

CL200

POS-LR1 / POS-LR2 Module Description

Edition

101

CL200

POS-LR1 / POS-LR2 Module Description

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1 Safety Instructions

Before you start working with the POS-LR1 or POS-LR2 Position Control Module with Closed Servo Loop ("Position Control Module"), we recommend that you thoroughly familiarize yourself with the contents of this manual. Keep this manual in a place where it is always accessible to all users.

1.1 Proper use


This instruction manual presents a comprehensive set of instructions and information required for the standard operation of the described products. The products described hereunder are used to provide positioning control for axes on tool machines.

The products described hereunder

- were 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 arise no risk of danger to personnel or property.
- are in compliance with the
 - 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
- are designed for operation in an industrial environment (class A emissions), 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 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 our skilled 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 to property.

For this reason, only electrical engineers as recognized under VDE 1000–10 who are familiar with the contents of this manual may install and service the products described.

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! Check EMERGENCY-STOP components before switching on the system!

**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. Therefore, possible retrofits or modifications to the system using third-party equipment require prior approval 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 be handled only 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

The present manual contains information about specifications, configuration procedures and operation of the POS-LR1 / POS-LR2 Positioning Modules with Closed Servo Loop.

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

Special keys or key combinations are represented by pointed brackets

- Special keys: e.g. <enter>, <pgup> ,
- 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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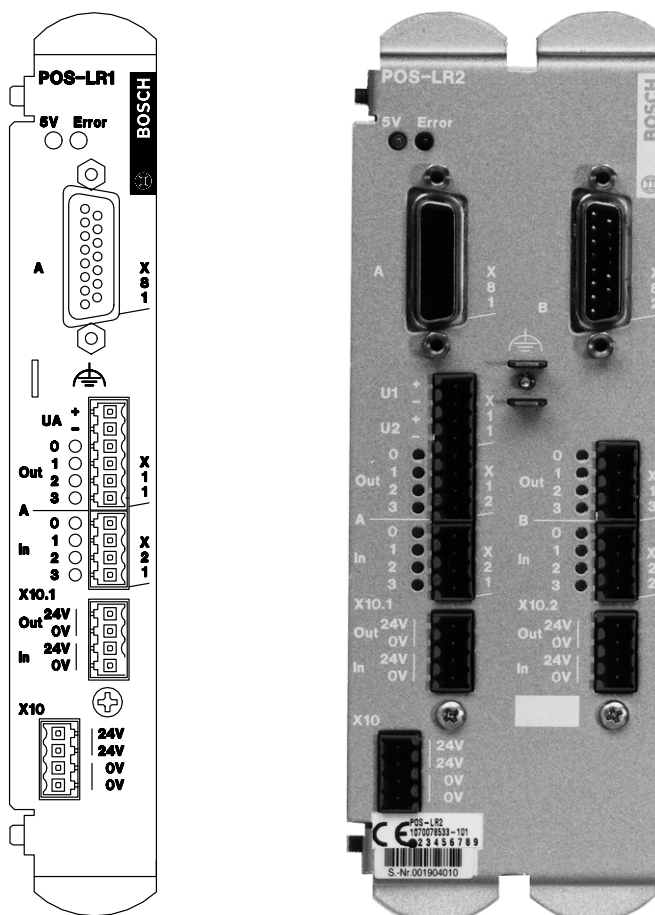
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Notes:

2 Introduction

The POS-LR1 and POS-LR2 Positioning Modules with Closed Servo Loop implement the required axis position concurrently with the controlling tasks handled by the central processing unit. (For the sake of simplicity, the modules shall be referred to as "Positioning Modules" hereinafter.)

POS-LR1 and POS-LR2



The POS-LR1 Positioning Module controls the positioning of a single axis (1 channel).

The POS-LR2 Positioning Module controls the positioning of 2 axes independently of each other (2 channels).

The POS-LR1 and POS-LR2 Positioning Modules are designed for centralized application in the CL200 Programmable Logic Controller.

When used in conjunction with an RM2-DP Decentralized Peripheral Module, the POS-LR1 and POS-LR2 Positioning Modules can be employed in a decentralized configuration with the following units:

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

POS-LR1

The POS-LR1 Positioning Module features one channel, providing:

- 1 selectable encoder system
- 1 analog output
- 4 digital inputs
- 4 digital outputs

POS-LR2

The POS-LR2 Positioning Module features two independent channels, each providing:

- 1 selectable encoder system
- 1 analog output
- 4 digital inputs
- 4 digital outputs

3 Installation

 All installation instructions applying to the CL200 must be observed.

3.1 Specifications

Specifications	POS-LR1	POS-LR2
Sensors		
Number of encoder connections	1	2
Incremental	<ul style="list-style-type: none"> ● 5 V differential signals ● 24 V signals max. 2 ³¹ increments	
Frequency	<ul style="list-style-type: none"> ● 5 V signals, max. 500 kHz ● 24 V signals, max. 200 kHz 	
Absolute	SSI (synchronous serial interface) max. 25 bits, Gray or dual code selectable, 70 through 800 kHz	
Cable length, screened <ul style="list-style-type: none"> ● 5 V encoder ● 24 V encoder 	50 metres, max. 500 kHz <ul style="list-style-type: none"> ● 20 metres, max. 150 kHz ● 100 metres, max. 50 kHz 	
Isolated potential	No	
Input type <ul style="list-style-type: none"> ● 5 V encoder signal ● 24 V encoder signal 	RS-422 Type 1, as per DIN EN 61131-2	
Input voltage and current <ul style="list-style-type: none"> ● Nominal <ul style="list-style-type: none"> ● LOW signal ● HIGH signal ● Switching threshold <ul style="list-style-type: none"> ● LOW → HIGH ● HIGH → LOW 	0 through 5 V / ≤ 1.3 mA 15 through 30 V / 3.9 through 7.9 mA typ. 10.7 V typ. 10.2 V	
Operating voltage, each encoder <ul style="list-style-type: none"> ● Short-circuit protection ● Fuse protection 	5 V- / 400 mA 24 V- / 600mA	

Specifications	POS-LR1	POS-LR2
Inputs		
Inputs, Type 1, as per DIN EN 61131	4	8, 4 per channel
Potential isolation	Yes	
Eingangsspannung, -strom <ul style="list-style-type: none"> Nominal value LOW signal HIGH signal 	24 V 0 through 5 V / 0 through 1.2 mA 11 through 30 V / 2.8 through 8.6 mA	
Verzögerungszeit <ul style="list-style-type: none"> LOW → HIGH HIGH → LOW 	typ. 2.7 ms typ. 2.9 ms	
Switching threshold <ul style="list-style-type: none"> LOW → HIGH HIGH → LOW 	typ. 10.4 V typ. 10.2 V	
Cable length, unscreened	max. 100 metres	
Outputs		
Number of outputs	4	8, 4 per channel
Potential isolation	Yes	
Operating voltage, for load <ul style="list-style-type: none"> Nominal value Permissible range 	24 V– 15 through 30 V	
Output voltage <ul style="list-style-type: none"> HIGH signal LOW signal 	Oper. voltage: < 1.5 V / I = 0.5 A < 40 mV	
Output current <ul style="list-style-type: none"> Nominal HIGH signal LOW signal 	0.5 A 2 through 600 mA 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 <ul style="list-style-type: none"> LOW → HIGH HIGH → LOW 	45 μs 280 μs	
Contacteur size	SG1; 6.2 W	
Lamp load	5 W, at 8 Hz	
Switching frequency <ul style="list-style-type: none"> Resistive load Inductive load 	100 Hz depending on contactor	
Limit, inductive cut-off voltage	Electronically limited to V_{ext} –50 V, typ.	
Reverse polarity protection	Plug-in fuse for 4 outputs per channel, 3 A, quick-acting	

Specifications	POS-LR1	POS-LR2
Internal current load on 24 V output voltage, each 4 outputs <ul style="list-style-type: none"> • A0 through A3 = 0 • A0 through A3 = 1 	typ. 1 mA 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 k Ω	
Cable length	max. 50 metres	
Resolution	12 bit	
24 V Power supply		
Nominal rating	24 V-	
Permissible range	16 through 30 V-	
Current draw, without output load and encoder operating current	typ. 200 mA	
Fuse for 24 V power supply	2.5 A, slow-blowing	
Miscellaneous		
Current load, peripheral bus (7.5 V)	1 mA (typ.)	
Storage temperature range	-25 °C through 70 °C	
Width	1 slot	2 Slots

3.2 Centralized and Decentralized Operation

The POS-LR1 and POS-LR2 Positioning Modules can be used in both centralized and decentralized (distributed) applications.

Centralized operation

The POS-LR1 or POS-LR2 Positioning Module is installed in a CL200 Basic Unit or a suitable expansion unit.

The positioning module is addressed via the POS2 and FIFOZM1 modules.

Decentralized (distributed) operation

The positioning module is installed in a GG3 Basic Unit equipped with an RM2-DP Decentralized Peripheral Module. It is addressed via the PROFIBUS-DP field bus, always using the FIFODM1 data module in combination with the following system-dependent modules:

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

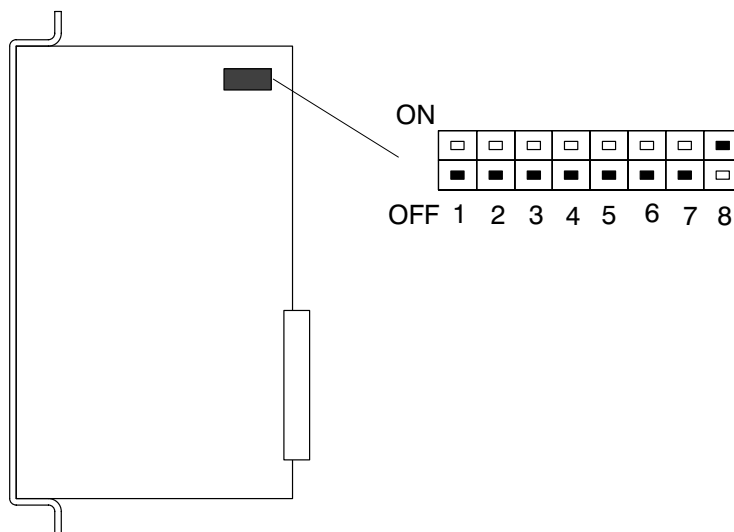
A maximum of two POS-LR1 or POS-LR2 Positioning Modules can be addressed by means of one RM2-DP Decentralized Peripheral Module.

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-numbered start address in the extended input / output must be set:
 DIP switch segment S1/1 must be set to OFF.
 DIP switch segment S1/8 must be set to ON.

On the CL200 control unit, the module occupies 4 bytes in the extended input field and 4 bytes in the extended output field. This indicates that a maximum of 32 hardware modules can be centrally installed.

Switch	8	7	6	5	4	3	2	1
Weight		2 ⁶	2 ⁵	2 ⁴	2 ³	2 ²	2 ¹	2 ⁰
Value	I: OFF E: ON	64	32	16	8	4	2	1
	ON	x	x	x	x	x	x	OFF

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

Decentralized (distributed) operation

 **Only module numbers ranging between 0 and 37 may be selected.**

★ Set module numbers 0 through 37 on the 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 WinDP programming software.

In decentralized operation (on the PROFIBUS-DP field bus), the hardware module is addressed via the RM2-DP12. The address assignment and/or allocation is handled by the WinDP software program. With each ZE200-DP or (ZE200A-DP) Bus Master, 64 slaves can be addressed. Each slave can accommodate the installation (insertion) of two positioning hardware modules.

Because the ZE200-DP and/or ZE200A-DP Bus Master is capable of managing 32 channels, a maximum of 32 POS-LR Positioning Modules can be installed.

 **For the ZE200-DP / ZE200A-DP Bus Master, D100 of the DBPOS0 function module is of no relevance.**

3.4 Module Slot



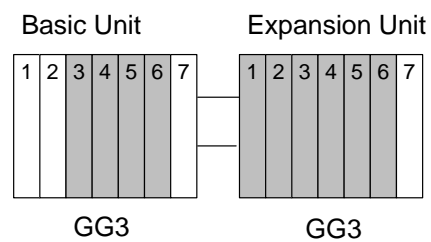
CAUTION

Danger to the module!

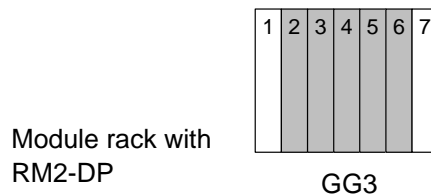
Do not insert or remove the module while the controller is switched ON! This may destroy the module. Prior to inserting or removing the module, switch OFF or remove the power supply module of the controller, external power supply and signal voltage!

Possible module slots are shown with grey shading.

Centralized operation



Decentralized (distributed) operation



In a two-tier module arrangement, the module may be installed in one of both tiers. In a three-tier arrangement, the module may be installed in the bottom tier only.

3.5 Required Connections

The potentials of the power supplies for the digital inputs and outputs are isolated from those of the power supplies for encoder and logic circuits. Separate power supplies must be used for encoder and logic power, and for inputs and outputs, respectively.

Installation instructions

All installation instructions referring to the CL200 shall similarly apply to the POS-LR1 and POS-LR2.

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 voltage of the module is directly with equipment ground (GND), i.e., in the event that several POS-LR1, POS-LR2 or RM2-DP12 are used, the 0 V terminals (GND) of the various power supplies must be interconnected on a common potential equalization bar. If at all possible, the POS-LR1, POS-LR2 and RM2-DP12 modules should be powered by one and the same 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.

In the event that the encoders are powered by an external power supply, the 0 V terminals (GND) of the encoder power supplies and that of the module's logic power supply must be brought to the same potential through the use of a potential equalization bar.

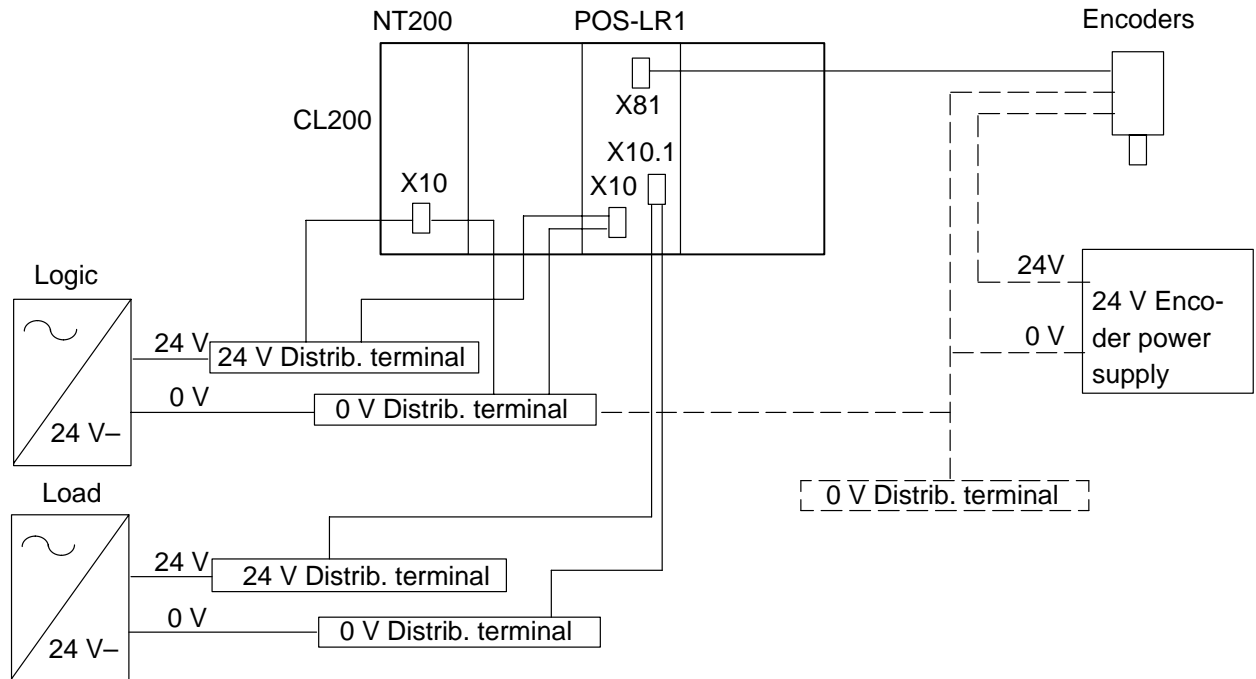
Example of encoder connection with 5 V power supply

If the encoder is powered by the module, the 5 V supply voltage may drop to 4.95 V. As the voltage drop caused by long encoder cables is a factor to be considered, a sufficient wire size (conductor cross-section) must be selected.

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 mm².

Example of mains connection for POS-LR1 and encoders



The power supply for module logic circuits and encoder operating power are connected to the X10 female plug connector. This power supply is interconnected via the 0 V terminal with the peripheral bus of the CL200 (identical 0 V reference for NT200 Power Supply, central processing unit or RM2-DP12). The power supply from the NT200 or from the RM2-DP12 can therefore be looped through to the module.

In the event that a separate power supply (logic power supply) is used as the power supply of the POS-LR, the 0 V terminal of this power supply must be interconnected with the 0 V terminal of the NT200 or RM2-DP12.

If it is not desirable for the power to a connected encoder to be supplied via the module, the encoder power supply can also be directly connected to the logic power supply.

In the event that a separate power supply is used for the encoder, the 0 V terminal of that power supply must be interconnected with the 0 V terminal of the logic power supply.

The power supply for the inputs and outputs of Channel1 are connected to the X10.1 connector.

The power supply for the inputs and outputs of Channel2 are connected to the X10.2 connector.

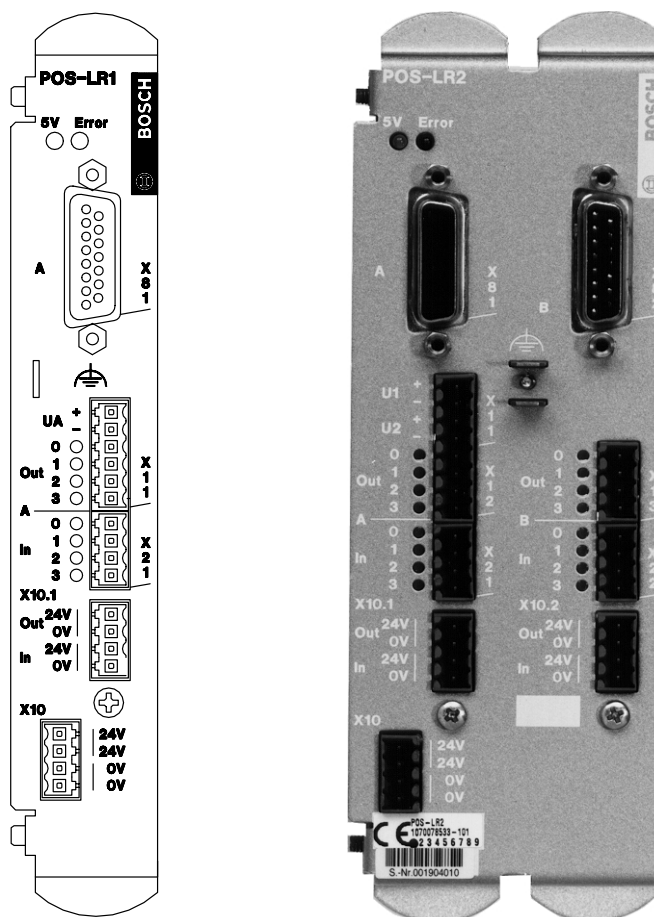
The connectors labelled OUT provide the power supply to the outputs. The connectors labelled IN provide the power supply to the inputs.

The inputs and outputs of the module can be connected to the external power supply feeding the remaining inputs and outputs of the CL200.

To provide additional isolation between inputs and outputs via optocouplers, two different power supply modules can be connected to connectors X10.1 and X10.2.

The analog outputs reference to 0 V of the logic power supply.

Connecting POS-LR1 and POS-LR2



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
- Function of digital inputs and outputs
- Commands

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

- Reference point approach
- Positioning via table entries
- Direct positioning
- Inching mode and Teaching mode
- Synchronous mode

4.1 Overview

4.1.1 Structure and Function

The POS-LR1 module is capable of regulating the position of a single axis (one channel).

The POS-LR2 module is capable of regulating the position of two axes independently of each other (two channels).

The POS-LR1 and POS-LR2 modules can be centrally installed in the CL200.

In conjunction with an RM2-DP, the POS-LR1 and POS-LR2 modules are suitable for decentralized application under one of the following units:

- 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 initialization is handled via software routines by the PLC program.

Sensors / encoders

The module accepts the following connections:

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

The POS-LR2 accepts the connection of only incremental-value or only absolute-value encoders.

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.	Sensor		
	Incr. value encoder, 5 V square-wave diff. signals	Incr. value encoder, 24 V square-wave abs. signals	Absolute-value encoder, SSI, 5 V differential signal
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 en- coder	24 V power supply for en- coder	24 V power supply for en- coder, max. 600 mA
15		Zero mark	

Digital inputs

X21 or X22	Inputs
Input0	Reference point (home position)
Input1	Limit switch
Input2	Limit switch
Input3	Controller enable

POS-LR1 – Digital and analog outputs

X11	Output signals
UA+	Analog nominal value
UA-	Analog nominal value
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

POS-LR2 – Digital outputs

X12 or X13	Output signals
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

POS-LR2 – Analog outputs

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


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.

As long as a Start command has not been generated and the “Channel Ready” bit (DBPOS0: Channel1 = DW48; Channel2 = DW56) is enabled, opening the position control loop merely signifies that the nominal position value is set equal to the actual positioning value. The “Axis Under Control” bit goes LOW, and an axis drift may occur due to an offset that may be present at the analog output. Closing the position control loop again causes the “Axis Under Control” bit to be reset (HIGH), enabling the axis to hold its position.

When generating a Start command, the position control loop must be closed. In the event that, at the time the Start command is generated, the position control loop is already open or is being opened in the course of the motion, an appropriate error message will be generated. In this case, the axis will be stopped instantly, and the READY output will remain enabled. The active error must be cancelled with the use of the "Cancel Movement (Reset)" instruction before a new movement can be started.

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)

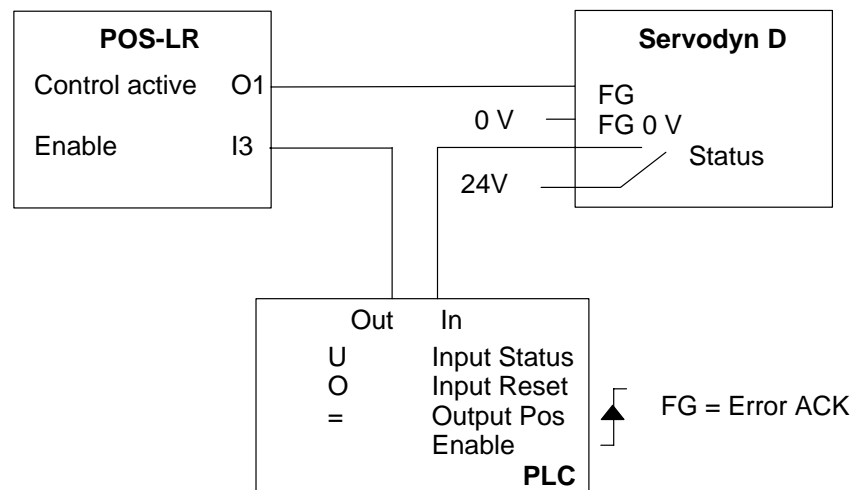
The “Axis In Position” signal on Output3 indicates that a selected position has been reached.

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

For each channel, the positioning modules feature an analog output for controlling servo drives. The output, which is potential-bound to the module GND, supplies power rated at ± 10 V at a resolution of 6.3 mV. The inputs of the drive amplifiers should be connected as differential amplifiers. If this is not the case, potential equalization between the drive and the POS-LR module must be provided.

The drive amplifier inputs must possess an input impedance of no less than 10 k Ω . 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

The communication with the module is handled via the POS2 function module. The function module contains commands to initiate the following actions:

- 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
- Cancel Movement (Reset)
- 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

Default:

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

Write Dynamic Axis Parameters

Default:

- 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
- Deceleration
- Relative or absolute approach

Halt Movement

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)

Motion is cancelled. Error messages are cleared.

Direct Positioning

Starting direct positioning.

The parameters are stored in the position entry:

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

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 (Selsyn 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	S _g	Data field / Comment		F
D	0		Word	N	Module operating mode and 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 "Write Module Configuration" is used to instruct the module as to which channel is to be configured, and whether incremental or SSI encoders are to be connected to the encoder connections (D0).

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

The return confirmation for the "Write Module Configuration" command occurs in D16.

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 Module Configuration" command transfers the relevant data to the POS-LR.

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	S _g	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

Once the module and channels have been configured successfully, dynamic axis parameters can be set with the use of the “Write Dynamic Axis Parameters” command. Default values are provided.

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, overshoot 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 overshoot 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.

The potentiometer value of 1000 (decimal) equals 100.0%, indicating that the axis is traversing at the selected speed.

The potentiometer value of 1200 (decimal) equals 120.0%: The axis is travelling at 1.2 times the selected speed. Default value is 1000 (100%).

D60 and D62 define the in-position range for the axis in μm . The default value is 1 000 μm (equals a position deviation of $\pm 1 \text{ mm}$).

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 over to lag.
- 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 konfiguration	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.

The reference point approach is possible once the channel configuration has been completed. The POS-LR provides a variety of options to approach the reference point, plus four variants of reference point determination. The reference approach procedure is defined by data words D38 through D50 in the DBPOS1 / DBPOS2 data module.

Reference point

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 must be located on the reference point, a reference offset of 0 must be defined (Fig. 2). If the reference position, as viewed in the direction of travel, is positioned on the near side of the reference point (thus corresponding to a positive reference offset in a positive traversing direction, and to a negative reference offset in a negative traversing direction), the positioning action that occurs will feature 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

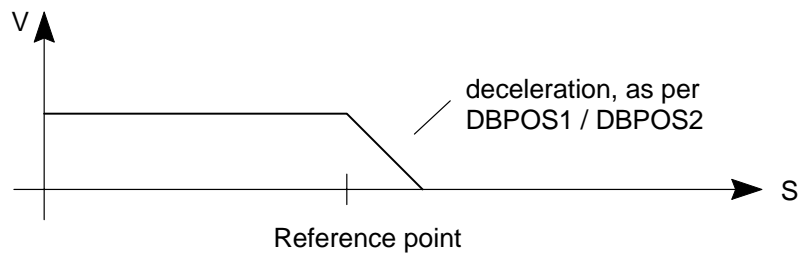


Fig. 1 The axis brakes upon reaching the reference point.

Traversing to reference point

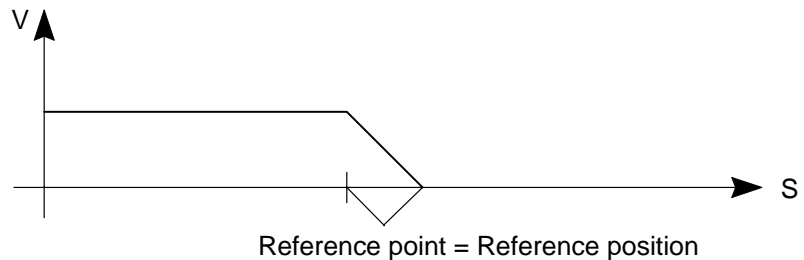


Fig. 2 Positioning on reference position at reference offset = 0

Reference point offset with direction reversal

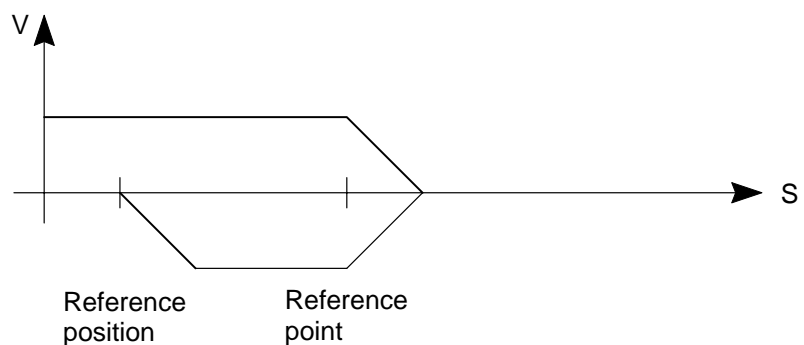


Fig. 3 Positioning on reference position with direction reversal

Reference point offset without direction reversal

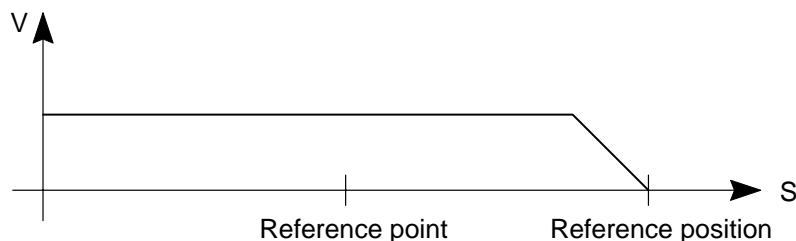


Fig. 4 Positioning on reference pos. without direction reversal; on-the-fly referencing

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.

Effective with version 2, the "Set Actual Value" method is also utilized for the correction of the actual position value for absolute-value encoders. In that case, only the entry of the reference position is effective. A reference offset that may be specified will not be included in the calculation.

 **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

The "Halt Movement" command can be used to interrupt the referencing approach. An interrupted motion can be continued by issuing another "Start Reference Point Approach" command. The "Axis Running" signal remains active. 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	Spped, 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	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.

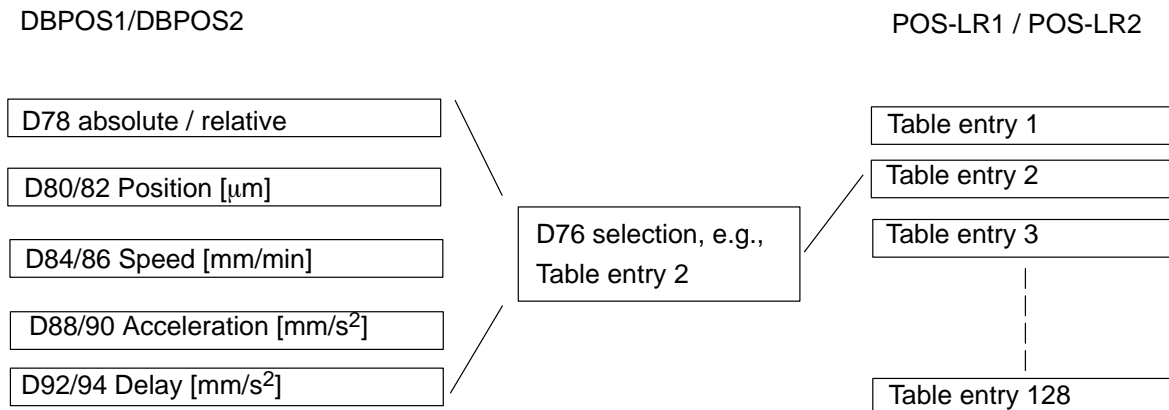
The "Clear Table" command clears all table entries in a specific table (for one channel).

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:

- 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)

In the event that the axis (actual value) is situated within the in-position window, the following will also be set HIGH:

- 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.

The channel information (inputs, outputs, internal status, errors) are updated through cyclical function module calls. Provided that the current block number (DBPOS0, D26 or D38) corresponds to the predefined table block number (DBPOS1 or DBPOS2, D76), the status signals (DBPOS0, D48 or D56) can be interpreted.

In the event that the same block is specified repeatedly (relative blocks), the use of the "ID" (refer to "Direct Positioning") will be required in order to differentiate the individual positioning procedures (version 1).

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, 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 cyclical call of the POS2 function module updates the channel information (digital I/O, status, error messages).

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 than 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 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	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 “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 (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)

In the event that the axis (actual value) is situated within the in-position window, the following will also be set HIGH:

- 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.**

The channel information (inputs, outputs, internal status, errors) are updated through cyclical function module calls. Provided that the current block number (DBPOS0, D27 or D39) corresponds to the predefined table block number (DBPOS1 or DBPOS2, D76), 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 that is specified in D78 through D94 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 "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).

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 selection of the active step size is defined via the inching parameter (D98). When a step size is selected, the respective direction bit serves as a start for the movement. The direction bit must be newly set for each new movement. To be able to use this function also with a nonreferenced axis, and because direct positioning is not permitted for nonreferenced axis with incremental encoders, the reference is briefly offset during each movement. This action is also indicated by the corresponding 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 synchronization 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 synchronization, 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 (Selsyn 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.

Self-synchronous System

In the "Self-synchronous System" synchronization mode, the position of the follow axis adjusts to the position of the lead axis in accordance with the selected transmission ratio. In addition, an offset (phase shift) can 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-LR2 controls the lead axis.

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

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

Externally controlled axis

The other channel of the POS-LR2 is used for the purpose of position sensing only.

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 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.

The "Synchronous Run Error Limit" parameter defines the maximum permissible deviation. When the deviation – taking into consideration both the transmission ratio and offset, if applicable – of follow axis and lead axis exceeds the synchronous run error limit, the "Synchronous Error" signal goes HIGH. The coupling of lead axis and follow axis is not cancelled automatically; an appropriate response must be received by the application program.

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


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

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:

- Output “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.

5 Function Module and PLC Program

The operation of the module is accomplished via –

- Commands issued via the POS2 function module
- Parameter values provided in the DBPOS0, DBPOS1 and DBPOS2 data modules.

 **The POS2 function module must be called in the initial PLC cycle immediately following the completion of the controller power-up sequence. This will normally also initiate the configuration of the hardware module and its data channels.**

The POS2 function module must be cyclically called in the PLC program. Even if no operation of the hardware module is intended, the data traffic from and to the module must be maintained. To this end, the "0000H" command may have to be used in order to update both 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 POS2 function module is stored on the supplied floppy disk in the form of a Pxl file. In the following cases, the POS2 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 belonging to the POS2, handling the actual data transport from and to the hardware 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 POS2 Function Module


 **The POS2 function module must be called in the initial PLC cycle immediately following the completion of the controller power-up sequence. This will normally also initiate the configuration of the hardware module and its data channels.**

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
- 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

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
- Status of 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 POS2 call

```

BA      -POS2,5           ;Function call
P0     W  -KOMMANDO      ;Command
P1     BY -QUITTTUNG     ;Address for user acknowledgement
P2     W  -DbNr          ;Data module number
P3     W  -PbNr          ;Program module number
P4     W  -FIFOKaNr      ;FIFO channel number, distributed 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 number <ul style="list-style-type: none"> • Centralized operation: FIFOZM1 • Distributed operation: FIFODM1 	
P4 (Word)	<ul style="list-style-type: none"> • Centralized operation: incon-sequential • 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

 **CL200: Because the bus master is integrated in the controller, the extended input/output field address (EI/EO address) is of no relevance. CL400/CL500: The extended input/output field address of the bus master (BM-DP12) is defined in D100 of the DBPOS0 data module. PCL: The I/O address of the POS-LR1 / POS-LR2 is defined in D100 of the DBPOS0 data module. This address is assigned to the POS-LR1 / POS-LR2 via the WinDP Windows 95/NT programming software.**

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 Positioning
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

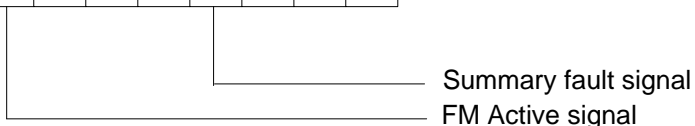
At the specified address, acknowledgements are returned to the user. The user may not write into the acknowledgement.

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



P2, Data module number

Data module number of the DBPOS0 data module.

P3, Program module number

- Centralized operation
Program module number (constant) of FIFOZM1
- Distributed operation
Program module number (constant) of FIFOZM1

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 exclusively for the POS-LR1 and POS-LR2 hardware modules. Uncommented data words must not be used because they can be used by the POS2 data 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

 **User data ranges occupied in the CL200:
DF8184 through DF8191
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	POS-LR1 / POS-LR2 firmware version	H
D122 through 510		Word	N	Internal use	

Data word groups

Data word groups	Data words
Write module configuration	D0 thru D2
Read module status	D16
Channel1, read status	D20 thru D26
Channel1, actual position or lag	D28 thru D30
Channel2, read status	D32 thru D38
Channel2, actual position or lag	D40 thru D42
Channel1, nominal position	D44 thru D46
Channel1, read internal status	D48
Channel1, error code	D50
Channel2, nominal position	D52 thru D54
Channel2, read internal status	D56
Channel2, error code	D58
Channel1, error field	D60 bis D68
Channel2, error field	D70 bis D78
EI/EO address of POS-LR1 / POS-LR2	D100
POS-LR1 / POS-LR2 firmware version (version 2 and up)	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, 1= double scan (version 2 and up)
7 thru 9	not used
10	Channel2, positioning
11 thru 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 initiated. 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.

By default, the watchdog timer is set to an interval length of 1000 ms.

The watchdog function will also respond in the event that, upon terminating Inching mode, bits 0 and 8 in D98 of the DBPOS1 or DBPOS2 data module are set LOW (no direction specified), and the “Start Inching Mode” command is sent again.

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 thru 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 thru 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 thru 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 reaches from 0 to 120%.

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

The potentiometer value of 1000 (decimal) equals 100.0%, indicating that the axis is traversing at the selected speed.

The potentiometer value of 1200 (decimal) equals 120.0%: The axis is travelling at 1.2 times the selected speed. Default value is 1000 (100%).

D26, Channel1 user ID / current block number

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 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.

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 thru 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 thru 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 thru 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 reaches from 0 to 120%.

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

The potentiometer value of 1000 (decimal) equals 100.0%, indicating that the axis is traversing at the selected speed.

The potentiometer value of 1200 (decimal) equals 120.0%: The axis is travelling at 1.2 times the selected speed. Default value is 1000 (100%).

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 position
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

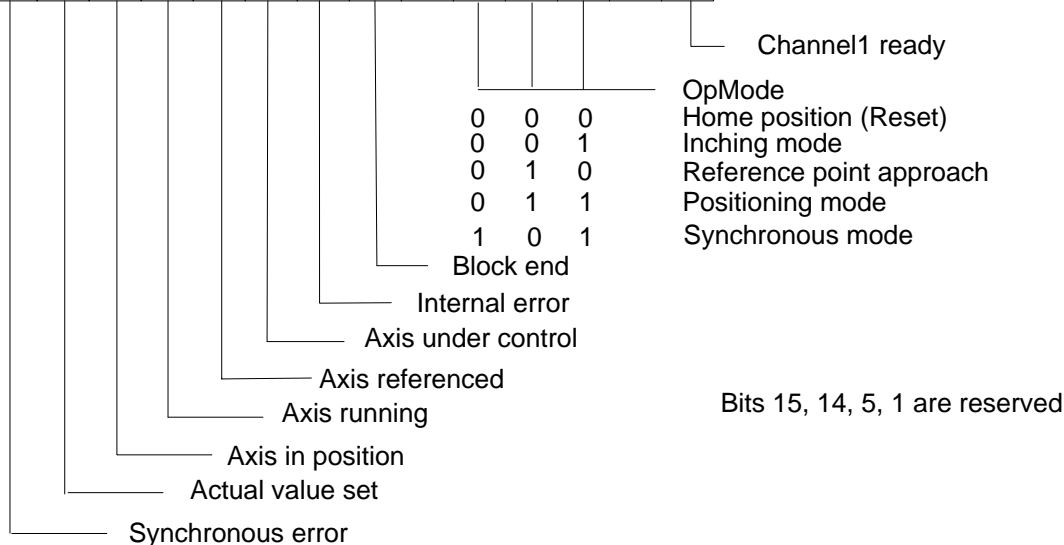
- Control loop open (Input3 = LOW)
D40 and D42 contain the actual value.
- Control loop closed (Input3 = HIGH or not configured).
Depending on the dynamic axis parameters in D52 of the DBPOS1 or DBPOS2 data modules, D40 and D42 contain the calculated actual value, the lag or the current actual-value from the encoder.

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.
- **Axis 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.

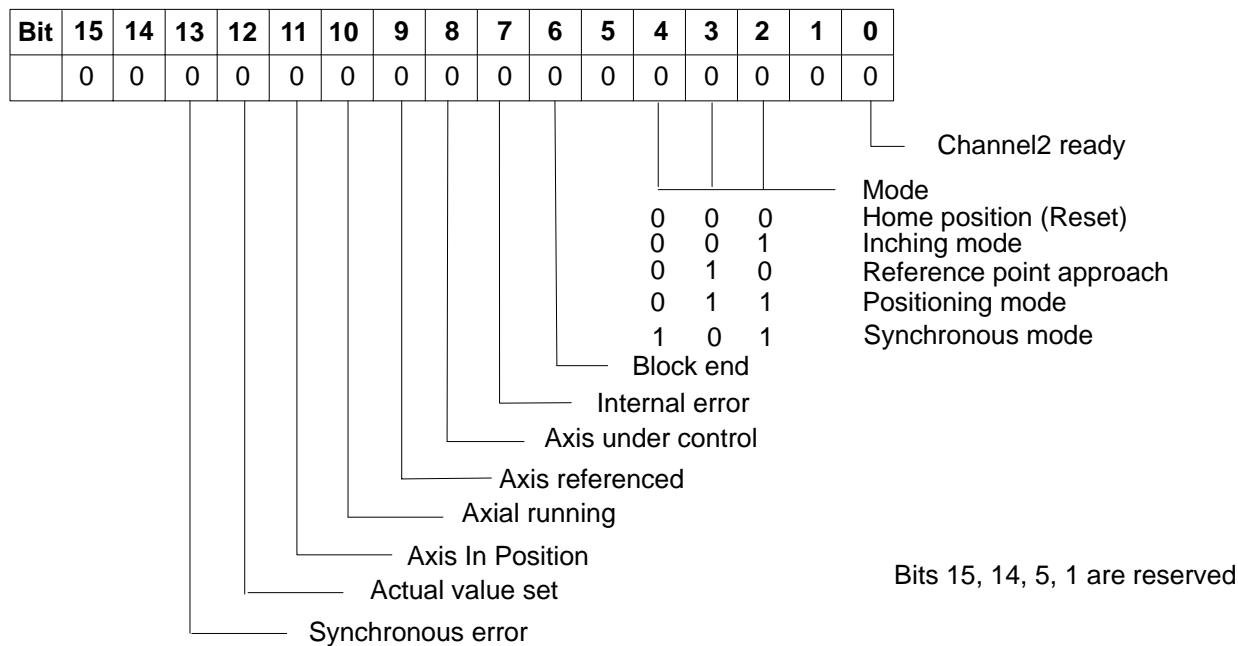
D50, Channel1 error code

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.

- **Axis 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**
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**
CL200: Because the bus master is integrated in the controller, the extended input/output field address (EI/EO address) is of no relevance.

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

PCL: The I/O address of the POS-LR1 / POS-LR2 is defined in D100 of the DBPOS0 data module. This address is assigned to the POS-LR1 / POS-LR2 via the WinDP Windows 95/NT programming software.

D120, POS-LR1 / POS-LR2 firmware version (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 (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
D 68 thru 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 thru 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 thru 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 thru 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.

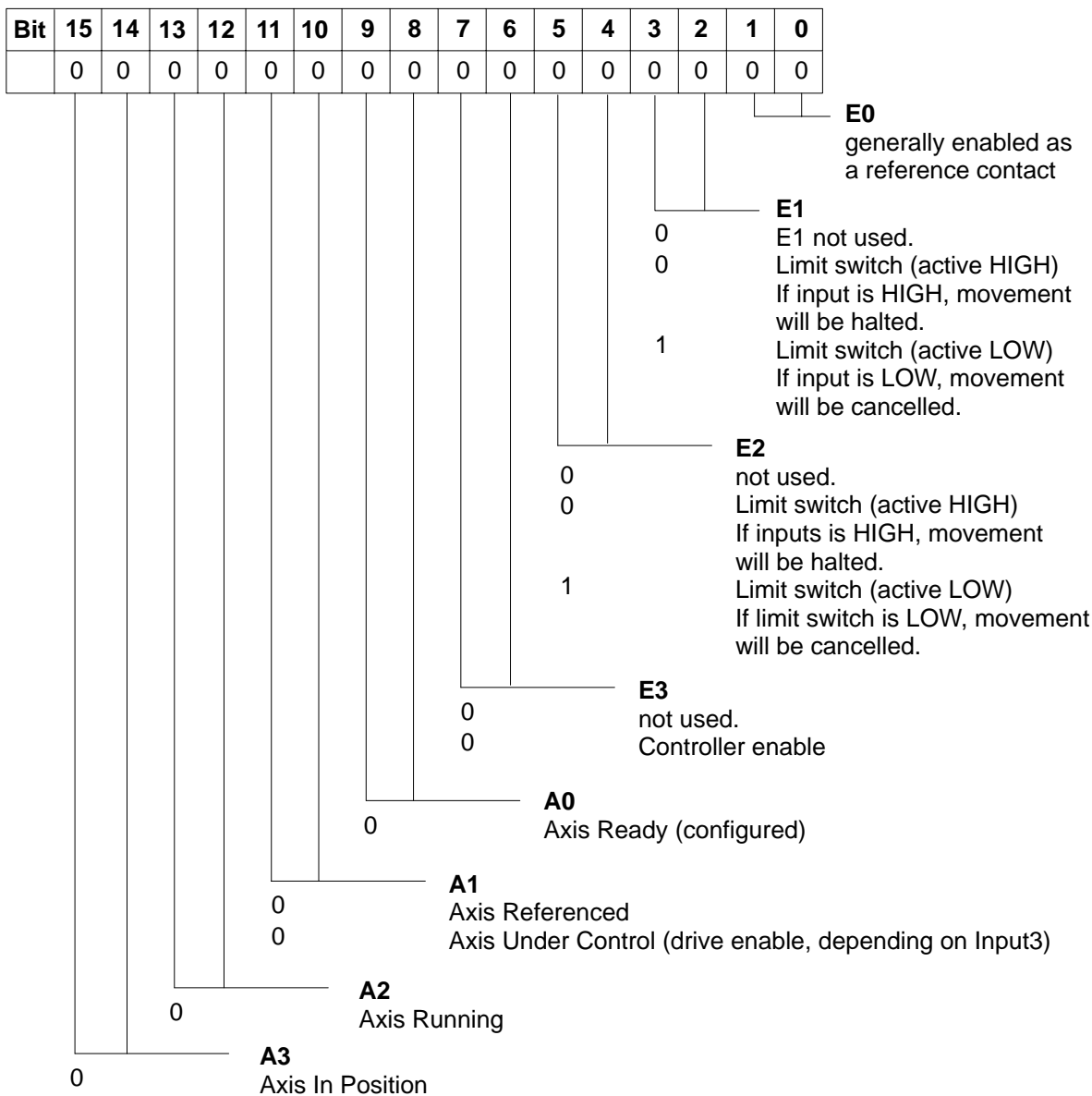
D0, Response to System STOP

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	Blocking digital outputs on the POS-LR1 / POS-LR2 hardware module

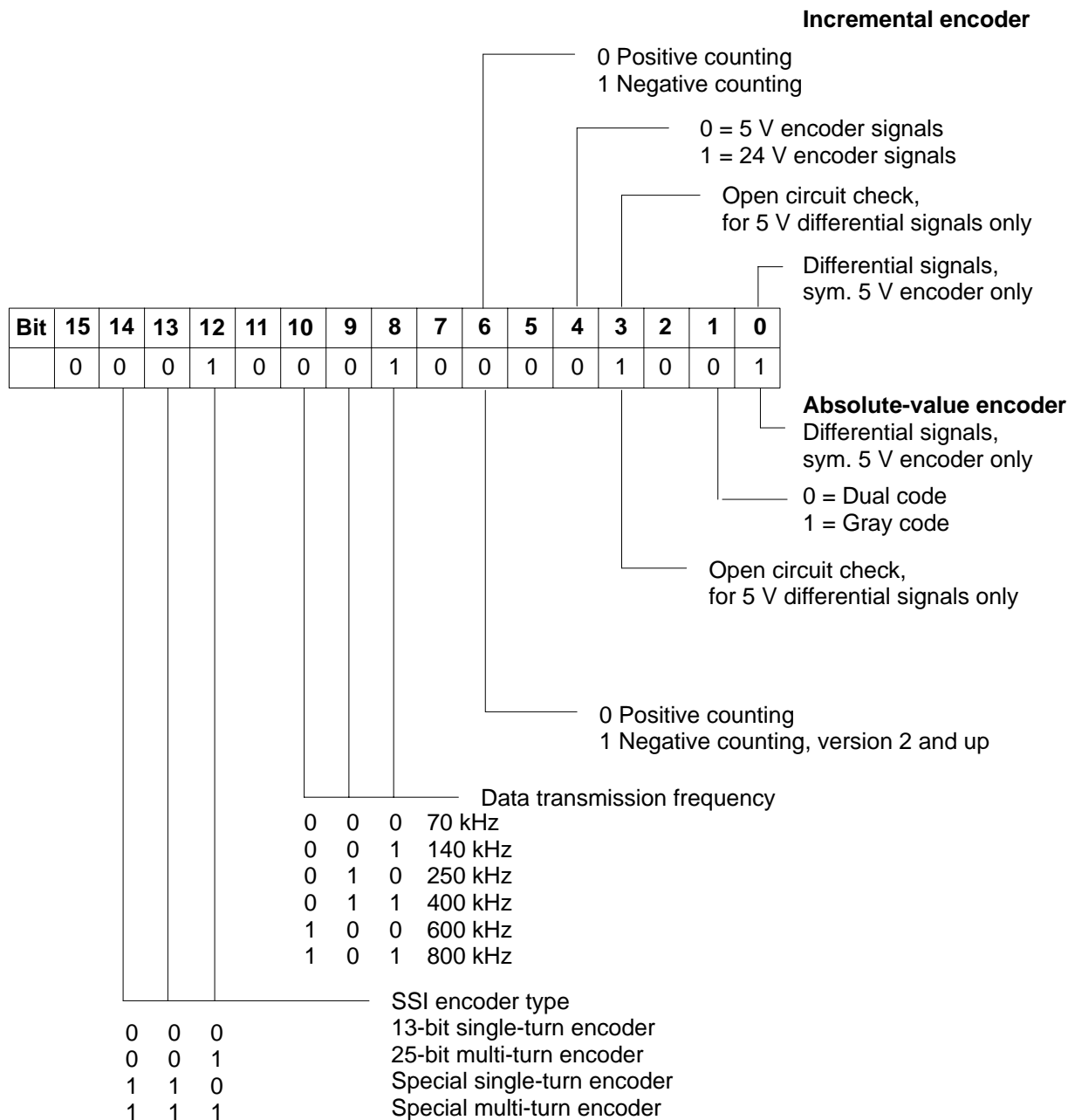
D2, Utilization of digital inputs / outputs



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 release.

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.
- Open circuit check
For 5 V differential signals the “Open Circuit Check” signal must be set (HIGH) in order to enable the encoder cable monitoring for cable breaks and short-circuits.

- 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.
- Dual data scan (version 2 and up)
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 initiated. For synchronous operation, a single data scan is required.

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 will be returned.

For multi-turn encoders –

- less than 12 bits (4096 revolutions) leading zeroes
- with less than 13 bits (8192 increments), trailing zeros will 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.

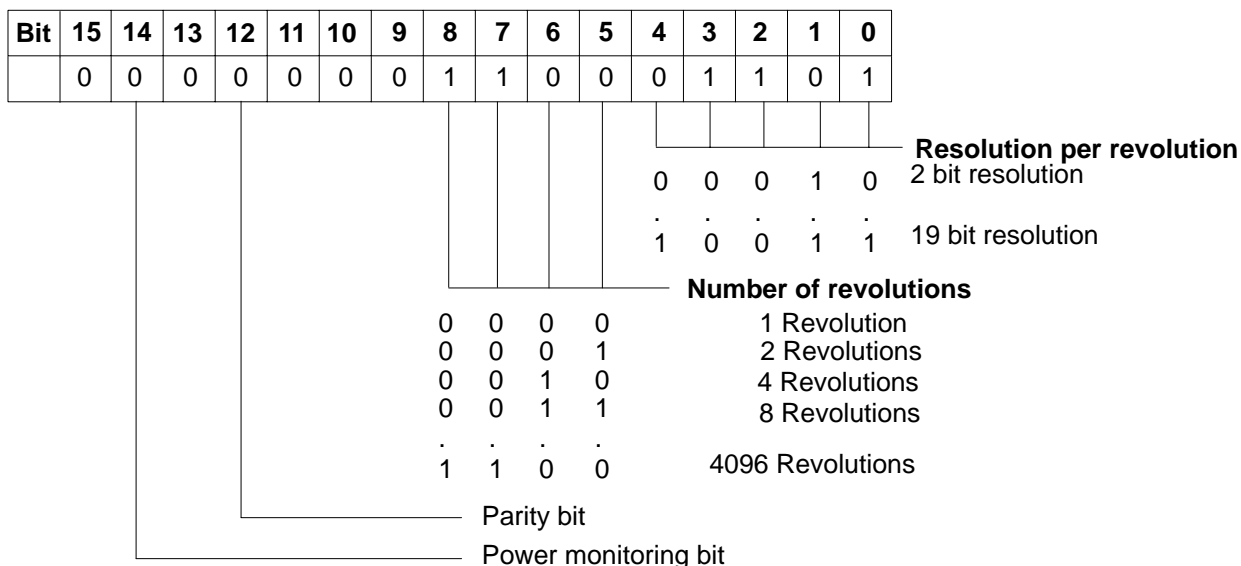
With a special multi-turn encoder, the number of data bits read from the absolute-value encoder corresponds to the number of revolutions and increments selected in the SSI parameter.

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.

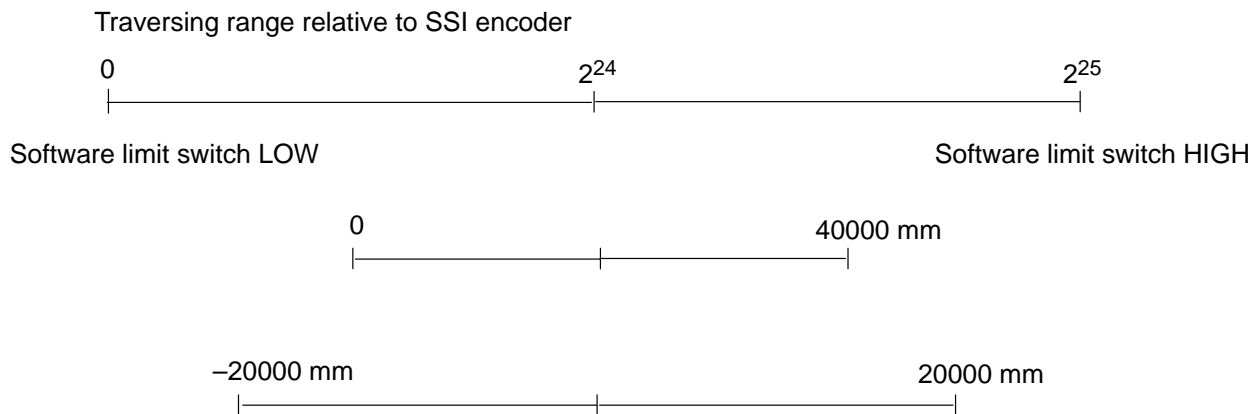
D6, SSI parameter



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 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 start-up, 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: 10000 increments per revolution

D12/14, Distance per revolution

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

Maximum value: 10,000,000 μm per 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:

Pos. limit value = \pm Feed constant * 26 843 545.59 / Graduation count

(The factor in the formula is 2 to the power of 31, divided by 80.)

Maximum value: \pm 107.374 m.

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

Example

Feed constant (D12/14) = 4000 μm per revolution

Graduation count (D8) = 1000 increments per revolution

The resulting positioning limit value equals = \pm 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 = \pm Accuracy * 1574 / Scan rate

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

Max. speed = \pm 1574 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:

RPM n = 3 000 RPM


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

Max. speed (D24/26) = 3 000 RPM * 40 000 μm per revolution

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

For 120 000 mm/min the nominal default value is 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 per revolution

Encoder resolution (D8) = 2 500 increments per revolution

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

Example2

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

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

Encoder resolution (D8) = 2 500 increments per revolution

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

D28/30, Max. acceleration

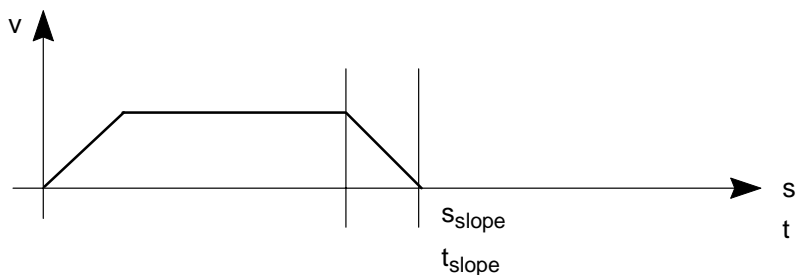
D28 and D30 define the maximum acceleration in mm/s². The maximum value that can be entered is 99 999 mm/s².

D32/34, Max. deceleration

D32 and D34 define the maximum deceleration in mm/s². The maximum value that can be entered is 99 999 mm/s².

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:

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

If acceleration distance s_{slope} is known:

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

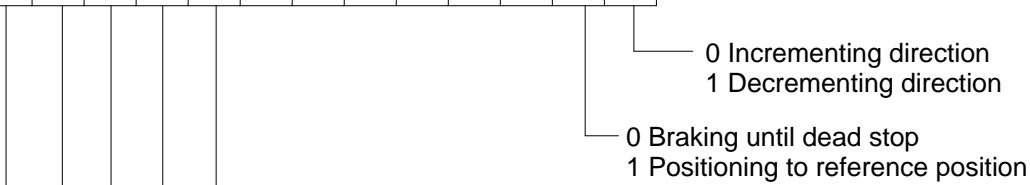
Example:

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:

$$\begin{aligned} \text{Maximum acceleration } a_{max} \text{ [m/sec}^2\text{]} &= \\ &= \frac{(v[m/min])^2}{2 \times s_{slope}[m] \times 3600} = \frac{(100)^2}{2 \times 0.2 \times 3600} = \frac{10000}{1440} = 6.94 \text{ [m/sec}^2\text{]} \end{aligned}$$

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 0 0 0 1 Reference point approach
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)

0 Incrementing direction
1 Decrementing direction

0 Braking until dead stop
1 Positioning to reference position

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 .

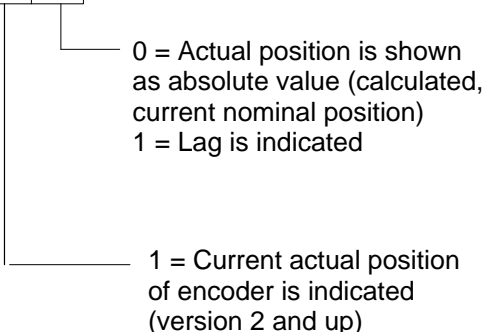
If an offset in positive direction is desired, a negative reference point offset value must be entered, and vice versa.

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 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: $\pm 12\,500$ 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 overshoot 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, overshoot 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.

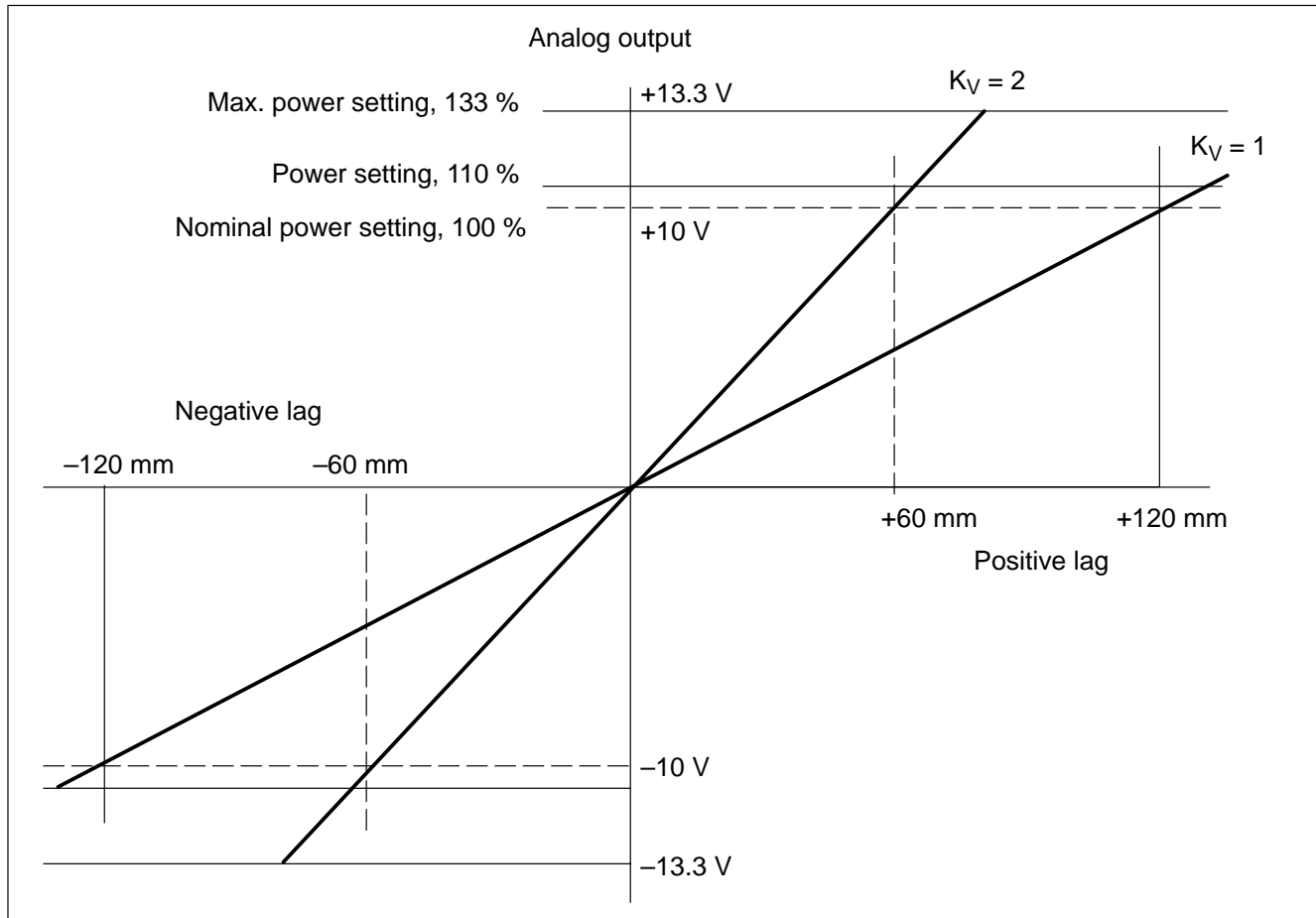
Default value: 1 (m/min)/mm.

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

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

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:

$$v = 120 \text{ m/min}$$

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

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

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.

The potentiometer value of 1000 (decimal) equals 100.0%, indicating that the axis is traversing at the selected speed.

The potentiometer value of 1200 (decimal) equals 120.0%: The axis is travelling at 1.2 times the selected speed. Default value is 1000 (100%).

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

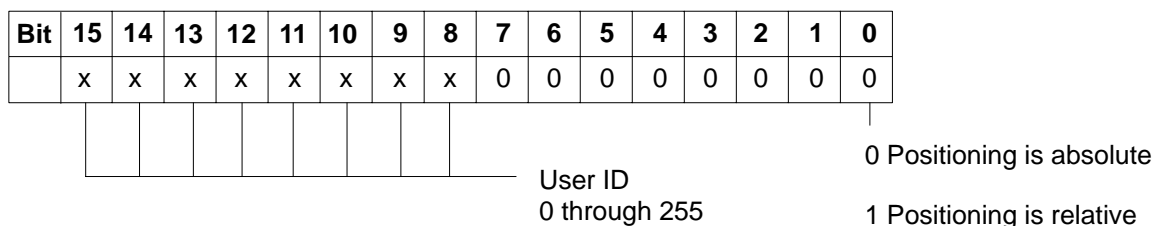
D76 contains a table block number.

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



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 mode parameters

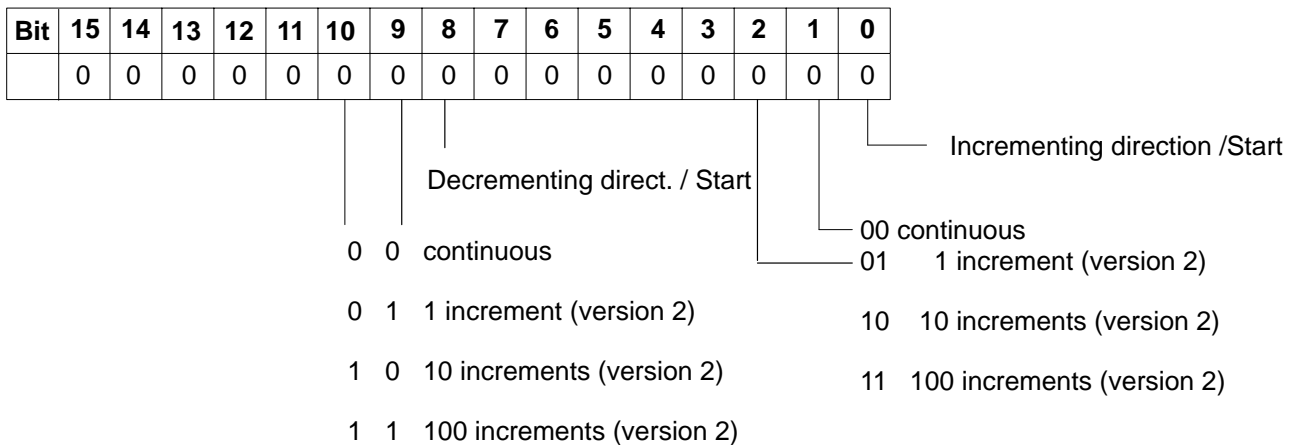
Bit	Explanation
0	1 = Incrementing direction
1 thru 7	not used
8	1 = Decrementing direction
9 thru 15	not used

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



D150, Synchronous mode (version 2 and up)

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

In “Electronic Transmission” synchronous mode, the RPM of the follow axis is equal to that of the RPM of the lead axis that is weighted based on the selected transmission ratio.

In absolute “Self-synchronous System” synchronous mode, the position of the follow axis is equal to that of the lead axis that is weighted based on the selected transmission ratio. In addition, an offset (phase shift) is considered.

In relative “Self-synchronous System” synchronous mode, the position of the follow axis is equal to that of the lead axis that is weighted based on the selected transmission ratio, relative to the starting value. In addition, an offset (phase shift) is considered.

D152, Lead axis

Bit	Explanation
0	Internally controlled axis
1	Externally controlled axis
2 thru 15	not used

If the lead axis is an internally controlled axis, the respective other channel of the POS-LR hardware module will control this lead axis. No change is required to the configuration of this channel. The lead axis movement is not influenced. The follow axis traverses in synch with the internally controlled axis.

If the lead axis is an externally controlled axis, the other channel channel of the POS-LR will sense only the position of this lead axis. The follow axis traverses in synch 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)
- $\pm 1\ 000$ μ m (Self-synchronous system)

D176/178, Synchronous run error limit

The "Synchronous Run Error Limit" parameter defines the maximum permissible deviation. When the deviation – taking into consideration both the transmission ratio and offset, if applicable – of follow axis and lead axis exceeds the synchronous run error limit, the "Synchronous Error" signal goes HIGH. The coupling of lead axis and follow axis is not cancelled automatically; an appropriate response must be received by the application program. This parameter applies in both positive and negative direction.

Default value:

- ± 10 mm/min (Transmission)
- $\pm 10\ 000$ μ m (Self-synchronous system)

D180/182, Offset

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

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

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 structure of identical data words is identical to those in the DBPOS1 data module. Only the Channel1 designation must be replaced with Channel2.

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 thru 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 thru 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 thru 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 thru 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

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 POS2 function module (3 to 4 ms), and of
- 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	135 – 140	140 – 150
Write Channel Configuration	25 – 31	25 – 33
Write Dynamic Axis Parameters	7 – 15	8 – 15
Start Reference Point Approach	10 – 20	15 – 23
Start Positioning	7 – 16	8 – 18
Writing "Start Positioning" command into table entry	30 – 38	30 – 40
Start Positioning with direct positioning	30 – 38	30 – 40
Halt Movement	8 – 18	11 – 21
Direct Positioning	8 – 18	10 – 20
Adopt Current Position As Table Entry	7 – 15	8 – 15
Start Inching Mode	5 – 13	5 – 13
Write Table Entry	15 – 23	15 – 23
Read Table Entry	7 – 14	7 – 14
Clear Table	750 – 800	750 – 800
Function module run time	3 – 4	3 – 4

5.2 Programming Example

Cyclical call

- ☞ **The command parameter of the POS2 function module may only be changed if the “Function Module Active” signal has been reset (LOW) in the user acknowledgement.**

The POS2 function module is called cyclically. Provided that no command is currently being processed, new commands may be entered. Associated with each command are data words in the DBPOS0, DBPOS1 and DBPOS2 data modules. These must be updated before a new command entry. In the event that no command is to be sent, the “0000h” command must be transferred. In this status, only the following data will be written into the DBPOS0 data module:

- 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

```

L   W   S30,A
A   B   A.3
O   B   A.4
JPCI -KeinAnlauf

```

```

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

```

```

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

-KeinAnlauf

```

Calling POS2 function module

```

CM      POS2,5           ;Function module call
P0     W  -Kommando     ;Command
P1     BY -Quittung     ;Adresse for user acknowledgement
P2     W  -DbNr         ;Data module number
P3     W  -PbNr         ;FIFOZM1 program module number
P4     W  -FIFOKaNr     ;FIFO channel, 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

```

Distributed operation

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

The POS-LR1 / POS-LR2 Positioning Module is addressed by the PLC program by means of channel numbers via the BM-DP12 Bus Master and the ZE200-DP and/or ZE200A-DP Central Processing Unit. These numbers are set with the use of the WinDP programming software and are transferred to parameter 4 in the function module.

The ZE200-DP and/or ZE200A-DP is capable of addressing 32 channels. The BM-DP12 can address 64 channels. The maximum number of modules that can be operated in a distributed system configuration is thus defined.

The extended I/O field address of the BM-DP12 is entered in D100 of the DPPOS0 data module. This value is not relevant for the ZE200-DP and/or ZE200A-DP because the master is integrated in the central processing unit.

The major device specifications effective with version 1.9, and the GSD (device specification) file effective with version 1.4 have been appropriately prepared for the POS-LR1 / POS-LR2. The POS-LR1/2 must be integrated.

The DIP switch on the POS-LR1 / POS-LR2 is used to make the following settings in conjunction with the respective equipment:

- with an RM2-DP, the module number defined in WinDP,
- with an RM4-DP, the extended I/O field address defined in WinDP.

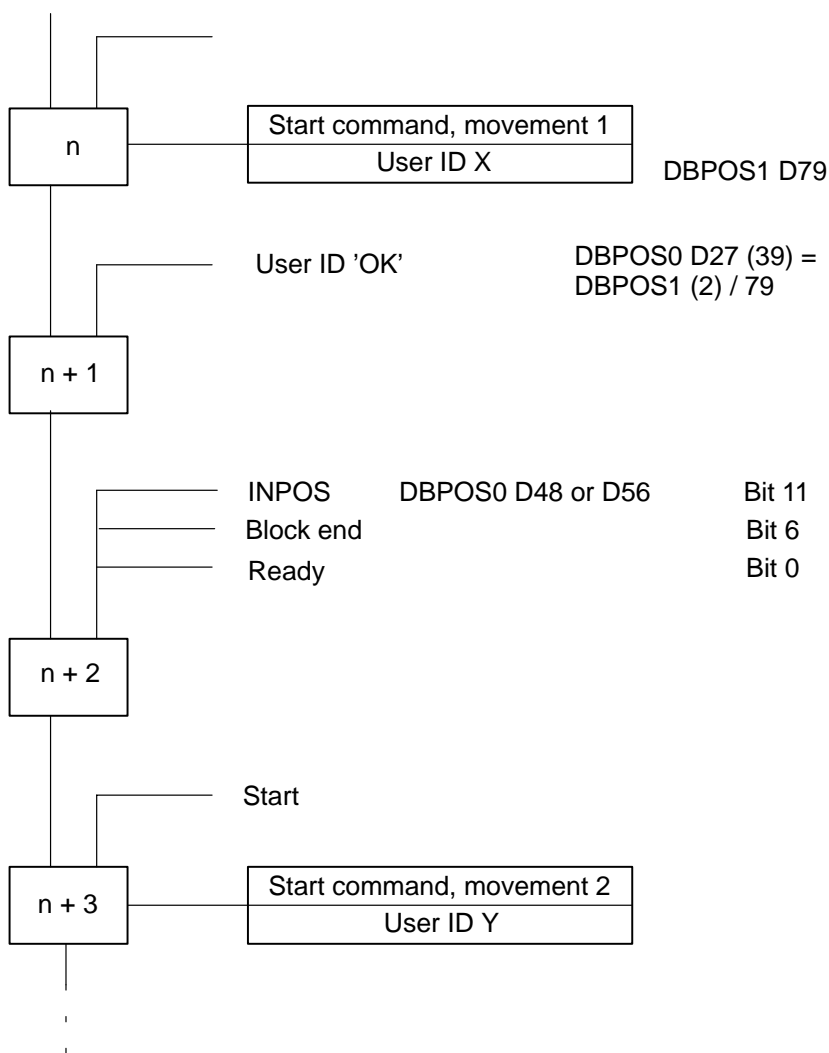
Two hardware modules can be inserted in each slave (RM2-DP, RM4-DP). The BM12-DP (front panel version designation 4 and up) also accepts the insertion of two hardware modules.

In the event that a PCL is used as a master, the module addressing will not occur via channels but by means of I/O addresses. In that case, parameter 4 of the function module call will be irrelevant.

The POS-LR1 / POS-LR2 Positioning Module occupies 50 I/O bytes. The PCL can manage 8192 I/O bytes, which means that 163 modules can be addressed.

In the WinDP programming software, the POS-LR1 / POS-LR2 must be integrated without channel mode.

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 between the POS-LR1/2 and the ZE200 serves the purpose of refreshing the data contained in the DBPOS0. The POS-LR1/2 provides the new information at a resolution of 10 ms. The refreshed data is destined for data words D16 through D58.


The User ID must be used to facilitate, subsequent to sending a positioning request, a query to the DBPOS0 data module for the current channel and/or axis distances that were refreshed by the POS-LR1/2.

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).

In the process of the data update/refreshment that follows each positioning request, the POS-LR1/2 writes this User ID into the HIGH byte of the respective block number (D27 for Channel1 and D39 for Channel2).

 **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 272 17. The programming examples are located in the directory labelled "POSITION".

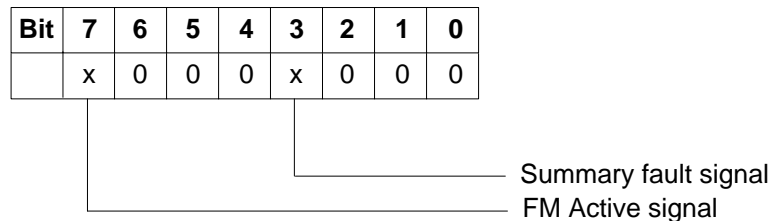
5.3 Error Messages

This section describes

- Communication errors that are indicated in the “Acknowledgement” parameter of the POS2 function module, and
- control / addressing faults in module or channels.

5.3.1 Communication Errors

A communication error is indicated in the “Acknowledgement” parameter of the POS2 function module.



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	<ul style="list-style-type: none"> The module is not powered and cannot therefore be addressed. 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
0203H	Command for 2nd channel sent but only one channel present (possible with POS-LR1 only)

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 Fault
0066H	<ul style="list-style-type: none"> • An excessive number of errors has occurred • 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 completed.
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 (servo loop amplification 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

D50 / D58 im DBPOS0	Cause of Fault
0630H	Wrong synchronous mode
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 / Addressing Faults

Error	Possible Fault Sources
Positioning fails to function	<ul style="list-style-type: none"> ● Module has not been configured ● Channel is not configured ● Reference point has not been approached ● When using digital inputs: Inputs have not been set accordingly. ● Faulty encoder connection ● 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	Indicates uncontrolled access to the module, such as direct read or write access to the extended I/O address of the module. Access to the module is permitted only via the POS2 function module.

A Appendix

A.1 Abbreviations

Abbr.	Explanation
C:	Drive letter (here, identifying first hard disk in computer)
DM	Data module
EEM	Electrostatically Endangered Module
EI	Extended input
ESD	Electrostatic Discharge. Abbreviation often used as a prefix to all designations referring to electrostatic discharges, such as "ESD protection", "ESD hazard", etc.
FM	Function Module
KV	KV factor: Servo loop amplification factor
LSB	Least Significant Bit
PE	Protective Earth (conductor)

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