Operating Instructions

Programmable
SyncPos motion controller

VLT 5000

VLT 5000 FLUX

Programmable SyncPos motion controller for VLT®5000 and VLT®5000Flux

This instruction manual covers two versions of the programmable SyncPos motion controller:

Ordering number	Description	Type code
175Z0833	SyncPos for VLT5000	A10 C0
175Z3029	SyncPos for VLT5000 with conformal coating	A10 C1
175Z3683	SyncPos for VLT5000Flux	A10 C0
175Z3684	SyncPos for VLT5000Flux with conformal coating	A10 C1

The basic functionality of the two versions is the same, the only differences are:

- The Flux version has two additional outputs on the VLT5000Flux control card.
- The Flux version does not yet support absolute encoders.

This instruction manual is valid for the following software versions:

SyncPos PC software version 6.5X
VLT5000/SyncPos software version 3.7/5.0X
VLT5000Flux/SyncPos software version 5.XX/5.0X

■ The voltage of the frequency converter is dangerous whenever the equipment is connected to mains. Incorrect installation of the motor or the frequency converter may cause damage to the equipment, serious personal injury or death.
Consequently, the instructions in this manual, as well as national and local rules and safety regulations, must be complied with.

■ Safety regulations

1. The VLT frequency converter must be disconnected from mains if repair work is to be carried out.
   Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
2. The [STOP/RESET] key on the control panel of the VLT frequency converter does not disconnect the equipment from mains and is thus not to be used as a safety switch.
3. Correct protective earthing of the equipment must be established, the user must be protected against supply voltage, and the motor must be protected against overload in accordance with applicable national and local regulations.
4. The earth leakage currents are higher than 3.5 mA.
5. Protection against motor overload is not included in the factory setting. If this function is desired, set parameter 128 to data value *ETR trip* or data value *ETR warning.*
   Note: The function is initialised at 1.16 x rated motor current and rated motor frequency.
   For the North American market: The ETR functions provide class 20 motor overload protection in accordance with NEC.
6. Do not remove the plugs for the motor and mains supply while the VLT frequency converter is connected to mains. Check that the mains supply has been disconnected and that the necessary time has passed before removing motor and mains plugs.
7. Please note that the VLT frequency converter has more voltage inputs than L1, L2 and L3, when loadsharing (linking of DC intermediate circuit) and external 24 V DC have been installed.
   Check that all voltage inputs have been disconnected and that the necessary time has passed before repair work is commenced.

■ Warning against unintended start

1. The motor can be brought to a stop by means of digital commands, bus commands, references or a local stop, while the frequency converter is connected to mains.
   If personal safety considerations make it necessary to ensure that no unintended start occurs, these stop functions are not sufficient.
2. While parameters are being changed, the motor may start. Consequently, the stop key [STOP/RESET] must always be activated, following which data can be modified.
3. A motor that has been stopped may start if faults occur in the electronics of the VLT frequency converter, or if a temporary overload or a fault in the supply mains or the motor connection ceases.

Warning:

Touching the electrical parts may be fatal - even after the equipment has been disconnected from mains.
Also make sure that other voltage inputs have been disconnected, such as external 24 V DC, load-sharing (linkage of DC intermediate circuit), as well as the motor connection for kinetic back-up.

Using VLT 5001-5006 220 and 500 V units: wait at least 4 minutes
Using VLT 5008-5500 220 and 500 V units: wait at least 15 minutes
Using VLT 5001-5005 550-600 V units: wait at least 4 minutes
Using VLT 5006-5022 550-600 V units: wait at least 15 minutes
Using VLT 5027-5250 550-600 V units: wait at least 30 minutes

Chapter 2

About this manual: How is it arranged?

Please read these operating instructions in full and, in order to be able to work with the system safely and professionally, particularly observe the hints and cautionary remarks.

⚠ Indicates a general warning

☝ Indicates something to be noted by the reader

⚡ Indicates a high-voltage warning

Chapter Input/output terminals

Information on the technical data of the option card, the allocation of the connecting terminals and the general connection requirements can be found in this chapter.

Fundamentals of the SyncPos program

First, let us explain the principle of SyncPos, the macro programming language, to you in brief. Then you will learn about the fundamentals of the SyncPos program – this is particularly important if you are not familiar with SyncPos or Windows.

Starting the SyncPos-Option step-by-step

Then you will start up the VLT with the 'SyncPos Motion Controller step-by-step'. This section offers you a quick general introduction which includes turning on the SyncPos option and familiarizing yourself with it, as well as starting operation of the control unit with the test programs provided and the most important basic settings.

Optimizing the PID-Controller

In this chapter you learn all about the PID control parameters and how to optimize the controller during one or more test runs, for example, in order to achieve better positioning results or shorter cycle times. Detailed instructions on how to proceed can be found in the section 'Ten steps for optimum control'.

CAM control and CAM box

This section explains the basics of CAM control and of CAM box. The editing of curves and the programming of controls can be reconstructed in detail with the included examples.

Chapter PC-Software Interface

All menus and functions are described in detail. For example, the Development menu to test the new programs or the Controller menu used to manage the programs and set the parameters and the CAM-Editor.

Chapter PC Software Interface in MCT10-Mode

SyncPos behaves different, if started directly by clicking on the application's icon or if started indirectly by opening up a program or configuration file via the Motion Control Tool MCT10. The main differences are related to the fact that all file handling is limited to MCT10 only. These limitations concerning the SyncPos GUI are explained in this chapter, e.g. how to open and save files or how to edit a cnf-curve or set parameters.

Chapter Programming with SyncPos, Software and Parameter Reference

You can learn everything about programming and about the commands in these chapters, ranging from the basic construction of the commands to a detailed description of all commands from ACC to #INCLUDE and also of the parameters.
First look in the general summary – here the commands are sorted according to groups, for example, control commands, commands for velocity control or for synchronization – and then look in the alphabetically ordered list where the commands are described more precisely.
The next section describes all parameters – first in alphabetical order in the summary – and then individually with the factory settings and ranges.

Chapter Messages and Error Reference

In the chapter for Messages and Error Reference an extra section is dedicated to messages from the VLT. The table is arranged according to error number in increasing order. It contains detailed information on possible errors and troubleshooting. The next section explains the most important messages from the SyncPos user interface.

Chapter Program samples

The manual presents some program samples (you will find much more in the online help) which you can use to familiarize yourself with the program or copy directly into your program.

Appendix

A short glossary explains used terms.

Get a quick overview on news in Version 2.5x and in the corresponding versions of the SyncPos Motion Controller in the appendix. These are primarily the necessary extensions and a modified GUI to use the SyncPos program in MCT10 mode.

Please consider also the news around marker filter and marker correction, which provide the current version.

Experienced users will find detailed information in the technical reference material for example the „Array Structure of CAM Profiles".

Plus, the handbook ends with a detailed index for a direct navigation.

Conventions

The information in this manual follows the system and uses the typographical features described below to the greatest extent possible:

Menus and functions

Menus and functions are printed in normal text with capitals, for example: "CONTROLLER" → "PARAMETERS".

Commands and parameters

Commands and parameter names are written in capitals, for example: AXEND and KPROP; Parameters are printed in bold faced italics, for example: ***Proportional factor***.

Variables

Variables are written in small letters, when they are being quoted they are emphasized with italics, for example: timeout or *timeout*.

Keys

The names of keys and function keys are emphasized in brackets, for example the control key [CNTL] key (or just [CNTL]), the [ESC] key or the [F1] key.

Cross references

Cross references to other parts of the text are underlined in the manual and are also marked in color in the online help, for example EXECUTE.

Chapter 3

■ Input/Output terminals

There are two interfaces to the SyncPos option:

- 36 terminals on the option card
- 24 terminals on the VLT control card

VLT control card terminals

The terminals on the control card can be allocated for synchronizing and positioning functions if the following parameter settings are made:

Digital inputs 16, 17, 18, 19, 27, 29, 32 and 33:

It is always possible to read the status of the digital inputs from the SyncPos application program with the IN command.
If Parameter 300–303 and 305–307 are set to "No operation" (default setting) then the inputs are ignored by the control card but they can still be used as inputs to the application program.
Parameter 304 can not be set to "No operation" which means that input 27 always has a stop function. There is one way to avoid this: Leave parameter 304 at "Coast inverse" and select "Serial port" in parameter 502.

Analogue inputs 53, 54 and 60:

It is always possible to read the value on the analogue inputs from the SyncPos application program with the INAD command.
If parameters 308, 311 and 314 are set to "No operation" then the inputs are ignored by the control card but they can still be used as inputs to the option card.

VLT5000: Digital/analogue outputs 42 and 45:

Outputs 42 and 45 can be controlled from the SyncPos application program with the OUTDA command, when parameters 319 and 321 are set to one of the following four settings:

OPTION DIGITAL	[90]	digital output
OPTION 0 ... 20 mA	[91]	analogue output (default setting)
OPTION 4 ... 20 mA	[92]	analogue output
OPTION 0 ... 32000P	[93]	pulse output

VLT5000Flux: Digital/pulse outputs 26 and 46

The outputs 26 and 46 on the VLT5000Flux control card can be controlled from the SyncPos application program with the OUTDA command when parameters 341 and 355 are set to one of the following settings:

OPTION DIGITAL	[90]	digital output
OPTION 0...50000P	[91]	pulse output

VLT5000Flux: Analogue outputs 42 and 45

The outputs 42 and 45 on the VLT5000Flux control card can be controlled from the SyncPos application program with the OUTDA command when parameters 319 + 321 are set to one of the following settings:

OPTION 0 ... 20 mA	[90]	analogue output 0...20mA
OPTION 4 ... 20 mA	[91]	analogue output 4...20mA

Relay outputs 01 and 04:

The relay outputs can be controlled from the SyncPos application program with the OUT command when parameters 323 and 326 are set to the default setting
CTRL WORD BIT 11/12

Technical data

Technical data on the control card terminals can be found in the VLT 5000 design guide.

Option card terminals

There are two encoder interfaces which are covering the following functions:

- Feedback encoder input
- Master encoder input / virtual master output

There are 8 digital inputs, 8 digital output and terminals for 5 V and 24 V supply. The functions and technical data of the terminals are described in the following.

Terminal description

There are 4 terminal blocks, 2 with 10 poles and 2 with 8 poles. *(See figure below)*

MK3A Digital Inputs

I1	I2	I3	I4	I5	I6	I7	I8	24 V	COM

MK3B Master / Virtual Master

5 V	COM	A1	$\overline{A1}$	B1	$\overline{B1}$	Z1	$\overline{Z1}$

MK3C Digital Outputs

O1	O2	O3	O4	O5	O6	O7	O8	24 V	COM

MK3D Feedback

5 V	COM	A2	$\overline{A2}$	B2	$\overline{B2}$	Z2	$\overline{Z2}$

Digital inputs

MK3A is a 10pole terminal block with 8 digital inputs (I1–I8) and 2 terminals for 24 V supply (*See Supply voltages on page 12)*.

The digital inputs are used by the SyncPos application program and are therefore free programable. All the inputs can also be assigned functions by the following parameters:

I_BREAK (105)	interrupt a running program
I_CONTINUE (106)	restart interrupted program
I_ERRCLR (107)	reset fault
I_NEGLIMITSW (47)	negative limit switch
I_POSLIMITSW (46)	positive limit switch
I_PRGCHOICE (104)	selection of SyncPos program
I_PRGSTART (103)	start of SyncPos program
I_REFSWITCH (45)	home switch

Only two of the inputs are assigned a specific function by parameter:

- *I5* is used as marker input for the Master when "*External marker signal*" is selected in parameter SYNCMTYPM (60).
- *I6* is used as marker input for the Slave when "*External marker signal*" is selected in parameter SYNCMTYPS (61).

Digital outputs

MK3C is a 10pole terminal block with 8 digital outputs and 2 terminals for 24 V supply (*See Supply voltages on page 12*).

The digital outputs are controlled by the SyncPos application program and are thus free programable. All the outputs can also be assigned functions by the following parameters:

O_AXMOVE (64)	axe is moving
O_BRAKE (48)	activation of mechanical brake
O_ERROR (108)	fault indication

Encoder interface 1

MK3B is a 8pole terminal block with 6 terminals for the encoder signals and 2 terminals with 5 V supply.

(*See Supply voltages on page 12*).

Encoder interface 1 can be used for one of the following 2 functions:

- Master encoder input (incremental or absolute) for synchronizing.
- Virtual master encoder output (incremental).

The table below shows the function of each terminal in the 3 possible modes. (*See fig. 1*)

NB!

When using the virtual master function termination must be switched off (sw 1.3) in all options except on the first and the last station connected in the network. See also connection example on page 16 and 17.

Encoder interface 2

MK3D is a 8pole terminal block with 6 terminals for the encoder signals and 2 terminals with 5 V supply

(*See Supply voltages on page 12*).

Encoder interface 2 can be used for one of the following 2 functions:

- Slave encoder input (incremental or absolute) for synchronizing.
- Feedback encoder input (incremental or absolute) for positioning.

The table below shows the function of each terminal in the 2 possible modes. (*See fig. 2)*

Terminal	A1	$\overline{\text{A1}}$	B1	$\overline{\text{B1}}$	Z1	$\overline{\text{Z1}}$
Incremental input	A in	$\overline{\text{A in}}$	B in	$\overline{\text{B in}}$	Z in	$\overline{\text{Z in}}$
Absolute input	Clk out	$\overline{\text{Clk out}}$	Data in	$\overline{\text{Data in}}$	Not used	Not used
Virtual master	A out	$\overline{\text{A out}}$	B out	$\overline{\text{B out}}$	Z out	$\overline{\text{Z out}}$

Fig. 1

Terminal	A2	$\overline{\text{A2}}$	B2	$\overline{\text{B2}}$	Z2	$\overline{\text{Z2}}$
Incremental input	A in	$\overline{\text{A in}}$	B in	$\overline{\text{B in}}$	Z in	$\overline{\text{Z in}}$
Absolute input	Clk out	$\overline{\text{Clk out}}$	Data in	$\overline{\text{Data in}}$	Not used	Not used

Fig. 2

Supply voltages:

The option card is supplied by the internal 24 V DC supply of VLT 5000, but as the available power is limited it can be necessary to use an external 24 V DC supply.

The 24 V DC supply of VLT 5000 can supply a total of 420 mA including the load on the control card (terminal 12, 13 and output 42 and 45).

The 5 V output on the option card is generated from the 24 V supply. The maximum power on the 5 V side is 5 V * 280 mA = 1.4 W, this corresponds to app. 60 mA on the 24 V side.

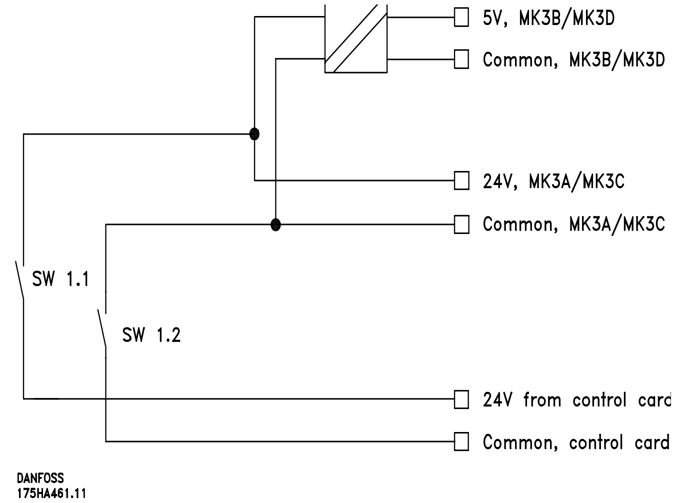
When an external 24 V DC voltage source is used the internal 24 V supply from the control card must be disconnected, this is done by opening switch 1.1 and 1.2

Each digital input on the option card takes 8 mA.

Each digital output on the option card can supply up to 0.7 A (external 24V-supply) depending on the load.

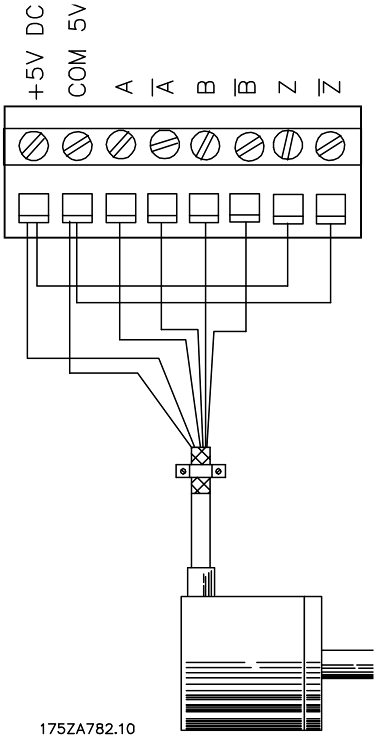
The load from the 24 V supply (internal or external) can be calculated as follows:

8 mA * number of digital inputs
+
Load on digital outputs
(mk3 C, O1 – O8)
+
load on 5 V supply
(mk3 B/D, 5 V/com)
+
Load on control card
(24 V supply, terminal 12/13 and
outputs, terminal 42/45)



Encoder monitor

Both encoder interfaces are equipped with a monitoring circuit that can detect open circuit as well as short circuit of each encoder channel. Each encoder channel has a LED showing the status: Green light means ok, no light means fault. Zero channel monitoring can be switched off by means of switch 1.4, this is necessary when using incremental encoders without Zero channel or absolute encoders. Switch 1.4 disables monitoring of both master and slave Zero channel. If disabling of only one of the two Zero channels is required (e.g. when using incremental master encoder and absolute slave encoder) the unused Zero channel input must be connected to 5V/common as shown below.



Physical placing of the LED's and the switches can be seen in the chapter "Option card layout".

An encoder fault will only result in an "Option error" calling the error handler (ON ERROR) if encoder monitoring is activated via parameter MENCODER (master) and ENCODER (slave).

Note: Monitoring of the master encoder is disabled when switch 1.3 is "OFF".

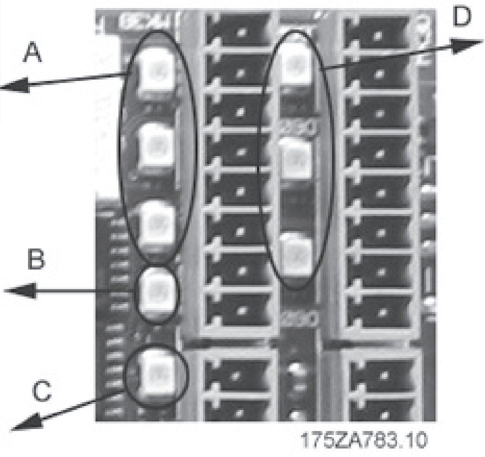
Option card layout:

Option card layout showing the position of connectors and dip switch.

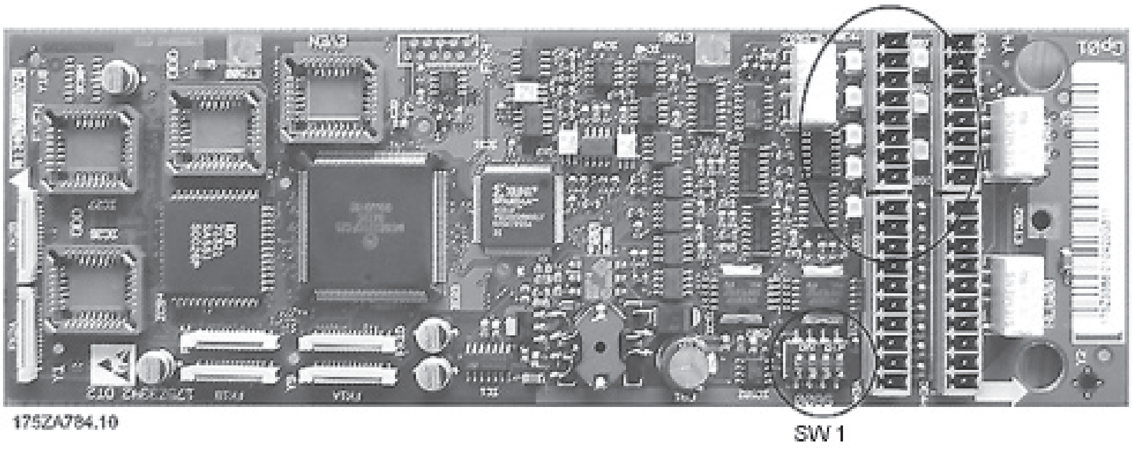
Encoder monitor master, channel A, B and Z:
LED off = Short or open circuit
LED green = Ok.

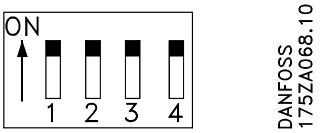
5V monitor:
LED off = no 5V
LED Green = 5V ok.

CPU monitor:
LED must flash at 1 Hz to indicate a running CPU system



Encoder monitor slave, channel A, B and Z:
LED off = Short or open circuit
LED green = Ok.





SW 1.1: Connect(ON)/disconnect(OFF) 24 V from control card (see description of supply voltages).
SW 1.2: Connect(ON)/disconnect(OFF) 24 V common from control card.
SW 1.3: Connect(ON)/disconnect(OFF) termination resistor for master encoder (see description of virtual master function).
Note: When OFF the master encoder monitor is disabled.
SW 1.4: Switch Z-channel encoder monitor ON/OFF for both master and slave.

Default setting of switch 1.1. - 1.4 is ON.

NB!
When using the virtual master function termination must be switched off (sw 1.3) in all options except on the first and the last station connected in the network. See also connection example on page 16 and 17.

■ Technical data

Terminals:

Type	Plugs with screw connections
Maximum cable size	1.3 mm^2 (AWG 16)

Digital inputs, MK3A:

Number of inputs which are used by SyncPos program	8
Terminal designations	I1 – I8
Voltage level	0 – 24 V DC (PNP positive logic)
Voltage threshold logical “0”	5 V DC
Voltage threshold logical “1”	10 V DC
Maximum voltage	28 V DC
Input impedance	4 kΩ
Min. pulse duration (ON INT)	1 msec

Galvanic isolation: All digital inputs are galvanically isolated by means of optocouplers, but with the same common as the digital outputs.

Digital outputs, MK3C:

Number of outputs which are used by SyncPos program	8
Terminal designations	O1 – O8
Voltage level	0 – 24 V DC
Maximum load	0.7A (with external power supply)
Update rate	1 msec

Galvanic isolation: All digital outputs are galvanically isolated by means of optocouplers, but with the same common as the digital inputs.

External 24 V DC supply:

(see VLT 5000 manual)

Encoder input 1, MK3B (master):

Terminal designations	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$.
Incremental:	
Signal level	5 V differential
Signal type	Linedriver, RS 422
Input impedance	120 Ω (Dip switch 1.3 = ON)
	> 24 kΩ (Dip switch 1.3 = OFF)
Maximum frequency	220 kHz (at 50 % duty cycle)
Phase displacement between A and B	90° ±30°
Absolute:	
Signal level	5 V differential
Signal type	SSI
Data coding	Gray code
Data length	25 bit
Parity	none
Clock frequency	105 or 260 kHz
Protocol	Gray
Maximum positions per revolution	8192
Maximum number of revolutions	4096

Encoder input 2, MK3D (slave):

Terminal designations	A2, $\overline{A2}$, B2, $\overline{B2}$, Z2, $\overline{Z2}$
Incremental:	
Signal level	5 V differential
Signal type	Linedriver, RS422
Input impedance	120 Ω
Maximum frequency	220 kHz (at 50 % duty cycle)
Phase displacement between A and B	90° ±30°
Absolute:	
Signal level	5 V differential
Signal type	SSI
Protocol	Gray code
Data length	25 bit
Parity	none
Clock frequency	105 or 260 kHz
Maximum positions per revolution	8192
Maximum number of revolutions	4096

Encoder cable:

Cable type .... Twisted pair and screened. **Note:** Please observe the prescriptions of the encoder supplier

Cable length .... Observe the prescriptions of the encoder supplier.

Absolute encoder is tested ok up to 150 meter cable at 105 kHz clock and 100 m at 262 kHz clock.

*(Tested with TR electronic encoder type CE-65 M 8192*4096 and appropriate cable prescribed by TR electronic.)*

Maximum allowed time delay between clock and data signal measured at the controller terminals ....

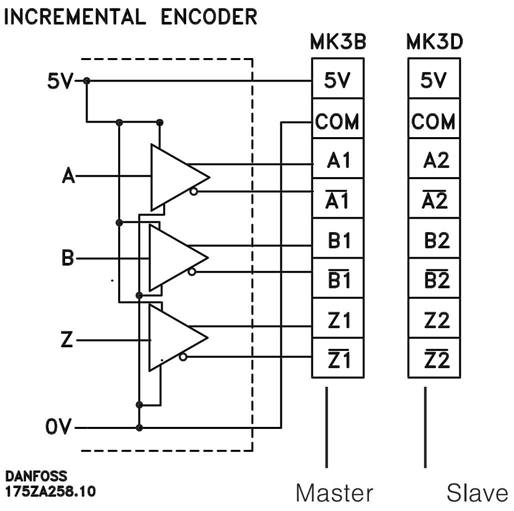
.... 105 kHz clock = 9μsec

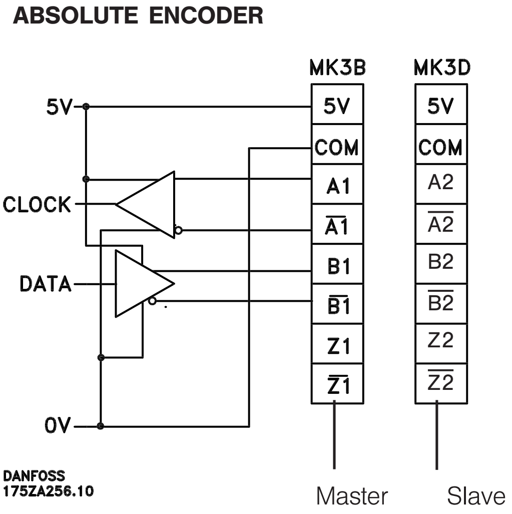
.... 262 kHz clock = 3.5 μsec

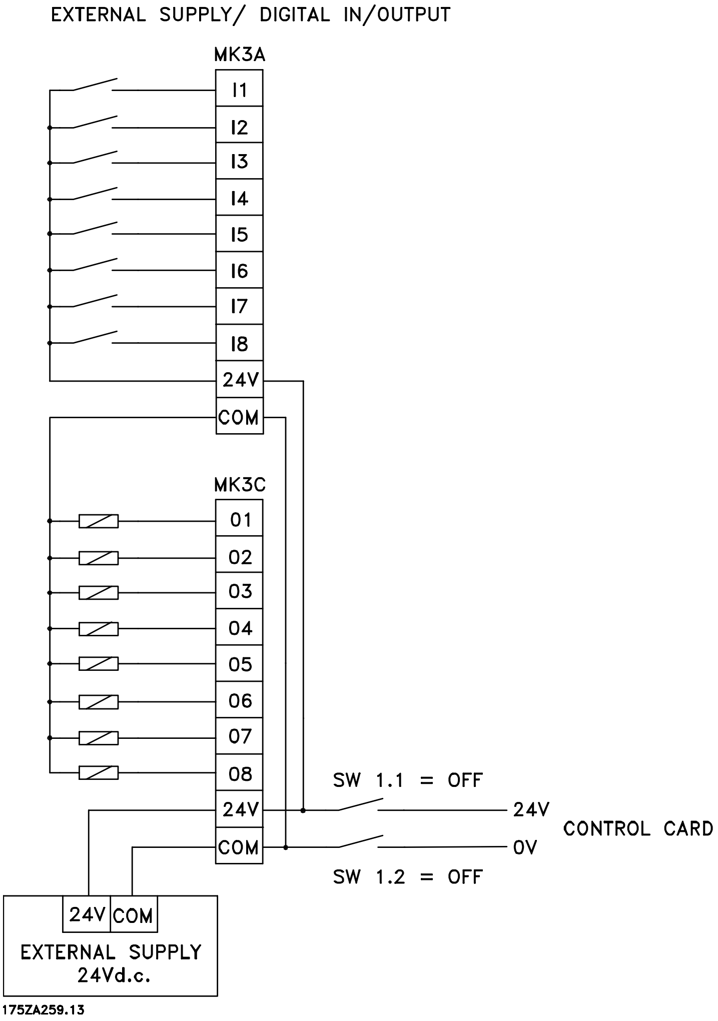
Encoder output, MK3B:

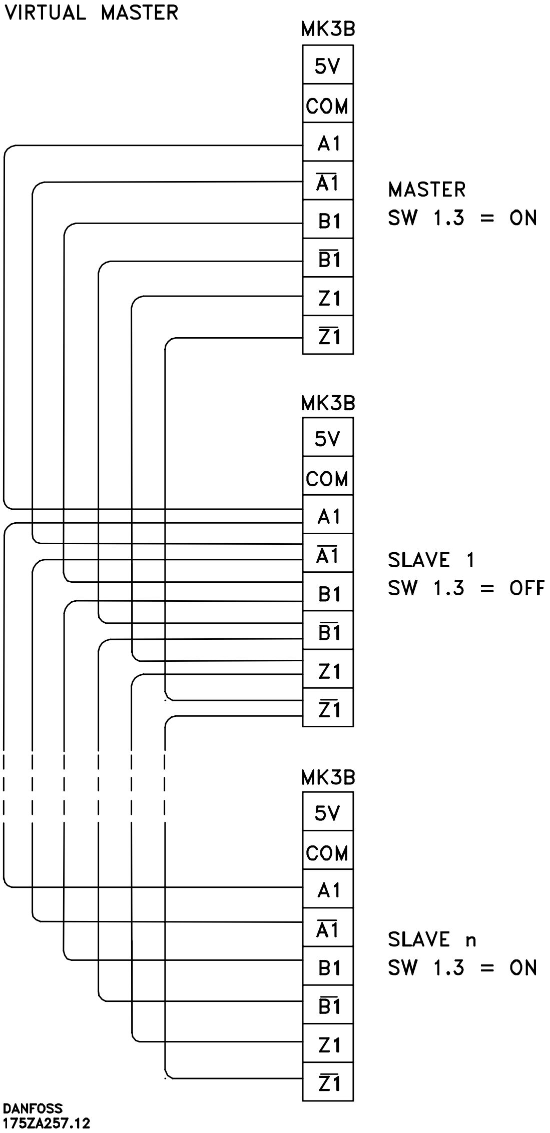
Terminal designations	A1, $\overline{A1}$, B1, $\overline{B1}$, Z1, $\overline{Z1}$
Signal type	Linedriver, RS485
Maximum frequency	150 kHz
Minimum frequency	150 Hz
Maximum number of slaves	31 (more when using repeaters)
Maximum cable length	400 m

■ Connection examples

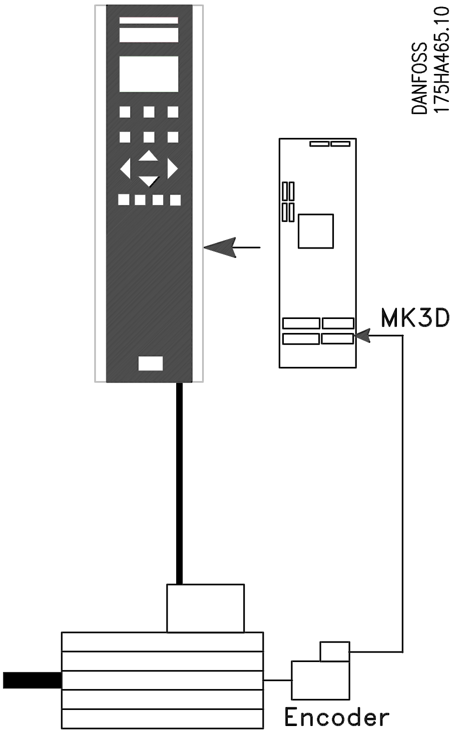






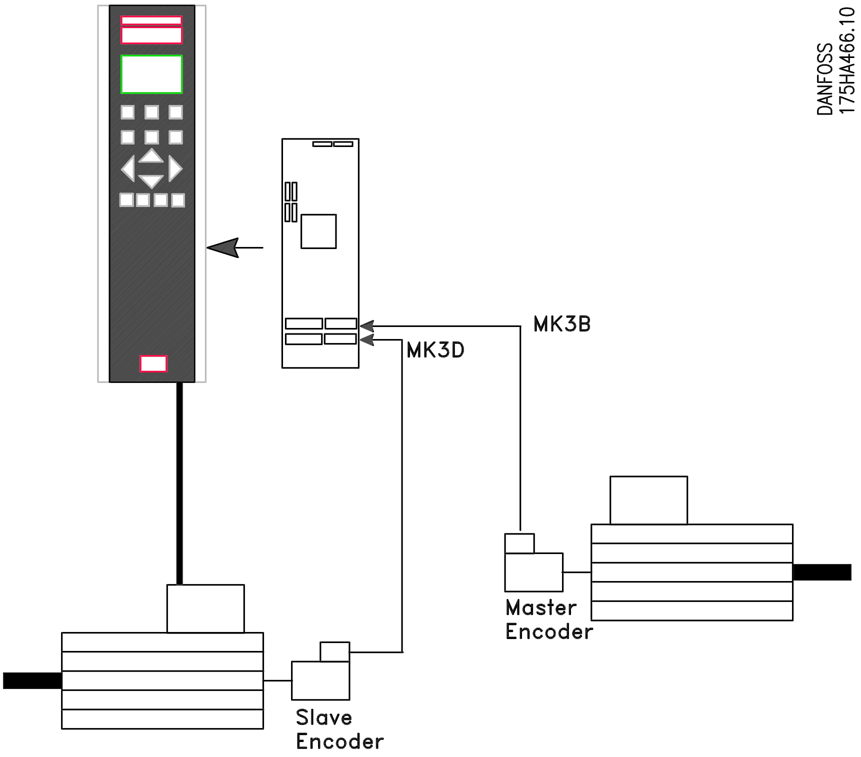


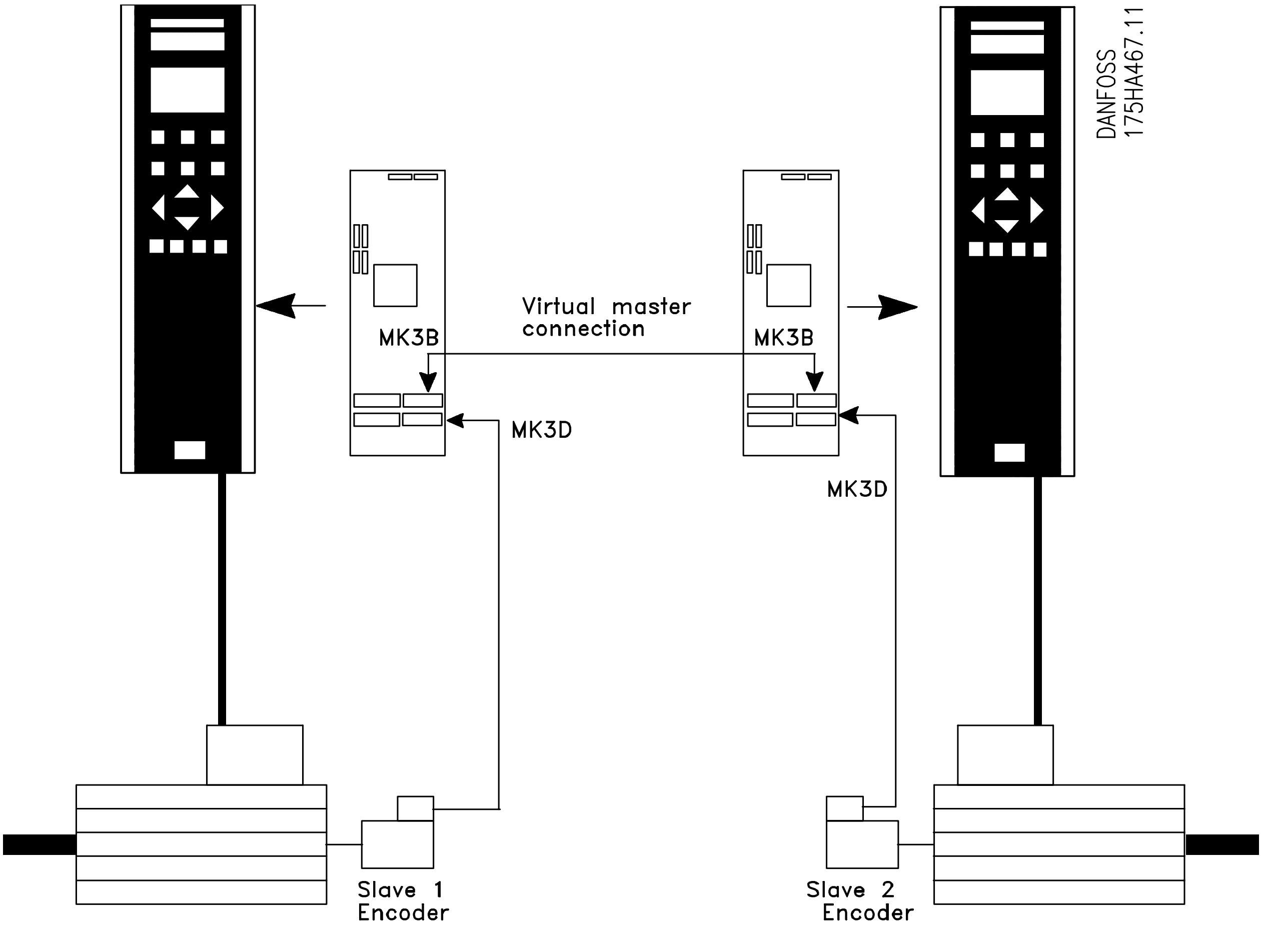
The terminating resistors on both end of the bus have to be switch on with dip switch SW 1.3.



left: encoder connection for positioning applications

below: encoder connection for master-/slave synchronization





Encoder connections for the synchronizing with virtual master.

Chapter 4

SyncPos is a Windows based development system with a programming language specially designed for synchronizing and positioning control which is easy to learn, the commands of which are based on frequently used control terminology. This macro-language makes it possible to realize complex functions with simple commands even without knowledge of the hardware processes and thus create control programs and general control programs in a very short time.
The SyncPos software contains all commands and menus necessary for the configuration, programming, optimization and, finally, for the transfer of commands to the SyncPos motion controller.

■ How SyncPos functions

Let us explain the basic principle of SyncPos in brief:

Determining parameters

Factory settings are stored in the program for all parameters. These factory settings are active upon delivery and can be re-activated at any time by performing a reset (see page 42).
You can adjust all the parameters for your controller. These user parameters are permanently saved in the EEPROM and are valid for all programs.
Before you start programming it is necessary to determine basic parameters of the VLT connected, such as ***Maximum velocity*** VELMAX (1) and ***Shortest ramp*** RAMPMIN (31), set the PID filter values and define the ***User factor*** with POSFACT_Z (23) and POSFACT_N (26).
Within a program you can temporarily alter the parameters with the command SET. After running the program these values are once again replaced with the user parameters which have been saved.

Programming with the SyncPos macro-language

In the "EDIT" menu you can create and comment on the programs just like in a text program. All commands are described in detail in the Chapter Software Reference.
Each command consists of a COMMAND WORD + ***parameter*** (if necessary), whereas the parameter can be a variable, constant or an array.
Comments are written between /* ... */ or after // for example:

```
POSA 3000
/* axis absolute to actual zero point move to
position 3000 */
// axis absolute to actual zero point move to
position 3000
```

It is particularly easy to write your program by using the "COMMAND LIST". Once you have selected the command, all the necessary input fields are immediately opened. After entering the values the syntax is automatically formed and you can insert the entire command in your program.
With teach-in programming you simply move the axis to the desired position and store the position which has been reached. In this manner you can quickly program the most complicated adjustments and sequences of movements.

Running and testing programs

In the "DEVELOPMENT" menu you can test new programs. The program is loaded into the VLT and started only after the "EXECUTE" function has been activated. Naturally, you can run the program being tested in "SINGLE STEPS" or start the program at a certain point and have it executed step-by-step.
Before every run a new program is automatically checked to ensure that the commands are correct. Or you can start the "SYNTAX CHECK" without running the program.

Saving programs in the VLT

Every time you Execute a program or start the syntax check, this program is temporarily stored in the RAM in an area that is always overwritten with every subsequent test.
Once you have finished writing a program for the SyncPos option, the temporary program can be saved permanently in EEPROM. It will then be assigned a number or name and can be tagged with "AUTOSTART" so it automatically will be started after turning on the VLT. This way you can drive the VLT offline.
All programs can also be started using the program number via the inputs, for example from a PLC. For this the inputs must be set accordingly with "CONTROLLER" → "PARAMETERS" → "GLOBAL".

Optimizing the controller with the control parameters

The position control unit integrated in the SyncPos motion controller automatically calculates a theoretical set course during each sequence of movements and tries to control the VLT or the motor so that the best possible convergence to the set course is achieved. By means of the control parameters you can directly influence to what degree and how quickly a deviation from the theoretical set course is counteracted.
These PID filter parameters can also, theoretically, be determined if you have comprehensive knowledge of the entire drive, including the load connected. However, the experimental method with the functions in the "TESTRUN" menu is considerably faster and simpler.
After every "TESTRUN" it is also possible to evaluate the control parameters on the basis of four graphics: they show the actual and set curves for the velocity, the acceleration, the position and the power curve. Thus, you can successively adjust the PID filter parameters and optimize the controller.

We wish you the best in your work with SyncPos! For questions regarding programming or operating the controller, please contact your supplier.

Requirements

SyncPos is for use on standard PC's with operating systems Windows 95 resp. NT 3.5.
You should be familiar with the basic functions and terminology of the Microsoft Windows interface, for example the **Task bar** and the **Explorer**. You can find further information in the corresponding Windows manuals if necessary.

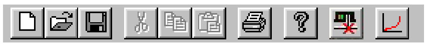
The SyncPos Window

The following figure serves to explain the most important elements of the SyncPos Windows.

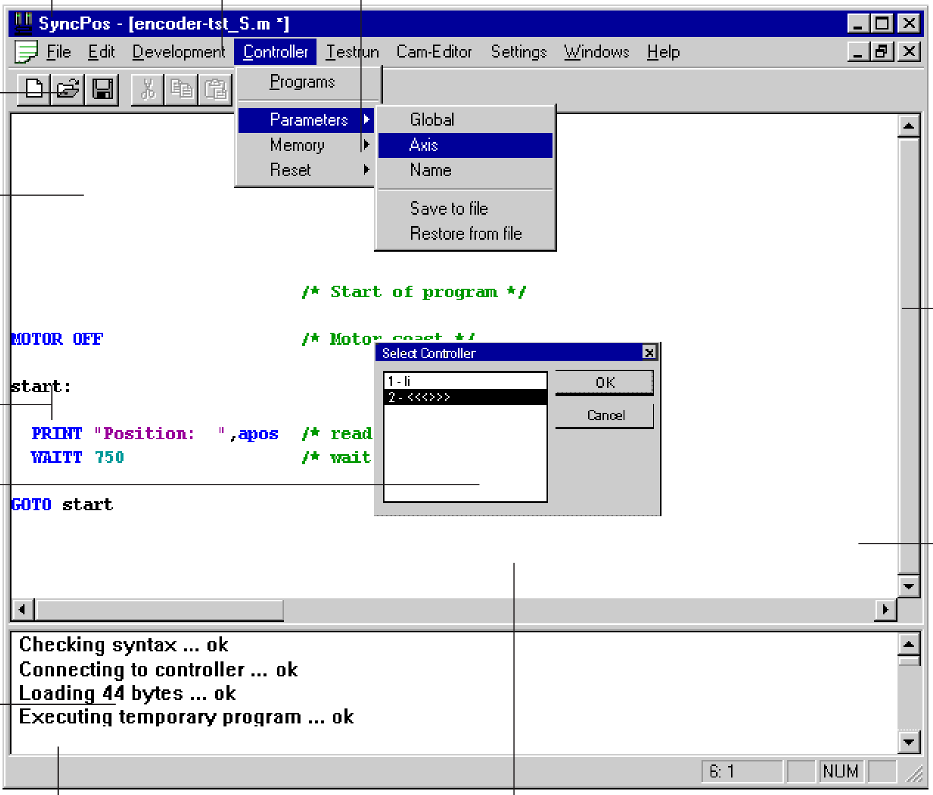
Each window represents a SyncPos program which can be connected with a VLT. Thus, you can open at least the same number of edit windows as the number of controllers resp. VLTs you have selected.

Symbol bar

Click on the icons in the symbol bar to quickly select a function.



From left to right: New file, Open file, Save file, Cut, Copy, Paste, Print, Info, Close Interface and CAM-Editor.



```
                      /* Start of program */
MOTOR OFF             /* Motor coast */
start:
  PRINT "Position:  ",apos   /* read
  WAITT 750                  /* wait
GOTO start
```

```
Checking syntax ... ok
Connecting to controller ... ok
Loading 44 bytes ... ok
Executing temporary program ... ok
```

Title bar shows the names of the SyncPos File, the number and name of the VLT and the error number if applicable.

Open the menus in the Menu bar to select the SyncPos functions.

Menus with the functions which you can mark and select with the mouse.

Click on the icon in the Symbol bar to quickly select a function.

Edit window

The blinking cursor shows where the text to be entered will appear.

Dialog field

Communications window for messages from the controller and the compiler.

Use the Scroll Bar to scroll the file up or down

or left from left to right.

The status bar shows the line number and position where the cursor is located, information about the function keys and whether the [NUM lock key] or the [Shift lock key] have been pressed and are active.

If you want to change the size of the Edit window or the Communications window, move the cursor to the lower edge of the scrollbar and – as soon as the cursor has changed its shape – click and pull the window in the desired direction.

Menus

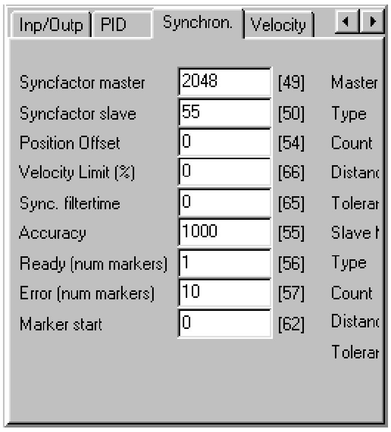
A check means that the function has been activated, for example in the Window menu it shows which files are open.
Disabled functions are not available until you trigger a preceding action, for example, when you have copied something to the notepad and want to insert it someplace else or "PREPARE SINGLE-STEP" to trigger each "SINGLE-STEP".
You can also select most menu commands using the keyboard. Press [ALT] and the underlined letter in the menu name and then the underlined letter in the command name, e.g. [ALT] + [C] + [P] for "CONTROLLER" → "PROGRAMS".

Dialog fields

Once you have selected a function, a dialog field often appears in which you can determine certain options. If an option is disabled, then it is not available for the current process.

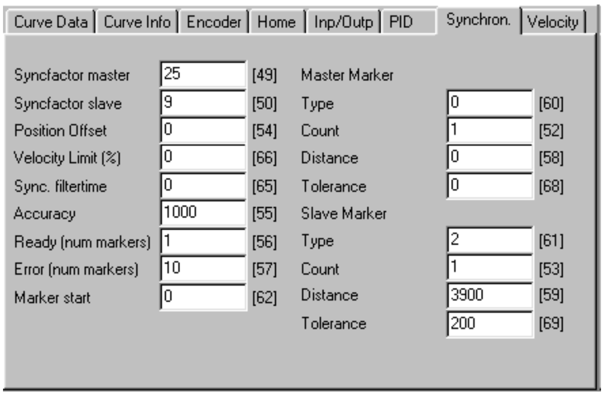
Index Cards

In the Windows user interface, dialog fields are provided on several levels together with the index cards for the selection of functions or the input of data. For example, the two index cards → "FIX POINTS" and → "START STOP POINTS" in CAM-Editor.



Syncfactor master	2048	[49]	Master
Syncfactor slave	55	[50]	Type
Position Offset	0	[54]	Count
Velocity Limit (%)	0	[66]	Distanc
Sync. filtertime	0	[65]	Tolerar
Accuracy	1000	[55]	Slave M
Ready (num markers)	1	[56]	Type
Error (num markers)	10	[57]	Count
Marker start	0	[62]	Distanc
			Tolerar

Click on the name of the index card and the corresponding level will be brought to the front.
In the case of the index cards "CURVE DATA", "CURVE INFO" and "PARAMETER", click on the scroll bars to scroll to the right and show additional index cards:

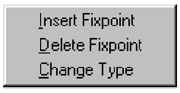


Syncfactor master	25	[49]	Master Marker		
Syncfactor slave	9	[50]	Type	0	[60]
Position Offset	0	[54]	Count	1	[52]
Velocity Limit (%)	0	[66]	Distance	0	[58]
Sync. filtertime	0	[65]	Tolerance	0	[68]
Accuracy	1000	[55]	Slave Marker		
Ready (num markers)	1	[56]	Type	2	[61]
Error (num markers)	10	[57]	Count	1	[53]
Marker start	0	[62]	Distance	3900	[59]
			Tolerance	200	[69]

This will automatically change the division of the CAM-Editor. If you click on "WINDOW" → "STANDARD", then on → "RECALC" or any other field in CAM-Editor, the standard window will be displayed again immediately.

Pop-up Menu

Pop-up menus are provided at certain program locations if you click on the right mouse button. For example: the context menu in the SyncPos edit window or a selection menu in CAM-Editor for inserting or deleting fixpoints. The pop-up menus are closed automatically when the selected function is being executed or if you click on any other location on the screen with the left mouse button.

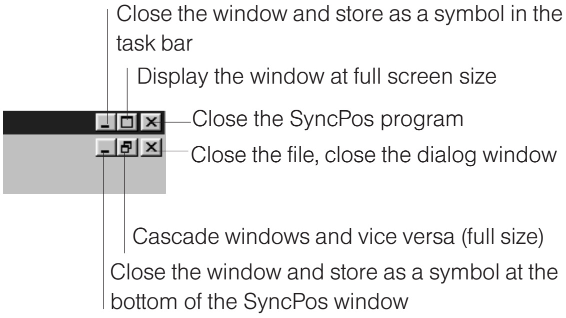


Edit window

In this window you can write your program with the assistance of the functions in the "EDIT" menu just like in a text editor. Different colors are used to distinguish between comments, program sections, operators, numbers etc. You can alter the colors using "SETTINGS" → "COLORS EDITOR".

Changing window size and window icons

If you want to change the size of the SyncPos windows, simply move the cursor to an outside edge of the window and pull - once the cursor has changed its shape - the window while pressing the mouse button until the window is the size you desire. The icons on the upper right in every window do the following ...


Close the window and store as a symbol in the task bar
Display the window at full screen size
Close the SyncPos program
Close the file, close the dialog window
Cascade windows and vice versa (full size)
Close the window and store as a symbol at the bottom of the SyncPos window

■ Using the mouse

If you have a mouse with several keys, the left mouse button is generally the “primary“ key (provided you haven’t changed the configuration).

“Click“ means that you press the mouse key for a short moment and then immediately release the button without moving the mouse. If nothing to the contrary is stated then always click with the left, or primary, key.

“Pull“ means that you point to the element and hold the mouse button depressed while moving the mouse.

■ Keyboard

[ESC] key

In addition to the standard functions of the [ESC] key, you can also use this key at any time to abort a program running under SyncPos.

NB!
A rotating drive will slow down with the maximum allowed deceleration!

Arrows

Using the arrows, [↓ key], [↑ key], [← key] and [→ key], you can move the insert marks in a file.

Direction keys

With the direction keys [HOME] and [END] you can move the cursor to the beginning or end of a line and with [Page ↑] and [Page ↓] to the beginning or end of a of a screen page. Some direction keys can also be combined with each other, thus, for example with [CNTL] + [HOME] the cursor will move to the beginning of the file.

Number pad

If you have an expanded keyboard available, you can also input numbers via the number pad, once you have pressed the [Num lock key] before inputting numbers.

Short cuts

Keys are often used as shortcuts with other keys either as a key combination or as a key sequence. For a key combination you have to hold the first key depressed while you press the second key, e.g. [SHIFT] + [INSERT], in order to insert the contents of the notepad. For key sequences you can press the keys one after the other, e.g. [ALT] + [E] in order to open the "EDIT" menu.

Function keys

Frequently used functions are allocated to the function keys, e.g. with [F9] you can very effectively control the step-by-step execution of a program: each time you press [F9], one line of the program is run. Or with [F1] you can access the on-line help.

List of shortcuts

Cut, Copy and Paste …

Copy the marked text to the notepad	[CNTL] + [INSERT]	or [CNTL] + [C]
Cut and save the text marked in the notepad	[CNTL] + [DEL] or [SHIFT] + [DEL]	or [CNTL] + [X]
Paste the contents of the notepad	[SHIFT] + [INSERT]	or [CNTL] + [V]
Line open above	[CNTL] + [SHIFT] + [N]	
Delete the (remaining) word to the right of the cursor	[CNTL] + [DEL]	
Delete the (remaining) word to the left of the cursor	[CNTL] + [BACKSPACE]	
Line by line deletion	[CNTL] + [Y]	

Cursor positioning

Go to document end	[CNTL] + [END]	
Go to document start	[CNTL] + [HOME]	
Go to line n	[CNTL] + [G]	
Shift scrollbars up or down line by line	[CNTL] + [↑–KEY]	resp. [CNTL] + [↓–KEY]
Shift scrollbars to the left or right	[CNTL] + [PAGE↑]	resp. [CNTL] + [PAGE↓]

Expand the text marked ...

...by one character to the right resp. to the left	[SHIFT] + [→ KEY]	resp. [← KEY]
…to the end of the word	[CNTL] + [SHIFT] + [→ KEY]	
…to the beginning of the word	[CNTL] + [SHIFT] + [← KEY]	
…to the end of the line	[SHIFT] + [END]	
…to the beginning of the line	[SHIFT] + [HOME]	
…down one line respl. up one line	[SHIFT] + [↓KEY]	resp. [↑KEY]
…to the beginning of the file	[CNTL] + [SHIFT] + [HOME]	or [SHIFT] + [PAGE↑]
…to the end of the file	[CNTL] + [SHIFT] + [END]	or [SHIFT] + [PAGE↓]
Mark the next or the previous command in the menu (when the menu is displayed).	[↑ KEY] resp. [↓KEY]	
Mark the menu on the right or left side, or changes from the main menu to the sub-menu if a sub-menu is displayed.	[← KEY] resp. [→ KEY]	

Further editing tools

Undo the last action (File Save deletes the Undo memory.)	[ALT] + [BACKSPACE] or [CNTL] + [Z]
In CAM-Editor: Undo the input up to the previous "RECALC". (File Save deletes the Undo memory.)	[ALT] + [BACKSPACE]
In CAM-Editor: "REDO": The action of the Undo command is cancelled.	[ALT] + [SHIFT] + [BACKSPACE]

List of function keys

Abort program	[ESC]
Access online help	[F1]
Switches the mouse cursor to context-sensitive help	[SHIFT] + [F1]
In "FIND" mode: jumps back and forth between the sites found.	[F2]
In "FIND" mode: jumps from one site found to the next one.	[F3]
Start "DEVELOPMENT" → "EXECUTE"	[F5]
Select line	[CNTL] +[ALT] + [F8]
In the "SINGLE-STEP" mode starts one program line each time it is pressed. or in CAM-Editor → "RECALCULATION"	[F9]
Calls up the "COMMAND LIST"	[F12]

Starting the SyncPos Motion Controller step-by-step

This section offers you a quick general introduction which includes turning on and familiarizing yourself with the program, how to set up a VLT with SyncPos motion controller using the test programs provided and the most important basic settings.

NB!
O.ERR 13 will show up right after power up if the VLT is not ready. The VLT is in the "Not ready" state when:

- it has an alarm (trip),
- it is in local mode (parameter 002 = local),
- local LCP stip is activated (display flashing),
- there is no signal on input 27 (coast).

O.ERR 13 can only be reset using the ERRCLR command or with "BREAK" [ESC] in the PC software and only when the VLT is in the "ready" state, which means none of the above may be true.

The VLT monitoring function can be switched off by selecting [2] in parameter 700.

Please follow the step-by-step guideline:
1. SyncPos installation and starting
2. Setting VLT parameters
3. Setting up communication
4. Setting of SyncPos parameters
5. Check encoder connection and direction of rotation
6. Execute test run program
7. Optimizing the PID controller

Safety tips

The controller and the motor must be able to be switched off at any time with an EMERGENCY STOP button.

The motor must be able to turn completely freely so that a sudden jolt can not cause damage.
Furthermore, it is absolutely essential to be familiar with and observe the safety tips in the hardware manual.

Installing SyncPos

Follow the directions given during the installation program. SyncPos and the program samples included will be installed in the default directory "Program Files\Danfoss Drives\VLT Motion Control Tool".

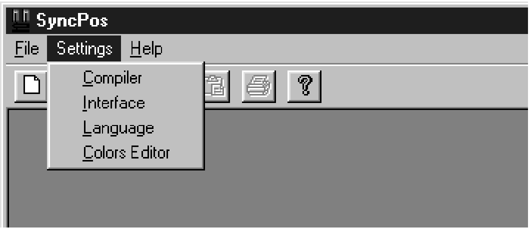
Starting SyncPos

Turn on the VLT, however, make sure the motor is not connected or it is not connected to a power source.

In the task bar, click on "START" → "PROGRAMS" → SyncPos.

Changing the dialog language

Now the SyncPos window has been opened – English is the standard dialog language.



If you desire another language, click on "SETTINGS" → "LANGUAGE" (before you open a file) and select for example "GERMAN" in the dialog field which will subsequently appear. "EXIT PROGRAM" and start SyncPos again.

Master Reset

If you press the [CANCEL] key on the VLT during the power-up, the SyncPos option card will not start a program even if the corresponding start conditions are fulfilled (auto recognition / Start input).
The SyncPos option card instead remains in the idle mode and waits for new commands. Error 19 User Interruption is triggered at the same time.

Exit SyncPos

You can only abort or end a program with [ESC]. In order to do this the file which is linked with the controller resp. VLT must be open or re-opened.

Setting of VLT parameters

During booting the VLT parameters are set to the factory settings. Only the motor parameters remain to be set:
Perform AMA (see VLT5000/VLT5000Flux manual) or manual optimizing of the VLT to the connected motor.

Adjust maximum output frequency in par. 202 (Flux: output speed high limit) and maximum reference in par. 205 according to maximum velocity of the encoder. Note that the maximum output frequency must be higher than the frequency corresponding to maximum allowed velocity of the shaft because of the slip of the motor.

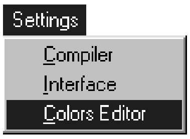
Terminal 27 must be connected to 24 V or parameter 502 must be set to ”serial port”.
Function of inputs and output must be selected in parameter group 3xx according to the required functions. Note that the default values are different from a drive without option.

Please note that Dead Time Compensation in parameter 780 (not Flux) is set to OFF. This parameter is to prevent oscillation at standstill.

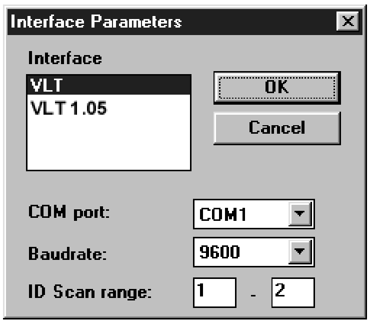
Setting up communication

Before you begin...

Check whether the baud rate has been set in the VLT (par. 501); for a serial connection the baud rate is permanently set at the factory. In this case set up communication in your PC as follows:
Open an existing file or create a new one. Click "SETTINGS" → "INTERFACE".



The VLT and the baud rate are pre-set. Click on OK.


Interface Parameters

Interface: VLT, VLT 1.05

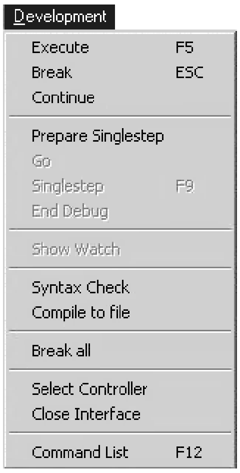
COM port: COM1

Baudrate: 9600

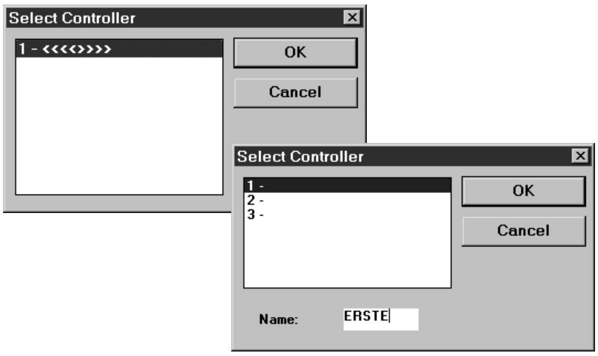
ID Scan range: 1 - 2

NB!
The baud rate in the VLT (Par 501) and in the program must always agree.

"SELECT CONTROLLER"



Click on "DEVELOPMENT" → "SELECT CONTROLLER", in the subsequent dialog field mark the VLT that you want to put into operation and click on "OK". For each VLT you have connected the address set on parameter 500 will automatically appear in the dialog field.


Select Controller

1 - <<<<>>>>

Select Controller

1 -
2 -
3 -

Name: ERSTE

In addition to the addresses, you can also enter names for each controller in the menu "CONTROLLER" → "PARAMETER" → "NAME".

RS485 connection

You need the RS232 standard interface in the PC or an additional RS232 interface card and an external converter for a RS485 connection.

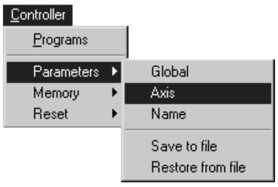
Ending communication Setup

A successful connection is reported in the communications window; the number and name of the controller is listed in the title bar of the actual file in addition to the file name.

Setting of SyncPos parameters

The following parameters must always be checked and if necessary adjusted. Depending on the requirements of the application it might be necessary to adjust other parameters as well.

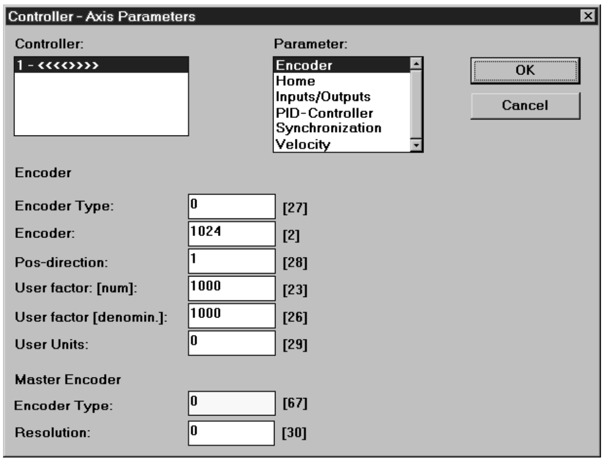
For the other parameters you can use the factory settings at first and then optimize the controller as needed at a later point in time with a "TESTRUN".



Click on "CONTROLLER" → "PARAMETER" → "AXIS" and select the VLT, of which you are currently adjusting the settings.

In the field **Parameter** mark the parameter group that you wish to define, for example **Encoder,** and enter the values in the corresponding fields.

Click on "OK" in order to load the new parameter values in the VLT and simultaneously save them.



Controller: 1 - <<<<>>>>

Parameter: Encoder, Home, Inputs/Outputs, PID-Controller, Synchronization, Velocity

Encoder

Encoder Type:	0	[27]
Encoder:	1024	[2]
Pos-direction:	1	[28]
User factor: [num]:	1000	[23]
User factor [denomin.]:	1000	[26]
User Units:	0	[29]

Master Encoder

Encoder Type:	0	[67]
Resolution:	0	[30]

For a detailed description of all global parameters and axis parameters please refer to the section Parameter Reference in the chapter Software Reference; for information concerning the use of dialog fields refer to Programming with SyncPos in the section menu "CONTROLLER" → "PARAMETERS" → "AXIS".

Setting of SyncPos parameters: Encoder

ENCODERTYPE (27)

Define the used type of encoder:
0 = incremental
1 = absolute encoder, standard ca. 262 kHz
2 = absolute Encoder, ca. 105 kHz
3 = absolute encoder without overflow (linear) but with error correction, approx. 262 kHz
4 = absolute encoder without overflow (linear) but with error correction, approx. 105 kHz
100 … 104 = like 0 … 4, however, the monitoring of the encoder will then be activated. If the encoder leads are interrupted, error 92 will be issued.

ENCODER (2)

Resolution of the encoder in pulses per revolution.

The following 2 parameters are only relevant for synchronizing applications:

MENCODERTYPE (67)

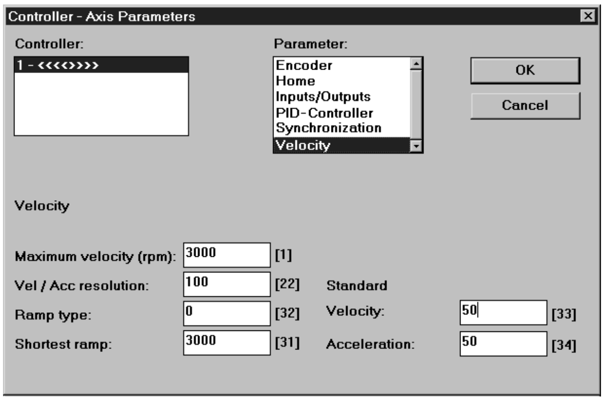
Define the used master encoder type:
0 = incremental
1 = absolute encoder, standard ca. 262 kHz
2 = absolute encoder, ca. 105 kHz
6 = The master position is not read by the encoder; instead, it is set with the system variable SYSVAR[4105].
100 … 102 = like 0 … 2, however, the monitoring of the encoder will then be activated. If the encoder leads are interrupted, option error 92 will be issued

MENCODER (30)

Resolution of the master encoder in pulses per revolution.

Setting of SyncPos parameters: Velocity

This parameters you will find in the parameter group **Velocity** in the menu "CONTROLLER" → "PARAMETER" → "AXIS":



Velocity

Maximum velocity (rpm):	3000	[1]			
Vel / Acc resolution:	100	[22]	Standard		
Ramp type:	0	[32]	Velocity:	50	[33]
Shortest ramp:	3000	[31]	Acceleration:	50	[34]

VELMAX (1)

Maximum velocity of the shaft where the encoder is mounted in RPM.

NB!
For synchronizing the setting must be at least the same as the maximum velocity of the master in order to be able to synchronize. For position synchronizing it must even be higher so that the slave can catch up lost position related to the master. All velocity commands (VEL, CVEL) are related to this value.

RAMPMIN (31)

The *Shortest ramp* is the time from 0 to maximum velocity and from maximum velocity to 0. All acceleration and deceleration commands (ACC. DEC) are related to this value.

Setting of SyncPos option parameters: Home

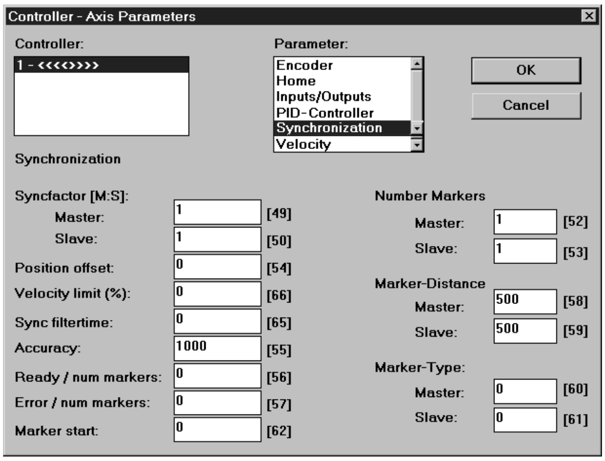
Homing is not necessary in standard synchronization applications and applications using an absolute encoder.
When using an incremental encoder the controller must be run to home after being switched on.
During this process the reference switch defines the position at which 0 is located and how the VLT functions during a home run: input depends on the application.

HOME_VEL (7)

Home speed is entered in % relative to the *maximum speed* of the drive.
You can find these values in the description of the motor.

Setting of SyncPos parameters: Synchronization

The following parameters are only relevant for synchronizing applications: Open in the menu "CONTROLLER" → "PARAMETERS" → "AXIS" the parameter group **Synchronization.**



Synchronization

Syncfactor [M:S]:			Number Markers		
Master:	1	[49]	Master:	1	[52]
Slave:	1	[50]	Slave:	1	[53]
Position offset:	0	[54]	Marker-Distance		
Velocity limit (%):	0	[66]	Master:	500	[58]
Sync filtertime:	0	[65]	Slave:	500	[59]
Accuracy:	1000	[55]	Marker-Type:		
Ready / num markers:	0	[56]	Master:	0	[60]
Error / num markers:	0	[57]	Slave:	0	[61]
Marker start:	0	[62]			

SYNCFACTM (49) and SYNCFACTS (50)

The ***Synchronizing factors master*** and ***slave*** SYNCFACTM and SYNCFACTS must be set according to the gear ratio between master and slave encoder.

Example: Both encoders has 1024 ppr, master is running 305 RPM and slave must run 1220 RPM.

SYNCFACTM =	305 and
SYNCFACTS =	1220.
Alternative:	SYNCFACTM = 1
	SYNCFACTS = 4.

The following parameters are only relevant when using synchronizing with marker correction (SYNCM).
Open the parameter group **Synchronization** in the menu "CONTROLLER" → "PARAMETERS" → "AXIS":

SYNCMARKM (52) and SYNCMARKS (53)

Number of master marker pulses and number of slave marker pulses.
SYNCMARKM and SYNCMARKS must be set according to the ratio between the number of marker signals from master and slave. A ratio of 1:1 means that each slave marker will be aligned with each master marker. A ratio of 2:1 means that each slave marker will be aligned with each second master marker.

SYNCMPULSM (58) and SYNCMPULSS (59)

When using the encoder zero pulse as marker signal the distance between 2 markers is the resolution (qc) of the encoder.
When external marker signals are used, the marker distance can be measured by means of the program sample "Marker count" (see chapter 7) if it is unknown.

SYNCMTYPM (60) and SYNCMTYPS (61)

Master marker type and Slave marker type.
Master marker signal: Input 5.
Slave marker signal: Input 6

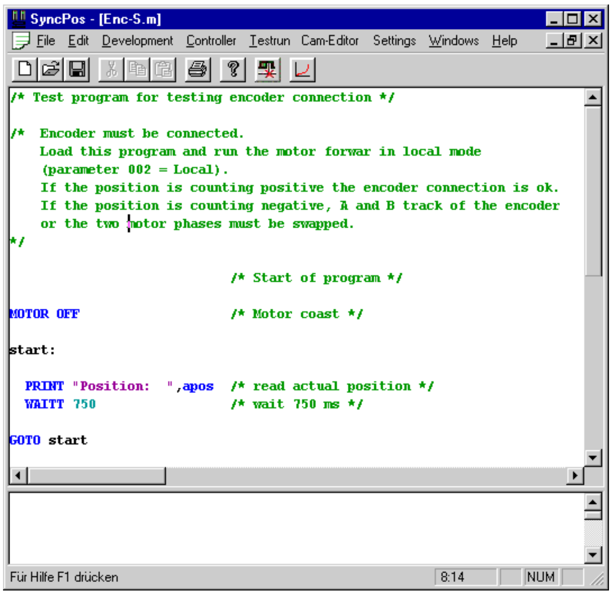
Marker signal type must be selected for master and slave:
0 = index pulse (positive flank)
1 = index pulse (negative flank)
2 = external marker (positive flank)
3 = external marker (negative flank)

■ Checking encoder connection and direction of rotation

If you have not yet done so, now is the time to connect and test the encoder.

NB!
Remember to turn off the power before connecting the encoder.

Check the encoder connections by means of the encoder test program. In the menu bar click on "FILE" and "OPEN" the file **Enc-S.m**, which is the first test program for starting.


SyncPos - [Enc-S.m]
File Edit Development Controller Testrun Cam-Editor Settings Windows Help
Für Hilfe F1 drücken
8:14
NUM

```
/* Test program for testing encoder connection */

/*  Encoder must be connected.
    Load this program and run the motor forwar in local mode
    (parameter 002 = Local).
    If the position is counting positive the encoder connection is ok.
    If the position is counting negative, A and B track of the encoder
    or the two motor phases must be swapped.
*/

                             /* Start of program */

MOTOR OFF                    /* Motor coast */

start:

  PRINT "Position:  ",apos  /* read actual position */
  WAITT 750                  /* wait 750 ms */

GOTO start
```

In the "DEVELOPMENT" menu click on "EXECUTE" in order to start the test program. Run the drive forward for example in local mode (Parameter 002 = ”Local”) then the position must count positive. If the position is counting negative you must swap A and B channels from the encoder or two motor phases.

The position 0 is registered in the communications window.
If you turn the motor by hand (the motor should not be connected!), you can test whether the encoder functions: the position is continuously registered in the communications window. For a full rotation you should receive 4 times the value of the resolution of the encoder, that means 2000 if the Encoder counts per revolution is 500.

Checking encoder for master synchronizing applications

If there is a master synchronizing application change the test program: replace the command APOS by MAPOS in "Enc-S.m" and run the master forward then the master position must count positive as well. If the position is counting negative you must swap A and B channel from the master encoder.

Checking direction of rotation

For this the VLT parameter 002 must also be set and the motor is to be driven with a local set value (Par. 003).
By turning the axis it is possible to make sure that the direction of rotation is correct. When rotating to the right, as viewed from the front, looking towards the end of the axis, the impulse generator must count up.
Otherwise the encoder tracks A and B as well as $\overline{A}$ and $\overline{B}$ must be exchanged. Often it is easier to swap two motor-phases though.
Or you simply use the parameter ***Positive Direction*** POSDRCT (28) to invert the evaluation of the encoder information.

Ending the encoder check

End the test of the encoder with the [ESC] key and close the test program with "FILE" → "CLOSE". A successful test of the encoder is a requirement for further starting up of operations.

If the encoder doesn’t work

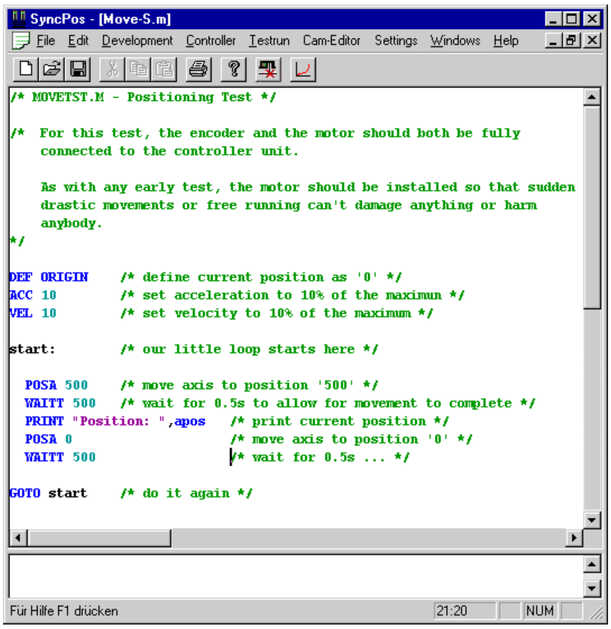
This could be a result of incorrect cable installation. Measure the signals coming from the encoder and compare them to the values listed in the specifications. Check whether the connection was made according to the application.

Execute the test run program

Now connect the motor to the VLT, make sure that the motor can turn completely freely.

NB!
The motor must be provided with an [EMERGENCY STOP] button.

Click on "FILE" and "OPEN" the file **Move-S.m**.


SyncPos - [Move-S.m]
File Edit Development Controller Testrun Cam-Editor Settings Windows Help
Für Hilfe F1 drücken
21:20
NUM

```
/* MOVETST.M - Positioning Test */

/*  For this test, the encoder and the motor should both be fully
    connected to the controller unit.

    As with any early test, the motor should be installed so that sudden
    drastic movements or free running can't damage anything or harm
    anybody.
*/

DEF ORIGIN    /* define current position as '0' */
ACC 10        /* set acceleration to 10% of the maximun */
VEL 10        /* set velocity to 10% of the maximum */

start:        /* our little loop starts here */

  POSA 500    /* move axis to position '500' */
  WAITT 500   /* wait for 0.5s to allow for movement to complete */
  PRINT "Position: ",apos   /* print current position */
  POSA 0                    /* move axis to position '0' */
  WAITT 500                 /* wait for 0.5s ... */

GOTO start    /* do it again */
```

Click on "DEVELOPMENT" and start the test program with "EXECUTE" or [F5].
The test is successful if the motor runs slowly back and forth and position 500 is registered.
End the test with [ESC] and "CLOSE" the "FILE".

If the motor sets off uncontrolled or vibrates heavily

NB!
Turn off the motor immediately with the EMERGENCY STOP button if it vibrates heavily or sets off uncontrolled.
If the motor sets off uncontrolled, but the encoder test previously was successful, then decrease the ***Proportional factor*** (parameter 702). (See Optimizing the PID controller)

If the motor doesn't move

If the motor doesn't move at all, then the proportional factor of the PID filter is probably too low or the VLT has not been enabled.
Check the VLT enable (terminal 27 = 24 V) and check that the VLT wasn't stopped via the LCP (flashing display). Then increase the ***Proportional factor*** (parameter 702). (See Optimizing the PID controller)

If the motor vibrates heavily ...

... then you have to optimize the PID controller and to adjust the other parameters of the controller: reduce either the ***Proportional factor*** KPROP (11) or increase the ***Derivative factor*** KDER (12).

If a "tolerated position error is exceeded" is reported

If the drive stops due to a “tolerated position error is exceeded” message it is possible to determine whether the drive was rotating in the wrong direction by comparing the curves of the set and actual values.
Check the connections of the motor or encoder. If the connections are correct, then it is necessary to increase the ***Tolerated position error*** POSERR (15). (See Optimizing the PID controller)

Starting the SyncPos motion controller step-by-step

Optimizing the PID controller

How the control process works

The "TESTRUN" explained in the chapter PC Software Interface can be used as a tool to optimize the SyncPos controller settings, thereby optimizing your system performance. To do that you only need to know a few things about the control scheme of SyncPos:

The SyncPos position controller has two parts:

1. The *Setpoint Generator* interprets the various positioning commands in SyncPos and generates a series of setpoint positions that eventually ends with the desired position.
   Normally, all positioning processes have a trapeze-shaped velocity curve. That means that after a phase of constant acceleration there is a phase with constant velocity and finally a phase with constant deceleration, which ends at the desired target position.
2. The *PID controller* receives the setpoint positions from the *Setpoint generator* and in turn calculates the speed reference needed for the motor to follow the current setpoint position. By setting the PID control parameters you can directly influence to what degree and how quickly a deviation from a theoretical set path (as specified by the setpoint series) should be counteracted.

The following behavior indicate that the control parameters are not optimally adjusted:

- Drive vibrates
- Drive is loud
- Frequent occurrence of position errors
- Poor control accuracy

NB!
The control parameters are load-dependent. Thus the drive must be optimized under the actual conditions of use.

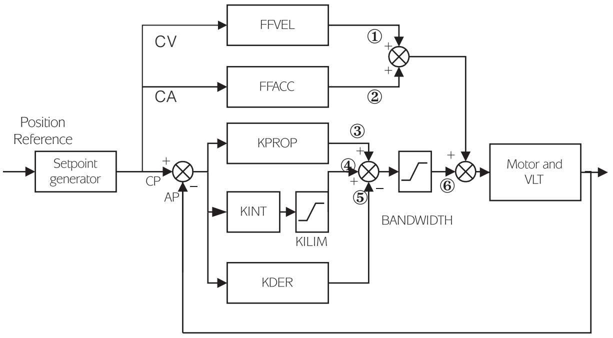
In exceptional cases it may be necessary to determine various sets of control parameters while working with heavily changing load conditions and to re-program them in subsequent application programs depending on the motion process.

Significance and influence of the control parameters

The PID control unit of the SyncPos option transfers the necessary output frequency via an internal speed reference to the VLT. This set value is periodically re-calculated with an interval of one millisecond (interval is programmable by the TIMER parameter). The SyncPos option is by default set with soft 'fit for all' controller parameters.

The PID filter works according to the following formula:

①= FFVEL * (Setpoint velocity)
②= FFACC * (Setpoint acceleration)
③= KPROP * (Position deviation)
④= KINT * (Sum of all previous position deviations) (limited by KILIM)
⑤ = KDER * (Velocity of position deviation)
⑥ = ③ + ④ + ⑤
(limited by BANDWIDTH)



AV is the actual velocity
AP is the actual position (calculated from encoder feedback) in qc (Quad Counts).
CP is the current Setpoint position in qc.
CV is the Setpoint velocity in qc/ms.
(Position deviation) is calculated by CP–AP.

NB!
In SYNCV mode the PID controller is working with speed deviation instead of position deviation. Speed deviation is calculated by CV–AV.

The controller in the SyncPos card utilizes two control strategies at the same time:

1. An open-loop feed-forward control. Since the asynchronous motor inherently has a good open loop performance the feed-forward control is a very important part of the controller in most applications. Benefits from using feed-forwards control is a very fast and accurate response to changes in the s*etpoint reference.*

2. A closed-loop PID control. The PID controller monitors the difference between the actual position and the setpoint position. Based on this information it calculates a control signal to minimize the position deviance. Thus the SyncPos option is able to compensate for changes in load or friction. The PID controller is also necessary to compensate for any position deviance caused by inaccurate setting of the open-loop feed-forward controller.

In short: The feed-forward control is used to handle changes in the setpoint reference (especially important in synchronization applications), while the PID control is used to handle changes in load conditions or inaccuracies of the feed-forward control.

Proportional factor KPROP (11)

The ***Proportional factor*** is multiplied with the position deviance and the result is added to the control signal (the internal speed-reference to the VLT). Since the calculated control signal is proportional to the position deviance (or error) this kind of control is called proportional control. The behavior of the proportional control is similar to that of a spring – the further the spring is extended the stronger the counter-force it produces.

*Influence of the **Proportional factor**:*

KPROP too small	large position deviation due to non-compensatable load and frictional moment;
KPROP larger	quicker reaction, smaller steady-state deviation, larger overshoot, lesser damping;
KPROP too great	heavy vibrations, instability.

Derivative factor KDER (12)

The ***Derivative factor*** is multiplied with the derivative of the position deviance (the 'velocity' of the position deviance) and the result is added to the control signal. The behavior of the derivative control is similar to that of an absorber – the faster the absorber is extended the stronger the counter-force it produces. Thus using the ***Derivative factor*** increases damping in your system.

*Influence of the **Derivative factor**:*

KDER small	no effect;
KDER larger	better dampening, lesser overshoot; if KPROP is increased simultaneously: faster reaction to control deviation at the same level of vibration;
KDER too large	heavy vibrations, instability.

Integral factor KINT (13)

The sum of all error is calculated every time the control signal is updated. The ***Integral factor*** is then multiplied with the sum of all positioning errors and added to the overall control signal. Thus in case that steady-state position errors occurs in your application, make sure you use the integral part of the controller. Steady-state errors will be levelled out as the summed error increases over time until the control signal eventually matches the load.
It is possible to set a limit for the control signal generated by the integral part of the controller (anti-windup).

*Influence of the **Integral factor**:*

KINT very small	steady-state position deviance is very slowly regulated to zero;
KINT larger	faster regulation towards zero steady-state position deviance, larger overshoot;
KINT too large	heavy vibrations, instability.

Integration limit KILIM (21)

The ***Integration limit*** sets a limit for the control signal generated by the integral part of the controller. This helps to prevent the so called 'wind-up' problems which typically occurs in applications where the overall control signal (the internal speed-reference) is maxed out for long periods of time.
This feature is also very helpful in applications where the power to the motor is turned off and on while the option card is controlling the VLT. Cutting of power to the motor (by setting terminal 27 low) while little positioning deviance is present in the controller, could result in an enormous control signal being generated once the power is turned back on.

Velocity Feed-forward FFVEL (36)

The ***Velocity feed-forward*** factor is a scaling factor that is multiplied with the derivative of the setpoint position (the velocity of the setpoint). The result of this operation is added to the overall control signal. This feature is especially useful in applications where there is a good correlation between the control signal (the VLT speed reference), and the speed of the motor. This is indeed the case with most applications using an asynchronous motor.

NB!
The scaling of the FFVEL parameter is dependent on the correct setting of the maximum reference (VLT parameter #205) as well as the SyncPos parameters VELMAX (1) and ENCODER (2).

Acceleration Feed-forward FFACC (37)

The ***Acceleration feed-forward factor*** is multiplied with the 2nd derivative of the setpoint position (the acceleration of the setpoint) and the result is added to the control signal. This feature should be used to compensate for the torque used to accelerate/decelerate the system inertia.

NB!
Scaling of the FFACC factor is depending on the setting of the ***Shortest ramp time*** (31). You should therefore increase the FFACC accordingly when decreasing SyncPos parameter ***Shortest ramp time*** (31) and vice versa.

Sampling time for the entire control algorithm TIMER (14)

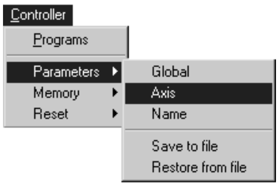
For particularly slow systems you can slow down the entire control system by entering multiples of 1 ms as the sampling time. However, it is important to remember that such a change influences all the control parameters!
Therefore, normally you should not deviate from the value of 1 ms.

BANDWIDTH

A ***Bandwidth*** of 1000 means that the set value is being executed 100%, thus ***Derivative***, ***Proportional*** and ***Integral factors*** are effective as defined. But if you are operating a system which could be jeopardized by vibrations, for example, a crane with a heavy load then you can limit the bandwidth in which the PID controller should function. BANDWIDTH (35) of 300 makes a limitation of 30% possible. The build-up of a vibration is thus prevented since the control is only moved to with 30% of the calculated set value.
However, then it is necessary also to use the feed-forward part of the controller in order to achieve the corresponding control.

■ Optimizing your controller settings step-by-step

For best results use the functions in the **testrun** menu for this purpose; these help you to evaluate and optimize the PID controller on the basis of graphs of the set and actual curves.
However, we recommend only changing one value at a time and subsequently determining the improvement with a testrun.



Click on "CONTROLLER" → "PARAMETER" → "AXIS" and select the VLT, of which you are currently adjusting the settings.

Setting controller behavior

Before you adjust the controller parameters it is important to determine which controller behavior should be achieved.

NB!
The drive elements must never be operated outside of the technical specifications. Thus the maximum acceleration is determined by the “weakest” drive element.

- “Stiff” axis: the fastest reaction possible is mainly influenced by the ***Proportional factor***. You can judge the results on the basis of the velocity graph.
- Damping of vibrations are mainly influenced by the ***Derivative factor***. The results can best be assessed in the velocity graph.
- Temporary (static) deviations in position are mainly reduced by the ***Integral factor*** and can best be judged on the basis of the positioning graph.

Ten steps for optimum control

The following procedure will optimize your controller settings in most applications:

1. Make sure that you have specified correct values for VLT parameter #205, as well as the SyncPos parameters VELMAX (1), ENCODER (2) and RAMPMIN (31). If you change these settings again at a later point you may need to optimize the controller again.
2. Set the POSERR (15) parameter to a very high value e.g. 1000000 to avoid getting the option error no. 8 during the following tests.

   NB!
   To avoid damaging the system, make sure, that you set the POSERR within the limits of the system, because the position error monitoring is not active with extremely high values.
3. Optimize the ***Velocity feed-forward*** control:
   Step 1)
   Execute a "TESTRUN" with KPROP=0, KDER=0, KINT=0, FFACC=0 and FFVEL=100.
   Step 2)
   View the velocity profiles: If the actual velocity profile is *lower* than the setpoint velocity profile, return to the TESTRUN dialog, click "REPEAT" and increase FFVEL. Of course if the actual velocity profile is *higher* than the specified setpoint velocity you should decrease FFVEL.
   Step 3)
   Run successive TESTRUNs until the two velocity profiles shown in the TESTRUN graph have the same maximum value.
   Step 4)
   FFVEL is now optimized, save the current value.
4. In systems with large inertia and/or rapid changes in the reference velocity it is a good idea to use and optimize the ***Acceleration feed-forward*** control (make sure the inertial load is connected when optimizing this parameter):
   Step 1)
   Execute a "TESTRUN" with KPROP=0, KDER=0, KINT=0, FFACC=0 and FFVEL at the optimized value found above. Use the highest possible acceleration setting. If RAMPMIN (31) is adjusted properly an acceleration value of 100 and a deceleration value of 100 should be sufficient. Start out with a low setting of FFACC approx. 10.
   Step 2)
   View the velocity profiles: If during acceleration the actual velocity is constantly lower than the reference velocity profile, then click "REPEAT" and set a higher value of FFACC. Then execute "TESTRUN" again.
   Step 3)
   Run successive TESTRUNs until the two velocity profiles shown in the TESTRUN graph have similar ramp-up and ramp-down curves.
   Step 4)
   FFACC is now optimized, save the current value.
5. Next step is finding the maximum stable value of the ***Proportional facto***r in the PID controller:
   Step 1)
   Execute a "TESTRUN" with KPROP=0, KDER=0, KINT=0. Set FFVEL and FFACC at the optimized values found above.
   Step 2)
   View the velocity profile. If the velocity profile isn't oscillating then click "REPEAT" and increase KPROP.
   Step 3)
   Run successive TESTRUNs until the actual velocity profiles is oscillating mildly.
   Step 4)
   Decrease this "mildly" unstable KPROP value to about 70 %. Save this new value.
6. In order to dampen the oscillations created by the KPROP-part of the controller, the ***Derivative factor*** should now be optimized.
   Step 1)
   Execute a "TESTRUN" with KINT=0 and KDER=200. Set FFVEL, FFACC and KPROP at the optimized values found above.
   Step 2)
   Run successive TESTRUNs with increasing values of the KDER factor. At first the oscillations will gradually reduce. Stop increasing KDER when the oscillations begin to increase.
   Step 3)
   Save the last value of KDER.
7. In any system that requires a zero steady-state error, the integration part of the controller must be used. Setting this parameter though is a trade-off between achieving zero steady-state error fast (which is good) and increasing overshoot and oscillations in the system (which is bad).

8. If you are using the integration part of the PID controller, remember to reduce the KILIM as much as possible (without losing the KINT-effect of course) in order to reduce oscillations and overshoot as much as possible.
9. Reduce the BANDWIDTH as much as possible. With a properly optimized open-loop control BANDWIDTH could be reduced to as little as 6 or 12 %.
10. Set the POSERR (15) parameter back to normal e.g. 20000.

"TEST PARAMETER" → "SAVE"

Once you have concluded the "TESTRUN" → "SAVE" the new parameters as the user parameters. Thus, these parameters are saved in the controller and in the future will be used for all programs.

■ What to do if...

... there is a tendency towards instability

In the event of a strong tendency towards instability reduce the proportional and derivative factors again, or reset the integral factor.

... stationary precision is required

If stationary precision is required then you must increase the integral factor.

... the tolerated position error is exceeded

If the test run is constantly interrupted with the message “position error” set the parameter for the ***Tolerated position error*** POSERR (15) – within the tolerable limits– as large as possible.

If the position error occur during the acceleration phase that suggests that the set acceleration cannot be achieved under the existing load conditions. Increase the ***Tolerated position error*** POSERR (15) or determine a maximum acceleration suitable for the entire system.

If position error do not occur until after the acceleration phase and they can be delayed but not eliminated by increasing the ***Tolerated position error,*** this suggests that the maximum velocity (rpm) chosen is too high. Determine a maximum velocity suitable for the entire system.

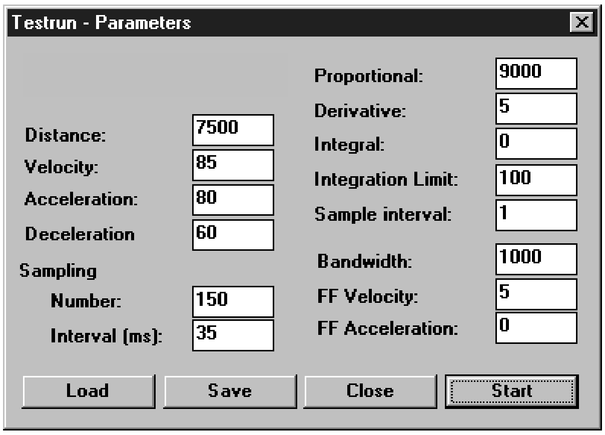
.. the maximum acceleration is not achieved

In general, the technical data for a drive are only valid for a freely rotating axle end. If the drive is carrying a load the maximum acceleration is reduced.

The theoretical maximum acceleration will also not be achieved if, for example, the PID controller output is too small or the VLT/motor is not sized correctly and therefore does not provide enough energy for peak consumption during acceleration.

■ Examples of control optimization

Dampening of vibrations

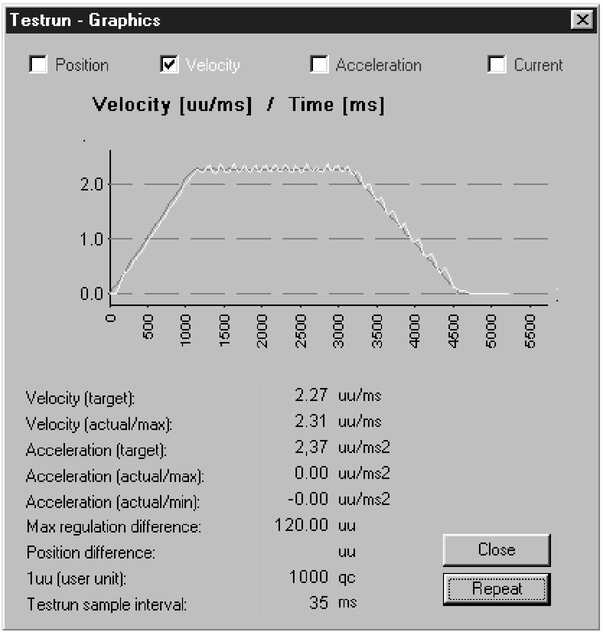


Testrun - Parameters

Distance: 7500
Velocity: 85
Acceleration: 80
Deceleration 60
Sampling
Number: 150
Interval (ms): 35

Proportional: 9000
Derivative: 5
Integral: 0
Integration Limit: 100
Sample interval: 1
Bandwidth: 1000
FF Velocity: 5
FF Acceleration: 0

The drive vibrates:

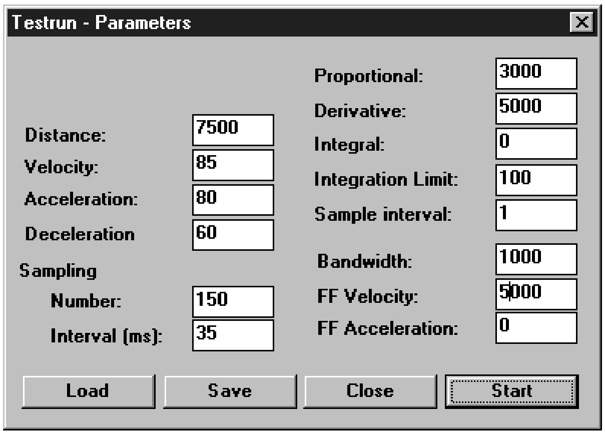


Testrun - Graphics

☐ Position ☑ Velocity ☐ Acceleration ☐ Current

Velocity (target): 2.27 uu/ms
Velocity (actual/max): 2.31 uu/ms
Acceleration (target): 2,37 uu/ms2
Acceleration (actual/max): 0.00 uu/ms2
Acceleration (actual/min): -0.00 uu/ms2
Max regulation difference: 120.00 uu
Position difference: uu
1uu (user unit): 1000 qc
Testrun sample interval: 35 ms

By increasing the ***Derivative factor*** to 5000 and reducing the ***Proportional factor*** to 3000 vibration during running and braking is lessened.

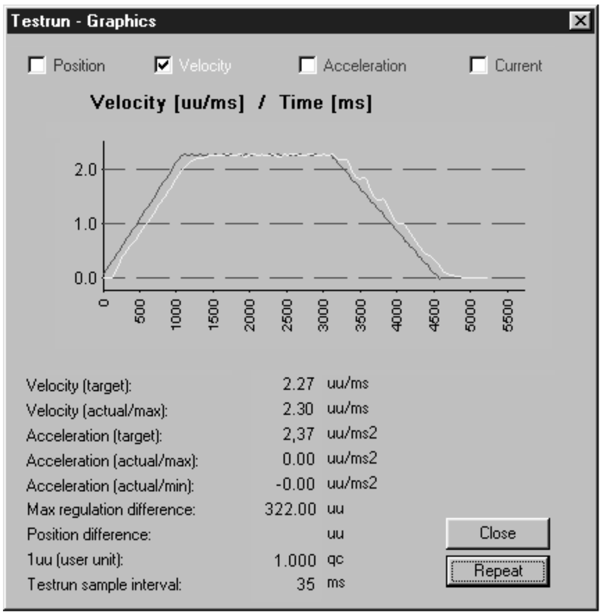


Testrun - Parameters

Distance: 7500
Velocity: 85
Acceleration: 80
Deceleration 60
Sampling
Number: 150
Interval (ms): 35

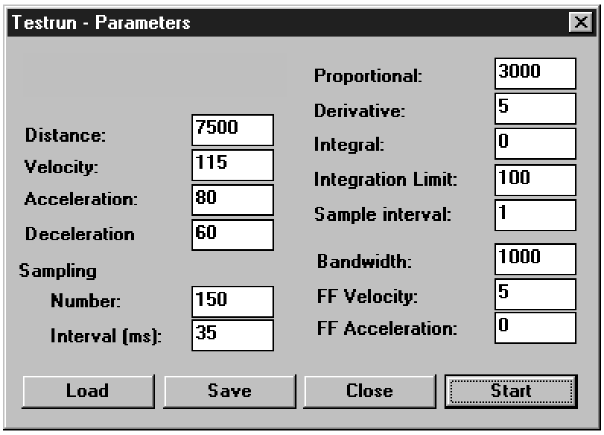
Proportional: 3000
Derivative: 5000
Integral: 0
Integration Limit: 100
Sample interval: 1
Bandwidth: 1000
FF Velocity: 5000
FF Acceleration: 0

However, the drive now reacts somewhat slowly to changes in velocity, which leads to a deviation from the set curve at the beginning of the acceleration phase:



Velocity (target): 2.27 uu/ms
Velocity (actual/max): 2.30 uu/ms
Acceleration (target): 2,37 uu/ms2
Acceleration (actual/max): 0.00 uu/ms2
Acceleration (actual/min): -0.00 uu/ms2
Max regulation difference: 322.00 uu
Position difference: uu
1uu (user unit): 1.000 qc
Testrun sample interval: 35 ms

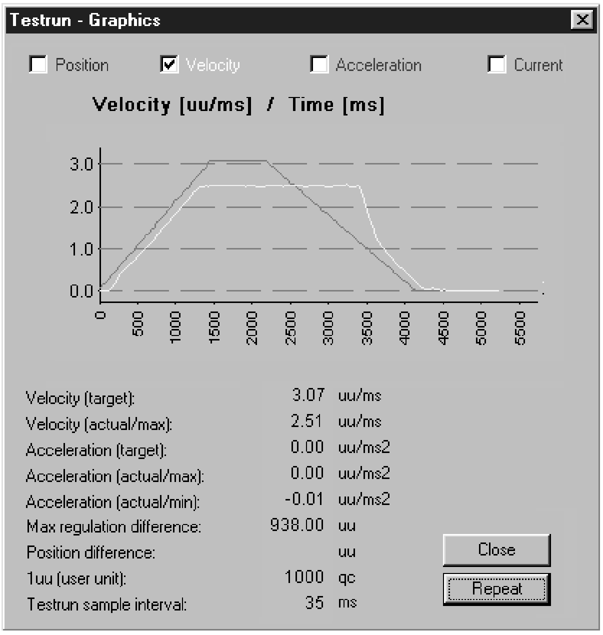
Determining the maximum velocity or maximum speed



Distance: 7500
Velocity: 115
Acceleration: 80
Deceleration 60
Sampling
Number: 150
Interval (ms): 35

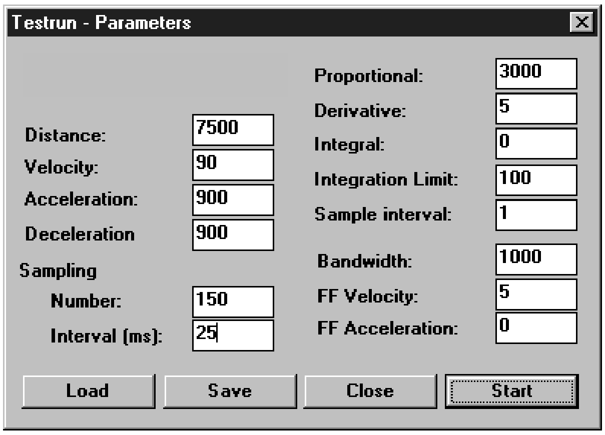
Proportional: 3000
Derivative: 5
Integral: 0
Integration Limit: 100
Sample interval: 1
Bandwidth: 1000
FF Velocity: 5
FF Acceleration: 0

The drive does not achieve maximum speed and thus starts to brake too late, since it is trying to catch up with the position reference.



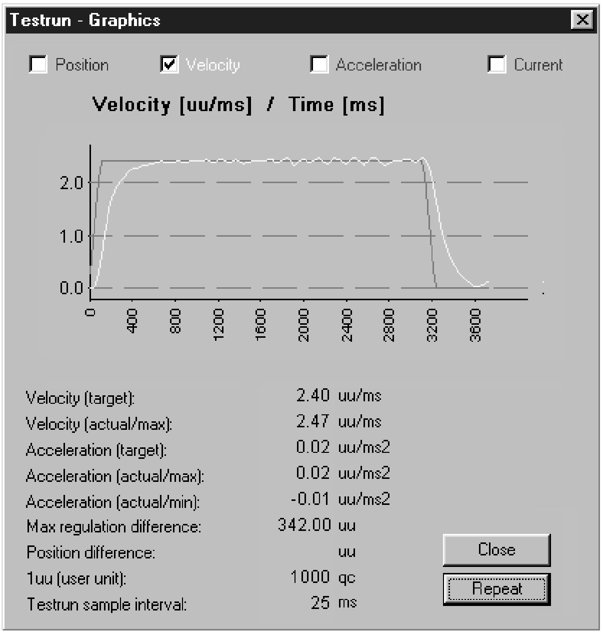
Velocity (target): 3.07 uu/ms
Velocity (actual/max): 2.51 uu/ms
Acceleration (target): 0.00 uu/ms2
Acceleration (actual/max): 0.00 uu/ms2
Acceleration (actual/min): -0.01 uu/ms2
Max regulation difference: 938.00 uu
Position difference: uu
1uu (user unit): 1000 qc
Testrun sample interval: 35 ms

By reducing the velocity to 90% of the maximum velocity and increasing acceleration and the deceleration to 900% the drive can achieve the required 2.47 UU/ms.



Distance: 7500
Velocity: 90
Acceleration: 900
Deceleration 900
Sampling
Number: 150
Interval (ms): 25

Proportional: 3000
Derivative: 5
Integral: 0
Integration Limit: 100
Sample interval: 1
Bandwidth: 1000
FF Velocity: 5
FF Acceleration: 0



Velocity (target): 2.40 uu/ms
Velocity (actual/max): 2.47 uu/ms
Acceleration (target): 0.02 uu/ms2
Acceleration (actual/max): 0.02 uu/ms2
Acceleration (actual/min): -0.01 uu/ms2
Max regulation difference: 342.00 uu
Position difference: uu
1uu (user unit): 1000 qc
Testrun sample interval: 25 ms

■ CAM Control

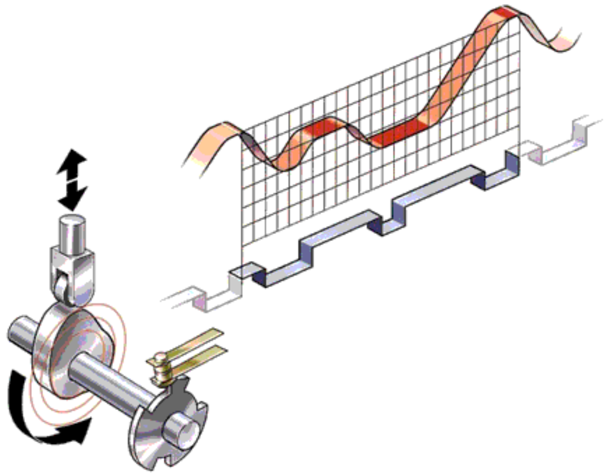
■ How CAM Control with SyncPos operates

In order to realize CAM control, you need – depending on the application – at least one curve which describes the slave position in relation to the master position, as well as the engaging and disengaging behavior. Of course, many additional parameters are required for a CAM control which, together with the fixpoints of the curve, produce a curve profile.

The synchronization in CAM-Mode (SYNCC command) can also be performed with marker correction (SYNCCMM and SYNCCMS). This would be required, for example, if the products are transported irregularly on a conveyor belt, or if adding errors need to be compensated for.

Diagram of the principle

The mechanical cam disc and the mechanical camshaft are shown on the left, the curves for the electronic cam control and the electronic cam box are shown on the right:



In order to create the curve profile, use the → "CAM-EDITOR", into which you first load the VLT parameters that have already been set. Then you set the fixpoints of the curve and define the parameters required for your application. You can enter all values in physical or user-defined units under a Windows interface. You can constantly control the curve profile graphically; in this way, you can check velocity and acceleration of the slave axis.

Interpolation

The CAM-Editor calculates the curve from fixpoints with the help of a spline interpolation. This is optimized to a minimum torque. In order to prevent speed leaps in the case of repeated curve cycles, the velocity at the beginning and the end is equated. You can choose between two types of curve for this calculation. In either type, the interpolation takes account of the gradient of the curve at the beginning and the end. In the case of curve type 0, the gradient at the beginning and at the end is averaged; in the case of curve type 1, the gradient at the beginning of the curve is also used for the end of the curve.

Tangent Points for straight sections

For areas where the velocity must be constant and the acceleration = 0, you need to use tangent points. A straight line will be drawn instead of a spline between these points.

Accuracy

The fixpoints are used directly as interpolation points provided that this is permitted by the interval distance. The CAM-Editor performs a linear interpolation between the interpolation points. If a fixpoint is not hit by the selected interval distance, then the corresponding slave reference value does not exist in the interpolation table. You can avoid such deviations if you have activated → ☑ "SNAP ON GRID".

Internal realization as array

The curve profiles are realized internally as arrays which you can call up by means of a DIM instruction and the SETCURVE command.

Quick Start Tutorial for impatient users

1. Start → "CAM-EDITOR" and load VLT parameters as cnf file into the CAM-Editor: "FILE" → "LOAD CNF".

2. Enter gearing factors or set user units MU and UU.

3. Enter at least three → "FIX POINTS" for master and slave in the index card with the same name.

4. Enter → "START STOP POINTS" for the engaging and disengaging.

5. Define the → "NUMBER OF INTERVALS" for a master cycle length in the index card "CURVE DATA".
   The → "INTERVAL TIME" in the index card "CURVE INFO" should not be less than 20 ms.

6. Define the → "SLAVE STOP POSITION" in the index card "CURVE INFO".

7. Enter the number of → "CYCLES/MIN MASTER" in the index card "CURVE INFO".

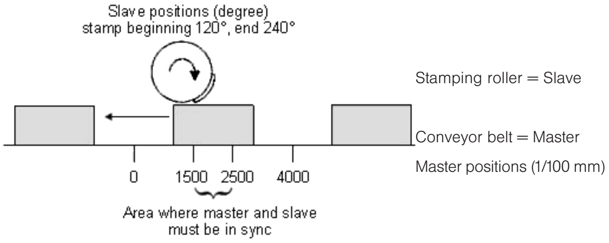
8. Check the velocity and acceleration of the slave with the help of the diagram.

9. Save curve as cnf file → "SAVE CNF AS" and load into the VLT.

Example: Stamping of boxes with use-by date

The following example explains step by step how to edit the curve for this application of the CAM control and then how to incorporate it into your control program.

A roller is supposed to stamp an inscription with a length of 10 cm on cardboard boxes. The stamp corresponds to a roller section of 120 degrees. 60 cardboard boxes are transported on the conveyor belt per minute. The cardboard boxes are always transported on the conveyor belt at exactly the same distance from each other (e.g. by means of a mechanical set pattern). During the printing process, the stamping roller and the cardboard box must run in sync:


Slave positions (degree)
stamp beginning 120°, end 240°
Stamping roller = Slave
Conveyor belt = Master
Master positions (1/100 mm)
0
1500
2500
4000
Area where master and slave must be in sync

How to edit the curve step by step

1. Set the VLT with the required parameters and save these user parameters with "PARAMETERS" → "SAVE TO FILE" with the extension „cnf“.

2. Start the → "CAM-EDITOR" and load this cnf file with File → "LOAD CNF".

3. Determine the gearing factor of the master in MU units.
   The input should be possible in 1/10 mm resolution.
   The drive is connected with the conveyor belt by means of a gearing of 25:11; i.e. the motor makes 25, the drive pulley 11 revolutions.
   Gearing factor = 25/11
   Incremental encoder directly on the master drive; encoder resolution = 4096.
   The drive pulley has 20 teeth/revolution,
   2 teeth correspond to 10 mm, thus 1 revolution corresponds to = 100 mm conveyor belt feed or 1000/10 mm.
   Thus, the scaling factor is 1000.

$$\frac{\text{Gearing factor * Encoder resolution * 4}}{\text{Scaling factor}}\ \text{qc} = 1\ \text{MU}$$

$$\frac{25/11 * 4096 * 4}{1000}\ qc = 1\ MU$$

$$\frac{25 * 4096 * 4}{1000 * 11}\ qc = \frac{2048}{55}\ qc = 1\ MU = \frac{SYNCFACTM\ (49)}{SYNCFACTS\ (50)}$$

Enter these values in the index card → "SYNCHRONIZATION" (the selected units should always be whole numbers):

Syncfactor Master [49] = 2048
Syncfactor Slave [50] = 55

4. Enter the gearing factor of the slave in UU units:
Gearing factor = 5/1
Encoder resolution (incremental encoder) = 500
One revolution of the roller is 360 degrees. We are going to work with a resolution of 1/10 degrees. This means that we are dividing one revolution of the roller into 3600 work units:
Scaling factor = 3600

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}}\ qc = 1\ UU$$

$$\frac{5/100 * 500 * 4}{3600}\ qc = 1\ UU$$

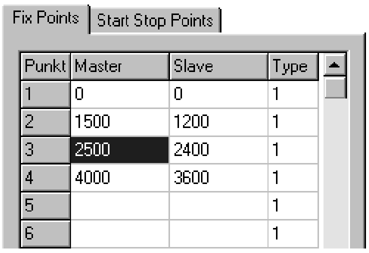
$$\frac{5 * 500 * 4}{3600}\ qc = \frac{25}{9}\ qc = 1\ UU = \frac{POSFACT\_Z\ (23)}{POSFACT\_N\ (26)}$$

Enter these whole number values in the index card → "ENCODER":

User factor numerator [23] = 25
User factor denominator [26] = 9

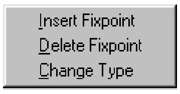
5. Determine a whole number factor for the intervals in the index card → "CURVE DATA" so that the fixpoints are on the interpolation points.
A complete cycle length of the master is 400 mm; this corresponds to 4000 MU.
The → "NUMBER OF INTERVALS" = 40 results in a reasonable interval time of 25 ms.

6. Define → "FIX POINTS" for the conveyor belt (master) and the roller (slave) and the point type „1“ for curve points. Click on the → "RECALC" button in order to depict the curve. The function → "SNAP ON GRID" should be activated.



Punkt	Master	Slave	Type
1	0	0	1
2	1500	1200	1
3	2500	2400	1
4	4000	3600	1
5			1
6			1

7. Master and slave must run synchronously with the same velocity between the position 1500 and 2500. This requires a straight line which is determined by two tangent points.
Enter „2“ for tangent point in the column → "TYPE" for the two positions in the index card → "FIX POINTS".
Alternatively, you can move the cursor to the fixpoint 2500, click on the right mouse button and select → "CHANGE TYPE" in the subsequent pop-up menu. Since two tangent points are always required, the previous one (left) will also be changed at the same time.

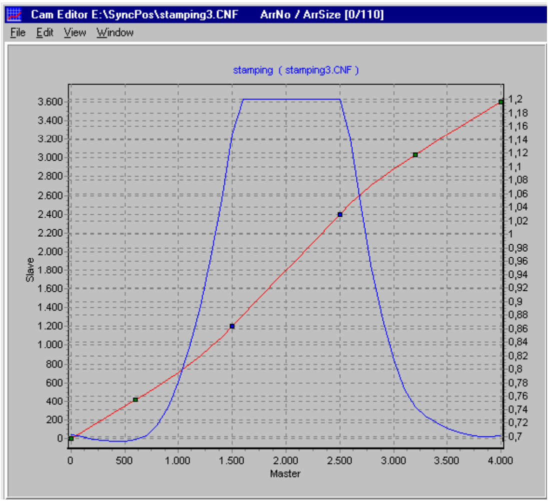


8. The curve will not be shown because the calculation of a spline always requires three points. In this case, you will therefore need an additional fixpoint before and after the tangent (straight section).

You can enter points in the table: Click on the row of the second fixpoints with the right mouse button and select → "INSERT FIXPOINT" in the pop-up menu that follows. The point will be inserted between this point and the previous one (left).

Alternatively, you can enter points in the diagram: Move the cursor to the (now) fifth point until the hand icon appears. Click on the right mouse button and select → "INSERT FIXPOINT" in the pop-up menu.

Activate the diagram of the → ☑ "VELOCITY" and move the two newly inserted fixpoints with the help of the mouse until you get a uniform velocity:



9. Enter the → "CYCLES/MIN MASTER" = 60 in the index card → "CURVE INFO". This is the (maximum) number of cardboard boxes that are processed per minute.

10. Verify whether the acceleration of the slave is within the limit. For this purpose, you must activate the illustration of the
→ ☑ "ACCELERATION" and of the
→ ☑ "ACC. LIMIT".

11. In order to load the curve into your control system, you must first save the file as a cnf file "FILE" → "SAVE AS ..." .
You will see the name of the curve and the number of array elements in the title bar. You will need the latter for the DIM instruction during programming.

How to load the curve into the VLT

You can load the cnf file with the modified parameters and the – automatically generated – curve arrays into the VLT by means of "PARAMETERS" → "RESTORE FROM FILE".

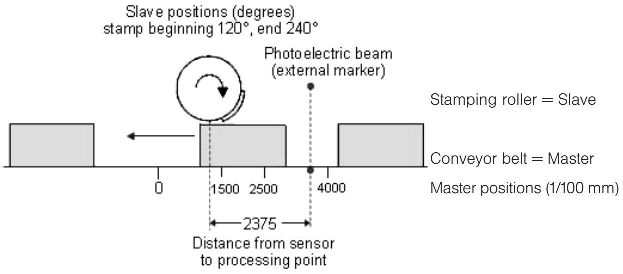
How to integrate the curve into the control program

Since the curve is stored internally as an array, the DIM instruction must appear first in your program:

```
DIM stamping[92]
    // Number of elements from the title bar
    // of the CAM-Editor

HOME
    // Slave axis performs a home run
    // (switch for zero position on top)
    // Afterwards, the slave will be in the
    // zero position (0 degrees)
    // (Omitted if an absolute encoder is used)

SETCURVE stamping
    // Set stamping curve
    // Assumption: A box is positioned at the
    // processing point with its front edge
    // and the master stands idle
DEFMCPOS 1000   // 1000 corresponds to this
                // position (front edge of box)
POSA CURVEPOS
    // Bring slave to the curve position that
    // corresponds to the master position
SYNCC 0
    // Change into and remain in CAM-Mode
SYNCCSTART 0
    // Engage roller immediately with the set
    // maximum velocity
    // This does not cause any movement since
    // the master is idle and in the correct position
    // Now the master can be started
start:
    // Empty main loop so that program will
    // not be terminated
    // Additional processing could take place here
goto start
```

■ Example: Printing of cardboard boxes with Marker Correction

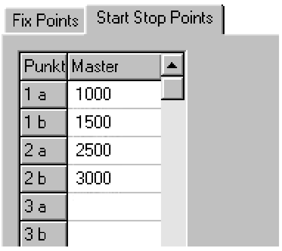
If the boxes are not always transported at the exact same distance from each other, markers will be required that can recognize a box and correct the synchronization.
The following section describes how you can adapt the curve of the previous example to this application.
Again, a roller is supposed to stamp an inscription with a length of 10 cm on cardboard boxes. A maximum of 60 boxes are transported on the conveyor belt per minute. During the printing operation, both the stamping roller and the box must run in sync.



How to edit a curve for Marker Synchronization

1. Steps 1 to 9 are the same as in the previous example.

10. Define the point pairs for the engaging and disengaging in the index card → "START STOP POINTS". We make the assumption that engaging takes place at the beginning of the box and disengaging is to take place until the end of the box.



Punkt	Master
1 a	1000
1 b	1500
2 a	2500
2 b	3000
3 a	
3 b	

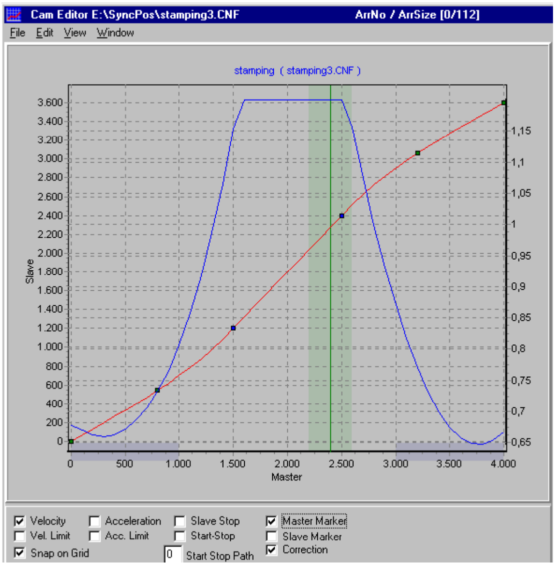
11. In the index card → "CURVE DATA", determine the position in which the roller should stop if no other Slave Stop Position is defined in the program.
The roller always needs to return to the position 0 degrees:
→ "SLAVE STOP POSITION" = 0

12. The photoelectric beam (external marker) has a distance of 237.5 mm from the processing point (= stamp touches the cardboard box) and detects the beginning of the box (corresponding to master position 1000). The marker distance is therefore 2375. Enter this value in the index card → "SYNCHRONIZATION" and define the permitted tolerance for the appearance of the markers and the external marker type = 2 for the master:
Master Marker

Distance	SYNCMPULSM (58) = 2375
Tolerance	SYNCMWINM (68) =200
Typ	SYNCTYPM (60) =2

Enter the master position in the index card → "CURVE DATA":
Master-Marker-Position = 1000

13. Take a look at the curve profile in order to determine when the correction of the synchronization may begin at the earliest and when it must be finished. The vertical green line indicates the master position where the marker is recognized, the light green area shows the tolerance window for the appearance of the master marker.
(See PC-Software for colour.)



Cam Editor E:\SyncPos\stamping3.CNF ArrNo / ArrSize [0/112]

☑ Velocity ☐ Acceleration ☐ Slave Stop ☑ Master Marker
☐ Vel. Limit ☐ Acc. Limit ☐ Start-Stop ☐ Slave Marker
☑ Snap on Grid 0 Start Stop Path ☑ Correction

At the earliest, the correction may begin when the printing of a box has been completed, since any change of velocity during the printing process would damage the box. The correction must be finished completely when the next box reaches the processing point. In this example, the master positions at the end and beginning of a box are quite suitable:
Correction Start = 3000
Correction End = 1000
Enter the values in the index card → "CURVE DATA"; the depiction of the area is shaded in blue in the curve profile.

14. Verify whether the velocity and acceleration of the slave remain within the limit. For this purpose, you must activate the illustration of the → ☑ "VELOCITY" and of the → ☑ "VEL.-LIMIT" and then the illustration of the → ☑ "ACCELERATION" and of the → ☑ "ACC.-LIMIT".

15. "FILE" → "SAVE as CNF"

How to load the curve into the VLT

You can load the cnf file with the modified parameters and the – automatically generated – curve arrays into the VLT by means of "PARAMETERS" → "RESTORE FROM FILE".

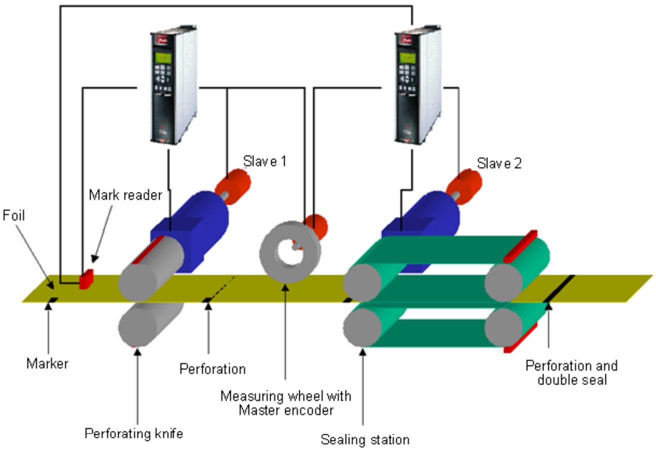
How to integrate the curve "marker synchronization" into the control program

Since the curve is stored internally as an array, the DIM instruction must appear first in your program:

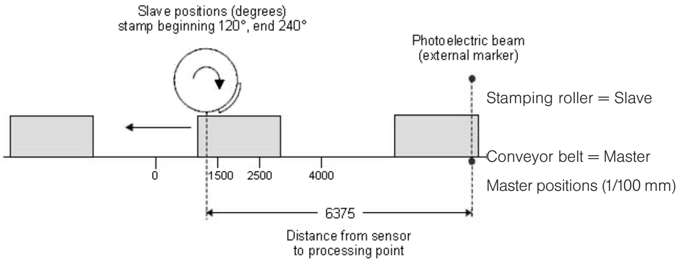
```
DIM marker[112]    // See number of elements in
                   // the title bar of CAM-Editor
HOME
    // Slave axis performs a home run (switch for
    // zero position on top); afterwards, the slave
    // will be in the zero position (0 degrees)
    // (Omitted if an absolute encoder is used)
SETCURVE marker
    // Set stamp curve with marker
dist = GET SYNCMPULSM    // Distance to sensor
DEFMCPOS (1000-dist)
    // This is the location that corresponds
    // to the sensor signal
SET SYNCMSTART 2000
    // Counting of the master pulse does not begin
    // until the next edge comes from the sensor
SYNCCMM 0
    // Synchronize in CAM-Mode until motor stop
SYNCCSTART 1
    // Engage roller with start point pair 1

    // Synchronous operation

WAITI 4 ON
    // Wait for input signal when conveyor belt
    // is being switched off
SYNCCSTOP 2 0
    // Disengage roller with stop point pair 1
    // and stop at position 0 degrees
```

■ **If the sensor distance is larger than one master cycle length**

In many applications, the marker cannot be placed within one master cycle length, for example in the case of the following equipment for the production of plastic bags:



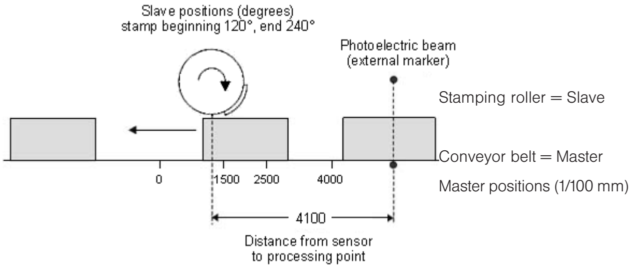
Since no markers can be installed between the slaves here, there is only a marker reader in this application; the welding station is much farther away than one master cycle length. Since the distance of the sensor is larger than one master cycle length, a buffer is provided for the marker deviation. When the marker appears, the value is entered in the buffer and read out upon the appearance of the next marker:



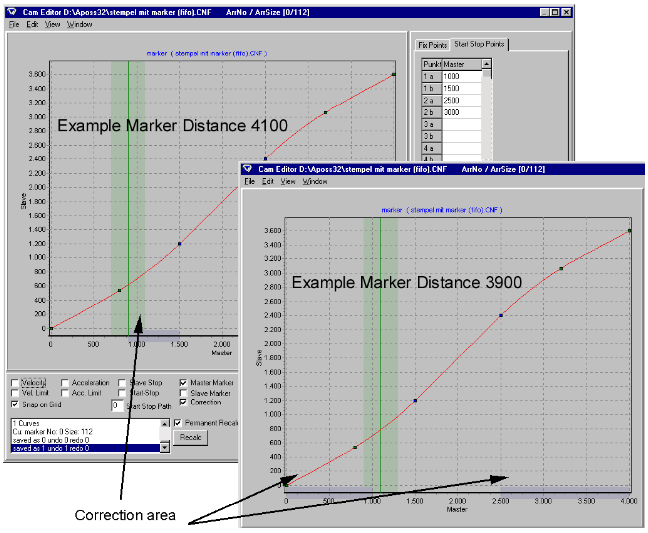
In order to assess in what area corrections may be made, you should subtract the master cycle length as often as necessary until the value is < 1 master cycle length. This is the maximum permitted distance for making corrections. In this example, it is 6375 – 4000 = 2375 and thus the same correction range as in the previous example.

Problematic situations in the determination of the marker distance

If the marker is mounted so close to the processing point that there is no time left to correct the synchronization after the marker has been detected, then you can remedy the problem only through mechanical modification of the marker. On the other hand, the same effect might also occur if the marker distance is larger than the master cycle length and if an insufficient distance likewise remains after the subtraction of this value, for example:



The value is entered into the buffer when the marker appears. The buffer is read out only when the next marker is recognized. This means that the marker is only ”recognized” at the master position 900 and that there is little time left in our example to correct the error. It is the same effect as if the sensor had been mounted at the value (distance – master cycle length) or (4100 – 4000), respectively, i.e. only 10 mm in front of the processing point.


Cam Editor D:\Aposs32\stempel mit marker (fifo).CNF ArrNo / ArrSize [0/112]
File Edit View Window
marker (stempel mit marker (fifo).CNF)
Example Marker Distance 4100
Slave
Master
3.600
3.400
3.200
3.000
2.800
2.600
2.400
2.200
2.000
1.800
1.600
1.400
1.200
1.000
800
600
400
200
0
500
1.000
1.500
2.000
Fix Points
Start Stop Points
Recalc
Cam Editor D:\Aposs32\stempel mit marker (fifo).CNF ArrNo / ArrSize [0/112]
File Edit View Window
marker (stempel mit marker (fifo).CNF)
Example Marker Distance 3900
2.500
3.000
3.500
4.000
Correction area

Punkt	Master
1 a	1000
1 b	1500
2 a	2500
2 b	3000
3 a	
3 b	
4 a	
4 b	

□ Velocity □ Acceleration □ Slave Stop ☑ Master Marker
□ Vel. Limit □ Acc. Limit □ Start-Stop □ Slave Marker
☑ Snap on Grid 0 Start Stop Path ☑ Correction
☑ Permanent Recalc

1 Curves
Cu: marker No: 0 Size: 112
saved as 0 undo 0 redo 0
saved as 1 undo 1 redo 0

Thus, it would be better to install the sensor in such a way that the distance to the processing point is either smaller or substantially larger than one master cycle length; here, for example, at a distance of 3900. Then it is possible to correct from 2500 to 1000.

Alternatively, the sensor could be installed further away, for example at a distance of 7900; this has the same effect as if the sensor had been installed at distance – master cycle length (7900 – 4000), i.e. 3900 in front of the processing point. This allows enough time to correct the synchronization. If this cannot be done mechanically, then the values must be manipulated somewhat in order to avoid the solution with the buffer. Please proceed as follows:

Subtract a value x from the actual distance so that the distance becomes < than the master cycle length, for example 4100 – 200 = 3900. You also subtract the value x from the master position, i.e. 1000 – 200 = 800.

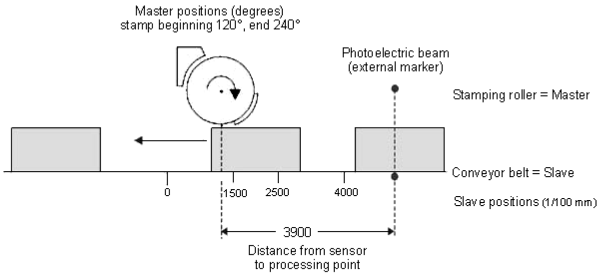
Enter both values in the index cards → "SYNCHRONIZATION" and → "CURVE DATA":

Master Marker Distance
SYNCMPULSM(58) = 3900
Master Marker Position = 800

Since no buffer is generated now, it would be possible to correct from 2500 to 800, for example.

Example: Slave Synchronization with Marker

In the following example, the conveyor belt is the slave and the stamp roller the master, since the take-up and delivery of the dye must be continuous for a uniform printing process. A maximum of 20 cardboard boxes are transported on the conveyor belt per minute. The distance of the boxes is not larger than one master cycle length. Stamp roller and box must run in sync during the printing operation:



In contrast to the synchronization with master marker correction, here the slave position is being corrected instead of the curve.

How to edit a curve for the Slave Synchronization

1. Set the VLT with the required parameters and save these user parameters with "PARAMETERS" → "SAVE TO FILE" with the extension „cnf".

2. Start the → "CAM-EDITOR" and load this cnf file with "FILE" → "LOAD CNF".

3. Determine the gearing factor of the master in MU units.
Gearing factor = 5/1
Encoder resolution (Increm. encoder) = 500
One revolution of the roller is 360 degrees. We are going to work with a resolution of 1/10 degrees. Therefore we are dividing one revolution of the roller into 3600 work units:
Scaling factor = 3600

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}} \quad \text{qc} = 1 \text{ MU}$$

Enter these whole number values in the index card → "SYNCHRONIZATION":
Syncfactor Master [49] = 25
Syncfactor Slave [50] = 9

4. Enter the gearing factor of the slave in user untis [UU]:
The input should be possible in 1/10 mm resolution.
The drive is connected with the conveyor belt by means of a gearing of 25:11; i.e. the motor makes 25, the drive pulley 11 revolutions.
Gearing factor = 25/11
Incremental encoder directly on the master drive; encoder resolution = 4096
The drive pulley has 20 teeth/revolution,
2 teeth correspond to 10 mm, thus 1 revolution corresponds to = 100 mm conveyor belt feed or 1000/10 mm.
Thus, the scaling factor is 1000

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}} \quad \text{qc} = 1 \text{ UU}$$

Enter these values in the index card → "ENCODER":
User factor numerator [23] = 2048
User factor denominator [26] = 55

5. Determine a whole number factor for the intervals in the index card → "CURVE DATA" so that the fixpoints are on the interpolation points.
A complete cycle length of the master is 360 degrees; this corresponds to 3600 MU.
The → "NUMBER OF INTERVALS" = 36 produces a reasonable interval time of 27.7ms.

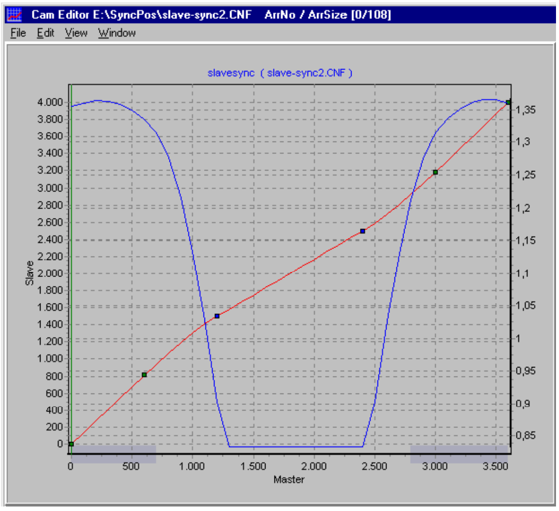
6. Define → "FIX POINTS" for the roller (slave) and the conveyor belt (master) and the point type „1" for curve points. The function → "SNAP ON GRID" should be activated.

Points	Master	Slave	Type
1	0	0	1
2	1200	1500	1
3	2400	2500	1
4	3600	4000	1

7. Master and slave must run synchronously with the same velocity between the master position 1200 to 2400. For this, you need to have a straight line which is determined with two tangent points. Thus, for these two fixpoints you must define the → "TYPE" = 2 for tangent point and insert two fixpoints so that the curve can be calculated.

Points	Master	Slave	Type
1	0	0	1
2	600	813	1
3	1200	1500	2
4	2400	2500	2
5	3000	3186	1
6	3600	4000	1

Activate the diagram of the → ☑ "VELOCITY" and move the two newly inserted fixpoints with the help of the mouse until you get a uniform velocity progression:



8. Enter the → "CYCLES/MIN MASTER" = 20 in the index card → "CURVE INFO". This is the (maximum) number of cardboard boxes that can be processed per minute.

9. Verify whether the acceleration of the slave is within the limit. For this purpose, you must activate the illustration of the
→ ☑ "ACCELERATION" and of the
→ ☑ "ACC. LIMIT".

10. Define in the index card → "START STOP POINTS" with some safe distance in order to start the synchronization at the beginning. Engaging should take place between 20 and 100 degrees because it must be completed at 120 degrees.

Points	Master
1a	200
1b	1000

11. In the index card → "CURVE DATA", define the position where the conveyor belt should stop if no other Slave Stop Position is being defined in the program:
The conveyor belt should always stop in position 0:
→ "SLAVE STOP POSITION" = 0

12. The photoelectric beam (external marker) has a distance of 390 mm from the processing point (= stamp touches the box) and detects the beginning of the box (corresponds to slave position 1000). Thus, the marker distance is 3900. Enter this value in the index card → "SYNCHRONIZATION" and define the permitted tolerance for the appearance of the markers and the external marker type = 2 for the slave:

Slave Marker	
Distance	SYNCMPULSM (59) = 3900
Tolerance	SYNCMWINM (69) =200
Type	SYNCTYPM (61) = 2

Enter the values in the index card → "CURVE DATA":
Slave-Marker-Position = 1000

13. Take a look at the curve profile in order to determine when the correction of the synchronization may begin at the earliest and when it must be finished. The green horizontal line indicates the master position where the marker is recognized, the light green area shows the tolerance window for the appearance of the master marker.
(See PC-Software for colour.)
At the earliest, the correction may begin when the printing of a cardboard box has been completed, since any change of velocity during the printing process would damage the printing stamp and/or the box. Also, the correction must have been completed in its entirety when the next box arrives at the processing point. In this example, the slave positions at the end and beginning of a box are quite suitable.
Enter the values in the index card → "CURVE DATA":

Correction Start	=2800
Correction End	=750

14. Verify whether the velocity and acceleration of the slave remain within the limit. For this purpose, you must activate the illustration of the → ☑ "VELOCITY" and of the → ☑ "VEL.-LIMIT" and then the illustration of the → ☑ "ACCELERATION" and of the → ☑ "ACC.-LIMIT".

15. "FILE" → "SAVE as CNF"

How to load the curve into the VLT

You can load the cnf file with the modified parameters and the – automatically generated – curve arrays into the VLT by means of "PARAMETERS" → "RESTORE FROM FILE".

How to integrate the curve "slave synchronization" into the control program

In order to determine the master position, a switch on the master is required that indicates the zero position. In order to put the slave into the correct position, it will be moved forward to the photoelectric beam. This corresponds to the beginning of the box = 1000. Then the slave will be moved further by 2900 (= marker distance 3900–1000); thus, the slave is exactly in front of the processing point with the beginning of the cardboard box 1000, i.e. at slave position 0.

```
DIM slavesync[108]
    // see number of elements in the title bar
    // of the CAM-Editor window
HOME
    // Slave axis performs a home run
    // (switch for zero position on top)
    // Afterwards, the slave will be in the
    // zero position (0 degrees)
    // (Omitted if an absolute encoder is used)
DEFMCPOS 0
    // Curve starts at master position 0
SET SYNCMSTART 2000
    // Counting of master pulse does not begin
    // until the next edge comes from the sensor
SETCURVE slavesync
    // Set curve for the slave synchronization

    // Go to start
CSTART
CVEL 10
    // Go forward slowly until photoelectric
    // beam appears
oldi = IPOS
    // oldi = last marker position of the slave
WHILE (oldi == IPOS) DO
    // Wait until box is detected
ENDWHILE
POSA (IPOS + 2900)
    // Move box forward by 2900
SYNCCMS 0
    // Synchronize in CAM-Mode
SYNCCSTART 1
    // Engage with start-stop point pair
```

CAM Box

How a CAM box with SyncPos operates

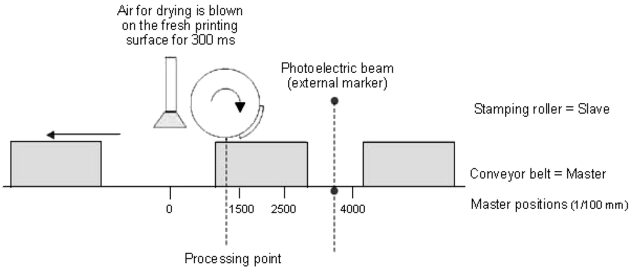
The mechanical camshaft is also reproduced by one (or more) curves. In order to realize a CAM box, it must be possible to engage and disengage the slave at specific master positions over and over again.

This is possible with SyncPos with the interrupt command ON MAPOS .. GOSUB and ON APOS .. GOSUB. It is possible to call up a subprogram whenever a defined master position has been passed (both in the positive or negative direction, to be precise).

It is possible to realize many applications that are typical for the packaging industry in connection with a curve profile in which several have been defined for engaging and disengaging.

Example of a CAM Box

After a cardboard box has been printed, the fresh print is to be dried immediately in the air stream:


Air for drying is blown on the fresh printing surface for 300 ms
Photoelectric beam (external marker)
Stamping roller = Slave
Conveyor belt = Master
Master positions (1/100 mm)
0
1500
2500
4000
Processing point

```
ON MCPOS 2500 GOSUB drier
      // Call up a subprogram when the master
      // position 2500 is passed in
      // positive direction
SUBMAINPROG
   SUBPROG drier
  OUT 1 1              // Turn on drier
  DELAY 300            // Dry for 300 ms
  OUT 1 0              // Turn off drier
RETURN
ENDPROG
```

Chapter 5

■ PC Software Interface

■ "FILE" menu

■ "EDIT" menu

■ "DEVELOPMENT" menu

■ "CONTROLLER" menu

■ **"TESTRUN" menu**

■ **"CAM-EDITOR" menu**

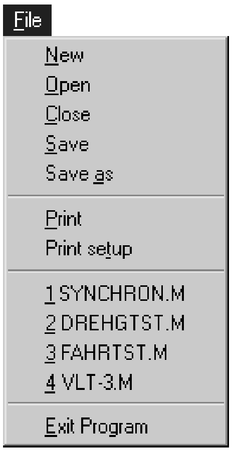
■ **"SETTINGS" menu**

■ **"WINDOW" menu**

PC Software Interface

Following chapter describes the individual menus of the SyncPos user interface. If you are familiar with the Windows interface then, naturally, you can skip the familiar menus and immediately move to the SyncPos-specific information.
The basic information about program layout, command structure, interrupt, elements of the programming language, arithmetic and User Unit can be found in the introduction to the software reference. All commands and parameters are described in detail and then alphabetically ordered in the chapters Software Reference and Parameter Reference.

"FILE" menu



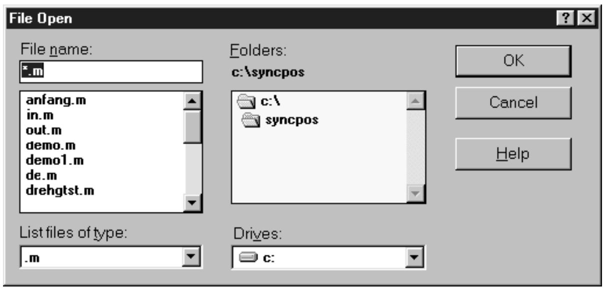
The "FILE" menu contains all the commands necessary to create, open, save and print a program. All commands can be used with a mouse click or with the key combination [ALT] and the underlined letter, for example [ALT] + [F] + [S], if you want to "FILE" → "SAVE".

"NEW"

In the menu bar click on "FILE" and then on "NEW" or click on the 🗎 icon in order to write a new program. The edit window is opened with the name “Unnamed Program1“ and you can begin to write your program.

"OPEN"

Click on "FILE" and "OPEN" or on the 🗁 icon in order to open a program file. In the menu "FILE" → "OPEN" select the file you want with a double-click or by clicking on "OK". If the file you are looking for is still in the list of files last used (max. 9 files) then click on it and open the file in this manner. Since all SyncPos program files require the extension .m, this file type must also be selected. If this is not the case, select the file type **.m** or **All files (*.*)** from the **List files of type**.



File name: *.m

anfang.m
in.m
out.m
demo.m
demo1.m
de.m
drehgtst.m

Folders: c:\syncpos

c:\
syncpos

List files of type: .m

Drives: c:

If you can’t find the file in the left field, click on a different directory in the **Folders** field or click on the drive which contains the file in the field **Drives**. Continue to double-click on the sub-directories until you can mark the file you are looking for in the left field. Then click on "OK".

Looking for lost files

If you have “lost“ a file in the system, you can search for all *.m-files with the **Explorer**.

"CLOSE"

"FILE" → "CLOSE"

Click on "FILE" → "CLOSE" if you want to close the program file which has been loaded or written, but don’t want to end the SyncPos program.

NB!
If you have not yet saved the newly written file or the changes in the old file, answer the question which follows with "YES", otherwise the new file will not be saved.

■ "SAVE" and "SAVE AS"

"FILE" → "SAVE"

Click on "FILE" → "SAVE" or on the 🖫 icon in order to save a new or changed program on the computer's hard drive from time to time or before closing the file. If you have not yet saved a new program file the corresponding window is automatically opened under "FILE" → "SAVE AS".

Click on "FILE" → "SAVE AS" in order to save a new or altered program under a new name. All program files have the extension **.m**.

NB!
You should always save your files on the PC. This is because although the program is also automatically saved for every execute and for each syntax check in the SyncPos-Option, at this point the program has already been compiled and thus can no longer be altered in the computer.
For reasons of compatibility between Windows '95 and earlier versions of Windows the input of more than 8 characters for the file names is not allowed. You can save as many program files as will fit in the free memory on the hard drive of the computer.

■ Printing and printer settings

"FILE" → "PRINT"

To print the file click on "FILE" → "PRINT", choose the area to be printed and the desired number of copies and start the printer with "OK".
The dialog field that appears is somewhat different depending on your operating system – Windows 95 or Windows NT. For further information please refer to the Windows help.
Click on "PRINT SETUP..." (or "PROPERTIES"), if you want to set other factors such as paper format or alignment (horizontal or vertical). These settings can also be reached by clicking on "PRINTER SETTINGS".
Click on → "PRINTER SETTINGS", if you want to set the paper size, the output size (scaling) or other options. You can find more information on the possibilities for Window's "PRINTER SETUP" in the Windows help.

■ "EXIT PROGRAM"

Ending SyncPos

The SyncPos program can be ended by clicking on "EXIT PROGRAM" or on the ☒ icon. If you have not yet saved a new file or changes to an old file, then you will have the chance to do this.

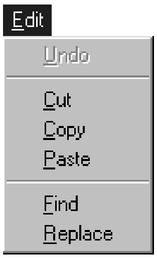
NB!
However, "EXIT PROGRAM" does not end a program running in the VLT. You can only abort or end a program with [ESC]. In order to do this the file which is linked with the controller resp. VLT must be open or re-opened.

NB!
However, if the VLT stops at "FILE" → "EXIT PROGRAM" then this can be due to the fact that the VLT is sending PRINT commands which can no longer be displayed by the communications window.

■ Delete file

You can delete one or more files – as usual in Windows – in the **Explorer**.

"EDIT" menu



The "EDIT" menu offers the necessary editing help for programming. Most of these commands can also be reached via certain keys and key combinations, as is usual in Windows.
When you are writing your program use the tabulators ⇆ and the different colors to visually structure your program. The tab increments are permanently set.

Marking text

Point to the position where the marking should begin and pull the mouse cursor over the text. If only one word should be marked, simply double-click on the corresponding word.
You can expand marked text in all directions using the shortcuts listed; for example, with [SHIFT] + [→] by one character to the right, with [CNTL] + [SHIFT] + [→] key to the end of the word, with [SHIFT] + [END] to the end of the line, etc. The various possibilities can be found in the List of shortcuts.

Deleting text

Single characters can be deleted either with the [DEL] key (which deletes character-by-character to the right of the cursor) or with the [BACKSPACE] key (which deletes character-by-character to the left of the cursor). If you are deleting words or lines which have been marked, both keys have the same effect.

Line number

Within your program you can use the line numbers for orientation purposes. For example, the syntax check not only places the cursor in the corresponding line, but also names the line number containing the incorrect command.
The current line number can be found in the status bar, for example 13:1. This means that the cursor is located in line 13 at position 1.

Context menu

Click on the right mouse key and then the "EDIT" menu is available as a context menu (only for Windows 95).
Context menus appear in the window at the location where you are currently working.
Close the context menu by clicking outside of the context menu without having selected a command. Or press [ESC].

"UNDO"

Click on "EDIT" and "UNDO", if you want to undo the last command. By clicking on "UNDO" again, you can restore the command which was undone. This can also be accomplished with the key combination [CNTL] + [Z] or [ALT] + [BACKSPACE].

"CUT"

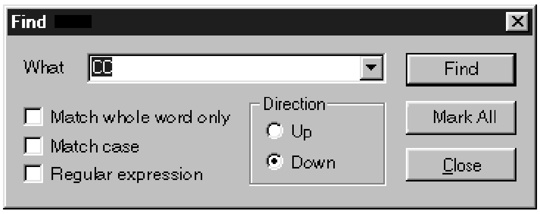
With "CUT" it is possible to copy and delete text. Mark the desired text fragment and click on "CUT" or on the ✂ icon. The text will be temporarily saved for inserting. With the next copy command the text stored in the temporary memory is automatically overwritten.
The key combination [CNTL] + [DEL] also serves the same function.

"COPY" and "PASTE"

Mark the desired text fragment and click on "COPY" or on the 📄 icon, the marked text is copied to the notepad. Move the cursor to the position where the text is to be inserted and click on "INSERT" or on the 📋 icon.
The key combination [CNTL] + [INSERT] serves the same purpose.

"FIND" and "REPLACE"

Find and replace is realized in accordance with the Windows conventions and supplemented by some useful functions.
Click on "EDIT" → "FIND" or press [CNTL] + [F] and enter the term searched into the following dialog field.
Use [F3] to jump from one site found to the next one.



What: CC

□ Match whole word only
□ Match case
□ Regular expression

Direction
○ Up
● Down

Mark all

Click on → "MARK ALL" instead of → "FIND" and all sites found are immediately marked with a blue triangle at the left margin. You can then jump back and forth with [F2] between the sites found.

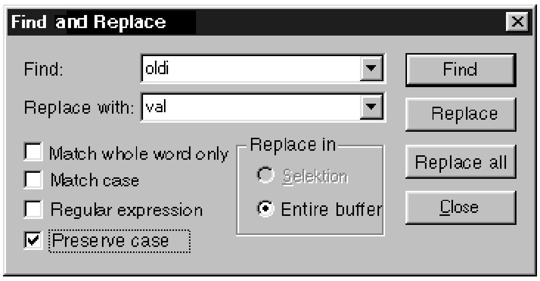
Regular Expression

The regular expression implementation in search and replace functionality handles the following syntax:

- Wildcards: ? (for any character), + (for one or more ot something), * (for zero or more of something).
- Sets of characters: Characters enclosed in square brackets will be treated as an option set. Character ranges may be specified with a - (e.g. [a-c]).
- Logical OR: Subexpressions may be ORed together with the | pipe symbol.
- Parenthesized subexpressions: A regular expression may be enclosed within parentheses and will be treated as a unit.
- Escape characters: Sequences such as \t, etc. will be substituted for an equivalent single character. \\ represents the backslash.

Replace

Use "EDIT" → "REPLACE" or [CNTL] + R to replace the found passage(s).


Find and Replace

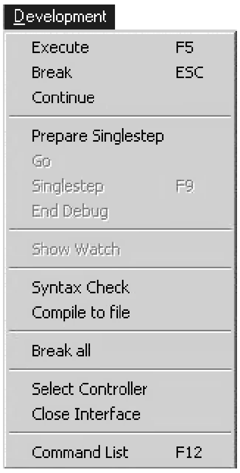
Find: oldi

Replace with: val

☐ Match whole word only
☐ Match case
☐ Regular expression
☑ Preserve case

Replace in
○ Selektion
● Entire buffer

"DEVELOPMENT" menu



With the "DEVELOPMENT" menu functions you can run, abort, continue or run the programs step-by-step, which is particularly useful when searching for errors. A debug mode and online status information as well as the possibility to change the variables during program execution make programming easier. You should always subject newly written programs to a "SYNTAX CHECK" before running them for the first time.

However, before you begin it is always necessary to select a controller resp. a VLT.

Several helpful functions can be found in the "COMMAND LIST": This lists a general overview of all SyncPos commands, which can be selected and transferred to the edit window immediately. And you can work here with the teach-in programming.

"EXECUTE"

Click on "DEVELOPMENT" → "EXECUTE" or press [F5] and the program that is opened and displayed in the editor will be started.

In doing so the program is loaded into the VLT but first it is complied, or translated into the internal system language. The size of a program is reduced considerably during compilation and thus the memory of the SyncPos Motion Controller is used very efficiently.

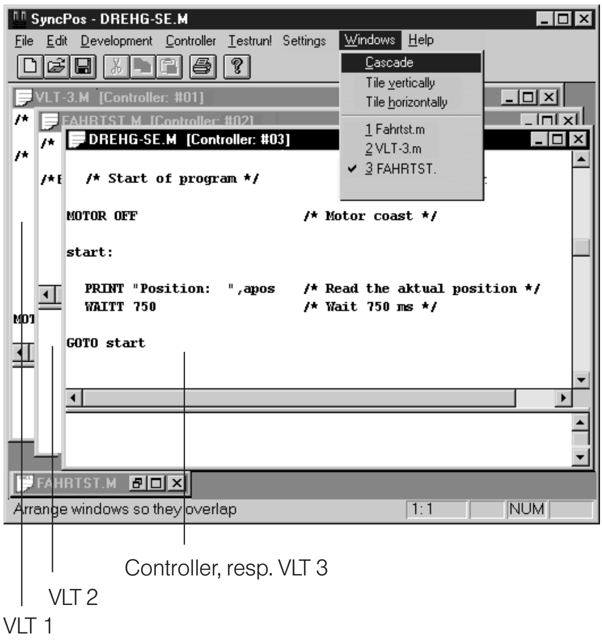
At the same time the program is loaded into the temporary sector of the RAM; this is overwritten with each subsequent execute command. Thus, when programming you have a quick and uncomplicated process to test the programs.

NB!

However, it is neither possible to move a compiled program back to the computer, nor to edit the source file on the PC again. Thus, in general, you should also save all programs on the hard drive of the computer.

Run programs in several VLTs

If you want to load the program into several VLTs, link the program with the corresponding VLT and click on → "EXECUTE".
If you want to load a different program in each VLT, open a different edit window for each VLT, then open the desired program file and connect it to the VLT with → "SELECT CONTROLLER". Then start each program, one after the other, with → "EXECUTE".



```
  /* Start of program */

MOTOR OFF                          /* Motor coast */

start:

  PRINT "Position:  ",apos         /* Read the aktual position */
  WAITT 750                        /* Wait 750 ms */

GOTO start
```

■ **"BREAK"**

Click on "DEVELOPMENT" → "BREAK" or press [ESC] in order to immediately abort the program. When doing so, it is possible that active motion processes could be ended prematurely.

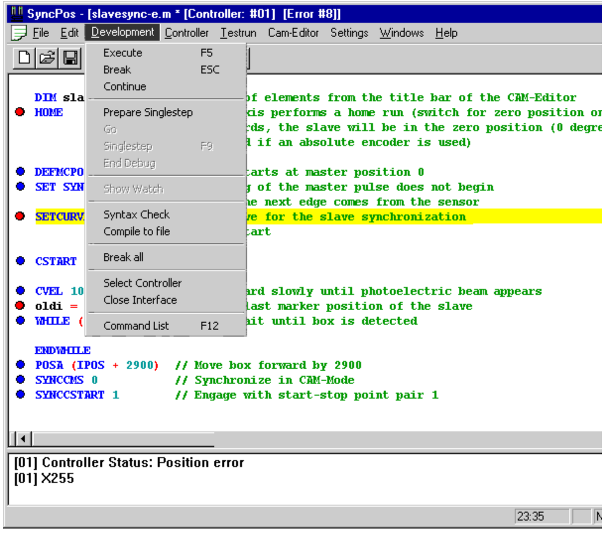
NB!
Braking is done with the maximum deceleration permitted.

■ **"CONTINUE" program**

Click on "DEVELOPMENT" → "CONTINUE", in order to continue a program which was just aborted. In doing so any motion processes which were interrupted will be completed.
If a program with an error message was aborted, you can → "CONTINUE" it again with this function once you have removed the error and/or erased the error message.

■ **Preparing "SINGLESTEP"**

Single-step processing (Tracing) is particularly suitable for testing newly developed programs and can be helpful when searching for errors.
Click on "DEVELOPMENT" → "PREPARE SINGLESTEP" and the program opened is prepared for the debug mode: It is compiled and a debug file is produced, the program is loaded into the VLT and all executable program lines are marked by blue dots. Now, also the respective menu items are ctivated.



```
  DIM sla         of elements from the title bar of the CAM-Editor
● HOME            xis performs a home run (switch for zero position or
                  rds, the slave will be in the zero position (0 degre
                  d if an absolute encoder is used)

● DEFMCPO         tarts at master position 0
● SET SYN         g of the master pulse does not begin
                  he next edge comes from the sensor
● SETCURV         ve for the slave synchronization
                  tart

● CSTART

● CVEL 10         ard slowly until photoelectric beam appears
● oldi =          last marker position of the slave
● WHILE (         ait until box is detected

  ENDWHILE
● POSA (IPOS + 2900)   // Move box forward by 2900
● SYNCCMS 0            // Synchronize in CAM-Mode
● SYNCCSTART 1         // Engage with start-stop point pair 1
```

```
[01] Controller Status: Position error
[01] X255
```

Set Breakpoints

By double-clicking you can set a breakpoint before every program line marked with a blue dot. This will be highlighted in red.
The program execution will then stop before this program line – being highlighted in yellow – is executed.
By further double-clicking the red breakpoints are changed again into blue markings for the program lines which shall be skipped while tracing, i.e. no break in debug mode.

NB!
Depending on the speed of the program execution and communication the number of breakpoints should be limited to a reasonable amount. A maximum of 10 breakpoints are allowed.

NB!
ON PERIOD functions should be deactivated during debugging, since the internal timer doesn't stop with singlestep. The program tries to recover the ON PERIOD features later on and this could be problematic.

Compatibility

The red breakpoints replace the former #DEBUG on/off commands, which is no longer executed from firmware version
VLT5000/SyncPos Software Version 3.xx/4.2x
VLT5000/FluxSyncPos Software Version 5.xx/4.2x
onwards.

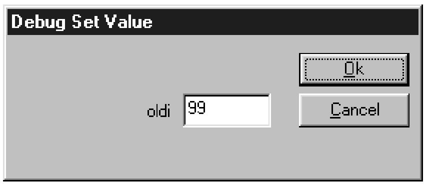
Existing #DEBUG commands may not necessarily be removed from the program as they will be ignored.

If a VLT with an earlier version is used, the program execution is started with "DEVELOPMENT" → "PREPARE SINGLESTEP" and gradually processed with → "SINGLESTEP" or [F9]. Other debug functions such as "GO" or "SHOW WATCH" cannot be selected.

Change variables online

In the debug mode you can change the variables during program execution. Please observe that such a change should also be considered for the program.

Click on the variable with the right mouse button and set the desired value in the following field:

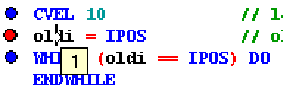


oldi 99

Read variables

In the debug mode you can read the current value of the variables after the program execution.

Click on the variable with the left mouse button and the value is displayed until you move the mouse cursor again.



```
CVEL 10              // 1
oldi = IPOS          // o
WHI 1 (oldi == IPOS) DO
ENDWHILE
```

"GO" (Debug) and "SINGLESTEP"

The program execution stops at the first breakpoint and waits for your input:

Click on "DEVELOPMENT" → "SINGLESTEP" or press F9 in order to execute the next program line.

Or click on "DEVELOPMENT"→ "EXECUTE" or press [F5] in order to process the program until the next breakpoint.

By pressing [F9] the program will then stop before the next program line, by pressing [F5] before each breakpoint.

Interrupt program execution in the Debug Mode

Click on "DEVELOPMENT" → "BREAK" or press [ESC] in order to immediately abort the program execution. When doing so, it is possible that active motion processes could be ended prematurely.

NB!
Braking is done with the maximum deceleration permitted.

Then, the cursor is in the program line which should be executed next. You can continue with "DEVELOPMENT" → "EXECUTE" [F5] or → "SINGLESTEP" [F9].

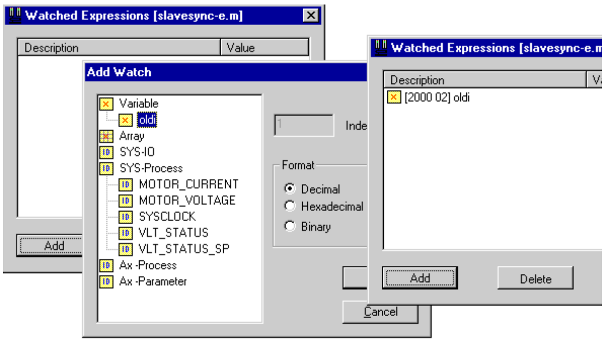
"END DEBUG"

With "DEVELOPMENT" → "END DEBUG" the program execution is ended immediately and you exit the debug mode. The marking of the program lines is removed, but the breakpoints are still displayed so that they can be used again with the next debugging. That means that if you insert program lines, the breakpoints wander along with it.

"SHOW WATCH"

This function enables online monitoring of the variables, arrays, system and axis processing data (according to the SYSVAR indices) and axis parameters.

Click on "DEVELOPMENT" → "SHOW WATCH" and in the following dialog window on → "ADD". In the next dialog window you can choose between the variables, arrays and parameters.



By double-clicking on the desired type, e.g. variable, you can choose between all variables used in the program. Mark the expression to be monitored and select the format in which it should be displayed (decimal, hexadecimal, binary). Then click on OK.

"ADD WATCH"

You can add more expressions for monitoring → "ADD" and, of course, delete again → "DELETE". You can monitor a maximum of 10 expressions simultaneously.

NB!
The monitoring window is updated constantly. Thus, depending on the speed of the program execution and communication the number of the monitored expressions should be limited to a reasonable amount.

NB!
The array watching is limited to the first 250 elements.

Change Watch window

If you want to change the size of the monitoring window (watched expressions), move the cursor to the lower edge of the dialog field and – as soon as the cursor has changed its shape – click and pull the window in the desired direction.

Close Watch window

Click on "DEVELOPMENT" → "CLOSE WATCH" or on the close symbol in the dialog window. If you open it again later, the previously selected expressions are monitored online and displayed.

■ "SYNTAX CHECK"

Check a newly written program before you start it for the very first time; click on "DEVELOPMENT" → "SYNTAX CHECK" and the program will be aborted as soon as an faulty command is found. The line number and an error description are outputted to the communications window. The cursor is automatically placed at the exact position of the syntax error and the program stops at this point..

The "SYNTAX CHECK" produces a debug file in addition to checking the syntax. This file will be called “temp.ad$”.

■ "COMPILE TO FILE"

When this menu item is selected, the current file will be compiled and saved in a binary file. A "SAVE AS" dialog will be displayed allowing the user to select the file name to be used to save the file.

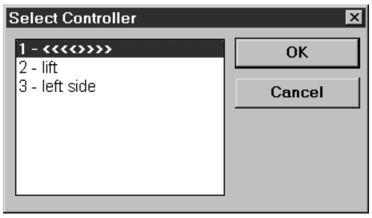
NB!
The file name will default to the name of the program with “.bin” as a file extension. This feature is available only if the CREATEBIN parameter in the APOS.DAT file is set to 1.

■ "BREAK ALL"

If you run the programs in several VLTs click on "DEVELOPMENT" → "BREAK ALL", to abort the programs running.

■ "SELECT CONTROLLER"

If you have configured more than one VLT, then use "DEVELOPMENT" → "SELECT CONTROLLER" to select the VLT that you want to use to load and start the programs. For this, simply mark the number of the VLT and click on "OK".



Select Controller

1 - <<<<>>>>
2 - lift
3 - left side

■ "CLOSE INTERFACE"

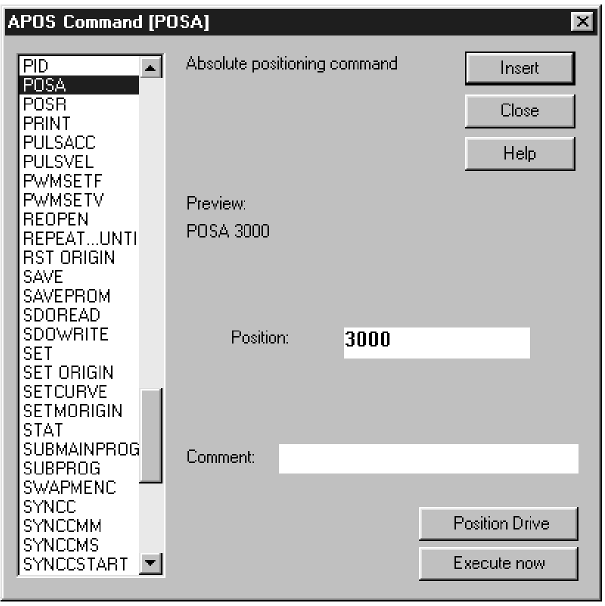
When this menu item is selected, if there is a currently open motor controller interface, then it is closed.

If there is no open interface, then the menu item has no effect.

■ "COMMAND LIST"

The Command List not only contains all commands in alphabetical order, but also displays the necessary input fields for every command and automatically constructs the correct syntax for each command, which you can simply "INSERT" into your program. In addition, it is also possible to program your VLT with teach-in programming.

Move the cursor in the edit window to the position where you want to insert one or more new commands, click on "DEVELOPMENT" → "COMMAND LIST" and select the necessary command in the dialog field, e.g. POSA.



APOS Command [POSA]

PID
POSA
POSR
PRINT
PULSACC
PULSVEL
PWMSETF
PWMSETV
REOPEN
REPEAT...UNTI
RST ORIGIN
SAVE
SAVEPROM
SDOREAD
SDOWRITE
SET
SET ORIGIN
SETCURVE
SETMORIGIN
STAT
SUBMAINPROG
SUBPROG
SWAPMENC
SYNCC
SYNCCMM
SYNCCMS
SYNCCSTART

Absolute positioning command

Preview:
POSA 3000

Position: 3000

Comment:

"HELP"

You can find detailed information on all commands in this dialog field. Simply click on "HELP" or press [F1] and you get information about the marked command.

Mark up a command and the preview shows you the exact syntax of the command. Now you can select from three alternatives which you can mix randomly to program the VLT.

"INSERT"

Either you can insert the command in your program immediately: click on "INSERT".

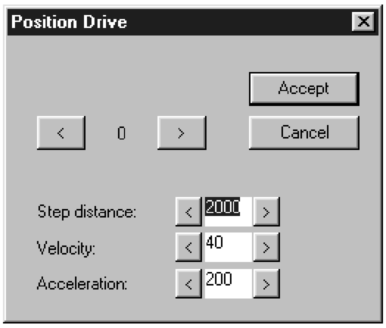
"EXECUTE NOW"

Or click on "EXECUTE NOW" and test this command before Inserting it in your program.

NB!
Enabled drives start up.

"POSITION DRIVE"

Or you can use the teach-in function and click on "POSITION DRIVE": in the dialog field the actual position of the axis is displayed. Click on the forwards > or on the backwards < symbol and move the drive to the position desired. This can be done either step-by-step, with individual mouse clicks, or with continuous movement by holding the mouse button depressed.



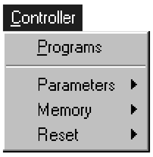
0

Step distance: 2000
Velocity: 40
Acceleration: 200

Once the drive has reached the desired position, click on "ACCEPT" and the value is entered in the dialog field for the axis.

NB!
In general, the values entered during programming are not tested whether they are within the permissible range. Due to the multitude of possible applications and various motor sizes this is not possible nor is it desirable.

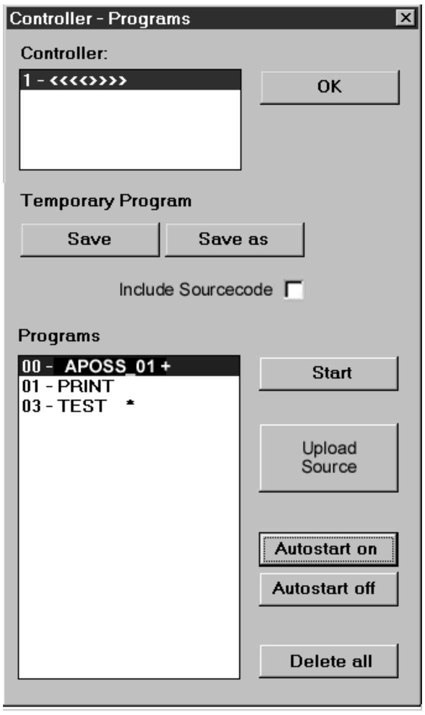
"CONTROLLER" menu



With the functions in the "CONTROLLER" menu you can manage your programs: You can save or delete the programs in the option EEPROM and can mark a program for autostart. In addition, you can also set all parameters here and make various resets and assign a name to every VLT connected.

"PROGRAMS"

Click on "CONTROLLER" → "PROGRAMS" and in the dialog field you will see all the VLTs in the first field. The controller marked is the VLT which is currently linked to the program displayed in the edit window. Naturally, you can also mark and edit another VLT.



Controller:
1 - <<<<>>>>

Include Sourcecode □

Programs
00 - APOSS_01 +
01 - PRINT
03 - TEST *

"PROGRAMS" → "SAVE"

Whenever you run a program, that means load a program into the controller, it is loaded into a temporary sector in the RAM, which is overwritten with each subsequent run. Here you can permanently "SAVE" the last **temporary program** executed.

NB!
Don't forget to always save and archive the program file on the hard drive of the computer since you can no longer edit the compiled source file in the VLT.

Click on "SAVE" and enter a name in the subsequent dialog field or confirm the file name suggested. The program number will be assigned automatically.

NB!
When an attempt is made to save a new program and a program is already active, then the new program cannot be saved.
However, in this case, the user is presented with a dialog box that will allow a "BREAK" to be sent to the currently active program. The new program will then be saved.

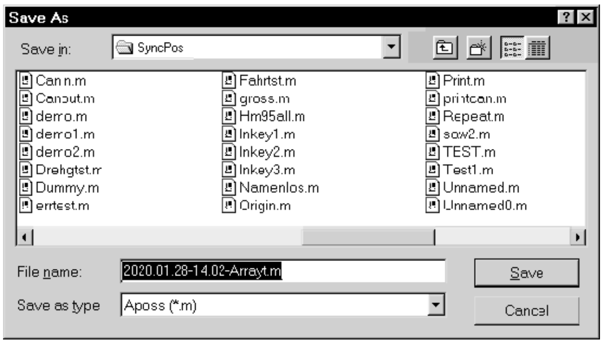
→ "SAVE AS"

Click on "SAVE AS" and you can also assign the program number (0 to 127) yourself, in addition to the program name.
Using this program number any program can also be started over the inputs, for example from a PLC. For this all inputs are to be set accordingly with "CONTROLLER" → "PARAMETERS" → "GLOBAL".

”SAVE” → “INCLUDE SOURCECODE”

When the check box is activated, the sourcecode is protected in VLT, in addition to directly executable and compiled program files. This can be re-accessed when necessary and saved in a file on a PC. When program sourcecode is downloaded, then "Include" files within the sourcecode are expanded and downloaded with the sourcecode. This allows a complete program, rather than only a partial program, to be stored on the controller.

Click on "SAVE AS" and enter a name in the dialog field or confirm the file name. The suggested filename contains the date and time to be safe from overwriting actual files in case of uploading.



File name: 2020.01.28-14.02-Arrayt.m

Save as type: Aposs (*.m)

The sourcecode is saved in Flash EPROM. If insufficient space is available for the sourcecode in Flash EPROM a message is displayed, and other program files must be erased before saving the new one.
All programs saved using source coding are marked with a '+' sign.

"PROGRAMS" → "START"

In this dialog window you can select a program and start it directly.

”UPLOAD SOURCE“

All programs marked with ‘+’ can be read out of the control in source coding format and can be filed on your PC for subsequent use.
Select the desired program and click on “UPLOAD SOURCE“. You can edit or duplicate the file for other VLT's.

"AUTOSTART ON / OFF"

With Autostart you can mark a program that, in the future, is to be started immediately after the VLT is turned on. Select the desired program and click on "AUTOSTART ON". The program selected will then be marked with a *.
If you want to remove an autostart command once it has been assigned, click on "AUTOSTART OFF" or simply mark another program.
If you want to have more than one program run with autostart, use the parameter PRGPAR (102). This allows you to determine which program should be started after the conclusion of the program run in autostart.
If nothing else has been determined in PRGPAR (102) or I_PRGSTART (103), the program marked with autostart will always be started.

A pre-set "AUTOSTART" has the following effect:

If no error is registered after a cold start (exceptions: tolerated position error is exceeded, end switch error and SW end switch error) the corresponding autostart program will be started.
If the autostart program is aborted by the user (SyncPos) it will not start again unless a new cold start is made. In this case no programs are started due to inputs or PRGPAR (102).
If the autostart program is aborted due to an error (since no ON ERROR routine was defined) or ended normally, then the program subsequently checks whether a start is planned through inputs or if the parameter PRGPAR (102) is set. If so, then the corresponding program is executed or the program waits for the start input. If not, the autostart program starts over again from the beginning. It follows that:
One-time execution of the autostart program
If, in principle, you plan to start the programs via the parameter PRGPAR (102) or via the inputs, then the autostart program is only executed once (for example for HOME functions).

Repeated execution of the autostart program

In all other instances the autostart program is started repeatedly.

Thus, it is also possible to simply start a program over again with an EXIT command. This is useful if, in an error situation (ON ERROR), you do not wish to continue with RETURN, but rather, for example, wish to force a repeated home run. However, it is important to make sure that an error has not occurred (except for a tolerated position error is exceeded, end switch errors and SW end switch errors), since otherwise the autostart program will not be started again.

Linking autostart programs

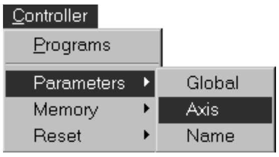
Naturally, starting via the parameter PRGPAR (102) can also be used for linking purposes: After a program has been started the program number defined by PRGPAR (102) can be converted. Thus, it is possible to determine which program is to be executed next.

NB!
If no autostart program has been defined, then it is not possible to start a program via PRGPAR (102); this always requires a terminated autostart program.

"DELETE ALL"

Click on "DELETE ALL" if you want to delete all the programs in the VLT. Make sure beforehand that you have saved the programs on the PC or in the archive for safety reasons.

■ "CONTROLLER" → "PARAMETERS"



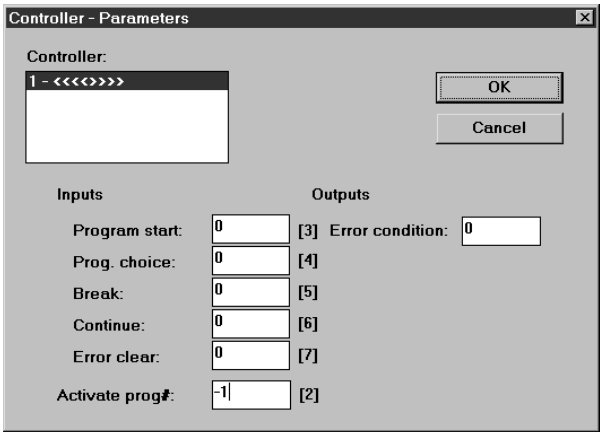
The parameters in the "CONTROLLER" menu are divided into two groups: the global parameters and the axis parameters. Both the general overview and the details on all parameters and parameter names with the respective factory settings can be found in the chapter Software Reference, section Parameters.

Or simply press [F1] when the mouse cursor is in one of the input fields and you get information about the corresponding parameter.

■ Global parameters

The global parameters include the functions of the inputs and outputs (GLI group) and the standard parameters (GLS group). The corresponding internal parameter number is listed after the name of the parameter. With these numbers, which are listed consecutively in the next chapter, Parameter Reference, you can find detailed information on the global parameters.

Mark the VLT you wish to edit. You can change each pre-set value individually. Click on "OK" to load the changes in the VLT as the user parameters.



Controller:
1 - <<<<>>>>

Inputs

Program start: 0 [3]
Prog. choice: 0 [4]
Break: 0 [5]
Continue: 0 [6]
Error clear: 0 [7]
Activate prog#: -1 [2]

Outputs

Error condition: 0

With "RESET" → "PARAMETERS" in the "CONTROLLER" menu can reset all the factory settings, however in doing so all parameters, including the axis parameters, are reset to the factory settings.

■ Axis parameters

The axis parameters are always valid for all the programs belonging to one controller. The units of the parameter values, the factory settings and all other information concerning the parameters can be found in the Software Reference in the section Parameters. This information is arranged according to the internal parameter numbers (in increasing order).

There are two possibilities to set or change the parameters:

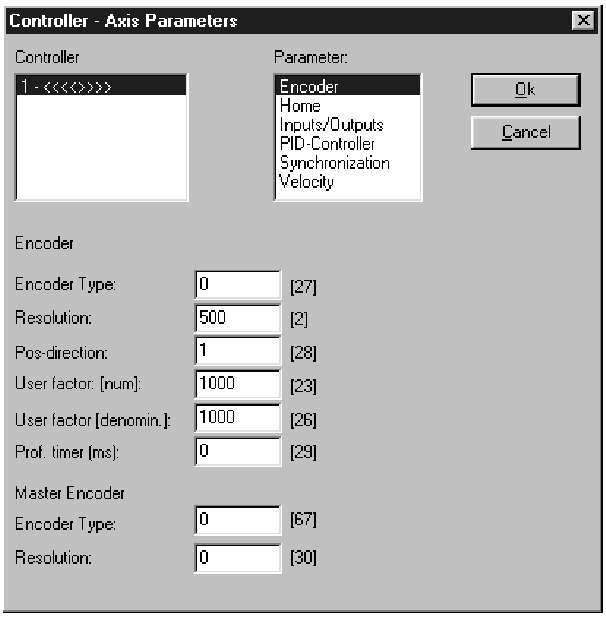
Set or change Axis parameters online

Click on "CONTROLLER" → "PARAMETERS" → "AXIS" and mark the controller the parameters of which you want to view or change in the subsequent dialog window. Also select the type in the field "PARAMETERS":

Encoder	AXE
Home	AXH
Inputs / Outputs	AXI
PID-Controller	AXR
Synchronization	AXS
Velocity	AXV

You can change each parameter and re-load it in the VLT by clicking on "OK". But you can also immediately select another VLT, change the parameters and then load all the changes into the VLT simultaneously with "OK".

Axis parameters with their factory settings

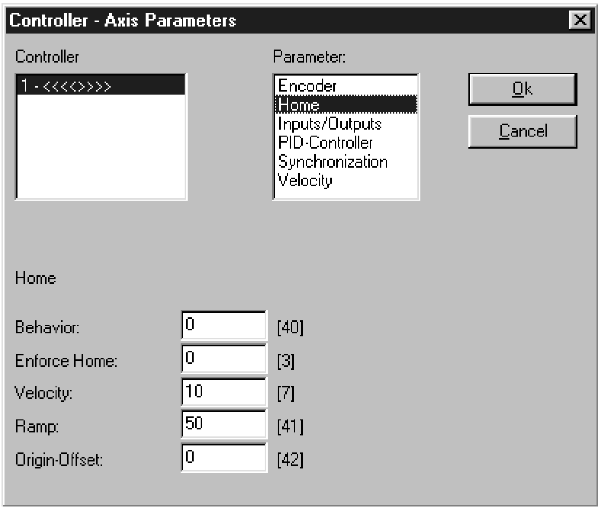


Encoder

Encoder Type: 0 [27]
Resolution: 500 [2]
Pos-direction: 1 [28]
User factor: [num]: 1000 [23]
User factor [denomin.]: 1000 [26]
Prof. timer (ms): 0 [29]

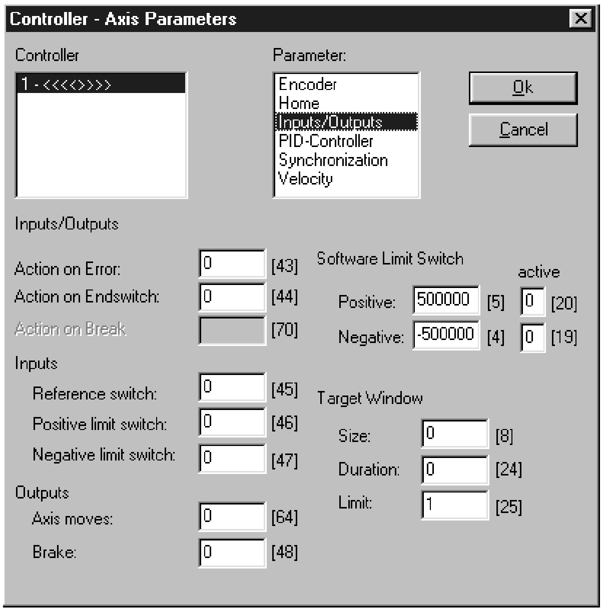
Master Encoder

Encoder Type: 0 [67]
Resolution: 0 [30]



Home

Behavior: 0 [40]
Enforce Home: 0 [3]
Velocity: 10 [7]
Ramp: 50 [41]
Origin-Offset: 0 [42]



Inputs/Outputs

Action on Error: 0 [43]
Action on Endswitch: 0 [44]
Action on Break [70]

Inputs

Reference switch: 0 [45]
Positive limit switch: 0 [46]
Negative limit switch: 0 [47]

Outputs

Axis moves: 0 [64]
Brake: 0 [48]

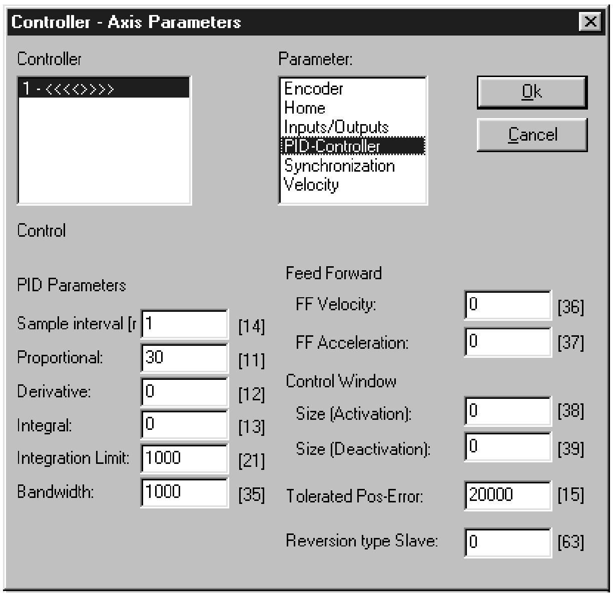
Software Limit Switch — active

Positive: 500000 [5] 0 [20]
Negative: -500000 [4] 0 [19]

Target Window

Size: 0 [8]
Duration: 0 [24]
Limit: 1 [25]

In this parameter group the inputs and outputs are assigned fixed functions – depending on the application. If necessary it is also possible to define a software end switch here.



Control

PID Parameters

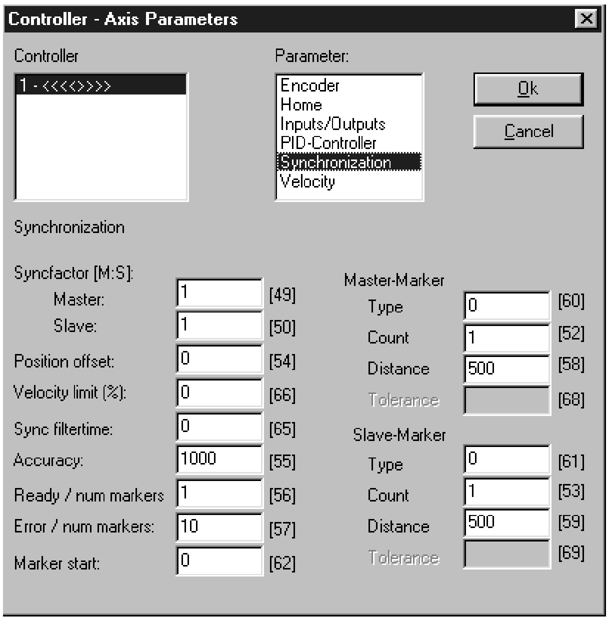
Sample interval [r 1 [14]
Proportional: 30 [11]
Derivative: 0 [12]
Integral: 0 [13]
Integration Limit: 1000 [21]
Bandwidth: 1000 [35]

Feed Forward

FF Velocity: 0 [36]
FF Acceleration: 0 [37]

Control Window

Size (Activation): 0 [38]
Size (Deactivation): 0 [39]
Tolerated Pos-Error: 20000 [15]
Reversion type Slave: 0 [63]



Controller - Axis Parameters

Controller: 1 - <<<<>>>>

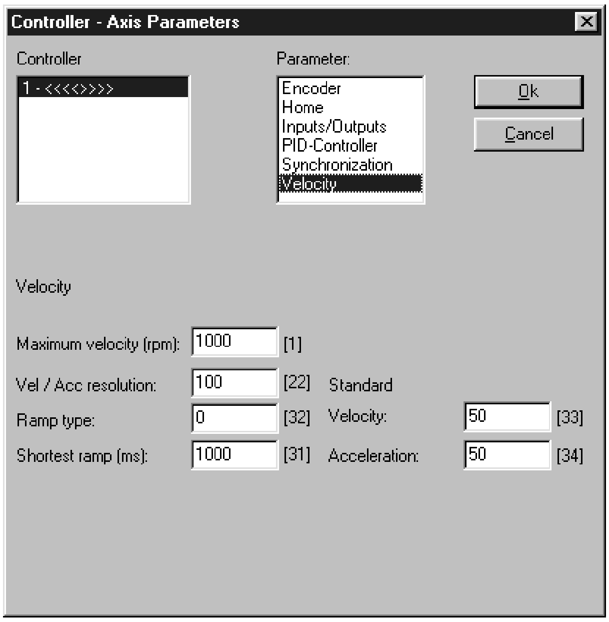
Parameter: Encoder, Home, Inputs/Outputs, PID-Controller, Synchronization, Velocity

Synchronization

Syncfactor [M:S]:
Master: 1 [49]
Slave: 1 [50]
Position offset: 0 [54]
Velocity limit (%): 0 [66]
Sync filtertime: 0 [65]
Accuracy: 1000 [55]
Ready / num markers 1 [56]
Error / num markers: 10 [57]
Marker start: 0 [62]

Master-Marker
Type 0 [60]
Count 1 [52]
Distance 500 [58]
Tolerance [68]

Slave-Marker
Type 0 [61]
Count 1 [53]
Distance 500 [59]
Tolerance [69]



Controller - Axis Parameters

Controller: 1 - <<<<>>>>

Parameter: Encoder, Home, Inputs/Outputs, PID-Controller, Synchronization, Velocity

Velocity

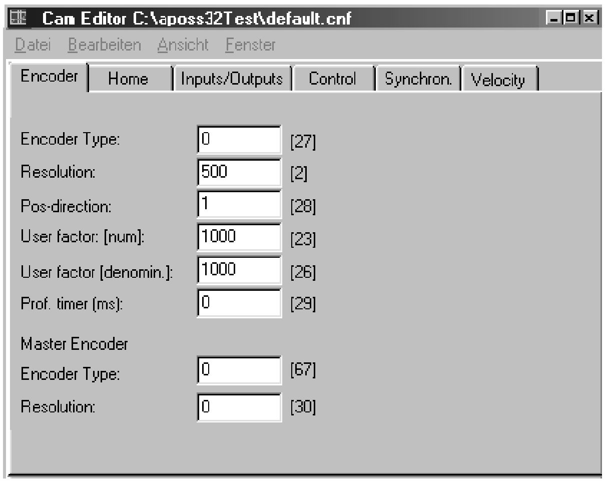
Maximum velocity (rpm): 1000 [1]
Vel / Acc resolution: 100 [22]
Ramp type: 0 [32]
Shortest ramp (ms): 1000 [31]

Standard
Velocity: 50 [33]
Acceleration: 50 [34]

How to change the parameters of a configuration file

Beside the possibility to change online the axis and global parameter, you can change all parameter settings of a saved configuration file, too. For this case open the → "CAM EDITOR" and change the parameter in the corresponding index cards.

NB!
These changes only relate to the cnf-file, but not to the parameter in the controller. To accept the changed settings of the cnf-file into the controller, you have to load the cnf-file into the controller: "CONTROLLER" → "PARAMETER" → "RESTORE FROM FILE".



Cam Editor C:\aposs32Test\default.cnf

Encoder Type: 0 [27]
Resolution: 500 [2]
Pos-direction: 1 [28]
User factor: [num]: 1000 [23]
User factor [denomin.]: 1000 [26]
Prof. timer (ms): 0 [29]

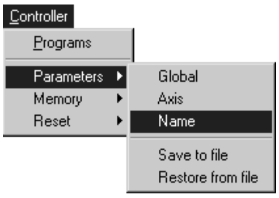
Master Encoder
Encoder Type: 0 [67]
Resolution: 0 [30]

Reset Axis Parameter

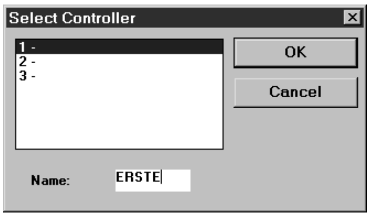
If you want the standard settings for all axis parameters, simply click on "CONTROLLER" → "RESET" → "PARAMETERS".

NB!
The global parameters will also be reset to the factory settings if you do this.

"PARAMETERS" → "NAME"



You can also enter a name for each VLT in addition to the number or change an existing name with this function. Click on "CONTROLLER" → "PARAMETERS" → "NAME" and select the VLT that you want to start in the subsequent dialog field:

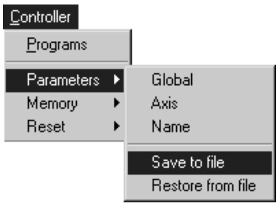

Select Controller

1 -
2 -
3 -

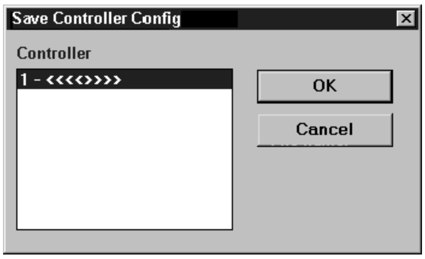
Name: ERSTE

In the field "NAME" enter a name for the VLT (no longer than 8 characters) or overwrite the existing name and click on "OK".

"PARAMETERS" → "SAVE TO FILE"



With "PARAMETERS" → "SAVE TO FILE" you save the user parameters including the arrays in a file with the extension ".cnf". This way you can quickly load the parameters in another VLT or re-load them in the VLT at any subsequent time, for example after deleting the EEPROM.

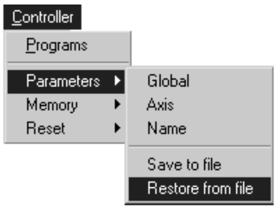

Save Controller Config

Controller

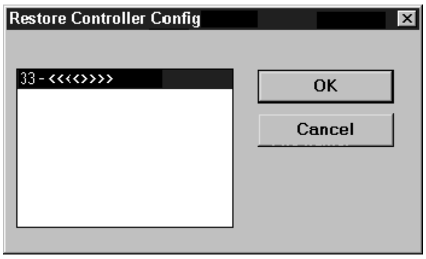
1 - <<<<>>>>

Click on "SAVE AS" and enter a name in the subsequent dialog field or confirm the file name. The suggested filename contains the date and time to be safe from overwriting actual parameters in case of restoring from file.

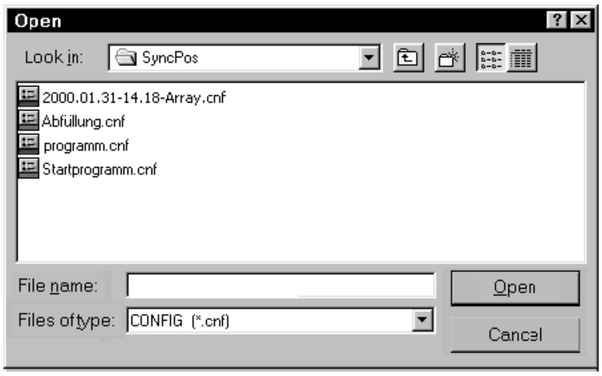
"PARAMETERS" → "RESTORE FROM FILE"



Click on "PARAMETERS" → "RESTORE FROM FILE" and select the VLT in which the data should be loaded.


Restore Controller Config

33 - <<<<>>>>


Open

Look in: SyncPos

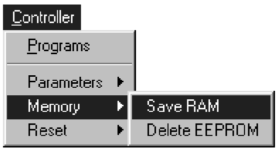
2000.01.31-14.18-Array.cnf
Abfüllung.cnf
programm.cnf
Startprogramm.cnf

File name:

Files of type: CONFIG (*.cnf)

Then select the file and click on "OPEN". The user parameters saved, including the arrays, are immediately loaded in the VLT.

■ "MEMORY" → ...



"MEMORY" → "SAVE RAM"

The function save RAM is usually not needed since the programs and parameters are automatically saved.
With → "SAVE RAM" you can also save the current array values in the EEPROM. "SAVE RAM" corresponds to the command SAVEPROM, since all programs, parameters and arrays are saved.

"MEMORY" → "DELETE EEPROM"

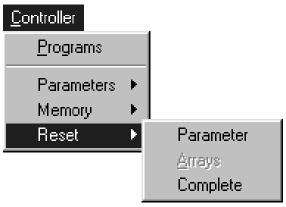
Delete the EEPROM in the SyncPos option if you either want to undo the array definition or want to reset all parameters to the factory settings.

NB!
When you delete the EEPROM all parameters are reset to the factory settings. However, this is only done after the VLT has been turned off.

NB!
Remember the following when you delete the EEPROM:

- Check whether you have saved all the necessary programs on the computer so that you can load these into the VLT again once the EEPROM has been deleted.
- Check whether you have saved the parameters for all the VLTs connected in a file on the computer.
- Click on "MEMORY" → "DELETE EEPROM".
- Re-load the user parameters and the necessary programs in the VLT resp. VLTs.

■ "RESET" → ...



"RESET" → "PARAMETERS"

With "RESET" → "PARAMETERS" all global parameters and all axis parameters in the SyncPos motion controller are reset to the factory settings.

"RESET" → "ARRAYS"

With "RESET" → "ARRAYS" you can delete all arrays in the RAM without – as was formerly the case – deleting the parameters etc. This new command has the same effect as the menu command DELETE ARRAYS.

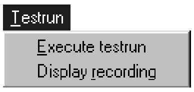
NB!
If you then carry out SAVE ARRAYS, the arrays in the EEPROM are also overwritten!

"RESET" → "COMPLETE"

With "RESET" → "COMPLETE" not only are all parameters, but also the programs and arrays are erased and the SyncPos option is reset to the basic factory setting ...

NB!
... and this happens immediately – not only after the controller has been turned on and off as is the case when you delete EEPROM.

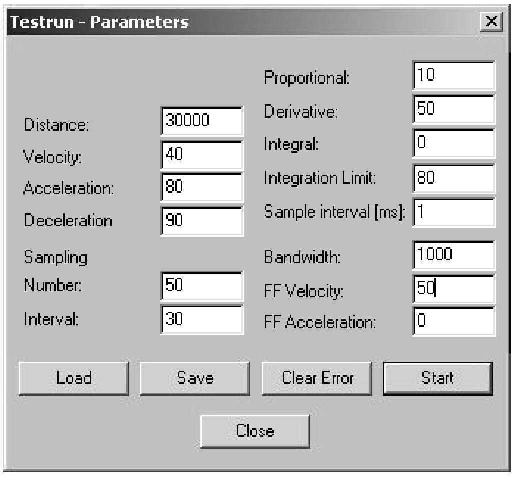
"TESTRUN" menu



The "TESTRUN" menu offers the functions "EXECUTE TESTRUN" from the entry of the test run parameters up to the graphic representation of the test run results.
If you have used TESTSETP to define a test run with different parameters, you can also graphically display these results after execution (TESTSTART) with "TESTRUN" → "DISPLAY RECORDING".
In order to correctly set the controller parameters it is important to choose the correct test parameters.

Setting parameters for a test run

Click on "TESTRUN" → "EXECUTE TESTRUN" and enter the test run parameters in the dialog field:



Testrun - Parameters

Distance: 30000
Velocity: 40
Acceleration: 80
Deceleration 90
Sampling
Number: 50
Interval: 30

Proportional: 10
Derivative: 50
Integral: 0
Integration Limit: 80
Sample interval [ms]: 1
Bandwidth: 1000
FF Velocity: 50
FF Acceleration: 0

If possible only change one parameter per measurement and check the effect this has.

Path of motion

Set the path of motion in user units and utilize the entire duration of the measurement as well as possible:
The number of measurement points multiplied by the time difference between two measurements result in the entire duration of measurement and thus determines the graph. For an optimal evaluation of the figures the path of motion should be selected so that the end position is reached after approximately 80% of the entire recording time. Thus vibrations at the target position are easily recognizable.

Example:
50 measurements in intervals of 30 ms = 1.5 sec recording time.

Velocity, acceleration and deceleration

The test run parameters of velocity, acceleration and deceleration are entered in percent of the respective maximum value.
Complete the measurements with the values most often needed for the controller for velocity, acceleration and deceleration.
In order to be able to evaluate the vibration behavior of the final velocity you should try to achieve a trapeze-shaped velocity course. For this it may be necessary to increase the sampling interval or reduce the final velocity.

NB!
Before you start to optimize the control behavior, check whether the maximum velocity and the maximum acceleration have been achieved.

Number of readings

The number of samples and the sample interval determine the entire duration of the measurement. 50 to 100 measurement points are sufficient for an optimal graph.
The number of maximum possible measurement points is limited by the internal memory of the SyncPos option and also by any programs that are stored there. If the memory is not sufficient for the desired number of samples then it is necessary to delete the programs stored in the SyncPos motion controller with "CONTROLLER" → "PROGRAMS" → "DELETE ALL".

Data sampling interval

Select a sampling interval which is suitable for the system and for the frequency converter, for example 20 to 30 ms.
For dynamic applications the sampling interval can be decreased to 1 ms. The shortest possible sampling interval should be set for servo-motors.
Naturally, to record slower or very long motion processes the time difference in milliseconds can be increased, however the maximum is 255 milliseconds.

NB!
The sampling interval mentioned here is the internal between measurements, not the controller sample interval.

■ "EXECUTE TESTRUN"

Before starting a testrun: Safety notes

Move the drive to the starting position, it is important to do this before you open the test window.

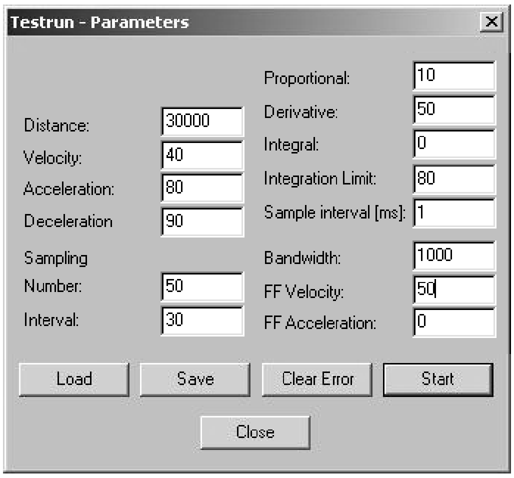
NB!
While optimizing the controller with the function "TESTRUN" the drive is automatically returned to the starting position after reaching the target position.
If run in reverse is not allowed, then the REVERS (63) parameter must be set to "no reversing = 2". Click on "CONTROLLER" → "PARAMETERS" → "AXIS" and change the setting in the parameter group **PID Controller**.

NB!
Make sure that any and all brakes are released and that there are not any obstacles in the positioning path.

NB!
Improperly adjusted control parameters can cause the motor and the mechanism to be damaged. For this reason never optimize controls without having an EMERGENCY STOP button.

Starting the Testrun

Click on "TESTRUN" → "EXECUTE TESTRUN" and the dialog field with the test run parameters is opened. The test run parameters last saved and the current axis parameters are already entered here:



Testrun - Parameters

Distance: 30000
Velocity: 40
Acceleration: 80
Deceleration 90
Sampling
Number: 50
Interval: 30

Proportional: 10
Derivative: 50
Integral: 0
Integration Limit: 80
Sample interval [ms]: 1
Bandwidth: 1000
FF Velocity: 50
FF Acceleration: 0

Begin the test series with 'stable' control parameters: If the standard set control parameters cause the drive to vibrate heavily in the starting position, select a low ***Proportional*** and ***Derivative factor*** (ca. 20) and set the integral factor to zero. Then, starting from these values, optimize the controller.

If it is at all possible you should optimize the controller first with the motor and the drive until the readings are no longer in the critical range. Then connect the mechanical load and complete the fine optimization.

Click on "START": The test run is executed, the current position values, etc. are saved and, at the end of the test run, transferred to the computer for evaluation.

NB!
Observe the behavior and temperature of the motor: if there are strong vibrations or an excessive increase in the motor temperature the motion process must be aborted prematurely with the EMERGENCY STOP button and different control parameters must be selected.

After making an EMERGENCY STOP you must move the drive back to the starting position before making another test run. Reduce the proportional factor, and if necessary also the derivative factor, before starting the next test run or measurement.

After the measurement is complete all measurement data is automatically transferred to the computer and, during this process, the drive returns to the starting position at a reduced velocity. The figures are plotted automatically.

The dialog field for the test run parameters is opened with "REPEAT".

"CLEAR ERROR"

Pressing this button will clear any currently pending error conditions in the motor controller.
If there are pending error conditions, then the "START" button will be grayed and a Testrun cannot be started.

Saving and loading test run parameters

Click on "SAVE", to save the test run parameters in the VLT. If, during additional test runs, you receive poorer control results then you can "LOAD" the parameters previously used again.

"DISPLAY RECORDING"

If you have used TESTSETP to define a test run with different parameters, you can also graphically display these results after execution (TESTSTART) with "TESTRUN" → "DISPLAY RECORDING".
Insofar as this is possible with the parameters you have selected, i.e. that the result can actually be displayed with the four graphics.
These four diagrams or seven curves are used as follows:

(1) The actual position curve shows the values of index w1 (see TESTSETP),
(2) the set position curve the values of index w2,
(3) and the current curve the values of index w3.
(4) The actual speed curve shows the difference of the recorded data to the values of w1; in the case that position data is being recorded this means the change in the position in ms = speed.
(5) The set speed curve shows the difference to the values of w2; in the case that position data is being recorded this means the change in the position in ms = speed.
(6) The actual acceleration curve shows the difference to the values of the actual speed (see 4); in the case that position data is being recorded this means the change in the speed in ms = acceleration.
(7) The set acceleration curve shows the difference to the values of the set speed (see 5); in the case that position data is being recorded this means the change in the speed in ms = acceleration.

Evaluating motion figures

Check the maximum position, the maximum velocity, the number of “overshoots“ and the duration of the building-up process.

For each graph the most important test run parameters, the corresponding maximum values and actual values are displayed:

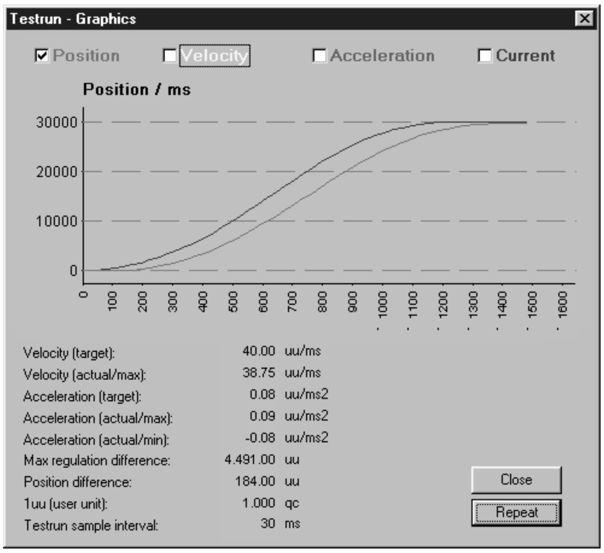
- velocity in user units/ms,
- acceleration in user units/ms^2),
- the maximum regulation difference which occurred during the process are shown,
- the actual position difference at the target,
- user units in qc,
- data sample interval in ms.

Click on the corresponding input field to view one of the other graphs, for example for velocity. You can also view two or even all four graphs at once. However, then no units are shown on the x-axis.

Repeat

If you click on "REPEAT" then the dialog field for the test run parameters is opened once again: You can change the parameters and start a new test run.

"TESTRUN" positioning graph

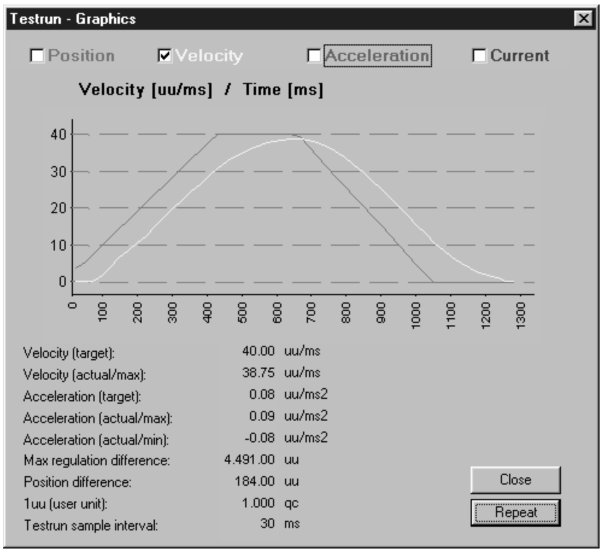


Velocity (target): 40.00 uu/ms
Velocity (actual/max): 38.75 uu/ms
Acceleration (target): 0.08 uu/ms2
Acceleration (actual/max): 0.09 uu/ms2
Acceleration (actual/min): -0.08 uu/ms2
Max regulation difference: 4.491.00 uu
Position difference: 184.00 uu
1uu (user unit): 1.000 qc
Testrun sample interval: 30 ms

The positioning graph shows the set positions (dark or brown curve) and the positions actually achieved (light or red curve).

"TESTRUN" velocity graph

The yellow (light) curve shows the achieved velocity path, the brown (dark) curve shows the desired trapeze-shaped set curve.



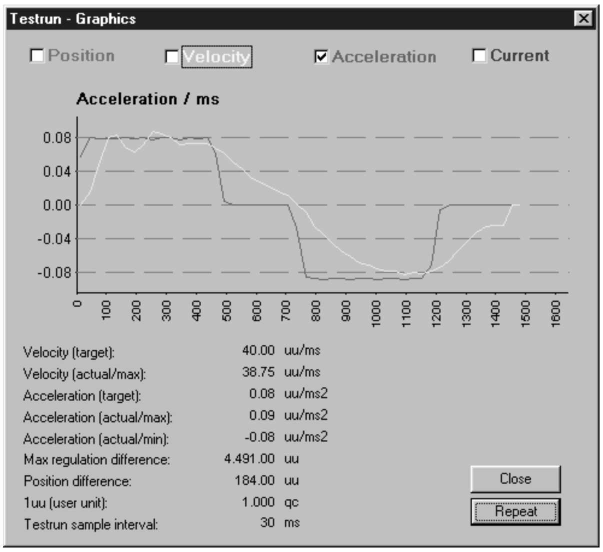
□ Position ☑ Velocity □ Acceleration □ Current

Velocity (target): 40.00 uu/ms
Velocity (actual/max): 38.75 uu/ms
Acceleration (target): 0.08 uu/ms2
Acceleration (actual/max): 0.09 uu/ms2
Acceleration (actual/min): -0.08 uu/ms2
Max regulation difference: 4.491.00 uu
Position difference: 184.00 uu
1uu (user unit): 1.000 qc
Testrun sample interval: 30 ms

In special instances the trapeze-shaped velocity curve can degenerate to a triangle shape. This effect occurs when the positioning distance is too short to achieve the maximum velocity at the desired acceleration.

"TESTRUN" acceleration graph

The light green curve shows the actual path of acceleration, the dark curve the desired trapeze-shaped set curve during acceleration and deceleration.

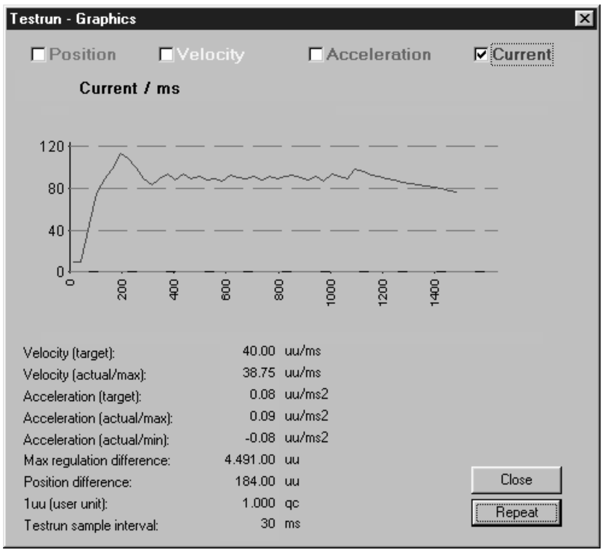


□ Position □ Velocity ☑ Acceleration □ Current

Velocity (target): 40.00 uu/ms
Velocity (actual/max): 38.75 uu/ms
Acceleration (target): 0.08 uu/ms2
Acceleration (actual/max): 0.09 uu/ms2
Acceleration (actual/min): -0.08 uu/ms2
Max regulation difference: 4.491.00 uu
Position difference: 184.00 uu
1uu (user unit): 1.000 qc
Testrun sample interval: 30 ms

"TESTRUN" current graph

The blue line shows the actual motor current.



□ Position □ Velocity □ Acceleration ☑ Current

Velocity (target): 40.00 uu/ms
Velocity (actual/max): 38.75 uu/ms
Acceleration (target): 0.08 uu/ms2
Acceleration (actual/max): 0.09 uu/ms2
Acceleration (actual/min): -0.08 uu/ms2
Max regulation difference: 4.491.00 uu
Position difference: 184.00 uu
1uu (user unit): 1.000 qc
Testrun sample interval: 30 ms

CAM-Editor menu

The curve profiles for any cam controls are realized with the CAM-Editor. The individual curves are defined by fixpoints, parameters for the engage and disengage motion, as well as parameters for the synchronization with the marker. There are index cards in the CAM-Editor for this input and for other curve data. The curves and parameters are illustrated in the diagram; in addition, you can also enter and manipulate the fixpoints interactively.

While you are working with the CAM-Editor, the SyncPos window remains open. You can switch back and forth as you like, for example to check parameters in the control or to take over the number of array elements into the DIM instruction.

One or more curves can be generated for a cam control. All curves required for an application are saved in the cnf file and loaded into the control.

Click on → "CAM-EDITOR" to start the editor. The CAM-Editor window will be opened and …

Before you begin to edit a curve

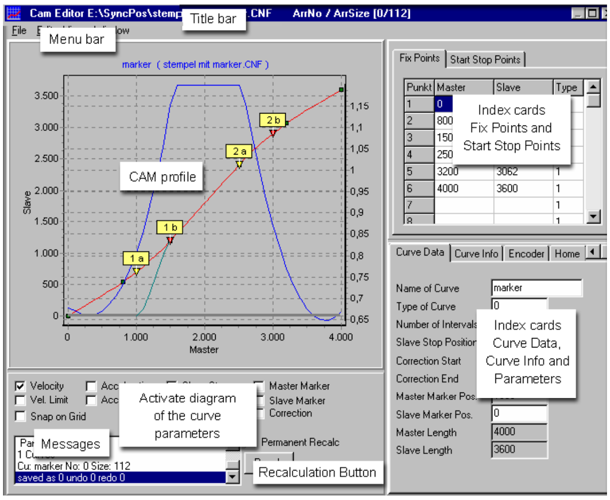
… you should load the parameters of the control as a cnf file into the curve editor because then the parameters will already be entered properly into the corresponding index card. You can get this file with "CONTROLLER" → "PARAMETERS SAVE TO FILE". During this operation, existing arrays, if any, will also be output.

If you do not load a cnf file, the VLT will be set to the factory settings.

CAM-Editor Window

The CAM-Editor window is divided into four sectors:

- Curve profile diagram,
- Checkbox for the activation of the diagram of parameters and calculation modi and Recal-Button
- Index cards: Table of the "FIX POINTS" and "START STOP POINTS",
- Index cards: "CURVE DATA", "CURVE INFO" and all parameters according to the dialog fields of the SyncPos program: Encoder, Home, Inputs/Outputs, PID-Controller, Synchronization and Velocity. Scroll to the left or to the right in order to view all index cards.



Punkt	Master	Slave	Type
1	0		
2	800		
3	150		
4	250		
5	3200	3062	1
6	4000	3600	1
7			1
8			1

Name of Curve: marker
Type of Curve: 0
Number of Intervals
Slave Stop Position
Correction Start
Correction End
Master Marker Pos.
Slave Marker Pos.: 0
Master Length: 4000
Slave Length: 3600

Par
1 Cu
Cu: marker No: 0 Size: 112
saved as 0 undo 0 redo 0

The entire CAM-Editor window can be enlarged or reduced as desired. When this happens, the two sectors on the right for the alphanumeric input remain the same size while the diagram is enlarged or reduced and the lower left sector is even clipped in the case of a substantial enlargement. If you enter data in the sectors of index cards that are initially not displayed, for example in Synchronization, then the entire card will be displayed temporarily and the diagram will be reduced in size. Click on "WINDOW" → "STANDARD", on → "RECALC" or on another field in the CAM-Editor, and the standard window will be displayed again immediately.

However, you can also modify the size of the individual sectors by moving on the horizontal or vertical borders of the sectors with the mouse cursor and by clicking – as soon as the cursor changes its form – and by dragging it in the desired direction.

CAM-Editor Title Bar

The title bar displays the name of the cnf file and the complete path.

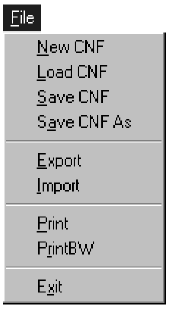
As soon as a curve has been saved → "SAVE CNF as .." in a cnf file for the first time, you will see on the right side of the title bar the number (the location) of the array in the cnf file and the quantity of the array elements which you need for the DIM instruction in the program.

Arr.Nr/ArrSize [0/350]

CAM-Editor Menu Bar

The menu bar offers the menus for loading and saving of files, for different settings, for calculation and view options.

"FILE" menu CNF



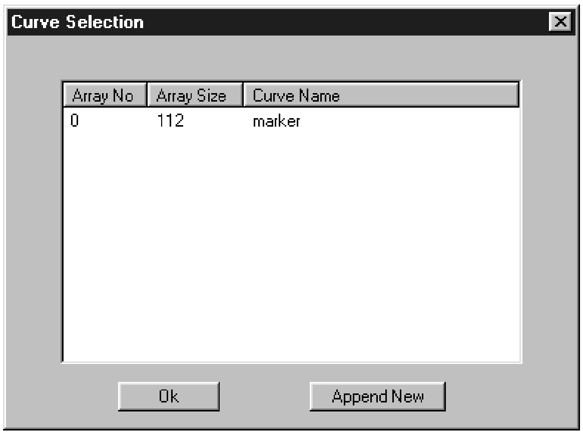
The menu File contains the commands for creating, opening and saving of a cnf file with the curves and parameters; it also contains functions for exporting, importing and printing of the cnf files. You can also go to all commands via mouse click or with the key combination Alt and the underlined letter, for example [ALT] + [D] + [S], if you want to "FILE" → "SAVE".

"NEW CNF"

With "FILE" → "NEW", an „empty" new cnf file is provided. This means that the VLT factory settings are entered in the parameters here.

"LOAD CNF"

You can open an existing cnf file with "FILE" → "LOAD CNF": Either the control parameters previously saved with "PARAMETERS" → "SAVE TO FILE", if you want to edit new curves; or a cnf file that already contains one or more curves for the control parameters which you want to edit.
Select the desired file in the following dialog field by double-clicking or by clicking on OK. If the selected cnf file contains more than one curve, another dialog field follows where you select the curve to be edited:



Array No	Array Size	Curve Name
0	112	marker

Click on → "APPEND NEW", if you do not want to edit any of these curves, but want to edit another one.
If the selected cnf file does not contain a curve, an empty file will be opened.

When an old version of a ".cnf" file (one that has does not have all the newest parameters defined) is loaded, then the CAM Editor will now use appropriate default values for the missing parameters. A dialog box is displayed that will inform the user when this happens. When the ".cnf" file is re-saved by the CAM Editor, then the file will contain the complete compliment of parameters.

"SAVE CNF" and "SAVE CNF AS .."

Click on "FILE" → "SAVE CNF" in order to save a new or modified cnf file from time to time or at the latest before closing the file.
If you have never saved a new cnf file, the corresponding dialog window "FILE" → "SAVE CNF AS" will be offered automatically.
Click on "FILE" → "SAVE CNF AS .." in order to save a new or modified cnf file under a new name. All of these files are automatically provided with the extension .cnf.

"EXPORT"

If you want to export the data to another format, for example in order to print or to further process these data, click on → "EXPORT". The data will be saved in the ASCII format with the extension „.dat".

"IMPORT"

You can only import dat files which you have created with → "EXPORT".

"PRINT" and "PRINT BW"

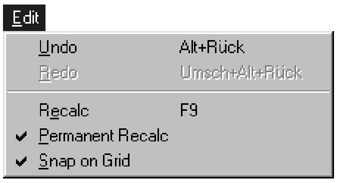
Depending on the connected printer, you can print the curve diagram. In black & white or color. If your printer is unable to convert the color diagram into black & white, you should use → "PRINT BW" for black & white.

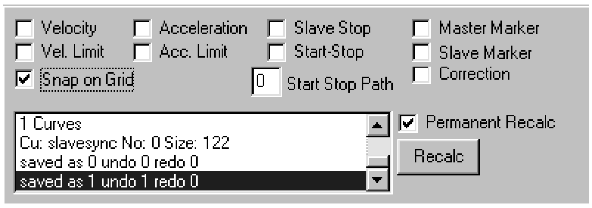
"EXIT"

You can close the CAM-Editor with → "EXIT" or by clicking on the exit icon.

■ "EDIT" curve menu

In the menu "EDIT", you will find functions that are required for the calculation of the curve; provided that they are frequently needed, they can also be started directly via a button in the editor or be selected in checkboxes.





1 Curves
Cu: slavesync No: 0 Size: 122
saved as 0 undo 0 redo 0
saved as 1 undo 1 redo 0

"UNDO" and "REDO"

How often and in what work steps Undo has an effect is determined by "RECALC". Every → "UNDO" restores the situation up to the previous Recalc. If you → "SAVE" the file, the Undo memory will be deleted.
Select "EDIT" → "UNDO" or use the key combination [ALT] + [BACKSPACE].

"EDIT" → "REDO" or the key combination [ALT] + [SHIFT] + [BACKSPACE] restores the work steps prior to the Undo command.

"RECALCULATION"

In many actions – for example in all interactive actions – the curve is recalculated and displayed immediately. When you fill out the fields such as the fixpoints or parameters, you determine the moment yourself with this function.
Select "EDIT" → "RECALC" or click on the Recal-Button or press [F9] in order to activate the Recalculation and the new curve display. This is always required if you add new fixpoints, for example, or if you change parameters or Curve Data.
During every recalculation of the curve, a consistency check is performed, too. This can lead to a series of error messages and notes which you must confirm. For example, if end and start points are not connected or if there are not enough fixpoints for a curve section (at least three).

"PERMANENT RECALCULATION"

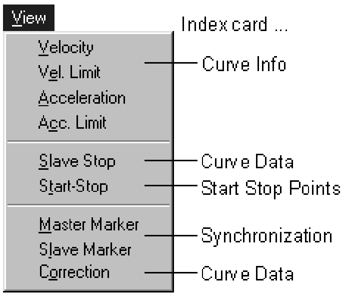
In all interactive actions and many other actions the curve is recalculated and displayed immediately. Turn off → "PERMANENT RECALC", if the interactive redrawing of the curve during the modification of the points is disruptive. You can then move the point with the help of the mouse first, before the curve is redrawn.

"SNAP ON GRID"

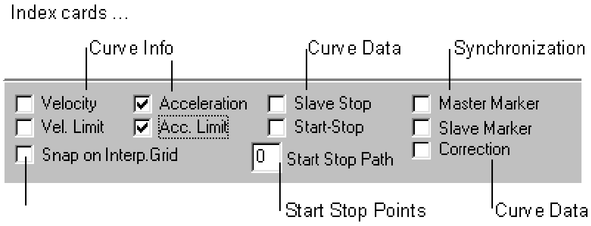
If the fixpoints are to be set automatically on the interpolation grid – this is recommended – you should activate → "SNAP ON GRID" align.
The function will not be executed if the master length is not divisible in whole numbers by the number of intervals.

■ "VIEW" menu

In addition to the fixpoints, you can graphically display the following curve information and parameters. For example, if you have reduced the size of the CAM-Editor window to such an extent that the checkboxes are no longer displayed, you can turn the graphic illustration of the parameters in the View menu on and off. The only item you cannot activate here is the diagram of the engage and disengage curves, since the curve and direction are determined by one input. The ü checks indicate the currently activated views.



The menu selection and the checkboxes are divided into groups which correspond to the index cards. Alternatively, you can activate the graphic display of the parameters by clicking on the checkboxes or by entering the number of the point pair in the case of the engage and disengage curves.



Familiarize yourself with the meaning and graphic illustration of the parameters in the corresponding index cards.

"WINDOW" CAM menu

Since many index cards temporarily change the size of the CAM window due to their size, you can display the standard window again by clicking on → "STANDARD". You can achieve the same result with → "RECALC" or by clicking on another input field outside of the “large” index card.

CAM Profile

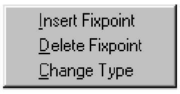
You can view the graphic illustration of the curve, parameters and other information in the curve profile; you are also able to interactively modify and insert fixpoints with the mouse and to enlarge the illustration.
A blue header shows the curve name and the file name of the displayed curve.

Inserting or deleting fixpoints with the mouse

Before you can interactively edit the fixpoints with the mouse, you must have defined at least two fixpoints with master and slave coordinates in the table. However, the curve is only displayed if at least three points have been defined and if the curve can be calculated.
You can insert points directly on the curve or at any position you like in the coordinate field.

Inserting points on the curve between already existing points:

Move the mouse cursor to a fixpoint until the hand icon appears, then click on the right mouse button. Select the desired action in the following pop-up menu:



An additional fixpoint is inserted between the selected and the previous point (to the left) with → "INSERT FIXPOINTS", it is also being added immediately in the table. You cannot insert an additional point in front of the first one with the mouse.

You can delete the selected point with → "DELETE FIXPOINT"; it will also be deleted immediately in the table. You cannot delete the first and last fixpoint.

How to set any points into the coordinate field

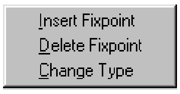
Click on the desired position with the right mouse button and select → "INSERT FIXPOINTs" in the pop-up menu.

How to move Fixpoints interactively with the mouse

Move the mouse cursor to a fixpoint until the hand icon appears, click on the left mouse button and drag the point to the desired new position. The curve will be redrawn simultaneously if "PERMANENT RECALC" is activated. If this creates a disruption on your computer, you can deactivate Permanent Recalc; the curve will then be recalculated and displayed as soon as you release the mouse button.
The fixpoints should be placed on interval borders. Otherwise, there can be no assurance that the curve really goes through the fixpoints. Thus, you should always activate → "SNAP ON GRID" if possible, provided that a meaningful → "NUMBER OF INTERVALS" has already been defined.

How to change the Point Type in the diagram

There are curve points (type 1, shown in green) and tangent points (type 2, shown in blue). Move the mouse cursor to a fixpoint until the hand icon appears and click on the right mouse button. In the following pop-up menu, select the desired action:



The selected and the previous point (to the left) are changed with → "CHANGE TYPE", either from curve points to tangent points or vice versa. The changes are also immediately executed in the table (index card fixpoints).

How to zoom CAM profiles

In order to enlarge the diagram, click and hold the left mouse button and drag a rectangle downwards and to the right. The diagram will be enlarged in accordance with the excerpt. You can repeat this procedure several times until you obtain an extremely detailed reproduction.
In order to reduce the diagram, click and hold the left mouse button and drag a rectangle upwards and to the left. The diagram will be displayed in the standard size again.

How to scroll CAM profiles

Click and hold the right mouse button and move the mouse in the desired direction. In order to display the diagram in the standard position again, click and hold the left mouse button and drag a rectangle upwards and to the left. Any possible enlargement will also be reset in the course of this action.

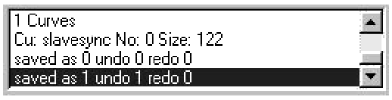
What to do ... if the curve is not displayed

If only points instead of a curve are displayed in the diagram window, then the curve could not be calculated. For example, you may have

- entered too few points (at least three points are required for the illustration),
- selected a larger number of intervals as master length,
- set tangent points incorrectly. (Rule of thumb: Two tangent points must always alternate with at least two curve points.)

CAM-Editor Messages

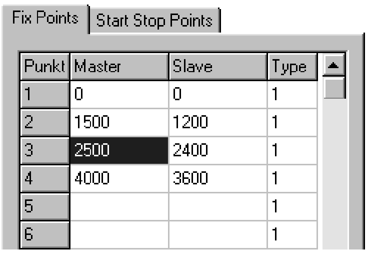
The display indicates input and syntax errors. You can scroll back and forth through the messages.



```
1 Curves
Cu: slavesync No: 0 Size: 122
saved as 0 undo 0 redo 0
saved as 1 undo 1 redo 0
```

Index card "FIX POINTS"

On principle, you must enter the fixpoints for the master and the slave in ascending order in the curve table. Do not select user units that are too small in order for the curve to get a reasonable resolution despite the whole number input. It is recommended to use at least four-figure units.



Punkt	Master	Slave	Type
1	0	0	1
2	1500	1200	1
3	2500	2400	1
4	4000	3600	1
5			1
6			1

Click on → "RECALC" to display the curve. A curve will only be displayed when you have entered at least three points each for the master and slave, respectively, and entered the point type „1".

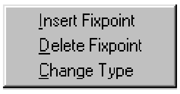
As soon as you have defined at least the start and end point of the curve, you can also set the additional fixpoints interactively with the help of the mouse.

The fixpoints should lie on interval borders. Thus, you should always activate → "SNAP ON GRID", if possible.

How to insert or delete Fixpoints in the table

You can always delete the last point or insert an additional point in the table. You can insert or delete points in the table with the help of the pop-up menu.

Using the right mouse button, click on the point you want to delete, or in front of which you want to insert a fixpoint. Select → "INSERT FIXPOINT" in the subsequent pop-up menu. The point will be inserted between this point and the previous one.



Alternatively, you can insert or delete the desired points interactively with the help of the mouse in the diagram.

You can change the set points in the table by overwriting in any way desired.

"TYPE": Curve and Tangent Points

Type 1 = curve point

Type 2 = tangent point for straight sections

The curve will be calculated as spline interpolation between curve points. For sectors where the velocity must be constant and the acceleration = 0, you should use the tangent points. A straight line instead of a spline will be placed between these points.

The calculation of a spline always requires three points, i.e. at least two fixpoints and one tangent (straight section) consisting of two tangent points.

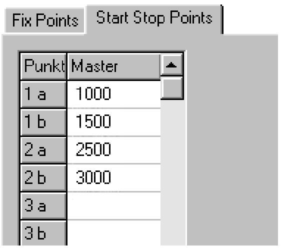
You can determine the point type either in the table by means of numerical input or by changing the existing type with the help of the pop-up menu.

Using the right mouse button, click on the point from which the tangent (straight section) should lead to the previous one. In the subsequent pop-up menu, select → "CHANGE TYPE". The type will be changed to tangent point = 2 for both fixpoints.

You can execute the same action in the diagram: Move the cursor to the point until the hand icon appears. Click on the right mouse button and select → "CHANGE TYPE". Here, both points are changed immediately, too.

■ Index Card "START STOP POINTS"

In this table, you define point pairs for engaging and disengaging the slave during the synchronization. You need one point pair to determine the master position where the synchronization should start and where the engaging should take place. You can determine with an additional point pair from what point on the disengaging should be made and where the synchronization should be stopped.



Fix Points | Start Stop Points

Punkt	Master
1 a	1000
1 b	1500
2 a	2500
2 b	3000
3 a	
3 b	

You can define several point pairs (a maximum of 25), for example for multiple starts and stops in a cycle in order to take account of different situations during the start, for example. With the commands SYNCCSTART *pnum* and SYNCCSTOP *pnum slavepos*, you can determine in your program which point pair is to be used.

If the A and B points are identical, the slave will be engaged with the set maximum velocity, i.e. without curve, as soon as the master has reached this point. If no start stop points have been defined, the slave will be engaged with the set maximum velocity in the case of SYNCCSTART.

These points are always entered in ascending order, too. This is because the run direction will be taken into account automatically by the program: When moving forward, the synchronization begins at point A and is finished up to point B. When moving backward, it begins at point B and is finished up to point A.

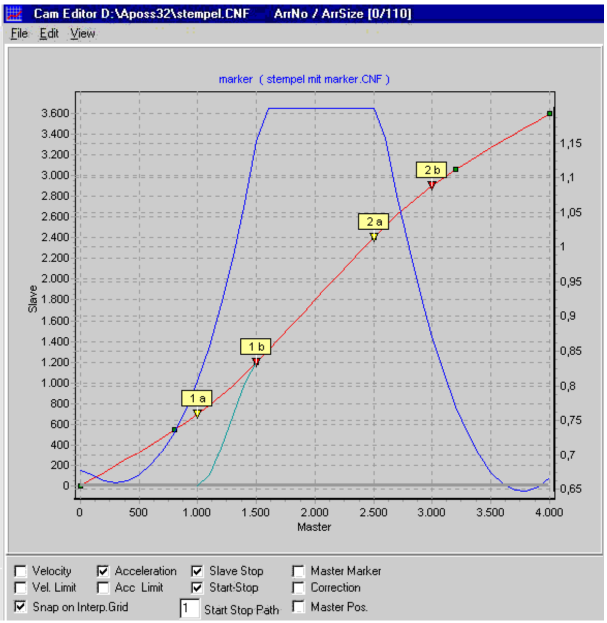
If the program is closed without the explicit command SYNCCSTOP *pnum slavepos*, the second point pair will always be used for disengaging.

How to graphically display Start Stop Points and progression

You can visually display the start stop points and the engage and disengage curves in the curve profile. Activate → ☑ "START STOP". Yellow flags indicate the point pairs for the engaging and disengaging in the synchronization.

In order to display the engage and disengage curves, enter the number of the point pair whose progression you want to see in → "START STOP PATH". Without an algebraic sign, engaging is shown when the master moves forward. Numbers with a negative sign show disengaging when the master moves forward.

When the master moves backward, the algebraic signs apply to the reverse situation, i.e. plus for disengaging and minus for engaging.



Cam Editor D:\Aposs32\stempel.CNF   ArrNo / ArrSize [0/110]

☐ Velocity ☑ Acceleration ☑ Slave Stop ☐ Master Marker
☐ Vel. Limit ☐ Acc Limit ☑ Start-Stop ☐ Correction
☑ Snap on Interp.Grid 1 Start Stop Path ☐ Master Pos.

■ Index Cards "CURVE DATA", "CURVE INFO" and Parameter

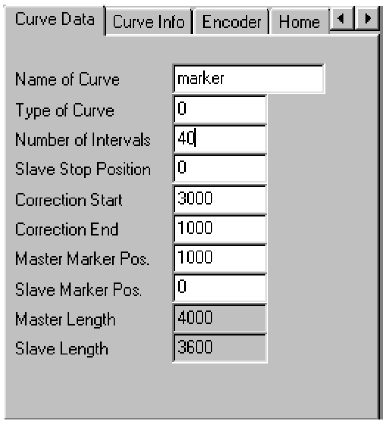
Before you edit a curve, you should always first load the parameters of your control into the CAM-Editor. You can save the user parameters including the arrays into a file with the extension „cnf" with "PARAMETERS" → "SAVE TO FILE". → "LOAD" this file into the CAM-Editor.

If you do not load any parameters, you will find that the VLT factory settings have been entered.

If you change the parameters in the course of creating the curve, they will also be saved in the cnf file and loaded into the control with Parameter → "RESTORE FROM FILE" and entered in the corresponding dialog fields of the axis parameters.

■ Index Card "CURVE DATA"

You can determine important key data of your curve in the index card → "CURVE DATA":



Name of Curve	marker
Type of Curve	0
Number of Intervals	40
Slave Stop Position	0
Correction Start	3000
Correction End	1000
Master Marker Pos.	1000
Slave Marker Pos.	0
Master Length	4000
Slave Length	3600

Name of Curve

If you edit several curves, you can give meaningful names to the curves for your own information here. If a cnf file contains several curves, these names are offered for selection in "FILE" → "LOAD CNF".

Type of Curve

In order to prevent velocity leaps in the case of repeated curve cycles, you can choose between two curve types. In either case, the interpolation takes account of the gradient of the curve at the beginning and end.

Select the curve type:

0 = The gradient of the curve at the beginning and end is averaged.

1 = The gradient at the beginning of the curve is also used for the end of the curve.

Number of Intervals

You can define the number of straight sections that are used for the entire curve with the number of intervals.

Do not select intervals that are too small (this would only lead to an unnecessary overhead), and use a whole number factor of the master length, if possible. For example, use an interval of 30 or 60 in the case of a master length of 3000. You can then put on the fixpoints without error when → ☑ "SNAP ON GRID" is turned on.

Slave Stop Position

Determine the position where the slave should run to and stop if no SYNCCSTOP command with the variable *slavepos* was set in the program. This position will also be used if SYNCC starts with a specific number of cycles and does not use a SYNCCSTOP command.

A grey line indicates this position in the curve profile. Activate → ☑ "SLAVE STOP" for this purpose.

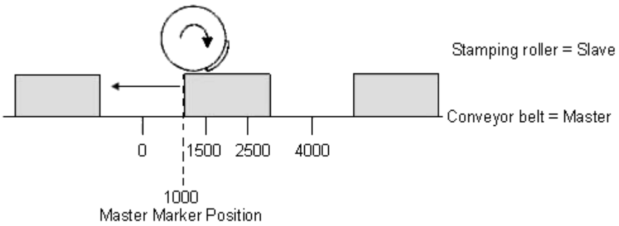
Correction Start / Correction End

Enter the master positions where the master correction is supposed to begin and where it is supposed to end. Be careful to leave enough time to correct the synchronization before the processing point is reached.

The correction area is shown in blue in the curve profile. Activate → ☑ "CORRECTION" for this purpose.

Master Marker Position / Slave Marker Position

Enter the master position (or the slave position in the case of a slave synchronization with marker) for which the marker has been set, here for example the beginning of a cardboard box.



The position of the curve where the marker is detected is calculated from the master marker position and the marker distance. This position is shown as a green line in the curve profile and allows you to fix the correction area. Activate → ☑ "MASTER MARKER" or "SLAVE MARKER" for this purpose.

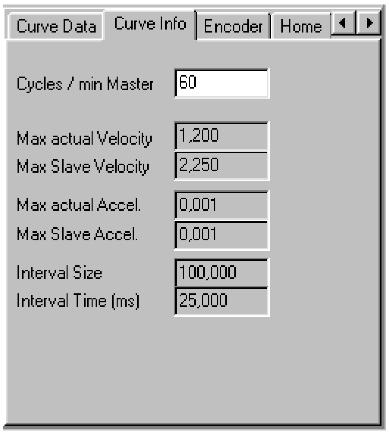
Master Length / Slave Length

Information about the cycle length of the master resp. slave set in the table of fixpoints.

NB!
Slave length must be positive, this can be ensured by defining positive direction in parameter POSDRCT (28).

■ Index Card "CURVE INFO"

In this index card, you can determine the number of → "CYCLES/MIN MASTER" in the input field. In the other fields, you can find curve information calculated from the parameters and the curve application.



Cycles / min Master	60
Max actual Velocity	1,200
Max Slave Velocity	2,250
Max actual Accel.	0,001
Max Slave Accel.	0,001
Interval Size	100,000
Interval Time (ms)	25,000

Cycles/min Master

Enter the number of cycles of the master per minute. In most cases, this will be the (maximum) number of products that are processed per minute.

Max. Actual Velocity

This value indicates the maximum velocity of the slave in this curve application in units.
You can graphically display the entire velocity progression in the curve profile. Activate → ☑ "VELOCITY". The blue curve shows the velocity progression of the slave in this curve application. On the right axis of the diagram, you can read the values in units that describe the change of the slave in relation to the master: Δ UU/MU.

Max. Slave Verlocity and Velocity Limit

This is the maximum velocity which the slave can reach, depending on the velocity of the master. The faster the master runs or the more cycles/min. it runs, the lower the velocity limit becomes. If the velocity progression exceeds this limit, the slave will not be able to follow the master.
You can also graphically display the velocity limit in the curve profile. Activate → ☑ "VEL. LIMIT".

Max. Actual Acceleration

The value indicates the maximum acceleration of the slave in this curve application in units that describe the change of the slave in relation to the master: Δ UU/MU.
You can graphically display the entire progression of the acceleration in the curve profile. Activate → ☑ "ACCELERATION". The yellow line shows the acceleration progression of the slave in this curve application. Normally, the acceleration is relatively small in comparison with the velocity. Thus, it is recommended to deactivate the display of the velocity and the velocity limit in order to see a good representation of the acceleration in the diagram.

Max. Slave Acceleration and Acceleration Limit

This is the maximum acceleration which the slave can reach, depending on the acceleration of the master. The faster the master runs or the more cycles/min. it runs, the lower the acceleration limit becomes. If the acceleration progression exceeds this limit, the slave will not be able to follow the master.
You can also graphically display the acceleration limit in the curve profile. Activate → ☑ "ACC. LIMIT".

Interval Size

The interval size is derived from the number of intervals per master cycle length.

Interval Time (ms)

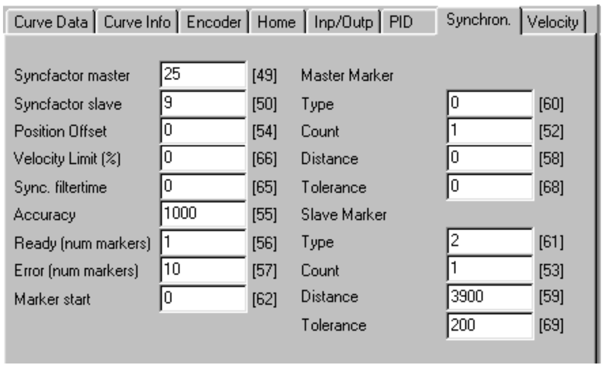
The time in (ms) for an interval is also derived from the number of intervals per master cycle length. It should not be smaller than 30 ms. (30 to 100 ms are suitable values.) Thus, you should make changes in "CURVE DATA" → "NUMBER OF INTERVALS" in order to get a reasonable value.

■ Index Cards Encoder, Home, Inputs/Outputs and PID

For further information regarding content, units, input areas and factory settings of these parameters, consult the Parameter Reference section or select the input field of the parameter and press [F1].

Index Card Synchronization

For further information regarding content, units, input areas and factory settings of these parameters, consult the Parameter Reference section or select the input field of the parameter and press [F1].



Syncfactor master	25	[49]	Master Marker		
Syncfactor slave	9	[50]	Type	0	[60]
Position Offset	0	[54]	Count	1	[52]
Velocity Limit (%)	0	[66]	Distance	0	[58]
Sync. filtertime	0	[65]	Tolerance	0	[68]
Accuracy	1000	[55]	Slave Marker		
Ready (num markers)	1	[56]	Type	2	[61]
Error (num markers)	10	[57]	Count	1	[53]
Marker start	0	[62]	Distance	3900	[59]
			Tolerance	200	[69]

For a CAM Control you need following parameters:

Syncfactor Master and Slave

The two parameters SYNCFACTM [49] and SYNCFACTS [50] are used to determine the MU units in the cam control.

Marker Distance

Enter the distance of the sensor to the processing point here; in the case of master markers in SYNCPULSM [58] and in the case of slave markers in SYNCPULSM [59].

The position of the curve where the marker is detected is calculated from the master marker position and the marker distance. This position is shown as a green line in the curve profile and allows you to fix the correction area.

Activate → ☑ "MASTER MARKER "or "SLAVE MARKER" for this purpose.

Tolerance

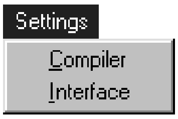
Tolerance window for the appearance of the master markers (Marker monitoring) SYNCMWINM [68] or the slave markers SYNCMWINS [69]. The tolerance window is shown as a green area in the curve profile. Activate → ☑ "MASTER MARKER" or "SLAVE MARKER" for this purpose.

Index card Velocity

For further information regarding content, units, input areas and factory settings of these parameters, consult the Parameter Reference section or select the input field of the parameter and press [F1].

In addition, the maximum velocity and acceleration reached in the current application are calculated here in qc/scan time. The display in the curve profile occurs in units. Activate → ☑ "VELOCITY" or "ACCELERATION" for this purpose.

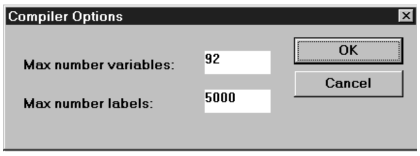
"SETTINGS" menu



This menu offers compiler options and interface settings. You can set the colors in the editor as you wish. If you would like to change the language of the user interface, please see below.

"COMPILER"

The default values for the compiler options are set accordingly for most applications. Thus, they do not require too much memory and, at the same time, they allow the necessary input to be made.



Max number variables: 92

Max number labels: 5000

Maximum number of variables

The number of variables has a direct effect on the amount of memory available in the option. It is important to remember that an array also occupies the space of a variable.

If you need more than 92 variables (incl. arrays) then increase this number.

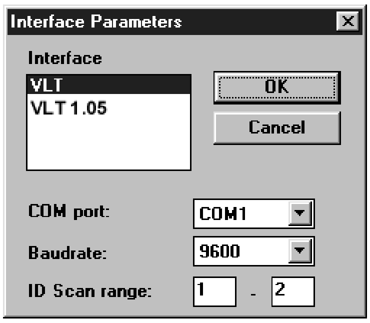
Maximum number of labels

The maximum number of labels determines how much memory is available for internal hyperlinks. Internal hyperlinks are automatically created for all branches of the program (GOTO, IF, LOOP, REPEAT, WHILE, GOSUB) during compiling. The recommended range is between 100 and 500 internal labels.

Increase the maximum values permitted if the number of labels is not sufficient for text input.

■ "INTERFACE"

You have already determined the interface settings while starting the VLT. A baud rate of 19.2k is also available for the VLT interface.
If you have to change one of the settings, for example the baud rate, click on "SETTINGS" → "INTERFACE" and enter the change.


Interface Parameters

Interface: VLT, VLT 1.05

COM port: COM1

Baudrate: 9600

ID Scan range: 1 - 2

NB!
However, it is important to remember that a change in the interface settings can cause the communication between the PC and the VLT to be lost.

Scan Range

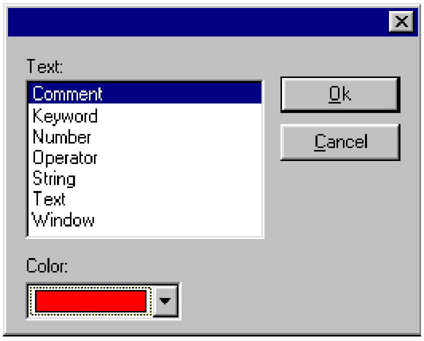
Define the range for scanning the connected VLTs. If you add one or more VLTs in the network, you have to extend the range.

RS485 connection

You need the RS232 standard interface in the PC or an additional RS232 interface card and an external converter for a RS485 connection.

■ "COLORS EDITOR"

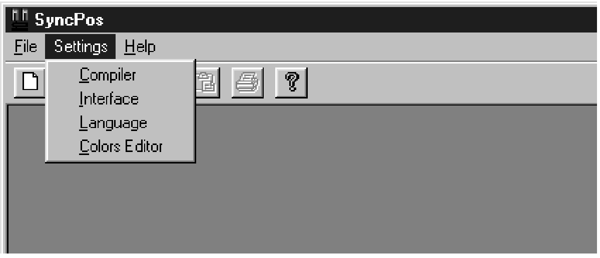
In order to provide greater clarity, different colors can be assigned to the various program sections such as comment, key word, number etc. To do this, open the "COLORS EDITOR" in menu "SETTINGS." Select the type, e.g. Comment, and select the desired color. Click OK to store the new settings.


Text: Comment, Keyword, Number, Operator, String, Text, Window

Color: 🟥

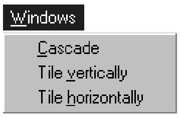
■ "LANGUAGE"

If you want to access the "SETTINGS" menu to change the language, then all dialog windows and edit windows must be closed. To close these windows click on the close ☒ icon in the upper right-hand corner of the open edit or dialog window.



If you desire another language, click on "SETTINGS" → "LANGUAGE" and choose from English and German in the subsequent dialog field. "EXIT PROGRAM" and start SyncPos again.

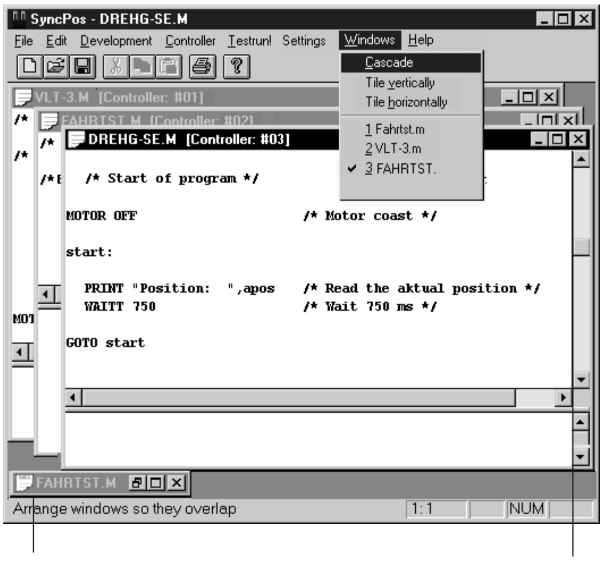
"WINDOW" menu



You can open several edit windows resp. files and each edit window can be linked with a controller.
In order to display a number of editing windows choose between → "CASCADE", "VERTICAL" (alongside each other) or "HORIZONTAL" (on top of each other) in the "WINDOWS" menu.
Click on the full screen symbol, if you do not want to cascade the windows or display them next to each other.
In general, if you chose to display files as symbols they are displayed at the bottom left of the SyncPos window.

"CASCADE"

All opened files are listed in the "WINDOW" menu. Click on the file that should be on top when the windows are cascaded.
The files are shown slightly staggered on top of each other:


SyncPos - DREHG-SE.M
File Edit Development Controller Testrun! Settings Windows Help
Cascade
Tile vertically
Tile horizontally
1 Fahrtst.m
2 VLT-3.m
✓ 3 FAHRTST.
VLT-3.M [Controller: #01]
FAHRTST.M [Controller: #02]
DREHG-SE.M [Controller: #03]
FAHRTST.M
1:1
NUM

```
/* Start of program */

MOTOR OFF                    /* Motor coast */

start:

  PRINT "Position:  ",apos   /* Read the aktual position */
  WAITT 750                  /* Wait  750 ms */

GOTO start
```

Arrange windows so they overlap

File symbol

Full size symbol

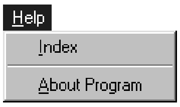
"TILE VERTICALLY"

If you want to look at a number of programs at the same time you can choose between different window representations. You can, for example, split the SyncPos window and display the files alongside each other.

"TILE HORIZONTALLY"

The SyncPos window is divided up and the files shown on top of each other.

"HELP" menu



The representation and functionality of the online-help varies, depending on the operating system used.

"INDEX"

Click on "HELP" → "INDEX". For example, if you are looking for details on the ACC command, select in the table of contents the topic “All SyncPos Commands from ACC to #INCLUDE“ and cklick on ACC.

Text retrieval

For text retrieval first click on "SEARCH", so that the word list is created. Then enter the search term “acc“, mark an equivalent term and then select the desired topic from the list displayed.

Search via Index

Or enter “acc“ in the index and select the corresponding index entry.

Context-sensitive help

The "COMMAND LIST", the parameter dialog fields in the menu "CONTROLLER" as well as the "CAM-Editor" offers a direct access to the online help. Mark a command in the "COMMAND LIST" resp. select one of the input fields of a parameter and press [F1]. You will get the corresponding information.

Cross-references

Cross-references to other texts are marked in green. Click on the marked cross-reference and the desired text is displayed. Click next on "BACK" in the menu bar to read again the previous section.
Click on the words marked with green dotted line and the corresponding popup shows images, graphics and explanation from the glossary, for example MLONG. Click on beside of the popup or press the Esc-key to close the popup.

Printing or copying help texts

You can print the help text or insert it in your edit window with "EDIT" → "COPY". For example, this can be used to insert complete program strings from program samples.

"ABOUT PROGRAM"

Here you can find the version numbers of the SyncPos program, the program library and the compiler.

Chapter 5 a

■ PC Software Interface in MTC10 Mode

SyncPos behaves different, if started directly by clicking on the application's icon or if started indirectly by opening up a program or configuration file via the Motion Control Tool MCT10. The main differences are related to the fact that all file handling is limited to MCT10 only. These limitations concerning the SyncPos GUI are explained in this chapter, e.g. how to open and save files or how to edit a cnf-curve or set parameters.

The following chapter describes the differences in the SyncPos User Interface, when running in MCT10 Mode, for example the file handling or editing a CAM curve. In addition the user interface is different depending of the mode of operation: Offline or Online Mode.

Operation Mode: Offline or Online

SyncPos is called up by MCT10 in Offline or Online mode depending, if MCT10 has a connection established to the drive. The selection of Offline or Online operating mode as well as the interface setting is done by MCT10 at start-up of SyncPos and can not be changed while SyncPos is running.

Opening SyncPos in MCT10 Mode

In MCT10 mode you cannot start up SyncPos as usual with "START" → "PROGRAMS" → "SYNCPOS", but it is opened automatically by selecting a program file (*.m) or a configuration file (*.cnf) via the MCT10.
MCT10 starts SyncPos, transfers the selected file name to it and opens this file. It is possible to open up multiple instances of SyncPos via the MCT10 file selection.
MCT10 also configures the language and interface settings of SyncPos.

Closing SyncPos in MCT10 Mode

Manual Closing

SyncPos can be closed by the menu item "FILE" → "EXIT PROGRAM" or the Exit button.

Automatic Closing

SyncPos is automatically closed in case of exit the program editor as well as when a possible opened configuration file in the CAM Editor is closed by the user. The reason for this is, that any file handling has to be done via MCT10 and there is no possibility to open up a new or existing file in SyncPos, if running in MCT10 mode. So, it isn't necessary to keep SyncPos active, if all files are closed.

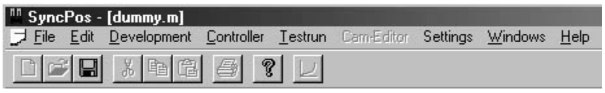
File Handling

MCT10 is responsible for the handling of SyncPos program files (*.m) as well as SyncPos configuration files (*.cnf). This means that files can only be created, opened up, renamed or printed via MCT10.
There is no file selection possible in SyncPos running in MCT10 mode. MCT10 commands SyncPos to open up the file selected by the user via the MCT10. Due to the fact that file handling is strictly restricted to MCT10, there are some menu items and functions of SyncPos disabled.

The SyncPos Window in MCT10 Mode

MCT10 Operation Mode: Online

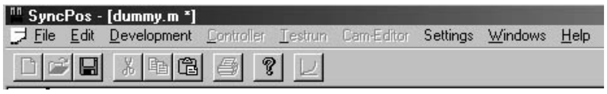
The CAM-Editor menu in the title bar and most of the icons in the symbol bar are disabled:


SyncPos - [dummy.m]
File Edit Development Controller Testrun Cam-Editor Settings Windows Help

The "CAM EDITOR" can not be opened up by SyncPos running in MCT10 mode, but it is always opened up automatically, if a configuration file (*.cnf) is selected for editing via MCT10 or if the program contains a cnf-file.
The icons "NEW FILE", "FILE OPEN", "PRINT" and the "CAM-EDITOR" are disabled, too. See the following description, how to create a new file, open and save files.

MCT10 Operation Mode: Offline

In operation mode offline all functions, which require access to the drive, can not be used. There are some more menu items disabled:


SyncPos - [dummy.m *]
File Edit Development Controller Testrun Cam-Editor Settings Windows Help

"CONTROLLER" menu

There is no connection to the drive possible. It can not be configured or commanded via SyncPos.

"TESTRUN" menu

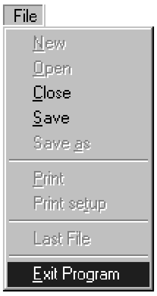
There is no connection to the drive possible. So, there is no possibility for a testrun.

"CAM-EDITOR" menu

The CAM editor can not be opened up by SyncPos running in MCT10 mode, but it is always opened up automatically, if a configuration file (*.cnf) is selected for editing via MCT10 or if the program contains a cnf-file.

"FILE" Menu in MCT10 Mode

Due to the fact that all file handling is done by MCT10, the following items of the File menu are disabled:



"FILE" → "NEW"

New files have to be created via MCT10.

"FILE" → "OPEN"

Select the file via the MCT10. SyncPos and with that the file is opened automatically.

"FILE" → "SAVE AS"

Please use the features of the MCT10, to rename a program file (*.m) or copy it thereby. But you can → "SAVE" the actual program or changes with the same file name in SyncPos.

"FILE" → "PRINT" and → "PRINT SETUP"

You can print program files (*.m) via the MCT10. The print setup has to be done via the MCT10 of course.

"FILE" → "LAST FILE"

There is no last file list, because SyncPos can not open up any file, if running in MCT10 mode.

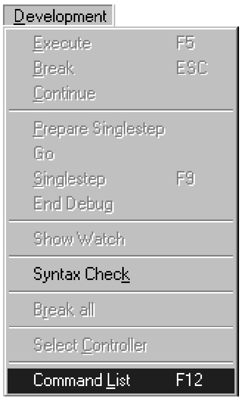
"DEVELOPMENT" Menu in MCT10 Mode

Online Mode

In Online Mode there is no difference to the SyncPos user interface; you can use all functions.

Offline Mode

In Offline Mode all functions, which require access to the drive, can not be used. Most of the menu items are disabled:



But following two items you can use in MTC10 offline mode:

"DEVELOPMENT" → "SYNTAX CHECK"

This can be used to check the syntax of the editor's program file.

"DEVELOPMENT" → "COMMAND LIST"

The Command List offers a limited functionality. It can just be used to insert commands in the editor's program file or to get context-sensitive help of a command.
But it is not possible to execute any of the commands directly or to move the drive to position.

CAM Editor in MCT10 Mode

You can open configurations files (*.cnf) only via the MCT10 such as it is with program files. MCT10 commands SyncPos to open up the file selected by the user via the MCT10.

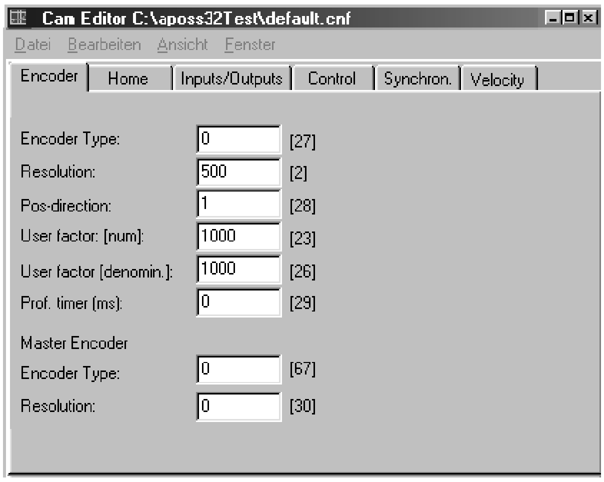
If there is a configuration file (*.cnf) including curve data, the CAM-Editor is open up automatically and you can edit the parameters (which the file contains) and edit interactive a possible present curve profile using all CAM-Editor features.

If there is a configuration without curve data, a modified reduced CAM-Editor including the parameter index cards is opened and it is possible to → "INSERT CAM-PROFILE" further if necessary.

If there is no configuration file with the start-up of SyncPos, the CAM-Editor is not opened and there is no possibility to do that by way of addition or to open a file for the CAM-Editor.

CAM-Editor window without curve data

Even when the configuration file doesn't contain curve data, you can change the parameters which are stored in the file using the reduced CAM-Editor. In this case the modified CAM-Editor shows instead of the four sectors just the parameter index cards.

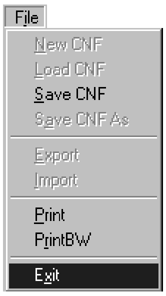


Encoder Type: 0 [27]
Resolution: 500 [2]
Pos-direction: 1 [28]
User factor: [num]: 1000 [23]
User factor [denomin.]: 1000 [26]
Prof. timer [ms]: 0 [29]

Master Encoder
Encoder Type: 0 [67]
Resolution: 0 [30]

"FILE" menu (CAM-Editor) in MCT10 Mode

Due to the fact that all file handling is done by MCT10, many menu items are disabled permanent or specific:



Disabled menu items

"FILE" → "NEW CNF"
Create new configuration files via MCT10.

"FILE" → "LOAD CNF"
The file selection and opening has to be done via the MCT10. The file will be load automatically when SyncPos is opened.
If the automatically opened configuration file doesn't contain a curve, you can insert one with "EDIT" → "INSERT CAM-PROFILE".

"FILE" → "SAVE CNF AS"
Please use the MTC10 features to rename a configuration file (*.cnf) or copy it thereby. But you can save the actual file resp. the changes under the same file name using → "SAVE CNF".

"FILE" → "EXPORT" and → "IMPORT"
It is not possible to export or import any curve data. This has to be done via MCT10.

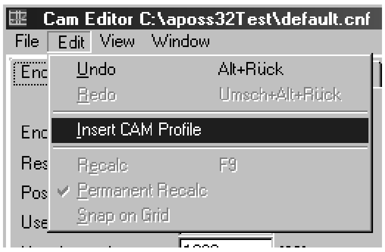
Specific menu items

"FILE" → "PRINT" and → "PRINT SW"
If there are curves within a configuration file, you can print the graphics, because there is no possibility to print diagrams with the MCT10. If there are no curves within a configuration file, the menu item is disabled.

"FILE" → "EXIT"
You cannot open again a configuration file, if you had closed them manual with "FILE" → "EXIT" or with clicking on the **Exit** button, because they have to be selected via the MCT10. If the program file isn't opened anymore, SyncPos will be closed also.

"EDIT" menu (CAM-Editor) in MCT Mode

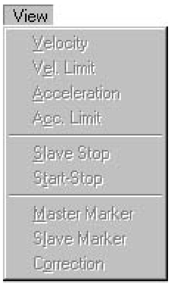
A CAM profile can be inserted via the new item "EDIT" → "INSERT CAM PROFILE" in configuration files, which doesn't contain a curve.



A blank curve profile is created and the "CAM-EDITOR" is opened with all four sectors to define the curve points and the curve data and to edit interactive the curve.

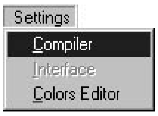
"VIEW" menu (CAM-Editor) in MCT Mode

As long as there is no curve data present in the configuration file, all items are disabled:



■ "SETTINGS" Menu in MCT10 mode

The menu is reduced to the "SETTINGS" → "COMPILER" and → "COLORS EDITOR".



Interface Settings and Language Selection

All the interface settings and the language selection are given to SyncPos during start-up by MCT10. The interface settings and the language selection too, can not be modified by the user via SyncPos in MCT10 mode.

Chapter 6

■ **Programming with SyncPos**

■ **Software Reference**

■ **Parameter Reference**

The following chapters describe how to program using SyncPos. Beginners should read the basic explanations on the programming language SyncPos, i.e. program layout, command structure, interrupt, elements of the programming language, arithmetic and user unit. Experienced users should inform themselves about the SyncPos-specific basic principles, e.g. user unit or parameters.

All commands are described in the Software Reference, first in a general overview and then alphabetically ordered, in detail and complemented with short examples. You can reconstruct as many as 50 programs with assistance of the information in the example programs in the Online-Help.

And in chapter Parameter Reference all the parameters are described, first in general and then in detail.

Programming with SyncPos

Fundamental Program Layout

- Definitions: Arrays, Interrupts, User parameters
- Initializing: Setting parameters, flags and variables
- Main program loop
    main:
    –
    GOTO *main*
- Sub program area
    SUBMAINPROG
      SUBPROG *name*
      –
      RETURN
    ENDPROG

Definitions

```
Array        DIM send[12], receive[12]

Interrupt    ON ERROR GOSUB errhandle
             ON INT –1 GOSUB stopprog
             ON PERIOD 500 GOSUB calc
             ON TIME 10000 GOSUB break
```

User parameters

```
             LINKAXPAR SYNCACCURACY 710
             "ACCURACY [qc]" 0 100000 0

             LINKGPAR 133 716 "Offset [qc]" 0
             100000 0
```

Initializing

```
Parameters          SET POSERR 100000000
                    SET 133 10000
                    SETVLT 205 50

Flags/variables     offset = 0
                    sync_flag = 0

System parameters   VEL 100
                    ACC 100
                    DEC 100
```

Main program

```
main:
IF (IN 3 == 1) THEN
/* Go into synchronizing mode, if input 3 = 1 */
    GOSUB syncprog
ELSE
    GOSUB speedprog
    /* If input 3 not = 1, run in speed mode */
GOTO main
```

Sub programs

```
SUBMAINPROG:
  SUBPROG syncprog
    IF (sync_flag ==0) THEN
    /* synchronize, if not already synchronized */
      SYNCP
      sync_flag = 1
    ENDIF
  RETURN
    SUBPROG errhandle
      WAITI 18 on
      /* waiting for digital input 18, clear the error */
      sync_flag = 0
      ERRCLR
    RETURN
ENDPROG
```

Sequential command processing

In general a command is processed to the end before a new command is begun. This means that for position commands the program waits until the target position has been reached.
Exception: If NOWAIT has been set to ON.

Fundamental Command Structure

All instructions consist of: COMMAND WORD + possible ***Parameter.*** A variable can also be used as parameter instead of an absolute number.

Example

```
    POSA 10000
or
    pos = 10000
    POSA pos
```

Command run times

If the command execution times are critical in an application it is possible to measure the run times of a command sequence under the different operating conditions using the command TIME.

Tips for Increasing Program Readability

- Use of capital and small initial letters (i.e. all commands capital letters, all variables small).
- Placement of spacing between command parts.
- Place comments in your program. The comments are between
  /* … */ or after //…
  /* Begin COMMENT End */
  // Begin COMMENT End
  Inadmissible is nesting comments (/* **...** /***...***/)
- Use of line identification within the loop.

Input values

As in other programming languages the values inputted are not tested. Thus, it is the programmer's responsibility to ensure that extreme values do not lead to problems. When searching for such potential problems use the debug mode.

■ Interrupt

In general there are three types of interrupts:

ON INT	Interrupt at the edges of an input
ON PERIOD / ON TIME	Interrupt after a certain period of time
ON COMBIT / ON STATBIT	Interrupt when Bit n is set
ON PARAM	Interrupt when a parameter n is changed

General processing of interrupt procedures

After every internal SyncPos command a query is made whether an interrupt event has occurred. It is important to remember that with every internal SyncPos command the compiler creates a command in SyncPos machine code.
Thus, for example, a simple command such as:

```
    POSA (target + 1000)
```

is broken down into the following SyncPos machine code:

```
    MOVE target to register 101
    MOVE immediate 1000 to register 102
    ADDREG register 102 plus register 101 to
            register 101
    POSA axis to register 101
```

Furthermore, for commands which take longer (such as DELAY or WAITAX) the program constantly checks whether an interrupt event has occurred. If this is the case, the command is interrupted and continued once the interrupt has been processed.

NB!
Do not use WAITT in connection with interrupts since the waiting process starts again after the interruption.

Use of variables within interrupt procedures

The example above with the "SyncPos machine code" clearly shows that it is necessary to use the utmost care when assigning variables within interrupt procedures.

If, for example, in the main program the following assignment is made:

target = *target* + value – 1000

this is broken down into a series of SyncPos machine code commands and the intermediate results are stored in temporary registers. Only at the end of the sequence is the result stored in *target*.

If during the execution of this command an interrupt is triggered and in the corresponding procedure the following command is executed:

target = 0

then, in this instance, problems will arise. This is because after processing the interrupt procedure the program jumps back to the main program and then the intermediate result which still exists is stored in *target*: Thus, the 0 in *target* is overwritten once again.

ON PERIOD

In contrast, for ON PERIOD functions the time when the next call instruction should take place is calculated at the start of such a function, thus

START_TIME = TIME + PERIOD.

As soon as this time has been reached the function is executed and subsequently the next start time is calculated with the following formula

START_TIME = START_TIME + PERIOD.

This ensures that the call intervals are really the same since the execution time does not influence the calculation. But this means that the user must make sure that the period of time is actually longer than the execution time as otherwise a "jam" is created. That means that actually only the ON PERIOD function is executed.

Response times

The existence of an interrupt is checked in a special function which is also used as a watch dog control. For this reason this is generally called up in any procedure which could last somewhat longer and in all loops, etc.

This procedure checks every 1 ms whether such an event exists and, if necessary, sets a corresponding flag. At the latest this flag is detected and evaluated after the current APOS machine code has been processed.

The response time is the maximum run time of the machine code or 1 ms, whichever is greater. For the VLT it is approx. 1 ms.

One exception is the time interrupt (ON TIME / ON PERIOD). This checks whether the time has elapsed every 20 ms. Thus, it is not logical to define an ON PERIOD with less than 20 ms.

NB!

Furthermore, in general, it is important to make sure that interrupt functions do not last too long. Particularly for ON PERIOD functions it is important to ensure that the function does not last longer than the period since otherwise a „jam“ of function procedure calls will be created.

Priorities

If two interrupt events should occur simultaneously then the processing is prioritized as follows:

If two interrupt events should occur simultaneously then the processing is prioritized as follows:

ON INT comes before
ON APOS, ON MAPOS, ON MCPOS before
ON COMBIT before
ON STATBIT before
ON PARAM before
ON TIME / ON PERIOD
but the other events are not lost.

Within the individual types of interrupts the following is true:

ON INT / ON COMBIT / ON STATBIT

If two (input) interrupts occur simultaneously, then the one with the lower number is executed first, however the other is not lost. After the interrupt procedure is completed the other is called up accordingly.

If the same input resp. interrupt occurs again while the procedure is being executed this is noted again and subsequently executed.

Thus, an interrupt can only be lost if it occurs twice during the execution of an interrupt procedure.

ON TIME / ON PERIOD

As described above the execution time for every temporal function is stored in an internal structure. For simultaneous execution times the procedure that is first on the list will be executed first. The priority is thus determined by the sequence of the ON PERIOD commands.

ON PARAM

If several of these interrupts occur simultaneously, they are processed according to the sequence of the ON PARAM commands in the program.

Interrupt nesting

It is not possible for one interrupt to be suspended by another. Accordingly, while one interrupt is being processed a second interrupt cannot be processed. The only exception is the ON ERROR function, which is also possible during the processing of interrupts.

However, an ON ERROR function cannot be suspended by an interrupt.

NOWAIT in interrupts

In general, during an interrupt NOWAIT is set to ON, that means that the program does not wait for the completion of POSA commands.

This is necessary since otherwise a POSA command cannot be suspended by an interrupt procedure, since this would immediately wait for the arrival of the axis. Thus, if you wish to wait for the arrival of an axis during an interrupt procedure, this must be done explicitly with WAITAX.

Elements of the Programming Language

Constants

Constants can be used anywhere where parameters or values are expected. Constants are usually entered in integral numbers, for example:

value = 5000
Constants …

… are integer number values between -2 to +2 billion,
… are valid within the entire program (they are global),
… can be entered as a decimal, hexadecimal (0x + hexadecimal number), octal (0 + octal number) or in ASCII (between apostrophes), for example:

value = 5000	= decimal 5000
value = 0x7F	= decimal 127
value = 0100	= decimal 64
value = ‘A’	= decimal 65

Hexadecimal and ASCII entries, in particular, avoid many conversions and make the program more readable, for example:
key = ‘A’

The advantage of constants is, that they don't need own storage capacity.

Variables ...

… can only be used for intermediate data storage of inquiry and calculation results.
… occur via the allocation of a value.
… must not be defined separately.
… are valid within the whole program, (i.e. they are global)
… contain integer number values between –2 to +2 billion.
… can be used within commands, instead of constant values.
… must be allocated a value before use in a command.

Variable Identification Names

… can be of any length
… can consist of letters, numerals and underlines
… must not contain any country-specifics, such as “ä”, “é”
… must begin with a letter
… can be written in small or capital letters (no difference!)
… may not be identical to a command name

Special Variables

ERRNO = A system variable, which contains the relevant error number

Arrays

Writing programs with dialog requires user input or positions to be stored for a longer period of time, for example, even after the VLT has been turned off. Usually such input consists of several values which are best stored in fields or arrays.

Arrays are stored in the memory area of the user program and are defined globally, that means they are independent of the current program. The user can determine how many arrays are defined and how large the individual arrays should be. This determination is made with the DIM statement and is then fixed and cannot be changed (except by erasing memory). Each program that is intended to use arrays must contain a corresponding DIM statement which corresponds to the original definition. Otherwise an error will be indicated.

DIM Statement

The DIM statement has to be the first statement in the program and must appear before the subroutine area.

The DIM statement specifies the arrays to be subsequently used. If no arrays have been previously created then they will be created now. If arrays had been previously defined then it is important that the information corresponds with the original definition.

Example

```
DIM target1[20], target2[20], target3[20], plant_offset[50]
DIM parameter[10]
```

With these commands a total of 5 arrays have been defined with their corresponding sizes. If this program is executed once then the arrays listed above will be created in the SyncPos option. If, when the program is re-started, it is determined that the definition of the arrays differs from the arrays in the SyncPos option, then this is indicated as an error. However, it is correct if a second program only contains the following line:

Example

```
DIM target1[20], target2[20], target3[20]
```

However, the sequence of definition must always be the same since the SyncPos option does not store the names of the arrays but only their position in the DIM statement. Thus the following program line is also correct and the xpos array is identical to the target1 array.

Example

```
DIM xpos[20], ypos[20], zpos[20], offs[50]
```

Indexes

The elements of an array are designated by a corresponding index in square brackets: xpos[5]. Indexes are allowed from 1 to the size of the array defined. Thus, in the above case for xpos from 1 to 20. If an attempt is made to access elements before or after this array then an error message is generated since this could lead to data overrun and destruction of the array.

Reading and Writing Arrays

Access to the arrays thus defined is made analog to the use of variables. Thus all of the following statements are correct:

Example

```
xpos [1] = 10000
xpos [2] = 20000
xpos [3] = 30000
i = 1
WHILE (i<20) DO
ypos [i] = i*1000
i = i+1
ENDWHILE
zpos [1] = APOS
POSA xpos [1]
offs [1] = (xpos[2]) % 20
```

Arrays versus Variables

In general arrays can be used everywhere variables are also permitted. Furthermore, an array only occupies the location of an internal variable and thus only reduces the number of maximally permitted variables by one. The maximum number of variables can be set in the menu "SETTINGS" → "COMPILER".

■ Arithmetic

The compiler offers the following commands and parameters:

Operators	plus, minus, times, divided by, XOR, Modulo, Division, Absolute amount
Bit operators	and, or, invert, left shift, rightshift, bit, byte, word, long
Comparison Operations	greater than, less than, greater than or equal to, less than or equal to, the same as, not equal
Logical Operations	and, or, not

Inform yourself about the type of assignment operation which is structured in accordance with the Bit/Byte commands and about the priorities of the operators and the operations.

NB!
All arithmetical operations are integer number operations.

Operators

Symbol	Meaning	Syntax / Example	Description
+	plus	3 + 3 = 6	Addition
–	minus	9 – 3= 6	Subtraction
*	times	2 * 3 = 6	Multiplication
%	divided by	19 % 3 = 6	Division (result is truncated)
^	XOR	expr1 ^ expr2 127 ^ 255 = 128	Exclusive Or (binary operation)
mod	modulo	expr1 mod expr2 250 mod 16 = 10	Mathematic modulo (rest of an integer division)
rnd	division	expr1 rnd expr2 250 rnd 16 = 16	Division with round-off (opposite to truncating)
abs	absolute amount	Abs(expr) abs (-5) = 5	Absolute amount of the expression

Bit operators

Symbol	Meaning	Syntax / Example	Description
&	and	7 & 6 = 6	bit-by-bit relationship
|	or	2 | 4 = 6	bit-by-bit relationship
~	invert	~(–7) = 6	bit-by-bit inversion
≪	left shift	3 << 1 = 6	bit-by-bit shift to the left
≫	right shift	12 >> 1 = 6	bit-by-bit shift to the right
.	Bit	expr1.expr2 7.1 = 1 7.3 = 1 7.4 = 0	Returns the Bit expr2 from expr1
.b	Byte	expr1.b expr2 0x027F.b1 = 127 0x027F.b2 = 2	Returns the Byte expr2 from expr1
.w	Word	expr1.w expr2 0x0010FFFF.w2 = 16	Returns the Word expr2 from expr1
.l	Long	expr1.l expr2	Returns the Long expr2 from expr1 (standard)

Comparison Operations and Logical Operations

Comparison operations	>	greater than
	<	less than
	>=	greater than or equal to
	<=	less than or equal to
	==	the same as
	!=	not equal
Logical operations	AND	and
	OR	or
	NOT	not

Assignment Operation

Value	=0	Standard assignment to a variable
Field[1]	=0	Standard assignment to an array value
Value.3	=1	Bit 3 is set at 1, value = 4
Field[1].8	=1	Bit 8 is set at 1, field[1] = 128
Value.b1	=72	The lowest byte of value is set at 72 Value = 72
Value.b2	= 128	Second byte of value is set at 128 Value = 0x00008048
Value.w2	= 15	Second word of value is set at the value 15. Value = 0x000F8048

Priority of the Operators and the Operations

Operators in the same line have the same priority, thus they are completed one after the other.
The priorities are described in decreasing order:

* %	multiplicative
+ –	additive
>> <<	bit-by-bit shifting
>= <= > <	relation
== !=	equality
&	bit-by-bit and
|	bit-by-bit inclusive or
AND	(logical and)
OR	(logical or)

■ User units

The units for the drive or the slave and the master, respectively, can be defined by the user in any way desired so that the user can work with meaningful measurements.

User Units [UU]

All path information in motion commands are made in user units and are converted to quad-counts internally. These also have an effect on all commands for the positioning: e.g. APOS, POS. Scaling determines how many quad-counts make up a user unit. For example, if it is 50375/1000, then one UU corresponds to exactly 50.375 qc.

The user can also select meaningful units for the cam control in order to describe the curve for the master and the slave. For example 1/100 mm, or 1/10 degrees in applications where a revolution is being observed.
In the CAM control, the maximum run distance of the slave or the slave cycle length are indicated in User Units UU (qc).
You can standardize the unit with a factor. This factor is a fraction which consists of a numerator and denominator:

1 UU = POSFACT_Z (23) / POSFACT_N (26)

Master Units [MU]

The curve length or the master cycle length and other information (e.g. the marker distance) for the cam control are indicated in master units MU.
A factor (fraction) is used for the conversion into qc, as with the user unit:

1 MU = SYNCFACTM (49) / SYNCFACTS (50)

Software Reference

List of Commands

Initialization of the SyncPos option (INI)

Commands to initialize the axis and the SyncPos option start up and define the zero point(s)

DEFMORIGIN	set the current master position as the zero point for the master
DEF ORIGIN	sets the actual position as real zero point
DELETE ARRAYS	delete all arrays in the RAM
ERRCLR	clears error
HOME	moves to machine zero point
INDEX	moves to next index position
MOTOR OFF	turns off motor control
MOTOR ON	turns on motor control
RST ORIGIN	resets temporary zero point
SETMORIGIN	set the current position as the zero point for the master
SET ORIGIN	sets temporary zero point
SAVE ARRAYS	save arrays in the EEPROM
SAVE AXPARS	save current axis parameters in the EEPROM
SAVE GLBPARS	save current global parameters in the EEPROM
SAVEPROM	saves memory in EEPROM
SWAPMENC	Swap master and slave encoder internally.

Control Commands (CON)

Commands for controlling the program flow and structuring the programs.

DELAY	time delay
DIM	declaration of a global array
EXIT	desired, premature program termination
GOSUB	calling up a subroutine
GOTO	jumping within a program
IF THEN	conditional program execution
... ELSE IF THEN	.. with conditional alternative branching
... ELSE	.. with alternative branching
... ENDIF	end of the conditional program execution
LOOP	repeats loop
CONTINUE	continues positioning from point of interruption, for example following a motor-stop
MOTOR STOP	motor-stop with a programmed delay (with ramp)
NOWAIT ON/OFF	on/off switch for waiting for the command execution
REPEAT	beginning of repeat loop
REPEAT... UNTIL	conditional loop, with an end criteria
SUBMAINPROG	commencement of the subroutine definition area
... ENDPROG	end of the subroutine definition area
SUBPROG	begins a subroutine
... RETURN	ends a subroutine
SYSVAR	system variable (pseudo array) reads system values
WAITAX	waits until target position is reached
WAITI	waits for input
WAITNDX	waits until the next index position is reached
WAITP	waits until a certain position is reached
WAITT	time delay in milliseconds
WHILE … DO	conditional loop with commencement criteria
… ENDWHILE	end of the loop
#INCLUDE	compiler directive: embedding further data

Absolute Motion (ABS)

Commands for the absolute positioning of the axis

ACC	sets acceleration
DEC	sets deceleration
POSA	positions axis absolutely
VEL	sets velocity for relative and absolute motions and set maximum allowed velocity for synchronizing

Speed Control (ROT)

Commands to obtain a permanently driving axis with constant speed

CSTART	starts the continuous movement in rpm mode
CSTOP	stops the drive in speed mode
CVEL	sets the velocity for speed regulation

Input/Output Commands (I/O)

Commands for setting and re-setting the outputs, reading the inputs, reading movement information, reading system data and entering and outputting user information.

APOS	reads actual position
AXEND	reads info on status of program execution
CPOS	reads set position
MAPOS	queries actual position of the master
MIPOS	queries last index or marker position of the master
IPOS	queries last index or marker position of the slave
MAVEL	queries actual velocity of the master
AVEL	queries actual velocity of an axis
TRACKERR	queries actual position error of the axis
SYNCERR	queries actual synchronization error of the slave
ERRNO	reads error number
IN	reads input bit-by-bit (individually)
INB	reads input by bytes (units of 8)
INAD	reads analog input
INKEY	reads key codes of VLT
OUT	sets output bit-by-bit (single)
OUTAN	sets VLT reference
OUTB	sets output by bytes (units of 8)
OUTDA	sets analog output (freely available)
PID	completes PID calculation
PRINT	output (display) texts and variables
STAT	reads axis status
TESTSETP	Specify recording data for test run
TESTSTART	Start the recording of a test run
TIME	reads internal controller time
_GETVEL	changes sample time for AVEL and MAVEL

Interrupt Functions (INT)

DISABLE ...	switches interrupt ... off
DISABLE ALL	switch off all interrupts except ON ERROR
ENABLE ...	switches interrupt ... on
ENABLE ALL	switches all interrupts on
ON APOS .. GOSUB	call up a subprogram when the slave position xxx is passed.
ON DELETE .. GOSUB	Deletes a position-interrupt: ON APOS, ON MCPOS or ON MAPOS
ON COMBIT .. GOSUB	call up a subprogram when Bit n of the communication buffer is set
ON ERROR GOSUB	calls subroutine in the event of an error
ON IN .. GOSUB	calls subroutine depending on input signal
ON MAPOS .. GOSUB	call up a subprogram when the master position xxx (qc) is passed.
ON MCPOS .. GOSUB	call up a subprogram when the master position xxx (MU) is passed.
ON PARAM .. GOSUB	call up a subprogram when a parameter is altered
ON PERIOD .. GOSUB	calls subroutine at regular intervals
ON STATBIT	call up a subprogram when bit n of the VLT status is set
ON TIME	calls subroutine after single timing

Parameter (PAR)

All global and axis parameters with a parameter code can be set and read with the following commands. (Parameter code see overview in Parameter Reference.)

GET	reads SyncPos parameter values (axis, global and user parameters)
GETVLT	reads VLT parameter values
GETVLTSUB	reads VLT parameter values with index number
SET	sets SyncPos parameter values (axis, global and user parameter)
SETVLT	sets VLT parameter values
SETVLTSUB	sets VLT parameter values with index number
LINKAXPAR	links axis parameter with LCP display
LINKGPAR	links global parameter with LCP display
LINKSYSVAR	links system variable with LCP displayCommunication option
COMOPTSEND	writes in the Communication option buffer
COMOPTGET	reads a Communication option telegram
PCD	pseudo array for direct access to the fieldbus data area

Relative Motion (REL)

Commands for the relative positioning of the axis

ACC	sets acceleration
DEC	sets deceleration
POSR	positioning relative to the actual position
VEL	sets velocity

Synchronization (SYN)

Commands to synchronize the slave with the master or the master simulation

DEF SYNCORIGIN	Defines master-slave relation for the next SYNCP or SYNCM command
MOVESYNCORIGIN	relative shifting of the origin of synchronization
SYNCV	synchronization of velocity
SYNCP	synchronization of angle/position
SYNCM	synchronization of angle/ position with marker correction
SYNCSTAT	queries flag for synchronization status
SYNCSTATCLR	resetting of the flags MERR and MHIT
PULSACC	sets acceleration for the virtual master
PULSVEL	sets velocity for the virtual master

CAM-Mode (CAM)

Commands for the synchronization in CAM-Mode (cam control)

CURVEPOS	Retrieve slave curve position that corresponds to the current master position of the curve.
DEFMCPOS	Define initial position of the master
POSA CURVEPOS	Move slave to the curve position corresponding to the master position
SETCURVE	Set CAM curve
SYNCC	Synchronization in CAM-Mode
SYNCCMM	Synchronization in CAM-Mode with master marker correction
SYNCCMS	Synchronization in CAM-Mode with slave marker correction
SYNCCSTART	Start slave for synchronization in CAM-Mode
SYNCCSTOP	Stop slave after the CAM synchronization

All Commands from ACC to #INCLUDE

In the following section all commands are listed in alphabetical order and described in detail with syntax examples.

ACC

The ACC command defines the acceleration for the next motion command (speed control, synchronizing or positioning). The value will remain valid until a new acceleration value is set, using the ACC command. The value is related to the parameters ***Shortest ramp*** RAMPMIN (31) and ***Maximum velocity*** VELMAX (1) as well as ***Velocity resolution*** VELRES (22).

NB!
If you work with the SyncPos option card then you should always set the ramps via the option card and not in the VLT. The VLT ramps must always be set to minimum.

Summary

setting acceleration for motion commands

Syntax

ACC a

Parameter

a = acceleration

NB!
If acceleration has not been defined previous to a motion command, then the acceleration will be the value of parameter DFLTACC(34).

Command group

REL, ABS

Cross Index

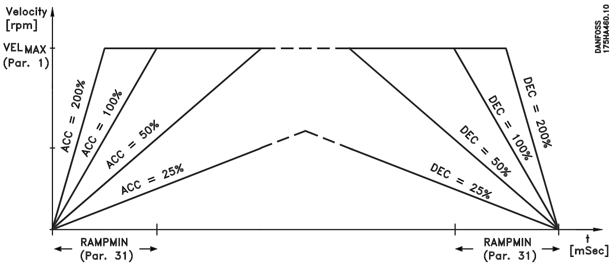
DEC, VEL, POSA, POSR
Parameter: RAMPMIN (31), VELMAX (1), VELRES (22)

Syntax-Example

```
ACC 10    /* Acceleration 10 */
```

Example

minimum acceleration time:	1000 msec
maximum velocity:	1500 Rpm (25 Rev./s)
velocity resolution:	100



Program sample

ACC_01.M

APOS

The APOS command can query the absolute position of the axis related to the actual zero point.

Summary

reads actual position

Syntax

res = APOS

Return value

res = absolute actual position in user units (UU) related to the actual zero point

All path information in motion commands are made in user units and are converted to quad-counts internally. *(See also Numerator and Denominator, Parameter 23 and 26.)*
The user unit (UU) corresponds in standard setting to the number of Quad counts.
Parameter POSFACT_Z (23) / POSFACT_N (26) = 1

NB!
If a temporary zero point which has been set via SET ORIGIN exists, then the position value is relative to this zero point.

Command group

I/O

Cross Index

CPOS, DEF ORIGIN, SET ORIGIN, POSA, POSR
Parameter: POSFACT_Z (23) and POSFACT_N (26)

Syntax-Example

```
PRINT APOS
/* display the actual position of axis on the PC */
```

Program sample

APOS_01.M,
GOSUB_01.M, MOTOR_01.M

AVEL

This function returns the actual velocity of the axis in User Units per second. The accuracy of the values depends on the duration of the measurement (averaging). The standard setting is 20 ms, but this can be changed by the user with the _GETVEL command. It is sufficient to call up the command once in order to work with another measuring period from then on.
Thus, the command:

```
    var = _GETVEL 100
```

sets the duration of the measurement to 100 ms, so that you have a considerably better resolution of the speed with AVEL and MAVEL, however, in contrast, quick changes are reported with a delay of a maximum of 100 ms.

Summary

queries actual velocity of axis

Syntax

res = AVEL

Return value

res= actual velocity of axis in UU/sec, the value is signed

Command group

I/O

Cross Index

MAVEL, APOS, _GETVEL

Syntax-Example

```
PRINT AVEL
/* queries actual velocity of axis and display on the PC */
```

AXEND

The AXEND command gives the actual status of the axis or the status of the program execution. This means for example that you can enquire when the "position is reached" and a positioning command (POSA, POSR) has actually been completed. When Bit 1 is set at "0" the positioning process is complete and the position reached.
If, however, the positioning command has been interrupted with MOTOR STOP and continued later with CONTINUE, then the following bits would be set at "1":

the Bit 0 for "motor is at a standstill"
the Bit 1 for "positioning process active"
the Bit 3 for "motor is at STOP status"
the Bit 6 for "axis controller switched off"

The AXEND command is especially suitable for determining whether or not a movement in the NOWAIT ON condition is terminated. With the help of the bit operators, the desired information from the axis status can be filtered out.

Summary

reads info on status of program execution

Syntax

res = AXEND

Return value

res = axis status with the following meaning:

Value	Bit	
128	7	1 = Motor is reset, i.e. it is ready to start and is controlling again, e.g. after ERRCLR, MOTOR STOP, MOTOR ON
64	6	1 = axis controller is OFF, motor is off
	4–5	not in use
8	3	
4	Bit 2	1 = speed mode is active
2	Bit 1	1 = positioning procedure is active
1	Bit 0	1 = target position reached; motor is not in motion

Command group

I/O

Cross Index

WAITAX, STAT

Syntax-Example

```
NOWAIT ON //do not wait until position is reached
POSA 100000
WHILE (AXEND&2) DO
// as long as the positioning process is active,
// repeat loop
   IF IN1 THEN        // if input 01 is set
      VEL 100         // increase velocity
      POSA 100000
      WAIT IN1 OFF    // Wait until input (key) is off
   ENDIF
ENDWHILE              // position reached
```

Syntax-Example

```
IF (AXEND&64) THEN
/* set output 01, when axis controller is switched
off */
    OUT 1 1
ELSE
    OUT 1 0
ENDIF
```

Program sample

AXEND_01.M

■ COMOPTGET

COMOPTGET reads from the Communication option buffer the *no* words and writes them in the array *array,* starting with the first element.

Summary

reads a Communication option telegram

Syntax

COMOPTGET *no* array

Parameter

array = the name of an array which must be at least the size of *no*

no = number of words to be read

Portability

built-in Communication option card

Communication option function

Parameters: Read and write parameters is not affected by the SyncPos option.

Control data:
The function of Control word (CTW) and Main Reference (MRV) depends on the setting of parameter 700; Status words (STW) and Main actual value (MAV) is always active:

	Parameter 700 "Enable SyncPos"	Parameter 700 "Disable SyncPos"
CTW/MRV	Disabled	Active
STW/MAV	Active	Active

Process data:
PCD's 1 – 4 of PPO type 2/ 4 and PCD's 1 – 8 of PPO type 5 are not assigned a parameter number by parameter 915 and 916 but are used as a free data area which can be used in a SyncPos program.
The command COMOPTGET is copying the data received on the communication option into an array, where each array element contains one data word (16 bit).
The command COMOPTSEND is copying data from an array, where each array element contains one data work (16 bit) into the send buffer on the communication option, from where it is send via the network to the master.

Command group

Communication option

Cross Index

COMOPTSEND

Program sample

COM_OPT

■ COMOPTSEND

COMOPTSEND writes in the Communication option buffer. In doing so the first *no* values are sent from the *array*.

Summary

writes in the Communication option buffer

Syntax

COMOPTSEND no array

Parameter

array = the name of an array which must be at least the size of *no*

no = number of words to be sent

Portability

built-in Communication option card

Communication option function

see command COMOPTGET

Command group

Communication option

Cross Index

COMOPTGET

Program sample

COM_OPT

Software Reference

CONTINUE

By using CONTINUE, positioning and speed motion commands which have been aborted via the MOTOR STOP command or an error condition or halted via MOTOR OFF can be resumed.
The CONTINUE command can be used especially in an error subroutine in connection with the ERRCLR command, to enable the correct continuation of a motion procedure following an error abort.

NB!
However CONTINUE does not continue interrupted synchronization commands.

Summary

continues positioning from point of interrupted motion

Syntax

CONTINUE

Command group

CON

Cross Index

MOTOR STOP, ERRCLR, ON ERROR GOSUB

Syntax-Example

```
CONTINUE
/* continue interrupted motion procedure */
```

Program sample

MSTOP_01.M

CPOS

The CPOS command queries the actual commanded position of the axis related to the actual zero point. The commanded position is understood to be the temporary set position which is re-calculated every ms by the positioning control during a positioning procedure or a movement in rotation mode.
The command position can be queried independently of the operating condition (position control during standstill, positioning process, speed control or synchronization).

Summary

reads the actual command position of the axis

Syntax

res = CPOS

Return value

res = Absolute commanded position in User Units (UU) related to the actual zero point

NB!
If a set and active temporary zero point (set via SET ORIGIN) exists, then the position value is relative to this zero point.

Command group

I/O

Cross Index

APOS, DEF ORIGIN, SET ORIGIN, POSA, POSR
Parameter: POSFACT_Z (23), POSFACT_N (26)

Syntax-Example

```
PRINT CPOS
/* actual command position of axis */
```

Program sample

CPOS_01.M
GOSUB_01.M

■ CSTART

The CSTART command is starting the drive in speed control mode.

Acceleration/deceleration, as well as the speed should be set via the ACC, DEC and CVEL commands prior to starting.

CSTART does not contains the command MOTOR ON which turns on the motor control. When using CSTART an explicit calling up of MOTOR ON is necessary after previous use of MOTOR OFF.

Summary

starts the speed mode

Syntax

CSTART

NB!

If no speed value has been defined via CVEL before the beginning of CSTART, then the default velocity 0 is used – this means that the motor will not rotate, but the PID controller is active.

All CVEL commands following the start of speed mode will be carried out immediately, i.e. a corresponding speed change will take place immediately, with the defined acceleration or deceleration (ACC/DEC).

Command group

ROT

Cross Index

ACC, DEC, CVEL, CSTOP

Syntax-Example

```
CSTART   /* rpm mode start */
```

Program sample

CMODE_01.M

■ CSTOP

Via the CSTOP command, the speed mode is terminated and the positioning mode is started, whereby a still rotating axis is stopped with the deceleration defined with DEC and the motor is held in the stop position.

Summary

stops the drive in speed mode

Syntax

CSTOP

NB!

A CSTOP command carried out in the positioning mode can also cause an abrupt termination of the positioning procedure.

Command group

ROT

Cross Index

ACC, DEC, CVEL, CSTART

Syntax-Example

```
CSTOP    /* rpm mode stop */
```

Program sample

CMODE_01.M

CURVEPOS

CURVEPOS returns the slave value which corresponds to the actual curve master position.

The position can be retrieved independently of the operating status (position control at standstill, positioning procedure, velocity control or synchronization).

CMASTERCPOS (SYSVAR) und CURVEPOS werden nun auch aktualisiert, sogar wenn SYNCC nicht mehr aktiv ist. Diese Werte werden aktualisiert nach einem Befehl SETCURVE (falls SYNCMSTART < 2000 ist) oder nach SYNCC und dem erster Master-Marker (falls SYNCMSTART = 2000).

Nachdem der SYNCC Befehl angehalten wurde, wird fortgefahren, diese Werte zu aktualisieren, wenn SYNCMSTART < 2000.

Summary

Retrieve slave curve position that corresponds to the current master position of the curve.

Syntax

res = CURVEPOS

Return value

res = Slave position in CAM units (UU) absolute to the current zero point.

NB!
The position is only defined if a SETCURVE has been set before.

NB!
If a temporary zero point exists which has been set with SET ORIGIN and is active, the position value will refer to this zero point.

NB!
DEFMCPOS and DEFMORIGIN can still modify this position.

Command group

CAM

Cross Index

APOS, DEF ORIGIN, SET ORIGIN, POSA, POSR, DEFMCPOS
Parameter: SYNCFACTM, SYNCTACTS

Syntax example

```
PRINT CURVEPOS
    // print actual slave position of the curve
```

CVEL

The velocity for the next speed controlled motor movement is set with the CVEL command. The value remains valid until a further CVEL command sets a new velocity.

The velocity value to be given will be related to the parameters ***Maximum velocity*** VELMAX (1) and ***Velocity resolution*** VELRES (22).

Summary

sets velocity for speed controlled motor movements

Syntax

CVEL v

Parameter

v = velocity value (negative value for reversing)

$$\text{Command velocity} = V * \frac{\text{VELMAX (1)}}{\text{VELRES (22)}}$$

NB!
CVEL commands which take place after CSTART will be carried out immediately i.e. the velocity will be adapted via the ACC/DEC set acceleration or deceleration to the new value of CVEL.

If a velocity has not been defined before the start of speed control mode (CSTART), then the default velocity is 0, i.e. the motor will not turn, and a velocity input via CVEL will start the movement in speed control mode.

Command group

ROT

Cross Index

ACC, DEC, CSTART, CSTOP
Parameter: VELMAX (1)

Syntax-Example

CVEL 100

Program sample

CMODE_01.M

DEC

The DEC command defines the deceleration for the next motion command (speed control, synchronization or positioning). The value will remain valid until a new deceleration value is set with another DEC command. The value is related to the parameters ***Shortest ramp*** RAMPMIN (31) and ***Maximum velocity*** VELMAX (1) as well as ***Velocity resolution*** VELRES (22).

NB!
If you work with the SyncPos option card then you should always set the ramps via the option card and not in the VLT. The VLT ramps must always be set to minimum.

Summary

sets deceleration

Syntax

DEC a

Parameter

a = deceleration

NB!
If deceleration is not defined previous to the positioning command then deceleration will be the setting (negative) of parameter ***Default acceleration*** DFLTACC (34).

Command group

REL, ABS

Cross Index

ACC
Parameter: RAMPMIN (31), VELMAX (1), VELRES (22)

Syntax-Example

```
ACC 50    /* acceleration: 50, while braking 10 */
DEC 10
```

Example

minimum acceleration time:	1000 msec
maximum velocity:	1500 Rpm
velocity resolution:	100

DEFMCPOS

DEFMCPOS defines the initial position of the master (in MU) in the CAM-Mode and thus the point where the curve begins as soon as the master pulses are being counted.

Summary

Define initial position of the master

Syntax

DEFMCPOS p

Parameter

p = position in Master Units (MU)

Command group

CAM

Cross Index

DEFMORIGIN, SETMORIGIN, SYNCC
Parameter: SYNCMSTART

Syntax example

```
DEFMCPOS 1000
     // Set internal MU counter to 1000
```

■ DEFMORIGIN

DEFMORIGIN defines the current master position as the zero point for the master. The master position (MAPOS) refers to this zero point until a redefinition takes place using DEFMORIGIN or SETMORIGIN.

Summary

Set the current master position as the zero point for the master.

Syntax

DEFMORIGIN

Command group

INI

Cross Index

MAPOS, SETMORIGIN

Syntax example

```
DEFMORIGIN
/* Set current position as the zero point for the
master */
```

■ DEF ORIGIN

With the DEF ORIGIN command the current position is set as the zero point. All absolute positioning commands (POSA) then refer to this zero point.

Summary

sets the actual position as real zero point

Syntax

DEF ORIGIN

Command group

INI

Cross Index

POSA

Syntax-Example

```
POSA 80000      /* Absolute positioning */
DEF ORIGIN      /* define actual position as
                zero point */
```

Program sample

DORIG_01.M, ORIG_01.M

■ DEF SYNCORIGIN

This command allows to define the relation between master and slave for the next SYNCP or SYNCM command. It sets the internal slave command position to the slave value.
The master value is used for an internal MOVESYNCORIGIN. For that reason, a MOVESYNCORIGN will be overwritten by this command. Both actions are done at the moment, when the SYNC command is activated. So it is guaranteed, that master and slave will be synchronized at the above master-slave position.

Summary

Defines master-slave relation for the next SYNCP or SYNCM command

Syntax

DEFSYNCORIGIN master slave

Parameter

master = reference position in qc
slave = reference position

Portability

Standard command with option card version 5.00 onwards

Command group

SYN

Cross Index

MOVESYNCORIGIN

Software Reference

■ DELAY

The DELAY command leads to a defined program delay. This parameter gives the delay time in milliseconds.

If an interrupt occurs during the delay time, then following the processing of the interrupt procedure, the programmed delay will take place after the correct inclusion of the interrupt time. Thus, the DELAY command gives a constant delay time, independent of whether various interrupts have to be processed during the programmed delay time.

If the interrupt requires more processing time than is available for the delay, then the interruption procedure will be carried out to the end, before the command following the DELAY instruction is commenced.

Summary

Time delay

Syntax

DELAY t

Parameter

t = time delay in milliseconds (maximum MLONG)

Command group

CON

Cross Index

WAITT, WAITI, WAITAX

Syntax-Example

```
DELAY 1000      /* 1 second delay */
```

Program sample

DELAY_01.M

■ DELETE ARRAYS

With DELETE ARRAYS you can delete all arrays in the RAM without – as was the case up to now – also deleting the parameters etc. This new command has the same effect as the menu command "CONTROL" → "RESET" → "ARRAYS".

Summary

Delete all arrays in the RAM

Syntax

DELETE ARRAYS

NB!
If you then execute a SAVE ARRAYS, the arrays in the EEPROM are also overwritten!

NB!
If DELETE ARRAYS is carried out after a DIM assignment in the program, it is then no longer possible to access the array elements.

NB!
If a program contains a DELETE ARRAYS command, there are no more arrays in the RAM after the program is exited.

Command group

INI

DIM

Via a DIM instruction at the commencement of the program, it is possible to declare one or more arrays (= Variable fields).

Arrays are valid for all programs. If arrays are not yet available in the SyncPos option memory, then the arrays are allocated via the DIM instructions. Arrays which are already available in the memory are checked to see if their size corresponds to the momentary DIM commands. If differences are found, then an error registration is made. If, additionally to the corresponding arrays, new arrays are declared, then these must also be added at the end of the DIM command.

Each array element can later be accessed, similar to a variable, calculation results, characters or other information can be stored.

An array element can be called up via the array name and an index. The indices are admissible from 1 to the defined size in the DIM allocation.

An essential difference between variables and array elements consists in the fact that arrays are stored in the non-volatile memory, and their contents are permanent even when the power supply is switched off – insofar as it is saved with SAVEPROM or SAVE ARRAYS.

In contrast to variables, arrays have a validity not only for one, but for all programs in the VLT flow. The only condition necessary is that the arrays must be accessible via a DIM command in the desired program which enables a data exchange between several programs. It is of no importance whether or not the array is identified with the same name in all the programs. What is important is the order of the array definitions. This means, for example, that the first defined array in all programs always refers to the first stored array in the memory, independent of the array name.

Summary

Definition of an array

Syntax

DIM array [n]

Parameter

array = name of the array
n = number of array elements

NB!
The DIM command must be the first instruction in a program, and must appear before the subroutines.
Indices from 1 to the defined size of the array are permissible.
A defined array size is valid for all programs, and cannot be altered. Only the order of the array definitions (not the names) determines which of the data-fields will be accessed.
Array definitions can only be canceled via erasure of the entire memory.

Command group

CON

Syntax-Example

```
DIM xpos[100], ypos[100]
/* define array XPOS and YPOS each with 100
elements */
```

Program sample

DIM_01.M

■ DISABLE ... interrupts

DISABLE switches off all or explicitly specified interrupts – apart from ON ERROR. If the function DISABLE.. is used in the main program, it can prevent interrupts of the corresponding type.
This is particularly useful if a variable, which is set in an interrupt procedure, is used in the main program. To do this you should first switch off the corresponding (or all) interrupts in the main program DISABLE.. alter the variable and then switch the corresponding (or all) interrupts back on with ENABLE..

Summary

Switches interrupts off

Syntax

DISABLE inttyp

NB!
DISABLE cannot be called up during interrupt procedures. (The system automatically switches back to enabled after an interrupt.)

Parameter

inttyp = ALL
INT
COMBIT
STATBIT
PARAM
PERIOD
TIME
POSINT

NB!
DISABLE ALL = all except ON ERROR:
in addition the pending interrupts are executed after the release with ENABLE ALL.

NB!
If an interrupt is disabled it still exist, but is not processed anymore (Exception: DISABLE ALL).
The detection is still running in the background and the interrupt is captured in case of a non (!) edge-sensitive or a message-oriented interrupt (ON PERIOD, ON APOS, ON PARAM etc.). If the interrupt is ENABLEd again and there was a captured (non edge-sensitive) interrupt before, this interrupt is processed immediately.
In case of edge-sensitive interrupts (e.g. ON INT, ON COMBIT, ON STATBIT), all interrupts, which take place during the DISABLEd phase are not processed, even not after switching on ENABLE again.
These interrupts have no memory in case of DISABLEd state. Edge-sensitive interrupts which take place after the anew ENABLEing are still processed again.

NB!
Exception: DISABLE ALL
In opposite to the selective disabling of edge-sensitive interrupts (e.g. DISABLE INT) – these will be ignored and not executed after enabling – in case of DISABLE ALL the request is stored (edge-sensitive interrupts too) and the interrupt are still executed after enabling (ENABLE ALL)!

Command group

INT

Cross Index

ON INT, ON COMBIT, ON STATBIT, ON PARAM, ON PERIOD, ON TIME, ENABLE .. Interrupts

Syntax example

```
DISABLE ALL      /* Switch off all interrupts */
DISABLE STATBIT
    /* Switch off the interrupt for the status bit */
```

ENABLE ... interrupts

ENABLE switches all or explicitly specified interrupts on again.

Summary

Switches interrupts on

Syntax

ENABLE inttyp

NB!
ENABLE cannot be called up during interrupt procedures. (The system automatically switches back to enabled after an interrupt.)

Parameter

inttyp = ALL
INT
COMBIT
STATBIT
PARAM
PERIOD
POSINT
TIME

NB!
See the difference between the non-edge-sensitive and message-oriented interrupts (ON PERIOD, ON APOS, ON PARAM, etc.) and the edge-sensitive interrupts (e.g. ON INT, ON COMBIT, ON STATBIT) in section DISABLE…

Command group

INT

Cross Index

ON INT, ON COMBIT, ON STATBIT, ON PARAM, ON PERIOD, ON TIME

Syntax example

```
ENABLE ALL        /* Switch on all interrupts */
ENABLE COMBIT     /* Switch on the interrupt for
                  the communication bit */
```

ERRCLR

An option card error can be cleared via the ERRCLR command. However, the cause of the error must be eliminated first, otherwise the same error alarm will occur again. If, in the meantime, another un-corrected error occurs, then only the first error will be canceled.

Summary

Error cancellation

Syntax

ERRCLR

The ERRCLR command should only be used in a subroutine for error handling (see ON ERROR GOSUB).

NB!
ERRCLR contains the command MOTOR ON, which automatically turns on the control again. (The motor is position controlled at the current position.)

UP TO VERSION 3.00
ERRCLR is only resetting option card errors, VLT alarms must be reset via a digital input or the LCP.
NEW
As of Version 3.1x ERRCLR also resets Bit 7 of the control word of the VLT. Then the VLT messages no longer need to be deleted.

Command group

INI, CON

Cross Index

ON ERROR GOSUB, ERRNO, CONTINUE, MOTOR ON
Messages and Error reference

Syntax-Example

```
ERRCLR   /* erase actual error alarm */
```

Program sample

ERROR_01.M, IF_01.M, INDEX_01.M

Software Reference

ERRNO

ERRNO is a system variable which is available in all the programs, and contains the momentary error code. All error codes are explained in the chapter Messages and Error Reference.
If, at the time of inquiry no error has occurred, then ERRNO will contain a 0.

Summary

System variable with the actual error code

Syntax

```
res = ERRNO
```

Command group

I/O

Cross Index

ON ERROR GOSUB, ERRCLR
Messages and Error reference

Syntax-Example

```
PRINT ERRNO   /* display actual error code */
```

Program sample

ERROR_01.M, IF_01.M, INDEX_01.M

EXIT

EXIT ends a program where active positioning procedures are being carried out to the end.
The EXIT command is especially intended for use in an error treatment routine, and permits an unplanned program termination in the case of an un-correctable error occurrence.
After an abort with EXIT, programs marked with "AUTOSTART“ will start up again automatically if SET PRGPAR = –1.

Summary

Premature program termination

Syntax

```
EXIT
```

NB!
A program should only be terminated in the case of a serious error, e.g. when reacting to a limit switch.

Cross Index

ON ERROR GOSUB, SET PRGPAR, "AUTOSTART"

Syntax-Example

```
EXIT         /* Program termination */
```

Program sample

EXIT_01.M, ERROR_01.M, GSVEL_01.M

GET

Reads the value of an axis parameter, a global parameter or an user parameter of the SyncPos option.
Global and axis parameter are addressed with a code, for example KPROP (11) for the ***Proportional factor,*** KDER (12) for the ***Derivative Factor*** or POSERR (15) for the ***Tolerated position error***. A complete list of the codes can be found in the Parameter reference.
User parameter are addressed with a number, 130 – 229. See also the Parameter reference for details.

Summary

Reads an axis parameter, a global parameter or an user parameter

Syntax

```
res = GET par
```

Parameter

par = parameter identification

Return value

res = parameter value

Command group

PAR

Cross Index

SET, GETVLT, SETVLT, LINKGPAR, LINKAXPAR
Parameter reference

Syntax-Example

```
PRINT GET POSLIMIT
/* Print-out positive positioning limit */
posdiff = GET POSERR
/* Read actual setting tolerated position error */
```

Syntax-Example

```
PRINT GET I_BREAK /* reads input for abort */
```

Program sample

GETP_01.M

■ GETVLT

GETVLT reads VLT parameters and return the corresponding value. Thus, with GETVLT you have access to the operating data (e.g. motor current P520) or to the configurations (e.g. max. command value P205) of the VLT.
Since only integer values are transmitted, it is necessary to take the conversion index into consideration when evaluating the return value.
Thus an LCP value of 50.0 Hz (conversion index = –1) is equivalent to a return value of 500.
The list of VLT parameters with their respective conversion index can be found in the VLT5000 and VLT5000 Flux operating instructions.

Summary

Reads a VLT parameter

Syntax

res = GETVLT par

NB!
Use GETVLTSUB to read parameters with index numbers, e.g. VLT parameter 606…617.

Parameter

par = parameter number

Return value

res = parameter value

Command group

PAR

Cross Index

SETVLT

Syntax-Example

```
PRINT GETVLT 202
/* reads parameter 202 output frequency high */
```

■ GETVLTSUB

GETVLTSUB reads VLT parameters with index numbers, e.g. VLT parameter 606…617, and return the corresponding value.
Since only integer values are transmitted, it is necessary to take the conversion index into consideration when evaluating the return value.
Thus an LCP value of 50.0 Hz (conversion index = –1) is equivalent to a return value of 500.
The list of VLT parameters with their respective conversion index can be found in the VLT5000 and VLT5000 Flux operating instructions.

Summary

Reads a VLT parameter with index number

Syntax

res = GETVLTSUB par indxno

Parameter

par = parameter number
indxno = index number

Return value

res = parameter value

Portability

With option card version 5.00 onwards.

Command group

PAR

Cross Index

SETVLTSUB

Syntax example

```
PRINT GETVLTSUB 25 1
    // reads index 1 of the Quick menu parameter
    // (VLT5000Flux only)
```

■ GOSUB

The GOSUB command will call up a subroutine, and the accompanying program will be carried out. The main program will be continued following the completion of the last subroutine command (RETURN).

Summary

calls a subroutine

Syntax

GOSUB name

Parameter

name = subroutine name

NB!
The subroutine must be defined at the beginning or end of a program within the SUBMAINPROG area.

Command group

CON

Cross Index

SUBMAINPROG...ENDPROG, SUBPROG...RETURN
ON ERROR GOSUB, ON INT n GOSUB

Syntax-Example

```
GOSUB testup  /* Call-up the subroutine testup */
Command line 1
Command line n
SUBMAINPROG
/* Subroutine testup must be defined */
SUBPROG testup
Command line 1
Command line n
RETURN
ENDPROG
```

Program sample

GOSUB_01.M
AXEND_01.M, INCL_01.M, STAT_01.M

■ GOTO

The GOTO command enables an unconditional jump to the indicated program position and the program processing at this position will be carried out.
The jumped-to position is identified with a label. A label can consist of one or more characters and may not be identical to a variable name or a command word. A label must also be unique, i.e. it may not be used for different program positions.
It is therefore possible to program a continuous loop via the GOTO command.

Summary

Jump to a program label

Syntax

GOTO label

Parameter

label = identification of program target position

NB!
The label for the program target position must be followed by a colon (:).

Command group

CON

Cross Index

LOOP

Syntax-Example

```
endless:          /* Label to be jumped to */
Command line 1
Command line n
GOTO endless
/* jump command to label endless */
```

Program sample

GOTO_01.M
EXIT_01.M, IF_01.M

■ HOME

The HOME command is moving the drive to the machine reference switch, which must be placed at the machine zero or reference position. Velocity and acceleration/deceleration for HOME positioning is defined in the parameters HOME_VEL (7) and HOME_RAMP (41).
To achieve accurate positioning HOME_VEL (7) should not be higher than 10 % of maximum velocity.
The sign of HOME_VEL (7) determines the direction in which the reference switch is searched.
When the HOME position is reached, this position will be defined as 0.
The reference switch can be approached in 4 different ways defined in parameter HOME_TYPE(40):

0 Moves to reference switch, moves in opposite direction leaving the references switch and stops at the next index pulse (encoder zero pulse or external marker signal).
1 Like 0 but without searching for the index pulse.
2 Like 0 but leaving the switch without reversing the direction.
3 Like 2 but without searching for the index pulse.

If HOME is aborted via an Interrupt, HOME will not be continued automatically at the end of the interrupt routine function. Instead the program continues with the next command. This makes it possible for HOME to also be aborted after an error.

Summary

Move to device zero point (reference switch) and set as the real zero point.

Syntax

HOME

Peculiarities

The system must be fitted with a reference switch, when possible with an encoder with an index pulse.

NB!
The HOME command will also be carried out to the end in the NOWAIT ON mode, before other program processing will be begun.

Please note, that ON PERIOD xx GOSUB xx must be disabled during homing.
E.g. ON PERIOD n GOSUB x and the resetting after homing is completed.

Command group

INI

Cross Index

INDEX
Parameter: HOME_VEL (7), HOME_RAMP (41), HOME_TYPE (40), HOME_FORCE (3)

Syntax-Example

```
HOME      /* move to reference switch and index */
```

Program sample

HOME_01.M

■ IF ..THEN .., ELSEIF .. THEN .. ELSE .. ENDIF

Conditional program branching can be realized with the IF..ENDIF construction.

When the conditions following IF or ELSEIF are fulfilled, then the commands leading to the next ELSEIF, ELSE or ENDIF are carried out – and the program will be continued after the ENDIF instruction.

When the conditions are not fulfilled, then the following ELSEIF branching will be checked and, in as much as the conditions are fulfilled, the corresponding program part will be carried out, and the program continued after ENDIF.

The branching conditions that are checked after IF or ELSEIF can be made up of one or more comparison operations.

Any number of ELSEIF branching can occur within an IF...ENDIF construction – however, only one ELSE instruction should be available. Following the ELSE instruction is a program part that must be carried out, in as much as none of the conditions are fulfilled.

The ELSEIF and ELSE instructions can, but do not have to be, contained within an IF ENDIF construction.

Summary

Conditional single or multiple program branching. (When the conditions are fulfilled, then ..., else ...)

Syntax

```
IF condition THEN command
ELSEIF condition THEN command
ELSE command
ENDIF
```

Parameter

condition = Branching criteria
command = one or mor program commands

NB!
After a condition has been fulfilled, the appropriate program part will be carried out and the program following the ENDIF instruction continued. Further conditions will no longer be checked.

Command group

CON

Cross Index

REPEAT .. UNTIL, WHILE ..ENDWHILE

Syntax-Example

```
/* simple branch */
IF (a == 1) THEN        /* Variable a = 1, then */
command line 1
command line n
ENDIF

/* multiple branch */
IF (a == 1 AND b != 1) THEN
command lines
ELSEIF (a == 2 AND b != 1) THEN
command lines
ELSEIF (a == 3) THEN
command lines
ELSE
command lines
ENDIF
```

Program sample

IF_01.M; ERROR_01.M, EXIT_01.M, HOME_01.M, IN_01.M, ...

IN

The status of a digital input can be read with the IN command. Depending on the signal level, a 0 or 1 will be given.

Summary

reads status of digital input

Syntax

res = IN n

Parameter

n = input number
SyncPos option: 1 ... 8
VLT control card: 16, 17, 18, 19, 27, 29, 32, 33

Return value

res = input status
  0 = Low-level or undefined
  1 = High-level

NB!
The definition of a high or low level, as well as the input circuit, can be taken from the chapter Input/output terminals, as well as the VLT5000 manual.

Command group

I/O

Cross Index

INB, OUT, OUTB

Syntax-Example

```
in4 = IN 4
/* store condition input 4 in variable in4 */
IF (IN 2) THEN
 /* If high level on terminal 2, set output 01 */
    OUT 1 1
ELSE
    OUT 1 0
ENDIF
```

Program sample

IN_01.M

INAD

The INAD command reads the value of the analog inputs.

Summary

reads analog input

Syntax

res = INAD n

Parameter

n = number of the analog input: 53, 54 and 60

Return value

res = analog value

NB!
The resolution of the analog inputs was increased with the introduction of software version SyncPos VLT 3.12.

For these versions the following return values are true:

terminal 53/54	–1000 ... 1000	= –10 V ... 10 V
terminal 60:	0 ... 2000	= 0 ... 20 mA

For the software version SyncPos VLT2.03 following return value are valid:

terminal 53/54	0 ... 10 V	res = 0 ... 100
terminal 60:	0 ... 20 mA	res = 0 ... 200

You will find the number of the software version in parameter 624 on the VLT display.

Command group

I/O

Syntax-Example

```
an1 = INAD 53
PRINT “Analog input 53 “ ,an1
```

INB

The condition of the digital inputs can be read as byte via the INB command.
The values reflect the condition of the individual inputs.

Summary

reads one byte from digital inputs

Syntax

res = INB n

Parameter

n= input byte
0 = input 1 (LSB) … 8 (MSB)
1 = input 33 (LSB) … 16 (MSB)

Return value

res = value of the input byte (0 ... 255)

The least significant bit corresponds to the condition of input 1/33.

NB!
The definition of the high and low level, as well as the input circuit, can be taken from the chapter Input/output terminal or the VLT5000 manual.

Command group

I/O

Cross Index

IN, OUT, OUTB

Syntax-Example

```
in = INB 0
 /* store the condition of the first 8 inputs */
```

Example

IN1 = low, IN2 = high, IN3 = high,
all other inputs are low
res = 2^1 + 2^2 = 6

Program sample

INB_01.M, INB_02.M,
OUTB_01.M

INDEX

Movement to the index position of the encoder will be started via the INDEX command. The Index search takes places from the ***Home velocity*** defined in parameter HOME_VEL (7). The HOME_VEL sign determines the rotational direction in which the Index signal will be searched.

Summary

Move to index position of the encoder

Syntax

INDEX

Peculiarities

The utilized encoder must have an index channel.

NB!
Only encoders with a low active index pulse can be used.

If an index pulse is not found within a complete revolution, then an alarm signal occurs.
The INDEX command will also be carried out to the end in NOWAIT ON, before further program processing can be begun.

Command group

INI

Cross Index

HOME, POSA, DEF ORIGIN

Syntax-Example

```
INDEX            /* move to index */
```

Program sample

INDEX_01.M

INKEY

With the INKEY command it is possible to read a key signal from the VLT keyboard. The parameter entered with INKEY determines whether the program waits unconditionally for a key signal, for a certain period of time or not at all.

One key signal is read in per successful INKEY command respectively. To input a string of characters it is necessary to repeat the INKEY command (p<>0) in a loop until no further key signals exist.

Summary

Read in a key signal

Syntax

INKEY (p)

Parameter

p is the maximum waiting time, defined ...

p = 0 wait for key code
p > 0 wait of max. p milli-seconds
p < 0 no wait for key code

Return value

key code for the received character
resp –1 in case no character available

Following key codes are sent back, as long as the key is pressed. If more than one key were pressed simultaneously the corresponding sum of the values will be sent back:

key:	value:
MENU	1
QUICK MENU	2
DISPLAY / STATUS	8
OK	16
CANCEL	32
CHANGE DATA	128
→-key	256
↑-key	512
↓-key	1024
←-key	2048
START	4096
FWD. REV.	8192
JOG	16384
STOP / RESET	32768

Combinations send the corresponding values:

OK and CANCEL	48
START and ↑-key	4608

NB!
The keys keep their VLT-functions, unless they are disabled in Parameter 014–017.

A negative parameter must be given in brackets.

Command group

I/O

Cross Index

PRINT
Chapter Fundamentals of the SyncPos program

Syntax-Example

```
input = INKEY 0
/* wait until key signal is read */
input = INKEY 5000
/* wait max. 5 seconds to input */
input = INKEY (-1)
/* do not wait for input */
```

Program sample

INKEY_01.M
EXIT_01.M, WHILE_01.M

■ IPOS

Summary

Queries last index or marker position of the slave.

Syntax

res = IPOS

Return value

res = last slave position (index or marker) absolute to actual zero point.

The position input is made in user units (UU) and corresponds in the standard setting (parameter POSFACT_Z (23) and POSFACT_N (26) = 1) to the number of quadcounts.

Description

The command IPOS returns the last index or marker position of the slave absolute to the current zero point.

NB!
If a temporary zero point, set and activated via SET ORIGIN, exists, then the position is respective to this zero point.

The configuration of IPOS, that is whether the slave index- or marker position (= controlled drive) is returned, is done via the parameter SYNCMTYPS.

NB!
The trigger signal for the marker position has to be connected mandatory to the input 2.

The position value in IPOS is accurate to +/- 1qc. In opposite to the position information in APOS, which is just updated in a controller cycle of typically 1 ms, the actual position value is hardware stored in real time a buffer (in an internal processor register), when the configured signal is high. Then it will be copied in the system variable IPOS.

If simultaneously to the marker position an interrupt is initiated (ON INT 2 GOSUB ...) and within this interrupt it is operated with IPOS, you should use before IPOS reading a delay of 2 milliseconds (DELAY 2) within the interrupt subroutine. So it can be ensured, that the latched position value is already complete copied in the system variable IPOS and that not be taken an old value.

See also sample.

Command group

I/O

Cross Index

CPOS, DEF ORIGIN, SET ORIGIN, POSA, POSR, MIPOS

Parameter: POSFACT_Z (23), POSFACT_N (26)

Syntax-Example

```
PRINT IPOS
/* queries last index position and display on PC */
```

Sample

```
// Definition interrupt handler
ON INT 2 GOSUB slave_int
// Define IPOS latching on positive edge at input 2
SET SYNCMTYPS 2
// Start moving
CVEL 10
CSTART x(1)
// Endless-Loop
mainloop:
// ...
GOTO mainloop

SUBMAINPROG
SUBPROG slave_int
    // Latching APOS for testing,
    // how exact it would be ...
    int_pos = APOS
    // Wait 2 milliseconds, to be sure,
    // that IPOS is correct updated
    DELAY 2
    // Latching IPOS for a later handling etc.
    triggered_pos = IPOS
    // ....
    // ...
    PRINT “Interrupt position: “,int_pos
    PRINT “Triggered position: “,triggered_pos
   RETURN
ENDPROG
```

LINKAXPAR

With LINKAXPAR it is possible to link an axis parameter with the LCP display. Subsequently it is possible to change this parameter via the LCP or read out the set value.

When a linked parameter is changed with a SET command, the new value is also automatically transferred to the LCP, but is not changed in the factory settings since the SET command only has a temporary effect.

If the user changes a linked parameter on the LCP, the new value is accepted and executed. After turning the VLT off and then on again the factory settings or the last user parameter to be stored is activated.

Only after the user has confirmed the parameter with OK is the new value accepted as the user parameter and saved permanently. (Corresponds to the OK function in the menu "CONTROLLER" → "PARAMETERS" → "AXIS".)

Summary

links axis parameter with LCP display

Syntax

LINKAXPAR param optpar “text” min max typ

Parameter

param	=	axis parameter name
optpar	=	LCP parameter number (710–779 and 795–799)
text	=	descriptive text for display
min	=	minimum value for this parameter
max	=	maximum value for this parameter
typ	=	type of parameter 0 = offline, i.e. changes are only active after they have been confirmed with OK. 1 = online, that means changes via the LCP display are active at once

NB!
If the value of the parameter is out of the range defined by the min and max value the command is not displayed and executed correct.

Command group

PAR

Cross Index

LINKGPAR, SET, GET
User parameter, Parameter reference

Syntax-Example

LINKAXPAR POSERR 712
“position error” 300 50000 0

LINKGPAR

With LINKGPAR it is possible to link a pre-defined global parameter or a free internal user parameter with the LCP display. Subsequently it is possible to change this parameter via the LCP or read out the set value.

When a linked parameter is changed with a SET command, the new value is also automatically transferred to the LCP, but is not changed in the factory settings since the SET command only has a temporary effect.

If the user changes a linked parameter on the LCP, the new value is executed. Only after the user has confirmed this value with OK is the new value saved permanently as a user parameter in the EEPROM.

NEW: The command LINKGPAR tests whether the value of the user parameter is within the specified range. If not, the corresponding limit is used and this value saved. This ensures that a display appears.

Summary

links global parameter with LCP display

Syntax

LINKGPAR param optpar “text” min max typ

Parameter

param	=	global parameter name or user parameter number (130–229)
optpar	=	LCP parameter number (710–779 and 795–799)
text	=	descriptive text for display
min	=	minimum value for this parameter
max	=	maximum value for this parameter
typ	=	type of parameter 0 = offline, i.e. changes are only active after they have been confirmed with OK. 1 = online, that means changes via the LCP display are active at once

NB!
If the value of the parameter is out of the range defined by the min and max value the command is not displayed and executed correct.

Command group

PAR

Cross Index

LINKAXPAR, SET, GET
User parameter, Parameter Reference

Syntax-Example

```
LINKGPAR I_ERRCLR 710 “ “ 0 33 0
/* Predefined global parameter */
LINKGPAR 132 711 “name” 0 100000 0
/* Free internal user parameter */
LINKGPAR PRGPAR 701 “auto-program” –1 10 0
/* Define autostart */
```

■ LINKSYSVAR

The command LINKSYSVAR links the system variable SYSVAR[indx] with the VLT Parameter vltno (795-799) and the display text text. This means that you can link internal values on the display without using LINKGPAR.
If, for example, you are compiling with #DEBUG NOSTOP, link the internal line number with the VLT parameter 795. Then you can selectively observe the program execution.

Summary
Link system variable with LCP display

Syntax

```
LINKSYSVAR indx vltno "text"
```

Parameter

indx = Index of the system variable SYSVAR
vltno = LCP-Parameter number (795...799)
text = descriptive text for display

NB!
If the value of the parameter is out of the range defined by the min and max value the command is not displayed and executed correct.

NB!
The parameter vltnr is updated every 40 ms. Therefore, if five parameters are linked in this way, it takes at least 200 ms until the same parameter is updated.

Command group
PAR

Cross Index
LINKGPAR, SYSVAR
User parameter, Parameter Reference

Syntax-Example

```
LINKSYSVAR 33 795 "internal line number"
LINKSYSVAR 30 796 "Motor voltage"
    // Determine with user parameter 11 and 12:
    // line number in the first display line and
    // motor voltage in the second display line
```

■ LOOP

A single or multiple repetition of a certain program part can be realized by using the LOOP command. The number of loop repetitions can be given as either an absolute value or in the form of a variable. The program position to be jumped to is identified via a label. A label can be made up of one or more characters, and must not be identical with a variable name or a command word. A label must also be unique, i.e. the same label may not be used more than once for different program positions.

Summary
Defined loop repetition

Syntax

```
LOOP n label
```

Parameter

n = number of loop repetitions
label = identification of target program position

NB!
The label on the target program position must be followed by a colon(:).
Because the internal loop counter monitors only at the end of the loop and then decreases by one, the commands within the loop will be carried out with one more sequence than keyed in (keyed in loop repetitions 10 = 11 real repetitions).

Command group
CON

Cross Index
GOTO, WHILE...ENDWHILE, REPEAT...UNTIL

Syntax-Example

```
next_in:          /* jump to label */
command line 1
command line n
LOOP 9 next_in
/* repeat loop contents 10 times */
```

Program sample
LOOP_01.M
APOS_01.M, IN_01.M, MOTOR_01.M, NOWAI_01.M

■ MAPOS

With the MAPOS command it is possible to query the actual master position (absolute to the actual zero position).

Summary

Queries current actual position of the master

Syntax

res = MAPOS

Return value

res = master position to absolute actual zero point in qc

Command group

I/O

Cross Index

CPOS, DEF ORIGIN, SET ORIGIN, POSA, POSR
Parameter: POSFACT_N (26), POSFACT_Z (23)

Syntax-Example

PRINT MAPOS
/* Queries actual master position and print to PC */

■ MAVEL

This function returns the actual velocity of the master drive in qc/sec, with qc referring to the master encoder.
The accuracy of the values depends on the duration of the measurement (averaging). The standard setting is 20 ms, but this can be changed by the user with the _GETVEL command. It is sufficient to call up the command once in order to work with another measuring period from then on. Thus, the command:

var = _GETVEL 100

sets the duration of the measurement to 100 ms, so that you have a considerably better resolution of the speed with AVEL / MAVEL, however, in contrast, quick changes are reported with a delay of a maximum of 100 ms.

Summary

Queries actual velocity of the master

Syntax

res = MAVEL

Return value

res = actual velocity of the master in qc/sec, the valve is signed

Command group

AVEL

Cross Index

PRINT MAVEL
/* Queries actual velocity of the master and print to PC */

MIPOS

Summary

Query last index or marker position of the master

Syntax

res = MIPOS

Return value

res = last index or marker position of the master absolute to actual zero point in qc

Description

The command MIPOS returns the last index or marker position of the master absolute to the current zero point.

The configuration of MIPOS, that is whether master-encoders index- or marker position (= controlled drive) is returned, is done with the parameter SYNCMTYPM.

NB!
The trigger signal for the marker position has to be connected mandatory to the input 1.

The position value in MIPOS is accurate to +/- 1qc. In opposite to the position information in MAPOS, which is just updated in a controller cycle of typically 1 ms, the actual position value is hardware stored in real time a buffer (in an internal processor register), when the configured signal is high. Then it will be copied in the system variable MIPOS.
If simultaneously to the marker position an interrupt is initiated (ON INT 1 GOSUB ...) and within this interrupt it is operated with MIPOS, you should use before reading of MIPOS a delay of 2 milliseconds (DELAY 2) within the interrupt subroutine. So it can be ensured, that the latched position value is already complete copied in the system variable MIPOS and that not be taken an old value.
See also sample.

Command group

I/O

Cross Index

CPOS, DEF ORIGIN, SET ORIGIN, POSA, POSR, SYNCMTYPM
Parameter: POSFACT_N (26), POSFACT_Z (23)

Syntax-Example

```
PRINT MIPOS
/* Print to the PC the last index position of the
master */
```

Sample

```
// Definition Interrupt-Handler
ON INT 1 GOSUB master_int
// Definition of IPOS-Latching on positive edge
// at input 1
SET SYNCMTYPM 2

// Start moving
CVEL 10
CSTART x(1)
// Endless-Loop
mainloop:
// ...
GOTO mainloop

SUBMAINPROG
SUBPROG master_int
    // Latching MAPOS for testing,
    // how exact it would be …
    int_mpos = MAPOS
    // Wait 2 milliseconds, to be sure,
    // that MIPOS is correct updated
    DELAY 2
    // Latching IPOS for a later handling etc.
    triggered_mpos = MIPOS
    // ....
    // ...
    PRINT “Interrupt master position: “,int_mpos
    PRINT “Triggered master position:
    “,triggered_mpos
  RETURN
ENDPROG
```

■ MOTOR OFF

The motor control can be disabled by using the MOTOR OFF command. After MOTOR OFF, the drive axis can be moved freely, as long as there is no motor brake. A monitoring of the actual position will continue to take place, i.e. the actual position (APOS) can still be queried after MOTOR OFF.

NB!
For a restart of a motion process after MOTOR OFF the command MOTOR ON must be used. Only the command ERRCLR automatically activates MOTOR ON.

Summary

turns off motor control

Syntax

MOTOR OFF

Command group

INI

Cross Index

MOTOR ON

Syntax-Example

MOTOR OFF
/* switch off controller of the axis */

Program sample

MOTOR_01.M
POS_01.M

■ MOTOR ON

The motor control can be enabled again, following a previous MOTOR OFF, by use of the MOTOR ON command. When carrying out the MOTOR ON, the commanded position is set to the actual position, i.e. the motor remains at the actual position. Thus the positioning error is reset at the execution of MOTOR ON.

Summary

turns on motor control

Syntax

MOTOR ON

NB!
The MOTOR ON command is not suitable for re-activation of position control following an error. For this purpose, the ERRCLR command is to be used.

Command group

INI

Cross Index

MOTOR OFF

Syntax-Example

MOTOR ON
/* switch on controller of the axis */

Program sample

MOTOR_01.M
POS_01.M

MOTOR STOP

By using the MOTOR STOP command, a drive in positioning, speed or synchronizing mode can be decelerated with programmed acceleration and arrested at the momentary position.

A drive arrested with this command can, at a later point, via the CONTINUE command, resume its original motion. (Exception: CONTINUE does not continue an interrupted synchronization command.)

NB!

If MOTOR STOP is executed in a subprogram or if NOWAIT is set to ON, then the next lines in the program are already processed while MOTOR STOP is being processed; the braking process runs in the background.

Therefore, in order to slow the drive down to a speed of zero it is necessary to ascertain that no new positioning command is given during braking.

Summary

stops the drive

Syntax

MOTOR STOP

Command group

CON

Cross Index

POSA, POSR, CSTART, CONTINUE, CSTOP

Syntax-Example

MOTOR STOP /* interrupt motion of the axis */

Program sample

MSTOP_01.M

MOVESYNCORIGIN

The command shifts the origin of synchronization in relation to the master. While SET SYNCPOSOFFS sets the offset position absolutely, MOVESYNCORIGIN always relates to the last one and shifts the offset position relatively. If you have to shift the offset position continually, you can prevent too large numbers or an overflow in this way.

Summary

Relative shifting of the origin of synchronization

Syntax

MOVESYNCORIGIN mvalue

Parameter

mvalue = Relative offset in relation to the Master in qc

Value range = –MLONG / SYNCFACTS (50) … MLONG / SYNCFACTS (50)

NB!

Valid for position synchronization SYNCP and position synchronization with marker correction SYNCM.

Command group

SYN

Cross Index

SET, SYNCPOSOFFS (54)

Syntax example

MOVESYNCORIGIN 1000

NOWAIT

The NOWAIT command defines the program flow for positioning commands.

When NOWAIT OFF is set, the positioning commands are carried out in their entirety, i.e. until the target position is reached, before any following commands will be executed.

When starting a positioning command with NOWAIT ON, further command procedures are continued and the positioning work takes place in the background (so to say). In the NOWAIT ON condition it is thus possible to query the momentary position, or to alter the velocity or the target position during the positioning procedure.

Summary

Wait / Do not wait after a POSA/POSR command

Syntax

NOWAIT s

Parameter

s = condition:

ON = no wait for positioning till target position is reached

OFF = wait till positioning achieved

NB!

The default condition is NOWAIT OFF, i.e. if no NOWAIT instruction is contained within a program, then the positioning procedure is carried out in its entirety before the processing of the next command is begun.

If, when in NOWAIT condition during an active positioning procedure, a further positioning command follows, then the new target position will be tracked without interruption. The HOME as well as the INDEX commands will be processed to the end in the NOWAIT ON condition, before the next command can be begun.

Command group

CON

Cross Index

WAITAX, AXEND, POSA, POSR, HOME, INDEX

Syntax-Example

```
NOWAIT ON
/* no waiting after POS-commands */
NOWAIT OFF
/* wait after POS-commands till target reached */
```

Program samples

NOWAI_01.M, MSTOP_01.M, OUT_01.M, VEL_01.M

ON APOS .. GOSUB

It is possible to call up a subprogram with the instruction ON APOS, if a specific slave position (UU) has been passed in positive or negative direction. The instruction can be useful for positioning and synchronization controls, as well as for cam controls and cam boxes. For example, in order to replace the increasing slave position in the case of open curves after each cycle by a recurring reference point.

NB!

An ON APOS interrupt can be deleted with the command ON DELETE .. GOSUB ...

Summary

Call up a subprogram when the slave position xxx is passed.

Syntax

ON sign APOS xxx GOSUB name

Parameter

sign	+	when the slave position xxx is passed in positive direction
	–	when the slave position xxx is passed in negative direction
xxx =	slave position in UU	
name =	name of the subprogram	

```
100         xxx      0
        <- - - - - -  positive direction
        - - - - - - > negative direction
```

Note

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!

During the execution of subprograms triggered by an interrupt, NOWAIT ON is set automatically.

Command group

INT

Cross Index

SUBPROG…RETURN, DISABLE.. , ENABLE, Priorities of interrupts, ON DELETE . GOSUB

Syntax Example

```
ON -APOS 800 GOSUB name
    // Call up the subroutine name when slave
    // position 800 is passed in negative direction
```

■ ON COMBIT .. GOSUB

The instruction ON COMBIT is used to call up a subprogram when Bit n of the communication buffer is set.

Summary

Call up a subprogram when Bit n of the communication buffer is set.

Syntax

ON COMBIT n GOSUB name

Parameter

n =	Bit n of communication buffer –32 <= n<=32, n!= 0
name =	name of subprogram

NB!
ON COMBIT refers to the first 32 Bits of the process data memory.

Priority

If a number of interrupts occur simultaneously, the subprogram assigned to the lowest bit is worked through first. The other interrupts will be processed afterwards. If, during an interrupt subroutine, the same interrupt occurs (exception: error interrupt), then it will be ignored and thus lost.

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of an ON COMBIT subroutine NOWAIT is set to ON.

Portability

In the case of COMOPTGET and COMOPTSEND, the offset of 2 Word is retained for compatibility reasons.

Command group

INT

Cross Index

SUBPROG…RETURN, COMOPTGET, COMOPTSEND

Syntax-Example

```
ON COMBIT 5 GOSUB test
    // set interrupt on fieldbus bit 5
```

■ ON DELETE .. GOSUB

Summary

Deletes a position interrupt ON APOS, ON MAPOS or ON MCPOS

Syntax

ON DELETE pos GOSUB name

Parameter

pos = value
name= name of subprogram

Description

The command can be used to delete an ON APOS interrupt, which is defined as follows:

ON sign APOS xxx GOSUB name

The parameter 'pos' of this command can hold any value, e.g. 0. It is not checked and has no relevance for the deletion of the interrupt. The main importance belongs to the parameter 'name', which has to hold the name of the subprogram, that was formerly defined in the ON APOS command. So, the 'ON DELETE pos GOSUB name' command deletes any (!) position interrupt, which belongs to the subprogram identified by the given name. Please see sample 1.

NB!
Only position interrupts are deleted, but no other type of interrupt.

Re-routing of an ON ... APOS ... GOSUB

It is possible to "re-route" a position interrupt to another subprogram. This does not define a new interrupt, but just modifies the subprogram, which has to be executed in case of interrupt detection. The command syntax is the same like for the ON APOS command:

ON sign APOS xxx GOSUB newname

The parameters 'sign' and 'xxx' have to be exactly the same like within the original definition. The position which is concerned is identified by these two parameters. The parameter 'newname' has to hold the updated name of the subprogram, which has to be called up in case of the interrupt takes place. Please see sample 2.

NB!
Only position interrupts can be re-routed, but no other type of interrupt .

Command group

INT

Cross Index

ON APOS … GOSUB, ON MAPOS … GOSUB, ON MCPOS … GOSUB

Syntax-Example 1

```
ON - APOS 20000 GOSUB hitinfo      // Interrupt #1
ON - APOS 10000 GOSUB hitinfo      // Interrupt #2
ON + APOS 10000 GOSUB hitinfo      // Interrupt #3
ON + APOS 0     GOSUB hitzero      // Interrupt #4
ON - APOS 0     GOSUB hitzero      // Interrupt #5
ON INT 3 GOSUB hitinfo             // Interrupt #6
…
ON DELETE 0 GOSUB hitinfo
…
ON + APOS 99999 GOSUB hitinfo
    // New defined position interrupt
```

Result:

All the position interrupts (#1, #2, #3) belonging to the subprog hitinfo are deleted as soon as 'ON DELETE 0 GOSUB hitinfo' is executed. These interrupts don't count anymore for the maximum number of available interrupts and can not be enabled or disabled anymore. All other non-position interrupts, even the ones belonging to the same subprogram (e.g. ON INT 3) are still valid!

As soon as the command line 'ON + APOS 99999 GOSUB hitinfo' is executed, this defines a new position interrupt, which is "linked" to the given subprogram (that has been already in use before).

Syntax-Example 2

```
ON - APOS 10000 GOSUB hitinfo      // Interrupt #1
ON + APOS 10000 GOSUB hitinfo      // Interrupt #2
…
ON + APOS 10000 GOSUB hitposdir
    // Re-routed interrupt #2
```

Result:

As soon as the second definition of the 'ON + APOS 10000 …' is executed, the interrupt #2 is "re-routed" to the newly defined subprogram 'hitposdir'. It is still the same interrupt (i.e. not an additional one), which calls up another subprogram now. The "old" definition of interrupt #1 'ON - APOS 10000 GOSUB hitinfo' is still valid without any modification.

■ ON ERROR GOSUB

By using the ERROR GOSUB instruction, a subroutine will be defined, which can be called up in case of error. If an error occurs after the definition, then an automatic program abort will not take place – instead, the defined subroutine will be called up. Within this subroutine, it is possible to target the reaction to the error, to wait for user intervention via ERRCLR (clear error) or, in the case of non-correctable errors, to abort the program via the EXIT instruction.

If the program is not aborted, then the processing will continue from the point where the interruption occurred.

By using the CONTINUE command, it is possible to continue the error-interrupted motion. (Exception: synchronization commands)

Summary

Definition of an error subroutine

Syntax

ON ERROR GOSUB name

Parameter

name = name of the subroutine

Priority

Error subroutines cannot be interrupted through any other interrupts.

Peculiarities

The ON ERROR GOSUB instruction should be at the start of a program, so that it has validity for the entire program.

The subroutine to be called up must be defined within the identified SUBMAINPROG and ENDPROG program.

The identification of an error condition and the call up of the corresponding subroutine requires a maximum of 2 milliseconds.

NB!
During the execution of an error routine NOWAIT is automatically set to ON.

If the error subroutine is exited with the error still active because e.g. ERRCLR was not carried out or another error has occurred, then a new call takes place.

NB!
The ON ERROR GOSUB xx routine does not terminate the HOME and INDEX command. This means they will be executed after the error has been cleared. To prevent this an ON TIME 1 can be included in the error routine.

Command group

INT

Cross Index

SUBPROG…RETURN, ERRCLR, ERRNO, CONTINUE, EXIT

Syntax-Example

```
ON ERROR GOSUB errhandle
/* definition of an error subroutine */
command line 1
command line n
SUBMAINPROG
/* subroutine errhandle must be defined */
SUBPROG errhandle
command line 1
command line n
RETURN
ENDPROG
```

Program sample

ERROR_01.M
IF_01.M, INDEX_01.M

■ ON INT .. GOSUB

By using the ON INT GOSUB instruction, a subroutine must be defined which will be called up when an edge is detected at the monitored input.
A maximum of one subroutine per input can be defined. It is not possible to define an interrupt for the falling and the rising edges of the same input
This definition can take place at any time. If, following this definition, a corresponding interrupt occurs, then the accompanying subroutine is called up and processed. After the last subroutine command (RETURN), the program will continue from the point of interrupt.

Summary

Defining an interrupt input

Syntax

ON INT n GOSUB name

Parameter

n = number of the input to be monitored;
(input area –8 … 8
and VLT inputs 16 … 33 and –33 …–16)
positive input numbers (1 … 8) =
reaction to the rising edge
negative input numbers (–1 … 8) =
reaction to the falling edge
name = subroutine name

Priority

If a number of interrupts occur simultaneously, the subprogram assigned to the lowest bit is worked through first. The other interrupts will be processed afterwards. If, during an interrupt subroutine, the same interrupt occurs (exception: error interrupt), then it will be ignored and thus lost.

Peculiarities

The ON INT GOSUB instruction should be at the start of the program, so that it has validity for the entire program.
The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.
The identification of an interrupt and the call up of the corresponding subroutine requires a maximum of 2 milliseconds. Interrupt from VLT input add additional 2 ms, in worst case.
A minimal signal length of 1 msec is necessary for the sure identification of a level change! The chapter input/output terminal contain more information concerning the input circuit and input technical data.

NB!
The instruction for ON INT GOSUB is edge and not level triggered.

NB!
During the execution of a subroutine called by an interrupt NOWAIT is automatically set to ON.

Command group

INT

Cross Index

SUBPROG...RETURN, ON ERROR GOSUB, WAITI

Syntax-Example

```
ON INT 4 GOSUB posin
/* Definition of Input 4 (positive edge) */
ON INT -5 GOSUB negin
/* Definition of input 5 (negative edge) */
   command line 1
   command line n
subroutine must be defined
SUBMAINPROG
SUBPROG posin
   command line 1
   command line n
RETURN
SUBPROG negin
   command line 1
   command line n
RETURN
ENDPROG
```

Program sample

ONINT_01.M
DELAY_01.M, GSVEL_01.M

■ ON MAPOS .. GOSUB

It is possible to call up a subprogram with the instruction ON MAPOS, if a specific master position (MU) has been passed in positive or negative direction. For example, in order to set an output at any point in the case of a linear drive (slave) with a traversing range from 0 to 10000 UU.

NB!
An ON MAPOS Interrupt can be deleted with the command ON DELETE .. GOSUB ...

Summary

Call up a subprogram when the master position xxx (MU) is passed.

Syntax

ON sign MAPOS xxx GOSUB name

Parameter

sign = + when the master position xxx is passed in positive direction
– when the master position xxx is passed in negative direction
xxx = master position in MU
name = name of the subprogram

```
100        xxx     0
        <- - - - - -  positive direction
         - - - - - -> negative direction
```

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of subprograms triggered by an interrupt, NOWAIT ON is set automatically.

Command group

INT

Cross index

SUBPROG...RETURN, DISABLE ENABLE, Priorities of interrupts, ON DELETE .. GOSUB

Syntax Example

```
ON +MAPOS 1200 GOSUB name
    // Always call up subprogram at position 1200
```

■ ON MCPOS .. GOSUB

It is possible to call up a subprogram with the instruction ON MCPOS which is typical for cam controls if a specific master position (MU) has been passed in positive or negative direction. This allows not only the realization of cam boxes, but also the execution of tasks that are much more complex. For example, one could change parameters online depending on the position.

Summary

Call up a subprogram when the master position xxx (MU) is passed.

Syntax

ON sign MCPOS xxx GOSUB name

Parameter

sign =	+	when the master position xxx is passed in positive direction
	–	when the master position xxx is passed in negative direction
xxx =	master position in MU	
name =	name of the subprogram	

```
100        xxx     0
        <- - - - - -  positive direction
         - - - - - -> negative direction
```

NB!
A DEFMCPOS or a SETCURVE must always be placed in front of the command ON MCPOS .. GOSUB, since otherwise the curve position is not known.

NB!
An ON MCPOS Interrupt can be deleted with the command ON DELETE .. GOSUB ...

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of subprograms triggered by an interrupt, NOWAIT ON is set automatically.

Command group

INT

Cross index

SUBPROG…RETURN, DISABLE ENABLE, Priorities of interrupts, ON DELETE… GOSUB

Syntax Example

Cardboard boxes are transported irregularly on a conveyor belt. By setting an output, the slave will always be started when the position xxx is reached.

```
ON +MCPOS 4500 GOSUB output
                  // call subprogramm output
                  // always on position 4500
SUBMAINPROG       // set subprogram output
SUBPROG output
  OUT 3 1         // 03 on
RETURN
ENDPROG
ON +MCPOS 4500 GOSUB output
                  // call subprogramm output
                  // always on position 4500
```

■ ON PARAM .. GOSUB

The instruction ON PARAM can be used to respond when parameters are altered via the VLT display and to call up a subprogram.

Summary

Call up a subprogram when a parameter is altered.

Syntax

ON PARAM n GOSUB name

Parameter

n =	701 … 779
name =	subroutine name

Priority

If, during an interrupt subroutine, the same interrupt occurs (exception: error interrupt), then it will be ignored and thus lost.

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

A maximum of 10 ON PARAM functions are possible.

NB!
During the execution of a subroutine called by an interrupt NOWAIT is automatically set to ON.

Command group

INT

Cross Index

SUBPROG…RETURN

Syntax-Sample

```
LINKAXPAR POSERR 712 „position error“ 300 5000
0
ON PARAM 712 GOSUB poserr
// when position error is changed
SUBMAINPROG
SUBPROG poserr
   PRINT „New position error:   „, GET POSERR
RETURN
```

■ ON PERIOD

With ON PERIOD it is possible to call up a subprogram at regular intervals (time triggered). ON PERIOD works like an interrupt. It is checked every 20 ms.

Summary

calls up a subroutine at regular intervals

Syntax

ON PERIOD n GOSUB name

Parameter

n > 20 ms	= time in ms, after which the subroutine is called up again
n = 0	= switch off the function

NB!
The precision with which the time is kept depends on the remaining program. Typically the precision is ±1 ms.

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of an ON PERIOD subroutine NOWAIT is set to ON.

Command group

INT

Cross Index

ON TIME, GOSUB

■ ON STATBIT .. GOSUB

The instruction ON STATBIT is used to call up a subprogram when bit n of the VLT status is set. These 32 bits of the VLT status consist of the VLT status word, the byte 2 of the internal status (e.g. MOVING) and the bit n of SYNCSTAT.

Summary

Call up a subprogram when bit n of the VLT status is set.

Syntax

ON STATBIT n GOSUB name

Parameter

n = Bit n of the VLT status
Bit 1…16 VLT status word
Bit 17…24 Byte 2 of the internal status:
Bit 17 = MOVING
Bit 18 = Overflow Slave Encoder
Bit 19 = Overflow Master Encoder
Bit 20 = POSFLOAT active *)
Bit 25…32 SYNCSTAT
Bit 25 = SYNCREADY
Bit 26 = SYNCFAULT
Bit 27 = SYNCACCURACY
Bit 28 = SYNCMMHIT
Bit 29 = SYNCSMHIT
Bit 30 = SYNCMMERR
Bit 31 = SYNCSMERR
name = subroutine name

*) Explanation: i.e. the axis is within the tolerance range of the control window REGWINMAX / REGWINMIN. As soon as the control window is set, the axis controller is switched on again.

Priority

If a number of interrupts occur simultaneously, the subprogram assigned to the lowest bit is worked through first. The other interrupts will be processed afterwards. If, during an interrupt subroutine, the same interrupt occurs (exception: error interrupt), then it will be ignored and thus lost.

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of a subroutine called by an interrupt NOWAIT is automatically set to ON.

Command group

INT

Cross Index

SUBPROG…RETURN

Syntax-Example

```
ON STATBIT 30 GOSUB markererror
/* Interrupt, if error flag Master */
SUBMAINPROG
   SUBPROG markererror
   SYNCSTATCLR 32
   /* clear error flag SYNCMMERR */
   /* use value 32 of Parameter SYNCSTATCLR,
   not the bit-number! */
RETURN
ENDPROG
```

■ ON TIME

After expiration of the time set the corresponding subroutine is called up. In the meantime the program flow continues normally.

Summary

One-time access of a subroutine

Syntax

ON TIME n GOSUB name

Parameter

n =	time in ms, after which the subroutine is called up (maximum MLONG)
name =	name of the subroutine

NB!
The precision with which the time is kept depends on the remaining program. Typically the precision is ±1 ms.

Peculiarities

The subroutine to be called up must be defined within the SUBMAINPROG and ENDPROG identified program.

NB!
During the execution of an ON TIME subroutine NOWAIT is set to ON.

Command group

INT

Cross Index

ON PERIOD, GOSUB

Syntax-Example

```
OUT 1 1            /* light on */
ON TIME 200 GOSUB off1
/* light off again after 200 ms */
SUBMAINPROG
SUBPROG off1
OUT 1 0
RETURN
ENDPROG
```

■ OUT

The 8 digital outputs of the SyncPos option and the 2 relay outputs of the VLT5000 can be set and reset by using the OUT command.

Summary

Set or reset digital outputs

Syntax

OUT n s

Parameter

n = output number
SyncPos option: O1 ... O8
Relay O1 = 11
Relay O4 = 14
s = condition (0 = OFF, 1 = ON)

NB!
After switching on the system, all outputs are OFF.

These outputs, which have pre-defined functions according to the I/O parameter settings, will also be influenced by the OUT commands! The actual output status remains as it is, even after program end or program abort. The output circuit and maximum load current can be taken from the chapter input/output terminal and the VLT5000 manual.

Command group

I/O

Cross Index

OUTB, IN, INB

Syntax-Example

```
OUT 3 1          /* 03 on */
OUT 6 0          /* 06 off */
```

Program sample

OUT_01.M

OUTAN

The OUTAN command can set VLT bus reference (speed or torque reference depending on setting of VLT parameter 100).

NB!
The command MOTOR OFF must be executed previously. Thus, monitoring of the position error is no longer active.

With OUTAN it is also possible to turn off the controller in OPEN LOOP using MOTOR OFF and to operate the VLT without return as a pure frequency converter. In this manner you can use SyncPos to directly output set values, to read inputs, etc.

Summary

sets speed reference

Syntax

OUTAN v

Parameter

v = speed reference
range: –0X4000 … 0X4000 = –100 % … 100 %

NB!
Remember that with older versions a different scale may exist.

Command group

I/O

Cross Index

MOTOR OFF
Chapter input/output terminal; VLT5000 manual

Syntax-Example

```
MOTOR OFF
OUTAN 0X2000  /* set speed reference 50 % */
```

OUTB

With the OUTB command the condition of the digital outputs can be changed byte-by-byte. The byte value transferred determines the condition of the individual outputs. The bit with the lowest value in the byte corresponds to the set condition of output 1.

Summary

Alteration of the condition of a digital output byte

Syntax

OUTB n v

Parameter

n = output byte (0 = O1 ... O8)
v = value (0 ... 255)

NB!
After switching on the system, all outputs are OFF. Outputs which have pre-defined functions according to the I/O parameter settings, will also be influenced by the OUTB command! The actual output status remains as it is even after program end or program abort. Output circuit and maximum load current see chapter input/output terminal.

Command group

I/O

Cross Index

OUT, IN, INB

Syntax-Example

```
OUTB 0 10
/* switch through outputs 2 and 4, disable other
outputs */
OUTB 0 245
/* disable outputs 2 and 4, switch through all other
outputs */
OUTB 0 128
/* switch through output 8 only, disable others */
```

Program sample

OUTB_01.M

OUTDA

With the OUTDA command it is possible to control the analogue and digital outputs of the VLT control card.

VLT5000 has two configurable outputs that can be analogue or digital, they are configured via parameter 319 (output 42) and parameter 321 (output 45).

VLT5000Flux has two analogue outputs (output 42 configured in parameter 319 and output 45 configured in parameter 321) and two digital/pulse outputs (output 26 configured in parameter 341 and output 46 configured in parameter 355).

A VLT control card output can only be controlled from the application program when it is configured as option output in the appropriate parameter.

Summary

Sets VLT output

Syntax

OUTDA no value

Parameter *VLT5000*

```
no    = output number (42 or 45)
value = if parameter 319/321 =
        "Option digital": value = 0 or 1
           0 = output low (0 V)
           1 = output high (24 V)
      = if parameter 319/321 =
        "Option 0…20 mA": then value = 0…100000
              corresponding to 0…20 mA
        "Option 4…20 mA": then value = 0…100000
              corresponding to 4…20 mA
        "Option 0…32 kHz": then value = 0…100000
              corresponding to 0…32 kHz
```

Parameter *VLT5000Flux*

```
no    = output number (26, 42, 45 and 46)
value = if parameter 319/321 (output 42/45) =
        "Option 0…20 mA": then value = 0…100000
           corresponding to 0…20mA
        or
        "Option 4…20 mA": then value = 0…100000
              corresponding to 4…20 mA
        or
      = if parameter 341/355 (output 26/46) =
        “Option digital”: then value = 0 or 1
           0 = output low (0 V)
           1 = output high (24 V)
        or
        "Option 0…50 kHz": then value = 0…100000
           corresponding to 0…50 kHz
```

Command group

I/O

Cross Index

VLT parameter 319, 321, 341 (only Flux) and 355 (only Flux)

Syntax-Example

```
OUTDA 42 5000    // set analog output to 10 mA
                 // condition: parameter 319 is
                 // set to "option 0…20 mA"
```

PCD

You can directly access the fieldbus data area with the command PCD without an additional command COMOPTGET or COMOPTSEND. The communications memory is written or read word by word (16-Bit).

Summary

Pseudo array for direct access to the fieldbus data area

Syntax

PCD[n]
n = index

Command group

Communication option

Cross Index

SYSVAR

Syntax-Example

```
Variable = PCD[1]       // Word 1
Variable = PCD[1].2     // Bit 2 of Word 1
Variable = PCD[2].b1    // Byte 1 of Word 2
PCD[1] = Variable
PCD[1].3 = Variable
```

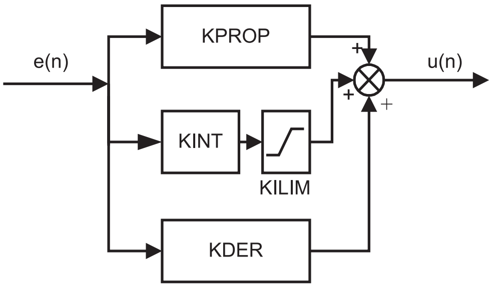
Program sample

```
_IF (PCD [2] ==256) THEN    // compare value
_IF (PCD [3].2) THEN   // is bit 2 of PCD3 high?
```

PID

A PID filter can be calculated with this function. The PID filter works according to the following formula:

$u(n) = (k_p * e(n) + k_d*(e(n)\text{-}e(n-1)) + k_i*\Sigma e(n)) /$ timer



where the following is true:

e(n)	error occurring at time n
k_p	proportional factor of the PID control
k_d	derivative factor
k_i	integral factor (limited by Integration Limit)
Timer	controller sample time

The corresponding factors can be set with the following commands:

```
SET PID KPROP 1       /* set kp 1 */
SET PID KDER 1 /* set kd 1 */
SET PID KINT 0        /* set ki 0 */
SET PID KILIM 0 /* Integration limit 0 */
SET PID TIMER 1       /* Sample time = 1 */
```

The following syntax examples which also show the default allocation of the factors.

Summary

calculates PID filter

Syntax

u(n) = PID e(n)

Parameter

e(n) = actual deviation (error) for which the PID filter should be used

Return value

u(n) = result of the PID calculation

Command group

I/O

Syntax-Example

```
e = INAD 53
u = PID e
PRINT “input = “,e, “output = “,u
```

POSA

The axis can be moved to a position absolute to the actual zero position.
When the POSA command exceeds the software limit switch NEGLIMIT (4) or POSLIMIT (5) the program continue with the next command after an error.

Summary

Positioning in relation to actual zero point

Syntax

POSA p

Parameter

p = Position in user units (UU) absolute to the actual zero point; the UU corresponds in the standard setting the number of Quadcounts.

NB!
If a temporary zero point, set via SET ORIGIN, exists and is active, then the position result refers to this zero point.

NB!
If an acceleration and/or velocity has not been defined at the time of the POSA command, then the procedure will take place with the values of parameter DFLTVEL (33) and DFLTACC (34).

Command group

ABS

Cross Index

VEL, ACC, POSR, HOME, DEF ORIGIN, SET ORIGIN
Parameter: POSFACT_N (26), POSFACT_Z (23)

Syntax-Example

```
POSA 50000      /* move axis to position 50000 */
```

Program sample

POS_01.M

■ POSA CURVEPOS

This command acts like POSA and moves the slave to the corresponding position on the curve, which is given by the actual master position.

Summary

Move slave to the curve position corresponding to the master position

Syntax

POSA CURVEPOS

NB!

If a temporary zero point, set via SET ORIGIN, exists and is active, then the position result refers to this zero point.

NB!

If an acceleration and/or velocity has not been defined at the time of the POSA command, then the procedure will take place with the values of parameter DFLTVEL (33) and DFLTACC (34).

Command group

ABS, CAM

Cross Index

CURVEPOS, SET ORIGIN

Syntax example

```
POSA CURVEPOS
    // Move slave to the curve position
    // corresponding to the master position
```

■ POSR

The axis can be moved to a position relative to the actual position by use of the POSR command.

Summary

Positioning in relation to actual position

Syntax

POSR d

Parameter

d = distance to actual position in user units (UU); this corresponds in the standard setting for the number of Quadcounts.

NB!

If acceleration and/or velocity has not been defined at the time of the POSR command, then the procedure will take place with the values of parameter DFLTVEL (33) and DFLTACC (34).

Command group

REL

Cross Index

VEL, ACC, POSA

Parameter: POSFACT_N (26), POSFACT_Z (23)

Syntax-Example

```
POSR 50000      /* move axis relative 50000 UU */
```

Program sample

POS_01.M

PRINT

Calculation results, variables contents and text information can be displayed on the connected PC via the RS485 communication interface by use of the PRINT command, if the SyncPos software is open and the connection active.
To obtain multiple data with a single PRINT command, the individual elements must be separated with a comma (,). Text information must be given in quotation marks (“).
A line feed is normally created following each PRINT instruction. This automatic line feed can be suppressed with a semi-colon (;) after the last output element.

Summary
Information output

Syntax
PRINT i or PRINT i;

Parameter
i = information, for example, variables, text, CHR (n) separated by commas. The CHR command returns the ASCII characters corresponding to a certain number.

NB!
If there is no PC connected all prints are acted as a dummy output. But if a PC sends a XOFF because it is busy or the serial communication is not connected the messages are buffered. When the buffer is full, the next print command will wait until the buffer can be written again. That means, that the program stands still.

Command group
I/O

Cross Index
INKEY

Syntax-Example
```
PRINT “Information is important !”
/* print text information */
PRINT “Information is important !”;
/* print information without line feed */
variable = 10
PRINT variable  /* print contents of variables */
PRINT APOS      /* print returned value function */
PRINT “Variable“, variable,“Pos.:",APOS
/* print mixed information */
```

Program sample
Uses – see all program samples in Online Help

PULSACC

With PULSACC it is possible to set the acceleration/deceleration for the virtual master (encoder output).
The virtual master signal simulates an encoder signal. To calculate the pulse acceleration PULSACC the parameters ***Encoder resolution***, master velocity and the ramp times must be taken into consideration.
Example:
The virtual master signal should correspond to an encoder signal of 1024 counts/revolution. The maximum speed of 25 encoder revolutions/s should be achieved in 1 s.

$$\text{PULSACC} = \frac{\Delta \text{ pulse velocity (PULSVEL) [Hz]}}{\Delta \text{ t[s]}}$$

$$= \frac{25 \frac{\text{counts}}{\text{s}} \cdot 1024 \text{ counts/turn}}{1 \text{ s}}$$

$$= 25600 \frac{\text{counts}}{\text{S}^2} \quad = 25600 \frac{\text{Hz}}{\text{S}}$$

The signals generated are evaluated simultaneously as master input so that MAPOS, MIPOS etc. function as they would in an external master.

PULSACC = 0 is the condition for switching off the virtual master mode, provided it is followed by a PULSVEL command.

NB!
Changes in the acceleration in PULSACC are only valid after the next PULSVEL command.

Summary
Set acceleration for the virtual master

Syntax
PULSACC a

Parameter
a = acceleration in Hz/sec

Command group
SYN

Cross Index
PULSVEL

PULSVEL

With PULSVEL it is possible to set the velocity for the virtual master (encoder output).

The virtual master signal simulates an encoder signal. To calculate the pulse velocity the parameters ***Encoder resolution*** and master velocity must be taken into consideration.

Example:

The virtual master signal should correspond to an encoder signal of 2048 counts /revolution within a encoder speed of 50 revolutions/sec.

$$\text{PULSVEL} = \text{encoder counts per turn} \cdot \frac{\text{turns}}{\text{s}}$$

$$= 2048 \cdot 50\ \text{Hz} = 102400\ \text{Hz}$$

Summary

Set the velocity for the virtual master

Syntax

PULSVEL v

Parameter

v = velocity in pulses per second (Hz)

Command group

SYN

Cross Index

PULSACC

REPEAT .. UNTIL ..

The REPEAT..UNTIL construction enables any number of repetitions of the enclosed program section, dependent on abort criteria. The abort criteria consist of one or more comparative procedures and are always checked at the end of a loop. As long as the abort criteria are not fulfilled, the loop will be processed repeatedly.

Summary

Conditional loop with end criteria
(Repeat ... until condition fulfilled)

Syntax

REPEAT
UNTIL condition

Parameter

condition = Abort criteria

NB!
Because the abort criteria are checked at the end of the loop, the commands within the loop will be carried out at least once. To avoid the possibility of an endless loop, the processed commands within the loop must have a direct or indirect influence on the result of the abort monitoring.

Command group

CON

Cross Index

LOOP, WHILE .. DO .. ENDWHILE

Syntax-Example

```
REPEAT                  /* start loop */
command line 1
command line n
UNTIL (A != 1)          /* Abort condition */
```

Program sample

REPEA_01.M
DIM_01.M, ONINT_01.M, OUT_01.M, INKEY_01.M

RST ORIGIN

A previously with SET ORIGIN set temporary zero point can be erased by use of the RST ORIGIN command. This means that all the following absolute positioning commands (POSA) again refer to the real zero point.

Summary

Erase temporary zero point

Syntax

RST ORIGIN

Command group

INI

Cross Index

SET ORIGIN, DEF ORIGIN, POSA

Syntax-Example

```
RST ORIGIN      /* reset temporary zero point */
```

Program sample

TORIG_01.M, OUT_01.M, VEL_01.M

SAVE part

Summary

Save arrays, current axis parameters or global parameters in the EEPROM

Syntax

```
SAVE part
part =    ARRAYS
          AXPARS
          GLBPARS
```

Description

If you alter array elements, axis parameters while the program is running you can save the altered values in the EEPROM with SAVE ARRAYS. To save the range of global parameters and user parameters (130–229) individually in the EEPROM, use the command SAVE GLBPARS.

NB!
The EEPROM can only handle execution of this command up to 10000 times

Command group

INI

Cross Index

DELETE ARRAYS, SAVEPROM

SAVEPROM

Summary

saves memory in EEPROM

Description

When changing array elements or user parameters (130–229) while the program is running SAVEPROM offer the possibility of saving the values which have been changed. This must be done by triggering the command SAVEPROM explicitly.
SAVEPROM triggers the same process, which can also be started in the menu "CONTROLLER".
If you want to save only array elements or only global and user parameters, use the commands SAVE ARRAY and SAVE GLBPARS.

NB!
The execution time of SAVEPROM depends on the amount of data to be saved. It can be up to 4 seconds.

NB!
Please note that AXE parameters are not saved by SAVEPROM. To do this you must use the command SAVE AXPARS.

NB!
The EEPROM can only handle execution of this command up to 10000 times

Command group

INI

Syntax-Example

```
PRINT “please wait”
SAVEPROM
PRINT “Thanks”
```

■ SET

With the SET command certain axis and global parameters can be temporarily changed while the program is running.
The parameter codes permitted can be found in the respective overviews of the Parameter reference in the left-hand column, for example, KPROP (11) for the ***Proportional factor,*** KDER (12) for the ***derivative factor*** or POSERR (15) for the ***Tolerated position error.*** Sample for global parameters: SET PRGPAR (102) for the ***Activated program number*** and SET I_BREAK (105) for the ***Input for abort.***

Summary

sets a parameter

Syntax

SET par v

Parameter

par = Parameter identification
v = parameter value

NB!
The parameter alterations are only valid while the program is running. After program end or abort, the original parameter values are valid again.
The parameter alterations can be made permanent by using the command SAVEPROM.

Command group

PAR

Cross Index

GET
Parameter-reference

Syntax-Example

```
SET POSLIMIT 100000
/* set positive positioning limit */
SET KPROP 150
/* change proportional factor */
```

Syntax-Example

```
SET KPROP 150
/* change proportional factor */
```

■ SETCURVE

This command defines the actual used curve, which is described in *array.* This command has to be used, before you can use the commands CURVEPOS, SYNCCxx, SYNCCSTART or SYNCCSTOP.
When this command is executed, the necessary pre calculations are done.

Summary

Set CAM curve

Syntax

SETCURVE array

Parameter

array = name of the array or of the curve

NB!
The DIM instruction with the name of the curve or array and the number of array elements must stand in front of the command SETCURVE or at the beginning of the program. If there are several arrays or curves in the cnf file, then the order in the DIM instruction must match the order of the arrays in the cnf file.

NB!
If SYNCC is not active:
If SETCURVE is used while SYNCC is not active, then SETCURVE will reset the curve master position depending on the actual master position. That means, CMASTERCPOS (SYSVAR 4230) is calculated out of MAPOS. This Position is not longer reset by SYNCC. This Position can only be reset by a DEFMCPOS or by a new SETCURVE outside of SYNCC-mode.
If SYNCC is active:
If SETCURVE is used while SYNCC is active, the CMASTERCPOS will not be changed.
All other parameters like POSFACT_N, POSFACT_Z, SYNCMSTART, SYNCMARKM, SYNCMARKS, SYNCMPULSM, SYNCMPULSS, SYNCMWINM, SYNCMWINS, and all Curve-Array Information will be updated, after the next restart of the curve.
While SYNCC is active, the only way to influence the CMASTERCPOS is an DEFMCPOS (which is executed with next restart of curve) or MOVESYNCORIGN which is executed immediately.
CMASTERCPOS (SYSVAR) and CURVEPOS are now updated even if SYNCC is no longer active. We start to update these values after a SETCURVE command (if SYNCMSTART is < 2000) or after SYNCC and the first master marker (if SYNCMSTART = 2000).
After the SYNCC command is stopped, we continue to update these values if SYNCMSTART < 2000.

Command group

PAR

Portability

Update of CMASTERCPOS in dependence of SYNCC up option card version 4.50 onwards.

Cross Index

DIM, CMASTERCPOS, CURVEPOS

Syntax example

```
DIM curve [280]
    // See number of elements in the title bar
    // of the CAM-Editor
SETCURVE curve
```

SETMORIGIN

With the SETMORIGIN command you can set any position as the new zero point for the master.

Summary

Set any position as the zero point for the master.

Syntax

SETMORIGIN value

Parameter

value = absolute position

NB!
The command SETMORIGIN cancels the command DEFMORIGIN.

NB!
Thus, to alter the zero point for the master again, you have to reset it with SETMORIGIN or DEFMORIGIN. RST ORIGIN does not have any effect on the zero point for the master.

Command group

INI

Cross Index

DEFMORIGIN, MAPOS

Syntax-Example

```
SETMORIGIN 10000
/* Set the zero point for the master at 10000 */
```

SET ORIGIN

Any absolute position can temporarily be set as a new reference point for absolute positioning command (POSA) by use of the SET ORIGIN command. This position is called temporary zero point. In combination with the command CURVEPOS, one can fix in this way that the current slave position matches the corresponding value of the curve.

Summary

Set absolute position as temporary zero point

Syntax

SET ORIGIN p

Parameter

p = absolute position in relation to the real zero point

NB!
It is possible to carry out several SET ORIGIN commands without out a previous RST ORIGIN. The absolute position value always refers to the real zero point. The last carried out SET ORIGIN command therefore determines the position of the temporary zero point in relation to the real zero point.

Command group

INI

Cross Index

RST ORIGIN, DEF ORIGIN, POSA, CURVEPOS, POSA CURVEPOS

Syntax Example

```
SET ORIGIN 50000
    // set temporary zero point to 50000
```

Syntax Example

```
SET ORIGIN (–CURVEPOS)
    // Set temporary zero to the beginning
    // of the curve
```

Program sample

TORIG_01.M
OUT_01.M, VEL_01.M

Software Reference

SETVLT

With the SETVLT command VLT parameters can be changed temporarily and thus the configuration of the VLT can also be changed temporarily.
Since only integer values can be transmitted the parameter value to be transmitted must be adjusted with the associated conversion index.
A list of the VLT parameters with the corresponding conversion index can be found in the VLT5000 manual.

Summary

sets a VLT parameter

Syntax

SETVLT par v

Parameter

par = Parameter number
v = Parameter value

NB!
The parameter alterations are only stored in RAM. After power down the original parameter values are restored.

Command group

PAR

Cross Index

GETVLT

Syntax-Example

/* change parameter 202 "maximum reference" high to 60 Hz */
–Conversion index = –3 (Multiplied with 10^3 during transmission)
SETVLT 202 60000

SETVLTSUB

With the SETVLT commands VLT parameters can be changed temporarily and thus the configuration of the VLT can also be changed temporarily, in this case parameters with index numbers too.
Since only integer values can be transmitted the parameter value to be transmitted must be adjusted with the associated conversion index.
A list of the VLT parameters with the corresponding conversion index can be found in the VLT5000 manual.

NB!
The parameter alterations are only stored in RAM. After power down the original parameter values are restored.

Summary

Sets a VLT parameter with index number

Syntax

SETVLTSUB par indxno v

Parameter

par = parameter number
indxno = index number
v = parameter value

Command group

PAR

Cross Index

GETVLTSUB

Syntax example

```
SETVLT 25 1 100
    // sets index 1 of the parameter 25
    // “Quick menu” to 100 “configuration”
    // (VLT5000Flux only)
```

■ STAT

The STAT command reports the actual status of the axis control unit as well as that of the axis. For example, whether the axis controller shuts down, ends the motion or the end switch is active. The status of the program execution cannot be called up with STAT, but only with AXEND.

The status consists of a total of four bytes.

Summary

Query axis and control status

Syntax

res = STAT

Return value

res = Axis- and Control status (4-Byte value):

Byte 3	MSB	
	Bit 0	1 = MOVING
	Bit 1	1 = OVERFLOW Slave Encoder
	Bit 2	1 = OVERFLOW Master Encoder
	Bit 3	1 = POSFLOAT active *)
Byte 2	Status byte of axis control	
	Bit 7	1 =axis control switched off
	Bit 2	1 =position reached
	Bit 0,1,3-6	has no meaning
Byte 1	not used	
Byte 0	LSB	
	Bit 7	1 =limit switch active
	Bit 6	1 =Reference switch active
	Bit 2	1 =axis control switched off
	Bit 0,1,3,4	not in use

*) Explanation: i.e. the axis is within the tolerance range of the control window REGWINMAX / REGWINMIN. As soon as the control window is set, the axis controller is switched on again.

Command group

I/O

Cross Index

AXEND

Syntax-Example

```
PRINT STAT              /* print status word */
```

Program sample

STAT_01.M

■ SUBMAINPROG .. ENDPROG

The code word SUBMAINPROG begins the subroutine section, and the code word ENDPROG ends this specific program. The term subroutine means command sequences that, via the GOSUB instructions, can be called up and executed from various program positions.

All necessary subroutines must be contained within the subroutine section. It is possible to insert a subroutine anywhere within a main program; however, for reasons of clarity, it is advisable to insert it either at the beginning or end of a program.

Summary

Subroutine section definition

Syntax

SUBMAINPROG

ENDPROG

NB!

Only one subroutine area may be inserted within a program.

Command group

CON

Cross Index

SUBPROG ...RETURN,
GOSUB, ON ERROR GOSUB, ON INT n GOSUB

Syntax-Example

```
SUBMAINPROG
 /* Begin the subroutine section */
subroutine 1
subroutine n
ENDPROG/* End the subroutine section */
```

Program sample

GOSUB_01.M
AXEND_01.M, ERROR_01.M, INCL_01.M,
STAT_01.M

SUBPROG name .. RETURN

The instruction SUBPROG identifies the beginning of a subroutine. The name of the subroutine must directly follow SUBPROG code word. The name can be made up of one or more characters, and must be unique, i.e. only one subroutine may have that name. A subroutine can be called up and executed at any time by use of the GOSUB instruction.
A subroutine can have any number of command lines and can refer to all program variables. The last command in each subroutine must be the RETURN instruction, which permits exiting the subroutine and continuing the program with the command following the GOSUB instruction.

Summary

Subroutine definition

Syntax

SUBPROG name
RETURN

Parameter

name = subroutine name

NB!
All subroutines must be contained within the SUBMAINPROG and ENDPROG defined areas. It is not admissible to declare a second subroutine within an existing subroutine.

Command group

CON

Cross Index

SUBMAINPROG ... ENDPROG,
GOSUB, ON ERROR GOSUB, ON INT n GOSUB

Syntax-Example

```
SUBMAINPROG      /* begin SP-section */
SUBPROG sp1      /* begin sp1        */
command line 1
command line n
RETURN           /* end sp1          */
ENDPROG          /* end SP-section   */
```

Program sample

GOSUB_01.M, AXEND_01.M, ERROR_01.M, IF_01.M, STAT_01.M

SWAPMENC

This command allows swapping of the master and slave encoders. This is particularly meaningful if one wishes to alternately use two motors with one control.
Prior to the command SWAPMENC ON/OFF, a MOTOR OFF must always be executed in order to avoid a tolerated position error exceeded. Also, the controller parameters or axis parameters must be changed if both motors are different.
The motor leads could be switched via relay.

Summary

Swap master and slave encoder internally.

Syntax

SWAPMENC s

Parameter

s = condition
  ON = master encoder input is feedback input
  OFF = slave encoder input is feedback input

NB!
In this changeover, no positions are lost, even if the motors are moved by hand while the other motor is controlled. It is possible to always access the uncontrolled motor through MAPOS as well.

Command group

INI

Cross Index

MAPOS

Syntax Example

```
SWAPMENC ON  // Swap slave encoder internally
             // with master encoder
```

Sample

```
MOTOR OFF
OUT 1 1          // Switch motor leads
SET KPROP ...    // Change axis parameters
SWAPMENC ON      // Swap encoder internally
MOTOR ON         // Turn on control again
POSA 10000       // Move the motor which is
                 // connected to master encoder

MOTOR OFF
OUT 1 0          // Switch motor leads
SET KPROP ...    // Change axis parameters
SWAPMENC OFF     // Swapencoder
MOTOR ON         // Turn on control again
POSA 0           // Move the motor again which is
                 // connected to the slave encoder
```

■ SYNCC

The command SYNCC starts the CAM-Mode (cam control). From this moment, the curve positions of the master are counted depending on the actual master positions and the defined starting behavior in SYNCMSTART (62): Where and when counting is started. With the parameter SYNCMSTART = 2000, the curve positions of the master are only counted after the next master marker.

Summary

Synchronization in CAM-Mode

Syntax

SYNCC num

Parameter

num = number of curves to be processed
0 = the drive remains in CAM-Mode until another mode is started with commands such as MOTOR STOP, CSTART, POSA etc.

NB!
SYNCC does not start the slave drive nor does it interrupt on-going motions (e.g. CVEL), only SYNCCSTART does.

NB!
The drive remains in CAM-Mode until num curves have been processed successfully. If the synchronization (after num curves) is being closed normally, the start stop point pair 2 will be used – if no SYNCCSTOP with a corresponding point pair is defined – in order to stop the drive. It will then come to a stop at the position slavepos (see parameters).

Command Group

CAM

Cross Index

SYNCCSTART

Syntax Example

```
DIM curve [280]     // see number of elements in
                    // the title bar of CAM-Editor
SETCURVE curve      // Set curve
SYNCC
                    // Synchronization in
                    // CAM-Mode
```

■ SYNCCMM

Like SYNCC, the command SYNCCMM brings about a synchronization in CAM-Mode, but beyond that it also performs a marker correction (only if the master moves forward).

In order to save the distance between sensor and processing point, the parameter SYNCMPULSM is used. It allows the correction of the marker position without changing the curve. Also, larger sensor distances than the actual curve length are possible. In this case, a FIFO is used for the marker correction (see example).

Summary

Synchronization in CAM-Mode with master marker correction

Syntax

SYNCCMM num

Parameter

num = number of curves to be processed;
0 = the drive remains in CAM-Mode until another mode is started with commands such as MOTOR STOP, CSTART, POSA etc.

NB!
SYNCCMM does not start the slave drive nor does it interrupt on-going motions (e.g. CVEL), only SYNCCSTART does.

NB!
The drive remains in CAM-Mode until num curves have been processed successfully. If the synchronization (after num curves) is being closed normally, the start stop point pair 2 will be used – if no SYNCCSTOP with a corresponding point pair is defined – in order to stop the drive. It will then come to a stop at the position slavepos (see parameters).

Marker signal

The marker can be the zero pulse from the encoder or an external 24 volt signal:
I5 = master
I6 = slave

Command Group

CAM

Cross Index

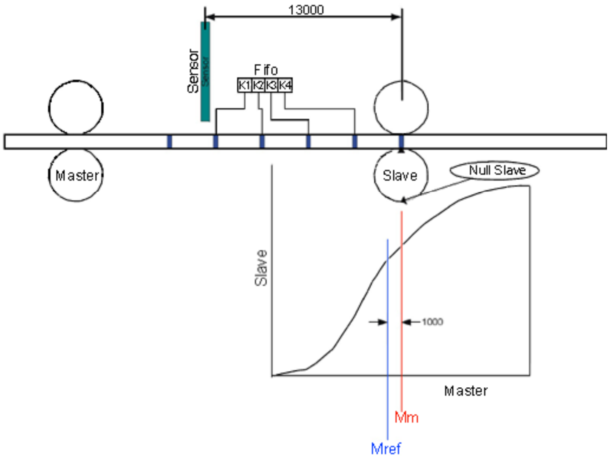
SYNCMPULSM

Syntax Example

```
SETCURVE curve
SYNCCMM 1        // Synchronize 1 x in CAM mode
                 // with marker correction
```

Sample

If for example curve length is 3000 and distance of sensor to working point is 13000, we will have a FIFO with 4 register and an offset of 1000 which has to be concerned.
See the following diagram:



SYNCCMS

Like SYNCC, the command SYNCCMS brings about a synchronization in CAM-Mode, but beyond that it also performs a marker correction of the slave. Here, the slave position is corrected, not the curve position.
In contrast to SYNCCMM, no FIFO is created.

Summary

Synchronization in CAM-Mode with slave marker correction

Syntax

SYNCCMS num

Parameter

num = number of curves to be processed;
0 = the drive remains in CAM-Mode until another mode is started with commands such as MOTOR STOP, CSTART, POSA etc.

NB!
SYNCCMS does not start the slave drive nor does it interrupt on-going motions (e.g. CVEL), only SYNCCSTART does.

NB!
The drive remains in CAM-Mode until num curves have been processed successfully.
If the synchronization (after num curves) is being closed normally, the start stop point pair 2 will be used – if no SYNCCSTOP with a corresponding point pair is defined – in order to stop the drive. It will then come to a stop at the position slavepos (see parameters).

Marker signal

The marker can be the zero pulse from the encoder or an external 24 volt signal:
I5 =master; I6 = slave

Command Group

CAM

Syntax Example

```
SETCURVE curve
SYNCCMS 0        // Synchronization in CAM-Mode
                 // with slave marker correction
```

SYNCCSTART

The command starts the movement of the slave. With *pnum*, the point pair is selected that determines in which master position the synchronization begins and where it should be finished.

When moving forward, the synchronization begins at point A and is finished up to point B. When moving backward, it begins at point B and is finished up to point A.

Summary

Start slave for synchronization in CAM-Mode

Syntax

SYNCCSTART pnum

Parameter

pnum =Start stop points number

pnum > 0 Engaging begins when the corresponding point A is reached, provided the master moves in positive direction; the engage curve is finished at point B. If point A and B are identical, the slave will be engaged with the set maximum velocity – i.e. without curve – as soon as the master has reached this point.

pnum = 0 The slave will be engaged immediately with the set maximum velocity. It does not matter in what direction the master moves or whether it moves at all.

pnum < 0 Again, the corresponding point pair is used, however, engaging begins at point B and is finished at point A, i.e. in negative direction.

Command Group

CAM

Syntax Example

```
SETCURVE curve
SYNCC 0          // CAM mode synchronization
SYNCCSTART 1 // Engage slave at point A from
                 // start stop point pair 1
```

SYNCCSTOP

This command stops synchronization without leaving SYNCC mode. The slave will be disengaged according to the point pair defined in pnum. Only then will the slave actually be stopped. When the stop point has been reached, the slave must be at slavepos.

Summary

Stop slave after the CAM synchronization

Syntax

SYNCCSTOP pnum slavepos

Parameter

pnum =Start stop points number

pnum > 0 Engaging begins when the corresponding point A is reached, provided the master moves in positive direction; the engage curve is finished at point B. If point A and B are identical, the slave will be engaged with the set maximum velocity – i.e. without curve – as soon as the master has reached this point.

pnum = 0 The slave will be engaged immediately with the set maximum velocity. It does not matter in what direction the master moves or whether it moves at all.

pnum < 0 Again, the corresponding point pair is used, however, engaging begins at point B and is finished at point A, i.e. in negative direction.

slavepos = Position where the slave is supposed to stand after disengaging.

NB!
When moving forward, disengaging begins at point A and is finished at point B; vice versa when moving backward.

NB!
If the program is closed without SYNCCSTOP command, disengaging occurs by default with the second point pair and a stop occurs at the Slave Stop Position defined in the curve data.

Command Group

CAM

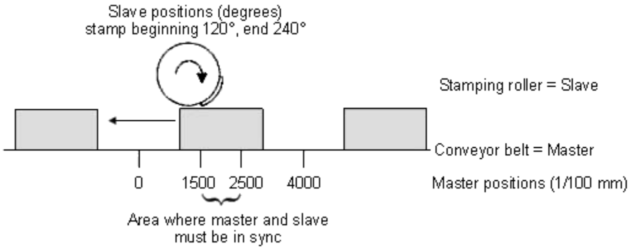
Cross Index

Curve Data, Slave Stop Position

Syntax Example

```
SETCURVE curve
SYNCC 0           // Synchronize in CAM-Mode
SYNCCSTART 1
    // Start slave with start point pair 1
SYNCCSTOP 2 0
    // Stop slave with stop point pair 2 at the
    // slave position 0 or 3600
```

Sample


Slave positions (degrees)
stamp beginning 120°, end 240°
Stamping roller = Slave
Conveyor belt = Master
0
1500
2500
4000
Master positions (1/100 mm)
Area where master and slave must be in sync

■ SYNCERR

SYNCERR returns the actual synchronization error in User Units UU. This is the distance between the actual master position (converted with drive factor and offset) and the actual position of the slave.
If the parameter SYNCACCURACY (55) is defined by a minus sign, you can also determine whether the synchronization is running ahead (negative result) or running behind (positive result).

Summary

Queries actual synchronization error of the slave.

Syntax

res = SYNCERR

Return value

res = actual synchronization error of the slave in UU and

a) as an absolute value when the value of the accuracy window is defined with a plus sign in the parameter SYNCACCURACY;

b) with polarity sign when in SYNCACCURACY the value of the window is defined with a minus sign.

NB!
Up to option card version < 5.00: SYNCERR only functions in synchronization mode. As soon as you exit SNYCM or SYNCP, the pulses are no longer counted. SYNCERR is only updated within a SYNC command.
With option card software 5.00 onwards the SYNCERR is also updated when SYNCP or SYNCM are not longer active, e.g. after a MOTOR STOP.

Command group

I/O

Cross Index

TRACKERR, MAPOS, APOS, SYNCPOSOFFS (54), SYNCMFACTM (49), SYNCMFACTS (50), SYNCACCURACY (55)

Syntax-Example

```
PRINT SYNCERR
/* query actual synchronization error of the slave */
```

■ SYNCM

The SYNCM command functions just like the SYNCP command by making a angle/position synchronization with the master, but also makes a marker correction. Thus, during the starting of synchronization the program is synchronized to the next marker calculated. In this manner it is possible to compensate for differing running behaviors, for example slippage.
Once synchronization has been completed, deviation is determined at every marker (or every n-th marker if the number of markers is not identical for the master and slave). This is input into the control as the new offset and the program immediately attempts to compensate for this. However, in doing so the values set for velocity, VEL, and acceleration, ACC or DEC are not exceeded.

Summary

angle/position synchronization with the master with marker correction

Syntax

SYNCM

Pecularities

In addition to the parameters used by SYNCP, SYNCREADY (56) and SYNCFAULT (57) are also of significance.

NB!
Since the following parameters could lead to overdefinition, it is important to ensure that these values are logical, match one another and are consistent with the information on the gear factors.
SYNCMARKM (52) and SYNCMARKS (53)
SYNCMPULSM (58) and SYNCMPULSS (59)
SYNCMTYPM (60) and SYNCMTYPS (61)

NB!
SYNCM should only be called up once since the synchronizing continues until the next motion or stop command. All additional SYNCM commands cause the synchronization to start over again from the beginning and this is not normally intended, as you reset the actual SYNCERR.

NEW
When defined in SYNCMSTART (62), the system waits for the first evaluation of the marker pulses on starting SYNCM and only then the offset SYNCPOSOFFS (54) is applied.

Marker signal

The marker can be the zero pulse from the encoder or an external 24 volt signal
(I5 = master; I6 = slave).

Command group

SYN

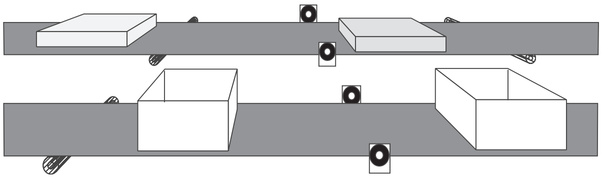
Cross Index

parameter of the AXS group

Syntax-Example

SYNCM /* synchronization of the position with marker correction */

Example



Even when both belts are running synchronously the lids may not be aligned with the boxes at the right time. With SYNCM the difference between master and slave is detected by means of the external markers and the possible position deviation is corrected.

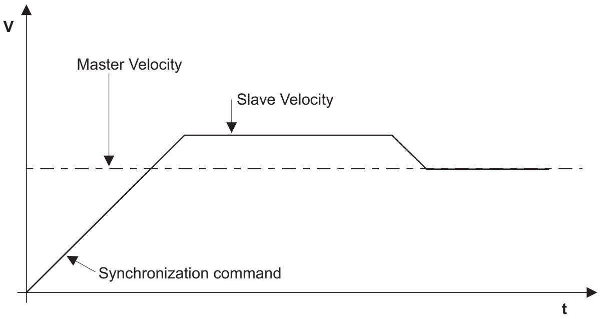
■ SYNCP

The SYNCP command completes an angle/ position synchronization with the master. In doing so the position according to the gear factors to the master is kept synchronous, that means after an external disturbance the program subsequently tries to recover the corresponding stretch. However, in doing so the values set for velocity, VEL, and acceleration, ACC or DEC are not exceeded.

The following parameters affect the behavior:

SYNCFACTM (49), SYNCFACTS (50)	gear factors
SYNCPOSOFFS (54)	position offset
SYNCACCURACY (55)	accuracy for flag
REVERS (63)	reverse behavior

During synchronization the program proceeds as follows:
When the SYNCP command is started, the actual master position is determined and is retained. From the master velocity, and in consideration of the acceleration allowed, the necessary slave velocity is calculated in order to reach the master position. The slave is accelerated so long until the calculated position has been reached or until it is close enough to the reference position to reach it.



Summary

angle/position synchronization with the master

Syntax

SYNCP

NB!
As soon as the deviation between the position of the slave and master is less than SYNCACCURACY (55), the ACCURACY flag is set.

If REVERS (63) is set so that it is not possible to drive in reverse, but for some reason the slave is further than the master (e.g. because only the master has moved in reverse) then the slave will wait at velocity 0.
In doing so the slave takes its own acceleration time into consideration and will start moving if necessary before the correct position has been reached if the master already has a higher velocity.
Instead of using this catch-up procedure it is also possible to move the slave with CVEL to approximately the same velocity as the master and then trigger SYNCP.
A change in the SYNCPOSOFFS (54) during the synchronization leads to a new synchronization procedure with ramps (see above).

NB!
SYNCP should only be called up once since the synchronizing continues until the next motion or stop command. All additional SYNCP commands cause the synchronization to start over again from the beginning and this is not normally intended, as you reset the actual SYNCERR.

Command group

SYN

Cross Index

parameter of the AXS group

Syntax-Example

```
SYNCP
    /* normal synchronization of the position */
CVEL 50
    /* achieve velocity before synchronization */
CSTART
WAITT 500
SYNCP
```

SYNCSTAT

The following flags are defined and can be queried with SYNCSTAT: READY, FAULT, ACCURACY and MHIT and MERR for both the master and the slave.

Summary

Flag to query synchronization status

Syntax

res = SYNCSTAT

Return value

res = synchronization status with the following meaning:

	Value	Bit
SYNCREADY	1	0
SYNCFAULT	2	1
SYNCACCURACY	4	2
SYNCMMHIT	8	3
SYNCSMHIT	16	4
SYNCMMERR	32	5
SYNCSMERR	64	6

SYNCACCURACY

The controller checks whether SYNCERR < SYNCACCURACY (55) is true every ms. If this is true, then SYNCACCURACY is set, otherwise the flag is deleted. This check is made for both SYNCP and SYNCM.
This flag is not used with SYNCV.
When executing a SYNCP or SYNCM command the flag is deleted.

SYNCFAULT / SYNCREADY

For every SYNCP or SYNCM command these flags are deleted. Subsequently the program checks whether SYNCACCURACY is set or not at every marker pulse of the slave (SYNCP) or when a marker pulse of the master and a marker pulse of the slave exist (SYNCM).
If it is set the ready counter is increased and the fault counter is set to 0, otherwise the fault counter is increased and the ready counter set to 0.
If the ready counter is greater than the value determined by the parameter SYNCREADY (56), then the flag SYNCREADY is set. Otherwise it is deleted.
If the fault counter is greater that the value determined by the parameter SYNCFAULT (57) then the flag SYNCFAULT is set. Otherwise it is deleted.

SYNCMMHIT / SYNCSMHIT

SYNCMMHIT and SYNCSMHIT are set, when the master marker resp. the slave marker is occurred. These flags are deleted for every SYNCM command. Subsequently the flag SYNCMMHIT is set after the first occurrence of a master marker pulse or after the n-th marker pulse (parameters SYNCMARKM 52).
The same is true for SYNCSMHIT with the slave.

SYNCMMERR / SYNCSMERR

If in the ***marker window*** SYNCMWINM (68) or SYNCMWINS (69) a tolerance range is defined, then SYNCMMERR or SYNCSMERR are set as soon as the maximum distance allowed has been achieved and no marker was identified.
Example:

Distance between two master markers
SYNCMPULSM (58) = 30000
Marker Window SYNCMWINM (68) = 1000
The flag is set at 31000 if no marker is identified.

These flags are deleted for every SYNCM command.

If the ***marker window*** is 0 and thus no tolerance range is defined, the program checks every marker pulse (or after every n-th pulse) whether the distance between the two last markers registered is less than 1.8 times the value defined by the parameter SYNCMPULSM (58). If not the corresponding flag is set.
The same applies analogously for SYNCSMERR in the slave.

NB!
These flags are automatically reset: during the next successful marker correction and in the event of a new start of SYNCM or through the command SYNCSTATCLR.

Command group

SYN

Cross Index

SYNCSTATCLR

Syntax-Example

```
IF (SYNCSTAT & 4) THEN OUT 1 1
    /* If ACCURACY then set output */
ENDIF
```

■ SYNCSTATCLR

The corresponding bits can be reset in SYNCSTAT with SYNCSTATCLR value thus resetting the error flags MERR and the HIT flags MHIT. None of the other flags can be altered.

Summary

Resetting of the flags MERR and MHIT

Syntax

SYNCSTATCLR value

The SYNCSTATCLR command should only be used in a subprogram for dealing with errors. (see ON ERROR GOSUB).

Parameter

value =	8 = SYNCMMHIT
	16 = SYNCSMHIT
	32 = SYNCMMERR
	64 = SYNCSMERR

NB!
ERRCLR contains the command MOTOR ON, which automatically switches the controller on again. (The motor is position-controlled at the current position.)

Command group

SYN

Cross Index

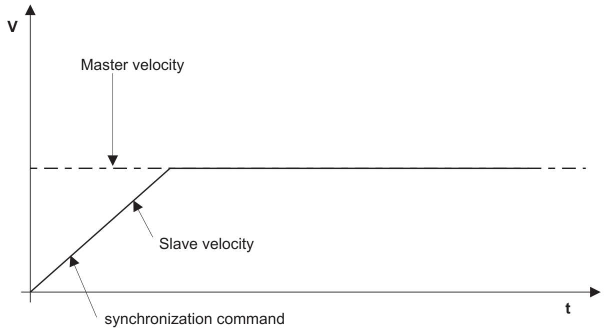
ON STATBIT, ON ERROR GOSUB, ERRNO, CONTINUE, MOTOR ON

Syntax example

```
SYNCSTATCLR 32
/* clear current error message */
```

■ SYNCV

With SYNCV a velocity synchronization with the master is completed. In doing so only the velocity is taken into consideration and the controller does not attempt to recover the position.



For synchronization and during the synchronization process neither the pre-set velocity, VEL, nor the preset acceleration, ACC or DEC, are exceeded.
The parameters of the gear factors used for synchronization are: SYNCFACTM (49), SYNCFACTS (50).

Furthermore, the speeds are not simply determined on the basis of the difference between the current position minus the last position (master/slave), rather the values are filtered according to the settings in SYNCVFTIME (65). This means the filter for the slave is determined by the maximum speed.
In other words:
VELMAX * 5 corresponds to the encoder resolution for the filter table, where VELMAX is the speed in qc/ms. (The formula is a result of the assumption that the filter table for the encoder resolution was made with a maximum speed of 3000 Rpm.)

During the transition from the speed controller to the position controller this is done as smoothly as possible. In addition the new set position is defined in such a manner that the following is true:

command_pos = actual_pos + error

old_error, cvel, avel are maintained. Sumerr is also accepted unchanged.

Summary

velocity synchronization with the master

Syntax

SYNCV

NB!
SYNCV should only be called up once since the synchronizing continues until the next motion or stop command. All additional SYNCV commands cause the synchronization to start over again from the beginning and this is not normally intended, as you reset the actual SYNCERR.

NB!
Position error is not monitored in SYNCV mode, it is therefore recommendable to use the hardware encoder monitor.

Command group

SYN

Cross Index

parameter of the AXS group

■ SYSVAR

The system variable SYSVAR – a prepared pseudo array – provides detailed system information. You also need this index if you link the system variable with the LCP display using LINKSYSVAR or specify recording data of a test run with TESTSETP.

Summary

System variable (Pseudo array) reads system values.

Syntax

SYSVAR[n]
n = index

System Process Data

Index	Description
1	Input Byte 0 (I1 … I8)
2	Input Byte 1 (VLT input 16 … 33)
9	Output Byte 0
17	Top 2 bytes which are provided by the SyncPos command STAT
22	Value which is also supplied by the SyncPos command TIME
28	Actual motor current [1/100 Amp.]
30	Motor voltage voltage [1/10 V]
31	VLT status word
32	Actual output frequency
33	current line number of the SyncPos program in case of #DEBUG NOSTOP
35	The unfiltered value of analog input 1.

Axis Process Data

Index	Description
4096	Current position slave in qc (without conversion to UU) (see APOS)
4097	Set position slave in qc (without conversion to UU) (see CPOS)
4098	Last slave index position in qc (without conversion to UU) (see IPOS)
4099	Actual velocity in qc/st, where st is the sample time set by _GETVEL.
4100	Current velocity Master (as above)
4101	Current position error in qc
4102	Contains the number of revolutions of the encoder after the first overflow of the absolute encoder, provided the graduation per revolution is entered correctly in ENCODER (2).
4103	As above for the master
4105	Current master position without conversion (qc) (see MAPOS)
4106	Last Master index position without conversion (qc) (see MIPOS)
4107	Internal current velocity (ACTPOS – last ACTPOS) (qc/1 ms)
4108	Internal Master velocity (see above)

4109	Current frequency of the master simulation (1/1000 Hz) (see PULSVEL)
4110	Determines whether the master simulation is active or not (1 or 0)
4111	Actual set value which is output by the control through the position controller (between –FFFFF and FFFFF resp. –1048575 and 1048575 decimal)
4113	Current used timer for the PID loop (TIMER).
4114	Current used timer for the profile generator (PROFTIME).
4115	Specifies, whether negative references should be read (!=0) out or not (=0).
4116	Specifies, whether reference with 0-10V and direction output should be read out (>0). If so these parameter contains the output number, which is used (1…8).
4117	Actual acceleration of the virtual master.
4118	Target frequency for virtual master (unit see above).
4119	Vlamode (abs / relative ?)
4120	Number of qc between index-pulses.
4121	Type of z pulse SYNCMTYPM
4122	User reference value given by OUTAN, scaling see REG_REFERENCE
4123	Slave encoder type (ENCDODERTYPE = 0..2)
4124	Master encoder type (MENCODERTYPE = 0..6)
4125	Slave encoder resolution
4126	Master encoder resolution
4127	Defines whether amplifier is set to stop mode (!=0) or to idle (==0) in case of motor off.
4128	Delivers same information as MAVEL does, but always gives information of real encoder, even if master is simulated (MENCODERTYPE == 6).

Axis Process Data, Profile generator value

Index	Description
4218	Returns all 32 flags of the profile generator. These are:
	PG_FLAG_BUSY 1 L // Flag for busy information
	PG_FLAG_COMMANDERR 2 L // Flag for Command Error occurred (not used)
	PG_FLAG_POSREACHED 4 L // Flag for Position reached
	PG_FLAG_INDEX_HIT 8 L // Flag for Index observed
	PG_FLAG_WRAP_OCC 16L // Flag for Wraparound occurred (not used)
	PG_FLAG_POS_ERR 32L // Flag for Position Error occurred
	PG_FLAG_BRKPT_RCHD 64L // Flag for Breakpoint reached (not used)
4218 ff	
	PG_FLAG_FLOATING 128L // Flag for MOTOR OFF
	PG_FLAG_MOVING 1L << 8 // Flag for axes is moving
	PG_FLAG_OVERFLOWS 2L << 8 // Flag for overflow of slave position
	PG_FLAG_OVERFLOWM 4L << 9 // Flag for overflow of master position
	PG_FLAG_POSFLOAT 8L << 8 // Flag for floating in pos control
	PG_FLAG_INTERNTST 64L << 8 // Flag for internal use
	PG_FLAG_SYNCREADY 1L << 24 // Flag for Synchronization ready
	PG_FLAG_SYNCFAULT 2L << 24 // Flag for Synchronization failed
	PG_FLAG_SYNCACCUR 4L << 24 // Flag for Accuracy reached (syn)
	PG_FLAG_SYNCMMHIT 8L << 24 // Flag for master marker hit
	PG_FLAG_SYNCSMHIT 16L << 24 // Flag for slave marker hit
	PG_FLAG_SYNCMMERR 32L << 24 // Flag for master marker distance exceeded
	PG_FLAG_SYNCSMERR 64L << 24 // Flag for slave marker distance exceeded
	PG_FLAG_TESTFLAG 128L << 24 // Flag for internal use

Axis Process Data, CAM profile

Index	Description
4220	CINDEX Actual index into the curve interpolation area (number of actual interpolation point 0..Intno-1)
4221	CVINDEX Actual value index used. Is equal to CINDEX if not starting or stopping is active. In that case the CVINDEX points into the start or stop path data.
4222	CMAXINDEX Maximum index allowed (Intno – 1)
4223	CIMPS Curve position within the actual interpolation interval (integer part of 64 bit value)
4224	CMILEN Length of interpolation interval in MU units (integer part of 64 bit value)
4225	CWRAP Actual curve counter (0 .. CCOUNTER)
4226	CSSTART Slave start offset of actual curve in qc (for closed curves always 0).

4227	CCOUNTER Demanded value of number of curves to do (last SYNCC command)
4228	CCURVEPOS Slave curve position in UU units (updated in SETCURVE and when SYNCCxx active).
4229	CSLAVECPOSQ Actual slave curve position in qc (relative to CSSTART)
4230	CMASTERCPOS Actual master curve position in MU units (initialised in SETCURVE and updated after SYNCCxx). see also CURVEPOS

Further Axis Process Data

Index	Description
4231	GETCMDVEL Gives command velocity (intgr part * 128) with sign (see also 4186)
4240	PFG_G_STARTKORR Contains the first correction value after SYNCM start. It specifies, how many marker faults must be compensate from the start-up. (Will be filtered, if SYNCOFFTTIME and SYNCMFTIME are set).
4241	PFG_G_STARTKORRREST Contains the carryover of the start correction value, which has to be executed yet. Scaled with PFG_G_SCALESHIFT.
4242	PFG_G_KORRFILT Contains the filtered correction value, scaled with PFG_G_SCALESHIFT.
4243	PFG_G_LASTMMDIST Contains the last measured distance between two master marker (qc master).
4244	PFG_G_MMARKCORR Contains the gear correction factor, which was calculated; scaled with PFG_G_SCALESHIFT.
4245	PFG_G_KORRUNFILT Contains the last unfiltered correction value (qc - slave).
4246	PFG_G_MDISTMARK Contains the actual master position distance of the last master marker in % of the nominal marker distance.
4247	PFG_G_SDISTMARK Contains the actual slave position distance of the last slave marker in % of the nominal marker distance.
4248	PFG_G_STARTKORRVAL STARTKORRVAL is the value with that the start correction value will be relieved (reduced) at every marker correction.
4249	PFG_G_LASTSMDIST Last measured distance between two slave marker in qc - slave.
4250	PFG_G_MARKERFILTER Tau for the PT filter used to calculate medium marker distance.
4251	PFG_G_KORRTAU Tau for the PT filter used to calculate PFG_G_KORREKTUR
4252	PFG_G_INTMMERROR Sum of all errors of the marker distance (actual – medium distance)
4253	PFG_G_MMARKERR Filtered sum of all errors (scaled value)

NB!
The values of the system variables are internal, hardware-dependent values which may change.

Command group

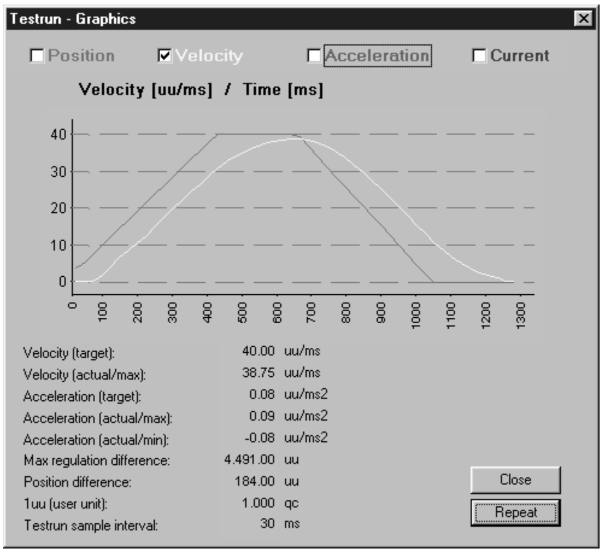
CON

Cross index

LINKSYSVAR, TESTSETP

TESTSETP

As standard you can use the menu "TESTRUN" to trigger a test run which records desired and current position, speed, acceleration and current and whose result can be seen in the test run graphic:



Velocity (target): 40.00 uu/ms
Velocity (actual/max): 38.75 uu/ms
Acceleration (target): 0.08 uu/ms2
Acceleration (actual/max): 0.09 uu/ms2
Acceleration (actual/min): -0.08 uu/ms2
Max regulation difference: 4.491.00 uu
Position difference: 184.00 uu
1uu (user unit): 1.000 qc
Testrun sample interval: 30 ms

In addition, with the two commands TESTSETP and TESTSTART you can record other or additional parameters, for example you can record the master position. And, in contrast to a test run, you can record this data while executing the program.
With TESTSETP you determine the parameters of the recording (which parameters are to be recorded, how often and in which array) and with TESTSTART you then start recording.

Summary

Specify recording data for test run

Syntax

TESTSETP ms vi1 vi2 vi3 arrayname

Parameter

ms = interval in milliseconds between two measurements

vi 1...3 = indices of the three values to be recorded. The agreements for the system array apply. Three values are always recorded.

array name = Name of the array used for the recording

Array format

The values are stored as follows within the array (all values 4 Byte):

Designation	Content	Meaning
version	000	Version of the data structure
ms	1	Interval between two measurements in ms
vi1	i	Value, recorded at point 1 (Index)
vi2	i	Value, recorded at point 2 (Index)
vi3	i	Value, recorded at point 3 (Index)
number	nn	Specifies how many measurements follow
data	...	Measurement data
...	...	(total nn*3)
number	0-mm	Number of measurements (if others are present)
data	...	(see above)

NB!
Please make sure that the size of the array is sufficient for the recording. You need 6 elements for the header, 1 element for the number, and 3 elements for each measurement. Thus for 100 measurements you need 307 elements.

Command group

I/O

Cross index

TESTSTART, DIM, SYSVAR,
"DISPLAY RECORDING"

Syntax-Example

```
DIM tstfahrtarray[307]   //Array with 307 elements
TESTSETP 3 4096 4105 4101 tstrunarray
// Record current slave position, current master
// position and current tolerated position error

... Start positioning run ...

TESTSTART 100        // Start recording
```

TESTSTART

This command is used to start the recording of a test run with the contents as defined in TESTSETP. The recorded data can then – as required – be graphically represented using "TESTRUN" → "DISPLAY RECORDING". There are four graphics: Position, Speed, Acceleration and Current available for this.

Summary

Start the recording of a test run

Syntax

TESTSTART no

Parameter

no = number of measurements to be carried out

NB!

If an array does not have sufficient space for no. measurements, the error O_ERR 71 „Field limits exceeded“ is triggered.

Command group

I/O

Cross references

TESTSETP, "DISPLAY RECORDING"

Syntax example

```
SYNCP           // Synchronization of the position
WAITI 1 ON      // When the key is pressed
TESTSTART 200
// Start recording (200 measurements)
```

Syntax example

```
NOWAIT ON
    // Do not wait until the position is reached
VEL 50
POSA 100000
    // Start positioning with velocity 50%
WHILE (APOS<50000) DO
    // Wait untill position 50000 is reached
ENDWHILE
VEL 100         // Increase velocity to 100%
TESTSTART 200
    // Start recording (200 measurements)
DELAY 20// Wait 20 ms
POSA 100000
    // Start positioning with new velocity
NOWAIT OFF
    // Wait untill positioning is finished
```

TIME

The internal system-time can be read out using the TIME command. The TIME command is most suitable for calculating the execution time of a command sequence or device cycle time.

Summary

reads system-time

Syntax

res = TIME

Return value

res= system-time in milliseconds after switching on

NB!

Please note that after counting up to MLONG the value will change to –MLONG.

Command group

I/O

Syntax-Example

```
PRINT TIME      /* print current system-time */
timestop1 = TIME
/* store current entary system-time */
```

Program sample

ACC_01.M, DELAY_01.M, EXIT_01.M, GOSUB_01.M

TRACKERR

With TRACKERR it is possible to query the actual position error of the axis in User Units (in consideration of the signs). This is the difference between the set value (CPOS) and the actual position (APOS).

Summary

queries actual position error of the axis

Syntax

res = TRACKERR

Return value

res = actual trailing of the axis in UU

Command group

I/O

Cross Index

APOS, CPOS, POSERR (15)

Syntax-Example

```
PRINT TRACKERR
/* query actual position error of the axis */
```

VEL

The velocity for the next absolute and relative positioning procedures and the maximum allowed velocity for synchronizing procedures is determined with the VEL command.
The value remains valid until a new velocity is set via another VEL command. The new velocity value will be set in reference to the parameters VELMAX (1) and VELRES (22). If the velocity value equals the ***Velocity resolution***, then the rpm value set in ***Maximum velocity*** VELMAX (1) will be used.

Note: Slave velocity in synchronizing mode is also limited by the VEL command.

Summary

Set velocity for relative and absolute motion as well as the maximum allowed velocity for synchronizing

Syntax

VEL v

$$\text{command velocity (rpm)} = V * \frac{\text{VELMAX (1)}}{\text{VELRES (22)}}$$

Parameter

v = scaled velocity value

NB!
If no velocity has been set prior to a positioning or synchronizing command, then the value of parameter DFLTVEL (33) will be used.

If the velocity needs to be altered during positioning, it is possible in the NOWAIT ON mode, when the VEL command is followed by another POSA command targeting to the desired position.
The maximum speed allowed can be changed at any time with the command VEL, if a SYNCV, SYNCP or SYNCM follows the VEL command.

Command group

REL, ABS

Cross Index

ACC, POSA, POSR
Parameter: Maximum velocity VELMAX (1)

Syntax-Example

```
VEL 100          /* Velocity 100 */
```

Program sample

VEL_01.M

WAITAX

The WAITAX command has been designated for use with an active NOWAIT mode. By use of this command in NOWAIT ON condition, it is possible to wait for further program processing after a positioning command, until the axis has achieved its set position.

Summary

Wait till target position is achieved

Syntax

WAITAX

Command group

CON

Cross Index

NOWAIT ON/OFF, POSA, POSR, AXEND, STAT, WAITI

Syntax-Example

```
WAITAX   /* Wait till the axis has ended motion */
WAIT AX  /* Alternative form */
```

Program sample

WAIT_01.M
VEL_01.M

WAITI

The WAITI command waits before continuing the processing until the specified input has got the desired signal level.

Summary

Wait for defined input condition

Syntax

```
WAITI n s
```

Parameter

n = input number	1 – 8 or 16 – 33

s = expected condition:	ON = High-Signal
	OFF = Low-Signal

NB!

If the expected input condition does not occur, then the program will remain 'stuck' at this point. A minimal signal length is required for the sure identification of a signal condition!
The VLT manual and the chapter input/output terminals give information about the circuit and technical data for the inputs.

Command group

CON

Cross Index

ON INT GOSUB, DELAY, WAITT, WAITAX
VLT5000 manual

Syntax-Example

```
WAITI 4 ON
/* Wait till High level reached input 4 */
WAITI 4 1        /* 3 alternative forms: */
WAIT I 4 ON
WAIT I 4 1

WAITI 6 OFF
/* Wait till Low level reached input 6 */
WAITI 6 0        /* 3 alternative forms: */
WAIT I 6 OFF
WAIT I 6 0
```

Program sample

WAIT_01.M

WAITNDX

Waits for the index while checking timeout. The program waits until either the index of the axis is found or the time (timeout) is exceeded.

Summary

waits until the next index position is reached

Syntax

```
WAITNDX t
```

Parameter

t = timeout in ms

NB!

If the time is exceeded then an error is triggered which can be evaluated with a ON ERROR function.

Command group

CON

Cross Index

WAITI, WAITP, INDEX

Syntax-Example

```
CVEL 1
CSTART
WAITNDX 10000
OUT 1 1
/* Waits a maximum of 10 seconds for the axis to
reach the index position */
```

WAITP

The WAITP command causes the program to wait until position p is reached.
If, from the speed and the current position, it follows that the point p has already been exceeded then the command is also terminated.

Summary

waits until a certain position is reached

Syntax

WAITP p

Parameter

p = absolute position being waited for

NB!
Active ON INT or ON PERIOD commands can affect the precision and reproducibility.

Command group

CON

Cross Index

DELAY, WAITI, WAITAX

Syntax-Example

```
NOWAIT ON
POSA 100000
WAITP 50000      /* wait on position 50000 */
OUT 1 1          /* set output 1 */
NOWAIT OFF
```

WAITT

The WAITT command is suitable for achieval of a defined program time delay. The inputted parameter shows the delay time in milliseconds.

Summary

Time delay

Syntax

WAITT t

Parameter

t = delay time in milliseconds (maximum MLONG)

NB!
If an interrupt occurs during the delay time, then the entire delay procedure will be rebegun following the processing of the interrupt. The DELAY command is preferable to the WAITT command, because of its constant time behavior.

Command group

CON

Cross Index

DELAY, WAITI, WAITAX

Syntax-Example

```
WAITT 5000      /* wait 5000 seconds */
WAIT T 5000     /* Alternative form: */
```

Program sample

WAIT_01.M

WHILE .. DO .. ENDWHILE

By using the WHILE. .. ENDWHILE construction you can repeat the enclosed program area one or more times, dependent on any criteria. The loop criteria is made up of one or more comparison operations, and is always monitored at the start of a loop. When a negative result already appears at the first monitoring, this can cause an omission of the commands within the loop, and the program will continue after the ENDWHILE instruction.

Summary

Conditional loop with start criteria
(While condition is fulfilled, repeat ...)

Syntax

WHILE condition DO
ENDWHILE

Parameter

condition = abort criteria

NB!
Depending on the loop criteria, it can happen that the contents of the loop will never be processed.
To avoid an endless loop, the processed commands within the loop must have a direct or indirect influence on the result of the abort check.

Command group

CON

Cross Index

LOOP, REPEAT .. UNTIL ..

Syntax-Example

```
WHILE (A != 1 AND B == 0) DO
command line 1
command line n
ENDWHILE
```

Program sample

WHILE_01.M, INKEY_01.M

_GETVEL

With the _GETVEL command it is possible to change the sampling time for AVEL and MAVEL. AVEL and MAVEL usually work with a sampling time of 20 ms. With this sampling time the resolution is better. However, a new measurement is only sampled every 20 ms.
The command _GETVEL lasts exactly as long as the assigned value, e.g.
_GETVEL 200 ca. 200 ms.

Summary

Changes sample time for AVEL and MAVEL

Syntax

var = _GETVEL t
The values are displayed in UU/sec for AVEL or qc/sec for MAVEL.

Parameter

t = sample time in msec

Command group

I/0

Cross Index

AVEL, MAVEL

Syntax-Example

```
var = _GETVEL 200
```

Thus, the measurement resolution is considerably better; however changes are only seen after a delay of 200 ms.

■ #DEBUG

With introducing the debug mode into the PC user interface, the #DEBUG commands are no longer executed from firmware version

VLT5000/SyncPos Software Version 3.xx/4.2x
VLT5000/FluxSyncPos Software Version 5.xx/4.2x
onwards.

Existing #DEBUG commands may not necessarily be removed from the program as they will be ignored.

Cross Index

Look up user Interface: "DEVELOPMENT" → "PREPARE SINGLESTEP"

■ INCLUDE

The #INCLUDE instruction tells the Compiler to include the contents of the given file in the corresponding program position during the translation of the program.

The INCLUDE instruction is therefore not a genuine command that causes a reaction within the SyncPos option, but an instruction for the translation program – a Compiler Directive.

The #INCLUDE instruction can be placed in any program position, as many times as desired within a program. However, attention must be given to the fact that the data to be included contains commands that may be used in the momentary program position, and that the command syntax is correct.

The #INCLUDE instruction is especially suitable for storing frequently used subroutines in separate files and to include them in the application within the SUBMAINPROG ..ENDPROG area.

Summary

Inclusion of file contents in the indicated program position

Syntax

#INCLUDE file

Parameter

file = complete name of the file to be included
(path commands inadmissible)

NB!

The file to be included must be in the current directory. The given data names must end with ".M". The commands within the file to be included must have correct syntax.

Command group

CON

Syntax-Example

```
#INCLUDE INC_UP01.M
/* Include contents from file INC_UP01.M */
```

Program sample

INCL_01.M + INCSTA01.M + INCPOS01.M + INCIN01.M

■ Parameter Reference

■ VLT parameter and SyncPos parameter

Basically there are 2 main parameter types: VLT parameters and SyncPos option parameters.
The parameters of VLT parameter group 7.. are both VLT parameters and SyncPos option parameters.

VLT parameters except groups 7.. , 8.. and 9.. are described in VLT5000/VLT5000Flux operating instruction, this manual describes changes to the VLT parameters including group 7.. and the SyncPos option parameters.

VLT parameter groups 8.. and 9.. are only available if a field bus option is installed and they are described in the manuals covering these option cards (see field bus option manual).

Factory settings of the parameter

All parameters has a default value called the factory setting. It is possible to reset the parameters to factory setting:
VLT parameters can be reset to factory settings by manual initialization of the VLT or by means of the setup copy function (see in VLT5000/VLT5000Flux operating instruction for further details).

SyncPos option parameters can be reset to factory settings in menu ”CONTROLLER” → ”RESET” → ”PARAMETERS” or ”CONTROLLER” → ”RESET” → ”COMPLETE”. Deleting the entire memory in menu ”CONTROLLER” → ”MEMORY” → ”DELETE EEPROM” will reset the parameters to factory setting as well.

User parameter

The parameters 710 though 779 and 795 though 799 are user parameters which can be defined and used in a SyncPos program.

The user parameters are defined in a SyncPos program using the commands LINKAXPAR and LINKGPAR, it is possible to specify a text which will be displayed as parameter name in the LCP, a minimum limit, a maximum limit and the way how parameters will be executed:

0 = Online executes a changes to the parameter value immediately after the input in display.
1 = Offline change means that a change to the parameter value is activated when the OK key is pressed.

An user parameter can be linked to a global option card parameter or an axis option card parameter.
There are two types of global parameters:

- Predefined global parameters as for example I_ERRCLR (107)
- Free internal parameters which can be accessed from the SyncPos program.
  Parameters 130–229 are used for this purpose.

Syntax examples:

```
/* Predefined global parameter */
LINKGPAR I_ERRCLR 710 “ “ 0 33 0
/* Free internal parameter */
LINKGPAR 132 711 “name” 0 100000 0
/* Axis parameter */
LINKAXPAR POSERR 712 “position error” 0
100000 0
```

Parameters 795 – 799 are read only parameters which can be used for data read out on the LCP. These parameters can be read out in display line 1 or 2. You can select which parameters from 795 to 799 are displayed at which position on the VLT display in the VLT parameters 9, 10, 11 and 12:
User parameter 95 [90]
User parameter 96 [91]
User parameter 97 [92]
User parameter 98 [93]
User parameter 99 [94]

Parameter changes and storage

VLT parameters changed via the Local Control Panel and SyncPos option parameter changed via menu ”CONTROLLER” → ”PARAMETERS” → "AXIS" are saved in an EEPROM and thus retained at power down.
VLT parameters changed from the SyncPos application program with the command SETVLT are only stored in RAM and thus lost at power down.
SyncPos option parameters changed from the SyncPos application program with the command SET are only active while the application program is running. SyncPos option parameters changed from the application program can be saved in an EEPROM and thus retained at power down by means of the command SAVEPROM or press the OK-key on the VLT display.

NB!
Please note that an EEPROM has limited lifetime; but in can be reprogrammed approximately 10000 times.

0..
1..
2..
3..
4..
5..
6..
7..
8..
9..

Parameter 009, 010, 011 and 012 (Display line 1 and 2) has got 5 additional selections:

	VLT5000	VLT5000Flux
User parameter 95	[90]	[90]
User parameter 96	[91]	[91]
User parameter 97	[92]	[92]
User parameter 98	[93]	[93]
User parameter 99	[94]	[94]

Parameter 115 (Slip compensation): Factory setting changed from 100% to 0%.

Factory settings changed:	From	to
Parameter 200	Only clockwise 132Hz [0]	Both directions 132 Hz [1]
Parameter 203	Min ... Max [0]	–Max ... +Max [1]
Parameter 207	Power dependent	0,05 sec
Parameter 208	Power dependent	0,05 sec

Factory settings VLT5000:

Parameters 300 - 303, 305 - 308, 314 changed to:	”No operation”	[0]
Parameters 319 + 321 changed to:	”Option 0 ... 20mA”	[91]
Parameters 323 + 326 changed to:	”Control word bit 11/12”	[33]

4 Additional selections in parameters 319+321:	Option digital	[90]
	Option 0 ... 20mA	[91]
	Option 4 ... 20mA	[92]
	Option 0 ... 32000 pulses	[93]

Factory settings VLT5000Flux:

Changed factory settings:

Parameters 300...303, 305...308, 314 changed to	“No operation”	[0]
Parameters 319 + 321 changed to	“Option 0 ... 20mA”	[90]
Parameters 323 + 326 changed to	“Control word bit11/12	[33]
Parameters 341 + 355 changed to	“Option digital”	[90]

2 Additional selections in parameters 319 + 321:	Option 0 ... 20mA	[90]
	Option 4 ... 20mA	[91]
2 Additional selections in parameters 341 + 355:	Option digital	[90]
	Option pulse output	[91]

Only available if a field bus option is installed (see field bus option manual).

Group 7: next page

Group 7:

VLT par. # LCP access	Option parameter # and name	Parameter Read/Write Application program
700	—	GETVLT/SETVLT parameter number Ex.: var = GETVLT 700
701	102 PRGPAR	GET/SET parameter name Ex.: var = GET KPROP
702	11 KPROP	
703	12 KDER	
704	13 KINT	
705	21 KILIM	
706	35 BANDWIDTH	
707	36 FFVEL	
708	37 FFACC	
709	65 SYNCVFTIME	
710-779	130 – 229	GET/SET parameter number Ex.: var = GET 131
780	–	GETVLT/SETVLT parameter number
781	– Program ID	Ex.: var = GETVLT 780
795-799	130 – 229	GET/SET parameter number Ex.: var = GET 132

NB!
In general it is very important to optimize the VLT parameters to the motor, i.e. by using AMA, in order to obtain a good control behavior.

Parameter 205

Parameter 205, maximum reference must be set in accordance with maximum velocity (option parameter #1) before the controller parameters are optimized.

System Control 700

When "enable SyncPos" is selected the VLT is controlled by the SyncPos motion controller.
When "disable SyncPos" is selected the VLT is not controlled by the SyncPos PID controller. It is thus possible to control the VLT by traditional inputs or serial interface.
One can select “ENABLE SP. W/O MONI.” as third setting and thus avoid Option Error 13 (status error "VLT NOT READY").

Content

Controlled by the option or not

Value range

0 ... 2	★ 0

0 = enable SyncPos
1 = disable SyncPos
2 = enable SyncPos without VLT monitoring

D.TIME CMP.ACT. 780

The active inverter dead time compensation which is part of the VLT5000 control algorithm (VCC+) is causing instability at standstill when working in closed loop control. The purpose of this parameter is switching off the active dead time compensation to avoid instability.
Select OFF when the VLT is controlled from the SyncPos option in speed, position or synchronizing control. Select ON if the VLT is operated in open loop speed control. The inverter dead time compensation is providing better control performance in open loop control.

Content

active inverter dead time compensation

Compatibility

Not available in VLT5000Flux

Value range

0 ... 1	★ 0

0 = OFF
1 = ON

Program ID 781

When making customer specific programs that has to be factory downloaded the type code must be set in parameter 781 that means the following line must be included at the beginning of the SyncPos application program:

SETVLT 781 xy
Where xy is the type code (Byx).

The value of parameter 781 is readout during the final test in the production and compared with the type code string of the drive to verify that the correct program is installed.

Content

The type code number.

Value range

0 ... 1000	★ 0

VLT parameter list

PNU	Parameter description	Factory settings	Range	Changes during Operation	4-Setup	Con-version index	Data type
700	System control	0	0 … 2	Yes	No	0	6
701	Program number	-1	-1 … 127	Yes	No	0	4
702	PID, Proportional factor	30	0 … 65000	Yes	No	0	4
703	PID, Derivative factor	0	0 … 65000	Yes	No	0	4
704	PID, Integral factor	0	0 … 65000	Yes	No	0	4
705	PID, Integral bandwidth	1000	0 … 1000	Yes	No	0	4
706	PID, BANDWIDTH	1000	0 … 65000	Yes	No	0	4
707	PID, Velocity Feed-forward	0	0 … 65000	Yes	No	0	4
708	PID, Acceleration Feed-forward	0	0 … 65000	Yes	No	0	4
709	PID, Velocity filter	0	–500000 … 500000	Yes	No	0	4
710	User parameter 10	0	Defined by user[1]	Yes	No	0	4
711	User parameter 11	0	Defined by user[1]	Yes	No	0	4
…							
778	User parameter 78	0	Defined by user[1]	Yes	No	0	4
779	User parameter 79	0	Defined by user[1]	Yes	No	0	4
780	Activated dead time compensation (Not available in VLT5000Flux)	OFF	0 … 1	No	No	0	6
781	Program ID	0	0…1000	No	No	0	6
795	User parameter 95 (read only)	0	Defined by user[1]	Read only	No	0	4
796	User parameter 96 (read only)	0	Defined by user[1]	Read only	No	0	4
797	User parameter 97 (read only)	0	Defined by user[1]	Read only	No	0	4
798	User parameter 98 (read only)	0	Defined by user[1]	Read only	No	0	4
799	User parameter 99 (read only)	0	Defined by user[1]	Read only	No	0	4

Changes during operation

”Yes” means that the parameter can be changed, while the VLT frequency converter is in operation. ”No” means that the VLT frequency converter must be stopped before a change can be made.

4-Setup

”Yes” means that the parameter can be programmed individually in each of the four setup’s, i.e. the same parameter can have four different data values. ”No” means that the data value will be the same in all four setup’s.

Conversion index

The conversion index is used when transferring parameter values with decimals by means of serial communication. Conversion index 0 means that the parameter value is multiplied by 1.

Data type

Indicates the data type of the parameter value. **Data type 4** is an **Integer 32bit** and **data type 6** is an **Unsigned 16bit**.

[1] The maximum range is -2^{32} to 2^{32}-1 (-2147483648 to 2147483647) but the actual range is specified when defining a user parameter in the application program using LINKGPAR or LINKAXPAR.

All SyncPos parameters in Alphabetical Order

For a better overview the parameters for the SyncPos program are divided into groups:

Global Parameters GL

The program language is prepared for multi axis applications. Therefore all parameters independent of an axis such as the ***Activated Program Number*** PRGPAR (102) and the I/O parameters such as ***clear error*** I_ERRCLR (107) are combined in the group global parameters (GL).

Axis parameters AX...

This group contains all axis-specific parameters which can be processed with the GET and SET commands and need axis information in the command:

AXE	Axis parameter encoder
AXV	Axis parameter velocity (velocity and acceleration values)
AXI	Axis parameter I/O (I/O configuration)
AXH	Axis parameter home (parameters affecting home motion)
AXR	Axis parameter control (everything concerning control behavior) and
AXS	Axis parameter synchronization

The column parameter group (AXV, AXR etc.) references to the dialog fields "CONTROLLER" → "PARAMETERS" → "AXIS", resp. → "GLOBAL", where you can define and change the parameters.

Parameter Code	Parameter Name	VLT-No.	SyncPos Par.No.	Par. Group	Unit	Factory setting
ACCMAXQC	Maximum acceleration		10	AXV	qc/ms^2 * 1/65536	
BANDWIDTH	Bandwidth within which the PID filter is active	706	35	AXR	%	1000
DFLTACC	Default acceleration		34	AXV	%	50
DFLTVEL	Default velocity		33	AXV	%	50
ENCODER	Encoder counts per revolution		2	AXE	counts/ revolution	500
ENCODERTYPE	Encoder type for encoder 0 (Slave)		27	AXE	–	0
ENDSWMOD	Behavior at limit switch		44	AXI	–	0
ERRCOND	Behavior after error		43	AXI	–	0
ESCCOND	Behavior after error		70	AXI	–	0
FFACC	Acceleration feed-forward	708	37	AXR	%	0
FFVEL	Velocity feed-forward	707	36	AXR	%	0
HOME_FORCE	Force HOME?		3	AXH	–	0
HOME_OFFSET	Zero point offset in relation to machine zero point or index		42	AXH	qc	0
HOME_RAMP	Ramp for home motion		41	AXH	%	10
HOME_VEL	Velocity of home motion		7	AXH	%	10
HOMETYPE	Behavior during home motion		40	AXH	–	0
I_BREAK	Input for abort		105	GLI	–	0
I_CONTINUE	Continue program		106	GLI	–	0
I_ERRCLR	Clear error		107	GLI	–	0
I_NEGLIMITSW	Negative limit switch		47	AXI	–	0
I_POSLIMITSW	Positive limit switch		46	AXI	–	0
I_PRGCHOICE	Input for beginning program choice		104	GLI	–	0
I_PRGSTART	Input for program start		103	GLI	–	0
I_REFSWITCH	Input for reference switch		45	AXI	–	0
KDER	Derivative value for PID control	703	12	AXR	–	1
KILIM	Limit value for integral sum for PID control	705	21	AXR	–	0

Parameter Code	Parameter Name	VLT-	SyncPos	Par.	Unit	Factory
		No.	Par.No.	Group		Setting
KINT	Integral value for PID control	704	13	AXR	–	0
KPROP	Proportional value for PID control	702	11	AXR	–	30
MENCODER	Resolution of the encoder 1 (master)		30	AXE	counts/rev.	500
MENCODERTYPE	Encoder type for encoder 0 (Master)		67	AXE	–	0
NEGLIMIT	Negative software limit switch		4	AXI	qc	–500000
O_AXMOVE	Output for motion command active		64	AXI	–	0
O_BRAKE	Output for mechanical brake		48	AXI	–	0
O_ERROR	Output for error		108	GLS	–	0
POSDRCT	Rotational direction		28	AXE	–	1
POSERR	Maximum tolerated position error		15	AXR	qc	20000
POSFACT_N	Denominator user factor		26	AXE	–	1000
POSFACT_Z	Numerator user factor		23	AXE	–	1000
POSLIMIT	Positive software limit switch		5	AXI	qc	500000
PRGPAR	Activated program number	701	102	GLS	–	–1
PROFTIME	Scan time for profile generator		29	AXE	msec	1000
RAMPMIN	Shortest ramp		31	AXV	msec	1000
RAMPTYPE	Ramp type		32	AXV		0
REGWMAX	Size of the control window (activation)		38	AXR	qc	0
REGWMIN	Size of the control window (deactivation)		39	AXR	qc	0
REVERS	Reverse behavior for slave		63	AXR	–	0
SWNEGLIMACT	Negative software limit switch active		19	AXI	–	0
SWPOSLIMACT	Positive software limit switch active		20	AXI	–	0
SYNCACCURACY	Size of the precision window for position synchronization		55	AXS	qc	1000
SYNCFACTM	Synchronization factor master (M:S)		49	AXS	qc	1
SYNCFACTS	Synchronization factor slave (M:S)		50	AXS	qc	1
SYNCFAULT	Marker number for fault		57	AXS	–	10
SYNCMARKM	Marker number for master		52	AXS	–	1
SYNCMARKS	Marker number for slave		53	AXS	–	1
SYNCMFTIME	Defines filter time for marker correction		18	AXS	msec	0
SYNCMFPAR	Marker filter configuration		17	AXS	–	0
SYNCMMAXCORR	Limits max. correction done by marker correction		6	AXS	qc	0
SYNCMPULSM	Marker interval for master		58	AXS	qc	500
SYNCMPULSS	Marker interval for slave		59	AXS	qc	500
SYNCMSTART	Start behavior for marker synchronization		62	AXS	–	0
SYNCMTYPM	Marker type for master		60	AXS	–	0
SYNCMTYPS	Marker type for slave		61	AXS	–	0
SYNCMWINM	Tolerance window for master marker monitoring		68	AXS	qc	0
SYNCMWINS	Tolerance window for lave marker monitoring		69	AXS	qc	0
SYNCOFFTIME	Compensation velocity of an offset		16	AXS	msec	0
SYNCPOSOFFS	Position offset for positioning synchronization		54	AXS	qc	0
SYNCREADY	Marker number for ready		56	AXS	–	1
SYNCTYPE	Type of synchronization: normal or with look ahead		51	AXS	–	0
SYNCVELREL	Tolerated deviance of the slave drive from the master velocity in %		66	AXS	%	0
SYNCVFTIME	Velocity filter	709	65	AXS	τ_filt (μsec)	0
TESTTIM	Time in target window		24	AXI	ms	0
TESTVAL	Limit value for reading in target window		25	AXI	qc	1
TESTWIN	Size of target window		8	AXI	qc	0
TIMER	Sampling time for PID control		14	AXR	msec	1
VELMAX	Maximum velocity		1	AXV	Rpm	3000
VELMAXQC	Maximum velocity (internal parameter)		9	AXV	qc/ms * 1/65536	
VELRES	Velocity resolution		22	AXV		100

■ All SyncPos Parameters in Detail

The sequence of parameters is determined by the internal parameter number. We recommend using the overview as a guide; then you will be able to find detailed information very quickly using the internal parameter number.

General Information on the Parameter Values

Some limiting values are listed at 1 billion to make them more easily readable. However, the exact value is 1,073,741,824.

NB!
The unit defined by the parameter ***User factor*** POSFACT_Z (23) and POSFACT_N (26) is not used for all path and position parameters. For various parameters (for example a software limit switch like I_POSLIMITSW (46) and the parameter ***Tolerated position error*** POSERR(15) the quad-count unit (qc) is valid.
4 quad-counts correspond to one sensor unit.

Abbreviation

For a description which is not dependent on the version or the hardware, variables were used in the following section for some limit values: thus the value of
MLONG = 1.073.741.824

Factory settings

Each factory setting is marked with ★.

Input range

Whether the input range listed is exceeded is not checked by the program, since due to the large domain there is no suitable test possibilities.

NB!
Even within the areas indicated illogical inputs can result from the large differences in performance of the motors and the wide variety of possible applications. Therefore, it is the responsibility of the programmer and the user to observe the performance ranges of the drive and of the system.

1 VELMAX

VELMAX defines the rated speed of the drive. This value is listed in Rpm and is needed for the calculation of ramps and actual velocities.

NB!
The nominal speed refers to the speed of the encoder.

Content

Rated speed of the drive

Parameter Group

Axis parameter Velocity AXV
CAM-Editor: index card Velocity

Unit

Rpm

Value range

1 ... 65535 ★ 3000

2 ENCODER

The parameter ***Encoder count per revolution*** contains the position feedback transmitter of the actual encoder (incremental or absolute encoder) in relation to one encoder revolution.
The number of quad-counts (qc) per revolution is calculated from this information. Quadcounts are the basic units for all path measurements. Quadcounts are generated by extracting of all edges of the A and B tracks. One encoder count corresponds to four quad-counts. In the case of absolute encoders, the absolute values are returned 1 : 1.
The number of quad-counts per revolution is needed for the index pulse search during the reference drive and for the conversion of velocity and acceleration to internal units.
The ***Encoder counts per revolution*** also supplies information whether during a HOME or INDEX movement the index signal has been missed. If more than a complete revolution is executed without registering an index signal then the corresponding error message will be made.

Content

Encoder counts per revolution

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Unit

counts/revolution

Value range

1 … MLONG ★ 500

NB!
No negative values are allowed. Whether index pulses are being used or not is entered in the parameter HOMETYPE (40).

Limit values

In order to guarantee perfect functioning of the SyncPos option the product of the ***Encoder counts per revolution*** ENCODER (2) and the ***Maximum velocity*** in encoder revolution/sec of the limit frequency of the encoder input level (220 kHz) may not be exceeded.
ENCODER * VELMAX $[^{\text{Encoder revolution}}/_{\text{sec}}] \leq$ 220 kHz

3 HOME_FORCE

If this parameter is set to yes = 1, then movement to the home position must be completed before any other positioning movement can be completed.
For a motion command that is not executed with a terminated home run the error O.ERR_6 is triggered.

Content

Forced movement to home position

Parameter Group

Axis parameter Home AXH
CAM-Editor: index card Home

Value range

0; 1 ★0

0 = Homerun is not forced.
After being turned on the current position is valid as the real index point
1 = Homerun is forced.
After turning on the VLT and after changing axis parameters a forced tracking of the home position must be made before a motion command is executed directly or by the program.
Internally the parameters can also contain the value 255, which indicates that a forced tracking of the HOME position is necessary and has already taken place.

NB!
For safety reasons and to avoid false positioning the parameter should always be set to 1 and thus forcing tracking of the home position. However, in this case it is necessary to consider that all programs must complete a HOME command before the first motion command in order to receive perfect functioning.

4 NEGLIMIT

NEGLIMIT indicates the ***Negative position limit*** for all movements. If this value is exceeded then an error is triggered. NEGLIMIT is only active if SWNEGLIMACT (19) has been set.
If a positioning command is entered which exceeds the limits set, then it is not executed.

Content

Negative software limit switch

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Unit

qc

Value range

–MLONG … MLONG ★ –500000

NB!
When using the command DEF ORIGIN the path limitation is automatically adapted so that the original position of the positioning range is maintained.

5 POSLIMIT

POSLIMIT indicates the ***Positive position limit*** for all movement. If this value is exceeded then an error is triggered. POSLIMIT is only active if SWPOSLIMACT (20) is set. If a positioning command is entered which exceeds the limits set, then it is not executed.

Content

Positive software limit switch

Parameter Group

Inputs/Outputs

Unit

qc

Value range

–MLONG … MLONG ★ 500000

NB!
When using the command DEF ORIGIN the path limitation is automatically adapted so that the original position of the positioning range is maintained.

6 SYNCMMAXCORR

SYNCMMAXCORR is used to limit the maximum correction done by marker correction. The value is given in qc (slave). This is working with SYNCM and SYNCC.
After the PFG_G_KORREKTUR is calculated, the PFG_G_KORREST is set to the minimum of G_Korrektur or SYNCMMAXCORR. This value will then be used for correction.

NB!
If you have set SYNCMFTIME (18) or SYNCVFTIME (65) (negative), this correction will be spread over a certain time, depending on these factors.

Content

Limits the maximum correction done by marker correction.

Parameter Group

AXS Synchronization;
(It is not yet in the parameter dialog window.)

Unit

qc

Value range

0 … MLONG ★ 0
0 = no limit

7 HOME_VEL

HOME_VEL determines the ***Home velocity***, with which the movement to the reference switch is made. The velocity statement refers to the rated speed and depends on the VELRES (22) parameters. Generally this statement is made in % of the rated speed.

$$\text{Home velocity} = \text{HOME\_VEL} \cdot \frac{\text{VELMAX (1)}}{\text{VELRES (22)}}$$

Content

Velocity for movement to home position

Parameter Group

Axis parameter Home AXH
CAM-Editor: index card Home

Unit

% (VELRES = 100)

Value range

–VELRES … VELRES ★ 10
A negative sign means the search will be made in the other direction.

NB!
Since the program always searches for the reference switch in the same direction of rotation (depending on sign) this should be set at the limits of the motion area. Only in this manner is it possible to guarantee that the drive actually moves towards the reference switch when moving home and not away from it. In order to maintain a good repeatability of the reference motion no more than 10% of the maximum speed should be used.

8 TESTWIN

TESTWIN indicates the size of the target window. AA position is only viewed as reached when the reference-run (trapez) is executed, the actual position is within the window and the velocity is less than TESTVAL (Precondition I: TESTWIN and TESTTIM are activated.)
In this content the velocity is given as TESTVAL in qc / TESTTIM.
The controller wait to execute the next command until the actual position is within the target window.
If TESTWIN is not active (parameter 0), then the target has been reached if the set position is the target position. However, this does not necessarily correspond with the actual position of the drive.

Content

Size of the target window

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Unit

qc

Value range

0 … MLONG ★ 0
0 = inactive
TESTWIN must always be less than TESTVAL.

NB!
If the target window surrounding the end position is selected to be too small, the drive could move in a very small area around the end position without reaching the target window. Thus the program would be 'stuck' after the corresponding positioning command.
A target window of 0 deactivates the monitoring of the actual position and only monitors the command position.

9 VELMAXQC

VELMAXQC determines the ***Maximum velocity***. All statements made with the assistance of VELRES (22) refer to this speed. The sample time is 1 ms.

VELMAXQC is an internal parameter which cannot be changed. It is automatically calculated from VELMAX (1) which the user enters in Rpm. These internal values are decisive for the permitted value range. However, in practice these limit values are of no importance since they exceed the encoder input frequency determined by the hardware by far.

Content

Maximum velocity

Parameter Group

Axis parameter velocity AXV
CAM-Editor: index card velocity

Unit

qc/ms * 1/65536

Value range

1 … MLONG

10 ACCMAXQC

ACCMAXQC determines the maximum acceleration. This is the amount of time the drive needs with a connected load to achieve the maximum rotation.
All other statements made with the assistance of the scaling VELRES (22) refer to this acceleration.
This internal parameter – which cannot be changed – is automatically calculated from RAMPMIN (31), which the user enters in ms. These internal values are decisive for the value range permitted. However, in practice these limit values are of no importance.

Content

Maximum acceleration

Parameter Group

Velocity

Unit

qc/(ms)^2 * 1/65536

Value range

1 … MLONG

NB!
If a starting time is entered which is too short, which under the existing mechanical conditions causes non-achievable acceleration, usually a position error will occur.

11 KPROP (702)

The ***Proportional factor*** KPROP indicates the linear correction factor with which the deviation between the current set and actual position is evaluated and a corresponding correction of the motor torque is made.
Rule of Thumb:
KPROP greater = Drive will become ‘stiffer’
KPROP too high = Tendency to overswing

Content

Proportional value for PID control

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Value range

1 … 65000 ★ 30

12 KDER (703)

The ***Derivative factor*** KDER is the correction factor with which the changing speed of a motor position error is evaluated.
The derivative factor works against the tendency to overswing due to a high proportional share and 'dampens' the system. However, if the derivative factor selected is too large this will lead to a 'nervous' drive.

Content
Derivative value for PID control

Parameter Group
Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Value range
0 … 65000 ★ 0

13 KINT (704)

The ***Integral Factor*** KINT is the weighting factor, with which at time n the sum of all motor position errors are evaluated.
The integral factor of the PID filter causes a corresponding corrective motor torque which increases over time. Through the integral share a static position error is reduced to zero, even if a constant load is affecting the motor.
However, an integral factor which is too large leads to a 'nervous' drive.

Content
Integral value for PID control

Parameter Group
Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Value range
0 … 65000 ★ 0

14 TIMER

The TIMER parameter determines the sampling time of the control algorithm.
For example, increase the value of the factory settings

- for very low pulse frequency, such as from 1 to 2 qc per sampling time. You need at least 10 to 20 qc per sampling time.
- Or for very slow systems with a long dead time. If 1 ms is used here for control, large motors will vibrate.

Content
Sampling time for PID control

Parameter Group
Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit
msec

Value range
1… MLONG ★ 1
Accordingly, the value should not be set higher than 1000 (= 1 s). This would be a very slow control.

NB!
Note that is has a direct effect on the PID loop e.g. if you double the TIMER the KPROP (11) has twice the effect.

15 POSERR

The maximum ***Tolerated position error*** POSERR defines the tolerance allowed between the current actual position and the calculated command position. If the value defined with POSERR is exceeded then the position control is turned off and a position error is triggered.

Content

Maximum ***Tolerated position error***

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

qc

Value range

1 … MLONG ★ 20000

The maximum ***Tolerated position error*** does not affect the positioning accuracy, but merely determines how precisely the theoretically calculated path of motion must be followed, without an error being triggered.

NB!
For safety reasons the maximum ***Tolerated position error*** selected should not be too large since this could be dangerous for both the machine and its operator.
On the other hand, if the values for the ***Tolerated position error*** are too small this could result in frequent errors. As a guideline, it is wise to set the quadruple of Encoder counts per revolution. This corresponds to one encoder rotation.

16 SYNCOFFTIME

The offset filter SYNCOFFTIME also influences the way, how a new SYNCPOSOFFS value is handled. The offset which has to be realized will be done step by step. The step which is realized every sample time (ms) is calculated as follows:

step size =
SYNCMPULSM / SYNCOFFTIME (integer part)

So it will take around SYNCOFFTIME to realize the offset. SYNCOFFTIME also has influence on the marker start correction and on the correction of marker error (see SYNCMFTIME).

Content

Compensation velocity of an offset (1. synchronize; 2. new offset)

Parameter Group

AXS Synchronization
(It is not yet in the parameter dialog window.)

Unit

1 msec

Value range

0 … MLONG ★ 0

17 SYNCMFPAR

This parameter SYNCMFPAR is used to influence the behavior of marker filtering, see SYNCMFTIME.

Content

Marker filter configuration

Parameter Group

AXS Synchronization
(It is not yet in the parameter dialog window.)

Value range

0 or 1 or 2 or 4 or 16 ★ 0

0 = Every time we find a real master marker, we calculate the Marker Filter constant as the Filtered Old master velocity * SYNCMFTIME / (SYNCMPULSM * 3)
1 = Calculate the Marker Filter constant as SYNCMFTIME/300
2 = Gear correction is made
4 = Correction time is used instead of using SYNCOFFTIME
16= We don’t make the correction concerning the error of marker distances.

For further descriptions of the selection see SYNCMFTIME

18 SYNCMFTIME

Content

Defines the filter time for marker correction

Application example

Newspaper manufacturing needed this sort of filtering to synchronizing a chain to the newspaper stream coming from a printing machine. Because the newspaper stream is not quite constant, the problem is that if synchronized without filter the movements of the chain are very hard and dynamic. With all other sort of filters the system starts swinging in sinusoidal waves.
When using this complex filter the synchronizing work very well and solve the problem.

Description

SYNCMFTIME is given in ms and is used as follows:

NB!
Master velocity filtering SYNCVFTIME (65) is given in 1/1000 ms for a better resolution, but the marker filtering (SYNCMFTIME) is given in units of 1ms.

Example:
SET SYNCVFTIME –50000
SET SYNCMFTIME 2000

This means, that the master velocity is filtered over a period of 50 ms. A marker error is corrected within a period of 2000 ms.

The actual filtered marker distance can be read out with SYSVAR 4238 indices if this filter is activated by setting SYNCMFTIME. To achieve the filter value, we internally calculate how much markers will pass by, if we run at maximum allowed speed over a period of SYNCMFTIME.

The SYNCMFTIME and Parameter SYNCOFFTIME (16) and parameter SYNCMFPAR (17) are used to influence the behavior of Marker Filtering (see below).

Portability

If SYNCMFTIME is 0, the behavior is same as up to Option Card version 5.04, that means the filter time for marker correction depends on the parameter value of SYNCVFTIME (65).

Filtering is handled as follows:

Calculation of Marker Filter

only if SYNCMFTIME > 0

if SYNCMFPAR = 1,

Every time we find a real master marker, we can calculate the Marker Filter constant as SYNCMFTIME/300,

if SYNCMFPAR = 0

Every time we find a real master marker, we calculate the Marker Filter constant as the Filtered Old master velocity * SYNCMFTIME / (SYNCMPULS * 3) which means, that the Marker Filter constant is used as time constant for filtering. Then the time which is needed to get an output corresponding to a steady input should be nearly SYNCMFTIME.
The calculation is necessary, because the filter is executed every marker and not every ms.
This Marker Filter constant is now used when filtering the marker distance. The result is then used to calculate the necessary gear correction.
The Gear correction can be calculated as follow:
Gear correction = (SYNCMPULSM – Filtered marker distance) / Filtered marker distance

Filtering master velocity and gear correction

Every sample time we calculate the filtered master velocity (difference of actual and last master position).

If (SYNCVFTIME < 0) then we calculate Filtered Old master velocity with a filter time constant equal SYNCVFTIME / 1000
Else the Filtered Old master velocity is set equal to the actual master velocity.
In case where SYNCMFTIME > 0 and SYNCMFPAR = 2 the gear correction is made by taking the current gear ratio and add the master velocity multiplied by the Gear correction.

Start correction

only if SYNCMFTIME > 0

Start correction is the correction we have to realize after start condition is fulfilled. That means either we observed the first two markers (SYNCMSTART 1,6) or we reached master velocity and have observed the first two markers (SYNCMSTART 2,3,4,5). This start correction is split in such a way, that it will be eliminated after SYNCOFFTIME. (Actually its divided by the amount of markers, which will be passed in SYNCOFFTIME at the actual master velocity and that value is added to the normal marker correction.

If SYNCOFFTIME == 0, Start correction will be eliminated at once, which means that the correction will be done in between two markers.

Marker correction

SYNCMFTIME > 0

From SyncPos PC-Software version 5.04 onwards: First we take the marker error and subtract the remaining start correction. Then we set correction filtering time corresponding to the SYNCOFFTIME (master velocity dependant see start correction number of markers).

Now we put the sum of all marker distance errors into a marker filter to calculate the filtered sum. Then we subtract the filtered error sum from the unfiltered one. This result is then used to correct the marker correction.
This corrected correction is then given into the correction filter. The result of this correction filter is then stored (plus start correction part if necessary).

Then we try to spread this correction over one marker distance. This is done by dividing the correction by the number of samples which will be necessary to pass one marker distance at actual master speed. This value is stored and will be used every sample time to correct the calculated slave position.

Following SYNCMFPAR settings modify behavior:

SYNCMFPAR & 4 ➜ correction time is used instead of using SYNCOFFTIME.

SYNCMFPAR & 16 ➜ We don't make the correction concerning the error of marker distances.

Marker correction

SYNCMFTIME == 0

In the first case where marker correction > 0, we spread the correction over a time of (-SYNCVFTIME / 100) ms.
In the second case we add the correction to our demand position at once.
The reaction of course is limited by the actual acceleration and deceleration in every case.

Parameter Group

AXS Synchronization
(It is not yet in the parameter dialog window.)

Unit

1 ms

Value range

–MLONG ... MLONG ★ 0

0 = If SYNCVFTIME (65) is negative,
the marker correction is spread by
SYNCVFTIME /100

19 SWNEGLIMACT

By setting this parameter (to 1) the VLT is informed that the negative software limit switch should be monitored. Then it is checked whether the target position is located outside of the permissible movement range during every movement. In this case an error message is issued and the drive control is switched off.

In the positioning mode this means that the corresponding positioning process is not started and the error can be cleared with the ERRCLR command.

In the impulse mode an error can only be recognized after the limit has been exceeded, thus when the error message is issued the drive is already outside of the permissible area of movement. In this case, it is necessary to move the drive, by hand, back to the admissible area, and to erase the error – or in the menu "CONTROLLER" → "PARAMETERS" → "AXIS" to temporarily turn off the corresponding ***Software limit switch*** and then delete the error.

Content

Negative limit enable

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

0 … 1	★ 0
0 = inactive	
1 = active	

20 SWPOSLIMACT

By setting this parameter (to 1) the VLT is informed that the positive software limit switch is to be monitored. In this case it is checked whether the target position is located outside of the permissible movement range during every movement. If necessary an error message is issued and the drive control is switched off.

In the positioning mode this means that the corresponding positioning process is not started and the error can be cleared with the ERRCLR command.

In the impulse mode an error can only be recognized after the limit has been exceeded, thus when the error message is issued the drive is already outside of the permissible area of movement. In this case, it is necessary to move the drive, by hand, back to the admissible area, and to erase the error – or in the menu "CONTROLLER" → "PARAMETERS" → "AXIS" to temporarily turn off the corresponding ***Software limit switch*** and then delete the error.

Content

Positive software limit switch active

Parameter Group

Inputs/Outputs

Value range

0 …1	★ 0
0 = inactive	
1 = active	

21 KILIM (705)

The ***Integration limit*** KILIM indicates the maximum value that can be inputted into the PID filter via the integral factor. Thus it can be prevented that due to a high additive error too strong of counter control is used which would cause the system to swing.

Content

Limit value for integral sum for PID control

Parameter Group

PID-Controller

Value range

0 … 65000	★ 0
0 = OFF	

22 VELRES

The ***Velocity resolution*** VELRES defines a relative size for the velocity values of the motion commands and parameters.
The information concerning speed and acceleration can then be made in whole numbers in relation to this scaling. The value 100 means that the information in the commands are related to 100, thus in percent.

Content

Velocity resolution

Parameter Group

Axis parameter velocity AXV
CAM-Editor: index card velocity

Value range

1 … MLONG ★ 100

23 POSFACT_Z

All path information in motion commands are made in user units and are converted to quad-counts internally. By choosing these scaling units correspondingly it is possible to work with any technical measurement unit (for example mm).
This factor is a fraction which consists of a numerator and denominator.
POSFACT_Z / POSFACT_N = 1 UU
Scaling determines how many quad-counts make up a user unit. For example, if it is 50375/1000, then one UU corresponds to exactly 50.375 qc.

In CAM-Mode, the parameter is used to fix the unit for the slave drive so that it is possible to work with meaningful units in the CAM-Editor. See sample 2.

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}}\ \text{qc} = 1\ \text{UU}$$

provided that:

$$\text{Gearing factor} = \frac{\text{Motor revolutions}}{\text{Revolutions on output}}$$

Encoder = Incremental encoder (in the case of absolute encoders, the multiplier 4 is omitted)
Scaling factor = Number of user units UU (qc) that correspond to one revolution at the drive

In addition, it is possible to compress or expand the curves with this factor without having to define new curves each time. The use of numerator and denominator for the gearing factor leads to a very precise result since transmission ratios can be represented as a fraction in virtually all cases.

Content

Numerator user factor
or in CAM mode conversion of the units qc into UU

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Value range

1 … MLONG/max. position (UU) ★ 1000
The limit depends on the maximum target position
max. position (UU) * POSFACT_Z < MLONG
where by
Example: POSA max. position (UU)

Example 1: Shaft or spindle

25 motor revolutions result in 1 spindle revolution; gearing factor = 25/1
Encoder resolution (incremental encoder) = 500
Spindle gradient = 1 revolution of the spindle = 5 mm
Scaling factor if we want to work with 1/10 mm resolution = 5 * 10 = 50

$$\frac{25/1 * 500 * 4}{50}\ \text{qc} = \frac{25 * 10 * 4}{1}\ \text{qc} = \frac{1000}{1}\ \text{qc} = 1\ \text{UU}$$

Numerator user factor [23]	= 1000
Denominator user factor [26]	= 1

Example 2: Cylinder

Gear factor = 5/1
Encoder resolution (incremental encoder) = 500
One revolution of the cylinder is 360 degrees. We want to work with a resolution of 1/10 degrees. This means that we divide one revolution of the cylinder into 3600 units.
Scaling factor = 3600

$$\frac{5/100 * 500 * 4}{3600}\ \text{qc} = 1\ \text{UU}$$

$$\frac{5 * 500 * 4}{3600}\ \text{qc} = \frac{25}{9}\ \text{qc} = 1\ \text{UU} = \frac{\text{POSFACT\_Z (23)}}{\text{POSFACT\_N (26)}}$$

Numerator user factor [23]	= 25
Denominator user factor [26]	= 9

24 TESTTIM

Once the target window has been reached the position is read twice and compared with the parameter TESTVAL (25). If the result is less than TESTVAL (25), then the position has been reached, otherwise a new reading is taken. TESTTIM indicates the time interval between the measurements.

Content

Measuring time in target window

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Unit

ms

Value range

0 ... 10 ★ 0

NB!
The reason for the limitation to 10 ms is to be seen, that the function *diffval* waits really and in this time the monitoring of the limit switch and the position error is not active. For this reason the value should be not too long.

25 TESTVAL

Once the target window has been reached the position is read twice with an interval of TESTTIM (24) and the interval is compared with the ***target window limit value*** TESTVAL. The result determines whether the position is viewed as having been reached or not.

NB!
For longer time intervals it must be taken into consideration that reaching this target position will be delayed by this amount of time in any case.

Content

Limit value for readings in target window

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Unit

qc

Value range

1 ... 65535 ★ 1

26 POSFACT_N

All path information in motion commands are made in user units and are converted to quad-countsinternally. By choosing these scaling units correspondingly it is possible to work with any technical measurement unit (for example mm).
This factor is a fraction which consists of a numerator and denominator.
POSFACT_Z / POSFACT_N = 1 User unit [UU]
Scaling determines how many quad-counts make up a user unit. For example, if it is 50375/1000, then one UU corresponds to exactly 50.375 qc.
In CAM mode, the parameter is used to determine the unit for the slave drive so that it is possible to work with meaningful units in the CAM-Editor. See prerequisites of the formula and example under POSFACT_Z (23).

$$\frac{\text{Gearing factor * Encoder resolution * 4}}{\text{Scaling factor}}\ \text{qc} = 1\ \text{UU}$$

In addition, it is possible to compress or expand the curves with this factor without having to define new curves each time.
The use of numerator and denominator for the gearing factor leads to a very precise result since transmission ratios can be represented as a fraction in virtually all cases.

Content

Denominator user factor
or in CAM mode conversion of the units qc in UU

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Value range

1 ... MLONG ★ 1000

Sample

See POSFACT_Z (23)

27 ENCODERTYPE

This parameter determines the type of encoder: incremental or absolute.
Errors can occur when a linear absolute encoder is used. A possible leap in the position data can be detected with the encoder types "3" and "4" if it is larger than the encoder resolution/2. The correction is made by means of an artificial position value which is calculated from the last velocity. If the error continues for more than 100 read-outs (> 100 ms), there will be no further correction which will then indeed lead to a tolerated position error exceeded. The total number of errors will be saved in an internal variable which can be read out via SYSVAR[16].

Content

Type of encoder for slave encoder (encoder 0)

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Value range

0 … 4, 100 … 104 ★ 0
0 = Incremental encoder
1 = Absolute encoder, standard ca. 262 kHz
2 = Absolute encoder, ca. 105 kHz
3 = absolute encoder without overflow (linear) but with error correction, approx. 262 kHz
4 = absolute encoder without overflow (linear) but with error correction, approx. 105 kHz
100 … 104 = like 0 … 4, however, hardware monitoring of the encoder will be activated. Error 92 will be issued in case of open or short circuit.

NB!
The following commands cannot be used with absolute encoders: DEF ORIGIN, HOME, INDEX and WAITNDX.

NB!
The following commands can only be used with absolute encoders if external markers are used: IPOS, MIPOS.

28 POSDRCT

A normal requirement for the axis controller is that a positive reference value brings about a positive change of the position. If this is not the case (e.g. encoder transposed or motor connected improperly), the reference value can be reversed internally by the parameter POSDRCT = 2.
In some applications it is desirable to reverse the direction of rotation in user units. This is achieved by the negative sign in POSDRCT.
Die Richtung der Synchronisation (Verhältnis zum Master) kann durch negativen SYNCFACTM umgedreht werden.
The direction of rotation (relation to master) can be turned by negative SYNCFACTM.
In the case of a synchronization in CAM-Mode, you can determine a positive direction of rotation for the slave with POSDRCT. This is a prerequisite for the CAM functionality.

Content

Positive direction of rotation

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Value range

–2 … 2 ★ 1
1 = No change, i.e. positive reference values produce positive encoder values.
–1 = The sign of the user unit is reversed. Thus, positive reference values produce positive encoder values which are indicated as negative values, however. This applies to all outputs (APOS, CPOS, …), all user inputs (POSA, POSR, …) and all synchronization factors, as well as the velocities (CVEL, HOME_VEL).
2 = The sign of the reference value is reversed internally (plus becomes minus and vice versa). This is equal to a reversal of the motor leads, or a transposition of the A and B tracks on the encoder.
–2 = Same as "2", i.e. the sign of the reference value is reversed internally; in addition, the sign of the user unit is negated as in "–1".

29 PROFTIME

The Parameter gives the possibility to set the sample time for the profile generator, which is independent of the sample time for the PID controller.
For demanding control tasks in the background (SYNCP, SYNCM, SYNCC), the execution time of the SyncPos program may rise drastically. In such cases, the scan time of the profile generator can be increased to 2000 in order to have more time available for the SyncPos program. Values higher than 2000 provide hardly any benefits.

NB!
The VEL, ACC and DEC has to be set after a SET PROFTIME command.

Content

Scan time for profile generator

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

ms

Value range

1000, 2000 ★ 1000
1000 = 1 ms
2000 = 2 ms

30 MENCODER

MENCODER indicates the number of counts of the master encoders in pulses counts per revolution.

Content

Resolution of master encoder

Parameter Group

Axis parameter Encoder AXE
CAM-Editor: index card Encoder

Unit

Encoder counts per revolution

Value range

1 … MLONG ★ 500

31 RAMPMIN

The RAMPMIN parameter determines the shortest ramp (maximum acceleration). It indicates how long the acceleration phase lasts at the very least in order to achieve the rated velocity.

NB!
If you work with the SyncPos option card then you should always set the ramps via the option card and not in the VLT. The VLT ramps must always be set to minimum.

Content

Shortest ramp

Parameter Group

Axis parameter Velocity AXV
CAM-Editor: index card Velocity

Unit

msec

Value range

1 … 65535 ★ 1000

32 RAMPTYPE

RAMPTYPE determines the type of ramp used (trapeze or sinusoidal).

Content

Ramp type

Parameter Group

Axis parameter Velocity AXV
CAM-Editor: index card Velocity

Value range

0 – 1 ★ 0
0 = trapeze
1 = sinusoidal

33 DFLTVEL

DFLTVEL indicates the default velocity which is always used when no velocity is defined in the process set. This value refers to the ***Velocity resolution*** VELRES (22).

Content

Default velocity

Parameter Group

Axis parameter Velocity AXV
CAM-Editor: index card Velocity

Unit

$^1/_{\text{VELRES;}}$
Standard = $^1/_{100}$ = %

Value range

1 … VELRES ★ 50

34 DFLTACC

DFLTACC indicates the acceleration used when no explicit statements have been made. This statement is made in relation to RAMPMIN (31) and refers to the VELRES (22) parameter.

Content

Default acceleration

Parameter Group

Axis parameter Velocity AXV
CAM-Editor: index card Velocity

Unit

$^1/_{\text{VELRES;}}$
Standard = $^1/_{100}$ = %

Value range

1 … VELRES ★ 50

35 BANDWIDTH (706)

You can limit the bandwidth in which the PID controller should function, for example to avoid the built-up of a vibration if you are operating a system which could be jeopardized by vibrations.
However, then it is necessary to enter considerably higher values for the parameters FFVEL (36) and FFACC (37) in order to achieve the corresponding control. A system adjusted in such a manner is not as dynamic as it could be, but is considerably more stable and tends to experience less uncontrolled vibrations.

Content

Bandwidth within which the PID filter is active

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

%
The value 1000 means that the PID filter can output the full command value. For a BANDWIDTH of 500 only 50 % of the set value is output. Thus, values less than 1000 limit the P-share accordingly.

Value range

0 … 1000 ★ 1000

36 FFVEL (707)

When a control has a limited bandwidth then a base velocity must be set so that it can be ruled out that the control will entirely prevent the drive from running due to the limit set. FFVEL indicates the value with which the velocity feed-forward is completed.
When working with a normal PID algorithm the FFVEL must always be the same as the KDER factor in order to achieve typical dampening.

Content

Velocity feed-forward

Parameter Group

PID-Controller

Unit

%

Value range

0 … 65000 ★ 0

37 FFACC (708)

Set the base velocity whenever you have limited the bandwidth. Thus you will prevent the control from not accelerating at all due to the limit set. FFACC indicates the value with which the acceleration feed-forward is completed.
For a normal PID algorithm this value is equal to 0.

Content

Acceleration feed-forward

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

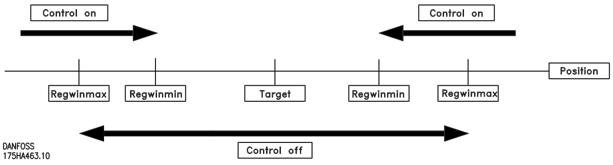
%

Value range

0 ... 65000 ★ 0

38 REGWMAX

The parameters REGWMAX and REGWMIN (39) are used to turn the position control within defined areas (control windows) on and off: REGWMAX indicates the size of the window outside of which the control should begin again.



Content

Size of the control window (activation)

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

qc

Value range

0 ... MLONG ★ 0

39 REGWMIN

REGWMIN indicates the size of the window inside of which the control is to be deactivated until the REGWMAX (38) control window is reached again.

Content

Size of the control window (deactivation)

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Unit

qc

Value range

0 ... MLONG ★ 0

40 HOMETYPE

Determines behavior during movement to home:

0= Moves to reference switch with HOME velocity and direction, then reverses and slowly leaves the switch, subsequently moves to the next index impulse.
1 = like 0, but does not search for index impulse
2 = like 0 but without reversing, rather continues movement in the same direction out of the switch
3= like 1 but without reversing

Content

Behavior during movement to home

Parameter Group

Axis parameter Home AXH
CAM-Editor: index card Home

Value range

0 ... 3 ★ 0

41 HOME_RAMP

Acceleration to be used during movement to home position. This statement refers to the minimum ramp, which is defined under the RAMPMIN (31) parameter. This unit results from the parameter VELRES (22) usually in % of the minimal ramp; 50% means half as fast, i.e. twice as long.
The following cohesion for HOME_RAMP results:

$$\text{HOME\_RAMP [ms]} = \frac{\text{VELRES (22)}}{\text{HOME\_RAMP (41)}} \cdot \text{RAMPMIN (31) [ms]}$$

Content

Ramp for home tracking normalized to the unit VELRES (22)

Parameter Group

Axis parameter Home AXH
CAM-Editor: index card Home

Unit

VELRES

Value range

1 … 65535 ★ 10

NB!
HOME_RAMP can never have a higher value than DFLTACC (34).

42 HOME_OFFSET

HOME_OFFSET is used to introduce an offset compared to the reference switch or index pulse. After homing, the drive is positioned to HOME_OFFSET. At this point the zero point is set.

Content

Zero point offset for machine zero point or index

Parameter Group

Axis parameter Home AXH
CAM-Editor: index card Home

Unit

qc

Value range

–MLONG … MLONG ★ 0

43 ERRCOND

ERRCOND determines the behavior in event of an error as follows:

0 = Standard, i.e. drive moves in COASTING, control loop is interrupted.
1 = like 0, but brake is activated, see O_BRAKE (48)
2 = motor stop with max. deceleration (stop ramp), subsequently standstill control
3 = like 2, brake is activated in addition, but only after MOTOR STOP.
All other activities such as MOTOR OFF etc. must be set in the ON_ERROR routine.

Content

Behavior in event of an error

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

0 … 3 ★ 0

44 ENDSWMOD

ENDSWMOD indicates how the control resp. the VLT should behave when a limit switch has been reached.
Error behavior see ERRCOND (43)

Content

Behavior at limit switch

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

0 – 1 ★ 0
0 = Trigger error
1 = Stop motor with max. deceleration

45 I_REFSWITCH

I_REFSWITCH determines which input of the option card should serve as reference switch. It is possible to react to a positive or negative edge, using a positive or negative number.
Behavior after reaching see HOMETYPE (40).

Content

Input reference switch

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

46 I_POSLIMITSW

I_POSLIMITSW determines which input should be interpreted as the positive limit switch.
It is possible to react to a positive or negative edge, using a positive or negative number.

Content

Positive limit switch

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

47 I_NEGLIMITSW

I_NEGLIMITSW determines which input should be interpreted as the negative limit switch.
It is possible to react to a positive or negative edge, using a positive or negative number.

Content

Negative limit switch

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

48 O_BRAKE

O_BRAKE indicates the output with which the brake can be activated.
NEW: If an output is defined for the brake, this remains active even when the program is terminated with ESC.
O_BRAKE is activated in the case of an an abort or option error if ERRCOND (43) is set to 1 or 3.
A positive number means that the output is high (24 V) when the function is active. A negative number means that the output is low (0 V) when the function is active.

NB!
The brake output must always be reset by an OUT command in the program.

Content
Output for brake

Parameter Group
Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range
–8 … 8 and
–14, –11, 11, 14 ★ 0

Example

```
ON ERROR GOSUB err_handle
SET O_BRAKE –1
SET ERRCOND 1
/* Main program loop */
…
SUBPROG err_handle
  WAITI 1
  ERRCLR
  OUT 1 1
RETURN
```

49 SYNCFACTM

The synchronization is described with a ratio of qc (Master : Slave); SYNCFACTM determines the synchronization factor for the master.
SYNCFACTM (49) and SYNCFACTS (50) make the compensation of different drive factors possible or the adaptation of the slave speed in relation to the master speed set.

$$\text{Slave velocity} = \text{Master velocity} * \frac{\text{SYNCFACTS (50)}}{\text{SYNCFACTM (49)}}$$

In conjunction with curve synchronization the parameters SYNCFACTM and SYNCFACTS are used to transform qc into MU units. This allows the user to work with meaningful units in the CAM-Editor. See example 2 below.

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}}\ \text{qc} = 1\ \text{MU}$$

provided that:

$$\text{Gearing factor} = \frac{\text{Motor revolutions}}{\text{Revolutions on output}}$$

Encoder = Incremental encoder (the multiplier 4 is omitted in the case of absolute encoders)
Scaling factor = Number of user units UU (qc) that correspond to one revolution at the drive.

Content
Synchronization factor master (M:S)
or in CAM mode conversion qc in MU units

Parameter Group
Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit
qc

Value range
1 … MLONG ★ 1
–MLONG … –1 = turns the direction of synchronization (ratio to the master)

Example 1
If the master is to run twice as fast as the slave, then the ratio is 2 : 1
SYNCFACTM = 2
SYNCFACTS = 1

Example 2: Conveyor belt

The input should be possible in 1/10 mm resolution. The drive is connected to the conveyor belt with a gearing of 25:11; this means that the motor makes 25 revolutions and the drive pulley 11.
Gear factor = 25/11
Incremental encoder directly on the master drive; encoder resolution = 4096
The drive pulley has 20 teeth/revolution, 2 teeth correspond to 10 mm; thus, 1 revolution = 100 mm conveyor belt feed.
Thus, the scaling factor is 1000

$$\frac{25/11 * 4096 * 4}{1000}\ \mathrm{qc} = 1\ \mathrm{MU}$$

$$\frac{25 * 4096 * 4}{1000 * 11}\ \mathrm{qc} = \frac{2048}{55}\ \mathrm{qc} = 1\ \mathrm{MU} = \frac{\mathrm{SYNCFACTM\ (49)}}{\mathrm{SYNCFACTS\ (50)}}$$

Set the following parameters in order to work with 1/10 degree division
SYNCFACTM = 2048
SYNCFACTS = 55

Example 3: Calculation of the scaling factor for a friction drive

Assume that the output is equipped with a friction wheel (radius 60 mm); we want to work with a resolution of 1/10 mm:
One revolution on the output is thus calculated as follows:
Scaling factor = 2 Π r * 10 = 2 Π * 60 * 10 = 3969,91
Scaling factor = 3970
Since an error will occur in any case due to the rounding, a marker adjustment must be performed after each full revolution.

50 SYNCFACTS

The synchronization is described with a ratio of qc (Master : Slave); SYNCFACTS determines the synchronization factor for the slave.
SYNCFACTM (49) and SYNCFACTS (50) make the compensation of different drive factors possible or the adaptation of the slave speed in relation to the master speed set.

$$\text{Slave velocity} = \text{Master velocity} * \frac{\mathrm{SYNCFACTS\ (50)}}{\mathrm{SYNCFACTM\ (49)}}$$

In conjunction with CAM synchronization the parameters SYNCFACTM and SYNCFACTS are used to transform qc into MU units. This allows the user to work with meaningful units in the CAM-Editor. See example 2 below.
See prerequisites of the formula and example under SYNCFACTM (49).

$$\frac{\text{Gearing factor} * \text{Encoder resolution} * 4}{\text{Scaling factor}}\ \mathrm{qc} = 1\ \mathrm{MU}$$

Content

Synchronization factor slave (M:S)
or in CAM mode conversion qc in MU units

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc

Value range

1 … 2 * MLONG/max. master velocity ★ 1
where by
max. master velocity unit is in QC/PROFTIME(29)

Example

See SYNCFACTM (49)

51 SYNCTYPE

Content

Type of synchronization: Normal synchronization (0) or with look ahead synchronization (1).

Description

The way how synchronisation is done can be changed:
In the standard case (SYNCTYPE=0), the position difference is eliminated.
That means, that the actual master position (where master is now) is compared with the future slave position (where slave will be in 1 msec). Thus you will always drive behind master, as long as you don't use INTEGRAL.
If you choose SYNCTYPE = 1, the system compares actual master position with actual commanded position. That means, that the system will try to make this zero, no matter how PID is set.

NB!
Be aware, that SYNCERR equals to actual (new) master command position minus actual position of the slave plus pending errors of filtering and pending corrections.

Parameter Group

Axis parameter Synchronization AXS (It is not yet in the parameter dialog window.)

Value range

0 … 1 ★ 0

0 = The actual master position is compared with the future slave position (where slave will be in 1 msec). (This is the way it is done with PC version < 5.04)

1 = The actual master position is compared with actual commanded position.

52 SYNCMARKM

SYNCMARKM and SYNCMARKS must be set according to the ratio between the number of marker signals from master and slave.
A ration of 1:1 means that each slave marker will be aligned with each master marker. A ratio of 2:1 means that each slave marker will be aligned with each second master marker.

Content

Marker number of the master

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Value range

0 … 65535 ★ 1

53 SYNCMARKS

SYNCMARKM and SYNCMARKS must be set according to the ratio between the number of marker signals from master and slave.
A ration of 1:1 means that each slave marker will be aligned with each master marker. A ratio of 2:1 means that each slave marker will be aligned with each second master marker.

Content

Marker number of the slave

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Value range

0 … 65535 ★ 1

Example

The master marker is an external signal which reports when a transport article arrives; the corresponding slave marker is the index impulse of the motor. If the motor always requires 3 rotations until the article arrives, then this means that 3 index impulses must elapse before a marker comes. Thus, this results in a ratio of 3 : 1; only every 3rd slave pulse is evaluated.

54 SYNCPOSOFFS

Defines the offset for position synchronization (SYNCM, SYNCP). The offset is also valid for position synchronization with marker correction.
This position offset can be altered online at any time during the synchronization with a command.

$$\text{Slave Offset} = \text{SYNCPOSOFFS} \, \frac{\text{SYNCFACTS (50)}}{\text{SYNCFACTM (49)}}$$

NB!
The offset will be executed immediately when the command SYNCP follows.

NEW
When SYNCM is started, however, the system waits for the first evaluation of the market pulses. Only then is the offset applied.

Compatability

To avoid compatibility problems you should determine the start-up behavior of SYNCM with SYNCMSTART.

Content

Position offset for position synchronization

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc

Value range

–MLONG/SYNCFACTS (50)
… MLONG/SYNCFACTS (50) ★ 0

55 SYNCACCURACY

Defines how large the difference between the actual master and slave position can be during a position synchronization (SYNCP and SYNCM), so that the required accuracy is still fulfilled. In contrast SYNCERR provides the actual synchronization error of the slave in user units.
In the program you can query whether SYNCACCURACY will be fulfilled using SYNCSTAT.
SYNCACCURACY is important for the marker synchronization in order to be able to report READY, since otherwise SYNCERR would have to be queried and compared beforehand.

Content

Size of the accuracy window for position synchronization

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc
or in CAM mode in UU

Value range

–MLONG … MLONG	★ 1000
0 … MLONG	A plus sign supplies the absolute value to SYNCERR.
–MLONG … –1	A minus sign supplies the synchronization error to SYNCERR with polarity sign. It is then possible to tell whether the synchronization is running ahead or behind.

56 SYNCREADY

SYNCREADY defines how often during a marker synchronization (SYNCM and SYNCCMM) a synchronization evaluation with ACCURACY must be completed with accuracy so that ready is fulfilled.
ACCURACY is checked during every correction. If ACCURACY is fulfilled then 1 is added until the set marker number has been achieved.
Synchronization evaluation is always executed after n marker pulses by the master SYNCMARKM (52).
ACCURACY and READY can be queried using SYNCSTAT.

Content

Number of markers for READY

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Value range

0 … 65535 ★ 1

57 SYNCFAULT

Defines how often during a marker synchronization (SYNCM and SYNCCMM) an inaccuracy may occur during a synchronization evaluation before a FAULT is registered.
In the program this condition can be queried using SYNCSTAT.

Content

Marker number for fault

Parameter Group

Axis parameter synchronization AXS

Value range

0 … 65535 ★ 10

58 SYNCMPULSM

SYNCMPULSM indicates how many qc (master) lie between two master markers.
If you use the encoder index impulse as a marker signal, then the distance between two markers is the resolution (qc) of the encoder.
If external marker signals are used, then it is possible to measure the marker distance with the program “marker count” (refer to program sample in Chapter 7), if it is unknown.
SYNCMPULSM is only valid for synchronization with marker correction (and SYNCCMM).
In a CAM synchronization, the distance of the sensor to the working position in MU will be indicated instead of the distance between two master markers. (The distance is brought about automatically by the master cycle length (Mt))
If the parameter is larger than one master cycle length (Mt), a marker-FIFO register will be created automatically for the handling of the marker correction.

Content

Distance between two master markers
or in CAM-Mode the distance between sensor and working position

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc
in CAM mode: MU

Value range

0 … 2 * MLONG / (SYNCMARKM(52) * SYNCFACTS(50) * n) ★ 500
whereby
n = number of the marker, which can be between master and slave, when the slave tries to catch up with the master when starting.

59 SYNCMPULSS

SYNCMPULSS defines how many qc (slave) lie between two markers (slave) or in CAM-Mode the distance of the sensor to the working position in UU.
SYNCMPULSS is only valid for synchronization with slave marker correction (SYNCM and SYNCCMS).

Content

Marker interval slave (marker distance slave)
or in CAM-Mode the distance of the sensor to the working position in UU.

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc
in CAM mode: UU

Value range

0 … 2* MLONG / 9 ★ 500

60 SYNCMTYPM

Defines the signal resp. the marker type for the master: Index pulse of the encoder or external marker.
SYNCMTYPM is only valid for synchronization with marker correction (SYNCM and SYNCCMM) or if you want to use the command MIPOS in your program.
Master marker signal: Input 5.

Content

Marker type for master

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Cross reference

MIPOS, SYNCMTYPS

Value range

0 … 3 ★ 0
0 = index pulse (positive flank)
1 = index pulse (negative flank)
2 = external marker (positive flank)
3 = external marker (negative flank)

61 SYNCMTYPS

Defines the signal resp. the marker type for the slave: Index pulse of the encoder or external marker.
SYNCMTYPS is only valid for marker synchronizations (SYNCM).
Slave marker signal: Input 6

Content

Marker type slave

Parameter Group

AXS

Cross reference

IPOS, SYNCMTYPM

Value range

0 … 3 ★ 0
0 = index pulse (positive flank)
1 = index pulse (negative flank)
2 = external marker (positive flank)
3 = external marker (negative flank)

62 SYNCMSTART

SYNCMSTART defines whether at start the synchronization should be made to the leading, subsequent or closest marker impulse of the master. SYNCMSTART is only valid for synchronization with marker correction (SYNCM and SYNCCMM).

Content

Start behavior for synchronization with marker correction

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Value range

0 … 6 and 1000 … 1006, 2000 ★ 0

0 = The slave marker following the first master marker (after SYNCM) is aligned with the first master marker.

1 = The first slave marker (after SYNCM) is aligned with the following master marker.

2 = After reaching the master velocity the next 2 markers will be aligned (correction can be forward or backward)

3 = After reaching the master velocity the next slave marker will be aligned with the master marker in front (correction is forward)

4 = After reaching the master velocity the next slave marker will be aligned with the marker behind (correction is backward)

5 = After reaching the master velocity the next slave marker will be aligned with the closest master marker (correction can be forward or backward, always the shortest distance).

6 = After the command SYNCM the first two markers are taken and the program synchronizes to these markers.

1000 … 1006 = as above, an offset (SYNCPOSOFFS) is not active before the first marker correction ist done.

2000 = in CAM mode: Counting of the master pulses in MU begins with the master marker.

NB!
Only the parameter 2000 is effective in curve synchronizations.

63 REVERS

REVERS determines the behavior while moving in reverse (moving in a negative direction): whether reverse is allowed, only allowed when the master is reversed or not allowed in general.
REVERSE is always valid even for the positioning errors VEL and "TESTRUN".
In order to prevent automatic reversing during the “TESTRUN” adjust the value to 1 or 2.

Content

Reverse behavior for the slave

Parameter Group

Axis parameter PID-Controller AXR
CAM-Editor: index card PID

Value range

0 … 2 ★ 0

0 = reverse always allowed, reference ±10 V

1 = reverse only allowed when the master is reversed, reference ±10 V

2 = reverse not allowed, reference ±10 V

64 O_AXMOVE

Set the output number which must be controlled by the AXMOVE function. The output is always activated as soon as a motion command is active, regardless in which mode (position, velocity or synchronization command).
This function is not suitable for monitoring the motor, since the motor could be standing still although the control is in motion.
It is possible to react to a positive or negative edge.
A positive number means that the output is high (24 V) when the function is active. A negative number means that the output is low (0 V) when the function is active.

Content

Output for motion command active

Parameter Group

Axis parameter Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

–8 … 8 ★ 0

65 SYNCVFTIME (709)

This parameter configures the velocity filter which is used for the velocity synchronization. Since the velocity synchronization only uses the currently active master velocity and the values can decrease to very small values (e.g. 2 qc/ms) a small fluctuation in velocity can have dramatic effects. In order to even this out the following filter function is applied:
Cmdvel =
Old_Cmdvel + (Actvel – Old_Cmdvel) * ms/τ_filt
With the following:

Cmdvel	= set velocity
Old_Cmdvel	= last set velocity
Actvel	= actual velocity of the master
ms	= sampling time (fixed 1ms)
τ_filt	= filter time constants

Generally the value for t_filt is taken from a table, depending on the Encoder counts per revolution of the master. This value can be overwritten by the SYNCVFTIME parameter and is always used when SYNCVFTIME is not equal zero.

If the speed filter is defined with a negative number, the corresponding value also applies for angle/position synchronization SYNCP and for marker correction SYNCM.
In this case filtering takes place as described above, but the errors made are summed up. This error sum is taken into the calculation with 1000/(τ*10) in each case, so that no position deviation can occur over prolonged periods.
The value returned by SYNCERR always contains the error made so that this is also used for the evaluation of the synchronicity. In the case of marker correction the correction value is balanced more slowly and with the same factor as the error sums.
If, for example, a filter factor of –100000 (100 ms) is used, a marker correction is balanced within 1 sec. (100 ms * 10). This allows a “taming” of the synchronization without restricting the acceleration.

Content

velocity filter

Syntax

SET SYNCVFTIME value
value = filter time constants

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

τ_filt (µsec)

Value range

–MLONG … MLONG ★ 0

-999 … 999 = Standard table

Standard table

Encoder resolution	t_filt (msec)
250	39500
256	38600
500	19500
512	19000
1000	9500
1024	9300
2000	4500
2048	4400
2500	3500
4096	1900
5000	1400

66 SYNCVELREL

This parameter indicates by how many percent the slave drive can deviate from the velocity of the master while attempting re-synchronization. For example, during changes in SYNCPOSOFFS (54) or at the start of synchronization or during the correction of deviation for marker evaluation. The following is valid:
If the slave need to catch up it runs with the maximum speed allowed; this is either the speed set with VEL or the master velocity calculated with
MAVEL + MAVEL * SYNCVELREL/100
depending which of the two is less. (MAVEL is the actual master velocity).

If the slave needs to slow down and wait for the master it will run with at least the following speed
MAVEL – MAVEL * SYNCVELREL/100.
That means, if SYNCVELREL is 50, for example, the slave will not run slower than MAVEL/2.

Content

tolerated deviance of the slave drive from the master velocity in %

Syntax

set syncvelrel value
value = percent value

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

%

Value range

0 … MLONG ★ 0

0 = OFF, i.e. no restriction

67 MENCODERTYPE

This parameter determines the type of master encoder: incremental or absolute encoder.
Errors can occur when a linear absolute encoder is used. A possible jump in the position data can be detected with the encoder types "3" and "4", as long as it is larger than the encoder resolution/2. The correction is made by means of an artificial position value which is calculated from the last velocity. If the disruption is present for more than 100 read-outs (> 100 ms), no further corrections are made, which will then in fact lead to a tolerated position error exceeded.
The total number of disruptions that have occured will be stored in an internal variable which can be read out via SYSVAR[16].
It is possible to simulate a master by means of APOSS command with the encoder type "6", for example when the master position is read via the bus. The simulated master positions are set and read with the system variable SYSVAR[4105].

Content

Type of encoder for master encoder

Parameter Group

Axis parameter encoder AXE
CAM-Editor: index card encoder

Value range

0 … 2 and 6 and 100 … 102 ★ 0

0 = Incremental encoder
1 = Absolute encoder, standard ca. 262 kHz
2 = Absolute encoder, ca. 105 kHz
6 = The master position is not read by the encoder; instead, it is set with the system variable SYSVAR[4105].
100 … 102 = like 0 … 2, however, hardware monitoring of the encoder will be activated. Error 92 will be issued in case of open or short circuit.

NB!
With absolute encoders the following commands can not be used: DEF ORIGIN, HOME, INDEX and WAITNDX.

NB!
The following commands can only be used with absolute encoders if external markers are used: IPOS, MIPOS

68 SYNCMWINM

The ***Marker Window Master*** SYNCMWINM shows how large the permitted tolerance for the occurrence of the markers is.
With the works setting "0" the window is not monitored, which means that it is always synchronized to the next marker even if this has a considerably larger interval.
At every other setting only those markers are accepted which are within the window. If there is no marker within the tolerance window the corresponding flag (SYNCSTAT) is set and no marker correction takes place. The corresponding other marker is also ignored and only corrected the next time – i.e. no catching up to the next marker.
When SYNCM (or SYNCCSTART) is started the monitoring only begins when the first marker has been found.

Content

Tolerance window for marker monitoring

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc
or in CAM mode: MU

Value range

0 … MLONG or. max. Marker interval SYNCMPULSM (58) ★ 0

0 = The window is not monitored.
1 … MLONG = Only one marker is accepted within the window. If no marker is within the tolerance window, the corresponding flag (SYNCSTAT) is set and no marker correction carried out. This flag can be reset with an interrupt (ON STATBIT).

NB!
Changes of the parameter will become active immediately – not only after the next SYNCM command.

Sample

Marker interval SYNCMPULSM = 30000
Tolerance window SYNCMWINM = 1000
Only one marker within an interval of 29000 to 31000 is accepted.

69 SYNCMWINS

The Marker Window Slave SYNCMWINS shows how large the permitted tolerance for the occurrence of the markers is.
With the works setting „0“ the window is not monitored, which means that it is always synchronized to the next marker even if this has a considerably larger interval.
At every other setting only those markers are accepted which are within the window. If there is no marker within the tolerance window the corresponding flag (SYNCSTAT) is set and no marker correction takes place. The corresponding other marker is also ignored and only corrected the next time – i.e. no catching up to the next marker.
When SYNCM (or SYNCCSTART) is started the monitoring only begins when the first marker has been found.

Content

Tolerance window for slave marker monitoring

Parameter Group

Axis parameter Synchronization AXS
CAM-Editor: index card Synchron.

Unit

qc
or in CAM mode: UU

Value range

0 ... MLONG or. max. Marker interval
SYNCMPULSS (59) ★ 0

0= The window is not monitored.
1 ... MLONG = Only one marker is accepted within the window. If no marker is within the tolerance window, the corresponding flag (SYNCSTAT) is set and no marker correction carried out. This flag can be reset with an interrupt (ON STATBIT).

NB!
Changes of the parameter will become active immediately – not only after the next SYNCM command.

70 ESCCOND

With ESCCOND you can determine how the VLT will react to a program termination using ESC.

Content

Condition on program termination

Parameter Group

Axis parameters Inputs/Outputs AXI
CAM-Editor: index card Inp/Outp

Value range

0 ... 2 ★ 0

0= The motor is stopped with maximum deceleration, the brake is activated (if defined), the master simulation is stopped.
The outputs remain in the current status.
1 = As 0, but all outputs including the VLT5000 outputs 11, 14, 42 and 45 (resp. the VLT5000Flux outputs 26 and 46) are set at “0”.
Exception: The brake output – if defined – is always activated.
2= As “0”, but all outputs including the VLT5000 outputs 11, 14, 42 and 45 (resp. the VLT5000Flux outputs 26 and 46) are set at “1”.
Exception: The brake output – if defined – is always activated

102 PRGPAR (701)

With PRGPAR it is possible to set which program should be started after the conclusion of a program executed via autostart (auto identification). This parameter can also be changed and stored with other programs or via the display.
If the program parameters are set within a program with the command SET, for example
SET PRGPAR 5 then after the program is run program no. 5 will be started. Thus it is possible to start other programs from an SyncPos program and link several programs together.
If no program number is activated and no input for the program start I_PRGSTART (103) is set, then the program with auto identification will be started.

NB!
If no autostart program is defined then it is not possible to start a program via PRGPAR (102); this always requires a terminated autostart program.

Content
Activated program number

Parameter Group
Global parameters GLS

Value range
–1 … 127 (optionally + 1000) ★ –1

–1	= program number is not activated, i.e. no program to start after autoexec
0…127	= activated program number is started after power up (and autoexec)
0…127 +1000	= activated program number is started, but at power on the motor is turned off (motor off)
–1 + 1000	= (999) same as –1, but with motor disabled after power up

Portability
Parameter value +1000 with option card version 5.00 onwards.

Example

```
SET PRGPAR 5   // program number 5 is started
               // immediately after power up
               // and after execution of autoexec
SET PRGPAR 1005
    // program number 5 is started,
    // but at power on the motor is off
```

103 I_PRGSTART

If the input for I_PRGSTART ≠ 0, then the autostart program is run first and then the program waits until input I_PRGSTART comes. This is then evaluated relevant to the program selection I_PRGCHOICE (104) in order to determine the number of the program to be run.
If no input for the program start I_PRGSTART is set, then the program with auto identification will be started.

Content
Input for program start

Parameter Group
Global parameters GLI

Value range
0 … 8 ★ 0

104 I_PRGCHOICE

If I_PRGCHOICE > 0 then this parameter indicates the input number starting at which the inputs for the ***Program selection*** are used. This includes all numbers up to I_PRGSTART (103).

Example:
If I_PRGCHOICE = 3 and I_PRGSTART = 7, then upon activation of input 7 the inputs 3, 4, 5, and 6 will be evaluated binary and the result will be used as a program number.

Input	Level	Binary value
3	low	0
4	high	2
5	high	2^2
6	low	0
=> program to be started:		6

Thus it is possible to choose between a maximum of 128 programs, identified with the numerals 0 to 127.

Content
Input for program selections start number

Parameter Group
Global parameters GLI

Value range
0 … 8 ★ 0

105 I_BREAK

If this input is defined, then when this input is activated the program running will be aborted immediately. Such a program can be continued with CONTINUE. It is possible to react to a positive or negative edge, using a negative or positive number.

Content

Input for abort

Parameter Group

Global parameters GLI

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

106 I_CONTINUE

I_CONTINUE determines which input is used to continue aborted programs. It is possible to react to a positive or negative edge, using a negative or positive number.

Content

Continue program

Parameter Group

Global parameters GLI

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

107 I_ERRCLR

I_ERRCLR determines which input is used to clear an error. It is possible to react to a positive or negative edge, using a negative or positive number.

Content

Clear error

Parameter Group

Global parameters GLI

Value range

1 … 8	= Reaction to a positive edge on input 1 … 8	
0	= no function	★ 0
–1 … –8	= Reaction to a negative edge on input 1 … 8	

108 O_ERROR

The output defined by O_ERROR is set when an option error has occurred. When the error is cleared this output is reset.
A positive number means that the output is high (24 V) when the function is active. A negative number means that the output is low (0 V) when the function is active.

Content

Output for error

Parameter Group

Global parameters GLI

Value range

–8 … 8 ★ 0

NB!
The setting of the O_ERROR parameter does not influence the use of the OUT and OUTB commands. With these commands it is also possible to change the outputs which have predefined functions.

Chapter 6

■ Messages and Error Reference

VLT and SyncPos Motion Controller messages

All messages are shown in the LCP display of the VLT in short and in the SyncPos software in plain text.
You can find brief information on the error messages in the table or detailed information in the following section.

Table of Messages

The tables contain the messages in numerical order. Letters following a % sign represent variables which can be used in plain text at the corresponding locations.

O.ERR_	LCP-Display	SyncPos message
3	AXES NOT IN SYSTEM	Axis no. *%bu* not in system
5	ERROR NOT CLEARED	Axis no: 1 Error not cleared
6	HOME NOT EXECUTED	Axis no: 1 Failed to move to HOME position
7	HOME_VEL ZERO	Axis no: 1 Home vel 0
8	POSITION ERROR	Axis no: 1 Position error
9	INDEX NOT FOUND	Axis no: 1 Index pulse (encoder) not found
10	UNKNOWN COMMAND	Unknown command
11	SOFTWARE LIMIT ACT.	Axis no.1 Software limit switch activated
12	ILLEGAL PARAMET. NO	Illegal parameter number
13	General VLT error	General VLT error
14	TOO MANY NEST. LOOP	Too many nested loops
16	PARAM. ERROR EEPROM	Parameters in EEPROM are corrupted
17	PROGR. ERROR EEPROM	Programs in EEPROM are corrupted
18	RESET BY CPU	Reset by CPU
19	USER ABORT	User abort
25	LIMIT SWITCH ACTIV.	Axis no. 1 Limit switch activated
49	TOO MANY INTERRUPTS	Too many interrupt functions
51	TOO MANY NEST. GOSUB	Too many nested GOSUB commands
52	TOO MANY RETURN	Too many RETURN commands
62	ERROR IN VERIFYING	EEPROM: address % defect
70	ERROR IN DIM COMMD	Error in DIM command
71	ARRAYBOUNDS CROSSED	Attempt was made to cross arraybounds
79	TIMEOUT WAITNDX	Timeout while waiting for index
84	TOO MANY ONTIME	Too many time interrupts
87	OUT OF MEMORY (VAR)	No more room for variables
90	MEMORY locked	The program memory is write-protected.
91	ILLEGAL CURVE ARRAY	Curve array wrong
92	ENCODER ERROR	Error from encoder monitoring
xx	INTERNAL ERROR	Internal error ##

SyncPos option messages in detail

As in the table above, the messages are in numerical order. Here you can find additional information about possible causes and tips on troubleshooting.

O.ERR_3

SyncPos

Axis no. *%bu* not in system

Cause

An attempt has been made to find another axis which does not exist in the controller. (The program allows for input of axis numbers greater than 1 since it is configured for multi-axes applications.)

Tip

Check to see if the program axis command has an invalid number or a general axis command (...X(*)).

O.ERR_5

SyncPos

Axis no: 1 - Error not cleared

Cause

An attempt has been made to execute a motion command, although a momentary error message has not been cleared.

O.ERR_6

SyncPos

Axis no: 1 - Failed to move to HOME position

Cause

According to the axis parameter HOME_FORCE (3), a forced move to the machine zero-point is demanded, before other motion commands can be executed. This move to the machine zero-point has not been executed.

O.ERR_7

SyncPos

Axis no: 1 - Home vel 0

Cause

HOME was executed with HOME_VEL set to zero.

O.ERR_8

SyncPos

Axis no: 1 - Position error

Meaning

The distance between the set and the real position was greater than the ***Tolerated position error*** defined in parameter POSERR (15).

Cause

Mechanically blocked or overloaded drive,
Tolerated position error POSERR (15) too small,
commanded speed greater than VLT Parameter 202 and 205,
commanded acceleration too great,
Proportional factor KPROP (11) too small or
VLT not enabled.

O.ERR_9

SyncPos

Axis no: 1 - Index pulse (encoder) not found

Meaning

At reference resp. index search, the encoder index pulse could not be found within a motor rotation.

Cause

An encoder without an index pulse has been used,
index pulse not connected correct,
index pulse incorrect (all three channels must have a simultaneous low) or
the parameter ENCODER (2) is set too low.

O.ERR_10

SyncPos

Unknown command

Cause

A communication or program error.

Tip

The program must be re-compiled and re-loaded.

O.ERR_11

SyncPos

Axis no. 1 Software limit switch activated

Cause

A motion command will cause / has caused the software limit switch to be activated.

Tip

Identification of attainment of software limit at a motion in the speed mode will only be made after the current position is identical to the software limit switch.

The control unit will be switched off and the drive must be manually moved back to within the admissible area, or the monitoring of the software limit switch must be temporarily de-activated via the axis parameter SWPOSLIMACT (20) resp. SWNEGLIMACT (19). Only then is it possible to clear the error.

In positioning mode, it will be known before motion start that the target position lies outside the path. In this case, the movement will not be executed and the error message can be cleared.

O.ERR_12

SyncPos

Illegal parameter number

Cause

An attempt has been made to change a parameter (SET or SETVLT command), which does not exist.

O.ERR_13

VLT NOT READY

Cause

VLT is not ready but the PID controller is active. The VLT status word (Bit 09 and Bit 11) is monitored every 20 msec when the PID controller is active.

The VLT is in the "Not ready" state when:

- it has an alarm,
- it is in local mode (parameter 002 = local),
- local LCP stop is activated,

O.ERR 13 can be reset by toggling input 27.

Note

When pressing local stop on the LCP error 13 may show on the display. To avoid this you can set parameter 014 to "disable" but that will disable the stop function of the local control panel.

O.ERR_14

SyncPos

Too many nested loops

Cause

Too many nested loops exist in the executed program.

O.ERR_16

SyncPos

Parameters in EEPROM are corrupted

Meaning

The parameters in EEPROM are no longer correct.

Cause

EEPROM defective or
power outage while saving.

Tip

You have to re-initialize the parameter with "CONTROLLER" → "PARAMETERS" → "RESET" and then overwrite these parameters with your own user parameters. Otherwise motion programs which require user parameters will no longer function correctly.

O.ERR_17

SyncPos

Programs in EEPROM are corrupted

Meaning

The program data stored in EEPROM cannot be found resp. are no longer correct.

Cause

EEPROM defective or
power outage while saving.

Tip

Delete the EEPROM with "CONTROLLER" → "MEMORY" → "DELETE EEPROM" and then reload the programs and parameters.

O.ERR_18

SyncPos

Reset by CPU

Meaning

The processor has been stopped and a re-set has automatically been executed (watchdog).

Cause

Short term voltage drop,
voltage peak or
short circuit.

O.ERR_19

SyncPos

User-Abort

Cause

The autostart-program has been aborted by the user.
Or the [CANCEL] key was pressed during switching on and a Master Reset triggered.

O.ERR_25

SyncPos

Axis 1: Limit switch activated

Cause

A motion command has caused an axis limit switch to be activated.

Tip

Through activation of a limit switch, the controller – depending on the parameter ENDSWMOD (44) – is automatically switched off and the drive must be manually moved out of this position, before the error message can be cleared.

O.ERR_49

SyncPos

Too many interrupt functions

Cause

More interrupt functions than the maximum possible number were used …

Tip

…permitted are:
32 ON INT
32 ON STATBIT
32 ON COMBIT
10 ON PARAM
20 ON APOS, ON MAPOS, ON MCPOS

O.ERR_51

SyncPos

Too many nested GOSUB commands

Cause

In the program, too many calls from one subroutine to another subroutine exist.
The error usually occurs when there is a recurrent reference to one of the sub-programs in a sub-program.

Tip

Avoid too many (10 is maximum) opposing subroutine calls,
avoid subroutines which call themselves (re cursive subroutine procedures).

O.ERR_52

SyncPos

Too many RETURN commands

Cause

There are either more RETURN than corresponding GOSUB commands in the program, or there is a direct jump from a subroutine with a GOTO command.
Only one RETURN is allowed per sub-program.
It is always better to jump to the beginning of a sub-program and then to jump with IF… to a previously defined label.

O.ERR_62

SyncPos

Error in verifying

Meaning

After saving something in the EEPROM (a program or parameters) an error was detected during verification.

Tip

Delete the EEPROM with "CONTROLLER" → "MEMORY" → "DELETE EEPROM" and try to save the program or parameters again. If this is not successful please call the technical service department.

O.ERR_70

SyncPos

Error in DIM command

Meaning

The definition of an array in a DIM command does not correspond to an already existing array in the SyncPos option.

Cause

The fields are from older SyncPos programs. The current program has other definitions.

Tip

Either adapt the SyncPos program to the correct array size or delete the old arrays with "CONTROLLER" → "MEMORY" → "DELETE EEPROM".

NB!
Remember to follow the recommendations concerning saving programs and parameters before deleting the EEPROM.

O.ERR_71

SyncPos

Attempt was made to cross arraybounds

Meaning

An attempt was made to describe an array element that is located outside of the defined array limits.

Cause

Error in the SyncPos program. Array sizing does not agree with the space required (e.g. due to an incorrectly programmed loop).
Or the array is too small for the number of test runs triggered by TESTSTART.

Tip

Check loop variables.

O.ERR_79

SyncPos

Timeout while waiting for index.

Meaning

The command WAITNDX was executed and the timeout listed was exceeded.

Cause

The timeout is probably too short or the index impulse could not found (see also O.ERR_9).

O.ERR_84

SyncPos

Too many time interrupts

Meaning

Too many ON TIME or ON PERIOD commands were used within the program.

Tip

A maximum of 12 of these ON TIME and/or ON PERIOD commands are allowed within one program.

O.ERR_87

SyncPos

No more space for variables

Meaning

When the SyncPos program is started the space for the necessary variables is reserved dynamically. This space is now no longer available.

Cause and tip

You may have selected a maximum number of variables which is too high. Reduce the maximum number in "SETTINGS" → "COMPILER" (Standard =92).
Or the memory available is occupied with programs or arrays. Delete the programs with "CONTROLLER" → "PROGRAMS" → "DELETE ALL"
or delete both the programs and arrays, i.e. by deleting the entire memory with "CONTROLLER" → "MEMORY" → "DELETE EEPROM".

NB!
Remember to follow the recommendations concerning saving programs and parameters before deleting the EEPROM.

O.ERR_90

SyncPos

MEMORY locked

Meaning

The program memory is write-protected and cannot be altered.

Tip

This means that autorecognition can neither be set nor deleted and programs can neither be saved or deleted. Equally, → "RAM SAVE" and → "EEPROM DELETE" will not be executed.

O.ERR_91

SyncPos

Curve array wrong

Meaning

An incorrect or old array is defined in the DIM instruction for SETCURVE.

Tip

An old array may exist if the cnf file with all parameters and arrays has not been loaded into the CAM-Editor.

An incorrect array could be caused by the following:

- It was not created by the curve editor.
- Previous version of a curve editor. Such an array must first be converted by the current curve editor (→ "LOAD" and "SAVE").
- Or the order of the arrays in the DIM instruction does not match the order in the cnf file. Refer to the number of the array in the title bar of the CAM-Editor in this respect.

O.ERR_92

SyncPos

Error from encoder monitoring

Meaning

Open or short circuit in accordance with the displayed LED

NB!

An error will be indicated even if no encoder is connected.

O.ERR_xx

SyncPos

Internal error ##

Meaning

If such an error should occur, please contact your dealer and report the error number displayed to the technical service department.

■ VLT software SyncPos messages

The VLT software SyncPos messages are arranged in alphabetical order. Letters following a % sign represent variables which can be used in plain text at the corresponding locations.

■ Compilation error ...

SyncPos

Compilation error(s): program not saved!

Meaning and tip

A file is always compiled first and then saved. If you want to save the program, for example in the menu "CONTROLLER“ → "SAVE PROGRAM" and a syntax error is found during compilation this message will be displayed.

Start the “SYNTAX CHECK” in the menu “DEVELOPMENT”, correct the syntax error and then save the program.

■ Connection to ... already exists ...

SyncPos

Connection to %d already exists [%s] - change to new Window?

Meaning

When opening a new window or when trying to connect a window with a controller that is already linked to a window.

Yes The controller is disconnected from the old window and linked to the new window.

No The controller stays connected to the old window, the new window is not linked to a controller.

■ Controller is executing a program ...

SyncPos

Controller is executing a program or command!

Meaning

When the controller is executing a command or program it is not available for additional commands. You have to → "BREAK" the new command and restart it once the previous command has been completely executed.

■ Error in array ...

SyncPos

Error in array part of file.

Meaning

When re-saving a configuration ("CONTROLLER" → "PARAMETERS" → "RESTORE FROM FILE") the computer recognizes that the data in the array area is formatted incorrectly.

Cause

In order to be able to save a file, the following conditions must be fulfilled:

- Identical software versions
- same configuration (e.g. same number of axes)
- In the case that arrays have already been inputted, these must match the ones that are to be saved in terms of type and size.

■ Error in axis parameter ...

SyncPos

Error in axis parameter part of file.

Meaning

When re-saving a configuration ("CONTROLLER" → "PARAMETERS" → "RESTORE FROM FILE") the computer recognizes that the data in the area of the axis parameters is formatted incorrectly. The parameter number and the sequence must be correct and numbering must be continuous.

Cause

In order to be able to save a file, the following conditions must be fulfilled:

- Identical software versions, that provides same number and order of the parameters
- same configuration (e.g. same number of axes)

■ Error in global parameter ...

SyncPos

Error in global parameter part of file.

Meaning

When re-saving a configuration ("CONTROLLER" → "PARAMETERS" → "RESTORE FROM FILE") the computer recognizes that the data in the area of the global parameters is formatted incorrectly.

Causes

In order to be able to save a file, the following conditions must be fulfilled:

- Identical software versions, that provides same number and order of the parameters
- same configuration (e.g. same number of axes)

■ Lost connection to ...

SyncPos

Lost connection to #%d!

Meaning

If the VLT is turned off or the plug is pulled, etc. the window is disconnected from the VLT and the lost connection is registered.

■ Timeout: no reply from VLT

SyncPos

Timeout: no reply from VLT

Meaning

The VLT does not answer; check the connection.

Chapter 8

■ Program samples

■ Program samples

■ Introduction

WARNING!

The entire unit must be installed according to the installation instructions and the functionability of the individual components and connections must be tested.

An EMERGENCY STOP must be installed according to the specific guidelines of the respective country.

The program samples may only be used with a drive which can turn freely without a path limitation.

The drive should be fixed in a stable holding device.

When using a linear unit limit switches for path limitation must be mounted and connected.

When using a linear unit the area of movement of the program samples must be calculated roughly and compared with the paths of movement which are mechanically permissible.

Cross references to the online help program samples

In the online help you will find all the other program samples, which are mentioned in the chapter software reference. You can copy these programs or parts of them directly into your program.

■ COM_OPT

```
/* Program for sending and reveiving 8 bytes of */
/* data via a communication option using */
/* PPO type 2 */

/* Definition of arrays */
DIM send [4]
DIM receive [4]

/* Definition of user parameters */
LINKGPAR 133 710 “DATA WORD 1” 0 255 0
LINKGPAR 134 711 “DATA WORD 2” 0 255 0
LINKGPAR 135 712 “DATA WORD 3” 0 255 0
LINKGPAR 136 713 “DATA WORD 4” 0 255 0

/* Initialize arrays (all elements = 0) */
i = 1
WHILE (i<=4) DO
   receive [i] = 0
   i = i+1
ENDWHILE
j = 1
WHILE (j<=4) DO
   send [j] = 0
   j = j+1
ENDWHILE

/* Main program loop */
main:
send [1] = GET 133
   /* send array, element 1 = value of par. 710 */
send [2] = GET 134
   /* send array, element 2 = value of par. 711 */
send [3] = GET 135
   /* send array, element 3 = value of par. 712 */
send [4] = GET 136
   /* send array, element 4 = value of par. 713 */

COMOPTGET 4 receive
   /* Copy 4 words from comm. option */
   /* to receive array */
COMOPTSEND 4 send
   /* Copy 4 words from send array to */
   /* communication option */

/* Print data of receive array */
print “RECEIVED(4 WORDS)”,” “,receive [1],”
“,receive [2],” “,receive [3],” “,receive [4]

GOTO main
   /* End of program */
```

■ Marker count

```
/* Measurement of marker distance in */
/* connection  with SYNCM */
/* Master and slave must run when this program */
/* is executed */

DIM test[4]  /* Definition of array with 4 elements */

/* Definition of variables */
dones = 0
donem = 0

/* Save last marker position for slave and master */
test [1] = IPOS
test [2] = MIPOS

/* Start of main program loop */
main:
/* Monitor the next slave marker and */
/* save it’s position */
IF (IPOS != test [1] AND dones == 0) THEN
   test [3] = IPOS
   dones = 1
   res = test [3] - test [1]
   /* Calculate distance between 2 consecutive */
   /* slave markers */
   PRINT “Slave distance    “, res
   /* Print result */
ENDIF
   /* Monitor the next master marker and */
   /* save it’s position */
IF (MIPOS != test [2] AND donem == 0) THEN
   test [4] = MIPOS
   donem = 1
   res = test [4] - test [2]
   /* Calculate distance between 2 consecutive */
   /* master markers */
   PRINT “Master distance    “, res
   /* Print result */
ENDIF
GOTO main
```

■ syncc_msim.m

```
// Simulation of a master via software command

DIM curve[112], test [1000]
SET MENCODERTYPE 6
    // switch to internal software simulation
SETCURVE curve
simpos = 0
SYNCC 0
SYNCCSTART 0
start:
    SYSVAR[4105] = simpos
    // set master position (in qc)
    // Subsequently, gear system will be employed

     simpos = simpos + 100

    // ATTENTION, MAPOS continues
    // to supply the encoder values

GOTO start
TORIG_01
```

Chapter 9

■ Appendix

Glossary terms

FPGA

Field programmable gate array

Inverted value

notA = /A =
$\overline{A}$

LED

Light Emitting Diode

Master Units [MU]

The curve length or the master cycle length and other information (e.g. the marker distance) for the cam control are indicated in master units MU.
A factor (fraction) is used for the conversion into qc, as with the user unit:
1 MU = SYNCFACTM (49) / SYNCFACTS (50)

MLONG

For a description which is not dependent on the version or the hardware, variables were used for some limit values: thus the value of
MLONG = 1,073,741,824

Mt

Master (working) cycle length

MTC10

Motion Control Tool

Quadcounts

The unit defined by the parameter ***User factor*** POSFACT_Z (23) and POSFACT_N (26) is not used for all path and position parameters. For various parameters (for example a software limit switch like I_POSLIMITSW (46) and the parameter ***Tolerated position error*** POSERR (15) the quad-count unit (qc) is valid.
4 quad-counts correspond to one sensor unit (incremental encoder). In the case of absolute encoders, the absolute values are returned 1 : 1.

st

sample time = 1 ms

User units [UU]

The units for the drive or the slave and the master, respectively, can be defined by the user in any way desired so that the user can work with meaningful measurements. The user units and are converted to quad-counts internally.
In the CAM control, the maximum run distance of the slave or the slave cycle length are indicated in User Units UU (qc).
The User Units are standardized with a factor:
1 UU = POSFACT_Z (23) / POSFACT_N (26)

Zero impulse

= Index impulse

What's new in PC Software 2.1x / Option card Software 3.1x?

Extension of the user interface

Greater comfort in the editing window

Various colors are used to distinguish between comments, program sections, operators, numbers etc. You can change the colors with "SETTINGS" → "COLORS EDITOR".
You can also split the window vertically or horizontally for the display of a number of files.

Further editing tools and shortcuts

There are new editing commands, key combinations and function keys. The following editing tools have been added:
Unlimited undo and redo and the function find and replace.

If you press the CANCEL key on the VLT when switching on, the SyncPos option card will not start any program.

Extension of the compiler, commands and parameters

Extension of the compiler

Identification of comments using // analogously to the programming language C.
Further operators, such as XOR and Modulo and further bit operators.
Assignment Operation

Further interrupts

ON COMBIT	Interrupt when Bit n is set
ON STATBIT	Interrupt when Bit n is set
ON PARAM	Interrupt when a parameter n is changed

New commands

DEFMORIGIN	Set the current master position as the zero point for the master.
DELETE ARRAYS	Delete all arrays in the RAM.
DISABLE .. inttyp	Switches interrupts off
DISABLE ALL	Switches all interrupts off (except ON ERROR)
ENABLE ...	Switches interrupts on
ENABLE ALL	Switches all interrupts on
LINKSYSVAR	Link system variable with LCP display
MOVESYNCORIGIN	Relative shifting of the origin of synchronization
ON COMBIT .. GOSUB	Call up a subprogram when Bit n of the communication buffer is set.
ON PARAM .. GOSUB	Call up a subprogram when a parameter is altered.
ON STATBIT	Call up a subprogram when bit n of the VLT status is set.
PCD	Pseudo array for direct access to the profibus data area
SAVE ARRAYS	Save arrays in the EEPROM
SAVE AXPARS	Save current axis parameters in the EEPROM
SAVE GLBPARS	Save current global parameters in the EEPROM
SETMORIGIN	Set any position as the zero point for the master.
SYNCSTATCLR	Resetting of the flags MERR and MHIT
SYSVAR	System variable (Pseudo array) reads system values.
TESTSETP	Specify recording data for test run
TESTSTART	Start the recording of a test run

■ Commands which have been extended

SYNCERR

The return value informs, whether the synchronization is running ahead (negative result) or behind (positive result), if SYNCACCURACY is set to a negative value.

ERRCLR

As of Version 2.1x ERRCLR also resets Bit 7 of the control word of the VLT. Then the VLT messages no longer need to be deleted.

LINKGPAR

The command LINKGPAR tests whether the value of the user parameter is within the specified range. If not, the corresponding limit is used and this value saved. This ensures that a display appears.

SYNCM

When defined in SYNCMSTART (62), the system waits for the first evaluation of the marker pulses on starting SYNCM and only then the offset SYNCPOSOFFS (54) is applied.

#DEBUG

In addition to ON and OFF you can define NO STOP. The system is not stopped, but internal break commands update the line number when the program is executed incrementally with "DEVELOPMENT" → "SINGLESTEP F9"
The line numbers generated in this way can then be laid on a VLT parameter 795-799 with LINKSYSVAR and observed on the LCP display.

■ New Parameters

ESCCOND (70)

With ESCCOND you can determine how the VLT will react to a program termination using [ESC].

SYNCMWINM (68) / SYNCMWINS (69)

The Marker Window Master and Slave shows how large the permitted tolerance for the occurrence of the markers is.

■ Parameters which have been extended

POSDRCT (28)

You can invert the evaluation of the encoder information without changing the wiring (turning around the motor leads or exchanging the A and B tracks in the encoder).

O_BRAKE (48)

If an output is defined for the brake, this remains active even when the program is terminated with ESC.

SYNCPOSOFFS (54)

When SYNCM is started – in opposite to SYNCP – the system waits for the first evaluation of the marker pulses. Only then is the offset applied.

SYNCACCUARY (55)

Extended input range: A minus sign supplies the synchronization error to SYNCERR with polarity sign. It is then possible to tell whether the synchronization is running ahead or behind.

SYNCMSTART (62)

Additional possibilities to define the start conditions of the marker synchronization.

SYNCVFTIME (65)

Master filter for SYNCP and SYNCM

What's new in PC Software 2.2x and in corresponding SyncPos Motion Controller Software:

VLT5000/SyncPos software version 3.xx/4.1x
VLT5000Flux/SyncPos software version 5.xx/4.1x

CAM-Editor

This PC software version contains a CAM-Editor for the creation of the curves for cam control with and without marker correction of the master and slave. All parameters required for this application are set in the CAM-Editor.

The curve definition is possible alphanumeric as well as interactive. The curve path and requisite parameters are visualized in the curve profile.

Extension of the commands and parameters

New interrupts

The new position interrupts POSINT have been developed especially for the cam box function: ON APOS, ON MAPOS and ON MCPOS.

New commands

The new commands have been developed for the realization of cam control and cam box:

CURVEPOS	Retrieve slave curve position that corresponds to the current master position of the curve.
DEFMCPOS	Define initial position of the master
ON APOS .. GOSUB	Call up a subprogram when the slave position xxx is passed
ON MAPOS .. GOSUB	Call up a subprogram when the master position xxx (qc) is passed.
ON MCPOS .. GOSUB	Call up a subprogram when the master position xxx (MU) is passed.
POSA CURVEPOS	Move slave to the curve position corresponding to the master position
SETCURVE	Set CAM curve
SYNCC	Synchronization in CAM-Mode
SYNCCMM	Synchronization in CAM-Mode with master marker correction
SYNCCMS	Synchronization in CAM-Mode with slave marker correction
SYNCCSTART	Start slave for synchronization in CAM-Mode
SYNCCSTOP	Stop slave after the CAM synchronization
SWAPMENC	Transpose master and slave encoder internally.

Modified and Expanded Commands

SET ORIGIN

In combination with the command CURVEPOS, one can fix in this way that the current slave position matches the corresponding value of the curve.

SYNCSTAT

The flags SYNCMMERR and SYNCSMERR are automatically reset: during the next successful marker correction and in the event of a new start of SYNCM or through the command SYNCSTATCLR.

SYSVAR

Completion with the axis processing data for the curve profile.

New parameter

PROFTIME (29)

Scan time for profile generator

Modified and Expanded Parameters

Parameter 700

One can select „ENABLE SP. W/O MONI." as third setting and thus avoid Option Error 13 (VLT not ready).

ENCODERTYPE (27)

The disruption can be corrected in the case of absolute encoders without overflow (linear encoders).

POSFACT_Z (23) and POSFACT_N (26)

Is used in CAM-Mode to convert the units qc into user units.

SYNCFACTM (49) and SYNCFACTM (50)

Is used in CAM-Mode to convert the units qc into user units MU.

SYNCMPULSM (58) and SYNCMPULSS (59)

In CAM-Mode the distance between sensor and working position in MU resp. UU.

What's new in PC Software 2.2x and in SyncPos Motion Controller?

SYNCMTYPM (60) and SYNCMTYPS (61)

The signal resp. marker type applies also for the command MIPOS.

SYNCMSTART (62)

Additional parameter for the starting behavior: 2000 = in CAM-Mode: Counting of the master pulses in MU begins with the master marker.

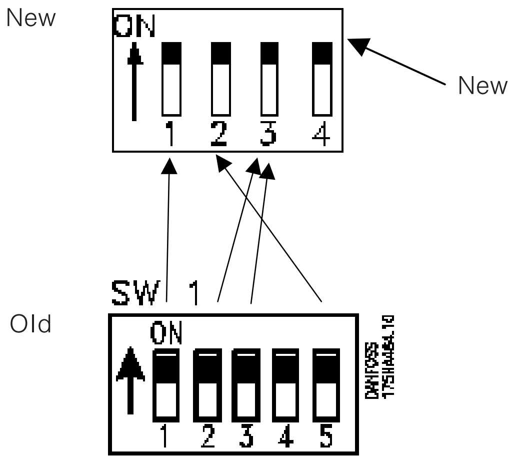
SYNCMWINM (68) and SYNCMWINS (69)

Changes of the parameter will become active immediately – not only after the next SYNCM command.

■ New hardware

The hardware of the Programmable SyncPos motion controller has been updated:

- Memory for programs has been extended from 38 kByte to 62 kByte.
- Hardware encoder monitor has been added.
- New LED's
- Dip switch changed, switches 2, 3 and 4 are combined to one switch (3) in the new hardware:



SyncPos for VLT5000Flux is always based on the new hardware.
SyncPos for VLT5000 based on the new hardware can be identified via the serial number which can be found on the bar-code label. Serial number xxxxxx**G**xxx means new hardware, serial number xxxxxx**N**xxx means old hardware.

Software compatibility

The new hardware is supported by option card software version 4.xx or newer.
The old hardware is supported by option card software version 3.12 or older.

■ What's new in PC Software 2.3x and in SyncPos Motion Controller Software

VLT5000/SyncPos Software Version 3.xx/4.2x
VLT5000FluxSyncPos Software Version 5.xx/4.2x?

■ Debug Modus

A comfortable debug mode and online status information as well as the possibility to change the variables during program execution.

"PREPARE SINGLESTEP"

All executable program lines are marked by blue dots.

"SINGLESTEP" or [F9]

In the debug mode: executes the next program line.

Breakpoints

In the debug mode: → "EXECUTE" or press [F5] in order to process the program until the next breakpoint.

Change variables online

In the debug mode: set value

Read variables

In the debug mode: read the current value of the variables after the program execution.

"SHOW WATCH"

Enables online monitoring of the variables, arrays, system and axis processing data (according to the SYSVAR indices) and axis parameters.

■ "FIND" and "REPLACE"

Find and replace in accordance with the Windows conventions and:

"MARK ALL"	marks all sites found with a blue triangle at the left margin
[F2]	jumps back and forth between the sites found
[F3]	jumps from one site found to the next one

What's new in the PC Software Version 2.5x and in Option Card Version 5.00?

This version contains primarily the necessary extensions and a modified GUI to use the SyncPos program in MCT10 mode.
Further on there is an additional feature to set or change the axis parameters with the modified CAM-Editor.

New and modified Commands

DEF SYNCORIGIN

Defines master-slave relation for the next SYNCP or SYNCM command

SYNCERR

The SYNCERR (as well as the internal master command position G_Mpcmd) is also updated when SYNCP or SYNCM are not active, e.g. after a MOTOR OFF.

Modified and Expanded Parameter

PRGPAR - 102

Extended with the possibility to start the activated program number, but at power on the motor is turned off (motor off).

What's new in the PC Software Version 6.5x and in Option Card Version 5.04

VLT5000/SyncPos Software Version 3.7x/5.04x
VLT5000FluxSyncPos Software Version 5.xx/5.04?

User interface

"DEVELOPMENT" menu

A "CLOSE INTERFACE" menu item has been added to close a currently open motor controller interface. For a fast access, the function has also been placed as a button on the toolbar.

A "COMPILE TO FILE" menu item has been added to compile the current file and save it in a binary file.

The "SYNTAX CHECK" will now produce a debug file in addition to checking the syntax. It will be called "emp.ad$".

"TESTRUN" menu

A "CLEAR ERROR2 button has been added to the Testrun-Parameters dialog that is displayed when the user → "EXECUTE TESTRUN" to clear any currently pending error conditions in the motor controller.

"CONTROLLER" menu

When program sourcecode is downloaded using the "PROGRAM" menu item and then checking the "INCLUDE SOURCECODE" checkbox, then "Include" files within the sourcecode are now expanded and downloaded with the sourcecode.

When an attempt is made to → "SAVE" a new "PROGRAM" using the Program menu item and a program is already active, then the new program cannot be saved. However, in this case, the user is now presented with a dialog box that will allow a "BREAK" to be sent to the currently active program. The new program will then be saved.

CAM Editor

When an old version of a „.cnf“ file (one that has does not have all the newest parameters defined) is loaded by the CAM Editor then the CAM Editor will now use appropriate default values for the missing parameters.

"SETTINGS" menu

A baud rate of 19.2k for the VLT interface can be set using the → "INTERFACE" menu.

New commands

MOVESYNCORIGIN

Relative shifting of the origin of synchronization

ON DELETE .. GOSUB

Deletes a position-interrupt: ON APOS, ON MAPOS or ON MCPOS

Modified and expanded Commands

CURVEPOS

CMASTERCPOS (SYSVAR) and CURVEPOS are now updated even if SYNCC is no longer active.

SETCURVE

Please see different behavior when SYNCC is active or not.

SYSVAR

Delivers some more information for the user:
New system process data index 35 for unfiltered value of analog input 1 and some more axis process data (indices 4113 … 4128 and 4240 … 4253).

New and modified parameters

SYNCMMAXCORR (6)

Limits the maximum correction done by marker correction.

SYNCOFFTIME (16)

Compensation velocity of an offset (1. synchronize; 2. new offset)

SYNCMFPAR (17)

Marker filter configuration

SYNCMFTIME (18)

The behavior of SYNCMFTIME – filter time for marker correction – is changed a little bit.

SYNCTYPE (51)

Indicates whether normal synchronization (0) or with look ahead (1).

Technical Reference

This section documents data structures and compiler details which are only required in exceptional cases by the user. For example, if an automatically generated programming is to be modified like a curve profile.

Array Structure of CAM Profiles

Header

The header contains general information like

- Identification for curve array
- Version number for curve structure
- Type of curve
- Name of curve
- Index to curve information section
- Index to start/stop point section
- Index to fixed point section
- Index to interpolation point section
- Index to start/stop point indices (in interpolation section)
- Index to start/stop velocities (times 100000)
- Index to startpath interpolation points
- Index to stoppath interpolation points

Curve information section

This section of the array contains all information about the type of curve like

- Length of curve (master)
- Length of curve (slave)
- Number of fix points
- Number of Interpolation points (this gives the resolution)
- Type of interpolation
- Slave stop point, point where slave is positioned, when synchronization is stopped
- Correction start point (only valid for marker synchronization)
- Correction end point (only valid for marker synchronization)
- Maximum correction which is allowed (only valid for marker synchronization)
- Maximum start/stop path length (Size of start/stop path area)(min. 2)
- No of start/stop point pairs
- Maximum number of cycles per minute (Application information)

Curve start/stop point section

This section contains the start/stop points. Because the use of this point is up to the user, we just speak of a path, which can be a start or a stop sequence. Every path consists of 2 points. If we are moving forward, the path starts (start or stop) with the a-point and ends with the b-point. If we are moving backward, the path starts with the b-point and ends with the a-point. So the user is able to tell us in the program, which pair of points to use for starting or stopping, when he uses a STARTCURVE or STOPCURVE command.

- Path 1 (a – point)
- Path 1 (b – point)
- Path 2 (a – point)
- Path 2 (b – point)
- …

These points have to lie on interpolation points, so possibly the PC software has to adjust them according to the interpolation resolution. This should not be a real restriction, because the interpolation points are normally very dense. So for example if we have rotating master which makes one revolution per cycle and we choose a cycle length of 3600 MU (1 MU = 1/10 degree). Let us further assume, that we choose the number of interpolation points as 1200, than you have a resolution of 3 MU = 3/10 degree for defining your start and stop points.

Fixed point section

This section contains the fix points, which were the basis for the interpolation calculation. These points always consist of the following triple

- Master coordinate
- Slave coordinate
- Type of point (tangent, curve)

These points are defined by the user in MU units (see internal description). If you want to avoid, that the real interpolation curve misses your fix points, you have to choose them in such a manner that they lay on an interpolation point (see above). This can be forced through a snap function within the PC software.

Interpolation point section

This section contains a list of slave coordinates. They belong to master coordinates which are of equal distance, given by the interpolation resolution.

Indices of start/stop points

Here we have the indices of the start/stop points (see above) within the interpolation array. These are necessary for the ease of start and stop recognition. We are waiting until start index for example equals the actual index and direction of movement is correct. If both is true, we start synchronization. The same is true for stopping.

Start Stop Velocities

To be able to calculate an appropriate starting or stopping path, we need the velocity we have to reach at end (start) or we will have at the beginning (stop) in UU/MU units (Slave units per Master units).

Start / Stop paths

This is the place for the interpolation points of the actual start and stop path. These points are calculated when a SYNCCSTART or SYNCCSTOP command is executed, but we have to reserve the room right now.

■ CAM Array Definition

Part	Index	Name	Unit	Value	Description
General	1	Identification	(dec)	999.000.001	Number to identify array
	2	VersioNumber	(dec)	100	Version as decimal (1.00 = 100)
	3	CurveType	(dec)	0	0 = symmetrical, 1 = compatible
	4	CurveName 1	(4char)	Nona	Name of curve total 16 char.
	5	CurveName 2	(4char)	meCu	default is:
	6	CurveName 3	(4char)	rve0	NonameCurve00001
	7	CurveName 4	(4char)	0001	
	8	IndexCIF	(dec)	16	Index to Curve Information Part
	9	IndexSTP	(dec)	27	Index to Start/Stop Point Part
	10	IndexFIP	(dec)	IndexSTP + STPno*2	Index to Fix Point Part
	11	IndexINP	(dec)	IndexFIP + FixPointNo * 3	Index to Interpolation Point Part
	12	IndexSTPInd	(dec)	IndexINP + InterpolPointNo	Index to StartStop Interpolation Indices
	13	IndexSTPVel	(dec)	IndexSTPInd +STPno*2	Index to StartStop Velocities
	14	IndexSTIP	(dec)	IndexSTPVel +STPno*2	Index to Startpath interpolation points
	15	IndexSTPIP	(dec)	IndexSTIP + MaxStartStopLen	Index to Stoppath interpolation points

Part	Index	Name	Unit	Value	Description
Curve Information	1	MasterCycleLen	MU	-	Length of Curve in Curve Master units
	2	SlaveCycleLen	UU	-	Slave max. travel distance in CurveSlave units
	3	FixPointNo	(dec)	4	Number of fix points (min. 4)
	4	InterpolPointNo	(dec)	-	Number of interpolation points (including first and last, which correspond to the same location)
	5	InterpolType	(dec)	0	0 = cubic spline 1 = periodic cubic spline
	6	SlaveStopPosition	UU	0	Position, where slave stands after stopping
	7	CorrectionStartPoint	MU	0	Position, where Correction may start
	8	CorrectionStopPoint	MU	MasterCycleLen	Position, where Correction has to be finished
	9	MaximumCorrection	UU	-	Maximum Correction which is allowed in one cycle
	10	MaxStartStopLen	(dec)	0	Maximum length of start/stop path (no of int. points)
	11	StartStopNo	(dec)	0	Number of start stop point pairs (n) (see below)
	12	MMaxCycles	(dec)	0	Max. number of cycles per minute (application info)
	13	MMarkerPos	CM	0	Master Marker Position in curve
	14	SMarkerPos	CS	0	Slave Marker Position in curve
Start/Stop Point	1	STPoint_1.a	MU	0	Start (forward) / Stop (backward) Point no. 1
	2	STPoint_1.b	MU	0	Stop (forward) / Start (backward) Point no. 1
	3	STPoint_2.a	MU	0	Start (forward) / Stop (backward) Point no. 2
	4	STPoint_2.b	MU	0	Stop (forward) / Start (backward) Point no. 2
	5	...	MU	0	
	6	...	MU	0	
	2*n-1	STPoint_n.a	MU	0	Start (forward) / Stop (backward) Point no. n
	2*n	STPoint_n.b	MU	0	Stop (forward) / Start (backward) Point no. n
Fix Point	1	FixPoint_1.master	MU	0	Fix Point no. 1 - master coordinate
	2	FixPoint_1.slave	UU	-	Fix Point no. 1 - slave coordinate
	3	FixPoint_1.type	(dec)	C	Fix Point no. 1 - type of point (1 = Curve Point, 2 = Tangent Point)
	4	...			
	3*n-2	FixPoint_n.master	MU	MasterCycleLen	Fix Point no. n - master coordinate

Part	Index	Name	Unit	Value	Description
	3*n-1	FixPoint_n.slave	UU	-	Fix Point no. n - slave c oordinate
	3*n	FixPoint_n.type	(dec)	C	Fix Point no. n - type of point (1 = Curve Point, 2 = Tangent Point)
Interpolation Point	1	IntPoint_1	UU	0	Interpolation Point no. 1 - slave coordinate
	...				
	n	IntPoint_n	UU	-	Interpolation Point no. n - slave coordinate
StartStop Indices	1	STPoint_1.a-index	(dec)	0	Index in Interpolation Array, corresponding to Startpoint
	2	STPoint_1.b-index	(dec)	0	Index in Interpolation Array, corresponding to Sartpoint
	3	..			
StartStop locities	1	STPoint_1.a-veloc.	(dec)	(*100000)	Velocity (UU/MU * 100000) in **Ve-** startpoint
	2	STPoint_1.b-veloc.	(dec)	(*100000)	Velocity (UU/MU * 100000) in startpoint
	...				
StartPath Interpolation Points	1	StartPoint_1	UU	0	Interpolation Point no. 1 - for start path
	...				
	n				
StopPath Interpolation Points	1	StopPoint_1	UU	0	Interpolation Point no. 1 - for stop path
	...				
	n				

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