Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth Positioning Terminal for Absolute Encoders R-IB IL SSI-PAC

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Application Description

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Table of Contents

Table of Contents

Table of Contents

Table of Contents

1 Function and Structure of the Positioning Terminal

1.1 Function Description

The R-IB IL SSI-PAC terminal is part of the Rexroth Inline product range. It is a universal positioning module designed for use within an Inline station.

The R-IB IL SSI-PAC terminal can be used for point-to-point positioning on both rotary and linear axes. In this context, it has sole responsibility for drive control with regard to approaching the desired position. The position values are either assigned directly by the higher-level control system or up to two setpoint positions are stored in the terminal and these are approached automatically by the module when called.

As the 24 V digital outputs supply the control signals for the drives (forward/reverse traversing direction in addition to rapid motion/creeping motion traversing rate), both electric (AC or DC) and pneumatic and hydraulic drives can be controlled.

The R-IB IL SSI-PAC is suitable for applications in which the drive is not to apply any force in the target position. This is the case, for example, on a conveyor container positioned for loading and on which, during loading, no forces are applied in either the direction of transport or the opposite direction. Nor do drives need to apply forces in the target position if gears or spindles are used in an application for what is known as self-locking.

A prerequisite for the use of the R-IB IL SSI-PAC is that absolute encoders (linear or rotary encoders) are used for position detection. Symmetrical encoders with a 5 V signal and 5 V or 24 V supply can be connected. The associated limit switches can be used as an option. Four 24 V digital outputs enable the drives to respond quickly to prevailing conditions.

Positioning terminals are often used in woodworking machinery and in paper processing and conversion, as well as in packaging machinery and for metalworking. As well as supporting the positioning of transport equipment such as conveyor belts, chain conveyors or lifting equipment, the terminals can also be used for format adjustments affecting limit stops, guideways or pressure rollers.

The R-IB IL SSI-PAC is a compact positioning terminal for an axis. It can be used to create bus-independent control solutions for point-to-point positioning according to the rapid motion/creeping motion principle (also known as switching axes).

In addition to the complete function logic for controlling the positioning process, the R-IB IL SSI-PAC positioning terminal supports actual position detection (input for absolute encoder) and drive control (four digital inputs).

The higher-level control system assigns a target position to the R-IB IL SSI-PAC positioning terminal and sends the start signal for positioning. The positioning terminal then carries out positioning automatically and confirms the result to the higher-level control system. For confirmation to be positive, the axis must have been able to actually stop in the target window on stopping.

The point-to-point positioning terminal can be operated on any fieldbus for which there is an Inline bus coupler, e.g., INTERBUS, CANopen, PROFIBUS, Ethernet, and DeviceNet. It can be installed anywhere on the Inline station.

Its sister terminal, the IB IL INC-PAC, which is designed for the connection of incremental encoders, is also available.

Function and Structure of the Positioning Terminal

The positioning terminal can be used with any absolute encoder with an SSI interface. It is designed for the connection of an encoder. The terminal supplies the encoder with 5 V DC and 24 V DC.

The encoder supply is taken from the Inline U_M main circuit. A short-circuit-proof power supply unit provides +5 V DC or +24 V DC to the connection terminals for the encoder supply. This enables both the initiator voltage and the output voltage to be monitored.

The isolation between the encoder input and bus interface is designed for a test voltage of 500 V AC.

The terminal has three digital inputs of 24 V DC, four digital outputs of 24 V DC, 500 mA, and a connection for enabling the hand-held operator panel (HHOP). Limit switches can be connected to the digital inputs in positioning mode. The signals for controlling the drive (e.g., for traversing direction and traversing rate) are output directly via the digital outputs.

If you want to use the positioning terminal to simply determine the position of a drive, subject to certain restrictions, you can use the three inputs and four outputs as digital inputs and outputs independent of all positioning functions (see "Using the Terminal for Position Detection" on page 127).

The terminal is configured (encoder data, resolution, etc.) and parameterized (start window, pre-stop window, etc.) via the bus system. Once these settings have been made, the desired position values to be approached automatically by the terminal once it has been called can be assigned via the control program. If the application permits, up to two parameter records can be saved. The module monitors positioning and sends a status message to the control system. In the event of an error, the drive is stopped immediately. Following configuration, the terminal operates independently of the bus and control system.

Application examples

- Format adjustments
- Compound table positioning
- Position monitoring at valves
- Position control in transport systems (goods, containers)
- Positioning of lifting systems

In the case of many machines, there is a cost problem: In order to increase flexibility, automated axes are being used more and more frequently. This increases the cost of equipping and starting up positioning control systems so significantly that the machines are no longer able to compete on the global market. One of the reasons for this is that excessively powerful and, therefore, overly expensive control systems are required for simple motion control tasks, such as those involving the positioning of:

- Transport equipment
  (conveyor belts, cranes, chain and monorail conveyors, etc.)
- Format adjustments
  (e.g., settings for limit stops, guideways and rollers)
- Tools (spindles, saw blades, cutting and bending tools)

The R-IB IL SSI-PAC positioning terminal can provide a cost-effective solution for many of these positioning applications. This can prove particularly worthwhile if the axes have gears.

What the terminal looks like

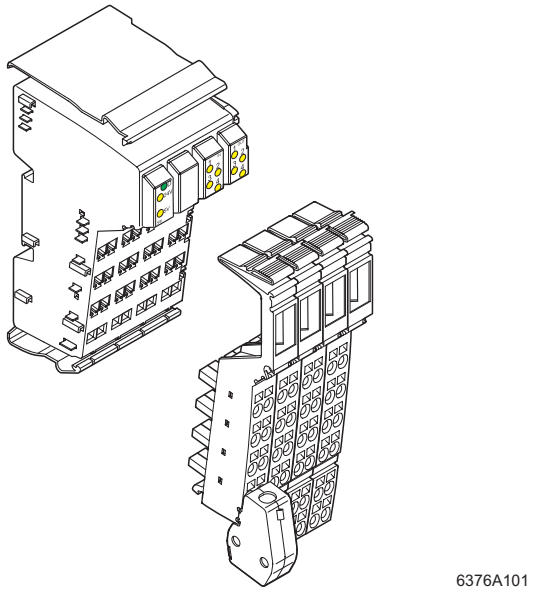


Fig. 1-1 The R-IB IL SSI-PAC terminal with appropriate connectors

1.2 Terminal Structure

1.2.1 Housing Dimensions

Small I/O stations are frequently installed in standard control boxes with a depth of 80 mm. The Inline terminal has been designed for use in this type of control box.

The housing dimensions of the positioning terminal are determined by the dimensions of the electronics base and those of the connector.

The electronics base for the terminal has a design width of 48.8 mm.

It accepts four 12.2 mm wide connectors.

With connectors, the terminal is 71.5 mm deep and 132 mm high (height of the shield connector).

The R-IB IL SSI/INC-PLSET connector set is used on the positioning terminal. It contains a shield connector, a standard connector, and two extended double signal connectors.

Electronics base

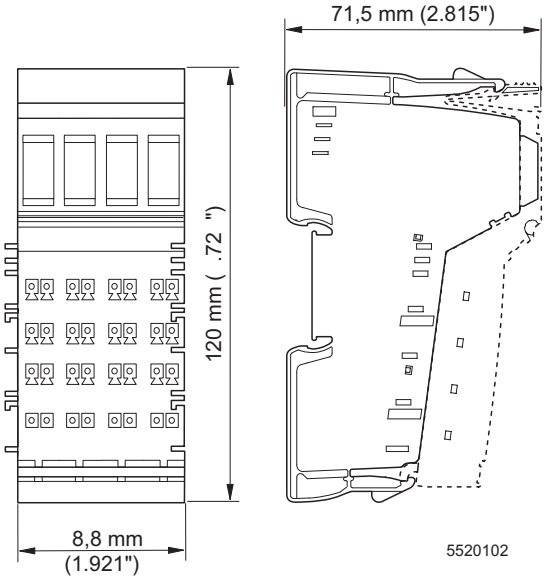


Fig. 1-2 Electronics base dimensions

Connectors

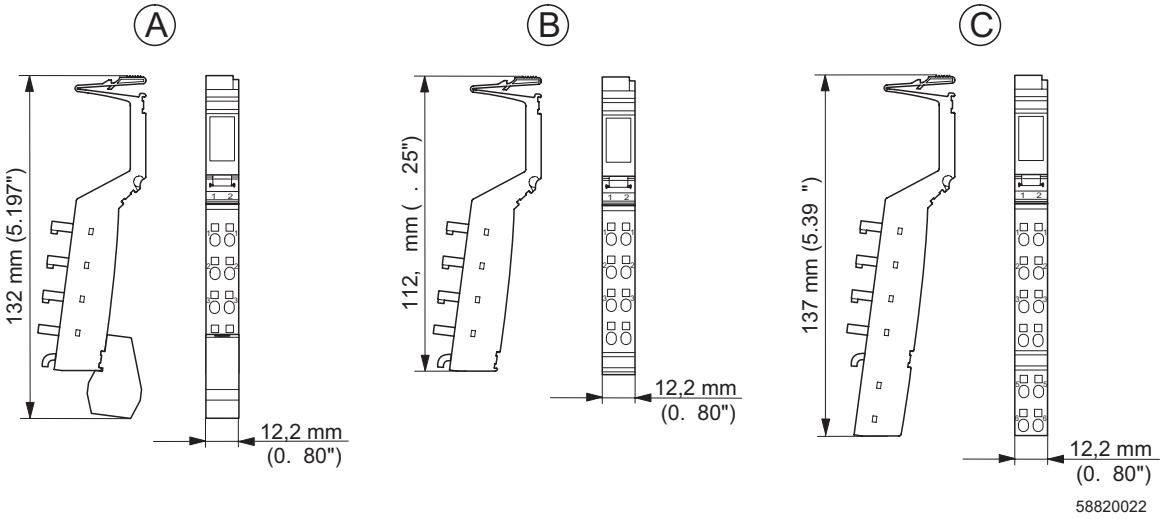


Fig. 1-3 Connector dimensions

Key:

A Shield connector

B Standard connector

C Extended double signal connector

The depth of the connector does not influence the overall depth of the terminal.

1.2.2 Terminal Point Assignment

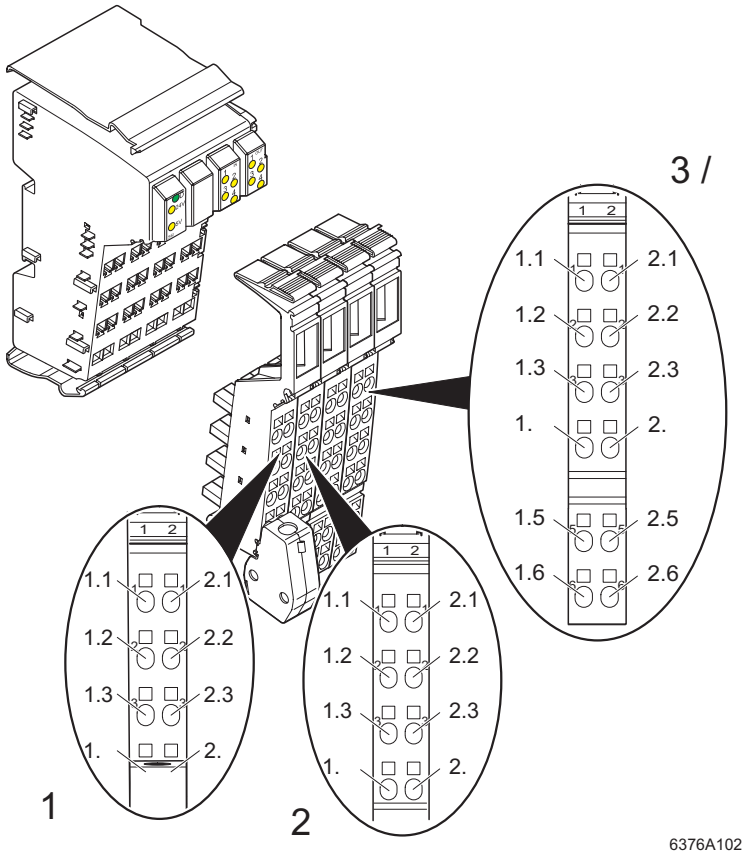


Fig. 1-4 Terminal point assignment for the R-IB IL SSI-PAC terminal

Connector	Terminal Point	Signal	Assignment
1 Shield connector	**1.1**	**24 V**	+24 V DC encoder supply
	1.2	**GND**	Reference ground for the encoder supply
	1.3	**5 V**	+5 V DC encoder supply
	1.4	**Shield**	Shield connection (high resistance and a capacitor to FE)
	2.1, 2.2 2.3, 2.4	**–**	Not used
2 Standard connector	**1.1**	**$\overline{T}$**	Clock
	2.1	**T**	Clock inverted
	1.2	**$\overline{D}$**	Data
	2.2	**D**	Data inverted
	1.3, 2.3 1.4, 2.4	**–**	Not used
3 Extended double signal connector	**1.1**	**IN1**	Input 1
	2.1	**IN2**	Input 2
	1.2, 2.2	**24 V**	+24 V DC supply voltage (U_M)
	1.3, 2.3	**GND**	GND of the supply voltage
	1.4	**IN3**	Input 3
	2.4	**HHOP**	Enable hand-held operator panel mode (HHOP enable)
	1.5, 2.5	**24 V**	+24 V DC supply voltage (U_M)
	1.6, 2.6	**GND**	GND of the supply voltage
4 Extended double signal connector	**1.1**	**OUT1**	Output 1
	2.1	**OUT2**	Output 2
	1.2, 2.2	**GND**	GND of the supply voltage
	1.3, 2.3	**FE**	Functional earth ground
	1.4	**OUT3**	Output 3
	2.4	**OUT4**	Output 4
	1.5, 2.5	**GND**	GND of the supply voltage
	1.6, 2.6	**FE**	Functional earth ground

Fig. 1-5 Terminal point assignment

The encoder supply is generated from the main voltage U_M.

1.2.3 Diagnostic and Status Indicators

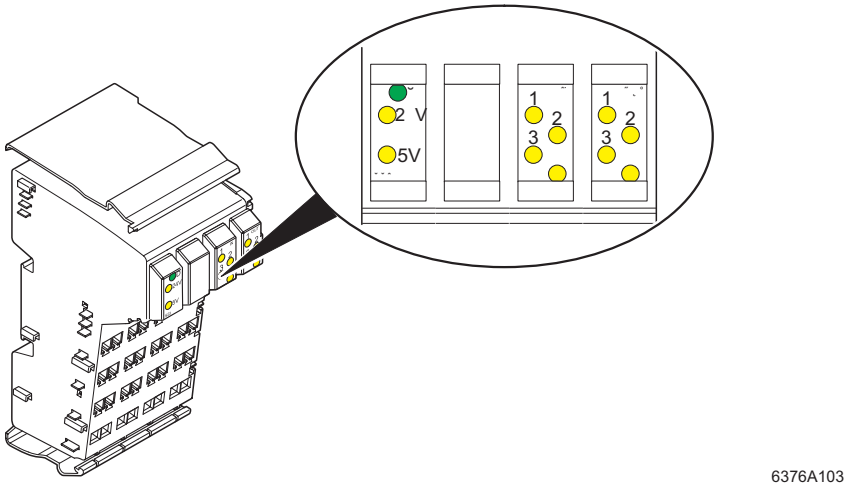


Fig. 1-6 Diagnostic and status indicators

Diagnostics The following states can be read from the positioning terminal:

LED	Color	Meaning	Status	Description of the LED States
D	Green	**D**iagnostics	ON:	Bus active
			Flashing: 0.5 Hz: (slow)	Communications power present, bus not active
			2 Hz: (medium)	Communications power present, bus active, I/O error
			4 Hz: (fast)	Communications power present, bus connection to the flashing terminal has failed; terminals after the flashing terminal are not part of the configuration frame
			OFF:	Communications power not present, bus not active
24V	Green	**24 V** encodersupply	ON:	24 V encoder supply present
			OFF:	24 V encoder supply not present
5V	Green	**5 V** encoder supply	ON:	5 V encoder supply present
			OFF:	5 V encoder supply not present

Status The status of the inputs and outputs can be read from the corresponding yellow LEDs:

LED	Color	Meaning	Status	Description of the LED States
Slot 3 (IN)				
1, 2, 3	Yellow	Status of the corresponding input	ON:	Input set
			OFF:	Input not set
4	Yellow	HHOP status	ON:	Hand-held operator panel mode active
			OFF:	Hand-held operator panel mode not active
Slot 4 (OUT)				
1, 2, 3, 4	Yellow	Status of the corresponding output	ON:	Output set
			OFF:	Output not set

Function and Structure of the Positioning Terminal

1.2.4 Circuit Diagram

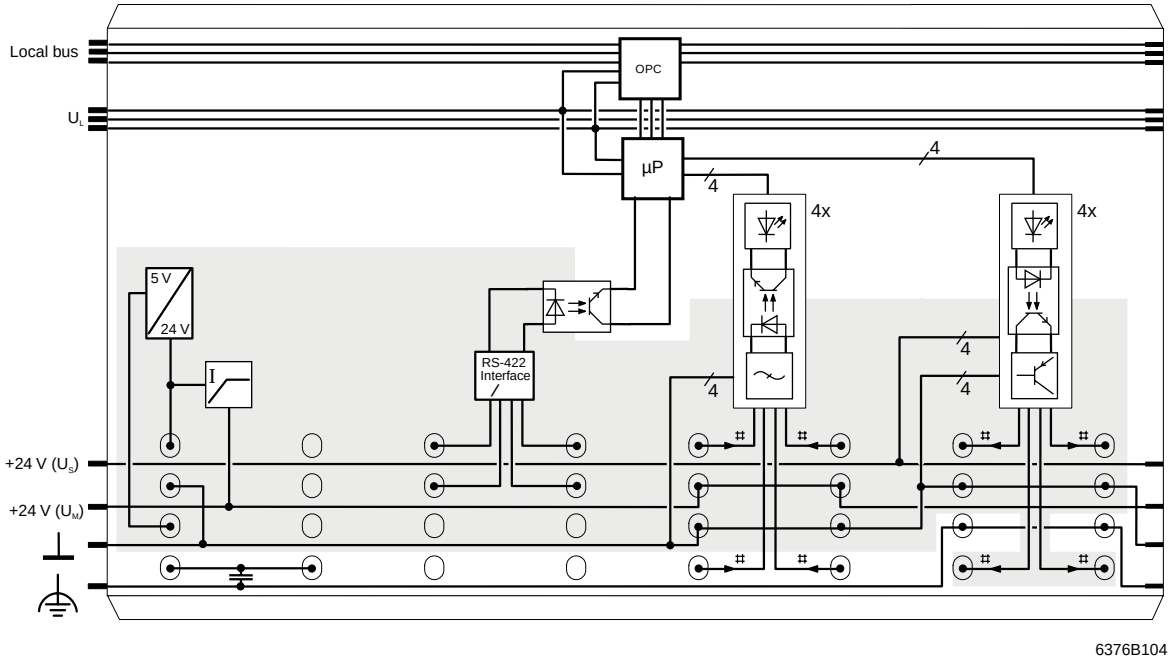
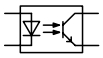


Fig. 1-7 Circuit diagram for the R-IB IL SSI-PAC

Key:

Protocol chip (bus logic including voltage conditioning)

Microprocessor



Optocoupler

RS-422 interface

LED(s)

Filter

Transistor

Capacitor

Power supply unit without electrical isolation

Encoder supply U_G with short-circuit protection

Digital input

Digital output

Ground

Functional earth ground

Terminal point

Potential or data jumper with jumper contacts on the side

1.3 Compatibility Test

All Rexroth controls and drives are developed and tested according to the latest state-of-the-art.

As it is impossible to follow the continuing development of all materials (e.g., lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For that reason, test new lubricants, cleaning agents, etc. for compatibility with our housings/our housing materials before using the particular material concerned.

2 Important Directions for Use

2.1 Appropriate Use

2.1.1 Introduction

Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Important Directions for Use

2.1.2 Areas of use and application

The system of Rexroth is

The Rexroth system may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Typical applications of the Rexroth system are:

- Handling and assembly systems,
- Packaging and foodstuff machines,
- Printing and paper processing machines and
- Machine tools.

The Rexroth system may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

In residential areas as well as in business and commercial areas Class A devices may be used with the following note:

This is a Class A device. In a residential area, this device may cause radio interferences. In such a case, the user may be required to introduce suitable countermeasures at his own cost.

2.2 Inappropriate Use

Using the Rexroth system outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified is defined as "inappropriate use".

The Rexroth system may not be used if

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Bosch Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

3 Safety Instructions for Electric Drives and Controls

3.1 Safety Instructions - General Information

3.1.1 Using the Safety Instructions and Passing them on to Others

Do not attempt to install or commission this device without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with the device. If you do not have the user documentation for the device, contact your responsible Bosch Rexroth sales representative. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the device.

If the device is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the device in the official language of the user's country.

WARNING

Improper use of these devices, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

Observe the safety instructions!

3.1.2 How to Employ the Safety Instructions

Read these instructions before initial commissioning of the equipment in order to eliminate the risk of bodily harm and/or material damage. Follow these safety instructions at all times.

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before commissioning the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of this device.
- Only assign trained and qualified persons to work with electrical installations:
  - Only persons who are trained and qualified for the use and operation of the device may work on this device or within its proximity. The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the product, as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and devices on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.

Safety Instructions for Electric Drives and Controls

- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The devices have been designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Only use safety-relevant applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded. Safety-relevant are all such applications which can cause danger to persons and material damage.
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
- The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only permitted if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective documentation (Project Planning Manuals of components and system).
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connection and installation conditions are specified in the product documentation and must be followed at all times.

National regulations which the user must take into account

- European countries: according to European EN standards
- United States of America (USA):
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  - regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  - International Organization for Standardization (ISO)
  - International Electrotechnical Commission (IEC)

3.1.3 Explanantion of Warning Symbols and Degrees of Hazard Seriousness

The safety instructions describe the following degrees of hazard seriousness. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions:

Warning symbol	**Signal word**	**Degree of hazard seriousness acc. to ANSI Z 535.4-2002**
	Danger	Death or severe bodily harm will occur.
	Warning	Death or severe bodily harm may occur.
	Caution	Minor or moderate bodily harm or material damage may occur.

Fig. 3-1 Hazard classification (according to ANSI Z 535)

Safety Instructions for Electric Drives and Controls

3.1.4 Hazards by Improper Use

DANGER

High electric voltage and high working current! Risk of death or severe bodily injury by electric shock!

Observe the safety instructions!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

Observe the safety instructions!

WARNING

High electric voltage because of incorrect connection! Risk of death or bodily injury by electric shock!

Observe the safety instructions!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

Observe the safety instructions!

CAUTION

Hot surfaces on device housing! Danger of injury! Danger of burns!

Observe the safety instructions!

CAUTION

Risk of injury by improper handling! Risk of bodily injury by bruising, shearing, cutting, hitting or improper handling of pressurized lines!

Observe the safety instructions!

CAUTION

Risk of injury by improper handling of batteries!

Observe the safety instructions!

3.2 Instructions with Regard to Specific Dangers

3.2.1 Protection Against Contact with Electrical Parts and Housings

This section concerns devices and drive components with voltages of more than **50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating electrical equipment, it is unavoidable that some parts of the units conduct dangerous voltage.

DANGER

High electrical voltage! Danger to life, electric shock and severe bodily injury!

- Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain and repair this equipment.
- Follow general construction and safety regulations when working on electrical power installations.
- Before switching on the device, the equipment grounding conductor must have been permanently connected to all electrical equipment in accordance with the connection diagram.
- Do not operate electrical equipment at any time, even for brief measurements or tests, if the equipment grounding conductor is not permanently connected to the mounting points of the components provided for this purpose.
- Before working with electrical parts with voltage potentials higher than 50 V, the device must be disconnected from the mains voltage or power supply unit. Provide a safeguard to prevent reconnection.
- For electrical drive and filter components, observe the following:
  Wait **30 minutes** after switching off power to **allow capacitors to discharge** before beginning to work. Measure the electrical voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.
- Never touch the electrical connection points of a component while power is turned on.
- Install the covers and guards provided with the equipment properly before switching the device on. Before switching the equipment on, cover and safeguard live parts safely to prevent contact with those parts.
- A residual-current-operated circuit-breaker or r.c.d. cannot be used for electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device according to the relevant standards.
- Secure built-in devices from direct touching of electrical parts by providing an external housing, for example a control cabinet.

For electrical drive and filter components with voltages of **more than 50 volts**, observe the following additional safety instructions.

DANGER

High housing voltage and high leakage current! Risk of death or bodily injury by electric shock!

- Before switching on, the housings of all electrical equipment and motors must be connected or grounded with the equipment grounding conductor to the grounding points. This is also applicable before short tests.
- The equipment grounding conductor of the electrical equipment and the devices must be non-detachably and permanently connected to the power supply unit at all times. The leakage current is greater than 3.5 mA.
- Over the total length, use copper wire of a cross section of a minimum of 10 mm² for this equipment grounding connection!
- Before commissioning, also in trial runs, always attach the equipment grounding conductor or connect to the ground wire. Otherwise, high voltages may occur at the housing causing electric

3.2.2 Protection Against Electric Shock by Protective Extra-Low Voltage

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

All connections and terminals with voltages between 5 and 50 volts at Rexroth products are PELV systems[1]. It is therefore allowed to connect devices equipped with basic insulation (such as programming devices, PCs, notebooks, display units) to these connections and terminals.

WARNING

High electric voltage by incorrect connection! Risk of death or bodily injury by electric shock!

If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV[1].

3.2.3 Protection Against Dangerous Movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

These errors can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily harm and/or material damage, this alone cannot be relied upon to ensure complete safety. Until the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

1) "Protective Extra-Low Voltage"

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

- For the above reasons, ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation.
  They have to be provided for by the user according to the specific conditions within the installation and a hazard and fault analysis. The safety regulations applicable for the installation have to be taken into consideration. Unintended machine motion or other malfunction is possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, bodily harm and/or material damage

- Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:
  - use safety fences
  - use safety guards
  - use protective coverings
  - install light curtains or light barriers
- Fences and coverings must be strong enough to resist maximum possible momentum.
- Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before commissioning. Do not operate the device if the emergency stop switch is not working.
- Isolate the drive power connection by means of an emergency stop circuit or use a safety related starting lockout to prevent unintentional start.
- Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example:
  - mechanically securing the vertical axes,
  - adding an external braking/arrester/clamping mechanism or
  - ensuring sufficient equilibration of the vertical axes.
- The standard equipment motor brake or an external brake controlled by the drive controller are **not sufficient to guarantee personal safety**!
- Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection for:
  - maintenance and repair work
  - cleaning of equipment
  - long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near electronics circuits and supply leads. If the use of such devices cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial commissioning. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

Safety Instructions for Electric Drives and Controls

3.2.4 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated by current-carrying conductors and permanent magnets in motors represent a serious personal danger to those with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

- Persons with heart pacemakers and metal implants are not permitted to enter following areas:
  - Areas in which electrical equipment and parts are mounted, being operated or commissioned.
  - Areas in which parts of motors with permanent magnets are being stored, repaired or mounted.
- If it is necessary for somebody with a pacemaker to enter such an area, a doctor must be consulted prior to doing so. The noise immunity of present or future implanted heart pacemakers differs greatly so that no general rules can be given.
- Those with metal implants or metal pieces, as well as with hearing aids, must consult a doctor before they enter the areas described above. Otherwise health hazards may occur.

3.2.5 Protection Against Contact with Hot Parts

CAUTION

Hot surfaces at motor housings, on drive controllers or chokes! Danger of injury! Danger of burns!

- Do not touch surfaces of device housings and chokes in the proximity of heat sources! Danger of burns!
- Do not touch housing surfaces of motors! Danger of burns!
- According to the operating conditions, temperatures can be **higher than 60 °C**, 140 °F during or after operation.
- Before accessing motors after having switched them off, let them cool down for a sufficiently long time. Cooling down can require **up to 140 minutes**! Roughly estimated, the time required for cooling down is five times the thermal time constant specified in the Technical Data.
- After switching drive controllers or chokes off, wait 15 minutes to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, the manufacturer of the end product, machine or installation, according to the respective safety regulations, has to take measures to avoid injuries caused by burns in the end application. These measures can be, for example: warnings, guards (shielding or barrier), technical documentation.

3.2.6 Protection During Handling and Mounting

In unfavorable conditions, handling and mounting certain parts and components in an improper way can cause injuries.

CAUTION

Risk of injury by improper handling! Bodily injury by bruising, shearing, cutting, hitting!

- Observe the general construction and safety regulations on handling and mounting.
- Use suitable devices for mounting and transport.
- Avoid jamming and bruising by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- If necessary, use suitable protective equipment (for example safety goggles, safety shoes, safety gloves).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids because of the danger of skidding.

3.2.7 Battery Safety

Batteries consist of active chemicals enclosed in a solid housing. Therefore, improper handling can cause injury or material damage.

CAUTION

Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not recharge the batteries as this may cause leakage or explosion.
- Do not throw batteries into open flames.
- Do not dismantle batteries.
- When replacing the battery/batteries do not damage electrical parts installed in the devices.
- Only use the battery types specified by the manufacturer.

Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separate from other waste. Observe the local regulations in the country of assembly.

Safety Instructions for Electric Drives and Controls

3.2.8 Protection Against Pressurized Systems

According to th e information given in the Project Planning Manuals, motors cooled with liquid and compressed air, as well as drive controllers, can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricating agents. Improper handling of the connected supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (for example safety gog gles, safety shoes, safety gloves).
- Immediately clean up any spilled liquids from the floor.

Environmental protection and disposal! The agents used to operate the product might not be economically friendly. Dispose of ecologically harmful agents separately from other waste. Observe the local regulations in the country of assembly.

4 Mounting/Removing the Positioning Terminal and Connecting Cables

4.1 Installation Instructions

4.1.1 Unpacking a Terminal

ESD Regulations

In order to protect Inline terminals against electrostatic discharge when working with the terminals, operating personnel must remove electrostatic discharge before packing or unpacking the terminals, opening control boxes or control cabinets, and before touching the terminals.

Unpacking the Terminal

The terminal is supplied in an ESD box together with a pa ckage slip with installation instructions. PIease read the complete package slip carefully before unpacking the terminal.

CAUTION

Only qualified personnel should pack, unpack, mount, and remove the terminal while observing the ESD regulations.

4.1.2 Replacing Terminals

CAUTION

Do not replace terminals while the power is connected

Before working on a terminal, removing a terminal from the station or inserting a terminal in the station, disconnect the power to the entire station. Make sure the entire station is reassembled before switching the power back on.

4.2 Mounting and Removing the Terminal

The positioning terminal is designed for use within an Inline station.

An Inline station is set up by mounting the individual components side by side. No tools are required. Mounting the components side by side automatically creates potential and bus signal connections between the individual station components.

All Inline terminals are mounted on 35 mm standard DIN rails. The terminals are mounted perpendicular to the DIN rail. This ensures that they can be easily mounted and removed even when space is at a premium.

After a station has been set up, individual terminals can be exchanged by pulling them out or plugging them in. Tools are not required.

The structure of an Inline station and instructions for mounting and removing a terminal are described in the application descriptions for the Rexroth Inline system or the application description for your bus system.

In addition, the order of the terminals is specified in "Sequence of the Inline terminals" on page 123.

4.3 Power Supply

The terminal is supplied with power via the potential jumpers. No additional power connections are required.

4.4 Connecting Encoders, Sensors, and Actuators

4.4.1 Connection Notes and Shielding

Encoders should always be connected using **shielded** cables. Unshielded cables may lead to erroneous results in environments subject to heavy noise. On the terminal side, the shield is capacitively connected to functional earth ground (FE) via the shield connector. On the encoder side, the shield must be connected with the grounded encoder housing.

Connect the encoder, sensors, and actuators using connectors. The R-IB IL SSI/INC-PLSET connector set is designed for the R- IB IL SSI-PAC terminal. It comprises a shield connector, a standard connector, and two extended double signal connectors.

Connect the encoder using the shield connector, and all other cables using connectors without shield connection.

Connect unshielded cables as described in "Connecting Cables to a Connector Without Shield Connection" on page 30.

Connect shielded cables as described in "Connecting Shielded Cables Using the Shield Connector" on page 32.

Mounting/Removing the Positioning Terminal and Connecting Cables

4.4.2 Connection Methods for Sensors and Actuators

Sensors The sensors can be connected using the following methods:

- 2-wire technology (signal and 24 V)
- 3-wire technology (signal, 24 V, and GND)

Actuators The actuators can be connected using the following methods:

- 2-wire technology (signal and GND)
- 3-wire technology (signal, GND, and FE)

Sensor Connection

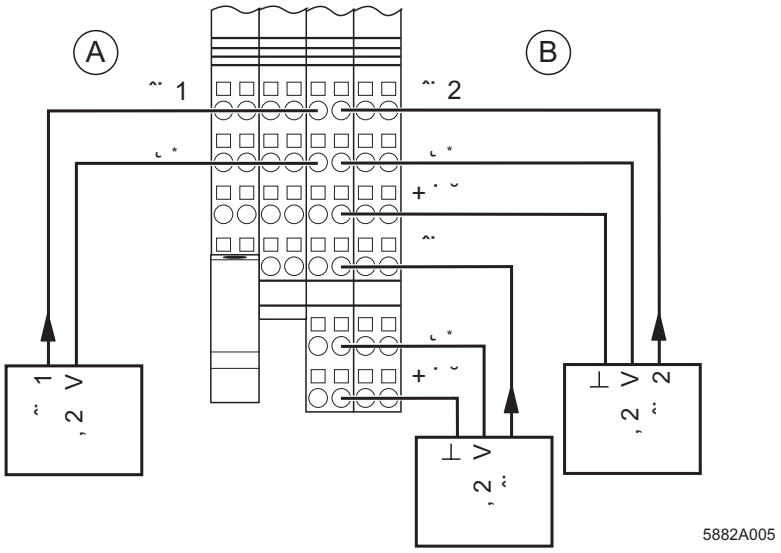


Fig. 4-1 Sensor connection

2-wire technology The left-hand side (A) shows the connection of a 2-wire sensor. The sensor signal is routed to terminal point IN1. The sensor is supplied by voltage U_M.

3-wire technology The right-hand side (B) shows the connection of two 3-wire sensors. The sensor signals are routed to terminal points IN2 and IN4. The sensors are supplied via terminal points U_M and GND.

Actuator Connection

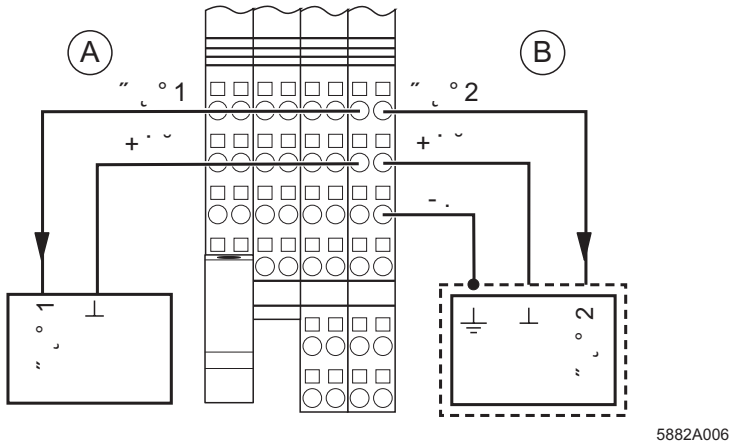


Fig. 4-2 Actuator connection

2-wire technology The left-hand side (A) shows the connection of a 2-wire actuator. The actuator is supplied by output OUT1. The load is switched directly via the output.

3-wire technology The right-hand side (B) shows the connection of a shielded actuator. The actuator is supplied by output OUT2. The load is switched directly via the output.

CAUTION

The maximum current carrying capacity for each output (500 mA) must not be exceeded.

4.5 Connecting Cables

Both shielded and unshielded cables are used with the R-IB IL SSI-PAC terminal.

A shielded cable is used to connect the encoder. The shield is connected via the shield connector, and the encoder via connectors 1 and 2 according to "Terminal Point Assignment" on page 6.

Sensors and actuators are connected via extended double signal connectors. If shielded actuators are used, the shield is connected via the FE connection.

The cables for the I/O devices are connected using the spring-cage connection method. This method supports the connection of cables with a connection cross-section of 0.2 mm^2 to 1.5 mm^2 (24 - 16 AWG).

4.5.1 Connecting Cables to a Connector Without Shield Connection

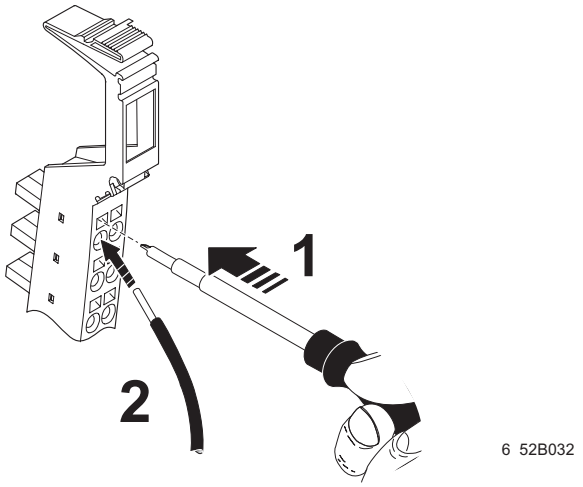


Fig. 4-3 Connecting unshielded cables

Wire the connectors according to your application.

The connector pin a ssignment is specified in "Terminal Point Assignment" on page 6.

When wiring, proceed as follows:

- Strip 8 mm off the cable.

Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

- Push a screwdriver into the slot above the appropriate terminal point (1 in Fig. 4-3), so that you can insert the wire into the spring opening. Bosch Rexroth recommends using a screwdriver with a blade measuring 0.6 mm x 3.5 mm x 100 mm.
- Insert the wire (2 in Fig. 4-3). Remove the screwdriver from the opening. This clamps the wire.

Following installation, the wires and the terminal points should be labeled (see application descriptions for the Rexroth Inline system or the appli cation description for your bus system).

Mounting/Removing the Positioning Terminal and Connecting Cables

4.5.2 Connecting Shielded Cables Using the Shield Connector

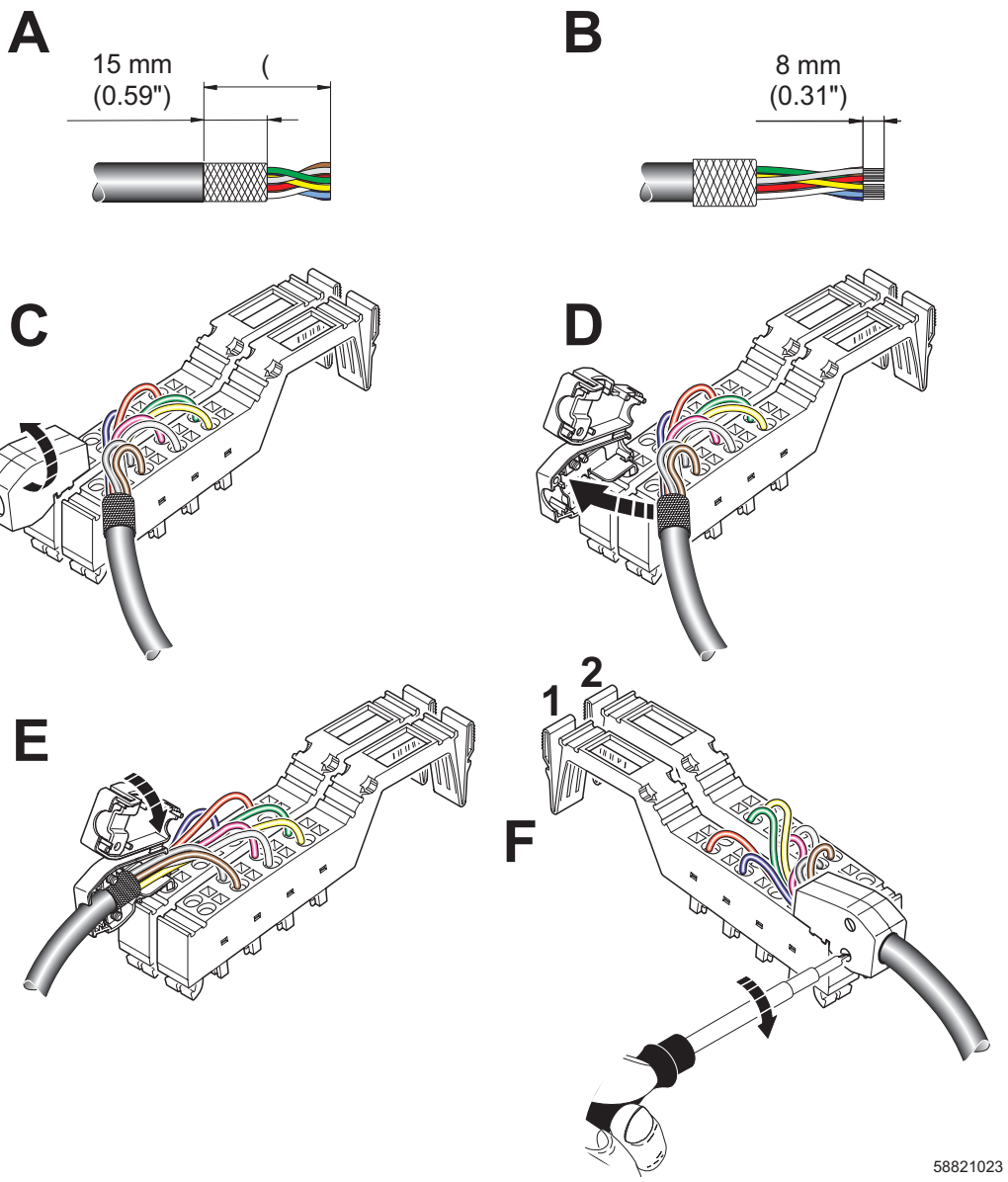


Fig. 4-4 Connecting the shield to the shield connector

The encoder is connected via shielded cables. The basic procedure for connecting shielded cables is described here. The connection method differs for incremental encoders. The specific con nector pin assign ment is specified in "Terminal Point Assignment" on page 6.

To connect the cable, proceed as follows:

Stripping cables

- Strip the outer cable sheath to the desired length (a) (A).

  Select a length (a) that also enables proper connection of the cable to connector 2. The required length (a) also depends on whether the wires are to be generous or tight between the connection points and the shield connection.
- Shorten the braided shield to 15 mm (A).
- Fold the braided shield back over the outer sheath (B).
- Remove the protective foil.
- Strip 8 mm off the wires (B).

Inline wiring is normally done without ferrules. However, it is possible to use ferrules. If using ferrules, make sure they are properly crimped.

Wiring the connectors

Wire the connectors according to "Connecting Cables to a Con nector Without Shield Connection" on page 30.

For the connector assignments, please refer to "Terminal Point Assignment" on page 6.

Connecting the shield

- Open the shield connection (C).
- Insert the shield connection clamp in the shield connection according to the cable cross-section (see Fig. 4-5 or Fig. 4-6).
- Insert the cable with the folded braided shield in the shield connection (D).
- Close the shield connection (E).
- Use a screwdriver to tighten the screws for the shield connection (F).

Mounting/Removing the Positioning Terminal and Connecting Cables

Shield connection clamp

The shield connection clamp (a in Fig. 4-5, B and Fig. 4-6, B) in the shield connection can be used in various ways depending on the cable cross-section. For thinner cables, the dip in the clamp must be turned towards the cable (Fig. 4-5, C). For thicker cables, the dip in the clamp must be turned away from the cable (Fig. 4-6, C).

Connecting a shield connection clamp for thin cables

To position the shield connection clamp for thin cables, proceed as shown in Fig. 4-5:

- Open the shield connection housing (A).
- Connect the shield connection clamp as shown in Fig. 4-5, B.
- Figure C shows the position of the shield connection clamp for thin cables.

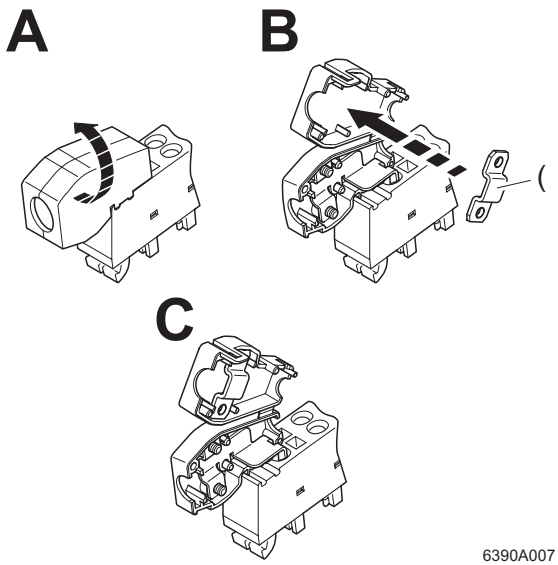


Fig. 4-5 Position of the shield connection clamp for thin cables

Connecting a shield connection clamp for thick cables

To position the shield connection clamp for thick cables, proceed as shown in Fig. 4-6:

- Open the shield connection housing (A).
- Connect the shield connection clamp as shown in Fig. 4-6, B.
- Figure C shows the position of the shield connection clamp for thick cables.

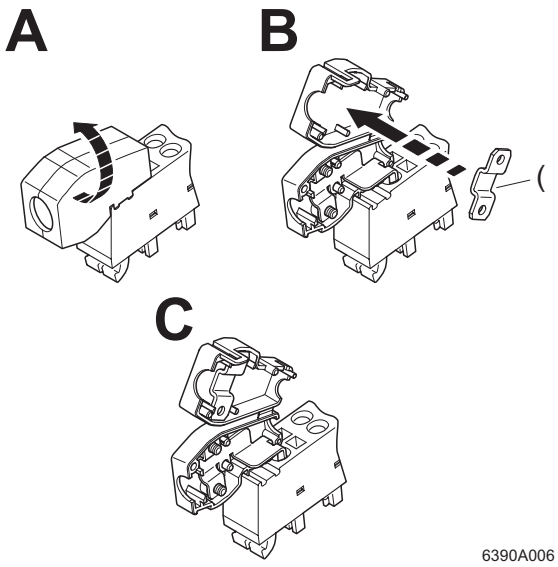


Fig. 4-6 Position of the shield connection clamp for thick cables

Mounting/Removing the Positioning Terminal and Connecting Cables

4.6 Connection Examples

4.6.1 Example Wiring of the Inputs and Outputs

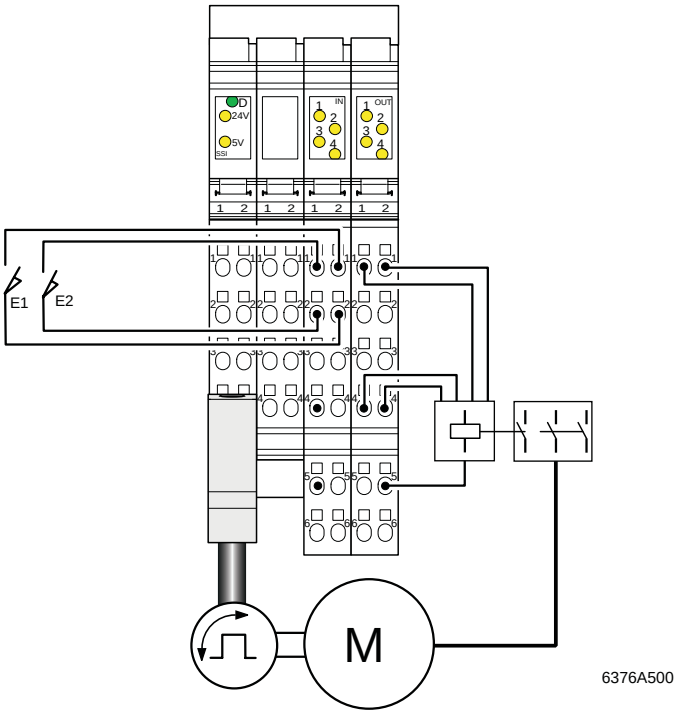


Fig. 4-7 Example wiring of the inputs and outputs

E1	Limit switch 1 (minimum limit switch)
E2	Limit switch 2 (maximum limit switch)

Connect the four digital outputs to the power contactors according to their output version (see "Function of th e Switching Outputs (OutputFunction)" on page 85).
Configure the inputs and outputs according to ""Configuration of Axis Types, Behavior in th e Event of a Bus Failure, Initiators, and Switching Outputs" Command (DefineInOut)" on page 81.

4.6.2 Wiring of the Positioning Terminal When Using Hand-Held Operator Panel Mode

For detailed information about hand-held operator panel mode, please refer to "Hand-Held Operator Panel Mode" on page 65.

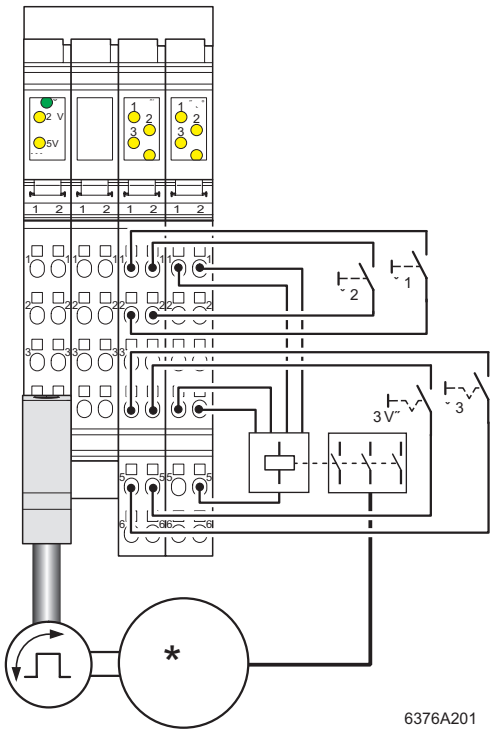


Fig. 4-8 Wiring of an R-IB IL SSI-PAC when using hand-held operator panel mode

Connect the four digital outputs to the power contactors according to their output version (see "Function of the Switching Outputs (OutputFunction)" on page 85).

The switches and buttons have the following meaning:

HHOP	Hand-held operator panel
S1	Slow negative run
S2	Slow positive run
S3	0 - Output version 1 or 2 1 - Output version 3

CAUTION

Check that the configuration is correct

Avoid incorrect configuration of the output versions, as this can result in errors or damage the connected components.

Mounting/Removing the Positioning Terminal and Connecting Cables

Connector for HHOP mode

In hand-held operator panel mode, the extended double signal connector, which is connected to the limit switches, is removed and replaced by a double signal connector, which is wired for hand-held operator panel mode. The connector for hand-held operator panel mode is connected to two manual switches and two manual buttons. Activating the HHOP switch enables hand-held operator panel mode. Switch S3 is used to select the desired output version. Buttons S1 and S2 can be used to drive the motor slowly in a positive or negative direction.

When terminating hand-held operator panel mode, deactivate hand-held operator panel mode and re-insert the connector that was originally connected to the limit switches.

CAUTION

Avoid errors

Terminal point 2.4 of connector 3 (HHOP enable) must only be used for hand-held operator panel mode. If this terminal point is connected accidentally, the positioning terminal interprets this as HHOP mode, which results in errors.

4.7 Startup

After installation, the terminal is in the initial state. In order to use the terminal, it must be parameterized.

For the commands to parameterize the terminal, please refer to Section 7, "Commands for Working With the Positioning Terminal".

A flowchart for parameterizing a position is provided in Fig. 7-19 on page 121. To parameterize your terminal and to read or approach a position, carry out the steps in the specified order.

Please note that in the event of a communications power failure on the terminal, the pa rameterization is **not** saved. In this case, the terminal must be pa rameterized again once the communications power has been restored.

Some parameterization examples are provided in Section 8.2, "Examples".

Mounting/Removing the Positioning Terminal and Connecting Cables

5 Positioning

The higher-level control system assigns a target position to the R-IB IL SSI-PAC positioning controller. Positioning can be started by the higher-level control system or via an input. The positioning controller then carries out positioning automatically and confirms the result to the higher-level control system.

The positioning controller uses the rapid motion/creeping motion principle for positioning. The drives travel at two fixed speeds (first rapid motion, then creeping motion) until they reach the stop point. Then the drive is switched off. This means that positioning is achieved by means of rapid motion/creeping motion, whereby the positioning controller enables and switches over the output signals for drive control following the start of positioning should the axis overshoot the predefined position thresholds. The signals are first switched from rapid motion to creeping motion and then from creeping motion to stop. Once the target position has been reached, the drive is stopped (i.e., it does not supply torque in the target position).

Due to its fast-response logic, the positioning terminal can achieve positioning accuracy rates of micrometers using this simple method.

The terminal controls a positioning process by comparing the current position value with the specified target position and the parameterized window limits. The traversing direction is calculated on the basis of the type of axis and the result of the comparison and the corresponding output bits are activated to control the drive. This means that four switching outputs control the traversing rate and the traversing direction of the drive.

The positioning terminal differentiates between linear axes and rotary axes in order to determine the path to be taken to the target. For linear axes, the target is approached in a positive or negative direction, depending on whether the difference between the target position and actual position is positive or negative. In the case of rotary axes, either the shorter path to the target is selected or the target continues to be approached in one direction (if the other traversing direction has been disabled).

The current position value can be read in every bus cycle.

Positioning

In addition to the input for the encoder signals, the terminal also has three 24 V digital inputs for limit switches.

2 or 3-wire initiators can be connected to these inputs.

The drive stops when the limit switch is activated.

To ensure the correct operation of the terminal, first configure the encoder, the initiators, and the switching outputs. Then parameterize all windows, which belong to a position, and the target position. By default, all windows are set to 0 and must be adapted if necessary.

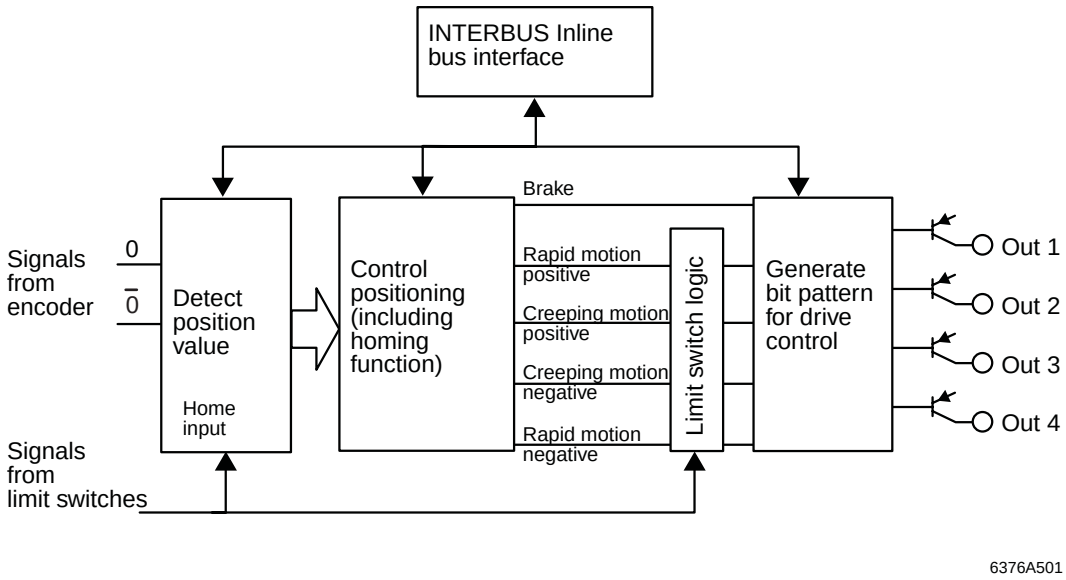


Fig. 5-1 Function block of the R-IB IL SSI-PAC terminal

5.1 Positioning and Structure of a Position

When approaching the specified target position, the drive is controlled automatically by the terminal according to the terminal parameterization.

The value for the target position and the parameters that define the switch-over positions are written to the terminal. During positioning, the terminal recognizes the individual states (e.g., negative creeping motion) and controls the drive accordingly. The output bits are set accordingly for the various drives (pole-changing motors, Dahlander circuit, etc.) (the settings are not the same for each drive).

The bit combination the terminal works with is defined via the "Function of the switching outputs" parameter. There are five versions, which are listed in "Function of the Switching Outputs (OutputFunction)" on page 85. Depending on the parameterization of the output behavior, the position will be approached at two or three speeds (for the version for controlling variable speed drives, e.g., frequency inverters).

For positioning with two speeds, creeping motion and rapid motion are used. For positioning with three speeds, fast motion is available in addition to creeping motion and rapid motion.

Once the positioning process is complete, i.e., once the drive has stopped, the terminal checks whether the required position has been reached. To do this, it checks whether the drive has stopped by waiting until the latter is moving more slowly than defined in the *Time interval* and *Path* parameters under "Drive stop".

It then determines whether the axis position is within the target window and sends positive confirmation of the positioning process. If the axis is not within the target window, either a negative confirmation will be sent or positioning is repeated until such confirmation can be sent (target repeating counter REPEATING COUNT 1 or REPEATING COUNT 2).

Positioning

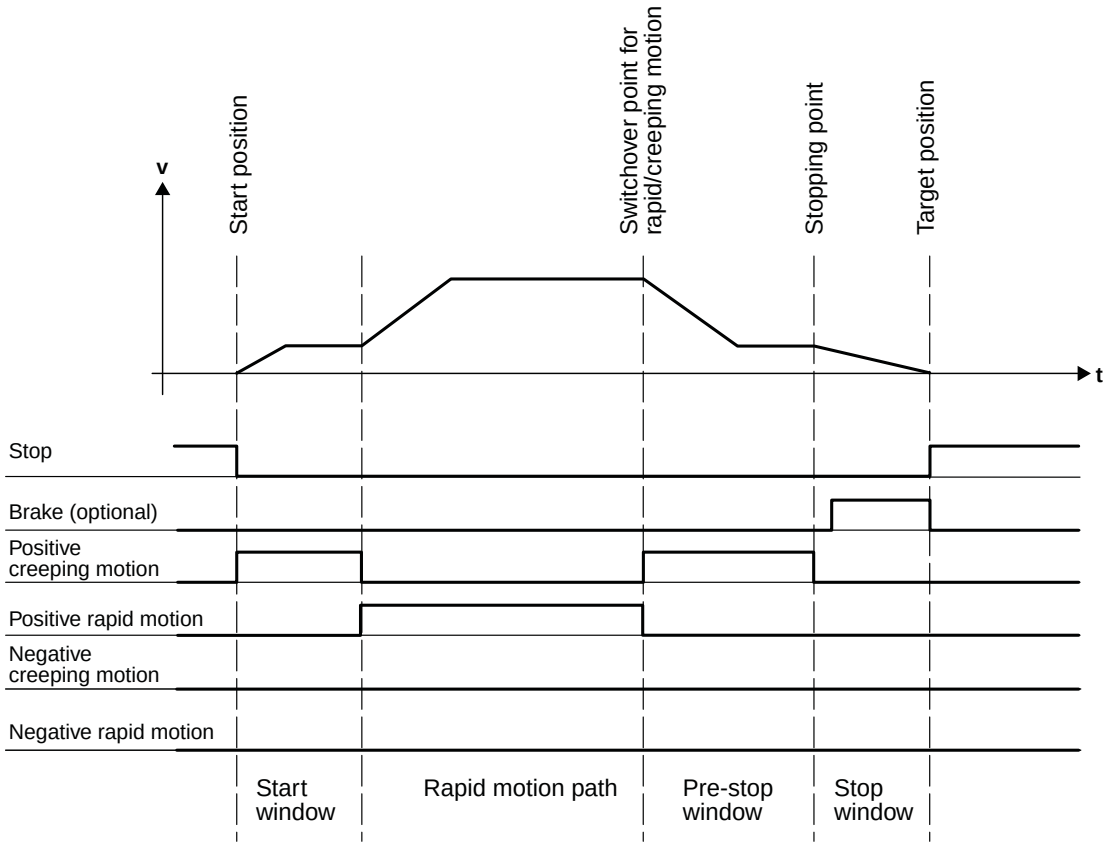


Fig. 5-2 States for positioning in a positive direction

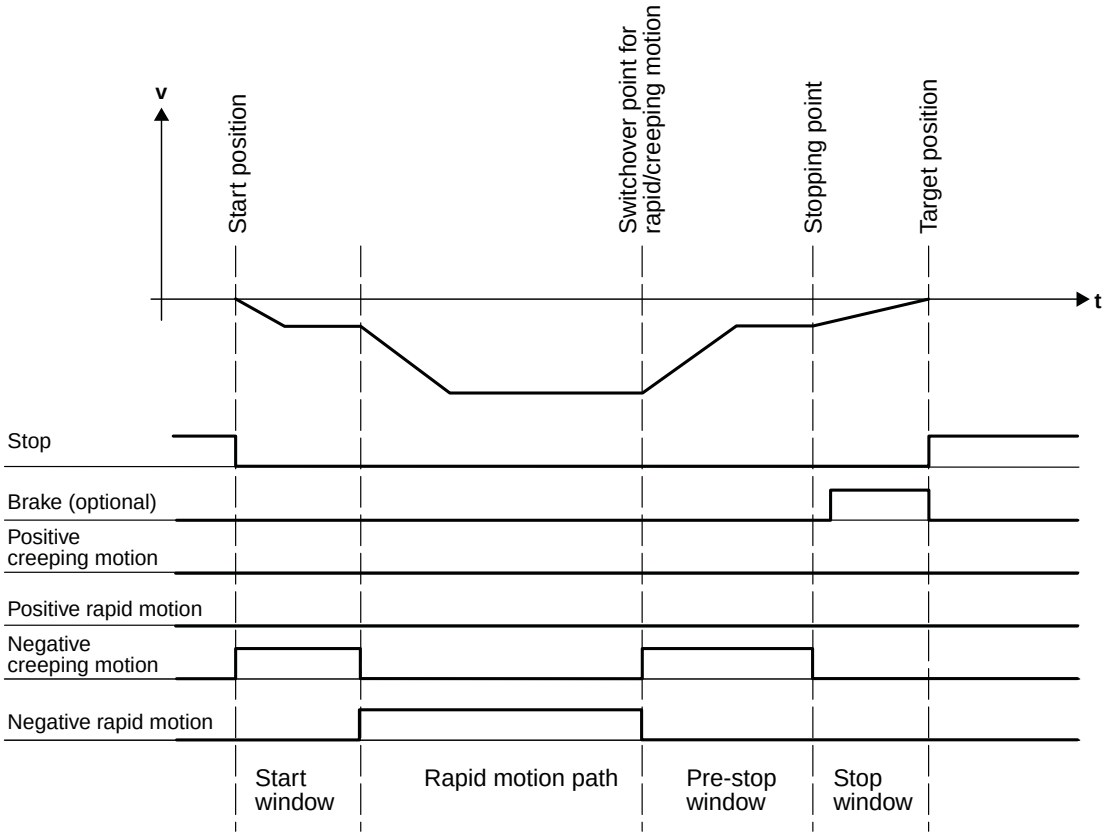


Fig. 5-3 States for positioning in a negative direction

Positioning

Structure of a positioning data record

The parameter record for a position comprises the following values:

- Target position (TargetPosition)
- Target window (TargetWindow)
- Stop window (StopWindow)
- Pre-stop window (Pre-StopWindow)
- Start window (StartWindow)
- Lubrication and friction compensation value (LubFricCompValue)

Plus, if version 4 has been selected under "Function of the switching outputs":

- Rapid stop window (RapidStopWindow)
- Rapid start window (RapidStartWindow)

Each of these parameters is defined independently of the others using the corresponding commands (see "Commands for Parameterizing the Path" on page 94). Examples of the arrangement of the individual switching points and the stop point during positioning are provided in Fig. 5-5 and Fig. 5-4.

On the positioning terminal, two parameter records can be defined for target positions.

Positioning phases

The phases (states) of a positioning process with **two** speeds (function of the switching outputs, versions 1, 2, and 3) are illustrated in Fig. 5-4:

- Start the drive and run at creeping speed.
- Switch the drive to rapid motion (on leaving the start window).
- Switch the drive to creeping speed (pre-stop window reached).
- Stop the drive: Roll to a stop in the target window (stop window reached).

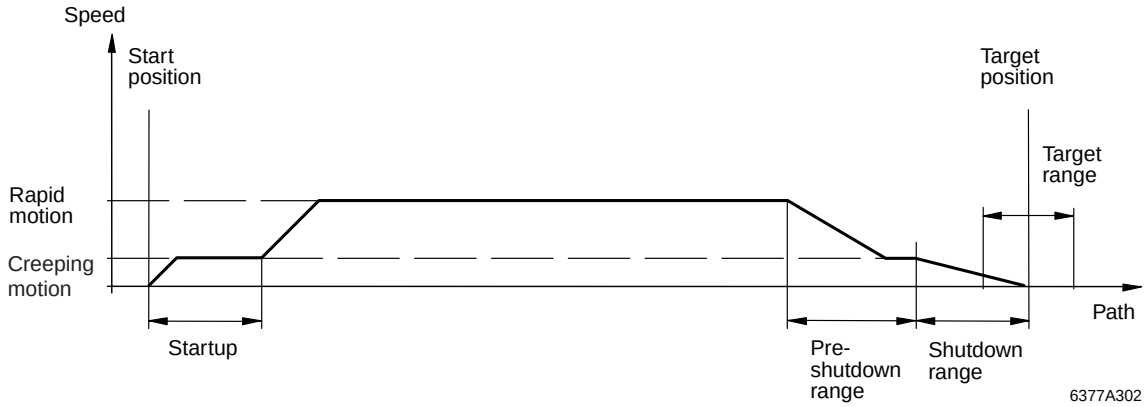


Fig. 5-4 Curve for positioning with two speeds

The phases (states) of a positioning process with **three** speeds (output behavior version 4, see page 85) are illustrated in Fig. 5-5:

- Start the drive and run in rapid motion.
- Switch the drive to fast motion (on leaving the rapid start window).
- Switch the drive to rapid motion (rapid stop window reached).
- Switch the drive to creeping speed (pre-stop window reached).
- Stop the drive: Roll to a stop in the target window (stop window reached).

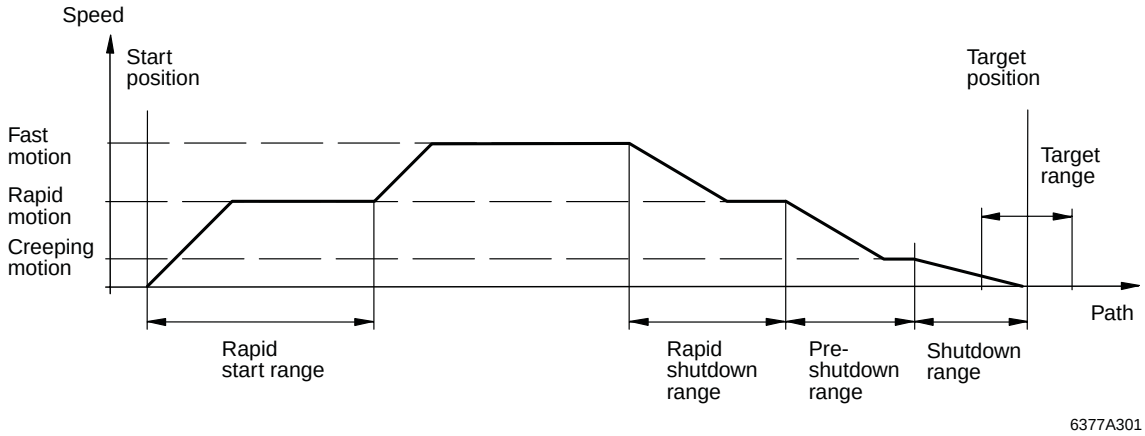


Fig. 5-5 Curve for positioning with three speeds

In order to support the maximum possible number of applications, the terminal is very flexible in terms of adapting position detection to the requirements of the mechanics (gear ratio).

In addition to its dedicated positioning function, the terminal also features a number of monitoring functions, which promote error-free operation of the automated axes. First, the function of the position encoder is monitored continuously. Second, the error-free operation of the drive is checked (direction of rotation and motion).

Changing a saved position once a positioning process is underway has no effect on the active process. The new values only take effect when the next positioning process starts.

The target position and the remaining parameters can be specified using control commands in the output words (see "Control Commands" on page 112).

Configuration

To ensure the correct operation of the terminal, first configure the encoder, initiators, and switching outputs.

Finally, you need to parameterize the positioning data record.

By default, all areas are set to 0. Only the values required for the application have to be parameterized.

Please also note that the firmware cycle time is 500 µs. This means that the positioning error caused by the positioning terminal corresponds to the path traveled at creeping speed in 500 µs. The actual position is read in with the same time offset.

Positioning

Example At a creeping speed of 1 cm/s, the path will be:

6 5 $\frac{4}{\$}$

4 5 6 7 $

4 5 1) m/4 7 500 ˜ 4 5 5 ˜ m

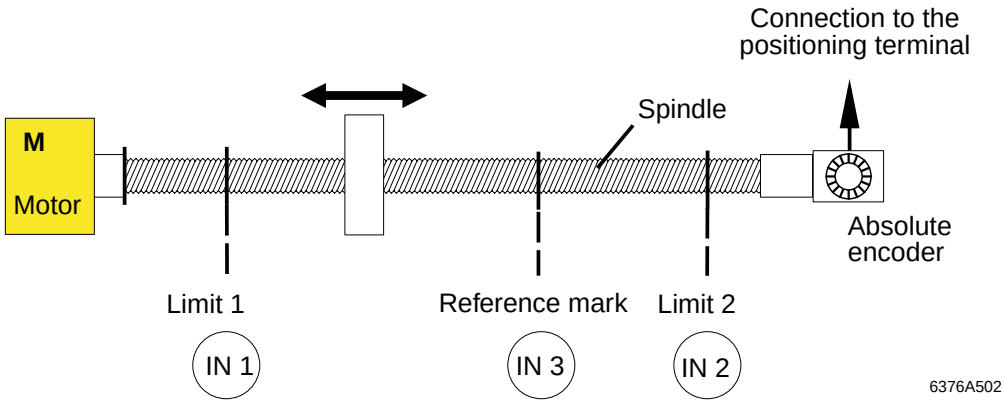


Fig. 5-6 Application example for the inputs for linear axis positioning

5.2 Drive Stop

The module uses the speed threshold set by the drive stop for two functions:

1 Monitoring the drive during positioning
During positioning, the module checks whether the drive is **running correctly**, i.e., whether it is running in the right direction faster than when the drive is in stop.

2 Detection that the drive has actually come to a stop after stopping (if the target window has been reached)
During positioning, once the drive has stopped, the system waits until the terminal has detected the stop.

To define the drive stop, a path and time interval must be specified. If a path less than that specified is covered in the defined time interval, the terminal detects this as a drive stop.

The parameters for detecting a drive stop can be specified using the *Define drive stop* command (see ""Drive Stop" Command (DefineDrvStop)" on page 86).

This path/time combination is the maximum speed, which the terminal still interprets as "drive stopped". If, when the time has elapsed, the terminal detects that the count value of the increment has not increased (forward running) or decreased (backward running) by at least the predefined value, it is presumed that the drive has stopped.

The module uses the speed threshold set by the drive stop for two functions:

Monitoring the drive during positioning

During positioning, the module checks whether the drive is **running correctly**, i.e., whether it is running in the right direction faster than when the drive is in stop. The module checks whether, within the specified time interval, the positioning counter has increased (forward running) or decreased (backward running) by the value that was specified for the increment, since it was last checked. If the desired path was not covered within the time, the module switches to the error status "Drive stop detected" (error message 14_{dec}). The drive is switched off in this error status.

Set the parameters according to your application. Please observe the following points to prevent the error message being triggered unnecessarily:

- If the motor is to start up against a large load or against a brake, the "Delay time for detection of direction and stop" parameter must be defined in addition to the "Drive stop" parameter. This means that the drive can start moving within this time without the error message "Drive stop detected" being generated.
  Drive stop monitoring only starts once the delay time for detection of direction and stop has elapsed (see ""Delay Time for Detection of Direction and Stop and Output Delay Time" Command (DefineDsdOd)" on page 92).
- If vibrations occur in the drive train, the time for defining the drive stop must be increased so that it is greater than the vibrations.

After the drive stop, the module only detects this stop once the set time has elapsed (the worst-case scenario is that double the set time elapses). Therefore, do not select a time any longer than necessary.

Detection That the Drive Has Actually Come to a Stop After Stopping (if the Target Window Has Been Reached)

During positioning, after drive shutdown the system waits until the terminal has detected the stop. The terminal checks whether the drive is moving slower than defined in "drive stop", i.e., has traveled less than the set increments in the predefined time. Once the stop has been detected, the stop bit is set to "1" (see ""Control Position and Read Status" Command (ControlPosition, ReadStatus)" on page 117).

Only after this stop has been detected is a check made to determine whether the drive is in the target window. Next, the positioning process is completed by entering the result in the status word.

If you read the status after positioning, the status words indicate the result of the positioning process (see ""Control Position and Read Status" Command (ControlPosition, ReadStatus)" on page 117).

If the target window has been reached, IN[1] bit 2 (positioning process with parameter record 1 completed successfully) or IN[1] bit 4 (positioning process with parameter record 2 completed successfully) is set in the status word.

If the target window has not been reached, IN[0] bit 15 (error) is set in the status word, and an error message (error code 17_{dec}: "Target window could not be reached") is generated.

If the parameters for monitoring the drive stop are set too low, effects such as vibrations on the axis may mean that no stop is detected. In this case, the positioning process is not completed, and can only be aborted by the user sending the stop command.

Please note that the selected time interval is added to the duration of the positioning cycle. This means that once the drive stops, the time interval selected will continue to run until the terminal detects the drive stop and interprets the positioning process as being at an end.

If drive stop monitoring is not active, the stop bit is constantly set. As positioning without a drive stop makes no sense, it is not possible to enter a value of zero for the drive stop.

5.3 Looping

If the difference between the start and target positions is less than the sum of the start window and stop window, it will not be possible to approach this target position directly. Looping can be used to exit the range automatically and approach the position again.

Looping must be enabled for this. It is enabled using output word OUT[1] bit 12 for the *Control positioning* command (see "Control Commands" on page 112).

The traversing direction on exiting the target window is the opposite of the approach direction specified in OUT[1] bit 11 (Approach direction of the target position for active backlash compensation or looping).

The direction of the loop is determined by OUT[1] bit 11 (Approach direction of the target position for active backlash compensation or looping).

A new positioning process is carried out according to the parameterization.

If looping is required to reach the target position, the terminal executes the process automatically, provided that looping is enabled. The current target position is only approached again once the drive has stopped.

Positioning

Example In Fig. 5-7, A, the end position of the last positioning process is the start position of the next positioning process. This start position is within the sum of the start and stop windows and, therefore, cannot be approached directly. The drive must be moved out of the start/stop windows using looping. The end point of this looping process is the start position for approaching the target position (Fig. 5-7, B).

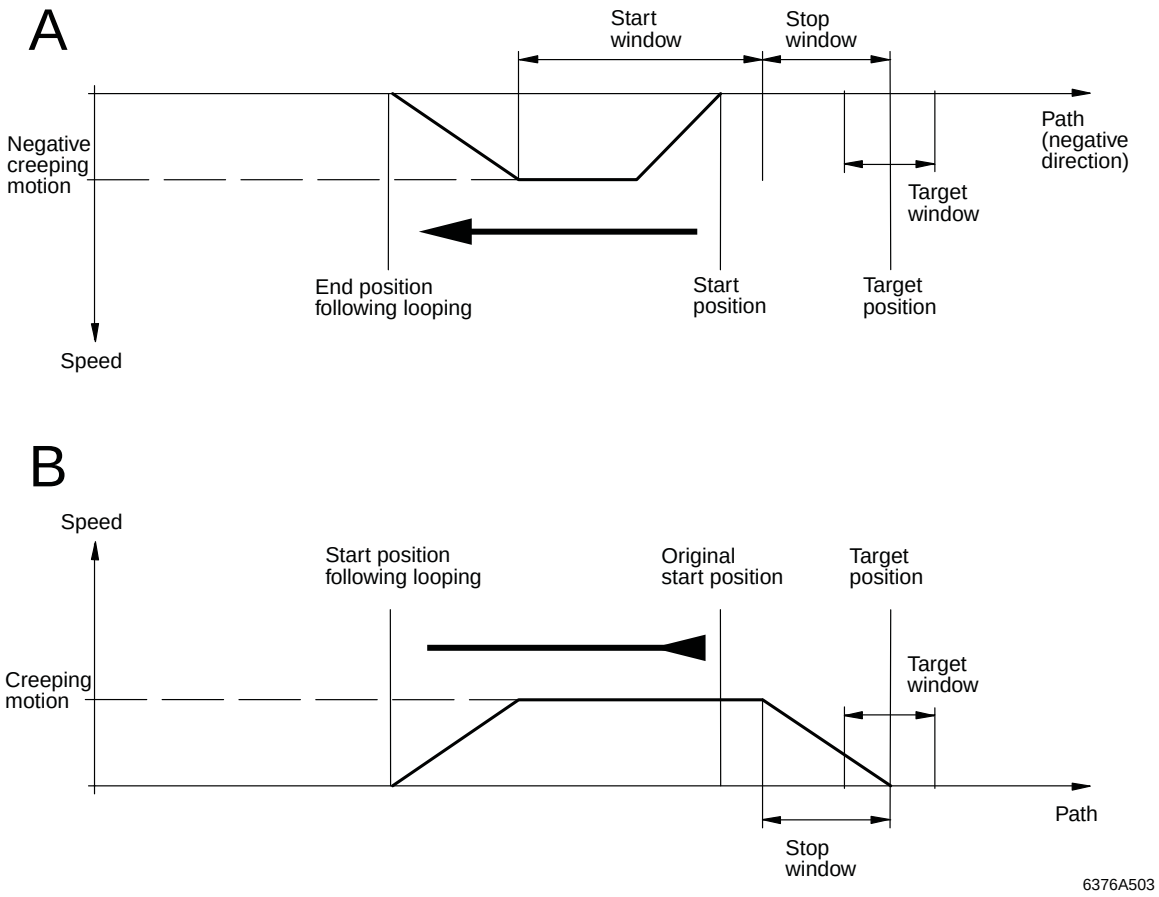


Fig. 5-7 Example of a looping process

5.4 Backlash Compensation

Usually, drive systems have clearance, referred to as "backlash" in practice. Every time the direction changes, the backlash causes a motor rotation without changing the drive position. If the position encoder is linked to the motor axis, this leads to a reduction in positioning accuracy. The positioning terminal enables you to compensate the backlash by approaching all positions from one direction.

Backlash compensation can be activated and deactivated via OUT[1] bit 10 (Activate backlash compensation, ActBacklashComp) of the control word. The approach direction of the position can be specified using OUT[1] bit 11 of the control word (Approach direction of the target position for active backlash compensation, DefDrvDir).

Active backlash compensation monitors whether the software limit switches are overrun during the positioning process. If this happens, the position will not be approached. The terminal generates an error message (error code 10_{dec}: "Function cannot be executed, as software limit switches would be overrun", see Fig. 7-18 on page 119).

Example

Fig. 5-8, A:
If the specified approach direction is positive (OUT[1] bit 11 = 0), and the position is approached in a negative direction, then with backlash compensation activated, the target position will first be overrun. Once the rapid stop window is reached, the drive is stopped and comes to a standstill outside the range calculated by adding together the stop window and the start window.

Fig. 5-8, B:
Since the target position was overrun, the drive now changes direction, and approaches the target position again in a positive direction.

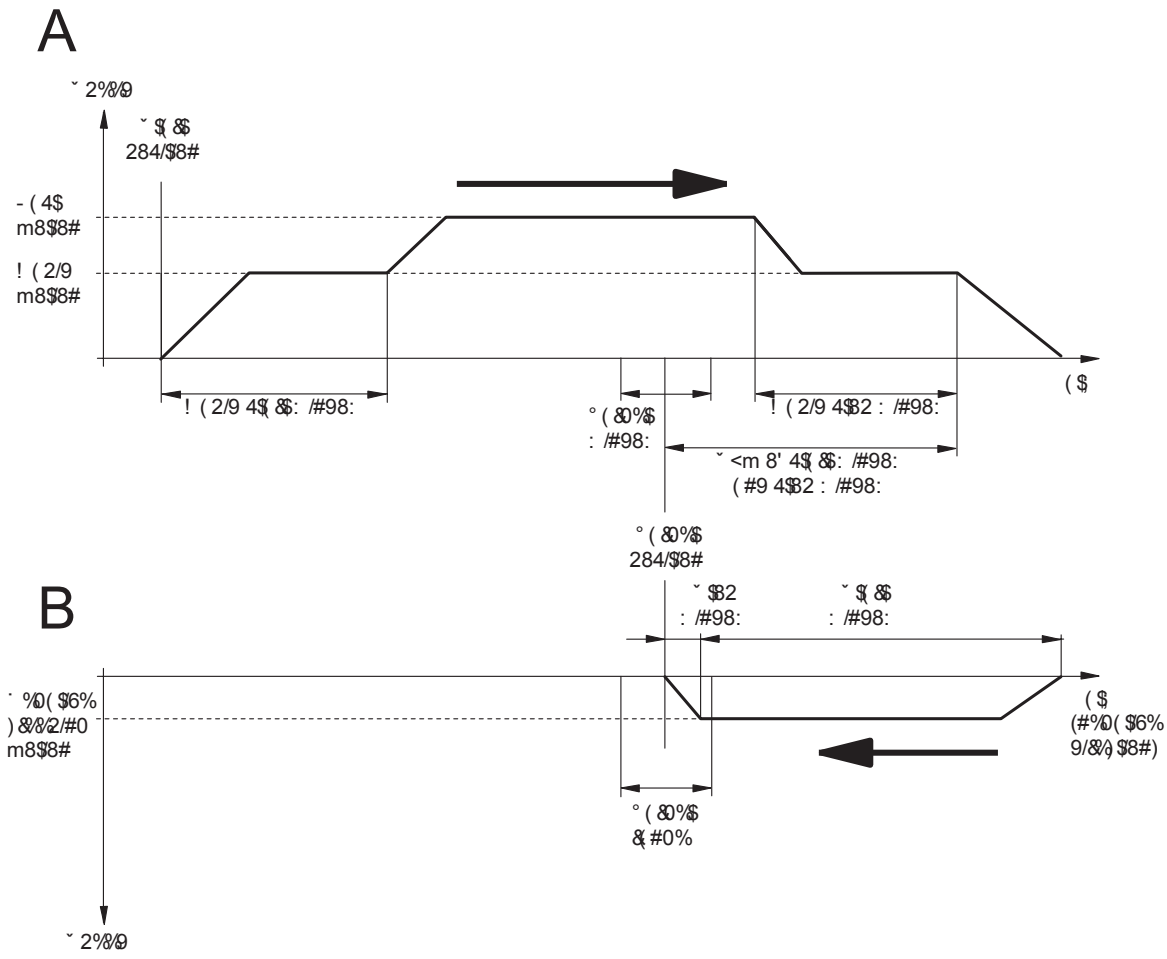


Fig. 5-8 Example of approaching a position with backlash compensation

5.5 Lubrication and Friction Compensation

The disadvantage of positioning processes with switched drives (rapid motion/creeping motion principle) is that positioning accuracy is very much dependent upon the stability and reproducibility of the shutdown times of the power switch and the braking response of the mechanics.

If, over time, these parameters change continuously and slowly, the resulting positioning error can be corrected by offsetting the stop point (stop window). To do this, after every positioning process, the positioning terminal determines the positioning error and adds this to the friction compensation value. When the next positioning process gets underway, the drive is stopped at the position calculated from the difference between the stop point and the friction compensation value. It is for this reason that the positioning terminal supports lubrication and friction compensation.

Lubrication and friction compensation will **only** work if the shutdown time of the power switch or the braking response of the mechanics change **continuously**.

If lubrication and friction compensation has been activated by setting the bit of the same name in the control word (OUT[1] bit 14 = 1), the target position is corrected by this value.

Once the positioning process has been completed, the friction compensation value is recalculated. The compensation values from previous positioning processes are not taken into account.

The friction compensation value can be set and requested at any time by a higher-level control system.

5.6 Software Limit Switches

Software limit switches are used to protect your system. These software limit switches prevent the drive traveling to a position beyond the software limit switches in normal operation, and thus prevent it driving right up to the limits (hardware limit switches). Hardware limit switches can also be used (these will continue to function even if the position encoder fails).

Software limit switches can be defined using the *Define minimum software limit switch* (see page 90) and *Define maximum software limit switch* (see page 91) commands.

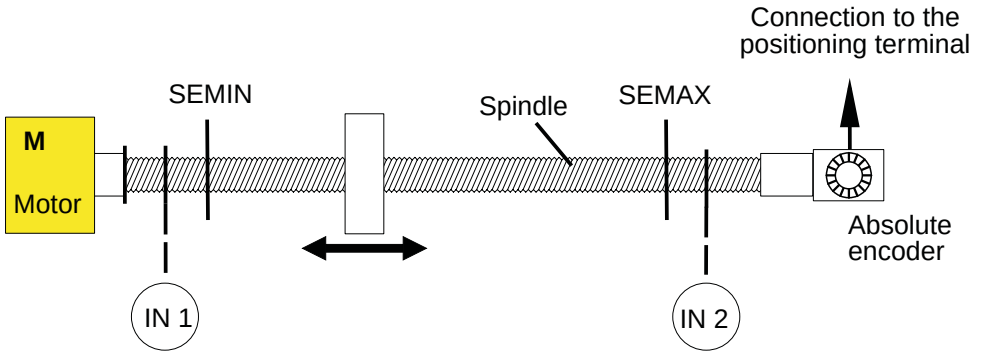


Fig. 5-9 Example of a software limit switch

IN 1	Limit position 1
IN 2	Limit position 2
SEMIN	Minimum software limit switch
SEMAX	Maximum software limit switch

In rotary axis mode and for homing, the software limit switches are **deactivated**.
In jog mode, both the software and hardware limit switches are **deactivated** for terminals with **firmware Version 1.1** or earlier.
For terminals with **firmware Version 1.1 or later**, both the software and hardware limit switches are **activated** in jog mode, although they can be deactivated. The hardware limit switches are deactivated using the *Define initiators and switching outputs* command (see page 81). The software limit switches are deactivated using the *Define software limit switches* command (see page 90).
The software limit switches are effective immediately.

Positioning

5.7 Axis Types

The positioning terminal can be used to execute positioning with both linear and rotary axes. The desired axis type must be specified during parameterization. Depending on the axis type, there are differences during parameterization and operation.

Linear axis

A linear axis is an axis with a limited path. The path is limited by parameterized software limit switches (SEMIN, SEMAX) and/or hardware limit switches (IN1, IN2).

The maximum path is the permissible position range of -2^{25} to $2^{25}-1$ increments.

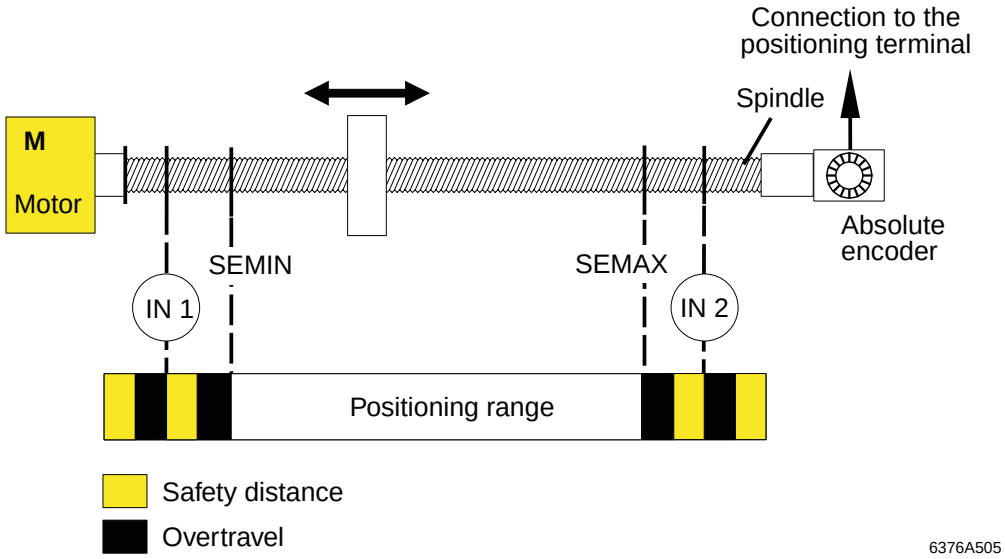


Fig. 5-10 Example of a linear axis

IN 1	Limit position 1
IN 2	Limit position 2
SEMIN	Minimum software limit switch
SEMAX	Maximum software limit switch

Rotary axis

A rotary axis is an axis with an unlimited path (rotary table, continuous conveyor belt). For a rotary axis, the path starts and ends at the same physical point on the axis. Hardware and software limit switches are not considered.

For rotary axes, the path (increments) for a rotation is referred to as a modulo value. The modulo value corresponds to the resolution of the absolute encoder.

For rotary axes, limitations can be specified with regard to the direction of motion. Some rotary axes can only move in a negative or in a positive direction, others can move in both directions.

The permissible traversing directions are determined by bits 4 and 5 of output word OUT[0] of the *Configure initiators and switching outputs* command (see page 81).

If rotary axis mode is active, the drive must be freely rotatable. If this is not possible, the axis will not meet the requirement for operation as a rotary axis and must, therefore, be parameterized as a linear axis.

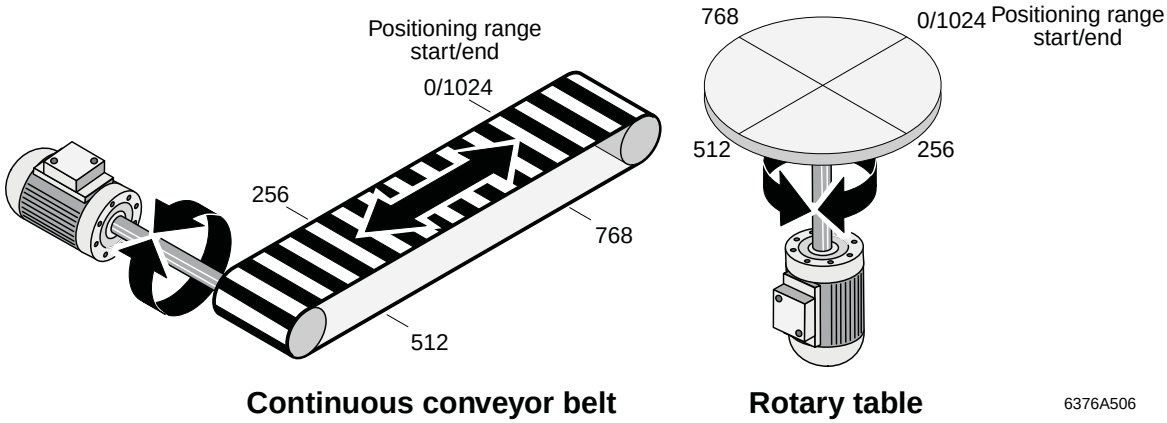


Fig. 5-11 Example of rotary axes

In Fig. 5-11 the modulo value is set to 1024. This value has the same position on the axis as the value 0. The actual value range is indicated by the terminal as 0 to 1023. The value 1024 is not indicated.

The module value is not converted via the gear ratio, i.e., it has to be specified in increments.

Path optimization

For rotary axes, which can travel in both a positive and a negative direction, the traversing direction is selected so that the target position is reached via the shortest path.

Example

On a rotary table, the encoder resolution (modulo value) is set to 10 bits. The current position is 896 and the specified target position is 128. If it is possible to travel in a positive and a negative direction, the table takes the shortest path to position 128, namely via the start/end of the path (0/1024).

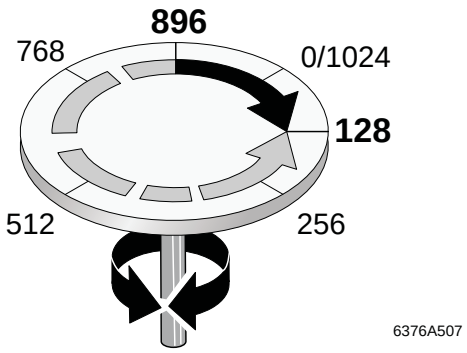


Fig. 5-12 Example of path optimization

If travel were only permitted in the negative direction, the table would travel from position 896 through positions 768, 512, and 256 to position 128.

5.8 Jog Mode

In jog mode, the two external bits routed via the bus system ensure that the positioning terminal is able to control the movement of the drive in a positive or negative direction. In jog mode, the drive can only travel at creeping speed.

There are two versions of the jog mode function:

1. Drive travels as long as the control bit is activated

   For this purpose, the "Delay time for continuous signal in jog mode" must be shorter than the "Monoflop time for jog mode".

2. Drive travels for a predefined period of time

   Here, a low-high edge on the "Jog mode control" bit will initiate the output of a drive control pulse of a predefined length. This makes it possible for the drive to approach a setpoint position manually in very small increments, step by step. As the pulse time used to control the drive can be shorter than the response time of the operator (or even shorter than, e.g., the bus cycle time), this function supports more precise increments than are possible with version 1.

The functions of the two versions can also be combined. In this case, a low-high edge on the control bit will initiate a drive control pulse on which the drive will travel a short distance. Following this, if the control bit remains pending, the drive will be controlled again once the "Delay time for continuous signal in jog mode" has elapsed until the control pulse is withdrawn.

In jog mode, bit 2 (jog mode negative direction) or bit 1 (jog mode positive direction) of the control word (OUT[0]) can be set to activate travel in the corresponding direction (see Section 7.13, "Control Commands").

Jog mode has the highest priority. This means that while jog mode is active, no other processes (positioning, looping) can be started. However, activating jog mode does not abort other processes.

For terminals with **firmware Version 1.1 or later**, both the software and hardware limit switches are **activated** in jog mode, although they can be deactivated.

5.9 Encoder Offset

When the encoder is installed, it might not be set to zero. An encoder offset can be set to avoid manually turning the encoder to the zero position.

Example An encoder with a resolution of 12 bits is used. Therefore, a range from 0 to 4096 increments can be used.

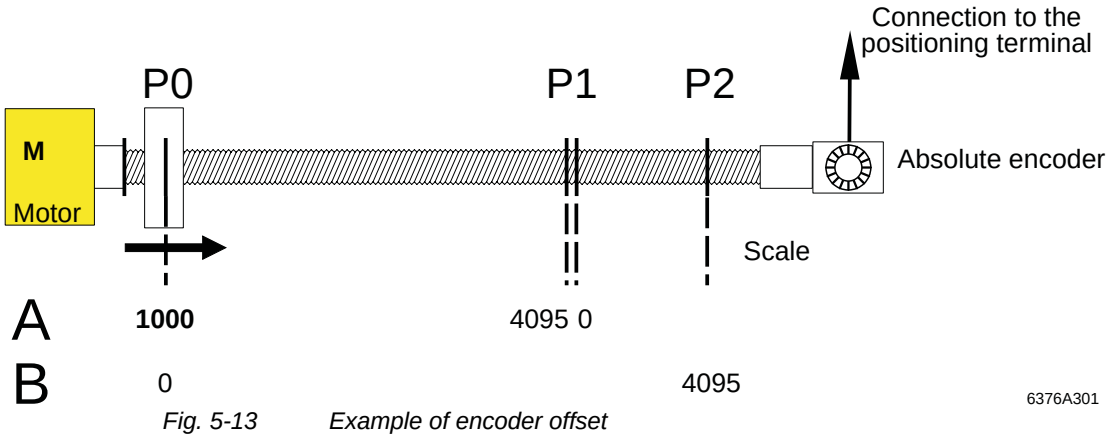


Fig. 5-13 Example of encoder offset

The encoder has been installed and the drive is in the presumed zero position (P0).

Read the current position (see ""Control Position and Read Position" Command (ControlPosition, ReadPosition)" on page 115).

In the example, this position is equal to 1000 (A in Fig. 5-13). If the drive now travels through position 4095 (P1), error message 18 "Counter overflow" is generated (see Fig. 7-18 "Error codes" on page 7-119). It is not possible to approach position P2.

To use the entire range of 4096 increments, position P0 must have the value 0. The encoder can also be removed and turned backwards. However, the terminal offers the option of assigning a certain position to this value using the *Define encoder offset* command. In the example, position P0 is to have the value "0 increments".

Define the encoder offset as 1000 (see ""Encoder Offset" Command (DefineEncoderOffset)" on page 93).

A gear ratio should not yet have been set when defining the encoder offset.

If you define the encoder offset with a value, which is not equal to the read position, you will still be operating with a limited range.

Positioning

5.10 Actual Position Detection

The R-IB IL SSI-PAC terminal generates the actual position, taking into consideration the counting direction from the data flow, the logic offset, and the gear ratio.

Reading the absolute encoder

To transfer the data from the absolute encoder correctly, the pulse train shown in Fig. 5-14 is generated by the R-IB IL SSI-PAC terminal.

Data transmission is im plemented by generating a clock pulse train every 33 pulses. The first pulse latches the position of the absolute encoder. The next 32 pulses are used to transmit the position of the encoder to the R-IB IL SSI-PAC. There is a pause t_P of at least 100 µs between clock pulse trains.

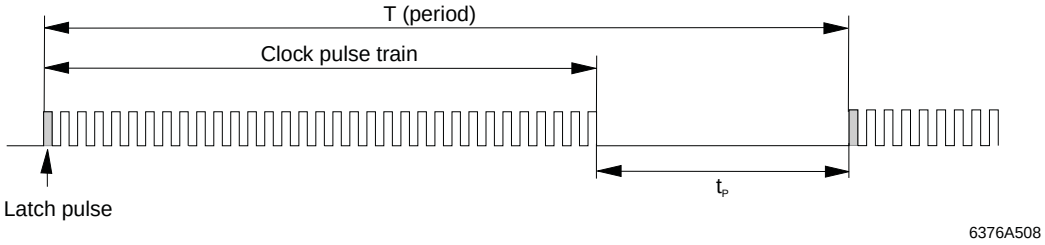


Fig. 5-14 Clock sequence during data transmission

Latch pulse	Start signal for data transmission	
t_P	Pause between two clock pulse trains	t_P > 100 µs

The data transmission sequence is illustrated in Fig. 5-15.

On the first pulse of a clock pulse train, the encoder writes the current position to its register. On the nex t falling edge of the clock signal, the most significant bit (D_n, MSB) is read, and on each subsequent falling edge, the next bit is read. Ifthe least significant bit (D_0, LSB) is read, up to two other bits (special bits, e.g., parity) are read for encoders with a corresponding function.

If, following transmission of bit D_0 or the special bits, signals are still pending at the clock input, data transmission will be repeated starting with the MSB (D_n). D_X represents the last bit transmitted.

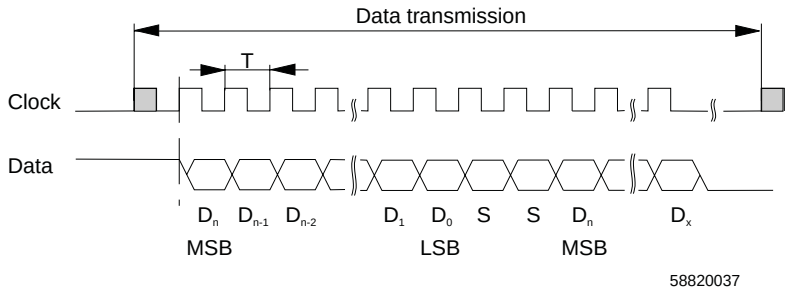


Fig. 5-15 Data transmission

S	Special bit	
T	Duration of a clock signal	T = 2.5 µs

The encoder must be configured appropriately to enable the received data to be evaluated correctly (see ""Encoder Configuration" Command (DefineEncoder)" on page 78).

When data transmission is complete, the corresponding number of data bits is evaluated (masked out) by the module firmware, according to the configuration of the "Resolution" parameter.

The data flow determined is converted into an absolute position value according to the code (Gray code or binary code). The current actual position is determined from this position value, taking into consideration the gear ratio and the logic offset.

The current actual position can be requested using the *Read position* command (see ""Control Position and Read Position" Command (ControlPosition, ReadPosition)" on page 115).

The resolution can be determined using the *Configure encoder* command (see also ""Encoder Configuration" Command (DefineEncoder)" on page 78).

Count range for actual position

The defined value range for the actual position is between -2^{25} and $2^{25}-1$ increments.

On exiting the defined actual value range, the counter enters the overflow range. Pulse detection continues, but error code 18_{dec} is set in the status word ("Counter overflow"; see Fig. 7-18 "Error codes" on page 7-119).

If a rotary axis is being parameterized, the actual position value is always mapped in the specified path, which is determined for the R-IB IL SSI-PAC terminal by the resolution of the encoder.

Positioning

Effect of the logic offset

The positioning terminal calculates the value displayed for the current position on the basis of the gear ratio and the logic offset according to the following formula:

$$P = G' \times \frac{A}{B} + O$$

Where:

P	Current position
G´	Value of the encoder minus encoder offset (if applicable, see page 59)
A	Numerator gear ratio
B	Denominator gear ratio
O	Logic offset

The offset is calculated using the formula:

$$O = S - G' \times \frac{A}{B}$$

Where:

O	Logic offset
G´	Value of the encoder minus encoder offset (if applicable, see page 59)
S	Setpoint position

G´ is calculated using the formula:

G´ = G - G0

Where:

G	Value of the encoder
G0	Encoder offset (see page 59)

Please note that when determining the current position, the logic offset must equal 0.

The current position can be determined using the *Read position* command (see ""Control Position and Read Position" Command (ControlPosition, ReadPosition)" on page 115).

Example An encoder with a resolution of 12 bits is used. Therefore, a range from 0 to 4095 increments can be used.

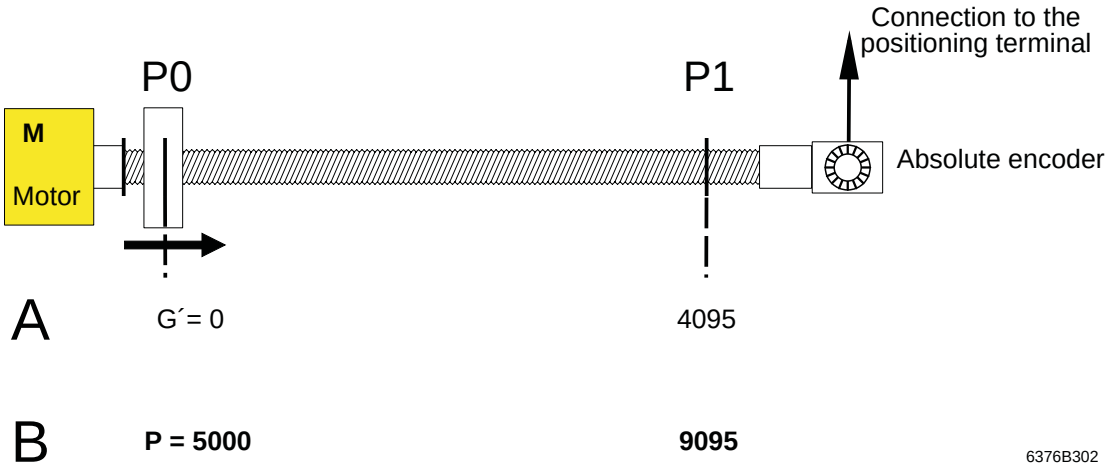


Fig. 5-16 Logic offset example

The encoder has been installed and the drive is in the zero position (P0). This state is either reached immediately or after defining the encoder offset (see "Encoder Offset" on page 59).

It is now possible to position within the range 0 to 4095 increments (A). However, if you want to shift your positioning range to another coordinate system, you can do this by defining the logic offset.

Define the logic offset, e.g., as 5000 (see ""Logic Offset" Command (DefineLogicOffset)" on page 89).

The value range is now between 5000 and 9095 increments, as shown in B.

Positioning

5.11 Gear Ratio

The *Define gear ratio* command can be used to specify the gear ratio, i.e., how many units of a measurement unit correspond to a certain number of increments (see also ""Gear Ratio" Command (DefineGearRatio)" on page 88).

A gear ratio can be used for linear and rotary axes.

Example You want to specify the position in centimeters rather than increments. You know that the entire path is 20 0 centimeters long and that this r epresents 4000 increments.

Therefore:

- Numerator gear ratio NGR = 200 (cm) (1 to 1023)
- Denominator gear ratio NGR = 4000 (1 to 2^{16} - 1)

$$\frac{NGR}{DGR} = \frac{200}{4000} = \frac{1}{20} \text{ (cm)}$$

All other values must now be specified in centimeters:

- Software limit switches
- Parameter records (start window, rapid start window, pre-stop window, stop window, target window, target position)
- Drive stop
- Logic offset

The terminal will also indicate all values (e.g., actual position) in centimeters.

Do **not** change the gear ratio during operation.
If the parameters specified above have not be en defined for the corresponding gear ratio, entering or changing the gear ratio during operation will corrupt the positioning process.

The user must specify a numerator and denominator ratio for the gear ratio as appropriate for the mechanics. The gear ratio must be ≤ 1.

If you wish to have the resolution in micrometers, you must use an encoder on the axis, which supplies at least one increment per micrometer. Otherwise, you will not be able to set the desired resolution via the gear ratio.

Stay within the value ranges for the numerator and denominator.

Example of a correct value range

$$\frac{NGR}{DGR} = \frac{4000}{16000}$$

An NGR > 1023 will corrupt the positioning process.

The following value is, therefore, preferable:

$$\frac{NGR}{DGR} = \frac{400}{1600} = \frac{1}{4}$$

5.12 Output Assignment

The terminal uses digital outputs to control the traversing rate and traversing direction of the drive. The output bits must be set accordingly for the various drives (pole-changing motors, Dahlander circuit, etc.) (the settings are not the same for each drive).

The bit combination the terminal works with is defined via the "Function of the switching outputs" parameter (see ""Configuration of Axis Types, Behavior in the Event of a Bus Failure, Initiators , and Switching Ou tputs" Command (DefineInOut)" on page 81).

The available output versions are described in ""Configuration of Axis Types, Behavior in the Event of a Bus Failu re, Initiators, and Switc hing Outputs" Command (DefineInOut)" on page 81.

CAUTION

Do not damage the system

Avoid damage by selecting a bit combination that is appropriate for your drive.

5.13 Hand-Held Operator Panel Mode

Hand-held operator panel mode is only designed for startup. It is activated by enabling (with a logic 1) hand-held operator panel mode at connector 3 (see "Terminal Point Assignment" on page 6).

For an example of how to wire the terminals, please refer to "Wiring of the Positioning Terminal When Using Hand-Held Operator Panel Mode" on page 37.
This section also describes the assembly of a connector specifically for hand-held operator panel mode. When hand-held operator panel mode is activated, the commands are generated via this connector and forwarded directly to the drive. Although the limit switches are monitored and this is indicated in the process data, the limit switches have no effect on drive control.

Positioning

6 Process Data Mode

Process data is used to configure, control, and read the positioning terminal.

6.1 Process Data Channel Assignment

Each positioning terminal's process image has two data words.

CAUTION

Ensure data consistency

Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.
See also "Tips for Working With the Positioning Terminal" on page 123.

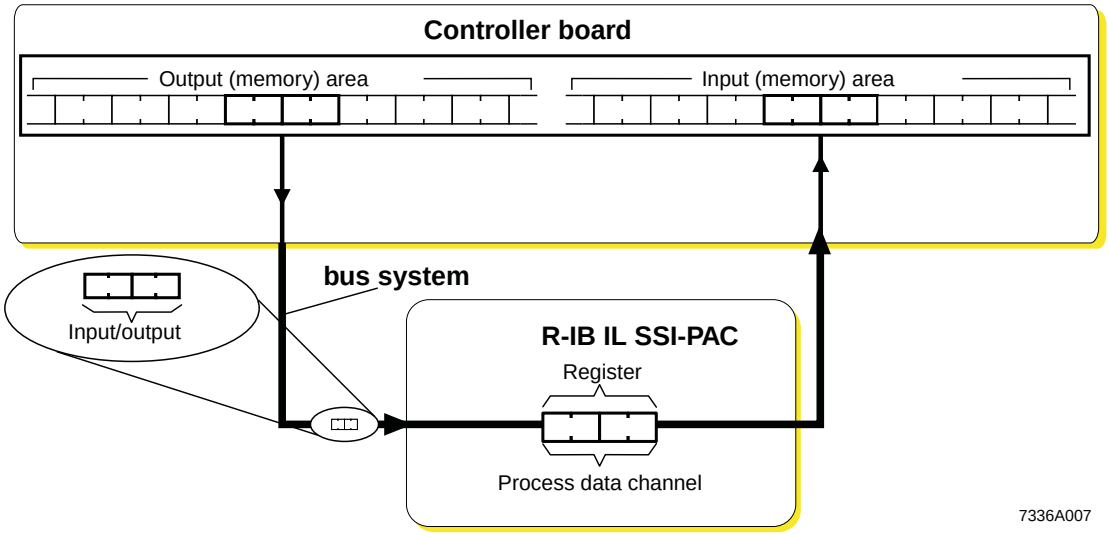


Fig. 6-1 Process image in the I/O (memory) area of the controller board

The data words are located in the process data (memory) area on the controller board. This memory area is a process image of the overall application, i.e., the bus configuration. The addresses are assigned by means of the automatic or logical addressing of the controller board.

The process data (memory) area comprises an output (memory) area and an input (memory) area. The two memory areas do not necessarily have to be different.

Definition

Direction of output data flow:	From the controller board to the terminal
Direction of input data flow:	From the terminal to the controller board

Process Data Mode

6.2 Output Words

The R-IB IL SSI-PAC terminal is configured and controlled by means of different commands transmitted via the two output words.

The command code and, if necessary, the associated parameters, are transmitted from the controller board to the terminal via the output words. If no parameters are required, the assignment of the parameter bits is not relevant.

Specify whether the system should write to a register of the terminal or read from this register using bit 15 of the first output data word (Read/Write; R/W). If R/W = 1, data is written to the register; if R/W = 0, data is read from the register.

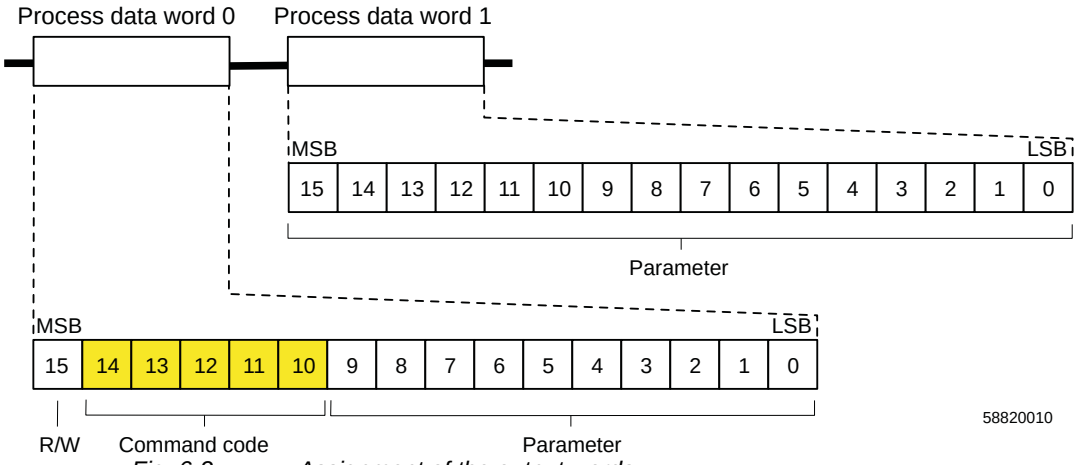


Fig. 6-2 Assignment of the output words

Valid command codes are listed in "Commands for Working With the Positioning Terminal" on page 71.

6.3 Input Words

Each R-IB IL SSI-PAC terminal uses two input words.

During parameterization, the output words are mirrored in the input words (command code and if applicable, appropriate parameters).

When reading parameters and the actual position, the desired value will be written to the input word.

In bit 15 of the first input data word, the R/W bit of the output data word is not mirrored. An error bit is set here, if one of the following is true:

- The terminal has not yet been completely configured.
- There is an invalid parameter in the default operating mode.
- A reserved bit has been set.

Read the status for additional information about the error.

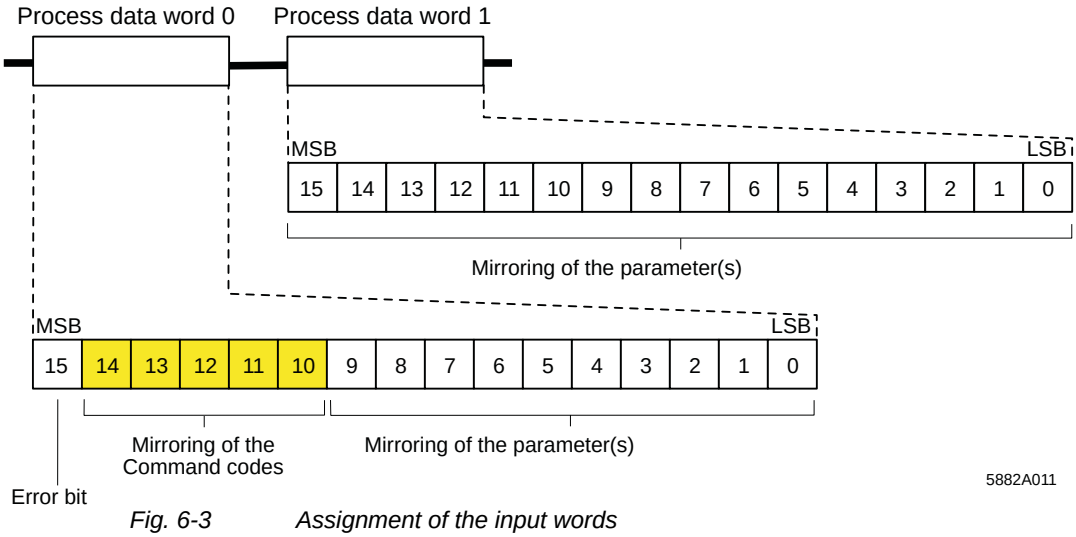


Fig. 6-3 Assignment of the input words

Process Data Mode

7 Commands for Working With the Positioning Terminal

Various types of commands are available for working with the positioning terminal:

- Commands for configuring position value detection
- Commands for configuring the positioning system
- Commands for parameterizing the path
- Commands for controlling functions

In order to carry out a positioning process, the commands highlighted in bold in Fig. 7-2 on page 74 need to be executed as a minimum.

7.1 Overview of Commands

Communication with the positioning terminal can only take place via the process data channel. It works like this:

- A command is sent to the module.
- The module detects the command and acknowledges this by mirroring the command.
- In the case of commands used to write parameters, the module also mirrors the parameters.
- Commands used to read a value are mirrored and the value read is sent in the remaining bits.
- Commands used to send a parameter comprise both the command code and the parameter.

Generating Codes for Parameterization

The basic code for the relevant command is entered as the command code.

You will need to add the code associated with the required parameters to this basic code or link the two codes (basic code and parameter code) using the OR function.

Example

Configure encoder command code (see page 74)	**90**00 0000
Parameters (see page 78)	PAR = 01_{bin}; REV = 1_{bin}; RESOLUTION = 00101_{bin}; CODE = 1_{bin}
Parameter code (with leading zeros added)	00**11 0501**
Code for parameterization	**9011 0501**

Command Descriptions (Default Values)

The **default values** preset on the positioning terminal appear in **bold** in the data relating to valid ranges of values for parameters.

For some parameters, the default value is not a valid value for parameterization. In this case, a value **appropriate for your system configuration must** be set (e.g., switching outputs, see page 82). If you do not make this setting, the terminal will generate an error message.

In addition to appearing in the language of the document, the command and bit names also appear in English and *italics*.

Representation of Output Words and Codes

For the assignment of output words, the bit assignment is displayed in binary and hexadecimal representation.

A	4 or X

In order to more effectively distinguish between adjacent nibbles, these are displayed against a black/white background.

Here, the code is specified in hexadecimal representation.

A The code is unique.

X The code is determined by the assignment of the individual bits.

4 or X
- X The code is determined by the assignment of the individual bits.
- 4 Code for basic code; bits, which do not belong to the basic code, are still at 0.

C/E Depending on a bit position, the code will either be C or E.

In a code, nibble, byte or word limits are indicated by a blank space.

Data Types Associated With Parameters:

The data type of a parameter is specified for each individual parameter. The following data types are used:

Designation	Example	Meaning
INTx	INT26	Signed value, represented in x bits.
USIGNx	USIGN5 USIGN8 USIGN10 USIGN12 USIGN16 USIGN26	Unsigned value, represented in x bits.
–		Parameters for which a data type has not been specified are represented as bit strings.

Fig. 7-1 Data types associated with parameters

With regard to the representation of values in your control or computer system, please note:

- In the case of an INT26 value represented in 32 bits, the sign bit (bit 25; word[1], bit 9) is copied to the free most significant bits (bits 26 to 31).
  If bit 25 = 0, bits 26 to 31 must be set to 0.
  If bit 25 = 1, bits 26 to 31 must be set to 1.
- In the case of a USIGN value, the free most significant bits must be set to 0.
  Example: A USIGN10 value is saved in a word (16 bits). This means that bits 10 to 15 are set to 0.

Commands for Working With the Positioning Terminal

Bits 15 Through 10 (bin) (OUT[0])	Command Code (Hex) (Basic Code) Write/Read	Command Description	*Command*	Default value	Page
Configuration of position detection					
1001 00 **0001 00**	**9000 0000/** **1000 0000**	**Define encoder configuration/Read encoder configuration**	***DefineEncoder/*** ***ReadEncoderConfiguration***	See page 78	78
1001 01 **0001 00**	**9400 0000/** **1400 0000**	**Define configuration of axis types, behavior in the event of a bus failure, initiators, and switching outputs/Read configuration of axis types, behavior in the event of a bus failure, initiators, and switching outputs**	***DefineInOut/*** ***ReadInOut***	See page 81	81
1010 00 0010 00	A000 0000/ 2000 0000	Define gear ratio/ Read gear ratio	*DefineGearRatio/* *ReadGearRatio*	$01\ 0001_{hex}$ Factor 1	88
1010 01 0010 01	A400 0000/ 2400 0000	Define logic offset/ Read logic offset	*DefineLogicOffset/* *ReadLogicOffset*	0	89
1011 00 0011 00	B000 0000/ 3000 0000	Define encoder offset/ Read encoder offset	*DefineEncoderOffset/* *ReadEncoderOffset*	0	93

Fig. 7-2 Overview of commands for working with the positioning terminal

Bits 15 Through 10 (bin) (OUT[0])	Command Code (Hex) (Basic Code) Write/Read	Command Description	*Command*	Default value	Page
Configuration of the positioning system					
1001 10	9800 0000/ 1800 0000	Define drive stop/Read drive stop	*DefineDrvStop/* *ReadDrvStop*	0A 0001_{hex} 1 increment/s	86
1001 11 0001 11	9C00 0000/ 1C00 0000	Define delay time for detection of direction and stop and output delay time/ Read delay time for detection of direction and stop and output delay time	*DefineDsdOd* *ReadDsdOd*	00 $000A_{hex}$ 0 ms/10 ms	92
1010 10 0010 10	A800 0000/ 2800 0000	Define minimum software limit switch/ Read minimum software limit switch	*DefineMinSWLimSwitch/* *ReadMinSWLimSwitch*	-2^{25}	90
1010 11 0010 11	AC00 0000/ 2C00 0000	Define maximum software limit switch/ Read maximum software limit switch	*DefineMaxSWLimSwitch/* *ReadMaxSWLimSwitch*	$2^{25} - 1$	91
1011 01	B400 0000/ 3400 0000	Reserved	Reserved		
1011 10	B800 0000/ 3800 0000	Reserved	Reserved		
0011 11	3C00 0000	Read firmware version	*ReadFirmwareVersion*	–	87
1001 01 0001 01	9500 0000/ 1500 0000	Define jog mode/ Read jog mode	*DefineJogMode/* *ReadJogMode*	–	110

Fig. 7-2 Overview of commands for working with the positioning terminal (Continued)

Commands for Working With the Positioning Terminal

Bits 15 Through 10 (bin) (OUT[0])	**Command Code (Hex) (Basic Code) Write/Read**	**Command Description**	***Command***	**Default value**	**Page**
Parameters for path (record 1) (*Parameter record 1*)					
1100 00 0100 00	C000 0000/ 4000 0000	Define start window/ Read start window	*DefineStartWindow/* *ReadStartWindow*	0	95
1100 01 0100 01	C400 0000/ 4400 0000	Define rapid start window/ Read rapid start window	*DefineRapidStartWindow/* *ReadRapidStartWindow*	0	97
1100 10 0100 10	C800 0000/ 4800 0000	Define rapid stop window/ Read rapid stop window	*DefineRapidStopWindow/* *ReadRapidStopWindow*	0	99
1100 11 0100 11	CC00 0000/ 4C00 0000	Define pre-stop window/ Read pre-stop window	*DefinePre-StopWindow/* *ReadPre-StopWindow*	0	101
1101 00 0101 00	D000 0000/ 5000 0000	Define stop window/ Read stop window	*DefineStopWindow/* *ReadStopWindow*	0	103
1101 01 0101 01	D400 0000/ 5400 0000	Define target window/ Read target window	*DefineTargetWindow/* *ReadTargetWindow*	0	105
1101 10 0101 10	D800 0000/ 5800 0000	Define target position/ Read target position	*DefineTargetPosition/* *ReadTargetPosition*	0	107
1101 11 0101 11	DC00 0000/ 5C00 0000	Define lubrication and friction compensation value/ Read lubrication and friction compensation value	*DefineLubFricCompValue/* *ReadLubFricCompValue*	0	109
Parameter for path (record 2) (*Parameter record 2*)					
1110 00 0110 00	E000 0000/ 6000 0000	Define start window/ Read start window	*DefineStartWindow/* *ReadStartWindow*	0	95
1110 01 0110 01	E400 0000/ 6400 0000	Define rapid start window/Read rapid start window	*DefineRapidStartWindow/* *ReadRapidStartWindow*	0	97
1110 10 0110 10	E800 0000/ 6800 0000	Define rapid stop window/ Read rapid stop window	*DefineRapidStopWindow/* *ReadRapidStopWindow*	0	99
1110 11 0110 11	EC00 0000/ 6C00 0000	Define pre-stop window/ Read pre-stop window	*DefinePre-StopWindow/* *ReadPre-StopWindow*	0	101
1111 00 0111 00	F000 0000/ 7000 0000	Define stop window/ Read stop window	*DefineStopWindow/* *ReadStopWindow*	0	103
1111 01 0111 01	F400 0000/ 7400 0000	Define target window/ Read target window	*DefineTargetWindow/* *ReadTargetWindow*	0	105
1111 10 **0111 10**	**F800 0000**/ 7800 0000	**Define target position/** **Read target position**	*DefineTargetPosition/* *ReadTargetPosition*	0	107
1111 11 0111 11	FC00 0000/ 7C00 0000	Define lubrication and friction compensation value/ Read lubrication and friction compensation value	*DefineLubFricCompValue/* *ReadLubFricCompValue*	0	109

Fig. 7-2 Overview of commands for working with the positioning terminal (Continued)

Bits 15 Through 10 (bin) (OUT[0])	**Command Code (Hex) (Basic Code) Write/Read**	**Command Description**	***Command***	**Default value**	**Page**
Control functions					
1000 00 0000 00	**8000 0000/ 0000 0000**	**Control position, read position/ Read position**	***ControlPosition, ReadPosition/ ReadPosition***	0	115
1000 01 0000 01	8400 0000/ 0400 0000	Control position, read velocity/ Read velocity	*ControlPosition, ReadVelocity/* *ReadVelocity*	–	116
1000 10 0000 10	8800 0000/ 0800 0000	Control position, read status/ Read status	*ControlPosition, ReadStatus/ ReadStatus*	–	117

Fig. 7-2 Overview of commands for working with the positioning terminal (Continued)

7.2 "Encoder Configuration" Command (*DefineEncoder*)

Command 9000 0000_{hex} can be used to define the type of encoder connected to the terminal and how that encoder is evaluated. Configure the encoder using the OR function to link command 9000 0000_{hex} to the bits listed below. x indicates dependence on the value of the parameter.

To read the encoder configuration from the corresponding register on the terminal, send command 1000 0000_{hex} (bit 15 = 0).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**PAR**		**0**	**0**	**0**	**ER**
9 (Write)/1 (Read)				**0**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**RESO**					**0**	**0**	**0**	**0**	**0**	**0**	**0**	**CODE**
X				**X**				**0**				**X**			

Permissible Values for *DefineEncoder*:

Code (Bin)	PAR: Parity *(Parity)*
00	**None**
01	Even
10	Odd
11	Reserved

Code (Bin)	ER: Encoder Installation Direction (*Enc Rotation*)
0	**Normal**
1	Inverted

Code (Bin)	RESO: Resolution (*Resolution*)
00000	**Invalid**
00001	8
00010	9
00011	10
00100	11
00101	12
00110	13
00111	14
01000	15
01001	16
01010	17
01011	18
01100	19
01101	20
01110	21
01111	22

Code (Bin)	RESO: Resolution (*Resolution*)
10000	23
10001	24
10010	25
10011	26
10100	Reserved
10101	
10110	
10111	
11000	
11001	
11010	
11011	
11100	
11101	
11110	
11111	

Code (Bin)	CODE: Code *(Code)*
0	**Binary code**
1	Gray code

Commands for Working With the Positioning Terminal

PAR: Parity

If you have configured a parity check for your encoder and the encoder supports this function, the parity check will be carried out when the current actual position is detected. In the event of this parity check returning an error twice in succession, the error message will be generated with error code 5_{dec} ("A parity error has occurred") (see Fig. 7-18 on page 119).

ER: Encoder installation direction

The installation direction allows you to invert the interpretation of the encoder's code string (count direction of the encoder and coordinate system).

If, for example, you have installed an encoder so that the position counter counts up when the axis is rotating in a positive direction, you can set the ER bit to parameterize the positioning terminal to count down when the axis is rotating in a positive direction.

The advantage of this, for example, is that the same encoder can be used on both sides of the axis without range limits having to be changed.

RESO: Resolution

The resolution for the R-IB IL SSI-PAC terminal must be the same as the resolution supported by the absolute encoder.

Example:

A multi-turn encoder is used with the 12 bits/12 bits parameter. This encoder indicates a position in the following terms:

- Number of rotations (displayed in 12-bit format)
- Resolution per rotation (displayed in 12-bit format)

The resolution is, therefore, 24 bits (12 bits + 12 bits).

CODE: Code

Depending on type, an encoder will work in Gray code or binary code. The Code parameter must be set accordingly.

7.3 "Configuration of Axis Types, Behavior in the Event of a Bus Failure, Initiators, and Switching Outputs" Command (*DefineInOut*)

Command 9400 0000_{hex} can be used to write the parameters for:

- Axis type
- Behavior in the event of a bus system failure
- Switching outputs
- Initiator function

To read the parameters from the corresponding register on the terminal, send command 1400 0000_{hex} (bit 15 = 0).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**AXIS**		**0**	**0**	**0**	**AABR**
9 (Write)/1 (Read)				**4**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**OUTF**			**0**	**IN3F**			**0**	**IN2F**			**0**	**IN1F**		
X				**X**				**X**				**X**			

Commands for Working With the Positioning Terminal

Permissible Values for *DefineInOut*:

Code (Bin)	AXIS: Axis Type (Rotary Axis/Linear Axis) *(AxisType)* (See Also "Axis Types" on page 56)
00	**Linear axis**
01	Rotary axis: Movement only possible in negative direction of rotation
10	Rotary axis: Movement only possible in positive direction of rotation
11	Rotary axis: Negative and positive direction of rotation

Code (Bin)	AABR: Behavior of the Outputs on Bus Reset *(Action at Bus Reset)*
0	**In the event of a bus reset, the switching outputs are reset and, as a consequence, any active positioning processes are stopped.**
1	Resetting the bus has no effect on the positioning process. This means that the inputs can continue to start positioning processes.

Code (Bin)	OUTF: Switching Outputs (Output Version) *(Output Functions)*
000	**Invalid**
001	Version 1
010	Version 2
011	Version 3
100	Version 4
101	Version 5
110	Reserved
111	Reserved

The possible versions are listed in "Function of th e Switching Outputs (OutputFunction)" on page 85.

If, in the case of the following parameters, the bit marked "x" = 1, the inverse input function will be executed. This means that the switches will be active at low level or the function will be triggered on an edge which is the opposite of that specified.

Code (Bin)	**Active**	**IN3F: Initiator 3 Function** ***(Initiator3Function)***
x00	–	**Reserved**
x01	↑	Start positioning with parameter record 2
x10	↑	Start positioning with parameter record 1
x11	•	None (digital input only)

Code (Bin)	**Active**	**IN2F: Initiator 2 Function** ***(Initiator2Function)***
x00	•	**Maximum limit switch**
x01	↓	Maximum limit switch
x10	↑	Start positioning with parameter record 2
x11	•	None (digital input only)

Code (Bin)	**Active**	**IN1F: Initiator 1 Function** ***(Initiator1Function)***
x00	•	**Minimum limit switch**
x01	↓	Minimum limit switch
x10	↑	Start positioning with parameter record 1
x11	•	None (digital input only)

- • Signal is level-controlled (signal is evaluated when set to 1)
- ↑ Signal is edge-controlled (signal is evaluated when the bit changes from 0 to 1)
- ↓ Signal is edge-controlled (signal is evaluated when the bit changes from 1 to 0)

Commands for Working With the Positioning Terminal

AXIS: Axis type

The positioning terminal can be used to automate both linear and rotary axes. The "Axis Type" variable is used to select the operating mode of the axis. The positioning function differs depending on the type of axis:

- If a rotary axis is selected, the hardware limit switches and the software limit switches have no function (see "Axis Types" on page 56).

AABR: Behavior on bus reset

Bit 0 in output word OUT[0] (AABR) can be used to parameterize the behavior of the switching outputs in the event of a bus reset (bus failure). If the bit is reset (AABR = 0), the switching outputs are also reset in the event of a bus reset and, as a consequence, any active positioning processes are stopped. If the bit is set (AABR = 1), resetting the bus has no effect on the positioning process. This means that the inputs can continue to start new positioning processes.

OUTF: Switching outputs

The terminal uses digital outputs to control the traversing rate and traversing direction of the drive. The output bits must be set accordingly for the various drives (pole-changing motors, Dahlander circuit, etc.) (the settings are not the same for each drive).

The bit combination the terminal works with is defined via the "Function of the switching outputs" parameter (OUTF).

INxF: Initiators

The initiators can be used as limit switches or as control inputs. If the initiators are used as control inputs, positioning processes can be started by external events. In order that the control function can be executed, as well as the initiator concerned being parameterized accordingly, the parameter record must also be enabled by the control command for external positioning (ELC2 or ELC1 in the control word; see "Control Commands" on page 112). An external control command will then only be accepted if no other positioning processes are active at the time.

7.3.1 Function of the Switching Outputs (*OutputFunction*)

State	Output 1	Output 2	Output 3	Output 4
Stop	0	0	0	0
Positive creeping motion	0	1	1	0
Positive rapid motion	1	1	1	0
Negative creeping motion	0	1	0	1
Negative rapid motion	1	1	0	1

Fig. 7-3 Version 1

State	Output 1	Output 2	Output 3	Output 4
Stop	0	0	0	0
Positive creeping motion	0	1	1	0
Positive rapid motion	1	0	1	0
Negative creeping motion	0	1	0	1
Negative rapid motion	1	0	0	1

Fig. 7-4 Version 2

State	Output 1	Output 2	Output 3	Output 4
Stop	0	0	0	0
Positive creeping motion	0	1	0	0
Positive rapid motion	1	0	0	0
Negative creeping motion	0	0	1	0
Negative rapid motion	0	0	0	1

Fig. 7-5 Version 3

State	Output 1	Output 2	Output 3	Output 4
Stop	0	0	0	0
Brake	0	0	1	1
Positive creeping motion	1	0	0	0
Positive rapid motion	1	1	0	0
Positive fast motion	1	1	1	0
Negative creeping motion	1	0	0	1
Negative rapid motion	1	1	0	1
Negative fast motion	1	1	1	1

Fig. 7-6 Version 4

State	Output 1	Output 2	Output 3	Output 4
Outputs that can be freely controlled via a control command (see Fig. 7-16 on page 112)	OUT 1	OUT 2	OUT 3	OUT 4

Fig. 7-7 Version 5

Commands for Working With the Positioning Terminal

7.4 "Drive Stop" Command (*DefineDrvStop*)

Define the drive stop by assigning a maximum path to be traveled within a specific time interval. If this maximum path is traveled within the time interval, the terminal detects a drive stop.

See also Section 5.2, "Drive Stop".

Define the drive stop using the OR function to link command 9800 0000_{hex} to the variables for Time and Distance.

To read the parameters, send command 1800 0000_{hex} (bit 15 = 0).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**TIME (USIGN5)**				
9 (Write)/1 (Read)	**8**							**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DSTD (USIGN16)															
X				**X**				**X**				**X**			

Permissible Value Ranges for *DefineDrvStop*:

Code (Dec)	TIME: Time Interval for Drive Stop *(DefineStopTime)*
0	No monitoring of drive stop
1 to 31	0.1 s to 3.1 s
10	**1 s**

Code (Dec)	DSTD: Drive Stop Distance *(DefineStopDistance)*
0 to 2^{16} - 1	0 increments to 2^{16} - 1 increments
1	**1 increment**

7.5 "Read Firmware Version" Command (*ReadFirmwareVersion*)

Command 3C00 0000_{hex} can be used to read the firmware version of your positioning terminal. This command can be used at any time. The result is shown immediately in input word IN[1].

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3 (Read)				**C**				**0**				**0**			

Output word 1 is 0000_{hex}.

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ST	**0**	**1**	**1**	**1**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
3 or X				**C**				**0**				**0**			

Example Input word 1 (IN[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Firmware version															
0	**0**	**0**	**1**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**X**	**X**	**X**	**X**
1				**2**				**3**				**A**			

In this example input word IN[1] has the value $123A_{hex}$. The firmware Version is 1.23. The value of bits 3 to 0 of input word 1 is not relevant.

Commands for Working With the Positioning Terminal

7.6 "Gear Ratio" Command (*DefineGearRatio*)

Define the gear ratio using the OR function to link command A000 0000_{hex} to the numerator and denominator of the gear ratio.

To read the parameters, send command 2000 0000_{hex} (bit 15 = 0).

The gear ratio can be used to scale the position value. The gear ratio can, therefore, be used to assign all paths in a unit of your choice (e.g., mm or cm, see also "Gear Ratio" on page 64).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**1**	**0**	**0**	**0**	**NGR (USIGN10)**									
A (Write)/2 (Read)	**0 or X**					**X**						**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
DGR (USIGN16)															
X				**X**				**X**				**X**			

Permissible Value Ranges for *DefineGearRatio*:

Code (Dec)	NGR: Numerator Gear Ratio *(NumeratorGearRatio)*
1 to 1023	**1 increment** to 1023 increments

Code (Dec)	DGR: Denominator Gear Ratio *(DenominatorGearRatio)*
1 to 2^{16} - 1	**1 increment** to 2^{16} - 1 increments

7.7 "Logic Offset" Command (*DefineLogicOffset*)

The position values can be shifted by defining the logic offset.

You should not define the logic offset until **after** you have defined the gear ratio, as the logic offset must be specified in the corresponding unit (see also "Effect of the logic offset" on page 62).

Remember the difference between the logic offset and the encoder offset. See ""Encoder Offset" Command (DefineEncoderOffset)" on page 93 and "Encoder Offset" on page 59.

Define the logic offset using the OR function to link command A400 0000_{hex} to the 26-bit variables for the logic offset.

To read the logic offset, send command 2400 0000_{hex} (bit 15 = 0).

The logic offset is a 26-bit value.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**1**	**0**	**0**	**1**	**LO (26-bit value; INT26)**									
A (Write)/2 (Read)	**4 or X**					**X**						**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LO (26-bit value; INT26)															
X				**X**				**X**				**X**			

Permissible Value Range for *DefineLogicOffset*:

Code (Dec)	LO: Logic Offset *(LogicOffset)*
-2^{25} to $+(2^{25} - 1)$	-2^{25} increments to $+(2^{25} - 1)$ increments
0	**0 increments**

Commands for Working With the Positioning Terminal

7.8 "Software Limit Switch" Command (*MaximumSoftwareLimitSwitch*, *MinimumSoftwareLimitSwitch*)

Taking into account the gear ratio, the software limit switches define the minimum and maximum position of the path. The software limit switches are specified as 26-bit values.

Before positioning starts, the system checks whether the software limit switches have been overrun. If the target position is outside the software limit switches, positioning is not started and an error message with error code 10_{dec} is generated (see "Error codes" on page 119).

Please refer to the notes about software limit switches in rotary axis mode and jog mode in "Software Limit Switches" on page 55.

7.8.1 "Minimum Software Limit Switch" Command (*DefineMinSWLimSwitch*)

Define the minimum software limit switch using the OR function to link command A800 0000_{hex} to the variable for the minimum software limit switch.

To read the minimum software limit switch, send command 2800 0000_{hex} (bit 15 = 0).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**1**	**0**	**1**	**0**	**MINL (26-bit value; INT26)**									
A (Write)/2 (Read)	**8 or X**					**X**						**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MINL (26-bit value; INT26)															
X				**X**				**X**				**X**			

Permissible Value Range for *DefineMinSWLimSwitch*:

Code (Dec)	MINL: Minimum Software Limit Switch *(MinSWLimSwitch)*
-2^{25} to $+(2^{25} - 1)$	**-2^{25} increments** to $+(2^{25} - 1)$ increments

7.8.2 "Maximum Software Limit Switch" Command (*DefineMaxSWLimSwitch*)

Define the maximum software limit switch using the OR function to link command AC00 0000_{hex} to the variable for the maximum software limit switch.

To read the maximum software limit switch , send command 2C00 0000_{hex} (bit 15 = 0).

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**1**	**0**	**1**	**1**	**MAXL (26-bit value; INT26)**									
A (Write)/2 (Read)				**C or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MAXL (26-bit value; INT26)															
X				**X**				**X**				**X**			

Permissible Value Range for *DefineMaxSWLimSwitch*:

Code (Dec)	MAXL: Maximum Software Limit Switch *(MaxSWLimSwitch)*
-2^{25} to **+(2^{25} - 1)**	-2^{25} increments to **+(2^{25} - 1) increments**

7.9 "Delay Time for Detection of Direction and Stop and Output Delay Time" Command (*DefineDsdOd*)

Define the "Delay time for detection of direction and stop" and "Output delay time" parameters using the OR function to link command 9C00 0000_{hex} to the variables.

To read the parameters, send command 1C00 0000_{hex} (bit 15 = 0).

The delay time for detection of direction and stop defines the time during which monitoring of the drive stop is deactivated once the drive has started. This enables the mechanics to start up during a positioning process without a stop being detected if drive stop monitoring is active.

If contactors are connected to the outputs of the R-IB IL SSI-PAC positioning terminal to control the drive, delay times must be observed before controlling the individual contactors. Otherwise, there is a risk of short circuits if a contactor picks up more quickly than the previous one drops out. These delay times are defined using the "Output delay time" variable.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**1**	**1**	**1**	**0**	**0**	**DSD (USIGN8)**							
9 (Write)/1 (Read)	**C**							**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**0**	**ODT (USIGN12)**											
0				**X**				**X**				**X**			

Permissible Value Ranges for *DefineDsdOd*:

Code (Dec)	DSD: Delay Time for Detection of Direction and Stop *(DriveStartingDelay)*
0 to 255	**0 s** to 25.5 s

Code (Dec)	ODT: Output Delay Time (*OutDelayTime*)
0 to 4095	0 ms to 4095 ms
10	**10 ms**

7.10 "Encoder Offset" Command (*DefineEncoderOffset*)

Define the encoder offset using the OR function to link command B000 0000_{hex} to the encoder offset and send this command to the terminal.

To read the encoder offset, send command 3000 0000_{hex} (bit 15 = 0).

The encoder offset physically shifts the representation range on the basis of increments.

Define the encoder offset **before** you define the gear ratio (see also "Encoder Offset" on page 59).

Remember the difference between the encoder offset and the logic offset. See ""Logic Offset" Command (DefineLogicOffset)" on page 89 and "Effect of the logic offset" on page 62.

The encoder offset is specified as a 26-bit value.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**1**	**1**	**0**	**0**	**ENCO (26-bit value; USIGN26)**									
B (Write)/3 (Read)	**0 or X**					**X**						**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ENCO (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

Permissible Value Range for *DefineEncoderOffset*:

Code (Dec)	ENCO: Encoder Offset *(EncoderOffset)*
0	**No** encoder offset
1 to 2^{26} - 1	1 increment to 2^{26} - 1 increments

The value for the encoder offset must not exceed the resolution of the encoder.

7.11 Commands for Parameterizing the Path

See also "Positioning and Structure of a Position" on page 43.

The positioning terminal supports an option to use two positioning data records to parameterize two independent paths.

A path is defined by the following parameters:

- Start window
- Rapid start window (only version 4 of "Function of the switching outputs")
- Rapid stop window (only version 4 of "Function of the switching outputs")
- Pre-stop window
- Stop window
- Target window
- Target position
- Friction compensation value (only if bit 14 (ALFC) in control word 1 is set)

Bit 13 of output word 0 is used to select the parameter record for each individual parameter (**P***arameter* **r***ecord* **x**; PRx).

- PRx = 0: Parameterization for parameter record 1
- PRx = 1: Parameterization for parameter record 2

7.11.1 "Start Window" Command (*StartWindow*)

Define the start window using the OR function to link command C000 0000_{hex} for parameter record 1 or E000 0000_{hex} for parameter record 2 to the value for the start window and send this command to the terminal.

To read the value, send command 4000 0000_{hex} for parameter record 1 (bit 15 = 0) or 6000 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**0**	**0**	**0**	**SW1/SW2 (26-bit value; USIGN26)**									
C/E (Write)/4/6 (Read)				**0 or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
SW1/SW2 (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1)*
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

If output version 4 is parameterized, the start window is only taken into account during looping (looping, backlash compensation).

Permissible Value Range for *StartWindow*:

Code (Dec)	SW1/SW2: Start Window (*StartWindow*)
0 to 2^{26} - 1	**0 increments** to 2^{26} - 1 increments

Commands for Working With the Positioning Terminal

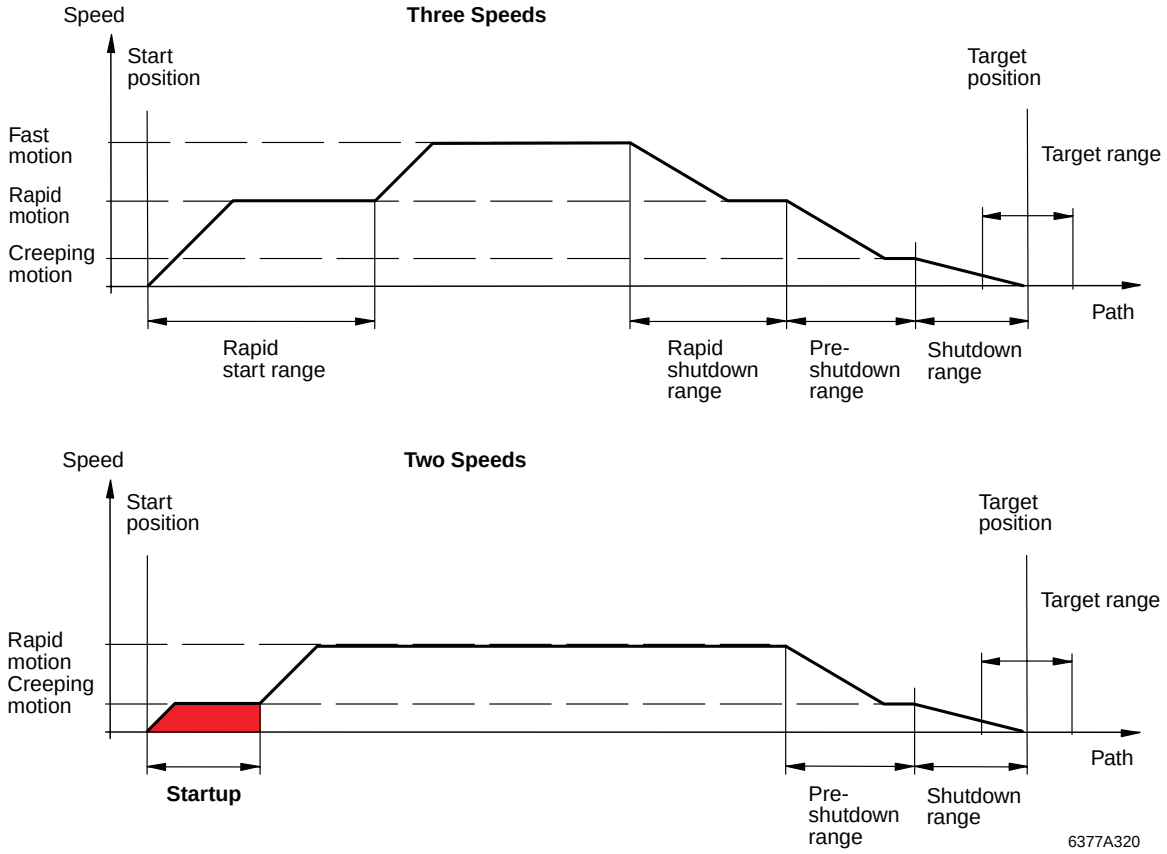


Fig. 7-8 Start window

7.11.2 "Rapid Start Window" Command (*RapidStartWindow*)

This command is only required if version 4 has been selected for "Function of the switching outputs".

Define the rapid start window using the OR function to link command C400 0000_{hex} for parameter record 1 or E400 0000_{hex} for parameter record 2 to the value for the rapid start window and send this command to the terminal.

To read the value, send command 4400 0000_{hex} for parameter record 1 (bit 15 = 0) or 6400 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**0**	**0**	**1**	**RSW1/RSW2 (26-bit value; USIGN26)**									
C/E (Write)/4/6 (Read)				**4 or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RSW1/RSW2 (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *RapidStartWindow*:

Code (Dec)	RSW1/RSW2: Rapid Start Window *(RapidStartWindow)*
0 to 2^{26} - 1	**0 increments** to 2^{26} - 1 increments

Commands for Working With the Positioning Terminal

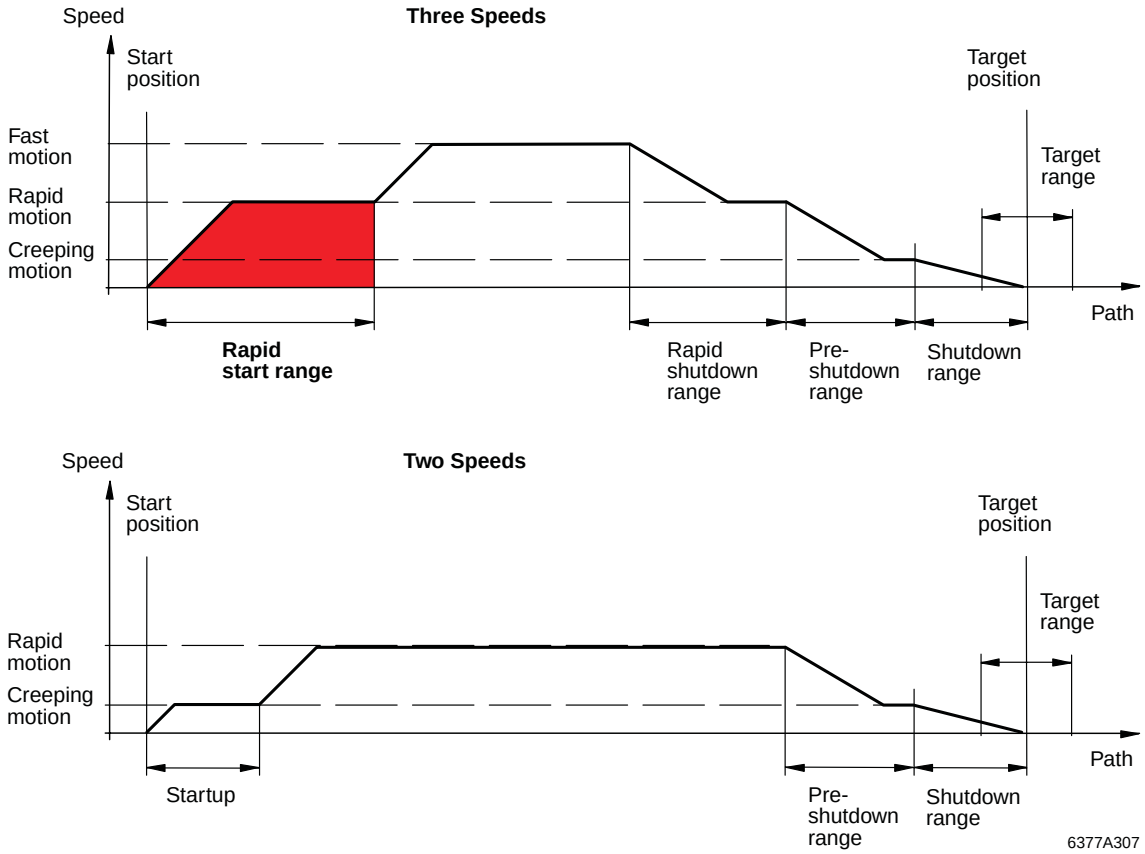


Fig. 7-9 Rapid start window

7.11.3 "Rapid Stop Window" Command (*RapidStopWindow*)

This command is only required if version 4 has been selected for "Function of the switching outputs".

Define the rapid stop window using the OR function to link command C800 0000_{hex} for parameter record 1 or E800 0000_{hex} for parameter record 2 to the value for the rapid stop window and send this command to the terminal.

To read the value, send command 4800 0000_{hex} for parameter record 1 (bit 15 = 0) or 6800 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 1 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**0**	**1**	**0**	**RTW1/RTW2 (26-bit value; USIGN26)**									
C/E (Write)/4/6 (Read)				**8 or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RTW1/RTW2 (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *RapidStopWindow*:

Code (Dec)	RTW1/RTW2: Rapid Stop Window *(RapidStopWindow)*
0 to 2^{26} - 1	**0 increments** to 2^{26} - 1 increments

Commands for Working With the Positioning Terminal

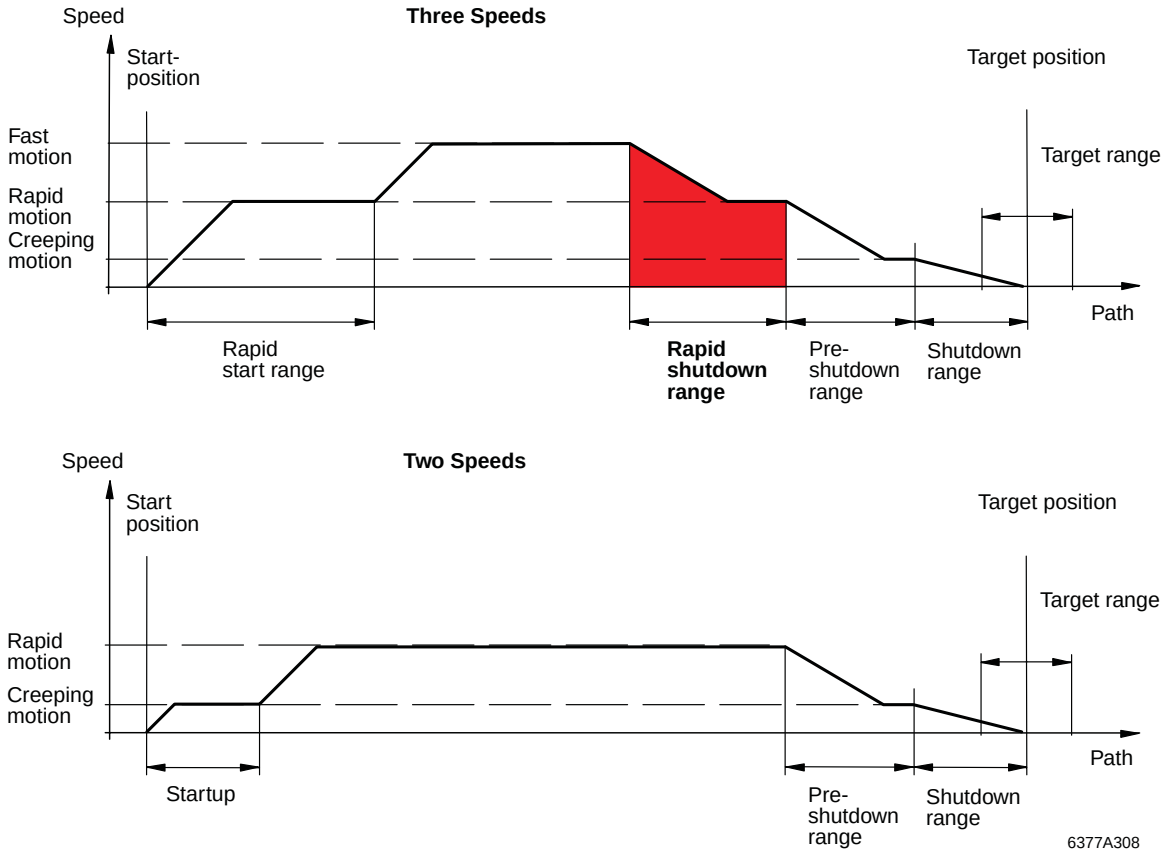


Fig. 7-10 Rapid stop window

7.11.4 "Pre-Stop Window" Command (*Pre-StopWindow*)

Define the pre-stop window using the OR function to link command CC00 0000_{hex} for parameter record 1 or EC00 0000_{hex} for parameter record 2 to the value for the pre-stop window and send this command to the terminal.

To read the value, send command 4C00 0000_{hex} for parameter record 1 (bit 15 = 0) or 6C00 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**0**	**1**	**1**	**PSW1/PSW2 (26-bit value; USIGN26)**									
C/E (Write)/4/6 (Read)				**C or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
PSW1/PSW2 (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *Pre-StopWindow*:

Code (Dec)	PSW1/PSW2: Pre-Stop Window *(Pre-StopWindow)*
0 to 2^{26} - 1	**0 increments** to 2^{26} - 1 increments

Commands for Working With the Positioning Terminal

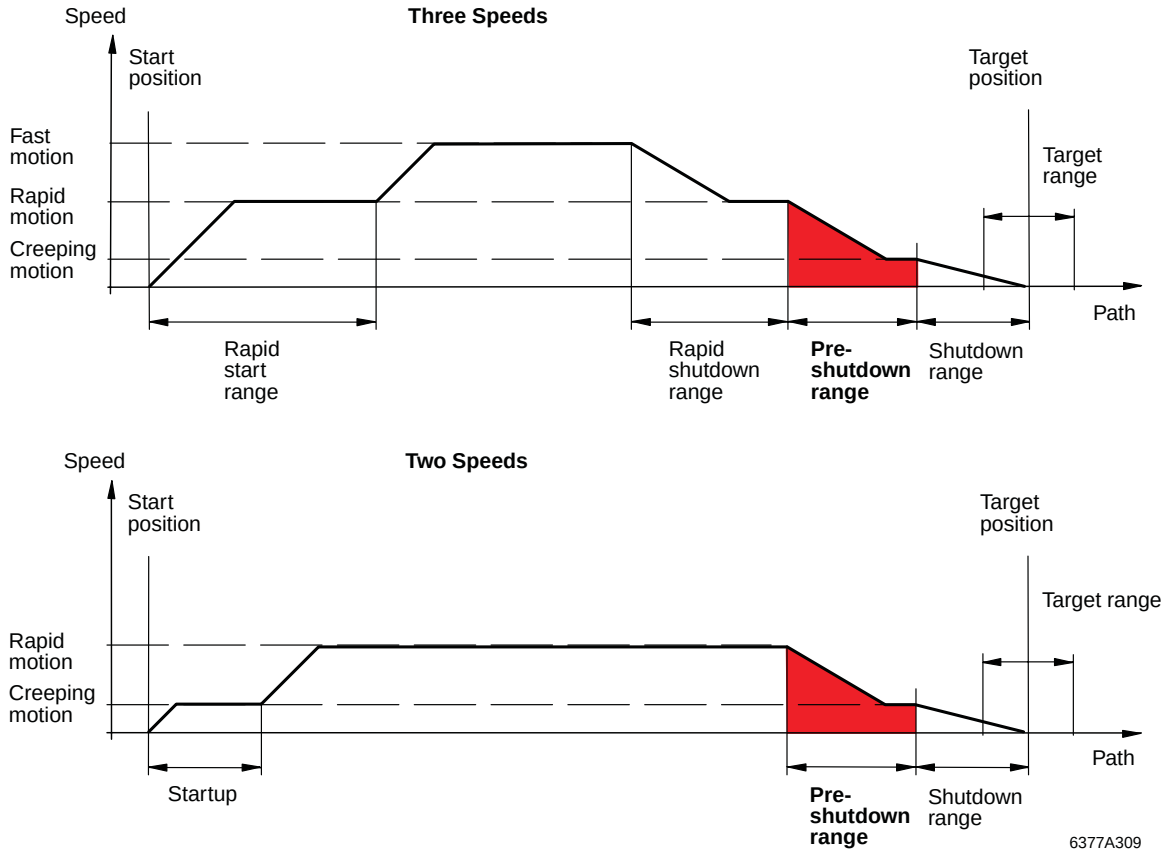


Fig. 7-11 Pre-stop window

7.11.5 "Stop Window" Command (*StopWindow*)

Define the stop window using the OR function to link command D000 0000_{hex} for parameter record 1 or F000 0000_{hex} for parameter record 2 to the value for the stop window and send this command to the terminal.

To read the value, send command 5000 0000_{hex} for parameter record 1 (bit 15 = 0) or 7000 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 1 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**1**	**0**	**0**	**STW1/STW2 (26-bit value; USIGN26)**									
D/F (Write)/5/7 (Read)				**0 or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
STW1/STW2 (26-bit value; USIGN26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *StopWindow*:

Code (Dec)	STW1/STW2: Stop Window *(StopWindow)*
0 to 2^{26} - 1	**0 increments** to 2^{26} - 1 increments

Commands for Working With the Positioning Terminal

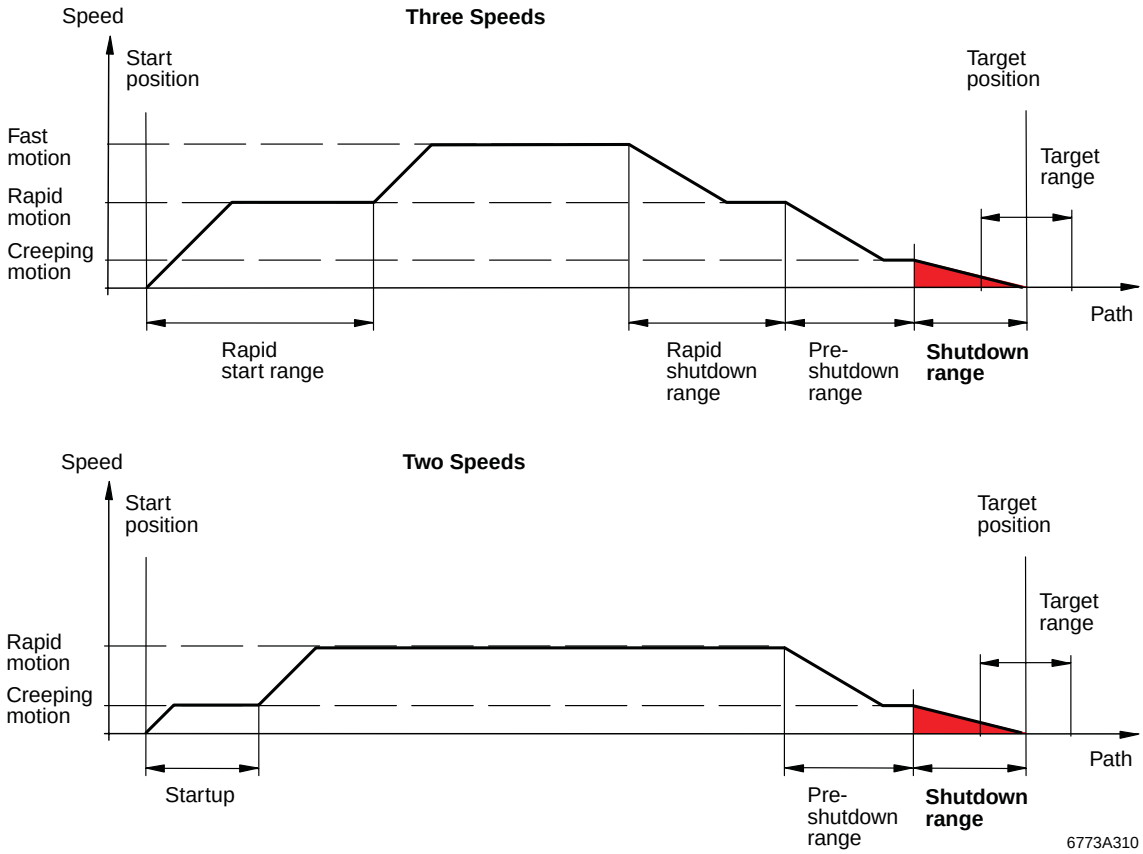


Fig. 7-12 Stop window

7.11.6 "Target Window" Command (*TargetWindow*)

Define the target window using the OR function to link command D400 0000_{hex} for parameter record 1 or F400 0000_{hex} for parameter record 2 to the value for the repeating counter and the value for the target window, and send this command to the terminal.

To read the value, send command 5400 0000_{hex} for parameter record 1 (bit 15 = 0) or 7400 0000_{hex} (bit 15 = 0) for parameter record 2.

If the target window is not reached, the terminal can automatically start a new process to approach the target position. In order that a new attempt can be made to approach the target position, looping must first be activated. The maximum number of repeat attempts is specified by the repeating counter. Between 0 and 15 repeat attempts can be made.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**1**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**RCN1/RCN2**			
D/F (Write)/5/7 (Read)				**4**				**0**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TW1/TW2 (16-bit value; USIGN16)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Ranges for *TargetWindow*:

Code (Dec)	RCN1/RCN2: Target Repeating Counter *(RepeatingCounter)*
0 to 15	**0 repeats** to 15 repeats

Code (Dec)	TW1/TW2: Target Window *(TargetWindow)*
0 to 2^{16} - 1	**0 increments** to 2^{16} - 1 increments

Commands for Working With the Positioning Terminal

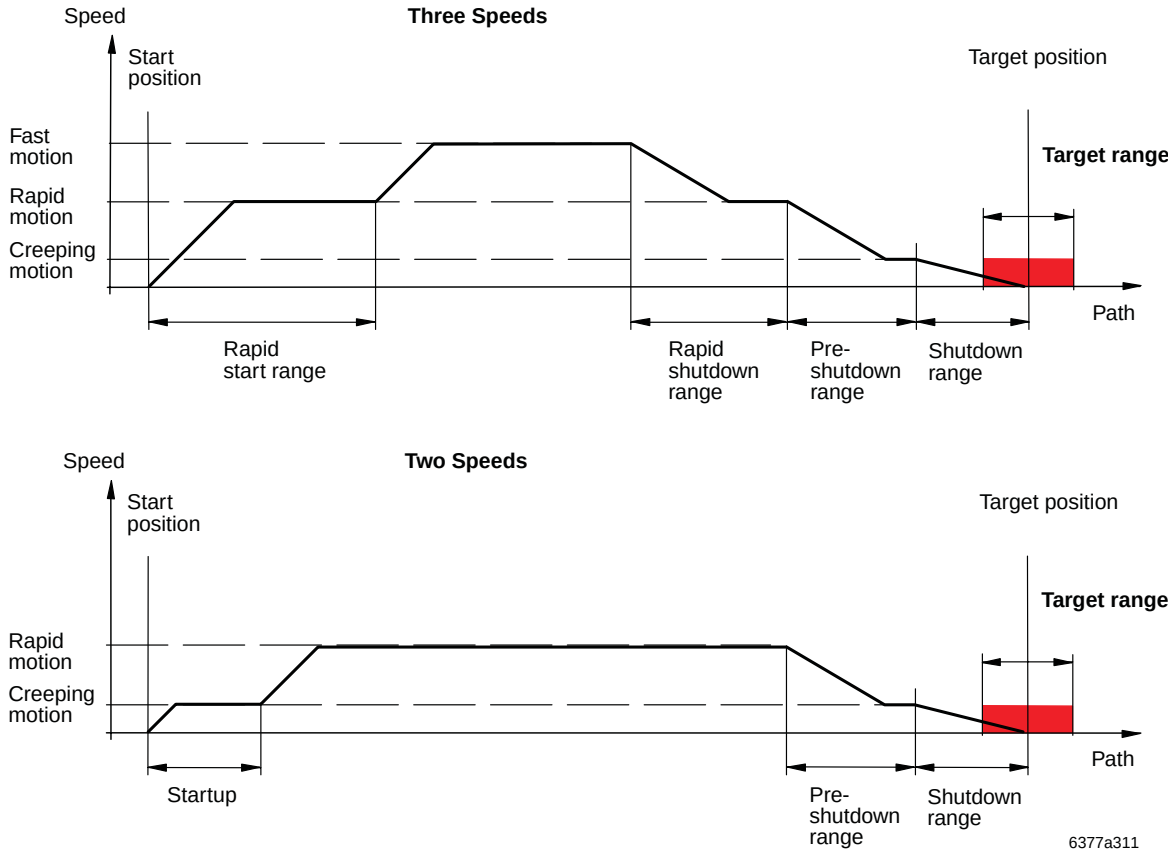


Fig. 7-13 Target window

7.11.7 "Target Position" Command (*TargetPosition*)

Define the target position using the OR function to link command D800 0000_{hex} for parameter record 1 or F800 0000_{hex} for parameter record 2 to the value for the target position and send this command to the terminal.

To read the value, send command 5800 0000_{hex} for parameter record 1 (bit 15 = 0) or 7800 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**1**	**1**	**0**	**TP1/TP2 (26-bit value; INT26)**									
D/F (Write)/5/7 (Read)				**8 or X**				**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
TP1/TP2 (26-bit value; INT26)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *TargetPosition*:

Code (Dec)	TP1/TP2: Target Position *(TargetPosition)*
-2^{25} to $+(2^{25} - 1)$	-2^{25} increments to $+(2^{25} - 1)$ increments
0	**0 increments**

Commands for Working With the Positioning Terminal

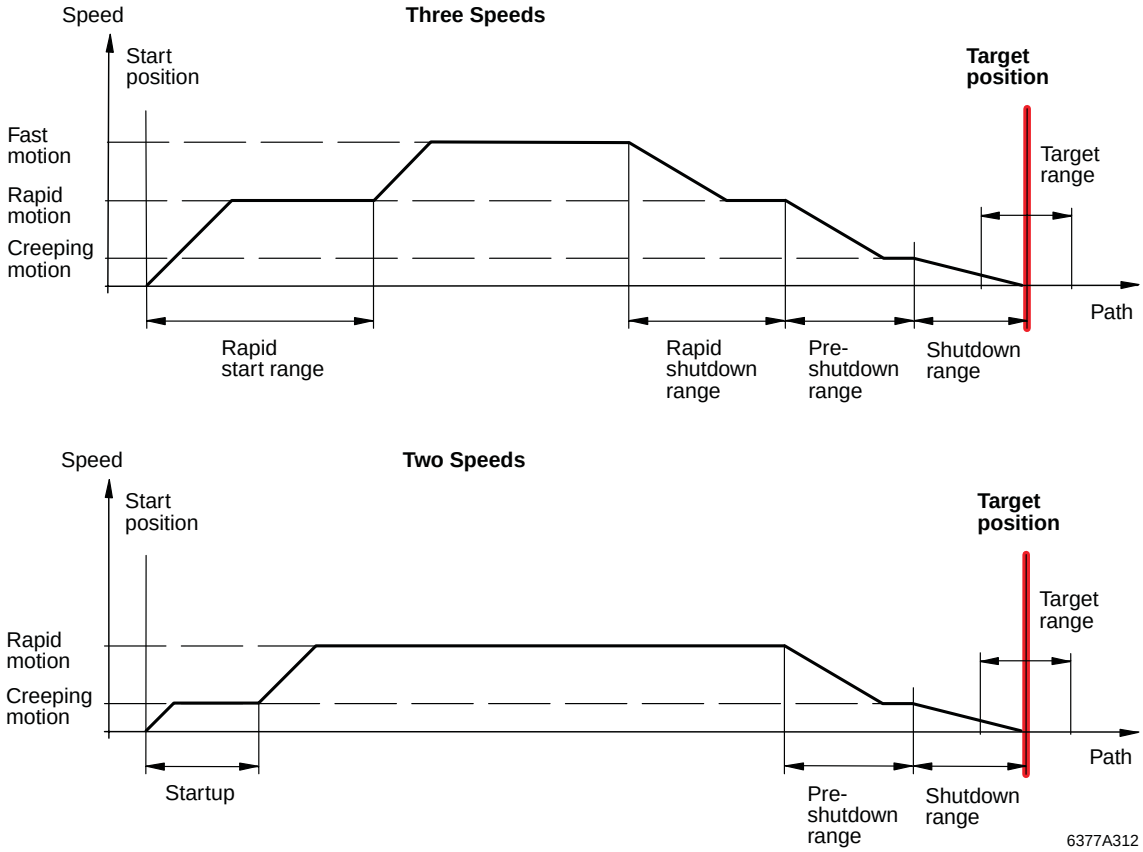


Fig. 7-14 Target position

7.11.8 "Lubrication and Friction Compensation Value" Command (*DefineLubFricCompValue*)

Define the lubrication and friction compensation value using the OR function to link command DC00 0000_{hex} for parameter record 1 or FC00 0000_{hex} for parameter record 2 to the compensation value and send this command to the terminal.

To read the value, send command 5C00 0000_{hex} for parameter record 1 (bit 15 = 0) or 7C00 0000_{hex} (bit 15 = 0) for parameter record 2.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**1**	**PRx**	**1**	**1**	**1**	**LFC1/LFC2 (26-bit value)**									
D/F (Write)/5/7 (Read)			**C or X**					**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
LFC1/LFC2 (26-bit value)															
X				**X**				**X**				**X**			

PRx = 0: Parameterization for parameter record 1 (***P**arameter **r**ecord 1*)
PRx = 1: Parameterization for parameter record 2 (***P**arameter **r**ecord 2*)

Permissible Value Range for *DefineLubFricCompValue*:

Code (Dec)	LFC1/LFC2: Lubrication and Friction Compensation Value *(LubFricCompValue)*
-2^{25} to $+(2^{25} - 1)$	-2^{25} increments to $+(2^{25} - 1)$ increments
0	**0 increments**

Commands for Working With the Positioning Terminal

7.12 "Jog Mode" Command (*DefineJogMode*)

Define jog mode using the OR function to link command 9500 0000_{hex} to the monoflop time values and delay time, and send this command to the terminal.

To read the parameters, send command 1500 0000_{hex} (bit 15 = 0).

Monoflop Time for Jog Mode (JogMonoflopTime)

The monoflop time can be used to set the time during which the drive should be set in motion for a jog pulse. The monoflop time can be set in millisecond increments; the setting range is between 0 and 65,535 ms.

Delay Time for Continuous Signal in Jog Mode (JogDelayTimeCount)

If a control bit is "activated" for a prolonged period for jog mode via the "Delay time for continuous signal", once this time has elapsed, the position is traversed in creeping motion (continuous signal) until the control bit is deactivated again.

The delay time for continuous signal in jog mode is set in increments of 100 ms; the setting range is between 0 and 25.5 ms.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**1**	**0**	**1**	**0**	**1**	**JDTC (USIGN8)**							
9 (Write)/1 (Read)					**5**			**X**				**X**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
JMT (USIGN16)															
X				**X**				**X**				**X**			

Permissible Value Ranges for *DefineJogMode*:

Code (Dec)	JDTC: Delay Time for Continuous Signal in Jog Mode *(JogDelayTimeCount)*
0 to 255	**0 s** to 25.5 s

Code (Dec)	JMT: Monoflop Time for Jog Mode *(JogMonoflopTime)*
0 to 65,535	**0 ms** to 65,535 ms

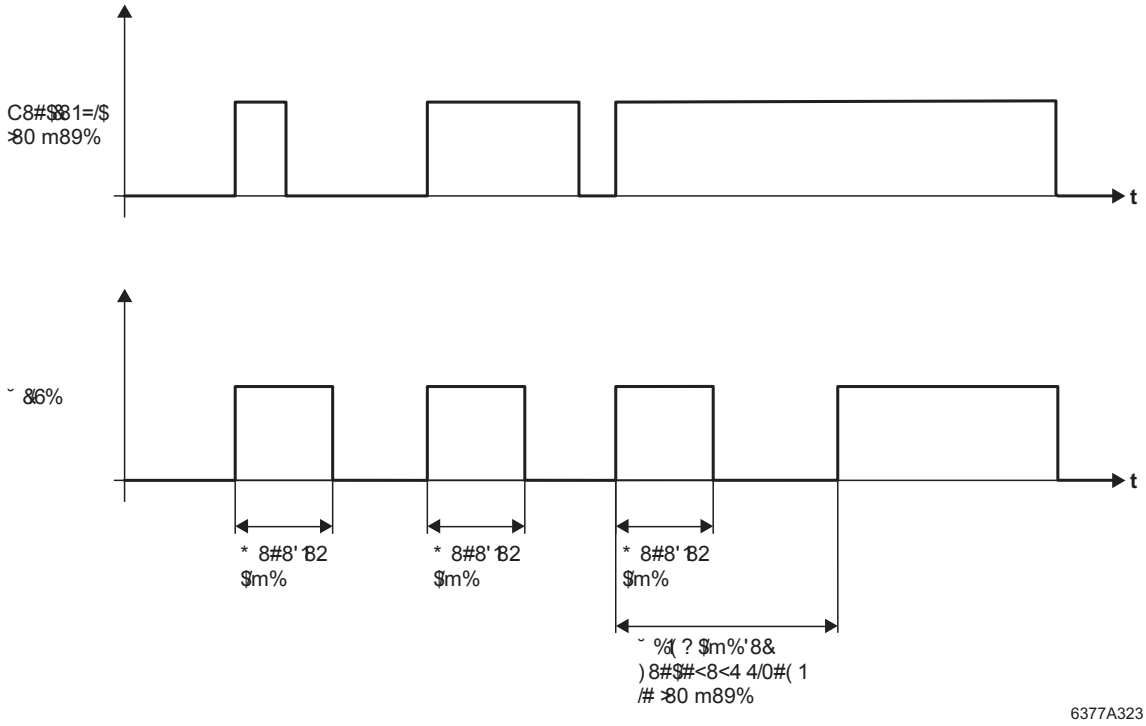


Fig. 7-15 Times in jog mode

If the default values (0) for "Delay time for continuous signal in jog mode" and "Monoflop time for jog mode" are set, the drive follows the control bit directly.

Commands for Working With the Positioning Terminal

7.13 Control Commands

These commands are used to control the positioning terminal and, simultaneously, to read specific information. Control is activated by setting bit 15 of output word OUT[0] to 1. Set the bit to 0 to execute the read function only.

Control is via bits 7 to 0 of output word OUT[0] and bits 15 to 0 of output word OUT[1]. Depending on the command code used to transmit the control parameters, the following information can be requested simultaneously.

- Position of the drive (page 115)
- Status of the positioning terminal (see page 117)

Please note that some control bits are level-controlled and some are edge-controlled.

Key for the following table:

- • Signal is level-controlled (signal is evaluated when set to 1)
- ↑ Signal is edge-controlled (signal is evaluated when the bit changes from 0 to 1)

Word		Bit	Active	Des.	Description	Description
OUT[0]		7	•	OUT4	***Out**put* **4**	If output version 5 is activated, otherwise not relevant
		6	•	OUT3	***Out**put* **3**	
		5	•	OUT2	***Out**put* **2**	
		4	•	OUT1	***Out**put* **1**	
		3	0	0	Reserved	
		2	•	JOGN	Jog mode in negative direction (**JogN**egative: *Jogging in negative direction*)	The drive travels at creeping speed. The behavior with regard to the software limit switches depends on the firmware version or the configuration (see "Software Limit Switches" on page 55).
		1	•	JOGP	Jog mode in positive direction (**JogP**ositive: *Jogging in positive direction*)	
		0	0	0	Reserved	

Fig. 7-16 Control bits for controlling the positioning terminal

Word	Bit	Active	Des.	Description	Description
OUT[1]	15	–	0	Reserved	
	14	•	ALFC	**A**ct**L**ub**F**ric**C**omp: *Activate lubrication and friction compensation*	
	13	–	0	Reserved	
	12	•	ELP	**E**nable**L**oo**p**ing: *Enable looping*	
	11	•	DDD	Specify approach direction of the target position during active backlash compensation or looping (**D**ef**D**rv**D**ir: *Define drive direction of target position during active backlash compensation or looping*)	0: Positive direction 1: Negative direction During active backlash compensation or looping
	10	•	ABC	**A**ct**B**acklash**C**omp: *Activate backlash compensation*	The direction is specified by bit 11
	9	–	0	Reserved	
	8	–	0	Reserved	

Fig. 7-16 Control bits for controlling the positioning terminal (Continued)

Commands for Working With the Positioning Terminal

Word		Bit	Active	Des.	Description	Description
OUT[1]		7	–	0	Reserved	
		6	–	0	Reserved	
		5	•	ELC2	**E**nable**L**ocal**C**trl**2**: *Enable local positioning control using digital inputs (initiators) with parameter record 2*	
		4	↑	SPD2	**S**tart**P**os**D**rv**2**: *Start positioning with parameter record 2*	
		3	•	ELC1	**E**nable**L**ocal**C**trl**1**: *Enable local positioning control using digital inputs (initiators) with parameter record 1*	
		2	↑	SPD1	**S**tart**P**os**D**rv**1**: *Start positioning with parameter record 1*	
		1	↑	RES	**Res**et: *Reset error*	
		0	•	STOP	**Stop**: *Stop positioning immediately*	The command currently being executed is aborted. A new positioning process can only be started once the stop bit has been reset.

Fig. 7-16 Control bits for controlling the positioning terminal (Continued)

7.14 "Control Position and Read Position" Command (*ControlPosition*, *ReadPosition*)

Positioning can be controlled and the current position read simultaneously using the OR function to link command 8000 0000_{hex} to the control bit (Fig. 7-16 on page 112) and sending this command to the terminal.

To read the current position, send command 0000 0000_{hex} (bit 15 = 0) without setting any parameters.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**OUT4**	**OUT3**	**OUT2**	**OUT1**	**0**	**JOGN**	**JOGP**	**0**
8 (Write)/0 (Read)				**0**				**0**				**0**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**ALFC**	**0**	**ELP**	**DDD**	**ABC**	**0**	**0**	**0**	**0**	**ELC2**	**SPD2**	**ELC1**	**SPD1**	**RES**	**STOP**
X				**X**				**X**				**X**			

The current position is transmitted to the process input words. Representation is in two's complement format (as INT26).

If an error has occurred, this is indicated in the status bit (***St****atus bit*; ST). The type of error that has occurred can be determined using the *Read status* command (see page 117).

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ST	**0**	**0**	**0**	**0**	**0**	**POSI (26-bit value; INT26)**									

Input word 1 (IN[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
POSI (26-bit value; INT26)															

Value Range for *ControlPosition, ReadPosition*:

Code (Dec)	POSI: Value of the Current Position *(CurrentPosition)*
-2^{25} to $+(2^{25} - 1)$	-2^{25} increments to $+(2^{25} - 1)$ increments

Commands for Working With the Positioning Terminal

7.15 "Control Position and Read Velocity" Command (*ControlPosition, ReadVelocity*)

The position can be controlled and the current velocity read simultaneously using the OR function to link command 8400 0000_{hex} to the control bit (Fig. 7-16 on page 112) and sending this command to the terminal.

To read the current position, send command 0400 0000_{hex} (OUT[0] bit 15 = 0) without setting any parameters.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**OUT4**	**OUT3**	**OUT2**	**OUT1**	**0**	**JOGN**	**JOGP**	**0**
8 (Write)/0 (Read)				**4**				**0**				**0**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**ALFC**	**0**	**ELP**	**DDD**	**ABC**	**0**	**0**	**0**	**0**	**ELC2**	**SPD2**	**ELC1**	**SPD1**	**RES**	**STOP**
X				**X**				**X**				**X**			

The current velocity (increments per time interval) is transmitted to the process input words. Representation is in two's complement format (as INT26). The time interval is set using the *Define stop* command (see page 86).

If an error has occurred, this is indicated in the status bit (***St**atus bit*; ST). The type of error that has occurred can be determined using the *Read status* command (see page 117).

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ST	**0**	**0**	**0**	**0**	**1**	**VELO (26-bit value; INT26)**									

Input word 1 (IN[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
VELO (26-bit value; INT26)															

Value Range for *ControlPosition, ReadVelocity*:

Code (Dec)	VELO: Value of the Current Velocity *(CurrentVelocity)*
-2^{25} to $+(2^{25} - 1)$	-2^{25} increments/time interval to $+(2^{25} -1)$ increments/time interval

7.16 "Control Position and Read Status" Command (*ControlPosition*, *ReadStatus*)

Positioning can be controlled and the current status read simultaneously using the OR function to link command 8800 0000_{hex} to the control bit (Fig. 7-18 on page 119) and sending this command to the terminal.

To read the current status, send command 0800 0000_{hex} (bit 15 = 0) without setting any parameters.

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
1/0	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**OUT4**	**OUT3**	**OUT2**	**OUT1**	**0**	**JOGN**	**JOGP**	**0**
8 (Write)/0 (Read)				**8**				**0**				**0**			

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**ALFC**	**0**	**ELP**	**DDD**	**ABC**	**0**	**0**	**0**	**0**	**ELC2**	**SPD2**	**ELC1**	**SPD1**	**RES**	**STOP**
X				**X**				**X**				**X**			

The current status is transmitted to the process input words.

If an error has occurred, this is indicated in the status bit (***St****atus bit*; ST). The type of error that has occurred can be determined using the *Read status* command (see page 117).

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ST	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**OUT4**	**OUT3**	**OUT2**	**OUT1**	**IN4**	**IN3**	**IN2**	**IN1**

Input word 1 (IN[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**ERRC**					**0**	**0**	**PPA2**	**PPE2**	**PPA1**	**PPE1**	**INCN**	**DS**

Commands for Working With the Positioning Terminal

Word	Bit	Des.	Description
IN[0]	7	OUT4	*Status of* **out***put* **4**
	6	OUT3	*Status of* **out***put* **3**
	5	OUT2	*Status of* **out***put* **2**
	4	OUT1	*Status of* **out***put* **1**
	3	IN4	*Status of* **in***put* **4**
	2	IN3	*Status of* **in***put* **3**
	1	IN2	*Status of* **in***put* **2**
	0	IN1	*Status of* **in***put* **1**
IN[1]	15	0	Reserved
	14	0	Reserved
	13	0	Reserved
	12	ER12	**Er***ror code* **n** (see Fig. 7-18 on page 119)
	11	ER11	
	10	ER10	
	9	ER09	
	8	ER08	
	7	0	Reserved
	6	0	Reserved
	5	PPA2	**P***ositioning with* **p***arameter record* **2** ***a**ctive*
	4	PPE2	**P***ositioning with* **p***arameter record* **2** *finished successfully*
	3	PPA1	**P***ositioning with* **p***arameter record* **1** ***a**ctive*
	2	PPE1	**P***ositioning with* **p***arameter record* **1** *finished successfully*
	1	INCN	Terminal is not yet completely initialized (encoder configuration, I/O configuration) *(Terminal* **n***ot* **c***ompletely* **i***nitialized)*
	0	DS	**D***rive* **s***top detected or drive stop monitoring switched off*

Fig. 7-17 Status bits

If a function is aborted with an error message, a new action can only be started once the error has been acknowledged. The error must be acknowledged with OUT[1] bit 1 (acknowledge error, RES) of the control command for positioning (see "Control Commands" on page 112).

Fig. 7-18 lists the meanings of the error codes and possible causes and provides tips for error removal.

Error code Bits 12 to 8		**Meaning**	**Note/Cause and Tips for Error Removal**
Bin	**Dec**		
0 0000	0	No errors have occurred	
0 0001	1	Terminal is in HHOP mode	Control via the bus is not possible in this mode.
0 0010	2	Output driver overload or short circuit	This error also triggers a module error message. • Remove the short circuit or overload.
0 0011	3	Encoder supply error	This error also triggers a module error message. Cause: No encoder supply or encoder supply short circuit. • Connect the encoder supply or remove the short circuit.
0 0100	4	The encoder configuration is invalid.	Check the encoder configuration.
0 0101	5	A parity error has occurred.	Connection to the sensor is faulty or sensor has been configured incorrectly. • Check connection and configuration.
0 0110	6	The initiator or switching output configuration is invalid.	• Check the configuration.
0 0111	7	Reserved	
0 1000	8	Invalid control command	• Check the control command.
0 1001	9	Position to be approached is out of the permissible range or is not defined.	• Check settings.
0 1010	10	Function cannot be executed, as software limit switches would be overrun.	• Software limit switches may have to be modified.
0 1011	11	Motor is not moving or is traveling in the wrong direction.	
0 1100	12	Reserved	
0 1101	13	The distance to the target position is shorter than the sum of the stop and start windows.	• Enable looping.
0 1110	14	Drive stop detected.	
0 1111	15	Software limit switches reached.	
1 0000	16	Hardware limit switches reached.	
1 0001	17	Target window could not be reached.	• Check the parameters of the stop and target windows.
1 0010	18	Counter overflow	The current position value is greater than the representation range. • Define a different gear ratio.

Fig. 7-18 Error codes

Commands for Working With the Positioning Terminal

Error code Bits 12 to 8		Meaning	Note/Cause and Tips for Error Removal
Bin	Dec		
1 0011	19	Invalid action	An attempt was made to start an invalid action. Example: A control command was still in progress. • Check action.
1 0100	20	Bus reset	
1 0101	21	Invalid system configuration	• Check system configuration.

Fig. 7-18 Error codes (Continued)

7.17 Overview of a Command Sequence

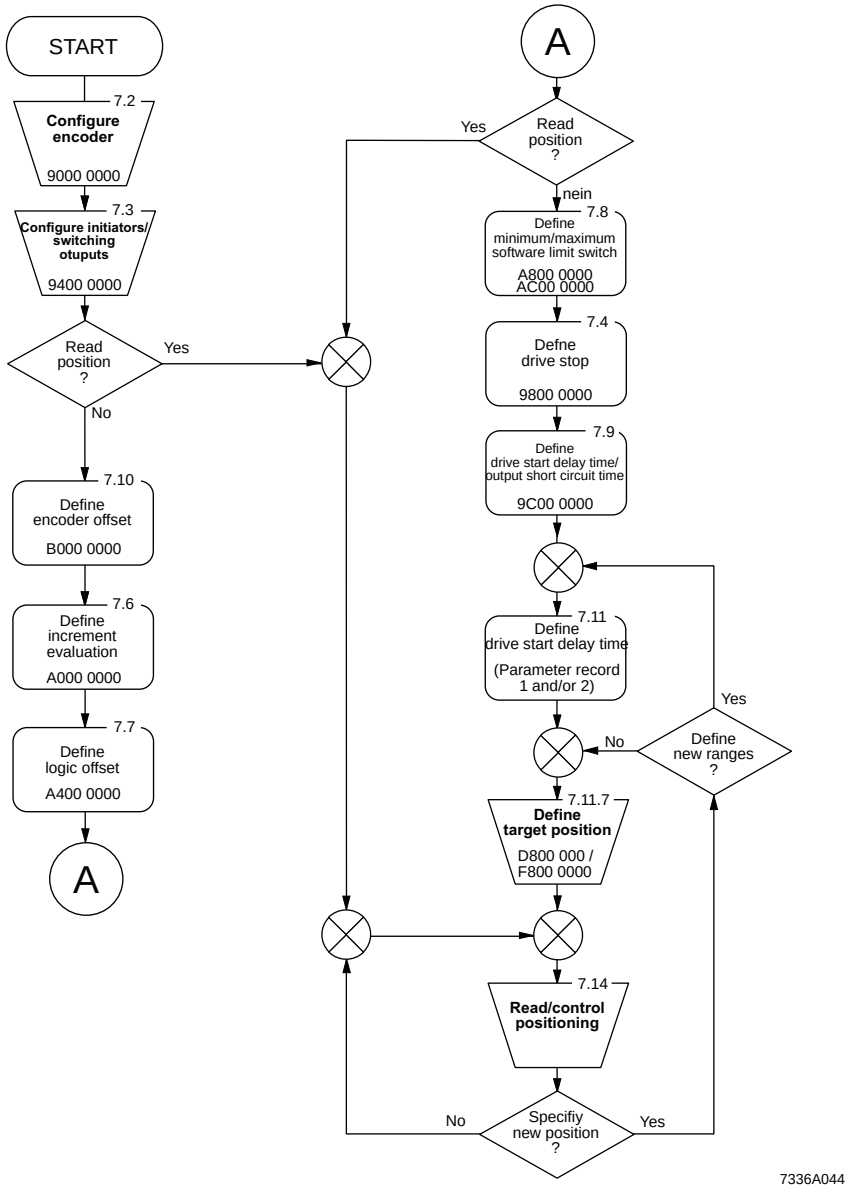
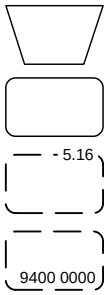


Fig. 7-19 Flowchart for parameterizing a positioning terminal

Key:



Command that is absolutely necessary for positioning

Command that is only necessary in some cases

Page on which the commanc and its parameters are described

Command code (basic code) in hexadecimal representation

Decision

Connected procedure

A Connection point

6376A001

Commands for Working With the Positioning Terminal

Define Parameter Record 1 and/or 2

	Parameter record 1/2	On page
Start window	C000 0000/E00 0 0000	95
Rapid start window	C400 0000/E40 0 0000	97
Rapid stop window	C800 0000/E80 0 0000	99
Pre-stop window	CC00 0000/EC0 0 0000	101
Stop window	D000 0000/F000 0000	103
Target window	D400 0000/F400 0000	105
Friction compensation value	DC00 0000/FC0 0 0000	109

Read/Control Positioning

		On page
Control positioning/ Read position	8000 0000/ 0000 0000	115
Control positioning and read status/ Read status	8800 0000/ 0800 0000	117
Control positioning and read status/ Read velocity	8400 0000/ 0400 0000	116

Control Bits for Control Commands (See Also "Control Commands" on page 112)

Output word 0 (OUT[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
R/W	0	0	0	X	X	0	0	OUT4	OUT3	OUT2	OUT1	0	JOGN	JOGP	0

Output word 1 (OUT[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	ALFC	0	ELP	DDD	ABC	0	0	0	0	ELC2	SPD2	ELC1	SPD1	RES	STOP

XXXXX One of the command codes for transmitting the control bits

Status Bits (See Also ""Control Position and Read Status" Command (ControlPosition, ReadStatus)" on page 117)

Input word 0 (IN[0])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
ST	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**OUT 4**	**OUT 3**	**OUT 2**	**OUT 1**	**IN4**	**IN3**	**IN2**	**IN1**

Input word 1 (IN[1])

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	**0**	**0**	**ERRC**					**0**	**0**	**PPA2**	**PPE2**	**PPA1**	**PPE1**	**INCN**	**DS**

Some parameterization examples are provided in Section 8.2, "Examples".

8 Examples and Tips

CAUTION

Ensure data consistency

Always follow the notes on data consistency when programming.

8.1 Tips for Working With the Positioning Terminal

Application description

When configuring your system observe the information in the "Configuring and Installing the Rexroth Inline Product Range for INTERBUS" a pplication description or the application description for your bus system.

Ensure data consistency

Ensure a data consistency of two words (32 bits) to prevent the possibility of the values being misinterpreted.

Output word OUT[1] must be written first, followed by output word OUT[0], so that the terminal can ensure the required data consistency.

Sequence of the Inline terminals

The sequence of th e terminals within an Inline station should depend on the current consumption of the I/O devices from the potential jumpers U_M and U_S.

As the voltage at every power terminal is fed back into the potential jumpers U_M and U_S, the se ction (main circuit) between bus coupler and power terminal or between power terminal and power terminal must always be considered when calculating the current. If power terminals are not used, the entire station is a main circuit.

Within a main circuit, place the terminals with the highest current consumption first. This has th e advantage that the high supply current does not flow through the entire main circuit.

This results in the following sequence:

1. Power-level terminals
2. Digital output terminals with 8-slot housing
3. Digital output terminals with 2-slot housing
4. Digital input terminals with 8-slot housing
5. Digital input terminals with 2-slot housing
6. Function modules in any order,
   including the **R-IB IL SSI-PAC positioning terminal**.
7. Analog terminals in any order

The current consumption of the terminals is specified in the "Configuring and Installing the Rexroth Inline P roduct Range for INTERBUS" application description DOK-CONTRL-ILSYSPRO***-AW..-EN-P, in the application description for your bus system, and in all terminal-specific data sheets.

8.2 Examples

8.2.1 Minimum Configuration for Reading a Position

The example shows the minimum commands that are required to read a position.

If you compare these steps with the "Flowchart for parameterizing a positioning terminal" on page 121, these are the steps up to the first decision "Read position?" through to Section 7.14, ""Control Position and Read Position" Command (ControlPosition, ReadPosition)".

Action	Remark
OUT[0] = 0000_{hex}	Delete command code
OUT[0] = 9000_{hex} OUT[1] = 0100_{hex}	Command: *Configure encoder* (page 78) • Parity: None • Installation direction: Normal • Resolution: 8 bits • Code: Binary code
Wait until: IN[0] = 1000_{hex} & IN[1] = 0100_{hex}	Wait for confirmation
OUT[0] = 9400hex OUT[1] = 2000hex  **CAUTION**	Command: *Define configuration of axis types, behavior in the event of a bus failure, initiators, and switching outputs* (page 81) • Initiator 1: Limit switch • Initiator 2: Limit switch • Switching outputs: Version 2 **Adjust the switching outputs to your application.** • Bus reset: Stops an active positioning process • Axis type: Linear axis
Wait until: IN[0] = 1400_{hex} & IN[1] = 2000_{hex}	Wait for confirmation
OUT[0] = 0000_{hex} OUT[1] = 0000_{hex}	Command: *Read position* (page 115)
IN[0] = $xxxx_{hex}$ IN[1] = $0xxx_{hex}$	The current position is specified in the input words.

Fig. 8-1 Commands for reading a position

8.2.2 Minimum Configuration for Reading a Position Using a Gear Ratio

The example shows the minimum commands that are required to read a position, taking the gear ratio into consideration.

If you compare these steps with the "Flowchart for parameterizing a positioning terminal" on page 121, these are the steps up to the second decision "Read position?" through to Section 7.14, ""Control Position and Read Position" Command (ControlPosition, ReadPosition)".

Action	Remark
OUT[0] = 0000_{hex}	Delete command code
OUT[0] = 9000_{hex} OUT[1] = 0100_{hex}	Command: *Configure encoder* (page 78) • Parity: None • Installation direction: Normal • Resolution: 8 bits • Code: Binary code
Wait until: IN[0] = 1000_{hex} & IN[1] = 0100_{hex}	Wait for confirmation
OUT[0] = 9400_{hex} OUT[1] = 2000_{hex} **CAUTION**	Command: *Define configuration of axis types, behavior in the event of a bus failure, initiators, and switching outputs* (page 81) • Initiator 1: Limit switch • Initiator 2: Limit switch • Switching outputs: Version 2 **Adjust the switching outputs to your application.** • Bus reset: Stops an active positioning process • Axis type: Linear axis
Wait until: IN[0] = 1400_{hex} & IN[1] = 2000_{hex}	Wait for confirmation
	No rotary axis
	No encoder offset
OUT[0] = $A001_{hex}$ OUT[1] = $000A_{hex}$	Command: *Define gear ratio* (page 88) • Gear ratio 1/10
Wait until: IN[0] = 2001_{hex} & IN[1] = $000A_{hex}$	Wait for confirmation
OUT[0] = $A400_{hex}$ OUT[1] = 0000_{hex}	Command: *Define logic offset* (page 89) • Set logic offset to 0
Wait until: IN[0] = 2400_{hex} & IN[1] = 0000_{hex}	Wait for confirmation
OUT[0] = 0000_{hex} OUT[1] = 0000_{hex}	Command: *Read position* (page 115)
IN[0] = $xxxx_{hex}$ IN[1] = $0xxx_{hex}$	The current position is specified in the input words.

Fig. 8-2 Commands for reading a position using a gear ratio

Examples and Tips

8.2.3 Minimum Configuration for Approaching a Position

The example shows the minimum commands that are required to approach a position.

For the sequence of these commands, please refer to the "Flowchart for parameterizing a positioning terminal" on page 121. Some of the commands, which are only necessary in some cases, are not listed in the example, since they are not required for this application. You must decide which parameterization is required for your application.

Action	Remark
OUT[0] = 0000_{hex}	Delete command code
OUT[0] = 9000_{hex} OUT[1] = 0100_{hex}	Command: *Configure encoder* (page 78) • Parity: None • Installation direction: Normal • Resolution: 8 bits • Code: Binary code
Wait until: IN[0] = 1000_{hex} & IN[1] = 0100_{hex}	Wait for confirmation
OUT[0] = 9400_{hex} OUT[1] = 2000_{hex} **CAUTION**	Command: *Define configuration of axis types, behavior in the event of a bus failure, initiators, and switching outputs* (page 81) • Initiator 1: Minimum limit switch • Initiator 2: Maximum limit switch • Switching outputs: Version 2 **Adjust the switching outputs to your application.** • Bus reset: Stops an active positioning process • Axis type: Linear axis
Wait until: IN[0] = 1400_{hex} & IN[1] = 2000_{hex}	Wait for confirmation
OUT[0] = $D800_{hex}$ OUT[1] = $03E8_{hex}$	Command: *Define target position 1* (page 107) • Target position: 1000 ($3E8_{hex}$)
Wait until: IN[0] = 5800_{hex} & IN[1] = $03E8_{hex}$	Wait for confirmation
OUT[0] = 8800_{hex} OUT[1] = 0004_{hex}	Command: *Read status and control positioning* (page 117) • Start positioning with parameter record 1. (Approach position 1000)
Please note that optimum positioning accuracy cannot yet be achieved because not all of the different ranges have been parameterized.	
Wait until: IN[0] = $08xx_{hex}$ & IN[1] = $xxx8_{hex}$ or $xxx4_{hex}$	Wait for confirmation

Fig. 8-3 Commands for approaching a position

8.3 Using the Terminal for Position Detection

The positioning terminals can also be used to simply determine the position of a drive.

In this case, connect the encoder to the encoder interface. The position of the drive is determined using the input data words.

In this case, inputs 1 to 3 are available as digital inputs independent of the positioning terminal. The status of the inputs is determined using the input data words (IN[0] bits 2 to 0; see ""Control Position and Read Status" Command (ControlPosition, ReadStatus)" on page 117).

In addition, the outputs are freely available because they are not being used for positioning. In this case, select output version 5 (see "Function of the Switching Outputs (OutputFunction)" on page 85), and control the outputs independent of the positioning terminal using the output words (OUT[0] bits 7 to 4; see "Control Commands" on page 112).

Examples and Tips

9 Programming Data and Technical Data

This data is valid for the preferred mounting position (vertical).
The technical data do es not claim to be complete. Technical modifications reserved.

For additional technical data for the Rexroth Inline product range, please refer to the a pplication descriptions for the Rexroth Inline system or the application description for your bus system.

9.1 Programming Data/Configuration Data

Local Bus

ID code	BF_{hex} (191_{dec})
Length code	02_{hex}
Process data channel	32 bits
Input address area	4 bytes
Output address area	4 bytes
Parameter channel (PCP)	0 bytes
Register length (bus)	4 bytes

Other Bus Systems

For the configuration data of other bus systems, please refer to the corresponding electronic device data sheet (e.g., GSD, EDS) at www.boschrexroth.com.

CAUTION

Ensure data consistency

Ensure data consistency of two words to prevent the possibility of the values being misinterpreted.

Programming Data and Technical Data

9.2 Process Data Words

The "Configuring and Installing the Rexroth Inline Product Range for INTERBUS" application descripti on contains a de scription of INTERBUS software configuration.

Output Data Words for Configuring the Terminal (See "Output Words" on page 68)

(Word.bit) view	Word	Word 0															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	Assignment	R/W	Command code					Parameter									

(Word.bit) view	Word	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	Assignment	Parameter															

R/W: This bit indicates whether the specified parameter is to b e read from the positioning terminal (R/W = 0) or written to the corresponding register of the terminal (R/W = 1).

Command code: The settings for these bits depend on the command to be transmitted.
Set the bits according to you r application and the explanations in Section 7, "Commands for Working With the Positioning Terminal".

Parameter: The settings for these bits depend on the command to be transmitted.
Set the bits according to you r application and the explanations in Section 7, "Commands for Working With the Positioning Terminal".

Input Data Words
(See "Input Words" on page 69)

Input Words During Parameterization

During parameterization the output words are mirrored in the input words.

(Word.bit) view	Word	Word 0															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0	Assignment	ST	Mirroring of the command code					Result (parameter, position, status)									

(Word.bit) view	Word	Word 1															
	Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 1	Assignment	Result (parameter, position, status)															

ST: Status bit

If bit 15 = 0, the command has been processed successfully.
If bit 15 = 1, an error occurred when the command was processed. The type of error that has occurred can be determined using the *Read status* command (see ""Control Position and Read Status" Command (ControlPosition, ReadStatus)" on page 117).

Programming Data and Technical Data

9.3 Ordering Data

Products

Description	Type	MNR	Pcs./Pck.
Positioning terminal for absolute encoders, with connector set and labeling fields; transmission speed of 500 kbps	R-IB IL SSI-PAC	R911308594	1

Documentation

Description	Type	MNR	Pcs./Pck.
"Configuring and Installing the Rexroth Inline Product Range for INTERBUS" application description	DOK-CONTRL-ILSYSPRO***-AW..-EN-P	R911317023	1
"Automation Terminals of the Rexroth Inline Product Range" application description	DOK-CONTRL-ILSYSINS***-AW..-EN-P	R911317021	1

For additional ordering data (accessories), please refer to the product catalog at www.boschrexroth.com.

Make sure you always use the latest documentation. It can be downloaded at www.boschrexroth.com.

9.4 Technical Data

General Data	
Housing dimensions (width x height x depth)	48.8 mm x 120 mm x 71.5 mm
Weight	210 g (with connectors)
Ambient Temperature	
Ambient temperature (operation)	-25°C to +55°C
Ambient temperature (storage/transport)	-25°C to +85°C
Operating mode	Process data mode with 2 words
Connection method for sensors	2 and 3-wire technology
Connection method for actuators	2 and 3-wire technology
Connection method for all cables	Spring-cage terminals
Cable cross-section (typical)	0.2 mm² to 1.5 mm² (solid or stranded), 24 - 16 AWG

Ambient Conditions	
Regulations	Developed according to VDE 0160, UL 508
Humidity	
Humidity (operation/storage/transport)	10% to 95%, according to DIN EN 61131-2
Air Pressure	
Air pressure (operation/storage/transport)	70 kPa to 106 kPa (up to 3000 m above sea level)
Degree of protection according to DIN 40050, IEC 60529	IP20
Protection class according to DIN 57106-1	Class 3
Air and creepage distances	According to IEC 60644/IEC 60664A/ DIN VDE 0110: 1989-01 and DIN VDE 0160: 1988-05
Housing material	Basic material: Arnite plastic PA6.6, self-extinguishing (V0)
Pollution degree according to EN 50178	2; condensation not permitted during operation
Surge voltage class	II (low-level signal) III (power level)
Gases that may endanger functions according to DIN 40046-36, DIN 40046-37	
Sulfur dioxide (SO_2)	Concentration 10 ±0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 10 days
Hydrogen sulfide (H_2S)	Concentration 1 ±0.3 ppm Ambient conditions - Temperature: 25°C (±2°C) - Humidity: 75% (±5%) - Test duration: 4 days
Resistance of the housing material to termites	Resistant
Resistance of housing material to fungal decay	Resistant

Programming Data and Technical Data

Power Consumption	500 kbps
Communications power U_L	7.5 V DC
Current consumption at U_L	60 mA, maximum
Power consumption at U_L	0.45 W, maximum
Segment supply voltage U_S	24 V DC (nominal value)
Nominal current consumption at U_S	2 A, maximum
Main supply voltage U_M	24 V DC (nominal value)
Nominal current consumption at U_M	1 A, maximum

Data Transfer	
Protocol	EN 50254; INTERBUS 2-wire 500 kbps
Chip	Optical Protocol Chip
Transmission	Data jumper
Level	Logic level

Mechanical Requirements	
Vibration test Sinusoidal vibrations according to IEC 60068-2-6; EN 60068-2-6	2g load (low-level signal)
Shock test according to IEC 60068-2-27; EN 60068-2-27	25g load for 11 ms, half sinusoidal wave, three shocks in each space direction and orientation

Conformance With EMC Directive 89/336/EEC		
Noise Immunity Test According to EN 50082-2		
Electrostatic discharge (ESD)	EN 61000-4-2/ IEC 61000-4-2	Criterion B 6 kV contact discharge 6 kV air discharge (without labeling field) 8 kV air discharge (with labeling field in place)
Electromagnetic fields	EN 61000-4-3 IEC 61000-4-3	Criterion A Field strength: 10 V/m
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	Criterion B Supply lines: 2 kV I/O cables: 2 kV Criterion A All interfaces: 1 kV
Conducted interference	EN 61000-4-6 IEC 61000-4-6	Criterion A Test voltage 10 V
Noise Emission Test According to EN 50081-2		
Noise emission of housing	EN 55011	Class A

Interface	
Local bus	Through data routing

Supply of the Module Electronics and I/O Through the Bus Coupler/Power Terminal (U_M, U_S, U_L)	
Connection method	Through potential routing

Absolute Encoder Inputs	
Number	1
Encoder signals	Clock, clock inverted, data, data inverted
Signal connection method	Shielded cables; unshielded cables may lead to erroneous results in environments with heavy noise.

Encoder	
Types	Single-turn or multi-turn
Resolution	8 bits to 26 bits (can be parameterized)
Code type	Gray code, binary code
Parity monitoring	None, even, odd
Reversal of direction of rotation	Yes
Encoder supply	5 V (500 mA) or 24 V (500 mA)
Transmission frequency	400 kHz
Cable length	Less than 30 m for shielded cables

Encoder Supplies	
5 V Encoder Supply	
Voltage range	4.75 V to 5.25 V
Short-circuit protection	Electronic and thermal
Current carrying capacity	500 mA
24 V Encoder Supply	
Voltage range	19.2 V to 30.0 V
Short-circuit protection	Electronic and thermal
Current carrying capacity	500 mA

The status of the encoder supplies (5 V/24 V) is indicated via two LEDs. If the internal voltage for the encoder electronics fails, an I/O error is generated. This error is indicated by the "D" diagnostic LED flashing at 2 Hz and transmitted to the controller board.

Power Dissipation	
Power dissipation of the housing P_{HOU}	2.7 W (within the permissible operating temperature)

Digital Inputs	
Number	4
Input design	According to EN 61131-2, Type 1
Signal range low	-30 V DC to +5 V DC (according to DIN 19240)
Signal range high	+13 V DC to +30 V DC (according to DIN 19240)
Common potentials	Main supply, ground
Nominal input voltage U_{IN}	24 V DC
Permissible range	-30 V DC < U_{IN} < +30 V DC
Nominal input current for U_{IN}	5 mA, typical
Connection method	2 and 3-wire technology
Current flow	Linear in the range 1 V < U_{IN} < 30 V

Programming Data and Technical Data

Digital Inputs (Continued)	
Delay Time	< 1 ms
Permissible cable length to the sensor	30 m
Use of AC sensors	AC sensors in the voltage range < U_{IN} are limited in application

Input Characteristic Curve	
Input Voltage (V)	**Typical Input Current (mA)**
-30 < U_{IN} < 0.7	0
3	0.4
6	1.0
9	1.7
12	2.3
15	3.0
18	3.7
21	4.4
24	5.0
27	5.7
30	6.4

Digital Outputs	
Number	4
Connection method	2 and 3-wire technology
Nominal output voltage U_{OUT}	24 V DC
Differential voltage for I_{Nom}	≤ 1 V
Nominal current per output I_{Nom}	0.5 A
Tolerance of the nominal current	+10%
Total current of the outputs	2 A
Protection	Short circuit; overload (thermal)
Nominal load	
Ohmic	48 Ω/12 W
Lamp	12 W
Inductive	12 VA (1.2 H, 50 Ω)
Signal delay upon power up of:	
Nominal ohmic load	100 µs, typical
Nominal lamp load	100 ms, typical (with switching frequencies up to 8 Hz; above this frequency the lamp load responds like an ohmic load)
Nominal inductive load	100 ms (1.2 H, 50 Ω), typical
Signal delay upon power down of:	
Nominal ohmic load	1 ms, typical
Nominal lamp load	1 ms, typical
Nominal inductive load	50 ms (1.2 H, 50 Ω), typical

Programming Data and Technical Data

Digital Outputs (Continued)	
Switching frequency with:	
Nominal ohmic load	300 Hz, maximum

This switching frequency is limited by the selected data rate, the number of bus devices, the bus structure, the software, and the control or computer system used.

Nominal lamp load	300 Hz, maximum

This switching frequency is limited by the selected data rate, the number of bus devices, the bus structure, the software, and the control or computer system used.

Nominal inductive load	0.5 Hz at 500 mA (0.5 H, 48 Ω), maximum
Overload response	Auto restart
Response with inductive overload	Output may be damaged
Response time in the event of a short circuit	400 ms, approximately
Reverse voltage protection against short pulses	Protected against reverse voltages
Resistance to polarity reversal of the supply voltage	Protective elements in the bus coupler or the power terminal
Resistance to permanently applied surge voltages	No
Validity of output data after connecting the 24 V supply voltage (power up)	5 ms, typical
Response upon power down	The output follows the supply voltage without delay
Single maximum energy in free running	400 mJ, maximum
Protective circuit type	Integrated 38.6 V Zener diode in the output
Overcurrent shutdown	0.7 A, minimum
Output current when switched off	100 µA, maximum
Output voltage when switched off	1 V, maximum

Output Characteristic Curve When Switched On (Typical)	
Output Current (A)	**Differential Output Voltage (V)**
0	0
0.1	0.04
0.2	0.08
0.3	0.12
0.4	0.16
0.5	0.20

Limitation of Simultaneity, Derating
None

Safety Equipment	
Surge voltage	Protective elements in the bus coupler or the power terminal
Polarity reversal of the supply voltage	Protective elements in the bus coupler or the power terminal The supply voltage must be protected. The power supply unit should be able to supply 4 times (400%) the nominal current of the fuse.
Short-circuit protection for the outputs (segment circuit)	Short-circuit-proof (automatic restart)

Programming Data and Technical Data

Error Messages to the Higher-Level Control or Computer System	
Short circuit/overload of an output	Yes
An error message is generated when an output is short circuited and switched on. In addition, the "D" diagnostic LED flashes on the terminal at 2 Hz (medium) under these conditions.	
Short circuit/overload of the encoder supply	Yes
An error message is generated when an output is short circuited and overloaded. In addition, the "D" diagnostic LED flashes on the terminal at 2 Hz (medium) under these conditions.	
Failure of the main or segment voltage (U_M/U_S)	Yes
Failure of the internal voltage for the encoder electronics	Yes, I/O error at the controller board. In addition, the diagnostic LED (D) flashes on the terminal at 2 Hz (medium) under these conditions.

Electrical Isolation/Isolation of the Voltage Areas

CAUTION

To provide electrical isolation between the logic level and the I/O area it is necessary to supply the station bus coupler and the function terminal described here via the bus coupler or a power terminal from separate power supply units. Interconnection of the power supply units in the 24 V area is not permitted.

Common Potentials

The 24 V main voltage, 24 V segment voltage, and GND have the same potential.
FE is a separate potential area.

Separate Potentials in the System Comprising Bus Coupler/Power Terminal and Function Terminal

- Test Distance	- Test Voltage
5 V supply incoming remote bus/7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min.
5 V supply outgoing remote bus/7.5 V supply (bus logic)	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logic)/24 V supply (I/O)	500 V AC, 50 Hz, 1 min.
7.5 V supply (bus logic)/functional earth ground of the encoder supply	500 V AC, 50 Hz, 1 min.
24 V supply (I/O)/functional earth ground	500 V AC, 50 Hz, 1 min.
24 V supply (I/O)/functional earth ground of the encoder supply	500 V AC, 50 Hz, 1 min.
Functional earth ground of the encoder supply/functional earth ground	500 V AC, 50 Hz, 1 min.

Approvals

For the latest approvals, please visit www.boschrexroth.com.

10 Disposal and Environmental Protection

10.1 Disposal

10.1.1 Products

Our products can be returned to us free of charge for disposal. However, it is a precondition that the products are free of oil, grease or other dirt.

Furthermore, the products returned for disposal must not contain any undue foreign matter or foreign component.

Please send the products free domicile to the following address:

Bosch Rexroth AG

Electric Drives and Controls

Bürgermeister-Dr.-Nebel-Straße 2

D-97816 Lohr am Main

10.1.2 Packaging Materials

The packaging materials consist of cardboard, wood and polystyrene. These materials can be easily recycled in any municipal recycling system. For ecological reasons, please refrain from returning the empty packages to us.

10.2 Environmental Protection

10.2.1 No Release of Hazardous Substances

Our products do not contain any hazardous substances which may be released in the case of appropriate use. Accordingly, our products will normally not have any negative effect on the environment.

10.2.2 Materials Contained in the Products

Electronic Devices

Electronic devices mainly contain:

- steel
- aluminium
- copper
- synthetic materials
- electronic components and modules

Motors

Motors mainly contain:

- steel
- aluminium
- copper
- brass
- magnetic materials
- electronic components and modules

Disposal and Environmental Protection

10.2.3 Recycling

Due to their high content of metal most of the product components can be recycled.In order to recycle the metal in the best possible way, the products must be disassembled into individual modules.

Metals contained in electric and electronic modules can also be recycled by means of special separation processes. The synthetic materials remaining after these processes can be thermally recycled.

If the products contain batteries or rechargeable batteries, these batteries are to be removed and disposed before they are recycled.

11 Service & Support

11.1 Helpdesk

Our service helpdesk at our headquarters in Lohr, Germany, will assist you with all kinds of enquiries.

Contact us:

- By phone through the Service Call Entry Center,
  Mo - Fr 7:00 am - 6:00 pm CET
  +49 (0) 9352 40 50 60
- By Fax
  +49 (0) 9352 40 49 41
- By email: service.svc@boschrexroth.de

11.2 Service Hotline

Out of helpdesk hours please contact our German service department directly:

+49 (0) 171 333 88 26

or

+49 (0) 172 660 04 06

Hotline numbers for other countries can be found in the addresses of each region (see below).

11.3 Internet

Additional notes regarding service, maintenance and training, as well as the current addresses of our sales and service offices can be found on

http://www.boschrexroth.com

Outwith Germany please contact our sales/service office in your area first.

11.4 Helpful Information

For quick and efficient help please have the following information ready:

- detailed description of the fault and the circumstances
- information on the type plate of the affected products, especially type codes and serial numbers
- your phone/fax numbers and e-mail address so we can contact you in case of questions

Service & Support

12 Index

Index

Index

Index

Notes

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