MOVIDRIVE® MD_60A Drive Inverters

Addendum to System Manual

Bus Positioning

Edition 02/2000

0918 421X / 022000

DIN EN ISO 9001

SEW EURODRIVE

- **This additional information does not replace the detailed operating instructions!**
- **Installation should only be performed by electrical specialists observing applicable accident prevention regulations and the MOVIDRIVE® operating instructions!**

- **Read through this manual carefully before you commence installation and startup of MOVIDRIVE® drive inverters with bus positioning.**
  This manual assumes that the user has access to and is familiar with the documentation on the MOVIDRIVE®system, in particular the MOVIDRIVE®System Manual and the fieldbus documentation.

- **Safety notes:**
  Always follow the safety and warning instructions 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 instructions for safe and fault-free operation of the driven machine/system, e.g. pre-setting before startup.

- In this manual, **cross references** are signified by →, e.g.:(→ Sec. X.X)
  means: Further information can be found in section X.X of this manual.

- A requirement of fault-free operation and fulfillment of any rights to claim under guarantee is that this information is observed.

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1 Project Planning

1.1 Application Fields

Bus positioning is particularly suited to the following sectors and applications:

- **Materials handling technology**
  - Trolleys
  - Hoists
  - Rail vehicles

- **Logistics**
  - Storage and retrieval units for high-bay warehouses
  - Transverse carriages

- **Palletizing/handling**
  - Multi-axis handling robots
  - Gantries

Bus positioning offers the following advantages in these applications:

- User-friendly user interface
- You only have to enter the parameters required for bus positioning (ratios, speeds, diameters)
- User-friendly application programs guide you through the process of setting parameters, so there is no need for complicated programming
- Monitor mode for optimum diagnosis
- You do not need any programming experience
- It doesn't take long to get to know the system

1.2 Hardware and Software Requirements

1.2.1 PC and Software

Bus positioning is implemented as an IPOS$^{plus®}$ program and forms part of the SEW MOVITOOLS software package. In order to use MOVITOOLS, you must have a PC with one of the following operating systems: Windows 95®, Windows 98® or Windows NT® version 4.0.

1.2.2 Inverters, Motors and Encoders

- **Inverters**

  Bus positioning can be performed using MOVIDRIVE® MDV60A or MOVIDRIVE® MDS60A. You need the MOVIDRIVE® option (DFP11A, DFI11A, DFC11A or DFD11A) corresponding to the bus type you are going to be using. However, you do not need one of these options if you are going to use the system bus (SBus) which is provided as standard.

  An external encoder is required for positioning in applications with a non-positive connection between the motor shaft and the load. Absolute encoder interface type DIP11A is required if an absolute encoder is being used as well.

  Bus positioning is not possible with MOVIDRIVE® MDF60A because no encoder feedback is possible.

- **Motors**
  - For operation on MOVIDRIVE® MDV60A:

    Asynchronous servo motors CT/CV, encoder installed as standard.

    AC motors DT/DV/D with incremental encoder option or combination encoder AV1Y.
  - For operation on MOVIDRIVE® MDS60A:

    Synchronous servo motors DS/DY, resolver installed as standard.

- **External encoders**
  - Interlocking connection between the motor shaft and the load:
    No external encoder is needed*.
  - Non-positive connection between the motor shaft and the load:
    An external encoder is needed in addition to the motor encoder/resolver.
    Incremental encoder as external encoder → Connection on the basic unit X14:
    Absolute encoder as external encoder → Connection on the DIP11A option X62:

  * If you also want to use an external encoder for positioning when there is an interlocking connection, you have to proceed in exactly the same way as with a non-positive connection.

- **Possible combinations**

Motor shaft/load connection	Interlocking, no external encoder needed.	Non-positive, external encoder needed	
Encoder type, ext. encoder	-	Incremental encoder	Absolute encoder
Reference travel	Yes	Yes	No
Bus type → Required option	PROFIBUS → DFP11A INTERBUS → DFI11A CAN bus → DFC11A DeviceNet → DFD11A System bus (SBus) → No option necessary		
Other MOVIDRIVE® option required	No	No	Absolute encoder interface Type DIP11A

1.3 Functional Description

The “bus positioning” application offers the following functional characteristics:

- Any number of target positions can be defined and selected by means of a fieldbus/system bus.
  Important: The maximum possible travel distance depends on the travel unit which is set.

Travel unit	Max. possible travel distance
1/10 mm	3.27 m
mm	32.7 m
cm	327 m

- For positioning travel, the speed can be selected as required using the bus.
- Software limit switches can be defined and evaluated.
- Either incremental encoders or absolute encoders can be evaluated as external encoders.
- Straightforward connection to the machine control (PLC).

The functions are implemented with three operating modes:

- **Jog mode**
  - The drive is moved clockwise or counterclockwise using bits 9 and 10 in control word 2 (PO1).
  - The speed in jog mode is variable and is specified by the PLC via the bus.

- **Referencing mode**
  - Reference travel is started with bit 8 in control word 2 (PO1). Reference travel establishes the reference point (**machine zero**) for absolute positioning operations.

- **Automatic mode**
  - Set speed and target position are specified using process output data (PO2 and PO3).
  - Cyclical checkback of actual speed and actual position in the user unit via process input data (PI2 and PI3).
  - Confirmation of the target position to which movement has taken place via virtual binary output “target position reached”.

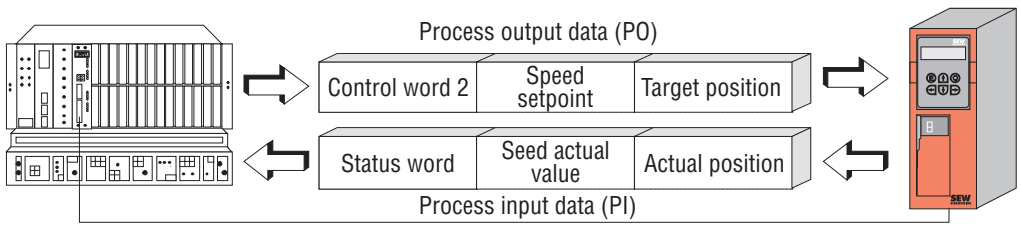

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Fig. 1: Data exchange via process data

1.4 Scaling of the Drive

The control needs to know the number of encoder pulses (increments) per travel unit so it can calculate the travel information and position the drive correctly. Furthermore, you can use the scaling function to tailor the unit of measurement suitable to your application.

Drives without an external encoder (interlocking connection):

In drives without an external encoder, you can have scaling performed automatically by the bus positioning startup procedure. To do this, you have to enter the following data:

- Diameter of the drive wheel or the spindle pitch
- Gear unit ratio (i gear unit, speed reduction)
- Additional gear ratio (i additional gear, speed reduction)

The following scaling factors are then calculated.

1. Pulses/distance scaling factor [inc/mm] according to the formula:
   Pulses = $4096 \times i_{\text{gear unit}} \times i_{\text{additional gear}}$
   Distance = $\pi \times d_{\text{drive wheel}}$ or $s_{\text{spindle pitch}}$
2. Speed scaling factor (numerator value in rpm and denominator value in mm/s).
   You can also enter m/min or rpm as the unit for the denominator value.

It is also possible to enter the pulses/distance and the scaling factor of the speed directly. If you enter a unit other than millimeter [mm] as the travel unit, then this user unit is also used for the position of the software limit switches, the reference offset and the bus positions.

Drive with an external encoder (non-positive connection):

In this case, you must have activated and scaled the external encoder before starting up the bus positioning. Make the following settings in Shell in order to do this:

- Set P941 “Source actual position”, EXT. ENCODER (X14) with incremental encoder or ABSOLUTE ENCODER (DIP). You can also make this setting during the startup of the bus positioning.

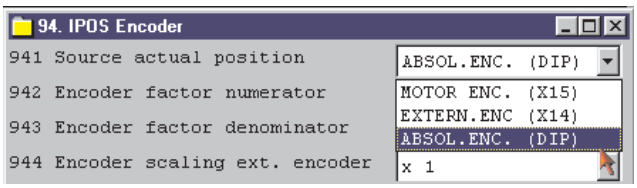

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Fig. 2: Setting the source actual position

- Set P942 – P944 encoder factor numerator, encoder factor denominator and encoder scaling ext. encoder. This setting must be made in SHELL prior to the startup of bus positioning.

Calculation of the scaling is now blocked during startup.

For more information about scaling an external encoder, please refer to the “IPOS$^{plus®}$ Positioning and Sequence Control System” manual (publication number 0919 1712).

If you are using an absolute encoder, follow the startup instructions in the “Positioning with Absolute Encoder and Absolute Encoder Interface DIP11A” manual (publication number 0919 5912).

1.5 Limit Switches, Reference Cams and Machine Zero Point

Note the following points during project planning:

- The software limit switches must be located within the travel range of the hardware limit switches.
- When defining the reference position (position of the reference cam) and the software limit switches, make sure they do not overlap. Fault message F78 “IPOS SW limit switch” is generated in the event of an overlap during referencing.
- You can enter a reference offset during startup of the bus positioning if you do not want the machine zero (= reference point for bus positioning) to be located on the reference point. The following formula applies: Machine zero = Reference position + Reference offset
  In this way, you can alter the machine zero without having to move the reference cam.

1.6 Process Data Assignment

The machine control (PLC) sends three process output data words (PO1 – PO3) to the inverter and receives three process input data words (PI1 – PI3) from the inverter.

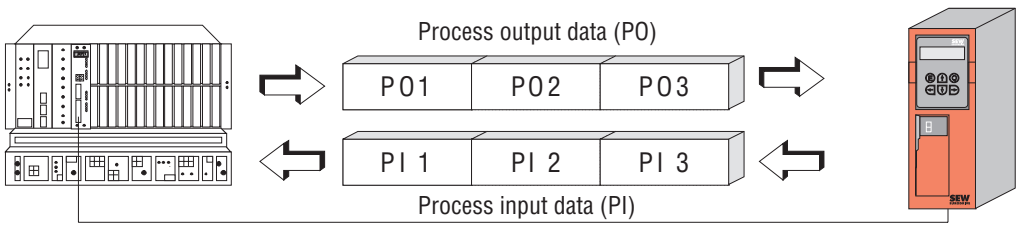

Fig. 3: Process data channel

The assignment of the process output data words is as follows:

- **PO1 control word 2**

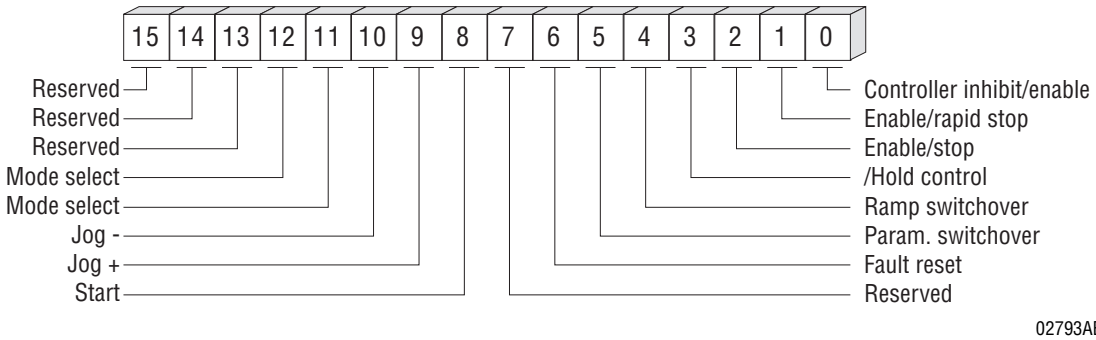

Fig. 4: PO1 control word

- **PO2 setpoint speed**

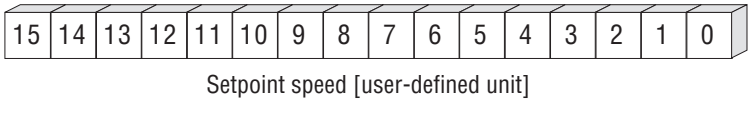

Fig. 5: PO2 setpoint speed

- **PA3 target position**

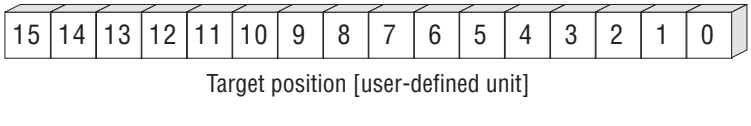

Fig. 6: PO3 setpoint position

The assignment of the process input data words is as follows:

- **PI1 status word**

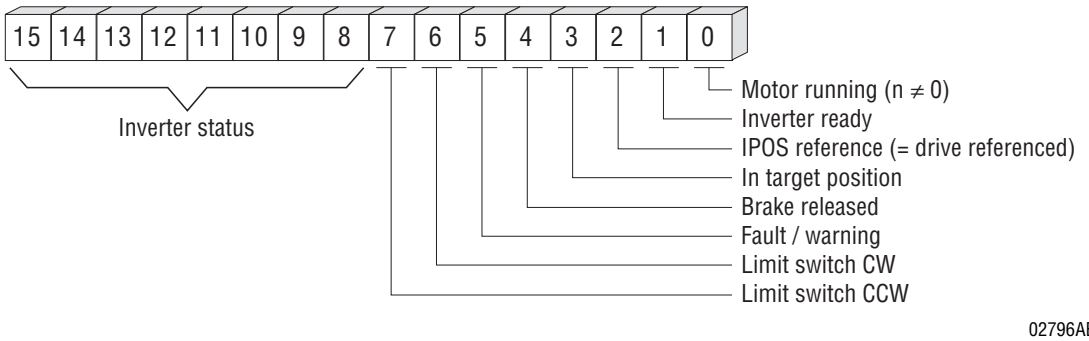

Fig. 7: PI1 status word

- **PI2 actual speed**

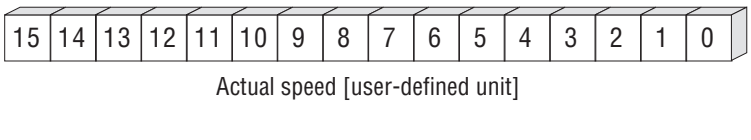

Fig. 8: PI2 actual speed

- **PI3 actual position**

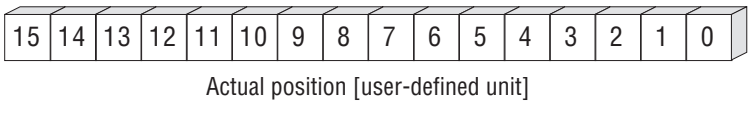

Fig. 9: PI3 actual position

2 Installation

2.1 Software

Bus positioning is a part of the SEW MOVITOOLS software package. Proceed as follows to install MOVITOOLS on your computer:

1. Insert the MOVITOOLS CD into the CD ROM drive of your PC.
2. Select “Start/Run...”.
3. Type “{Drive letter of your CD drive}:setup” and press the Enter key.
4. The MOVITOOLS setup menu appears. Follow the instructions of the installation wizard.

Now proceed as follows to install the bus positioning software:

1. Insert disk 1/2 with the fieldbus positioning into the disk drive of your PC.
2. Select “Start/Run...”.
3. Type “{Drive letter of your floppy disk drive}:setup” and press the Enter key.
4. The bus positioning setup menu appears. Follow the instructions of the installation wizard.

You can now use Program Manager to start MOVITOOLS. If a MOVIDRIVE® unit is connected to your PC, select the correct port (PC COM port) and set point-to-point connection. Select <Update> to display the inverter in the "Connected Units" window.

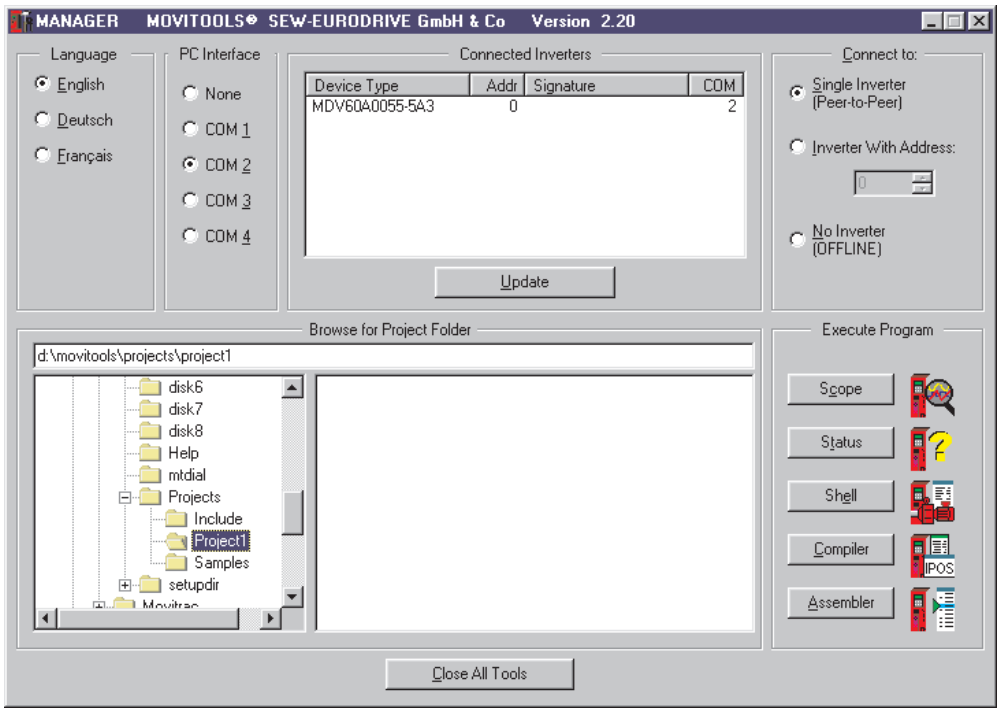

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Fig. 10: MOVITOOLS window

2.2 MOVIDRIVE® Basic Unit

You must wire up the MOVIDRIVE® basic unit as shown in the following wiring diagram, irrespective of the bus type you are using.

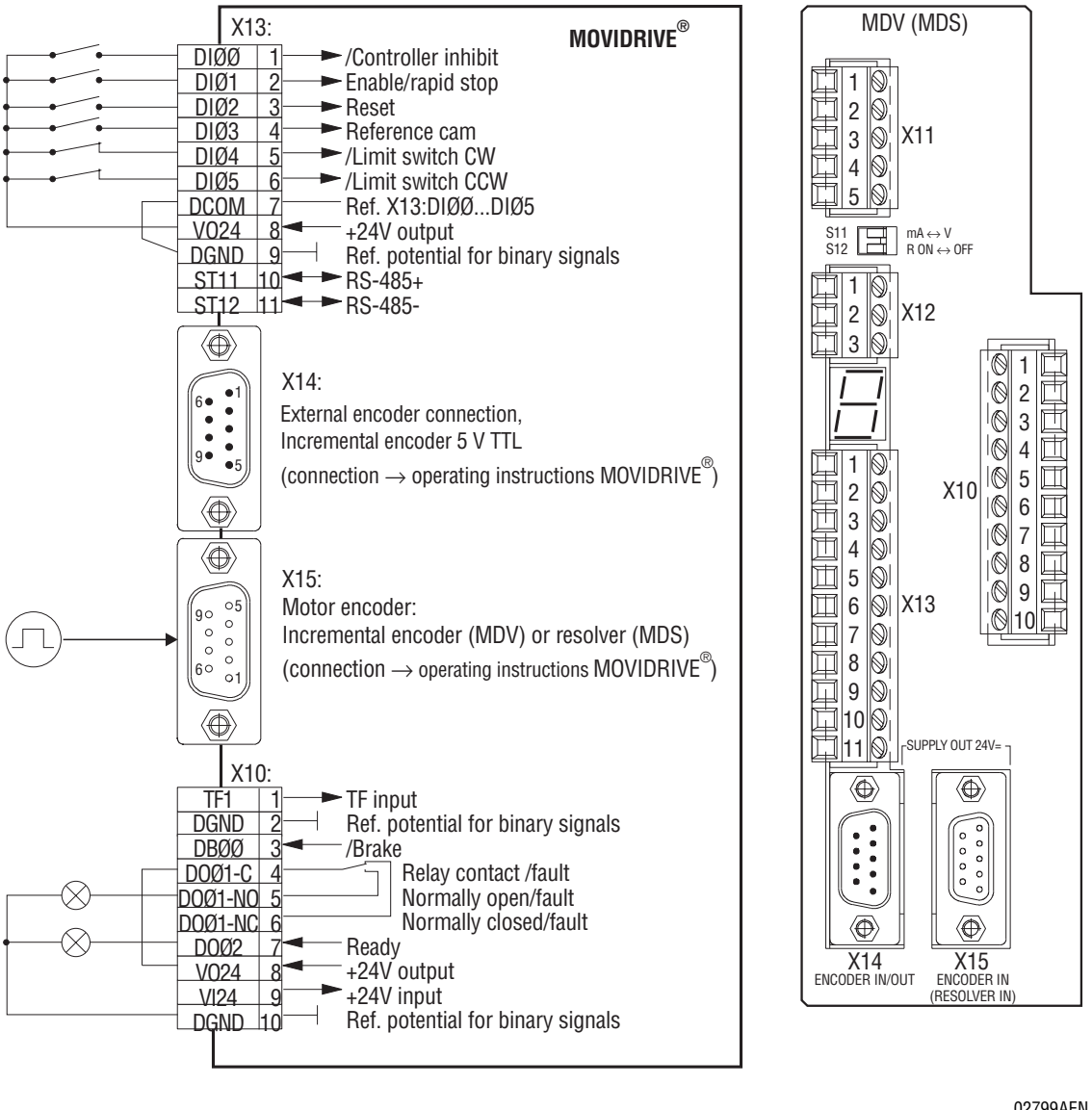

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Fig. 11: Wiring diagram for MOVIDRIVE® basic unit

2.3 Bus Installation

Please refer to the information in the relevant addendums to the operating instructions for information about bus installation. These addendums are included with the DFP11A, DFI11A, DFC11A and DFD11A fieldbus interfaces. Please refer to the operating instructions for information about installing the system bus (SBus).

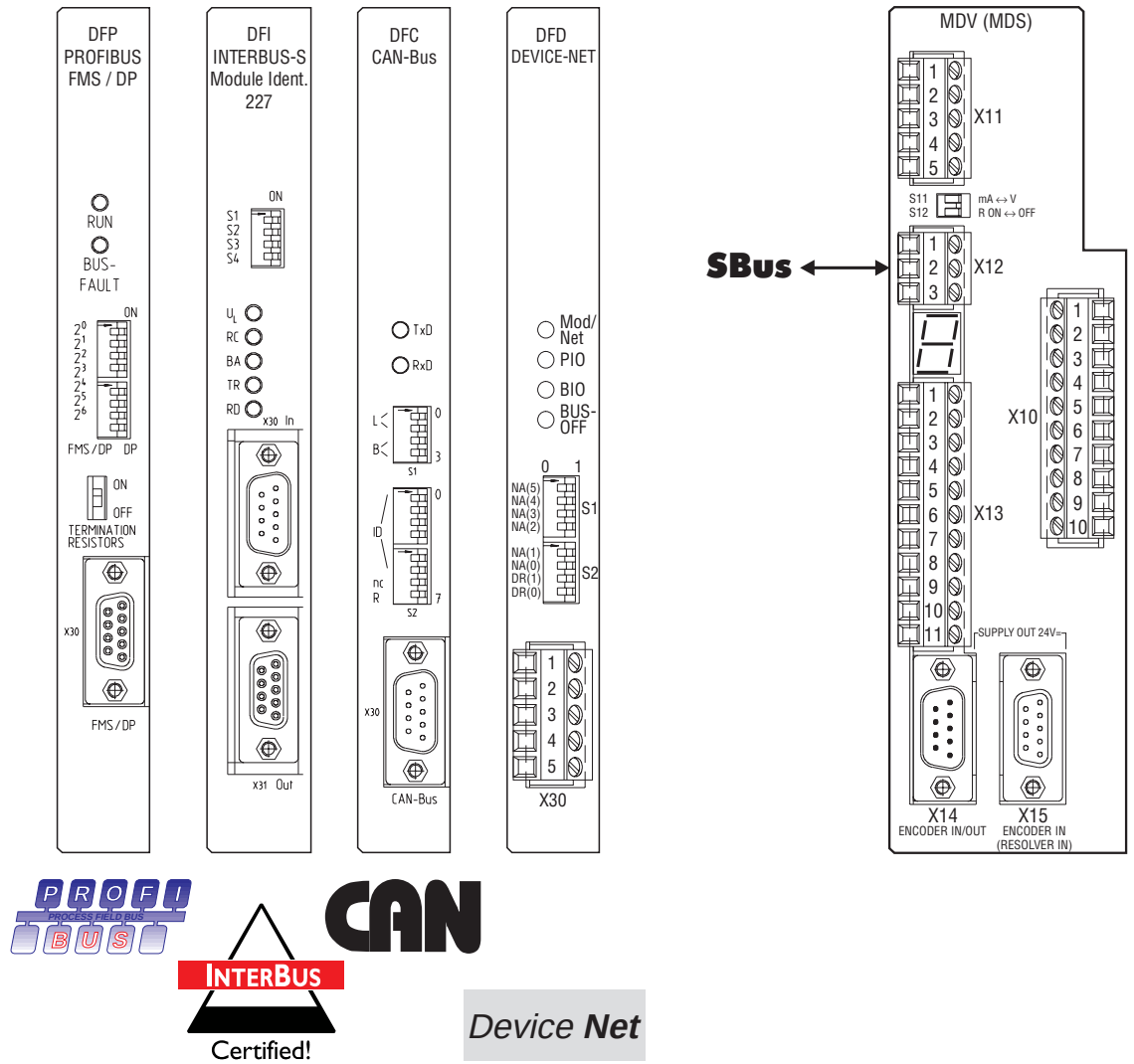

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Fig. 12: Bus types

2.3.1 PROFIBUS

The PROFIBUS documentation package contains detailed information. This package can be obtained from SEW, publication number 0919 3219. This documentation package contains the GSD files and type files for MOVIDRIVE® to help with project planning and facilitate startup.

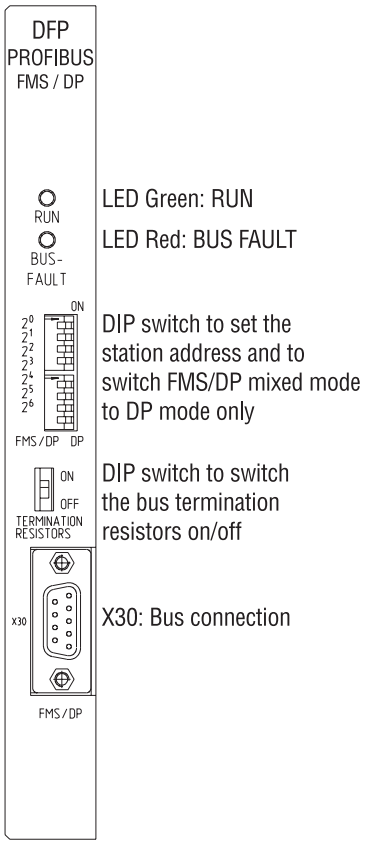

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Fig. 13: Front view of DFP11A

Technical data:

Option	PROFIBUS fieldbus interface type DFP11A
Part number	822 724 1
Resources for startup/diagnosis	DBG11A keypad MOVITOOLS or MX_SHELL PC program
Protocol types	PROFIBUS-DP to EN 50170 V2 / DIN E 19245 P3 PROFIBUS-FMS to EN 50170 V2 / DIN E 19245 P3 Mixed mode PROFIBUS DP/FMS (combi-slave)
Supported baud rates	Automatic detection of baud rate: 9.6 kbaud, 19.2 kbaud, 93.75 kbaud 187.5 kbaud, 500 kbaud, 1500 kbaud
Connection	9-pin sub D socket Assignment to EN 50170 V2 / DIN 19245 P3
Bus termination	Can be activated for cable type A (up to 1500 kbaud) to EN 50170 V2 / DIN 19245 P3
Station address	0 – 125, can be set using DIP switch
Default bus parameter	Min-T_{SDR} for FMS/DP or DP mode can be selected via DIP switch
GSD file	SEW_6000.GSD
DP identity number	$6000_{hex} = 24576_{dec}$

Pin assignment:

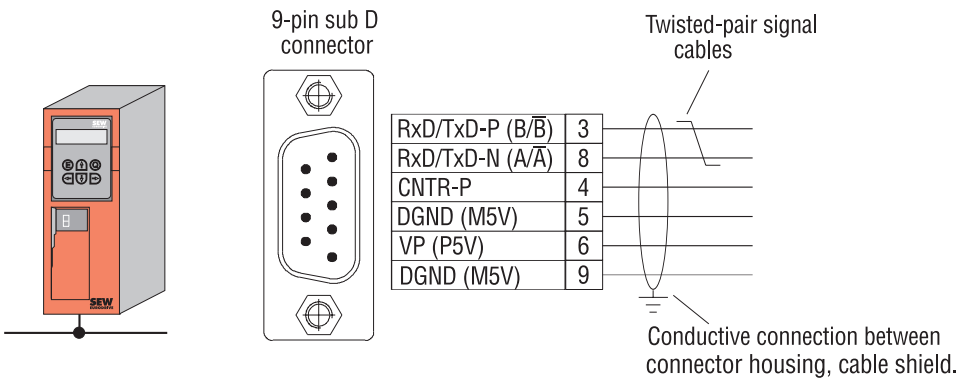

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Fig. 14: Assignment of 9-pin sub D plug to DIN 19245

2.3.2 INTERBUS

The INTERBUS documentation package contains detailed information. This package can be obtained from SEW, publication number 0919 3278.

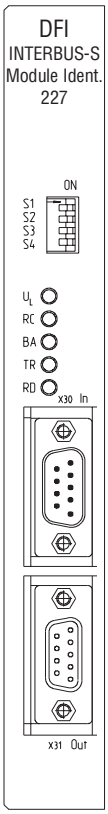

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Fig. 15: Front view of DFI11A

Technical data:

Option	INTERBUS fieldbus interface type DFI11A
Part number	822 723 3
Resources for startup/diagnosis	DBG11A keypad MOVITOOLS or MX_SHELL PC program
Connection	Remote bus input: 9-pin sub D plug Remote bus output: 9-pin sub D socket RS-485 transmission technology, 6-core shielded and twisted-pair cable
Module ID	$E3_{hex} = 227_{dec}$

Pin assignment:

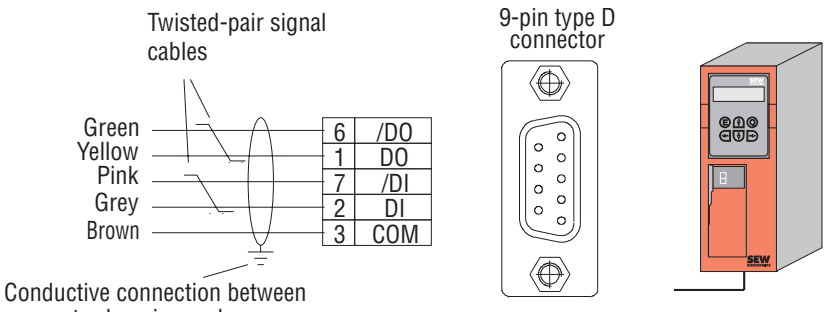

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Fig. 16: Assignment of 9-pin sub D socket of the incoming remote bus cable

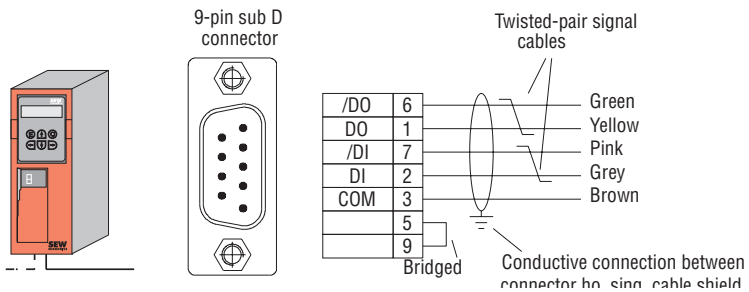

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Fig. 17: Assignment of 9-pin sub D plug of the outgoing remote bus cable

2.3.3 CAN Bus

The CAN bus documentation package contains detailed information. This package can be obtained from SEW, order number 0919 3316.

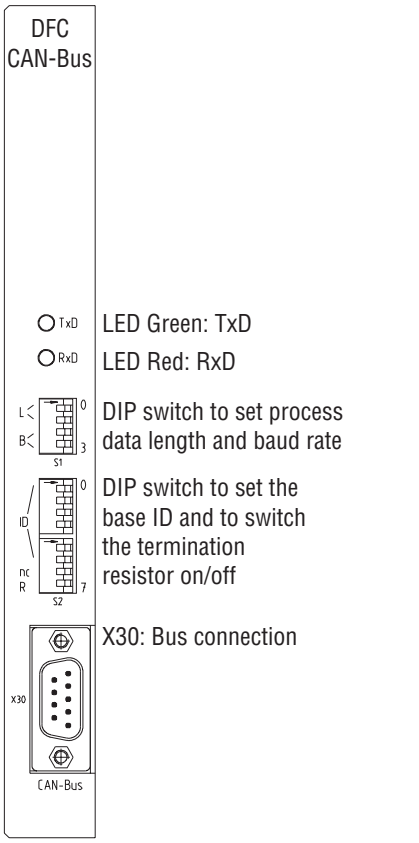


Fig. 18: Front view of DFC11A

Technical data:

Option	CAN fieldbus interface type DFC11A
Part number	822 725 X
Resources for startup/diagnosis	DBG11A keypad MOVITOOLS or MX_SHELL PC program
Supported baud rates	can be selected via DIP switch: 125 kbaud 500 kbaud 250 kbaud 1000 kbaud
Connection	9-pin sub D plug Assignment to CiA standard 2-core twisted cable to ISO 11898
Bus termination	Can be switched on using DIP switch (120Ω)
ID range	3 – 1020 Base ID: 0 – 63, can be selected using DIP switch

Pin assignment:

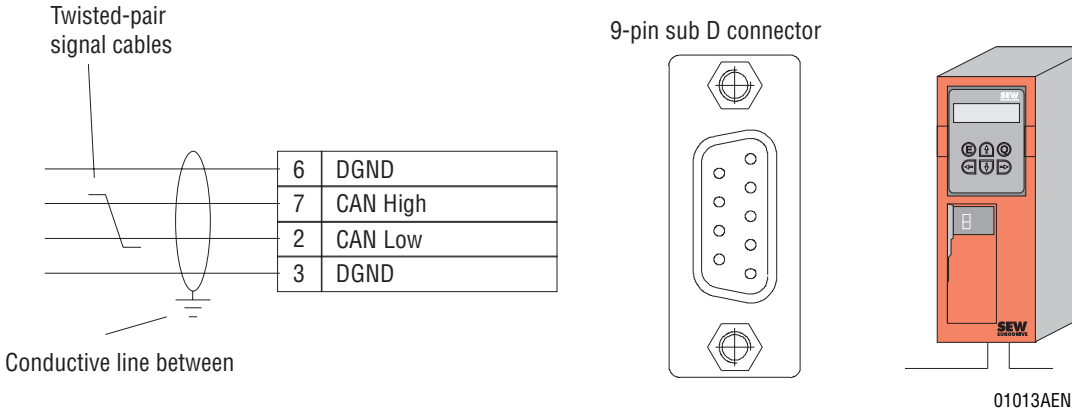


Fig. 19: Assignment of 9-pin sub D connection

2.3.4 DeviceNet

The DeviceNet documentation package contains detailed information. This package can be obtained from SEW, order number 0919 5262.

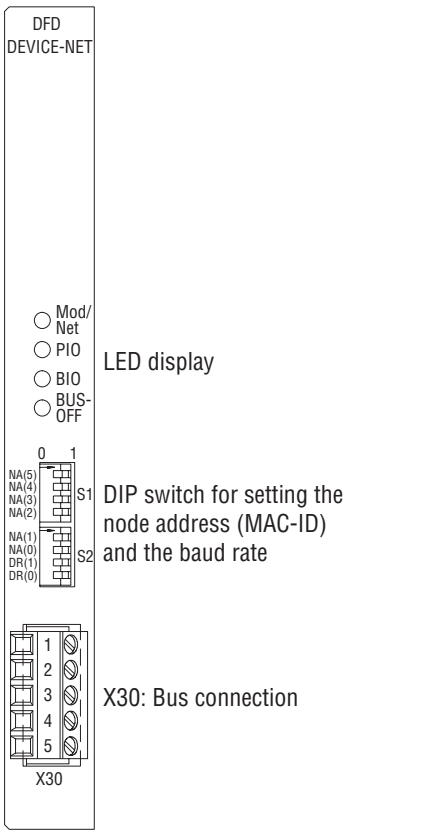


Fig. 20: Front view of DFD11A

Technical data:

Option	DeviceNet fieldbus interface type DFD11A
Part number	822 887 6
Resources for start-up/diagnosis	DBG11A keypad MOVITOOLS or MX_SHELL PC program
Supported baud rates	can be selected via DIP switch: 125 kbaud 250 kbaud 500 kbaud
Connection	5-pin Phoenix terminal Assignment to DeviceNet specification (Volume I, Appendix B)
Permitted line cross section	According to DeviceNet specification
Bus termination	Use of bus connectors with integrated bus terminating resistor (120 Ω) at the start and finish of the bus segment.
Address range which can be set (MAC-ID)	0 – 63 can be selected via DIP switch

Terminal assignment:

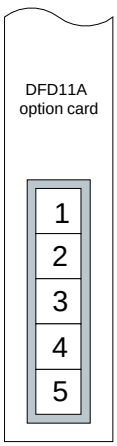


Fig. 21: DeviceNet terminal assignment

The assignment of connecting terminals is described in the DeviceNet specification Volume I, Appendix A.

Pin no.	Meaning	Meaning	Color
1	V-	0V24	Black
2	CAN_L	CAN_L	Blue
3	DRAIN	DRAIN	Bright
4	CAN_H	CAN_H	White
5	V+	24 V	Red

2.3.5 System Bus (SBus)

The "System Bus" manual contains detailed information about the system bus (SBus). This manual can be obtained from SEW, publication number 0918 0915.

Max. 64 CAN bus stations can be interconnected using the system bus (SBus). The SBus supports transmission systems compliant with ISO 11898.

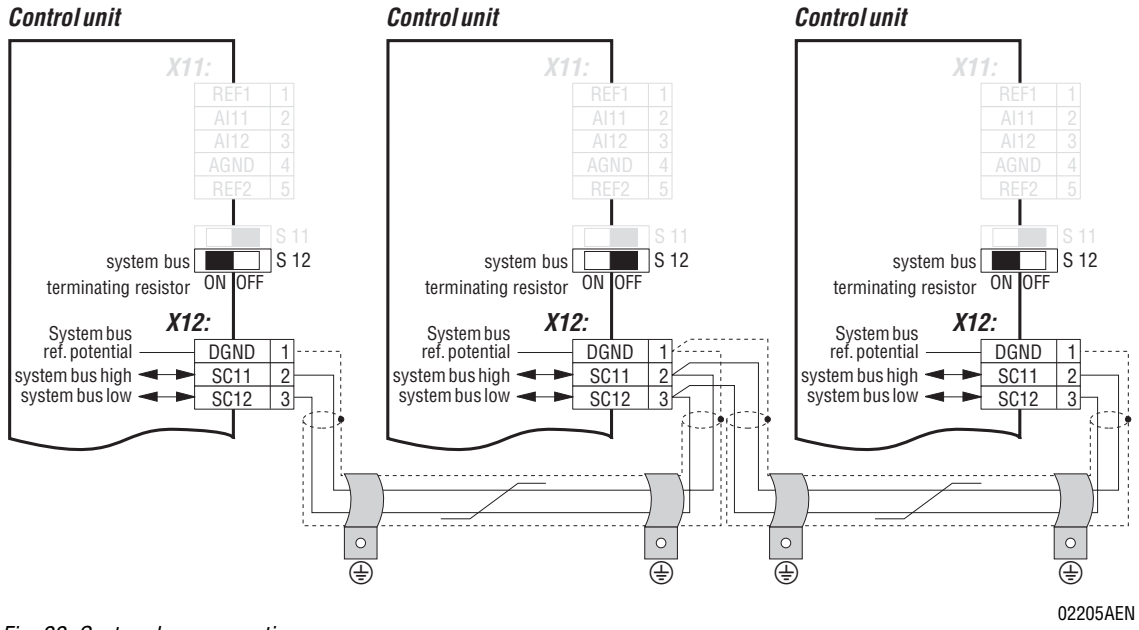


Fig. 22: System bus connection

Special note:

- Use a 2-core twisted and shielded copper cable (data transmission cable with shield comprising copper braiding). Connect the shield at either end to the electronics shield clamp of MOVIDRIVE® or the master control and ensure the shield is connected over a large area. Also connect the ends of the shield to DGND.
  The cable must meet the following specifications:
  - Conductor cross section 0.75 mm^2 (AWG18)
  - Cable resistance 120 Ω at 1 MHz
  - Capacitance per unit length ≤ 40 pF/m (12 pF/ft) at 1 kHz
  Suitable cables are CAN bus or DeviceNet cables, for example.
- The permitted total cable length depends on the baud rate setting of the SBus:
  250 kbaud → 160 m (528 ft)
  500 kbaud → 80 m (264 ft)
  1000 kbaud → 40 m (132 ft)
- Switch on the system bus terminating resistor (S12 = ON) at the beginning and end of the system bus connection. Switch off the terminating resistor on the other units (S12 = OFF).
- There must not be any potential displacement between the units which are connected together using the SBus. Take suitable measures to avoid a potential displacement, e.g. by connecting the unit ground connectors using a separate lead.

2.4 Connecting the Limit Switches

The cams of the limit switches must cover the travel range up to the stop.

Only use limit switches with NC contacts (low-active)!

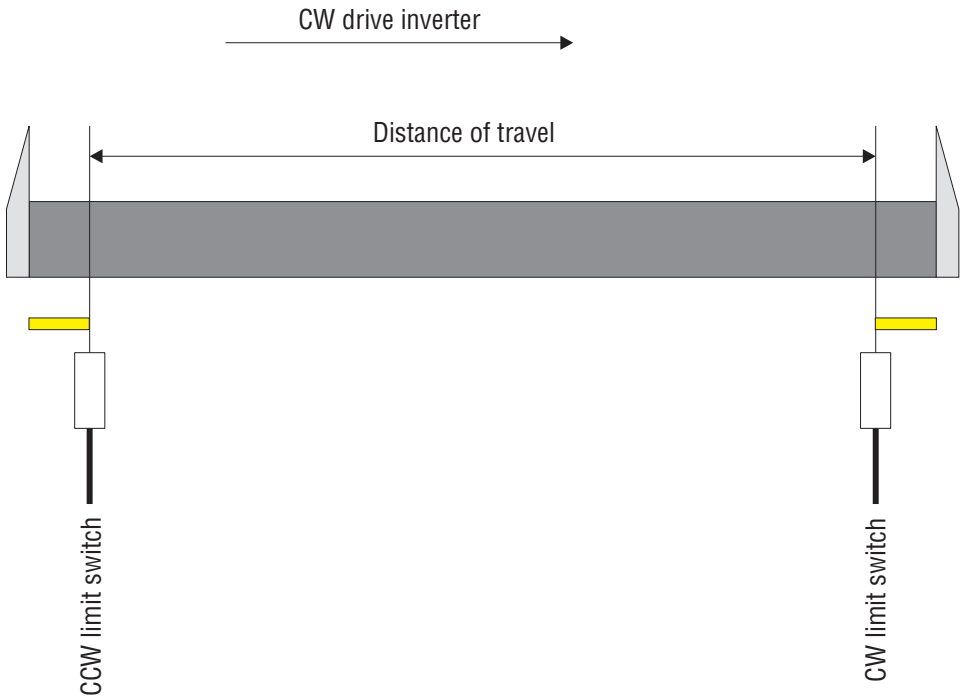


Fig. 23: Connecting the limit switches

3 Startup

3.1 General Information

Correct project planning and installation are the pre-requisites for successful startup. Refer to the MOVIDRIVE®system manual for detailed project planning instructions. The system manual forms part of the MOVIDRIVE® documentation package (publication number 0919 3219).

Check the installation, including the encoder connection and the fieldbus interface installation, by following the installation instructions in the MOVIDRIVE®MD_60A operating instructions, the fieldbus documentation packages and in this manual (Sec. 2, page 10).

If you are using an absolute encoder as the external encoder (connection on DIP11A X62:), please also refer to the installation and startup instructions in the "Positioning with Absolute Encoder and Absolute Encoder Interface DIP11A" manual (publication number 0919 5912).

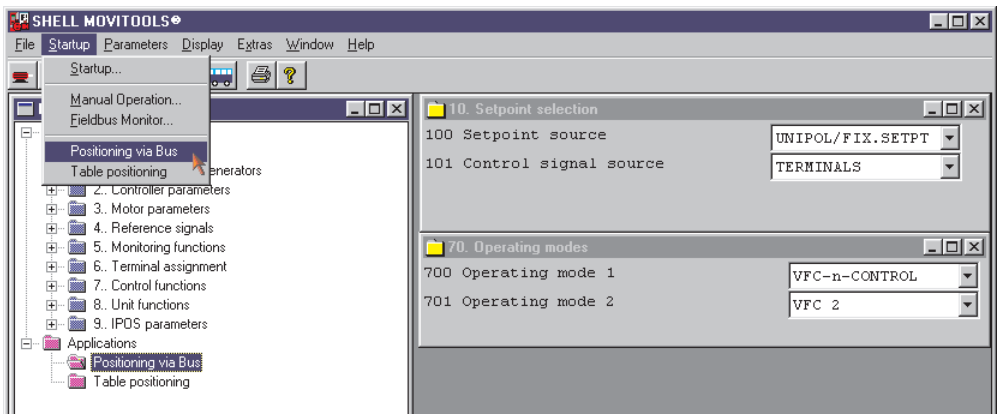
3.2 Preliminary Work

Perform the following steps before the startup of bus positioning:

- Connect the inverter to the PC using the serial port (RS-232, USS21A on PC-COM).
- Install MOVITOOLS on the PC (Sec. 2.1, page 10) and start the program.
- Start up the inverter using <Shell>.
  - With MOVIDRIVE® MDV60A and DT/DV/D motors, in VFC-n-CONTROL operating mode.
  - With MOVIDRIVE® MDV60A and CT/CV motors, in CFC operating mode.
  - With MOVIDRIVE® MDS60A and DS/DY motors, in SERVO operating mode.
- Only for operation with an external encoder (absolute or incremental encoder).
  - Absolute encoder: Start up the DIP11A absolute encoder interface; this sets parameters P942 – P944 (→ "Positioning with Absolute Encoder and Absolute Encoder Interface DIP11A" manual, publication number 0919 5912).
  - Incremental encoder: Set P942 – P944 encoder factor numerator/denominator and encoder scaling ext. encoder in Shell. Refer to the "IPOS^{plus}®Positioning and Sequence Control System" manual, number 0919 1712, for a detailed description of the parameters.
- "0" signal at terminal X13:1 (DIØØ, /Controller inhibit).

3.3 Starting the "Bus Positioning" Program

- Start <Shell>.
- In Shell, start "Startup/bus positioning".



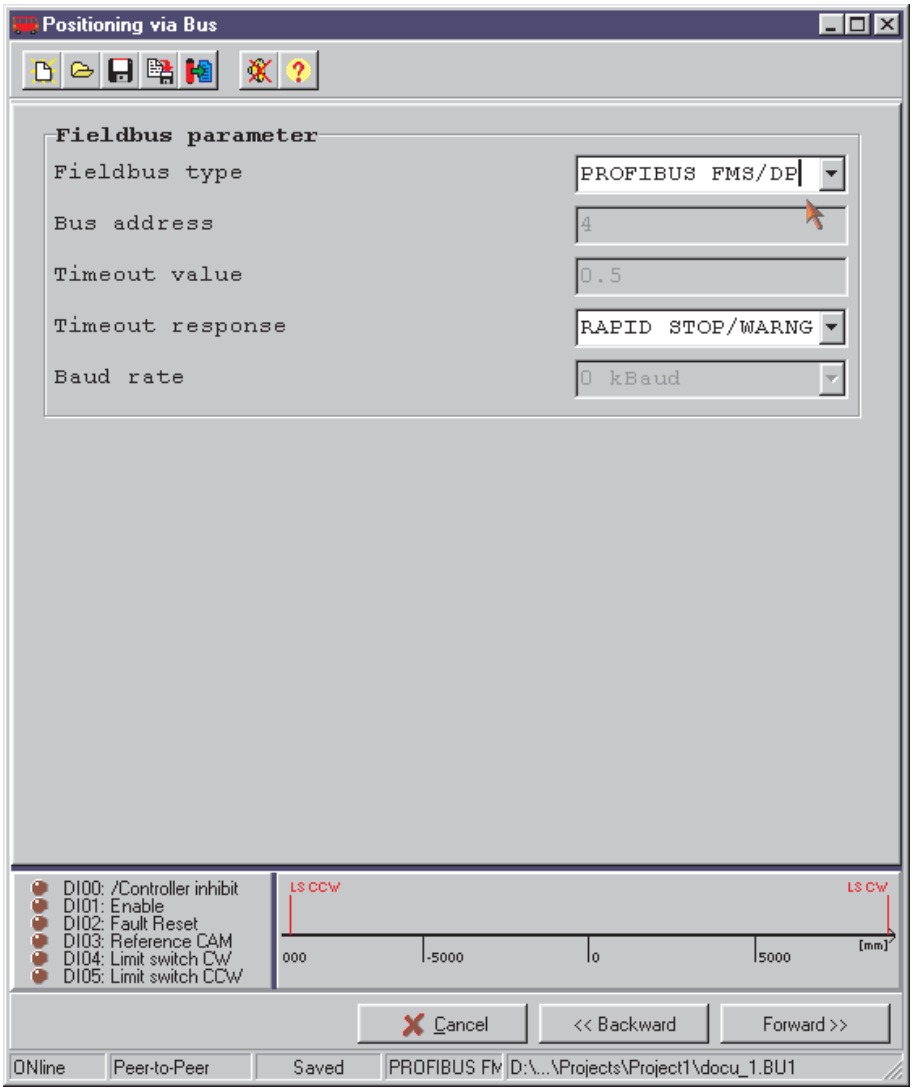
02989AEN

Fig. 24: Starting the "Bus positioning" program

3.3.1 Setting the Fieldbus Parameters

Initial startup:

The window for setting the fieldbus parameters appears straight away if the bus positioning program has been started for the first time.



02804AEN

Fig. 25: Fieldbus parameters of bus positioning

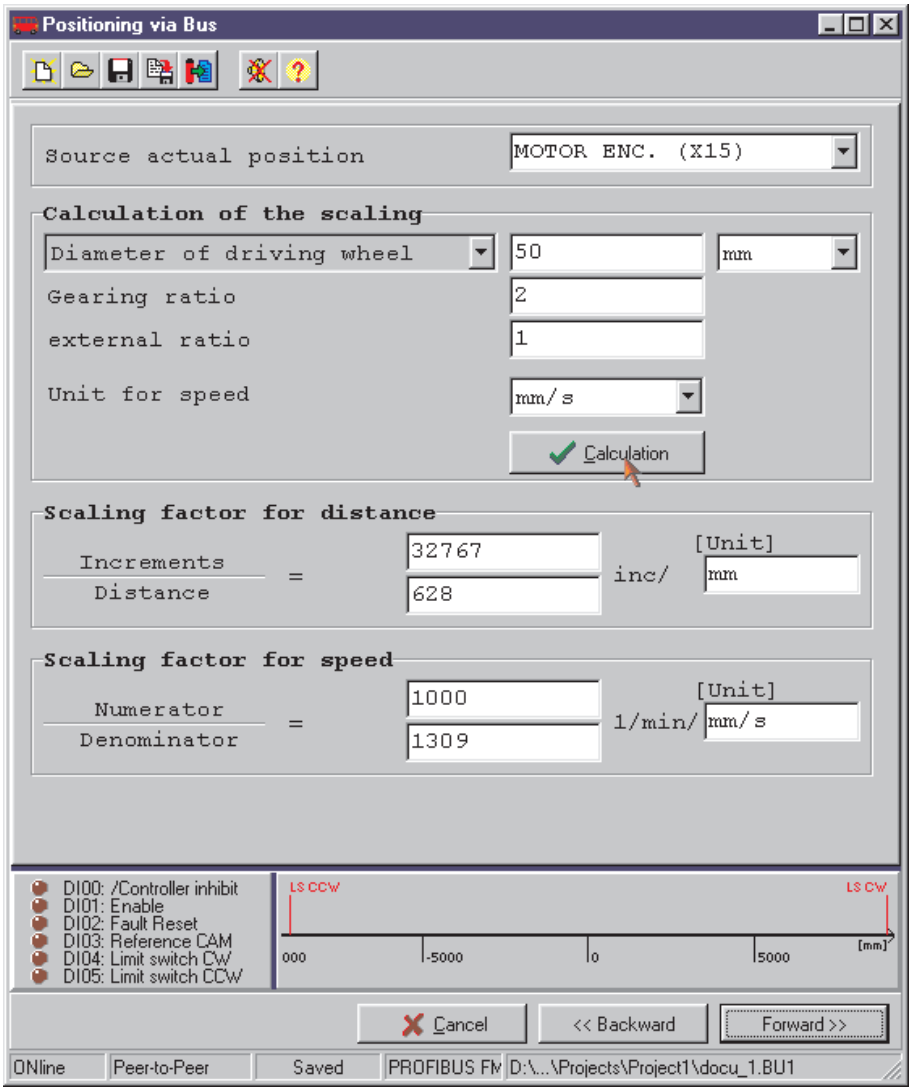
You have to make the following settings in this window:

- Set the fieldbus type

  The system bus (SBus) can always be set; no option is required for this. You can also select PROFIBUS, INTERBUS, CAN or DEVICENET if there is a fieldbus interface (DFP11A, DFI11A, DFC11A or DFD11A) connected to the OPTION1 slot.
- Set the address
- Set the timeout time
- Set the timeout response
- Set the baud rate

A few of these settings must be made using DIP switches on the fieldbus interface. The corresponding boxes have a gray background and nothing can be entered in them.

3.3.2 Setting the Scaling



02806AEN

Fig. 26: Setting the scaling

You have to make the following settings in this window:

- Set the source actual position; this selects which encoder is used for position measurement in positioning:
  - Motor encoder (X15) for operation without an external encoder.
  - EXT. ENCODER (X14) with an incremental encoder as the external encoder.
  - ABSOLUTE ENCODER (DIP) with an absolute encoder as the external encoder.
- If you are not using an external encoder: Calculate the pulses/distance scaling factor.
  - Select the “Drive Wheel Diameter” or “Spindle Pitch” box and enter the value in millimeters [mm] or 1/10 millimeter [1/10 mm].
  - Enter the ratio (i) values for the gear unit and additional gear.
  - Press <Calculate> to calculate the scaling factor. The pulses/distance are entered in the unit inc/mm.

  You can also enter the scaling factor directly. In this case, you can enter a unit of your choice for the distance.

  It is not possible to calculate the scaling for drives with an external encoder.

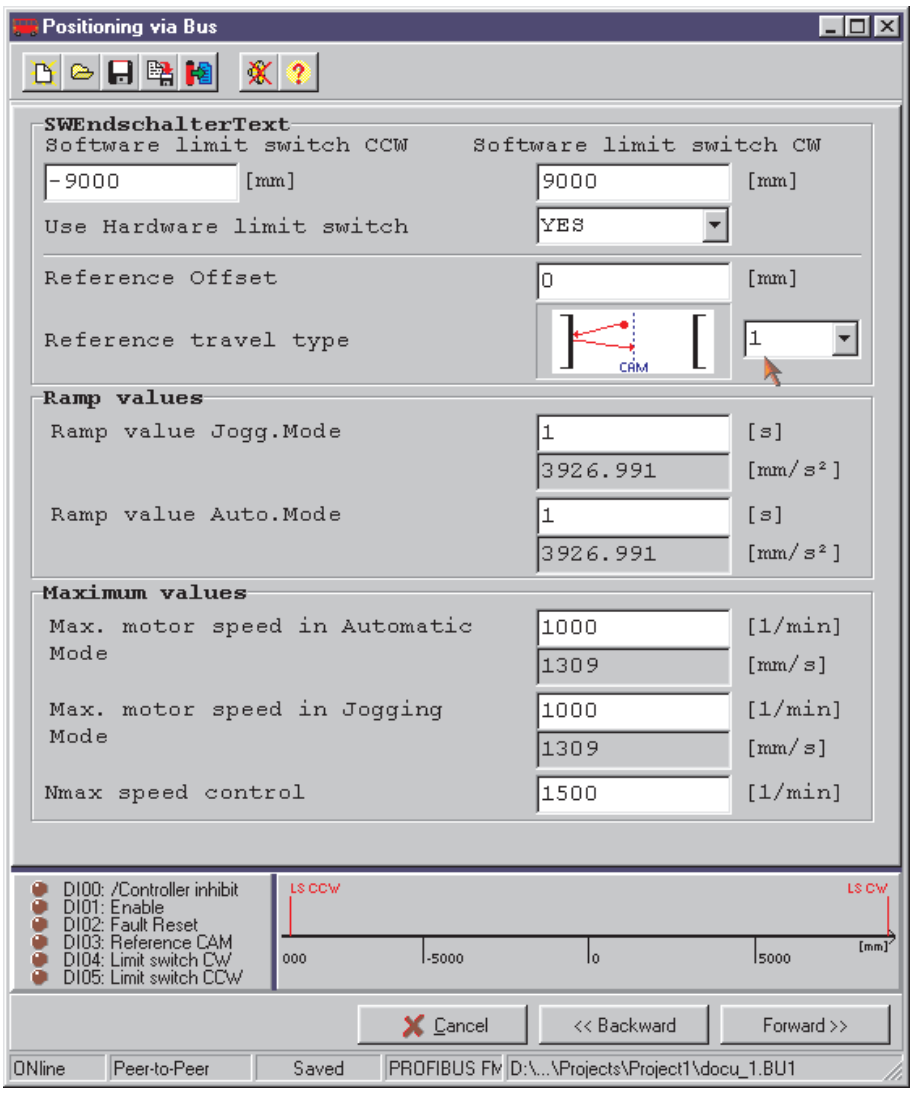
- Distance scaling factor

  The distance scaling factor is calculated and entered automatically if you have the scaling calculated by the program. You have to calculate and enter the distance scaling factor yourself if you do not have it calculated by the program, for example if you are using an external encoder. This is explained with two examples in the online help for the bus positioning.

- Speed scaling factor

  The speed scaling factor is calculated and entered automatically if you have the scaling calculated by the program. You have to calculate and enter the speed scaling factor yourself if you do not have it calculated by the program, for example if you are using an external encoder.

3.3.3 Setting Ramps and Limits

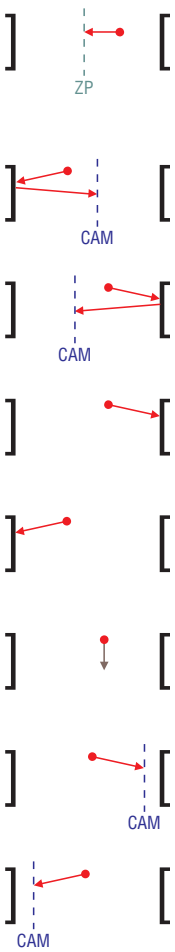


02807AEN

Fig. 27: Setting ramps and limits

You have to make the following settings in this window:

- Enter software limit switches and the reference offset. The entries are made in the user units of the scaling.
  - Enter the position of the software limit switches. A line of numbers appears in the bottom half of the screen. This represents the travel distance delimited by the software limit switches.
    Make sure the positions of the software limit switches are within the travel distance of the hardware limit switches and that they do not overlap the reference position. Entering zero for both software limit switches causes them to be deactivated.
  - Enter the reference offset. The reference offset corrects the machine zero. The following formula applies: Machine zero = Reference position + Reference offset.
- Select the correct type of reference travel (0 – 7).



02791AXX

Type 0: No reference travel. The reference position is the zero pulse left of the current position.
Machine zero = Zero pulse left of the current position + Reference offset

Type 1: The reference position is the left end of the reference cam.
Machine zero = Reference point + Reference offset

Type 2: The reference position is the right end of the reference cam.
Machine zero = Reference point + Reference offset

Type 3: The reference position is the right-end limit switch. No reference cam is required for this.
Machine zero = Reference point + Reference offset

Type 4: The reference position is the left-hand limit switch. No reference cam is required for this.
Machine zero = Reference point + Reference offset

Type 5: No reference travel. The reference position is the current position without reference to a zero pulse.
Machine zero = Current position + Reference offset

Type 6: The reference position is the left-hand end of the reference cam.
Machine zero = Reference point + Reference offset

Type 7: The reference position is the right-hand end of the reference cam.
Machine zero = Reference point + Reference offset

- Enter ramp times for jog mode and automatic mode.

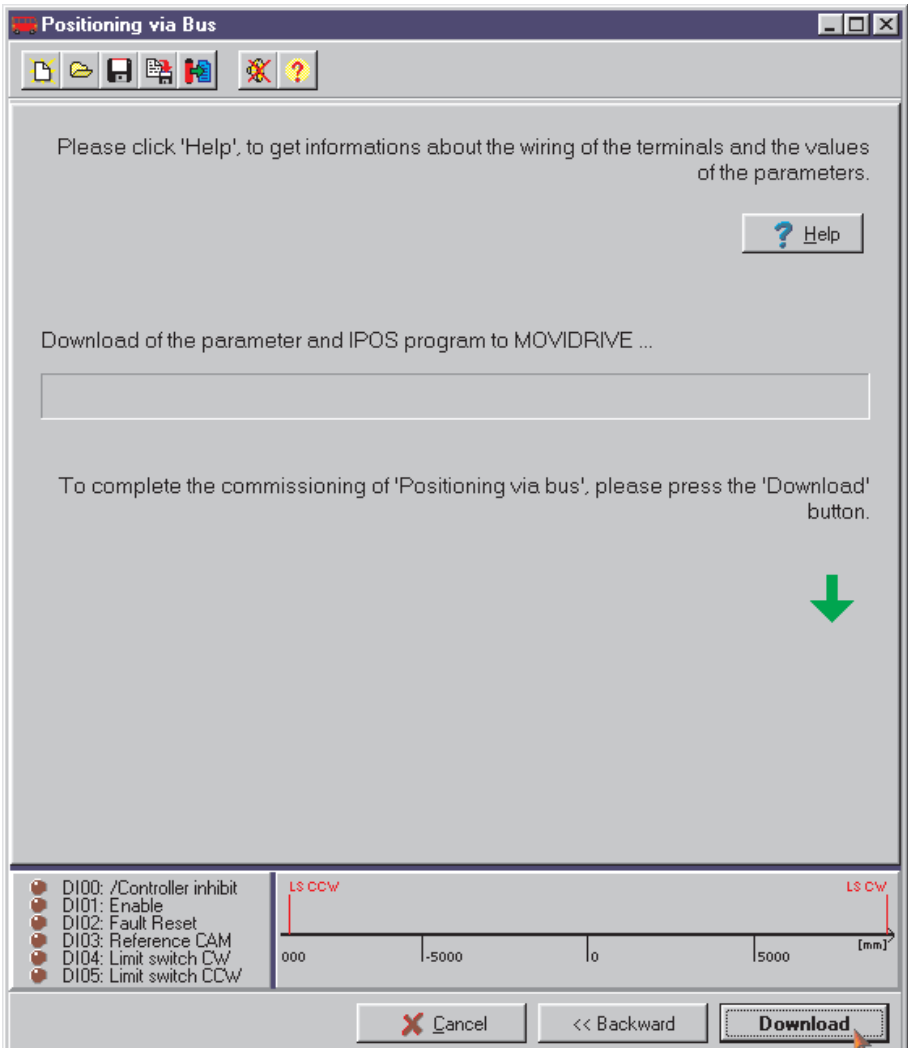
  You must enter the ramp times in the unit [s]. They are used for calculating the speed values in the unit [mm/s] on the basis of the scaling factor.
- Enter speed limits.

  Enter the maximum speeds for automatic mode, jog mode and the closed-loop speed controller. The speed values for automatic mode and jog mode must be at least 10 % less than for the closed-loop speed controller (P302 “Maximum speed 1”).

Press “Next>>” when you have entered the values you want. The program prompts you to save the values you have set. The download window appears after the settings have been saved.

AUTO

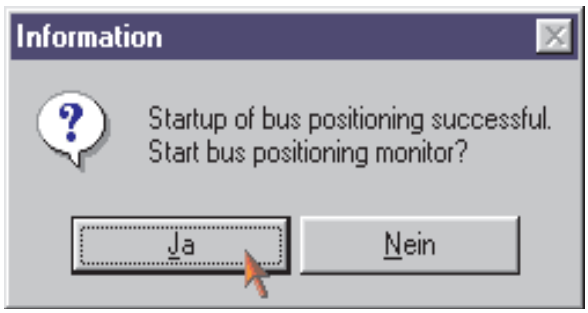
Press <Download>. All necessary settings are automatically made in the inverter and the “Bus positioning” IPOS program is started.



02809AEN

Fig. 28: Download window

After the download, the program asks you if you want to switch to the monitor. In the monitor, you can run a diagnostic of your application and check the control signals.



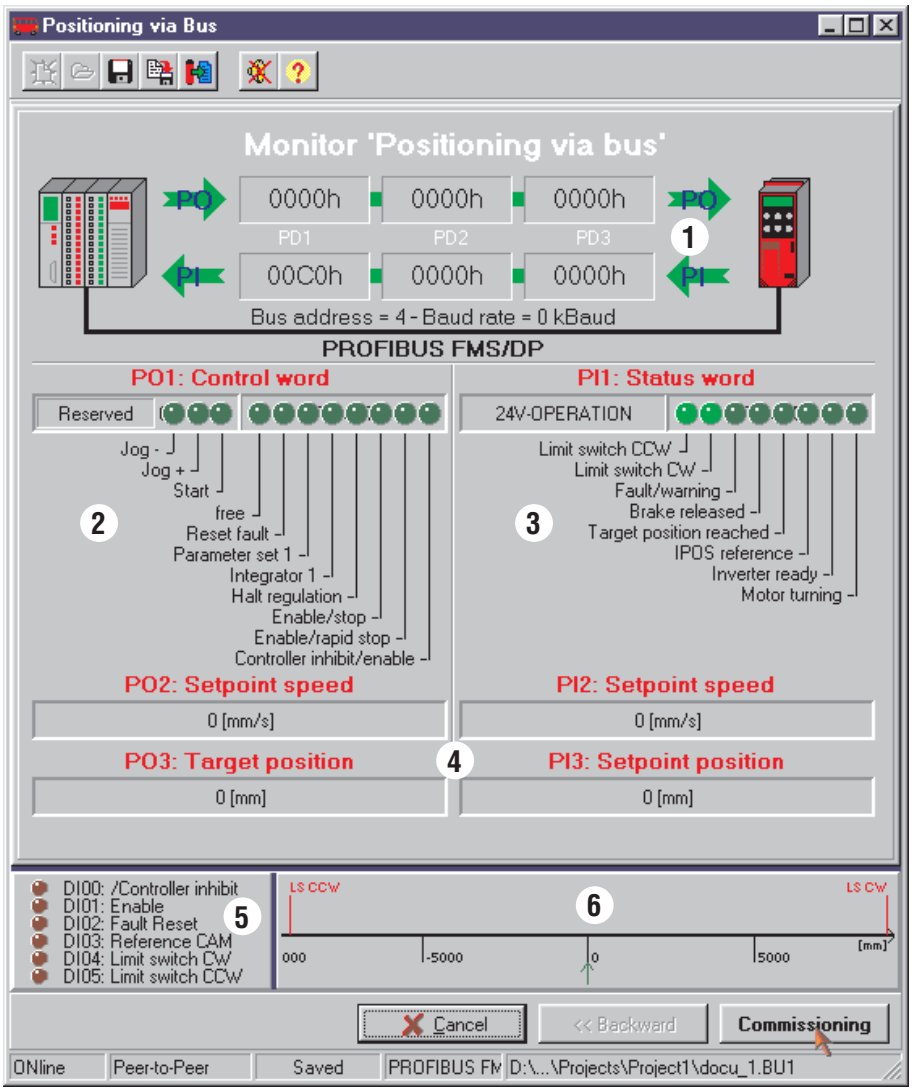
02810AEN

Fig. 29: Monitor Yes/No

Select “Yes” to switch to the bus positioning monitor (→ Fig. 30, page 25). You can start in the operating mode you want there. Select “No” and you switch to the Shell window.

Repeat startup:

The bus positioning monitor appears if bus positioning is started after the startup procedure has already been performed.



02811AEN

1 Process data traffic in hexadecimal notation
2 PO1 control word 2, decoded into individual bits.
3 PI1 status word, decoded into individual bits.
4 Process data in decimal notation and with user units.
5 Status of the binary inputs of the basic unit.
6 Position of the software limit switches and current position of the drive.

Fig. 30: Bus positioning monitor

Pressing <Startup> calls up the window for setting the fieldbus parameters. You can then perform the startup.

3.4 Parameters

The bus positioning startup automatically sets the following parameters:

Parameter number	Parameter	Setting
100	Setpoint source	SBus or FIELDBUS
101	Control signal source	SBus or FIELDBUS
302	Maximum speed 1	0 – 5500 rpm
600	Binary input DIØ1	Enable/rapid stop
601	Binary input DIØ2	Reset
602	Binary input DIØ3	Reference cam
603	Binary input DIØ4	/CW limit switch
604	Binary input DIØ5	/CCW limit switch
610 – 617	Binary inputs DI1Ø – DI17	IPOS input
630 – 637	Binary outputs DO1Ø – DO17	IPOS output
813	SBus address	0...63
815	SBus timeout delay	0.01 – 650 s
816	SBus baud rate	125/250/500/1000 kbaud
819	Fieldbus timeout delay	0.01 – 650 s
831	Response fieldbus timeout	No response Display fault Immediate switch-off/fault Emergency stop/fault Rapid stop/fault Immediate switch-off/warning Emergency stop/warning Rapid stop/warning
836	Response SBus timeout	
870	Setpoint description PO1	IPOS PO data
871	Setpoint description PO2	IPOS PO data
872	Setpoint description PO3	IPOS PO data
873	Actual value description PI1	IPOS PI data
874	Actual value description PI2	IPOS PI data
875	Actual value description PI3	IPOS PI data
876	PO data enable	On

These parameters must not be altered after startup!

3.5 Starting the Drive

After downloading the startup data, select "Yes" to switch to the bus positioning monitor. The operating mode is set using control word 2.

3.5.1 Operating Modes

The operating modes are selected with bits 11 and 12 (mode select) of PO1 control word 2.

Operating mode	Invalid mode	Jog mode	Referencing mode	Automatic mode
PO1: Bit 11	"0"	"1"	"0"	"1"
PO1: Bit 12	"0"	"0"	"1"	"1"

PO1 control word 2:

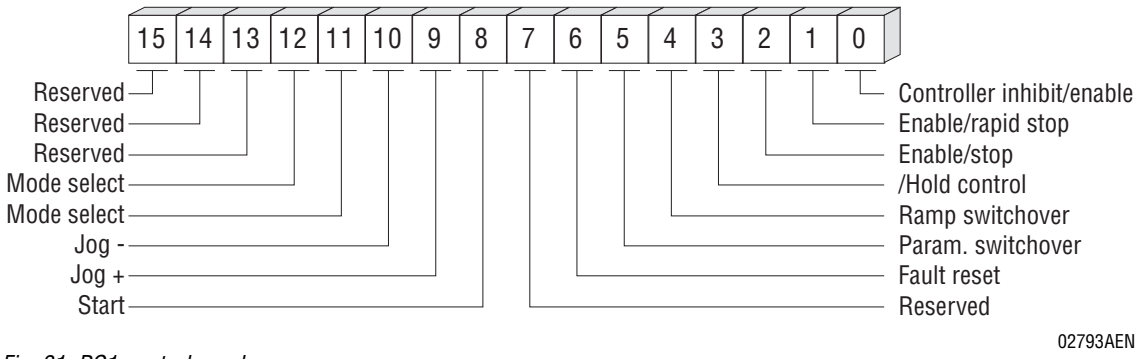


Fig. 31: PO1 control word

- **Jog mode**

  The drive is moved clockwise or counterclockwise using bits 9 and 10 in the control word (PO1). The speed is specified in PO2 set speed.

- **Referencing mode**
  - Reference travel is started with bit 8 in the control word (PO1). Reference travel establishes the reference point (**machine zero**) for absolute positioning operations.

- **Automatic mode**
  - Positioning is started in automatic mode with bit 8 in the control word (PO1).
  - The control specifies PO2 set speed and PO3 set position.
  - The inverter signals PI2 actual speed and PI3 actual position back to the control.

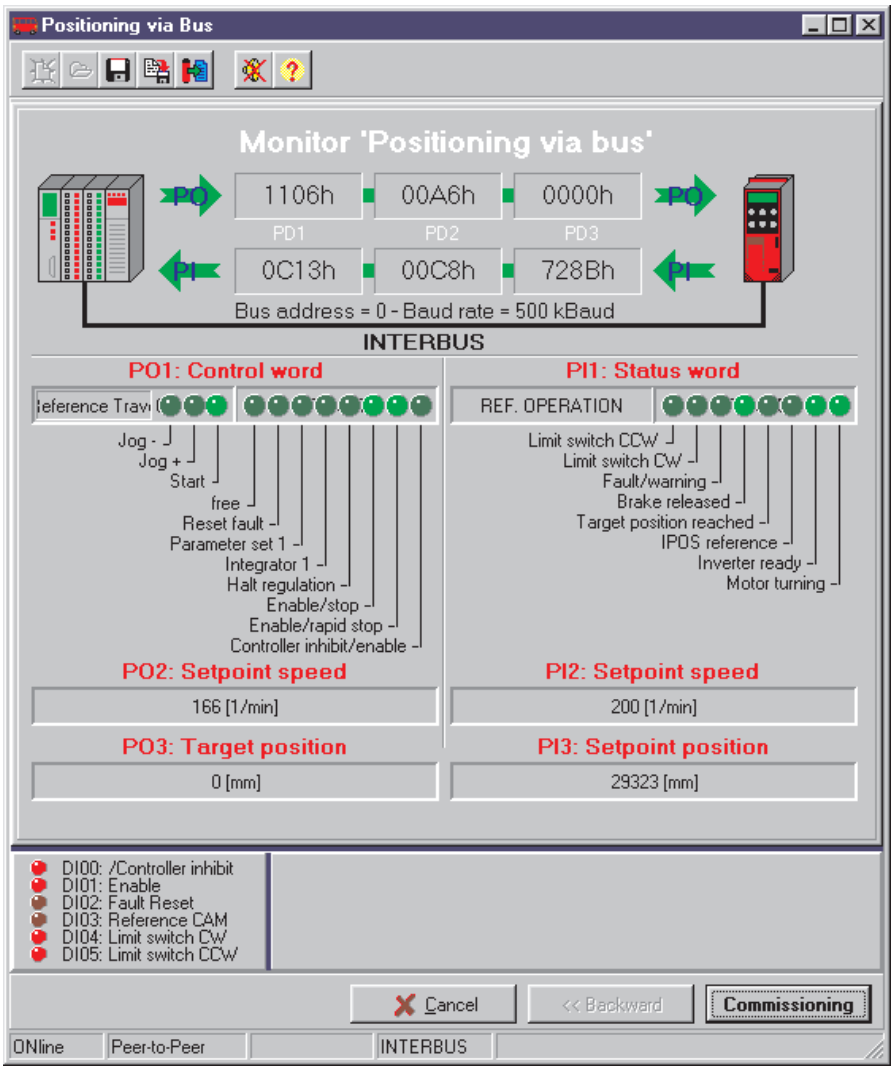
You have to select "Referencing mode" operating mode with the control word (PO1) if the drive has not yet been referenced or if you want to reference it again.

It is impossible to select automatic mode unless reference travel has been performed successfully.

3.5.2 Referencing Mode

- PO1: bit 11 = “0” and bit 12 = “1”

The reference position is defined by reference travel to the reference cam. The reference offset is set during startup and you can use it to alter the machine zero without having to move the reference cam.
The following formula applies: Machine zero = Reference point + Reference offset



02813AEN

Fig. 32: Referencing mode

- The correct type of reference travel must be set. If it is not, repeat the bus positioning startup and set the type of reference travel you want.
- Apply “1” signals to DIØØ “/Controller inhibit” and DIØ1 “Enable/rapid stop” and set the control bits PO1: 1 “Enable/rapid stop” and PO1: 2 “Enable/stop” = “1”.
- Start reference travel with control bit PO1: 8 “Start” = “1”. The “1” signal must be present for the entire duration of the reference travel.
- If the drive reaches the reference position (DIØ3 “Reference cam” = “1”), the drive continues moving at reference speed 2 and stops with position control when it leaves the reference position (DIØ3 “1” → ”0”). Status bit PI1: 2 “IPOS reference” is set (= “1” signal). The “1” signal at PO1: 8 can now be revoked.

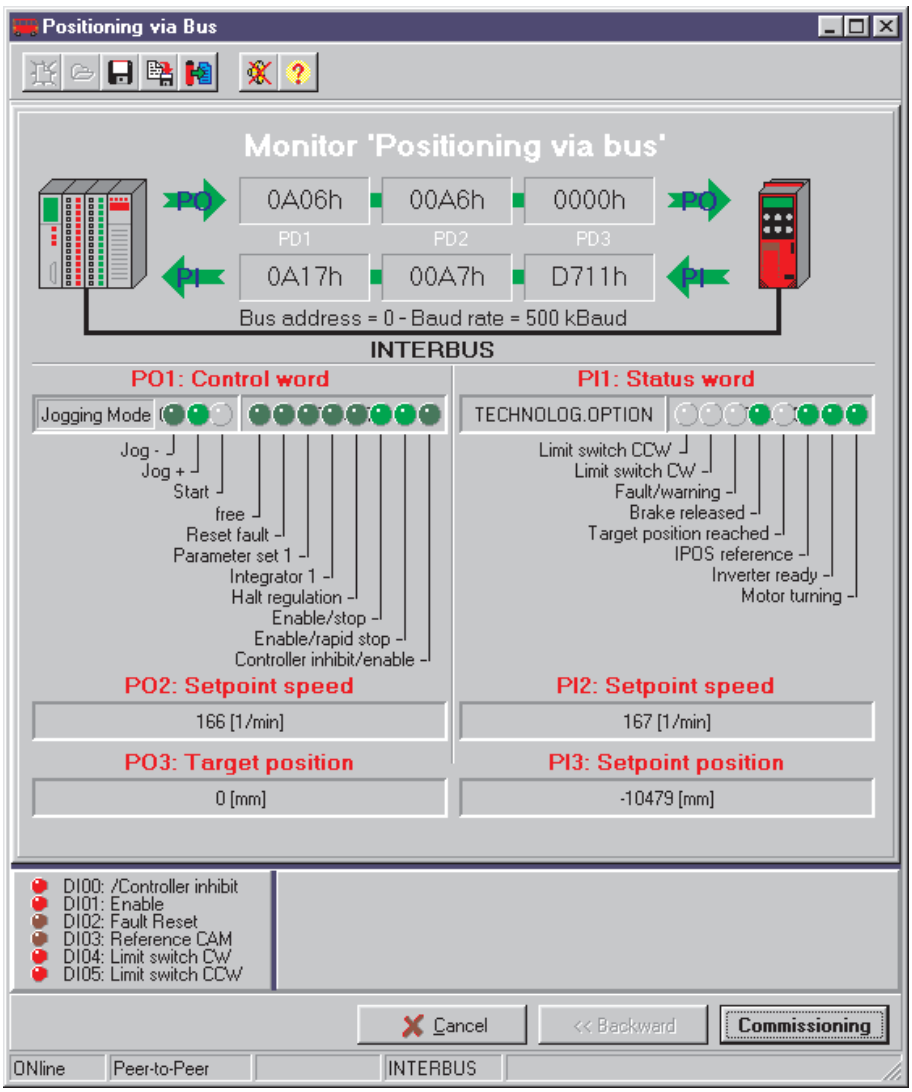
The drive has now been referenced. Now set the operating mode you require.

3.5.3 Jog Mode

- PO1: bit 11 = “1” and bit 12 = “0”

In jog mode, you can set the control bits PO1: 9 “Jog +” and PO1: 10 “Jog -” to move the drive clockwise or counterclockwise. The speed is specified by PO2 set speed.

Jog mode is required for service purposes when the drive should be moved independently of the automatic function of the machine.



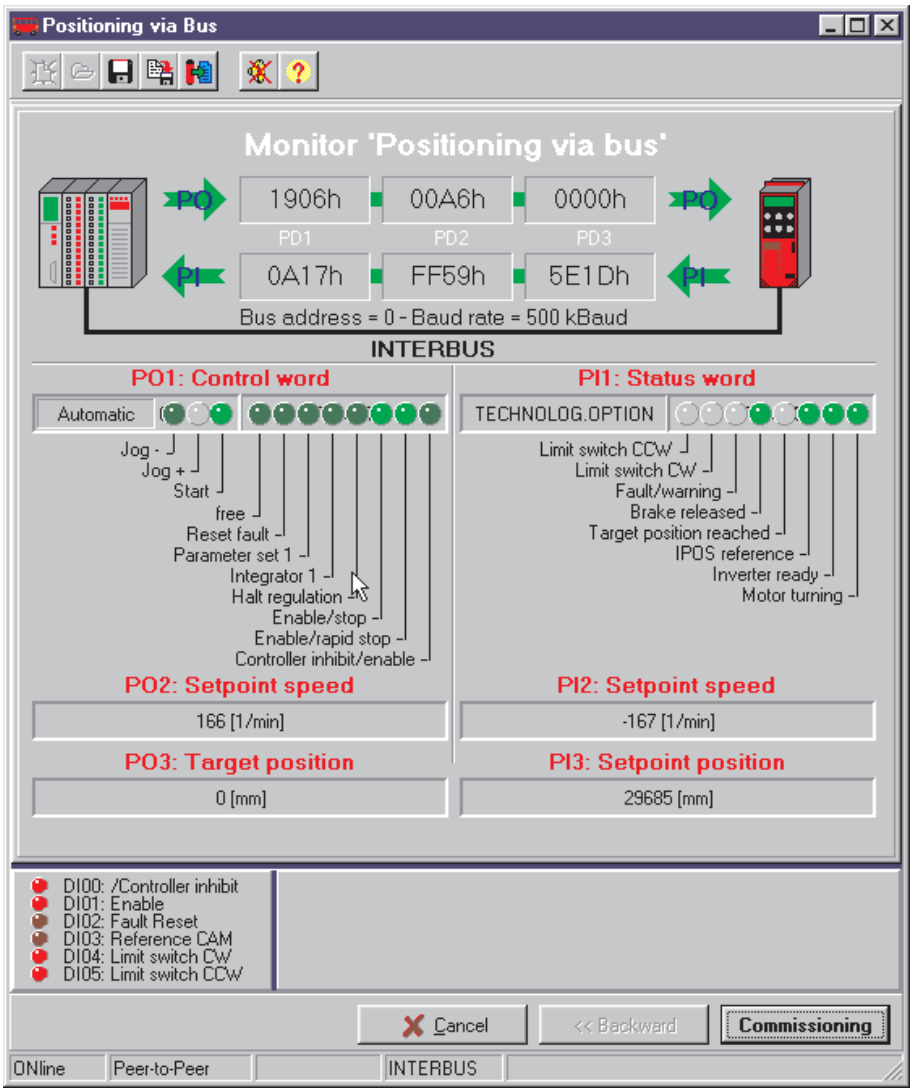
02814AEN

Fig. 33: Jog mode

3.5.4 Automatic Mode

- PO1: bit 11 = “1” and bit 12 = “1”

In automatic mode, you use the controller to specify the set speed and set position by means of process output data words (PO2 and PO3). The inverter signals the actual speed and actual position back to the control in process input data words (PI2 and PI3).



02815AEN

Fig. 34: Automatic mode

- Apply “1” signals to DIØØ “/Controller inhibit” and DIØ1 “Enable/rapid stop” and set the control bits PO1: 1 “Enable/rapid stop” and PO1: 2 “Enable/stop” = “1”.
- Start positioning with control bit PO1: 8 “Start” = “1”. The “1” signal must be present for the entire duration of positioning.
- Bit 3 “Set position” = “1” is set in status word PI1 when the drive has reached the required position. The drive stops with position control.
- The drive immediately moves to the new position if control bit PO1: 8 “Start” continues to be = “1” and a new position is specified with PO3 set position.

4 Operation and Servicing

4.1 Timing Diagrams

The following preconditions apply to timing diagrams:

- DIØØ "/Controller inhibit" = "1" and
- DIØ1 "Enable/rapid stop" = "1" signals.

Binary output DBØØ "/Brake" is set. The brake is released and the drive stops with position control.

4.1.1 Referencing Mode and Automatic Mode

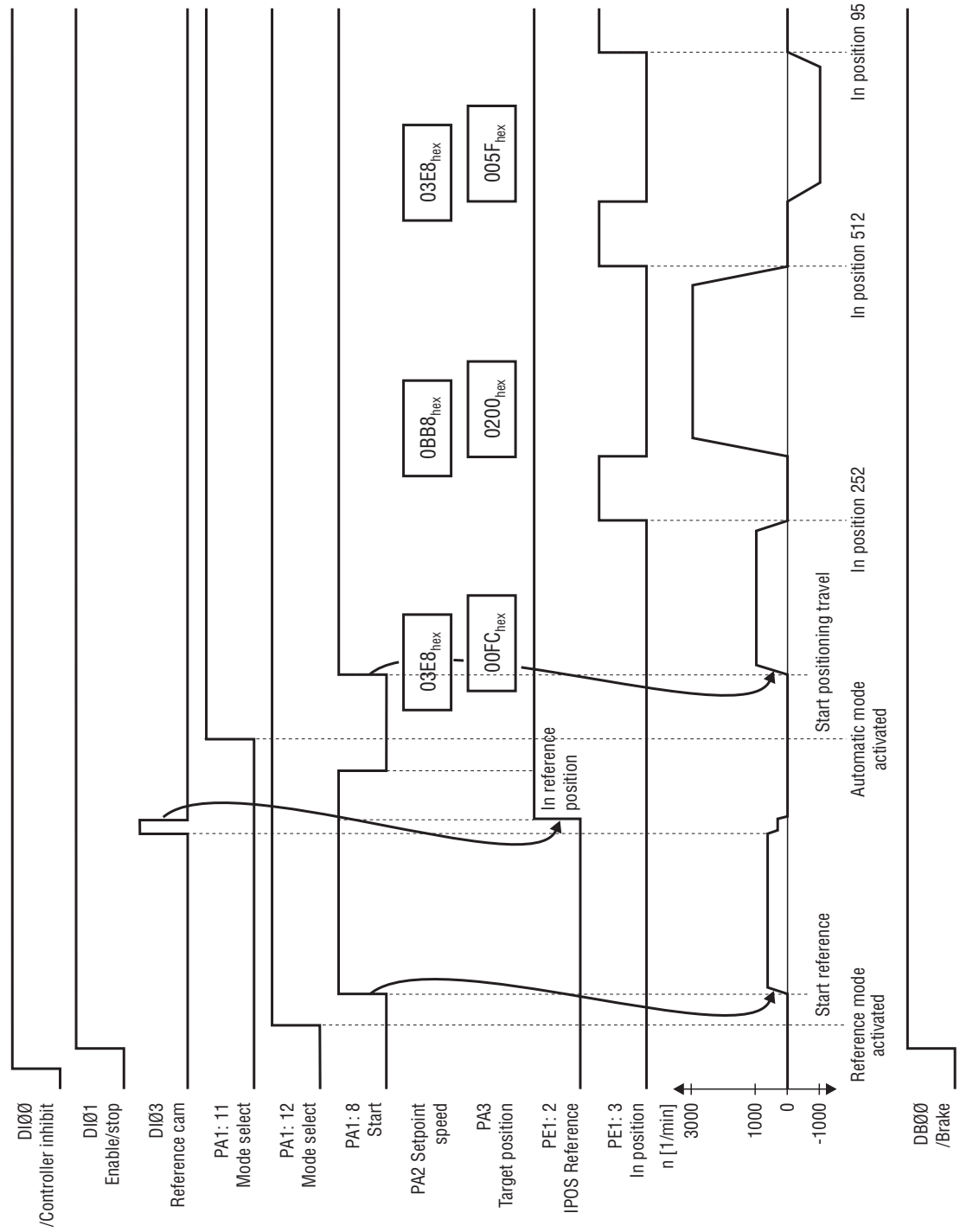


Fig. 35: Timing diagram of referencing mode and automatic mode

4.1.2 Jog Mode

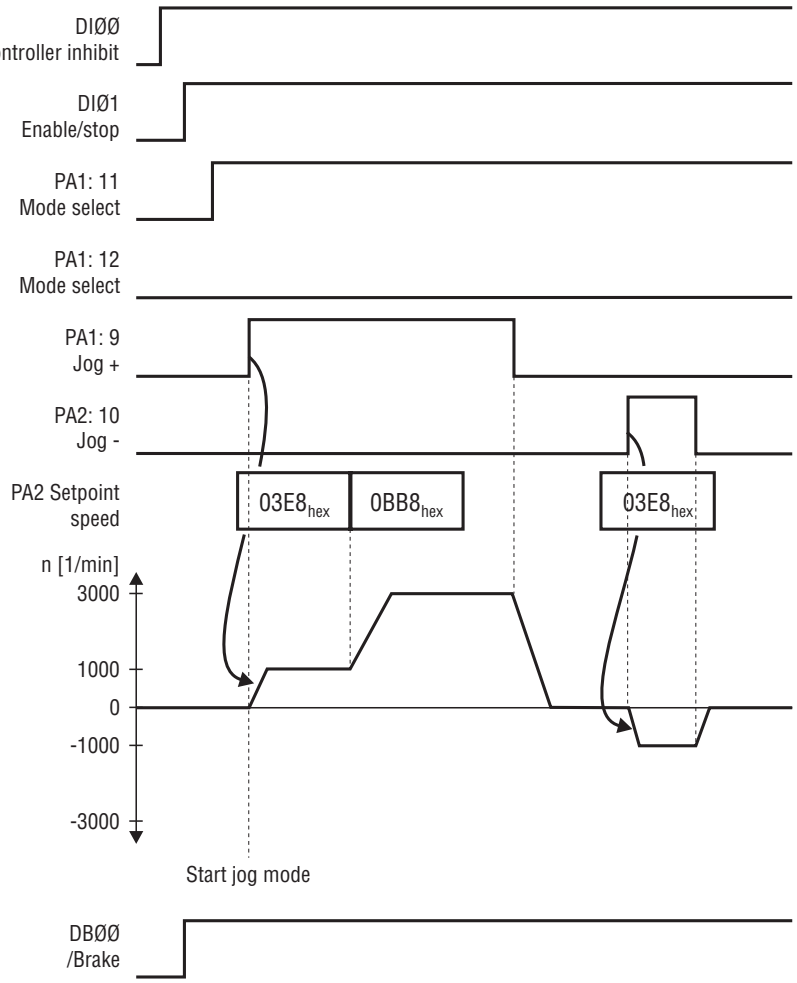


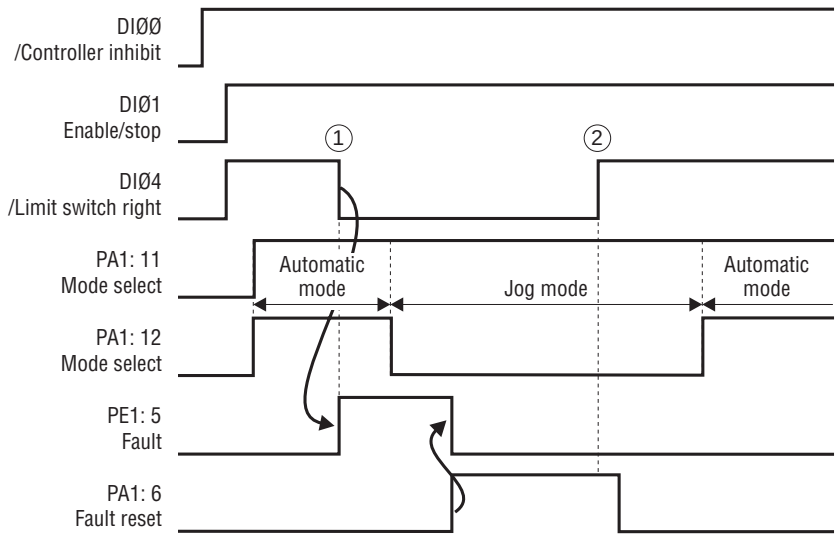
Fig. 36: Timing diagram of jog mode

4.1.3 Moving Clear of Limit Switches

When the drive moves onto a limit switch (DIØ4 or DIØ5 = “0”), bit PI1: 5 (fault) is set to “1” and the drive is stopped with an emergency stop (→ Sec. 4.2, page 34).

Proceed as follows to move the drive clear again:

1. Set jog mode as the operating mode (PO1: 11 = “1” and PO1: 12 = “0”).
2. Set bit PO1: 6 (fault reset) to “1”; bit PI1: 5 (fault) is set to “0”.
3. Leave bit PO1: 6 set to “1”. This means the drive is automatically moved clear at a motor speed of n = 100 rpm.
4. Once the drive has moved clear, DIØ4 or DIØ5 is set from “0” → “1”. Now set PO1: 6 to “0” and set the required operating mode, for example automatic mode (PO1: 11 = “1” and PO1: 12 = “1”).



① Movement onto limit switch

② Movement clear of limit switch

Fig. 37: Moving clear of limit switches

4.2 Fault Information

The fault memory (P080) stores the last five fault messages (faults t-0 – t-4). The fault message of longest standing is deleted whenever more than five fault messages have occurred. The following information is stored when a fault occurs:

Fault which occurred • Status of the binary inputs/outputs • Operating status of the inverter • Inverter status • Heat sink temperature • Speed • Output current • Active current • Unit utilization • DC link circuit voltage • ON hours • Enable hours • Parameter set • Motor utilization.

There are three shut-off responses depending on the fault; the inverter is inhibited when in fault status.

- **Instant disconnection:**
  The unit can no longer brake the drive; the output stage goes to high resistance in the event of a fault and the brake is applied immediately (DBØØ "/Brake" = "0").
- **Rapid stop:**
  The drive is braked with the stop ramp t13/t23. Once the stop speed is reached, the brake is applied (DBØØ "/Brake" = "0"). The output stage goes to high-resistance after the brake reaction time has elapsed (P732 / P735).
- **Emergency stop:**
  The drive is braked with the stop ramp t14/t24. Once the stop speed is reached, the brake is applied (DBØØ "/Brake" = "0"). The output stage goes to high-resistance after the brake reaction time has elapsed (P732 / P735).

RESET: A fault message can be acknowledged by:

- Switching the mains power off and on again.
  Recommendation: Observe a minimum switch-off time of 10 s for the main contactor K11.
- Reset by binary input DI02. Startup of the bus positioning causes this binary input to be assigned the "Reset" function.
- Press the reset button in the MOVITOOLS manager.

02771AEN

Fig. 38: Reset with MOVITOOLS

- Manual reset in Shell (P840 = "YES" or [Parameter] / [Manual reset])
- Manual reset using the DBG11A (pressing the <E> key in the event of a fault gives direct access to parameter P840)

Timeout active:

If the inverter is controlled via a communications interface (fieldbus, RS-485 or SBus) and the power was switched off and back on again or a fault reset was performed, then the enable remains ineffective until the inverter once again receives valid data via the interface which is monitored with a timeout.

4.3 Fault Messages

The fault or warning code is displayed in BCD format. The following display sequence is adhered to:

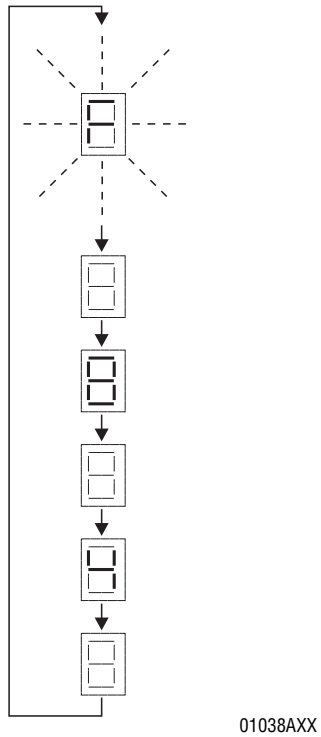


Fig. 39: Fault message

The display switches over to the operation display following a reset or if the fault or warning code once more resumes the value "0".

List of faults:

The following table shows a selection from the complete list of faults (→ MOVIDRIVE® MD_60A operating instructions). It only lists those faults which can occur specifically in table positioning.

A dot in the "P" column means that the response is programmable (P83_ Fault response).
The factory set fault response is listed in the "Response" column.

Fault code	Name	Response	P	Possible cause	Action
00	No fault	-			
07	DC link over-voltage	Immediate switch-off		DC link voltage too high	- Extend deceleration ramps - Check feeder cable to braking resistor - Check technical data of braking resistor

Fault code	Name	Response	P	Possible cause	Action
08	n-monitoring	Immediate switch-off		- Speed controller or current controller (in VFC operating mode without encoder) operating at setting limit due to mechanical overload or phase fault in the power system or motor - Encoder not connected correctly or incorrect direction of rotation - n_{max} is exceeded during torque control	- Reduce load - Increase deceleration time setting (P501 or P503) - Check encoder connection, possibly swap over A/$\overline{A}$ and B/$\overline{B}$ in pairs - Check encoder voltage supply - Check current limitation - Increase length of ramps, if appropriate - Check motor cable and motor - Check mains phases
14	Encoder	Immediate switch-off		- Encoder cable or shield not connected correctly - Short circuit/open circuit in encoder cable - Encoder defective	Check encoder cable and shield for correct connection, short circuit and open circuit
26	External terminal	Emergency stop	•	External fault signal read in via programmable input	Eliminate specific cause of fault; reprogram terminal if appropriate
27	Limit switches missing	Emergency stop		- Open circuit/both limit switches missing - Limit switches swapped over in relation to motor sense of rotation	- Check wiring of limit switches - Swap over limit switch connections - Reprogram terminals
28	Fieldbus timeout	Rapid stop	•	No master-slave communication took place within the configured response monitoring period	- Check master communication routine - If appropriate, extend fieldbus timeout time (P819) or switch off monitoring
29	Limit switch reached	Emergency stop		**In IPOS mode**, a limit switch was reached	- Check travel range - Correct user program
31	TF sensor	No response	•	- Motor too hot, TF has tripped - Motor TF not connected or connected incorrectly - Connection of MOVIDRIVE® and TF interrupted on motor - Jumper missing between X10:1 & X10:2. With MDS: X15:9 – X15:5 connection missing.	- Let motor cool down and reset fault - Check connections/link between MOVIDRIVE® and TF - If no TF is connected: Jumper X10:1 to X10:2. With MDS: Jumper X15:9 to X15:5. - Set P834 to “No response”
36	No option	Immediate switch-off		- Type of option pcb not allowed - Setpoint source, control signal source or operating mode not allowed for this option pcb - Incorrect encoder type set for DIP11A	- Use correct option pcb - Set correct setpoint source (P100) - Set correct control signal source (P100) - Set correct operating mode (P700 or P701) - Set correct encoder type
39	Reference travel	Immediate switch-off		- No reference cams - Limit switches not connected correctly - Type of reference travel was altered during reference travel	Check type of reference travel which is set and conditions required for it

Fault code	Name	Response	P	Possible cause	Action
42	Lag error	Immediate switch-off	•	- Incremental encoder connected incorrectly - Acceleration ramps too short - P-component of positioning controller too small - Speed controller parameters incorrect - Value for lag error tolerance too small	- Check incremental encoder connection - Increase length of ramps - Set P-component to higher value - Set speed controller parameters again - Increase lag error tolerance - Check encoder, motor and mains phase wiring - Check mechanical components can move freely, possibly blocked up
47	System bus timeout	Rapid stop	•	Fault during communication via system bus	Check system bus connection
78	IPOS SW limit switches	No response		**Only in IPOS operating mode:** Programmed target position is outside travel range delimited by software limit switches	- Check user program - Check position of software limit switches
92	DIP work area	Emergency stop		Only with DIP11A option: Drive has moved beyond the permitted work area of the absolute encoder. Setting of encoder type/work area DIP parameters may be incorrect.	Check position offset and zero offset parameters
93	DIP encoder fault	Emergency stop		**Only with DIP11A option:** **The encoder signals a fault, e.g. power failure** - Connection cable between the encoder and DIP does not meet the requirements (twisted pair, shielded) - Cycle frequency too high for cable length - Permitted max. speed/acceleration of encoder exceeded - Encoder defective	- Check absolute encoder connection - Check connection cable - Set correct cycle frequency - Reduce max. traveling velocity or ramp - Fit new absolute encoder
94	EEPROM checksum	Immediate switch-off		Inverter electronics disrupted. Possibly due to EM interference or defect.	Send the unit in for repair
95	DIP plausibility error	Emergency stop		**Only with DIP11A option:** **Unable to determine a plausible position** - Incorrect encoder type set - IPOS travel parameter set incorrectly - Numerator/denominator factor set incorrectly - Zero adjustment performed - Encoder defective	- Set correct encoder type - Check IPOS travel parameter - Check traveling velocity - Correct numerator/denominator factor - Reset after zero adjustment - Fit new absolute encoder

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SEW-EURODRIVE GmbH & Co · P.O.Box 30 23 · D-76642 Bruchsal/Germany
Tel. +49-7251-75-0 · Fax +49-7251-75-19 70 · Telex 7 822 391
http://www.SEW-EURODRIVE.com · sew@sew-eurodrive.com