*CL350 / CL400 / CL500*

# POS-LR
# Module Description

Edition 101

BOSCH
Automation

*CL350 / CL400 / CL500*

# POS-LR
# Module Description

1070 072 192-101 (99.10) GB



Discretionary charge 20.00 DM

# Contents

# 1 Safety Instructions

Before you switch on the POS-LR module, read these operating instructions. Keep these operating instructions in a place where they are always accessible to all users.

## 1.1 Proper use

These operating instructions contain all the information required for the proper use of the described product. The described product is used to position axes.

The described product

- was developed, manufactured, tested and documented in accordance with the relevant safety standards. In standard operation, and provided that the specifications and safety instructions relating to the project phase, installation and correct operation of the product are followed, there should be no risk of danger to personnel or property.
- satisfies the requirements
  - EEC Directive on electromagnetic compatibility (89/336/EEC, 93/68/EEC and 93/44/EEC)
  - EEC Directive on operation within certain voltage limits (73/23/EEC)
  - harmonized standards EN 50081-2 and EN 50082-2
- is designed for operation in an industrial environment (Emission class A), i.e.,
  - not directly connected to the public low-voltage power supply
  - connected via transformer to the medium to high-voltage network

  The following guidelines shall apply to the use of this equipment in private residences, business and retail premises as well as in small-industry settings:
  - Installation in a switching cabinet and/or a housing that provides a high screening factor.
  - Cables exiting from the screened area must be protected through the application of filtering and screening measures.
  - You will be required to obtain a single operating license from the national authority of approval body. In Germany, this is the Federal Institute for Posts and Telecommunications, and/or its local branch offices.

☞ **This is a Class A device. In a residential area, this device may cause radio interference. If this is the case, the user or operator may be required to provide appropriate remedial measures at his own expense.**

Prerequisites for trouble-free service and and safe operation of the product are proper transport, handling and storage, placement, installation, plus careful operation of the equipment.

## 1.2 Qualified personnel

The relevant requirements of qualified personnel are based on the job specifications as outlined by the ZVEI and VDMA professional associations in Germany. Please refer to the following German-language publication:
**Weiterbildung in der Automatisierungstechnik**
**Hrsg.: ZVEI und VDMA**
**MaschinenbauVerlag**
**Postfach 71 08 64**
**60498 Frankfurt**

This instruction manual is specifically designed for PLC technicians.

Interventions in the hardware and software of our products which are not described in this instruction manual may only be performed by specially trained Bosch personnel.

Unqualified interventions in the hardware or software or non-compliance with the warnings listed in this instruction manual or indicated on the product may result in serious personal injury or damage of property.

Installation and maintenance of the product described hereunder is the exclusive domain of trained electricians as per VDE 1000-10 who are familiar with the contents of this manual.

Trained electricians are persons of whom the following is true:

- They are capable, due to their professional training, skills and expertise, and based upon their knowledge of and familiarity with applicable technical standards, of assessing the work to be carried out, and of recognizing possible hazards.
- They possess, subsequent to several years' experience in a comparable field of endeavour, a level of knowledge and skills that may be deemed commensurate with that attainable in the course of a formal professional education in this area.

Please note our comprehensive range of training courses. Our training center will be pleased to provide you with further information, telephone: +49 (0)6062 78-258.

## 1.3 Safety markings on components

Danger: High voltage!

Danger: Battery acid!

Electrostatically sensitive components!

Disconnect at mains before opening!

Pin for connecting PE conductor only!

This connection for functional earthing or low-noise earth only!

For screened conductor only!

## 1.4 Safety instructions in this manual

**DANGEROUS ELECTRICAL VOLTAGE**
This symbol is used to warn of the presence of **dangerous electrical voltage.** Insufficient or lacking compliance with these instructions may result in **personal injury.**

**DANGER**
This symbol is used wherever an insufficient or lacking compliance with instructions may result in **personal injury**.

**CAUTION**
This symbol is used wherever insufficient or lacking compliance with instructions may result in **damage to equipment or data files**.

☞ This symbol is used to inform the user of special features.

## 1.5 Safety instructions concerning the described product

**DANGER**
**Danger of life through inadequate EMERGENCY-STOP devices!**
**EMERGENCY-STOP devices must be active and within reach in all system modes. Releasing an EMERGENCY-STOP device must not result in an uncontrolled restart of the system!**
**First check the EMERGENCY-STOP circuit, then switch the system on!**

**DANGER**
**Danger to personnel and equipment!**
**Test every new program before operating the system!**

**DANGER**
**Retrofits or modifications may adversely affect the safety of the products described!**

**The consequences may include severe injuries, damage to equipment, or environmental hazards. Possible retrofits or modifications to the system using third-party equipment therefore have to be approved by Bosch.**

**DANGEROUS ELECTRICAL VOLTAGE**
**Unless otherwise indicated, maintenance procedures must always be carried out with the system switched OFF! The system must be protected and secured against inadvertent restart.**

**In the event that measuring and testing procedures on the live system are required, these must be carried out by trained electricians.**

**CAUTION**
**Danger to the module!**
**Do not insert or remove the module while the controller is switched ON! This may destroy the module. Prior to inserting or removing the module, switch OFF or remove the power supply module of the controller, external power supply and signal voltage!**

**CAUTION**
**Only Bosch approved spare parts may be used!**

**CAUTION**
**Danger to the module!**
**All ESD protection measures must be observed when using the module! Prevent electrostatic discharges!**

Observe the following protective measures for electrostatically endangered modules (EEM)!

- The personnel responsible for storage, transport and handling must be trained in ESD protection.
- EEMs must be stored and transported in the dedicated protective packaging specified for this purpose.
- Out of principle, EEMs may only be handled at special ESD work stations equipped for this particular purpose.
- Personnel, work surfaces and all devices and tools that could come into contact with EEMs must be on the same potential (e.g. earthed).
- An approved earthing wrist strap must be worn. It must be connected to the work surface via a cable with integrated 1 MΩ resistor.
- EEMs may under no circumstances come into contact with objects susceptible to accumulating an electrostatic charge. Most items made of plastics belong to this category.
- When installing EEMs in or removing them from an electronic device, the power supply of the device must be switched OFF.

## 1.6 Documentation, version and trademark

### Documentation

This manual provides information about the functionality of the POS-LR module.

☞ **In this manual the floppy disk drive is always drive A and the hard disk drive is always drive C.**

Special keys or combinations of keys are represented by pointed brackets

- Special keys: e.g. <enter>, <pgup> , <del>
- Key combinations (pressed simultaneously): e.g. <ctrl>+<pgup>

★ This asterisk symbol shows that the manual is describing an activity which you will be required to perform.

### Version

☞ **This manual applies to the following product versions:**
**Hardware module: Version 1 and version 2**
**Function module: Version 1 and Version 2**

In this manual, all references to “Version 2” refer to “Hardware Module, Version 2” and “Function Module, Version 2”.

### Trademarks

All trademarks referring to software that is installed on Bosch products when shipped from the factory represent the property of their respective owners.

At the time of shipment from the factory, all installed software is protected by copyright. Software may therefore be duplicated only with the prior permission of the respective manufacturer or copyright owner.

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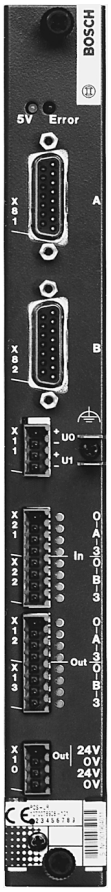
MS-DOS® and Windows™ are registered trademarks of Microsoft Corporation.

Notes:

# 2 Introduction

The POS-LR module positions axes chronologically parallel to the control tasks of the central processing unit.

**Front panel of the POS-LR**




The POS-LR module can control the positions of two axes independently of each other (2 channels).

The POS-LR module can be centralized in the CL350, CL400, CL500 and in the expansion unit of the ICL700.

The POS-LR module can be decentralized via RM4-DP12 under a:

- CL200
- CL350
- CL400
- CL500
- PCL-M
- PCL-X

**External interfaces of the POS-LR**

The POS-LR consists of two independent channels, each of which has access to:

- a selectable encoder system,
- an analog output,
- 4 digital inputs,
- 4 digital outputs.

# 3 Installation

☞ **All installation instructions applying to the CL350, CL400, CL500, and/or ICL700 must be observed.**

## 3.1 Specifications

| Specifications | POS-LR |
|---|---|
| **Sensors** | |
| Number of encoder connections | 2 |
| Incremental | • 5 V differential signals<br>• 24 V signals<br>max. $2^{31}$ increments |
| Frequency | • 5 V signals, max. 500 kHz<br>• 24 V signals, max. 200 kHz |
| Absolute | SSI (synchronous serial interface)<br><br>max. 25 bits, Gray or dual code selectable, 70 through 800 kHz |
| Cable length, screened<br>• 5 V encoder<br>• 24 V encoder | <br>50 metres, max. 500 kHz<br>• 20 metres, max. 150 kHz<br>• 100 metres, max. 50 kHz |
| Potential isolation | No |
| Input type<br>• 5 V encoder signal<br>• 24 V encoder signal | <br>RS-422<br>Type 1, as per DIN EN 61131-2 |
| Input voltage and current<br>• Nominal rating<br>  • LOW signal<br>  • HIGH signal<br>• Switching threshold<br>  • LOW → HIGH<br>  • HIGH → LOW | <br><br>0 through 5 V / ≤ 1.3 mA<br>15 through 30 V / 3.9 through 7.9 mA<br><br>typ. 10.7 V<br>typ. 10.2 V |
| Operating voltage, each encoder<br>• Short-circuit protection<br>• Fuse protection | <br>5 V– / 400 mA<br>24 V– / 900mA |

| Specifications | POS-LR |
|---|---|
| **Inputs** | |
| Inputs, Type 2 DIN EN 61131 | 8, 4 per channel |
| Potential isolation | No |
| Input voltage and current<br>● Nominal value<br>● LOW signal<br>● HIGH signal | <br>24 V<br>0 to 5 V, 0 to 2.7 mA<br>11 to 30 V, 6.1 to 17.6 mA |
| Delay time<br>● LOW → HIGH<br>● HIGH → LOW | <br>typ. 2.7 ms<br>typ. 2.9 ms |
| Switching threshold<br>● LOW → HIGH<br>● HIGH → LOW | <br>typ. 10.4 V<br>typ. 10.2 V |
| Cable length, unscreened | max. 100 metres |
| **Outputs** | |
| Number of outputs | 8, 4 per channel |
| Potential isolation | yes, between outputs and module |
| Operating voltage, for load<br>● Nominal value<br>● Permissible range | <br>24 V–<br>15 through 30 V |
| Output voltage<br>● HIGH signal<br>● LOW signal | <br>Oper. voltage: < 1.5 V / I = 0.5 A<br>< 40 mV |
| Output current<br>● Nominal rating<br>● HIGH signal<br>● LOW signal | <br>0.5 A<br>2 through 600 mA<br>max. 0.5 mA |
| Short-circuit protection | Electronic; protection activates upon reaching a current of 1.2 A (typical). Due to considerations of thermal loads, output currents may not exceed nominal rating. |
| Delay time<br>● LOW → HIGH<br>● HIGH → LOW | <br>45 µs<br>280 µs |
| Contactor size | SG1; 6.2 W |
| Lamp load | 5 W; at 8 Hz |
| Switching frequency<br>● Resistive load<br>● Inductive load | <br>100 Hz<br>depending on contactor |
| Limit, inductive cut-off voltage | Electronically limited to $V_{ext}$–50 V, typ. |
| Reverse polarity protection | plug-in fuse for all 8 outputs together, 3 A fast-acting |

| Specifications | POS-LR |
|---|---|
| Internal current load on 24 V output voltage, each 4 outputs<br>● A0 through A3 = 0<br>● A0 through A3 = 1 | <br>typ. 1 mA<br>typ. 65 mA |
| Cable length, unscreened | max. 100 m |
| **Analog output** | |
| Nominal voltage | ±10 V |
| Maximum voltage | 13.3 V |
| Input impedance, drive amplifier | min. 10 kΩ |
| Cable length | max. 50 metres |
| Resolution | 12 bit |
| **24 V Power supply** | |
| Nominal rating | 24 V– |
| Permissible range | 15 to 30 V– |
| Current draw, without output load and encoder operating current | typ. 100 mA |
| Fuse for 24 V power supply | 2.5 A, slow-blowing |
| **Miscellaneous** | |
| Periphery bus current load (12 V) | typ. 7.5 mA |
| Storage temperature range | –25 °C through 70 °C |
| Width | 1 slot |

## 3.2 Centralized and Decentralized Operation

The POS-LR module can be both centralized and decentralized.

**Centralized operation**

The POS-LR module is connected to the basic unit of the CL350, CL400, CL500 or to the expansion unit of the ICL700.

The module is actuated via modules POS45 and FIFOZM1.

**Decentralized (distributed) operation**

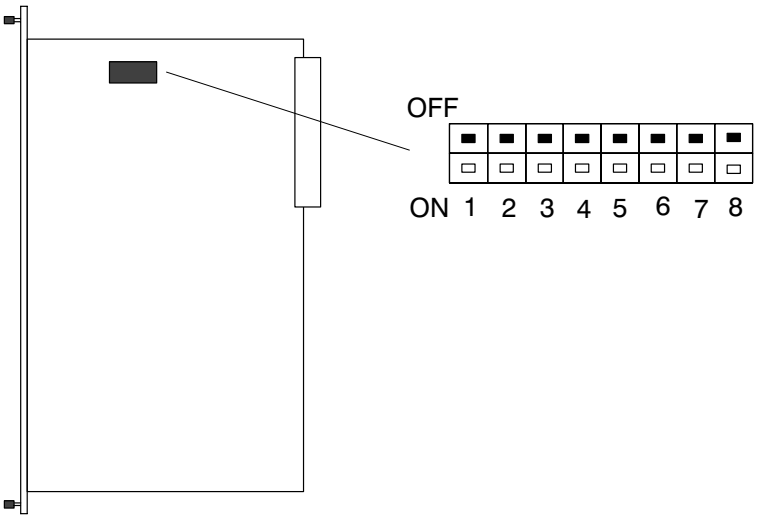
The module is inserted into an EG2 module rack with RM4-DP12 and actuated via PROFIBUS-DP from module FIFODM1 and

- CL200: POS2
- CL350: POS45
- CL400: POS45
- CL500: POS45
- PCL-M: POSPCL
- PCL-X: POSPCL

## 3.3 Selecting the Start Address

**CAUTION**
**Danger to the module!**
**All ESD protection measures must be observed when using the module! Prevent electrostatic discharges!**

The S1 DIP switch is located at the front of the mainboard.




### Centralized operation

An even start address in the extended input/output must be set:

- Switch S1/1 and
- S1/2 must be OFF

The module may be operated only at addresses which are divisible four.

The extended input/output address 0 must not be used as this address is reserved for PLC interrupts. Allocation to the processors for the CL500 is with switches S1/7 and S1/8.

The module occupies 4 bytes in the extended input and 4 bytes in the extended output field.

The following maximum number of modules per system can be plugged in:

| ZE | EI/EO field | max. number of POS-LR modules |
|---|---|---|
| CL350 | 64 bytes | 15 |
| CL400 | 256 bytes | 63 |
| CL500 | 64 through 256 bytes | 15 through 63 |

| Switch S1 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|
| Weight | $2^7$ | $2^6$ | $2^5$ | $2^4$ | $2^3$ | $2^2$ | $2^1$ | $2^0$ |
| Value | 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |
| | x | x | x | x | x | x | OFF | OFF |

☞ **The first extended input/output field utilized by the hardware module must be defined in DBPOS0, D100.**

**Decentralized operation (not for ICL700)**

☞ **Only module numbers between 0 and 243 may be selected.**

★ Set module number 0 to 243 on S1 DIP switch.

The S1 DIP switch is used to set the module number for decentralized operation. This module number will be an essential configuration component when using the Win-DP programming software.

In decentralised operation the module is actuated via the RM4-DP12. The address is assigned by the WIN-DP software.

124 slaves can be actuated for each BM-DP12 bus master. The number of POS-LR modules which can be connected to each slave is dependent on the hardware version of the master. Hardware version 1.1 allows one POS-LR to be connected to each slave and hardware version 1.2 allows two modules to be actuated for each slave.

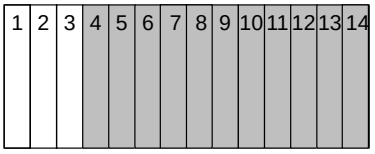
## 3.4 Module Slot

**CAUTION**
**Danger to the module!**
**Do not insert or remove the module while the controller is switched ON! This may destroy the module. Prior to inserting or removing the module, switch OFF or remove the power supply module of the controller, external power supply and signal voltage!**

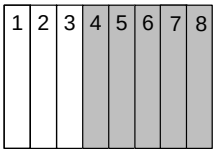
Possible module slots are shown with grey shading.

**Slots in centralized operation**

CL350, CL400

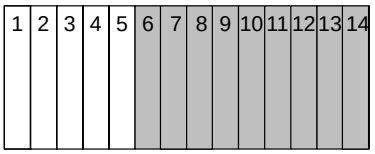



GG1 and GG2 basic unit

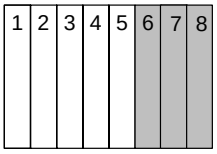



GG1/K and GG2/K basic unit

CL500

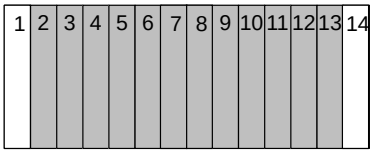



GG2 basic unit

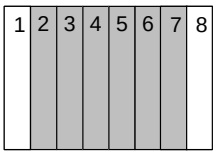



GG2/K basic unit

Expansion units




Expansion unit EG2

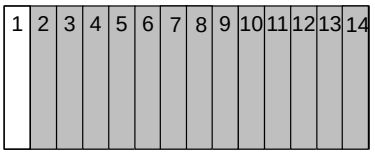



Expansion unit EG2/K

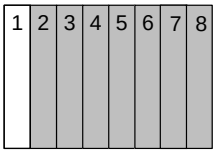
## Slots in decentralized operation

In conjunction with the RM4-DP12 module the POS-LR can be operated decentralized in an expansion unit via the PROFIBUS-DP.

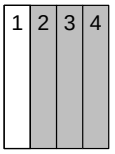
CL400, CL500




Expansion unit EG2




Expansion unit EG2/K




Expansion unit EG2/K-4

## 3.5 Required Connections

The power supply for the digital outputs is isolated from the encoder and logic input power supply. Separate power supply units must be used for encoder and logic input power and outputs.

### Installation instructions

All installation instructions applying to the CL350, CL400, CL500 and ICL700 must be observed for the POS-LR.

The operating power for the outputs may not be bridged with the logic power supply. The power for the logic circuits must be provided by a separate power supply unit.

The logic input power of the module is connected directly to the 0 V connection (GND) of the system, i.e. if using several POS-LR or RM4-DP12, the 0 V connections (GND) of the different power supply units must be connected to each other via an equipotential bonding strip. If possible, the POS-LR and RM4-DP12 modules should be supplied by one power supply unit.

The encoders must be connected to the module by means of screened cables. The cable screen must be earthed (grounded) on both ends.

If the encoders are fed via an external power supply, the 0 V connections (GND) of the encoder power supply units and the power supply for the module logic circuit must be set to the same potential via an equipotential bonding strip.

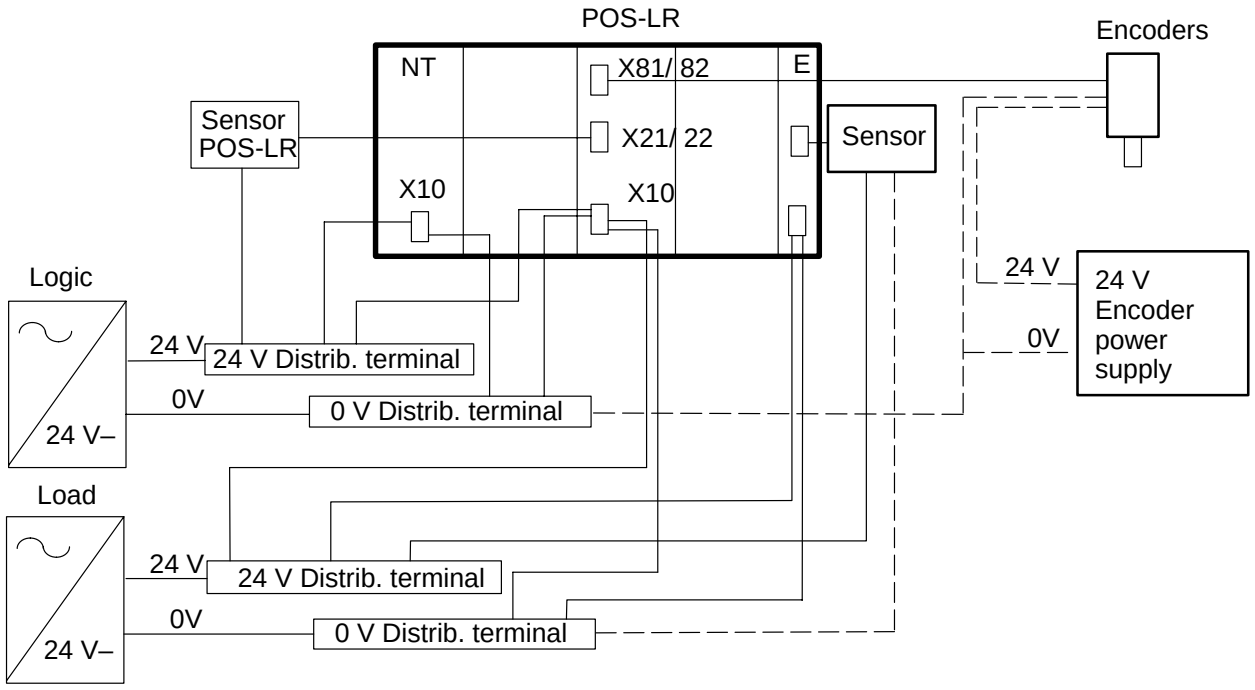
### Example of encoder connection with 5 V power supply

Take into consideration the voltage drop along long encoder cables and select an adequate cable cross-section.

Example:

The minimum required cable cross-section for an encoder with a minimum power rating of 4.75 V / 200 mA and a cable length of 25 metres is 1 $mm^2$.

**Example of connecting POS-LR and encoder to power supply**




The power supply for the module logic circuit, the digital inputs and outputs is connected to plug X10.

Both lower connections of X10 are used to supply:

- the logic circuits of the module
- the digital inputs
- the analog outputs

The 0 V connections of the digital inputs must be connected to the 0 V connection of the logic input power supply. The inputs are non-floating with respect to the logic input power and therefore have the same 0 V. The digital inputs must be supplied by the same 24 V logic power supply unit.

The digital inputs of the POS-LR must have no 0 V coupling with the other digital inputs of the PLC. The digital inputs of the POS-LR must be supplied with the logic input power of the POS-LR.

The power supply for the digital outputs is connected to both upper connections of X10. The digital outputs of Channel 1 and Channel 2 have a common power supply. The digital outputs are opto-isolated from the logic and input voltages.

The connected encoders (encoder connectors X81, X82) can be supplied directly from the logic input power supply. However, if a separate power supply unit is used for the encoders, the 0 V connection of this power supply unit must be connected to the 0 V connection of the logic power supply unit via an equipotential bonding strip.

## Connecting POS-LR

# 4 Module Functions

This chapter describes those module functions that are performed in parallel with the control tasks of the respective central processing unit.

The first section provides an overview of the following:

- Structure and function
- Connectors
- Digital input / output functions
- Commands

The remaining sections provide detailed descriptions of the following module functions:

- Approaching the reference point
- Positioning via table entries
- Direct positioning
- Inching mode and teaching mode
- Synchronous mode

## 4.1 Overview

### 4.1.1 Structure and Function

The POS-LR module can control the positions of two axes independently of each other, two channels.

The POS-LR module can be centralized in the CL400, CL500 and in the expansion unit of the ICL700.

The POS-LR module can be decentralized via RM4-DP12 under a:

- CL200
- CL350
- CL400
- CL500
- PCL-M
- PCL-X

Incremental or absolute-value encoders sense the axis position, and analog outputs control the drives. Digital inputs and outputs are available for control purposes.

The module is initialized by software initiated by the PLC program.

**Sensors / encoders**

The module accepts the following connections:

- Incremental-value sensors or
- Absolute-value encoders SSI

Only incremental-value encoders or absolute-value encoders may be connected to the POS-LR.

**Position control**

The position control is effected via:

- Input and output signals and
- Software instructions

### Inputs / Outputs

The following are examples of input signals:

- Controller enable
- Reference point (home position)
- Limit switch

The following are examples of output signals:

- In position
- Axis running
- Reference or Axis Under Control
- READY

### Signal level

A 5 V or 24 V signal level for incremental-value encoders can be selected for each channel.

Absolute-value encoders require a signal level of 5 V.

## 4.1.2 Connectors

### Encoder connectors

Encoder types:

- Incremental-value encoders, 5 V square-wave differential signals
- Incremental-value encoders, 24 V square-wave absolute signals
- Absolute-value encoders with 5 V SSI interface (differential signals)
  - 13 bit single-turn
  - 25 bit multi-turn
  - Special single-turn
  - Special multi-turn

| X81 / X82 Pin No. | Sensors / encoders | | |
|---|---|---|---|
| | **Incr. value encoder, 5 V square-wave diff. signals** | **Incr. value encoder, 24 V square-wave abs. signals** | **Absolute-value encoder, SSI, 5 V diff. signals** |
| 1 | Signal A | | SSI-DATA + |
| 2 | Signal A inv. | | SSI-DATA – |
| 3 | Signal B | | |
| 4 | Signal B inv. | | |
| 5 | 5 V encoder operating power | | 5 V encoder operating power |
| 6 | Zero mark | | |
| 7 | Zero mark inv. | | |
| 8 | | Signal A | |
| 9 | | Signal B | |
| 10 | | | SSI Timing |
| 11 | | | SSI Timing inv. |
| 12 | GND | GND | GND |
| 13 | | | |
| 14 | 24 V power supply for encoder | 24 V power supply for encoder | 24 V power supply for encoder, max. 900 mA |
| 15 | | Zero mark | |

### Digital inputs

| X21 | Inputs (Channel 1) |
|---|---|
| Input0 | Reference point (home position) |
| Input1 | Limit switch |
| Input2 | Limit switch |
| Input3 | Controller enable |

| X22 | Inputs (Channel 2) |
|---|---|
| Input0 | Reference point (home position) |
| Input1 | Limit switch |
| Input2 | Limit switch |
| Input3 | Controller enable |

## Analog outputs

| X11 | Output signals |
|---|---|
| UA+ | Analog nominal value, Channel1 |
| UA– | Analog nominal value, Channel1 |
| UB+ | Analog nominal value, Channel2 |
| UB– | Analog nominal value, Channel2 |

## Digital outputs

| X12 | Outputs (Channel 1) |
|---|---|
| Output0 | READY |
| Output1 | Axis Referenced or Axis Under Control signal, depending on DW2 in DBPOS1/2 data modules |
| Output2 | Axis running |
| Output3 | Axis in position |

| X13 | Outputs (Channel 2) |
|---|---|
| Output0 | READY |
| Output1 | Axis Referenced or Axis Under Control signal, depending on DW2 in DBPOS1/2 data modules |
| Output2 | Axis running |
| Output3 | Axis in position |

## 4.1.3 Digital Input / Output Functions

**Digital inputs**

The configuration for the utilization of the digital inputs is stored in DW2 of the DBPOS1 / DBPOS2 data module.

**Limit switch (Input1 and Input2)**

The limit switch inputs monitor the traversing movements of the axis. As the axis reaches the limit of the permitted traversing range, one of the two limit switches is tripped. This causes the axis to be braked at maximum deceleration. Any occurrence of a tripped limit switch serves as an indication of a functional system failure. The READY output is disabled.

☞ **In the event that a limit switch has been tripped, the channel will need to be reconfigured. It will then be possible to depart from the limit switch in Inching mode. The required motion away from the negative limit switch is in positive direction, and from the positive limit switch in negative direction. The configuration of the limit switches can be set to "Enabled" (HIGH), "Disabled" (LOW), or "Unused" (DW2 in DBPOS1 / DBPOS2 data modules).**

**Reference point (Input0)**

Input0 is interpreted by the POS-LR only while approaching the reference point (home position).

In accordance with the configuration stored in DW2, Input0 is either used for direct referencing, or the reference point switch (home position switch) is connected to Input0.

- Reference contact: The user value is loaded on the occurrence of the positive transition of the input signal.
- Reference point switch: A wait interval to allow the reference signal from the encoder to be recognized is inserted subsequent to the occurrence of the positive transition of the input signal. Only then will the user value be loaded. Input0 must remain enabled until the encoder reference signal has been received.

The reference input is enabled (HIGH).

**Controller enable (Input3)**

In the event that Input3 has been configured in DW2 to handle the Controller Enable signal, Input3 will facilitate a direct intervention in the controller action without requiring PLC communications. The position control loop is closed or opened by means of the external Controller Enable signal.

Provided no Start command has been generated and the "Channel ready" bit (DBPOS0: Channel 1 DW48, Channel 2 DW56) is active, the opening of the control loop signifies nothing more than equating the nominal-position value with the actual-position value. The "Axis in control" bit is reset and the axis drifts if required with a pending offset at the analog output, see subsection 4.2.2 "Performing the Offset Calibration". If the control loop is closed again, the "Axis in control" bit is set again and the axis retains its position.

If a start command is generated, the control loop must be closed. If the control loop is already open during generation of the start command or is opened during the movement, the corresponding error is generated. In this case the axis is stopped immediately, the Ready output continues to be present. Before a new movement can be started, the pending error must be reset by the “Terminate movement” (Reset) command.

The Controller Enable signal is active (HIGH).

### Digital outputs

The configuration for the utilization of the digital outputs is stored in DW2 of the DBPOS1 / DBPOS2 data module.

All outputs are enabled (HIGH).

### READY (Output0)

There is a READY signal for each channel. Output0 signals the fault-free operation of the respective channel. Output0 is set HIGH as a result of the successful configuration of both hardware module and channel.

The READY signal goes LOW in the presence of the following error conditions:

- Cable break on encoder, if appropriately configured
- Excessive lag, servo error
- Contact with a hardware limit switch

☞ **Because the module remains ready for positioning action, resetting the controller enable on Input3 (if so configured) will not cause the READY signal to be reset (LOW). The position control loop is opened, and either 0 V or the preset offset value will appear at the analog output.**

### Axis Referenced / Axis Under Control (Output1)

In accordance with the configuration stored in DW2, Output1 carries the “Axis Referenced” or “Axis Under Control” signal:

- Axis referenced: Subsequent to completed referencing, Output1 goes HIGH. Output1 will be set LOW through the completion of new configuration or referencing procedure.
- Axis under control: If Input3 has been preconfigured for Controller Enable, and Controller Enable is HIGH, Output1 will indicate the fault-free operation of the controller. Output1 will be set LOW by the occurrence of a severe error (cable break, excessive lag, contact with hardware limit switch), and by setting Controller Enable to LOW.

### Axis Running (Output2)

The “Axis Running” signal on Output2 indicates an active positioning request in any operating mode.

### Axis In Position (Output3)

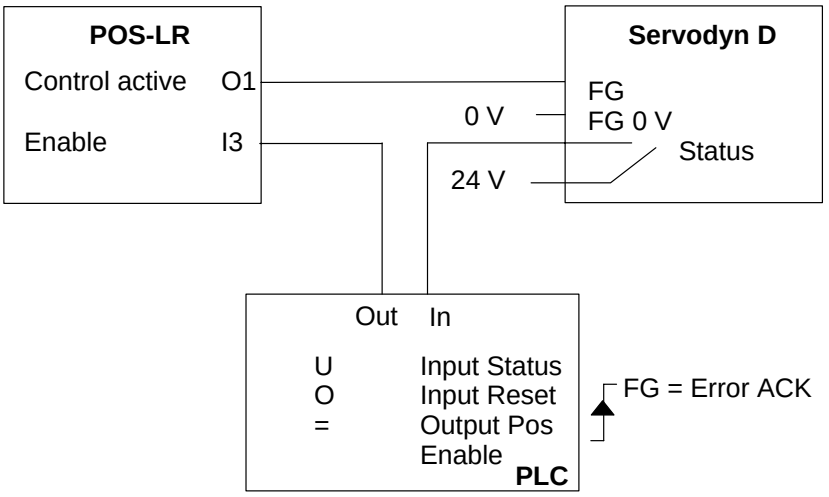
The “Axis In Position” signal on Output3 indicates that a selected position has been reached.

When the actual value calculated by the controller has reached the specified position and the axis is located in the configured in-position window (stored in DW 72 through 74 of DBPOS1 / DBPOS2), Output3 will go HIGH. Output3 will go HIGH only if the lag dimension is smaller than the in-position window.

If the offset dimension is larger than that of the in-position window, the in-position will not be reached, and Output3 will not go HIGH. If required, an offset calibration must be performed with one of the following:

- DW54 in DBPOS1 / DBPOS2 or
- Drive amplifier

### Example: Connecting Controller Enable in conjunction with Servodyn D




### Analog outputs

The positioning modules have one analog output per channel for actuating the servo drives. The output supplies a voltage of ±10 V at a resolution of 6.3 mV. It is non-floating with respect to the GND of the module. The inputs of the drive amplifiers should be actuated as differential amplifiers. If this is not the case, equipotential bonding must be set up between the drive and the POS-LR.

The drive amplifier inputs must possess an input impedance of no less than 10 kΩ. The maximum permitted cable length is 50 metres. The offset calibration is handled via the dynamic input parameters (DW54 in DBPOS1 / DBPOS2).

## 4.1.4 Commands

Communication with the module is via the POS45 function module. The function module contains commands on

- Writing data to the POS-SA module
- Reading data from the POS-SA module

This data is handled by the POS-LR as follows:

- Read from and/or written into the DBPOS0, DBPOS1 and DBPOS2 data modules
- Written into the DBPOS0 data module

### Overview of Commands

- Write Module Configuration
- Write Channel Configuration
- Write Dynamic Axis Parameters
- Start Reference Point Approach
- Start Positioning
- Halt Movement command
- Cancel Movement (Reset) command
- Direct positioning
- Start Inching Mode
- Adopt Current Position As Table Entry (Teaching mode)
- Start Synchronous Mode (version 2 and up)
- Write Dynamic Synch Parameters (version 2 and up)
- Write Table Entry
- Read Table Entry
- Clear Table

### Write Module Configuration

- 1 or 2 channels
- Encoder type
  - Incremental encoders
  - SSI absolute encoders
  - Dual or single data scan
- Inching mode timeout

### Write Channel Configuration

Specification:

- I/O configuration
- Encoder data
- Software limit switches
- Max. traversing speed
- Max. acceleration
- Max. deceleration

**Write Dynamic Axis Parameters**

Specification:

- Analog offset voltage
- KV factor (servo loop amplification factor)
- Speed correction (potentiometer)
- Inching speed
- In-position range (window)

**Start Reference Point Approach**

Start reference point approach with preferences / defaults:

- Reference point approach variant
- Reference point offset
- Referencing offset
- Referencing direction
- Referencing speed

**Start Positioning**

Start positioning with specified table number, containing information about:

- Position
- Speed
- Acceleration
- Delay
- Relative or absolute approach

**Halt Movement Command**

Once the “Halt Movement” command has been issued, the “Start Positioning” command is used to continue the movement to the original destination. The destination coordinates transferred in conjunction with the “Start Positioning” command will be ignored.

**Cancel Movement (Reset) Command**

Motion is cancelled. Error messages are cleared.

**Direct Positioning**

Starting direct positioning.

The parameters are stored in the position entry:

- Position
- Speed
- Acceleration
- Delay
- Relative or absolute approach

**Start Inching Mode**

Procedure for manual operation.

Specification:

- Direction of incrementation
- Direction of decrementation
- No traversal
- Incremental inching, version 2 and up

**Adopt Current Position As Table Entry**

Reading actual position (Teach Mode) and depositing the same under the specified table entry.

**Start Synchronous Mode** (version 2 and up)

Synchronizing the axis to a lead axis.

Synchronous modes:

- Electronic transmission
- Self-synchronous system

The lead axis function is provided by

- an internal axis (the alternate channel), OR
- an external axis (second channel as position pickup)

**Write Dynamic Synch Parameters** (version 2 and up)

Optional on-the-fly modification of dynamic synchronization parameters during ongoing operation:

- Lead spindle RPM
- Synchronous spindle RPM
- Synchronous Run Window
- Synchronous Run Error Limit
- Offset

**Write Table Entry**

Writes an entry from the DBPOS1 or DBPOS2 data module into the POS-LR table (remanent, max. 128).

**Read Table Entry**

Reads movement parameters from the POS-LR table and writes them into the position entry of the DBPOS1 or DBPOS2 data module.

**Clear Table**

Deletes all table entries (but not the table itself).

## 4.2 Operation

☞ **Markers M174 through M177 must be reserved for operation with the BT20 Control Panel.**

### 4.2.1 Configuring Module and Channels

**Configuring Module**

| DB 250 Name: DBPOS0 Comment: Configuration data & status RAM/EPROM: R | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D | 0 | | Word | N | Module mode with encoder connection | B |
| D | 2 | | Word | N | Watchdog timer for both channels | D |
| D | 16 | | Word | N | Module status | B |

The module must first be configured.

**D0**

The module is configured with D0, i.e. the “Write module configuration” command informs the module which channel is to be positioned and whether incremental-value encoders or SSI encoders have been connected to the encoder connections.

**D2**

D2 is used to set the watchdog timer. This function is active during Inching mode. In the event that, within the time interval defined in D2, no new command is transferred, the movement will be cancelled and the axis halted.

**D16**

D16 contains the configuration results as a checkback signal to the “Write module configuration” command.

### Configuring channels

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 0 | | Word | N | Response at system STOP | B |
| D 2 | | Word | N | Utilization of digital outputs / inputs | B |
| D 4 | | Word | N | Encoder configuration | B |
| D 6 | | Word | N | SSI parameters | B |
| D 8 | | Word | N | Increments per revolution | D |
| D 10 | | Word | N | Internal use | |
| D 12 | | Word | N | Distance / revolution, bit 0 through bit 15 | H |
| D 14 | | Word | N | Distance / revolution, bit 16 through bit 31 | H |
| D 16 | | Word | N | Software limit switch, negative bit 0 through 15 | H |
| D 18 | | Word | N | Software limit switch, negative bit 16 through 31 | H |
| D 20 | | Word | N | Software limit switch, positive bit 0 through 15 | H |
| D 22 | | Word | N | Software limit switch, positive bit 16 through 31 | H |
| D 24 | | Word | N | Maximum speed, bit 0 through 15 | H |
| D 26 | | Word | N | Maximum speed, bit 16 through 31 | H |
| D 28 | | Word | N | Maximum acceleration, bit 0 through 15 | H |
| D 30 | | Word | N | Maximum acceleration, bit 16 through 31 | H |
| D 32 | | Word | N | Maximum delay, bit 0 through 15 | H |
| D 34 | | Word | N | Maximum delay, bit 16 through 31 | H |

Module configuration is to be followed by channel configuration.

Channel configuration is required for the following:

- Module configuration
- Subsequent to the occurrence of errors such as:
  - Cable break
  - Servo error
  - Hardware limit switch

The data for Channel1 are stored in the DBPOS1 (D0 through D34), and the data for Channel2 in the DBPOS2 data module (D0 through D34).

The “Write channel configuration” command transfers the relevant data to the POS-LR; see subsection on Commands.

D0 defines the module responses to a system STOP condition.

D2 is used to configure the utilization of the digital inputs and outputs.

D4 through D8 are used to configure the encoders.

D12 through D34 define the kinematic data.

The return confirmation relative to the configuration of module and channels is handled via the module status (DBPOS0, D16, bits 13 through 15). The module will be ready for operation only after a successful configuration.

**Dynamic axis parameters**

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D | 52 | | Word | N | Settings | B |
| D | 54 | | Word | N | Analog offset voltage | D |
| D | 56 | | Word | N | KV factor (servo loop amplification factor) | D |
| D | 58 | | Word | N | Channel potentiometer | D |
| D | 60 | | Word | N | In-position range, bit 0 through 15 | H |
| D | 62 | | Word | N | In-position range, bit 16 through 31 | H |
| D | 64 | | Word | N | Setup speed, bit 0 through 15 | H |
| D | 66 | | Word | N | Setup speed, bit 16 through 31 | H |

When module and channels have been successfully configured, dynamic axis parameters can be set with the 'Write dynamic axis parameters' command; see subsection on Commands. Standard values are assigned.

As a one-time option, e.g., at the time of configuration, the dynamic axis parameters may be written prior to or together with a movement command (higher priority ranking). Modifications of in-position range, KV factor or channel potentiometer have a direct effect (also during the traversing movement). A modification of the setup speed takes effect only when a new motion specification is made.

D52, bit 0 is used to define whether DBPOS0, D28 (Channel1) and/or D40 (Channel2) are to contain the calculated actual value (current nominal position), the lag or the current actual value (version 2 and up). The calculated actual position is used as the default value.

☞ **If required, D54 can be used to perform and offset calibration of the analog output. Although the default offset is supplied as increments with a resolution in mV, the module changes the returned offset voltage only in steps of 6.3 mV each. For this reason, the module performs a rounding-off function. A correct offset calibration is manifested by an absence of axis drift while the position control loop is open. The default value is 0 mV.**

☞ **A high KV factor translates into a "hard and fast" position control. As a possible consequence, overswing or lack of position control stability may occur.**

D56 defines the KV factor (speed / lag ratio) in 0.01 (m/min)/mm. Representing the servo loop amplification factor, the KV factor comprises an essential control loop parameter. The value range reaches from 0.01 to 100.00. A value of 0 is not permitted. A low KV factor denotes a "soft and slow" position control, and no overswing occurs in the case of jumps in nominal values. D56 = 1 corresponds to 0.01 (m/min)/mm. D56 = 100 (decimal) equals 1.00 (m/min)/mm. The default value is 1.00 (m/min)/mm.

D58 can be used to influence the speed. The selected speeds (table entries) are multiplied with the potentiometer value. The potentiometer remains effective with all traversing requests, positioning actions, referencing approaches and during Inching mode. The potentiometer is applied to the speed that is current in a respective operation.

The value range reaches from 0 to 120 %.

A potentiometer value of 0 equals 0.0 %: The axis is at a standstill.

Potentiometer value 1.000 (decimal) corresponds to 100.0 %: The axis moves at the set speed.

Potentiometer value 1.200 (decimal) corresponds to 120.0 %: The axis moves at 1.2 times the set speed. Standard value: 1.000 (100 %).

D60 and D62 specify the in-position area of the axis in µm. Standard value is 1.000 µm, corresponding to a position deviation of ±1 mm.

D64 and D66 supply the setup speed in mm/min. Recommended value: 10 % of maximum speed (stored in D24 through 26 of DBPOS1 / DBPOS2 data modules).

### 4.2.2 Performing the Offset Calibration

The offset calibration for the analog output is performed

- at the drive, and with the use of
- D54 of the DBPOS1 / DBPOS2 data modules.

D54 defines the offset in steps measured in mV.

The default value for D54 is 0 mV.

The foregoing notwithstanding, the module changes the returned offset voltage only in steps of 6.3 mV. For this reason, the module performs a rounding-off operation.

The offset calibration is first performed at the drive.

Additional procedural steps:

- First, the axis display in D52 is switched to “Tracking”.
- Offset calibration by specifying values in D54.
- The lag indication should be as close to zero as possible.
- With the control loop closed, the lag provides a measure for the offset.
- Subsequent to the successful calibration, the axis display is again set to “Calculated Actual Position”.

The offset calibration has been performed properly if the axis does not drift while the control loop is open, and/or the lag in the in-position window is as small as possible.

## 4.2.3 Approaching the Reference Point

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D | 38 | | Word | N | Reference configuration | B |
| D | 40 | | Word | N | Reference position, bit 0 through 15 | H |
| D | 42 | | Word | N | Reference position, bit 16 through 31 | H |
| D | 44 | | Word | N | Reference point offset, bit 0 through 15 | H |
| D | 46 | | Word | N | Reference point offset, bit 16 through 31 | H |
| D | 48 | | Word | N | Reference approach speed, bit 0 through 15 | H |
| D | 50 | | Word | N | Reference approach speed, bit 16 through 31 | H |

For axes featuring incremental measuring systems, a reference point must be approached. This is the only way in which a fixed reference point for the following positioning actions can be determined.

Reference point approach is possible when the channel has been configured. The POS-LR offers various options of approaching the reference point and four variants of determining the reference point. How the reference approach runs is specified by data words D38 through D50 in DBPOS1/2.

**Reference point (home position)**

This is the point on the system on which the hardware of the POS-LR module forms the reference. This point can be determined with the use of several procedural variants.

**Reference position**

This is the nominal value for the position which the axis will occupy subsequent to positioning and in consideration of the referencing offset.

**Referencing offset**

This term describes the offset between the reference point and reference position. (“Referencing offset equals reference point minus referencing position.”)

**Reference point approach**

To perform the reference point approach, the axis starts at referencing speed in the specified direction and checks the conditions for the reference point. Once the point has been reached, the sum of reference position and referencing offset is adopted as the new actual position. As defined in bit 11 of D38, the axis brakes instantly (Fig. 1) or positions itself on the reference position (Fig. 2-4).

If the reference position is directly on the reference point, a reference displacement of 0 must be specified (Fig. 2). If the reference position, as viewed in the direction of travel, is situated on the near side of the reference point, corresponding to a positive reference displacement in a positive direction of travel and to a negative reference displacement in a negative direction of travel, positioning will occur with a reversal of direction, Fig. 3.

If the reference position, as viewed in the direction of travel, is positioned on the far side of the reference point (thus corresponding to a negative reference offset in a positive traversing direction, and to a positive reference offset in a negative traversing direction), the result will be direct positioning on the reference position without braking action on the reference point (Fig. 4); referencing will occur on-the-fly.

Subsequent to the completion of the referencing approach, the “Axis Referenced” bit in the channel status will go HIGH. Depending on the configuration of the outputs, this status will also be indicated on Output1.

The acceleration and deceleration values that will be active during the referencing approach correspond to the maximum values contained in the channel configuration.

### Traversing modes

### Braking

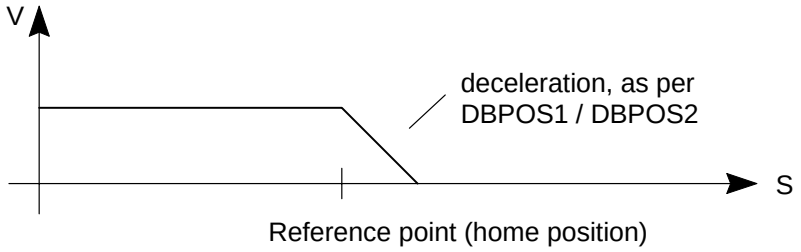



*Fig. 1 The axis brakes upon reaching the reference point.*

### Traversing to reference point

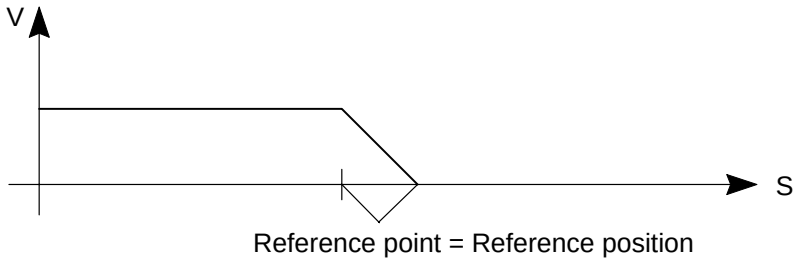



*Fig. 2 Positioning on reference position at reference offset = 0*

### Reference point offset with direction reversal

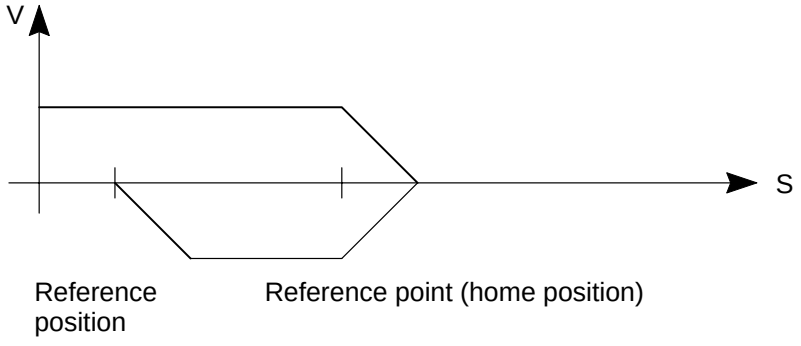



*Fig. 3 Positioning on reference position with direction reversal*

### Reference point offset without direction reversal

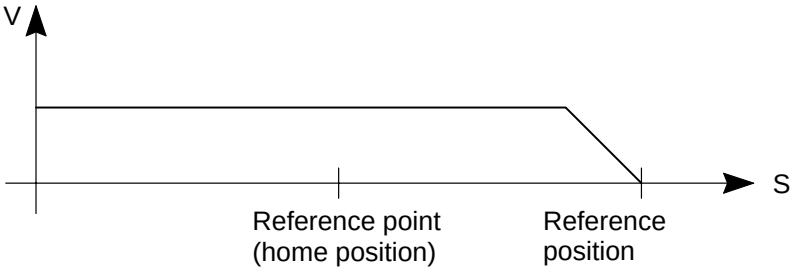



*Fig. 4 Positioning on reference pos. without direction reversal; on-the-fly referencing*

### Procedural variants of reference point determination

#### With reference point switch and reference pulse

Bit 8 in data word D38 is set HIGH. As soon as the reference point switch is actively recognized via Input0, the reference is formed with the next reference pulse of the encoder. The reference point switch must remain enabled until the reference pulse is received. The signal of the reference point switch must always be enabled (HIGH).

In the event that the reference point switch is already active at the time the reference point approach is activated, the axis will first depart from the reference point switch in the opposite direction of the reference approach, and will then traverse to the reference point in the direction of the reference approach.

#### Using reference pulse only

Bit 9 in data word D38 is set HIGH. The reference will be formed with the next reference pulse received from the encoder.

Input0 is not interpreted.

#### Using reference point switch only

Bit 10 in data word D38 is set HIGH. As in the preceding example, the switch is initially departed upon activation of the reference point switch. The reference will be formed upon the detection of a positive signal transition on Input0.

The reference pulse of the encoder is not interpreted.

### Set Actual Value command

Bit 11 in data word D38 is set HIGH. As soon as the command reaches the module, the new actual-position value is loaded. If the reference offset is equal to 0, the axis will not traverse; otherwise the reference offset will be traversed in this mode also. In the status of the channel D48/52, the “Actual Value Set” bit is displayed besides the “Axis Referenced” bit. Neither Input0 nor the reference pulse from the encoder is interpreted.

The “Set actual value” method is used from Version 2 also for correcting the actual-position value for absolute-value encoders. In this case only the entry of the reference position is effective. Any indicated reference displacement is not taken into consideration.

☞ **The “Set Actual Value” command should only be used with the axis at a standstill. This is the only way to establish a reference to a fixed point in the system.**

### Set Reference command

Bit 12 in data word D38 is set HIGH. This function is used to offset the reference in the case of a current actual-position value. The axis remains stationary. The actual-position value does not change.

### Halt Movement command

Reference approach can be interrupted with the “Halt movement” command. An interrupted movement can be continued by issuing the “Reference approach” command again. The “Axis running” signal continues to be present. The “Channel ready” bit remains inactive.

### Cancel Movement (Reset) command

The “Cancel Movement” command interrupts the referencing approach. The “Axis Running” signal is disabled, and the “Channel Ready” signal is enabled. Current errors are deleted.

### 4.2.4 Positioning via Table Entries

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D | 76 | | Word | N | Table block number | D |
| D | 78 | | Word | N | Absolute / relative position , plus user ID | B |
| D | 80 | | Word | N | Position, bit 0 through 15 | H |
| D | 82 | | Word | N | Position, bit 16 through 31 | B |
| D | 84 | | Word | N | Speed, bit 0 through 15 | H |
| D | 86 | | Word | N | Speed, bit 16 throughs 31 | H |
| D | 88 | | Word | N | Acceleration, bit 0 through 15 | H |
| D | 90 | | Word | N | Acceleration, bit 16 through 31 | H |
| D | 92 | | Word | N | Delay, bit 0 through 15 | H |
| D | 94 | | Word | N | Delay, bit 16 through 31 | H |

A table containing positions and movement parameters can be stored on-board the module for each channel.

Each table contains 128 table entries.

Each table entry contains the following:

- Specification of absolute or relative movement
- Position
- Speed
- Acceleration
- Delay

The tables are persistent, and remain unaffected by a loss of operating power in the hardware module.

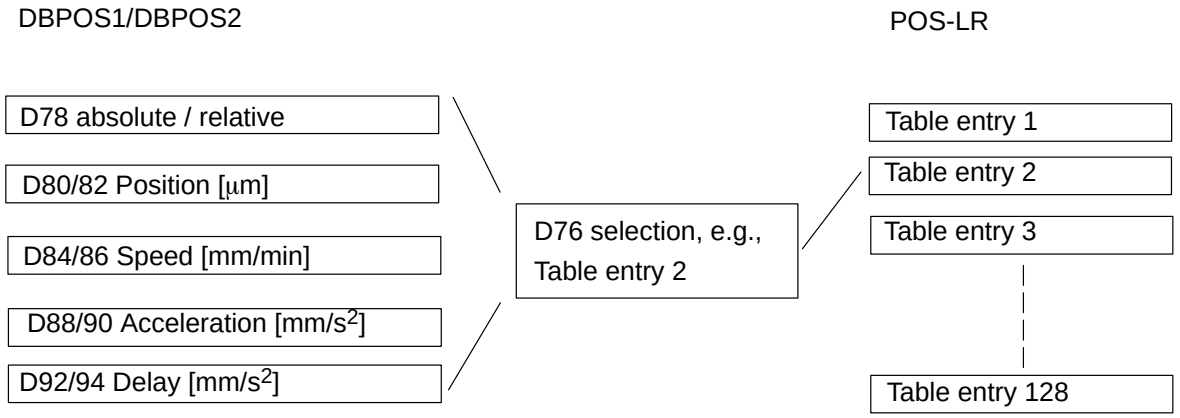
The “Clear Table” command clears all table entries in a specific table (for one channel).

The “Write Table Entry” command causes a table entry to be read from the DBPOS1 or DBPOS2 data module and to be written into the table entry defined in D76.

Data transport in the reverse direction is also possible. The “Read Table Entry” command causes the table entry defined in D76 to be loaded from the hardware module and to be written into D78 through D94 of the respective data module.

The “Write Table Entry” command is repeated until all desired positions and their movement parameters have been written to the hardware module.

**Reading and/or writing table entries**




When the “Channel Ready” signal (DBPOS0, D48 or D56) is set HIGH, the axis is positioned by specifying the table block number in D76 of DBPOS1 or DBPOS2, and by the “Start Positioning” command. The movement parameters contained in this table entry are used to approach the position specified herein.

In the event that a “Start Positioning” command is issued too early, i.e., the hardware module is still processing the preceding positioning command and the “Channel Ready” signal is not yet HIGH, the hardware module will acknowledge the command by returning an error message (DPBOS0, error bit D22 or D34, error code 603 D50 or D58).

As long as the axis is positioned, the following are set HIGH:

- Output “Axis Running” (DBPOS0, D20 or D32)
- Internal “Axis Running” status (DBPOS0, D48 or D56)

When the nominal position is reached, the following are set HIGH:

- “Channel Ready” (DBPOS0, D48 or D56)
- “Block End” (DBPOS0, D48 or D56)

When the axis (actual value) is inside the In Position window, the following are also set:

- Output3 “Axis In Position” (DBPOS0, D20 or D32)
- Internal “Axis In Position” status (DBPOS0, D48 or D56)

☞ **If the lag dimension exceeds that of the in-position window, the axis will fail to attain its position. This must be remedied by calibrating the lag (offset calibration) or by enlarging the in-position window.**

Channel information (inputs, outputs, internal status, errors) is updated when the function module is called cyclically. If the current record number (DBPOS0, D26 or D38) corresponds with the specified table record number (DBPOS1 or DBPOS2, D76), the status signals (DBPOS0, D48 or D56) can be evaluated.

If the same record is specified several times (relative records), the “ID” must be employed (see subsection on Direct positioning) to differentiate between the individual position processes (Version 1).

The ’Channel ready’ signal indicates that the channel is available for a new positioning. The ’Channel ready’ signal can be set even if the ’InPos’ signal has not been set. The lag dimension is even greater than the in-position window.

If the movement was not cancelled, and both the “Axis In Position” and “Block End” signals are HIGH, the axis has reached the specified position.

The positioning can be interrupted or completely cancelled (Reset) with the use of the commands discussed in the following sections.

### Halt Movement command

The “Halt Movement” command causes the axis to be halted; Output2 “Axis Running” and internal “Axis Running” status remain HIGH.

The following signals (DBPOS0, D48 or D56 and Output3) are LOW:

- “Channel Ready”
- “Block End”
- “Axis In Position”

☞ **Regardless of the table block number that is specified in D76 of the DBPOS1 or DBPOS2 data modules, the “Start Positioning” command continues a movement that has been halted.**

### Cancel Movement (Reset) command

The “Cancel Movement” command causes the axis to be stopped and all current errors to be deleted.

The following signals are set LOW:

- Output2 “Axis Running” (DBPOS0, D20 or D32)
- Internal “Axis Running” status (DBPOS0, D48 or D56)

The “Channel Ready” signal (DBPOS0, D48 or D56) goes HIGH.

The “Block End” signal (DBPOS0, D48 or D56) remains LOW because the specified position was not attained.

☞ **The “Axis In Position” signal (DBPOS0, D48 or D56) and Output3 (DBPOS0, D20 or D32) go HIGH as soon as the lag dimension of the axis has become less than that of the in-position window.**

☞ **The “Start Positioning” command starts a new movement in accordance with the table block number defined in D76 of the DBPOS1 or DBPOS2 data module.**

## Processing principles

The channel information (digital I/O, status, error messages) is updated by cyclically calling the POS45 function module.

When the current block number in D26 of DBPOS0 (Channel1) and D38 (Channel2) corresponds to the specified table number, the internal status displays DBPOS0, D48 and D56 can be interpreted.

When the “Axis In Position” bit 11 is HIGH, this indicates that the axis has attained the specified position (within the in-position window).

The “Channel Ready” bit 0 indicates that the POS-LR hardware module is available for a new positioning action. Bit 0 may be HIGH, even if the “In Position” bit 11 has not (yet) gone HIGH. Although the calculated actual value is equal to the nominal position, the lag dimension is greater that that of the in-position window. If required, the lag should be calibrated (offset calibration).

## Data backup

☞ **In certain situations, i.e., prior to exchanging the hardware module, the remanent table entries stored onboard the module should be loaded via a loop, and the data backed up to one or more data modules.**

The DBPOS1 and DBPOS2 data modules contain precisely one table entry.

The hardware module contains up to 128 table entries per channel and commits the data to remanent storage.

## 4.2.5 Direct positioning

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D | 78 | | Word | N | Absolute / relative position , plus user ID | B |
| D | 80 | | Word | N | Position, bit 0 through 15 | H |
| D | 82 | | Word | N | Position, bit 16 through 31 | B |
| D | 84 | | Word | N | Speed, bit 0 through 15 | H |
| D | 86 | | Word | N | Speed, bit 16 throughs 31 | H |
| D | 88 | | Word | N | Acceleration, bit 0 through 15 | H |
| D | 90 | | Word | N | Acceleration, bit 16 through 31 | H |
| D | 92 | | Word | N | Delay, bit 0 through 15 | H |
| D | 94 | | Word | N | Delay, bit 16 through 31 | H |

Positioning can also be effected directly without the use of the tables.

The direct positioning information for Channel1 is handled in data module DBPOS1, and for Channel2 in DBPOS2.

The “Direct Positioning” command causes the position and its movement parameters to be loaded from the DBPOS1 or DBPOS2 data module, and to be written to the hardware module.

An identifier (ID) entered in data byte D79 is mirrored by the module in data byte DBPOS0, D27 or D39. D26 and D38 are set HIGH.

**Positioning routine**

When the “Channel Ready” signal (DBPOS0, D48 or D56) is HIGH, the axis is positioned by means of the “Direct Positioning” command.

In the event that a “Direct Positioning” command is issued too early, i.e., the hardware module is still processing the preceding positioning command and the “Channel Ready” signal is not yet HIGH, the hardware module will acknowledge the command by returning an error message (DBPOS0, error bit D22 or D34, error code 603 D50 or D58).

As long as the axis is positioned, the following are set HIGH:

- Output2 “Axis Running” (DBPOS0, D20 or D32)
- Internal “Axis Running” status (DBPOS0, D48 or D56)

When the nominal position is reached, the following are set HIGH:

- “Channel Ready” (DBPOS0, D48 or D56)
- “Block End” (DBPOS0, D48 or D56)

When the axis (actual value) is finally inside the In Position window, the following are also set:

- Output3, “Axis In Position” (DBPOS0, D20 or D32)
- internal status, “Axis In Position” (DBPOS0, D48 or D56)

☞ **If the lag dimension exceeds that of the in-position window, the axis will fail to attain its position. This must be remedied by calibrating the lag (offset calibration) or by enlarging the in-position window.**

The channel information (inputs, outputs, internal status, errors) are updated through cyclical function module calls. Provided that the the current block number (DBPOS0, D27 or D39) corresponds to the predefined table block number (DBPOS1 or DBPOS2, D79), the status signals (DBPOS0, D48 or D56) can be interpreted.

The “Channel Ready” signal indicates that the channel is available for a new positioning action. The “Channel Ready” signal can be HIGH even if the “In Position” signal is not: lag dimension exceeds that of the in-position window.

If the movement was not cancelled (see below), and both the “Axis In Position” and “Block End” signals are HIGH, the axis has reached the specified position.

The positioning can be interrupted or completely cancelled (Reset) with the use of the commands discussed in the following sections.

### Halt Movement command

The “Halt Movement” command causes the axis to be halted; Output2 “Axis Running” and internal “Axis Running” status (DBPOS0, D48 or D56) remain HIGH.

The following signals (DBPOS0, D48 or D56) and Output3 are LOW:

- “Channel Ready”
- “Block End”
- “Axis In Position”

☞ **Regardless of the positioning data and movement parameters defined in D78 through D94 of the DBPOS1 or DBPOS2 data module, the “Start Positioning” command continues a movement that has been halted.**

**Cancel Movement (Reset) command**

The “Cancel Movement” command causes the axis to be stopped and all current errors to be deleted.

The following signals are set LOW:

- Output2 “Axis Running” (DBPOS0, D20 or D32)
- Internal “Axis Running” status (DBPOS0, D48 or D56)

The “Channel Ready” signal (DBPOS0, D48 or D56) goes HIGH.

The “Block End” signal (DBPOS0, D48 or D56) remains LOW because the specified position was not attained.

☞ **The “Axis In Position” signal (DBPOS0, D48 or D56) and Output3 (DBPOS0, D20 or D32) go HIGH as soon as the lag dimension of the axis has become less than that of the in-position window.**

☞ **The “Direct Positioning” command starts a new movement in accordance with the positioning and the movement parameters contained in D78 through D94 of the DBPOS1 or DBPOS2 data module.**

## 4.2.6 Inching Mode and Teaching Mode

Two commands can be used to traverse the axis in Inching mode and to store the attained position (Teaching mode).

### Start Inching Mode

As long as the “Start Inching Mode” command is written cyclically, the axis traverses in the direction defined in D98 of the DBPOS1 or DBPOS2 data module.

The axis will traverse only if a direction bit (D98) has been defined.

The movement parameters are loaded from the DBPOS1 or DBPOS2 data module and transferred to the hardware module:

- D98: Direction via “Start Inching Mode” command
- D64/66: Setup speed via “Write Dynamic Axis Parameters” command
- D58: Potentiometer via “Write Dynamic Axis Parameters”

The “Start Inching Mode” command must be written constantly in order to keep the axis in motion. In the event that the respective command repetition is not received within the time interval defined in D2 of the DBPOS0 data module, the axis movement will be halted. The watchdog timer is restarted with each new “Start Inching Mode” command. In the event of an error, the axis will continue to travel until the watchdog function times out.

☞ **The Inching mode must be terminated, without requiring a direction to be entered, by repeatedly sending the “Start Inching Mode” command. If this is not the case, the axis will continue its travel until the watchdog function times out.**

For example, the the negative transition of a corresponding input signal can be interpreted (Inching button) to stop the axis movement.

The Inching mode is terminated in the following manner:

- Bits 0 and 8 in D98 of DBPOS1 or DBPOS2 go LOW (no direction defined)
- Sending the “Start Inching Mode” command

### Incremental inching

Effective with version 2, Inching mode provides for axis travel in defined increments. The hardware module models this function via internally derived direct positioning.

The hardware module provides the following step sizes:

- 1 increment in positive direction
- 10 increments in positive direction
- 100 increments in positive direction
- 1 increment in negative direction
- 10 increments in negative direction
- 100 increments in negative direction

To facilitate the traversal of the smallest possible path dimension in any resolution, the steps are performed with the increments supplied by the respective encoder type. The resulting path distance is derived from the encoder resolution (D8) and the distance per revolution (D12/14). The movement parameters are equal to those defined for continuous inching at the the channel was configured (see above).

The active step dimension is selected via the inching parameter (D98). If a step dimension has been selected, the particular direction bit acts as a start for the movement. The direction bit must be reset for each new movement. To be able to use this function also for a non-referenced axis, and a direct position default for unreferenced axes with incremental-value encoders is not permitted, the reference is briefly superimposed for each movement. This is visible also on the associated outputs and status signals.

**Teaching mode**

When the desired position has been reached in Inching mode, the “Adopt Current Position As Table Entry” command can be used to store the absolute position onboard the hardware module.

The table block number is stored in D76 of the DBPOS1 or DBPOS2 data module, and the movement parameters are defined in D84 through D94:

- D76: Table block number
- D84/86: Speed
- D88/90: Acceleration
- D92/94: Delay

The position is always identified as an absolute position.

## 4.2.7 Synchronous Mode

In Synchronous mode (version 2 and up) an axis (follow axis) in snychronization with a lead axis (guide axis).

The movement of the lead axis is not influenced.

The controller startup is followed by the configuration of the hardware module and its channels.

If the axes utilize incremental measuring systems, the lead axis will be required to approach the reference point. A follow axis needs to be referenced only in conjunctions with an absolute self-synchronous system (selsyn system). The approach to the reference point occurs without synchronizion, and separate for each channel.

Only single scans are possible for SSI encoders (no dual scan).

The “Start Synchronous Mode” command is used to define a channel as the follow axis. The corresponding parameters are written also.

Two synchronization modes are available:

- Electronic Transmission
- Self-synchronous System

On-the-fly synchronization is possible.

### Electronic Transmission

In the “Electronic Transmission” synchronous mode, the RPM of the follow axis adjusts to the RPM of the lead axis in accordance with the selected transmission ratio.

The transmission ratio defined in D168 and D170 may be changed while the movement is in progress.

### Electronic shaft

In the “Electronic Shaft” synchronous operating mode the position of the follow axis is adjusted to the position of the lead axis according to the set transmission ratio. An offset (phase shift) can also be set.

Both the offset and the transmission ratio may be changed while the movement is in progress.

There are two modes available to the follow axis to trail the lead axis:

- Relative
- Absolute

In the event that a follow axis is to trail the lead axis in Absolute mode, a follow axis with incremental measuring system will first have to be referenced.

### Lead axes

A lead axis may comprise:

- An internally controlled axis, or
- an externally controlled axis.

### Internally controlled axis

The other channel of the POS-LR controls the lead axis.

No change is required to the configuration of this channel. The lead axis movement is not influenced.

The follow axis moves synchronously with the internally controlled axis.

### Externally controlled axis

The other channel of the POS-LR is used only for logging the position.

The configuration is handled identical to that of the internally controlled axis. However, the digital Input3 of the lead axis must be configured as a controller enable input, but may not be connected or must be connected to a 0 V potential. In this manner, the pulses of the connected encoder are picked up but the respective axis is not controlled.

The follow axis traverses in sync with the externally controlled axis.

### Write Dynamic Synch Parameters command

While a movement is in progress, the “Write Dynamic Synch Parameters” command may be used to modify the dynamic synchronization parameters:

- Lead Spindle RPM (lead axis)
- Synchronous Spindle RPM (follow axis)
- Synchronous Run Window
- Synchronous Run Error Limit
- Offset

The “Lead Spindle RPM” and “Synchronous Spindle RPM” parameters determine the transmission ratio (lead spindle / synchronous spindle).

The synchronous run window parameter defines a window with respect to the synchronous operation of speed (electronic transmission) or position (electronic shaft). If the difference between the lead axis and follow axis, taking into consideration both the transmission ratio and offset, if applicable, is smaller than the synchronous run window in the parameter, the condition for the synchronous run has been satisfied and the “Axis In Position” signal (DBPOS0, D48 or D56) is set.

The synchronous run error limit parameter defines the maximum permitted deviation. If the deviation between the lead axis and follow axis, taking into consideration both the transmission ratio and offset, if applicable, is greater than the synchronous run error limit defined in the parameter, the “Synchronous error” signal (DBPOS0, D48 or D56) is set. The lead axis and follow axis coupling is not automatically reset, there must be a response by the user program.

When in the “Self-synchronous System” mode, the “Offset” parameter defines the phase shift between lead axis and follow axis:

$$Position_{Follow\ axis} = (Transmission\ ratio * Position_{Lead\ axis}) + Offset$$

### Halt Movement command

By issuing the “Halt Movement” command to the lead axis, the internally controlled lead axis and the follow axis are halted. Output2 “Axis Running” and internal “Axis Running” status remain HIGH.

The following signals (DBPOS0, D48 or D56) and Output3 are LOW:

- “Channel Ready”
- “Block End”
- “Axis In Position”

☞ **Regardless of the positioning data and movement parameters defined in D78 through D94 of the DBPOS1 or DBPOS2 data module, the “Start Positioning” command continues a movement that has been halted.**

### Cancel Movement (Reset) command

Issuing the “Cancel Movement” command to the lead axis causes the movement of both lead and follow axis to be stopped and all current errors to be deleted.

The following signals are set LOW:

- Output2 “Axis Running” (DBPOS0, D20 or D32)
- Internal “Axis Running” status (DBPOS0, D48 or D56)

The “Channel Ready” signal (DBPOS0, D48 or D56) goes HIGH.

The “Block End” signal (DBPOS0, D48 or D56) remains LOW because the specified position was not attained.

☞ **The “Axis In Position” signal (DBPOS0, D48 or D56) and Output3 (DBPOS0, D20 or D32) go HIGH as soon as the lag dimension of the axis has become less than that of the in-position window.**

☞ **The “Direct Positioning” command starts a new movement in accordance with the positioning and the movement parameters contained in D78 through D94 of the DBPOS1 or DBPOS2 data module.**

### Cancelling Synchronous mode

**CAUTION**
Mechanically-coupled lead and follow axis
Equipment damage may occur if synchronous mode is cancelled during a traversing movement. For this reason, synchronous mode must only be cancelled when the axes are at a standstill.

The synchronous mode can be cancelled by issuing the “Cancel Movement” (Reset) command to the follow axis. The “Channel Ready” bit appears.

### Dynamic response of follow axis

To facilitate the highest degree of synchronization possible in lead axis lag, the dynamic response of the follow axis should be equal to or better than that of the lead axis. The maximum acceleration should be approximately equal to the maximum deceleration.

Notes:

# 5 Function Module and PLC Program

The operation of the module is accomplished via –

- Command default via the function module POS45 and
- Value defaults in the data modules DBPOS0, DBPOS1 and DBPOS2.

☞ **The POS45 function module must be called up in the first PLC cycle immediately after start-up of the controller. The module and the channels are also usually configured.**

The POS45 function module must be called up cyclically in the PLC program. Even if the module is not to be operated, the data traffic from and to the module must be maintained. If required, use the 0000H command to update the status and actual values in the DBPOS0 data module.

To each command, data ranges in the data modules are permanently assigned. These must be initialized before the respective command is executed.

## Function modules

The POS45 function module is stored on the supplied floppy disk in the form of a PxL file. In the following cases, the POS45 function module must be integrated in the user project and entered in the symbol file:

- In centralized operation, together with the FIFOZM1 function module, or
- in decentralized (distributed) operation (PROFIBUS-DP), together with the FIFODM1 function module.

FIFOZM1 or FIFODM1 are secondary function modules of POS45 and transfer the data from and to the module.

To facilitate simplified communications with the function module, a user interface is available on the BT20 Control Panel which can be ordered as an optional accessory.

## PROFI software data modules

Data modules DBPOS0, DBPOS1 and DBPOS2 are stored in the form of text files on the supplied floppy disk, and can be copied into the symbol file of freely selectable data modules. The data modules must be arranged one after the other, with DBPOS0 being the initial one.

All data that is read by or written to the hardware module is managed exclusively by these data modules.

## WinSPS software data modules

Data modules DBPOS0, DBPOS1 and DBPOS2 are stored in the form of pxd files on the supplied floppy disk and can be directly integrated in the user-written project.

## 5.1 Position control with the POS45 function module

☞ **The POS45 function module must be called up in the first PLC cycle immediately after start-up of the controller. The module and channels are also usually configured.**

The function module is capable of executing the following commands:

- Write module configuration
- Write Channel Configuration
- Write Dynamic Axis Parameters
- Start Reference Point Approach
- Start Positioning
- Halt Movement
- Cancel Movement (Reset)
- Direct Positioning
- Inching mode
- Adopt Current Position As Table Entry (Teaching mode)
- Start Synchronous Mode (version 2 and up)
- Write Dynamic Synch Parameters (version 2 and up)
- Write Table Entry
- Read table Entry
- Clear Table

Data that is to be written to the hardware module must first be provided with the appropriate parameter values in the DBPOS0, DBPOS1 and DBPOS2 data modules.

Subsequent to a cyclical call of the POS2 function module, the acknowledgement parameters must be used to check whether or not the command was executed without error.

☞ **New commands can be sent to the hardware module only after a positive acknowledgement (“FM Active” signal HIGH, and error=0) has been received.**

The data read by the hardware module is deposited in the DBPOS0 (normally), DBPOS 1 or DBPOS2 (table entries) data modules.

Data module DBPOS0 contains:

- Module configuration
- Module status
- Channel status (1 or 2 channels)
- Actual positions
- Nominal positions
- Current speed compensation values (potentiometer values)
- Current table number
- I/O statuses

Data module DBPOS1 / DBPOS2 contains:

- Channel-specific data
- Table entries

☞ **Only when a positive acknowledgement is returned for a read-access command may the data modules interpret the data and subject it to further processing.**

### Example of POS45 call-up

```
BA       -POS45.5              ;Function call-up
;
P0    W   -COMMAND              ;Command
P1    BY  -ACKNOWLEDGEMENT      ;Address for user acknowledgement
P2    W   -DmNo                 ;Data module number
P3    W   -FIFOZM1              ;Symbolic name of the FIFOZM1/FIFODM1
P4    W   -FIFOChNo             ;FIFO channel number, decentralized operation
```

### Parameters

| Parameter | Input parameters | Output parameters |
|---|---|---|
| P0 (Word) | Command and special command | |
| P1 (Byte) | | Operand address for acknowledgement |
| P2 (Word) | Data module number | |
| P3 (Word) | Program module type and number or symbolic name<br>● Centralized operation:FIFOZM1<br>● Distributed operation:FIFODM1 | |
| P4 (Word) | ● Centralized operation:incon-sequential<br>● Distributed operation:PLC chan-nel number | |

### Centralized operation

☞ **In D100 of the DBPOS0 data module, the address of the first utilized extended input/output field address (EI/EO address) of the hardware module must be defined.**

### Distributed operation

☞ **CL400/CL500: The extended input/output field address of the bus master (BM-DP12) is defined in D100 of the DBPOS0 data module.**

☞ **CL200/PCL see POS-LR1/POS-LR2 Module Description.**

### P0, Commands

| Bit | Explanation |
|---|---|
| 0 | Write Configuration |
| 1 | Write Dynamic Axis Parameters |
| 2 | Start Reference Point Approach |
| 3 | Start Positioning |
| 4 | Halt Movement |
| 5 | Cancel Movement (Reset) |
| 6 | Direct Posistioning |
| 7 | Adopt Current Position as Table Entry (Teaching mode) |
| 8 | Inching mode |
| 9 | Start Synchronous Mode (version 2 and up) |
| 10 | Write Dynamic Synch Parameters (version 2 and up) |
| 11 | Bit 11 = 0 (no special command) |
| 12 | not used |
| 13 | Channel2 |
| 14 | Channel1 |
| 15 | Module |

In the event that several commands are to be transferred via a single function module call, the function module will commence with the command described by the LSB. The function module will process all commands in succession. The command has been processed error-free if all bits on the user acknowledgment have gone LOW.

The “FM Active” signal in the acknowledgement is HIGH as long as the function module remains active. As long as the function module remains active, the function module command may not be changed.

The configuration of the hardware module and of the individual channels must precede all other commands.

For the hardware module, the “Write Configuration” command is provided. For the two channels, all commands are available.

With a single command, instructions for the module and for both channels can be transferred simultaneously.

Bits 13, 14, and 15 determine whether the command refers to the module, Channel1 or Channel2, respectively.

### P0, Structure of Special Commands

For special commands, bit 11 in parameter 0 is set HIGH.

| Bit | Explanation |
|---|---|
| 0 | Write Table Entry |
| 1 | Read table Entry |
| 2 | Clear Table |
| 3 | not used |
| 4 | not used |
| 5 | not used |
| 6 | not used |
| 7 | not used |
| 8 | not used |
| 9 | not used |
| 10 | not used |
| 11 | Bit 11=1 (special command) |
| 12 | not used |
| 13 | Channel2 |
| 14 | Channel1 |
| 15 | not used |

### P1, Operand address for acknowledgement

At the specified address, acknowledgements are returned to the user. The user may not write into the acknowledgement.

While the function module is being processed, the “FM Active” signal is HIGH.

The “FM Active” signal goes LOW as soon as all data has been written to or read from the hardware module.

The summary fault signal in the acknowledgement indicates transfer errors.

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | x | 0 | 0 | 0 | x | 0 | 0 | 0 |

Summary fault signal
FM Active signal

### P2, Data module number

Data module number of the DBPOS0 data module.

**P3, Program module**

- Program module type and program module number
- symbolic name des FIFOZM1/FIFODM1 for
  - Centralized operation (e.g. FIFOZM11)
  - Decentralized operation (e.g. FIFODM11)

**P4, FIFO channel number**

- Centralized operation
  Although this parameter is inconsequential, it must be defined, e.g., K0.
- Distributed operation
  FIFO channel number

## 5.1.1 Managing Data with the DBPOS0 Data Module

**PROFI software data modules**

Data modules DBPOS0, DBPOS1 and DBPOS2 are stored in the form of text files on the supplied floppy disk, and can be copied into the symbol file of freely selectable data modules. The data modules must be arranged one after the other, with DBPOS0 being the initial one.

**WinSPS software data modules**

Data modules DBPOS0, DBPOS1 and DBPOS2 are stored in the form of pxd files on the supplied floppy disk and can be directly integrated in the user-written program.

☞ **These data modules are reserved only for the POS-LR. Non-commented data words must not be used as they may be used by the POS45 function module for internal data management.**

**Example**

| DM no. | Name | Comment | R/E | Length |
|---|---|---|---|---|
| DB 250 | DBPOS0 | Module configuration data, module status and channel status | R | 512 |
| DB 251 | DBPOS1 | Channel1 write and read data | R | 512 |
| DB 252 | DBPOS2 | Channel2 write and read data | R | 512 |

☞ **Allocated user areas in the CL350, CL400, CL500 (POS45 V1.01):**
**M248 through M255**
**M174 through M177 (for BT20)**

**DBPOS0**

The DBPOS0 data module contains the following:

- Hardware module configuration data
- Hardware module status
- Channel1 status and Channel2 status

The data words are listed in the table below. The table is followed by a detailed discussion of the data word structure. The data words are shown with their default values.

Abbreviations used in the data module:

R = RAM
Sg = Sign
F = Format
B = Binary
D = Decimal
H = Hexadecimal

| DB 250 Name: DBPOS0 Comment: Configuration data and Status RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 0 | | Word | N | Module mode and encoder connection | B |
| D 2 | | Word | N | Watchdog timer for Channel1 and Channel2 | D |
| D4 through 14 | | Word | N | Internal use | |
| D 16 | | Word | N | Module status | B |
| D 18 | | Word | N | Internal use | |
| D 20 | | Word | N | Channel1, digital input/output statuses | B |
| D 22 | | Word | N | Channel1, status and error messages | B |
| D 24 | | Word | N | Channel1, current potentiometer value | D |
| D 26 | | Word | N | Channel1, user ID / current block number | H |
| D 28 | | Word | N | Channel1, encoder value, bit 0 through 15 | H |
| D 30 | | Word | N | Channel1, encoder value, bit 16 through 31 | H |
| D 32 | | Word | N | Channel2, digital input/output statuses | B |
| D 34 | | Word | N | Channel2, status and error messages | B |
| D 36 | | Word | N | Channel2, current potentiometer value | D |
| D 38 | | Word | N | Channel2, user ID / current block number | H |
| D 40 | | Word | N | Channel2, encoder value, bit 0 through 15 | H |
| D 42 | | Word | N | Channel2, encoder value, bit 16 through 31 | H |
| D 44 | | Word | N | Channel1, nominal position, bit 0 through 15 | H |
| D 46 | | Word | N | Channel1, nominal position, bit 16 through 31 | H |
| D 48 | | Word | N | Channel1, interne Statusanzeige | B |
| D 50 | | Word | N | Channel1, error code | H |
| D 52 | | Word | N | Channel2, nominal position, bit 0 through 15 | H |
| D 54 | | Word | N | Channel2, nominal position, bit 16 through 31 | H |
| D 56 | | Word | N | Channel2, interne Statusanzeige | B |
| D 58 | | Word | N | Channel2, error code | H |
| D60 through 68 | | Word | N | Channel1, error field | H |
| D70 through 78 | | Word | N | Channel2, error field | H |

| DB 250 Name: DBPOS0 Comment: Configuration data and Status RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 100 | | Word | N | Hardware module EI/EO address | H |
| D102 through 118 | | Word | N | Internal use | |
| D 120 | | Word | N | Firmware version of the POS-LR | H |
| D122 through 510 | | Word | N | Internal use | |

### Data word groups

| Data word group | Data words |
|---|---|
| Write module configuration | D0 through D2 |
| Read module status | D16 |
| Channel1, read status | D20 through D26 |
| Channel1, actual position or lag | D28 through D30 |
| Channel2, read status | D32 through D38 |
| Channel2, actual position or lag | D40 through D42 |
| Channel1, nominal position | D44 through D46 |
| Channel1, read internal status | D48 |
| Channel1, error code | D50 |
| Channel2, nominal position | D52 through D54 |
| Channel2, read internal status | D56 |
| Channel2, error code | D58 |
| Channel1, errror field | D60 through D68 |
| Channel2, errror field | D70 through D78 |
| EI/EO address of the POS-LR | D100 |
| Firmware version of the POS-LR (from Version 2) | D120 |

### D0, Module mode and encoder connection

| Bit | Explanation |
|---|---|
| 0 and 1 | not used |
| 2 | Channel1, positioning |
| 3 | not used |
| 4 | Channel-independent, absolute-value encoder (SSI) |
| 5 | Channel-independent, incremental encoder |
| 6 | 0 = SSI encoder, single scan,<br>1 = double scan<br>(version 2 and up) |
| 7 through 9 | not used |
| 10 | Channel2, positioning |
| 11 through 15 | not used |

The position control timing depends on the number of channels that are configured with D0:

- 2 ms (one channel)
- 4 ms (two channels)

SSI encoder: The dual data scan increases data security because the SSI encoder data is read twice in succession. If the compared values are different, another scan will be imitated. For synchronous operation, a single data scan is required.

**D2, Watchdog timer for both channels**

While in Inching mode, the “Start Inching Mode” command must be written constantly in order to keep the axis in motion. In the event that the respective command repetition is not received within the time interval defined in D2 of the DBPOS0 data module, the axis movement will be halted. The watchdog timer is restarted with each new “Start Inching Mode” command. In the event of an error, the axis will continue to travel until the watchdog times out.

The watchdog timer in ms has been set as a standard feature to 1.000 ms.

If bits 0 and 8 in DBPOS1 or DBPOS2, D98 (no direction specified) are not reset at the end of inching mode, and the “Start Inching Mode” command is transmitted again, the watchdog timer is also actuated.

**D16, Module status**

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | x | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

0 = Module configured

1 = Module not configured

0 = Channel1 not configured

1 = Channel1 configured

0 = Channel2 not configured

1 = Channel2 configured

### D20, Channel1 digital input/output statuses

| Bit | Explanation |
|---|---|
| 0 | Digital Output0, Ready |
| 1 | Digital Output1, Axis Referenced / Axis Under Control |
| 2 | Digital Output2, Axis Running |
| 3 | Digital Output3, Axis In Position |
| 4 through 7 | not used |
| 8 | Digital Input0, reference contact |
| 9 | Digital Input1, positive limit switch |
| 10 | Digital Input2, negative limit switch |
| 11 | Digital Input3, controller enable |
| 12 through 15 | not used |

### D22, Channel1 status and error messages

| Bit | Explanation |
|---|---|
| 0 | not used |
| 1 | Encoder cable break, A-signal |
| 2 | Encoder cable break, B-signal |
| 3 | Encoder cable break, R-signal |
| 4 | SSI encoder, power monitoring |
| 5 | SSI encoder parity error |
| 6 | not used |
| 7 | Error bit (error code in data word 50) |
| 8 through 15 | not used |

### D24, Channel1 current potentiometer value

The potentiometer value is used to influence the speed. The selected speeds (table entries) are multiplied with the potentiometer value. The potentiometer remains effective with all traversing requests, positioning actions, referencing approaches, and in Inching mode. The potentiometer is applied to the speed that is current in a respective operation.

The value range encompasses 0 through 120 %.

Potentiometer value of 0 corresponds to 0.0 %: The axis is at a standstill.

Potentiometer value 1.000 (decimal) corresponds to 100.0 %: The axis moves at the set speed.

Potentiometer value 1.200 (decimal) corresponds to 120.0 %: The axis moves at 1.2 times the set speed.

**D26, Channel1 user ID / current block number**

The upper byte (byte 27) contains the user ID.

The lower byte (byte 26) contains the current block number.

- Positioning via table

  The current block number contains the number of the table entry that is currently being processed.

- Direct position default

  The current block number is equal to 1.

  The user ID contains the freely selectable identification that is specified in data byte 79 of the DBPOS1 or DBPOS2 data module upon processing this positioning.

**D28/30, Channel1 encoder value**

- Control loop open (Input3 = LOW)

  D28 and D30 contain the actual value.

- Control loop closed (Input3 = HIGH or not configured).

  Depending on the dynamic axis parameters in D52 of the DBPOS1 or DBPOS2 data modules, D28 and D30 contain the calculated actual value, the lag or the current actual-value from the encoder (version 2 and up).

**D32, Channel2 digital input/output statuses**

| Bit | Explanation |
|---|---|
| 0 | Digital Output0, Ready |
| 1 | Digital Output1, Axis Referenced / Axis Under Control |
| 2 | Digital Output2, Axis Running |
| 3 | Digital Output3, Axis In Position |
| 4 through 7 | not used |
| 8 | Digital Input0, reference contact |
| 9 | Digital Input1, positive limit switch |
| 10 | Digital Input2, negative limit switch |
| 11 | Digital Input3, controller enable |
| 12 through 15 | not used |

### D34, Channel2 status and error messages

| Bit | Explanation |
|---|---|
| 0 | not used |
| 1 | Encoder cable break, A-signal |
| 2 | Encoder cable break, B-signal |
| 3 | Encoder cable break, R-signal |
| 4 | SSI encoder, power monitoring |
| 5 | SSI encoder parity error |
| 6 | not used |
| 7 | Error bit (error code in data word 58) |
| 8 through 15 | not used |

### D36, Channel2 current potentiometer value

The potentiometer value is used to influence the speed. The selected speeds (table entries) are multiplied with the potentiometer value. The potentiometer remains effective with all traversing requests, positioning actions, referencing approaches, and in Inching mode. The potentiometer is applied to the speed that is current in a respective operation.

The value range encompasses 0 through 120 %.

A potentiometer value of 0 equals 0.0 %: The axis is at a standstill.

Potentiometer value 1.000 (decimal) corresponds to 100.0 %, the axis moves at the set speed.

Potentiometer value 1.200 (decimal) corresponds to 120.0 %, the axis moves at 1.2 times the set speed.

### D38, Channel2 user ID / current block number

The top byte (byte 39) contains a user ID.

The lower byte (byte 38) contains the current block number.

- Positioning via table

  The current block number contains the number of the table entry that is currently being processed.

- Direct positioning

  The current block number is equal to 1.

  The user ID contains the freely selectable identification that is specified in data byte 79 of the DBPOS1 or DBPOS2 data module upon processing this positioning.

### D40/42, Channel2 encoder value

- Control loop open, Input3 = LOW
  D40 and D42 contain the actual value.

- Control loop closed, Input3 = HIGH or not configured
  Depending on the dynamic axis parameters DBPOS1 or DBPOS2 (D52), D40 and D42 contain the calculated actual value, the lag dimension or the current actual value of the encoder (from Version 2)

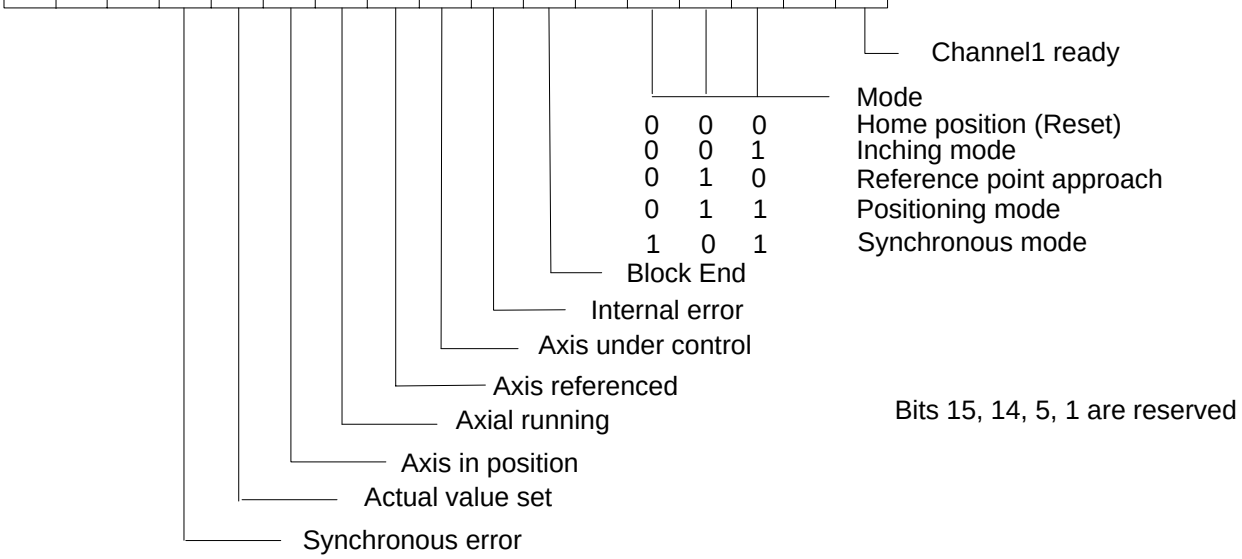
### D44/46, Channel1 nominal position

- Control loop open, Input3 = LOW
  D44 and D46 contain the actual value.

- Control loop closed (Input3 = HIGH or not configurable).
  D44 and D46 contain the position to be approached, positioning via table or direct positioning.

### D48, Channel1 internal status indication

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |




- Channel1 Ready
  The “Channel1 Ready” signal must be interpreted in the user-written program.

  The “Channel1 Ready” signal goes HIGH when the nominal value of the preceding positioning has been attained, and the hardware module is ready to accept a new positioning task. The axis does not have to be within the in-position window, e.g., due to lag or offset.

- Block End

  The “Block End” signal must be interpreted in the user-written program.

  The “Block End” signal goes HIGH when the positioning has been successfully concluded, i.e., the calculated actual value is equal to the nominal value or the reference point has been reached during the reference point approach.

  If a movement is aborted with the “Cancel Movement (Reset)” command, the “Block End” signal will not go HIGH.

- Axis Under Control

  The “Axis Under Control” signal goes HIGH when the control loop is closed.

  If the control loop is opened or in the event of a relevant error occurrence (e.g., excessive lag dimension), the signal will go LOW.

- Axis Referenced

  The “Axis Referenced” signal goes HIGH when an axis with incremental measuring system has approached its reference point. The signal will remain HIGH until the next configuration procedure or the next reference point approach.

- Axial running

  The “Axis Running” signal is HIGH while the hardware module is executing a positioning task.

  The signal will go LOW when the nominal position has been reached.

- Axis In Position

  The “Axis In Position” signal goes HIGH when the calculated position is equal to the nominal value, and the lag dimension is smaller than that of the in-position window.

  The signal will again go LOW upon processing the next positioning task.

- Synchronous Error

  The “Synchronous Error” signal goes HIGH if the follow axis is located outside the synchronous run error limit.

**D50, Channel1 error code**

If the error bit 7 in D22 is HIGH, D50 will contain the error code.

**D52/54, Channel2 nominal position**

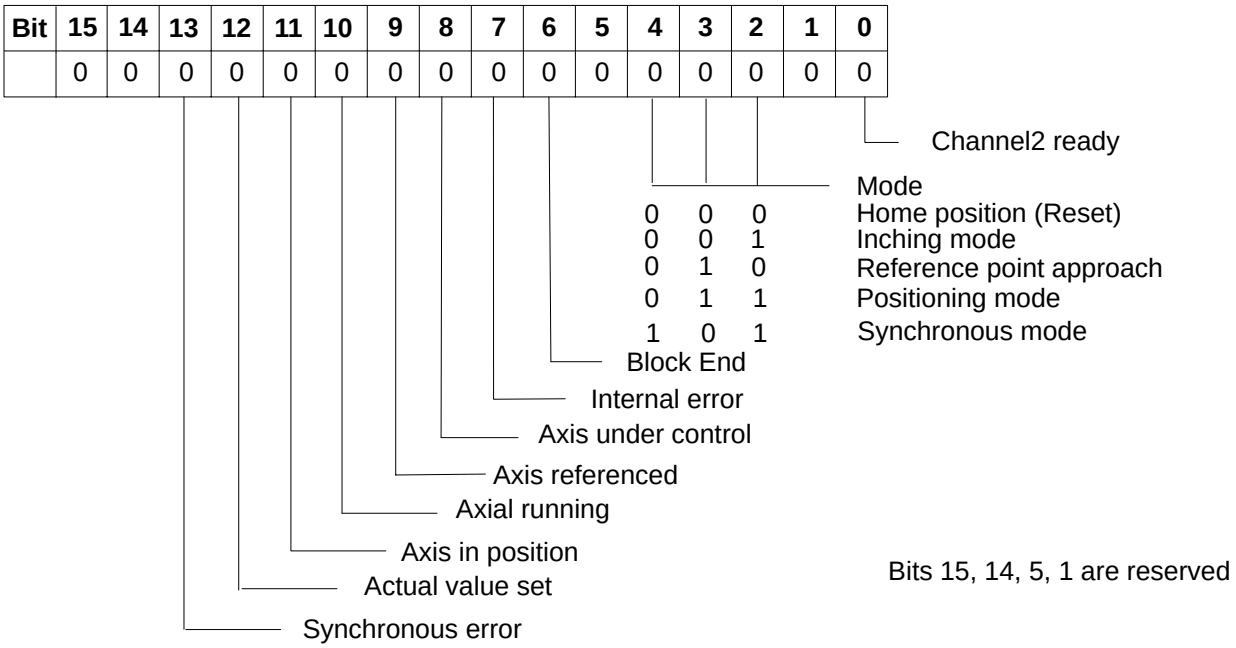
- Control loop open, Input3 = LOW

  D44 and D46 contain the actual value.

- Control loop closed, Input3 = HIGH or not configured

  D44 and D46 contain the position to be approached, positioning via table or direct positioning.

**D56, Channel2 internal status indication**




- Channel2 Ready

  The “Channel2 Ready” signal must be interpreted in the user-written program.

  The “Channel1 Ready” signal goes HIGH when the nominal value of the preceding positioning has been attained, and the hardware module is ready to accept a new positioning task. The axis does not have to be within the in-position window, e.g., due to lag or offset.

- Block End

  The “Block End” signal must be interpreted in the user-written program.

  The “Block End” signal goes HIGH when the positioning has been successfully concluded, i.e., the calculated actual value is equal to the nominal value or the reference point has been reached during the reference point approach.

  If a movement is aborted with the “Cancel Movement (Reset)” command, the “Block End” signal will not go HIGH.

- Axis Under Control

  The “Axis Under Control” signal goes HIGH when the control loop is closed.

  If the control loop is opened or in the event of a relevant error occurrence (e.g., excessive lag dimension), the signal will go LOW.

- Axis Referenced

  The “Axis Referenced” signal goes HIGH when an axis with incremental measuring system has approached its reference point. The signal will remain HIGH until the next configuration procedure or the next reference point approach.

- Axial running

  The “Axis Running” signal is HIGH while the hardware module is executing a positioning task.

  The signal will go LOW when the nominal position has been reached.

- Axis In Position

  The “Axis In Position” signal goes HIGH when the calculated position is equal to the nominal value, and the lag dimension is smaller than that of the in-position window.

  The signal will again go LOW upon processing the next positioning task.

- Synchronous Error

  The “Synchronous Error” signal goes HIGH if the follow axis is located outside the synchronous run error limit.

**D58, Channel2 error code**

If the error bit 7 in D34 is HIGH, D58 will contain the error code.

**D60 through D68, Channel1 error field**

Version 2 and up: The error messages in D204 are also mapped in D50 (Channel1). The error message of the first error that occurs is mapped. Up to five additional errors are mapped in D60 through D68 (Channel1).

**D70 through D78, Channel2 error field**

Version 2 and up: The error messages in D204 are also mapped in D58 (Channel2). The error message of the first error that occurs is mapped. Up to five additional errors are mapped in D70 through D78 (Channel2).

**D100, EI/EO address**

- Centralized operation

  The first utilized extended input/output address (EI/EO address) of the module must be input in DBPOS0, D100. 4 EI/EO bytes each are allocated from this address.

- Distributed operation

  CL350, CL400, CL500: DBPOS0, D100 contains the extended input/output address of the master (BM-DP12).

  PCL: The I/O address of the POS-LR is in DBPOS0, D100. This address is assigned to the POS-LR with WIN-DP.

  CL200: not relevant as master is in the controller.

**D120 firmware version of the POS-LR** (Version 2 and up)

## 5.1.2 DBPOS1 Data Module

The DBPOS1 data module contains the following:

- Channel1 configuration data
- Channel1 reference approach parameters
- Channel1 dynamic axis parameters
- Channel1 table entry
- Channel1 synchronous configuration
- Channel1 inching parameters
- Channel1 dynamic synchronous parameters

The data words are listed in the table below. The table is followed by a detailed discussion of the data word structure. The data words are shown with their default values.

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 0 | | Word | N | Response to system STOP | B |
| D 2 | | Word | N | Utilization of digital inputs / outputs | B |
| D 4 | | Word | N | Encoder configuration | B |
| D 6 | | Word | N | SSI parameters | B |
| D 8 | | Word | N | Increments per revolution | D |
| D 10 | | Word | N | Internal use | |
| D 12 | | Word | N | Distance per revolution, bit 0 through bit 15 | H |
| D 14 | | Word | N | Distance per revolution, bit 16 through Bit 31 | H |
| D 16 | | Word | N | Negative software limit switch, bit 0 through 15 | H |
| D 18 | | Word | N | Negative software limit switch, bit 16 through 31 | H |
| D 20 | | Word | N | Positive software limit switch, bit 0 through 15 | H |
| D 22 | | Word | N | Positive software limit switch, bit 16 through 31 | H |
| D 24 | | Word | N | Maximum speed, bit 0 through 15 | H |
| D 26 | | Word | N | Maximum speed, bit 16 through 31 | H |
| D 28 | | Word | N | Maximum acceleration, bit 0 through 15 | H |
| D 30 | | Word | N | Maximum acceleration, bit 16 through 31 | H |
| D 32 | | Word | N | Maximum deceleration, bit 0 through 15 | H |
| D 34 | | Word | N | Maximum deceleration, bit 16 through 31 | H |
| D 36 | | Word | N | Internal use | |
| D 38 | | Word | N | Reference configuration | B |
| D 40 | | Word | N | Reference position, bit 0 through 15 | H |
| D 42 | | Word | N | Reference position, bit 16 through 31 | H |
| D 44 | | Word | N | Reference point offset, bit 0 through 15 | H |
| D 46 | | Word | N | Reference point offset, bit 16 through 31 | H |

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 48 | | Word | N | Reference approach speed, bit 0 through 15 | H |
| D 50 | | Word | N | Reference approach speed, bit 16 through 31 | H |
| D 52 | | Word | N | Settings | B |
| D 54 | | Word | N | Analog offset voltage | D |
| D 56 | | Word | N | KV factor | D |
| D 58 | | Word | N | Channel potentiometer | D |
| D 60 | | Word | N | In-position range, bit 0 through 15 | H |
| D 62 | | Word | N | In-position range, bit 16 through 31 | H |
| D 64 | | Word | N | Setup speed, bit 0 through 15 | H |
| D 66 | | Word | N | Setup speed, bit 16 through 31 | H |
| D 68 through 74 | | Word | N | Internal use | |
| D 76 | | Word | N | Table block number | D |
| D 78 | | Word | N | Absolute / relative position and user ID | B |
| D 80 | | Word | N | Position, bit 0 through 15 | H |
| D 82 | | Word | N | Position, bit 16 through 31 | B |
| D 84 | | Word | N | Speed, bit 0 through 15 | H |
| D 86 | | Word | N | Speed, bit 16 through 31 | H |
| D 88 | | Word | N | Acceleration, bit 0 through 15 | H |
| D 90 | | Word | N | Acceleration, bit 16 through 31 | H |
| D 92 | | Word | N | Deceleration, bit 0 through 15 | H |
| D 94 | | Word | N | Deceleration, bit 16 through 31 | H |
| D 96 | | Word | N | Internal use | |
| D 98 | | Word | N | Inching parameters | B |
| D100 through D148 | | Word | N | Internal use | |
| D 150 | | Word | N | Synchronous mode, bit 0 through 15 | B |
| D 152 | | Word | N | Lead axis, bit 0 through 15 | B |
| D154 through D166 | | Word | N | Internal use | |
| D 168 | | Word | N | Lead spindle RPM, bit 0 through 15 | D |
| D 170 | | Word | N | Synchronous spindle RPM, bit 0 through 15 | D |
| D 172 | | Word | N | Synchronous run window, bit 0 through 15 | D |
| D 174 | | Word | N | Synchronous run window, bit 16 through 31 | D |
| D 176 | | Word | N | Synchronous run error limit, bit 0 through 15 | D |
| D 178 | | Word | N | Synchronous run error limit, bit 16 through 31 | D |

| DB 251 Name: DBPOS1 Comment: Channel1 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 180 | | Word | N | Offset, bit 0 through 15 | D |
| D 182 | | Word | N | Offset, bit 16 through 31 | D |
| D184 through D510 | | Word | N | Internal use | D |

**Data word groups**

| Data word group | Data words |
|---|---|
| Write channel configuration | D0 through D34 |
| Write reference configuration | D38 through D50 |
| Write dynamic axis parameters | D52 through D66 |
| Read or write positioning entry | D76 through D94 |
| Inching parameters | D98 |
| Write synchronous mode | D150 through D152 |
| Dynamic synchronous parameters | D168 through D182 |

☞ **All configuration combinations not listed in the following tables are invalid.**

**D0, Response to System STOP**

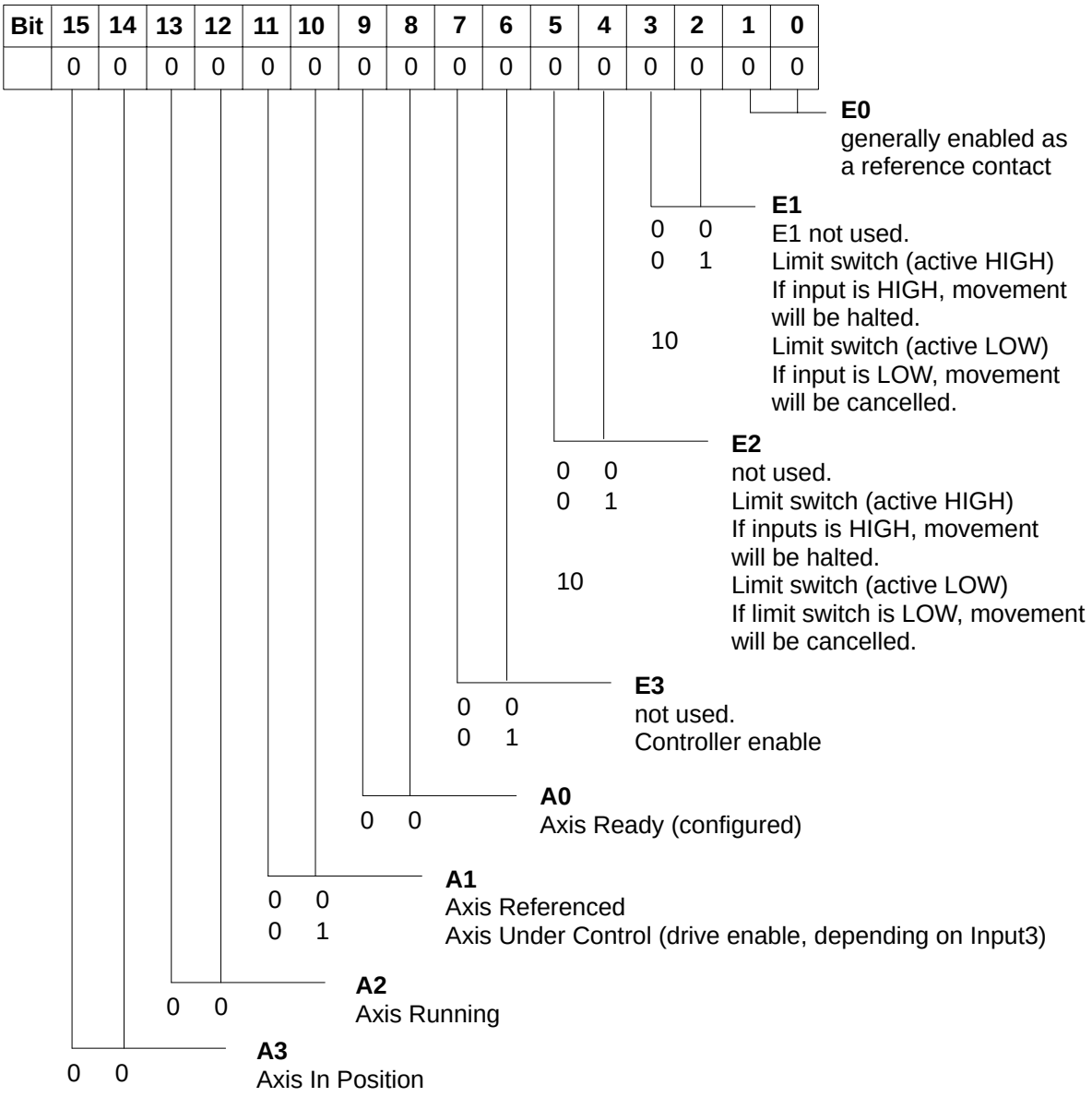
| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Response to System STOP**

0 0 No response

1 0 Disable digital outputs on the POS-LR

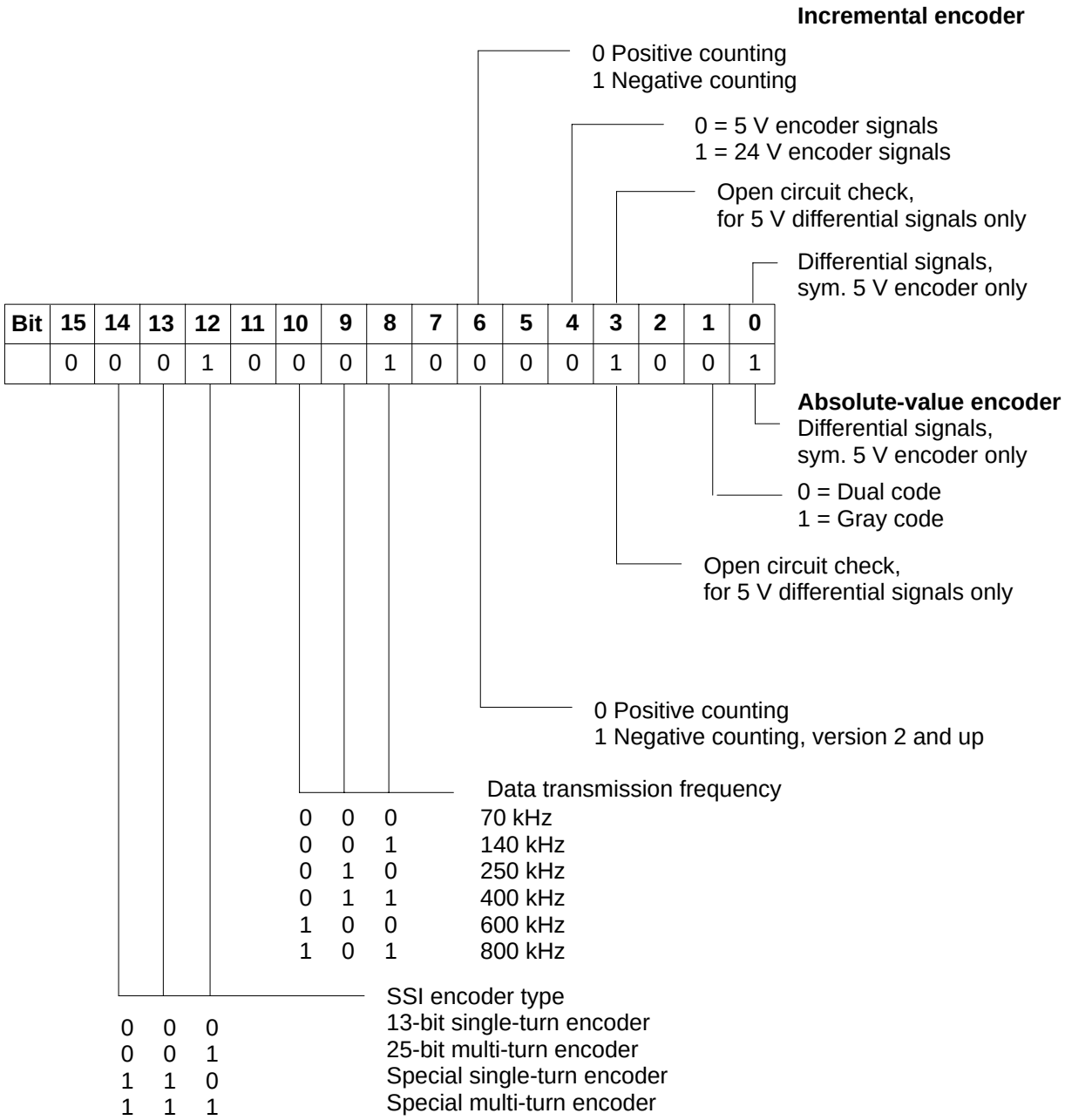
**D2, Utilization of digital inputs / outputs**




☞ **If Input3 is utilized for Controller Enable, the hardware module will close the control loop only if the Input3 signal is HIGH (drive “On”). In the event that a signal transition from LOW to HIGH occurs on Input3, the actual position will be adopted as the nominal position, i.e., lag = 0. This prevents a jump in the nominal value in the upon enabling the re-lase.**

## D4, Encoder configuration

☞ **In accordance with the encoder type – absolute (SSI) or incremental – only the relevant data bits must be set in each case.**




- Positive / negative counting (SSI encoders, version 2 and up)

  With the direction of rotation for a counter preselected, this signal can be used to reverse the direction of count. If the rotation direction of the entire axis is to be changed, the polarity of the analog output must be reversed also in order to prevent direct feedback.

- Interruption check

  To activate sensor cable monitoring for interruption and short-circuit, the “Interruption Check” signal must be set for 5 V differential signals.

- Differential signals

  As a rule, 5 V encoders produce differential signals. In that case, this signal must be set (HIGH) to achieve improved operational security.

**13 Bit single-turn and 25 bit multi-turn encoder**

For data reading/scanning, different encoder types require different numbers of read pulses to be sent to them. For a 13 bit single-turn encoder, this is always 13, and for a 25 bit multi-turn encoder, this is always 25 pulses.

Most standard single-turn or multi-turn encoders utilize these pulse counts.

If the voltage monitoring bit is set (HIGH) for a 13 bit single-turn or a 25 bit multi-turn encoder, the last bit to be read on an absolute-value encoder will be the power monitoring bit instead of the status bit. This power monitoring bit is not written into the actual value but is instead deposited in the channel status and error message in DW16 or DW28, bit 4 of the DBPOS0 data module.

If a 13 bit single-turn or a 25 bit multi-turn encoder with parity bit is used, the parity bit in the SSI parameter can be set (HIGH). The parity bit will then be read additionally from the absolute-value encoder and deposited in the channel status and error message in DW16 or DW28, bit 5 of the DBPOS0 data module.

The data produced by the 13 bit single-turn or 25 bit multi-turn encoders is transferred from encoder to hardware module in tree structure format.

For single-turn encoders with less than 13 bits (8192 increments), trailing zeros with be returned.

For multi-turn encoders –

- less than 12 bits (4096 revolutions) leading zeroes
- with less than 13 bits (8192 increments), trailing zeros with be returned per revolution.

However, the actual value in the data words of the DBPOS0 data module is always indicated correctly.

Based upon the definitions in the SSI parameter, the scanned value is shifted in the data word by the trailing numbers to ensure right-hand justification.

## Special Single-turn and Multi-turn Encoders

With a special single-turn encoder, the number of data bits read from the absolute-value encoder corresponds to the number of increments selected in the SSI parameter.

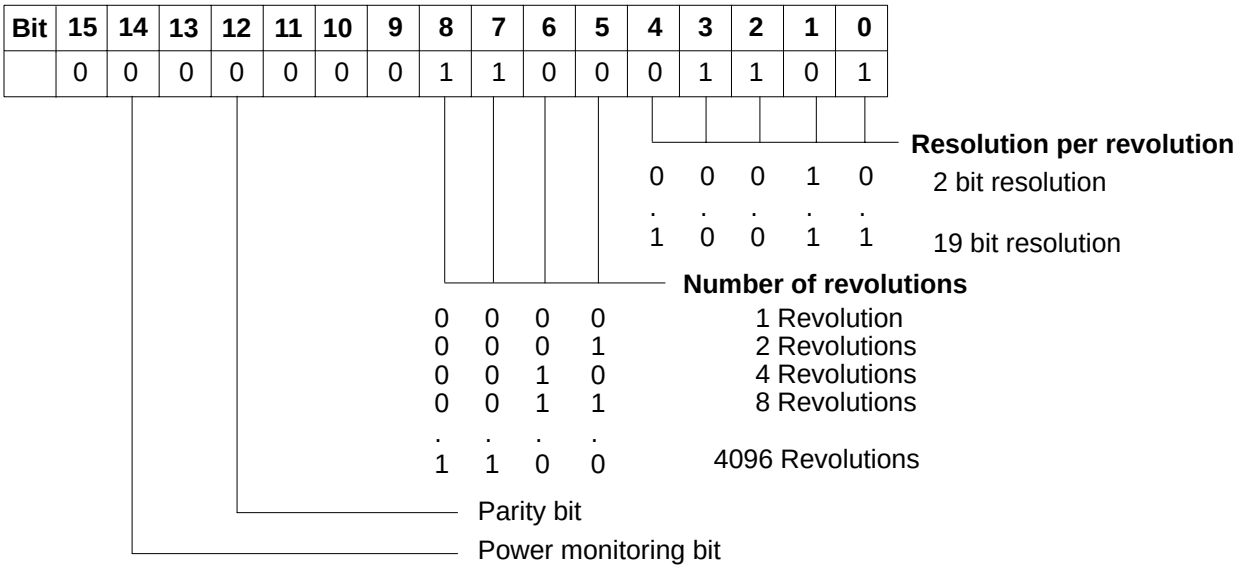
With a special multi-turn encoder, the number of data bits read from the absolute-value encoder corresponds to the number of revolutions and increments selected in the SSI parameter.

The power monitoring bit is not supported by special single-turn and multi-turn encoders.

If the parity bit is set for a special encoder, the parity bit will be read as an additional data bit, regardless of the selected RPM and steps. This parity bit is not stored in the actual value but is instead written to the status and fault message of the respective channel.

The actual values read from the special encoders are not shifted for right-hand justification but are shown as read.

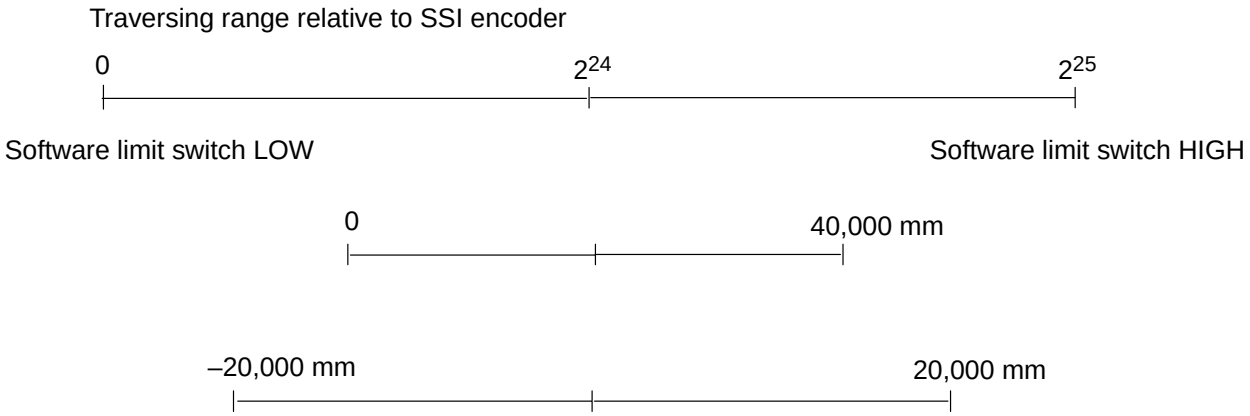
### D6, SSI parameter



**Traversing range for SSI encoders, version 1**

For axes with SSI encoders, the mid-point of the traversing range is congruent with the range mid-point of the SSI encoder.

**Example**




☞ **When using axes with SSI encoder and version 1, both limit switches are positioned symmetrical with the mid-point of the traversing range. If this principle is not observed in the case of a subsequent limit switch repositioning, the traversing range will shift relative to the SSI encoder, and the previously defined positions will be "lost" (unusable).**

At the time of first system startup, the feed constant and the software limit switches should be selected in such a manner that at least the entire encoder range is positioned within the limit switches. If the encoder is positioned outside of the limit switches, a "0" will be returned as the actual value. The encoder must then be rotated until it is positioned within the limit switches.

**Traversing range for SSI encoders, version 2**

The “Approach Reference Point” command and the “Set Actual Value” function are used to adapt the value range of the SSI encoder to the traversing range of the axis.

Immediately after configuring the channels the current encoder position is used to calculate the position based on the default unit of length. This position must be compared with the desired actual position in the application program. If the position of the axis at this location is not known, it may be required to approach a reference position (see note below). The difference between the desired and indicated actual position must be written into the data word for the reference position, followed by issuing the “Approach Reference Point” command in conjunction with the “Set Actual Value” function. The actual position of the encoder will now be corrected with the reference position.

☞ **Due to the encoder installation, approaching the reference point may cause a roll-over of the encoder values. This may cause a servo error. The encoder value roll-over can be prevented by estimating the difference and by determining a temporary actual position. This facilitates the approach of the reference position. The exact difference is determined and the actual position corrected.**

The difference that is determined in this manner is remains stored in the data module. The difference must be newly determined if a change has occurred in the system or in the measuring components.

☞ **In the event that the actual value is not corrected after the system startup, the approached positions will likely be faulty.**

The “Approach Reference Point” command in conjunction with the “Set Actual Value” function must be used after each channel configuration: the axis does not traverse, only the actual position is corrected by the difference that has been determined.

☞ **In the event that the software limit switches are not positioned in symmetry with traversing limits of the axis, faulty positions may be determined at the time of startup when the axis is positioned in close proximity of a hardware end stop.**

**D8, Increments per revolution**

D8 defines the encoder increments (graduation marks) per revolution (graduation count).

Maximum value: 10,000 increments/revolution

**D12/14, Distance per revolution**

D12 and D14 define the feed constant in µm per revolution.

Maximum value: 10,000,000 µm/revolution

**D16/18, Negative software limit switch**

D16 and D18 define the negative software limit switch in µm.

**D20/22, Positive software limit switch**

D20 and D22 define the positive software limit switch in µm.

The traversing range of the axis is defined by the software limit switches.

**Positioning limit value**

The positioning range depends on the encoder resolution (D8) and on the feed constant (D12/14). The positioning limit value is calculated as follows:

Positioning limit value = ±Feed constant * 53,687,091.18 / line number

(The factor in the formula is 2 to the power 31 divided by 40.)

Maximum value: ±200.00 m.

☞ **If the actual value is positioned outside of the positioning limit value, it will be shown as “0”.**

**Example**

Feed constant (D12/14) = 2.000 µm/revolution

Line number (D8) = 1,000 increments/revolution

The resulting positioning limit value equals = ±107.374 m.

**Example**

**Maximum speed at predefined accuracy**

To maintain a specific accuracy and to calculate the maximum speed for this process, the following formula shall apply:

max. speed = ±Precision * 1,574 / scanning time

To traverse with 1 µm accuracy at a scan rate of 2 ms (1 channel), the following maximum speed will result:

max. speed = ±1,574 µm / 2 ms = 47.22 m/min

The accuracy that can be maintained does not only depend on the speed but also on the graduation count of the encoder. This count must be sufficiently high to facilitate the desired accuracy.

The speed limit values stated for each encoder type earlier in this section may not be exceeded.

**D24/26, Max. speed**

D24 and D26 define the maximum speed in mm/min.

The speed specified here represents the drive speed at a default nominal 10 V. It is the product of RPM and feed constant.

Example:

Speed n = 3,000 revolutions/min

Feed constant (D12/14) = 40,000 µm/revolution

Max. speed (D24/26) = 3,000 revolutions/min * 40,000 µm/revolution

Max. speed (D24/26) = 120,000 mm/min

The preset nominal value for 120,000 mm/min equals 10 V.

☞ **The maximum encoder frequency may not be exceeded here.**

☞ **The speed for a positioning task is not defined in D24/26. The speeds are defined in the setup speed or in the table entries, and can also be additionally influenced by potentiometer values.**

**Speed limit value**

The speed limit value depends on the encoder resolution (D8), the feed constant (D12/14) and the maximum encoder frequency.

The maximum encoder frequency is 500 kHz for a 5 V incremental encoder, and 200 kHz for a 24 V incremental encoder.

The speed limit value “v-Limit value” is:

- 5 V incremental encoder
  v-limit value = (feed constant * 30,000,000) / (encoder resolution * min)
- 24 V incremental encoder
  v-limit value = (feed constant * 12,000,000) / (encoder resolution * min)
- SSI encoder
  v-limit value = (feed constant * 60,000,000) / (encoder resolution * min)

Example1 (Cut-off frequency = 500 kHz)

5 V incremental encoder

Feed constant (D12/14) = 5,000 µm/revolution

Encoder resolution (D8) = 2,000 increments/revolution

This produces a speed limit value of = ± 60 m/min

Example2

24 V incremental encoder (cut-off frequency = 200 kHz)

Feed constant (D12/14) = 5,000 µm/revolution

Encoder resolution (D8) = 2,500 increments/revolution

This produces a speed limit value of = ± 24 m/min.

**D28/30, Max. acceleration**

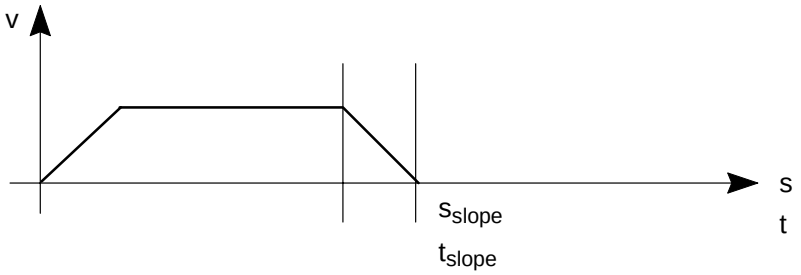
D28 and D30 specify the maximum acceleration in mm/s$^2$. The max. value which can be input is 99,999 mm/s$^2$.

**D32/34, Max. deceleration**

D32 and D34 specify the maximum deceleration in mm/s$^2$. The max. value which can be input is 99,999 mm/s$^2$.

**Calculating acceleration and deceleration parameters**

In the event that besides the maximum speed (D24/D26) only the maximum time to attain this speed or the distance for the acceleration phase is known, the deceleration parameters can be determined with the following calculation:




If acceleration time $t_{slope}$ is known:

$$\text{Maximum acceleration } a_{max}\ [m/sec^2] = \frac{v[m/min]}{t_{slope}[sec] \times 60}$$

If acceleration distance $s_{slope}$ is known:

$$\text{Maximum acceleration } a_{max}\ [m/sec^2] = \frac{(v[m/min])^2}{2 \times s_{slope}[m] \times 3600}$$

Example:

The maximum speed at a nominal RPM shall be 100 m/min, and the maximum speed shall be attained after a distance of 0.2 metres:

Maximum acceleration $a_{max}$ [m/sec$^2$] =

$$= \frac{(v[m/min])^2}{2 \times s_{slope}[m] \times 3600} = \frac{(100)^2}{2 \times 0,2 \times 3600} = \frac{10000}{1440} = 6.94\ [m/sec^2]$$

### D38, Reference configuration

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

0 Incrementing direction
1 Decrementing direction

0 Braking until dead stop
1 Positioning to reference position

Reference point approach

| | | | | | |
|---|---|---|---|---|---|
| 0 | 0 | 0 | 0 | 1 | E0 as preliminary contact for encoder reference signal |
| 0 | 0 | 0 | 1 | 0 | Encoder reference signal serves as reference signal |
| 0 | 0 | 1 | 0 | 0 | E0 as reference signal |
| 0 | 1 | 0 | 0 | 0 | Reference position and reference point offset are added up and loaded as actual value (Set Actual Value) |
| 1 | 0 | 0 | 0 | 0 | Set Reference (version 2 and up) |

### D40/42, Reference position

D40 and D42 define the reference position in µm.

### D44, Reference point offset

D44 and D46 define the reference point offset in µm.

If an offset in positive direction is desired, a negative reference point offset value must be entered, and vice versa.

### D48/50, Reference approach speed

D48 and D50 define the reference approach speed in mm/min.

### D52, Settings

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

0 = Actual position is shown as absolute value (calculated, current nominal position)
1 = Lag is indicated

1 = Current actual position of encoder is indicated (version 2 and up)

Default value is the calculated actual position

**D54, Analog offset voltage**

D54 defines the analog offset voltage in mV.

When the control loop is open, e.g., due to removal of “Controller Enable” signal (Input3), the hardware module places a 0 V potential on the analog output. In practical application, the axis drifts out of its position. Outputting a low offset voltage can cause the axis to come to a complete or almost complete standstill.

Although the offset can be defined in in D54 in increments measured in mV, the hardware module will change the actual offset voltage at the output in increments of only 6.3 mV. The module therefore performs a rounding-off operation.

Default value: 0 mV

Max. value: ±12,500 mV.

**D56, KV factor (servo loop amplification factor)**

D56 defines the KV factor in hundredths of (m/min)/mm.

The KV factor (servo loop amplification factor) is an essential parameter of the control loop.

The value range encompasses 0.01 through 100.00.

A value of 0 is not permitted.

A low KV factor denotes a “soft and slow” position control, and no overswing occurs in the case of jumps in nominal values.

☞ **A high KV factor translates into a “hard and fast” position control. As a possible consequence, overswing or lack of position control stability may occur.**

D56 = 1 corresponds to 0.01 (m/min)/mm.

D56 = 100 (decimal) corresponds to 1,00 (m/min)/mm.

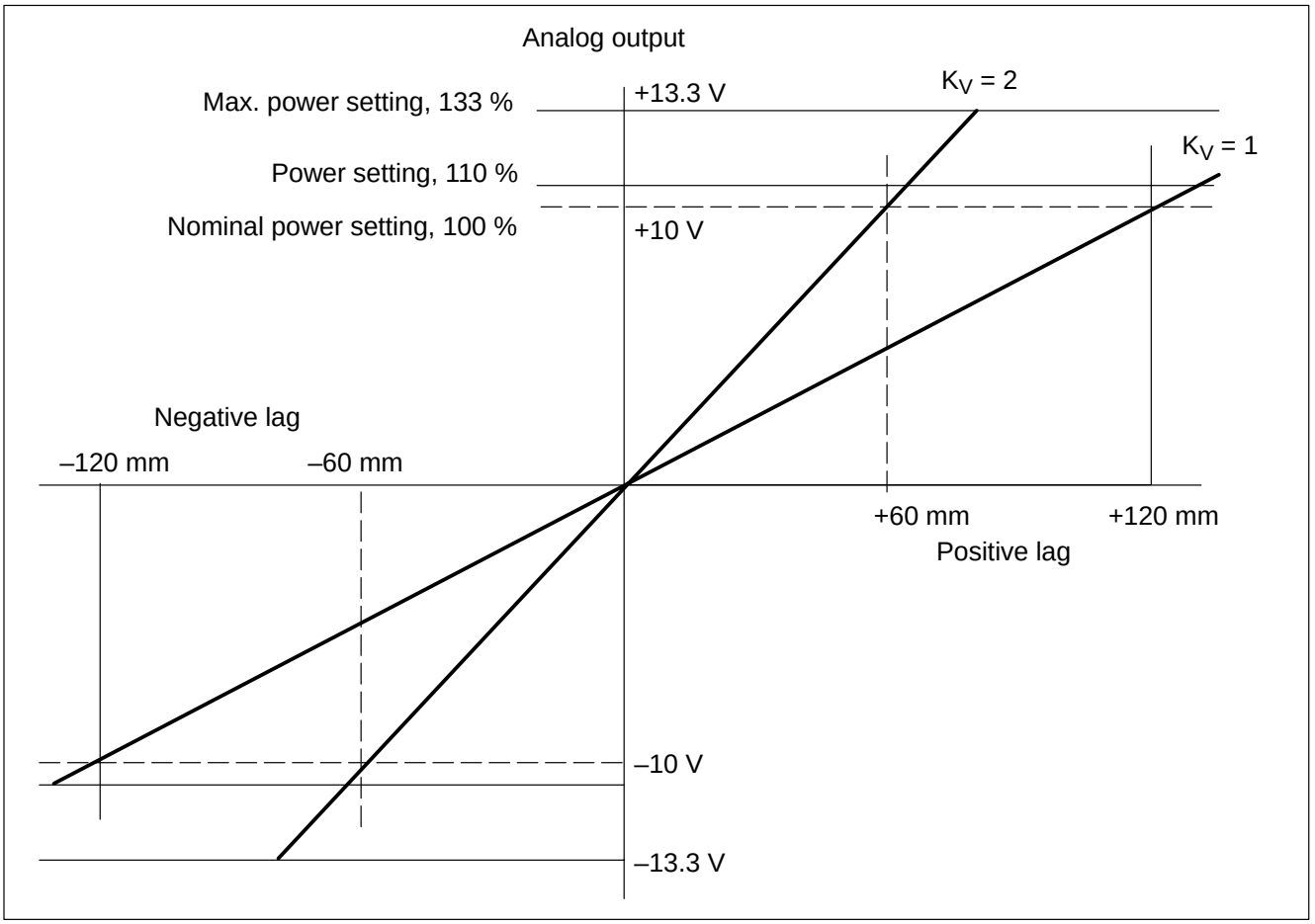
Default value: 1 (m/min)/mm.

$$K_V = \frac{v[m/min]}{Lag[mm]}$$

$$Lag = \frac{v[m/min]}{K_V\left[\frac{m/min}{mm}\right]}$$

The following applies to the POS-LR hardware modules:

- The maximum voltage on the analog output is 13.3 V.
- Exceeding 13.3 V at the analog output will produce a servo error.
- Interpolator Stop occurs at 11 V output voltage (lag error).




*Example: Dependence of lag on KV factor*

**Example:**

v = 120 m/min

$$K_V = 2\frac{m}{\min \times mm}$$

$$\text{Lag} = \frac{120[m/min]}{2\left[\frac{m/min}{mm}\right]} = 60 \text{ mm}$$

The above indicates that at nominal speed the axis follows the calculated nominal value with a lag dimension of 60 mm. If $K_V$ is reduced to 1 m/(min x mm), lag will increase correspondingly to 120 mm.

**D58, Channel potentiometer**

D58 is used to influence the speed. The selected speeds (table entries) are multiplied with the potentiometer value. The potentiometer is active with all traversing requests, positioning actions, reference approaches and during Inching mode. In all named actions, the potentiometer acts upon the speed that is currently valid.

The value range encompasses 0 through 120 %.

Potentiometer value of 0 corresponds to 0.0 %: The axis is at a standstill.

Potentiometer value 1.000 (decimal) corresponds to 100.0 %: The axis moves at the set speed.

Potentiometer value 1.200 (decimal) corresponds to 120.0 %: The axis moves at 1.2 times the set speed.

The default value is 100.0%.

**D60/62, In-position range bit**

D60 and D62 define the in-position range of the axis in μm.

The default value is 1 mm.

In both the positive and negative direction, the axis in-position range encompasses the value defined in D60/D62, for example, ±1 mm.

**D64/66, Setup speed**

D64 and D66 define the setup speed in mm/min.

Guidance value: 10 % of maximum speed; DBPOS1/DBPOS2, D24–26.

**D76, Table block number**

D76 contains a table block number.

The value range encompasses 1 through 128.

D76 points to a table entry in the table onboard the hardware module.

D78 through D94 encompass the positioning and movement parameters of a table entry.

### D78, Absolute/relative position and user ID

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | x | x | x | x | x | x | x | x | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

User ID
0 through 255

0 Positioning is absolute

1 Positioning is relative

Data byte 79 may contain a freely selectable user ID which can be interpreted in data byte 27 of the DBPOS0 data module for Channel1 (and data byte 39 of the DBPOS0 for Channel2). In the event that a positioning request involving a position that has already been approached is issued, the cascade will hang on the “Running” / “In Position” query, although the cascade will continue to run when “ID Accepted” / “In Position” is queried.

### D80/82, Position

D80 and D82 define the position in µm.

D78, bit 0 defines whether the approach to the position will be absolute or relative.

### D84/86, Speed

D84 and D86 define the speed in mm/min.

### D88/90, Acceleration

D88 and D90 define the acceleration in $mm/s^2$.

### D92/94, Deceleration

D92 and D94 define the deceleration in $mm/s^2$.

### D98, Inching parameter

| Bit | Explanation |
|---|---|
| 0 | 1 = Incrementing direction |
| 1 through 7 | not used |
| 8 | 1 = Decrementing direction |
| 9 through 15 | not used |

Bit 0 and bit 8 = LOW does not indicate a default direction; i.e., the axis will not start or it is being halted.

Bit 0 and bit 8 = HIGH constitutes an error; error code 606.

☞ **To exit Inching mode and stop the drive, bit 0 and bit 8 must be set LOW, and the “Start Inching Mode” command must be issued again, but this time without default direction.**

**D98, Inching mode settings**

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Incrementing direction / Start

Decrementing direct. / Start

00 continuous

01 1 increment (version 2)

10 10 increments (version 2)

11 100 increments (version 2)

0 0 continuous

0 1 1 increment (version 2)

1 0 10 increments (version 2)

1 1 100 increments (version 2)

**D150, Synchronous mode** (version 2 and up)

| Bit | Explanation |
|---|---|
| 0 | Electronic Transmission |
| 1 | Self-synchronous System, absolute |
| 2 | Self-synchronous System, relative |
| 3 through 15 | not used |

In “Electronic Transmission” synchronous mode the speed of the follow axis is equal to the speed of the lead axis evaluated with the set transmission ratio.

In absolute “Electronic Shaft” synchronous mode the position of the follow axis is equal to the position of the lead axis evaluated with the set transmissiom ratio. An offset (phase shift) is also taken into consideration.

In relative “Electronic Shaft” synchronous mode the position of the follow axis is equal to the position of the lead axis evaluated with the set transmission ratio relative to the start value. An offset (phase shift) is also taken into consideration.

**D152, Lead axis**

| Bit | Explanation |
|---|---|
| 0 | Internally controlled axis |
| 1 | Externally controlled axis |
| 2 through 15 | not used |

If the lead axis is an internally controlled axis, the other channel of the POS-LR controls this lead axis. The configuration of this channel must not be changed. The movement of the lead axis is not affected. The follow axis moves synchronously with the internally controlled axis.

If the lead axis is an externally controlled axis, the other channel of the POS-LR logs only the position of this lead axis. The follow axis moves synchronously with the externally controlled axis.

**D168, Lead spindle revolutions**

The Lead Spindle RPM and Synchronous Spindle RPM parameters determine the transmission ratio, Lead Spindle/Synchronous Spindle.

The default value is 1.

**D170, Synchronous spindle revolutions**

The Lead Spindle RPM and Synchronous Spindle RPM parameters determine the transmission ratio, Lead Spindle/Synchronous Spindle.

The default value is 1.

**D172/174, Synchronous run window**

The “Synchronous Run Window” parameter defines a window for the synchronism of speed (electronic transmission) or position (selsyn system). When the synchronous run – taking into consideration both the transmission ratio and offset, if applicable – of follow axis and lead axis is indicated in the synchronous run window, then the prerequisite for synchronous operation has been met and the “Axis In Position” signal will go HIGH. This parameter applies in both positive and negative direction.

Default value:

- ± 1 mm/min (transmission)
- ± 1,000 µm (shaft)

**D176/178, Synchronous run error limit**

The “Synchronous Run Error Limit” parameter defines the maximum permitted deviation. If the deviation – taking into consideration both the transmission ratio and offset, if applicable – of the follow axis and lead axis is greater than the synchronous run error limit, the “Synchronous error” signal is set. The lead axis and follow axis coupling is not automatically reset, there must be a response by the user program. The parameter applies in both positive and negative direction.

Default value:

- ± 10 mm/min (transmission)
- ± 10,000 µm (shaft)

**D180/182, Offset**

When in the “Self-synchronous System” mode, the “Offset” parameter defines the phase shift between lead axis and follow axis:

$\text{Position}_{\text{Follow axis}}$ = (Transmission ratio * $\text{Position}_{\text{Lead axis}}$) + Offset

### 5.1.3 DBPOS2 Data Module

The DBPOS2 data module contains the following:

- Channel2 configuration data
- Channel2 referencing approach parameters
- Channel2 dynamic axis parameters
- Channel2 table entry

The data words are listed in the table below. The structures of the individual data words are exactly the same as in data module DBPOS1. Accordingly, only channel 1 must be replaced by channel 2.

| DB 252 Name: DBPOS2 Comment: Channel2 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 0 | | Word | N | Response to system STOP | B |
| D 2 | | Word | N | Utilization of digital inputs / outputs | B |
| D 4 | | Word | N | Encoder configuration | B |
| D 6 | | Word | N | SSI parameters | B |
| D 8 | | Word | N | Increments per revolution | D |
| D 10 | | Word | N | Internal use | |
| D 12 | | Word | N | Distance per revolution (feed constant), bit 0 through bit 15 | H |
| D 14 | | Word | N | Distance per revolution (feed constant), bit 16 through Bit 31 | H |
| D 16 | | Word | N | Negative software limit switch, bit 0 through 15 | H |
| D 18 | | Word | N | Negative software limit switch, bit 16 through 31 | H |
| D 20 | | Word | N | Positive software limit switch, bit 0 through 15 | H |
| D 22 | | Word | N | Positive software limit switch, bit 16 through 31 | H |
| D 24 | | Word | N | Maximum speed, bit 0 through 15 | H |
| D 26 | | Word | N | Maximum speed, bit 16 through 31 | H |
| D 28 | | Word | N | Maximum acceleration, bit 0 through 15 | H |
| D 30 | | Word | N | Maximum acceleration, bit 16 through 31 | H |
| D 32 | | Word | N | Maximum deceleration, bit 0 through 15 | H |
| D 34 | | Word | N | Maximum deceleration, bit 16 through 31 | H |
| D 36 | | Word | N | Internal use | |
| D 38 | | Word | N | Reference configuration | B |
| D 40 | | Word | N | Reference position, bit 0 through 15 | H |
| D 42 | | Word | N | Reference position, bit 16 through 31 | H |
| D 44 | | Word | N | Reference point offset, bit 0 through 15 | H |
| D 46 | | Word | N | Reference point offset, bit 16 through 31 | H |

| DB 252 Name: DBPOS2 Comment: Channel2 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 48 | | Word | N | Reference approach speed, bit 0 through 15 | H |
| D 50 | | Word | N | Reference approach speed, bit 16 through 31 | H |
| D 52 | | Word | N | Settings | B |
| D 54 | | Word | N | Analog offset voltage | D |
| D 56 | | Word | N | KV factor | D |
| D 58 | | Word | N | Channel potentiometer | D |
| D 60 | | Word | N | In-position range, bit 0 through 15 | H |
| D 62 | | Word | N | In-position range, bit 16 through 31 | H |
| D 64 | | Word | N | Setup speed, bit 0 through 15 | H |
| D 66 | | Word | N | Setup speed, bit 16 through 31 | H |
| D 68 through 74 | | Word | N | Internal use | |
| D 76 | | Word | N | Table block number | D |
| D 78 | | Word | N | Absolute / relative position and user ID | B |
| D 80 | | Word | N | Position, bit 0 through 15 | H |
| D 82 | | Word | N | Position, bit 16 through 31 | B |
| D 84 | | Word | N | Speed, bit 0 through 15 | H |
| D 86 | | Word | N | Speed, bit 16 through 31 | H |
| D 88 | | Word | N | Acceleration, bit 0 through 15 | H |
| D 90 | | Word | N | Acceleration, bit 16 through 31 | H |
| D 92 | | Word | N | Deceleration, bit 0 through 15 | H |
| D 94 | | Word | N | Deceleration, bit 16 through 31 | H |
| D 96 | | Word | N | Internal use | |
| D 98 | | Word | N | Inching parameters | B |
| D100 through D148 | | Word | N | Internal use | |
| D 150 | | Word | N | Synchronous mode, bit 0 through 15 | B |
| D 152 | | Word | N | Lead axis, bit 0 through 15 | B |
| D154 through D166 | | Word | N | Internal use | |
| D 168 | | Word | N | Lead spindle RPM, bit 0 through 15 | D |
| D 170 | | Word | N | Synchronous spindle RPM, bit 0 through 15 | D |
| D 172 | | Word | N | Synchronous run window, bit 0 through 15 | D |
| D 174 | | Word | N | Synchronous run window, bit 16 through 31 | D |
| D 176 | | Word | N | Synchronous run error limit, bit 0 through 15 | D |
| D 178 | | Word | N | Synchronous run error limit, bit 16 through 31 | D |

| DB 252 Name: DBPOS2 Comment: Channel2 configuration and axis parameters RAM/EPROM: R | | | | | |
|---|---|---|---|---|---|
| **No.** | **Symbol** | **Type** | **Sg** | **Data field / Comment** | **F** |
| D 180 | | Word | N | Offset, bit 0 through 15 | D |
| D 182 | | Word | N | Offset, bit 16 through 31 | D |
| D184 through D510 | | Word | N | Internal use | D |

**Data word groups**

| Data word group | Data words |
|---|---|
| Write channel configuration | D0 through D34 |
| Write reference configuration | D38 through D50 |
| Write dynamic axis parameters | D52 through D66 |
| Read or write positioning entry | D76 through D98 |
| Write synchronous mode | D150 through D152 |
| Dynamic synchronous parameters | D168 through D182 |

## 5.1.4 Execution Times

The execution time is the interval that elapses between the instant of the function call and the point at which the “Function Module Active” signal in the user acknowledgement is reset (LOW). However, the execution time must not be equated to the response time of the hardware module.

Execution time fluctuations occur as a result of

- the run time of the POS45 function module (0.45 to 4 ms) and
- the cycle time of the hardware module, which is 2 ms for single-channel and 4 ms for 2–channel operation.

The commands can be processed by the hardware module only within specific time intervals. The cycle time results in various wait times that precede command execution.

If a single function module call is used to transfer several commands to the module at once, the individual execution times must be added together.

| **Commands** | **Execution times** [ms] | |
|---|---|---|
| | 1 channel | 2 channels |
| Write module configuration | 105 | 105 |
| Write Channel Configuration | 14 – 15 | 14 – 15 |
| Write Dynamic Axis Parameters | 2 – 4 | 2 – 4 |
| Start Reference Point Approach | 5 – 8 | 6 – 15 |
| Start Positioning | 3 – 6 | 3 – 8 |
| Writing “Start Positioning” command into table entry | 20 – 22 | 20 – 25 |
| Start Positioning with direct positioning | 20 – 22 | 20 – 25 |
| Halt Movement | 4 – 7 | 6 – 11 |
| Direct Positioning | 3 – 6 | 3 – 8 |
| Adopt Current Position As Table Entry | 2.5 – 3.5 | 2 – 3.5 |
| Start Inching Mode | 1 – 3 | 1 – 3 |
| Write Table Entry | 4 – 6 | 4 – 6 |
| Read table Entry | 1 – 2 | 1 – 2 |
| Clear Table | 750 – 800 | 750 – 800 |
| Function module run time | 0.45 – 0.7 | 0.45 – 0.7 |

## 5.2 Programming Example

### Cyclical call

☞ **The command parameter of the POS45 function module may only be changed when the FB active signal in the acknowledgement has been reset.**

The POS45 function module is called up cyclically. If no command is active, new commands may be specified. Data words in the DBPOS0, DBPOS1 and DBPOS2 data modules which must be updated beforehand are still assigned to each command. If no command is to be sent, the 0000h command must be transferred. In this status only the following data is written to the DBPOS0:

- Module status
- Channel status (1 or 2 channels)
- Actual values
- Nominal values
- Current potentiometer values
- Current block number

### Defining Parameters

☞ **In order to prevent a dual assignment of the operands, the parameters should be defined in the symbol file,**

```
DEF   M0,          -Kommando
DEF   K000H,       -BgStatus    ;Read module status and channel status
DEF   KE001H,        -Konfig    ;Configure hardware module and channels
DEF   M2,           Quittung    ;Address in user acknowledgement
DEF   M2.3,        -FbFehler    ;Error in user acknowledgement
DEF   M2.7,         -FbAktiv    ;Function module active (being processed)
DEF   K4,           -AdrEZAZ    ;Hardware module peripheral address
DEF   K0,              -DbNr    ;Number of first data module of hardware module
DEF   K0,              -PbNr    ;Program module number from FIFOZM1 symbol file
DEF   K0,          -FIFOKaNr    ;FIFO channel number is not used
```

### Newly configuring hardware module upon startup

```
A     B   SM20.0
O     B   SM20.7
JPCI      -NoStartup

                               ;Module is newly configured upon Power-On,
                               ;program loading or STOP/RUN.

L     W   -Konfig,A
T     W   A,-Kommando

      -NoStartup
```

### Calling POS2 function module

```
CM      POS45.5              ;Function module call-up
P0   W  -Command             ;Command
P1   BY -Acknowledgement     ;Address for user acknowledgement
P2   W  -DmNo                ;Data module number
P3   W  -FIFOZM1             ;Program module type and number of the FIFOZM1
P4   W  -FIFOChNo            ;FIFO channel number, not used in centralized
                             ;operation
```

### Acknowledgement query

```
A    B  FbAktiv              ;Query "Function Module Active" signal (bit 7 of ACK)
JPC     -WARTEN
A    B  -FbFehler            ;Query error (bit 3 of ACK)
JPC     -Fehler

L    W  -BgStatus,A          ;Read module status
T    W  A,-Kommando

     -WARTEN
     .
     .                       ;Additional program processing steps
     EP

     -Fehler
     .                       ;Error interpretation
     .
     EP
```

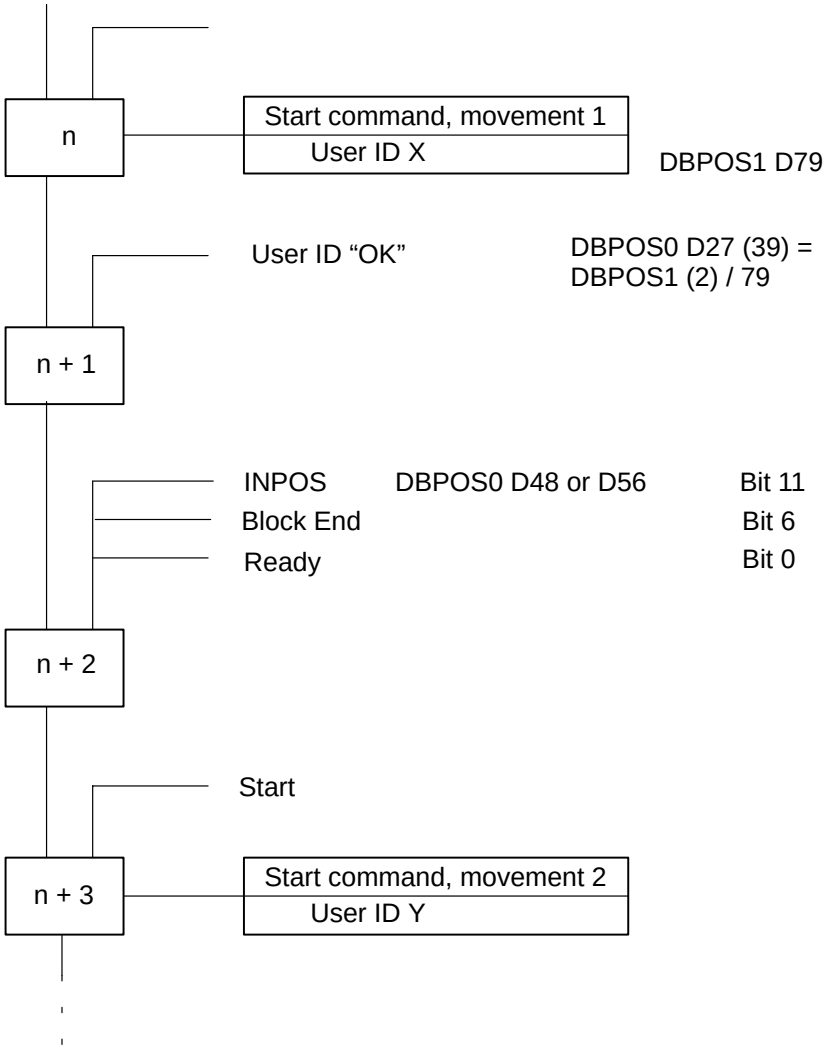
### Decentralized operation (not for ICL700)

For distributed operation, the FIFODM1 module replaces the FIFOZM1 module.

124 slaves can be actuated for each BM-DP12 bus master. The number of POS-LR modules which can be connected to each slave is dependent on the hardware version of the master. Hardware version 1.1 allows one POS-LR to be connected to each slave and hardware version 1.2 allows two modules to be actuated for each slave.

If a PCL is used as the master, the module is addressed not via channels but via I/O addresses. Parameter 4 of the FM call is not relevant.

**Positioning via cascade sequences**




The user ID must always change because otherwise the “User ID OK” signal queried in the cascade would be returned too early.

**User ID**

The user ID is required for version 1 POS-LR hardware modules and function modules.

Cyclical data traffic, which refreshes the data of the DBPOS0, takes place between the POS-LR and the central processing unit. The POS-LR provides the new information at a resolution of 10 ms. Data words D16 to D58 are refreshed.

Following execution of a positioning request the current channel or axis distances in the DBPOS0 which were refreshed by the POS-LR following the processed positioning request can only be queried by the user ID.

The User ID represents the identification of the current positioning request. It must be individually assigned to each request, and may not correspond to the block number or another position assignment. When positioning with the use of table entries, the User ID is defined in the HIGH byte of the block number (D77). By contrast, when using direct positioning, the User ID is entered in the HIGH byte of the Relative/Absolute parameters (D79).

The POS-LR mirrors this ID when the data module is refreshed, following the positioning request, into the high byte of the respective record number (D27 channel 1 and D39 channel 2).

☞ **In the PLC program, each positioning request should first be followed by the query for individual User ID, and then by the interpretation of the channel and axis statuses. This is the only way to prevent the occurrence of faulty program sequences that are caused by channel and axis statuses that may no longer be current.**

In the event that a version 2 POS-LR is used in conjunction with a version 2 function module, the synchronization between the function module command and the subsequent refreshing of DBPOS data module contents has already been implemented at both the function module (software) and POS-LR (hardware) level. As soon as the “Function Module Active” bit is set LOW by the function module, the data module will have already been refreshed with current status information.

☞ **The initial access to the DBPOS0 data module may occur only after invoking the function module call in the first PLC cycle, and after the “Function Module Active” bit has gone LOW. It can be stated categorically that access to the data modules is not permitted while the “Function Module Active” bit remains HIGH.**

**Additional examples in online mailbox**

Additional examples can be obtained through our online mailbox at the following telephone number: +49 6062 / 72 17. The programming examples are located in the directory labelled “POSITION”.

## 5.3 Error Messages

This section describes

- Communication errors which are displayed in the Acknowledgement parameter of the POS45 function module, and
- control / addressing faults in module or channels.

### 5.3.1 Communication Errors

A communication error is displayed in the Acknowledgement parameter of the POS45 function module call.

| Bit | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| | x | 0 | 0 | 0 | x | 0 | 0 | 0 |

Summary fault signal
FM Active signal

If the summary fault signal in the acknowledgement is HIGH, this is an indication that this command has not been executed on the POS-LR module.

If the command encompassed several requests, e.g., module configuration and channel configuration, data word D102 of the DBPOS0 data module will indicate which request in the command in question has caused an error.

Subsequent to the successful processing of each request, the respective bit in data word D102 is reset (LOW). Those bits that remain HIGH provide an indication of the request which has caused an error.

Starting at the LSB, the first HIGH bit indicates which request in the command in question has caused an error.

The topmost three bits indicate whether this was a request addressed to the hardware module or for Channel1 or Channel2 (bit 15 = hardware module, bit 14 = Channel1, bit 13 = Channel2).

**Example 1: D102**

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |

Data word D102 indicates a communication error that has occurred in conjunction with the “Write Module Configuration” command.

**Example 2: D102**

| Bit | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |

Data word D102 indicates a communication error that has occurred in conjunction with the “Write Dynamic Axis Parameters” command.

**Possible causes of communication errors**

| Command | Error message |
|---|---|
| Write module configuration | • The module is not powered and cannot therefore be addressed.<br>• The selected extended I/O address does not correspond to the extended I/O address called in the function module. |

**No communication error but processing fault**

If bit 3 (error) in the user acknowledgement is HIGH, an error code will be returned in data word D204 of the DBPOS0 data module.

**Error messages in D204 of DBPOS0**

| D204 in DBPOS0 | Cause of error |
|---|---|
| 0101H | Hardware fault in module |
| 0102H | Erroneous encoder selection in module configuration |
| 0104H | Errored hardware mode setting |
| 0201H | Command not possible. |
| 0202H | Errored configuration |

**Programming errors**

The error codes listed in the table below are channel-specific, and occur independently of the commands. They are written into the DBPOS0 data module together with the module status and the channel statuses.

Data word D50, (error code for Channel1) or D58 (error code for Channel2) must be queried when error bit 7 is HIGH in D22 (Channel1) or D34 (Channel2).

The error codes remain active as long as the cause of the error remains to be corrected.

### Error message in D50 (Channel1) or D58 (Channel2) of DBPOS0

| D50 / D58 im DBPOS0 | Cause of error |
|---|---|
| 0066H | • An excessive number of errors has occurred<br>• Error list overflow condition |
| 00D0H | Wrong feed constant, encoder graduation count, speed or positioning limit value |
| 00D3H | Wrong feed constant, encoder graduation count, speed or positioning limit value |
| 00D6H | Axis not under control |
| 012FH | Controller enable was removed while traversing |
| 0130H | Excessive lag dimension |
| 0134H | Overrun, upper software limit switch |
| 0135H | Overrun, lower software limit switch |
| 0196H | Axis not referenced |
| 0404H | The traversing range defined by the software limit switches exceeds the range limit of the SSI encoder. Software limit switches must be positioned within the SSI range. |
| 0602H | Channel not yet configured |
| 0603H | Channel not yet ready for new positioning request. Very likely the execution of the previous positioning request has not yet been complteted. |
| 0604H | Position to be approached is situated outside of the range covered by the software limit switches. |
| 0605H | Referencing error |
| 0606H | Faulty Inching mode parameters |
| 0607H | Encoder cable break |
| 0608H | Hardware limit switch contacted |
| 0609H | Encoder resolution error |
| 060AH | In-position window |
| 060BH | KV factor |
| 060CH | Setup speed too high |
| 060DH | Reference speed too high |
| 060EH | Excessive referencing offset |
| 060FH | Reference position too high |
| 0610H | Reference type |
| 0611H | Channel not configured |
| 0612H | Channel not configured |
| 0613H | Excessively high feed constant |
| 0614H | Upper software limit switch is situated outside of traversing range |
| 0615H | Lower software limit switch is situated outside of traversing range |
| 0616H | Maximum speed too high |
| 0617H | Maximum acceleration too high |
| 0618H | Maximum deceleration too high |
| 0620H | Dual-scan error on SSI encoder |
| 0621H | Hardware limit switch active during configuration |
| 0622H | The table entry specified for the positioning has not been initialized |
| 0630H | Wrong synchronous mode |

| D50 / D58 im DBPOS0 | Cause of error |
|---|---|
| 0631H | Wrong lead axis |
| 0634H | Channel not yet configured |
| 0635H | Dual scan (SSI) not possible |
| 0640H | Lead spindle revolution error |
| 0641H | Synchronous spindle revolution error |
| 0642H | Synchronous run window error |
| 0643H | Synchronous run error window error |
| 0644H | Synchronization not configured |
| 0645H | Synchronous offset error |

Effective with version 2: Errors are no longer indicated in data word D204. All errors are indicated in data word D50 (Channel1) and D58 (Channel2). D50 and D58 map the error message for the initial error. D60 through D68 (Channel1) and D70 through D78 (Channel2) are used to map up to five additional errors.

### 5.3.2 Control faults

| Error | Possible Fault Sources |
|---|---|
| Positioning fails to function | • Module has not been configured<br>• Channel is not configured<br>• Reference point has not been approached<br>• When using digital inputs: Inputs have not been set accordingly<br>• Faulty encoder connection<br>• Encoder configuration fails to correspond to connected encoder, causing incorrect interpretation of encoder signals |
| POS-LR addressing failure | The selected address on the hardware module does not correspond to the extended I/O address of the function module. |
| Error LED on module front panel illuminates | Uncontrolled access, by reading or writing directly to the extended input/output address of the module. The module may be accessed via the POS45 function module only. |

# A Appendix

## A.1 Abbreviations

| Abbr. | Explanation |
|---|---|
| C: | Drive letter (here, identifying first hard disk in computer) |
| DM | Data module |
| EEM | Electrostatic sensitive devices |
| ESD | Electrostatic Discharge. Abbreviation often used as a prefix to all designations referring to electrostatic discharges, such as “ESD protection”, “ESD hazard”, etc. |
| EI | Extended input |
| FM | Function module |
| LSB | Least Significant Bit |
| PE | Protective Earth (conductor) |

## A.2 Index

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