MOVIDYN®
Servo Controller

IPOS Positioning Control
Manual

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SEW EURODRIVE

Contents

SEW EURODRIVE

- **Read through this manual carefully before you start to install and commission MOVIDYN® servo controllers with the IPOS positioning control option.**
  This manual assumes that the user has access to and is familiar with the documentation on the MOVIDYN® system, in particular operating instructions.

- **Safety notes**
  Always following the safety notes contained in this manual!
  Safety notes are marked as follows:

Electrical hazard, e.g. during live working.

Mechanical hazard, e.g. when working on hoists.

Important information for safe and fault-free operation of the driven machine/system.

- **General safety notes on IPOS**
  The IPOS positioning control allows you to match the MOVIDYN® drive system to the specifics of your application to a very high degree. As with all positioning systems there is, however, the risk of a programming error in the program, which may result in unexpected (not uncontrolled, though!) system behavior.

- **In this manual, cross references are marked with a →, e.g.:**
  (→ MD_SHELL) means: Please refer to the MD_SHELL manual for detailed information or information on how to carry out this instruction.
  (→ Sec. x.x) means: Further information can be found in section x.x of this manual.

- Each unit is manufactured and tested to current SEW-EURODRIVE technical standards and specifications.
  The manufacturer reserves the right to make changes to the technical data and designs as well as the user interface herein described, which are in the interest of technical progress.
  A requirement of fault-free operation and fulfillment of any rights to claim under guarantee is that the instructions and information given in this manual are observed.
  The instructions also contain important information about servicing; as a result, they should be kept in the vicinity of the unit.

1 System description

1.1 General information

The 'IPOS' positioning control provides a user-friendly means of achieving point-to-point positioning with the MOVIDYN® servo controller. The MD_SHELL PC software is used for startup of the inverter and writing IPOS programs.

1.2 Characteristic features of IPOS

- Support for fieldbuses and serial communication via RS-485 and RS-232
- Table position, max. 64 positions can be stored to non-volatile memory
- Teach mode
- Touch probe function
- Possibility of altering the torque, speed and ramp time during travel
- Ramp functions: linear, sinusoidal and quadratic
- Processing of analog input signals (-10 V – +10 V)
- Relative travel in "uni-directional operation" (no counter overrun)
- Programming interface integrated in the MD_SHELL software

1.3 Optional expansions (only one option possible)

- Fieldbus interfaces
- Profibus-DP and FMS with AFP 11.. or INTERBUS-S with AFI 11..
  or CAN bus with AFC 11..
- Terminal expansion AIO 11.. digital inputs/outputs, RS-232

Setpoint sources:

Setpoint sources positioning control	
Analog input	- Analog input n1 as override input or for teach setpoint
PC interface (USS11A)	- Control word from PC is linked to terminal functions
FIELDBUS (AFP11.. or AFI11.. or AFC11..)	- Control and setpoint selection possible via fieldbus

1.4 Operating modes

- Automatic mode
  An IPOS program written by the customer is processed in cycles in the inverter. A PC is required for startup and writing the program. Control is via terminal signals or fieldbus, depending on the configuration. The drive can be diagnosed using MD_SHELL and MD_SCOPE.
- Manual mode
  The drive can be moved semi-manually using MD_SHELL alone, even without a positioning program.
- It is only possible to change over between automatic and manual mode or between IPOS and speed-controlled operation with the PC using the MD_SHELL software.

1.5 Technical data

- Max. program length approx. 256 program lines
- Command processing time: 5 ms / program line
- Variables: 256; of which 64 can be stored to non-volatile memory
- Value range: $-2^{31} – +2^{31}$
- Touch probe inputs 200 ms processing time
- Sampling interval of digital and analog inputs:1 ms

2 Installation and Default Setting

2.1 Pre-requisites

The power supply and axis module or compact servo controller must be correctly installed and commissioned (see operating instructions for MOVIDYN® servo controller).

2.2 Encoder connection

No additional encoder wiring is required specifically for IPOS. The only encoder system used is the resolver evaluation inside the unit with 4096 increments/motor revolution.

2.3 Function/activation of binary inputs and outputs

Binary inputs and outputs are set and activated in parameter group 300.

- See Sec. 5.2 for the function of the "controller inhibit" and "enable" input terminals.
- It is possible to use the input and output terminals of the basic unit (X21) as well as the input and output terminals of the AIO 11 option pcb for the IPOS program.
  The basic unit parameters need to be set accordingly in order to address this (→ Sec. 2.5).
- In principle, all programmable input terminals can be used for connecting hardware limit switches. The limit switches must be "zero active" (normally closed contacts). Comply with the instructions in the MOVIDYN® operating instructions when connecting.

  Note: The correct arrangement of limit switches is always:
  – Move towards "CW limit switch" for motor speed ≥ 0!
  – Move towards "CCW limit switch" for motor speed ≤ 0!

  A sustained signal must be guaranteed within the entire limit switch range!
  The hardware limit switches are used for limiting the travel distance. The limit switch range does not represent a "useful" travel range for movement during operation. Depending on the type of reference travel, the hardware limit switches serve as reversing switches or as reference cams for reference travel (see reference travel in Sec. 5.1).

2.4 Function/activation of analog inputs

- Override function:
  An analog positive setpoint can be applied to input terminals X21/2 and X21/3 in order to have the sequence specified in a travel program performed at a speed other than the programmed speed.
  This means the traveling velocity can be controlled between 0 and 150 % (0 V and 10 V) of the programmed speed (e.g. for setup purposes).
  In any event, the maximum speed value is restricted by the values of parameters 210 (Max. speed CW) and P211 (Max. speed CCW).
  The override function is activated in the machine parameters.
- Teach function:
  When teach mode is active, the analog input X21:2 and X21:3 is used for traveling to the teach position (→ Sec. 7.4.6).
- Reading in analog values:
  The values of the analog inputs can be loaded into variables in the positioning program using a SET function (→ Sec. 7.4.5).
  Take care when using the AIO 11 option card with the analog input circuitry:
  The factory setting for parameter 103 (Operat. mode analog input 2) is "Ext. I limit" (current limit). This current limit function is active for the operating mode "reference travel" and "rapid stop". It is therefore necessary to ensure that a +10 V signal is present at terminal X14:3 so the drive has the full torque at its disposal. The motor does not have any torque if 0 V is present at

terminal X14:3. **A hoist without speed monitoring set would drop down.**
The motor always has full torque available if parameter 103 **(Operat. mode analog input 2)** is set to **"No function"**.

2.5 Basic unit parameters relevant to IPOS

***Parameter* 100:**	**Operating mode**	IPOS is activated in the ***Positioning*** setting.
***Parameter* 110:**	**Setpoint source**	For IPOS, the parameter should be set to ***Analog input*** or **Fieldbus** because the "PC terminals" are "ANDed" with the physical terminals in the ***PC interface***. In IPOS operation without a PC, this leads to the "rapid stop" operating mode.
***Parameter* 140:**	**Rapid stop ramp**	This ramp is used when the **STOP** command is performed and when the enable is revoked.
***Parameter* 150:**	**Emergency stop ramp**	This ramp is used throughout reference travel (see reference travel in Sec. 5.1). The emergency stop ramp is also used for dealing with faults in IPOS.
***Parameter* 203:**	**Feedforward threshold**	This parameter is ineffective in IPOS mode.
***Parameter* 204:**	**Gain feedforward**	Also in effect in IPOS mode (see MOVIDYN® operating instructions).
***Parameter* 205:**	**Filter feedforward**	Also in effect in IPOS mode (see MOVIDYN® operating instructions).
***Parameter* 210:**	**Max. speed CW**	This value limits the machine parameter "CW positioning speed". It should always be set to a value higher than (approx. 10 %) the required positioning speed (otherwise there is a risk of a lag error).
***Parameter* 211:**	**Max. speed CCW**	This value limits the machine parameter "CCW positioning speed". It should always be set to a value higher than (approx. 10 %) the required positioning speed (otherwise there is a risk of a lag error).
***Parameter* 212:**	**Maximum current**	Limiting the manipulated variable of the closed-loop speed controller. This parameter must be set in accordance with the general startup (see MOVIDYN® operating instructions). **Note:** This parameter can also be altered with the **SETMMAX** command in the automatic program. It is not permitted to set it to a value which allows a current greater than 3 x I_0 of the connected motor. This can lead to motor damage.
***Parameter* 300 – 302, 310 – 316:**	**Binary inputs basic unit and AIO 11**	The input terminals initially have the functions and properties as described in the MOVIDYN® operating instructions. The input terminals must be programmed to ***No function*** in order to use them **exclusively** for IPOS. In order to use them in the automatic program, the places in the menu screens for the individual commands must be set to 1. The following IPOS commands are possible: – wait until terminals are 1 or 0, – jump if terminals are 1 or 0, – select table positions with terminals, – teach function.
***Parameter* 320, 330 – 335:**	**Binary outputs basic unit and AIO 11**	Function linked to IPOS: – axis in position, – 8 user-programmable binary outputs (of which 7 can be physically implemented using AIO 11). In order to be able to address the binary inputs in the IPOS program, their parameters must be set to **"IPOS output 1–8"** in the basic unit parameters **"Binary outputs basic unit"** (P320) and **"Binary outputs AIO 11" (P330)**. These outputs are addressed in the automatic program by setting them to 1 in the menu screens for the individual commands.

2.6 Summary of startup

This general, simple procedure does not replace the detailed description in this manual.
The details must always be adapted to the specific application.

1. Comply with the MOVIDYN® operating instructions as well as the MD_SHELL and IPOS manuals.

- Configure the serial interface and select the required axis address.
- Take the MOVIDYN® servo controller into operation using MD_SHELL.
- "Commissioning" / [F5] in MD_SHELL.
- Make the following settings: Maximum current, max. speed, individual messages, etc.
- Program the binary inputs and outputs of the inverter and the AIO 11 (input/ output expansion, in particular those specific to IPOS:
  Inputs: reference cams, reference travel, limit switch, etc.
  Outputs: pos. output 1, pos. output 2, etc.
- Set the "Positioning" operating mode ("Parameters" / "Main menu" / "Setpoints/ Gen. Ramps" / "Operating Mode").
- Set "Analog input" as the setpoint source ("Parameters" / "Main menu" / "Setpoints/ Gen. Ramps" / "Setpoint source").

2. Setting IPOS parameters

(Menu "IPOS" / "Machine parameters", Sec. 4)

These parameters are used for defining travel units, acceleration ramps, reference travel type and speed, lag error, positioning window, etc.

Important:

Set the operating mode of analog input 2 to "No function" (P103).

3. Save the settings on the PC

(Menu command "Environment" / "Save parameter file")

4. Test the IPOS parameter settings

(Menu "IPOS" / "Manual mode", Sec. 6.2)

Manual mode makes it possible (by transferring commands from the PC) to move the axis, check travel units, the wiring of inputs/outputs, ramps, etc.

Go back to step 2 if required.

5. Write the program

(Menu command "IPOS" / "Positioning", Secs. 3.1 and 7.1)

The program (max. 128 lines) is written by selecting commands from a menu. The program can also contain subroutine calls which are named and selected with "jump flag".

6. Save the program

Save onto the hard disk (menu command "IPOS" / "Save program")

It is only possible to transfer the program into the inverter's RAM (menu command "IPOS" / "Positioning" / "Download", Sec. 3.2) provided the controller inhibit is switched on, i.e. X21.5 = "0".

It is only possible to save the program into the inverter's non-volatile memory (menu command "IPOS" / "Save to EEPROM", Sec. 3.2) provided the controller inhibit is switched on, i.e. X21.5 = "0".

7. Test the program

(Menu command “IPOS” / “Positioning”, Sec. 7.1)
Check the results on the screen whilst the program is running (the number of the program line which is currently being processed is displayed on the screen):

– Step-by-step (F7): “STEP”
  The program stops after each program line has been processed. It only restarts when you press F7.
– With manual cancel (F4): “GOTO CURSOR”
  he program runs until the cursor is switched back on with F4.
– Let the program run (F9): “RUN”
  The program runs through completely.
  If necessary, use the TEACH functions for setting positions: First move the axis manually with the analog differential input X21.2/3, then store the position using TEACHS or TEACHT.
  Have one processing cycle displayed including the inputs and outputs (menu command “IPOS” / “Status”).
  Go back to step 5 if required.

8. Optimize the sequence and the accuracy of the cycle (if required)

– Use MD_SCOPE for recording and displaying.
– Menu command “Parameters” / “Commissioning” or “Parameters” / “Main menu” / “Control. parameters”.

9. Save the parameters and the program onto the hard disk

Save the parameters onto the hard disk: Menu command “Environment” / “Save parameter file”.
Save the program onto the hard disk: Menu command “IPOS” / “Save program”.

10. Document your work

Print out the inverter parameters (menu command “Environment” / “Print parameter file”).
Print out the IPOS program (menu command “IPOS” / “Positioning” / “Print”).
Print out the MD_SCOPE settings (MD_SCOPE menu command “Environment” / “Print”). The printer configuration can be modified using the HC-SELECT.EXE program.

3 User Interface

Help function: Pressing F1 causes a help text to be displayed for the selected functions. The key combinations for the windows which are open can be listed by selecting the "Help" / "Key assignment" menu item.

3.1 Loading / saving a positioning program from / to PC

Select the **Positioning** command from the **IPOS** main menu if you want to enter new programs for IPOS or modify existing programs. When the "Positioning" window is opened, the positioning program stored in the axis module is loaded if communication has been established (RS-232). Select the ***Save program*** menu command in order to save a program. After doing this, it is possible to enter a file name to save a program in the positioning window as a file. The name of the file must not be longer than 8 characters and must have the file name extension **".prg"**. The dialog box for entering a new program file can be called up by pressing the "right arrow key" or using the mouse. Use the ***Load program*** menu command for loading a positioning program from a file into the **Positioning** window. Only programs with the extension ".prg" are displayed for selection.

3.2 Loading / saving a positioning program from / to the axis module

Positioning programs are loaded from an axis into the positioning window using **F3 UPLOAD**. Conversely, a positioning program is transferred from the positioning window to the axis using **F2 DOWNLOAD** (only possible if the controller inhibit is in effect). This means the program is held in the IPOS working memory. Consequently, the program can be run. The **Save to EEPROM** menu command must be used for saving it permanently in the unit (i.e. so the program is also retained even if the power is switched off). The progress of the saving operation is displayed in the status section of the "Positioning" window using a cross at EEPROM. This process takes about 15 s and can be performed at the same time as a positioning program is running.

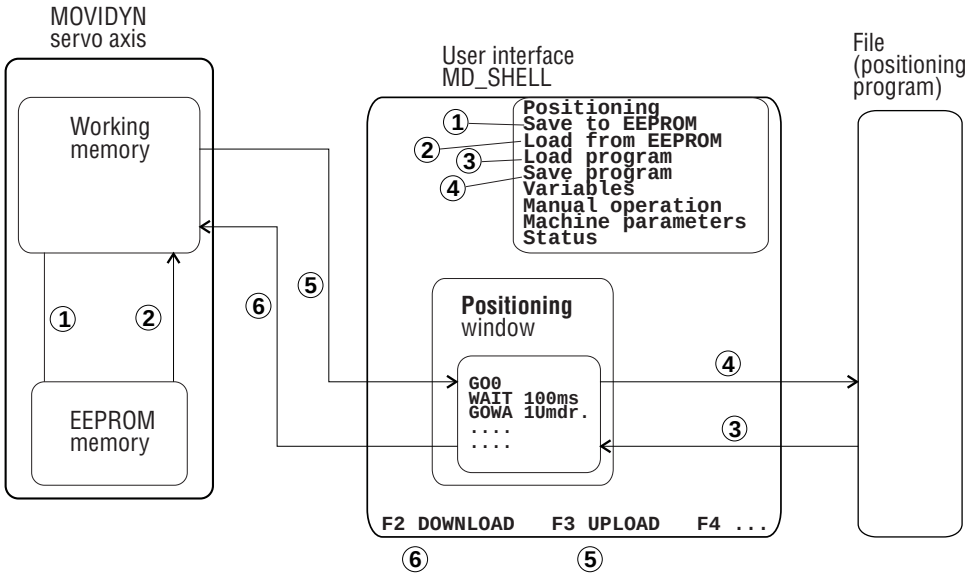

Fig. 1

Note: All comment lines are discarded when a program is transferred into the MOVIDYN® memory. Programs with comment lines can only be stored in files on the PC.
All user-specific permanently stored data (machine parameters and IPOS program) for the axis is lost if a factory setting is performed for the axis module.

3.3 Writing / editing a positioning program

Positioning programs are **written** or **edited** in the ***Positioning* window** of the program. Positioning commands are entered in dialog boxes with a menu system. When the "Positioning" window is open, pressing the **Insert** key activates the table for selecting commands. This lists all the IPOS commands. A dialog box for entering the command arguments appears when you select the required command and confirm it by pressing the **ENTER** key. The command arguments are selected using the **Tab** key and then the required values are entered. The command is transferred into the "Positioning" window after the entries have been confirmed by pressing Enter. In each command, pressing **F1** calls up a **help text**.
The Del key can be used for deleting command lines.

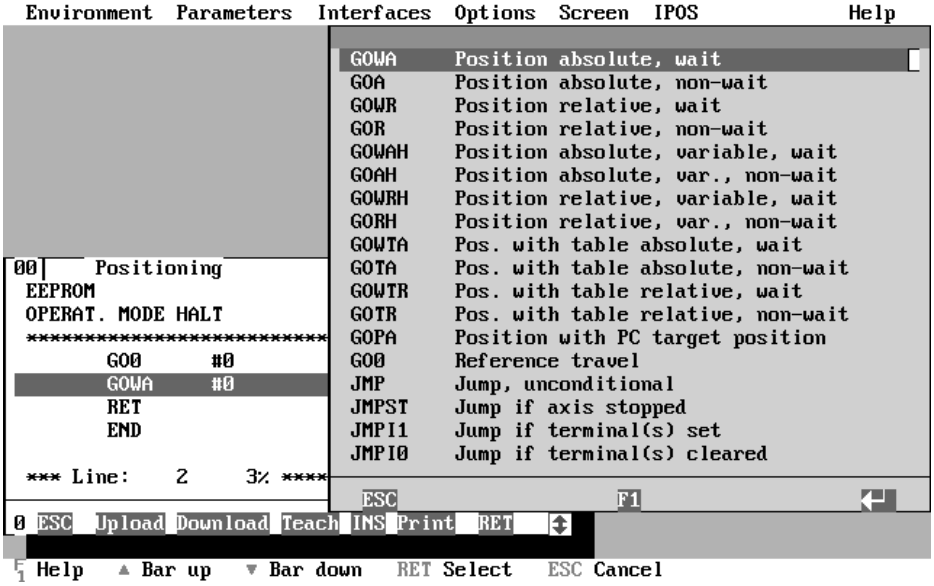

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Fig. 2

It is also possible to copy program lines within the "Positioning" window. See the "Help" menu / "Key assignments" for more information.

3.4 The “Manual mode” menu command

It is possible to position the servo controller directly in manual mode, i.e. even without a positioning program.
The following window appears when the “Manual mode” menu command is activated:

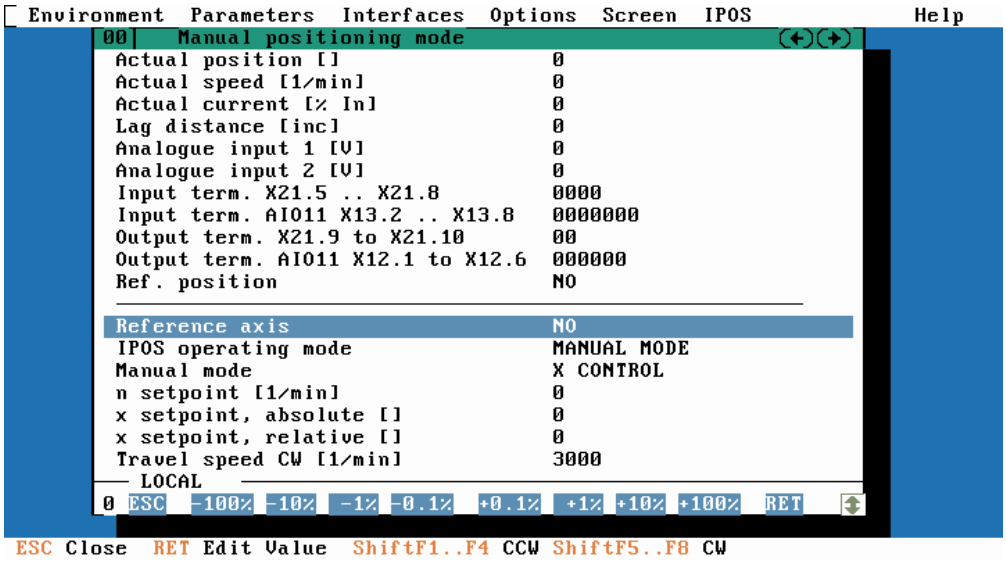

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Fig. 3

Two different types of positioning are available: “n control” (speed control) and “x control” (position control, Sec. 6.2).

Reference travel is activated by setting the “Reference axis” menu item to “Yes” in the manual positioning mode window. See Sec. 4.2 for details about performing reference travel.

4 Machine Parameters

4.1 General information

The machine parameters adapt IPOS to the conditions of the system. The dialog box for setting the machine parameters can be called up in the IPOS menu. The most important settings for IPOS operation can be undertaken in this window.

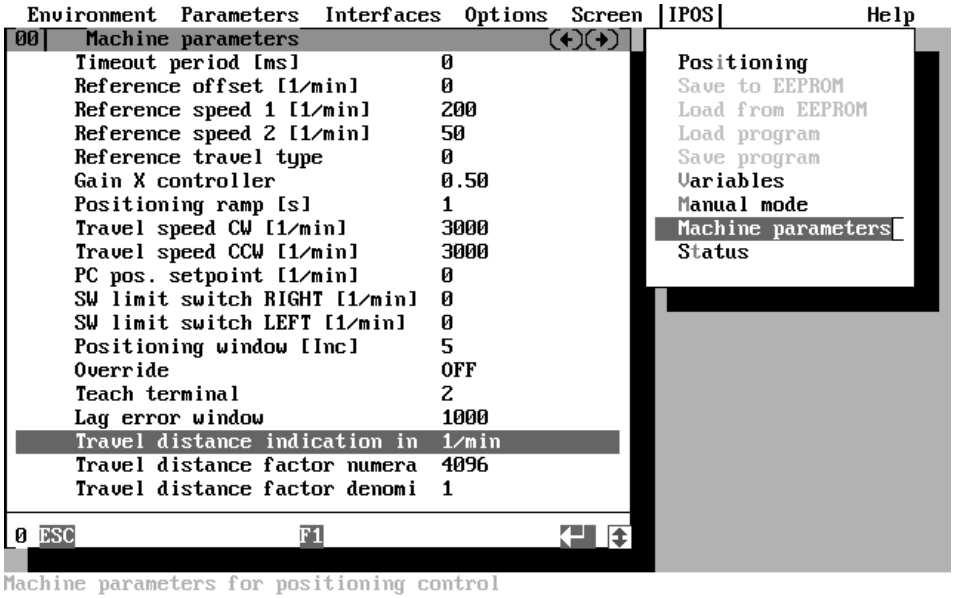

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Fig. 4

The **machine parameters** are “normal” unit parameters and are therefore transferred to the unit **directly** when they are modified. They are **stored in the non-volatile memory** depending on the setting of parameter P650. As all other parameters, their default settings are the factory settings.

4.2 Reference travel

4.2.1 General information

The purpose of reference travel is to establish a **machine zero** to which all absolute positioning commands refer. During reference travel, the drive moves until it reaches a reference cam, where it remains subject to positioning control. This position is the **reference point**. However, reference cams may develop a switching hysteresis (inaccuracies) as a result of aging and wear. Consequently, the zero pulse of the encoder system closest to the reference point can be taken as the machine zero (→ Sec. 4.2.5).

The **reference offset** provides the user with a software parameter for varying the machine zero without having to move the reference point physically. See the following equation:

Machine zero = reference point + reference offset

The reference cam is a normally open input. The first search direction is established by the reference travel type (→ Sec. 4.2.5). The limit switches are used as a “reversing switch” and/or as a “reference point”, depending on the reference travel type. When reference travel is complete, the drive stops at the first zero pulse following the reference cam where it remains subject to positioning control. This is the reference point. It is also the machine zero if the reference offset = 0.

An axis which has been referenced can only be referenced again from the manual mode window, or by using the GO0 # 1 command in the automatic program.

Once reference travel has started, it is brought to a conclusion even if the request for reference travel is revoked. The seven-segment display changes from “c” (reference travel) to “A” (automatic program) when reference travel is complete.

4.2.2 Reference offset (→ Sec. 4.2.1)

This value is added to the reference point to determine the machine zero. The reference offset makes it possible to move the machine zero by means of software. The following equation applies:

Machine zero = reference point + reference offset

As with all length data, this menu item is set in user units (see Sec. 4.3.13).
Factory setting: 0

4.2.3 Reference speed 1 (→ Sec. 4.2.1)

Determines the speed for the reference travel. The sense of rotation is established by the reference travel type.
Value range: 0 – 5000 rpm
Factory setting: 200 rpm

4.2.4 Reference speed 2 (→ Sec. 4.2.1)

Determines the speed for traveling to the reference cam. The sense of rotation is established by the reference travel type.
Value range: 0 – 5000 rpm
Factory setting: 50 rpm

4.2.5 Reference travel type (→ Sec. 4.2.1)

Explanation of the reference travel type illustrations

Possible starting points for the drive:

① Drive between reference cam and CW limit switch
② Drive on the reference cam
③ Drive between reference cam and CCW limit switch

Key to the abbreviations used in the illustrations:

CW LS	CW hardware limit switch (positive limit switch)
CCW LS	CCW hardware limit switch (negative limit switch)
ref cam	Reference cam
ZP	Zero pulse ⇔ reference point
VRef1	Reference speed 1
VRef2	Reference speed 2

Type 0: The reference point is the CCW zero pulse of the rotor position. (No reference cam is required.)

Machine zero = CCW zero pulse of the rotor position + reference offset

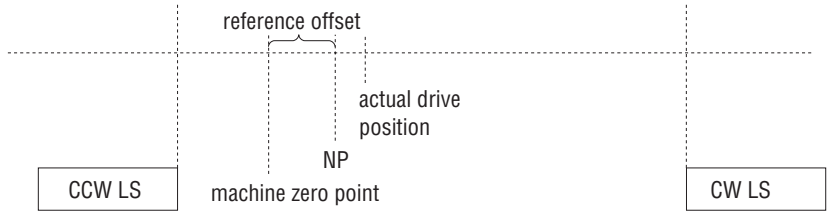

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Fig. 5

Type 1: The reference point is the first zero pulse to the left of the reference cam.

Machine zero = reference point (ZP) + reference offset

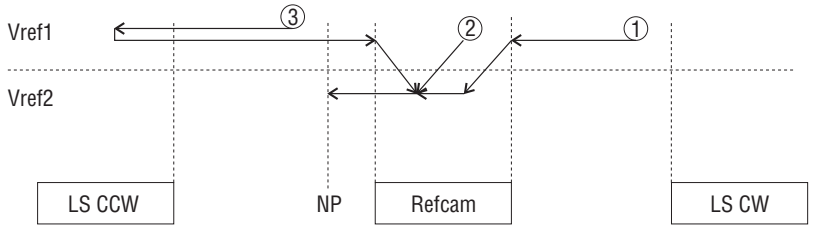

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Fig. 6

Type 2: The reference point is the first zero pulse to the right of the reference cam.

Machine zero = reference point (ZP) + reference offset

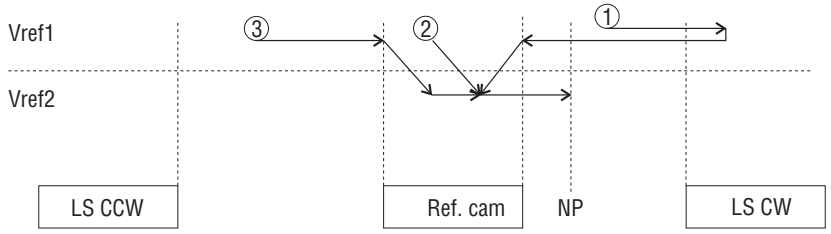

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Fig. 7

Type 3: The reference point is the first zero pulse to the left of the CW limit switch. (No reference cam is required.)

Machine zero = reference point (ZP) + reference offset

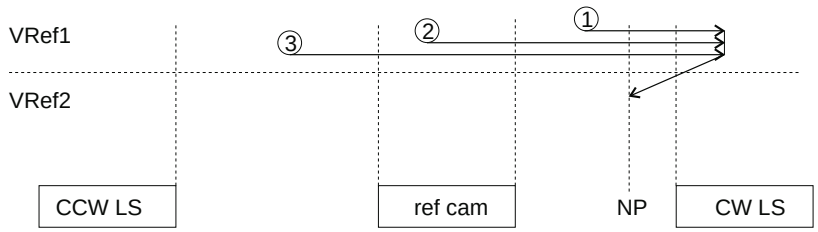

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Fig. 8

Type 4: The reference point is the first zero pulse to the right of the CCW limit switch. (No reference cam is required.)

Machine zero = reference point (ZP) + reference offset

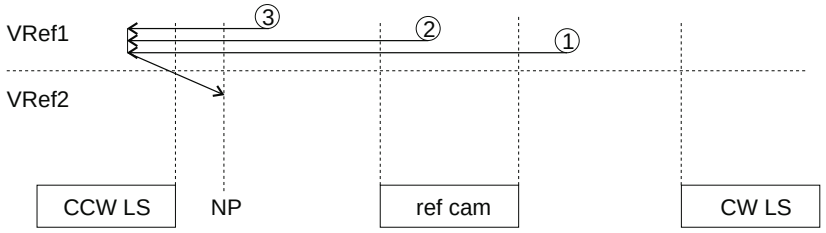

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Fig. 9

Type 5: No reference travel, the reference point is the absolute rotor position.

Machine zero = rotor position (no reference to zero pulse) + reference offset

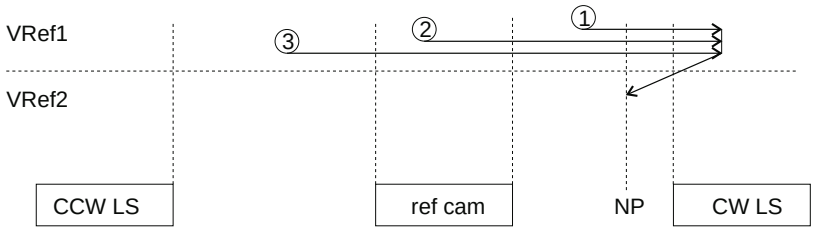

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Fig. 10

Note: See the user note in Sec. 8 for information about reference travel without zero pulse evaluation, e.g. in uni-directional operation (rotary table).

4.3 Description of machine parameters

4.3.1 Timeout period

The timeout period is the time within which data must be exchanged between MOVIDYN® and the PC (or a controller), otherwise the drive is stopped with the emergency stop ramp.
This monitoring **only** takes place in IPOS **manual mode**.
"PC time monitoring" (called up using the "Panel" menu command) must be set for monitoring the communication between MOVIDYN® and a machine control.
Value range:
Factory setting: 0 (monitoring off)

Safety note:

Timeout period monitoring ensures that the drive stops after the time set here in the event of an interruption in the link to the PC. This is particularly important if a setpoint speed or position is sent in manual mode although intervention via the PC is prevented due to the interruption. In any event, however, a switch-off can be performed using terminals.

4.3.2 Gain X controller (IPOS)

Setting value for the P controller of the position control loop in IPOS. In the basic setting, the value is set here automatically as with the hold controller of the basic unit (P220).
Setting range: 0.1 – 32
Factory setting: 0.5

4.3.3 Positioning ramp

Setting value for the ramp which is used during the positioning operation. The **same** ramp is used for acceleration and deceleration. The setting is in accordance with the basic unit (integrators) as a time value for the change of speed, in relation to 3000 rpm.
Setting range: 0 ms, 20 ms – 10 s
Factory setting: 1 s

4.3.4 Travel speed CW

Specifies the travel speed in the positive range (n > 0).
The setting is made in revolutions per minute and must be matched to the maximum motor speed.
Setting range: 0 – 5000 rpm
Factory setting: 3000 rpm

Note: Parameter 210 limits this machine parameter, so consequently always set menu item 210 greater than the travel speed CW (by approx. 10 %). Otherwise, there may be a lag error!

4.3.5 Travel speed CCW

Specifies the travel speed in the negative range (n < 0).
The setting is made in revolutions per minute and must be matched to the maximum motor speed.
Setting range: 0 – 5000 rpm
Factory setting: 3000 rpm

Note: Parameter 211 limits this machine parameter, so consequently always set menu item 211 greater than the travel speed CCW (by approx. 10 %). Otherwise, there may be a lag error!

4.3.6 PC pos. setpoint

This parameter enables a position value to be set which can be used at any point in the automatic program with the **GOPA** command. The setting is made in user units. Depending on the unit, the value is specified via serial interface RS-485, RS-232 or via USS 11A.
When transferred, the parameter value is only stored for as long as the unit is switched on.
Setting range: -2^{31} – $+2^{31}$ -1 increments
Factory setting: 0

4.3.7 SW limit switch RIGHT/LEFT

The software limit switches permit the user to restrict the range in which travel commands are accepted. The parameters define the limits of the movement range by means of the software. **They do not take effect until after a reference travel has been performed.** When the IPOS program has been activated and "referenced", a check is performed to see whether the target position of the current travel command is beyond the software limit switch. The travel command is not carried out if the position is beyond the software limit switch. If a drive is already in motion, it is decelerated using the emergency stop ramp. A fault message (F78) is generated. The IPOS program changes to "STOP" operating mode and sets the program pointer to the start of the program. It is not necessary to restart the program once the fault has been reset.

Fault reset: a) Drive stopped at limit of movement range:
Reset by:– Reset button
– "Enable" input 0 → 1
– Positioning window of the MD_SHELL IPOS software: F9 or F4
– Mains power OFF / ON

b) Drive stopped beyond limit of movement range:
Reset by:Mains power OFF / ON (not in 24 V backup mode)
– Hold the reset button pressed whilst moving the axis clear.
(Caution! The axis address may be altered in this case;
check the axis address afterwards.)

⇒ Drive moves to the selected position if this is within the limit of the movement range of the software limit switch.
Otherwise, F78 is generated again. In that case, it is necessary to check the travel commands, setpoint of any machine control and the software limit switch positions set in the parameters.

Caution: The drive can move to the travel position selected in the IPOS program immediately when there is a 1-level at the "controller inhibit" and "enable"!

Set both **parameter values** to 0 during uni-directional operation. This **deactivates** the software limit switch function.
Setting range: -2^{31} – $+2^{31}$ -1 increments
Factory setting: 0, input in user units

4.3.8 Positioning window

The parameter defines a distance range (positioning window) around the target position of a travel or STOP command. This distance range is the criterion used for checking whether the target position has been reached. The travel command is regarded as having been completed as soon as the drive moves into the positioning window; the "axis in position" message is sent. The next program line is performed if a travel command is waiting.

The "axis in position" output terminal status is reset immediately when a new travel command is sent. The "axis in position" output terminal status is also reset (monitored) if the positioning window is exited (e.g. hoist dropping downwards) when an IPOS program is running. This monitoring of the positioning window only takes place when an IPOS program is active.

The positioning window is not monitored when the IPOS program is interrupted (e.g. low level with "controller inhibit" or "enable") as well as when the brake has been applied (activated brake function P500).
Setting range: 0 – 2^{15} -1 increments (positioning window = ± entered value)
Factory setting: 5

However, this condition is only permanently checked and output to the corresponding binary output terminal in the "IPOS" unit status, i.e. when the 7-segment display is showing "A". The current terminal status "1" or "0" is always retained when the "IPOS" unit status is exited.

Mains on	/Controller inhibit	Enable	IPOS program	"In position"
1	1	1	Start (program running), drive stopped	1
1	1	1	GO0 command	During reference travel "In position" = previous status After reference travel "In position" = 1
1	1	1	GO command	At start of positioning "In position" = 0 as soon as the target position exceeds the distance of the positioning window At the end of positioning, i.e. reaching the positioning window "In position" = 1
1	1	1	No GO command in configuration	Axis stopped, "In position" = 1
1	1	1 → 0	Start (program is running)	The program is interrupted and a rapid stop performed when the enable is revoked "In position" = previous status
1	1	0 → 1	Stop	Any ongoing travel command which is interrupted is brought to its completion and "In position" = 1 is signaled when the positioning window is reached
1	1 → 0	1	Start (program is running)	Program adopts "Halt" "In position" = previous status
1	0 → 1	1	Stop (program stopped)	Reset of automatic program. "In position" = 1 Program remains at "Stop"

4.3.9 Override

This machine parameter allows the override function to be switched ON and OFF (see also the override connection, Sec. 2.4).

The travel speed can be influenced between 0 and 150 % (0 to 10 V) of the programmed speed by applying a positive analog setpoint to terminals X21.2 and X21.3. The speed is limited by the maximum CW speed (P210) and the maximum CCW speed (P211).

4.3.10 Teach terminal (→ Sec. 7.4.6)

This parameter specifies which of the physical input terminals (basic unit or AIO 11) is used for the teach function. The physical input terminals (basic unit and AIO 11) are numbered consecutively.

Terminal strip	X13 AIO 11 option	X21 Basic unit
Terminals	8 7 6 5 4 3 2	8 7 6 5
Teach terminal value	10 9 8 7 6 5 4	3 2 1 0

Setting range: 0 – 10
Factory setting: 0

4.3.11 Lag error window

The lag error window defines the maximum permitted difference in values between the setpoint and actual positions. Lag error monitoring reliably detects all faults which prevent positioning.

A lag error (F42) is caused if the difference in values is exceeded.
The motor is decelerated with the emergency stop ramp.
Lag error monitoring is deactivated when the value is set to 0.
Unit: Increments
Setting range: $0 – 2^{31}$ -1 increments
Factory setting: 1000

Note: The factory setting for the lag error should be increased accordingly if the controller setting is weak (low P-proportion; small feedforward).

4.3.12 Travel distance indication

For displaying a symbolic designation of the travel units ("mm", "m", "degrees"). Five character string for the length units which the user can enter in the machine parameters. All travel distance information in the "Machine parameters", "Manual mode" and "Positioning" dialog boxes is displayed with this **symbolic designation**.

Note: This parameter does not have any specific effects on the procedure.

4.3.13 Travel dist. factor numerator/denominator

Users can determine the user travel unit using the travel distance factor numerator/denominator. The travel distance information for the travel commands in the automatic program and in manual mode is then evaluated using this user travel unit (for example, mm on the travel distance).

The following formula specifies the conversion between internal increment representation (4096 increments/motor revolution) and travel unit:

$$x_{IPOS}\ [\text{increments}] = \frac{\text{Travel distance factor numerator}}{\text{Travel distance factor denominator}} \times x_{command}\ [\text{user travel unit}]$$

Travel distance factor numerator: Number of increments which the motor moves in order to achieve the defined user travel unit

Travel distance factor denominator: Number of user travel unit(s)

Note that IPOS always operates internally with **4096 increments/motor revolution**.
Setting range: $0 – 2^{31}$ -1
Factory setting: 1

Example: The following units are to be programmed into the following drive (for filling bottles):
a) **mm** on the linear axis
b) **Increments**
c) **Drive revolutions**
d) **Bottles** (3 bottles / 400 mm)

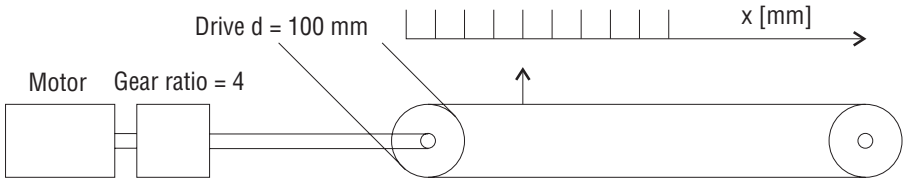

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Fig. 11:

Machine parameters:

a)
Travel distance indication = **mm**
Travel distance factor numerator =
(increments/motor revolution × gear ratio i) × extension factor = 4096 × 4 × 1000 = 16384000
Travel distance factor numerator = ($d_{output} \times \pi$) × extension factor = 100 × 314159.2654 × 1000 = 314159.2564

Note: A more accurate conversion can be achieved by expanding the numerator and denominator (this is only appropriate if the numerator or denominator is not a whole number). This does **not** restrict the maximum travel range. The travel distance factors are stored in the axis; the conversion is performed by the PC operating program. The conversion does not take place when IPOS is running, so any violation of the maximum travel range can be detected whilst the program is being written.

b)
Travel distance indication = **Incr.**
Travel distance factor numerator = 1
Travel distance factor denominator = 1

c)
Travel distance indication = **rev**
Travel distance factor numerator = Increments/motor revolution × gear ratio i = 4096 × 4 = 16384
Travel distance factor denominator = 1

d)
Travel distance indication = **FI.**
Travel distance factor numerator =
Increments/motor revolution × gear ration i × output revolutions/travel definition ×

$$\text{extension factor} = 4096 \times 4 \times \frac{400\ \text{mm}}{\pi \times d_{output}} \times 10\,000 = 208\,607\,567$$

Travel distance factor denominator =
User travel units/travel definition × extension factor = 3 bottles × 10 000 = 30 000

Practical information for determining the travel distance factor during commissioning

For example, setting the user travel units in mm.

① Set the travel distance factors for both the numerator and the denominator to the value 1.
→ User travel units = increments.

② In manual mode, move any number of user travel units (in this case, increments), e.g. 100 000 increments.

③ Measure the distance covered on the system in point ②, e.g.:
Starting position = 1000 mm, target position = 1453 mm, distance covered = 453 mm.

④ Enter the travel distance factors in the machine parameters:
Travel distance factor numerator = 100 000

Travel distance factor denominator = 453

4.3.14 Brake function

This function, which can also be set with parameter P500, supports the activation of a mechanical brake on the motor (see MOVIDYN® operating instructions). If the brake function is activated, the system takes account of the brake reaction time when stopping and moving off.

The brake output X21.9 and the output stage are controlled accordingly when this happens.

Note: This machine parameter can be switched off and on using a command in the automatic program. If the brake function is employed and successive, waiting positioning commands with the same target position are used within the IPOS program, then the positioning window must be set larger than the mechanical brake play. The IPOS program stops and waits at the waiting positioning command if the drive is located outside the positioning window after the brake is applied. The drive is not re-adjusted. Monitoring of the output terminal status "In position" is active (→ Sec. 4.3.8). A program restart is required in order to continue the program.

Max. brake play with servo motors: $0.25^0 \Rightarrow$ minimum size of the positioning window to be set with 4096 increments/motor revolution = 3 increments

Reaction of the axis when the brake function is switched on:

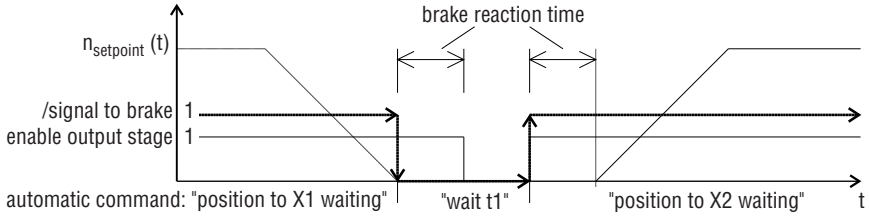

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Fig. 12

The brake function is always active when IPOS is operated in position control (and the function is switched on). This is the case in automatic mode and in manual operating mode / x control.

The brake is always released in manual mode speed control!

4.3.15 Brake reaction time

This parameter (P501) specifies the time interval between electrical activation and mechanical application/release of the brake (see the MOVIDYN® installation and operating instructions).
Setting range: 0 – 1000 ms
Factory setting: 200 ms

4.3.16 IPOS bus mode

This parameter can be used for linking IPOS to a field bus card.
This is where the definition is made as to what significance the bus position setpoint should have in conjunction with IPOS.
The following are possible:

IPOS bus mode	Use of the setpoint of the fieldbus
0	The bus position setpoint is not used.
1	The bus position setpoint is used as a manual mode setpoint.
2	The bus position setpoint is used for the GOPA command in the automatic program.
3	The bus position value is processed directly by the positioning controller, i.e. without using the internal profile generator. The travel profile must be specified by the machine control.

In some instances, the handling of bus communication in the PLC is extremely complicated when, in addition to defining position setpoints (which is done simply and quickly via the process data channel), other values such as acceleration, speed, etc. have to be stipulated as well.

In this case, complex PCP communication (INTERBUS-S) or FMS communication (PROFIBUS) have to be used. In many cases, it is now possible to dispense with PCP/FMS communication because the position setpoint specified via the process data channel is also placed on variable 254 in IPOS bus mode 2. There, it can be interpreted by the IPOS program as required.
Factory setting: 0

Note: Operation via field bus requires the setpoint source parameter P110 to be set to fieldbus in advance.

4.3.17 Feedforward

With a value of 100 %, the drive operates with a linear speed profile optimized in respect of time.

If a value less than 100% is specified, a larger gap between position setpoint and actual position occurs (lag distance) during a positioning operation.

This results in a “soft” run-in to the target position for the acceleration procedure.

Setting instructions

Desired control response	Setting value Feedforward	Advantage	Disadvantage
Time-optimal positioning with minimum lag distance	100 %	– Minimum travel time – Short lag distance	– Block-type torque characteristic – Hard run-in to target position
Soft run-in to target position	50 % – 80 %	– Soft run-in to target	– Greater lag distance – Positioning process takes longer

Setting range: - 150 % – + 150 %
Factory setting: 100 %

Note: This function is inoperative with “sinusoidal” and “squared” acceleration types!

4.3.18 Change direction of rotation

This parameter specifies the direction of rotation of the motor. The following interrelations apply:

	Change direction of rotation	Positive setpoint (positive travel direction)	Negative setpoint (negative travel direction)
Factory setting	No	Motor turns CW	Motor turns CCW
	Yes	Motor turns CCW	Motor turns CW

Note:

The motor is turning CW if the motor shaft is rotating clockwise when viewed onto the end of the output shaft.

Setting instructions: Move the drive in manual operating mode (n control) with a positive setpoint (see 6.2.3). The motor should move in the direction which has been defined as the positive direction. Alter the ”Change direction of rotation” parameter if it does not.

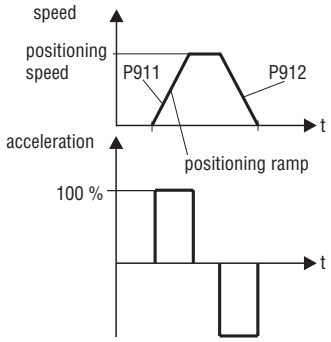
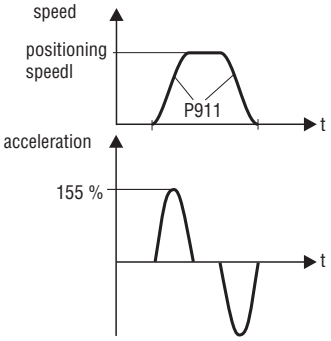
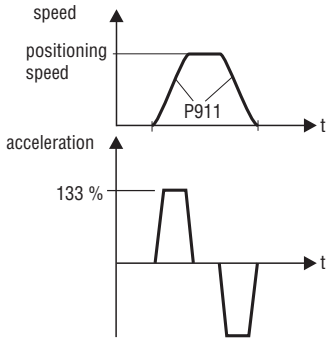
Safety note:

Altering the “Change direction of rotation” parameter after the system has been referenced causes the system to lose its reference point for the absolute position. This may result in undesirable travel movements of the axis.

Consequently, the parameter should be set prior to reference travel. If this is not possible, the system must be referenced again or the unit de-energized (switching-off the external 24 V as well).

4.3.19 Ramp type

This parameter specifies the type of positioning ramp. This has an effect on the speed or acceleration characteristic during positioning. As well as the **linear** setting which has been possible to date, the functions **squared** and **sinusoidal** are also available.

Ramp type	Positioning behavior	Applications
Linear 	**Speed characteristic** This setting produces a trapezoidal speed profile during the travel process. It is specified by the positioning ramp and the travel speed. **Acceleration characteristic** The acceleration adopts a block-type characteristic. This can be disruptive, in particular when fluid or soft goods are being moved. This is due to the action of forces (F = m ×a) which is proportional to the acceleration, and in particular the steep acceleration gradient.	Particularly for drivelines with lower dynamic properties or less flexibility. Fast ramps are feasible whilst only requiring relative low torque, in particular for rapid positioning operations. The **feedforward** parameter makes it possible to smoothen the positioning ramp.
Sinusoidal 	**Speed characteristic** Results in a sine-square shaped speed profile during the travel procedure. This, like all ramp types, is determined by the positioning ramp and travel speed. **Acceleration characteristic** The acceleration characteristic is smooth and jerk-free. Acceleration at the start and finish of the ramp is very small, so it has to be increased in the middle (whilst retaining the same ramp time as the linear shape).	In particular for fast positioning operations with dynamic or flexible drivelines. This results in increased acceleration and, consequently, 55 % more torque than the linear ramp. When configuring the system, note that the motor or the shaft has to provide the require torque capacity (risk of lag errors).
Squared 	**Speed characteristic** Results in a quadratic speed profile during the travel procedure. **Acceleration characteristic** The acceleration characteristic is smoother than the linear shape. This is a compromise between torque requirement and ramp smoothening.	The application range is similar to the sinusoidal shape. The particular advantage lies in that the torque increase is less than with the sinusoidal shape. The extra 33 % required is usually available even in drives initially configured for linear shapes. In many cases, the practical effect is equivalent to the sinusoidal shape.

5 Activating IPOS

5.1 Preliminary work for IPOS

- Take the inverter into operation in “speed control” operating mode (P100) in accordance with the MOVIDYN® operating instructions
- Check the terminal assignment with the inverter in “controller inhibit” status. Program the input/output terminals required for positioning control (→ Sec. 2.5).
- Check the limit switches and the EMERGENCY OFF circuit.
- Use MD_SHELL to set the machine parameters (→ Sec. 4).

IPOS is programmed and parameterized using the MD_SHELL user interface which is supplied with IPOS. See Sec. 3 and the MD_SHELL manual for information about installation and operation. IPOS is selected by setting parameter 100, “Operating mode” to positioning and parameter 110, ”Setpoint source” as shown in the table below. The 7-segment display shows A when IPOS is activated (controller inhibit deactivated). The setting values for **operating mode** (parameter 100) and **setpoint source** (parameter 110) can be found in the following tables.

Setting values for the operating mode unit parameter (parameter 100)	**IPOS operation**
Torque control	No IPOS operation possible
Speed control	No IPOS operation possible
Positioning	IPOS operation provided: – There is no unit fault (also 24 V external) – Enable has been given (via terminal) – There is no controller inhibit – There is no APA/API operation – There is no hold control – No limit switches have been triggered – There is no reference travel

Setting values for the setpoint source unit parameter (parameter 110)	**IPOS operation**
Analog input	IPOS operation possible, – Input terminals of the MOVIDYN® have the same range of functions as without IPOS – Analog input 1 can be used as an override input or for the teach setpoint
API/APA	No IPOS operation possible
PC interface	IPOS operation possible, – Input terminals of the MOVIDYN® have the same range of functions as without IPOS – Control word from the PC panel is linked with terminal functions as without IPOS (see MOVIDYN® operating instructions) – Analog input 1 can be used as an override input or for the teach setpoint
FIELDBUS	IPOS operation possible, – Input terminals of the MOVIDYN® have the same range of functions as without IPOS – Analog input 1 can be used as an override input or for the teach setpoint – Control and setpoint selection are possible via fieldbus

5.2 Unit function of "controller inhibit" and "enable"

The controller inhibit and rapid stop (no enable) unit functions interrupt IPOS processing (automatic or manual mode). The two functions implement the unit characteristics described in the MOVIDYN® operating instructions.

Unit function of "controller inhibit" and "enable"

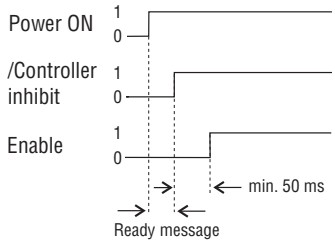
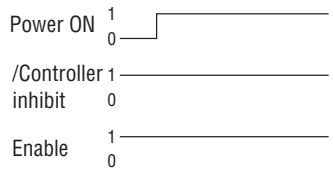
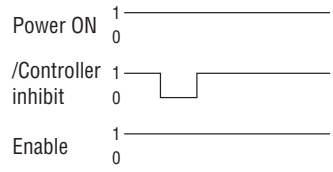
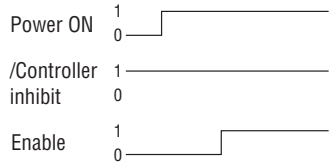
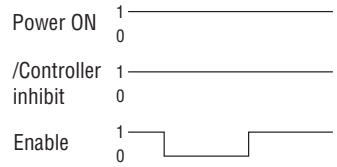
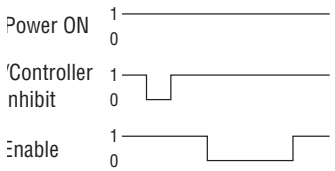
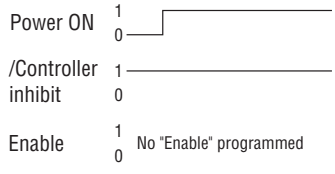
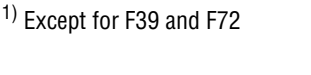
	Input	Input level	**No IPOS** function parameterized (P100 and P110)	**IPOS** function parameterized (P100 and P110)
Controller inhibit	Fixed on X21:5	"1"	Power output element enabled	
		"0"	Power output element inhibited Inverter status = "controller inhibit" 7-segment display = "4"	
Enable (Input controller inhibit = "1")	User-parametrizable (P300 – 316)	"1"	Drive running in the selected operating mode with the specified setpoint 7-segment display = "1" / "2" / "7" / "9"	Drive is in IPOS mode 7-segment display = "A"
		"0"	Drive stopped with speed control and internal setpoint 0 rev./min. 7-segment display = "3" Deceleration with the rapid stop ramp at the "1" ⇒ "0" edge, with speed control	

5.3 Switching the IPOS program on/off

The "controller inhibit" and "enable" functions have additional properties for IPOS. No difference is made as to whether the functions are set using the physical unit terminals, using the MD_SHELL panel or via a fieldbus link-up.

- The following IPOS functions can be implemented using both functions (see the table below):
- Resetting the automatic program without PC
- Resetting an IPOS fault without PC
- Restarting the automatic program without PC
- Stopping the drive axis (as feed enable) and continuing the automatic program at the point of interruption
- Revoking the limit switch inhibit for moving clear from the hardware limit switches (see Sec. 6.4)

Switching the IPOS program on and off by mains power on/off, controller inhibit and enable

Signal patterns from: Power on: /Controller inhibit: Enable: Power on:	Last setting of IPOS operating mode in MD_SHELL program	
	Automatic RUN	**Manual mode (only with PC)**
	IPOS automatic program starts with the first IPOS command. Movement clear of hardware limit switch.	IPOS manual mode with setpoint = 0 until new setpoint is sent from controller or MD_SHELL.
	IPOS automatic program starts with the first IPOS command. No “start terminal” necessary.	IPOS manual mode with setpoint = 0 until new setpoint is sent from controller or MD_SHELL.
	Automatic program is reset, operating mode HALT (after axis has stopped → STOP mode). Automatic program does not restart. Movement clear of hardware limit switch.	IPOS manual mode with setpoint = 0, reset of automatic program, operating mode HALT (after axis has stopped → STOP mode). Movement clear of hardware limit switch.
	Automatic program starts after enable. Automatic program is not reset.	IPOS manual mode with setpoint = 0 until new setpoint is sent from controller or MD_SHELL.
	Automatic program is interrupted by “No enable” and then continues from the point of interruption. IPOS faults are reset. [1]	Manual mode is interrupted by “No enable” and then continues from the point of interruption.
	Reset of automatic program by controller inhibit = 0 → 1. Automatic program is started after subsequent switching of enable from 0–1. IPOS faults are reset. [1]	Manual mode is interrupted by controller inhibit. Manual mode is set again after subsequent switching of enable from 0–1. IPOS faults are reset. [1]
	Automatic program only starts if there is a 1-signal at the controller inhibit input after the mains power is switched on and the ready message is given.	Manual mode can be activated with mains power on and controller inhibit 1-signal.
		

[1] Except for F39 and F72

6 Operating Modes

6.1 Survey of IPOS operating modes

- Manual mode (Sec. 6.2)
  - Reference the axis (→ Sec. 4.1)
  - Manual operation mode: x control (positioning control)
  - Manual operation mode: n control (speed control)
- Automatic mode (Sec. 6.3)
- Reference travel (Sec. 4.2)
- Limit switch processing (Sec. 6.4)

Note:
The status display of the operating modes in the positioning window exclusively refers to the setting by the PC. This does not always display a change of the unit's status due to the input terminals.

The individual operating modes can be activated in accordance with the following points.

6.2 Manual mode

Manual mode can be activated by opening the **manual mode dialog box** in the **IPOS main menu** and then setting the "IPOS operating mode" to "Manual mode". The following operating modes and operating states prevent the activation of manual mode:

– Unit fault (also 24 V external)
– Rapid stop (/ENABLE)
– Controller inhibit
– API operation
– Limit switch CW/CCW
– Hold control

It is possible to use the n setpoint or the x setpoint to move the drive once manual mode has been activated. Reference travel can also be activated.

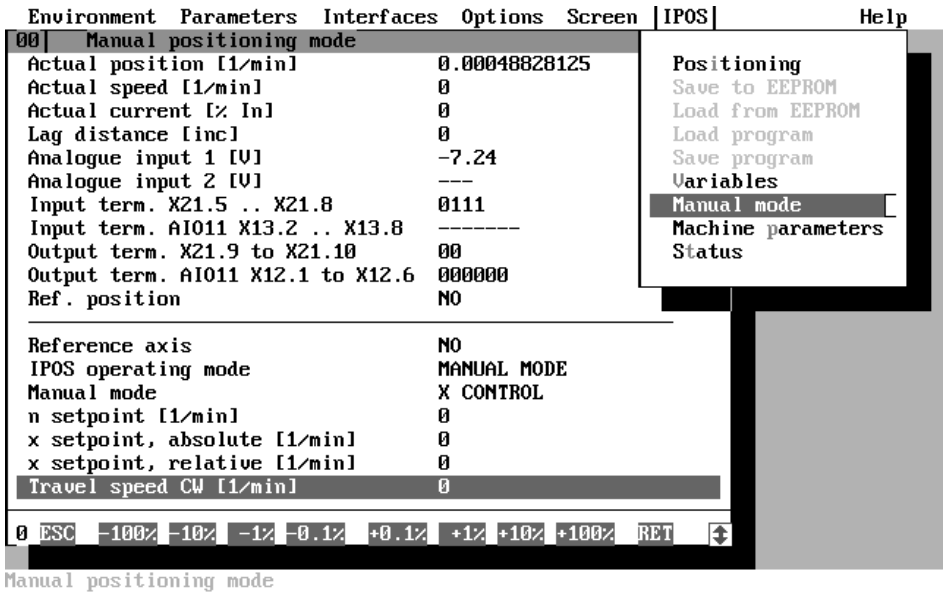


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Fig. 13

The “Manual positioning mode” dialog box is split into two parts:

The values in the top half of the box are display values which cannot be edited. They display important status information for positioning such as the actual position or the actual speed.

The bottom half contains parameters which are required for single axis positioning with MD_SHELL.

6.2.1 Referencing the axis

Setting the “Reference axis” menu command causes the axis to be referenced in accordance with the set machine parameters (→ Sec. 4.2). The status section of the manual positioning mode dialog box shows when reference travel has been completed. The reference request is actively revoked by the unit. This menu command allows an axis which has already been referenced to be referenced again.

6.2.2 IPOS operating mode

It is possible to switch between manual mode and automatic operating mode here.

Manual mode: MANUAL MODE (an axis which is moving can be stopped with STOP (F8))

Automatic mode: STOP (F8); START (F9); BREAKPOINT (F4); STEP (F7); HALT (F3)

6.2.3 Manual operating mode

Here, it is possible to set whether the axis should be moved with speed control (n control) or positioning control (x control). With n control, the drive is turned CW or CCW at the specified speed for as long as the corresponding key combination on the PC is pressed or the appropriate button is clicked with the mouse.

With x control, the target position to which the drive is to move is entered. The drive automatically moves to the target once an x setpoint (absolute or relative to the current actual position) has been entered.

The positioning ramp (machine parameters) is used in either setting. The “Software limit switch” function is active in both cases.

6.2.4 n setpoint

n control sequence:

1. Open the “Manual positioning mode” dialog box. The servo controller must be in the “Positioning” operating mode (parameter 100) and in ”Enabled” status (→ Sec. 5.2). The 7-segment display of the axis must show “A”.
2. Set the IPOS operating mode in the “Manual positioning mode” dialog box to “MANUAL MODE”. The “Manual mode” parameter must be set to “n control”.
3. The required positioning speed is set in the “n setpoint” parameter.

4a. Click on one of the buttons from “-100 %” to “+100 %” to start positioning travel.
Negative values are for CCW travel, positive values for CW travel.
100 % means the servo controller moves at the speed set in 3, whilst 0.1 %, 1 % and 10 % are the corresponding percentage values for more exact positioning. The motor only continues to turn for as long as the mouse button remains pressed. The servo controller is sent the setpoint zero when the mouse button is released; the motor stops.

4b. Alternatively to 4a., the servo can also be controlled using the keyboard: The key combinations from <SHIFT-F1> to <SHIFT-F8> correspond to the buttons from “-100 %” to “+100%”. Bear in mind that the motor does not start moving until first the “SHIFT” key and then one of the function keys from <F1> to <F8> are pressed. The motor stops as soon as the shift key is released, irrespective of the function keys.

6.2.5 x setpoint absolute / relative

x setpoint, absolute:
The value is used as an absolute target position if it is confirmed with the ENTER key. This position is specified in user travel units (→ 4.3.13). The set travel parameters (machine parameters) are used.

x setpoint, relative:
The value is used as a relative target position if it is confirmed with the ENTER key. This position is specified in user travel units (→ 4.3.13). The set travel parameters (machine parameters) are used.

x control sequence:

1. Open the “Manual positioning mode” dialog box. The servo controller must be in the “Positioning” operating mode (parameter 100) and in “Enabled” status. The 7-segment display of the axis must show “A”.
2. Set the IPOS operating mode in the “Manual positioning mode” dialog box to “MANUAL MODE”. The “Manual mode” parameter must be set to ”x control”.

3a. Reference travel must be performed prior to “x setpoint, absolute” positioning. Set the “x setpoint, absolute” parameter to the required target position. Once the entry has been confirmed by pressing ENTER, the edited x setpoint is sent to the servo controller and the unit positions accordingly.

3b. No reference travel is required for “x setpoint” positioning. As an alternative to 3a., positioning can also be performed relative to the current actual position. The “x setpoint” parameter must be edited for this purpose. The edited value is added to the read actual position of the servo and the resulting total is sent to the servo controller once the ENTER key has been pressed. The servo controller then positions accordingly.

6.2.6 Travel parameters

The functions of the ***Travel speed CW***, ***Travel speed CCW*** and ***Positioning ramp*** are as described in the machine parameters section (Sec. 4).

6.2.7 Timeout period

The timeout period for manual operating mode can be set with this parameter.

Note: Setting the value to 0 switches off timeout monitoring! This means no monitoring of the setpoint transfer is guaranteed in the event of an interruption in the serial connection between the PC and MOVIDYN®.

The axis performs a HALT function after the set timeout period if the serial connection is interrupted. A timeout does not lead to a unit fault.

Safety note

Timeout period monitoring ensures that the drive stops after the time set here in the event of an interruption in the link to the PC. This is particularly important if a setpoint speed or position is sent in manual mode although intervention via the PC is prevented due to the interruption. In any event, however, a switch-off can be performed using terminals.

6.2.8 Teach function

A **TEACH function** can be implemented with the Manual positioning mode dialog box in conjunction with the positioning window (program entry window). To do this, the travel command to be altered must be marked with the cursor bar in the positioning window. Pressing the TEACH button or using the **ALT + F9** key combination opens the manual positioning mode dialog box in which the drive can be moved to the required position. This position can written in the place of the marked travel command by pressing the **ESC** key followed by RETURN as confirmation.

6.3 Automatic mode

Automatic mode may be active even when no PC is connected (IPOS **must be exited in the START (F9) operating mode** for this purpose). The settings are made and viewed in the **Positioning** window.

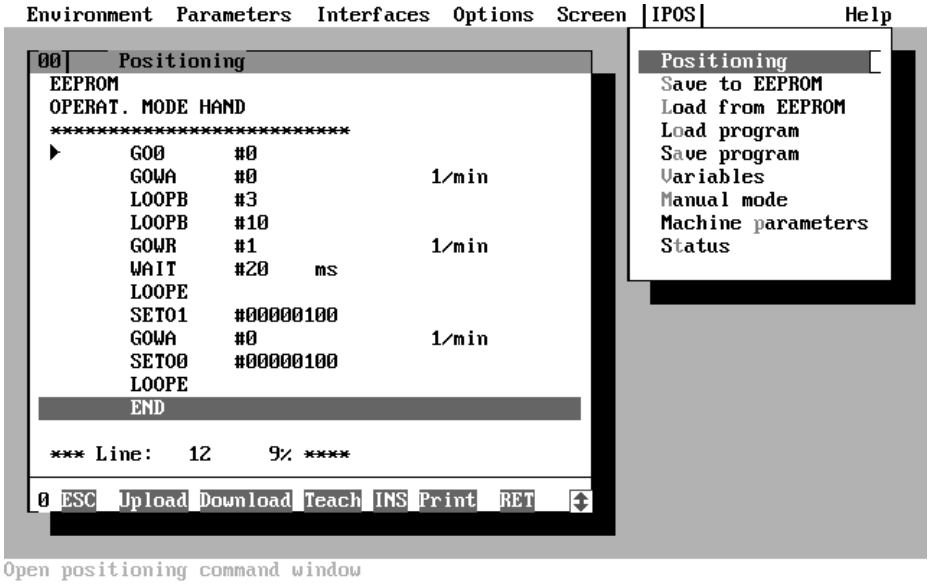

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Fig. 14

Automatic mode is divided into: GOTO CURSOR (BREAKPOINT); HALT (F4); STEP (F5); STOP (F8); RUN (START) (F9)

The specific automatic settings which have been made are displayed in the status part of the **Positioning** window. The settings can be changed using the function keys.

The active program line of the IPOS program is identified by a cursor arrow. However, there is a time lag on this display due to the transfer time of the serial PC interface.

6.3.1 Automatic STOP

Stop at the current position in the automatic program. Travel commands in progress are continued and completed. Position control is then activated. The **Automatic STOP** setting is activated by pressing the **F8** function key in the **Positioning** window which is called up from the ***IPOS*** menu.

STOP is displayed in the **Positioning** window. Press the **F9** function key to continue a program which has been stopped.

6.3.2 Automatic RUN (START)

The automatic program is processed (endless loop). The specific program line number which is currently active is displayed in the **Positioning** window. **Automatic RUN (START)** is activated by pressing the **F9** function key in the **Positioning** window.

6.3.3 Automatic STEP

Only the current command is performed in the automatic program. Processing of the program stops after this. The axis automatically changes to the automatic mode STOP. STEP (single step) is activated by pressing the **F7** function key. The cursor arrow is in the program line which will be processed after the **F7** function key is pressed again.

6.3.4 Automatic GOTO CURSOR (BREAKPOINT)

In this setting, the automatic program is continued until the set break address (the program line marked with the cursor) is reached (the marked program line is not itself processed). BREAK-POINT is activated using the **F4** function key. The automatic program is not stopped if the break address cannot be reached (e.g. due to a jump command).

6.3.5 Automatic HALT

HALT mode (function key F5) allows the automatic program to be halted at any point (with the emergency stop ramp). The automatic program is reset at the same time. Once the axis has come to a halt, the unit changes to Automatic STOP and can be operated further from there.

6.4 Limit switch processing

See Sec. 4.3.7 regarding software limit switch processing.

The drive stops with the emergency stop ramp if a hardware limit switch is triggered by IPOS. The drive then remains in the area of the limit switch subject to position control. The 7-segment display shows “5” / “6” to show that the CW / CCW limit switch has been triggered. The IPOS program changes to “STOP” operating mode and sets the program pointer to the start of the program. The IPOS program has to be restarted (Sec. 5.3) once the drive has been moved clear of the limit switch.

Possibilities for moving clear:

- The drive is moved clear of the hardware limit switch at reference speed 2 after an edge change in the terminal signal of the controller inhibit from 0 → 1.
- The drive is moved clear of the hardware limit switch at reference speed 2 when there is zero level at the teach terminal. To do this, the parameters must be set so the teach terminal is on an input other than “controller inhibit” or “enable” (→ Sec. 5.2).
- The drive is moved clear of the hardware limit switch at reference speed 2 after the mains power is switched OFF / ON.
- In manual operating mode with n control, the drive can be moved clear with the n setpoint.
- The limit switch is used as a changeover switch or reference cam if the drive is performing reference travel, depending on the specified reference travel strategy (→ Sec. 4.2).
- The set setpoint source can be used for moving clear immediately if the hardware limit switch(es) were not triggered in the IPOS operating mode (feature of the basic unit).

Limit switch monitoring “Limit switches swapped over” (F29) is also active if the limit switches are triggered in the IPOS operating mode. In this case, it is necessary to reset the fault using the reset button or by switching the mains power OFF / ON. The drive can be moved clear after this (see above).

Note:

It has to be ensured that the drive comes to a stop in the hardware limit switch area when it triggers a hardware limit switch. This means the active limit switch range (limit switch lead-in) has to be long enough otherwise the drive may behave in an undefined manner!

7 Travel Programs

7.1 Programming travel programs

Programs are entered using menus as described in Sec. 3.3 **Entering programs**. It is not possible to enter and write IPOS programs with a text editor externally of MD_SHELL.

7.1.1 Basic programming rules for IPOS

IPOS provides commands which permit a structured approach to problem-solving by means of the automatic program. These are:

- Subroutine structures (max. 100 subroutines).
- Loop command with the start of loop, end of loop (block structure) and a value for the number of loop cycles (it is possible to nest loops).
- Use of jump flags as jump destinations with automatic calculation of the absolute address.

The program processing returns to the first line when the main program is finished (endless loop). A jump to the start of the program is not necessary even when the first command is a **GOØ** (as is usual). Reference travel is only triggered with the **GOØ** command if the axis has not yet been referenced.

Safety note: Subroutines must never be exited with a jump into the main program or into another subroutine. If a subroutine is to be exited conditionally, it is possible to jump to the end of the subroutine.

Never exit a loop block with a jump command. However, it is permitted to use jumps within a LOOP block.

Errors will occur when the program is running if these instructions are not followed.

7.2 Program structure

Syntax:	**Explanation:**
Command	No explicit program header is required
[Comment]	Comments are only saved to the file
CALL [FLAG 1]	First subroutine call
RET command	End of the main program
[FLAG 1] command	Start of the first subroutine (via flag)
[Comment]	
RET command	End of the subroutine
END command	End of the entire program

Block representation:

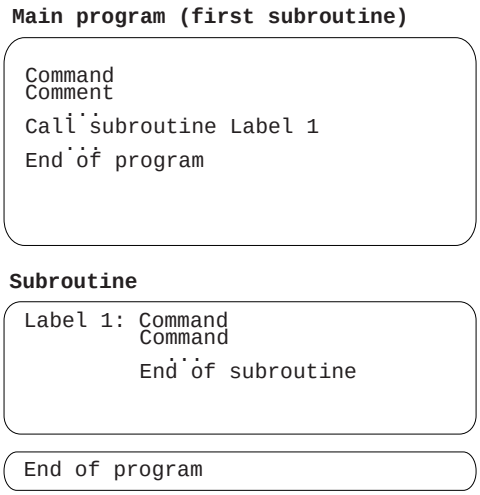

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Fig. 15

Sample IPOS program with a main program and a subroutine:

```
Main program
     GOØ        #Ø
     GOWA       #1Ø rev.
     CALL       MØ1
     GOWA       #25 rev.
     RET
Subroutine terminal toggle
MØ1: SETO1      #ØØØØØØØ1
     WAIT       #1ØØØ ms
     SETOØ      #ØØØØØØØ1
     WAIT       #1ØØØ ms

     RET
     END
```

The main program first performs reference movement followed by absolute positioning to +10 revolutions and then calls the subroutine. The first IPOS output terminal is switched over once in the subroutine. Positioning to +25 revolutions takes place when the subroutine is complete. The program continues without interruption.

7.3 Set of commands

There follows a survey of all commands for automatic programs, a detailed description and sample programs.

7.3.1 Survey

Positioning commands:	
GOWA	Position absolute, wait
GOA	Position absolute, non-wait
GOWR	Position relative, wait
GOR	Position relative, non-wait
GOWAH	Position absolute, variable, wait (only in increments)
GOAH	Position absolute, variable, non-wait (only in increments)
GOWRH	Position relative, variable, wait (only in increments)
GORH	Position relative, variable, non-wait (only in increments)
GOWTA	Position with table absolute, wait
GOTA	Position with table absolute, non-wait
GOWTR	Position with table relative, wait
GOTR	Position with table relative, non-wait
GOPA	Position with PC target position
GOØ	Reference travel
Jump commands:	
JMP	Jump, unconditional
JMPST	Jump if axis stopped (n < 15 rpm)
JMPNPOS	Jump if axis not in position
JMPI1	Jump if terminal(s) set
JMPIØ	Jump if terminal(s) cleared
JMPTØ=Ø	Jump if timer Ø = Ø
JMPT1=Ø	Jump if timer 1 = Ø
JMPH>K	Jump if variable greater constant
JMPH<K	Jump if variable smaller constant
JMPH=K	Jump if variable equal constant
JMPH>H	Jump if variable greater variable
JMPH<H	Jump if variable smaller variable
JMPH=H	Jump if variable equal variable
JMPAP>K	Jump if actual position > constant
JMPAP<K	Jump if actual position < constant
JMPAP>H	Jump if actual position > variable
JMPAP<H	Jump if actual position < variable
JMPCUR>K	Jump if current greater constant
JMPCUR<K	Jump if current smaller constant
JMPCUR>H	Jump if current greater variable
JMPCUR<H	Jump if current smaller variable
Wait commands:	
WAIT	Wait specified time
WAITI1	Wait until terminal(s) are set
WAITIØ	Wait until terminal(s) are cleared
WAITPOS	Wait until position is reached

Set functions:	
SETO1	Set terminals
SETOØ	Clear terminals
SETNMAX	Set positioning speed
SETNMAX=H	Write variable to positioning speed
SETMMAX	Set positioning torque
SETMMAX=H	Write variable to positioning torque
SETAMAX	Set positioning ramps
SETAMAX=H	Write variable to positioning ramps
SETTØ	Set timer Ø
SETT1	Set timer 1
SETWDON	Turn on watchdog
SETWDOFF	Turn off watchdog
Variable commands:	
SETH=K	Write constant to variable
SETH=H	Write variable to variable
SET[H]=H	Write variable to indir. addressed variable
SETH=[H]	Write indir. addressed variable to variable
SETH=TØ	Write timer count Ø to variable
SETH=T1	Write timer count 1 to variable
SETH=AP	Write actual position to variable
SETAP=H	Write variable to actual position
SETH=A12	Write analog setpoints to 2 variables
ADDHK	Add constant to variable
ADDHH	Add variable to variable
SUBHK	Subtract constant from variable
SUBHH	Subtract variable from variable
MULHK	Multiply variable by constant
MULHH	Multiply variable by variable
DIVHK	Divide variable by constant
DIVHH	Divide variable by variable
Teach commands:	
TEACHS	Teach line number
TEACHT	Teach table position
Touch probe commands:	
SETTP	Activate touch probe
GOTPH	Position to touch probe
JMPNTP	Jump if no touch probe
Other commands:	
NOP	No operation
CALL	Subroutine call (unconditional)
RET	End of subroutine
END	End of program
LOOPB	Beginning of program loop
LOOPE	End of program loop
SAVE	Save positioning program to EEPROM
BRAKE	Turn brake function on/off
STOP	Stop drive axis (rapid stop ramp)
COMMENT	Comment

7.4 Detailed description

7.4.1 Positioning commands

7.4.1.1 Position, wait/non-wait

The absolute position and the travel distance are specified either as fixed values or variables. When this is done, it is possible to make a basic differentiation between “wait” and “non-wait” commands. With the non-wait commands, processing of the program is continued after the travel procedure has started. This permits parallel processing whilst a travel procedure is in progress.

Typical application of “non-wait positioning”, stepped profile for the speed, without stopping:

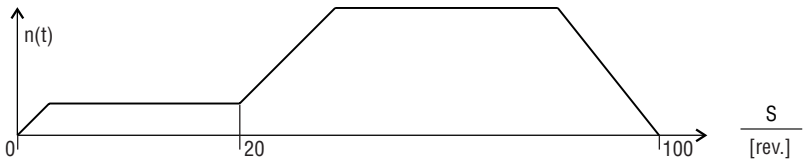

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Fig. 16

The sample program for this is as follows:

```
     GOØ      #Ø                    /*Perform reference travel*/
     GOWA     #Ø revs.              /*Move to position Ø, wait!*/
     SETNMAX #1ØØ rpm   #1ØØ rpm   /*Travel speed = 1ØØ rpm*/
     GOA      #1ØØ revs.            /*Move after 1ØØ revs., non-wait*/
MØØ: JMPAP<K #2Ø revs.  MØØ        /*Wait until actual position > 2Ø revs.*/
     SETNMAX #3ØØØ rpm  #3ØØØ rpm  /*Travel speed = 3ØØØ rpm*/
     WAITPOS                       /*Wait until axis is at 1ØØ revs.*/
     END
```

The program causes movement to take place between the positions X = 0 revs. and X = 100 revs. Movement from X = 0 revs. to X = 100 revs. initially takes place at 100 rpm. The axis moves the rest of the travel distance at 3000 rpm after it has passed the actual position of 20 revs. 3000 rpm is also used for the “return trip”.

The units in the position arguments result from the following machine parameters: “Travel distance factor numerator” and “Travel distance factor denominator” (see the description of machine parameters in Sec. 4). The symbolic designation is determined using the “Travel distance indication” machine parameter.

7.4.1.2 Position relative, wait/non-wait

The positioning commands for relative positioning are also configured as either wait or non-wait.

Changes in position can be entered in user travel units (see machine parameters in Sec. 4).

Example:

```
GOØ     #Ø              /*Reference axis*/
GOWA    #Ø revs.        /*Position after X = Ø revolutions*/
LOOPB   #1Ø             /*Start of loop (1Ø times)*/
GOWR    #5 revs.        /*Relative positioning by 5 revs., wait*/
LOOPE                   /*End of the loop*/
END                     /*End of the main program*/
```

The program initially moves to position X = 0. Following this, relative movement by 5 revolutions is performed 10 times in a loop. A wait command was used in this example. This means the drive stops after every 5 revolutions (until it is in the positioning window) and then starts again. The program continues without interruption.

Note:

See GOR in the user notes.

7.4.1.3 Positioning with table

Variables no. 0 to no. 63 are available for table positioning. Fixed values can be saved for these variables. These are saved together with the positioning program, stored in the unit and can be modified using the MD_SHELL user interface. (See the description of the teach function in Sec. 7.4.6 for information about the teach options for table positions).

The structure of the commands for table positioning is as follows:

GOWTA	#Terminal mask	#Table offset	Position with table absolute, wait
GOTA	#Terminal mask	#Table offset	Position with table absolute, non-wait
GOWTR	#Terminal mask	#Table offset	Position with table relative, wait
GOTR	#Terminal mask	#Table offset	Position with table relative, non-wait

#Terminal mask

All physical terminals are marked with a 1 here if they are to be used as pointers to the table of variables. All unused physical terminals must be marked with 0.

#Table offset

This can be used for setting an offset for the set terminal pointer.

Example:

GOTA	**#ØØØØØ**	**ØØØ111Ø**	**ØØØØ**	**#Ø**
	Reserved	E-terminals of the option pcb AIO11 (X13.8 ... X13.2)	E-terminals of the basic unit (X21.8 ... X21.5)	Tab. offset

Terminal	13.8	13.7	13.6	13.5	13.4	13.3	13.2	21.8	21.7	21.6	21.5
Terminal mask	0	0	0	1	1	1	0	0	0	0	0
Signifi-cance				↓ 2^3	↓ 2^2	↓ 2^1					
Terminal level	0	0	0	0	1	1	1	1	0	1	1
Weighting				↓ $0x2^3$	↓ $1x2^2$	↓ $1x2^1$					
Table pointer	Table offset + $0x2^3$ + $1x2^2$ +$1x2^1$ = Table offset + 6										

16 table positions can be achieved with the 4 input terminals. The terminal values have the significance within the table pointer as described above.

7.4.1.4 Positioning with variables

The following commands are available for positioning to variable values:

GOWAH	H[XXX]	Position absolute, wait to the position in variable XXX
GOAH	H[XXX]	Position absolute, non-wait to the position in variable XXX
GOWRH	H[XXX]	Position relative, wait to the position in variable XXX
GORH	H[XXX]	Position relative, non-wait to the position in variable XXX

Variables 0 – 255 are available. The variables are not permanently stored (data loss after mains power OFF). Variables 0 – 63 are an exception to this since they can be permanently stored (SAVE command or "Save to EEPROM"). The range of values of the variables is $–2^{31}$ – $+2^{31}$ –1. The variables can be read and written using the user interface. The variables can be processed using the variable commands.

Note: In contrast to the other positioning commands, the unit of the variable values for positioning is always 4096/motor revolution (signed)!

It is possible to set travel variables beyond 2^{31} with IPOS; this involves moving into the negative portion of the number circle (→ Fig. 17). Increasing the variable further brings you back into the positive range. This means the motor can be moved for any distance. An offset of at least 100 motor revolutions (409600 increments) should be added to the current position every cycle in order to ensure smooth travel at 300 rpm.

Note: The GOR command always relates to the position setpoint. For example, if the GOR command is sent 100 times in a program, the position setpoint within IPOS is set to 100 x 1000 = 100000 increments. The position setpoint may "migrate" away from the actual position of the motor if the GOR command is called up cyclically in the program. The IPOS control may then fail if the difference is $2^{31}/2$.

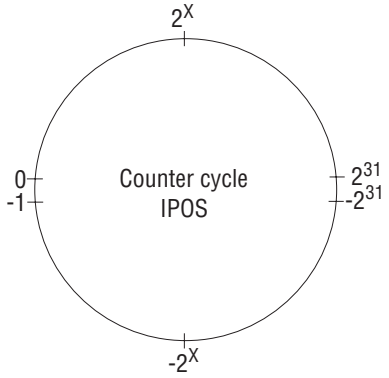

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Fig. 17: Number circle

7.4.1.5 Position with PC target position

The **GOPA** command makes it possible to move to a position setpoint in the IPOS program. This position setpoint is sent from the user interface (or from a controller) via the serial interface. This is a non-wait command (it can be supplemented by the WAITPOS command). The drive moves to the target position with the set values for the positioning ramp and travel speed. The setpoint for the **GOPA** command is only saved for as long as the unit is switched on.

Example:
```
GOØ #Ø
GOPA
END
```

The program starts by referencing the drive axis. Following this, the user interface or the controller moves the drive to the position setpoint. The program continues without interruption. A new position setpoint is used the next time the program runs through.

7.4.1.6 Saving the target position

In particular when using non-wait travel commands, it is helpful to know the target position of the travel command which was sent at some time previously and is currently in progress. The system automatically stores this information in variable 253 irrespective of the user programming. This value is no longer valid after the travel movement is interrupted, e.g. by a controller inhibit or a stop command.

7.4.2 Jump commands

General information: Each command can have a jump flag assigned to it using the MD_SHELL user interface. This jump flag can be used as a jump destination. The **basic programming rules** described in Sec. 7.1.1 apply to the use of jump commands. It is essential to follow the information given there in order to achieve trouble-free operation.

7.4.2.1 Unconditional jump

The **JMP M[XX]** command performs an unconditional jump to jump flag XX.

7.4.2.2 Jump if axis stopped

The **JMPST M[XX]** command makes it possible to implement a program branch depending on whether the drive is stopped or not.

The next command is carried out if the drive is not stopped.

7.4.2.3 Jump if axis not in position

The **JMPNPOS** command makes it possible to implement a program branch depending on whether the drive is in position or not.

The next command is carried out if the drive is in position.

7.4.2.4 Jump depending on terminal level

The following commands are available: **JMPI1** and **JMPIØ**. The command structure is as follows:

JMPI[YY] #Terminal mask M[XX]

All the physical terminals which are to be used in the jump condition should be marked with a 1 in the terminal mask. Zeros must be entered at the appropriate points in the terminal mask in order to set aside physical terminals.

If the **JMPI1** command is carried out, a jump to FLAG[XX] is performed if the level of **all** physical terminals set in the terminal mask with a 1 is 1. The next command is carried out if this condition is not met.

The same applies to the **JMPIØ** command, except that the jump condition here is that the level of all terminals selected in the terminal mask with a 1 must be 0.

The structure of the terminal mask is described in:

Terminal screen (see Sec. 8)

In each case, the least significant terminal is on the right.

Example:

```
      GOØ         #Ø
      JMPI1       #ØØØØØØØØØØ11ØØØØ    MØ1
      WAIT        #1ØØØ ms
MØ1:  GOWR        #1Ø revs.
      END
```

The program performs relative positioning by 10 revolutions in each cycle (following referencing). No 1 s waiting time is observed if the level of **both** the first input terminals of the AIO11 is 1. The program continues without interruption.

7.4.2.5 Jump depending on timer

Two timers are available. Each has a setting range of 0 – 30 s. After a timer has been set (see the set functions), it counts down to 0 in parallel to the positioning procedure or the program flow.

The **JMPTØ=Ø** and **JMPT1=Ø** commands perform a jump to the specified jump flag if timer Ø or timer 1 has run down (the timers count downwards). The next command is carried out if the timer in question has not yet run down.

Example:

```
      GOØ           #Ø
      GOWA          #Ø revs.
      SETTØ         #1ØØØØ ms
      GOWA          #5ØØ revs.
      JMPTØ=Ø       MØ1
      SETO1         #ØØØØØØØ1
      JMP MØ2
MØ1:  SETOØ         #ØØØØØØØ1
MØ2:  RET
      END
```

The sample program initially performs positioning to the 0 revolutions position (after reference travel). Timer 0 is loaded with a time of 10 s. The first output terminal is set to 1 when the positioning procedure to 500 revolutions has taken place, if the 10 s have not yet elapsed. A jump to label MØ1 is performed if the time has elapsed after the positioning. The first output terminal is then set to Ø.

7.4.2.6 Jump depending on variable value

The following jump commands depending on variable values are available:

JMPH>K Jump if variable greater constant
JMPH<K Jump if variable smaller constant
JMPH=K Jump if variable equal constant
JMPH>H Jump if variable greater variable
JMPH<H Jump if variable smaller variable
JMPH=H Jump if variable equal variable

In this case, both the variables and the constants used have a value range from -2^{31} to $+2^{31}-1$. The comparisons are performed with observance of signs.

Example:

```
     GOØ     #Ø
     SETOØ   #11111111            /*All outputs =Ø*/
     GOWA    #Ø revs.             /*Move to X=Ø first*/
     SETTØ   #1ØØØØ ms            /*Load timer with 1Ø s*/
MØØ: SETH=TØ HØØ1,TØ              /*Copy current timer value into variable*/
     JMPH>K  HØØ1, #8ØØØ, #MØØ    /*Jump back if 2 s have not elapsed*/
     SETO1   #ØØØØØØØ1            /*Switch on output 1 after 2 s*/
     JMPH>K  HØØ1, #6ØØØ, #MØØ    /*Jump back if 4 s have not elapsed*/
     SETO1   #ØØØØØØ1Ø            /*Switch on output 2 after 4 s*/
     JMPH>K  HØØ1, #4ØØØ, #MØØ    /*Jump back if 6 s have not elapsed*/
     SETO1   #ØØØØØ1ØØ            /*Switch on output 3 after 6 s*/
     JMPH>K  HØØ1, #2ØØØ, #MØØ    /*Jump back if 8 s have not elapsed*/
     SETO1   #ØØØØ1ØØØ            /*Switch on output 4 after 8 s*/
     END
```

The program initially deletes all output terminals and moves to X = 0. The timer is set to 10 s. An output terminal is set to level 1 every 2 s. The program is started again when the last output has been set.

7.4.2.7 Jump depending on the actual position

The **JMPAP>K** and **JMPAP<K** commands perform a program jump if the current actual position is greater than or less than the specified absolute value.

Syntax of the commands:

JMPAP>K #[Travel distance information], M[XX]
JMPAP<K #[Travel distance information], M[XX]

The travel distance information must be specified in user travel units (constant).

The **JMPAP>H** and **JMPAP<H** commands perform a jump to the specified jump flag if the current actual position is greater than or less than the value in the specified variable.

Syntax:

JMPAP>H H[XXX], M[YY]
JMPAP<H H[XXX], M[YY]

It should be noted that the variable values relating to positions **always** have the unit 4096/motor revolution. The settings of the "Travel distance factor numerator" and "Travel distance factor denominator" machine parameters **do not** have any effect on the variable units.

7.4.2.8 Jump depending on current value

The **JMPCUR>K, JMPCUR<K, JMPCUR>H** and **JMPCUR<H** commands permit a program branch depending on the magnitude of the setpoint current of MOVIDYN® at the time (active current component).

Syntax of the commands:

JMPCUR	>K #[%In]	M[XX]
JMPCUR	<K #[%In]	M[XX]
JMPCUR	>H H[YYY]	M[XX]
JMPCUR	<H H[YYY]	M[XX]

The current values are specified as amounts.

The value range is 0 – 150 % of the nominal axis module current.

Note: Take account of the acceleration torque and the system-related fluctuations in the current magnitude when using both commands.

7.4.3 Wait commands

Wait commands delay the progress of the program flow until the corresponding condition is met. The program is then continued with the next command. The following conditions are available:

WAIT #[Time] ms	Direct time information, unit ms, range 0 – 30000 ms
WAITI1#[Terminal mask]	Wait until the level of **all** physical terminals marked with 1 in the terminal mask is 1.
WAITIØ#[Terminal mask]	Wait until the level of **all** physical terminals marked with 1 in the terminal mask is 0.
WAITPOS	Wait until the drive is in the positioning window.

7.4.4 Set functions

A maximum of 8 output terminals can be set or cleared using the **SETOØ** and **SETO1** commands. (This number is 7 with the AIO 11 for hardware reasons.) It is possible to process several terminals at once if required. All terminals marked with a 1 in the argument to both commands are set active or cleared. Those terminals marked with a Ø remain unaffected.

Syntax:	SETOØ	[X8 X7 X6 X5 X4 X3 X2 X1]
	SETO1	[X8 X7 X6 X5 X4 X3 X2 X1]

X1 means pos. output no. 1
X2 means pos. output no. 2
X3 means pos. output no. 3
X4 means pos. output no. 4
X5 means pos. output no. 5
X6 means pos. output no. 6
X7 means pos. output no. 7
X8 means pos. output no. 8

In order for the **output terminals** of IPOS to have a physical effect, the required unit output must be set to the pos. output no. 1 – 8 function in the menu commands **320** or **330 – 335**.

Example:

```
GOØ      #Ø
WAIT     #1ØØØ ms
SETO1    #ØØØØ1Ø1Ø
WAIT     #1ØØØ ms
SETOØ    #ØØØØ1Ø1Ø
END
```

In this example, the logical terminals pos. output no. 2 and pos. output no. 4 are set or cleared simultaneously after every 1 s. Logical terminals pos. output no. 1, no. 3, no. 5, no. 6, no. 7 and no. 8 are not affected by this program. For example, pos. output terminal no. 2 must be set in menu command 320 if pos. output no. 2 on connector X21 of MOVIDYN® is now to take effect (see the MOVIDYN® installation and operating instructions).

Example: Setting output terminals SETO1

SETO1 (e. g.)	0	0	0	0	1	0	1	0
Pos. output no.	8	7	6	5	4	3	2	1
Assignment	Pos. outputs nos. 1 – 8 are assigned to physical terminals using parameters 320 and 330 – 335.							
Unit	AIO11						Basic unit	
Parameter / programming (e. g.)	335/Pos. outp. 4	334/Pos. outp. 4	333/–	332/Pos. outp. 2	331/–	330/–	320/Pos. outp. 1	
Terminal	12.6	12.5	12.4	12.3	12.2	12.1	21.10	
Level	1	0	–	1	–	–	0	

The level of terminals 12.1, 12.2 and 12.4 is not defined by SETO1 because the corresponding parameter is not programmed onto a pos. output number.

7.4.4.1 Setting travel-specific parameters

The following parameters can be modified in the positioning program using set functions: travel speed, positioning ramp and maximum torque (see the description of the machine parameters). The same applies during travel.

Note: It is essential to bear the system conditions in mind when using these set commands. The following conditions are of particular importance: maximum permitted motor current, rated motor speed, maximum achievable positioning ramp and minimum required holding torque. The unit **does not** itself limit the setting ranges.

The command syntax is as follows:

SETNMAX #[Travel speed CW], #[Travel speed CCW]

Specified in rpm, setting range: for CW = 1 rpm – 5000 rpm
for CCW = 1 rpm – 5000 rpm

SETNMAX H[xxx]

Specified in rpm, setting range: H[xxx] for CW = 1 rpm – 5000 rpm
[xxx+1] for CCW = 1 rpm – 500 rpm

SETAMAX #[Positioning ramp]

Specified in ms, setting range: 0 ms, 20 ms – 10000 ms

SETAMAX H[xxx]

Specified in ms, setting range: 0 ms, 20 ms – 10000 ms

SETMMAX #[Maximum current]

Specified in **1 %** nominal axis current, setting range: 0 % – 150 %

SETMMAX [Hxxx]

Specified in **0.1 %** nominal axis current, setting range: 0.1% – 150 %

After the set functions have been carried out, the modified values for the following parameters are displayed in the user interface: **Travel speed CW/CCW**, **Positioning ramp** and **Maximum current**. The values for the machine parameters modified using the set functions are retained until:

- the axis module is switched off,
- the controller inhibit is activated,
- the FS key in MD_SHELL (halt) is pressed,
- the machine parameters in MD_SHELL are overwritten.

They can be saved using the SAVE command in the IPOS program.

7.4.4.2 Setting timers

The timer enable a branch (JMPTIMER) to take place as a function of the real-time. Both timers can be loaded with a value using the **SETTØ** and **SETT1** commands. The timers count down in ms until they reach the value 0. The setting range is 0 – 30000 ms (see also the jump commands).

Syntax:

```
SETTØ    #[Time value]    /*No variable possible*/
SETT1    #[Time value]    /*No variable possible*/
```

7.4.4.3 Setting the watchdog timer

The watchdog timer permits time monitoring of an IPOS program section to be performed. The drive is stopped if the monitoring function is triggered (timer run down). This application monitoring is switched on using the **SETWDON** command.

Syntax:

```
SETWDON   #[Run-down time]
```

The set watchdog time counts down continuously. Fault 41 WATCHDOG FAULT is triggered (see fault description) if the watchdog timer is not switched off or reloaded within the “run-down time” (see SETWDOFF command).

The **SETWDOFF** command can be used to stop processing of the watchdog. Time monitoring only restarts when the **SETWDON** command is carried out again.

7.4.5 Variable commands

7.4.5.1 Loading variables

The variables (256 items) can be loaded with: **constants**, other **variables**, the **timer Ø**, **timer 1** and the **actual position**.

The range of values of all variables is -2^{31} – $+2^{31}$ -1. The variable values are only stored in the volatile memory and their values are lost when the mains power is switched off. Variables nos. 0 – 63 can be permanently saved as follows:

- By saving the program (Download F2) and “Save to EEPROM”
- “SAVE” whilst the IPOS program is running

Syntax:

SETH=K	H[XXX],	#[Constant]
SETH=H	H[XXX],	H[YYY]
SET[H]=H	H[XXX],	[HYYY]
SETH=[H]	H[XXX],	H[YYY]
SETH=TØ	H[XXX],	TØ
SETH=T1	H[XXX],	T1
SETH=AP	H[XXX],	Xact
SETAP=H	Xact,	H[XXX]
SETH=A12	H[XXX],	Analog input 1 / analog input 2

Please note that some variables have to be used by the IPOS system in conjunction with certain functions. These are:

– Variable no. 255, for the touch probe command
– Variable no. 254, in connection with fieldbus communication
– Variable no. 253, for storing the current target position

All variables can be addressed indirectly using the **SET[H]=H** and **SETH=[H]** commands. This is done by setting the variables in brackets accordingly. The indirectly addressed variable is loaded with the value of the variable which is not in brackets.

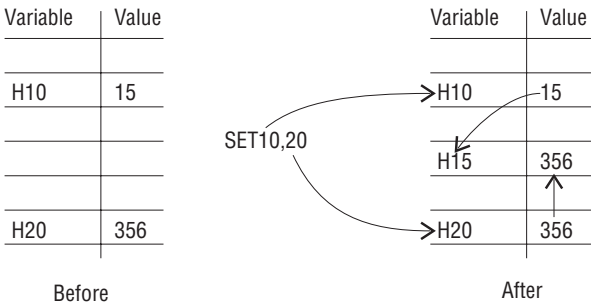

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Fig. 18:

The values of both analog inputs can be transferred into variable values using the **SETH=A12** load command. The unit is 10 mV. This means the voltage range from -10 V to +10 V is reproduced in the range -1000 to +1000.

Only a variable number is given as the argument. The value of analog input 1 of MOVIDYN®is entered in this variable. The value of the analog input of the AIO11 option pcb is written to the following variable. The filtered display values of the analog inputs (filter time constant approx. 200 ms) are used for this command.

Note:

Operating mode analog input 2 (main menu parameter 103)

Analog input 2 (AIO11) is used in the following unit states
– rapid stop (no enable),
– speed control,
– torque control,
– reference travel
as **external current limit**; it does not have any significance in the IPOS automatic program.

The "external current limit" function can be switched off by setting it to "No function" in order to allow analog input 2 to be read in during the IPOS automatic program without any disruption, without it being in effect in the aforementioned unit states.

This is particularly important when the enable function is switched (the external current limit is in effect there).

Setting values:
Reserved
External current limit
Reserved
No function
Factory setting: External current limit

Safety note
This current limit is in effect in the aforementioned unit states.
Depending on the system setpoint, there may therefore be no torque available. This can lead to hoists dropping down, for example. This problem does not exist when the "No function" setting is made.

7.4.5.2 Operations with variables

The four basic types of arithmetic can be performed with the variables. Also, **constants** or other **variables** can be used as a second operand.

The result of the operation is assigned to the variables (left-hand operand).

Syntax:

ADDHK	H[XXX],	#[Constant]
SUBHK	H[XXX],	#[Constant]
MULHK	H[XXX],	#[Constant]
DIVHK	H[XXX],	#[Constant]
ADDHH	H[XXX],	H[XXX]
SUBHH	H[XXX],	H[XXX]
MULHH	H[XXX],	H[XXX]
DIVHH	H[XXX],	H[XXX]

7.4.6 Teach commands

The drive can be moved to PC target positions manually in teach mode, and these can then be saved directly in the program or in variables for further processing.

Syntax:

TEACHS M[XX]
TEACHT #Terminal mask #Table offset (variable offset)

The teach command does not have any effect if the level of the teach terminal is Ø at the **moment when the command is carried out (TEACHS or TEACHT)**. **Teach mode** becomes **active** if the **level** is **1** when the command is carried out.

The teach terminal has setting values 0 – 10. The following applies:

Terminal strip	X13 AIO 11 option	X21 basic unit
Terminal	8 7 6 5 4 3 2	8 7 6 5
Teach terminal value	10 9 8 7 6 5 4	3 2 1 0

Teach mode means the analog setpoint (X21.2 / X21.3) is used as the setpoint speed. It is now possible to move to the required position with this analog setpoint. The following characteristic curve for the speed setpoint applies to the teach procedure to enable the analog setpoint to be maintained without drift at the required position.

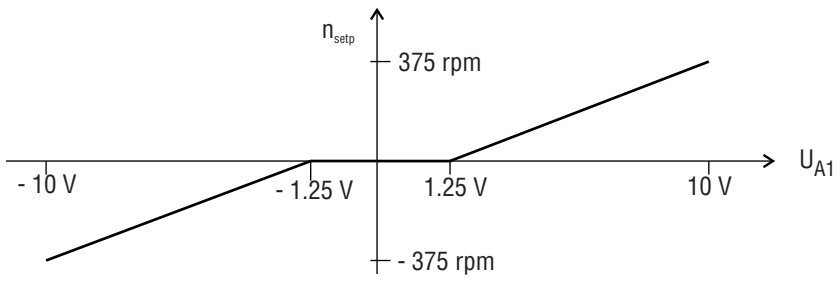

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Fig. 19

This makes it possible to stop in the voltage range -1.25 V to +1.25 V with the setpoint = Ø. The maximum teach speed is +/- 375 rpm.

With the TEACHS command, the **current actual position** is **written** into the argument of the corresponding positioning command if the level of the **teach terminal changes from 1 to Ø** at the required position. **With the TEACHT command, the current actual position is written into the variable selected by the terminal mask if the level of the teach terminal changes from 1 to Ø at the required position.** (See the TEACHS or TEACHT, commands page 49).

TEACHS

The **TEACHS** command permits a position to which the drive has been moved manually to be adopted as a new argument (target position) in a GOWA or GOA command (teach mode). To do this, the required positioning command must have a jump flag assigned to it. The jump flag must then be specified in the TEACHS command.

Example:

```
      GOØ        #Ø
MØ3   GOWA       #Ø revolutions
      WAIT       #1ØØØ ms
      TEACHS     MØ3
      GOWR       #25 revolutions
      SAVE
      END
```

In the sample program, the target position in the argument of the GOWA command (Ø revolutions) can be written over by the TEACHS command. The level of the teach terminal must be 1 to do this, so the drive can be moved to a required position with the analog setpoint. This position is transferred into the GOWA command when the level of the teach terminal changes from 1 → Ø (see page 39). The positioning window must be closed and re-opened before the overwritten argument can be viewed in the positioning window. The SAVE command saves the positioning program and the newly read-in table values. This command is carried out in the background (in parallel to processing of the program).

TEACHT

The **TEACHT** command makes it possible to write position values to table values (variables no. 1 to no. 63) by means of a teach procedure. These values are then stored in the non-volatile memory. When doing this, it is possible to use a terminal mask (see Sec. 8) to select all terminals which are to be used as pointers within the variables (in the same manner as for the table positioning commands). A constant value can be added to the current "variable pointer" by means of the table offset (variable offset).

Example:

```
      GOØ     #Ø
MØØ   TEACHT  #ØØØØØØØ 1111  ØØØØ  #Ø    Teach in the table position
      JMP5=Ø  ØØØØØØ1  ØØØØ  ØØØØ  #MØØ  Start/stop movement to the table position
      GOTA    #ØØØØØØØ 1111  ØØØØ  #Ø    Move to selected table position
      SAVE
      END
```

With this program, 16 table positions (variables no. 0 to no. 16) can be read in via the selected input terminals X13.2 to X13.5 using the TEACHT command. In the process, these 4 input terminals serve as pointers for the tables (variables) to be written. If the teach terminal (machine parameter) is always left at level 0, the GOTA command causes the drive to move to the table position selected using the terminals. The program will run though continuously. The SAVE command saves the positioning program and the newly read-in table values to the non-volatile memory. This command is carried out in the background (in parallel to processing of the program).

7.4.7 Touch probe commands

The touch probe function permits the current actual position to be saved in real-time (200 ms), e.g. during travel.

SETTP: The "touch probe" is activated with the **SETTP** command and terminal X21.6 is automatically evaluated as the touch probe input. It is a good idea to change over the factory setting in parameter group 300 from "Enable" to "No function" in order to avoid assigning this input twice. The "Enable" function should be set to another input in the parameters.

This means that after this command has been carried out, the next 1 level at terminal X21.6 leads to the actual position being determined at that moment and stored in a temporary memory.

The 1 level must be present for at least 200 ms in order to be detected reliably. Only the first 1 level (at X21.6) after the **SETTP** command has been carried out leads to the actual position ("touch probe position") being stored. The IPOS program is continued after the **SETTP** command, irrespective of whether the touch probe has come or not (1 level at X21.6). The touch probe position is also stored in IPOS variable 255 and can be used there, for example for "dynamic" measurement.

GOTPH: The **GOTPH** command "waits" until the touch probe has come. The command has a variable number as its argument. Once the touch probe is received, movement takes place to the target position = "touch probe position" + variable content. The command is non-wait.

JMPNTP: The "Jump if no touch probe" command can be used, for example, to continue working in the program until the touch probe is received.

Sample program:

```
M00: GO0      #0           Referencing the axis
     SETO0    #0000000     Reset signal output
     GOWA     #0           Move, wait to X = 0
     GOA      #100 revs.   Move, non-wait to 100 revs.
     SETT0    #2000ms      Start timer 0 with 2000 ms
     SETTP                 Activate touch probe
M01: JMPT=0   #M02         Have 2 s elapsed without touch probe?
     JMPNTP   #M01         Has the touch probe been detected?
     GOTP     H005         Position absolute to TP position + value in
                           variable 005
     WAITPOS               Wait until target position reached
     JMP      #M00         Repeat all again
M02: SET01    #00000001    Signal that no touch probe detected
     JMP      #M02
     END
```

7.4.8 Other commands

The **GOØ** command triggers reference travel in accordance with the set reference travel type. The IPOS operating mode is exited (7-segment display changes from A to c). The set reference speeds are used during reference travel (see reference travel in Sec. 5.1). The GOØ command possesses an argument. It has the following effect, depending on the argument:

GOØ #Ø	The drive is only referenced if it has not already been referenced. The next command is carried out if the axis has been referenced.
GOØ #1	The drive is always referenced, irrespective of whether it has already been referenced or not. The next command is carried out after the referencing has been performed.

The **NOP** command does not have any effect. All that happens is that the command processing time elapses until the next command is carried out.

An unconditional subroutine call can be made using the **CALL** command.

Syntax:

CALL M[XX]

This means the subroutine with the flag XX is carried out. Processing continues with the next command when the subroutine has been completed (with the RET command). Nested subroutine calls are possible. It is essential to observe the basic programming rules in Sec. 7.1.1 when the CALL command is used!

The **RET** command indicates the end of a subroutine. The entire program is completed by the **END** command (see Sec. 7.2 in this regard).

The **LOOPB** and **LOOPE** commands are for repeating processing of a command block.

Syntax:

```
LOOPB       #[Number of loop cycles]
Command
Command
...
...
LOOPE
```

All commands in the loop block are performed repeatedly depending on the specified number of loops. The next command is then carried out. The loop command can also be used in a nested structure.

Make sure the loop block is not exited by a jump. It is essential to comply with the basic programming rules in Sec. 7.1.1.

The **SAVE** command causes the positioning program and the variables no. 0 to no. 63, which can be permanently stored, to be saved from the main memory to the non-volatile memory. This process takes about 15 s and is carried out in parallel to normal processing of the program. This means the position to which the drive is moved manually in a teach procedure can be permanently saved.

Note:

The **SAVE** command saves **modifications** to the program, the machine parameter and variables no. 0 to no. 63 in the non-volatile memory. This memory has a limited number of memory cycles (approx. 10^5 – 10^6). The **SAVE** command should not be called up in every program cycle if variables are changed continually, e.g. for specifying the setpoint of a serial interface or using the SET H = A12 command or as a calculation variable. The variables > 63 should be used for the aforementioned variable applications if it is necessary or desirable that the **SAVE** command should be called up in every cycle.

The brake function can be switched on and off within the automatic program using the **BRAKE** command (see the description of the brake function).

The **STOP** command can be used for stopping the drive axis during a travel procedure. If it is implemented, the drive performs a stop procedure (with the rapid stop ramp and speed control) and maintains the position it reached when it came to a stop, with position control. The next command is then carried out.

8 User Notes

- **Preliminary parameterization of the inverter (start IPOS without PC)**
  In order to be able to start IPOS only via input terminals, the last PC setting of the operating mode in the positioning window must be set to START if the controller inhibit and enable are at level 1. Otherwise, this operating mode must be activated by pressing F9 or by pressing the "←" and "→" keys simultaneously on the ABG 11 diagnosis and service module.

- **Position measuring system**
  Only the internal encoder simulation of the resolver can be used as an impulse generator (no external encoder can be connected).

- **IPOS in conjunction with AIO 11**
  Jumper the terminals X14.1 and X14.3 on the AIO11 input/output card (if they are not jumpered, the motor has **no torque** when the enable terminal is revoked – caution with hoists!) or set the main menu parameter 103 "Operat. mode analog input 2" to "No function" (see also the note in Sec. 7.4.5.1).

- **External voltage supply** (24 V)
  The actual position and variable values are retained in the event of a power failure if an external voltage supply is connected.

- **Lag error**
  Parameters 210 and 211 (max. speed setpoint) must always be set approx. 10 % greater than the IPOS "Travel speed CW/CCW" machine parameters, otherwise there is a risk of lag errors!

- **Machine parameters**
  Define the machine parameters prior to writing the program, because they influence travel distances entered in the program, for example.

- **Travel commands with variables**
  Travel to variables is only possible in the increments unit (4096 incr./rev.).

- **Arrangement of terminals for JMPI1**

Example: Input terminal mask for JMPI1

Unit	**AIO11**							**Basic unit**			
Terminal	13.8	13.7	13.6	13.5	13.4	13.3	13.2	21.8	21.7	21.6	21.5
Level (e.g.)	0	0	0	1	1	0	0	0	1	1	0
Terminal mask (e.g.)	0	0	0	0	1	0	1	0	1	0	0
Result	0	0	0	0	1	0	0	0	1	0	0
JMPI1: Jump?	No jump takes place because **all** terminals set to 1 in the terminal mask actually must have the level 1, and this is not the case with terminal 13.2.										

8.1 Sample application for hoist

8.1.1 Schematic structure

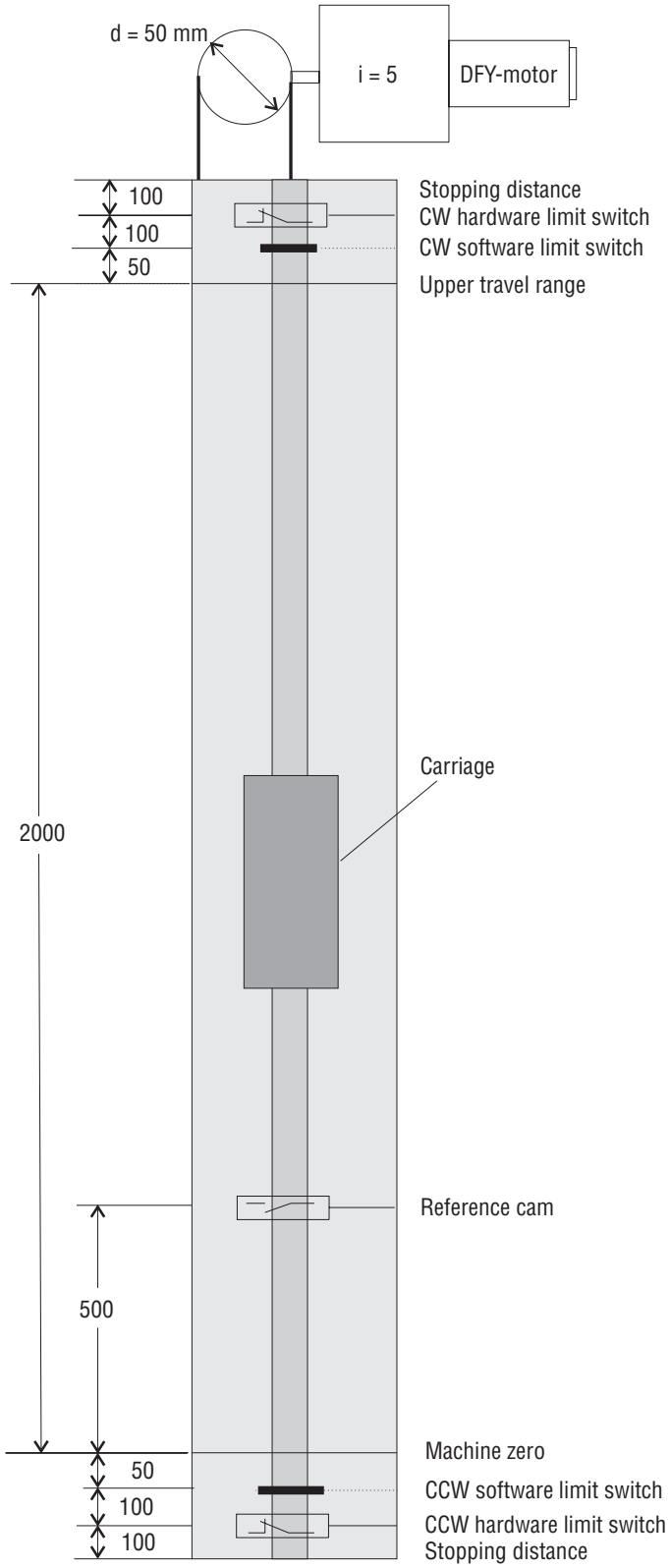

Fig. 20

8.1.2 Terminal assignment

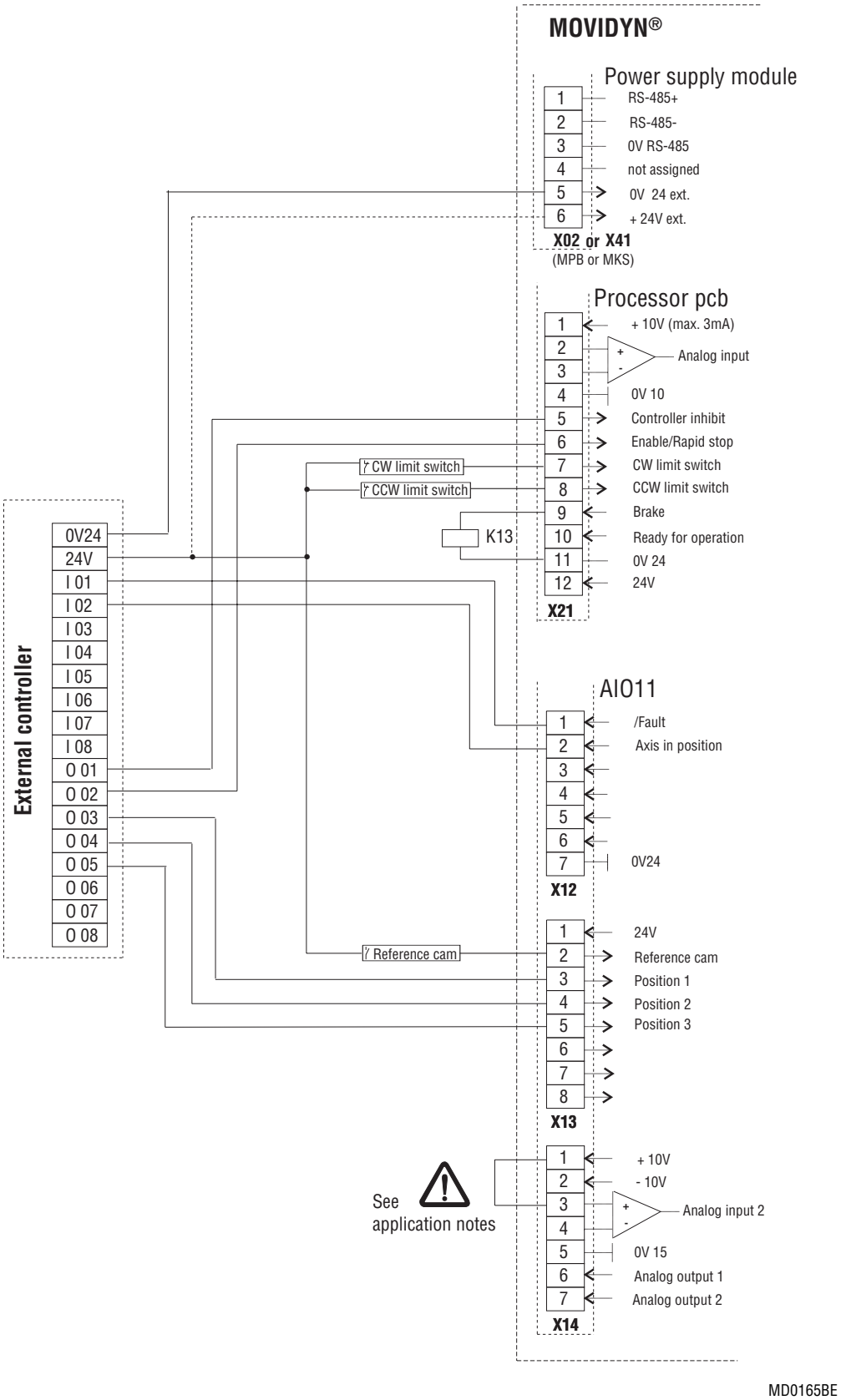

Fig. 21: Terminal assignment, hoist

8.1.3 MD_SHELL parameter setting for IPOS application

1..	**Setpoints/Gen. Ramps**	
100	Operating mode	POSITION
103	Operating mode analog input 2	NO FUNCTION
110	Setpoint source	ANALOG INPUT
21.	**Limits**	
210	Max. speed CW [rpm]	3000
211	Max. speed CCW [rpm]	3000
30.	**Binary inputs, basic unit**	
300	Terminal X21.6	ENABLE
301	Terminal X21.7	/LIMIT SWITCH CW
302	Terminal X21.8	/LIMIT SWITCH CCW
31.	**Binary inputs AIO**	
310	Terminal X13.2	REF. CAM
311	Terminal X13.3	NO FUNCTION
312	Terminal X13.4	NO FUNCTION
313	Terminal X13.5	NO FUNCTION
314	Terminal X13.6	NO FUNCTION
315	Terminal X13.7	NO FUNCTION
316	Terminal X13.8	NO FUNCTION
32.	**Binary outputs basic unit**	
320	Terminal X21.10	READY FOR OPERA.
33.	**Binary outputs AIO**	
330	Terminal X12.1	/FAULT
331	Terminal X12.2	IN POSITION
332	Terminal X12.3	NO FUNCTION
333	Terminal X12.4	NO FUNCTION
334	Terminal X12.5	NO FUNCTION
335	Terminal X12.6	NO FUNCTION

IPOS machine parameters

Reference offset		499.99453711
Reference speed 1	[rpm]	500
Reference speed 2	[rpm]	100
Reference travel type		1
Gain X controller		2.78
Positioning ramp	[s]	0.30
Travel speed CW	[rpm]	2700
Travel speed CCW	[rpm]	2700
SW limit switch RIGHT	[mm]	2049.993709
SW limit switch LEFT	[mm]	-50.000220703
PC pos. setpoint	[mm]	0
Position window	[inc]	5
Override		OFF
Teach terminal		0
Lag error window	[inc]	2000
Travel distance indication		mm
Travel distance factor numerator		2048000
Travel distance factor denominator		15708
P500 brake function		YES
P501 brake reaction time	[ms]	200
IPOS bus mode		0
Feed forward	[%]	100
Ramp type		SINUS

8.1.4 Calculating the IPOS machine parameters

Reference offset: See schematic structure

SW limit switch: See schematic structure

Travel distance indication: The unit after the travel-specific information should appear in mm.

Travel distance factor numerator: The travel distance unit shall be in mm!
Number of increments per drive wheel revolution
Increments/motor rev. ×gear ratio
4096 increments ×5 = 20480
20480 ×100 (extension factor*) = 2048000

Travel distance factor denominator: Drive wheel circumference in mm.
$d \times \pi$
50 mm ×p = 157.0796327
157.08 ×100 (extension factor*) = 15708
* An extension factor may be used for taking decimal places into consideration.

Travel speed: Rated engine speed

Position window: The “Drive in position” message should be issued at ±5 increments.
(The drive always regulates to ±1 increment.)

8.1.5 Hoist program

```
        GO Ø    #Ø                  /*Perform reference travel*/
MØ2: JMP IØ ØØØØ ØØØØ ØØ1Ø ØØØØ, MØØ/*If terminal X13.3 is set, travel*/
        GOWA    Ø mm                /*to position 0 mm*/
MØØ: JMP IØ ØØØØ ØØØØ Ø1ØØ ØØØØ, MØ1/*If terminal X13.4 is set, travel*/
        GOWA    999.989Ø7421 mm     /*to position 1000 mm*/
MØ1: JMP IØ ØØØØ ØØØØ 1ØØØ ØØØØ, MØ2/*If terminal X13.5 is set, travel*/
        GOWA    1999.9858183 mm     /*to position 2000 mm*/
        RET
        END
```

8.2 Jog mode sample program

Jog mode with uni-directional travel (no counter overrun at 2^{31} increments).

Example:

```
***** Jog mode / Uni-directional travel *****
          SETNMAX R#300 , L#300 rpm
M02: JMPI1 #0000000000010000, M00
          STOP
M03: JMPI1 #0000000000100000, M01
          STOP
          JMP M02
******** Jog forwards **********************
M00: SETH=AP H100 , AP
          ADDHK     H100 , #409600
          GOAH      H100
          JMP       M02
******** Jog backwards *********************
M01: SETH=AP H100 , AP
          SUBHK     H100 , #409600
          GOAH      H100
          JMP       M03
          END
```

This jog program permits a motor to be moved any distance without leading to the *Travel counter overrun at 2^{31} increments* error. This is achieved by defining the **travel variables** in each program cycle during movement on the basis of the **current actual position + offset**.

8.3 Sample program

Reference travel routine with exact detection of the start of the reference cam

(The motor encoder zero pulse is not evaluated; see the types of reference travel in Sec. 4.2.1.)

Applications:

- Systems in which the travel range is shifted accordingly by shifting the reference cam, without an inaccuracy occurring do to the grid settings of the motor encoder zero pulse.
- "Uni-directional travel drives" (e.g. rotary table). In "uni-directional mode", the motor encoder zero pulse may be shifted in relation to the reference cam position.
  This causes the reference position to move as well because referencing occurs to the motor encoder zero pulse during reference travel (see figure).

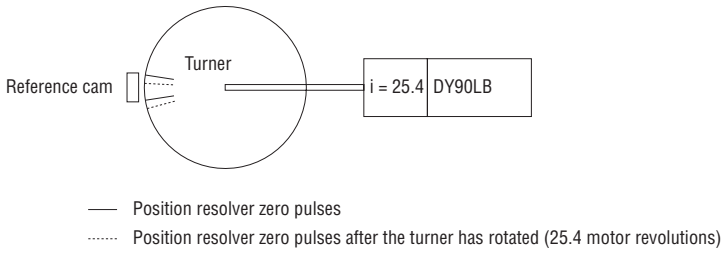

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Fig. 22

Referencing to the end of the ref. cam without zero pulse evaluation

with touch probe function, see → **Sec. 7.4.7** in this regard.

In reference travel types **1 and 3**, the value should be entered in **H247** as a positive value in accordance with the direction of rotation (+5000).

In reference travel types **2 and 4**, the value should be entered in **H247** as a negative value in accordance with the direction of rotation (–5000).

```
*************************************************************************
******* Start of the reference travel routine for reference types 1 and 3 ******
      Travel variable 5000 incr.: Zero pulse -> reference cam
      Travel variable 0 incr. from when the end of the ref. cam is reached
      Load position of the end of the ref. cam with value in H249 (0) / or enter
      the reference offset value here
      Set travel speed to 50 rpm
      Perform normal reference travel (with zero pulse)
      Move from zero pulse back to reference cam
      Set touch probe input (x21:6 <-> ref. cam) active
      Wait until ref. cam is reached
      Move exactly to the end of the ref. cam (0 incr.)
      Set position end of the ref. cam with value in H249
****************** End of the reference travel routine **********************
```

Note:

- The reference cam is detected with the touch probe function instead of evaluating the motor encoder zero pulse (→ Sec. 4.2.1). To do this, the reference cam must be wired up to the touch probe input (X21.6), the parameter of which must be changed to “No function” (P300). This means the parameter for the ”Enable” must be changed to another input (→ Sec. 7.4.7).

9 Fault Message / Service Information

9.1 Status displays

9.1.1 Status window

The “IPOS” status window displays all important information about the status of the connected axis.

This information is in detail:

– Fault

– Actual position in user units (see machine parameters)

– Actual speed (see machine parameters)

– Actual current

– Lag distance (in increments)

– Analogue input 1 (voltage)

– Analogue input 2 (voltage)

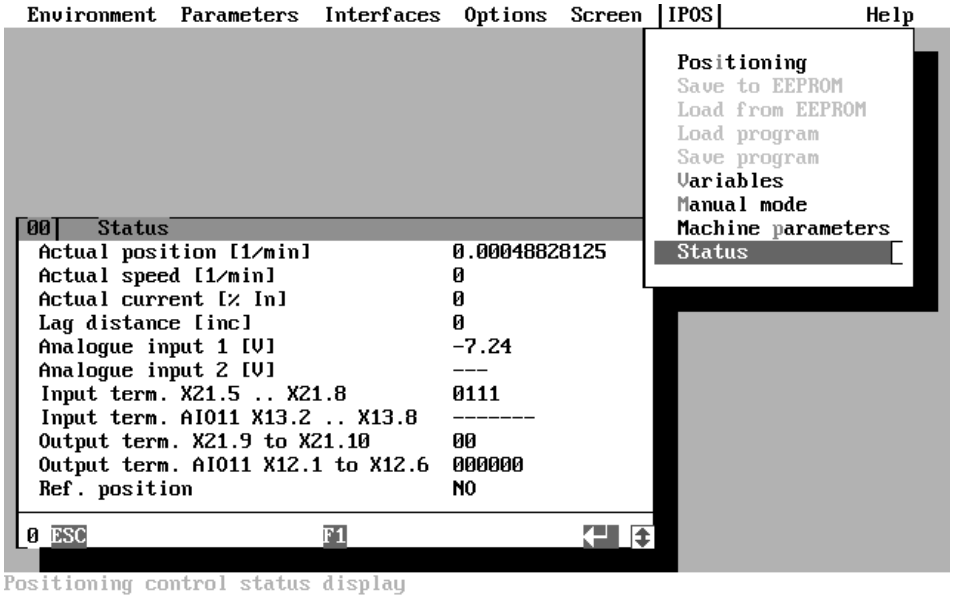
– Binary inputs, basic unit

– Binary inputs AIO11

– Binary outputs, basic unit

– Binary outputs AIO11

– Indication of whether the axis is referenced



MD0074AE

Fig. 23:

9.1.2 Display window (basic unit)

The “Process values” window provides further information important for operating the MOVIDYN® with IPOS (see the MOVIDYN® operating instructions).

9.2 IPOS fault response

9.2.1 List of IPOS errors

The following list provides an overview of all fault messages that can occur during operation of the MOVIDYN® servo controller with IPOS and that are directly related to IPOS. In addition to an explanation of the possible causes, the list provides information about how to remedy the fault.

Fault number	Meaning	Possible causes	Remedy (→ Sec. 9.2.2)	Ready message	/Fault message	Response
10	Invalid IPOS command	No program or wrong program stored in unit (e.g. after factory setting)	Check the content of the program memory	X	X	Emergency stop
39	Fault during reference travel	Reference cam not present or incorrect limit switch connection or reference type changed during reference travel	Check the reference type and its corresponding requirements		X	*
41	User watchdog (in positioning program)	System fault or wrong time setting	Check use of watchdog command	X	X	Emergency stop
42	Lag error	System fault or set value too small	Check set value	X	X	Emergency stop
58	Jump command error	Jump to invalid area	Check and correct user program	X	X	Emergency stop
72	Index overflow	Basic programming rules not observed (7.1.1), causing stack overflow	Check and correct user program		X	*
76	Teach error	Teach procedure incorrect	Check teach procedure	X	X	Emergency stop
77	Invalid control word	An attempt has been made to set an invalid automatic mode (usually only with external control)	Check the serial connection and the setting value of the external control	X	X	Emergency stop
78	Software limit switch	Target position lies beyond the software limit switch	Check the software limit switch and the travel program	X	X	Emergency stop

* Emergency stop with unit shutdown

All other fault descriptions can be found in the MOVIDYN® installation and operating instructions.

9.2.2 Fault reset

With the exception of fault 39 (fault during reference travel) and fault 72, the faults listed do not cause the unit to switch off. This enables the drive to continue in operation without a new reference travel. The IPOS program is in “STOP” operating mode after a fault and the program pointer is reset to the start of the program.

The IPOS program must be restarted when the fault has been acknowledged (→ Sec. 5.3), unless the program restarts automatically as a result of the fault acknowledgment. After rectifying the actual cause of the fault, the following methods may be used to acknowledge (reset) an IPOS fault:

1. Controller inhibit / enable (→ Sec. 5.3)
2. Pressing the reset button on the front of the unit
3. Turning the mains power OFF/ON (reset: all faults)

4. By setting one of the following in the MD_SHELL user interface:
   – AUTOMATIC RUN (F9)
   – AUTOMATIC BREAKPOINT (F4)
   – AUTOMATIC STEP (F7)
5. By activating parameter 632 “Manual reset” in the user interface.

10 Index

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