parameter download to device

The “Parameter download to device” function opens a parameter file on the PC and transmits all values to the device. The action can be called up using the “Device” toolbar or via the “Device/Parameter download to device” menu item. After executing the function, the following window and a file selection dialogue open. The user selects a parameter file in this dialogue and confirms with “Open”. Then it is checked whether the parameter file is suitable for the selected device. If this is the case, the download is started.

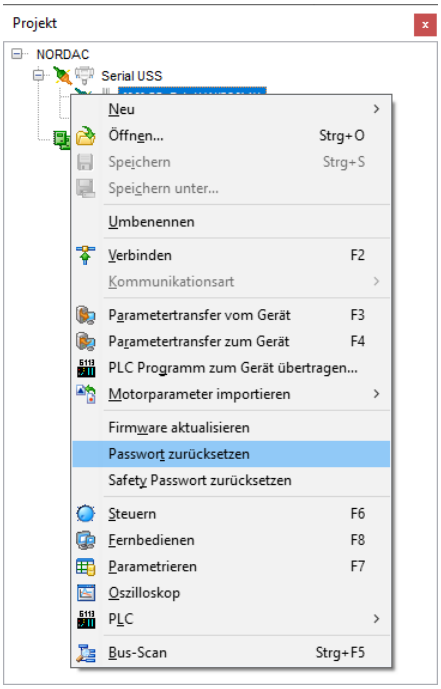


4.8 Reset password or safety password

Perform the following steps:

1. Start NORDCON.
2. Carry out a device search.

3. Select the required device in the project tree. Afterwards, start the function “Reset password” or “Reset safety password” via the context menu that opens via a right click.



4. Before the password can be reset, a warning will be displayed. Carefully read the warning information and confirm with the "I accept" button.

5. Please enter the device's serial number in the input field. Confirm afterwards with the button "Reset".

After the reset, the window will close automatically and the result will be displayed in the message window.

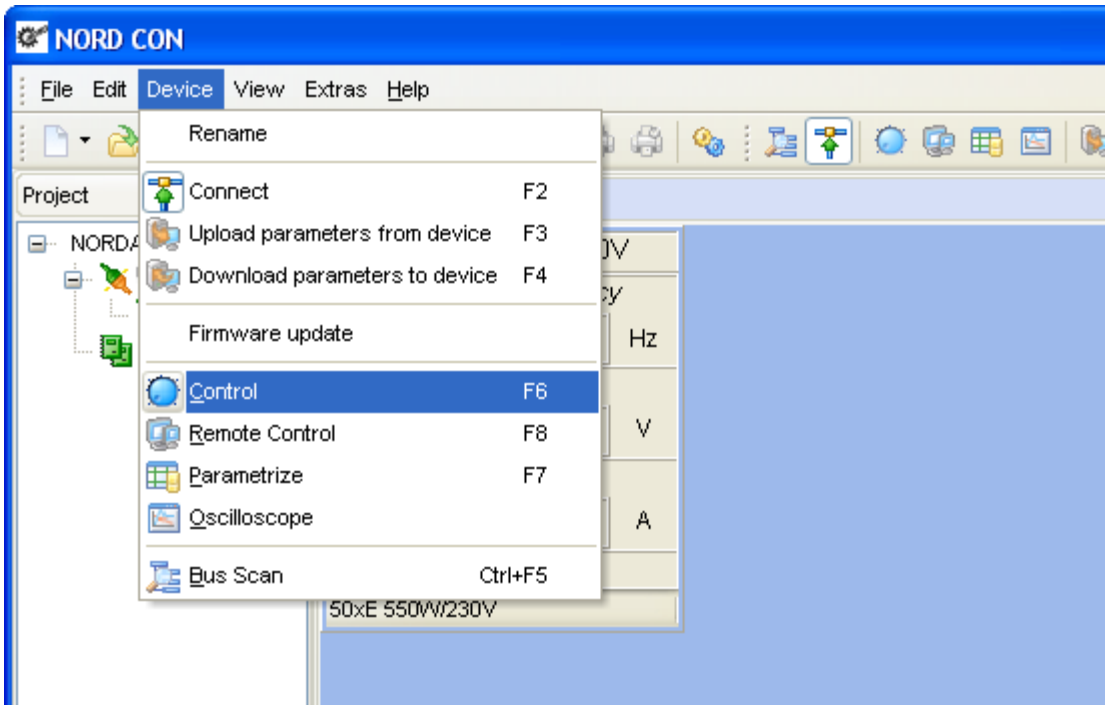
WARNING

If the safety password was reset, the device will afterwards be in an error state. The user has to set the safety parameter again and write the Safety CRC into the device. The device needs to the restarted afterwards.

5 Control

5.1 Overview

The program NORDCON can be used to control NORD Frequency inverter. To use this function the inverter must be parametrised in the right way. Because of different settings of different inverter types the user must check the manual to find the right settings. Before the inverter can be controlled the Bus-scan must be done. After the scanning process has finished all connected inverter are displayed in the main window. Now the inverter to be controlled can be chosen by mouse click. The window „Control" can be opened via "Device/Control (F6)" in the main menu or via popup menu (right mouse click).



Now the control configuration of the inverter is read and checked with the standard setting (setting/control/control configuration check). If the "Control" of inverter is limited or impossible there will be a warning note on the screen.

In the window "Control" there are two versions available:

5.2 "Standard control" The frequency inverter can be released and the setting value can be increased or decreased. Direction change and error acknowledge is possible, too.

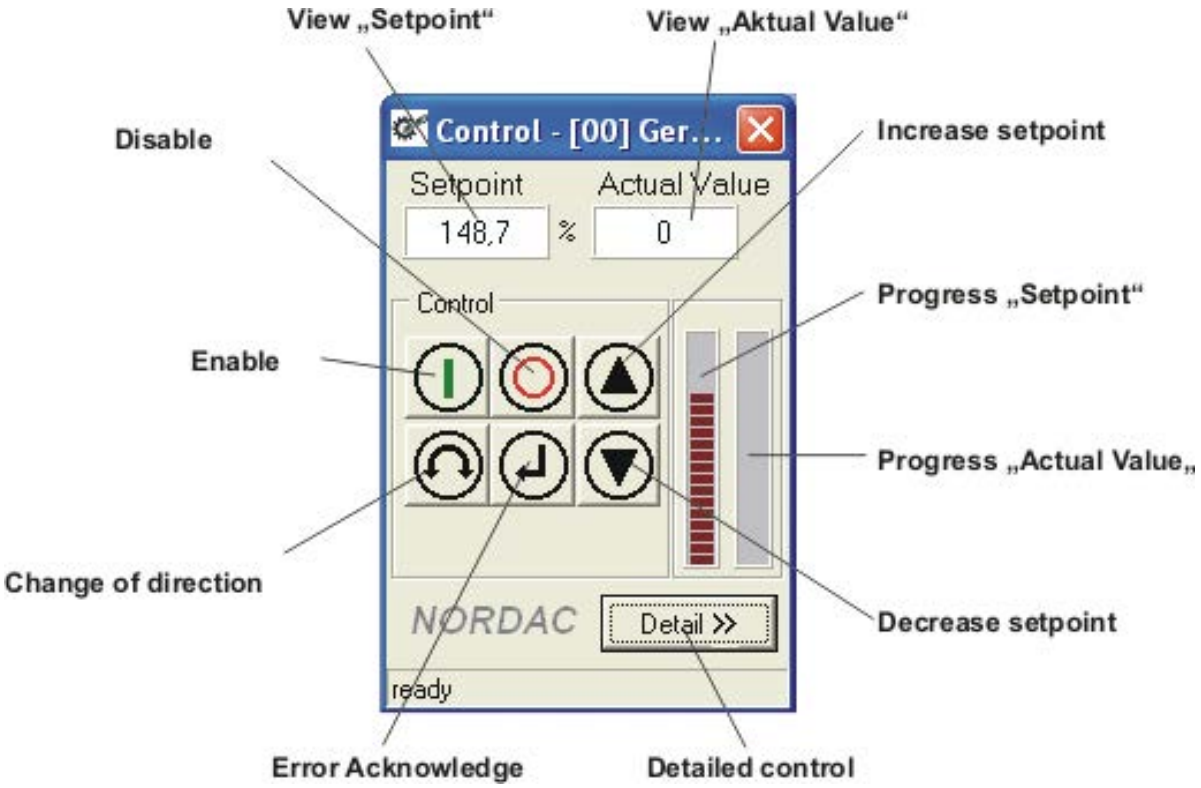
5.3.1 "Overview" All controls can be used with the window.

5.2 Standard control

Using the Standard control the following functions are available:

- Enabling the frequency inverter
- Increase or decrease of the setting value
- Change of direction
- Error Acknowledge

To use this functionality, the inverter must be programmed for control via bus. You can find the required parameter and settings in the manual available for each inverter type.



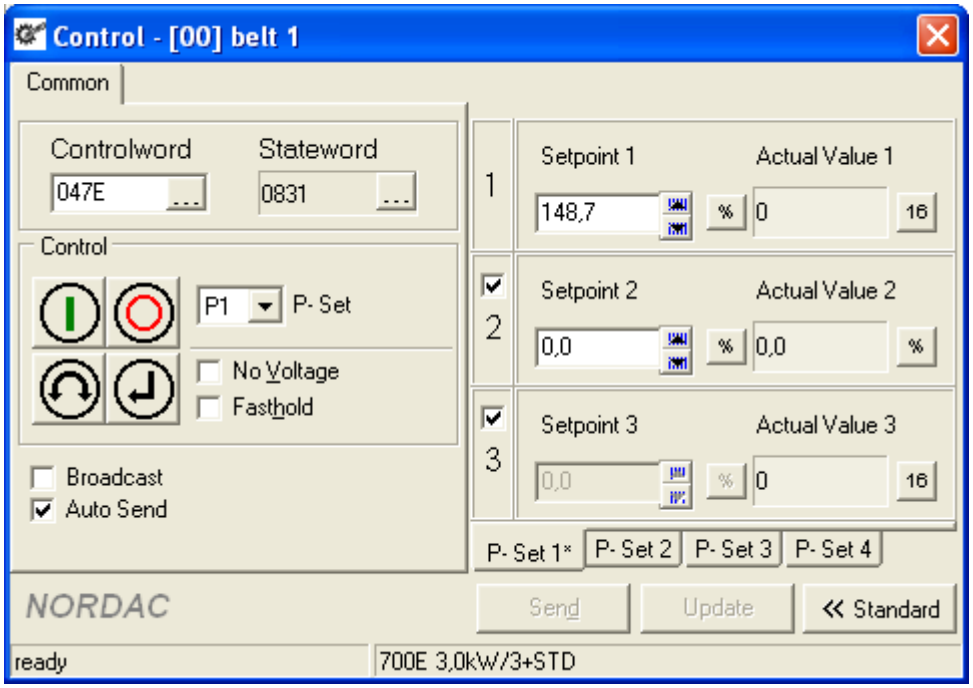
On the ”Standard" display only the first setting value and first actual value are displayed. The form of value is fixed for each configuration. By pressing the button “Detail” you can switch to the extended control function.

5.3 Detailed control

5.3.1 Overview

In the mode „Detailed control" some extra functions are available:

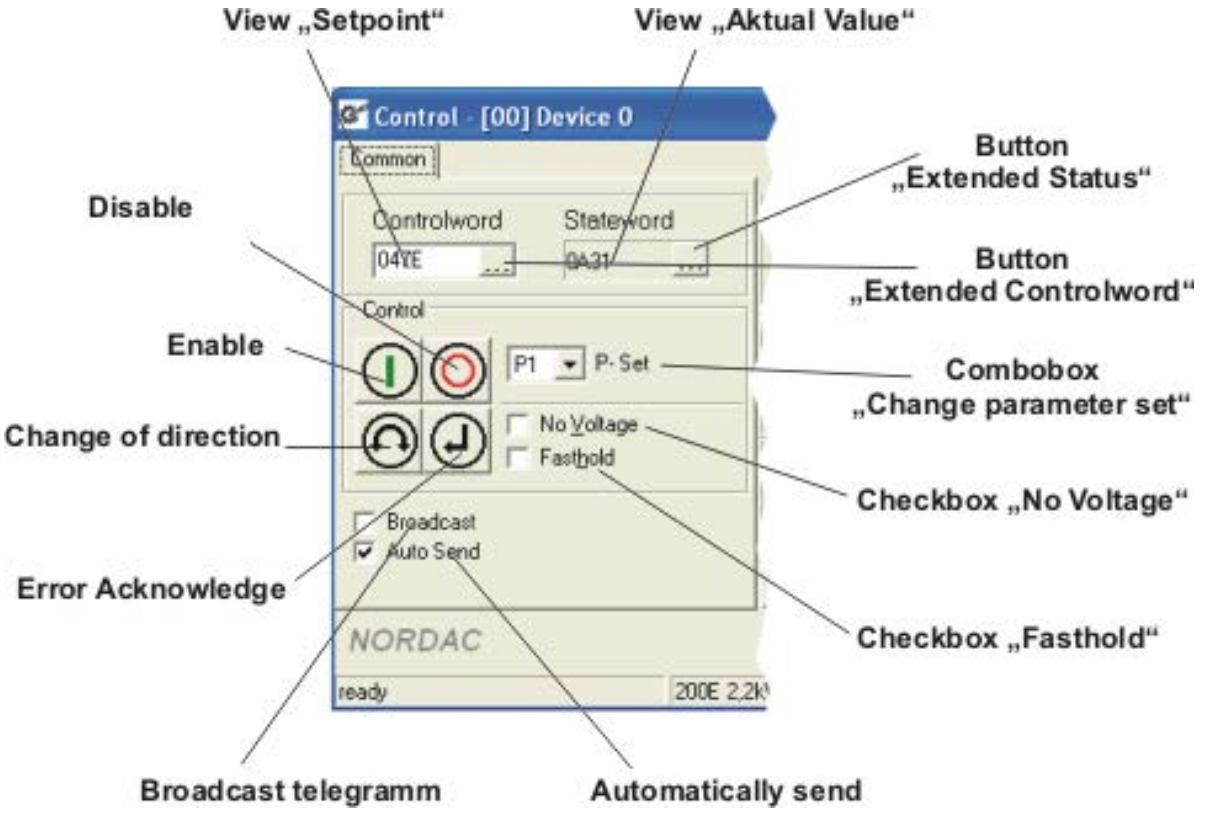
- 5.3.2 " Control "
- 5.3.3 "Management of setting values and actual values"
- Sending of broadcast telegram
- Choice of different parameter sets
- Automatic sending of control word and setting values



5.3.2 Control

The control word is displayed as a hexadecimal value in the field „Control word". By entering a new value (hexadecimal) the user can change the control word. For a bit-coded setting of control word the user can open up a new editorial window by pressing the button "Control word edit". In this window the control word is displayed in bits.

The status word is displayed as a hexadecimal in the screen „Status word". To display the status word in the bit resolution the button „Bit orientated detail view" can be chosen. The status is displayed in the status line of the status machine as clear text.

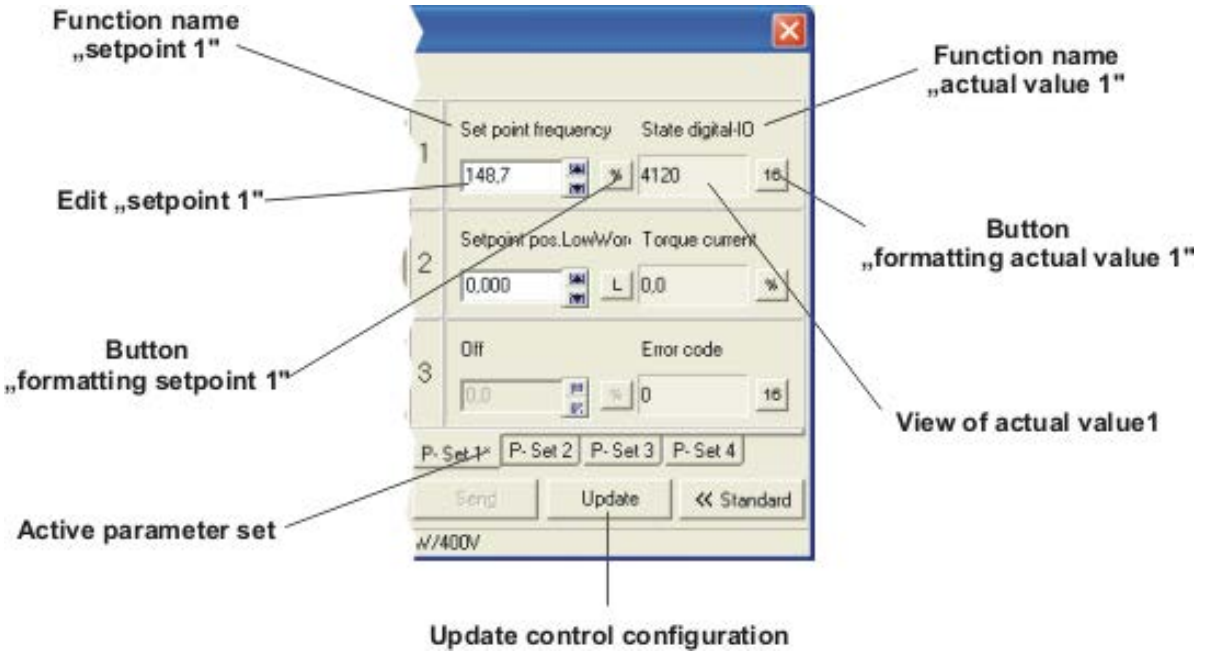


5.3.3 Management of setting values and actual values

For controlling the inverter the user can define up to 3 different setpoints and actual values (see user manual). The setpoints and actual values are displayed according to the **Fehler! Verweisquelle konnte nicht gefunden werden. "Fehler! Verweisquelle konnte nicht gefunden werden.**" (Button „formatting setting value x"). The input of setpoins can be done in same way.

With the option „Setting/control/ parameter set individual management" the setting values and actual values can be managed individually. So setting values can be set for each parameter set. With activation of a parameter set its setting values are transmitted to the frequency inverter. This is necessary because for each parameter set the setting values and actual values can be defined individually. The active parameter set is marked with a star.

If the option „Setting/control/configuration automatically checked" was not activated, the user can transmit the new configuration by pressing the button „Update".



5.3.4 Formatting of Setpoint and/or actual value

Char	Name	Description
"%"	16 Bit standardised values	This standardisation transforms the setpoint/actual value to a 16 Bit standardised value. Standardisation means a scaling of value range and is between -200% and 199% of a basic value (e.g. nominal frequency).
"16"	16 Bit not standardised	With this formatting the setpoint and actual value are transformed to 16 Bit value and transmitted to inverter and displayed without any scaling.
"B"	DigInBits	With this Formatting the setpoint and actual value are transformed to 8 Bit value. The bit status is displayed individually in check boxes. In these check boxes each bit of the setting value can be changed.
"L"	32 Bit Low-Word	With this formatting the setpoint and actual value are taken as the low word (16 Bit) of a 32 Bit word. If there is another setpoint or actual value parametrised with formatting "32 Bit High-Word", then both values are combined in the top display. The setting value can be given as a 32 Bit value.
"H"	32 Bit High-Word	With this formatting the setpoint and actual value are taken as the high word (16 Bit) of a 32 Bit word. (see "32 Bit Low-Word").

5.3.5 Status word

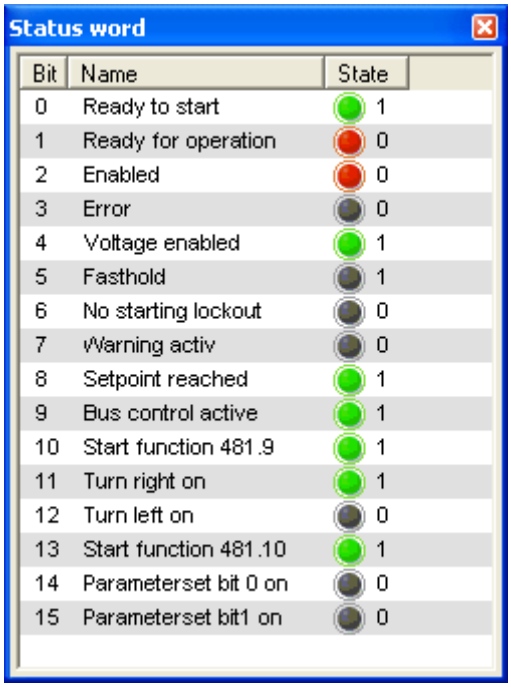
The present status word is displayed with each bit in the window „Status word". All bits are listed in a table including bit number, name and status. According to bit value and function there is a coloured LED shown.

Importance of LEDs:

LED	Importance
	The Bit is set and/or the inverter is enabled.
	An error is active or an enable signal is missing.
	The Bit is not set.

With the standard setting the status word is read in cycles and the changes are displayed in the window. For deactivating the cyclic reading switch off the function „Automatic" in the menu (right mouse click).

The window is docked left next to the „Control" window. If the window should be free on the desktop, the user should choose the popup menu "Docking/no". To save space the window can be added as an index card next to the index card “General". To do this the window must be moved (pressed left mouse button) over the index card "General". After release of the button the window is shown as an index card. With a double click (left mouse button) on the index card the user will get back to window mode.



5.3.6 Control word

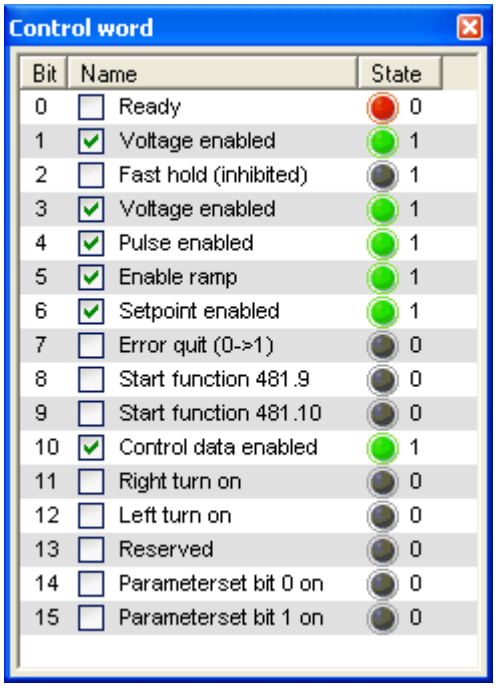
The present control word is displayed with each bit in the window „Control word". All bits are listed in a table including bit number, name and status. According to bit value and function there is a coloured LED shown. If inverter is programmed to USS control then the bits can be set by control buttons. Each change of control word is sent immediately to the inverter (see „Automatic sending").

Importance of LEDs:

LED	Importance
	The Bit is set and/or the inverter is enabled.
	An error is active or an enable signal is missing.
	The Bit is not set.

With the standard setting the control word is read in cycles and the changes are displayed in the window. For deactivating the cyclic reading switch off the function „Automatic" in the menu (right mouse click).

The window is docked left next to the „Control" window. If the window should be free on the desktop, you should choose the popup menu "Docking/no". To save space the window can be added as an index card next to the index card “General". To do this the window must be moved (pressed left mouse button) over the index card "General". After release of the button the window is shown as an index card. With a double click (left mouse button) on the index card the user will get back to window mode.



6 Remote control

NORDCON can simulate the control unit of the relevant frequency inverter. For this, the frequency inverter transfers the contents of its display to NORDCON. The key functions are simulated on the PC and sent to the frequency inverter. The frequency inverter can only be controlled via the remote control window, if it has not previously been enabled via the control terminals or via a serial interface (P509 = 0 and P510 = 0). In addition, for this the parameter “PotentiometerBox Function” (P549) must not be set to function {4} “Frequency addition” or function

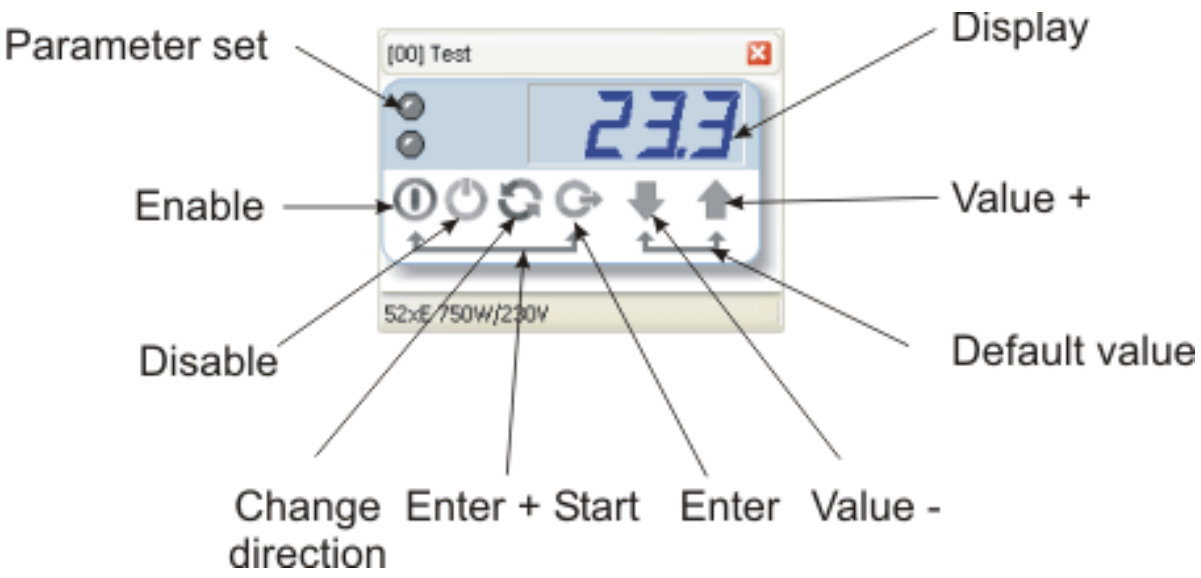
{5} “Freq. subtraction”.

Information **Timeout monitoring**

NORD Frequency inverter can be controlled via the keyboard (enable, setpoint +/-, direction of rotation, etc.). In this case the timeout monitoring is not enables, so that no further control is possible on interruption of the connection between the PC and the frequency inverter.

6.1 Standard

The standard window for the function "Remote" is used for all Devices, if the option "13.1 "User interface"" is not activated.



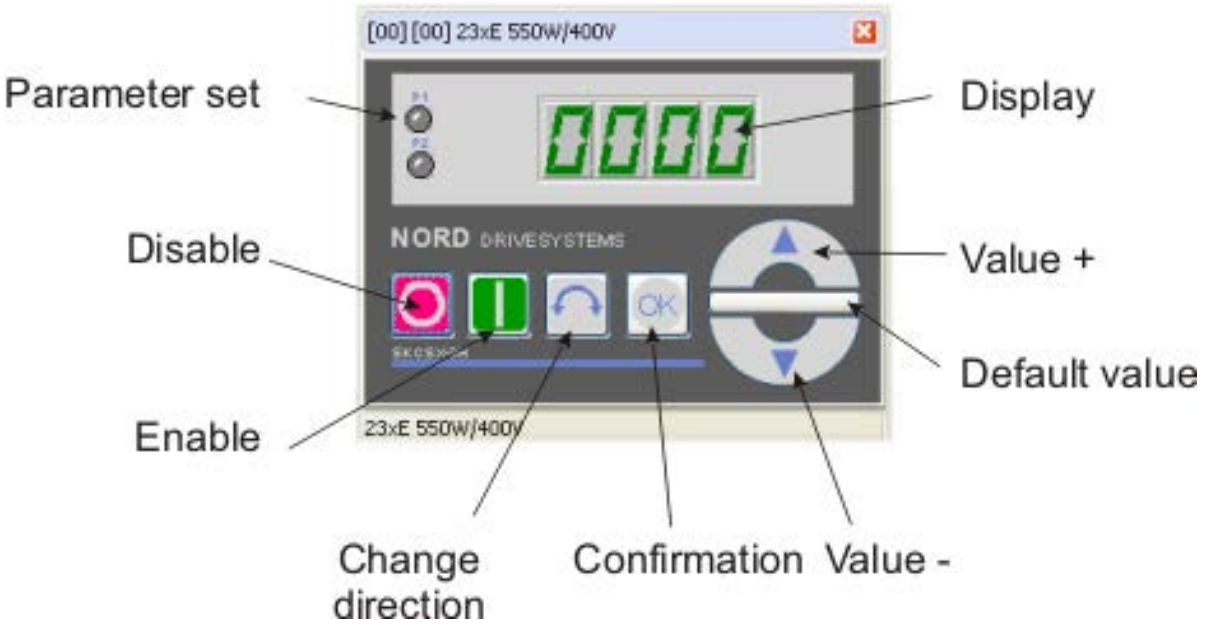
Name	Icon	Description
Enable		Switching on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A preset minimum frequency (P104) must at least be provided. Parameter >Interface< P509 and P510 must = 0.
Disable		Switching off the frequency inverter. The output frequency is reduced to the absolute minimum frequency (P505) and the frequency inverter shuts down.
Change dir		The motor rotation direction changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Attention:**

Name	Icon	Description
		Take care when operating pumps. screw conveyors, ventilators, etc. Block the key with parameter P540.
Up		Press key to increase the frequency. During parameterisation, the parameter number or parameter value is increased.
Down		Press the key to reduce the frequency. During parameterisation, the parameter number or parameter value is reduced.
Enter		Press "ENTER" to store an altered parameter value, or to switch between parameter number or parameter value. **Note**: If a changed value is not to be stored, the key can be used to exit the parameter without storing the change.
Change Dir + Stop		By simultaneously pressing the STOP key and the "Change direction key", a quick stop can be initiated.
Enter + Start		If the inverter is enabled via the "ON" key, the parameterisation mode can be reached by pressing the ON and ENTER keys simultaneously.

All functions available with the operating unit (control box) of the frequency inverter can be performed.

6.2 NORDAC SK 200 E

The window for remote control of the frequency inverters of the NORDAC SK 200 E series looks like this:



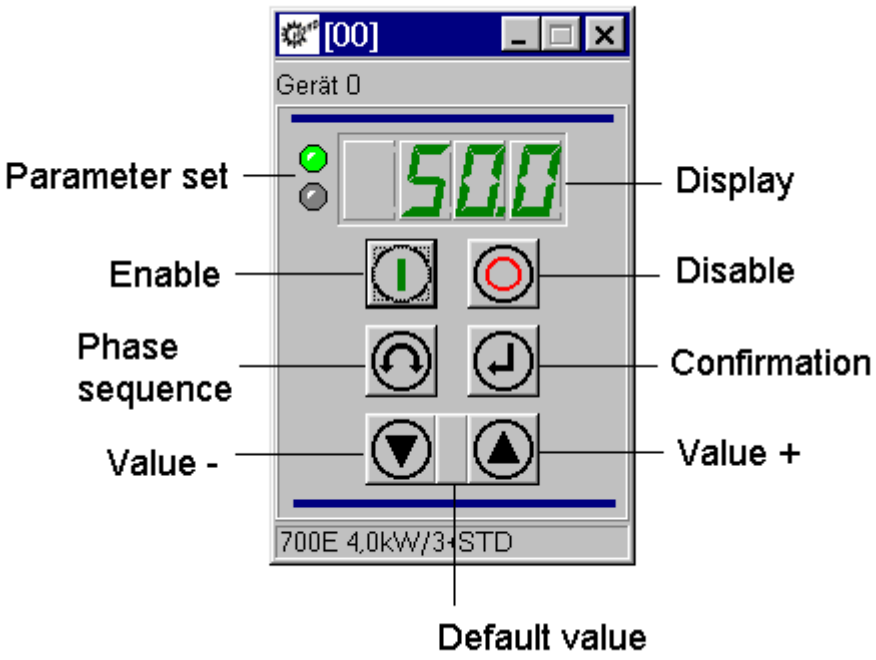
Name	Icon	Description
Enable		Switching on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A preset minimum frequency (P104) must at least be provided. Parameter >Interface< P509 and P510 must = 0.

Name	Icon	Description
Disable		Switching off the frequency inverter. The output frequency is reduced to the absolute minimum frequency (P505) and the frequency inverter shuts down.
Change dir		The motor rotation direction changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Attention:** Take care when operating pumps. screw conveyors, ventilators, etc. Block the key with parameter P540.
Up		Press key to increase the frequency. During parameterisation, the parameter number or parameter value is increased.
Down		Press the key to reduce the frequency. During parameterisation, the parameter number or parameter value is reduced.
Enter		Press "ENTER" to store an altered parameter value, or to switch between parameter number or parameter value. **Note**: If a changed value is not to be stored, the key can be used to exit the parameter without storing the change.
Change Dir + Stop		By simultaneously pressing the STOP key and the "Change direction key", a quick stop can be initiated.
Enter + On		If the inverter is enabled via the "ON" key, the parameterisation mode can be reached by pressing the ON and ENTER keys simultaneously.

All functions available with the operating unit (control box) of the frequency inverter can be performed.

6.3 NORDAC SK 700/500/300 E

The window for remote control of the frequency inverters of the NORDAC SK 700/500/300 E series looks like this:

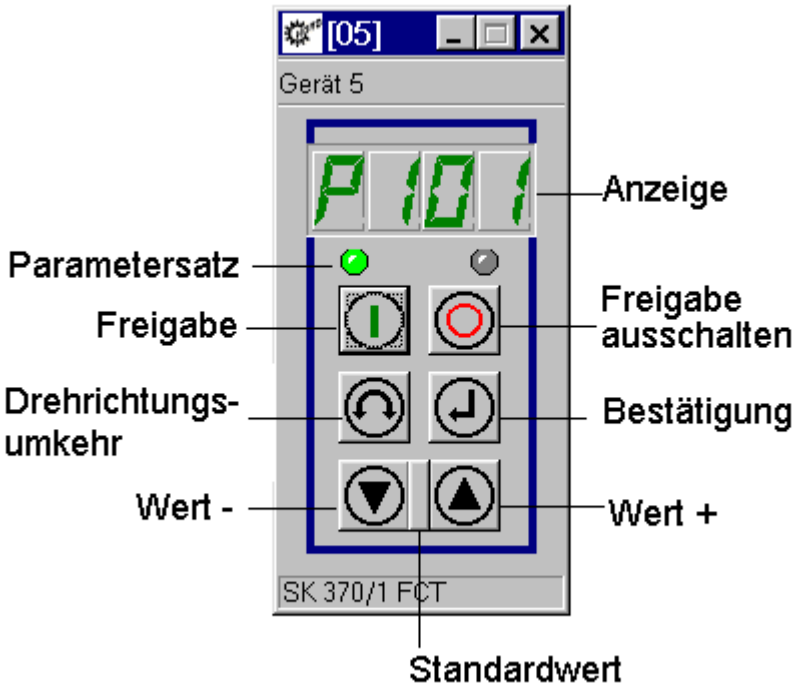


Name	Icon	Description
Enable		Switching on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A preset minimum frequency (P104) must at least be provided. Parameter >Interface< P509 and P510 must = 0.
Disable		Switching off the frequency inverter. The output frequency is reduced to the absolute minimum frequency (P505) and the frequency inverter shuts down.
Change dir		The motor rotation direction changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Attention:** Take care when operating pumps, screw conveyors, ventilators, etc. Block the key with parameter P540.
Up		Press key to increase the frequency. During parameterisation, the parameter number or parameter value is increased.
Down		Press the key to reduce the frequency. During parameterisation, the parameter number or parameter value is reduced.
Enter		Press "ENTER" to store an altered parameter value, or to switch between parameter number or parameter value. **Note**: If a changed value is not to be stored, the key can be used to exit the parameter without storing the change.
Change Dir + Stop		By simultaneously pressing the STOP key and the "Change direction key", a quick stop can be initiated.
Enter + On		If the inverter is enabled via the "ON" key, the parameterisation mode can be reached by pressing the ON and ENTER keys simultaneously.

All functions available with the operating unit (control box) of the frequency inverter can be performed.

6.4 NORDAC vector mc

The window for remote control of the frequency inverters of the NORDAC vector mc series looks like this:



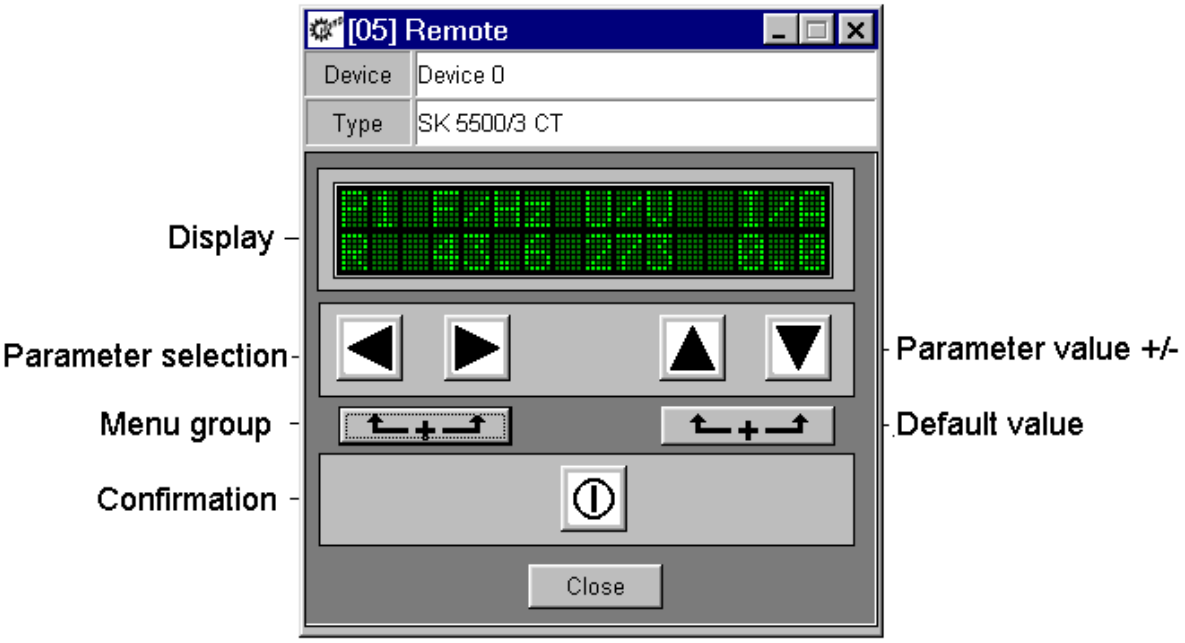
Name	Icon	Description
Enable		Switching on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A preset minimum frequency (P104) may at least be provided. Parameter >Interface< P509 and P510 must = 0.
Disable		Switching off the frequency inverter. The output frequency is reduced to the absolute minimum frequency (P505) and the frequency inverter shuts down.
Change dir		The motor rotation direction changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Attention:** Take care when operating pumps, screw conveyors, ventilators, etc. Block the key with parameter P540.
Up		Press key to increase the frequency. During parameterisation, the parameter number or parameter value is increased.
Down		Press the key to reduce the frequency. During parameterisation, the parameter number or parameter value is reduced.
Enter		Press "ENTER" to store an altered parameter value, or to switch between parameter number or parameter value. **Note**:

Name	Icon	Description
		If a changed value is not to be stored, the key can be used to exit the parameter without storing the change.
Change Dir + Stop		By simultaneously pressing the STOP key and the "Change direction key" , an quick stop can be initiated.
Enter + On		If the inverter is enabled via the "ON" key, the parameterisation mode can be reached by pressing the ON and ENTER keys simultaneously.

All functions available with the operating unit (control box) of the frequency inverter can be performed.

6.5 NORDAC vector ct

The remote control window for the NORDAC vector ct series has the following appearance:



Name of action	Picture	Description
Enable		To switch on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A pre-set minimum frequency (P104) may at least be provided. Parameter >Interface< P509 and P510 must = 0.
Switch off enable		To switch on the frequency inverter. The frequency inverter is now enabled with the set jog frequency (P113). A reset minimum frequency (P104) may at least be provided. Parameter >Interface< P509 and P510 must = 0.
Change direction of rotation		The direction of rotation of the motor changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Notice:** Take care when operating pumps, screw conveyors, ventilators, etc. Block the key with parameter P540.
Increase		The direction of rotation of the motor changes when this key is pressed. "Rotation to the left" is indicated by a minus sign.

Name of action	Picture	Description
		Notice: Take care when operating pumps, screw conveyors, ventilators, etc. Block the key with parameter P540.
Reduce		The direction of rotation of the motor changes when this key is pressed. "Rotation to the left" is indicated by a minus sign. **Notice:** Take care when operating pumps, screw conveyors, ventilators, etc. Block the key with parameter P540.
Confirm		Press this key to store a changed parameter value, or to switch between the parameter number and the parameter value. **Note:** If a changed value is not to be stored, the key can be used to exit from the parameter without saving the change.
Rotation direction + Switch off enable		By simultaneously pressing the STOP key and the "Change direction key ", a quick stop can be initiated.
Confirm + enable		Simultaneously pressing the ON key and the "Confirm" key switches to the editing mode for an enabled device.

All of the functions which are possible with the control unit (Control Box) can be carried out.

7 Oscilloscope

7.1 Overview

The oscilloscope function integrated in NORDCON can show process data of an NORD Frequency inverter as an arithmetic chart.

Information

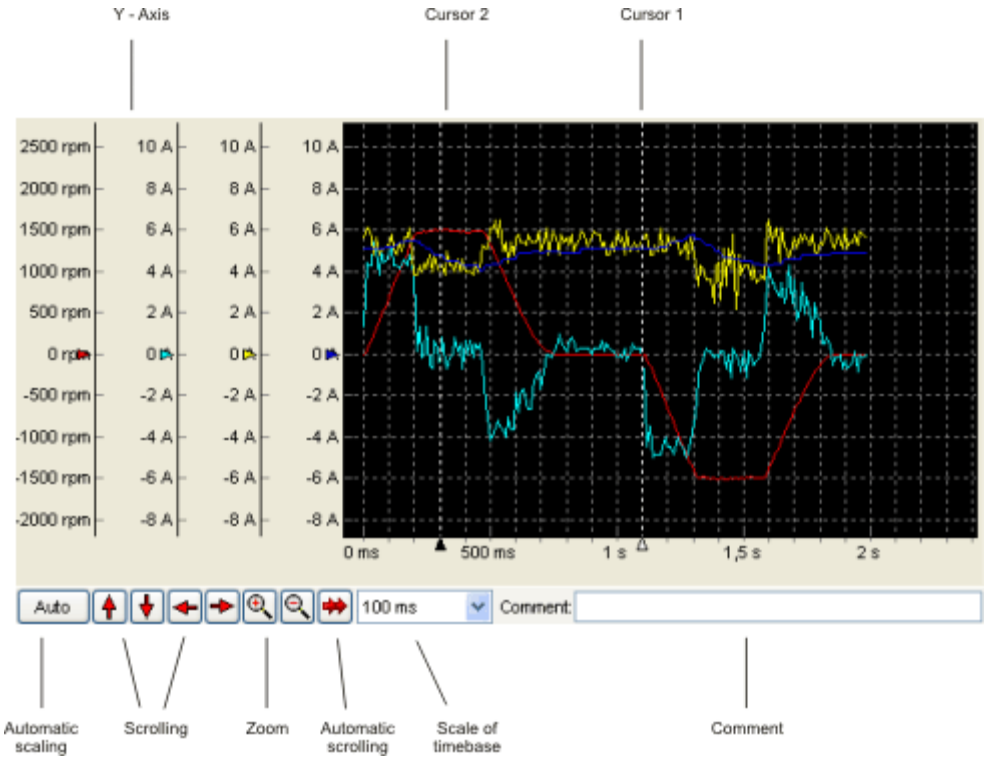
This option ist not available for serieses NORDAC vector ct and NORDAC vector mc!

The features of oscilloscope-function are:

- Monitoring of up to 4 channels
- Many different ways of triggering
- Scaling of each measurement
- Calculation of average values, effective value, etc.
- Save, print and export of measurement data

7.2 Display

The oscilloscope function can measure and display 4 channels max:



The following settings can be done:

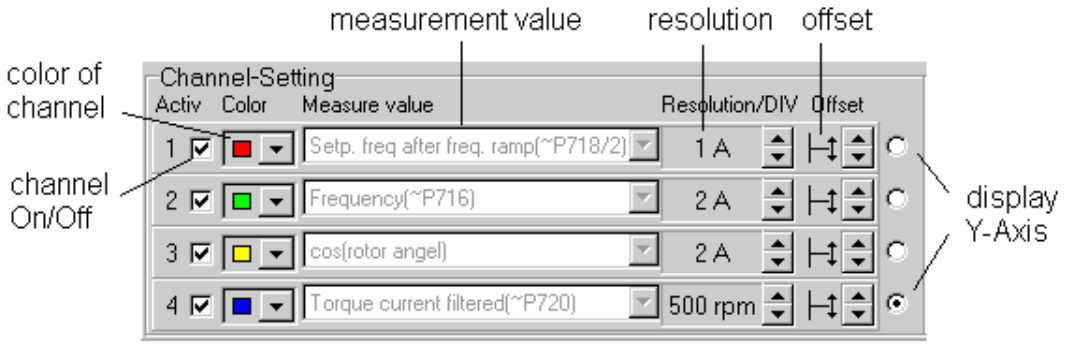
Name	Description
Auto	Automatic scaling of all measured data

Offset	Selection of display detail (displacement of all data in x- or y-direction)
Zoom	Display size (Zoom of all data) **Note**: With the right mouse button you can choose between the modes “Move” and “Measurement”, if the mouse pointer is on the display. In “Move” mode you can choose the detail of display by mouse pointer by pressing the left mouse button while moving over the display.
Auto scrolling	With this option during a recording the time axis is scrolled automatically to the last point.
Resolution	In this combination field the user can change the scaling of the time axis.
Comment	Additional information field, where further information for the measurement series can be stored.
Cursor	Execution of measurement

7.3 Handling

Follow the next steps to execute a measurement:

1. Choice of channels



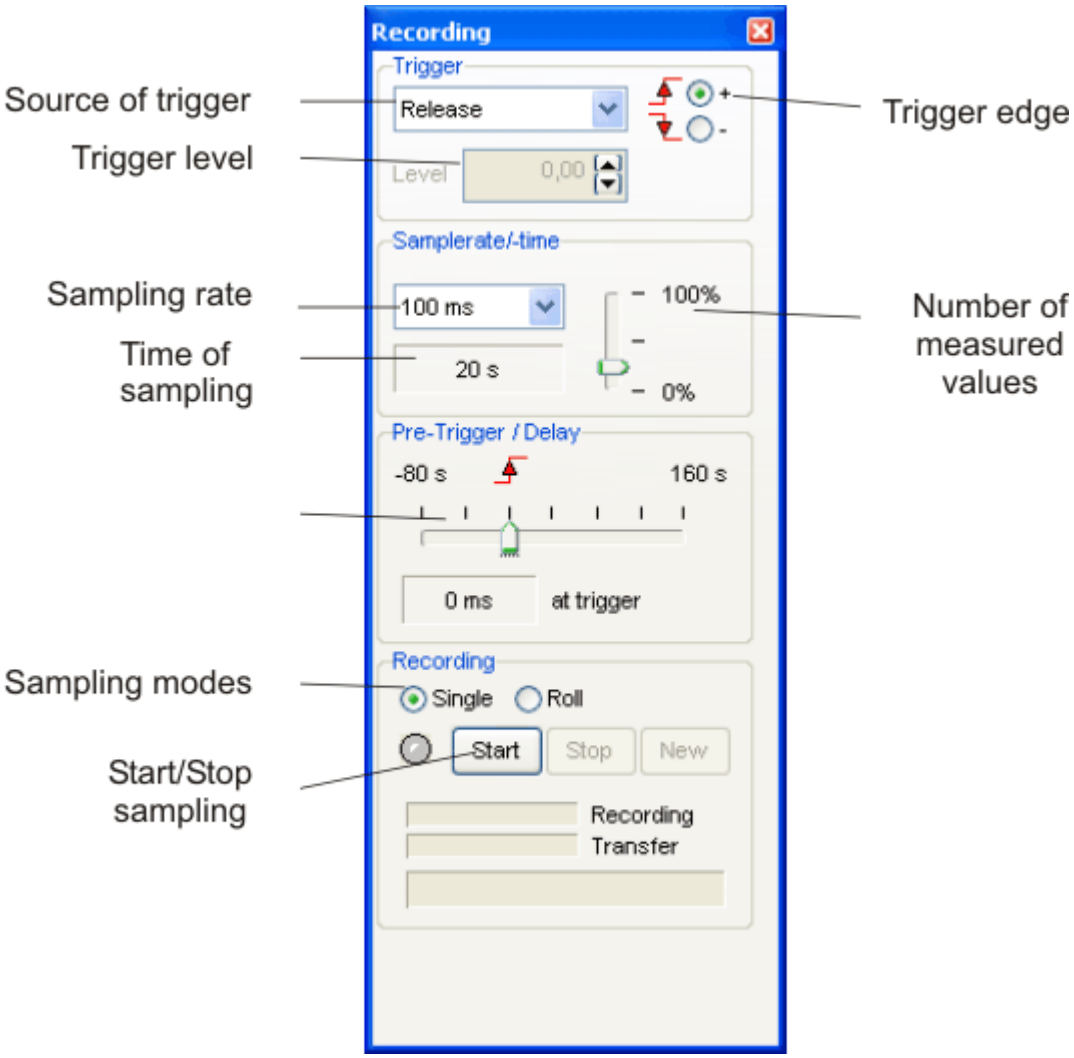
There is a popup menu to make the choice of the 4 channels. There is a colour referring to each channel. Each channel can be switched on and off by checkboxes. The resolution and offset can be chosen for each channel separately. When displaying the results of measurement, the values of the vertical axis of each channel can be chosen and indicated.

Importance of measured value

Measured value	Description
(=P[Number]) [Name]	The value of this measuring function is updated in the time slot pattern by approx. 100 milliseconds and corresponds to the value indicated of the parameter.
[Name]	The value of this measuring function is updated in a time slot pattern by approx. 100 milliseconds.
(≈P[Number]) [Name]	The value of this measuring function is updated in a time slot pattern by approx. 50 milliseconds.

(~P[Number]) [Name]	The value of this measuring function is updated in a time slot pattern of approx. 250 µs.

2. Setting of trigger



The trigger starts the measurement. First choose the source of trigger. Trigger sources can be measurement values, digital inputs, status of inverter, etc. The starting conditions are defined by trigger level respectively trigger edge.

Information — **Trigger levels**

The increments of the trigger levels are different depending on the trigger source. Therefore not every value can be set. After starting a recording, the closest possible value is calculated and set.

Time between two measured values is set by sampling rate. Numbers of measured values and sampling rate define the time of sampling. The Pre-trigger/Delay set the beginning of the measurement in relation to the trigger event.

Information — **Measured values**

The dynamic of measured values defines the best rate of sampling: fast changing values need a low sampling rate. The number of measured values defines the time of sending the values from inverter to NORDCON.

3. Sampling modes

The oscilloscope has 2 different modes. The user can choose between "Single" and "Roll" mode. The "Single" mode is the standard mode. In this mode a recording starts with the current trigger settings. The recording time depends on the oscilloscope memory of the device and amounts to max. 2000 seconds. The values are noted in the adjusted sampling rate.

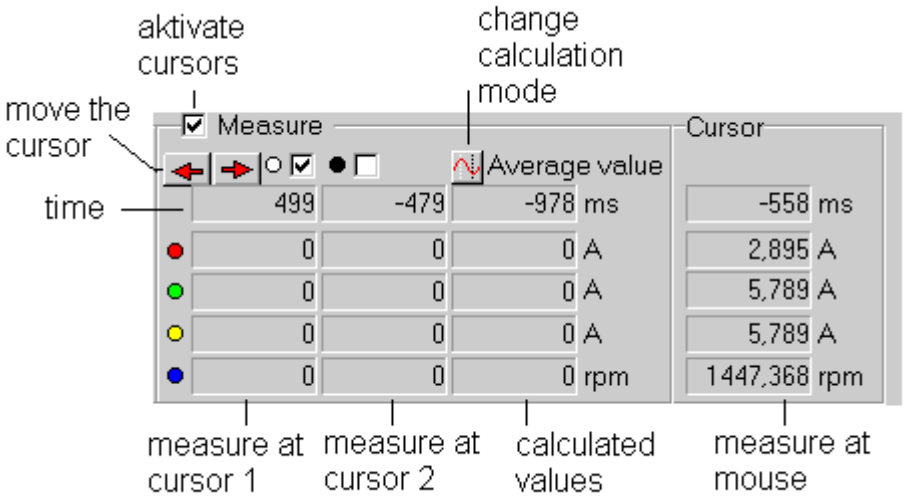
The roll mode makes a recording over longer period. The noted values are transferred immediately to the PC. Therefore the user cannot change the sampling rate. It depends on the speed of the transmission.

4. Starting of measurement

The Start-Button activates the measurement. The event of trigger is detected. When the event appears a recording starts in the inverter. The transmission of data to NORDCONstarts in the same moment. This can be cancelled by Stop. After transferring all data a new measurement can be started or new settings can be made by pressing the “New” button.

7.4 Measurement

After recording the measurement completely, measurements on the results can be done using cursors.



There are two cursors available for this. The cursors can be moved by  . The choice of cursor is made by  . To choose the mode “Move” and “Measurement” by right mouse button the pointer has to be on display. In the measure mode the cursors can be set by left mouse button. The values of the measured lines 1 and 2 are displayed on cursor 1 and cursor 2. Additionally the calculations like average values are performed. Pressing on the “Calculation” button starts the shift of calculation.

7.5 Save and Print

The recorded series of measurements can be saved, exported or printed.

Menu item "File"

Name	Description
Open	A stored measurement data file can be chosen and loaded. During loading there is a choice if only the setting should be loaded or all data of measurement.
Save as	The present measurement data and settings are saved with a new filename.
Export	The data can be exported as graphic file or data table.
Print	The lines of measurement are printed with present settings (colour of background: white).

Scope Offline

In Offline-mode (no inverter is connected) a saved measurement file can be loaded by menu item File|Open.

8 Macro editor

The macro editor is designed to create simple process sequences. The user interface provides a facility for creating and adapting a macro using context menus, toolbars or tool windows. The individual instructions can be moved within the view using Drag n Drop. The standard functions such as saving and loading a macro are also integrated in the context menu. The macros are stored in the standard format “XML”. The format of the preceding version can be imported using the “Open” menu item, file type “Macro Files V1.26”.

8.1 User interfaces and views

As well as the editor window, other views are also needed for macro generator handling. These views are available as tool windows. These windows can be docked and undocked at the edge of the main window. All views can be displayed and closed using the “View” menu item in the pop-up menu.

8.1.1 Window "Variables"

The view „variables" can be opened and closed over the menu option „View->Macro->Variables ". It is used for debugging. In this window after starting macros all variables and objects macros with current rating are indicated. The expenditure of the value can be stopped in the view „Properties->Display format".

There are the following formatting:

- Decimal
- Hexadecimal
- Binary

8.1.2 Properties window

The “Property” view can be opened and closed via the “View -> Properties” menu item. All properties of the current instruction are displayed in this window. Depending on the instruction, the number of properties and the type thereof can change.

Name	Description
Result	You can change the object to which you would like to assign a new value with this property. Only objects to which a new value can be assigned can be selected (e.g. control word, parameters or variables).
Operand	With this property the user can select the object that is to be used with an assignment or operation.
Operator	This property defines the type of operation (e.g. Addition).
Comment	The user can assign a comment to any instruction using this property.

Variables, control or status words, setpoints or actual values or parameters can be designated as objects in the macro generator. Each of these objects has different parameters.

Object	Parameter	Description
Variable	Name	The parameter defines the name of the variable or constant. All variables that have already been used are displayed in the selection box. If you would like to create a new variable, a name that has not yet been used must be entered. No distinction is made between upper and lower case.
	Display format	This parameter defines the display format in the “Variables” view. One of the following displays can be selected: • Decimal • Hexadecimal • Binary
Constant	Value	The parameter defines the value of the constant.
	Display format	This parameter defines the display format in the “Variables” view. One of the following displays can be selected: • Decimal • Hexadecimal • Binary
Control word, Status word	Node number	This parameter defines the USS node number of the required device. **Note**: Since the current control word cannot be read out of the device, the control word is set to 0 when the scheduler starts.
	Display format	This parameter defines the display format in the “Variables” view. One of the following displays can be selected: • Decimal • Hexadecimal • Binary
Setpoint and actual values	Node number	This parameter defines the USS node number of the required device. **Note**: Since the current setpoints cannot be read out of the device, the values are set to 0 when the scheduler starts.
	Type	This parameter defines the type of the value. The types listed in table “Setpoint and actual value types” are available to the user.
	Format	This parameter defines the formatting of the setpoint and actual values. The possible formats are shown in table “Setpoint and actual value formatting”.
	Resolution	This parameter defines the resolution of the setpoint and actual values. It is used to format the instruction in the editor.
	Display format	This parameter defines the display format in the “Variables” view. One of the following displays can be selected: • Decimal • Hexadecimal • Binary
Parameter	Node number	This parameter defines the USS node number of the required device.

Object	Parameter	Description
	Parameter number	This value defines the number of the parameter (see “Device catalogue” view).
	Sub-index	This value defines the sub-index of the parameter.
	Resolution	This value defines the resolution of the setpoint and actual values. It is used to format the instruction in the editor.
	Data type	This value defines the data type of the parameter. Only 2 data types are used in the current devices (16-bit integer and 32-bit integer).
	Display format	This parameter defines the display format in the “Variables” view. One of the following displays can be selected: • Decimal • Hexadecimal • Binary

Setpoint and actual value types

Type	Description
Value 1 (16-bit)	The 1st, 2nd or 3rd setpoint or actual value should be used.
Value 12 (32-bit)	The first and second setpoint or actual value should be used as a 32-bit value. **Note**: The device must be appropriately configured for this configuration (see “Setpoint or actual value configuration”).
Value 13 (32-bit)	The 1st and 3rd setpoint or actual value should be used as a 32-bit value. **Note**: The device must be appropriately configured for this configuration (see “Setpoint or actual value formatting”).
Value 23 (32-bit)	The 2nd and 3rd setpoint or actual value should be used as a 32-bit value. **Note**: The device must be appropriately configured for this configuration (see “Setpoint or actual value formatting”).

Setpoint and actual value formatting

Formatting	Description
Standardised	This formatting interprets the setpoint or actual value as a 16 bit standardised value. Standardisation means scaling of the value range and is between -200% and 199% of a basic value (e.g. nominal frequency).
Not standardised	In this formatting the setpoint or actual value is interpreted as a 16 bit value, which is transferred to the device and displayed without scaling.
Low word (32-bit)	This formatting defines that the first word is the low word and the 2nd value is the high word

Formatting	Description
	value (32-bit). This value can only be selected for 32-bit types.
High word (32-bit)	This formatting defines that the first word is the high word and the 2nd value is the low word value (32-bit). This value can only be selected for 32-bit types.

Note:

Please ensure that the configuration of the devices corresponds with the settings.

8.1.3 Log window

All events in the sequence control are saved in a log. To display the log, you need to open the “Log” view using the “View -> Log” menu item. The value is also a tool window and can be docked and undocked at the edge of the main window. All log entries are shown in a sorted list in the window. In this case, the last entry is at the beginning of the list.

Saving the log

The log can be saved using the “Save as...” menu item in the pop-up menu. A file selection dialogue then opens, and the user must stipulate the name and path for storing the log file. If the user confirms with “Save”, the current list is saved in the text file.

Deleting the log

The log can be deleted using the “Delete” menu item in the pop-up menu. All entries are then irretrievably deleted.

Filtering the entries

The user can filter the log entries in accordance with the type of entry using the filter function. The types of the entries to be entered in the log can be defined using the “Filter” menu item.

8.2 Working with macros

8.2.1 Create a new macro

A new document (macro) is generated by the menu option “New" in the context menu. Depending if the document was previously opened, the macro editor offers to store of the old document. A new document is generated if the user does not confirm with “Cancel". Only one document can be opened at the same time in the current version.

8.2.2 Open a macro

Opening macros is implemented in the menu option “Open" or with the combination of keys “Ctrl+O". Subsequently, a selection of files dialogue opens, in which the user can select the desired macro. If the user would like to open a previous version of the macro, he must change the data type in the file selection dialogue accordingly.

8.2.3 Save a macro

Storing macros is implemented in the menu option “Save" or the combination of keys a “Ctrl+S". This function is available however only for previously generated documents. For all new documents the function must be implemented “Save as…".

The function is implemented in the menu option “Save as…". Subsequently, a selection of files dialogue opens, in which the user must select the file name as well as the path. After confirmation with “Save" the macro is stored. After the completion of the procedure the newly named macro indicated in the title bar.

8.2.4 Inserting instructions

The “Insert” function is activated using the “Insert” menu item or key combination “Ctrl+V”. It inserts a previously copied or cut instruction below the current position in the document. If no instruction has been copied or cut beforehand, the menu item is deactivated. In the current version, each copied or cut instruction can only be inserted once.

8.2.5 Copying instructions

The “Copy” function is activated using the “Copy” menu item or key combination “Ctrl+C”. It copies the selected line into the clipboard of the generator. Only one line can be selected in the current version. This means that only one instruction can be copied. The Block instruction is an exception. This can only be copied in its entirety.

8.2.6 Cutting instructions

The “Cut” function is activated using the “Cut” menu item or key combination “Ctrl+X”. It copies the selected instruction into the clipboard of the generator. When the cut instruction is inserted, the old instruction is deleted from the document. The restriction that only one instruction can be cut also applies to this function.

8.2.7 Delete from instruction

The function is implemented in the menu option “Delete" or the combination of keys “Ctrl + Del". It deletes the marked instruction from the document.

8.2.8 Search and replace

The function “Search and replace" is implemented in the "Search and replace" menu or the combination of keys “Ctrl+H" where the dialogue “Search and replace" opens. This allows the user to insert the search and replacement vocabulary and start the change procedure.

8.2.9 Shift up instruction

The function is implemented in the menu option “Shift up". It shifts the marked instruction a line upward. If the top line of document is marked no action is implemented. Shifting of instructions can also be done by drag and drop with the mouse.

8.2.10 Shift down instruction

The function is implemented in the menu option “Down". It shifts the marked instruction one line downwards. If the last line of the document is marked no action is implemented. Shifting instructions can also be done by drag and drop with the mouse.

8.2.11 Creating new instructions

New instructions are created using the “Functions” menu item in the context menu. The new instructions are always inserted below the selected line. The user can then change the position of the new instruction (see “Up” and “Down”).

The following functions are available to the user in this version:

Name	Description

Assignment	The instruction assigns a new value to a macro object. The new value can be read out of another object, or the user defines a constant. By default, the line is inserted as shown in example 1. The Parameter function can be adapted in the “Properties” view.
	
	Example:
	Device 00 Controlword = 047F hex // Assign value of 1151 to control word
	Var1 = Device 00 Statusword // Assign value of status word to variable
	
	Note:
	Setpoints can only be assigned within a Block instruction.

Jump mark	The instruction defines a jumping point in the macro. The user can jump to the location of the jump mark using the “Goto” function. By default, the line is inserted as shown in example 1. The Parameter function can be adapted in the “Properties” view. The name of the jumping point must be changed, since duplicate names are not supported. The generator always jumps to the first jump mark in the macro. **Example:** Label1: // Defines the “Label1” jump mark· **or** Start: // Defines the “Start” jump mark
Sleep	The instruction generates a pause in the execution of the macro. The time is specified in units of “ms”. By default, the line is inserted as shown in example 1. The time can be adapted in the “Properties” view. **Example:** Sleep 1000 ms // Wait for 1s **or** Sleep 500 ms // Wait for 0.5s
Go to	The instruction generates a jump in the macro. After executing the instruction, the generator jumps to the line of the jump mark with the relevant name. If the generator does not find a jump mark with the name, the line is ignored. If no jump mark has been defined in the macro yet, the menu item is deactivated. The first jump mark is always entered by default. The name of the jump mark can be adapted in the “Properties” view. **Example:** Goto Start // Go to jump mark “Start”
Condition	The instruction generates a conditional jump in the macro. If the condition is true, the generator jumps to the line of the jump mark with the relevant name. By default, the line is inserted as shown in example 1. The parameters of the instruction can be adapted in the “Properties” view. **Example:** if Device 00 Controlword == 047F hex then // If the control word has a value of 1151 Goto Start // then go to jump mark “Start”
Block	This instruction allows the user to execute several instructions in one instruction. These assignments are restricted to the “Control word” and “Setpoints” objects. Depending on the configuration of the device and the purpose of use, the user can choose between “Control value with 1 setpoint”, “Control value with 2 setpoints” or “Control value with 3 setpoints”. **Example:** Block // Transmit control word and setpoint1 with 1 USS protocol

Name	Description
	Device 00 Controlword = 1151 // Assign value of 1151 to control word Device 00 Setpoint1 = 20.0 // Assign value of 20 to setpoint 1

Mathematical and logical operations	These instructions make it possible for the user to carry out simple mathematical and logical operations on objects. The newly-calculated value is then assigned to an object. The parameters of the instruction can be adapted in the “Properties” view.
	
	Example:
	Var1 = Device 00 Control word + 047F hex // Addition·
	Var1 = Device 00 Status word AND 047F hex // “And” operation

8.3 Scheduler

Auto

With this option activated (automatic mode) after starting the scheduler line for line processing occurs. If it is deactivated (single step mode) (menu entry “Next" or combination of keys “F12 ") the user must run each instruction manually.

Loop

With this option activated the macro is implemented in a continuous loop. This means that after doing the last instruction the scheduler jumps back to the beginning of the macro.

8.3.1 Start sequence

The scheduler is started using the “Start” menu item or key combination “F9”. If automatic mode is active, processing takes place line by line. In single-step mode, only the first line is executed after starting. The user must call up the “Next” action for each subsequent line. The scheduler can only be started again after the macro has been worked through or the user has aborted the run. The parameters of the instructions cannot be edited whilst the scheduler is running.

8.3.2 Cancel a macro

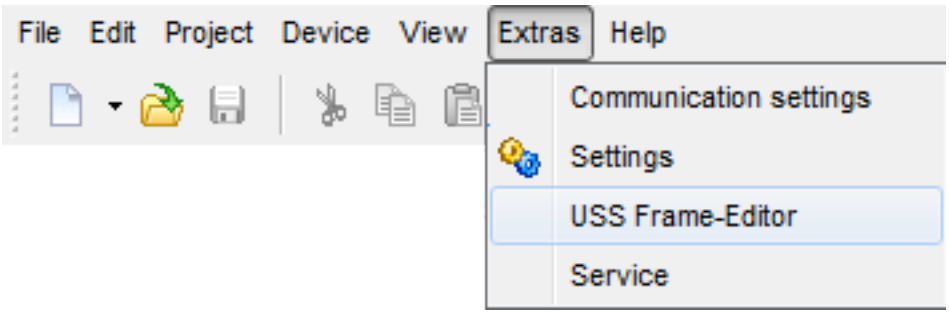
The scheduler is terminated in the menu option “Cancel" or the combination of keys “F11 ".

8.3.3 Execute next instruction

This function can be found in the menu option “Next" or with the key “F12 ". It is available only in the single step mode and instructs the scheduler to implement the next instruction in the macro. If the last instruction was implemented, the scheduler is terminated automatically.

9 USS Frame-Editor

The USS protocol defines an access procedure according to the Master/Slave principle for communication via a serial bus. A sub-set of this also includes point-to-point connection. A master and a maximum of 31 slaves can be connected to a bus. The individual slaves are accessed by the master via an address character in the telegram. Direct exchange of messages between the individual slaves is not possible. In semi-duplex mode communication is carried out using USS telegrams.



The USS Frame Editor was developed to generate and analyse USS telegrams. It is fully integrated in the NORDCON user interface and is opened via the menu item "Extras/USS Frame-Editor". The editor displays the master and slave telegram in several views. Via the tabs, the user can switch between the 9.1 "Master (order)"and the 9.2 "Device (response)".

<table>
<tr><th>Object</th><th>Description</th></tr>
<tr><td>Telegram type</td><td>This object specifies the size and structure of the USS telegram. The frequency inverter supports the following types:
<table>
<tr><th>Type</th><th>Length (LGE)</th><th>Description</th></tr>
<tr><td>PPO 0</td><td>12</td><td>Standard telegram with process data and 16 bit parameter value</td></tr>
<tr><td>PPO 1</td><td>14</td><td>Extended parameter data telegram with 32 bit parameter values and process data</td></tr>
<tr><td>PPO 2</td><td>18</td><td>Telegram with extended process data (main and two auxiliary setpoint values) and 32 bit parameter value</td></tr>
<tr><td>PPO 3</td><td>6</td><td>Process data telegram with main setpoint value without parameter data</td></tr>
<tr><td>PPO 4</td><td>10</td><td>Extended process data telegram with main and auxiliary setpoint values without parameter data</td></tr>
<tr><td>PPO 6</td><td>16</td><td>Telegram with 5 setpoint/actual values

Notice:
This telegram type is not supported by all frequency inverters.</td></tr>
</table></td></tr>
<tr><td>Address</td><td>This object contains the address of the frequency inverter which is accessed.</td></tr>
</table>

Status word	This object contains the status bit of the frequency inverter.
Control word	This object contains the control bits (e.g. enable or Quick Stop).
Setpoint/actual value 1-5	The setpoint/actual values are 16 bit or 32 bit values. These represent different values (e.g. frequency setpoint or position setpoint) depending on the parameterisation of the frequency inverter.
Format	This object contains the format of the setpoint. The following formats are supported: • 16 Bit standard value – This formatting interprets the setpoint as a 16 bit standardised value. Standardisation means scaling of the value range and is between -200% and 199% of a basic value (e.g. nominal frequency). • 16 Bit non-standardised – In this format the setpoint is interpreted as a 16 bit value, which is transferred to the frequency inverter and displayed without scaling.
Parameter order	The object contains the parameter order. The following orders are defined: • Request parameter value • Change parameter value (16 bit) • Change parameter value (32 bit) • Request parameter value (array) • Change parameter value (array 16 bit) • Change parameter value (array 32 bit) • Request the number of array elements • Change parameter value (array double word) without writing to the EEPROM • Change parameter value (array word) without writing to the EEPROM • Change parameter value (double word) without writing to the EEPROM • Change parameter value (word) without writing to the EEPROM
Parameter number	This object contains the parameter number.
Index	The object contains the parameter index.
Value	This object contains the parameter value. Depending on the telegram type, this is a 16 or 32 bit value. The display of the value still depends on the resolution of the value.
Resolution	This object contains the resolution of the parameter. If the resolution is changed, only the display of the parameter value changes. Please refer to the frequency inverter instructions for the resolution value.

Process value sequence 1,3,2 for SK700, SK300, Vector CT and VT

With this option, the sequence for the 2 and 3 process value can be changed for older frequency inverters. This option only affects the telegram types PPO 2 and PPO 4. The sequence of the process values is displayed in the table view.

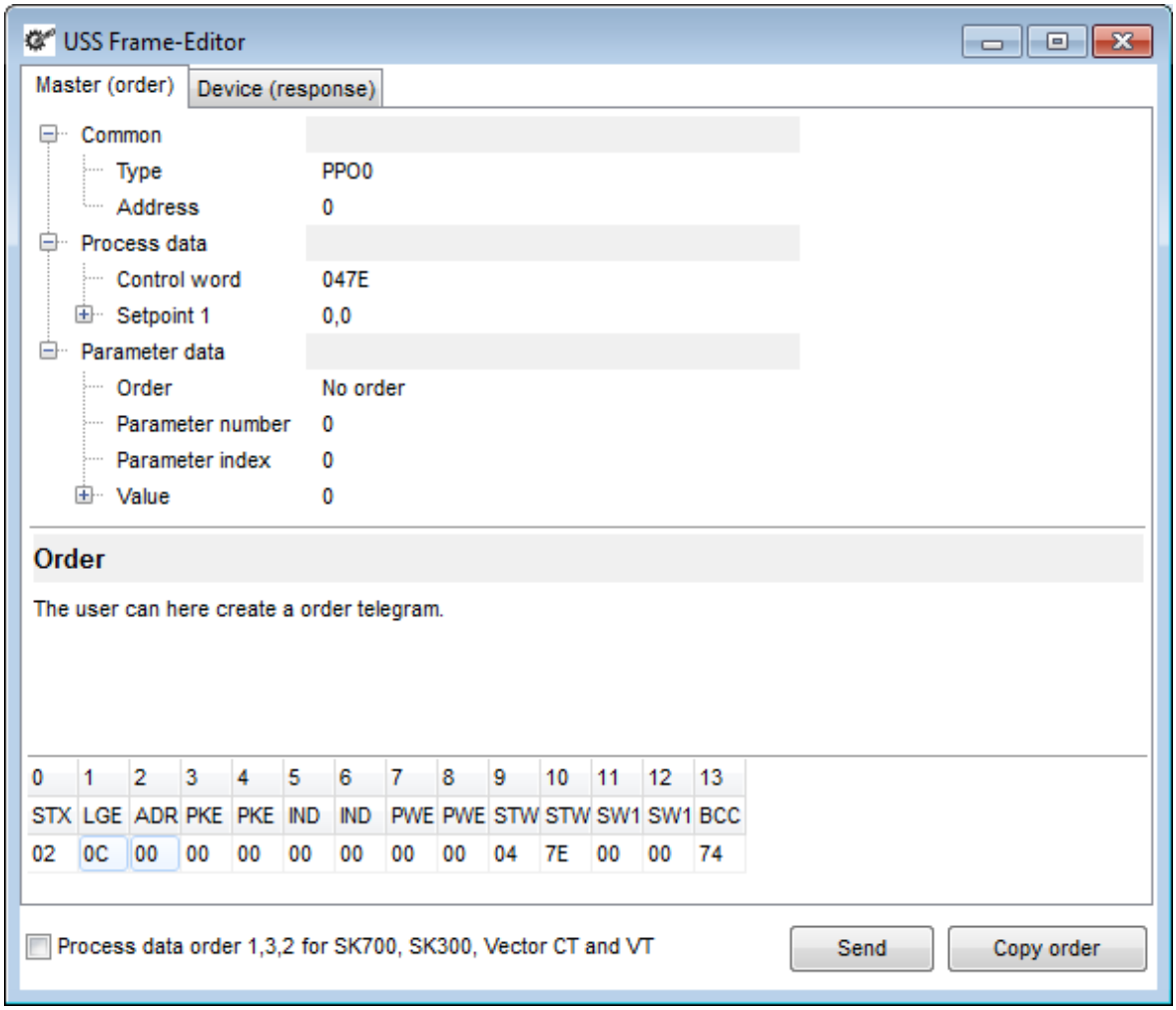
5.3.5 "Status word"

5.3.6 "Control word"

9.1 Master (order)

This view is divided into several sections. In the upper section, the order telegram is displayed as a tree structure. The individual components of the telegram are listed by subject in the tree structure. All entries with a white background can be changed by the user. To do this, the entry must be highlighted

with the mouse or the keyboard. A further click on the entry opens the input editor. The input editor may differ, depending on the entry. For numerical values, the input editor can also be opened by pressing a number key. The input for the new value is adopted and the input editor closed by pressing the "Enter" key or by highlighting a new entry. If the value cannot be adopted, the old value remains in use. If the input editor is a selection list, a new value is adopted by selecting an entry and the input editor is closed. If a change is not to be adopted, the user must exit from the input editor by pressing the "Esc" key. A description of each highlighted entry is displayed below the tree structure. In the lower section, the order telegram is displayed byte-wise in a table. The highlighted cells correspond to the entry which is highlighted in the tree structure.



Copy query

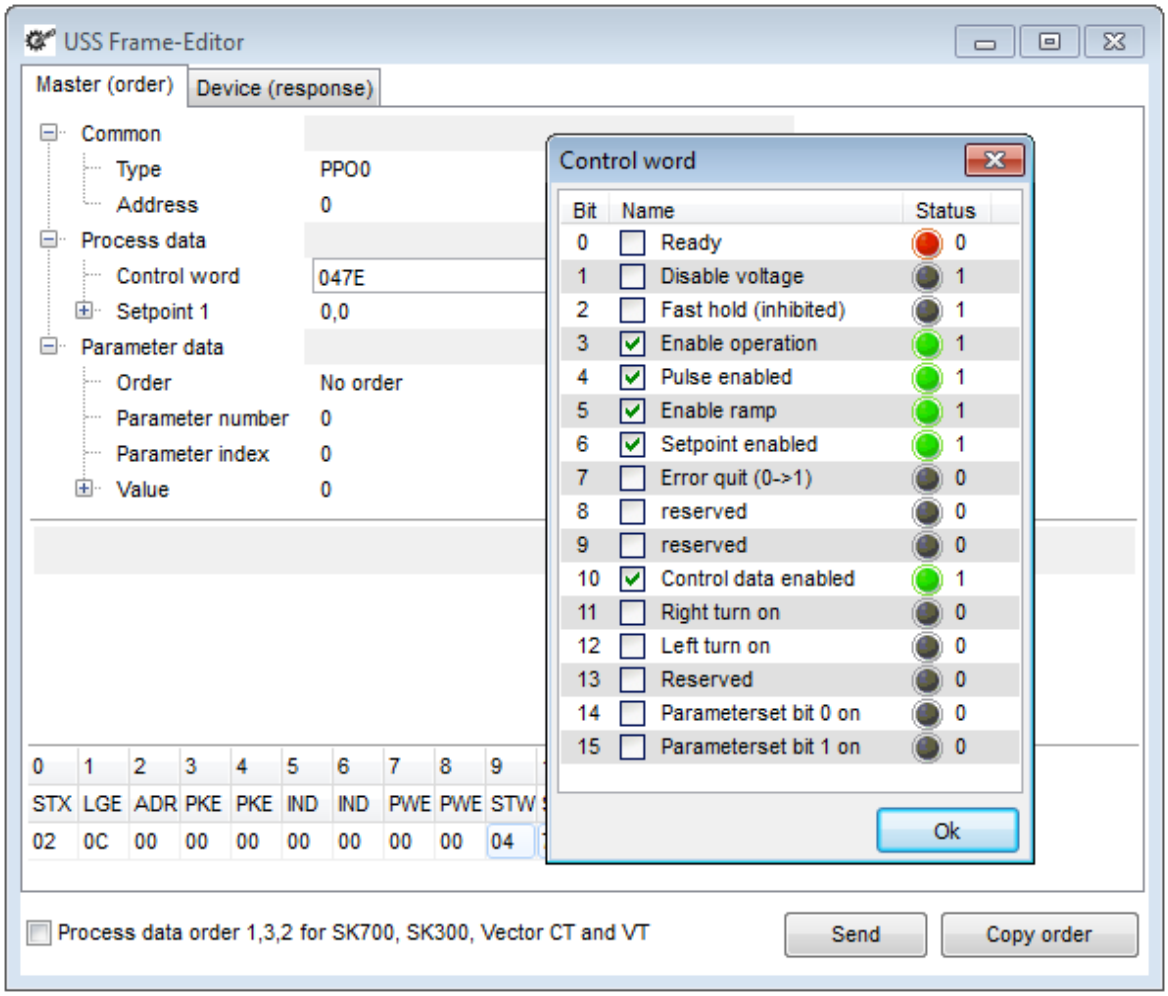
This action converts the order telegram into a hex coded byte string and copies the string to the Windows clipboard.

9.2 Device (response)

This view is divided into several sections. In the lower section, the response telegram is displayed byte-wise in a table. The user can change the response telegram in this table. All bytes except for STX, LGE and BCC can be changed. The user selects a cell and enters a new value in the table. The context menu of the table must be opened if the length and structure of the telegram is to be changed. After this, a new telegram type is selected in the menu.

The tree structure is updated after each change. The tree structure is only used to visualise the components of the USS telegram and cannot be edited. An exception to this is the formatting of actual values and the resolution of the parameter value. This information is not contained in the USS telegram. The formatting must be changed according to the settings for the actual values. The resolution must also be selected according to the parameter. Please refer to the instructions for the particular frequency inverter to obtain the value.

The status word is displayed as a hexadecimal value in the tree structure. A further view is implemented for visualisation of the individual bits. The status word must be highlighted to open the view. A further click on the entry opens the input editor in write-protected mode. The user can then open the view with the "..." button.



Enter response

This action opens an input dialogue for a response telegram. The user can enter the telegram as a hex-coded byte string.

10 PLC

10.1 General

The NORD frequency inverter series SK 180E/SK 190E, SK 2xxE, SK 2xxE-FDS, SK 300P, SK 520E – SK 545E and SK 5xxP as well as the motor starter series SK 155E-FDS/SK 175E-FDS contains logic processing which is similar to the current IEC61131-3 standard for memory programmable control units (SPS / PLC). The reaction speed or computing power of this PLC is suitable to undertake smaller tasks in the area of the inverter. Inverter inputs or information from a connected field bus can be monitored, evaluated and further processed into appropriate setpoint values for the frequency inverter. In combination with other NORD devices, visualisation of system statuses or the input of special customer parameters is also possible. Therefore, within a limited range, there is a potential for savings via the elimination of a previous external PC solution. AWL is supported as the programming language. AWL is a machine-orientated, text-based programming language whose scope and application is specified in IEC61131-3.

Information

Programming and download into the devices are possible exclusively via the NORD software NORDCON.

10.1.1 Specification of the PLC

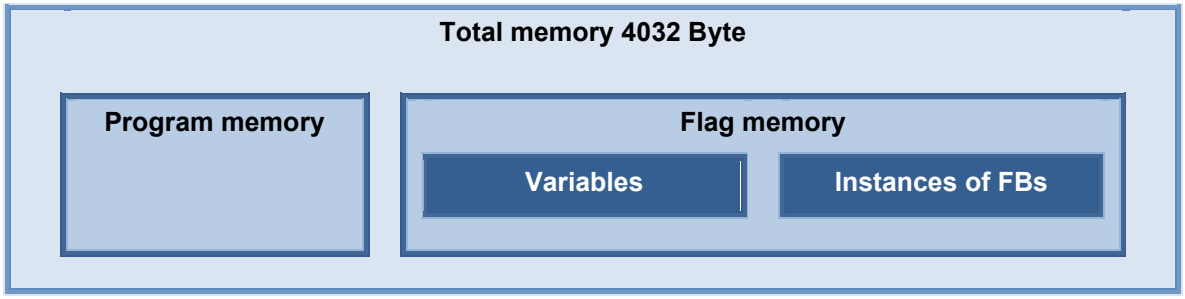
Function	Specification		
Standard	Orientated to IEC61131-3		
Language	Instruction list (IL), structured text (ST)		
Task	A cyclic task, program call-up every 5 ms		
Computer performance	Approximately 200 IL commands per 1 ms		
Program memory	SK 5xxP, SK 520E … SK 545E, SK 2xxE, SK 2x0E-FDS, On, On+	SK 190E / SK 180E	SK 155E-FDS / SK 175E-FDS
	8128 bytes for flags, functions and the PLC program	2032 bytes for flags, functions and the PLC program	2028 bytes for flags, functions and the PLC program
Max. possible number of commands	Approximately 2580 commands	Approximately 660 commands	Approximately 660 commands
	Note: This is an average value. Heavy use of flags, process data and functions considerably reduces the possible number of lines; see Resources section.		
Freely accessible CAN mailboxes	20 (except for On/On+)		
Supported devices	SK 5xxP SK 54xE SK 53xE / SK 52xE from V3.0 On/On+ SK 2xxE from V2.0		

Function	Specification
	SK 2x0E-FDS SK 180E / SK 190E SK 155E-FDS / SK 175E- FDS

10.1.2 PLC structure

10.1.2.1 Memory

The PLC memory is divided into the program memory and the flag memory. In addition to the variables, instances of function blocks are saved in the area of the flag memory. FB instance is a memory area in which all internal input and output variables of function command are saved. Each function command declaration requires a separate instance. The boundary between the program memory and the flag memory is determined dynamically, depending on the size of the flag area.



In the flag memory, two different classes of variables are stored in the variable section:

[VAR]

Memory variable for saving auxiliary information and statuses. Variables of this type are initialised every time the PLC starts. The memory content is retained during the cyclic sequence of the PLC.

[VAR_ACCESS]

These are used to read and describe process data (inputs, outputs, setpoints, etc.) of the frequency inverter. These values are regenerated with every PLC cycle.

10.1.2.2 Image of the process

Several physical dimensions such as torque, speed, position, inputs, outputs etc. are available to the device. These dimensions are divided into actual and setpoint values. They can be loaded into the process image of the PLC and influenced by it. The required processes must be defined in the list of variables under the class VAR_ACCESS. With each PLC cycle, all of the process data for the inverter which is defined in the list of variables is newly read in. At the end of each PLC cycle the writable process data are transferred back to the inverter, see following illustration.

Because of this sequence it is important to program a cyclic program sequence. Programming loops in order to wait for a certain event (e.g. change of level at an input) does not produce the required result. This behaviour is different in the case of function blocks which access process values. Here, the

process value is read on call-up of the function block and the process values are written immediately when the block is terminated.

Information

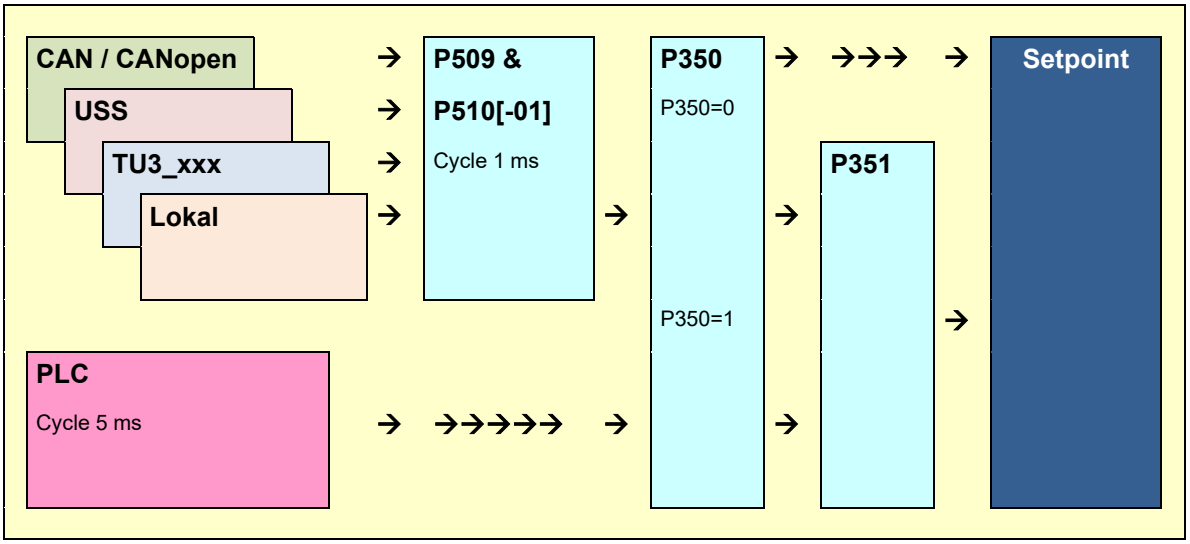
If the Motion blocks MC_Power, MC_Reset, MC_MoveVelocity, MC_Move, MC_Home or MC_Stop are used, the process values "PLC_Control_Word" and "PLC_Set_Val1" up to "PLC_Set_Val5" may not be used. Otherwise the values in the list of variables would always overwrite the changes to the function block..

10.1.2.3 Program Task

Execution of the program in the PLC is carried out as a single task. The task is called up cyclically every 5 ms and its maximum duration is 3 ms. If a longer program cannot be executed in this time, the program is interrupted and continued in the next 5 ms task.

10.1.2.4 Setpoint processing

The inverter has a variety of setpoint sources, which are ultimately linked via several parameters to form a frequency inverter setpoint.



If the PLC is activated (P350=1) preselection of setpoints from external sources (main setpoints) is carried out via P509 and P510[-01] Via P351, a final decision is made as to which setpoints from the PLC or values input via P509/P510[-01] are used. A mixture of both is also possible. No changes to the auxiliary setpoints (P510[-02]) are associated with the PLC function. All auxiliary setpoint sources and the PLC transfer their auxiliary setpoint to the frequency inverter with equal priority.

10.1.2.5 Data processing via accumulator

The accumulator forms the central computing unit of the PLC. Almost all AWL commands only function in association with the accumulator. The PLC has three accumulators. These are the 23 Bit Accumulator 1 and Accumulator 2 and the AE in BOOL format. The AE is used for all boolean loading, saving and comparison operations. If a boolean value is loaded, it is depicted in the AE Comparison operations transfer their results to the AE and conditional jumps are triggered by the AE. Accumulator 1 and Accumulator 2 are used for all operands in the data format BYTE, INT and DINT. Accumulator 1 is the main accumulator and Accumulator 2 is only used for auxiliary functions. All loading and storage operands are handled by Accumulator 1. All arithmetic operands save their results in Accumulator 1. With each Load command, the contents of Accumulator 1 are moved to Accumulator 2. A subsequent

operator can link the two accumulators together or evaluate them and save the result in Accumulator 1, which in the following will generally be referred to as the "accumulator".

10.1.3 Scope of functions

The PLC supports a wide range or operators, functions and standard function modules, which are defined in IEC61131-3. There is a detailed description in the following sections. In addition, the function blocks which are also supported are explained.

10.1.3.1 Motion Control Lib

The Motion Control Lib is based on the PLCopen specification "Function blocks for motion control". This mainly contains function blocks which are used to move the drive. In addition, function blocks for reading and writing of parameters of the device are also provided.

10.1.3.2 Electronic gear with Flying Saw

The frequency inverter is equipped with the functions Electronic gear unit (synchronous operation in positioning mode) and Flying saw. Via these functions the inverter can follow another drive unit with angular synchronism. As well as this, with the additional function Flying saw it is possible to synchronize to the precise position of a moving drive unit. The operating mode Electronic gear unit can be started and stopped at any time. This enables a combination of conventional position control with its move commands and gear unit functions. For the gear function a NORDAC vector with internal CAN bus is required on the master axis.

10.1.3.3 Visualisation

Visualisation of the operating status and the parameterisation of the frequency inverter is possible with the aid of a ControlBox or a ParameterBox. Alternatively, the CANopen Master functionality of the PLC CAN bus panel can be used to display information.

ControlBox

The simplest version for visualisation is the ControlBox. The 4-digit display and the keyboard status can be accessed via two process values. This enables simple HMI applications to be implemented very quickly. P001 must be set to "PLC-ControlBox Value" so that the PLC can access the display. A further special feature is that the parameter menu is no longer accessed via the arrow keys. Instead, the "On" and "Enter" keys must be pressed simultaneously.

ParameterBox

In visualisation mode, each of the 80 characters in the ParameterBox display (4 rows of 20 characters) can be set via the PLC. It is possible to transfer both numbers and texts. In addition keyboard entries on the ParameterBox can be processed by the PLC. This enables the implementation of more complex HMI functions (display of actual values, change of window, transfer or setpoints etc.). Access to the ParameterBox display is obtained via the function blocks in the PLC. Visualisation is via the operating value display of the Parameter Box. The content of the operating value display is set via the ParameterBox parameter P1003. This parameter can be found under the main menu item "Display". P1003 must be set to the value "PLC display". After this, the operating value display can be selected again by means of the right and left arrow keys. The display controlled by the PLC is then shown. This setting remains in effect even after a further switch-on.

10.1.3.4 Process controller

The process controller is a PID-T1 controller with a limited output size. With the aid of this function module in the PLC it is possible to simply set up complex control functions, by means of which various

processes, e.g. pressure regulation, can be implemented in a considerably more elegant manner than with the commonly used two-point controllers.

10.1.3.5 CANopen communication

In addition to the standard communication channels, the PLC provides further possibilities for communication. Via the CAN bus interface of the frequency inverter, it can set up additional communications with other devices. The protocol which is used for this is CANopen. Communications are restricted to PDO data transfer and NMT commands. The standard CANopen inverter communication via SDO, PDO1, PDO2 and Broadcast remains unaffected by this PLC function.

PDO (Process Data Objects)

Other frequency inverters can be controlled and monitored via PDO. However, it is also possible to connect devices from other manufacturers to the PLC. These may be IO modules, CANopen encoders, panels, etc. With this, the number of inputs/outputs of the frequency encoder can be extended as far as is required; analog outputs would then be possible.

NMT (Network Management Objects)

All CANopen devices must be set to the CANopen bus state "Operational" by the bus master. PDO communication is only possible in this bus state. If there is no bus master in the CANopen bus, this must be performed by the PLC. The function module FB_NMT is available for this purpose.

10.2 Creation of PLC programs

Creation of the PLC programs is carried out exclusively via the PC program NORDCON. The PLC editor is opened either via the menu item "File/New/PLC program" or via the symbol  . This button is only active if a device with PLC functionality forms the focus of the device overview.

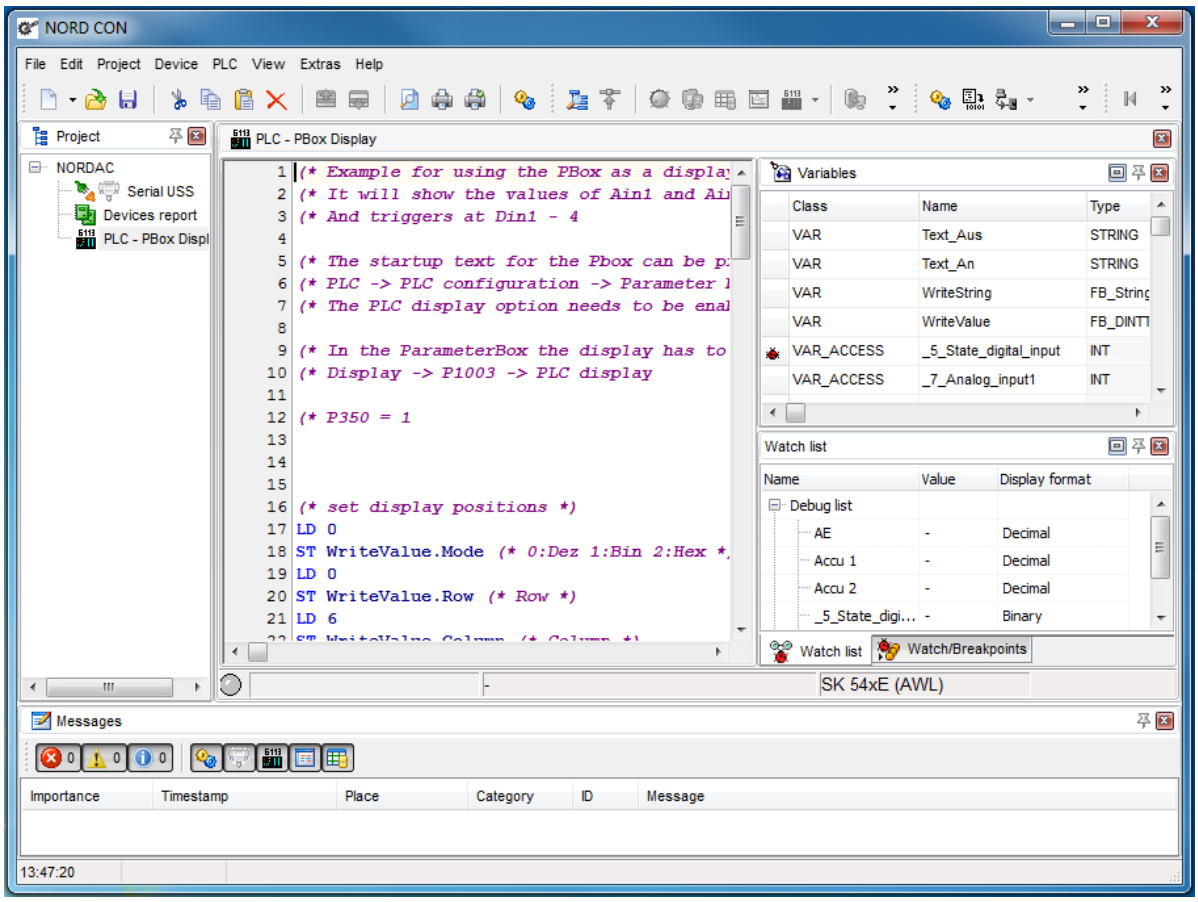
10.2.1 Loading, saving and printing

The functions Load, Save and Print are carried out via the appropriate entries in the main menu or in the symbol bars. When opening takes place, it is advisable to set the file type to "PLC Program" (*.awlx) in the "Open" dialogue. With this, only files which can be read by the PLC editor are displayed. If the PLC program which has been created is to be saved, the PLC Editor window must be active. The PLC program is saved by actuating "Save" or "Save as". With the "Save as" operation, this can also be detected from the entry of the file type (Program PLC (*.awlx)). The appropriate PLC window must be active in order to print the PLC program. Printout is then started via "File/Print" or the appropriate symbol.

PLC programs can also be saved as a backed-up PLC program. To do this, the user must set the file type to “Backed-up AWL files” or “Backed up ST files” in the file selection dialogue. Then the PLC program is saved in an encrypted (*.awls or *.nsts) and normal (*.awlx, *.nstx) version. The encrypted PLC program can only be transmitted to the device (see 2.2.4 "Category "Device"").

10.2.2 Editor

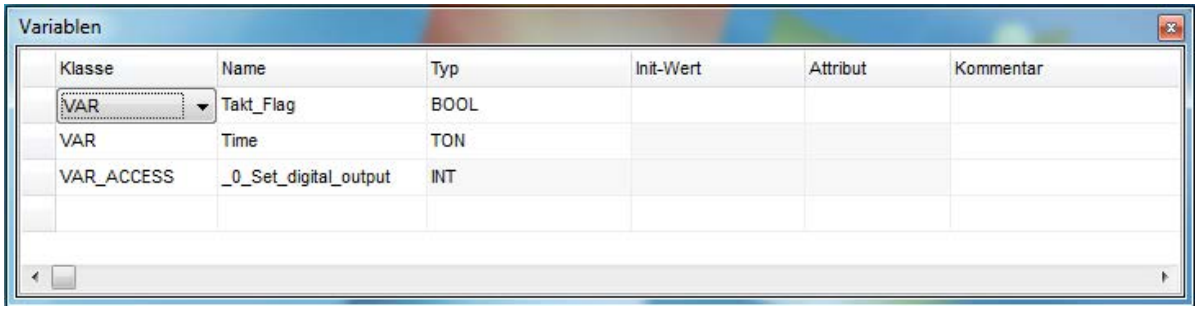
The PLC Editor is divided into four different windows.



The individual windows are described in more detail in the following sections.

10.2.2.1 Variables and FB declaration

All the variables, process values and function blocks which are required by the program are declared in this window.



Variables

Variables are created by setting the Class "VAR". The Name of the variable can be freely selected. In the Type field, a selection between BOOL, BYTE, INT and DINT can be made. A starting initialisation can be entered under Init-Value.

Process values

These are created by selecting the entry "VAR_ACCESS" under Class. The Name is not freely selectable and the field Init-Value is barred for this type.

Function modules

The entry "VAR" is selected under Class. The Name for the relevant instance of the function module (FB) can be freely selected. The required FB is selected under Type. An Init-Value cannot be set for function modules.

All menu items which relate to the variable window can be called up via the context menu. Via this, entries can be added and deleted. Variables and process variables for monitoring (Watchdog function) or debugging (Breakpoint) can be activated.

10.2.2.2 Input window

The input window is used to enter the program and to display the AWL program. It is provided with the following functions:

- Highlight syntax
- Bookmark
- Declaration of variables
- Debugging

Syntax Highlighting

If the command and the variable which is assigned to it are recognised by the Editor, the command is displayed in blue and the variable in black. As long as this is not the case, the display is in thin black italics.

Bookmarks

As programs in the Editor may be of considerable length, it is possible to mark important points in the program with the function Bookmark and to jump directly to these points. The cursor must be located in the relevant line in order to mark it. Via the menu item "Switch bookmark" (right mouse button menu) the line is marked with the required bookmark. The bookmark is accessed via the menu item "Go to bookmark".

Declaring Variables

Via the Editor menu "Add Variable" (right mouse button) new variables can be declared using the Editor.

Debugging

For the Debugging function, the positions of the breakpoints and watchpoints are specified in the Editor. This can be done via the menu items "Switch breakpoint" (Breakpoints) and "Switch monitoring point" (Watchpoints). The position of Breakpoints can also be specified by clicking on the left border of the Editor window. Variables and process values which are to be read out from the frequency inverter during debugging must be marked. This can be done in the Editor via the menu items "Debug variable" and "Watch variable". For this, the relevant variable must be marked before the required menu item is selected.

10.2.2.3 Watch and Breakpoint display window

This window has two tabs, which are explained below.

Holding points

This window displays all of the breakpoints and watchpoints which have been set. These can be switched on and off via the checkboxes and deleted with the "Delete key". A corresponding menu can be called up with the right mouse button.

Observation list

This displays all of the variables which have been selected for observation. The current content is displayed in the Value column. The display format can be selected with the Display column.

10.2.2.4 PLC message window

All PLC status and error messages are entered in this window. In case of a correctly translated program the message "Translated without error" is displayed. The use of resources is shown on the line below this. In case of errors in the PLC program, the message "Error X" is displayed. The number of errors is shown in X. The following lines show the specific error message in the format:

[Line number]: Error description

10.2.3 Transfer PLC program to device

There are several ways to transfer a PLC program to the device.

Transfer PLC program directly:

1. Select device in the project tree
2. Open popup menu (press the right mouse button)
3. Execute function "Transfer PLC program to device" 
4. Select file in the file selection dialogue and press "Open"

Transfer PLC program with PLC editor (offline):

1. Open PLC program (File->Open)
2. Connect PLC editor with a device (PLC->Connect)
3. Translate PLC program
4. Transfer PLC program to device 

Transfer PLC program with PLC editor (online):

1. Select device in the project tree
2. Open PLC editor 

3. Open PLC program

4. Import the file into online view

5. Translate PLC program

6. Transfer PLC program to device

Information **SK 1xxE-FDS – limited number of writing cycles**

In the devices SK 155E-FDS / SK 175E-FDS flash is used as a storage medium. The number of write cycles of Flash memory is very limited. By default, the program is loaded into the RAM. It can then be started and tested. If the PLC is then restarted, the program must be re-loaded to the device to initialize the PLC variables. Should the program be permanently stored in the device, you must execute the function "Transfer and store program to device".

10.2.4 Debugging

As programs only rarely function the very first time, the PLC provides several possibilities for finding faults. These possibilities can be roughly divided into two categories, which are described in detail below.

10.2.4.1 Observation points (Watchpoints)

The simplest debugging variant is the Watchpoint function. This provides a rapid overview of the behaviour of several variables. For this, an observation point is set at an arbitrary point in the program. When the PLC processes this line, up to 5 values are saved and displayed in the observation list (window "Observation List") The 5 values to be observed can be selected in the entry window or in the variable window using the context menu.

Information

In the current version, variables of functions cannot be added to the watch list!

10.2.4.2 Holding points (Breakpoints)

Via holding points it is possible to deliberately stop the PLC program at a specific line of the program. If the PLC runs into a Breakpoint, the AE, Accumulator 1 and Accumulator 2 are read out, as well as all variables which have been selected via the menu item "Debug variables". Up to 5 Breakpoints can be set in a PLC  program. This function is started via the  symbol. The program now runs until a holding point is triggered. Further actuation of the symbol bar allows the program to continue running until it reaches the next holding point. If the program is to continue running, the symbol is actuated.

10.2.4.3 Single Step

With this debugging method it is possible to execute the PLC program line for line. With each individual step, all the selected variables are read out of the PLC of the device and displayed in the "Observation list" window. The values to be observed can be selected in the input window or the variable window by means of the right mouse button menu. The condition for debugging in single steps is that at least one Breakpoint has been set before starting debugging. The debugging mode is switched on by actuating the  symbol. Only when the program has run into the first breakpoint,

can the following lines be debugged via the  symbol. Some command lines contain several individual commands. Because of this, two or more individual steps may be processed before the step indicator jumps forward in the entry window. The actual position is shown by a small arrow in the left PLC Editor window. When the  symbol is actuated, the program continues running until the next holding point. If the program is to continue running, the  symbol is actuated.

10.2.5 PLC configuration

The PLC configuration dialogue is opened via the  symbol. Here, basic settings for the PLC can be made, which are described in further detail below.

Cycle time monitoring

This function monitors the maximum processing time for a PLC cycle. With this, unintended continuous program loops in the PLC program can be caught. Error E22.4 is triggered in the frequency inverter if this time is exceeded.

Allow ParameterBox function module

If visualisation via the ParameterBox is to be performed in the PLC program, this option must be enabled. Otherwise the corresponding function blocks generate a Compiler Error when the frequency inverter is started.

Invalid control data

The PLC can evaluate control words which are received from the possible bus systems. However, the control words can only get through if the bit "PZD valid" (Bit 10) is set. This option must be activated if control words which are not compliant with the USS protocol are to be evaluated by the PLC. Bit 10 in the first word is then no longer queried.

Do not pause the system time at holding point

The system time is paused during debugging if the PLC is in the holding point or in single step mode. The system time forms the basis for all timers in the PLC. This function must be activated if the system time is to continue running during debugging.

10.3 Function blocks

Function blocks are small programs, which can save their status values in internal variables. Because of this, a separate instance must be created in the NORDCON variable list for each function block. E.g. if a timer is to monitor 3 times in parallel, it must also be set up three times in the list of variables.

Information — **Detecting a signal edge**

In order for the following function blocks to detect an edge at the input, it is necessary for the function call-up to be carried out twice with different statuses at the input.

10.3.1 CANopen

The PLC can configure, monitor and transmit on PDO channels via function blocks. The PDO can transmit or receive up to 8 bytes of process data via a PDO. Each of these PDOs is accessed via an

individual address (COB-ID). Up to 20 PDOs can be configured in the PLC. For simpler operation, the COB-ID is not entered directly. Instead, the device address and the PDO number are communicated to the FB. The resulting COB-ID is determined on the basis of the Pre-Defined Connection Set (CiA DS301). This results in the following possible COB-IDs for the PLC.

Transmit PDO		Receive PDO	
PDO	**COB-ID**	**PDO**	**COB-ID**
PDO1	200h + Device address	PDO1	180h + Device address
PDO2	300h + Device address	PDO2	280h + Device address
PDO3	400h + Device address	PDO3	380h + Device address
PDO4	500h + Device address	PDO4	480h + Device address

NORD Frequency inverter use PDO1 to communicate process data. PDO2 is only used for setpoint/actual value 4 and 5.

10.3.1.1 Overview

Function module	Description
FB_PDOConfig	PDO configuration
FB_PDOSend	Transmit PDO
FB_PDOReceive	Receive PDO
FB_NMT	Enable and disable PDO

10.3.1.2 FB_NMT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X		X	X	X	X

After a *Power UP* all CAN participants are in the Pre-Operational bus state. In this state, they can neither transmit nor receive a PDO. In order for the PLC to be able to communicate with other participants on the CAN bus, these must be set to the Operational state. Usually, this is realised by the bus master. If there is no bus master, this task can be taken over by the FB_NMT. The states of all participants connected to the bus can be controlled via the inputs **PRE**, **OPE** or **STOP**. The inputs are applied with a positive flank on **EXECUTE**. The function must be called until the output **DONE** or **ERROR** has been set to 1.

If the **ERROR** is set to 1, there is either no 24 V supply to the RJ45 CAN socket of the inverter, or the CAN driver of the inverter is in the status *Bus off*. With a negative flank on **EXECUTE**, all outputs are reset to 0.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	BOOL	DONE	NMT command is transmitted	BOOL
PRE	Set all participants to Pre-Operational state	BOOL	ERROR	Error in FB	BOOL
OPE	Set all participants to Operational state	BOOL			
STOP	Set all participants to Stopped state	BOOL			

10.3.1.3 FB_PDOConfig

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X		X	X	X	X

The PDOs are configured with this FB. With an instance of this function, all of the required PDOs can be configured. The FB must only be called up once for each PDO. Up to 20 PDOs can be set up. Each PDO has its own parameterisation. The assignment of the PDOs in the other CANopen FBs is carried out via the Messagebox number. The **TARGETID** represents the address of the device. With NORD Frequency inverter, it is set in P515 or via DIP switches. The required Messagebox number is entered under PDO (see Introduction). **LENGTH** specifies the transmission length of a PDO. The transmission/reception direction is specified via **DIR**. The data is adopted with a positive flank on the **EXECUTE** input. The **DONE** output can be queried immediately after the call-up of the FB. If **DONE** is set to 1, the PDO channel has been configured. If **ERROR** = 1, there was a problem, whose precise cause is stored in **ERRORID**. With a negative flank on **EXECUTE**, all outputs are reset to 0.

Transmit PDO		Monitored PDO	
PDO	**COB-ID**	**PDO**	**COB-ID**
PDO1	200h + Device address	PDO1	180h + Device address
PDO2	300h + Device address	PDO2	280h + Device address
PDO3	400h + Device address	PDO3	380h + Device address
PDO4	500h + Device address	PDO4	480h + Device address
PDO5	180h + Device address	PDO5	200h + Device address
PDO6	280h + Device address	PDO6	300h + Device address
PDO7	380h + Device address	PDO7	400h + Device address
PDO8	480h + Device address	PDO8	500h + Device address

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	BOOL	**DONE**	PDO configured	BOOL
NUMBER	Messagebox number Value range = 0 to 19	BYTE	**ERROR**	Error in FB	BOOL
TARGETID	Device address Value range = 1 to 127	BYTE	**ERRORID**	Error code	INT
PDO	PDO Value range = 1 to 4	BYTE			
LENGTH	PDO length Value range = 1 to 8	BYTE			
DIR	Transmit or receive Transmit = 1 / Receive = 0	BOOL			

ERRORID	Explanation
0	No error
1800h	Number value range exceeded
1801h	TARGETID value range exceeded
1802h	PDO value range exceeded
1803h	LENGT value range exceeded

Information — No dual use of the CAN ID

CAN IDs already used by the device may not be parameterised!

Relevant reception addresses:

- CAN ID = 0x180 + P515[-01] PDO1
- CAN ID = 0x180 + P515[-01]+1 CAN ID for absolute encoder
- CAN ID = 0x280 + P515[-01] PDO2

Relevant transmission addresses:

- CAN ID = 0x200 + P515[-01] PDO1
- CAN ID = 0x300 + P515[-01] PDO2

Example in ST:

```
(* Configure PDO *)
PDOConfig(
    Execute := TRUE,
    (* Configure Messagebox 1 *)
    Number := 1,
    (* Set CAN node number *)
    TargetID := 50,
    (* Select PDO (Standard for PDO1 control word, setpoint1, setpoint2, setpoint3) *)
    PDO := 1,
    (* Specify length of data (Standard for PDO1 is 8 *)
    LENGTH := 8,
    (* Transmit *)
    Dir := 1);

or

(* Configure PDO *)
PDOConfig(
    Execute := TRUE,
    (* Configure Messagebox 1 *)
    Number := 2,
    (* Set CAN node number *)
    TargetID := 50,
    (* Select PDO (Standard for PDO2 setpoint4, setpoint5 SK540E) *)
    PDO := 2,
    (* Specify length of data (Standard for PDO2 is 4 *)
    LENGTH := 4,
    (* Transmit *)
    Dir := 1);

or

(* Configure PDO *)
PDOConfig(
    Execute := TRUE,
    (* Configure Messagebox 2 *)
    Number := 2,
    (* Set CAN node number *)
    TargetID := 50,
    (* Select PDO (Standard for PDO1 status word, actual value1, actual value2, actual
     value3) *)
    PDO := 1,
    (* Specify length of data (Standard for PDO1 is 8 *)
    LENGTH := 8,
    (* Receive *)
    Dir := 0);
```

10.3.1.4 FB_PDOReceive

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X		X	X	X	X

This FB monitors a previously configured PDO channel for incoming messages. Monitoring starts if the **ENABLE** input is set to 1. After the function has been called up, the **NEW** output must be checked. If it changes to 1, a new message has arrived. The **NEW** output is deleted with the next call-up of the function. The data which have been received are shown in **WORD1** to **WORD4**. The PDO channel can be monitored for cyclical reception via **TIME**. If a value between 1 and 32767 ms is entered in **TIME**, a message must be received during this period. Otherwise, the FB changes into the error state (**ERROR** = 1). This function can be disabled with the value 0. The monitoring timer runs in steps of 5 ms. In case of error, **ERROR** is set to 1. In this case, **DONE** is 0. The corresponding error code is then valid in **ERRORID**. With a negative flank on **ENABLE**, **DONE**, **ERROR** and **ERRORID** are reset.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Execute	BOOL	**NEW**	New PDO received	BOOL
NUMBER	Messagebox number Value range = 0 to 19	BYTE	**ERROR**	Error in FB	BOOL
TIME	Watchdog function Value range = 0 to 32767 0 = Disabled 1 to 32767 = Monitoring time	INT	**ERRORID**	Error code	INT
			MONITOR	The output will be set on receiving a PDO message (MONITOR = TRUE). If no new PDO message is received or the module was deactivated during the watchdog time, the output will be reset (MONITOR = FALSE).	BOOL
			WORD1	Received data Word 1	INT
			WORD2	Received data Word 2	INT
			WORD3	Received data Word 3	INT
			WORD4	Received data Word 4	INT

ERRORID	Explanation
0	No error
1800h	Number value range exceeded
1804h	Selected box is not configured correctly
1805h	No 24 V for bus driver or bus driver is in “Bus off” state
1807h	Reception timeout (Watchdog function)

Information — PLC cycle time

The PLC cycle is about 5 ms, i.e. with one call-up of the function in the PLC program, a CAN message can only be read every 5 ms. Messages may be overwritten if several messages are transmitted in quick succession.

Example in ST:

```
IF bFirstTime THEN
  (* Set device to Pre-Operational status *)
  NMT(Execute := TRUE, OPE := TRUE);
  IF not NMT.Done THEN
    RETURN;
  END_IF;

  (* Configure PDO *)
  PDOConfig(
    Execute := TRUE,
    (* Configure Messagebox 2 *)
    Number := 2,
    (* Set CAN node number *)
    TargetID := 50,
    (* Select PDO (Standard for PDO1 status word, actual value1, actual value2, actual
value3) *)
```

```
      PDO := 1,
      (* Specify length of data (Standard for PDO1 is 8 *)
      Length := 8,
      (* Receive *)
      Dir := 0);
  END_IF;

  (* Read out status and actual values *)
  PDOReceive(Enable := TRUE, Number := 2);
  IF PDOReceive.New THEN
    State := PDOReceive.Word1;
    Sollwert1 := PDOReceive.Word2;
    Sollwert2 := PDOReceive.Word3;
    Sollwert3 := PDOReceive.Word4;
  END_IF
```

10.3.1.5 FB_PDOSend

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X		X	X	X	X

With this FB, PDOs can be transmitted on a previously configured channel. These can be transmitted once or cyclically. The data to be transmitted is entered in **WORD1** to **WORD4**. PDOs can be transmitted irrespective of the frequency inverter's CANopen state. The previously configured PDO channel is selected via **NUMBER**. The data to be transmitted is entered in **WORD1** to **WORD4**. Single (setting = 0) or cyclical transmission can be selected via **CYCLE**. The PDO is sent with a positive flank on **EXECUTE**. If **DONE** = 1, all entries were correct and the PDO is transmitted. If **ERROR** = 1, there was a problem. The precise cause is stored in **ERRORID**. All outputs are reset with a negative flank on **EXECUTE**. The time base of the PLC is 5 ms; this also applies for the **CYCLE** input. Only transmission cycles with a multiple of 5 ms can be implemented.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	**BOOL**	**DONE**	PDO transmitted = 1	BOOL
NUMBER	Messagebox number Value range = 0 to 19	**BYTE**	**ERROR**	Error in FB	BOOL
CYCLE	Transmission cycle Value range = 0 to 255 0 = Disabled 1 to 255 = Transmission cycle in ms	**BYTE**	**ERRORID**	Error code	INT
WORD1	Transmission data Word 1	**INT**			
WORD2	Transmission data Word 2	**INT**			
WORD3	Transmission data Word 3	**INT**			
WORD4	Transmission data Word 4	**INT**			

ERRORID	**Explanation**
0	No error

1800h	Number value range exceeded
1804h	Selected box is not configured correctly
1805h	No 24 V for bus driver or bus driver is in “Bus off” state

If **DONE** changes to 1, the message to be transmitted has been applied by the CAN module, but has not yet been sent. The actual transmission runs in parallel in the background. If several messages are now to be transmitted directly in sequence via an FB, it may be the case that the previous message has not yet been transmitted upon the new call-up. This can be seen by the fact that neither the **DONE** nor the **ERROR** signal have been set to 1 after the **CAL** call-up. The **CAL** call-up can be repeated until one of the two signals changes to 1. If several different CAN IDs are to be written on via a single FB, this is possible with a new configuration of the FB. However, this must not be done in the same PLC cycle as the transmission. Otherwise, there is a danger that the message to be transmitted will be deleted during configuration by the FB_PDOConfig.

Example in ST:

```
IF bFirstTime THEN
  (* Set device to Pre-Operational status *)
  NMT(Execute := TRUE, OPE := TRUE);
  IF not NMT.Done THEN
    RETURN;
  END_IF;

  (* Configure PDO*)
  PDOConfig(
    Execute := TRUE,
    (*Configure Messagebox 1*)
    Number := 1,
    (* Set CAN node number *)
    TargetID := 50,
    (* Select PDO (Standard for PDO1 status word, actual value1, actual value2, actual
     value3) *)
    PDO := 1,
    (*Specify length of data (Standard for PDO1 is 8*)
    LENGTH := 8,
    (* Transmit *)
    Dir := 1);

  IF not PDOConfig.Done THEN
    RETURN;
  END_IF;

  (* Transmit PDO - Set Device control word to status "Ready to switch-on" *)
  PDOSend(Execute := TRUE, Number := 1, Word1 := 1150, Word2 := 0, Word3 := 0, Word4 := 0);
  IF NOT PDOSend.Done THEN
    RETURN;
  END_IF;

  PDOSend(Execute := FALSE);
  bFirstTime := FALSE;
END_IF;

CASE State OF
  0:
      (* Has digital input 1 been set? *)
      IF _5_State_digital_input.0 THEN
        (*Transmit PDO - Set Device control word to status "Ready to switch-on" *)
        PDOSend(Execute := TRUE, Number := 1, Word1 := 1150, Word2 := 0, Word3 := 0,
          Word4 := 0);
        State := 10;
        RETURN;
      END_IF;

      (*Has digital input 2 been set? *)
      IF _5_State_digital_input.1 THEN
        (* Transmit PDO - Enable device with 50% max. frequency *)
        PDOSend(Execute := TRUE, Number := 1, Word1 := 1151, Word2 := 16#2000, Word3 := 0,
          Word4 := 0);
```

```
            State := 10;
            RETURN;
          END_IF;

      10:
          PDOSend;
          IF PDOSend.Done THEN
            PDOSend(Execute := FALSE);
            State := 0;
          END_IF;
    END_CASE;
```

10.3.2 Electronic gear unit with flying saw

For the electronic gear unit ("angularly synchronised operation") and the sub-function flying saw there are two function blocks which enable control of these functions. In addition, various parameters must be set for the correct execution of the two function blocks in the master and slave frequency inverters. An example of this is shown in the following table (explained by the example of a SK 540E).

Master FI			**Slave FI**		
Parameter	Settings	Description	Parameter	Settings	Description
P502[-01]	20	Setpoint frequency according to freq. Ramp	P509	10 *	CANopen Broadcast *
P502[-02]	15	Actual position in incl. High word	P510[-01]	10	CANopen Broadcast
P502[-03]	10	Actual position in incl. Low word	P510[-02]	10	CANopen Broadcast
P503	3	CANopen	P505	0	0,0 Hz
P505	0	0.0 Hz	P515[-02]	P515[-03]$_{Master}$	Broadcast Slave address
P514	5	250 kBaud (min. 100 kBaud)	P546[-01]	4	Frequency addition
P515[-03]	P515[-02] Slave	Broadcast master address	P546[-02]	24	Setpoint pos. Incl. High Word
			P546[-03]	23	Setpoint pos. Incl. Low Word
			P600	1.2	Position control ON
			Only for FB_Gearing		
			P553[-01]	21	Position setpoint pos. Low word
			P553[-02]	22	Position setpoint pos. High word
* (P509) must not necessarily be set to {10} "CANopen Broadcast". However, in this case the Master (P502 [-01]) must be set to {21} "Actual frequency without slip".					

Information **Actual position – transmission format**

The actual position of the master MUST be communicated in "Increments" (Inc) format.

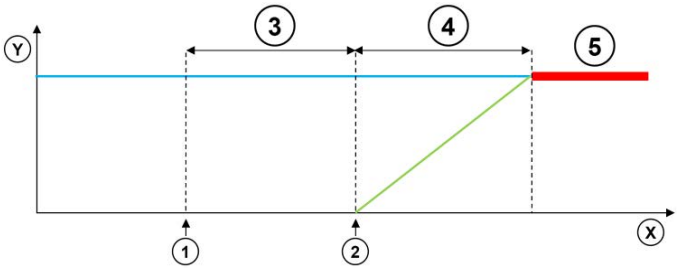
10.3.2.1 Overview

Function module	Description
FB_Gearing	FB for simple gear unit function
FB_FlyingSaw	FB for gear unit function with Flying Saw

10.3.2.2 FB_FlyingSaw

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	On+	X	X	X	

The flying saw function is an extension of the gear unit function. With the aid of this function it is possible to precisely synchronise to a running drive unit. In contrast to FB_Gearing, synchronisation is relative, i.e. the slave axis moves synchronously to the position of the master which applied at the start of the “Flying Saw”. The synchronisation process is illustrated in the figure below.



1	Position of the initiator
2	Starting point of the slave
3	Distance of the initiator from the start position of the slave frequency inverter
4	Acceleration
5	Synchronous mode for both drives
X	Position
Y	Speed

If the function is started, the slave frequency inverter accelerates to the speed of the master axis. The acceleration ramp is specified via the **ACCELERATION** path. At low speeds, the ramp is flatter and at high speeds, there is a steep ramp for the slave frequency inverter. The acceleration path is stated in revolutions (1000 = 1.000 rev.) if P553 is specified as the setpoint position. If the setpoint position INC is used for P553, the acceleration path is specified in increments.

If the initiator, with the distance saved in **ACCELERATION**, is set in front of the position of the slave drive, the slave is precisely synchronised with the triggering position from the master drive.

The FB must be switched on via the **ENABLE** input. The function can be started either via the digital input (P420[-xx]=64, *Start flying saw*) or via **EXECUTE**. The frequency inverter then accelerates to the speed of the master axis. When synchronisation with the master axis is achieved, the **DONE** output is switched to 1.

Via the **STOP** input or the digital input function P420[-xx] = 77, *Flying saw stopped*, the gear unit function is switched off, the frequency inverter decelerates to 0 Hz and remains at a standstill. Via the **HOME** input, the inverter is made to move to the absolute position 0. After termination of the **HOME** or **STOP** command, the relevant allocated output is active. The gear unit function can be restarted by reactivating **EXECUTE** or the digital input. With the digital input function (P420[-xx] = 63, *Synchronous mode off*), the gear unit function can be stopped and then moved to the absolute position 0.

If the function is interrupted by the MC_Stop function, **ABORT** is set to 1. In case of error, **ERROR** is set to 1 and the error code is set in **ERRORID**. These three outputs are reset if **ENABLE** is switched to 0.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**VALID**	Specified set point frequency reached	BOOL
EXECUTE	Start of synchronisation	BOOL	**DONEHOME**	Home run completed	
STOP	Stop synchronisation	BOOL	**DONESTOP**	Stop command executed	
HOME	Moves to position 0	BOOL	**ABORT**	Command cancelled	BOOL
ACCELERATION	Acceleration path (1 rev. = 1,000)	DINT	**ERROR**	Error in FB	BOOL
			ERRORID	Error code	INT

ERRORID	**Explanation**
0	No error
1000h	FI is not enabled
1200h	Position control is not activated

10.3.2.3 FB_Gearing

	SK 5xxP	**SK 54xE**	**SK 53xE SK 52xE**	**On/On+**	**SK 2xxE**	**SK 2xxE-FDS**	**SK 180E SK 190E**	**SK 155E-FDS SK 175E-FDS**
Availability	X	X	X	On+	X	X	X	

Via function module FB_Gearing, the position and speed of the frequency inverter can be synchronised to that of a master inverter. The slave which uses this function always follows the movements of the master inverter.

Synchronisation is absolute, i.e. the positions of the slave and the master are always the same.

Information

If the slave is switched to gear unit mode at a different position than the master, the slave moves with maximum frequency to the master's position.

If a gear ratio is specified, this also results in a new position when switched on again.

The position value to which synchronisation is carried out, as well as the speed, must be transmitted via the Broadcast channel. The function is enabled via the **ENABLE** input. For this, the position control and the output stage must be enabled. The output stage can be enabled, e.g. with the MC_Power function. If **ENABLE** is set to 0, the frequency inverter decelerates to 0 Hz and remains at a standstill. The inverter is now in position control mode again. If MC_Stop is activated, the frequency inverter exits the gear unit mode and the **ABORT** output changes to 1. In case of errors in the FB, **ERROR**

changes to 1 and the error cause is indicated in **ERRORID.** By setting **ENABLE** to 0, **ERROR, ERRORID** and **ABORT** can be reset.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Synchronous mode active	BOOL	**VALID**	Gear unit function is active	BOOL
RELATIVE	Relative mode (V2.1 and above)	BOOL	**ABORT**	Command cancelled	BOOL
			ERROR	Error in FB	BOOL
			ERRORID	Error code	INT

ERRORID	**Explanation**
0	No error
1000h	FI is not enabled
1200h	Position control is not activated
1201h	The PLC set value position High is not parameterised
1202h	The PLC set value position Low is not parameterised

10.3.3 Motion Control

The Motion Control Lib is based on the PLCopen specification "Function blocks for motion control". It contains function blocks for controlling and moving a frequency inverter and provides access to its parameters. Several settings must be made to the parameters of the device in order for the Motion Blocks to function.

Function blocks	**Required settings**
MC_MoveVelocity	P350 = PLC active P351 = Main setpoint comes from the PLC P553 [-xx] = Setpoint frequency P600 = Position control (positioning mode) is disabled
MC_MoveAbsolute MC_MoveRelative MC_MoveAdditive MC_Home	P350 = PLC active P351 = Main setpoint comes from the PLC P600 = Position control (positioning mode) is enabled In P553 [-xx] (PLC_Setpoints) the setpoint position High Word must be parameterised In P553 [-xx] (PLC_Setpoints) the setpoint position Low Word must be parameterised In P553 [-xx] (PLC_Setpoints) the setpoint frequency must be parameterised
MC_Power MC_Reset MC_Stop	P350 = PLC active P351 = Control word comes from the PLC

Information

The PLC_Setpoints 1 to 5 and the PLC control word can also be described via process variables. However, if the Motion Control FBs are used, no corresponding process variable may be declared in the table of variables, as otherwise the outputs of the Motion Control FBs would be overwritten.

Information

Detecting a signal edge

In order for the following function blocks to detect an edge at the input, it is necessary for the function call-up to be carried out twice with different statuses at the input.

Function blocks	Description
MC_ReadParameter	Reading access to parameters of the device
MC_WriteParameter	Writing access to parameters of the device
MC_MoveVelocity	Move command in speed mode
MC_MoveAbsolute	Move command with specification of absolute position
MC_MoveRelative	Move command with specification of relative position
MC_MoveAdditive	Move command with additive specification of position
MC_Home	Starts a home run
MC_Power	Switches the motor voltage on or off
MC_ReadStatus	Status of the device
MC_ReadActualPos	Reads out the actual position
MC_Reset	Error reset in the device
MC_Stop	Stops all active movement commands

10.3.3.1 MC_Control

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	

This function block is used to control the FI and provides the option of producing the FI control word in a form which is somewhat more detailed than is possible with MC_Power. The FI is controlled via the inputs **ENABLE (ENABLE_RIGHT)**, **ENABLE_LEFT, DISABLEVOLTAGE** and **QUICKSTOP**, please refer to the following table.

Module inputs				Frequency inverter behaviour
ENABLE (RIGHT)	ENABLE_ LEFT	QUICKSTOP	DISABLE VOLTAGE	
High	Low	Low	Low	The frequency inverter is switched on (enable right).

X	High	Low	Low	The frequency inverter is switched on (enable left).
Low	Low	Low	Low	The frequency inverter decelerates to 0 Hz (P103) and then disconnects the motor from the voltage supply.
X	X	X	High	The frequency inverter is disconnected from the voltage supply immediately and the motor runs to a standstill without deceleration.
X	X	High	Low	The frequency inverter performs a Quick stop (P426) and then disconnects the motor from the voltage supply.

The active parameter set can be set via the input **PARASET**.

If the output is in **STATUS** = 1, the FI is switched on and the motor is supplied with power.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**STATUS**	Motor supplied with power	BOOL
DISABLEVOLTAGE	Disconnect voltage	BOOL	**ERROR**	Error in FB	BOOL
QUICKSTOP	Quick stop	BOOL	**ERRORID**	Error code	INT
PARASET	Active parameter set Value range: 0 – 3	BYTE			
ENABLE_RIGHT	Enable right (as for **ENABLE**) (SK5xxP)	BOOL			
ENABLE_LEFT	Enable left (SK5xxP)	BOOL			

ERRORID	**Explanation**
0	No error
1001h	Stop function is active
1300h	The FI is in a state where the selected function cannot be executed.

Example in ST:

```
(* Device enabled with Dig3*)
Control.Enable := _5_State_digital_input.2;
(* Parameter sets are specified via Dig1 and Dig2. *)
Control.ParaSet := INT_TO_BYTE(_5_State_digital_input and 2#11);
Control;
(* Is the device enabled? *)
if Control.Status then
  (* Is a different position to be moved to? *)
  if SaveBit3 <> _5_State_digital_input.3 then
    SaveBit3 := _5_State_digital_input.3;
    if SaveBit3 then
      Move.Position := 500000;
    else
      Move.Position := 0;
    end_if;

    Move(Execute := False);
  end_if;
end_if;

(* Move to position if the device is enabled.  *)
Move(Execute := Control.Status);
```

10.3.3.2 MC_Control_MS

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability								X

This FB is used to control the starter (MS).

Module inputs				**Frequency inverter behaviour**
ENABLE_RIGHT	**ENABLE_LEFT**	**QUICKSTOP**	**DISABLEVOLTAGE**	
High	Low	Low	Low	MS is switched on, clockwise
Low	High	Low	Low	MS is switched on, counter-clockwise
High	High	Low	Low	MS is switched off
Low	Low	Low	Low	MS decelerates to 0 Hz (P103) and then disconnects the motor from the voltage supply
X	X	X	High	MS is disconnected from the voltage supply immediately and the motor runs to a standstill without deceleration

X	X	High	Low	MS performs a Quick stop (P426) and then disconnects the motor from the voltage supply.

(X = The level at the input is irrelevant)

If the output is **STATUS** = 1, the MS is switched on and the motor is supplied with power.

If **OPENBRAKE** is set to 1, the brake is opened.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE_RIGHT	Enable right	BOOL	**STATUS**	Motor supplied with power	BOOL
ENABLE_LEFT	Enable left	BOOL	**ERROR**	Error in FB	BOOL
DISABLEVOLTAGE	Disconnect voltage	BOOL	**ERRORID**	Error code	INT
QUICKSTOP	Quick stop	BOOL			
OPENBRAKE	Open brake	BOOL			

ERRORID	**Explanation**
0	No error
1001h	Stop function is active
1300h	MS is in an unexpected state

10.3.3.3 MC_Home

	SK 5xxP	**SK 54xE**	**SK 53xE SK 52xE**	**On/On+**	**SK 2xxE**	**SK 2xxE-FDS**	**SK 180E SK 190E**	**SK 155E-FDS SK 175E-FDS**
Availability		X	X		X	X	X	X

Causes the frequency inverter to start a reference point run if **EXECUTE** changes from 0 to 1 (flank). The frequency inverter moves with the setpoint frequency which is set in **VELOCITY**. If the input with the position reference signal (P420[-xx] =) becomes active, a change of direction of rotation occurs. On the negative flank of the position reference signal the value in **POSITION** is adopted. The frequency inverter then decelerates to 0 Hz and the **DONE** signal changes to 1. During the entire **HOME** run the **BUSY** output is active. If the input **MODE** is set to **True**, the drive adopts the average value of both positions during the reference point run (positive flank → negative flank) when the reference point switch is passed over and sets this value as the reference point. The drive reverses and therefore stops at the reference point which has been thus determined. The input **POSITION** cannot be used.

If the process is cancelled (e.g. by another MC function module), **COMMANDABORTED** is set.

In case of error, **ERROR** is set to 1. In this case, **DONE** is 0. The corresponding error code is then valid in **ERRORID**.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Specified setpoint position reached	BOOL
POSITION	Setpoint position	DINT	**COMMAND-ABORTED**	Command cancelled	BOOL
VELOCITY	Setpoint frequency	INT	**ERROR**	Error in FB	BOOL
MODE (V2.1 and higher)	See below	BOOL	**ERRORID**	Error code	INT
			BUSY	Home run active	BOOL

ERRORID	Explanation
0	No error
1000h	FI is not enabled
1200h	Position control is not activated
1201h	The High position is not entered in the PLC setpoint values (P553)
1202h	The Low position is not entered in the PLC setpoint values (P553)
1D00h	Absolute encoders are not supported

10.3.3.4 MC_Home (SK 5xxP)

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X			On+				

Causes the frequency inverter to start a reference point run if **EXECUTE** changes from 0 to 1 (flank). The frequency inverter moves with the setpoint frequency which is set in **VELOCITY**. If the input with the position reference signal (P420[-xx] =) becomes active, a change of direction of rotation occurs. On the negative flank of the position reference signal the value in **POSITION** is adopted. The frequency inverter then decelerates to 0 Hz and the **DONE** signal changes to 1. During the entire **HOME** run the **BUSY** output is active.

If the process is cancelled (e.g. by another MC function module), **COMMANDABORTED** is set.

In case of error, **ERROR** is set to 1. In this case, **DONE** is 0. The corresponding error code is then valid in **ERRORID**.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Specified setpoint position reached	BOOL
POSITION	Setpoint position	DINT	**COMMAND-ABORTED**	Command cancelled	BOOL
VELOCITY	Setpoint frequency	INT	**ERROR**	Error in FB	BOOL
MODE	See below	BYTE	**ERRORID**	Error code	INT
			BUSY	Home run active	BOOL

ERRORID	Explanation
0	No error
1000h	FI is not enabled
1200h	Position control is not activated
1201h	The High position is not entered in the PLC setpoint values (P553)
1202h	The Low position is not entered in the PLC setpoint values (P553)
1D00h	Absolute encoders are not supported
1D01h	Value range from "Mode" input exceeded or undershot (P623)

Mode

Value	Explanation
1..14	For reference point method see P623
15	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. The reference point is therefore typically in the side of the reference point switch on which the reference point run started. **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. (P623 = [15] Nord method 1)
16	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. The reference point is therefore definitely on the side of the reference point switch from which the reference point run was started. (P623 = [16] Nord method 2)
17	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. (P623 = [17] Nord method 3)
18..34	For reference point method see P623

10.3.3.5 MC_MoveAbsolute

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	On+	X	X	X	

Writes a position and speed setpoint to the frequency inverter if **EXECUTE** changes from 0 to 1 (flank). The set point frequency **VELOCITY** is transferred according to the scaling explained in MC_MoveVelocity.

POSITION:

MODE = False:

The setpoint position results from the value transferred into **POSITION**.

MODE = True:

The value transferred into **POSITION** corresponds to the index from parameter P613 increased by 1. The position stored in this parameter index corresponds to the setpoint position.

Example:

Mode = True; Position = 12

The FB moves to the position which is in the current parameter set of P613[-13].

If the inverter has reached the setpoint position, **DONE** is set to 1. **DONE** is deleted by resetting **EXECUTE**. If **EXECUTE** is deleted before the target position is reached, **DONE** is set to 1 for one cycle. During movement to the setpoint position, **BUSY** is active. If the process is cancelled (e.g. by another MC function module), **COMMANDABORTED** is set. In case of error, **ERROR** is set to 1 and the corresponding error code is set in **ERRORID**. In this case, **DONE** is 0. With a negative flank on **EXECUTE**, all outputs are reset to 0.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Specified setpoint position reached	BOOL
POSITION	Setpoint position	DINT	**BUSY**	Setpoint position not reached	BOOL
VELOCITY	Setpoint frequency	INT	**COMMAND-ABORTED**	Command cancelled	BOOL
MODE	Mode Source Setpoint position	BOOL	**ERROR**	Error in FB	BOOL
			ERRORID	Error code	INT

ERRORID	Explanation
0	No error
0x1000	FI is not enabled
0x1200	Position control is not activated
0x1201	The High position is not entered in the PLC setpoint values (P553)
0x1202	The Low position is not entered in the PLC setpoint values (P553)

Example in ST:

```
(* The device is enabled if DIG1 = TRUE *)
Power(Enable := _5_State_digital_input.0);
IF Power.Status THEN
  (* The device is enabled and moves to position 20000 with 50% max. frequency.
     For this action, the motor requires an encoder, and position control must be enabled.
     *)
  MoveAbs(Execute := _5_State_digital_input.1, Velocity := 16#2000, Position := 20000);
END_IF
```

10.3.3.6 MC_MoveAdditive

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	On+	X	X	X	

Except for the **DISTANCE** input, this corresponds in all points with MC_MoveAbsolute. The setpoint position results from the addition of the actual setpoint position and the transferred **DISTANCE**.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Specified setpoint position reached	BOOL
DISTANCE	Setpoint position	DINT	**COMMAND-ABORTED**	Command cancelled	BOOL
VELOCITY	Setpoint frequency	INT	**ERROR**	Error in FB	BOOL

MODE	Mode Source Setpoint position	BOOL	**ERRORID**	Error code	INT
			BUSY	Setpoint position not reached	BOOL

ERRORID	**Explanation**
0	No error
1000h	FI is not enabled
1200h	Position control is not activated
1201h	The High position is not entered in the PLC setpoint values (P553)
1202h	The Low position is not entered in the PLC setpoint values (P553)

10.3.3.7 MC_MoveRelative

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	On+	X	X	X	

Except for the **DISTANCE** input, this corresponds in all points with MC_MoveAbsolute. The setpoint position results from the addition of the actual current position and the transferred **DISTANCE**.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Specified setpoint position reached	BOOL
DISTANCE	Setpoint position	DINT	**COMMAND-ABORTED**	Command cancelled	BOOL
VELOCITY	Setpoint frequency	INT	**ERROR**	Error in FB	BOOL
MODE	Mode Source Setpoint position	BOOL	**ERRORID**	Error code	INT
			BUSY	Setpoint position not reached	BOOL

ERRORID	**Explanation**
0	No error
1000h	FI is not enabled
1200h	Position control is not activated
1201h	The High position is not entered in the PLC setpoint values (P553)
1202h	The Low position is not entered in the PLC setpoint values (P553)

10.3.3.8 MC_MoveVelocity

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	

Sets the set point frequency for the frequency inverter if **EXECUTE** changes from 0 to 1 (flank). If the frequency inverter has reached the set point frequency, **INVELOCITY** is set to 1. While the FI is accelerating to the set point frequency, the **BUSY** output is active. If **EXECUTE** has already been set to 0, **INVELOCITY** is set to 1 for only one cycle. If the process is cancelled (e.g. by another MC function module), **COMMANDABORTED** is set.

With a negative flank on **EXECUTE**, all outputs are reset to 0.

VELOCITY is entered with scaling according to the following formula:

VELOCITY = (Set point frequency (Hz) × 0x4000) / P105

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**INVELOCITY**	Specified set point frequency reached	BOOL
VELOCITY	Setpoint frequency	INT	**BUSY**	Set point frequency not yet reached	BOOL
			COMMAND-ABORTED	Command cancelled	BOOL
			ERROR	Error in FB	BOOL
			ERRORID	Error code	INT

ERRORID	**Explanation**
0	No error
1000h	FI is not enabled
1100h	FI not in speed mode (position control enabled)
1101h	No set point frequency parameterised (P553)

Example IL:

```
CAL Power
CAL Move

LD TRUE
ST Power.Enable

(* Set 20 Hz (Max. 50 Hz) *)
LD DINT#20
MUL 16#4000
DIV 50

DINT_TO_INT
ST Move.Velocity

LD Power.Status
ST Move.Execute
```

Example in ST:

```
(* Device ready for operation if DIG1 set *)
Power(Enable := _5_State_digital_input.0);
IF Power.Status THEN
  (* Device enabled with 50% of max. frequency if DIG2 set *)
  MoveVelocity(Execute := _5_State_digital_input.1, Velocity := 16#2000);
END_IF
```

10.3.3.9 MC_Power

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

The output stage of the device can be switched on and off with this function. If the **ENABLE** input is set to 1, the output stage is enabled. The prerequisite for this is that the device is in “Switch-on inhibit” or “Ready to switch-on” state. If the device is in “Fault” or “Fault response active” state, the fault must first be remedied and acknowledged. Only then, enabling can be carried out via this block. If the device is in “Not ready to switch-on ” state, switch-on is not possible. In all cases, the FB goes into error state and **ENABLE** must be set to 0 to acknowledge the fault.

If the **ENABLE** input is set to 0, the device is switched off. If this happens while the motor is running, it is first decelerated to 0 Hz via the ramp set in P103.

The **STATUS** output is 1 if the output stage of the device is switched on; otherwise it is 0.

ERROR and **ERRORID** are reset if **ENABLE** is switched to 0.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**STATUS**	Motor supplied with power	BOOL
			ERROR	Error in FB	BOOL
			ERRORID	Error code	INT

ERRORID	**Explanation**
0	No error

1001h	Stop function is active
1300h	Device is not in the state “Ready to switch-on” or “Switch-on inhibit”

Example in IL:

```
CAL Power
CAL Move

LD TRUE
ST Power.Enable

(* Set 20 Hz (Max. 50 Hz) *)
LD DINT#20
MUL 16#4000
DIV 50

DINT_TO_INT
ST Move.Velocity

LD Power.Status
ST Move.Execute
```

Example in ST:

```
(* Enable power block *)
Power(Enable := TRUE);
IF Power.Status THEN
  (* The device is ready to switch-on *)
END_IF
```

10.3.3.10 MC_ReadActualPos

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	On+	X	X	X	

Continually delivers the actual current position of the frequency inverter if **ENABLE** is set to 1. As soon as there is a valid current position at the output, **VALID** is set to valid. In case of error, **ERROR** is set to 1 and in this case, **VALID** is 0.

Position scaling: 1 motor revolution = 1000

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**VALID**	Output is valid	BOOL
			ERROR	Error in FB	BOOL
			POSITION	Actual current position of the FI	DINT

Example in ST:

```
ReadActualPos(Enable := TRUE);
IF ReadActualPos.Valid THEN
  Pos := ReadActualPos.Position;
END_IF
```

10.3.3.11 MC_ReadParameter

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Reads out a parameter cyclically from the device as long as **ENABLE** is set to 1. The read parameter is stored in Value and is valid if **DONE** is set to 1. For the duration of the reading process, the **BUSY** output is set to 1. If **ENABLE** remains 1, the parameter is constantly read out cyclically. The parameter number and index can be changed at any time when **ENABLE** is active. However, it is difficult to identify when the new value is read out, as the **DONE** signal remains 1 for the whole time. In this case, it is advisable to set the **ENABLE** signal to 0 for one cycle, as the **DONE** signal is then reset. The parameter index results from the index in the documentation minus 1. For example, P700 Index 3 (“Reason FI blocked”) is queried via parameter index 2. In case of error, **ERROR** is set to 1. In this case, **DONE** is 0 and the **ERRORID** contains the error code. If the **ENABLE** signal is set to 0, all signals and the **ERRORID** are deleted.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**DONE**	Value is valid	BOOL
PARAMETERNUMBER	Parameter number	INT	**ERROR**	Reading process failed	BOOL
PARAMETERINDEX	Parameter index	INT	**BUSY**	The process is not complete	BOOL
			ERRORID	Error code	INT
			VALUE	Read out parameter	DINT

ERRORID	**Explanation**
0	Invalid parameter number
3	Incorrect parameter index
4	No array
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

Example in ST:

```
(* Motion module FB_ReadParameter *)
ReadParam(Enable := TRUE,Parameternumber := 102, ParameterIndex := 0);
IF ReadParam.Done THEN
  Value := ReadParam.Value;
  ReadParam(Enable := FALSE);
END_IF
```

10.3.3.12 MC_ReadStatus

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Reads out the status of the device. The status machine is orientated to the PLCopen specification "Function blocks for motion control". The status is read out as long as **ENABLE** is set to 1.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**VALID**	Output is valid	BOOL
			ERROR	Error in FB	BOOL
			ERRORSTOP	The device has an error	BOOL
			DISABLED	The output stage of the device is switched off	BOOL
			STOPPING	A Stop command is active	BOOL
			DISCRETEMOTION	One of the three positioning FBs is active	BOOL
			CONTINUOUSMOTION	The MC_Velocity is active	BOOL
			HOMING	The MC_Home is active	BOOL
			STANDSTILL	The device has no active Move command. It is at a standstill with 0 rpm and the output stage switched on.	BOOL

Example in ST:

```
ReadStatus(Enable := TRUE);
IF ReadStatus.Valid THEN
  fError := ReadStatus.ErrorStop;
  fDisable := ReadStatus.Disabled;
  fStopping := ReadStatus.Stopping;
  fInMotion := ReadStatus.DiscreteMotion;
  fInVelocity := ReadStatus.ContinuousMotion;
  fInHome := ReadStatus.Homing;
  fStandStill := ReadStatus.StandStill;
end_if
```

10.3.3.13 MC_Reset

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Resets an error in the device (fault acknowledgement), on a rising flank from **EXECUTE**. In case of error, **ERROR** is set to 1 and the cause of the fault is entered in **ERRORID**. With a negative flank on **EXECUTE** all errors are reset.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Start	BOOL	**DONE**	Device error reset	BOOL
			ERROR	Error in FB	BOOL
			ERRORID	Error code	INT
			BUSY	Reset process is still active	BOOL

ERRORID	Explanation
0	No error
1001h	Stop function is active
1700h	An error reset could not be performed, because the cause of the error is still present.

Example in ST:

```
Reset(Execute := TRUE);
IF Reset.Done THEN
 (* The error has been reset *)
 Reset(Execute := FALSE);
ELSIF Reset.Error THEN
 (* Reset could not be executed, as the cause of the error is still present *)
 Reset(Execute := FALSE);
END_IF
```

10.3.3.14 MC_Stop

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

With a rising flank (0 to 1) the device is set to the state **STANDINGSTILL**. All motion functions which are active are cancelled. The device brakes to 0 Hz and switches off the output stage. As long as the Stop command is active **(EXECUTE** = 1), all other Motion FBs are blocked. The **BUSY** output becomes active with the rising flank on **EXECUTE** and remains active until there is a falling flank on **EXECUTE**.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Start	BOOL	**DONE**	Command has been executed	BOOL
			BUSY	Command is active	BOOL

10.3.3.15 MC_WriteParameter_16 / MC_WriteParameter_32

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Writes a 16/32 Bit parameter into the device if **EXECUTE** changes from 0 to 1 (flank). The parameter has been written if **DONE** is set to 1. For the duration of the reading process, the **BUSY** output is set to 1. In case of error, **ERROR** is set to 1 and the **ERRORID** contains the error code. The signals **DONE, ERROR, ERRORID** remain set until **EXECUTE** changes back to 0. If the **EXECUTE** signal changes to 0, the writing process is not cancelled. Only the **DONE** signal remains set for 1 PLC cycle.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Enable	BOOL	**DONE**	Value is valid	BOOL
PARAMETERNUMBER	Parameter number	INT	**BUSY**	The writing process is active	BOOL
PARAMETERINDEX	Parameter index	INT	**ERROR**	Reading process failed	BOOL
VALUE	Value to be written	INT	**ERRORID**	Error code	INT
RAMONLY	Saves the value only in RAM (version V2.1 and higher)	BOOL			

ERRORID	**Explanation**
0	Invalid parameter number
1	Parameter value cannot be changed
2	Lower or upper value limit exceeded
3	Incorrect parameter index
4	No array
5	Invalid data type
6	Only resettable (only 0 may be written)
7	Description element cannot be changed
201	Invalid order element in the last order received
202	Internal response label cannot be depicted

Example in ST:

```
WriteParam16(Execute := TRUE, ParameterNumber := 102, ParameterIndex := 0, Value := 300);
  IF WriteParam16.Done THEN
    WriteParam16(Execute := FALSE);
  END_IF;
```

10.3.4 Standard

10.3.4.1 CTD downward counter

	SK 5xxP	**SK 54xE**	**SK 53xE SK 52xE**	**On/On+**	**SK 2xxE**	**SK 2xxE-FDS**	**SK 180E SK 190E**	**SK 155E-FDS SK 175E-FDS**
Availability	X	X	X	X	X	X	X	X

With a rising flank on **CD** the counter of the function block **CV** is reduced by one, as long as CV is greater than -32768. If **CV** is less than or equal to 0, the output **Q** remains TRUE. Via **LD** the counter **CV** can be set to the value saved in **PV**.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
CD	Counter input	**BOOL**	**Q**	TRUE, if CV <= 0	**BOOL**
LD	Load starting value	**BOOL**	**CV**	Actual counter reading	**INT**
PV	Starting value	**INT**			

Example in IL:

```
LD VarBOOL1
ST CTDInst.CD
LD VarBOOL2
ST CTDInst.LD
LD VarINT1
ST CTDInst.PV
CAL CTDInst
LD CTDInst.Q
ST VarBOOL3
LD CTDInst.CV
ST VarINT2
```

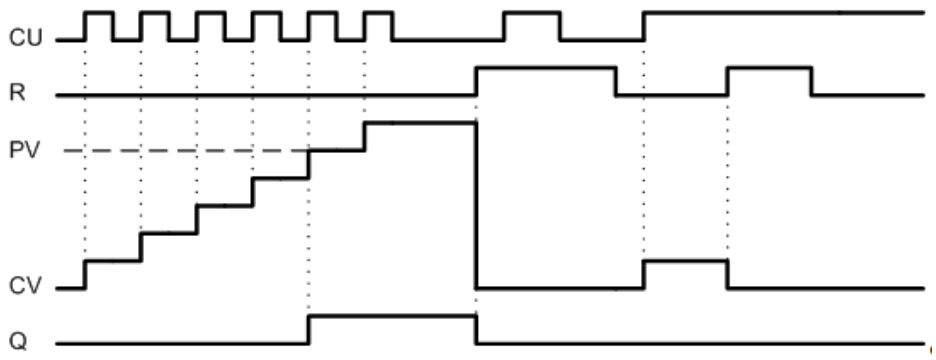
Example in ST:

```
CTDInst(CD := VarBOOL1, LD := VarBOOL2, PV := VarINT1);
VarBOOL3 := CTDInst.Q;
VarINT2 := CTDInst.CV;
```

10.3.4.2 CTU upward counter

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

With a rising flank on **CU**, the counter of the function block **CV** is increased by one. **CV** can be counted up to the value 32767. As long as **CV** is greater than or equal to **PV**, output **Q** remains TRUE. Via **R** the counter **CV** can be reset to zero.



VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
CU	Counter input	**BOOL**	**Q**	TRUE, if CV >= PV	**BOOL**
R	Reset: counter reading	**BOOL**	**CV**	Actual counter reading	**INT**
PV	Limit value	**INT**			

Example in IL:

```
LD VarBOOL1
ST CTUInst.CU
LD VarBOOL2
ST CTUInst.R
LD VarINT1
ST CTUInst.PV
CAL CTUInst(CU := VarBOOL1, R := VarBOOL2, PV := VarINT1)
LD CTUInst.Q
ST VarBOOL3
LD CTUInst.CV
ST VarINT2
```

Example in ST:

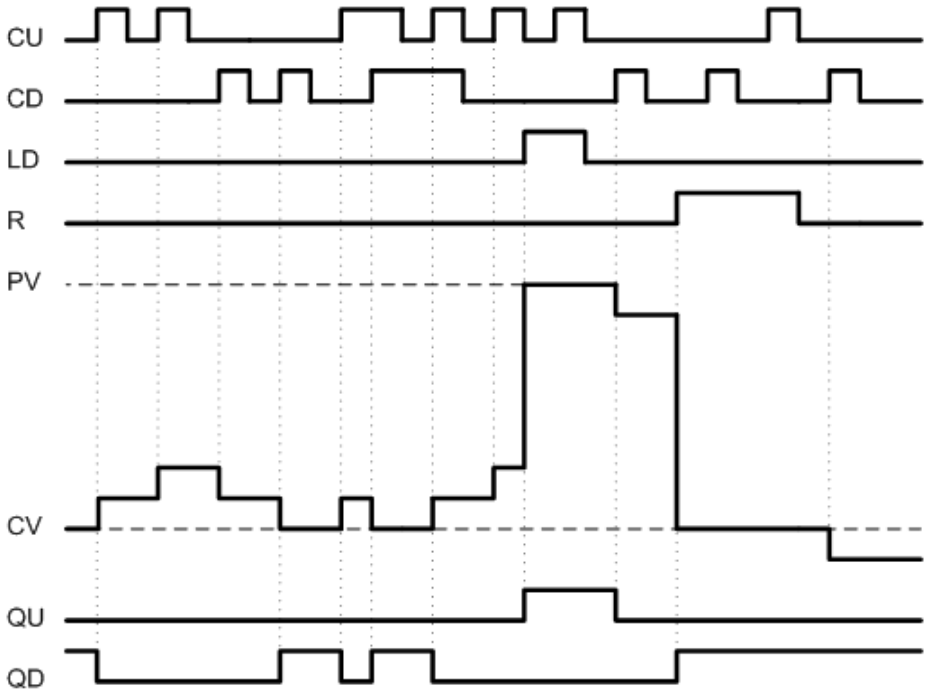
```
CTUInst(CU := VarBOOL1, R := VarBOOL2, PV := VarINT1);
VarBOOL3 := CTUInst.Q;
VarINT2 := CTUInst.CV;
```

10.3.4.3 CTUD upward and downward counter

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

With a rising flank on **CU** the counter CV is increased by one, as long as CV is less than 32767. With a rising flank on **CD** the counter of the function block **CV** is reduced by one, as long as **CV** is greater than -32768. Via **R** the counter **CV** can be set to zero. Via **LD** the value saved in **PV** is copied to **CV**.

R has priority over **LD**, **CU** and **CV**. **PV** can be changed at any time, **QU** always relates to the value which is currently set.



VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
CU	Counting upwards	BOOL	**QU**	TRUE, if CV >= PV	BOOL
CD	Counting downwards	BOOL	**QD**	TRUE, if CV <= 0	BOOL
R	Reset: counter reading	BOOL	**CV**	Actual counter reading	INT
LD	Load starting value	BOOL			
PV	Starting value / Limit value	INT			

Example in IL:

```
LD VarBOOL1
ST CTUDInst.CU
LD VarBOOL3
ST CTUDInst.R
LD VarBool4
ST CTUDInst.LD
LD VarINT1
ST CTUInst.PV
CAL CTUDInst
LD CTUDInst.QU
ST VarBOOL5
LD CTUDInst.QD
ST VarBOOL5
LD CTUInst.CV
ST VarINT2
```

Example in ST:

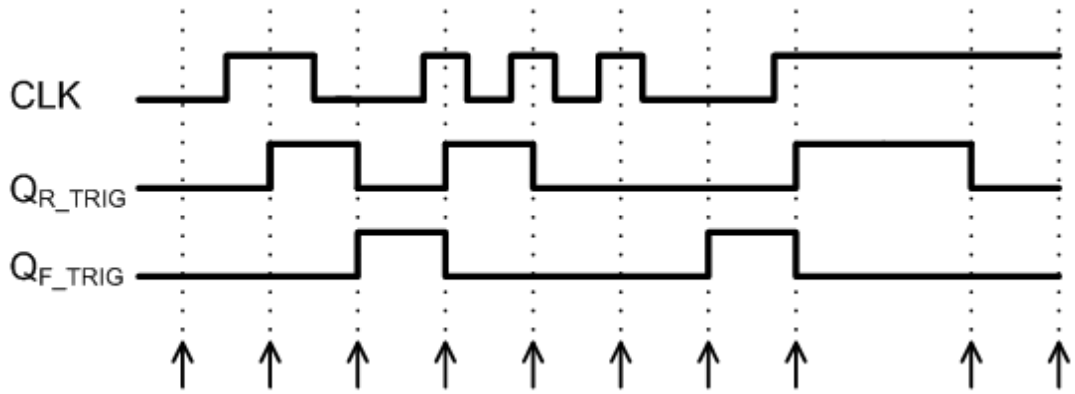
```
CTUDInst(CU:=VarBOOL1, R:=VarBOOL3, LD:=VarBOOL4, PV:=VarINT1);
VarBOOL5 := CTUDInst.QU;
VarBOOL5 := CTUDInst.QD;
VarINT2 := CTUDInst.CV;
```

10.3.4.4 R_TRIG and F_TRIG

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Both functions are used for flank detection. If a flank is detected on **CLK, Q** is set to TRUE until the next function call-up, after which it is reset to FALSE. Only with a new flank can **Q** become TRUE again for a cycle.

- R_TRIG = rising flank
- F_TRIG = falling flank



Function call-ups

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
CLK	set	**BOOL**	**Q**	Output	**BOOL**

Example in IL:

```
LD VarBOOL1
ST RTRIGInst.CLK
CAL RTRIGInst
LD RTRIGInst.Q
ST VarBOOL2
```

Example in ST:

```
RTRIGInst(CLK:= VarBOOL1);
VarBOOL2 := RTRIGInst.Q;
```

Information

The output of the function only changes if the function is called up. Because of this it is advisable to continually call up the flank detection with the PLC cycle.

10.3.4.5 RS Flip Flop

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Bi-stable function: via **S** the output **Q1** is set and via **R1** it is deleted again. If **R1** and **S** are both TRUE, **R1** is dominant.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
S	set	BOOL	**Q1**	Output	BOOL
R1	Reset	BOOL			

Example in IL:

```
LD VarBOOL1
ST RSInst.S
LD VarBOOL2
ST RSInst.R1
CAL RSInst
LD RSInst.Q1
ST VarBOOL3
```

Example in ST:

```
RSInst(S:= VarBOOL1 , R1:=VarBOOL2);
VarBOOL3 := RSInst.Q1;
```

10.3.4.6 SR Flip Flop

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

Bi-stable function; via **S1** the output **Q1** is set and via **R** it is deleted again. If **R1** and **S** are both TRUE, **S1** is dominant.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
S1	set	BOOL	**Q1**	Output	BOOL
R	Reset	BOOL			

Example in IL:

```
LD VarBOOL1
ST SRInst.S1
LD VarBOOL2
ST SRInst.R
CAL RSInst
```

```
LD SRInst.Q1
ST VarBOOL3
```

Example in ST:

```
SRInst(S1:= VarBOOL1 , R:=VarBOOL2);
VarBOOL3 := SRInst.Q1;
```

10.3.4.7 TOF switch-off delay

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

If **IN** = TRUE, then **Q** is set to TRUE. If **IN** changes to FALSE, the timer counts upwards. As long as the timer is running (**ET** < **PT**) **Q** remains set to TRUE. If (**ET** = **PT**) the timer stops, **Q** becomes FALSE. With a new rising flank on **IN**, the timer **ET** is reset to zero.

Here, literals can be used for simplified input, e.g.

- LD TIME#50s20ms = 50.020 seconds
- LD TIME#1d30m = 1 day and 30 minutes

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
IN	Timer active	BOOL	**Q**	TRUE ß (ET<PT)	BOOL
PT	Duration	DINT	**ET**	Current timer reading	DINT

Example in IL:

```
LD VarBOOL1
ST TOFInst.IN
LD DINT#5000
ST TOFInst.PT
CAL TOFInst
LD TOFInst.Q
ST VarBOOL2
```

Example in ST:

```
TOFInst(IN := VarBOOL1, PT:= T#5s);
VarBOOL2 := TOFInst.Q;
```

Information **Timer ET**

The time ET runs independently of a PLC cycle. Starting of the timer with IN and setting of the output Q are only executed with the function call-up "CAL". The function call-up takes place within a PLC cycle. However, with PLC programs which are longer than 5 ms this may result in the occurrence of jitter.

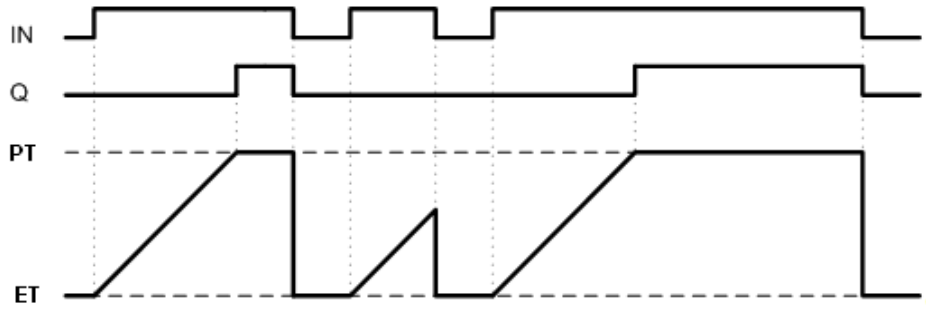
10.3.4.8 TON switch-on delay

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

If **IN** = TRUE is set, the timer counts upwards. If **ET** = PT, **Q** is set to TRUE and the timer stops. **Q** remains TRUE for as long as **IN** is also TRUE. With a new rising flank on **IN** the counter starts again from zero. **PT** can be changed while the timer is running. The time period in **PT** is entered in milliseconds. This enables a time delay between 5ms and 24.8 days. As the time base of the PLC is 5ms, the minimum time delay is also 5ms.

Here, literals can be used for simplified input, e.g.

- LD TIME#50s20ms = 50.020 seconds
- LD TIME#1d30m = 1 day and 30 minutes



VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
IN	Timer active	BOOL	**Q**	TRUE ß (IN=TRUE & ET=PT)	BOOL
PT	Duration	DINT	**ET**	Current timer reading	DINT

Example in IL:

```
LD VarBOOL1
ST TONInst.IN
LD DINT#5000
ST TONInst.PT
CAL TONInst
LD TONInst.Q
ST VarBOOL2
```

Example in ST:

```
TONInst(IN := VarBOOL1, PT:= T#5s);
VarBOOL2 := TONInst.Q;
```

Information **Timer ET**

The time ET runs independently of a PLC cycle. Starting of the timer with IN and setting of the output Q are only executed with the function call-up "CAL". The function call-up takes place within a PLC cycle. However, with PLC programs which are longer than 5 ms this may result in the occurrence of jitter.

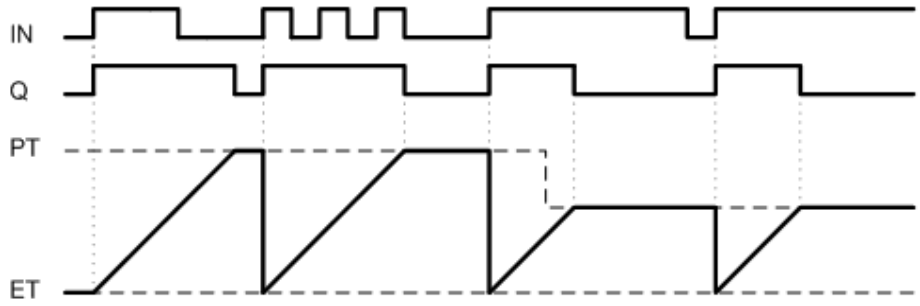
10.3.4.9 TP time pulse

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

With a positive flank on **IN** the timer is started with the value 0. The timer runs up to the value which is entered **PT** and then stops. This process cannot be interrupted! PT can be changed during counting. The output **Q** is TRUE, as long as the timer **ET** is less than **PT**. If **ET = PT** and a rising flank is detected on **IN**, the timer is started again at 0.

Here, literals can be used for simplified input, e.g.

- LD TIME#50s20ms = 50.020 seconds
- LD TIME#1d30m = 1 day and 30 minutes



VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
IN	Timer active	BOOL	**Q**	TRUE ß (ET<PT)	BOOL
PT	Duration	DINT	**ET**	Current timer reading	DINT

Example in IL:

```
LD VarBOOL1
ST TPInst.IN
LD DINT#5000
ST TPInst.PT
CAL TPInst
LD TPInst.Q
ST VarBOOL2
```

Example in ST:

```
TPInst(IN := VarBOOL1, PT:= T#5s);
VarBOOL2 := TPInst.Q;
```

Information **Timer ET**

The time ET runs independently of a PLC cycle. Starting of the timer with IN and setting of the output Q are only executed with the function call-up "CAL". The function call-up takes place within a PLC cycle. However, with PLC programs which are longer than 5 ms this may result in the occurrence of jitter.

10.3.5 Access to memory areas of the frequency inverter

If the intermediate saving of large quantities of data, its transmission to or reception from other devices is necessary, the modules FB_WriteTrace and FB_ReadTrace should be used.

10.3.5.1 FB_ReadTrace

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

The memory areas of the FI can be read out directly with the aid of this FB.

If the FB detects a positive flank on **ENABLE**, all parameters which are present on the input are adopted. The memory address which is to be read out is indicated with **STARTINDEX** and **MEMORY**. If the reading process is successful, the **VALID** output changes to 1 and the value which has been read out is in **VALUE**.

If the FB is now called up several times and the **ENABLE** input remains at 1, with each call up the memory address which is to be read out is increased by 1 and the content of the new memory address is immediately copied to the output **VALUE**.

The current memory index for the next access can be read out under the output **ACTINDEX**. If the end of the memory has been reached, the **READY** changes to 1 and the reading process is stopped.

Values can be read in INT or DINT format. For INT values, only the Low component is evaluated by the **VALUE** output. Allocation is carried out via the **SIZE** input; a 0 stands for INT and a 1 for DINT values.

Allocation of the memory areas is carried out via the MEMORY input:

MEMORY = 1 to P613[0-251] corresponds to 504 INT or 252 DINT values

MEMORY = 0 to P900[0-247] up to P906[0-111] corresponds to 3200 INT or 1600 DINT values

The FB cannot be interrupted by other blocks

With a negative flank on ENABLE, all outputs are set to 0 and the function of the FB is terminated.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Execute	BOOL	**VALID**	Reading process successful	BOOL
SIZE	Memory format	BOOL	**READY**	The entire memory has been read out	BOOL
MEMORY	Selection of memory area	BYTE	**ERROR**	the FB has an error	BOOL
STARTINDEX	Indicates the memory cell to be written to	INT	**ERRORID**	Error code	INT
			ACTINDEX	Actual memory index, to which will be read in the next cycle	INT
			VALUE	Value read out	DINT

ERRORID	Explanation
0	No error
1A00h	STARTINDEX value range exceeded
1A01h	MEMORY value range exceeded

10.3.5.2 FB_WriteTrace

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

Via this FB, individual values or large numbers of values can be intermediately saved in the FI. The values are not permanently saved, i.e. the values are lost if the FI is restarted.

If the FB detects a positive flank on **ENABLE**, all parameters with are present on the input are adopted. The value in VALUE is written to the storage address indicated in **STARTINDEX** and **MEMORY**. If the writing process is successful, the VALID output changes to 1.

If the FB is now called up several times and the **ENABLE** input remains at 1, then with each call up of the FB the input **VALUE** is read and saved and the memory address is increased by 1. The current memory index for the next access can be read out under the output **ACTINDEX**. If the end of the memory is reached, the output FULL changes to 1 and the saving process is stopped. However, if the input **OVERWRITE** is set to 1, the memory index is reset to the **STARTINDEX** and the values which have been previously written are overwritten.

Values can be saved in INT or DINT format. For INT values, only the Low component is evaluated by the **VALUE** input. Allocation is carried out via the **SIZE** input; a 0 stands for INT and a 1 for DINT values.

Allocation of the memory areas is carried out via the MEMORY input:

MEMORY = 1 to P613[0-251] corresponds to 504 INT or 252 DINT values

MEMORY = 0 to P900[0-247] up to P906[0-111] corresponds to 3200 INT or 1600 DINT values

The FB cannot be interrupted by other blocks

With a negative flank on **ENABLE**, all outputs are set to 0 and the function of the FB is terminated.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Execute	BOOL	**VALID**	Writing process successful	BOOL
SIZE	Memory format	BOOL	**FULL**	Entire memory is full	BOOL
OVERWRITE	Memory can be overwritten	BOOL	**ERROR**	the FB has an error	BOOL
MEMORY	Selection of memory area	BYTE	**ERRORID**	Error code	INT
STARTINDEX	Indicates the memory cell to be written to	INT	**ACTINDEX**	Actual memory index, to which saving will be carried out in the next cycle	DINT
VALUE	Value to be saved	DINT			

ERRORID	**Explanation**
0	No error
1A00h	STARTINDEX value range exceeded
1A01h	MEMORY value range exceeded

Information

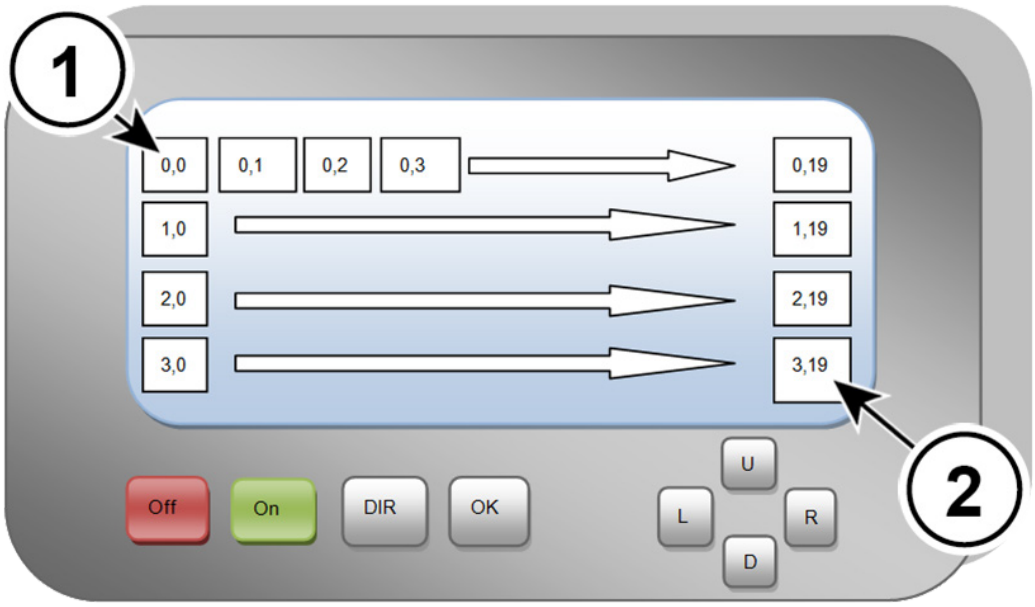
Please note: The memory area in the setting MEMORY = 0 is also used by the Scope function. Use of the Scope function overwrites the saved values!

10.3.6 Visualisation with ParameterBox

In the ParameterBox, the entire display can be used for the display of information. For this, the ParameterBox must be switched to visualisation mode. This is possible with the ParameterBox (Parameter P1308) firmware version V4.3 or higher, and is carried out as follows:

- In the menu item "Display", set the parameter P1003 to "PLC Display"
- Switch to the operating value display with the left or right arrow key
- PLC display is now enabled in the ParameterBox and remains permanently enabled.

In the visualisation mode of the ParameterBox, the content of the display can be set with the two FBs described below. However, before the item "Allow ParameterBox function modules" must be activated in the PLC configuration dialogue (Button ). With the process value "Parameterbox_key_state", the keyboard status of the box can also be queried. With this, input into the PLC program can be implemented. The display structure and the keys to be read out for the ParameterBox can be seen in the figure below.



1	First character	(0,0 → row = 0 , column = 0)
2	Last character	(3,19 → row = 3 , column = 19)

10.3.6.1 Overview visualisation

Function module	Description
FB_STRINGToPBox	Copies a string into the P-Box
FB_DINTToPBox	Copies a DINT value to the P-Box

10.3.6.2 FB_DINTToPBOX

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

This function module converts a DINT value into an ASCII string and copies this into the ParameterBox. The output can be in decimal, binary or hexadecimal format; the selection is performed via **MODE**. Via **ROW** and **COLUMN** the starting point of the string is set in the ParameterBox display. The parameter **LENGTH** transfers the length of the string in characters. In decimal **MODE** the parameter **POINT** positions a decimal point in the number which is to be displayed. In **POINT** it is stated how many characters are to the right of the decimal point. With the setting 0 the **POINT** function is disabled. If the number contains more characters than the length allows and no decimal point is set, the overflow is indicated by the character "#". If there is a decimal point in the number, all numbers behind the decimal point may be omitted if required. In hexadecimal and binary MODE the lowest value bits are displayed if the set length is too short. As long as **ENABLE** is set to 1, all changes to the inputs are adopted immediately. If **VALID** changes to 1, the string has been correctly transferred. In case of error, **ERROR** is set to 1. In this case, **VALID** is 0. The corresponding error code is then valid in **ERRORID**. With a negative flank on **ENABLE**, **VALID**, **ERROR** and **ERRORID** are reset.

Examples:

Setting	Number to be displayed	P-Box display
Length = 5 Point = 0	12345	12345
Length = 5 Point = 0	-12345	#####
Length = 10 Point = 3	123456789	123456.789
Length = 8 Point = 3	123456789	123456.7

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Transfer of the string	BOOL	**VALID**	String transferred	BOOL
MODE	Display format 0 = Decimal 1 = Binary 2 = Hexadecimal Value range = 0 to 2	BYTE	**ERROR**	Error in FB	BOOL
ROW	Line of the display Value range = 0 to 3	BYTE	**ERRORID**	Error code	INT
COLUMN	Column of the display Value range = 0 to 19	BYTE			
POINT	Position of decimal point Value range = 0 to 10 0 = Function is disabled	BYTE			
LENGTH	Output length Value range = 1 to 11	BYTE			
VALUE	Number to be output	DINT			

ERRORID	Explanation
0	No error
1500h	String overwrites the memory area of the P-Box array
1501h	Value range exceeded at LINE input
1502h	Value range exceeded at ROW input
1504h	Value range exceeded at POINT input
1505h	Value range exceeded at LENGTH input
1506h	Value range exceeded at MODE input

Example in ST:

```
(* Initialisation *)
if FirstTime then
  StringToPBox.ROW := 1;
  StringToPBox.Column := 16;
  FirstTime := False;
end_if;

(* Query actual position *)
ActPos(Enable := TRUE);
if ActPos.Valid then
  (* Display position in the PBox displays (PBox P1003 = PLC display ) *)
  DintToPBox.Value := ActPos.Position;
  DintToPBox.Column := 9;
  DintToPBox.LENGTH := 10;
  DintToPBox(Enable := True);
end_if;

(* Switch device on or off via DIG1 *)
Power(Enable := _5_State_digital_input.0);
if OldState <> Power.Status then
  OldState := Power.Status;
  (* Is device switched on? *)
  if Power.Status then
    StringToPBox(Enable := False, Text := TextOn);
  else
    StringToPBox(Enable := False, Text := TextOff);
  end_if;

  StringToPBox(Enable := TRUE);
else
  StringToPBox;
end_if;
```

10.3.6.3 FB_STRINGToPBOX

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

This function module copies a string (chain of characters) into the memory array of the ParameterBox. Via **ROW** and **COLUMN** the starting point of the string is set in the ParameterBox display. The parameter **TEXT** transfers the required string to the function module; the name of the string can be obtained from the table of variables. As long as **ENABLE** is set to 1, all changes to the inputs are adopted immediately. If the **CLEAR** input is set, the entire display content is overwritten with space characters before the selected string is written. If **VALID** changes to 1, the string has been correctly transferred. In case of error, **ERROR** is set to 1. In this case, **VALID** is 0. The corresponding error code is then valid in **ERRORID**. With a negative flank on **ENABLE**, **VALID**, **ERROR** and **ERRORID** are reset.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Transfer of the string	BOOL	**VALID**	String transferred	BOOL
CLEAR	Clear display	BOOL	**ERROR**	Error in FB	BOOL
ROW	Line of the display Value range = 0 to 3	BYTE	**ERRORID**	Error code	INT
COLUMN	Column of the display Value range = 0 to 19	BYTE			
TEXT	Text to be displayed	STRING			

ERRORID	Explanation
0	No error
1500h	String overwrites the memory area of the P-Box array
1501h	Value range exceeded at ROW input
1502h	Value range exceeded at COLUMN input
1503h	The selected string number does not exist
1506h	The option "Allow ParameterBox function modules" is not activated in the PLC configuration.

Example in ST:

```
(* Initialisation *)
if FirstTime then
  StringToPBox.ROW := 1;
  StringToPBox.Column := 16;
  FirstTime := False;
end_if;

(* Query actual position *)
ActPos(Enable := TRUE);
if ActPos.Valid then
  (* Display position in the PBox displays (PBox P1003 = PLC display ) *)
  DintToPBox.Value := ActPos.Position;
  DintToPBox.Column := 9;
  DintToPBox.LENGTH := 10;
  DintToPBox(Enable := True);
end_if;

(* Switch device on or off via DIG1 *)
Power(Enable := _5_State_digital_input.0);
if OldState <> Power.Status then
  OldState := Power.Status;
  (* Is device switched on? *)
  if Power.Status then
    StringToPBox(Enable := False, Text := TextOn);
  else
    StringToPBox(Enable := False, Text := TextOff);
  end_if;

  StringToPBox(Enable := TRUE);
else
  StringToPBox;
end_if;
```

10.3.7 FB_Capture (Detection of rapid events)

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

The cycle time of the PLC is 5ms. This cycle may be too long to detect very rapid external events. Via FB Capture it is possible to capture certain physical values on flanks at the FI inputs. Monitoring of the inputs is carried out in a 1ms cycle. The values which are saved can be read by the PLC later.

With a positive flank on **EXECUTE** all inputs are read in and the Capture function is enabled. The FI input which is to be monitored is selected via the **INPUT** input. Via **EDGE**, the type of flank and the behaviour of the module are selected.

EDGE = 0 With the first positive flank, the selected value is saved under **OUTPUT1** and **DONE1** is set to 1. The next positive flank saves under **OUTPUT2** and **DONE2** is set to 1. The FB is then disabled.

EDGE = 1 Behaviour as for **EDGE** = 0, with the difference that triggering is with the negative flank.

EDGE = 2 With the first positive flank, the selected value is saved under **OUTPUT1** and **DONE1** is set to 1. The next negative flank saves under **OUTPUT2** and **DONE2** is set to 1. The FB is then disabled.

EDGE = 3 Behaviour as for **EDGE** = 2, with the difference that triggering is first with the negative and then with the positive flank.

If the input **CONTINUOUS** is set to 1, then only the settings 0 and 1 are relevant to **EDGE**. The FB continues to run and always saves the last triggering event under **OUTPUT1**. **DONE1** remains active from the first event. **DONE2** and **OUTPUT2** are not used.

The **BUSY** output remains active until both Capture events (**DONE1** and **DONE2**) have occurred.

The function of the module can be terminated at any time with a negative flank on **EXECUTE**. All outputs retain their values. With a positive flank on **EXECUTE** first, all outputs are deleted and then the function of the module is started.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	BOOL	**DONE1**	Value in OUTPUT1 valid	BOOL
CONTINUOUS	Single execution or continuous operation	BOOL	**DONE2**	Value in OUT valid	BOOL
INPUT	**SK54xE** Input to be monitored 0 = Input 1 - - - - 7 = Input 8 **SK52xE, SK53xE, SK2xxE, SK2xx-EFDS** Input to be monitored 0 = Input 1 - - - - 3 = Input 4	BYTE	**BUSY**	FB still waiting for a Capture event	BOOL
EDGE	Triggering flank	BYTE	**ERROR**	the FB has an error	BOOL
SOURCE	Value to be saved 0 = Position in rotations 1 = Actual frequency 2 = Torque	BYTE	**ERRORID**	Error code	INT
			OUTPUT1	Value for 1st Capture event	DINT
			OUTPUT2	Value for 2nd Capture event	DINT

ERRORID	Explanation
0	No error
1900h	INPUT value range exceeded
1901h	EDGE value range exceeded
1902h	SOURCE value range exceeded
1903h	More than two instances are active

Example in ST:

```
Power(ENABLE := TRUE);
IF Power.STATUS THEN
    Move(EXECUTE := TRUE, POSITION := Pos, VELOCITY := 16#2000);
    (* The FB waits for a High signal on DIG1. When this is detected, the FB saves the actual
    position. The value can be queried with the property "OUTPUT1". *)
    Capture(EXECUTE := TRUE, INPUT := 0);

    IF Capture.DONE1 THEN
      Pos := Capture.OUTPUT1;
      Move(EXECUTE := FALSE);
    END_IF;
END_IF;
```

Information

Several instances of this FB may exist in the PLC program. However, only two instances may be active at the same time!

10.3.8 FB_DinCounter

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	V1.1 and above	

This FB is used to count pulses via the digital inputs. All flanks (Low - High and High - Low) are counted. The minimum pulse width is 1 ms.

The FB is enabled via ENABLE. With the positive flanks, the inputs PV, UD, DIN and MODE are adopted and all outputs are deleted.

UD defines the counting direction

- 0 = larger numbers
- 1 = smaller numbers

A counter value can be entered at PV. Depending on the setting of the **MODE** input this has different effects.

MODE

- 0 = Overflow, the counter is operated as a continuous counter. It can overflow in both positive and negative directions. When the function is started, CV = PV is set. In this Mode BUSY remains always 1 and Q always 0.
- 1 = without overflow
  - Counting forwards to CV starts at 0, BUSY = 1, and runs until CV=>PV. Then BUSY changes to 0 and Q to 1. The counting process stops.
  - Counting backwards to CV starts at PV and runs until CV<= 0. During this time is BUSY = 1 and changes to 0 when the end of the count is reached. In return, Q changes to 1.
  - The restart of the counter is reached at the ENABLE input via a new flank.

DIN defines the measuring input. The number of inputs depends on the respective FI (max. 4).

- Input 1 = 0
- Input 2 = 1
- Input 3 = 2
- Input 4 = 3

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Enable	BOOL	**Q**	Counting completed	BOOL
UD	Counting direction 0 = larger numbers 1 = smaller numbers	BOOL	**BUSY**	Counter runs	BOOL
PV	Counter value	INT	**ERROR**	the FB has an error	BOOL
MODE	Mode	BYTE	**ERRORID**	Error code	INT
DIN	Measuring input	BYTE	**CV**	Counter value	INT
			CF	Counting frequency (resolution of 0.1) [1)]	INT

ERRORID	Explanation
0	No error
0x1E00	Digital input is already used by other counter
0x1E01	Digital input does not exist
0x1E02	MODE value range exceeded

1) Measuring range 0,1 Hz to 1 kHz

10.3.9 FB_FunctionCurve

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	

This function module produces a mapping control. Defined points can be communicated to the function block, with which it emulates a function. The output then behaves according to the saved map. Linear interpolation is carried out between the individual base points. The base point are defined with X and Y values. The X values are always of the **INT** type, the Y values can either be of the **INT** or the **DINT** type, depending on the size of the largest base point. More memory is required if **DINT** is used. The base points are entered in the column "Init Value" in the variables window. If TRUE is detected at the **ENABLE** input, on the basis of the input value **INVALUE** the corresponding output value **OUTVALUE** is calculated. **VALID** = TRUE indicates that the output value **OUTVALUE** is valid. As long as **VALID** is FALSE, the output **OUTVALUE** has the value 0. If the input value **INVALUE** exceeds the upper or the lower end of the characteristic range, the first or the last output value of the characteristic range remain until the **INVALUE** returns to within the area of the characteristic range. If the characteristic range is exceeded or undershot, the appropriate output **MINLIMIT** or **MAXLIMIT** is set to TRUE. **ERROR** becomes TRUE, if the abscissa values (X values) of the characteristic range do not continuously increase or if no table is initialised. The appropriate error is output by **ERRORID** and the starting value is 0. The error is reset if **ENABLE** = FALSE.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Execute	BOOL	**VALID**	Output value is valid	BOOL
INVALUE	Input value (x)	INT	**ERROR**	Error in FB	BOOL
			ERRORID	Error code	INT
			MAXLIMIT	Maximum limit reached	BOOL
			MINLIMIT	Minimum limit reached	BOOL
			OUTVALUE	Output value (y)	DINT

ERRORID	Explanation
0	No error
1400h	Abscissa values (X values) of the characteristic range do not always increase
1401h	No map initialised

10.3.10 FB_PIDT1

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

The P-I-DT1 is a freely parameterisable individual controller. If individual components or the P, I or DT1 component are not required, their parameters are written as 0. The T1 component only functions together with the D component. Therefore a PT1 controller cannot be parameterised. Due to internal memory limitations, the control parameters are restricted to the following areas:

Permissible value range for control parameters			
Parameters	**Value range**	**Scaling**	**Resulting value range**
P (Kp)	0 – 32767	1/100	0.00 – 327.67
I (Ki)	0 – 10240	1/100	0.00 – 102.40
D (Kd)	0 – 32767	1/1000	0.000 – 32.767
T1 (ms)	0 – 32767	1/1000	0.000 – 32.767
Max.	-32768 – 32767		
Min.	-32768 – 32767		

The controller starts to calculate when **ENABLE** is set to TRUE. The control parameters are only adopted with a rising flank from**ENABLE**. While **ENABLE** is TRUE, changes to the control parameters have no effect. If **ENABLE** is set to FALSE, the output remains at its last value.

The output bit **VALID** is set, as long as the output value of Q is within the Min and Max limits and the **ENABLE** input is TRUE.

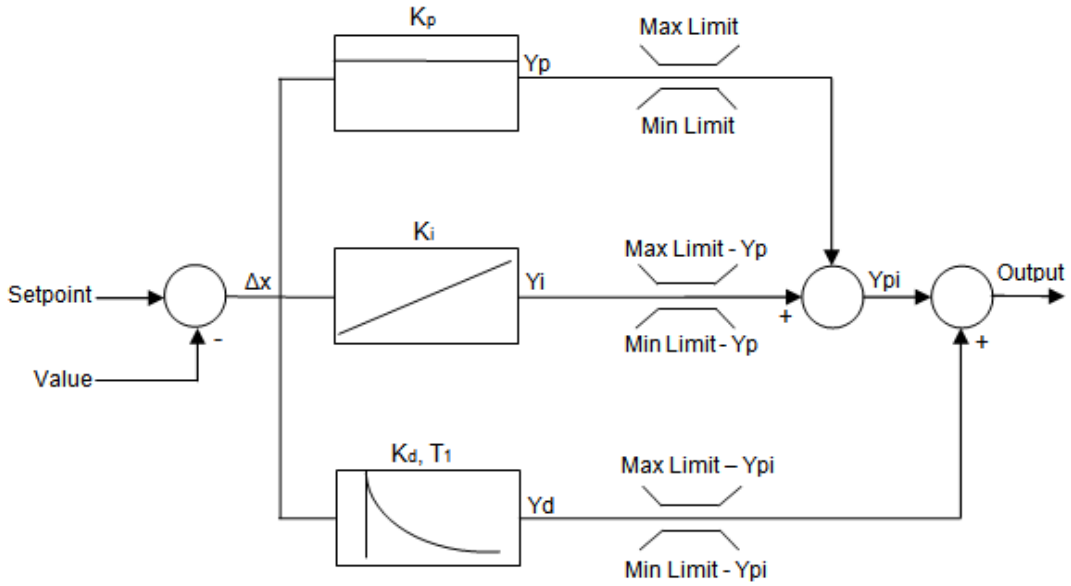
ERROR is set as soon as an error occurs. The **VALID** bit is then FALSE and the cause of the fault can be identified from the **ERRORID** (see table below).

If the **RESET** bit is set to TRUE, the content of the integrator and the differentiator are set to 0. If the **ENABLE** input is FALSE, the **OUTPUT** output is also set to 0. If the **ENABLE** input is set to TRUE, only the P component has an effect on the **OUTPUT** output.

If the output value **OUTPUT** is outside of the range of the maximum or minimum output values, the corresponding bit **MAXLIMIT** or **MINLIMIT** is set and the **VALID** bit is set to FALSE.

Information

If the entire program cannot be executed within a PLC cycle, the controller calculates the output value a second time with the old scanning values. This ensures a constant scanning rate. Because of this it is essential that the CAL command for the PIDT1 controller is executed in each PLC cycle and only at the end of the PLC program.



VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
ENABLE	Execute	BOOL	**VALID**	Output value is valid	BOOL
RESET	Reset outputs	BOOL	**ERROR**	Error in FB	BOOL
P	P component (Kp)	INT	**ERRORID**	Error code	INT
I	I component (Ki)	INT	**MAXLIMIT**	Maximum limit reached	BOOL
D	D component (Kd)	INT	**MINLIMIT**	Minimum limit reached	BOOL
T1	T1 component in ms	INT	**OUTPUT**	Output value	INT
MAX	Maximum output value	INT			
MIN	Minimum output value	INT			
SETPOINT	Setpoint	INT			
VALUE	Actual value	INT			

ERRORID	Explanation
0	No error
1600h	P component not within value range
1601h	I component not within value range
1602h	D component not within value range
1603h	T1 component not within value range

10.3.11 FB_ResetPostion

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	V2.3 and above	V3.1 and above	On+	V2.1 and above	X	V1.2 and above	

With a flank on the **EXECUTE** input, the current position (P601) is set to the value entered in Position. If a position offset is entered in parameter P609, this offset is subtracted from the position.

With absolute encoders the current position can only be reset to 0. The value is not used in the position.

VAR_INPUT			VAR_OUTPUT		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	BOOL			
Position	Position	DINT			

10.3.12 FB_Weigh

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	V2.3 and above	V3.1 and above	X	V2.1 and above	X	V1.2 and above	

This module is used to determine the average torque during movement at a constant speed. From this value, physical values, such as the weight which is being moved can be determined.

The FB is started via a positive flank on the **EXECUTE** input. With the flank, all inputs are adopted by the FB. The FI moves with the speed which is set in **SPEED**. The measurement is started after the elapse of the time which is set in **STARTTIME**. The duration of the measurement is defined under **MEASURETIME**. The FI stops after the elapse of the measurement time. If the input **REVERSE** = 1, the measurement process starts again, but with a negative speed. Otherwise the measurement is complete, the output **DONE** changes to 1 and the measurement result is in VALUE.

As long as the measurement process is running, **BUSY** is active.

The scaling of the measurement result **VALUE** is 1 = 0.01% of the rated torque of the motor.

Call-up of another Motion FB stops the measurement function and the output **ABORT** changes to 1.

All outputs of the FB are reset with a new positive flank on **EXECUTE**.

VAR_INPUT			**VAR_OUTPUT**		
Input	**Explanation**	**Type**	**Output**	**Explanation**	**Type**
EXECUTE	Execute	BOOL	**DONE**	Measurement ended	BOOL
REVERSE	Change of rotation direction	BOOL	**BUSY**	Measurement running	BOOL
STARTTIME	Time to start of measurement in ms	INT	**ABORT**	Measurement aborted	BOOL
MEASURETIME	Measurement time in ms	INT	**ERROR**	the FB has an error	BOOL
SPEED	Measuring speed in % (standardised to the maximum frequency, 16#4000 corresponds to 100%)	INT	**ERRORID**	Error code	INT
			VALUE	Measurement result	INT

ERRORID	**Explanation**
0	No error
0x1000	FI not switched on
0x1101	Setpoint frequency not parameterised as a setpoint (P553)
0x1C00	STARTTIME value range exceeded
0x1C01	MEASURETIME value range exceeded
0x1C02	The tolerance of the measurement values with respect to each other is greater than 1/8

Example in ST:

```
(* Enable device *)
Power(Enable := TRUE);
(* Is the device enabled? *)
if Power.Status then
  (* Specify starting time 2000ms *)
  Weigh.STARTTIME := 2000;
  (* Specify measuring time 1000ms *)
  Weigh.MEASURETIME := 1000;
  (* Specify speed 25% of maximum speed *)
  Weigh.SPEED := 16#1000;
end_if;

Weigh(EXECUTE := Power.Status);
(* Was weighing completed? *)
if Weigh.done then
  Value := Weigh.Value;
end_if;
```

Information

Only one instance of this FB is permissible in the PLC program!

10.4 Operators

10.4.1 Arithmetical operators

Information

Some of the following operators may also contain further commands. These must be placed in brackets behind the operator. It must be noted that a space must be included behind the opened bracket. The closing bracket must be placed on a separate line of the program.

```
LD Var1
ADD( Var2
SUB Var3
)
```

10.4.1.1 ABS

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type			X	X

Forms the absolute value from the accumulator

Example in IL:

```
LD -10 (* Loads the value -10 *)
ABS (* Accumulator = 10 *)
ST Value1 (* Saves the value 10 in Value1 ab *)
```

Example in ST:

```
Value1 := ABS(-10); (* The result is 10 *)
```

10.4.1.2 ADD and ADD(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Adds variables and constants together with the correct prefixes. The first value for addition is in the AE/accumulator, the second is loaded with the ADD command or is inside the bracket. Several variables or constants can be added to the ADD command. For bracket addition, the accumulator is added to the result of the expression in brackets. Up to 6 bracket levels are possible. The values to be added must belong to the same type of variable.

Example in IL:

```
LD 10
ADD 204 (* Addition of two constants *)
ST Value
LD 170 (* Addition of a constant and 2 variables. *)
ADD Var1, Var2 (* 170dez + Var1 + Var2 *)
ST Value
LD Var1
ADD( Var2
SUB Var3 (* Var1 + ( Var2 - Var3 ) *)
)
ST Value
```

Example in ST:

```
Ergebnis := 10 + 30; (* The result is 40 *)
Ergebnis := 10 + Var1 + Var2;
```

10.4.1.3 DIV and DIV(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Divides the accumulator by the operands For divisions by zero, the maximum possible result is entered into the accumulator, e.g. for a division with INT values, this is the value 0x7FFF or the value 0x8000 if the divisor is negative. For bracket division, the accumulator is divided by the result of the expression in brackets. Up to 6 bracket levels are possible. The values to be divided must belong to the same type of variable.

Example in IL:

```
LD 10
DIV 3 (* Division of two constants *)
ST iValue (* The result is 9 *)
LD 170 (* Division of a constant and 2 variables. *)
DIV Var1, Var2 (* (170dez : Var1) : Var2 *)
ST Value
LD Var1 (* Divide Var1 by the content of the brackets *)
DIV( Var2
```

```
SUB Var3
) (* Var1 : ( Var2 - Var3 ) *)
ST Value
```

Example in ST:

```
Ergebnis := 30 / 10; (* The result is 3 *)
Ergebnis := 30 / Var1 / Var2;
```

10.4.1.4 LIMIT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

The command limits the value in the accumulator to the transferred minimum and maximum values. Values If this is exceeded, the maximum value is entered in the accumulator and if it is undershot, the minimum value is entered. If the value lies between the limits, there is no effect.

Example in IL:

```
LD 10 (* Loads the value 10 into the accumulator *)
LIMIT 20, 30 (* The value is compared with the limits 20 and 30. *)
(* The value in the accumulator is smaller, the accumulator is overwritten with 20 *)
ST iValue (* Saves the value 20 in Value1 *)
```

Example in ST:

```
Ergebnis := Limit(10, 20, 30); (* The result is 20 *)
```

10.4.1.5 MAX

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

This value determines the maximum value of two variables or constants For this, the current value of the accumulator is compared with the value transferred in the MAX command. After the command, the larger of the two values is in the accumulator. Both values must belong to the same type of variable.

Example in IL:

```
LD 100 (* Load 100 into the accumulator *)
MAX 200 (* Compare with the value 200 *)
ST iValue (* Save 200 in Value2 (because larger value) *)
```

Example in ST:

```
Ergebnis := Max(100, 200); (* The result is 200 *)
```

10.4.1.6 MIN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

This command determines the minimum value of two variables or constants. For this, the current value of the accumulator is compared with the value transferred in the MIN command. After the command, the smaller of the two values is in the accumulator. Both values must belong to the same type of variable.

Example in IL:

```
LD 100 (* Load 100 into the accumulator *)
MIN 200 (* Compare with the value 200 *)
ST Value2 (* Save 100 in Value2 (because smaller value) *)
```

Example in ST:

```
Ergebnis := Min(100, 200); (* Save 100 in Value2 (because smaller value) *)
```

10.4.1.7 MOD and MOD(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

The Accumulator is divided by one or more variables or constant and the remainder of the division is the result in the accumulator. For the bracket Modulus, the accumulator is divided by the result of the expression in the brackets and the modulus is formed from this. Up to 6 bracket levels are possible.

Example in IL:

```
LD 25 (* Load the dividend *)
MOD 20 (* Division 25/20 per modulus = 5 *)
ST Var1 (* Save result 5 in Var1 *)
LD 25 (* Load the dividend *)
MOD( Var1 (* Result = 25/(Var1 + 10) per modulus into the accumulator *)
ADD 10
)
ST Var3 (* Save result 10 in Var3 *)
```

Example in ST:

```
Ergebnis := 25 MOD 20; (* Save result 5 in Var1 *)
Ergebnis := 25 MOD (Var1 + 10); (* Result = 25/(Var1 + 10) per modulus into the accumulator *)
```

10.4.1.8 MUL and MUL(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Multiplication of the accumulator with one or more variables or constants. For bracket multiplication, the accumulator is multiplied by the result of the expression in brackets. Up to 6 bracket levels are possible. Both values must belong to the same type of variable.

Example in IL:

```
LD 25 (* Load the multiplier *)
MUL Var1, Var2 (* 25 * Var1 * Var2 *)
ST Var2 (* Save result *)
LD 25 (* Load the multiplier *)
MUL( Var1 (* Result = 25*(Var1 + Var2) *)
ADD Var2
ST Var3 (* Save result as variable Var3 *)
)
```

Example in ST:

```
Ergebnis := 25 * Var1 * Var2;
Ergebnis := 25 * (Var1 + Var2);
```

10.4.1.9 MUX

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Various constants or variables can be selected via an index, which is located in front of the command in the accumulator. The first value is accessed via the Index 0. The selected value is loaded into the accumulator. The number of values is only limited by the program memory.

Example in IL:

```
LD 1 (* Select the required element *)
MUX 10,20,30,40,Value1 (* MUX command with 4 constants and a variable *)
ST Value (* Save result = 20 *)
```

Example in ST:

```
Ergebnis := Mux(1, 10, 20, 30, 40, Value1) (* Save result = 20 *)
```

10.4.1.10 SUB and SUB(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Subtracts the accumulator from one or more variables or constants. For bracket subtraction, the accumulator is subtracted from the result of the expression in brackets. Up to 6 bracket levels are possible. The values to be subtracted must belong to the same type of variable.

Example in IL:

```
LD 10
SUB Var1 (* Result = 10 - Var1 *)
ST Ergebnis
LD 20
SUB Var1, Var2, 30 (* Result = 20 - Var1 - Var12 - 30 *)
ST Ergebnis
LD 20
SUB( 6 (* Substract 20 from the contents of the bracket *)
AND 2
) (* Result = 20 - (6 AND 2) *)
ST Ergebnis (* Result = 18 *)
```

Example in ST:

```
Ergebnis := 10 - Value1;
```

10.4.2 Extended mathematical operators

Information

The operators listed here require intensive computing. This may result in a considerably longer running time for the PLC program.

10.4.2.1 COS, ACOS, SIN, ASIN, TAN, ATAN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

	BOOL	BYTE	ÎNT	DINT
Data type				X

Calculation of the relevant mathematical function. The value to be calculated must be available in minutes of arc. The scaling corresponds to 1 = 1000.

Conversion: Angle in radians = (Angle in degrees * PI / 180) * 1000 e.g. an angle of 90° is converted as follows: 90° * 3,14 / 180) *1000 = 1571

$$AE = \sin\left(\frac{AE}{1000}\right) \cdot 1000 \qquad AE = \cos\left(\frac{AE}{1000}\right) \cdot 1000 \qquad AE = \tan\left(\frac{AE}{1000}\right) \cdot 1000$$

Example in IL:

```
LD 1234
SIN
ST Ergebnis (* Result = 943 *)
```

Example in ST:

```
Ergebnis := COS(1234); (* Result = 330 *)
Ergebnis := ACOS(330); (* Result = 1234 *)
Ergebnis := SIN(1234); (* Result = 943 *)
Ergebnis := ASIN(943); (* Result = 1231 *)
Ergebnis := TAN(999); (* Result = 1553 *)
Ergebnis := ATAN(1553); (* Result = 998 *)
```

10.4.2.2 EXP

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

	BOOL	BYTE	ÎNT	DINT
Data type				X

Forms the exponential function to the base of Euler's Number (2.718) from the Accumulator. Up to 3 places behind the decimal point may be stated, i.e. 1.002 must be entered as 1002.

$$AE = e^{\left(\frac{AE}{1000}\right)} \cdot 1000$$

Example in IL:

```
LD 1000
EXP
ST Ergebnis (* Result = 2718 *)
```

Example in ST:

```
Ergebnis := EXP(1000); (* Result = 2718 *)
```

10.4.2.3 LN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

	BOOL	BYTE	ÎNT	DINT
Data type				X

Logarithm to base e (2.718). Up to 3 places behind the decimal point may be stated, i.e. 1.000 must be entered as 1000.

$$AE = \ln\left(\frac{AE}{1000}\right) \cdot 1000$$

Example in IL:

```
LD 1234
LN
ST Ergebnis
```

Example in ST:

```
Ergebnis := LN(1234); (* Result = 210 *)
```

10.4.2.4 LOG

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

	BOOL	BYTE	ÎNT	DINT
Data type				X

Forms the base 10 logarithm from the accumulator. Up to 3 places behind the decimal point may be stated, i.e. 1.000 must be entered as 1000.

$$AE = log_{10}\left(\frac{AE}{1000}\right) \cdot 1000$$

Example in IL:

```
LD 1234
LOG
ST Ergebnis (* Result = 91 *)
```

Example in ST:

```
Ergebnis := LOG(1234); (* Result = 91 *)
```

10.4.2.5 SQRT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X		

	BOOL	BYTE	ÎNT	DINT
Data type				X

Forms the square root from the accumulator. Up to 3 places behind the decimal point may be stated, i.e. 1.000 must be entered as 1000.

$$AE = \sqrt{\left(\frac{AE}{1000}\right)} \cdot 1000$$

Example in IL:

```
LD 1234
SQRT
ST Ergebnis (* Result = 1110 *)
```

Example in ST:

```
Ergebnis := SQRT(1234); (* Result = 1110 *)
```

10.4.3 Bit operators

10.4.3.1 AND and AND(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X	X	X	X

Bit-wise AND link of the AE/accumulator with one or two variables or constants. Bit-wise AND(...) linking with the AE/accumulator and the AE/accumulator which was previously formed in the bracket. Up to 6 bracket levels are possible. All values must belong to the same type of variable.

Example in IL:

```
LD 170
AND 204 (* AND link between 2 constants *)
(* Accumulator = 136 (See example in the table) *)

LD 170 (* Link between a constant and 2 variables.*)
AND Var1, Var2 (* Accumulator = 170dec AND Var1 AND Var2 *)

LD Var1
AND ( Var2 (* AE/Accumulator = Var1 AND ( Var2 OR Var3 ) *)
OR Var3
)
```

Example in ST:

```
Ergebnis := 170 AND 204; (* Result = 136dec *)
```

Var2	Var1	Result
0	0	0
0	1	0
1	0	0
1	1	1

Example: 170dec (1010 1010bin) AND 204dec (1100 1100bin) = (1000 1000bin) 136dec

10.4.3.2 ANDN and ANDN(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X	X	X	X

Bit-wise AND linking of the AE/accumulator with a negated operand. Bit-wise AND (...) linking of the AE/accumulator and the negated result of the bracket. Up to 6 bracket levels are possible. The values to be linked must belong to the same type of variable.

Example in IL:

```
LD 2#0000_1111
ANDN 2#0011_1010 (* ANDN link between 2 constants *)
(* Accu = 2#1111_0101 *)

LD 170 (* Link between a constant and 2 variables. *)
ANDN Var1, Var2 (* Accumulator = 170d ANDN Var1 ANDN Var2 *)

LD Var1
ANDN ( Var2 (* AE/Accumulator = Var1 ANDN ( Var2 OR Var3 ) *)
OR Var3
)
```

Var2	Var1	Result
0	0	1
0	1	1
1	0	1
1	1	0

Example: 170dec (1010 1010bin) AND 204dec (1100 1100bin) = (1000 1000bin) 136dec

10.4.3.3 NOT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X	X	X	X

Bit-wise negation of the accumulator.

Example in IL:

```
LD BYTE#10 (* Load the value 10dec into the ACCU in Byte format *)
NOT (* The value is resolved on the Bit level (0000 1010), *)
(* negated bit-wise (1111 0101) and then converted back *)
(* converted, result = 245dec *)
ST Var3 (* Save result as variable Var3 *)
```

Example in ST:

```
Ergebnis := not BYTE#10; (* Result = 245dez *)
```

10.4.3.4 OR and OR(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X	X	X	X

Bit-wise OR link of the AE/accumulator with one or two variables or constants. Bit-wise OR(...) linking with the AE/accumulator and the AE/accumulator which was previously formed in the bracket. Up to 6 bracket levels are possible. All values must belong to the same type of variable.

Example in IL:

```
LD 170
OR 204 (* OR link between 2 constants *)

LD 170 (* Link between a constant and 2 variables. *)
OR Var1, Var2 (* Accumulator = 170d OR Var1OR Var2 *)

LD Var1
OR ( Var2 (* AE/Accumulator = Var1 OR ( Var2 AND Var3 ) *)
AND Var3
)
```

Example in ST:

```
Ergebnis := 170 or 204; (* Result = 238 *)
```

Var2	Var1	Result
0	0	0
0	1	1
1	0	1
1	1	1

10.4.3.5 ORN andORN(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X	X	X	X

Bit-wise OR linking of the AE/accumulator with a negated operand. Bit-wise OR (...) linking of the AE/accumulator and the negated result of the bracket. Up to 6 bracket levels are possible. The values to be linked must belong to the same type of variable.

Example in IL:

```
LD 2#0000_1111
ORN 2#0011_1010 (* ORN link between 2 constants *)
(* Accumulator = 2#1100_0000 *)

LD 170 (* Link between a constant and 2 variables. *)
ORN Var1, Var2 (* Accumulator = 170d ORN Var1 ORN Var2 *)

LD Var1
ORN ( Var2 (* AE/Accumulator = Var1 ORN ( Var2 OR Var3 ) *)
OR Var3
)
```

Example in ST:

```
Ergebnis := 2#0000_1111 ORN 2#0011_1010; (* Result = 2#1100_0000 *)
```

Var2	Var1	Result
0	0	1
0	1	0
1	0	0
1	1	0

10.4.3.6 ROL

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Bit-wise rotation of the accumulator to the left. The content of the accumulator is shifted n times to the left, whereby the left bit is inserted again on the right.

Example in IL:

```
LD 175     (* Loads the value 1010_1111*)
ROL 2      (* Accumulator content is rotated 2x to the left *)
ST Value1  (* Saves the value 1011_1110 *)
```

Example in ST:

```
Ergebnis := ROL(BYTE#175, 2); (* Result = 2#1011_1110 *)
Ergebnis := ROL(INT#175, 2); (* Result = 16#C02B *)
```

10.4.3.7 ROR

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Bit-wise rotation of the accumulator to the right. The content of the accumulator is shifted n times to the right, whereby the right bit is inserted again on the left.

Example in IL:

```
LD 175     (* Loads the value 1010_1111*)
ROR 2      (* Accumulator content is rotated 2x to the right *)
ST Value1  (* Saves the value 1110_1011 *)
```

Example in ST:

```
Ergebnis := ROR(BYTE#175, 2); (* Result = 2#1110_1011 *)
```

10.4.3.8 S and R

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type	X			

Sets and resets a boolean variable if the result of the previous link (the AE) was TRUE.

Example in IL:

```
LD TRUE    (* Loads the AE with TRUE *)
S Var1     (* VAR1 is set to TRUE *)
R Var1     (* VAR1 is set to FALSE *)
```

Example in ST:

```
Ergebnis := TRUE;
Ergebnis := FALSE;
```

10.4.3.9 SHL

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	ÎNT	DINT
Data type		X	X	X

Bit-wise left shift of the accumulator. The content of the accumulator is shifted n times to the left and the bits which are pushed out are lost.

Example in IL:

```
LD 175     (* Loads the value 1010_1111*)
SHL 2      (* Accumulator content is shifted 2x to the left *)
ST Value1 (* Saves the value 1011_1100 *)
```

Example in ST:

```
Ergebnis := SHL(BYTE#175, 2); (* Result = 2#1011_1100 *)
Ergebnis := SHL(INT#175, 2); (* Result = 16#2BC *)
```

10.4.3.10 SHR

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Bit-wise right shift of the accumulator. The content of the accumulator is shifted n times to the right and the bits which are pushed out are lost.

Example in IL:

```
LD 175     (* Loads the value 1010_1111*)
SHR 2      (* Accumulator content is shifted 2x to the right *)
ST Value1 (* Saves the value 0010_1011 *)
```

Example in ST:

```
Ergebnis := SHR(BYTE#175, 2); (* Result = 2#0010_1011 *)
```

10.4.3.11 XOR and XOR(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X			

Bit-wise "exclusive OR" link between the AE/accumulator and one or two variables or constants. The first value is located in the AE/accumulator and the second is loaded with the command or is within the brackets. The values to be linked must belong to the same type of variable.

Example in IL:

```
LD 2#0000_1111
XOR 2#0011_1010 (* XOR link between 2 constants *)
                  (* Accu = 2#0011_0101 *)

LD 170          (* Link between a constant and 2 variables. *)
XOR Var1, Var2  (* Accumulator = 170d XOR Var1 XOR Var2 *)

LD Var1
XOR ( Var2      (* AE/Accumulator = Var1 XOR ( Var2 OR Var3 ) *)
OR Var3
)
```

Example in ST:

```
Ergebnis := 2#0000_1111 XOR 2#0011_1010; (* Result = 2#0011_0101 *)
```

Var2	Var1	Result
0	0	0
0	1	1
1	0	1
1	1	0

10.4.3.12 XORN and XORN(

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X			

Bit-wise Exclusive OR linking of the AE/accumulator with a negated operand. Bit-wise Exclusive OR (...) linking of the AE/accumulator and the negated result of the bracket. Up to 6 bracket levels are possible. The values to be linked must belong to the same type of variable.

Example in IL:

```
LD 2#0000_1111
XORN 2#0011_1010 (* XORN link between 2 constants *)
                 (* Accu = 2#1100_1010 *)

LD 170           (* Link between a constant and 2 variables. *)
XORN Var1, Var2  (* Accumulator = 170d XORN Var1 XORN Var2 *)

LD Var1
XORN ( Var2      (* AE/Accumulator = Var1 XORN ( Var2 OR Var3 ) *)
OR Var3
)
```

Example in ST:

```
Ergebnis := 2#0000_1111 XORN 2#0011_1010; (* Result = 2#1100_1010 *)
```

Var2	Var1	Result
0	0	1
0	1	0
1	0	0
1	1	1

10.4.4 Loading and storage operators (AWL)

10.4.4.1 LD

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X	X	X	X

Loads a constant or a variable into the AE or the accumulator.

Example in IL:

```
LD 10 (* Loads 10 as BYTE *)
LD -1000 (* Loads -1000 as INT *)
LD Value1 (* Loads the variable Value1 *)
```

10.4.4.2 LDN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X			

Loads a negated boolean variable into the AE.

Example in IL:

```
LDN Value1 (* Value1 = TRUE at AE = FALSE *)
ST Value2 (* Save to Value2 = FALSE *)
```

10.4.4.3 ST

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X	X	X	X

Saves the content of the AE/accumulator to a variable. The variable to be saved must match the previously loaded and processed data type.

Example in IL:

```
LD 100 (* Loads the value 1010_1111 *)
ST Value1 (* Accumulator content 100 is saved in Value1 *)
```

10.4.4.4 STN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X			

Saves the content of the AE to a variable and negates it. The variable to be saved must match the previously loaded and processed data type.

Example in IL:

```
LD Value1 (* Value1 = TRUE at AE = TRUE *)
STN Value2 (* Save to Value2 = FALSE *)
```

10.4.5 Comparison operators

10.4.5.1 EQ

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the values are equal, then AE is set to TRUE.

Example in IL:

```
LD Value1 (* Value1 = 5 *)
EQ 10 (* AE = Is 5 equal to 10 ? *)
JMPC NextStep (* AE = FALSE - program does not jump *)
ADD 1
NextStep:
ST Value1
```

Example in ST:

```
(* Is value = 10 *)
if Value = 10 then
  Value2 := 5;
end_if;
```

10.4.5.2 GE

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the value in the accumulator is greater or equal to the variable or constant, then AE is set to TRUE.

Example in IL:

```
LD Value1 (* Value1 = 5*)
GE 10 (* Is 5 greater than or equal to 10? *)
JMPC NextStep (* AE = FALSE - program does not jump *)
ADD 1

NextStep:
ST Value1
```

Example in ST:

```
(* Is 5 greater than or equal to 10? *)
if Value >= 10 then
  Value := Value - 1
end_if;
```

10.4.5.3 GT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the value in the accumulator is greater than the variable or constant, then AE is set to TRUE.

Example in IL:

```
LD Value1(* Value1 = 12 *)
GT 8 (* Is 12 greater than 8? *)
JMPC NextStep (* AE = TRUE - program jumps *)
ADD 1
NextStep:
ST Value1
```

Example in ST:

```
(* Is 12 greater than 8? *)
if Value > 8 then
  Value := 0;
end_if;
```

10.4.5.4 LE

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the value in the Accumulator is less than or equal to the variable or constant, then AE is set to TRUE.

Example in IL:

```
LD Value1 (* Value1 = 5*)
LE 10 (* Is 5 less than or equal to 10? *)
JMPC NextStep:
ST Value1
```

Example in ST:

```
(* Is Value less than or equal to 10?*)
if Value <= 10 then
  Value := 11;
end_if;
```

10.4.5.5 LT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the value in the accumulator is less than the variable or constant the AE is set to TRUE.

Example in IL:

```
LD Value1 (* Value1 = 12 *)
LT 8 (* Is 12 less than 8 ? *)
JMPC NextStep (* AE = FALSE - program does not jump *)
ADD 1
NextStep:
ST Value1
```

Example in ST:

```
(* Is Value less than 0? *)
if Value < 0 then
  Value := 0;
end_if;
```

10.4.5.6 NE

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X	X	X

Compares the content of the accumulator with a variable or constant. If the value in the Accumulator is not equal to the variable or constant, then AE is set to TRUE.

Example in IL:

```
LD Value1 (* Value1 = 5 *)
NE 10 (*Is 5 not equal to 10 ?*)
JMPC NextStep (* AE = TRUE - program jumps *)
ADD 1
NextStep:
ST Value1
```

Example in ST:

```
if Value <> 5 then
Value := 5;
end_if;
```

10.5 Processing values

All analogue and digital inputs and outputs or bus setpoints and actual values can be read and processed by the PLC or can be set by the PLC (if they are output values). Access to the individual values is via the process values listed below. For all output values, the output (e.g. digital outputs or PLC setpoint) must be programmed so that the PLC is the source of the event. All process data is read in from the PLC by the device at the start of each cycle and is only written to the device at the end of the program. The following table lists all of the values which can be directly accessed by the PLC. All other process values must be accessed via the function blocks MC_ReadParameter or MC_WriteParameter.

10.5.1 Inputs and outputs

All process values which describe the I/O interface of the device are summarised here.

Name	Function	Standardisation	Type	Access	Device
_0_Set_digital_output	Set digital outputs	Bit 0: Mfr1 Bit 1: Mfr2 Bit 2: DOUT 1 Bit 3: DOUT 2 Bit 4: DOUT 1 CU5-MLT Bit 5: DOUT 2 CU5-MLT Bit 6: DOUT 3 CU5-MLT Bit 7: DOUT 4 CU5-MLT Bit 8: dig. function AOUT	UINT	R/W	SK 5xxP

Name	Function	Standardisation	Type	Access	Device
_0_Set_digital_output	Setzen digitaler Ausgänge	Bit 0: Mfr1 Bit 1: Mfr2	UINT	R/W	On/On+
_0_Set_digital_output	Set digital outputs	Bit 0: Mfr1 Bit 1: Mfr2 Bit 2: DOUT1 Bit 3: DOUT2 Bit 4: dig. function AOUT Bit 5: DOUT3 (Din7) Bit 6: Status word Bit 10 Bit 7: Status word Bit 13 Bit 8: BusIO Bit0 Bit 9: BusIO Bit1 Bit 10: BusIO Bit2 Bit 11: BusIO Bit3 Bit 12: BusIO Bit4 Bit 13: BusIO Bit5 Bit 14: BusIO Bit6 Bit 15: BusIO Bit7	UINT	R/W	SK 54xE
_0_Set_digital_output	Set digital outputs	Bit 0: Mfr1 Bit 1: Mfr2 Bit 2: DOUT1 Bit 3: DOUT2 Bit 4: dig. function AOUT Bit 5: vacant Bit 6: Status word Bit 10 Bit 7: Status word Bit 13 Bit 8: BusIO Bit0 Bit 9: BusIO Bit1 Bit 10: BusIO Bit2 Bit 11: BusIO Bit3 Bit 12: BusIO Bit4 Bit 13: BusIO Bit5 Bit 14: BusIO Bit6 Bit 15: BusIO Bit7	UINT	R/W	SK 52xE SK 53xE
_0_Set_digital_output	Set digital outputs	Bit 0: DOUT1 Bit 1: BusIO Bit0 Bit 2: BusIO Bit1 Bit 3: BusIO Bit2 Bit 4: BusIO Bit3 Bit 5: BusIO Bit4 Bit 6: BusIO Bit5 Bit 7: BusIO Bit6 Bit 8: BusIO Bit7 Bit 9: Bus PZD Bit 10 Bit 10: Bus PZD Bit 13 Bit 11: DOUT2	UINT	R/W	SK 2xxE SK 2xxE-FDS

Name	Function	Standardisation	Type	Access	Device
_0_Set_digital_output	Set digital outputs	Bit 0: DOUT1 Bit 1: DOUT2 Bit 2: BusIO Bit0 Bit 3: BusIO Bit1 Bit 4: BusIO Bit2 Bit 5: BusIO Bit3 Bit 6: BusIO Bit4 Bit 7: BusIO Bit5 Bit 8: BusIO Bit6 Bit 9: BusIO Bit7 Bit 10: Bus PZD Bit 10 Bit 11: Bus PZD Bit 13	UINT	R/W	SK 180E SK 190E
_0_Set_digital_output	Set digital outputs	Bit 0: DOUT1 Bit 1: DOUT2 Bit 2: DOUT_BRAKE Bit 3: DOUT_BUS1 Bit 4: DOUT_BUS2	UINT	R/W	SK 155E-FDS SK 175E-FDS
_1_Set_analog_output	Set FI analogue output	10.0V = 100	BYTE	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE
_2_Set_external_ analog_out1	Set analogue output 1. IOE	10.0V = 100	BYTE	R/W	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_3_Set_external_ analog_out2	Set analogue output 2. IOE	10.0V = 100	BYTE	R/W	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_4_State_digital_output	Status of digital outputs	Bit 0: Mfr1 Bit 1: Mfr2 Bit 2: DOUT 1 Bit 3: DOUT 2 Bit 4: DOUT 1 CU5-MLT Bit 5: DOUT 2 CU5-MLT Bit 6: DOUT 3 CU5-MLT Bit 7: DOUT 4 CU5-MLT Bit 8: dig. function AOUT Bit 9: vacant Bit 10: DOUT1 IOE1 Bit 11: DOUT2 IOE1 Bit 12: DOUT1 IOE2 Bit 13: DOUT2 IOE2 Bit 14: vacant Bit 15: vacant	INT	R	SK 5xxP
_4_State_digital_output	Status of digital outputs	Bit 0: Mfr1 Bit 1: Mfr2	INT	R	On/On+
_4_State_digital_output	Status of digital outputs	Bit 0: Mfr1 Bit 1: Mfr2 Bit 2: DOUT1 Bit 3: DOUT2 Bit 4: dig. function AOUT Bit 5: DOUT3 (Din7) Bit 6: Status word Bit 8 Bit 7: Status word Bit 9 Bit 8: BusIO Bit0 Bit 9: BusIO Bit1 Bit 10: BusIO Bit2 Bit 11: BusIO Bit3 Bit 12: BusIO Bit4 Bit 13: BusIO Bit5 Bit 14: BusIO Bit6 Bit 15: BusIO Bit7	INT	R	SK 54xE
_4_State_digital_output	Status of digital outputs	P711	BYTE	R	SK 52xE SK 53xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_4_State_digital_output	Status of digital outputs	Bit 0: DOUT1 Bit 1: DOUT2 Bit 2: DOUT_BRAKE Bit 3: DOUT_BUS1 Bit 4: DOUT_BUS2	BYTE	R	SK 155E-FDS SK 175E-FDS

Name	Function	Standardisation	Type	Access	Device
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN1 CU5-MLT Bit 7: DIN2 CU5-MLT Bit 8: DIN3 CU5-MLT Bit 9 DIN4 CU5-MLT Bit 10 Safety DIN Bit 11 vacant Bit 12: Digital function AIN1 Bit 13: Digital function AIN2	INT	R	SK 5xxP
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4	INT	R	On/On+
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN7 Bit 7: Digital function AIN1 Bit 8: Digital function AIN2 Bit 9: DIN8	INT	R	SK 54xE
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN7	INT	R	SK 52xE SK 53xE

Name	Function	Standardisation	Type	Access	Device
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: vacant Bit 5: Thermistor Bit 6: vacant Bit 7: vacant Bit 8: DIN1 IOE 1 Bit 9: DIN2 IOE 1 Bit 10: DIN3 IOE 1 Bit 11: DIN4 IOE 1 Bit 12: DIN1 IOE 2 Bit 13: DIN2 IOE 2 Bit 14: DIN3 IOE 2 Bit 15: DIN4 IOE 2	INT	R	SK 2xxE
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: AIN1 Bit 4: AIN2 Bit 5: Thermistor Bit 6: vacant Bit 7: vacant Bit 8: DIN1 IOE 1 Bit 9: DIN2 IOE 1 Bit 10: DIN3 IOE 1 Bit 11: DIN4 IOE 1 Bit 12: DIN1 IOE 2 Bit 13: DIN2 IOE 2 Bit 14: DIN3 IOE 2 Bit 15: DIN4 IOE 2	INT	R	SK 180E SK 190E
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: TF (thermistor) Bit 4: DIN-BUS1 (ASiI1) Bit 5: DIN-BUS2 (ASiI2) Bit 6: DIN-BUS3 (ASiI3) Bit 7: DIN-BUS4 (ASiI4) Bit 8: BDDI1 (ASIO3) Bit 9: BDDI2 (ASIO4) Bit 10: STO	INT	R	SK 155E-FDS SK 175E-FDS

Name	Function	Standardisation	Type	Access	Device
_5_State_Digital_input	Status of digital inputs	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6/AIN1 Bit 6: DIN7/AIN2 Bit 7: Thermistor Bit 8: DIN1 IOE 1 Bit 9: DIN2 IOE 1 Bit 10: DIN3 IOE 1 Bit 11: DIN4 IOE 1 Bit 12: DIN1 IOE 2 Bit 13: DIN2 IOE 2 Bit 14: DIN3 IOE 2 Bit 15: DIN4 IOE 2	INT	R	SK 2xxE-FDS
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN1 CU5-MLT Bit 7: DIN2 CU5-MLT Bit 8: DIN3 CU5-MLT Bit 9 DIN4 CU5-MLT Bit 10 vacant Bit 11 vacant Bit 12: Digital function AIN1 Bit 13: Digital function AIN2	INT	R	SK 5xxP
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN7 Bit 7: Digital function AIN1 Bit 8: Digital function AIN2 Bit 9: DIN8	INT	R	SK 54xE
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4	INT	R	On/On+

Name	Function	Standardisation	Type	Access	Device
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6 Bit 6: DIN7	INT	R	SK 52xE SK 53xE
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: AIN1 Bit 4: AIN2 Bit 5: Thermistor Bit 6: vacant Bit 7: vacant Bit 8: DIN1 IOE 1 Bit 9: DIN2 IOE 1 Bit 10: DIN3 IOE 1 Bit 11: DIN4 IOE 1 Bit 12: DIN1 IOE 2 Bit 13: DIN2 IOE 2 Bit 14: DIN3 IOE 2 Bit 15: DIN4 IOE 2	INT	R	SK 2xxE SK 180E SK 190E
_6_Delay_digital_inputs	Status of digital inputs according to P475	Bit 0: DIN1 Bit 1: DIN2 Bit 2: DIN3 Bit 3: DIN4 Bit 4: DIN5 Bit 5: DIN6/AIN1 Bit 6: DIN7/AIN2 Bit 7: Thermistor Bit 8: DIN1 IOE 1 Bit 9: DIN2 IOE 1 Bit 10: DIN3 IOE 1 Bit 11: DIN4 IOE 1 Bit 12: DIN1 IOE 2 Bit 13: DIN2 IOE 2 Bit 14: DIN3 IOE 2 Bit 15: DIN4 IOE 2	INT	R	SK 2xxE-FDS
_7_Analog_input1	Value of analogue input 1 (AIN1)	10.00V = 1000	INT	R	All
_8_Analog_input2	Value of analogue input 2 (AIN2)	10.00V = 1000	INT	R	All
_9_Analog_input3	Value of analogue function DIN2	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 155E-FDS SK 175E-FDS

Name	Function	Standardisation	Type	Access	Device
_9_Analog_input3	Value of analogue function DIN2	10.00V = 4000h	INT	R	SK 2xxE SK 2xxE-FDS
_10_Analog_input4	Value of analogue function DIN3	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 155E-FDS SK 175E-FDS
_10_Analog_input4	Value of analogue function DIN3	10.00V = 4000h	INT	R	SK 2xxE SK 2xxE-FDS
_11_External_analog_input1	Value of analogue input 1 (1.IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_12_External_analog_input2	Value of analogue input 2 (1.IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_13_External_analog_input3	Value of analogue input 1 (2.IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_14_External_analog_input4	Value of analogue input 2 (2.IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_15_State_analog_output	Status of analogue output	10.0V = 100	BYTE	R	SK 5xxP SK 54xE
_16_State_ext_analog_out1	Status of analogue output (1. IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_17_State_ext_analog_out2	Status of analogue output (2. IOE)	10.00V = 1000	INT	R	SK 5xxP SK 54xE SK 2xxE SK 180E SK 190E

Name	Function	Standardisation	Type	Access	Device
_18_Dip_switch_state	DIP switch status	Bit 0: DIP1 Bit 1: DIP2 Bit 2: DIP3 Bit 3: DIP4 Bit 4: DIP_I1 Bit 5: DIP_I2 Bit 6: DIP_I3 Bit 7: DIP_I4	INT	R	SK 155E-FDS SK 175E-FDS
_19_State_digital_input_IOE	Status of digital inputs (IOE)	Bit 0: DIN1 IOE 2 Bit 1: DIN2 IOE 2 Bit 2: DIN3 IOE 2 Bit 3: DIN4 IOE 2 Bit 4: DIN1 IOE 1 Bit 5: DIN2 IOE 1 Bit 6: DIN3 IOE 1 Bit 7: DIN4 IOE 1	INT	R	SK 5xxP

10.5.2 PLC setpoint and actual values

The process values listed here form the interface from the PLC to the device. The function of the PLC setpoints is specified in (P553).

Information

The process value PLC_control_word overwrites the function block MC_Power. The PLC setpoints overwrite the function blocks MC_Move…. und MC_Home.

Name	Function	Standardisation	Type	Access	Device
_20_PLC_control_word	PLC control word	Corresponds to the USS profile	INT	R/W	All
_21_PLC_set_val1	PLC setpoint 1	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_22_PLC_set_val2	PLC setpoint 2	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_23_PLC_set_val3	PLC setpoint 3	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_24_PLC_set_val4	PLC setpoint 4	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS On/On+
_25_PLC_set_val5	PLC setpoint 5	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS On/On+
_26_PLC_additional _control_word1	PLC additional control word 1	Special functionality for IO control via PLC. Bit0 Fixed frequency 1 Bit1 Fixed frequency 2 Bit2 Fixed frequency 3 Bit3 Fixed frequency 4 Bit4 Fixed frequency 5 Bit5 Jog frequency Bit6 Enable with motor potentiometer Bit7 Remove enable via analogue	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_27_PLC_additional _control_word2	PLC additional control word 2	Special functionality for IO control via PLC. Bit0 Fixed frequency array Bit0 Bit1 Fixed frequency array Bit1 Bit2 Fixed frequency	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E

Name	Function	Standardisation	Type	Access	Device
		array Bit2 Bit3 Fixed frequency array Bit3 Bit4 Fixed frequency array Bit4 Bit5 Motor potentiometer function activated Bit6 Increase motor potentiometer frequency Bit 7 Reduce motor potentiometer frequency			On/On+
_28_PLC_status_word	PLC status word	Corresponds to the USS profile	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_29_PLC_act_val1	PLC actual value 1	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_30_PLC_act_val2	PLC actual value 2	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_31_PLC_act_val3	PLC actual value 3	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_32_PLC_act_val4	PLC actual value 4	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS On/On+
_33_PLC_act_val5	PLC actual value 5	100% = 4000h	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS On/On+
_34_PLC_Busmaster_ Control_word	Master function control word (bus master function) via PLC	Corresponds to the USS profile	INT	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_35_PLC_32Bit_set_ val1	32Bit PLC setpoint - P553[1] = Low part of the 32Bit value - P553[2] = High part of the 32Bit value	_	LONG	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_36_PLC_32Bit_act_ val1	32Bit PLC actual value - PLC actual value 1 = Low part of the 32Bit value - PLC 2 = High part of the 32Bit value	_	LONG	R/W	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_37_PLC_status_bits	Virtual status outputs of the PLC	Bit 0: PLC-DOUT1 Bit 1: PLC-DOUT2	INT	R/W	SK 155E-FDS SK 175E-FDS
_38_PLC_control_bits	Virtual control outputs of the PLC	Bit 0: PLC-DIN1 Bit 1: PLC-DIN2 Bit 2: PLC-DIN3 Bit 3: PLC-DIN4 Bit 4: PLC-DIN5 Bit 5: PLC-DIN6 Bit 6: PLC-DIN7	INT	R/W	SK 155E-FDS SK 175E-FDS

Name	Function	Standardisation	Type	Access	Device
		Bit 7: PLC-DIN8			
_39_PLC_set_digital_ output_bus	Outgoing PLC BusI/O data	Bit 0: BusIO Bit0 Bit 1: BusIO Bit1 Bit 2: BusIO Bit2 Bit 3: BusIO Bit3 Bit 4: BusIO Bit4 Bit 5: BusIO Bit5 Bit 6: BusIO Bit6 Bit 7: BusIO Bit7 Bit 8: Flag 1 Bit 9: Flag 2 Bit 10: Status word Bit 11 Bit 11: Status word Bit 12	INT	R/W	SK 5xxP On/On+

10.5.3 Bus setpoints and actual values

These process values reflect all setpoints and actual values which are transferred to the device via the various bus systems.

Name	Function	Standardisation	Type	Access	Device
_40_Inverter_status	FU status word	Corresponds to the USS profile	INT	R	All
_41_Inverter_act_val1	FU actual value 1	100% = 4000h	INT	R	All
_42_Inverter_act_val2	FU actual value 2	100% = 4000h	INT	R	All
_43_Inverter_act_val3	FU actual value 3	100% = 4000h	INT	R	All
_44_Inverter_act_val4	FU actual value 4	100% = 4000h	INT	R	SK 5xxP SK 54xE On/On+
_45_Inverter_act_val5	FU actual value 5	100% = 4000h	INT	R	SK 5xxP SK 54xE On/On+
_46_Inverter_lead_val1	Broadcast Master function Master value 1	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_47_Inverter_lead_val2	Broadcast Master function Master value 2	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E

Name	Function	Standardisation	Type	Access	Device
					SK 190E
_48_Inverter_lead_val3	Broadcast Master function Master value 3	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_49_Inverter_lead_val4	Broadcast Master function Master value 4	100% = 4000h	INT	R	SK 5xxP SK 54xE
_50_Inverter_lead_val5	Broadcast Master function Master value 5	100% = 4000h	INT	R	SK 5xxP SK 54xE
_51_Inverter_control_word	Resulting control word Bus	Corresponds to the USS profile	ÎNT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_52_Inverter_set_val1	Resulting main setpoint 1 Bus	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_53_Inverter_set_val2	Resulting main setpoint 2 Bus	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_54_Inverter_set_val3	Resulting main setpoint 3 Bus	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_55_Inverter_set_val4	Resulting main setpoint 4 Bus	100% = 4000h	INT	R	SK 5xxP SK 54xE On/On+
_56_Inverter_set_val5	Resulting main setpoint 5 Bus	100% = 4000h	INT	R	SK 5xxP SK 54xE On/On+
_57_Broadcast_set_val 1	Broadcast slave: Auxiliary setpoint 1	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E
_58_Broadcast_set_val 2	Broadcast slave: Auxiliary setpoint 2	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E
_59_Broadcast_set_val 3	Broadcast slave: Auxiliary setpoint 3	100% = 4000h	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E
_60_Broadcast_set_val 4	Broadcast slave: Auxiliary setpoint 4	100% = 4000h	INT	R	SK 5xxP SK 54xE
_61_Broadcast_set_val 5	Broadcast slave: Auxiliary setpoint 5	100% = 4000h	INT	R	SK 5xxP SK 54xE
_62_Inverter_32Bit_set _val1	Resulting main 32Bit main setpoint 1 Bus	- Low part in P546[1] - High part in P546[2]	LONG	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E On/On+
_63_Inverter_32Bit_act _val1	FI 32Bit actual value 1	- Low part in P543[1] - High part in P543[2]	LONG	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_64_Inverter_32Bit_lead_val1	32Bit master value 1	- Low part in P502[1] - High part in P502[2]	LONG	R	SK 5xxP SK 54xE SK 2xxE SK 180E SK 190E
_65_Broadcast_32Bit_set_val1	32Bit broadcast slave auxiliary set value 1	- Low part in P543[1] - High part in P543[2]	LONG	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E
_66_BusIO_input_bits	Incoming Bus I/O data	- Bit0 – 7 = Bus I/O In Bit 0 – 7 - Bit 8 = Flag 1 - Bit 9 = Flag 2 - Bit 10 = Bit8 of Bus control word - Bit 11 = Bit9 of Bus control word	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_67_BusIO_output_bits	Outgoing Bus I/O data	Bit0 = Bus / AS-i Dig Out1 Bit1 = Bus / AS-i Dig Out2 Bit2 = Bus / AS-i Dig Out3 Bit3 = Bus / AS-i Dig Out4 Bit4 = Bus / 1.IOE Dig Out1 Bit5 = Bus / 1.IOE Dig Out2 Bit6 = Bus / 2.IOE Dig Out1 Bit7 = Bus / 2.IOE Dig Out2 Bit8 = Bit 10 Bus status word Bit9 = Bit 11 Bus status word	INT	R	SK 5xxP SK 54xE On/On+
_67_BusIO_output_bits	Outgoing Bus I/O data	Bit0 = Bus / AS-i Dig Out1 Bit1 = Bus / AS-i Dig Out2 Bit2 = Bus / AS-i Dig Out3 Bit3 = Bus / AS-i Dig Out4 Bit4 = AS-i Actuator 1 Bit5 = AS-i Actuator 2	INT	R	SK 53xE SK 52xE

Name	Function	Standardisation	Type	Access	Device
		Bit6 = Flag 1 Bit7 = Flag 2 Bit8 = Bit 10 Bus status word Bit9 = Bit 11 Bus status word			
_67_BusIO_output_bits	Outgoing Bus I/O data	Bit0 = Bus / AS-i Dig Out1 Bit1 = Bus / AS-i Dig Out2 Bit2 = Bus / AS-i Dig Out3 Bit3 = Bus / AS-i Dig Out4 Bit4 = Bus / IOE Dig Out1 Bit5 = Bus / IOE Dig Out2 Bit6 = Bus / 2nd IOE Dig Out1 Bit7 = Bus / 2nd IOE Dig Out2 Bit8 = Bit 10 Bus status word Bit9 = Bit 11 Bus status word	INT	R	SK 2xxE
_67_BusIO_output_bits	Outgoing Bus I/O data	Bit0 = Bus / AS-i Dig Out1 Bit1 = Bus / AS-i Dig Out2 Bit2 = Bus / AS-i Dig Out3 Bit3 = Bus / AS-i Dig Out4 Bit4 = Bus / AS-i Dig Out5 Bit5 = Bus / AS-i Dig Out6 Bit6 = Bus / 2nd IOE Dig Out1 Bit7 = Bus / 2nd IOE Dig Out2 Bit8 = Bit 10 Bus status word Bit9 = Bit 11 Bus status word	INT	R	SK 2xxE-FDS

10.5.4 ControlBox and ParameterBox

The ControlBox can be accessed via the process values listed here. This enables implementation of simple HMI applications.

Information

In order for the "key-states" to be displayed in the PLC, the ControlBox and ParameterBox must be in PLC display mode. Otherwise only the value "0" is displayed

Name	Function	Standardisation	Type	Access	Device
_70_Set_controlbox_ show_val	ControlBox display value	Display value = Bit 29 – Bit 0 Decimal point = Bit 31 – Bit 30	DINT	R/W	All
_71_Controlbox_key_ state	ControlBox keyboard status	Bit 0: ON Bit 1: OFF Bit 2: DIR Bit 3: UP Bit 4: DOWN Bit 5: Enter	BYTE	R	All
_72_Parameterbox_ key_state	ParameterBox keyboard status	Bit 0: ON Bit 1: OFF Bit 2: DIR Bit 3: UP Bit 4: DOWN Bit 5: Enter Bit 6: Right Bit 7: Left	BYTE	R	All

10.5.5 Information parameters

The main actual values of the device are listed here.

Name	Function	Standardisation	Type	Access	Device
_80_Current_fault	Actual fault number	Error 10.0= 100	BYTE	R	All
_81_Current_warning	Actual warning	Warning 10.0= 100	BYTE	R	All
_82_Current_reason_ FI_blocked	Actual reason for the switch-on inhibit state	Problem 10.0= 100	BYTE	R	All
_83_Input_voltage	Actual mains voltage	100 V = 100	INT	R	All
_84_Current_frequenz	Actual frequency	10Hz = 100	INT	R	All

Name	Function	Standardisation	Type	Access	Device
_85_Current_set_ point_frequency1	Actual setpoint frequency from the setpoint source	10Hz = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_86_Current_set_ point_frequency2	Actual inverter set point frequency	10Hz = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_87_Current_set_ point_frequency3	Actual set point frequency after ramp	10Hz = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_88_Current_Speed	Actually calculated speed	100rpm= 100	INT	R	All
_89_Actual_current	Actual output current	10.0A = 100	INT	R	All
_90_Actual_torque_ current	Actual torque current	10.0A = 100	INT	R	All
_91_Current_voltage	Actual voltage	100V = 100	ÎNT	R	All
_92_Dc_link_voltage	Actual link circuit voltage	100V = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_93_Actual_field_ current	Actual field current	10.0A = 100	INT	R	All
_94_Voltage_d	Actual voltage component d-axis	100V = 100	INT	R	All

Name	Function	Standardisation	Type	Access	Device
_95_Voltage_q	Actual voltage component q-axis	100V = 100	INT	R	All
_96_Current_cos_phi	Actual cos (phi)	0.80 = 80	BYTE	R	All
_97_Torque	Actual torque	100% = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_98_Field	Actual field	100% = 100	BYTE	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_99_Apparent_power	Actual apparent power	1.00KW = 100	INT	R	All
_100_Mechanical_ power	Actual mechanical power	1.00KW = 100	INT	R	All
_101_Speed_encoder	Actual measured speed	100rpm= 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE On/On+
_102_Usage_rate_ motor	Actual usage rate of motor	100% = 100	INT	R	All
_103_Usage_rate_ motor_I2t	Actual usage rate of motor I2t	100% = 100	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_104_Usage_rate_ brake_resistor	Actual brake resistor usage rate.	100% = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+

Name	Function	Standardisation	Type	Access	Device
_105_Head_sink_temp	Actual heat sink temperature	100°C = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_106_Inside_temp	Actual internal temperature	100°C = 100	INT	R	SK 5xxP SK 54xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_107_Motor_temp	Actual motor temperature	100°C = 100	INT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 2xxE-FDS SK 180E SK 190E On/On+
_108_Actual_net_ frequency	Actual mains frequency	10Hz = 100	INT	R	SK 155E-FDS SK 175E-FDS
_109_Mains_phase_ sequence	Actual mains phase sequence	0=CW, 1=CCW	BYTE	R	SK 155E-FDS SK 175E-FDS
_141_Pos_Sensor_Inc	Position of incremental encoder	0.001 rotation	DINT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E
_142_Pos_Sensor_Abs	Position of absolute encoder	0.001 rotation	DINT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E
_143_Pos_Sensor_Uni	Position of universal encoder	0.001 rotation	DINT	R	SK 5xxP SK 54xE On/On+

Name	Function	Standardisation	Type	Access	Device
_144_Pos_Sensor_HTL	Position of HTL encoder	0.001 rotation	DINT	R	SK 5xxP SK 54xE On/On+
_145_Actual_pos	Actual position	0.001 rotation	DINT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E On/On+
_146_Actual_ref_pos	Actual setpoint position	0.001 rotation	DINT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E On/On+
_147_Actual_pos_diff	Position difference between setpoint and actual value	0.001 rotation	DINT	R	SK 5xxP SK 54xE SK 53xE SK 52xE SK 2xxE SK 180E SK 190E On/On+
_150_Direct_dc_link_voltage	Actual link circuit voltage (unfiltered)	100V = 100	INT	R	SK 5xxP On/On+
_151_Direct_torque_current	Actual torque current (unfiltered)	ST: `Value := INT_TO_DINT(_151_Direct_torque_current) * INT_TO_DINT(_153_Factor_InFu_B)) / DINT#819` 1A = 100	INT	R	SK 5xxP On/On+

Name	Function	Standardisation	Type	Access	Device
_152_Direct_field_ current	Actual field current (unfiltered)	IL: LD _153_Factor_InFu_B INT_TO_DINT ST Num_InFu LD _151_Direct_torque _current INT_TO_DINT MUL Num_InFu DIV DINT#819 ST Value 1A = 100	INT	R	SK 5xxP On/On+
_153_Factor_InFu_B	Factor for calculation of the actual torque or field current		INT	R	SK 5xxP On/On+

10.5.6 PLC errors

The device errors E23.0 to E24.7 can be set from the PLC program via the User Error Flags.

Name	Function	Standardisation	Type	Access	Device
_110_ErrorFlags	Generates user error in device	Bit 0: E 23.0 Bit 1: E 23.1 Bit 2: E 23.2 Bit 3: E 23.3 Bit 4: E 23.4 Bit 5: E 23.5 Bit 6: E 23.6 Bit 7: E 23.7	BYTE	R/W	all
_111_ErrorFlags_ext	Generates user error in device	Bit 0: E 24.0 Bit 1: E 24.1 Bit 2: E 24.2 Bit 3: E 24.3 Bit 4: E 24.4 Bit 5: E 24.5 Bit 6: E 24.6 Bit 7: E 24.7	BYTE	R/W	all

10.5.7 PLC parameters

The PLC parameters P355, P356 and P360 can be directly accessed via this group of process data.

Name	Function	Standardisation	Type	Access	Device
_115_PLC_P355_1	PLC INT parameter P355 [-01]	-	INT	R	all

Name	Function	Standardisation	Type	Access	Device
_116_PLC_P355_2	PLC INT parameter P355 [-02]	-	INT	R	all
_117_PLC_P355_3	PLC INT parameter P355 [-03]	-	INT	R	all
_118_PLC_P355_4	PLC INT parameter P355 [-04]	-	INT	R	all
_119_PLC_P355_5	PLC INT parameter P355 [-05]	-	INT	R	all
_120_PLC_P355_6	PLC INT parameter P355 [-06]	-	INT	R	all
_121_PLC_P355_7	PLC INT parameter P355 [-07]	-	INT	R	all
_122_PLC_P355_8	PLC INT parameter P355 [-08]	-	INT	R	all
_123_PLC_P355_9	PLC INT parameter P355 [-09]	-	INT	R	all
_124_PLC_P355_10	PLC INT parameter P355 [-10]	-	INT	R	all
_125_PLC_P356_1	PLC LONG parameter P356 [-01]	-	DINT	R	all
_126_PLC_P356_2	PLC LONG parameter P356 [-02]	-	DINT	R	all
_127_PLC_P356_3	PLC LONG parameter P356 [-03]	-	DINT	R	all
_128_PLC_P356_4	PLC LONG parameter P356 [-04]	-	DINT	R	all
_129_PLC_P356_5	PLC LONG parameter P356 [-05]	-	DINT	R	all
_130_PLC_P360_1	PLC display parameter P360[-01]	-	DINT	R/W	all
_131_PLC_P360_2	PLC display parameter P360[-02]	-	DINT	R/W	all
_132_PLC_P360_3	PLC display parameter P360[-03]	-	DINT	R/W	all
_133_PLC_P360_4	PLC display parameter P360[-04]	-	DINT	R/W	all
_134_PLC_P360_5	PLC display parameter P360[-05]	-	DINT	R/W	all
_135_PLC_Scope_ Int_1	PLC scope display value 1	-	INT	R/W	all
_136_PLC_Scope_ Int_2	PLC scope display value 2	-	INT	R/W	all
_137_PLC_Scope_	PLC scope display value	-	INT	R/W	all

Name	Function	Standardisation	Type	Access	Device
Int_3	3				
_138_PLC_Scope_ Int_4	PLC scope display value 4	-	INT	R/W	all
_139_PLC_Scope_ Bool_1	PLC scope display value 5	-	INT	R/W	all
_140_PLC_Scope_ Bool_2	PLC scope display value 6	-	INT	R/W	all

10.6 Languages

10.6.1 Instruction list (AWL / IL)

10.6.1.1 General

Data types

The PLC supports the data types listed below.

Name	Required memory space	Value range
BOOL	1 Bit	0 to 1
BYTE	1 Byte	0 to 255
INT	2 Byte	-32768 to 32767
DINT	4 Byte	-2147483648 to 2147483647
LABEL_ADDRESS	2 Byte	Jump marks

Literal

For greater clarity it is possible to enter constants for all data types in various display formats. The following table gives an overview of all possible variants.

Literal	Example	Number displayed in decimal
Bool	FALSE	0
	TRUE	1
	BOOL#0	0
	BOOL#1	1
Dual (Base 2)	2#01011111	95
	2#0011_0011	51
	BYTE#2#00001111	15
	BYTE#2#0001_1111	31
Oktal (Base 8)	8#0571	377
	8#05_71	377
	BYTE#8#10	8
	BYTE#8#111	73
	BYTE#8#1_11	73
Hexadecimal (Base 16)	16#FFFF	-1
	16#0001_FFFF	131071
	INT#16#1000	4096
	DINT#16#0010_2030	1056816
Integer (Base 10)	10	10
	-10	-10
	10_000	10000
	INT#12	12
	DINT#-100000	-100000
Time	TIME#10s50ms	10.050 seconds
	T#5s500ms	5.5 seconds
	TIME#5.2s	5.2 seconds
	TIME#5D10H15M	5days+10hours+15minutes
	T#1D2H30M20S	1day+2hours+30minutes+20seconds

Comments

It is advisable to provide the sections of the program with comments in order to make the PLC program understandable at a later date. In the application program these comments are marked by starting with the character sequence "(*" and finishing with "*)" as shown in the following examples.

Example:

```
(* Comment about a program block *)
LD 100 (* Comment after a command *)
ADD 20
```

Jump marks

With the aid of the operators JMP, JMPC or JMPCN whole sections of the program can be bypassed. A jump mark is given as the target address. With the exception of diacritics and „ß“ it may contain all letters, the numbers 0 to 9 and underscores; other characters are not permitted. The jump mark is terminated with a colon. This may stand on its own. There may also be further commands after in the same line after the jump mark.

Possible variants may appear as follows:

Example:

```
Jump mark:
LD 20

This_is_a_jumpmark:
ADD 10

MainLoop: LD 1000
```

A further variant is the transfer of a jump mark as a variable. This variable must be defined as type LABLE_ADDRESS in the variable table, then this can be loaded into the variable 'jump marks'. With this, status machines can be created very simply, see below.

Example:

```
LD FirstTime
JMPC AfterFirstTime
(* The label address must be initialized at the beginning *)
LD Address_1
ST Address_Var
LD TRUE
ST FirstTime
AfterFirstTime:

JMP Address_Var

Address_1:
LD Address_2
ST Address_Var
JMP Ende

Address_2:
LD Address_3
ST Address_Var
JMP Ende

Address_3:
LD Address_1
ST Address_Var

Ende:
```

Function call-ups

The Editor supports one form of function call-ups. In the following version, the function CTD is called up via the instance I_CTD. The results are saved in variables. The meaning of the functions used below is described in further detail later in the manual.

Example

```
LD 10000
ST I_CTD.PV
LD LoadNewVar
ST I_CTD.LD
LD TRUE
ST I_CTD.CD
CAL I_CTD
LD I_CTD.Q
ST ResultVar
LD I_CTD.CV
ST CurrentCountVar
```

Bit-wise access to variables

A simplified form is possible for access to a bit from a variable or a process variable.

Command	Description
LD Var1.0	Loads Bit 0 of Var1 into the AE
ST Var1.7	Stores the AE on Bit 7 of Var1
EQ Var1.4	Compares the AE with Bit 4 of Var1

10.6.2 Structured text (ST)

Structured text consists of a series of instruction, which are executed as in plain language ("IF..THEN..ELSE) or in loops (WHILE.. DO).

Example:

```
IF value < 7 THEN
  WHILE value < 8 DO
    value := value + 1;
  END_WHILE;
END_IF;
```

10.6.2.1 Common

Data types in ST

The PLC supports the data types listed below.

Name	Memory required	Value range
BOOL	1 Bit	0 to 1
BYTE	1 Byte	0 to 255
INT	2 Byte	-32768 to 32767
DINT	4 Byte	-2,147,483,648 to 2,147,483,647

Information

For numbers it is advisable to state the data type in order to create an efficient PLC program, e.g.: VarInt := INT#-32768, VarDINT := DINT#-2147483648.

Assignment operator

On the left hand side of an assignment there is an operand (variable, address) to which the value of an expression on the right hand side is assigned with the assignment operator "=".

Example:

```
Var1 := Var2 * 10;
```

After execution of this line, Var1 has ten times the value of Var2.

Call-up of function blocks in ST

A function block is called in ST by writing the name of the instance of the function block and then assigning the values of the parameters in brackets. In the following example a timer is called up with assignment of its parameters IN and PT Then the result variable Q is assigned to the variable A.

The result variable is accessed as in IL with the name of the function block, a following period and the name of the variable.

Example:

```
Timer(IN := TRUE, PT := 300);
A := Timer.Q;
```

Evaluation of expressions

The evaluation of the expression is performed by processing the operators according to certain linking rules. The operator with the strongest link is processed first and then the operator with the next strongest link, etc. until all of the operators have been processed. Operators with links of the same strength are processed from left to right.

The table below shows the ST operators in the order of the strength of their links:

Operation	Symbol	Link strength
Brackets	(Expression)	Strongest
Function call	Function name (parameter list)	
Negated complement formation	NOT	
Multiply Divide Modulus AND	* / MOD AND	
Add	+	

Subtract OR XOR	- OR XOR	
Compare Equality Inequality	<,>,<=,>= = <>	Light

10.6.2.2 Procedure

Return

The RETURN instruction can be used to jump to the end of the program, for example, depending on a condition.

IF

With the IF instruction, a condition can be tested and instructions carried out depending on this condition.

Syntax:

```
IF <Boolean_Expression1> THEN
  <IF_Instruction>
ELSIF <Boolean_Expression2> THEN
  <ELSIF_Instruction1>
ELSIF <Boolean_Expression n> THEN
  <ELSIF_Instruction n-1>
ELSE
  <ELSE_Instruction>}
END_IF;
```

The part in the curly brackets {} is optional. If <Boolean_Expression1> is TRUE, then only the <IF_Instructions> are executed and none of the other instructions.. Otherwise, starting with <Boolean_Expression2>, the boolean expressions are evaluated in sequence until one of the expressions is TRUE. Then, only the expressions following this boolean expression and before the next ELSE or ELSIF are evaluated. If none of the boolean expressions is TRUE, only the <ELSE_Instructions> are evaluated.

Example:

```
IF temp < 17 THEN
  Bool1 := TRUE;
ELSE
  Bool2 := FALSE;
END_IF;
```

CASE

With the CASE instruction, several conditional instructions with the same condition variables can be combined into a construct.

Syntax:

```
CASE <Var1> OF
  <Value1>: <Instruction 1>
  <Value2>: <Instruction 2>
  <Value3, Value4, Value5: <Instruction 3>
  <Value6 .. Value10 : <Instruction 4>
  ...
  <Value n>: <Instruction n>
ELSE <ELSE-Instruction>
END_CASE;
```

A CASE instruction is processed according to the following pattern:

- If the variable in <Var1> has the value <Value i>, the instruction <Instruction i> is executed.
- If <Var 1> does not have any of the stated values, the <ELSE instruction> is executed.
- If the same instruction is to be executed for several values of the variable, these values can be written separately in sequence, separated with commas as the condition of the common instruction.
- If the same instruction is to be executed for a range of values of the variable, the initial value and the end value can be written separated by a colon as the condition for the common instruction.

Example:

```
CASE INT1 OF
 1, 5:
   BOOL1 := TRUE;
   BOOL3 := FALSE;
 2:
   BOOL2 := FALSE;
   BOOL3 := TRUE;
 10..20:
   BOOL1 := TRUE;
   BOOL3:= TRUE;
 ELSE
   BOOL1 := NOT BOOL1;
   BOOL2 := BOOL1 OR BOOL2;
END_CASE;
```

FOR loop

Repetitive processes can be programmed with the FOR loop.

Syntax:

```
FOR <INT_Var> := <INIT_VALUE> TO <END_VALUE> {BY <STEP>} DO
 <Instruction>
END_FOR;
```

The part in the curly brackets {} is optional. The <Instructions> are executed as long as the counter <INT-Var> is not larger than the <END_VALUE>. This is checked before the execution of the <Instructions> so that the <Instructions> are never executed if the <INIT_VALUE> is larger than the <END_VALUE>. Whenever the <Instructions> are executed, the <INIT-Var> is increased by a <Step size>. The step size can have any integer value. If this is missing, it is set to 1. The loop must terminate, as <INT_Var> is larger.

Example:

```
FOR Zaehler :=1 TO 5 BY 1 DO
  Var1 := Var1 * 2;
END_FOR;
```

REPEAT loop

The REPEAT loop is different from the WHILE loop in that the termination condition is only tested after the loop has been executed. As a result, the loop must be run through at least once, regardless of the termination condition.

Syntax:

```
REPEAT
  <Instruction>
UNTIL
  <Boolean Expression>
END_REPEAT;
```

The <Instructions> are executed until the <Boolean Expression> is TRUE. If the <Boolean Expression> is TRUE with the first evaluation, the <Instructions> are executed exactly once. If the <Boolean Expression> is never TRUE, the <Instructions> will be executed endlessly, which will create a runtime error.

Information

The programmer must ensure that no endless loops are created by changing the condition in the instruction part of the loop, for example a counter which counts upwards or downwards.

Example:

```
REPEAT
  Var1 := Var1 * 2;
  Count := Count - 1;
UNTIL
  Count = 0
END_REPEAT
```

WHILE loop

The WHILE loop can be used in the same way as the FOR loop, with the difference that the termination condition can be any boolean expression. This means that a condition is stated, which, if it is true, will result in the execution of the loop.

Syntax:

```
WHILE <Boolean Expression> DO
  <Instructions>
END_WHILE;
```

The <Instructions> are executed repeatedly for as long as the <Boolean_Expression> is TRUE. If the <Boolean_Expression> is FALSE in the first evaluation, the <Instructions> will never be executed. If the <Boolean_Expression> is never FALSE, the <Instructions> will be repeated endlessly.

Information

The programmer must ensure that no endless loops are created by changing the condition in the instruction part of the loop, for example a counter which counts upwards or downwards.

Example:

```
WHILE Count <> 0 DO
  Var1 := Var1*2;
  Count := Count - 1;
END_WHILE
```

Exit

If the EXIT instruction occurs in a FOR, WHILE or REPEAT loop, the innermost loop will be terminated, regardless of the termination condition.

10.7 Jumps

10.7.1 JMP

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X

Unconditional jump to a jump mark.

Example AWL:

```
JMP NextStep (* Unconditional jump to NextStep *)
ADD 1

NextStep:
ST Value1
```

10.7.2 JMPC

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X

Conditional jump to a jump point If AE = TRUE, the command JMPC jumps to the stated jump point.

Example AWL:

```
LD 10
JMPC NextStep (* AE = TRUE - program jumps *)
ADD 1

NextStep:
ST Value1
```

10.7.3 JMPCN

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X

Conditional jump to a jump point JMPCN jumps if the AE register = FALSE. Otherwise the program continues with the next instruction.

Example AWL:

```
LD 10
JMPCN NextStep (* AE = TRUE - program does not jump *)
ADD 1

NextStep:
ST Value1
```

10.8 Type conversion

10.8.1 BOOL_TO_BYTE

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type	X			

Converts the data type of the AE from BOOL to BYTE. If the AE is FALSE, the accumulator is converted to 0. If the AE is TRUE, the accumulator is converted to 1.

Example in IL:

```
LD TRUE
BOOL_TO_BYTE (* AE = 1 *)
```

Example in ST:

```
Ergebnis := BOOL_TO_BYTE(TRUE); (* Result = 1 *)
```

10.8.2 BYTE_TO_BOOL

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X		

Converts the data type from BYTE to BOOL. As long as BYTE is not equal to zero, this always gives the conversion result TRUE.

Example in IL:

```
LD 10
BYTE_TO_BOOL (* AE = TRUE *)
```

Example in ST:

```
Ergebnis := BYTE_TO_BOOL(10); (* Result = TRUE *)
```

10.8.3 BYTE_TO_INT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type		X		

Converts the data type from BYTE to INT. The BYTE is copied into the Low component of the INT and the High component of INT is set to 0.

Example in IL:

```
LD 10
BYTE_TO_INT (* Accumulator = 10 *)
```

Example in ST:

```
Ergebnis := BYTE_TO_INT(10); (* Result = 10 *)
```

10.8.4 DINT_TO_INT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type				X

Converts the data type from DINT to INT. The High component of the DINT value is not transferred.

Example in IL:

```
LD 200000
DINT_TO_INT     (* Accumulator = 3392 *)

LD DINT# -5000
DINT_TO_INT     (* Accumulator = -5000 *)

LD DINT# -50010
DINT_TO_INT     (* Accumulator = 15526 *)
```

Example in ST:

```
Ergebnis := DINT_TO_INT(200000); (* Result = 3392 *)
Ergebnis := DINT_TO_INT(-5000); (* Result = -5000 *)
Ergebnis := DINT_TO_INT(-50010); (* Result = 15526 *)
```

10.8.5 INT_TO_BYTE

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type			X	

Converts the data type from INT to BYTE. Here, the High component of the INT value is not transferred. Prefixes are lost as the BYTE type does not have prefixes.

Example in IL:

```
LD 16#5008
INT_TO_BYTE (* Accumulator = 8 *)
```

Example in ST:

```
Ergebnis := INT_TO_BYTE(16#5008); (* Result = 8 *)
```

10.8.6 INT_TO_DINT

	SK 5xxP	SK 54xE	SK 53xE SK 52xE	On/On+	SK 2xxE	SK 2xxE-FDS	SK 180E SK 190E	SK 155E-FDS SK 175E-FDS
Availability	X	X	X	X	X	X	X	X

	BOOL	BYTE	INT	DINT
Data type			X	

Converts the data type from INT to DINT. The INT is copied into the Low component of the DINT and the High component of the DINT is set to 0.

Example in IL:

```
LD 10
INT_TO_DINT (* Accumulator = 10 *)
```

Example in ST:

```
Ergebnis := INT_TO_DINT(10); (* Result = 10 *)
```

10.9 PLC Error messages

Error messages cause the device to switch off, in order to prevent a device fault. With PLC error messages execution by the PLC is stopped and the PLC goes into the status "PLC Error". With other error messages the PLC continues operation. The PLC restarts automatically after the error has been acknowledged.

The PLC continues to operate with PLC User Fault 23.X and 24.X!

SimpleBox		Fault Text in the ParameterBox	Cause Remedy
Group	**Details in P700[-01] / P701**		
E022	**22.0**	**No PLC program**	The PLC has been started but there is no PLC program in the device - Load PLC program into the FI
	22.1	**PLC program is faulty**	The checksum check via the PLC program produced an error. - Restart the device (Power ON) and try again - Alternatively, reload PLC program
	22.2	**Incorrect jump address**	Program error, behaviour as for Error 22.1
	22.3	**Stack overflow**	More than 6 bracket levels were opened during the run time of the program - Check the program for run time errors
	22.4	**Max. PLC cycles exceeded**	The stated maximum cycle time for the PLC program was exceeded - Change the cycle time or check the program
	22.5	**Unknown command code**	A command code in the program cannot be executed because it is not known. - Program error, behaviour as for Error 22.1 - Version of the PLC and the NORDCON version do not match
	22.6	**PLC write access**	The program content has been changed while the PLC program was running
	22.9	**PLC Error**	The cause of the fault cannot be precisely determined - Behaviour as in Error 22.1
E023/ E024	**23.0 to 23.7**	**PLC User Fault 1 to 8**	This error can be triggered by the PLC program in order to externally indicate problems in the execution of the PLC program. Triggered by writing the process variable "ErrorFlags".
	24.0 to 24.7	**PLC User Fault 9 to 16**	

11 Project Mode

11.1 General

The project mode is an extension of the normal mode. As default, this is deactivated and must be activated in the Settings. The mode allows the user to manage a project. Projects can be loaded and saved. A project includes the frequency inverters with their data (parameters and PLC program), links to external parameter files or PLC programs, as well as the layout of the application. With a new start of NORDCON the last project which has been saved is always loaded. A new project is created if no project can be found. The project mode was developed for the following application:

- 11.2 "HMI"
- 11.3 "Save and restore"

Category	Name	Description
File	New project	This action creates an empty project.
	Open project...	This action opens a file selection dialogue and the user must select a project file (*.ncpx).
	Save project	This action opens a file selection dialogue and the user specifies a name for the project file (*.ncpx). After this, the project is saved under this name.
	Save all	The action
Project	Send all data	This action sends all parameters and the PLC program to the devices.
	Read all data	The action loads all parameters from the devices and saves them in the project file. In addition, the PLC program in the device is compared with that in the project. If they are not identical a warning is displayed in the log.
	Remove parameter	This action deletes the parameter for the selected device from the project.
	Remove PLC program	The action deletes the PLC program for the selected device from the project.
	Add PLC program	This action adds a saved PLC program for the highlighted device.
	Export parameters	This action exports the parameters for the selected device to a file.
	Export PLC program	This action exports the PLC program for the selected device to a file.
PLC	Save	This action saves the PLC in the project file.
	Save as ...	This action opens a file selection dialogue and the user must select a file name. After this, the PLC program is saved in a separate file.
Parameter setup	Save	This action saves the parameters in the project file.
	Save as ...	This action opens a file selection dialogue and the user must select a file

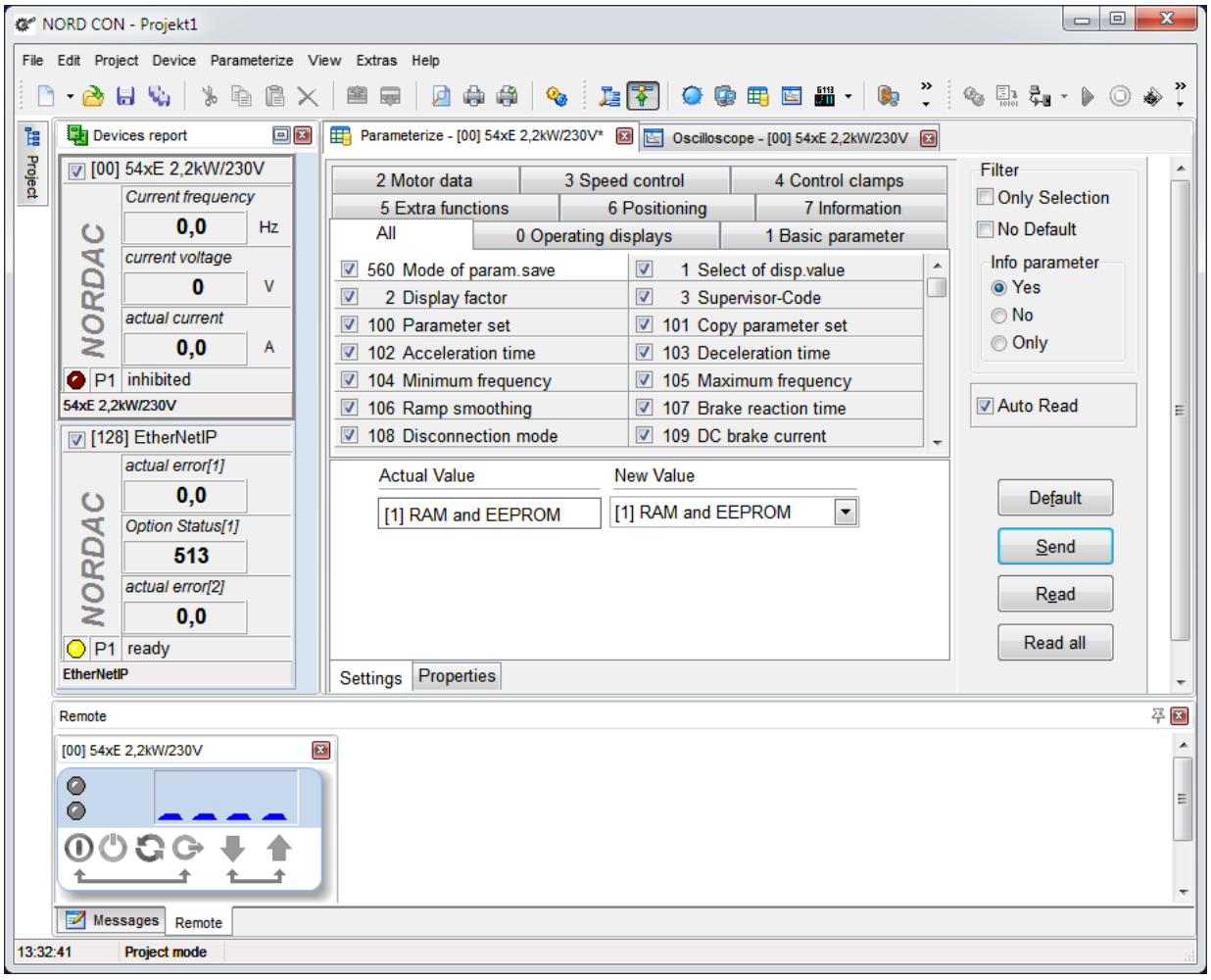
Category	Name	Description
		name. After this, the parameters are saved in a separate file.

11.2 HMI

The project mode is ideally suitable for good visualisation. The user connects the PC to the system and starts the device search (Bus scan Ctrl. F5). After the device search is complete, the user can place the required display elements for the device in the work area, e.g. parameter window, oscilloscope or control window. After this, the project must be saved. After the project has been opened, the devices and the layout are restored. This enables the user to always work with the same user interface.

Information

When a project is loaded, it is not checked whether the devices which are contained in the project are actually connected. Communication errors may result if other devices are connected to the bus. Please take care that you always use the same device for the communication connection if you use the system bus.



11.3 Save and restore

The project mode can also be used to save and restore parameters and PLC programs. The list of devices used can be further restricted after a device search (bus scan). By deactivating the device in the device overview, a device can be excluded from saving and restoring.

The procedure may take several minutes, as depending on the particular system, the device list may contain several devices. The progress of the action is displayed in a separate window. NORDCON cannot be used during this process.

Information

When a project is loaded, it is not checked whether the devices which are contained in the project are actually connected. Communication errors may result if other devices are connected to the bus. Please take care that you always use the same device for the communication connection if you use the system bus.

Save

After a device search (bus scan) the action "Read all Data" reads the parameters of all of the devices which are found. The parameters must first be saved in NORDCON and then saved manually in the project file (Save All). Three options are available to users for the action "Read all Data". These options can be activated or deactivated in the settings dialogue.

Option	Description
Delete all data records on cancellation	If this option is activated, the data records for all of the devices which are included in the project are deleted when the function "Read all Data" is cancelled. Otherwise, not all parameters will be read out and the data in the project file is incomplete.
Delete incomplete data records	If this option is enabled, the data record for a device is deleted if an error occurs during the function "Read all Data".
Delete data records from devices not ready for communication	If this option is enabled, the data record for a device is deleted if there is no communication with the device during execution of the function "Read all Data".

PLC programs cannot be read out in the current version of NORDCON. Because of this, the programs of the device and the project file are compared during the action "Read all Data". If they are not identical, a warning is given in NORDCON. This action is skipped if no PLC program is saved for a device.

If device parameters are saved in the project file, this is indicated with a special device symbol in the project structure. The same applies for the PLC program. However, the existence of the device symbol does not provide any information with regard to the current status and completeness of the data. After readout, the parameters can be edited with the parameter editor. The user selects a device in the project tree and opens the parameter editor (Parameterise F7). The parameters can be read or deleted in the editor. The action "Save" saves the parameters for the selected device in the project and also saves the project on the hard drive. If the parameter is to be saved in a separate file, the action "Save as" must be executed.

Information

If errors occur during "Read all Data", these are noted in the log and the backup is continued. All of the parameters which are noted in the log are not saved in the project file. We recommend that the fault is remedied and a new backup carried out for the device.

Restore

This function can be executed after opening the project via the main menu. For this, the parameters which are saved in the project file are sent to the devices. As standard, all parameters are always sent to the devices. However, in most cases this is not advisable and only takes up time. To reduce the number of parameters, the user must enable the option "Only transfer enabled parameters" and enable the required parameters in the parameter editor.

In the second step, the PLC programs which are saved in the project are loaded, translated and also sent to the device. As in normal mode, the PLC program for a device is edited with the PLC editor. When the editor is opened, the PLC program is automatically loaded from the project file. After editing, the program can be saved again in the project file with the action "Save". If the PLC program is to be saved in a separate file in this mode, the action "Save as" must be executed.

Information

If errors occur during the process, this is noted in the log and the process is continued All of the parameters which are noted in the log could not be saved in the device. The same applies for the PLC programs. We recommend that the fault is remedied and the action restarted.

11.4 Project Download

The automated project download enables downloading of parameters and PLC programs to one or more devices via a batch file. The result of the transfer is saved in a log file and can be subsequently evaluated. The parameters and PLC programs must be previously saved in a project. For this, the project mode must be activated in NORDCON. After the device search, all devices which are found are displayed in the project tree. Each selected device parameter and/or a PLC program can now be allocated.

Information

PLC programs can only be allocated to devices with PLC functionality!

To enable a faster download of the project, only the required parameters may be transferred. For this, only a value for these parameters can be assigned in the parameter editor.

To configure the project download, a batch file is saved in the installation directory of NORDCON. This file must be copied and adapted accordingly. The following transfer parameters exist for the function:

Transfer parameter	Description
AUTODOWNLOAD=[project file]	This transfer parameter activates the project download. The path to the project file must be entered after the "equal" sign. Example: „AUTODOWNLOAD=c:\Projekt_Starter.ncpx“
CONNECTIONSTRING=[ID=1, PORTNR=[COMx (x=serial port number)], BAUDRATE=[baud rate]] (Optional)	This transfer parameter specified the communication parameters. If this parameter is not transferred, the settings from the project are used. Example: "CONNECTIONSTRING=ID=1,PORTNR=COM1, BAUDRATE=38400"
AUTOLOG=[log file]	This transfer parameter specifies the path for the log file. A log file is not created if this parameter is not transferred.

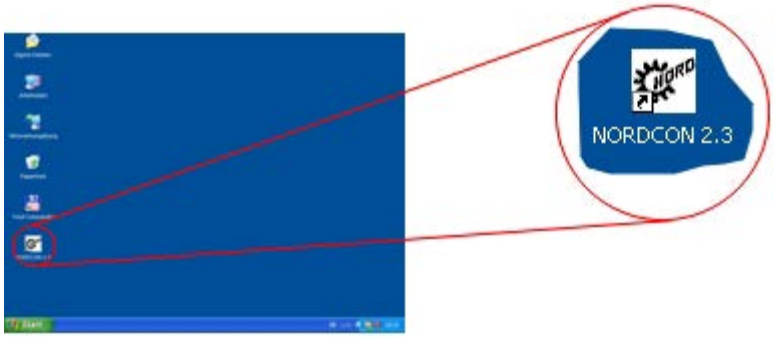
12 Firmware

12.1 Serial interface

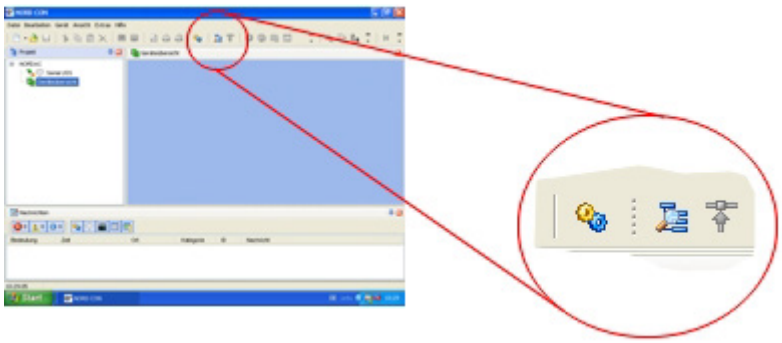
12.1.1 How to update the firmware

Perform the following steps:

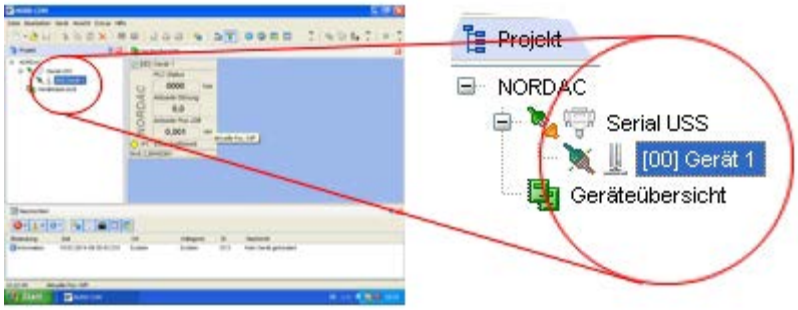
1.Start NORDCON.



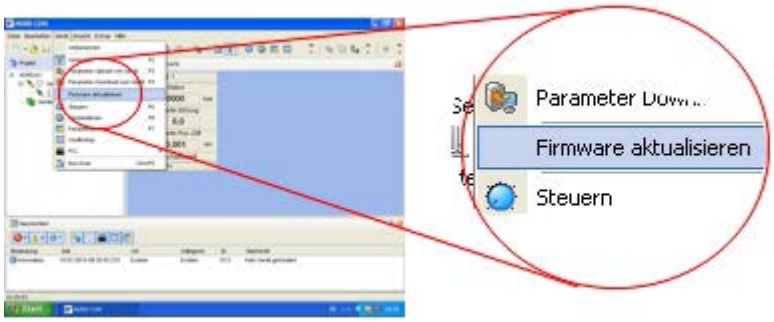
2.Carry out a device search.



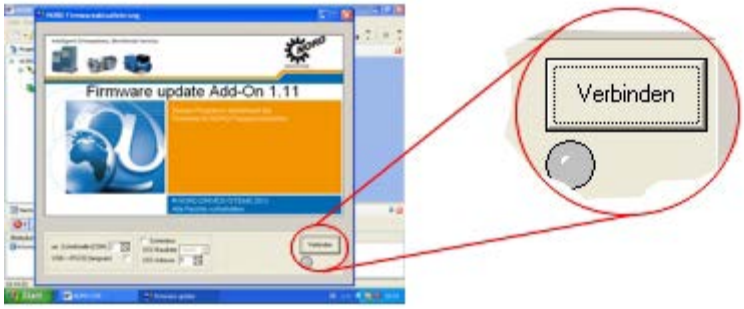
3.Select the required device in the project tree.



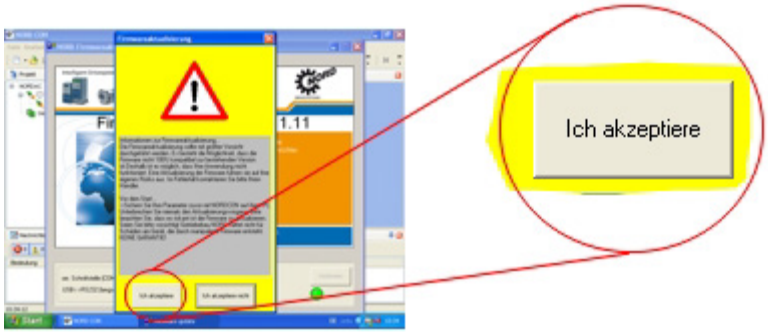
4.Start the firmware update program via the menu item "Device -> Update firmware".



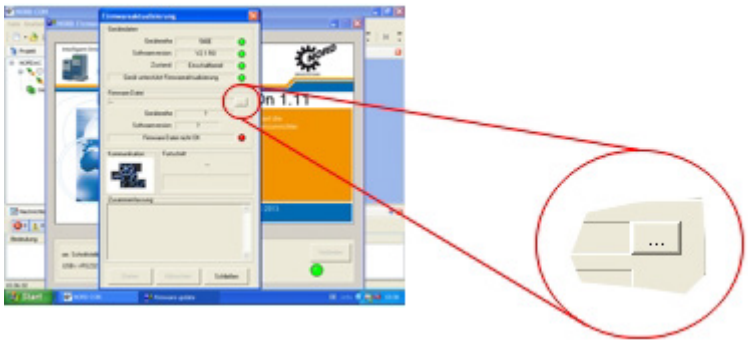
5.Click on “Connect”.



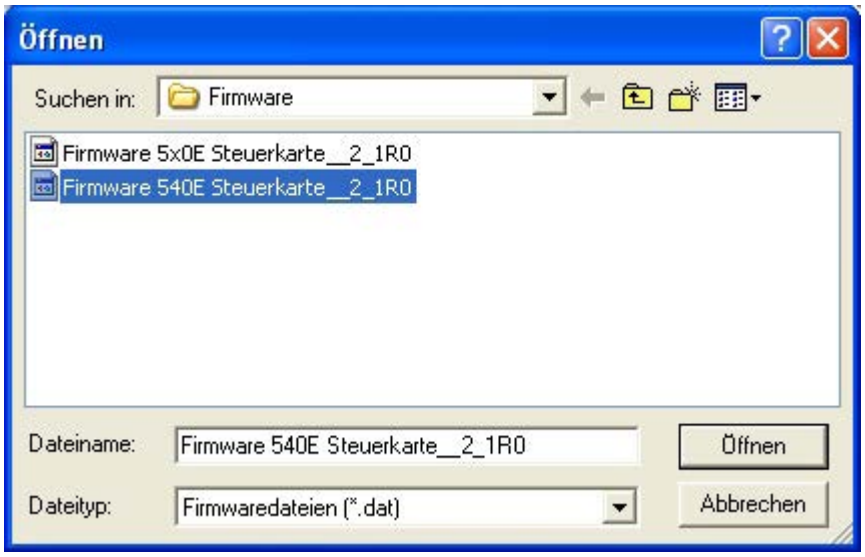
6.Carefully read the warning information and confirm with the "I accept" button.



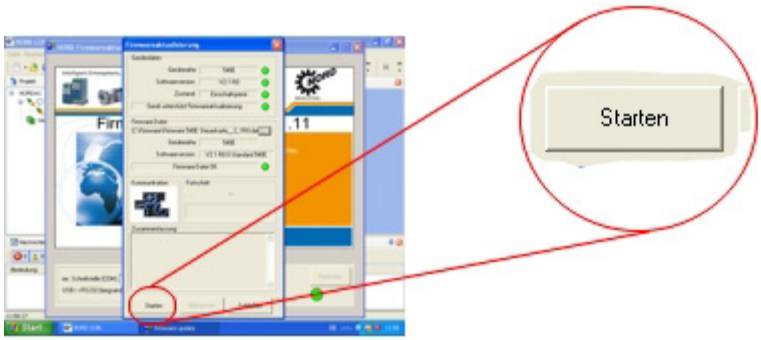
7.Use the "..." button to select a firmware file.



8.Select the firmware file and confirm with "Open".



9.Start the firmware transfer with the "Start" button.



Information

The firmware can only be updated if the device has the address 0 and the baud rate is set to 38400 bits/s.

Information

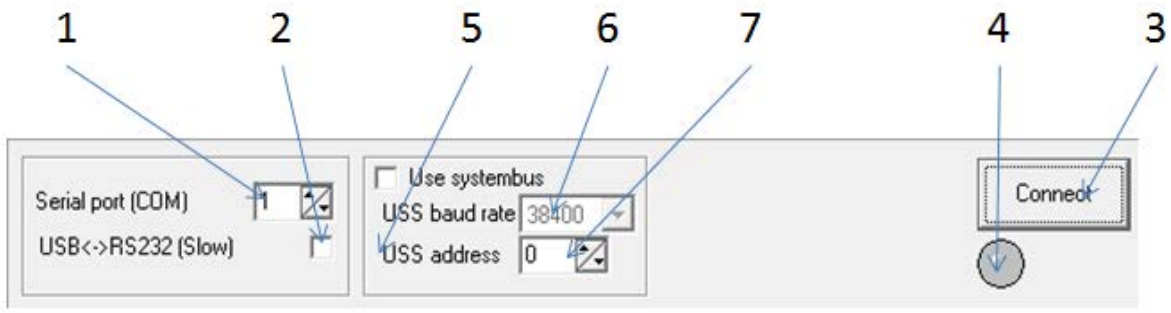
If the firmware transfer is interrupted or is not carried out correctly, restart the device. If the device is then not found in a bus scan, afterwards, the firmware updated program (FirmwareUpd.exe or FirmwareUpd3.exe with SK5xxP) can also be started manually. The programs are located in the main directory of NORDCON.

12.1.2 Firmware update program

1. Settings

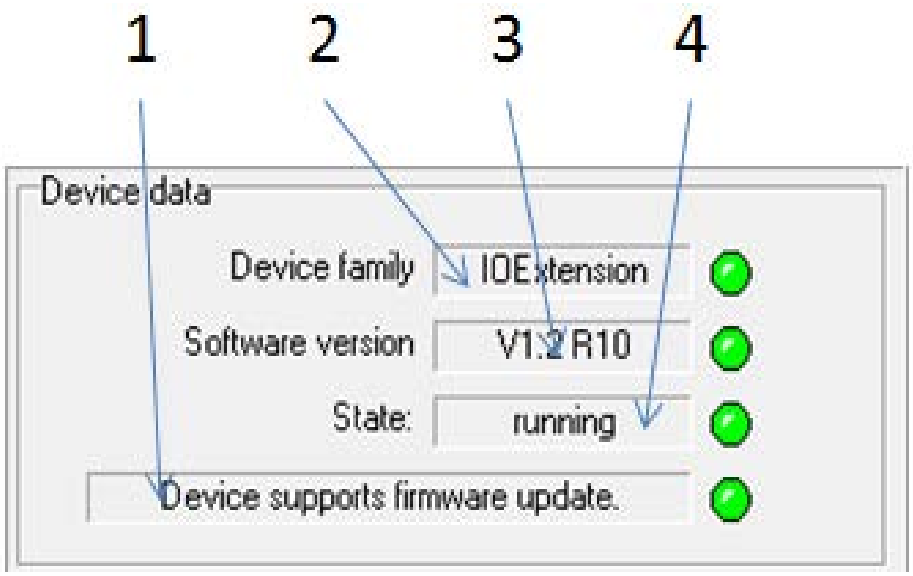
No.	Description
1	In the selection box, the user specifies the COM port of the PC to which the device is connected. If the program was called up via NORDCON, this parameter does not need to be set.
2	For some USB to RS232 converters, this setting may enable more stable communication. Only select this setting if you have problems with the connection.
3	The "Connect" button establishes a connection to the connected device. If a device was found, the LED (4) illuminates green and the firmware download window opens.

No.	Description
4	The LED indicates the connection status. Grey - Connection not yet established. Green - The program is connected to a device. Red - No device found.
5	This option activates the update of the firmware via the system bus.
6	In this selection box, specify the transfer speed between the PC and the connected device.
7	In this selection box, specify the mapped USS address of the device.



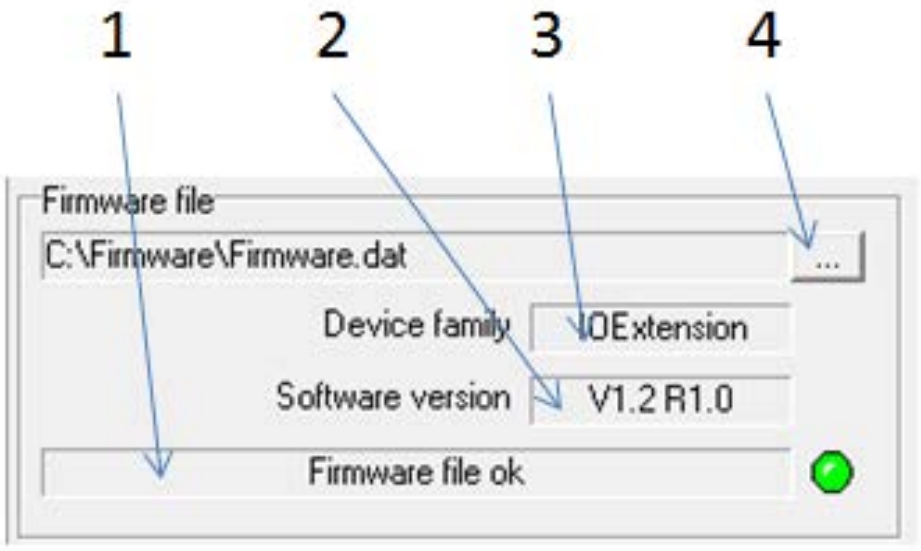
2. Device data

No.	Description
1	This field indicates whether the connected device supports firmware updates. If this is not the case, the LED next to the field is red.
2	This field displays the device family of the connected device. If a device cannot be detected, the LED next to the field is red, and a firmware update is not possible.
3	This field displays the version number of the connected device.
4	This field displays the status of the connected device. If the device is enabled, the LED next to the field is red and a firmware update is not possible.



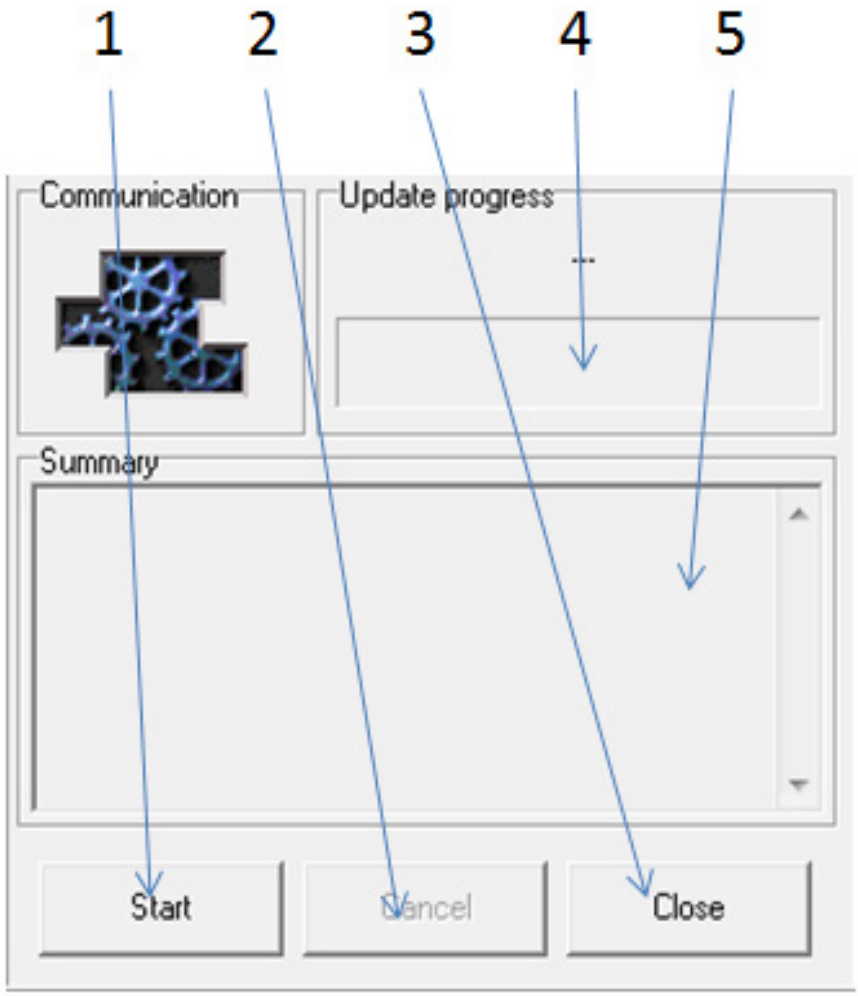
3. Select firmware file

No.	Description
1	This field displays the status of the currently loaded firmware. If the firmware file cannot be loaded or if the firmware does not match the connected device, the LED next to the field is red. A firmware update is not possible.
2	This field displays the version information for the currently loaded firmware.
3	This field displays the device family which is supported by the currently loaded firmware.
4	Clicking the "..." button opens a file selection dialogue. The user can select a firmware file in the window. The file name is applied by clicking "Open" and is then saved in the program configuration file.



4. Update firmware

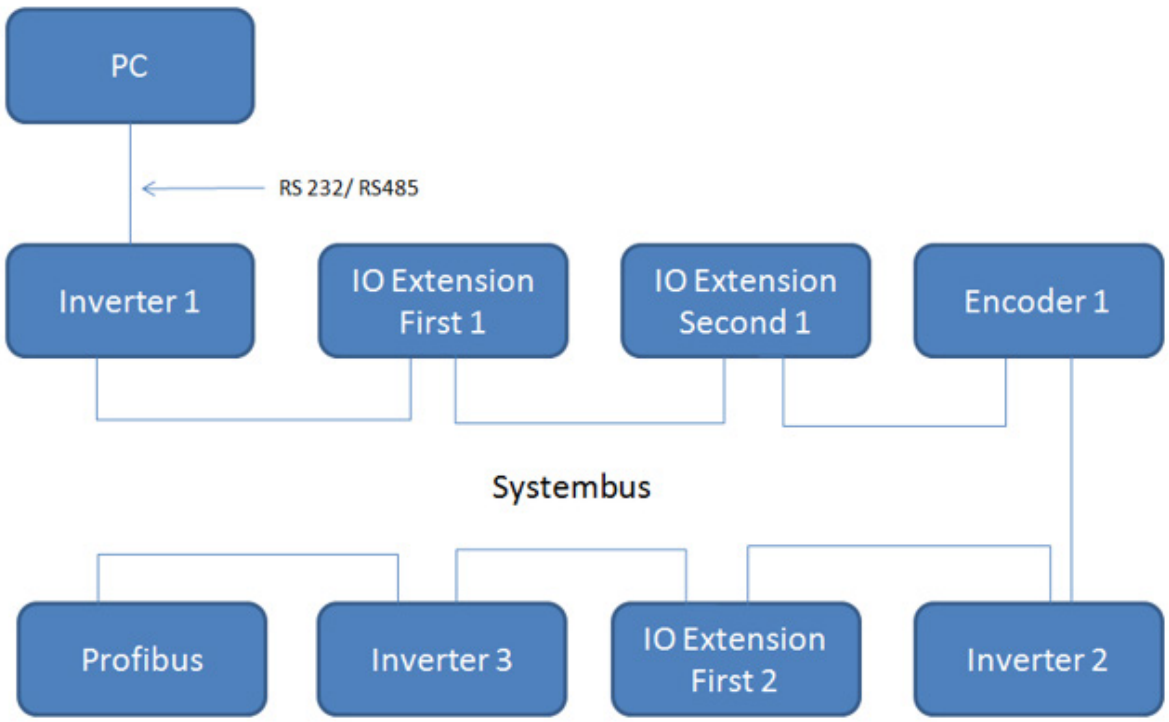
No.	Description
1	Press the "Start" button to start the firmware update. If the button is not active, the selected firmware cannot be loaded to the device.
2	Press the "Cancel" button to cancel a started update. Cancellation is only possible during the initialisation phase.
3	The download window cannot be closed during an update. Before or after a download, the user can cancel the update by pressing the "Close" button.
4	The progress indicator displays the progress of the update and the current status.
5	After the update, the result is displayed in the "Summary" field.



12.1.3 Firmware update via system bus

The system bus is a bus developed by NORD on the basis of the CAN bus. The bus is available for all SK2xxE and SK5xxE with an internal CAN interface, as well as for various additional modules. Up to four frequency inverters, each with 2 additional modules and a CANopen encoder, and a bus module can be connected simultaneously, so that in the maximum configuration 17 devices are connected to

the system bus. The protocol used for the system bus corresponds to CANopen. The CAN addresses for the individual devices have a fixed allocation in the system bus and cannot be changed.



All NORD modules connected to the system bus can be visualised and parameterised via a participant with an RS232/RS485 interface using NORDCON. For this, the communication requests are tunnelled via the device which is connected to NORDCON or the firmware update program. The following mapping procedure is used for tunnelling the requests:

USS address	Module
0	This address must be set for the module to which NORDCON is connected.
1	Frequency inverter 1 (CAN ID: 32)
2	Frequency inverter 2 (CAN ID: 34)
3	Frequency inverter 3 (CAN ID: 36)
4	Frequency inverter 4 (CAN ID: 38)
10	Additional module 1 for frequency inverter 1 (I/O extension)
11	Additional module 1 for frequency inverter 2 (I/O extension)
12	Additional module 1 for frequency inverter 3 (I/O extension)
13	Additional module 1 for frequency inverter 4 (I/O extension)
19	Device after cancelled firmware update
20	Additional module 2 for frequency inverter 1 (I/O extension)
21	Additional module 2 for frequency inverter 2 (I/O extension)

USS address	Module
22	Additional module 2 for frequency inverter 3 (I/O extension)
23	Additional module 2 for frequency inverter 4 (I/O extension)
30	Bus module

The following devices support tunnelling of firmware updates:

Device	Version
SK 1xxE	All
SK 2xxE	V1.3 and above
SK 5xxE	V2.0 and above
SK 540E	V2.0 and above
SK TU4-DEV	V1.4 and above
SK TU4-CAO	V2.2 and above
SK TU4-PBR	V1.2 and above
SK TU4-POL	All
SK TU4-PNT	All
SK TU4-IOE	V1.2 and above
SK TU4-EIP	All

The following devices support firmware updates via system bus:

Device	Version
SK 1xxE	All
SK 540E	V2.0 and above
SK TU4-DEV, SK CU4-DEV	V1.4 and above
SK TU4-CAO, SK CU4-CAO	V2.2 and above
SK TU4-PBR, SK CU4-PBR	V1.2 and above
SK TU4-POL, SK CU4-POL	All
SK TU4-PNT, SK CU4-PNT	All
SK TU4-IOE, SK CU4-IOE	V1.2 and above
SK TU4-EIP, SK CU4-EIP	All

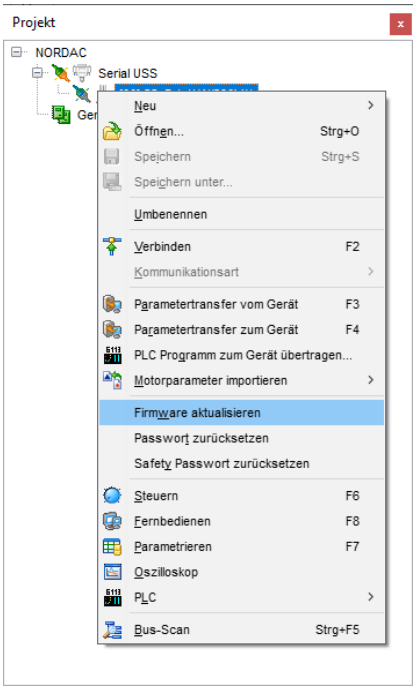
12.1.4 How to update the firmware (NORDAC PRO)

Perform the following steps:

1. Start NORDCON.
2. Carry out a device search.

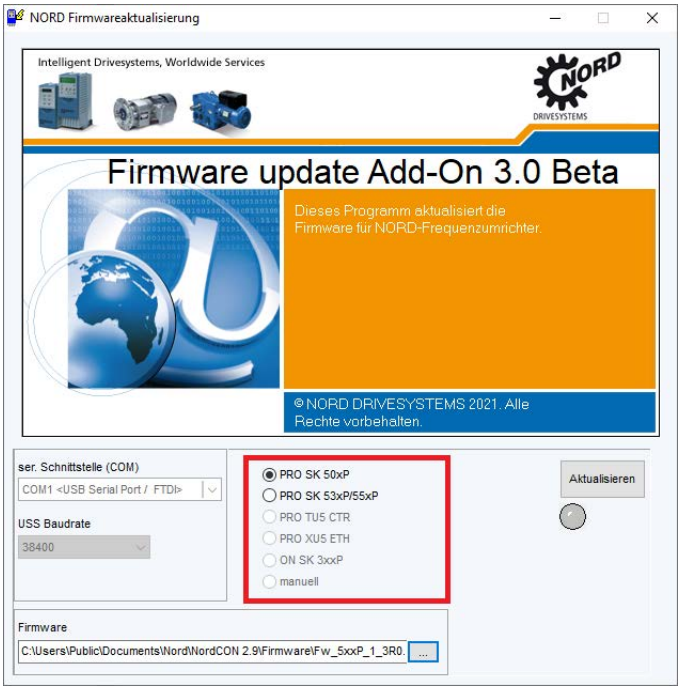
> **Information**
>
> The firmware update can only be done via the device's RJ12 interface. Additionally, the device's USS address = 0 (P512) and USS baud rate=38400 Baud (P511) must be set.

3. Select the required device in the project tree.



Start the firmware update program under "Update firmware" via the context menu that opens via right click.

4. Choose the device type.



5. Choose a firmware file.

6. Click on “Update”. Before the device firmware update begins, a warning is displayed. Carefully read the warning information and confirm with the "I accept" button.

Information

If the firmware transfer is interrupted or is not carried out correctly, restart the device. If the device is not found in a bus scan afterwards, the firmware updated program (FirmwareUpd.exe) can also be started manually. The program is located in the main directory of NORDCON.

12.2 Ethernet interface

The following devices support firmware updates via Ethernet:

Device	Version
SK TU3-PNT	V1.4R4 and above
SK TU4-PNT, SK CU4-PNT	V1.4R4 and above
SK TU4-PNS, SK CU4-PNS	Update only possible for the PROFINET IO part

12.2.1 How to update the firmware

Perform the following steps:

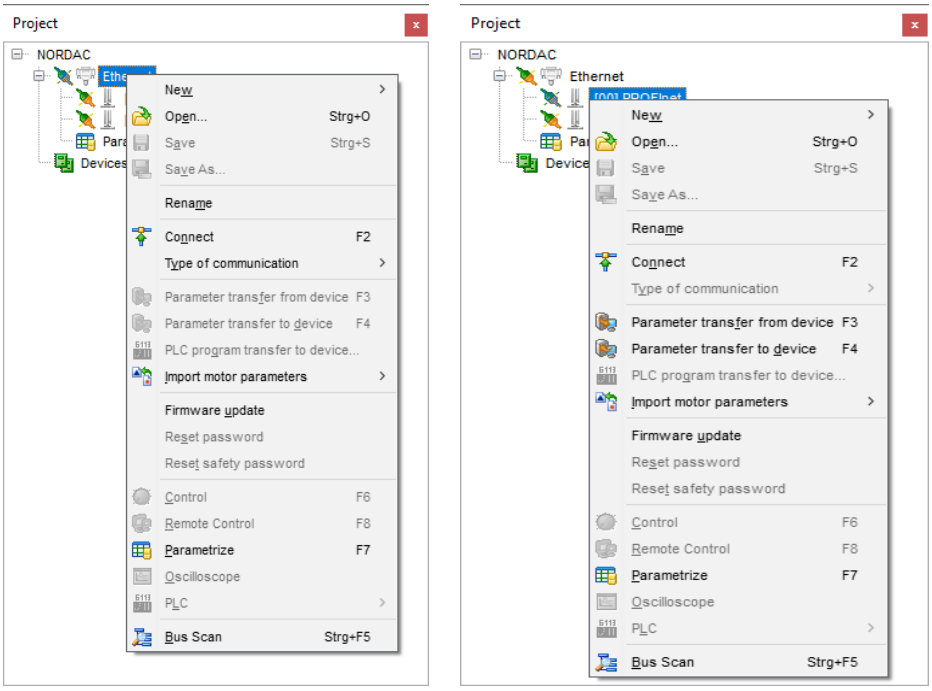
1. Start NORDCON.

2. Carry out a device search. The communication type “Ethernet” must be selected.

Information

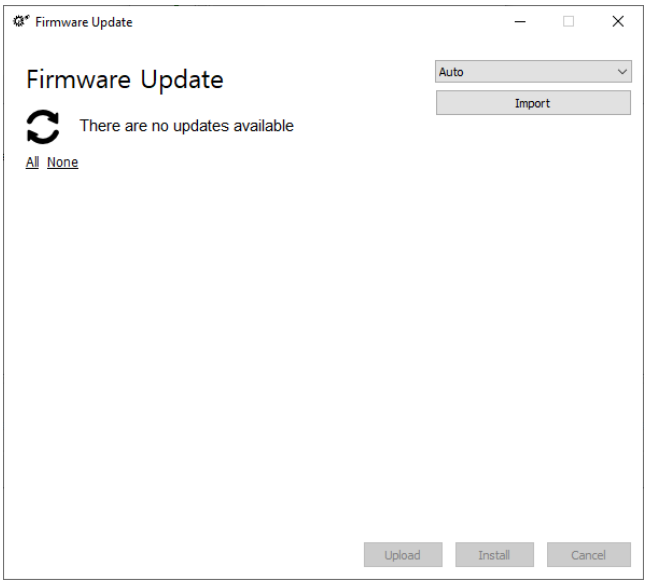
The firmware update’s speed and safety are largely dependent on the system’s bus load. Therefore, we recommend a maximal device number of 10.

3. Select the required device in the project tree. If you want to update several devices simultaneously, select the Ethernet node in the project tree.

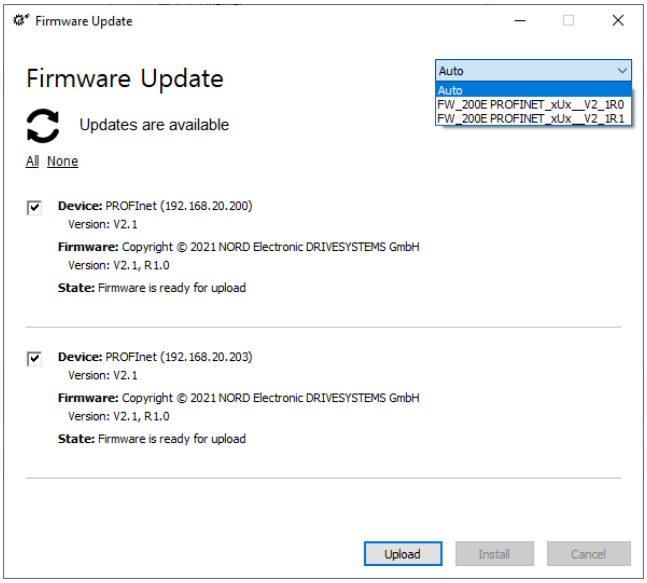


Start the firmware update program under “Update firmware” via the context menu that opens via right click.

4. Firmware update files must be imported into NORDCON once. If no or no newer firmware version has been imported into NORDCON than are available in the devices, the system displays “There are no updates available”.

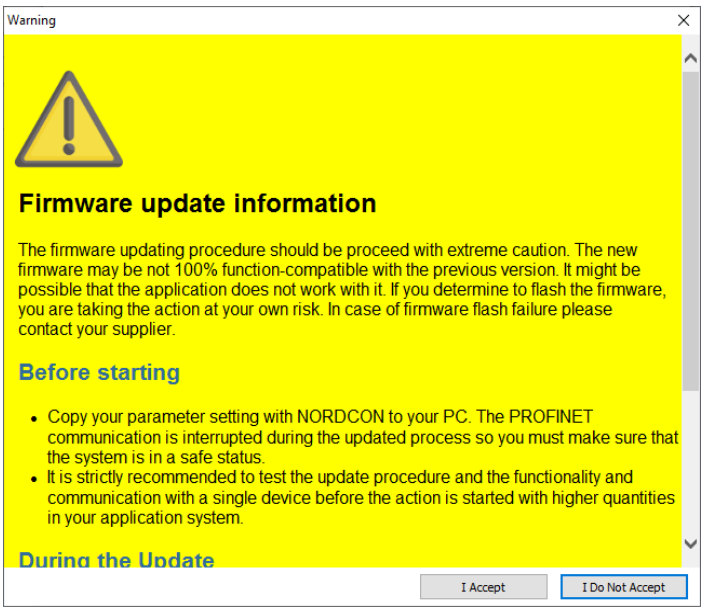


Use the dropdown list above the “Import” button to view the already imported firmware update files. When selecting “Auto”, the firmware is always updated to the latest version. As an alternative, select a specific firmware version.

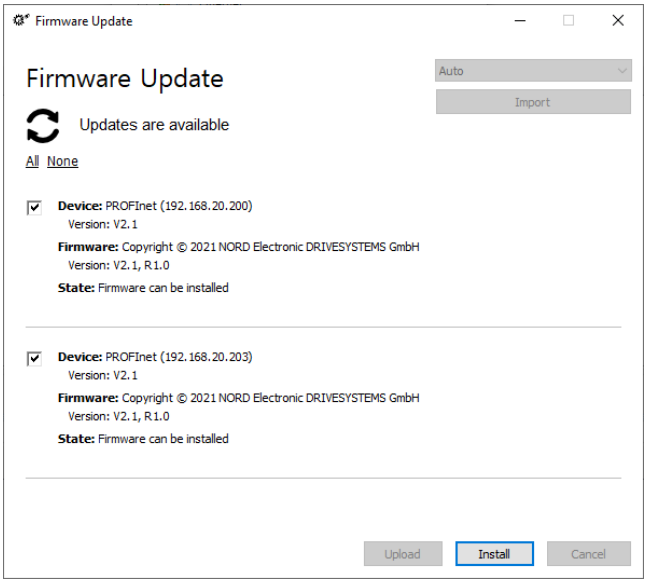


Use the “Import” button to import the firmware update files into NORDCON. The devices that can be updated to the firmware version are displayed in a list in the firmware update program. Use the checkboxes next to the devices to select the devices for an update.

5. Click on “Upload”. Before the device firmware update begins, a warning is displayed. Carefully read the warning information and confirm with the "I accept" button.



6. After a successful upload, the devices switch to the “Firmware can be installed” status and the “Install” button is released.



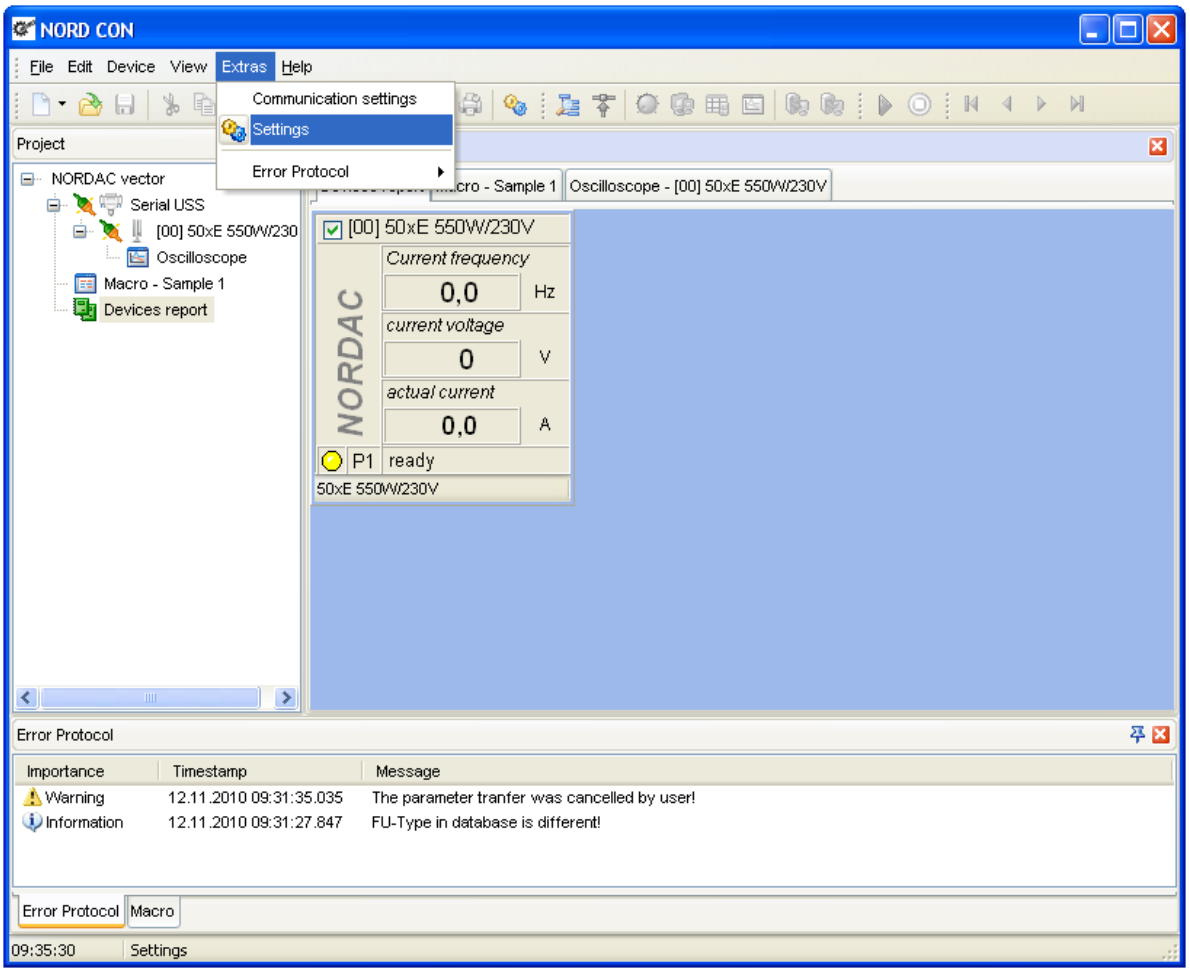
Click on “Install”.

WARNING

Please make sure that the devices’ voltage supply is not interrupted. The installation process is a critical update step that – in cause of failure – may lead to the devices no longer being responsive. In this case, the devices must be returned.

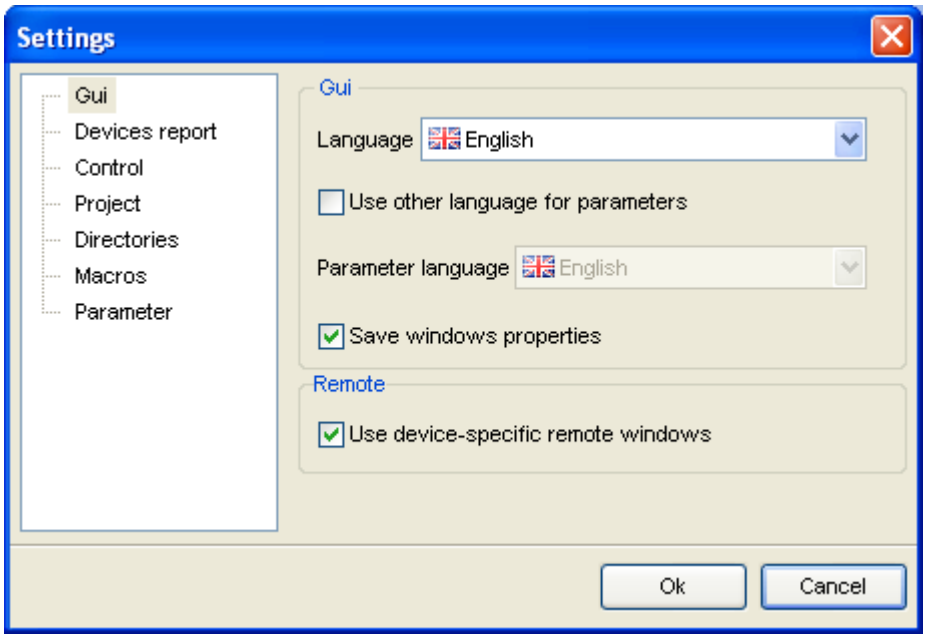
13 Settings

The user can change the current program settings with the menu option "Extras->Settings". The attitudes are divided into the following categories:



13.1 User interface

In this category the user can change the settings of the user interface. The following options are available:



Language

With this option the user can choose the language for the interface.

Use other language for parameter setting

With choice of this option the user can choose a different language for the parameter names in the dialog "Parameterisation" in the choice box "Parameter language".

Parameter language

With this option the user can choose a different language for the parameter name in the dialog “Parameterisation". This choice is activated by the option "Use other language for parameter setting".

Save window setting

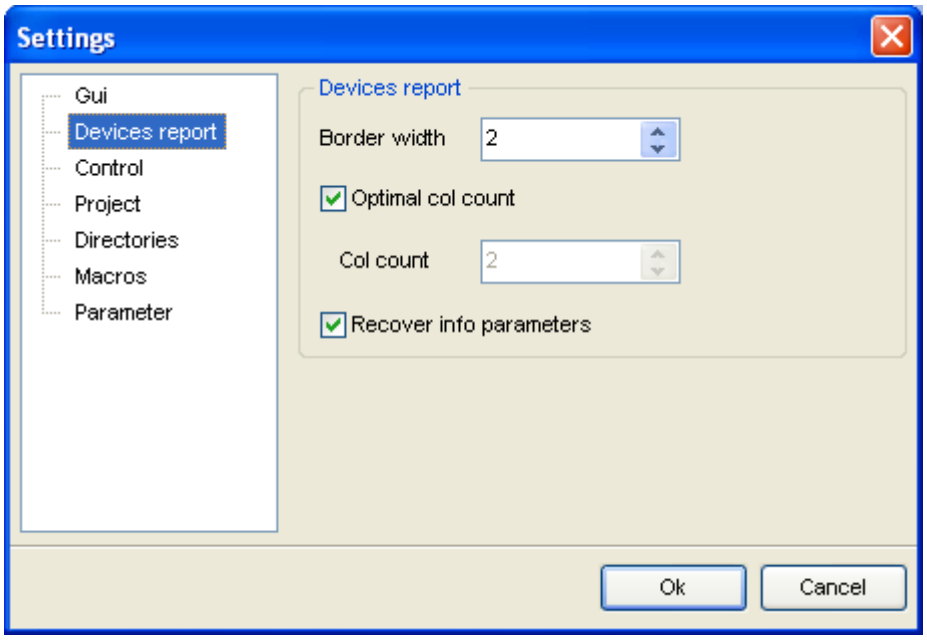
By activation of this option the window settings like position and size is stored and re-activated after opening again.

Use device-specific remote windows

If this option is activated, for each type of device special remote windows are produced. Otherwise the standard window is used.

13.2 Device report

In the category the user can change the settings of the window "Device overview".



Border width

With the parameter the user can change the border width of the device display. A value can be set between 0 and 10 pixels. More largely or if smaller value is registered, the largest or smallest value is used automatically.

Optimal number of columns

If this option is selected then the application calculates the optimal number of columns.

Number of columns

With this parameter the user specifies a firm number of columns. The value can be set between 1 and 10. If a larger or smaller value is registered, the largest or smallest value used automatically.

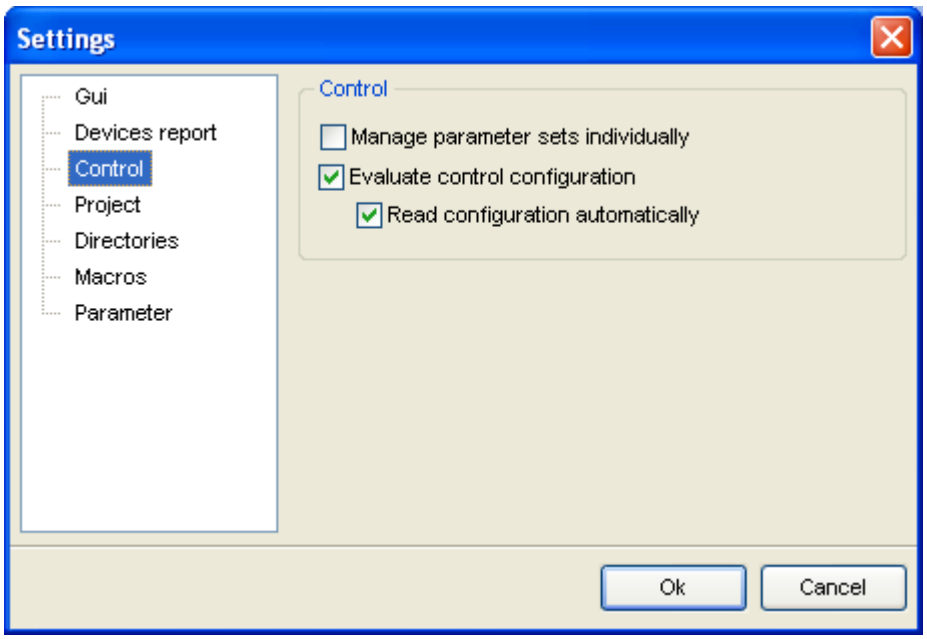
Attention 	This parameter can be only changed, if the option "optimal number of columns" was not selected.

Recover info parameters

If this option is selected, the adjusted info parameters of the device are stored and restored with a bus scan or a restart of application.

13.3 Control

In the category 5 "Control" the user can change the settings of the “Control" window.



Manage parameter sets individually

By activation of the option the setting values and actual values are managed individually in the ”Control" window.

Evaluate control configuration

The option activated or deactivates the control configuration. With this function being active some functions are released or blocked after checking the configuration. Additionally the names of the parameterised setting value functions or actual value functions are displayed in the window in clear text.

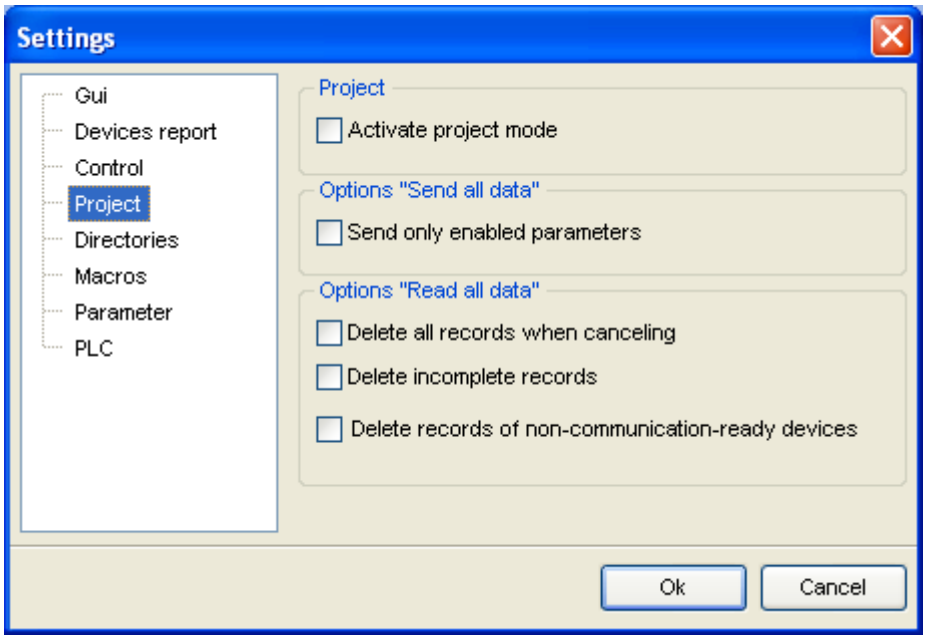
Read configuration automatically

The option activates or deactivates the automatic checking of the configuration. With this function activated the control configuration is checked again after focusing of the window.

NOTE	
	The function "Evaluate control configuration" is not available in all devices!

13.4 Project

In this heading, the user can specify the path for the project file. Settings such as the interface which is used, bus scan settings, device names, etc. are saved in this file. Old settings can be reloaded by selecting an existing file.



Activate project mode

The project mode can be enabled or disabled with this option. In project mode, the user can freely parameterise the type and number of devices on the bus. The device parameters and the settings for the application are saved in a project file.

Only transfer enabled parameters

If this option is enabled, only parameters which have been enabled by the user are sent to the device with the function "Send all Data". As standard, all parameters are always enabled. Enabling of the parameters can be changed in the parameter editor.

Delete all data records on cancellation

If this option is activated, the data records for all of the devices which are included in the project are deleted when the function "Read all Data" is cancelled.

Delete incomplete data records

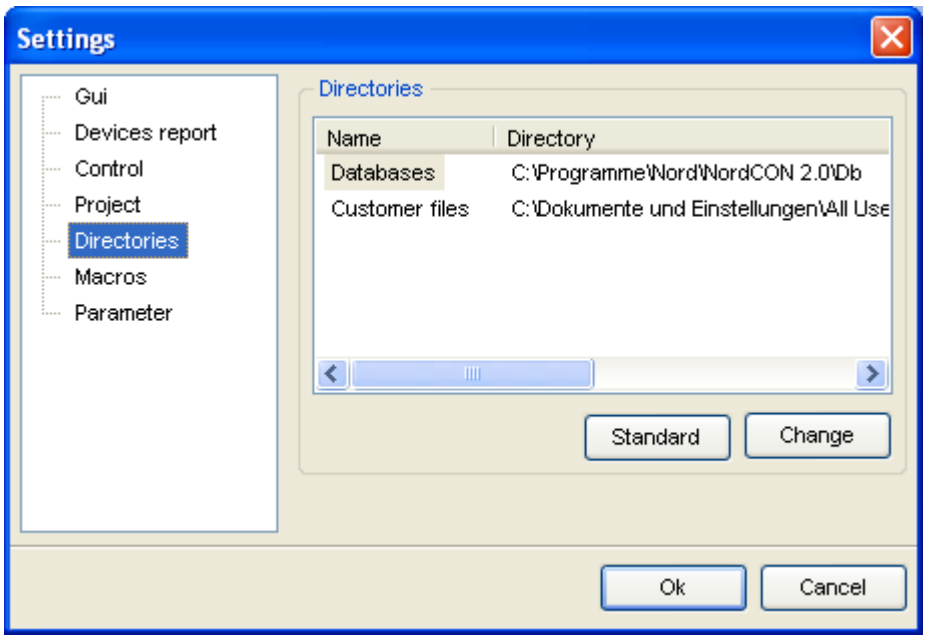
If this option is enabled, the data record for a device is deleted if an error occurs during the function "Read all Data".

Delete data records from devices not ready for communication

If this option is enabled, the data record for a device is deleted if there is no communication with the device during execution of the function "Read all Data".

13.5 Directories

In this heading the directories in which the parameter databases, configuration files, macro files and internal databases are located can be set. In order to change one of the paths, the required directory must be highlighted in the list. A new path can be selected by clicking on the "Change" button. The standard directory for each category can be entered with the aid of the "Standard" button.



Customer files

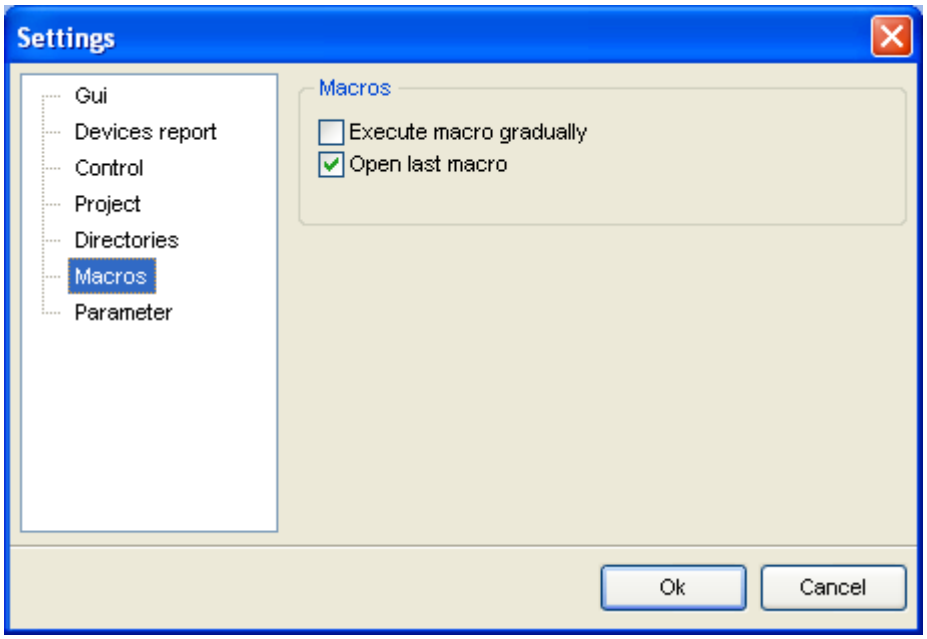
All customer-specific files, e.g. macros or parameter files are saved in this directory.

Internal databases

These databases are required for the internal execution of the program. The parameter structure for the particular frequency inverter families is saved in these databases.

13.6 Macro editor

In the category you can choose settings of 8 "Macro editor" .



Macro execution step by step

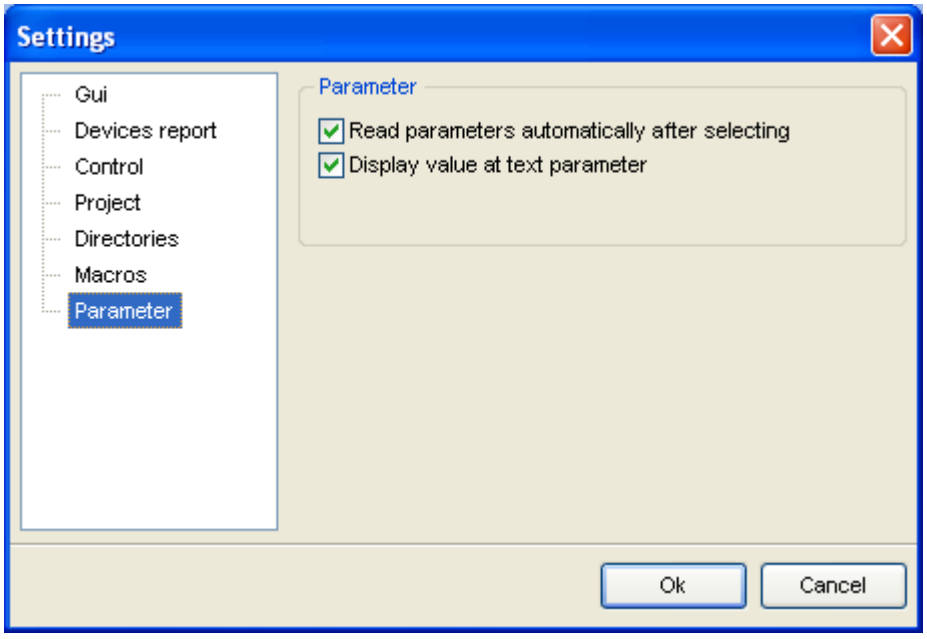
The option activates or deactivates the macro execution step by step. With this option being activated each macro step must be activated separately (cycle/start).

Open last macro

The option activates or deactivates the function to load the last opened macro.

13.7 Parameter

In the category you can choose settings of the 4 "Parameterization".



Read parameter automatically after selection

The option activates or deactivates the automatic reading of a parameter after selecting.

Show also the value with text parameter

The option activates or deactivates the display of numerical value with a text parameter.

13.8 PLC

Delete old log entries before compiling

Is this option enabled, the old log entries are deleted before compiling.

Jump to current breakpoint (debug mode)

Is this option enabled, the line of the current breakpoint is moved into the visual range.

14 Messages

14.1 Errors and information

A text and an error code are displayed for all errors and information

The messages have the following meanings:

No.	Description
100	Impermissible parameter number
101	Parameter valued cannot be changed
102	Parameter limits exceeded
103	Impermissible sub-index
104	No array parameter
105	Description cannot be changed
106	No description available
107	Reception timeout
108	Transmission timeout
109	Received data incorrect
110	Order label unknown
150	Reception timeout gateway
153	Device password protection (P4) is active
154	Safety password protection (P497) is active
155	Order label unknown (gateway)
156	Response label unknown
157	Reception timeout
158	Transmission timeout
159	Reception buffer has faulty data
160	Response and order differ
161	RAM area not active **Information** The error only occurs if a subsystem is not available. Check if the voltage is correctly connected.

No.	Description
162	Write parameter via TCP disabled (P853) **Information** Writing of parameters is disabled in the device. Use the parameter P853 to set the access to the parameters.
163	Parameter cannot be changed via Ethernet.
200	Error when opening the serial interface!
201	Error when closing the serial interface!
202	First close the previous interface!
203	Interface not open!
204	Communication module settings could not be set. Check whether the present baud rate is supported.
205	Buffer error!
206	Time out setting error!
207	No communication possible!
208	Internal object error!
210	Error writing the file!
211	Telegram cannot be generated!
212	No high-resolution timer found!
213	No device found!
214	Only 16-bit setpoint possible!
215	FI is in operation. Close window?
216	Firmware can only be updated if the device has the address 0!
217	Program to update the firmware cannot be started! Please re-install NORDCON to remedy the problem.
218	Please enter a communication module!
219	Do you want to import the file in the online view?
220	No device can be added at this point!
221	More than 1 device found on the bus. An update may cause problems. Do you wish to continue?
222	Control data will be inconsistent if macros and control windows are used simultaneously. Please close all control windows or the macro editor.
223	Transfer cannot be started because the parameter editor is open! Please close the editor and re-start the function.
224	Online help cannot be found! Please re-install NORDCON to remedy the problem.
225	Device cannot be disconnected because at least one window for the device is open.

No.	Description
226	File cannot be opened. Unknown file format.
227	File cannot be read!
228	Unknown file format!
229	File has been changed by the user!
230	Action cannot be executed because the device is not connected!
231	The settings have been changed. Do you wish to save the changes?
232	Your computer does not support the display of Chinese characters. Display errors may occur!
233	Value cannot be changed to an INT 16!
234	The present version of the device does not support firmware updates via the system bus!
235	The present version of the technology unit does not support firmware updates via the system bus!
236	The device at address 0 does not support firmware updates via the system bus!
237	PLC not registered! Please contact Support (+49 (0)180 500 61 84).
238	Incorrect registration code! Please contact Support (+49 (0)180 500 61 84).
239	Firmware download can only be executed with a baud rate of 38400 baud!
240	Report cannot be printed because no printer is installed!
241	File cannot be found in your system!
242	The current version of the TU3 technology unit does not support firmware updates!
243	No further devices can be added!
244	Project has changed! Do you wish to save the project?
245	Connection to device %s cannot be established!
246	No PLC program found for device %s!
247	No Parameter found for device %s!
248	Project transfer cancelled by user!
249	At least one error has occurred during the project transfer!
250	At least one warning has occurred during the project transfer!
251	Invalid IP address entered!
252	No further devices can be added!
253	File corrupt or has been tampered with!
254	Firmware update not possible via "TCP in USS" mode!
255	The changes require a bus scan! Do you wish to adopt the changes?
256	Project file cannot be found!
257	Please enter a bus extension unit!
258	Not all of the settings could be transferred to the selected bus extension unit? Do you wish to continue?

No.	Description
259	An error has occurred during the writing process!
260	PLC program for device %s is not correct!
261	No project file has been created! Do you want to save the project now?
262	Entered IP address in use!
263	Directory cannot be found!
264	The text cannot be converted into a byte array!
265	The USS telegram is not correct!
266	The PLC program can only be loaded to the device!
267	Do you wish to overwrite the existing PLC program?
268	The PLC program is secured and can only be loaded to the device!
269	Communication type changed. All devices have been deleted from the list! Do you wish to continue?
270	The Midas.dll is too old. The DLL was overwritten by another application with an older version. Delete the DLL and re-install NORDCON.
271	Midas.dll is not installed. The DLL was deleted by another application. Please reinstall NORDCON.
300	The path for the internal database must be corrected!
301	Incorrect path for the internal database. NORDCON will now be ended
302	Error when opening the databases!
303	Incompatible FI type in the database!
304	Different FI type in the database!
305	Save current database?
306	Database cannot be opened!
307	Impermissible path!
308	Database cannot be saved!
309	Read out all parameters immediately?
310	Please update NORDCON! Correct parameterisation is not guaranteed.
311	Printer not installed correctly!
312	Only 1 parameter window is permitted at a time. Display opened window?
313	The parameter window must be closed in order to end the program!
314	The parameter window must be closed in order to execute the device search!
315	A parameter comparison can only be saved as a PDF.
316	The parameter has not been permanently saved in the device. Do you still wish to exit?
317	Start address must not be greater than the end address!
318	Not all i parameters are current. Please execute "Read all".

No.	Description
319	Not all changed values have been transferred!
320	Not all i parameters are selected. Please change the filter!
321	NORDCON does not work correctly. Please reinstall NORDCON!
322	Parameter cannot be found!
323	The parameter value cannot be converted.
327	Not all i parameters are known.
328	CRC for I parameter cannot be calculated!
400	File cannot be loaded because the file version is unknown!
401	File cannot be loaded because the file format is unknown!
402	File has been changed by the user!
403	Error when opening the file!
405	No macro file!
406	Macro list empty!
407	Macro list executed!
408	Jump target not found!
409	Function cannot be executed because the scheduler has been started.
410	Do you wish to save the changes to the macro?
411	File has been changed by the user! Do you wish to open the file?
500	Only load settings?
501	The device types are different! Do you wish to open the file?
502	File cannot be opened because the version of the file format is unknown!
503	File cannot be opened because the file format is unknown!
504	File has been changed by the user! Do you wish to open the file?
600	Control of the device is restricted or not possible for the following reason: the control word (P509) is not configured for USS!
601	Control of the device is restricted or not possible for the following reason: setpoint source 1 (P510.0) is not configured for USS!
602	Control of the device is restricted or not possible for the following reason: setpoint source 2 (P510.1) is not configured for USS!
603	Control of the device is restricted or not possible for the following reasons: the control word (P509) and setpoint source 1 (P510.0) are not configured for USS!
604	Control of the device is restricted or not possible for the following reasons: the control word (P509) and setpoint source 2 (P510.1) are not configured for USS!
605	Control of the device is restricted or not possible for the following reasons: setpoint sources 1 (P510.0) and 2 (P510.1) are not configured for USS!

No.	Description
606	Control of the device is restricted or not possible for the following reasons: the control word (P509) and setpoint sources 1 (P510.0) and 2 (P510.1) are not configured for USS!
700	Action cannot be executed because the connection to the device is interrupted!
701	Action cannot be executed because access is disabled!
800	Action "Transfer parameters" successfully completed.
801	Errors have occurred during the action "Transfer parameters"!
802	Action "Transfer parameters" has been cancelled by the user!
803	Errors have occurred during the action "Transfer parameters"! Do you wish to save?
804	Action "Transfer parameters" has been cancelled by the user! Do you wish to save?
805	Differences have been detected! Do you wish to view the report?
806	Creation of the report cancelled by the user!
807	Connection to the device will now be re-established! Do you wish to continue?
808	A parameter is not available!
809	Parameter limit exceeded!
810	Parameter limit undershot!
811	Error during import of motor data!
900	Only a maximum of 5 variables can be entered in the observation list!
901	File must be saved before it can be converted. Do you wish to create a new file?
902	File cannot be opened because the file format is unknown!
903	File cannot be read!
904	File has been changed by the user! Do you wish to open the file?
906	PLC program must be saved before programming!
907	The PLC program has been changed! Do you wish to save?
908	The settings have changed! Do you wish to save?
909	PLC format 1.0 is not supported.
910	The PLC program could not be saved!
1100	All data records have been deleted (cancellation by user)!
1101	An incomplete data record for the device has been deleted!
1102	An incomplete data record for the device has been saved!
1103	The data record for a device which is not ready for communication has been deleted.
1104	No parameters have been saved for the device.
1105	Factory settings cannot be loaded!
1106	The parameter number cannot be read (line [x])!

No.	Description
1107	The index cannot be read (line [x])!
1108	The parameter set number cannot be read (line [x])!
1109	Line [x] cannot be read!
1110	The file contains no parameters
1200	Terminal assignment is incompatible on the target device. **Information** Digital functions for up to eight digital inputs can be configured in the source device. Without an expansion module the target device has six digital inputs. Please check whether the functions in digital inputs 7/8 can be implemented on other inputs and adjust P420 and P475 accordingly. or The input assignment for connecting an HTL rotary encoder is different on the target device (DI2/3 -> DI3/4). Please adjust the hardware connection of the HTL encoder and the parameterisation of the digital inputs 3 and 4 in P420 accordingly.
1201	Evacuation run is not supported by the target device. **Information** The “Evacuation mode” function is not supported by the target device. Please contact the customer support.
1202	Pulse frequency below the minimum value permissible for the target device. **Information** A pulse frequency below 4 kHz was set in the source device. The value for the target device is outside the permissible range. Please adjust the pulse frequency in P504 accordingly.
1203	USS baud rate is not available in the target device. **Information** A baud rate of 230400 baud or 460800 baud was selected in the source device. These settings are not supported by the target device. Please adjust P511 accordingly.
1204	ProfiBus is not available in the target device.
1205	InterBus is not available in the target device.
1206	DeviceNet is not available in the target device.
1207	Automatic conversion of reserved parameter values is not supported.

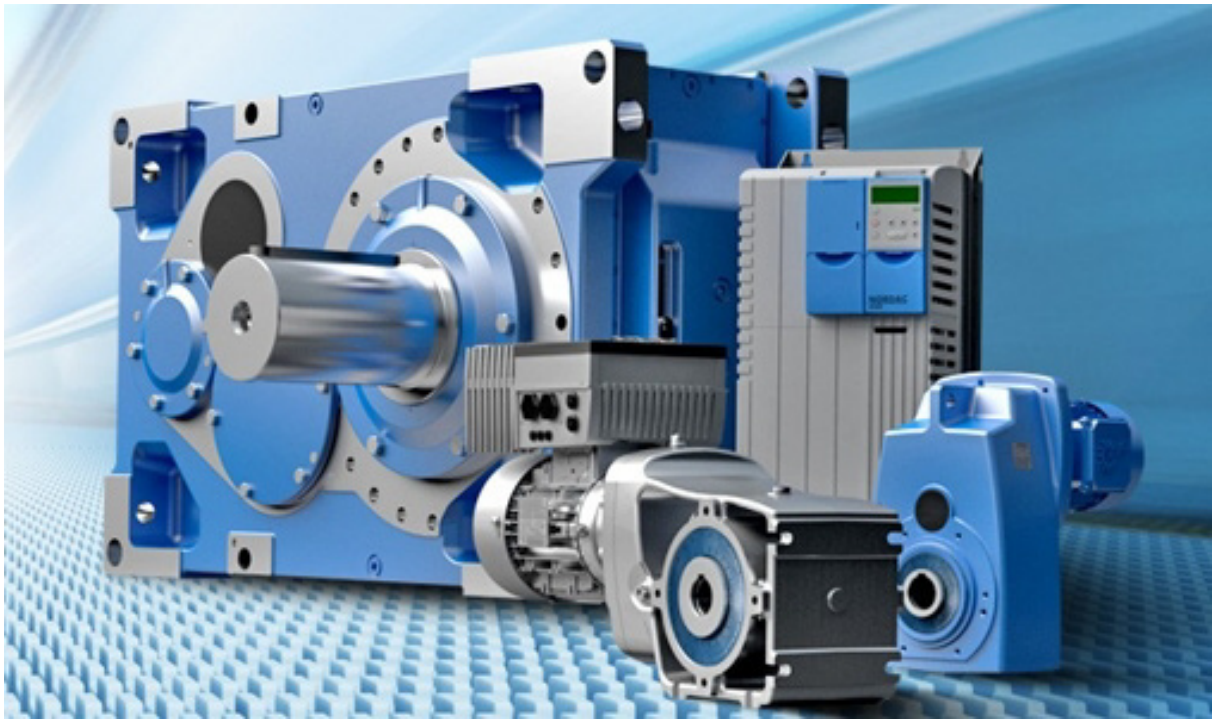
No.	Description
	Information You have entered a parameter value that was previously without function. The value now corresponds to a function in the target device. The values of the corresponding function remain in the factory setting during conversion in the target device.
1208	Maximum position outside the permissible value range in the target device. **Information** For rotary axes / turntable applications, a negative overrun point could be set in the target device via P615 (for TTL encoder) or P620 (for HTL encoder). The configuration for such applications with negative position value range is different in the target device. The overrun point can now be set in the target device for a TTL encoder in P620[1] and for a HTL encoder in P620[2] in a range from 0 to 50000 rev. Please adjust parameters P615 and P620 according to your application.
1209	Analogue function of digital input 2 and 3 must be configured manually in the target device. **Information** Evaluation of pulsed digital signals (analogue function of digital input) can only be carried out in the target device at digital input 3. Please configure the options 81 or 82 in P420[3] for this. The analogue function can then be set in P400[9].
1210	Manual configuration of the Hiperface encoder via parameter P301[3] required in the target device.
1211	Monitoring of a fourth option module is not supported by the target device.
1212	Manual configuration for the CANopen encoder is not supported by the target device. **Information** The manual configuration of the CANopen encoder is not supported by the target device. Please check whether an automatic configuration (P604 = 3) is possible.
1214	Converter error
1215	New parameter list cannot be generated.
1216	No suitable converter available.
1217	The parameter list cannot be loaded.
1218	Not all required parameters are set.
1219	No suitable device could be found! The standard device has been used.
1220	Connection of the temperature sensor via dedicated PTC thermistor input on the target device is recommended.
1221	Conversion with the device version less than [x] is to be checked separately!

No.	Description
	Information The conversion is designed for the devices SK5xxE from version 3.2 and SK540E from version 2.4. Older versions are not fully supported and must be checked separately. The functionality of the conversion may be limited because not all required parameters are available in older versions.
1301	Downloading the firmware is not possible as the access via TCP is not allowed (P853[2]).
1302	Installation is not possible as the access via TCP is not allowed (P853[1]).

15 NORD DRIVESYSTEMS

NORD on the road to success

NORD was founded in 1965 and now has net sales of approximately 460 million Euro. Our successful climb to the elite list of gearmotor manufacturers is due to our strategy to listen to and work closely with our customers. Together with the help of our customers we have created optimal drive solutions and have had solid growth as a company as well.



Global Knowledge and Local Support

NORD gear is represented in over 60 countries in the world. With more than 3,100 employees to ensure minimum short lead times and fast customer service, you can expect to receive your drive and have your questions answered regardless of your geographic location.

Putting Everything in Motion

With our powerful drive solutions, we put even the “Goliaths” of this world into motion: huge cranes in harbor facilities, retractable roofs sports stadiums, luggage conveyor belts in airports and ski lifts. No matter what your application is, NORD is sure to put it into motion

Motoring Ahead

Our products embody an innovative combination between compact mechanics and intelligent electronics. We market and produce a complete product line of mechanical and electronic drive components including, quality gear reducers, motors, frequency inverters, servo controllers and decentralized drive technology.

Moving Together

Our high quality and service standards result from our customer focus. We develop precise fitting, innovative drive solutions based on customer input. Together, NORD and our customers are building long term successful business relationship.

15.1 NORD DRIVESYSTEMS corporate history

Ever since NORD was founded in 1965, all companies of the group have adhered to the common strategy of satisfying the demands of our customers.	
	
1977	Construction of a modern gear production factory
1979	Establishment of worldwide subsidiaries and the expansion of assembly centres
1980	NORD's UNICASE™ "leak-proof" housing design introduced
1983	Construction of NORD's first motor manufacturing facility
1985	Construction of NORD's first frequency inverter manufacturing facility
1992	Machining factory for castings & steel components built.
	
1997	Construction of motor manufacturing plant in Italy
1998	New assembly plant in France
2000	New assembly plants in Great Britain and Austria
2001	New assembly plant in China
2002	Additional new assembly plant in China
2003	Construction of an assembly plant in Russia
2004	Construction of a new motor plant in Italy
2005	40 years of Nord Gear Opening of the high-rack storage system in Bargteheide, Germany

	Construction of a new assembly centre in China.
2006	New production plant for electronic products opened in Aurich, Germany
2007	Construction of new assembly plants in India and Czech Republic
2008	Expansion Getriebebau NORD, Bargteheide - Construction of a parking garage
	
2009	Expansion at Getriebebau NORD, Bargteheide - Construction of a next high rack storage - Construction of an assembly centre for industrial gear units
2011	NORD DRIVESYSTEMS celebrates the inauguration of the fourth construction stage of the production facility in Gadebusch and the 25th anniversary of NORD GEAR Ltd in Brampton, Canada. In China, NORD celebrates the opening of a second factory in Tianjin, about 100 km south-east of Beijing, while on the fifth continent, the NORD Australian subsidiary is opening in Darwin.
2012	At present NORD DRIVESYSTEMS is represented by 35 subsidiaries throughout the world. The NORD sales and service network is supplemented by sales and service partners in more than 60 countries. With a highly motivated team of employees and a complete range of technologically excellent and high quality drive technology products, the company is ideally equipped to face the challenges of the future.
2013	New construction of a further production facility in Souzhou
2014	Modernisation of the service area and the painting plant at the headquarters in Bargteheide
	
2015	50th company anniversary Construction of a new office building

15.2 Frequency Inverters

15.2.1 SK 135E

Performance: 0.25 .... 7.5 kW

SK 135E – Decentralised motor starter

Many applications, including those in the field of material handling require electronic starting and stopping of the drive units. NORD has developed the new, innovative motor starter SK 135E for this. Due to its versatility, not only motor starting functions, but also gentle starting or reversing mode are possible.Extensive monitoring functions e.g. protect against overheating. Thanks to the I2t triggering characteristic, a motor protection switch is not required. The integrated mains filter of the motor starter SK 135E (with motor-mounting) meets the very highest EMC requirements.

Features and Characteristics

- Gentle start function
- Reversing function
- Motor or wall-mounting
- IP55, (optional IP66)
- Power range: 3~ 200 240V from 0.25 kW to 4.0 kW 3~ 380, 500V from 0.25 kW to 7.5 kW
- Control and connection of an electromechanical brake
- Integrated mains filter (EMC Class C1 / C2)
- 2 digital inputs
- 2 digital outputs

- Temperature sensor input (TF+/TF-)
- RS232 interface via RJ12 plug
- Optional ATEX Zone 22 3D (in preparation)

Please find further details for the motor starter SK 135E here

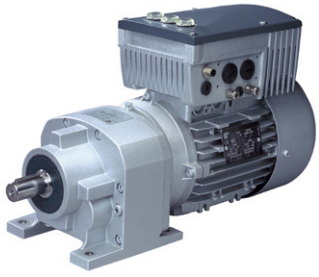
15.2.2 SK 180E

Performance: 0.25 .... 2.2 kW

SK 180E - economical decentralised frequency inverter

The SK 180E is the answer for all applications in the lower power range, where the main task is speed control. Tried-and-tested NORD know-how is used, so that the proven sensorless current vector control ensures an optimum voltage/frequency ratio at all times. The SK 180E achieves significant advantages for EMC classification. Because of this, a motor-mounted frequency inverter with an integrated mains filter can even be used in a residential environment (Class C1).

15.2.3 SK 200E



NEW - The SK 200E for distributed control versatility 0.33 - 30 hp

After many years of experience with motor-mounted AC Vector drives, with the release of the SK 200E NORD has now introduced a new series of devices which enable a wide range of decentralised drive technology solutions. These robust, reliable and economic systems are suitable for extensive use in plant applications such as conveying and are specially optimised for price sensitive market segments. Similar to the SK 500E panel mount series, an application-oriented performance level is available which offers the same high quality functionality. Expected features of decentralised components such as robust design, integration of plug connectors, rapid replacement and decentralised modules for communication and I/O signals ensure reliable integration of distributed drive units at the field level.

Scope of supply - SK 200E:

- 1~ 115 V 0.25 – 0.75 kW
  1~ 230 V 0.25 – 1.1 kW
  1~ 230 V 0.25 – 4.0 kW
  3~ 480 V 0.55 – 7.5 kW
- Wall-mounted version
- Decentralized modules (also with gateway functionality)

IP55 protection class as standard. Optional:

- Size 1 - 3: IP66 (components with "C" = coated)
- Size 4: Component with "C" = coated, with retention of protection class IP55
- Size 1 - 3: ATEX Zone 22, 3D or harsh ambient conditions

SK 205E Basic Unit

- High quality control process through sensorless current vector control (ISD)
- External 24DCV control card supply
- 4 control inputs, which can be parameterised to various digital functions
- Externally visible status LEDs (signal state of control inputs) externally adjustable setpoint potentiometers
- Plug-in memory storage module (EEPROM)
- Automatic motor parameter identification
- Four parameter sets, switchable online
- Incremental encoder evaluation (HTL)
- Regenerative, 4 quadrant generator 4Q operation possible by means of optional braking resistor
- PID controller and process controller
- RS 232 & RS485 (RJ12 connector) diagnostic interface

Motor potentiometer function

SK 215E

- Basic equipment – as SK 205E (see above)
- Safety function “Safe stop” as per EN 954-1 (EN13849) up to max. Category 4, Stop category 0 and 1.

SK 225E

- Basic equipment – as SK 205E (see above)
- ASi interface on board

SK 235E

- Basic equipment – as SK 205E (see above)
- Safety function “Safe stop” as per EN 954-1 (EN13849) up to max. Category 4, Stop category 0 and 1.
- ASi interface on board

15.2.4 SK 500E

Performance:	0.25 .... 2.2 kW 1/3 AC 200 ... 240 V 3.0 .... 18.5 kW 3 AC 200 ... 240 V 0.55 .... 90 kW 3 AC 380 ... 480 V 0.25 .... 160kW
Output frequency:	0 ... 400 Hz
Manuals	SK 5xxE SK 54xE

Key word index

P

Headquarters
Getriebebau NORD GmbH & Co. KG
Getriebebau-Nord-Str. 1
22941 Bargteheide, Deutschland
T: +49 45 32 / 289 0
F: +49 45 32 / 289 22 53
info@nord.com

6070002 / 1422